INDEX TO SECTIONS

SECTION A

GENERAL INFORMATION

2·4 litre and 3·4 litre models

Note: All references in this Manual to "right-hand side" and "left-hand side" are made assuming the person to be looking from the rear of the car or unit.

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

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INDEX

GENERAL INFORMATION

CAR IDENTIFICATION

It is imperative that the Car and Engine numbers, together with any prefix or suffix letters, are quoted in any correspondence concerning this vehicle. If the unit in question is the Gearbox or Overdrive the Gearbox number and any prefix or suffix letters must also be quoted. This also applies when ordering spare parts.

Car Number .. ..

Stamped in the bonnet catch channel, forward of the radiator header tank.
Suffix 'DN' to the car number indicates that an overdrive unit is fitted.
Suffix 'BW' to the car number indicates that automatic transmission is fitted.

Engine Number .. ..

Stamped on the right-hand side of the cylinder block above the oil filter and at the front of the cylinder head casting.
/7, /8 or /9 following the engine number denotes the compression ratio.

Gearbox Number

Stamped on a shoulder at the left-hand rear corner of the gearbox casing and on the top cover.
Letter 'N' at the end of the prefix letters indicates that an overdrive unit is fitted.

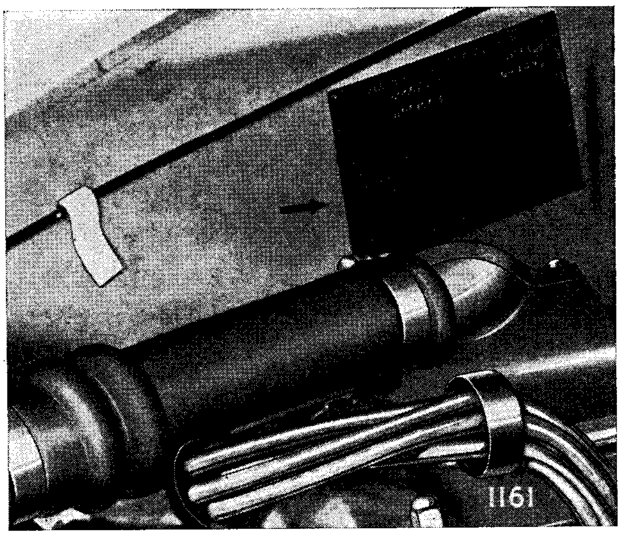

Fig. 1. The identification numbers are also stamped on a plate which is attached to the right-hand wing valance (3.4 litre illustrated).

Body Number .. ..

Stamped on a plate attached to the right-hand side of the scuttle.

Key Numbers (i) .. .. (ii) .. ..

Two different types of key are provided to enable the car to be left with the luggage boot and cubby locker locked, on the occasions when it is required to leave the ignition key with the car.

(a) The round headed key operates the ignition switch and door locks.
(b) The rectangular headed key operates the locks for the luggage boot lid and the cubby locker.

GENERAL DATA

DIMENSIONS AND WEIGHTS

Wheel base		8′ 11⅜″ (2.727 mm.)	
Track		Front	Rear
Cars with drum brakes		4′ 6⅛″	4′ 2⅛″
Cars with disc brakes		4′ 7⅝″	disc wheels 4′ 2⅜″
			wire wheels 4′ 2⅞″
Length (overall)		15′ 0¾″ (4.591 m.)	
Width		5′ 6¾″ (1.695 m.)	
Height		4′ 9½″ (1.460 m.)	
Weights (dry) approximate	2.4 litre	25 cwts. (1270 kg.)	
	3.4 litre	27 cwts. (1376 kg.)	
Turning circle		33′ 6″ (10.21 m.)	
Ground clearance		7″ (178 mm.)	

CAPACITIES

		Imperial	U.S.	Litres
Engine (refill)		11 pints	13¼ pints	6¼
Engine (total)		13 „	15½ „	7½
Gearbox (without overdrive)		2½ „	3 „	1½
Gearbox (with overdrive)		4 „	4¾ „	2¼
Automatic transmission unit		15 „	18 „	8½
Rear axle	2.4 litre	2¼ „	2¾ „	1.3
	3.4 litre	2¾ „	3¼ „	1.6
Cooling system (including heater)	2.4 litre	20 „	24 „	11¼
	3.4 litre	22 „	26½ „	12½
Petrol tank		12 galls.	14½ galls.	54½

TIGHTENING TORQUES

Engine :

Connecting rod bolts	37 lbs. ft. (450 lbs. ins.) (5.1 kg./m.)
Main bearing bolts	83 lbs. ft. (1000 lbs. ins.) (11.5 kg./m.)
Cylinder head nuts	54 lbs. ft. (650 lbs. ins.) (7.5 kg./m.)
Camshaft bearing cap nuts	15 lbs. ft. (175 lbs. ins.) (2.0 kg./m.)
Flywheel	67 lbs. ft. (800 lbs. ins.) (9.2 kg./m.)

Rear Axle :

Drive gear bolts—⅜″ (9.5 mm.) dia. bolts	50—60 lbs. ft. (600—720 lbs. ins.) (6.7—8.0 kg./m.)
7/16″ (11.1 mm.) dia. bolts	70—80 lbs. ft. (840—960 lbs. ins.) (9.3—10.6 kg./m.)
Differential bearing cap bolts	60—65 lbs. ft. (720—780 lbs. ins.) (8.0—8.7 kg./m.)
Pinion nut	120—130 lbs. ft. (1440—1560 lbs. ins.) (16.0—17.3 kg./m.)
Thornton " Powr-Lok " differential bolts	35—45 lbs. ft. (420—540 lbs. ins.) (4.6—6.0 kg./m.)

PERFORMANCE DATA

The following tables give the relationship between engine revolutions per minute and road speed in miles and kilometres per hour for top gear.

It is recommended that engine revolutions **in excess of 5,500 per minute (2.4 litre) and 5,000 per minute (3.4 litre)** should not be exceeded for long periods.

Note: The figures in the following tables are theoretical and make no allowance for changes in tyre radius due to the effect of centrifugal force.

2·4 LITRE

AXLE RATIO 4.27 : 1

(Ratio for cars with standard or automatic transmission)

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE
Kilometres per hour	Miles per hour	Top Gear 4·27
16	10	552
32	20	1104
48	30	1656
64	40	2208
80	50	2760
96	60	3312
112	70	3864
128	80	4416
144	90	4968
160	100	5520

AXLE RATIO 4.55 : 1

(Ratio for cars fitted with an overdrive)

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE	
Kilos. per hour	Miles per hour	Top Gear 4.55	Overdrive 3.54
16	10	588	457
32	20	1176	914
48	30	1764	1371
64	40	2352	1828
80	50	2940	2285
96	60	3528	2742
112	70	4116	3199
128	80	4704	3656
144	90	5292	4113
160	100	5880	4570

3·4 LITRE

AXLE RATIO 3.54 : 1

(Ratio for cars with
standard or automatic transmission)

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE
Kilometres per hour	Miles per hour	Top Gear 3.54
16	10	457
32	20	914
48	30	1371
64	40	1828
80	50	2285
96	60	2742
112	70	3199
128	80	3656
144	90	4113
160	100	4570
176	110	5027
192	120	5484

AXLE RATIO 3.77 : 1

(Ratio for cars fitted with an overdrive)

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE	
Kilos. per hour	Miles per hour	Top Gear 3.77	Overdrive 2.93
16	10	487	378
32	20	974	756
48	30	1461	1134
64	40	1948	1512
80	50	2435	1890
96	60	2922	2268
112	70	3409	2646
128	80	3896	3024
144	90	4383	3402
160	100	4870	3780
176	110	5357	4158
192	120	—	4536

OPERATING INSTRUCTIONS

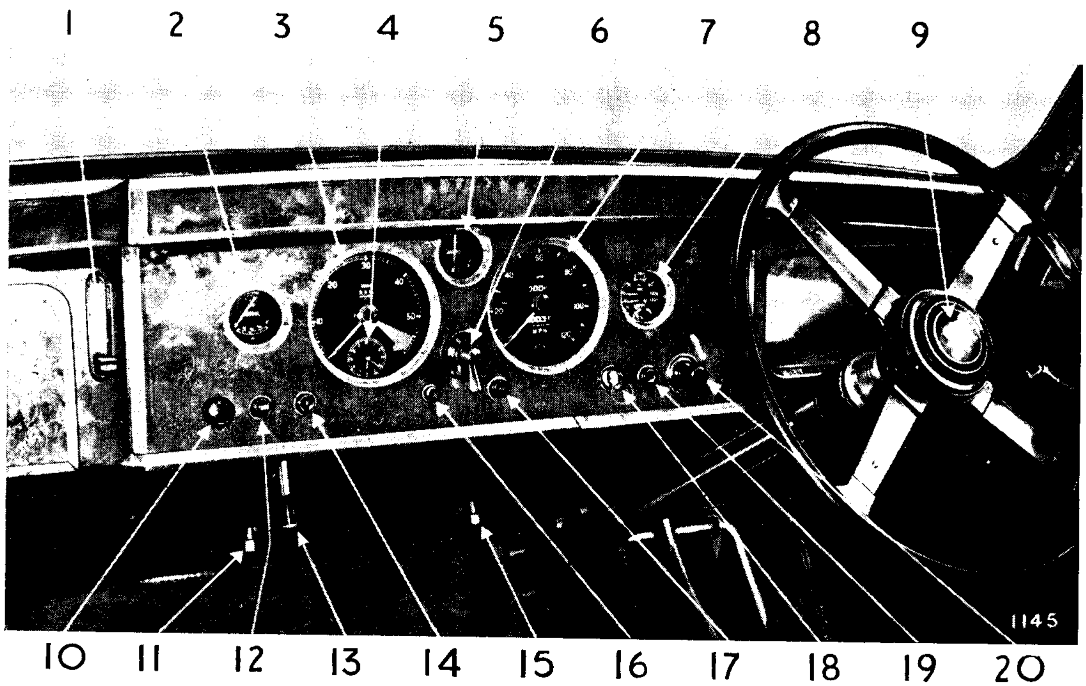

Fig. 2. Instruments and controls.

1. Heater temperature control.
2. Petrol gauge.
3. Revolution counter.
4. Electric clock
5. Ammeter.
6. Lighting switch.
7. Speedometer.
8. Oil pressure and water temperature gauge.
9. Horn push.
10. Windscreen wiper switch.
11. Clock adjuster.
12. Heater fan switch.
13. Scuttle ventilator control.
14. Panel light switch.
15. Speedometer trip control.
16. Windscreen washer button.
17. Interior light switch.
18. Ignition switch.
19. Starter switch.
20. Cigar lighter.

INSTRUMENTS

Ammeter

Records the flow of current into or out of the battery. Since compensated voltage control is incorporated, the flow of current is adjusted to the state of charge of the battery ; thus when the battery is fully charged the dynamo provides only a small output and therefore little charge is registered on the ammeter, whereas when the battery is low a continuous high charge is shown.

Oil Pressure and Water Temperature Gauge

The oil pressure gauge records the oil pressure being delivered by the oil pump to the engine ; it does not record the quantity of oil in the sump. The minimum pressure at maintained high r.p.m. when hot should not be less than 40 lbs. per square inch.

The water temperature gauge records the temperature of the coolant by means of a bulb screwed into the inlet manifold water jacket which is connected to the gauge by a capillary tube.

Petrol Level Gauge

Records the quantity of petrol in the supply tank. Readings will only be obtained when the ignition is switched ' on '. A red light situated in the petrol gauge lights up intermittently when the petrol level in the tank becomes low. When the petrol is almost exhausted the warning light operates continuously.

Electric Clock

The clock is built in the revolution counter instrument and is powered by the battery. The clock hands may be adjusted by pushing up the winder and rotating. Starting is accomplished in the same manner. The winder is situated below the instrument panel to the left of the heater doors.

Revolution Counter

Records the speed of the engine in revolutions per minute.

Speedometer

Records the vehicle speed in miles per hour, total mileage and trip mileage (kilometres on certain export models). The trip figures can be set to zero by pushing the winder upwards and rotating anti-clockwise. The winder is situated below the instrument panel to the right of the heater doors.

Headlamp Warning Light

A red warning light marked " Headlamps " situated in the speedometer, lights up when the headlamps are in full beam position and is automatically extinguished when the lamps are in the dipped beam position.

Ignition Warning Light

A red warning light marked " Ign " situated in the speedometer lights up when the ignition is switched 'on' and the engine is not running, or when the engine is running at a speed insufficient to charge the battery. The latter condition is not harmful, but always switch 'off' when the engine is not running.

Petrol Level Warning Light

A red light situated in the petrol gauge lights up intermittently when the petrol level in the tank becomes low. When the petrol is almost exhausted the warning light operates continuously.

Flashing Direction Indicators—Warning Light

A green light adjacent to the operating lever lights up intermittently when the flashing direction indicator lights are in operation. Flashing indicators only operate when the ignition is switched 'on'.

Mixture Control—Warning Light (2.4 litre)

A red light situated below the mixture control lights up when the starting device is in operation. The mixture control should be returned to the off (Run) position as soon as possible, when the warning light will be automatically extinguished.

CONTROLS AND ACCESSORIES

Accelerator

The pedal on the right. Controls the speed of the engine.

Brake

The centre pedal. Operates the vacuum servo assisted brakes on all four wheels.

Clutch

The pedal on the left. Connects and disconnects the engine and the transmission. Never drive with the foot resting on the pedal and do not keep the pedal depressed for long periods in traffic. Never coast the car with a gear engaged and clutch depressed.

Headlamp Dipper

Situated on the toe boards to the left of the clutch pedal. The switch is of the change over type and if the headlamps are in the full beam position a single pressure on the control will switch the lamps to the dipped beam position and they will remain so until another single pressure switches them to the full beam position again.

Gear Lever

Centrally situated and with gear positions indicated on the control knob. To engage reverse gear first press the gear lever against the spring pressure before pushing the lever forward. Always engage neutral and release the clutch when the car is at rest.

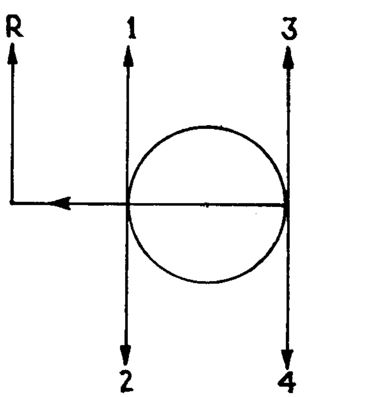

Fig. 3. Gear positions.

Handbrake Lever

Positioned at the outside of the driver's seat. The handbrake operates mechanically on the rear wheels only and is provided for parking, driving away on a hill and when at a standstill in traffic. To apply the brake, pull the lever upward and the trigger will automatically engage with the ratchet. The handbrake is released by pressing in the knob and pushing the lever downward.

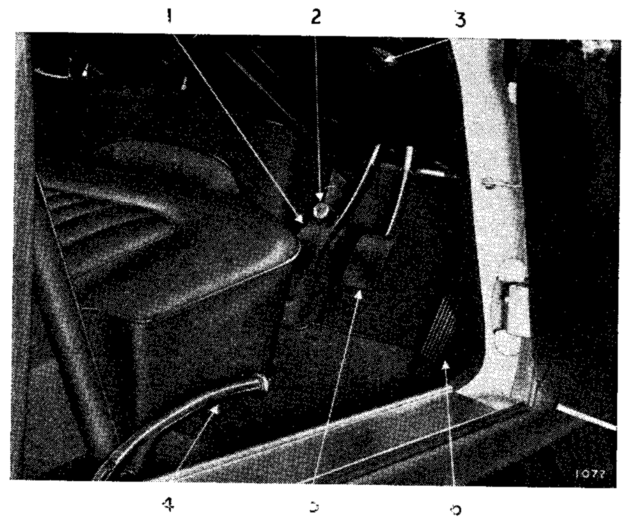

Fig. 4. Foot and hand controls.

1. Clutch pedal.
2. Headlamp dipper.
3. Bonnet lock control.
4. Handbrake.
5. Brake pedal.
6. Accelerator pedal.

Seat Adjustment

Both front seats are adjustable for reach. Push the lock bar, situated beside the inside runner, towards the inside of the car and slide into the required position. Release the lock bar and slide until the mechanism engages with a click.

Steering Wheel Adjustment

Rotate the knurled ring at the base of the steering wheel hub in an anti-clockwise direction when the steering wheel may be slid into the desired position. Turn the knurled ring clockwise to lock the steering wheel.

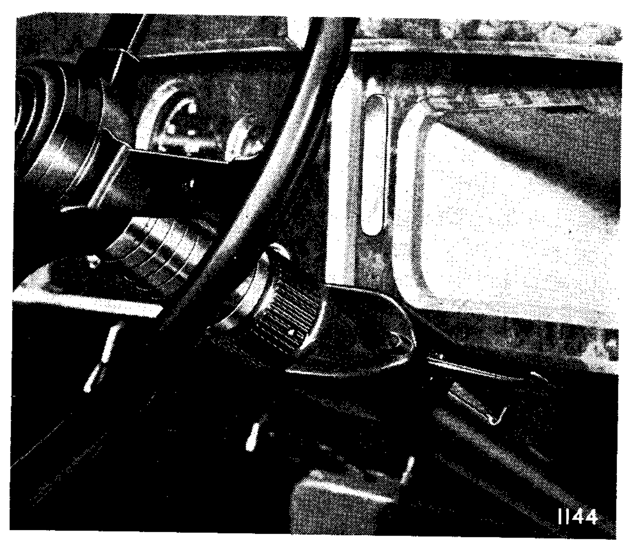

Fig. 5. Steering wheel adjustment. Rotate the knurled ring in the direction of the arrow to lock the wheel in the desired position.

Front Door Locks

The front doors may be opened from the outside by pressing the button incorporated in the door handle. The doors are opened from the inside by pulling the interior handles rearward.

Both front doors can be locked from the inside by pushing the interior handles forward and allowing them to return to their original position ; this feature only applies if the doors are fully closed before operating the interior handles.

Both front doors can be locked from the outside by means of the ignition key ; the locks are incorporated in the push buttons of the door handles.

To lock the right-hand door insert the key in the lock, rotate anti-clockwise as far as possible and allow the lock to return to its original position—the door is now locked. To unlock the right-hand door turn key clockwise as far as possible and allow the lock to return to its original position.

To lock the left-hand door rotate key clockwise ; to unlock, rotate key anti-clockwise.

KEYLESS LOCKING is obtainable by first pushing the interior door handle fully forward and allowing it to return to its original position. If the door is now closed from the outside with the push button of the handle **fully depressed** the door will become locked.

Warning.—If the doors are to be locked by this method the ignition key should be removed beforehand (or the spare key kept on the driver's person) as the only means of unlocking the front doors is with this key.

Rear Door Locks

The rear doors may be opened from the outside by pressing the button incorporated in the door handle. The doors are opened from the inside by pushing the interior door handle forward.

The rear doors are locked by pulling the interior door handles rearward.

Horn Switch

Situated in the centre of the steering wheel, the push switch operates the twin horns when depressed.

Ignition Switch

Inserting the key provided in the switch and turning clockwise will switch on the ignition.

Never leave the ignition on when the engine has stopped, a reminder of such circumstances is provided by the ignition warning light situated in the speedometer.

Interior Light Switch

Press the switch button marked " Int " to illuminate the car interior. Pressing the switch button a further time will switch off the lights. The interior lights are automatically switched on when either of the front doors are opened and are extinguished when the doors are closed.

Lighting Switch

From " Off " can be rotated clockwise into three positions, giving in the first location, side and tail, in the second location, head, side and tail, and in the third position, fog, side and tail lamps.

(Fog lamps are not fitted on cars for U.S.A.).

Panel Light Switch

Press the switch button marked " P " when it is desired to read the instruments at night. Pressing the switch button a further time will switch off the lights. The panel lights only operate when the side lamps are switched on.

Starter Switch

Press the switch adjacent to the ignition switch, with the ignition switched on, to start the engine. Release the switch immediately the engine fires and never operate the starter when the engine is running.

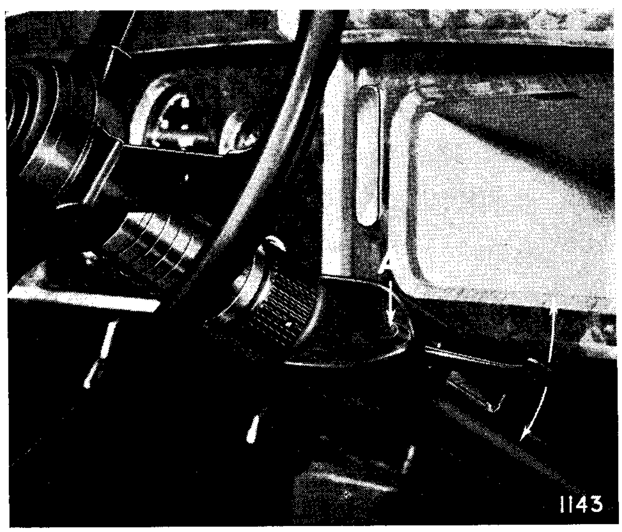

Fig. 6. Flashing direction indicator control. The warning light " A " lights up intermittently when the indicators are in operation.

Flashing Direction Indicators

The ' flashers ' are operated by a lever behind the steering wheel. To operate the flashing direction indicators on the right-hand side of the car move the lever clockwise ; to operate the left-hand side indicators move the lever anti-clockwise. A green warning light in the indicator control box lights up intermittently when the ' flashers ' are in operation.

Braking Lights

Twin combined tail/flasher and brake lights are situated at the rear of the car. The latter automatically light up when the footbrake is applied.

Reversing Light

The reversing light is automatically brought into operation when reverse gear is engaged and the ignition is switched on.

Luggage Compartment Illumination

The luggage compartment is automatically illuminated by a lamp when the lid is opened. The lamp operates only when the side lights are switched on.

Cigar Lighter

Fitted to the instrument panel ; thermostatically controlled. To operate, press holder into the socket and remove the hand. On reaching the required temperature, the holder will return to the extended position. Do not hold lighter in the ' pressed in ' position.

Windscreen Wipers

The wipers are controlled by a three-position rotary switch situated at the left of the instrument panel. The markings ' O ', ' N ' and ' H ' represent Off, Normal Speed and High Speed respectively.

The ' N ' (Normal) speed position is recommended for all normal adverse weather conditions and snow.

The ' H ' (High) speed position is recommended for conditions of very heavy rain and for fast driving in rain. This position should not be used in heavy snow or with a drying windscreen, that is, when the load on the motor is in excess of normal ; the motor incorporates a protective cut-out switch which under conditions of excessive load cuts off the current supply until normal conditions are restored.

When the control switch is placed in the ' O ' (Off) position the wipers will automatically return to a position along the lower edge of the screen.

Windscreen Washer

The windscreen washer should be used in conjunction with the windscreen wipers to remove foreign matter that settles on the windscreen.

Press the chromium-plated control button, to the left of the lighting switch, for a few seconds. Release button, when two fine jets of water will strike the windscreen at points one or two inches below the upper edge and in the centre of the arc of wipe provided by each windscreen wiper.

In summer the washer should be used freely to remove insects before they dry and harden on the screen.

The washer should not be used in sub-zero conditions as obviously the fine jets of water spread over the screen by the blades will tend to freeze up. Do not add radiator anti-freeze solution to the water as this is detrimental to the washer mechanism.

Car Heating Temperature Control

The lever controlling the flow of water from the engine cooling system to the heating element is situated at the left-hand side of the instrument panel.

When the lever knob is placed in the fully upward (Cold) position, the supply of hot water from the engine is completely cut off ; placed in the fully downward (Hot) position the maximum possible amount of hot water from the engine is allowed to pass through the heater element. By placing the lever knob in intermediate positions the temperature of the air from the heater can be varied between these two extremes.

Car Heating Fan Switch

The switch for the heater fan (marked Fan) is situated at the left of the instrument panel and is of the " push—push " type. If the fan is off, pressing the button will switch on the fan ; pressing the button a further time will switch off the fan.

Bonnet Lock Control

The bonnet lock is controlled from the driving compartment. To open the bonnet pull the control knob, situated under the facia on the right-hand side. This will release the bonnet which will now be retained by the safety catch. Insert the fingers under the nose of the bonnet and lift the safety catch upwards when the bonnet may be raised. The bonnet is automatically retained in the fully open position by the action of the hinge springs. The bonnet is self-locking when pushed down firmly into the closed position.

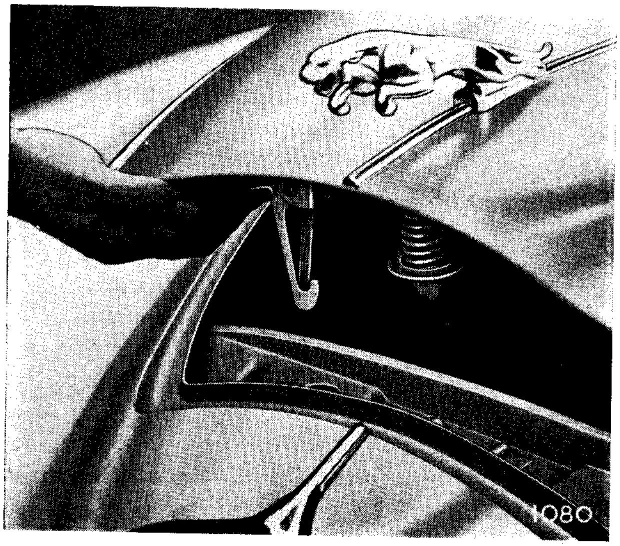

Fig. 7. Bonnet safety catch.

Scuttle Ventilator

Additional fresh air ventilation of the car interior can be obtained by opening the scuttle ventilator and the heater duct doors. To open the scuttle ventilator pull the lever, situated below the left-hand side of the instrument panel, rearward.

Petrol Filler

The petrol filler is situated in a recess in the left-hand rear wing, and is provided with a hinged cover.

No-Draught Ventilation

No-draught ventilator windows incorporating quick locking catches are fitted to both front and rear windows.

To open the window, release the locking catch and set the window to the desired position. The initial opening of the window gives extraction of air from the body, when the window is opened further, air is forced into the body due to the angle of the ventilator and forward motion of the car. Using the no-draught ventilator windows as extractors (that is partly open), has, to a minor degree, the effect of demisting the windscreen.

Spare Wheel and Jacking Equipment

The spare wheel is housed in a compartment underneath the luggage boot floor and is accessible after removal of the circular lid.

The wheel brace and jack are retained in clips at the front and top of the luggage compartment. The jack handle is stored in the tool container.

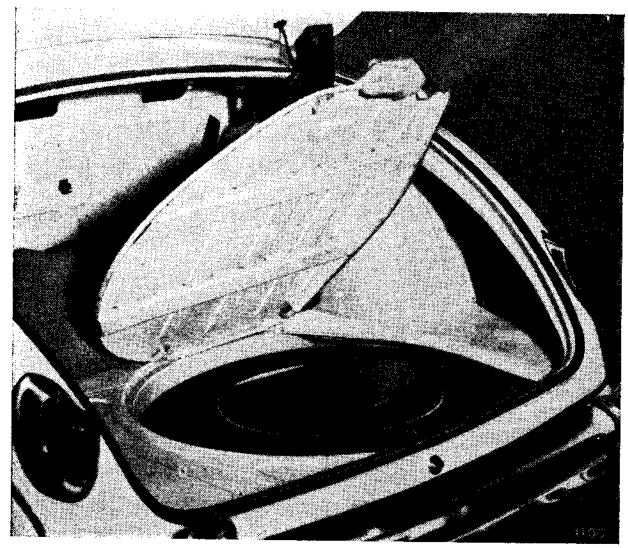

Fig. 8. The spare wheel is housed in a compartment underneath the luggage boot floor. The container for the hand tools and jack handle is also stored in this compartment.

Tools

The container for the hand tools and jack handle is housed in the spare wheel compartment. This compartment is accessible after removal of the circular lid which forms part of the luggage boot floor.

Luggage Compartment

The luggage compartment is unlocked by inserting the key in the lock immediately below the lid, and rotating clockwise through half a turn. Press the lock to release the catch when the lid can be raised; the boot lid is automatically retained in the fully open position by the action of the hinge springs.

WHEEL CHANGING

(Disc Wheels)

Whenever possible, the wheel changing should be carried out with the car standing on level ground and in all cases with the handbrake fully applied.

The spare wheel is housed in a compartment underneath the luggage boot floor ; the wheel changing equipment is retained in clips attached to the front and top of the luggage compartment.

Unlock the luggage compartment by turning the key in the lock, situated immediately below the lid, through half a turn. Press the lock, when the lid will be released. Raise the lid as far as possible where it will be retained by the action of the hinge springs.

Lift out the circular lid which forms part of the luggage boot floor. Unscrew the spare wheel clamping handle and lift out the wheel. Remove the jack and wheel brace from the clips at the top of the luggage compartment, and the jack handle from the tool kit.

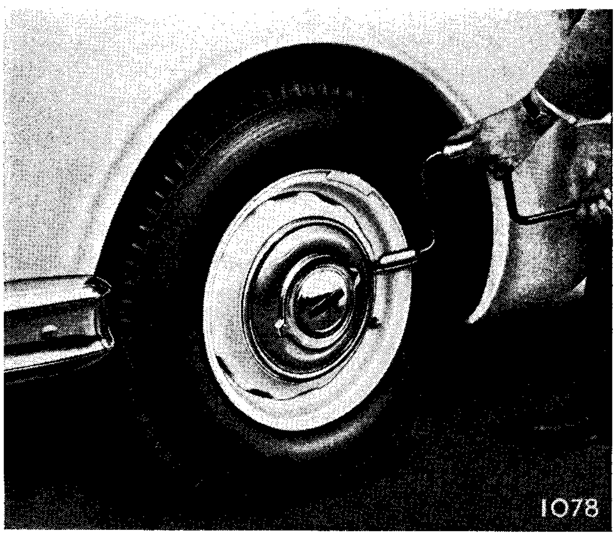

Fig. 9. Removal of the wheel nave plate. To avoid damaging the nave plate do not allow it to fall on to the ground.

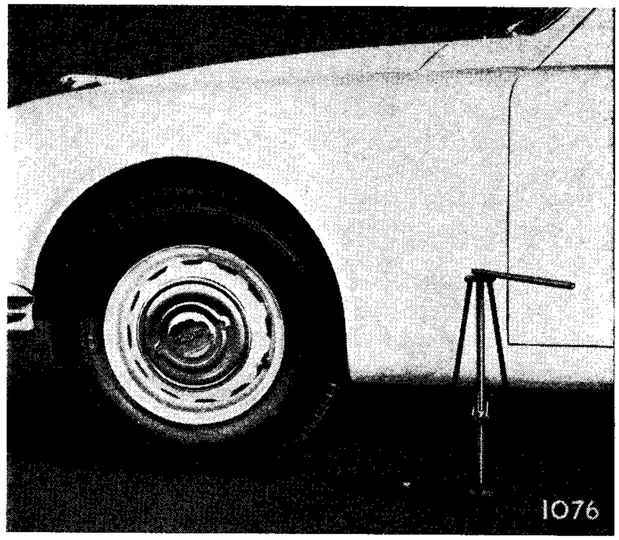

Fig. 10. The jack in position for raising the left-hand front wheel.

Changing a Front Wheel

Remove the wheel nave plate by levering off with the blade end of the wheel brace. Using the wheel brace loosen, but do not remove, the five wheel nuts ; all wheel nuts have right-hand threads, that is, they are unscrewed anti-clockwise.

Remove the rubber plug from the front jacking socket on the side to be raised. Insert the square portion of the jack well home in socket and elevate the jack with the ratchet handle fitted side marked ' LIFT ' upwards, until the wheel is clear of the ground. Remove the wheel nuts and withdraw the road wheel.

Mount the spare wheel on the fixing studs and start all five nuts on the threads by rotating clockwise. Apply the wheel brace and run up all the nuts until they are tight. Lower the jack, using the jack ratchet handle side marked ' LOWER ' upwards, until the weight of the car is on the wheel and finally tighten all wheel nuts.

Fit the nave plate over two of the three mounting posts and secure by a sharp tap from the hand at a point in line with the third mounting post.

Changing a Rear Wheel

First remove the rear wheel valance as follows : Open the rear door and with the blade end of the wheel brace or a coin turn the two screws, which secure the front end of the valance, through half a turn in an anti-clockwise direction. Remove the valance by withdrawing downwards and forward.

Remove the wheel nave plate by levering off with the blade end of the wheel brace. Using the wheel brace loosen, but do not remove, the five wheel nuts ; all wheel nuts have right-hand threads, that is, they are unscrewed anti-clockwise.

Remove the rubber plug from the rear jacking socket on the side to be raised. Insert the square portion of the jack well home in the socket and elevate the jack with the ratchet handle fitted side marked ' LIFT ' upwards, until the wheel is clear of the ground. Remove the wheel nuts and withdraw the road wheel.

Mount the spare wheel on the fixing studs and start all five nuts on the threads by rotating clockwise. Apply the wheel brace and run up all the nuts until they are tight. Lower the jack, using the jack ratchet handle side marked ' LOWER ' upwards, until the weight of the car is on the wheel and finally tighten all wheel nuts.

Fit the nave plate over two of the three mounting posts and secure by a sharp tap from the hand at a point in line with the third mounting post.

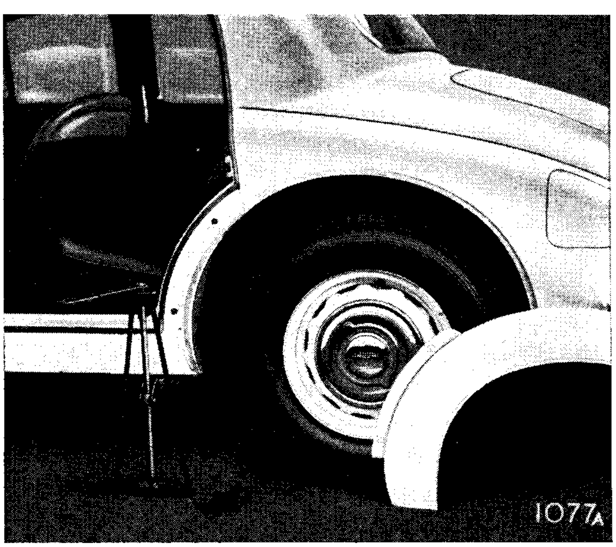

Fig. 11. The jack in position for raising the left-hand rear wheel.

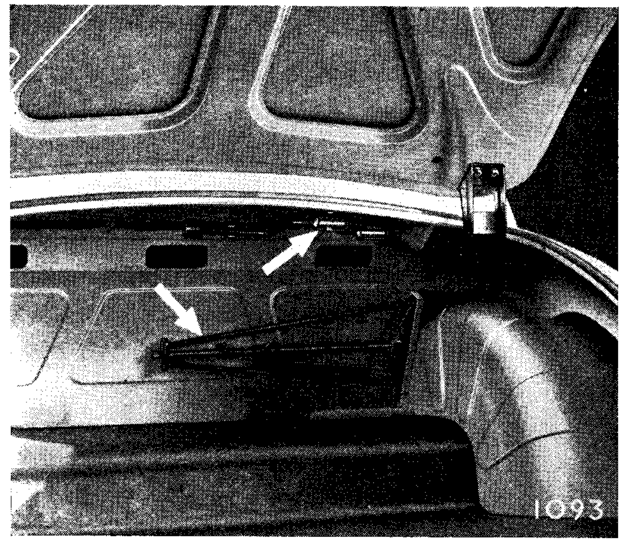

Fig. 12. The wheel base and jack are retained in clips at the front of the luggage compartment. The jack handle is stored in the tool container.

Wire Spoke Wheels

Remove the copper and hide mallet from the tool kit. Using the mallet, slacken but do not remove the hub cap ; the hub caps are marked ' Right (off) side ' or ' Left (near) side ' and the direction of rotation to remove, that is, clockwise for the right-hand side and anti-clockwise for the left-hand side.

Remove the rubber plug from the front or rear jacking socket on the side to be raised. Insert the square portion of the jack well home in the socket and elevate the jack with the ratchet handle fitted side marked ' LIFT ' upwards, until the wheel is clear of the ground. Remove the hub cap and withdraw the road wheel.

Mount the spare wheel on the splined hub. Refit the hub and tighten as much as possible by rotating the hub cap in the required direction, that is, anti-clockwise for the right-hand side and clockwise for the left-hand side.

Lower the jack by using the ratchet handle with the side marked ' LOWER ' uppermost, until the weight of the car is on the wheels.

Finally, tighten the hub cap fully with the copper and hide mallet.

STARTING AND DRIVING

Prior to Starting

Before starting the engine the new owner should be familiar with the location and function of the instruments and controls.

Ensure that the water level in the radiator and the oil level in the sump are correct. Check for sufficient petrol in the tank.

Place the gear lever in the neutral position and check that the handbrake is applied.

2.4 LITRE

Starting from Cold

For starting from cold the mixture control (marked Start) should be moved up to the fully rich (Cold) position.

Switch on the ignition and press the starter switch button but **do not touch the accelerator.** Release the starter button as soon as the engine fires—this is important. If for any reason the engine does not start, do not operate the starter switch again until both the engine and starter motor have come to rest.

As soon as the engine speed increases slide the mixture control to the intermediate (Hot) position ; this position will be felt as a marked resistance in the slide.

Drive off at a moderate speed progressively moving the mixture control to the off (Run) position until the knob is at the bottom of the slide and the red warning light is extinguished.

Starting in Moderate Temperature

In warm weather or if the engine is not absolutely cold, it is usually possible to start the engine with the mixture control in the intermediate (Hot) position by adopting the procedure given above.

Starting when Hot

Do not use the mixture control. If the engine does not start immediately, slightly depress the accelerator pedal when making the next attempt.

Do NOT pump the accelerator pedal as owing to the action of an accelerating pump in the carburettor an excessively rich mixture will be admitted into the engine.

Difficult Starting (Engine Hot)

On extremely hot days or when the engine is stopped after a fast climb, occasional difficulty may be experienced in starting immediately.

This may be due to a temporary richness of mixture. On no account pump the accelerator, but slowly depress it to about one-third of its travel, maintaining this position until the engine fires.

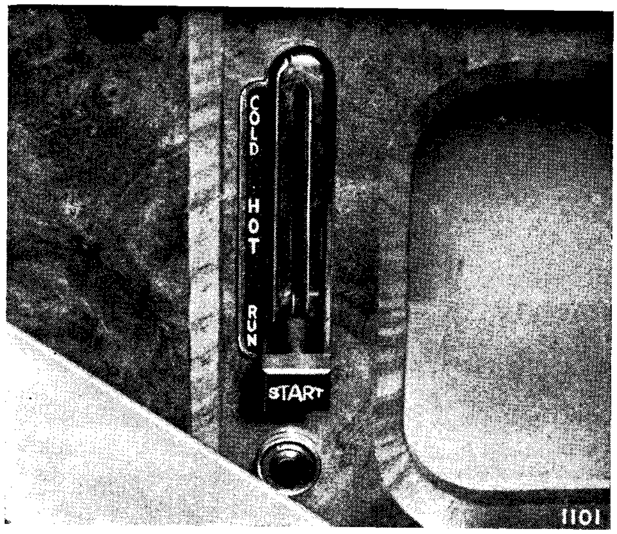

Fig. 13. Carburetter mixture control and warning light.

Use of the Mixture Control—Important

Use of the mixture control (marked ' Start ') brings into operation a starting device which provides the richer mixture necessary for starting. Do NOT permit the starting device to remain in operation longer than is necessary but return the control to the (Run) position as soon as the engine will allow. Unnecessary use of the mixture control will result in increased cylinder bore wear.

A reminder that the starting device is in operation is provided by a red warning light immediately below the mixture control slide. When the control is returned to the (Run) position the starting device is taken out of action and the warning light is extinguished.

3.4 LITRE

Starting from Cold

It is not necessary to use any manual choke control when starting from cold, since the auxiliary starting carburettor is entirely automatic and controls the mixture strength without assistance from the driver. The starting carburettor automatically cuts out when the temperature of the water in the cylinder head reaches 35°C.

Warming up

Do not operate the engine at a fast speed when first started but allow time for the engine to warm up and the oil to circulate. A thermostat is incorporated in the cooling system to assist rapid warming up. In very cold weather run the engine at 1,500 r.p.m. with the car stationary until a rise in temperature is indicated on the temperature gauge.

Driving

(a) Careful adherence to the 'Running-in Instructions' given on the next page, will be amply repaid by obtaining the best performance and utmost satisfaction from the car.

(b) The habit should be formed of reading the oil pressure gauge, water temperature gauge and ammeter occasionally as a check on the correct functioning of the car. Should an abnormal reading be obtained an investigation should be made immediately.

(c) Always start from rest in first or second gear ; on a hill always use first gear. To start in a higher gear will cause excessive clutch slip and premature wear. Never drive with a foot resting on the clutch pedal and do not keep the clutch depressed for long periods in traffic.

(d) The synchromesh gearbox provides a synchronized change into second, third and top. When changing gear the movement should be slow and deliberate.

When changing down a smoother gear change will be obtained if the accelerator is left depressed to provide the higher engine speed suitable to the lower gear. Always fully depress the clutch pedal when changing gear.

(e) Gear changing may be slightly stiff on a new car but this will disappear as the gearbox becomes 'run-in'.

(f) Always apply the footbrake progressively ; fierce and sudden application is bad for the car and tyres. The handbrake is for use when parking the car, when driving away on a hill and when at a standstill in traffic.

'Running-in' Instructions

Only if the following important recommendations are observed will the high performance and continued good running of which the Jaguar is capable be obtained.

During the 'running-in' period do not allow the engine to exceed the following speeds:

2.4 Litre

First 500 miles (800 km.)	2,500 r.p.m.
From 500—1,000 miles (800—1,600 km.)	3,000 r.p.m.
From 1,000—2,000 miles (1,600—3,200 km.)	4,000 r.p.m.

3.4 Litre

First 1,000 miles (1,600 km.)	2,500 r.p.m.
From 1,000—2,000 miles (1,600—3,200 km.)	3,000 r.p.m.

Continue to drive without overstressing the engine.

Have the engine sump drained and refilled and the oil filter attended to as recommended at the free service, that is, after the first 500 miles (800 km.).

AUTOMATIC TRANSMISSION

Operating and Maintenance

2.4 LITRE AND 3.4 LITRE

GENERAL DESCRIPTION

The transmission assembly consists of a three-element hydraulic torque converter followed by two planetary gear sets which permit the elimination of the clutch pedal and normal gear-shift lever. The planetary gear sets incorporate free-wheels and are controlled by hydraulically-operated band and disc clutches.

The manual control lever allows selection of the following conditions :—

P (Park). A pawl is mechanically engaged with teeth on the main shaft. A hydraulic interlock prevents engagement at speeds above 3 to 5 m.p.h.

N (Neutral). All clutches are disengaged and there is no drive beyond the torque converter.

D (Drive). Automatic changes between the low gear and intermediate gear and between the intermediate gear and direct drive.

Changes from low to intermediate gear and intermediate to direct drive depend upon the combination of road speed and throttle position ; the larger the throttle opening the higher the speed at which the change occurs. This is achieved by mechanically combining the motions of a mechanical centrifugal governor and the throttle linkage. The resultant motion operates a hydraulic valve.

Depression of the accelerator pedal beyond normal travel causes a " kick-down " change from direct to intermediate gear. Below 52 m.p.h. (40 m.p.h.) a downshift from direct to intermediate gear can be obtained by depressing the accelerator to the full throttle position short of " kick-down ". No " kick-down " downshift is possible for intermediate to low gear.

The torque converter and a gear reduction are operative in the low intermediate gears. Direct drive is obtained by coupling the engine directly to the main shaft by a disc clutch. The relevant road speeds are given in " Transmission Data ".

Manual L (Low). A low gear train and the torque converter are operative and no automatic change can occur. Manual changes between L and D may be made while the car is in motion but changes into L should be avoided at speeds above 45 m.p.h. (35 m.p.h.).

R (Reverse). A reverse-gear train and the torque converter are operative. A hydraulic interlock prevents engagement of the reverse clutch at forward speeds above 10 m.p.h. (9 m.p.h.).

Electrical connection to the starter is made only when N and P are selected. An anti-creep device traps brake fluid pressure when the car is stationary after the brakes have been applied. Opening the throttle releases the pressure.

TRANSMISSION DATA

Maximum torque ratio of converter	2.15 : 1
Low gear reduction	2.308 : 1
Intermediate gear reduction	1.435 : 1
Direct drive—no converter	1 : 1
Reverse gear reduction	2.009 : 1

(Speeds shown in brackets apply to the 2.4 litre model.)

AUTOMATIC GEAR CHANGE

Upshifts		2.4 litre m.p.h.	3.4 litre m.p.h.
Low to intermediate—light throttle		11	11
Low to intermediate—full throttle		32	40
Intermediate to direct—light throttle		20	23
Intermediate to direct—full throttle		50	64
Intermediate to direct—after " kick-down "		63	78
Downshifts			
Direct to intermediate—closed throttle		13	16
Intermediate to low—closed throttle		3	4
Direct to intermediate—" kick down "	Up to	55	68
Parking pawl permitted to engage	Below	3	3 to 5
Reverse gear permitted to engage	Below	9	10
Manual change from drive to low to be **avoided**	Above	35	45

DRIVING INSTRUCTIONS

The operation of the automatic transmission is controlled by the position of the selector lever in the quadrant marked P, N, D, L, R, situated at the bottom of the instrument panel.

Selector

The selector lever can be slid freely between the N and D positions and between the L and R positions.

To move between P and N and between D and L the lever must be depressed.

To select R from any other position other than L, depress the lever, move to L position and allow lever to spring upward before sliding along to the R position.

To start the engine the selector lever must be in the P or N positions.

P or Park provides a safe, positive lock on the rear wheels when the car is stopped. Movement of the selector lever to the P position actuates a mechanical locking device in the transmission which prevents the rear wheels from turning in either direction. For this reason, should the car be pushed from front or rear with sufficient force, the car will skid on the rear tyres. This condition is quite similar to that encountered when a car with conventional transmission is parked in gear or with the handbrake applied firmly. The fact that the engine may be started with the selector in P position is convenient when parked on an incline.

When the car is stopped on a hill and the P (Park) position is selected, the parking mechanism may become very firmly engaged due to the load on the pawl. To disengage the parking pawl under these conditions the following procedure should be adopted :—

To release transmission from P (Park) when facing UP HILL.

1. Start the engine.
2. Release the handbrake.
3. Select D and **hold** lever in this position (irrespective of the direction in which it is desired to move off).
4. Depress accelerator slowly until the car moves forward, indicating the release of the parking pawl.
5. The car is now " free " and can be driven away in the desired direction.

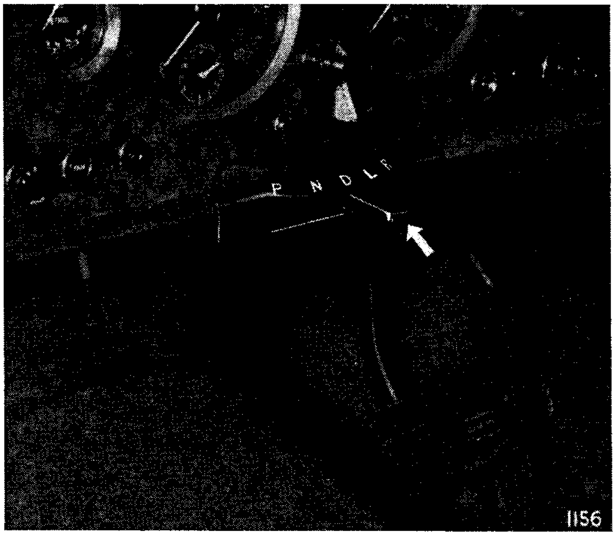

Fig. 14. Selector control.

To release transmission from P (Park) when facing DOWN HILL.

1. Start the engine.
2. Release the handbrake.
3. Select R and **hold** lever in this position (irrespective of the direction in which it is desired to move off).
4. Depress accelerator slowly until the car moves backward, indicating the release of the parking pawl.
5. The car is now " free " and can be driven away in the desired direction.

N or Neutral position permits idling the engine without the possibility of setting the car into motion by pressure on the accelerator and may be used when starting the engine. It is inadvisable to engage neutral for coasting above a speed of 45 m.p.h.

D or Drive provides the normal forward driving range and includes automatic shifting between the low, intermediate and direct drive ranges. Virtually all forward driving, accelerating and stopping can be done with the lever in the D position. Once the engine is started and the lever is moved to D it can be left in this position for all normal driving. When accelerating, the transmission shifts automatically from low to intermediate between 11 and 40 m.p.h. (11 and 32 m.p.h.) and from intermediate to direct between 23 and 64 m.p.h. (20 and 50 m.p.h.) depending on the position of the accelerator pedal. On deceleration, it will shift automatically from direct drive to intermediate at approximately 16 m.p.h. (13 m.p.h.) and from intermediate to low at approximately 4 m.p.h. (3 m.p.h.).

L or Low is an emergency engine power range for use on unusually long and steep grades or for braking on descents, for extra heavy pulling, and for rocking the car out of mud, sand or snow.

R or Reverse position of the selector lever provides reverse driving range.

Intermediate Speed Hold. A switch mounted on the facia provides a means for the driver to obtain a downshift from direct to intermediate without depressing the accelerator pedal (as advised under the heading " Additional Power and Acceleration ") and to retain the drive in the intermediate range. This will be found convenient for overtaking or when hill climbing.

With the switch in the " IN " position no upshift will take place between intermediate and direct drive ; placing the switch lever in the " OUT " position will cause the transmission to shift to direct drive, provided the normal upshift speed has been obtained.

Warning. Do NOT allow the maximum permitted engine revolutions to be exceeded through allowing the " Intermediate Speed Hold " to remain in operation longer than necessary, or by switching in the " hold " at speeds in excess of 75 m.p.h. (60 m.p.h.).

Additional Power and Acceleration in D range can be obtained as follows :—

(a) Below 52 m.p.h. (40 m.p.h.) depress the accelerator pedal to the full throttle position to effect a change into the intermediate range ; the drive will continue in the intermediate range until the release of the accelerator or approximately 64 m.p.h. (50 m.p.h.) is reached.

(b) Between 52 m.p.h. and 68 m.p.h. (40 m.p.h. and 55 m.p.h.) depress the accelerator pedal all the way to the floorboard to effect a " kick-down " change into intermediate range ; the drive will continue in intermediate range until release of the accelerator or approximately 78 m.p.h. (63 m.p.h.) is reached.

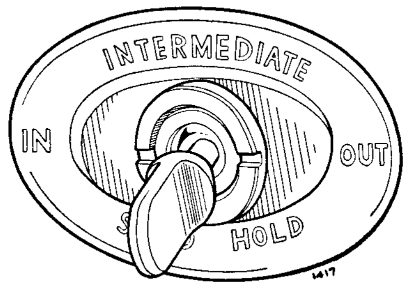

Fig. 15. Intermediate speed hold switch.

(Speeds shown in brackets apply to the 2.4 litre model.)

Hard Pulling, such as encountered in deep snow, mud or other adverse driving conditions, is best accomplished in the L range.

Rocking out of Mud, Sand or Snow is accomplished with the accelerator pedal slightly depressed and held steady while making quick alternate selections of L and R ranges.

Anti-Creep is a special braking feature which prevents the car from creeping forward when stopped on level ground or slight grades, as long as the ignition key is turned on. Apply the footbrake to stop the car and then remove the foot from the brake pedal. The car will not creep forward or backward. Any movement of the accelerator pedal, or turning off the ignition key, releases the anti-creep action.

Push Starting may sometimes be necessary, as in the case of a flat battery. Turn ignition key ON, place selector lever in the N position. The car may now be pushed and when it has reached 15 to 20 m.p.h. move the selector lever to D or L position. **Do not tow the car to start the engine—it may overtake the tow car.**

Engine Braking, for descending long mountainous grades, is easily secured by bringing the car speed below 45 m.p.h. (35 m.p.h.) and momentarily depressing the accelerator while placing the selector lever in the L position.

Prolonged Idling is sometimes unavoidable. In such cases, as a safety precaution, move the selector lever to the P or N position.

Towing should be done with the selector lever in the N position. Car should not be towed in excess of 30 m.p.h.

MAINTENANCE

The oil necessary for the operation of the torque converter is common with that used in the transmission. The total oil capacity of the transmission assembly is approximately 15 Imperial pints (18 U.S. pints ; 8.5 litres), but when draining the transmission a small quantity of oil will remain in the unit and the amount required to refill it will be that needed to bring the oil level to the FULL mark on the dipstick as described in " Draining and Refilling Transmission " below.

Every 1,000 miles (1,600 km.)

Check Transmission Oil Level as follows:—

1. With the car on a level floor, set the handbrake firmly, set the selector lever at L, and raise the transmission oil temperature by idling the engine to normal engine operating temperature.
2. Pull back the centre carpet and underfelt ; remove the rubber cover from the dipstick access aperture. Clean the area around the dipstick hole. Remove the dipstick and wipe it dry.
3. Stop the engine. **Immediately** insert and withdraw the dipstick and check the oil level. The space between the FULL and LOW on the dipstick represents approximately one pint.
4. If the addition of oil is required, repeat the above checking procedure after adding oil. DO NOT OVERFILL.

Every 15,000 miles (24,000 km.)

Drain and Refill Transmission as follows :—

1. Set the handbrake firmly. Set selector lever at L and raise transmission oil temperature by idling engine to normal engine operating temperature.
2. Stop the engine and remove the cover plate located underneath the floor carpet to expose the dipstick. Clean the area around the dipstick hole and remove the dipstick.

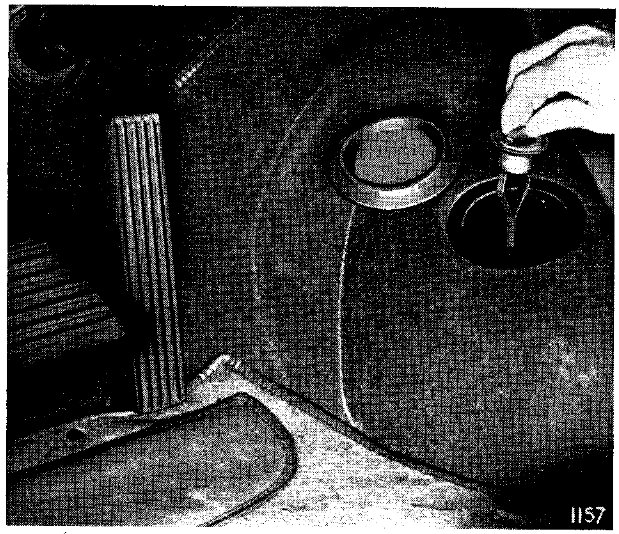

Fig. 16. Dipstick removal.

3. Remove the transmission oil pan drain plug. (A, Fig. 17.)
4. Remove the converter housing cover plate and rotate the converter until drain plug is in position for draining. Remove the converter drain plug (B).
5. To facilitate draining, remove the square-headed converter pressure take-off plug from the bottom of the housing attached to the left-hand side of the transmission casing (C).

(Speeds shown in brackets apply to the 2.4 litre model.)

6. After oil has drained, refit and tighten the drain plugs in the transmission oil pan and converter. Refit the converter housing cover plate. Refit and tighten the converter pressure take-off plug.
7. Pour 10 Imperial pints (12 U.S. pints ; 5.7 litres) of the recommended grade of oil into the transmission through the dipstick hole.
8. Start the engine and idle for approximately one minute with the selector lever set in the L position to transfer the oil to the converter from the transmission case.
9. With the engine still idling and the selector lever in the L position, add additional oil (approximately 5 Imperial pints, 6 U.S. pints or 2.8 litres) to bring the level to the FULL mark on the dipstick. DO NOT OVERFILL. Finally, recheck the level of the oil as described in " Check Transmission Oil Level ".

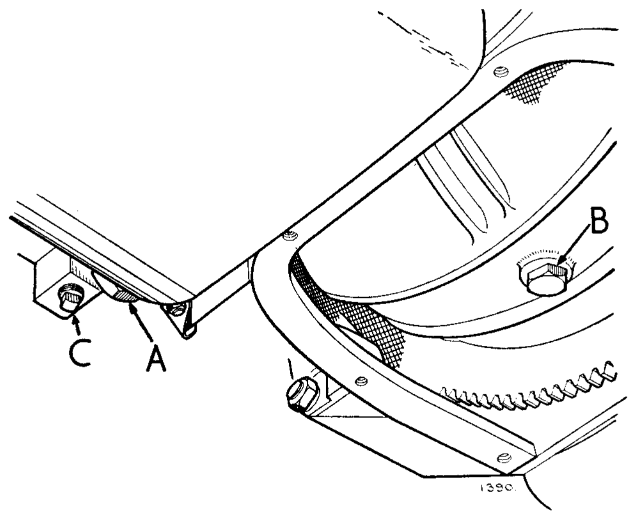

Fig. 17. Drain plugs (converter housing cover plate removed).

RECOMMENDED LUBRICANTS

Mobil	Castrol	Shell	Esso	B.P.	Duckham
Mobil-fluid 200	Castrol T.Q.	Shell Donax T6	Esso Automatic Fluid, Grade 55	Automatic Transmission Fluid, Type "A"	Nolmatic

S.A.E. Automatic Transmission Fluid, Type "A" (AQ-ATF).

Transmission and torque converter oil capacity : 15 Imperial pints (18 U.S. pints; 8.5 litres).

SUMMARY OF MAINTENANCE

Daily

Check radiator water level.

Check engine oil level.

Weekly

Check tyre pressures.

Check fluid level in brake and clutch master cylinder reservoirs.

Monthly

Check battery electrolyte level and connections.

Every 1,250 miles (2,000 km.)

Check fluid in Automatic Transmission unit (if fitted).

Every 2,500 miles (4,000 km.)

Drain engine sump and refill.

Clean oil filter element.

Check gearbox oil level and top up if necessary.

Check rear axle oil level and top up if necessary.

Lubricate steering box.

Lubricate steering idler housing.

Lubricate steering tie-rod ball joints.

Lubricate wheel swivels.

Lubricate propeller shaft universal joints.

Lubricate propeller shaft splines (Automatic Transmission and Overdrive models only).

Lubricate handbrake cable.

Lubricate carburetter hydraulic piston dampers.

Clean and re-oil air cleaner (oil bath type).

Lubricate distributor and check contact points.

Clean, adjust and test sparking plugs.

Check clutch pedal free travel and adjust if necessary.

Check handbrake adjustment.

Check carburetter slow running.

Change over road wheels.

Every 5,000 miles (8,000 km.)

Carry out 2,500 miles service.

Clean carburetter filters.

Clean petrol line filter.

Lubricate front wheel bearings (cars with disc brakes only).

Lubricate door hinges.

Lubricate rear wheel bearings.

Spray rear springs (avoid rubber mountings).

Check fan belt and adjust if necessary.

Clean and lubricate brake servo air cleaner.

Renew oil filter element.

Clear drain holes in bottoms of doors.

Carry out oil can lubrication of (a) seat runners and adjusting mechanism, (b) handbrake lever ratchet, (c) door locks, (d) boot hinges and lock, (e) bonnet hinges and catches, (f) windscreen wiper arms, (g) accelerator linkage, (h) petrol filler cover hinge, (i) handbrake cable compensator.

Examine brake linings for wear (drum brakes only).

Examine brake friction pads for wear (disc brakes only).

Every 10,000 miles (16,000 km.)

Carry out 2,500 miles and 5,000 miles service.

Drain and refill gearbox (and overdrive if fitted).

Clean overdrive oil pump filter (if overdrive fitted).

Clean engine sump strainer.

Drain and refill rear axle.

Dismantle front wheel bearing hubs, clean out and repack with h.m.p. grease (cars with drum brakes only).

Clean petrol pump filter.

Check and tighten all chassis and body nuts, screws and bolts.

Check rear wheel bearing end-float and adjust if necessary.

Renew sparking plugs.

Lubricate generator end bush (2.4 litre only).

Every 15,000 miles (24,000 km.)

Drain and re-fill Automatic Transmission unit (if fitted).

RECOMMENDED LUBRICANTS

Component	Mobil	Castrol	Shell	Esso	B.P.	Duckham	S.A.E. Viscosity
Engine—Summer, 32°F.—90°F.	Mobiloil A	Castrol XL	Shell X-100 30	Esso Extra Motor Oil 20W/30	Energol 30	NOL 30	30
Winter, below 32°F. ..	Mobiloil Arctic	Castrolite	Shell X-100 20/20W	Esso Extra Motor Oil 20W/30	Energol 20	NOL 20	20
Tropical, above 90°F. ..	Mobiloil AF	Castrol XXL	Shell X-100 40	Esso Extra Motor Oil 40/50	Energol 40	NOL 40	40
Upper cylinder lubrication ..	Mobil Upperlube	Castrollo	Shell UCL or Donax U	Esso UCL	Energol UCL	Adcoid Liquid	
Gearbox .. .. Carburetter hydraulic piston dampers .. .. Distributor oil can points .. Oil can lubrication	Mobiloil A	Castrol XL	X-100 30	Esso Extra Motor Oil 20W/30	Energol 30	NOL 30	30
Rear axle	Mobilube GX 90	Castrol Hypoy	Spirax 90 EP	Expee Compound 90	Energol EP 90	Hypoid 90	Hypoid 90
Propeller shaft—Universal joints Steering box	Mobilube C 140	Castrol D	Spirax 140 EP	Gear Oil 140	Energol 140	NOL EP 140	140
Front wheel bearings .. .. Rear wheel bearings .. .. Distributor cam	Mobilgrease MP	Castrolease WB	Retinax A	Esso High Temp. Grease	Energrease N 3	LB 10	
Propeller shaft—Spline .. .. Steering idler housing .. .. Steering tie-rods .. .. .. Wheel swivels .. .. .. Handbrake cable .. .. .. Door hinges	Mobilgrease MP	Castrolease Medium or WB	Retinax A or RB	Esso Grease or Esso High Temp. Grease	Energrease C 3 or N 3	LB 10 or HPG	
Automatic transmission unit ..	Mobil Fluid 200	Castrol TQ Automatic Transmission Fluid Grade 'A'	Shell Donax T 6	Esso Automatic Fluid 55	Energol Automatic Transmission Fluid Type 'A'	Nolmatic	Automatic Transmission Fluid Type 'A' AQ-ATF

MULTI-GRADE ENGINE OILS

(These oils should NOT be used in worn engines requiring overhaul)

Mobil	Castrol	Shell	B.P.	Duckham
Mobiloil Special 10W/30	Castrol XL 20W/50	Shell Super	Super Visco-Static	Q5500

Note. 1. If an SAE 30 or 40 oil has previously been used in the engine a slight increase in oil consumption may be noticed but this will be compensated by the advantages gained.

2. **Do not** use multi-grade oil in the gearbox ; use one of the recommended SAE 30 oils.

RECOMMENDED HYDRAULIC FLUIDS

Cars Fitted with Drum Brakes

Preferred Fluid

Lockheed Heavy Duty Brake Fluid.

Alternative Fluids

Castrol Crimson Hydraulic Brake Fluid.
Delco Special No. 11 Brake Fluid.
Chrysler MS 3511 Brake Fluid.
Wagner 21B Brake Fluid.

Cars Fitted with Disc Brakes

Preferred Fluid

Castrol Crimson Hydraulic Brake Fluid

Alternative Fluids

Lockheed Heavy Duty Brake Fluid.
Delco Special No. 11 Brake Fluid.
Chrysler MS 3511 Brake Fluid
Wagner 21B Brake Fluid.

Clutch Operation

Preferred Fluid

Lockheed Heavy Duty Brake Fluid

Alternative Fluids

Castrol Crimson Hydraulic Brake Fluid.
Delco Special No. 11 Brake Fluid.
Chrysler MS 3511 Brake Fluid.
Wagner 21B Brake Fluid.

Note. In countries where the above fluids are unobtainable use only a recognised brake fluid guaranteed to conform to the S.A.E. Specification 70 R.1.

SERVICE DEPARTMENTS

Factory:

The Service Division,
Jaguar Cars Limited, Coventry, England.
Telephone No. Allesley 2121 (P.B.X.)

London:

Messrs. Henlys Ltd.,
The Hyde, Hendon, London, N.W.9.
Telephone No. Colindale 6565

U.S.A.:

The Technical Service Department,
Jaguar Cars Inc.,
42-50 Twenty-First Street, Long Island City 1,
New York, U.S.A.

Canada:

The Technical Service Department,
Jaguar Cars (Canada) Ltd.,
8505 Delmeade Road, Montreal 9,
Quebec, Canada.

CONVERSION TABLES

METRIC INTO ENGLISH MEASURE

1 millimetre is approximately $\frac{1}{25}''$, and is exactly .03937″.
1 centimetre is approximately $\frac{3}{8}''$, and is exactly .3937″.
1 metre is approximately $39\frac{3}{8}''$, and is exactly 39.37″ or 1.0936 yards.
1 kilometre is approximately $\frac{5}{8}$ mile, and is exactly .6213 miles.
1 kilogramme is approximately $2\frac{1}{4}$ lbs., and is exactly 2.21 lbs.
1 litre is approximately $1\frac{3}{4}$ pints, and is exactly 1.76 pints.
To convert metres to yards, multiply by 70 and divide by 64.
To convert kilometres to miles, multiply by 5 and divide by 8 (approx.).
To convert litres to pints, multiply by 50 and divide by 88.
To convert grammes to ounces, multiply by 20 and divide by 567.
To find the cubical contents of a motor cylinder, square the diameter (or bore), multiply by 0.7854, and multiply the result by the stroke.
1 M.P.G.—0.3546 kilometres per litre or 2.84 litres per kilometre.

KILOMETRES INTO MILES

Kilo.	Miles	Kilo.	Miles	Kilo.	Miles	Kilo.	Miles	Kilo.	Miles
1	$\frac{5}{8}$	16	10	31	$19\frac{1}{4}$	46	$28\frac{5}{8}$	60	$37\frac{1}{4}$
2	$1\frac{1}{4}$	17	$10\frac{5}{8}$	32	$19\frac{7}{8}$	47	$29\frac{1}{4}$	70	$43\frac{1}{2}$
3	$1\frac{7}{8}$	18	$11\frac{1}{4}$	33	$20\frac{1}{2}$	48	$29\frac{7}{8}$	80	$49\frac{3}{4}$
4	$2\frac{1}{2}$	19	$11\frac{3}{4}$	34	$21\frac{1}{8}$	49	$30\frac{1}{2}$	90	$55\frac{7}{8}$
5	$3\frac{1}{8}$	20	$12\frac{3}{8}$	35	$21\frac{3}{4}$	50	$31\frac{1}{8}$	100	$62\frac{1}{8}$
6	$3\frac{3}{4}$	21	13	36	$22\frac{3}{8}$	51	$31\frac{3}{4}$	200	$124\frac{1}{4}$
7	$4\frac{3}{8}$	22	$13\frac{5}{8}$	37	23	52	$32\frac{1}{4}$	300	$186\frac{3}{8}$
8	5	23	$14\frac{1}{4}$	38	$23\frac{5}{8}$	53	$32\frac{7}{8}$	400	$248\frac{1}{2}$
9	$5\frac{5}{8}$	24	$14\frac{7}{8}$	39	$24\frac{1}{4}$	54	$33\frac{1}{2}$	500	$310\frac{3}{4}$
10	$6\frac{1}{4}$	25	$15\frac{1}{2}$	40	$24\frac{7}{8}$	55	$34\frac{1}{8}$	600	$372\frac{7}{8}$
11	$6\frac{7}{8}$	26	$16\frac{1}{8}$	41	$25\frac{1}{2}$	56	$34\frac{3}{4}$	700	435
12	$7\frac{1}{2}$	27	$16\frac{3}{4}$	42	$26\frac{1}{8}$	57	$35\frac{3}{8}$	800	$497\frac{1}{8}$
13	$8\frac{1}{8}$	28	$17\frac{3}{8}$	43	$26\frac{3}{4}$	58	36	900	$559\frac{1}{4}$
14	$8\frac{3}{4}$	29	18	44	$27\frac{3}{8}$	59	$36\frac{5}{8}$	1000	$621\frac{3}{8}$
15	$9\frac{3}{8}$	30	$18\frac{5}{8}$	45	28				

PINTS AND GALLONS TO LITRES

Pints	Gallons	Litres Approx.	Litres Exact	Pints	Gallons	Litres Approx.	Litres Exact
1	$\frac{1}{8}$	$\frac{1}{2}$	.57	40	5	23	22.75
2	$\frac{1}{4}$	1	1.14	48	6	27	27.30
3	$\frac{3}{8}$	$1\frac{1}{2}$	1.71	56	7	32	31.85
4	$\frac{1}{2}$	$2\frac{1}{4}$	2.27	64	8	$36\frac{1}{2}$	36.40
8	1	$4\frac{1}{2}$	4.54	72	9	41	40.95
16	2	9	9.10	80	10	$45\frac{1}{2}$	45.50
24	3	$13\frac{1}{2}$	13.65	88	11	50	50.05
32	4	18	18.20	96	12	$54\frac{1}{2}$	54.60

RELATIVE VALUE OF MILLIMETRES AND INCHES

mm.	Inches	mm.	Inches	mm.	Inches	mm.	Inches
1	0.0394	26	1.0236	51	2.0079	76	2.9922
2	0.0787	27	1.0630	52	2.0473	77	3.0315
3	0.1181	28	1.1024	53	2.0866	78	3.0709
4	0.1575	29	1.1417	54	2.1260	79	3.1103
5	0.1968	30	1.1811	55	2.1654	80	3.1496
6	0.2362	31	1.2205	56	2.2047	81	3.1890
7	0.2756	32	1.2598	57	2.2441	82	3.2284
8	0.3150	33	1.2992	58	2.2835	83	3.2677
9	0.3543	34	1.3386	59	2.3228	84	3.3071
10	0.3937	35	1.3780	60	2.3622	85	3.3465
11	0.4331	36	1.4173	61	2.4016	86	3.3859
12	0.4724	37	1.4567	62	2.4410	87	3.4252
13	0.5118	38	1.4961	63	2.4803	88	3.4646
14	0.5512	39	1.5354	64	2.5197	89	3.5040
15	0.5906	40	1.5748	65	2.5591	90	3.5433
16	0.6299	41	1.6142	66	2.5984	91	3.5827
17	0.6693	42	1.6536	67	2.6378	92	3.6221
18	0.7087	43	1.6929	68	2.6772	93	3.6614
19	0.7480	44	1.7323	69	2.7166	94	3.7008
20	0.7874	45	1.7717	70	2.7559	95	3.7402
21	0.8268	46	1.8110	71	2.7953	96	3.7796
22	0.8661	47	1.8504	72	2.8347	97	3.8189
23	0.9055	48	1.8898	73	2.8740	98	3.8583
24	0.9449	49	1.9291	74	2.9134	99	3.8977
25	0.9843	50	1.9685	75	2.9528	100	3.9370

RELATIVE VALUE OF INCHES AND MILLIMETRES

Inches	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16
0	0.0	1.6	3.2	4.8	6.4	7.9	9.5	11.1
1	25.4	27.0	28.6	30.2	31.7	33.3	34.9	36.5
2	50.8	52.4	54.0	55.6	57.1	58.7	60.3	61.9
3	76.2	77.8	79.4	81.0	82.5	84.1	85.7	87.3
4	101.6	103.2	104.8	106.4	108.0	109.5	111.1	112.7
5	127.0	128.6	130.2	131.8	133.4	134.9	136.5	138.1
6	152.4	154.0	155.6	157.2	158.8	160.3	161.9	163.5
Inches	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
0	12.7	14.3	15.9	17.5	19.1	20.6	22.2	23.8
1	38.1	39.7	41.3	42.9	44.4	46.0	47.6	49.2
2	63.5	65.1	66.7	68.3	69.8	71.4	73.0	74.6
3	88.9	90.5	92.1	93.7	95.2	96.8	98.4	100.0
4	114.3	115.9	117.5	119.1	120.7	122.2	123.8	125.4
5	139.7	141.3	142.9	144.5	146.1	147.6	149.2	150.8
6	165.1	166.7	168.3	169.9	171.5	173.0	174.6	176.2

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SECTION B

ENGINE

2·4 and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone ALLESLEY 2121 (PBX)
Code BENTLEY'S SECOND
Telegraphic Address "JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/B/4.

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INDEX *(continued)*

ENGINE

Both the 2.4 litre and 3.4 litre models are fitted with the twin overhead camshaft XK type of engine.

The cylinder head fitted to the 2.4 litre engine is of the standard type (painted silver) and is equipped with $\frac{5}{16}''$ lift camshafts. A ' B ' type cylinder head (painted light blue) equipped with $\frac{3}{8}''$ lift camshafts is fitted to the 3.4 litre engine.

Compression ratios of 7 to 1 or 8 to 1 are specified for the 2.4 litre engine and 7 to 1, 8 to 1 or 9 to 1 for the 3.4 litre, the differences in compression ratio being obtained by varying the crown design of the piston.

The compression ratio of an engine is indicated by /7, /8, /9 following the engine number.

DATA

<table>
<tr><th>Camshaft</th><th>2.4 litre</th><th>3.4 litre</th></tr>
<tr><td>Number of journals</td><td colspan="2">Four per shaft</td></tr>
<tr><td>Journal diameter</td><td colspan="2">1.00" —.0005"
—.001"
(25.4 mm. —.013" mm.)
—.025</td></tr>
<tr><td>Thrust taken</td><td colspan="2">Front end</td></tr>
<tr><td>Number of bearings</td><td colspan="2">Four per shaft (eight half bearings)</td></tr>
<tr><td>Type of bearing</td><td colspan="2">White metal steel backed shell</td></tr>
<tr><td>Diameter clearance</td><td colspan="2">.0005" to .002"
(.013 to .05 mm.)</td></tr>
<tr><td>Permissible end float</td><td colspan="2">.0045" to .008"
(.11 to .20 mm.)</td></tr>
<tr><td>Tightening torque—Bearing cap nuts</td><td colspan="2">15 lbs. ft. (175 lbs. ins.)
(2.0 kg/m.)</td></tr>
<tr><td>Connecting Rod</td><td></td><td></td></tr>
<tr><td>Length, centre to centre</td><td>$5\frac{5}{8}''$
(13.28 cm.)</td><td>$7\frac{3}{4}''$
(19.68 cm.)</td></tr>
<tr><td>Big end—Bearing type</td><td colspan="2">White metal steel backed shell
(later cars—lead indium)</td></tr>
<tr><td>Bore for big end bearing</td><td colspan="2">2.233" to 2.2335"
(56.72 to 56.73 mm.)</td></tr>
</table>

<table>
<tr><th></th><th>2.4 litre</th><th>3.4 litre</th></tr>
<tr><td>Big end—Width</td><td colspan="2">$1\frac{3}{16}''$ —.006"
—.008"
(30.16 mm. —.15 mm.)
—.20</td></tr>
<tr><td>Big end—Diameter clearance</td><td colspan="2">(white metal) .001" to .0025"
(.025 to .06 mm.)
(lead indium) .0025" to .0039"
(.06 mm. to .10 mm.)</td></tr>
<tr><td>Big end—Side clearance</td><td colspan="2">.0058" to .0087"
(.15 mm. to .22 mm.)</td></tr>
<tr><td>Bore for small end bush</td><td colspan="2">1.00" ± .0005"
(25.4 m. ± .013 mm.)</td></tr>
<tr><td>Small end bush—Type</td><td colspan="2">Phosphor bronze—steel backed</td></tr>
<tr><td>Small end—Width</td><td colspan="2">$1\frac{5}{64}''$
(27.4 mm.)</td></tr>
<tr><td>Small end bush—Bore diameter</td><td colspan="2">.875" +.0002"
—.0000"
(22.22 mm. +.005 mm.)
—.000</td></tr>
<tr><td>Tightening torque—Con rod bolts</td><td colspan="2">37 lbs. ft. (450 lbs. ins.)
(5.1 kg/m.)</td></tr>
<tr><td>Crankshaft</td><td colspan="2"></td></tr>
<tr><td>Number of main bearings</td><td colspan="2">Seven</td></tr>
<tr><td>Main bearing—Type</td><td colspan="2">White metal steel backed shell</td></tr>
<tr><td>Journal diameter</td><td colspan="2">Front, centre, rear 2.750" to 2.7505"
(69.85 to 69.86 mm.)
Intermediate 2.7495" to 2.750"
(69.84 to 69.85 mm.)</td></tr>
<tr><td>Journal length</td><td colspan="2"></td></tr>
<tr><td>Front</td><td colspan="2">$1\frac{11}{16}''$±.005"
(42.86 mm.±.13 mm.)</td></tr>
<tr><td>Centre</td><td colspan="2">$1\frac{3}{4}''$ +.0005"
+.001"
(44.45 mm. +.013 mm.)
+.025</td></tr>
<tr><td>Rear</td><td colspan="2">$1\frac{7}{8}''$
(47.63 mm.)</td></tr>
<tr><td>Intermediate</td><td colspan="2">$1\frac{7}{32}''$±.002"
(30.96 mm.±.05 mm.)</td></tr>
</table>

	2.4 litre	3.4 litre
Thrust taken	Centre bearing thrust washers	
Thrust washer—Thickness	.092″±.001″ and .096″±.001″ (2.33 mm.±.025 mm. and 2.43 mm.±.025mm.)	
End clearance	.004″ to .006″ (.10 to .15 mm.)	
Main bearing—Length		
Front, Centre, Rear	$1\frac{1}{2}$″±.005″ (38.1 mm.±.13 mm.)	
Intermediate	1″±.005″ (25.4 mm.±.13 mm.)	
Diameter clearance	.0015″ to .003″ (.04 to .08 mm.)	
Crankpin—Diameter	2.086″ +.0006″ —.000″ (52.98 mm. +.015 mm. —.000)	
Length	$1\frac{3}{16}$″ +.0007″ —.0002″ (30.16 mm. +.018 mm. —.006)	
Regrind undersize	.010″, .020″, .030″ and .040″ (.25, .51, .76 and 1.02 mm.)	
Minimum diameter for regrind	—.040″ (1.02 mm.)	
Tightening torque—main bearing bolts	83 lbs. ft. (1,000 lbs. ins.) (11.5 kg/m.)	

Cylinder Block

	2.4 litre	3.4 litre
Material	Chromium iron	
Cylinder bores—Nominal	83 mm. +.0127 mm. —.0064 mm. (3.2677" +.0005" —.00025")	
Maximum rebore size	+.030" (.76 mm.)	
Bore size for fitting liners	3.391" to 3.392" (86.13 to 86.16 mm.)	
Outside diameter of liner	3.3945" to 3.3955" (86.22 to 86.25 mm.)	
Interference fit	.0025" to .0045" (.06 to .11 mm.)	
Overall length of liner	$5\frac{15}{16}$" (15.08 cm.)	$6\frac{31}{32}$" (17.7 cm.)
Outside diameter of lead-in	3.389" to 3.391" (86.08 to 86.13 mm.)	
Size of bore honed after assembly into block—nominal	83.mm. (3.2677")	
Main line bore for main bearings	2.9165" +.0005" —.0000" (74.08 +.013 mm. —.000 mm.)	

Cylinder Head

Type	Standard	" B " Type
Material	Aluminium alloy	
Valve seat angle—Inlet	30°	45°
—Exhaust	45°	45°
Valve throat diameter—Inlet	$1\frac{3}{8}$" (34.9 mm.)	$1\frac{1}{2}$" (38.1 mm.)
—Exhaust	$1\frac{1}{4}$" (31.75 mm.)	$1\frac{3}{8}$" (34.9 mm.)
Tightening torque—Cylinder head nuts	54 lbs. ft. (650 lbs. ins.) (7.5 kg/m.)	

	2.4 litre	3.4 litre
Gudgeon Pin		
Type	Fully floating	
Length	2.840″ to 2.845″ (72.14 to 72.26 mm.)	
Inside diameter	$\frac{5}{8}$″ (15.87 mm.)	
Outside diameter	.8750″ to .8752″ (22.22 to 22.23 mm.)	
Lubricating System		
Oil pressure (hot)	40 lbs. per sq. in. at 3,000 r.p.m.	
Oil pump —Type	Eccentric rotor	
—Clearance at end of lobes	.010″ maximum (.25 mm.)	
—End clearance	.004″ maximum (.10 mm.)	
—Clearance between outer rotor and body	.010″ maximum (.25 mm.)	
Piston and Piston Rings		
Make	Brico	
Type	Semi-split skirt	
Piston		
Skirt clearance *(measured at bottom of skirt at 90° to gudgeon pin axis)*	.0011″ to .0017″ (.028 to .043 mm.)	
Gudgeon pin bore	.8749″ to 8751″ (2.223 to 2.227 mm.)	
Compression height		
7 : 1 Compression ratio	2.034″ to 2.039″ (51.66 to 51.79 mm.)	1.690″ to 1.695″ (42.93 to 45.05 mm.)
8 : 1 Compression Ratio	2.115″ to 2.120″ (53.72 to 53.85 mm.)	2.163″ to 2.168″ (54.94 to 55.067 mm.)
9 : 1 Compression ratio	—	1.914″ to 1.919″ (48.62 to 48.74 mm.)

	2.4 litre	3.4 litre
Pistons rings—Number		
Compression	2	2
Oil Control	1	1
Piston rings—Width		
Compression		0.777″ to .0787″ (1.97 to 2.00 mm.)
Oil Control		.155″ to .156″ (3.94 to 3.96 mm.)
Piston rings—Thickness		
Compression		.124″ to .130″ (3.15 to 3.30 mm.)
Oil control		.119″ to .127″ (3.02 to 3.23 mm.)
Piston rings—Side clearance in groove		
Compression		.001″ to .003″ (.02 to .07 mm.)
Oil Control		.001″ to .003″ (.02 to .07 mm.)
Piston rings—Gap when fitted to cylinder bore		
Compression		.015″ to .020″ (.38 to .51 mm.)
Oil control		.011″ to .016″ (.28 to 41 mm.)

Sparking Plugs

	2.4 litre	3.4 litre
Make	Champion	
Type :		
7 : 1 compression ratio	N.5	N.5
8 : 1 compression ratio	N.5	N.5
9 : 1 compression ratio	—	N.5
Gap	.030″ (.76 mm.)	.025″ (.64 mm.)

Tappets and Tappet Guides

	2.4 litre	3.4 litre
Tappet—Material	Cast iron (chilled)	
—Outside diameter	1.3738″ to 1.3742″ (34.89 to 34.90 mm.)	
—Diameter clearance	.0008″ to .0019″ (.02 to .048 mm.)	
Tappet guide—Material	Austenitic iron	
—Inside diameter (before reaming)	1.353″ to 1.357″ (34.37 to 34.48 mm.)	
—Reaming size (when fitted to cylinder head)	1.375″ +.0007″ —.0000″ (34.925 mm. +.018 mm. —.000)	
—Interference (shrink) fit in head	.003″ (.07 mm.)	

Timing Chains and Sprockets

	2.4 litre		3.4 litre
Type		Duplex	
Pitch		$\frac{3}{8}$″ (9.5 mm.)	
Number of pitches—Top chain	100		100
—Bottom chain	68		82
Crankshaft sprocket—Teeth		21	
Intermediate sprocket, outer—Teeth		28	
Intermediate sprocket, inner—Teeth		20	
Camshaft sprocket—Teeth		30	
Idler sprocket		21	

Valve Timing

	2.4 litre	3.4 litre
Inlet valve opens	10° B.T.D.C.	15° B.T.D.C.
Inlet valve closes	50° A.B.D.C.	57° A.B.D.C.
Exhaust valve opens	57° B.B.D.C.	57° B.B.D.C.
Exhaust valve closes	15° A.T.D.C.	15° A.T.D.C.

(with valve clearances set at .010″ [.25 mm.])

Valves and Valve Springs

	2.4 litre	3.4 litre
Valves—Material, Inlet	Silicon chrome steel	
Exhaust	Austenitic steel	
Valve head diameter, Inlet	$1\frac{3}{4}''\pm.002''$ (44.45 mm. ±.05 mm.)	
Exhaust	$1\frac{7}{16}''\pm.002''$ (36.51 mm. ±.05 mm.)	$1\frac{5}{8}''\pm.002''$ (41.27 mm. ±.05 mm.)
Valve stem diameter, Inlet and Exhaust	$\frac{5}{16}''$ —.0025" —.0035" (7.95 mm. —.06 mm. —.09 mm.)	
Valve lift	$\frac{5}{16}''$	$\frac{3}{8}''$
Valve clearance —Inlet	.004" (.10 mm.)	
—Exhaust	.006" (.15 mm.)	
Valve seat angle —Inlet	30°	45°
—Exhaust	45°	45°
Valve spring—Free length. Inner	$1\frac{21}{32}''$ (.42 mm.)	
Outer	$1\frac{15}{16}$ (49.2 mm.)	
Valve spring—Fitted length. Inner	$1\frac{7}{32}''$ (30.96 mm.)	
Outer	$1\frac{5}{16}''$ (33.34 mm.)	
Valve spring —Fitted load Inner	30.33 lbs. (13.76 kg.)	
Outer	48.375 lbs. (21.94 kg.)	
Valve spring—Solid length (max.) Inner	.810" (20.57 mm.)	
Outer	.880" (22.35 mm.)	
Number of free coils Inner	6	
Outer	5	
Diameter of wire Inner	12 SWG (.104") (2.64 mm.)	
Outer	10 SWG (.128") (3.25 mm.)	

Valve Guide and Valve Seat Insert	2.4 litre	3.4 litre
Valve guides—Material	Cast iron	
Valve guide—Length, Inlet	$1\frac{13}{16}''$ (46.04 mm.)	
Exhaust	$1\frac{15}{16}''$ (49.21 mm.)	
Valve guide—Inside diameter—Inlet	$\frac{5}{16}''$ $-.0005''$ $-.0015''$ (7.94 mm. $-.013$ mm.) $-.038$ mm.)	
Exhaust	$\frac{5}{16}''\pm.0005''$ (7.94 mm. $\pm.01$ mm.)	
Interference fit in head	.0005″ to .0022″ (.013 to .055 mm.)	
Valve seat inserts—Material	Cast iron (centrifugally cast)	
Inside diameter Inlet	$1\frac{3}{8}''$ $+.003''$ $-.001''$ (34.92 $+.076$ mm.). $-.025$ mm.)	$1\frac{1}{2}''$ $+.003''$ $-.001''$ (38.1 $+.076$ mm.) $-.025$ mm.)
Exhaust	$1\frac{1}{4}''$ $+.003''$ $-.001''$ (31.75 $+.76$ mm.) $-.025$	1.379″ to 1.383″ (35.03 to 35.13 mm.)
Interference (shrink) fit in head	.003″ (.076 mm.)	

Firing Order

1, 5, 3, 6, 2, 4.
No. 1 cylinder being at the rear of the engine unit.

ROUTINE MAINTENANCE

DAILY

Checking the engine Oil Level

Check the oil level with the car standing on level ground otherwise a false reading will be obtained.

Remove the dipstick and wipe it dry. Replace and withdraw the dipstick ; if the oil level is on the knurled patch, with the engine hot or cold, no additional oil is required. If the engine has been run immediately prior to making an oil level check, wait one minute after switching off before checking the oil level.

Note : Almost all modern engine oils contain special additives, and whilst it is permissible to mix the recommended brands it is undesirable. If it is desired to change from one brand to another this should be done when the sump is drained, and the Oil Company's recommendation in regard to flushing procedure should be followed.

EVERY 2,500 MILES (4,000 KM.)

Changing the Engine Oil

Note : Under certain adverse conditions, conducive to oil dilution and sludge formation, more frequent oil changing than the normal 2,500 mile (4,000 km.) period is advised. Where the car is used mainly for low-speed city driving, stop-start driving particularly in cold weather or in dusty territory the oil should be changed at least every 1,000 miles (1,6000 km.).

The draining of the sump should be carried out at the end of a run when the oil is hot and therefore will flow more freely. The drain plug is situated at the right-hand rear corner of the sump. When the engine oil is changed, the oil filter which is situated on the right-hand side of the engine, must also receive attention. First, drain the oil from the filter by removing the flat-headed drain plug situated at the bottom of the filter head ; do not disturb the domed plug as this retains the oil pressure relief valve. Unscrew the central bolt and remove the canister and element. Thoroughly wash these parts in petrol and allow to dry out. When replacing the canister ensure that the circular rubber seal in the filter head has not become displaced. (Attention is drawn to the importance of renewing the filter element at 5,000 mile (8,000 km.) intervals).

Note : Almost all modern engine oils contain special additives, and whilst it is permissible to mix the recommended brands it is undesirable. If it is desired to change from one brand to another this should be done when the sump is drained, and the Oil Company's recommendation in regard to flushing procedure should be followed.

Distributor—Lubrication

Take great care to prevent oil or grease from getting on or near the contact breaker points.

Remove the moulded cap at the top of the distributor by springing back the two clips. Lift off the rotor arm and apply a few drops of engine oil around the screw now exposed. It is not necessary to remove the screw as it has a clearance to permit the passage of oil.

Apply one drop of oil to the post on which the contact breaker pivots. Lightly smear the cam with grease. Lubricate the centrifugal advance mechanism by injecting a few drops of engine oil through the aperture at the edge of the contact breaker base plate.

Distributor Contact Breaker Points

Check the gap between the contact points with feeler gauges when the points are fully opened by one of the cams on the distributor shaft

The correct gap is .014"—.016" (.36—.41 mm.).

If the gap is incorrect, slacken the two screws securing the fixed contact plate and turn the eccentric-headed adjustment screw in its slot until the required gap is obtained. Tighten the securing screws and recheck the gap.

Examine the contact breaker points. If the contacts are burned or blackened, clean them with fine carborundum stone or very fine emery cloth. Afterwards wipe away any trace of grease or metal dust with a petrol moistened cloth.

Cleaning of the contacts is made easier if the contact breaker lever carrying the moving contact is removed. To do this, remove the nut insulating piece and connections from the post to which the end of the contact breaker spring is anchored. The contact breaker lever can now be lifted off its pivot post.

Oil Bath Type Air Cleaner—2.4 litre Model

The periods at which maintenance should be carried out will vary according to the conditions under which the car is operated. For normal conditions every 2,500 miles (4,000 km.) can be taken as the proper cleaning periods, but in dusty territories more frequent cleaning, as often as 1,000 miles (1,600 km.) or less may be necessary.

Unscrew the wing nut and remove the top cover. Lift out the filter element and oil base. Wash the element by swishing it up and down in a bowl of paraffin and allow to drain thoroughly. Empty the oil from the oil base and clean out the accumulated sludge. Fill the oil base with engine oil to the level indicated by the arrow. It is unnecessary to re-oil the filter element as this is done automatically when the car is driven. Ensure that the top cover gasket is in good condition and re-assemble the filter.

Oil Bath Type Air Cleaner—3.4 litre Model

The oil bath cleaner is situated underneath the left-hand front wing and should be completely removed from the car for attention.

The periods at which maintenance should be carried out will vary according to conditions under which the car is operated. For normal conditions every 2,500 miles (4,000 km.) can be taken as the proper cleaning periods, but in dusty territories more frequent cleaning, as often as 1,000 miles (1,600 km.) or less, may be necessary.

Slacken the clip and disconnect the large diameter hose from the cleaner. Slacken the pinch bolt securing the cleaner in the circular retainer and lift out the cleaner complete. Remove the rubber band, unscrew the central screw and withdraw the shell and top cover from the oil base. Lift out the filter element, and wash the element by swishing it up and down in a bowl of paraffin and allow to drain thoroughly. Empty the oil from the oil base and clean out the accumulated sludge. Fill the oil base with engine oil to the level indicated by the arrow. It is unnecessary to re-oil the filter element as this is done automatically when the car is driven. Ensure that the top cover gasket is in good condition.

Re-insert the centre screw through the shell and top cover and assemble to oil base. Refit the rubber band to cover the joint between shell and oil base.

Sparking Plugs

It is advisable to have sparking plugs cleaned on special plug cleaning and testing equipment which is possessed by most Service Stations.

After cleaning, check the gap between the electrodes. The correct gap for the respective models is given in the "Data" section. If adjustment is required, do this by setting the side electrode. Do not attempt to bend or lever against the centre electrode or the insulator may crack.

When replacing the sparking plugs ensure that the threads are clean and that the washers are in good condition.

EVERY 5,000 MILES (8,000 KM.)

Wire Mesh Type Air Cleaner—2.4 litre Model

Withdraw the rubber intake pipe from the air cleaner, spring back the three clips securing the end cover and withdraw the wire mesh element.

Clean the wire mesh by swilling the element in a bath of petrol or paraffin. Allow the mesh to dry out and then coat with engine oil.

Wire Mesh Type Air Cleaner—3.4 litre Model

Withdraw the rubber intake pipe from the air cleaner, spring back the two clips securing the end cover and withdraw the wire mesh element.

Clean the wire mesh by swilling the element in a bath of petrol or paraffin. Allow the mesh to dry out and then coat with engine oil.

Fan Belt Tension

When the fan belt is correctly tensioned it should be possible to depress the belt about half an inch (12 mm.) midway between the fan and dynamo pulleys.

Adjustment is effected by slackening the three dynamo mounting bolts, moving the dynamo until the correct tension is obtained and tightening the bolts.

Do not overtighten the fan belt or this will cause undue wear of the belt and the water pump and dynamo bearings. Slackness of the belt may cause slippage with the possible result of a squealing noise from the belt, a reduced charging rate from the dynamo or overheating of the engine.

Oil Filter Element

It is most important to renew the oil filter element every 5,000 miles (8,000 km.) as after this mileage it will have become choked with impurities.

To guard against the possibility of the filter being neglected to the extent where the element becomes completely choked, a balance valve is incorporated in the filter head which allows *unfiltered* oil to by-pass the element and reach the bearings. This will be accompanied by a drop in the normal oil pressure of some 10 lb. sq. in. and if this occurs the filter element should be renewed as soon as possible.

The oil filter is situated on the right-hand side of the engine and before removing the canister it will be necessary to drain the filter by removing the flat-headed drain plug situated at the bottom of the filter head ; do not disturb the domed plug as this retains the oil pressure relief valve. To gain access to the element, unscrew the central bolt when the canister complete with the element can be removed. Thoroughly wash out the canister with petrol and allow to dry before inserting the new element.

When replacing the canister ensure that the circular rubber seal in the filter head has not become displaced.

EVERY 10,000 MILES (16,000 KM.)

Engine Sump Strainer

A gauze bowl-type strainer fitted in the bottom of the engine sump is accessible after removal of the circular cover plate.

After draining the sump during the normal changing of the engine oil, remove the setscrews securing the circular plate and withdraw the plate and strainer, noting the positions of the gaskets. Thoroughly wash the gauze in petrol and allow to dry out. Refit the strainer and cover plate using new gaskets.

Recommended Lubricants

	Mobil	Castrol	Shell	Esso	B.P.	Duckham	S.A.E. Viscosity
Summer, 32°F.—90°F.	Mobiloil A	Castrol XL	Shell X-100 30	Esso Extra Motor Oil 20W/30	Energol 30	NOL 30	30
Winter, below 32°F.	Mobiloil Arctic	Castrolite	Shell X-100 20/20W	Esso Extra Motor Oil 20W/30	Energol 20	NOL 20	20
Tropical, above 90°F.	Mobiloil AF	Castrol XXL	Shell X-100 40	Esso Extra Motor Oil 40/50	Energol 40	NOL 40	40
Upper cylinder lubrication	Mobil Upperlube	Castrollo	Shell U.C.L. or Donax U.	Esso U.C.L.	Energol U.C.L.	Adcoid Liquid	

Capacities

	Imperial	U.S.	Litres
Engine (refill)	11 pints	13¼ pints	6¼
Engine (total)	13 pints	15½ pints	7½

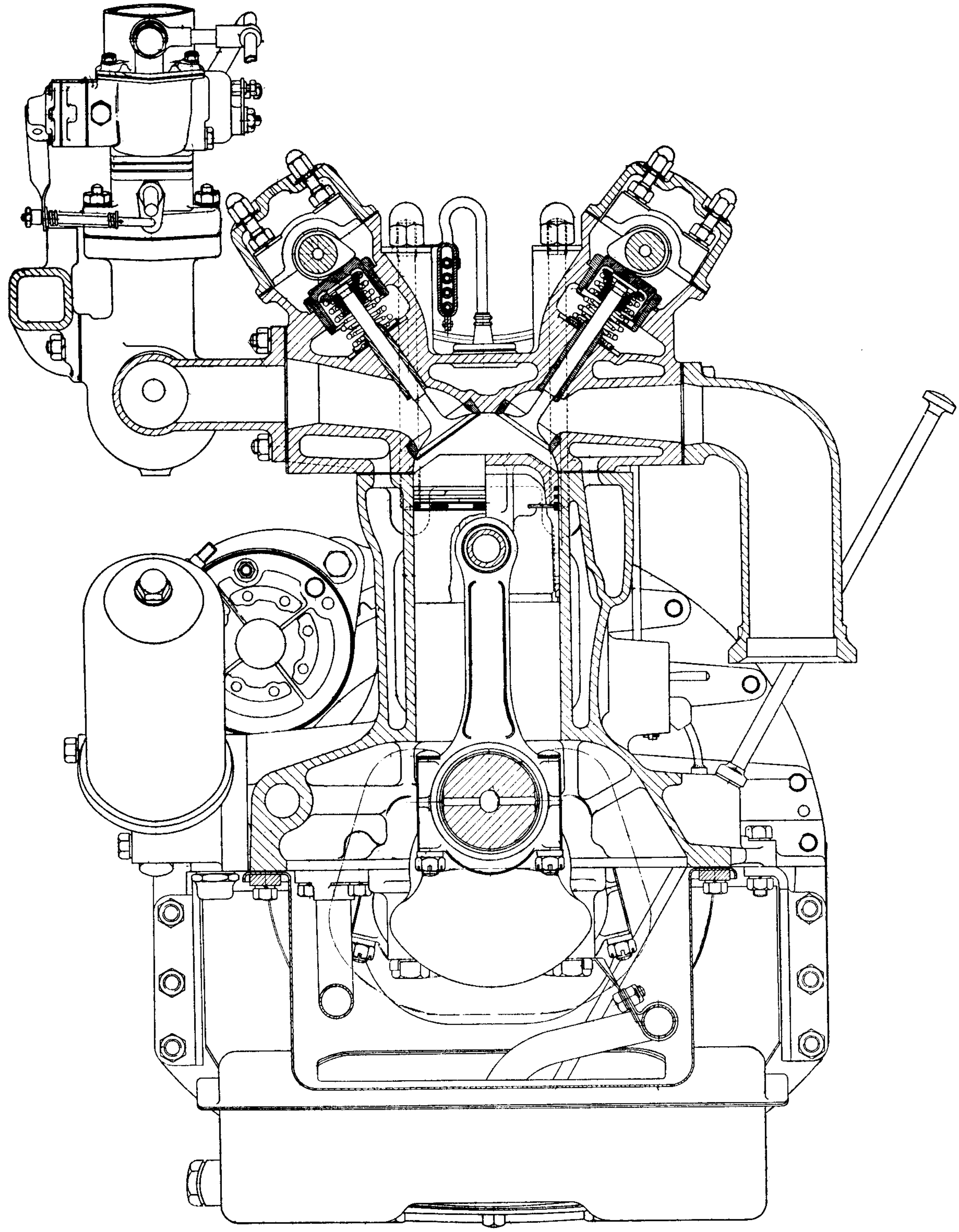


Fig. 1. Cross sectional view of engine (2.4 litre engine illustrated)

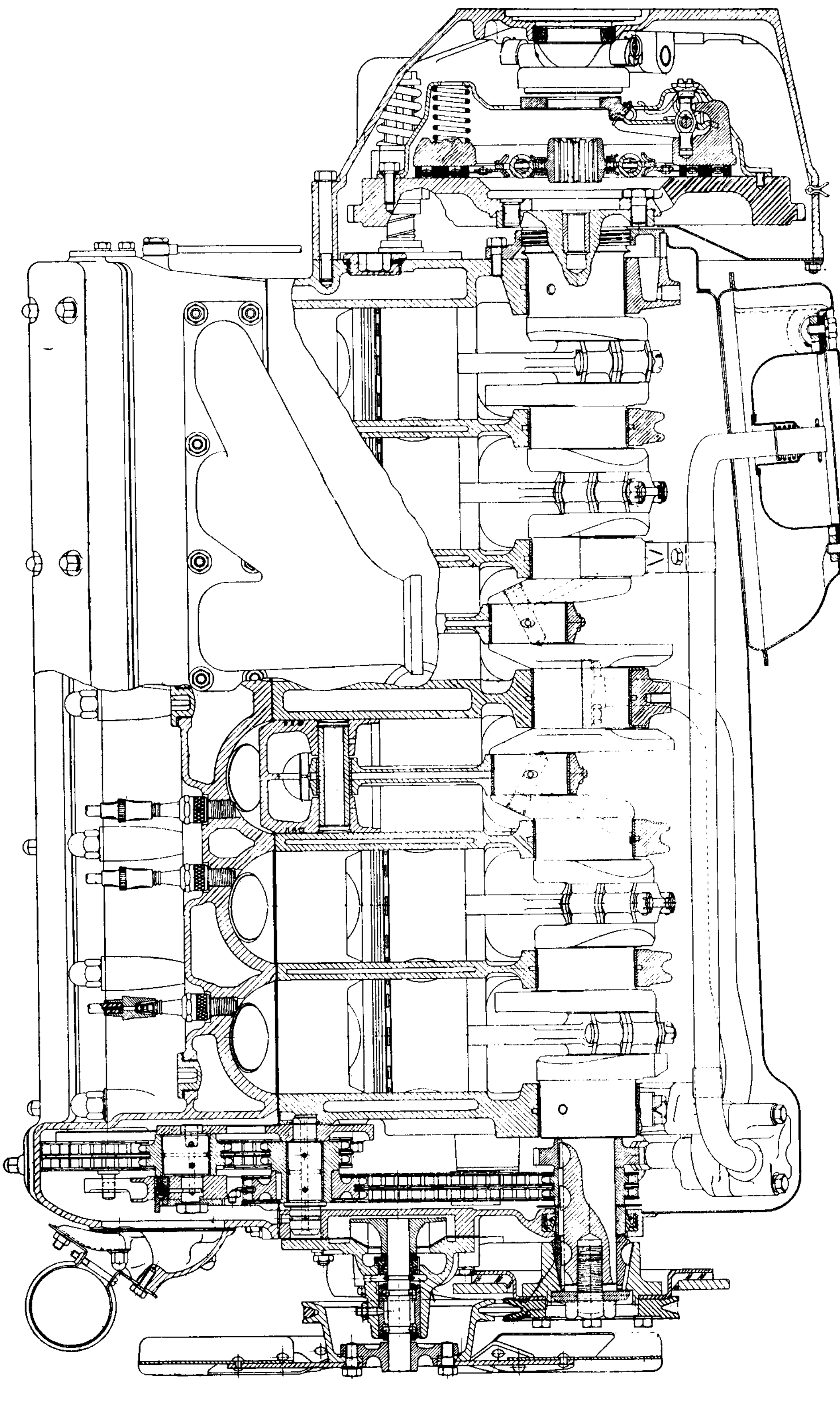


Fig. 2. Longitudinal section view of engine (2.4 litre engine illustrated)

ENGINE REMOVAL AND REFITTING

It is advisable to remove the engine complete with gearbox (and overdrive if fitted) by lowering the power unit away from the car after removal of the front suspension assembly. This operation must, therefore, be carried out on a hoist preferably of the " four poster " type or over a pit with lifting tackle running overhead.

REMOVAL

Remove the front suspension unit as described in Section ' J '.

Remove the bonnet after having previously marked the position of the hinges to facilitate alignment on reassembly.

Disconnect one of the battery leads and drain the radiator.

Remove the air cleaner and air cleaner brackets from the engine. Remove the engine dipstick.

Remove the engine breather pipe by disconnecting the clip securing the flexible pipe to the breather housing.

Slacken the clips securing the top and bottom water hoses and remove the hoses.

Remove the connections from the dynamo noting that the yellow wire is connected to the large terminal. If the car is fitted with a radio then the radio suppressor will also be fitted to this large terminal. Remove the two mounting bolts and nuts underneath the dynamo. Remove the adjusting bolt situated at the top of the dynamo, disengage the fan belt and lift out the dynamo.

On cars fitted with a fan cowl unscrew the four nuts securing the cowl and allow it to rest on the water pump housing behind the fan. Remove the two setscrews securing the sides of the radiator to the body. Remove the two securing nuts at the bottom of the radiator. Carefully lift out the radiator taking care not to damage the matrix on the fan blades. Remove the fan cowl.

Disconnect the exhaust system at the silencer clamp and remove the silencer and tail pipe leaving the down pipe in position.

Disconnect the clips securing the two heater pipes at the rear of the engine and remove the pipes.

Disconnect the rev. counter cable by unscrewing the union nut at the right-angled drive at the rear of the right-hand camshaft cover.

Disconnect the clutch fluid pipe at the bracket at the rear of the cylinder head.

Disconnect the oil pressure gauge pipe at the oil filter.

Disconnect the metal brake servo pipe from the rubber hose underneath the inlet manifold. On later cars disconnect the brake servo hose from the metal pipe at the front of the inlet manifold.

Disconnect the cable from the starter motor.

Disconnect the two snap connectors from the gearbox harness situated at the rear of the exhaust manifolds.

Withdraw the split pin from the top pin of the accelerator linkage. Disconnect the ball joint at the throttle spindle lever.

On some 3.4 litre cars it will be necessary to remove the ' U ' shaped starting carburetter pipe as the accelerator linkage passes through this pipe.

On the 2.4 litre model disconnect the carburetter mixture control wire from the two carburetters.

Remove the water temperature gauge bulb from the inlet manifold by unscrewing the hexagon union nut. Withdraw the bulb and capillary tube from clips and place clear.

Remove the wire from the SW terminal of the ignition coil. Remove the windscreen washer suction pipe from the adaptor at the rear of the inlet manifold.

Remove the locknut and washer from the engine stabilizer at the rear of the cylinder head.

Remove the two setscrews from the front engine mounting rubbers.

On the 3.4 litre model remove the two carburetters.

Remove the gear lever knob and the rubber grommet.

Disconnect the earth strap from the clutch housing bolt.

Disconnect the handbrake by removing the operating link fulcrum pin.

Disconnect the speedometer cable from the rear of the gearbox.

Sling the engine (if a plate is used under the cylinder head nuts, use the second and third pair of studs from the rear).

Remove the eight setscrews from the rear engine mounting member at the rear of the gearbox or overdrive. Remove the prop-shaft.

Note: In the case of a car fitted with automatic

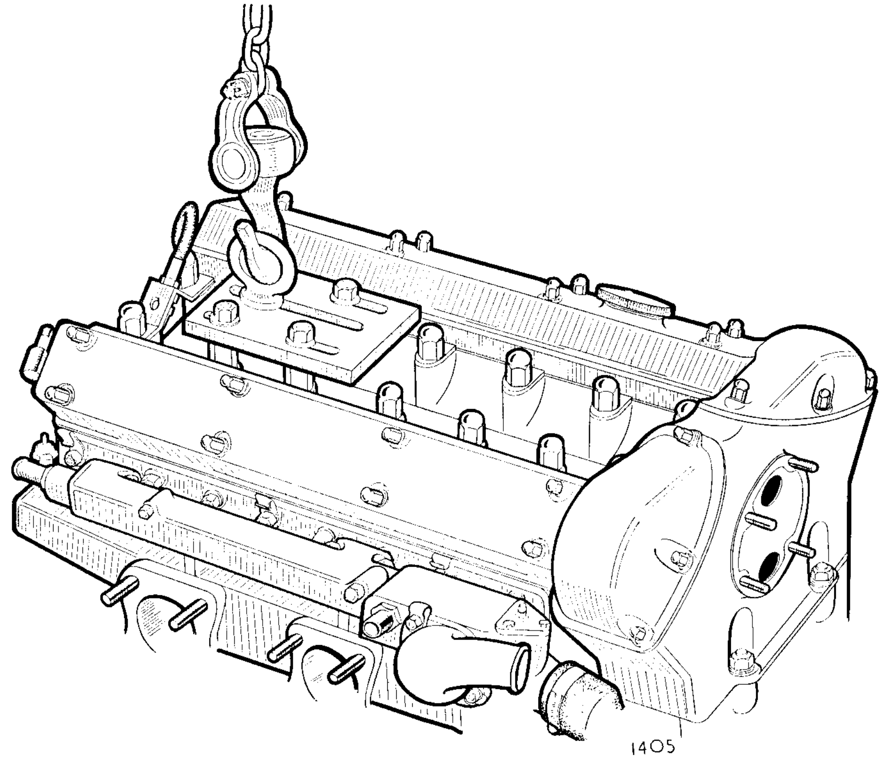


Fig. 3. Showing the lifting plate in position on the cylinder head studs.

transmission first remove the six setscrews securing the rear mounting to the body floor. Also remove the two nuts and spring washers securing the mounting plate to the two rubber mountings attached to the rear of the transmission, then remove the mounting plate. Disconnect the propeller shaft from the gearbox flange. Remove the two setscrews securing the centre bearing. Disconnect the propeller shaft from the rear axle flange and remove the propeller shaft. Disconnect the control rod from the selector lever at the left side of transmission. Remove the selector cable clamp from the reverse servo cylinder on the left front side of transmission. Disconnect the governor control rod from the governor lever at the rear of transmission. Remove the leads from the " anti-creep " pressure switch and disconnect the intermediate speed hold solenoid feed wire at the snap connect.

Lower the power unit keeping the engine as far left as possible.

REFITTING

Refitting is the reverse of the removal procedure, but it is important to adjust the engine stabilizer as described on page 70.

Refit the front suspension as described in Section ' J '.

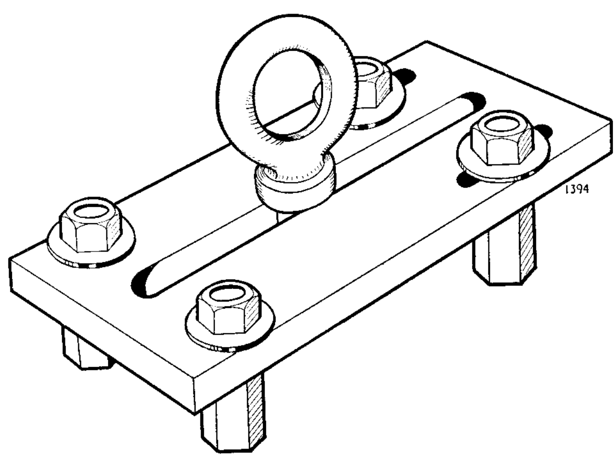


Fig. 4. The engine lifting plate.

ENGINE—TO DISMANTLE

GENERAL

The following instructions apply when the engine components are moved in the following sequence with the engine unit removed from the chassis. Dismantling of sub-assemblies and the removal of individual components when the engine is in the chassis frame are dealt with separately in this section.

All references made in this section to the top or bottom of the engine assume the engine to be in the normal upright position. References to the left- or right-hand side assume the engine to be upright and looking from the rear.

REMOVE STARTER

Remove the electrical cable from the terminal on the starter. Unscrew the two nuts securing the starter to the clutch housing and withdraw the starter.

REMOVE GEARBOX

Remove the set bolts and nuts securing the clutch housing to the engine and withdraw the gearbox unit. The gearbox must be supported during this operation in order to avoid straining the clutch driven plate and constant pinion shaft.

REMOVE DISTRIBUTOR

Spring back clips and remove the cover complete with high tension leads. Disconnect the electrical cable from the distributor. Slacken the clamp plate bolt and withdraw distributor. Remove the setscrew and remove the clamp plate. Note the cork seal in recess at the top of the distributor drive hole.

REMOVE CYLINDER HEAD

Disconnect the distributor vacuum feed pipe from the front carburetter. Remove the high tension leads from the sparking plugs and lead carrier from the cylinder head studs. Remove the sparking plugs. Disconnect the camshaft oil feed pipe from the rear of the cylinder head. Remove the eleven dome nuts from each camshaft cover and lift off the covers.

Remove the four dome nuts securing the breather housing and withdraw housing. Release the tension on the camshaft chain by slackening the nut on the eccentric idler sprocket shaft, depressing the spring-loaded stop peg and rotating serrated adjuster plate clockwise. Anti-clockwise rotation of the serrated

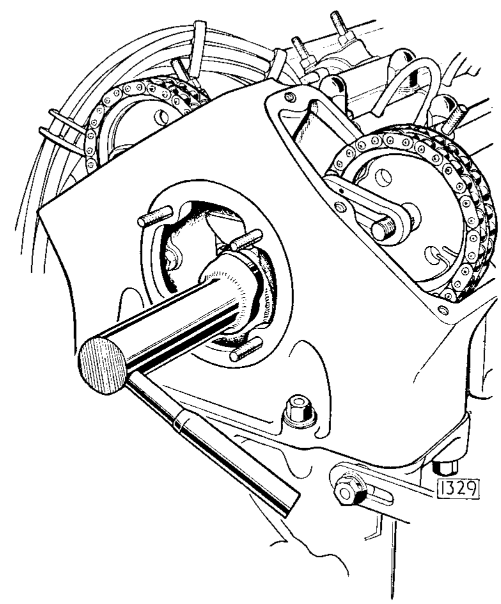


Fig. 5. The top timing chain adjuster in position.

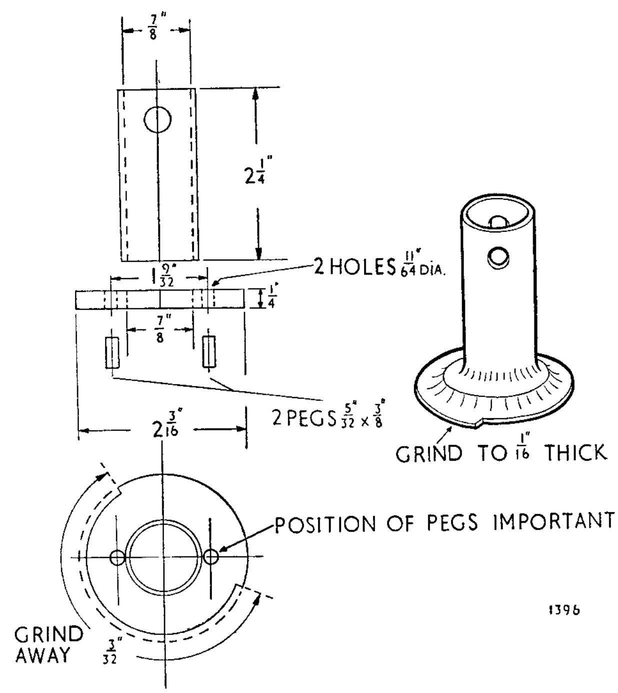


Fig. 6. Top timing chain adjusting tool.

adjuster viewed from the front of the engine tightens the chain.

Break the locking wire on the two setscrews securing the camshaft sprockets to their respective camshafts. Remove the setscrews and withdraw the sprockets from the camshafts with chain in position. Having once disconnected the camshaft sprockets do NOT rotate the engine or camshafts.

Slacken the fourteen cylinder head dome nuts and six nuts securing the front of the cylinder head a part of a turn at a time in the order shown in Fig. 11 until the nuts become free. Lift off the cylinder head complete with exhaust manifold and inlet manifolds. Remove and scrap the cylinder head gasket.

REMOVE CLUTCH AND FLYWHEEL

Unscrew the six setscrews securing the flange of the clutch cover to the flywheel and remove the clutch assembly. Note the balance marks ' B ' stamped on the clutch cover and on the edge of the flywheel.

Knock back the tabs of locking plate securing the ten flywheel bolts. Unscrew the flywheel bolts and remove the locking plate. Remove flywheel from the crankshaft flange by gently tapping with a rawhide mallet.

REMOVE FAN

Remove the fan and fan pulley from the hub by unscrewing the four set bolts fitted with shakeproof washers.

CRANKSHAFT DAMPERS

Knock back the tab washers and remove the two bolts securing the locking washer to the pulley.

Unscrew the large nut and remove the plain washer.

Insert two levers behind the damper and ease it off the split cone—a sharp tap on the end of the cone will assist removal.

REMOVE WATER PUMP

Unscrew the set bolts and three nuts, and remove the water pump from the timing cover. Note the gasket between the pump and timing cover.

REMOVE OIL FILTER

Unscrew the four set bolts securing the oil filter to the cylinder block and remove filter.

Note: On some engines a blanking plate is fitted between the filter and the sump.

REMOVE SUMP

Drain the sump by removing the hexagon plug and washer from the right-hand side of the sump.

Remove the twenty-six setscrews securing the sump to the crankcase and the four nuts securing the sump to the timing cover. The sump can now be removed.

REMOVE OIL PUMP AND PIPES

Tap back the tab washers and unscrew the two set bolts securing the oil feed pipe from the oil pump to the bottom face of the crankcase. Withdraw the pipe from the pump.

Remove the nut and bolt securing the oil pump inlet pipe clip to the bracket on the main bearing cap.

Remove the nut and bolt securing the oil pump inlet pipe clip in the bracket on the oil pump.

Withdraw the pipe from the pump.

Tap back the tab washers from the three bolt heads securing the oil pump to the front main bearing cap. The oil pump can now be withdrawn.

Remove the coupling shaft from the squared end of the distributor and oil pump drive shaft.

REMOVE PISTONS AND CONNECTING RODS

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top.

Remove the split pins from the connecting rod bolts nuts and unscrew nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are together.

Withdraw the piston and connecting rod from top of cylinder block.

Note: Split skirt pistons MUST be fitted with the split opposite to the thrust side, that is, with the split on the left-hand or exhaust side of the engine. To facilitate correct fitting the pistons crowns are marked " Front ".

REMOVE TIMING COVER

Remove the set bolts securing the timing cover to the front face of the cylinder block. Remove the timing cover, noting that the cover is located to the cylinder b'ock by two dowe!s.

REMOVE TIMING GEAR ASSEMBLY

When removing the bottom timing chain tensioner from the engine, remove the hexagon head plug and tab washer from the end of the body. Insert an Allen key into the hole until it registers in the end of the restraint cylinder. Turn the Allen key clockwise until the restraint cylinder can be felt to be fully retracted within the body. The adjuster head will then be free of the chain.

Knock back the tab washers on the two set bolts securing the chain tensioner to the cylinder block. Remove the bolts and withdraw the tensioner. If a conical filter is fitted in the tensioner oil feed hole in the cylinder block, this should be withdrawn and cleaned in petrol.

Unscrew the two set bolts securing the chain tensioner guide bracket to the cylinder block. Unscrew the four long set bolts securing the timing gear mounting brackets to the cylinder block.

The timing gear can now be removed.

REMOVE DISTRIBUTOR DRIVE GEAR

Tap back the tab washer securing the distributor drive gear nut and remove the nut and washer. Tap the squared end of the distributor drive shaft through the gear, noting that the gear is keyed to the shaft. Remove the gear and thrust washer and withdraw the drive shaft.

REMOVE CRANKSHAFT

Knock back the tab washers securing the fourteen main bearing cap bolts. Unscrew the bolts and the main bearing caps, noting the corresponding numbers stamped on the caps and bottom face of crankcase and also the thrust washers fitted to the recesses in the centre main bearing caps.

Detach the bottom half of the oil return thread cover from the top half by unscrewing the two Allen screws. Note that the two halves are located by hollow dowels.

The crankshaft can now be lifted out from the crankcase.

ENGINE—TO ASSEMBLE

GENERAL

All references in this section to the top or bottom of the engine assume the engine to be upright, irrespective of the position of the unit when the reference is made. References to the left- or right-hand side assume the engine to be upright and looking from the rear.

FIT DISTRIBUTOR DRIVE SHAFT BUSH

If a new bush is to be fitted, press the bush into the bore of the lug at front of cylinder block.

Ream the bush in position to a diameter of $\frac{3}{4}'' \begin{smallmatrix} +.0005'' \\ -.00025'' \end{smallmatrix}$ (19.05 mm. $\begin{smallmatrix} +.012 \text{ mm.} \\ -.006 \text{ mm.} \end{smallmatrix}$)

FIT CRANKSHAFT

Fit the main bearing shells to the top half of the main line bore in the cylinder block. Lay the crankshaft in the bearing shells. Fit the bottom half of the oil return thread cover to the top half which is bolted to the cylinder block behind the rear main bearing. The two halves are located by hollow dowels and secured with Allen screws. The clearance between the oil return thread cover and the oil return thread on the crankshaft should be .0025" to .0055" (.06 to .14 mm.).

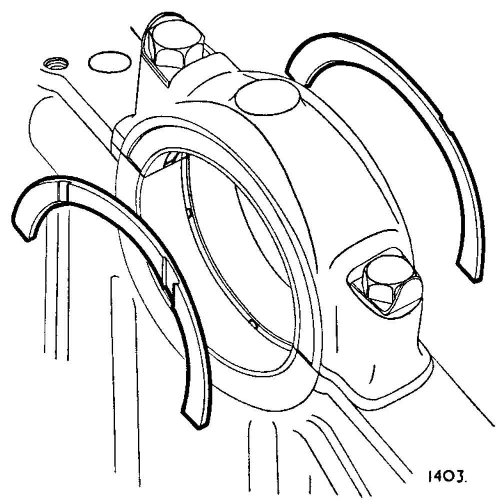


Fig. 7. The crankshaft thrust washers.

The two halves of the oil return thread cover are supplied only as an assembly together with the dowels and screws.

Fit the centre main bearing cap with a thrust washer, white metal side outward, to the recess in each side of cap. Tighten down the cap and check the crankshaft end float, which should be .004" to .006" (.10

to .15 mm.). The thrust washers are supplied in two thicknesses, standard and .004″ (.10 mm.) oversize and should be selected to bring the end float within permissible limits. The oversize thrust washers are stamped +.004″ (.10 mm.) on the steel face.

Fit the main bearing caps with the numbers stamped on the caps with the corresponding numbers stamped on the bottom face of the crankcase.

Fit the main bearing cap bolts and tab washers and tighten to a torque of 83 lbs. ft. (11.5 kg/m.).

The tab washers for the rear main bearing bolts are longer than the remainder and the plain ends should be tapped down around the bolt hole bosses.

Test the crankshaft for free rotation.

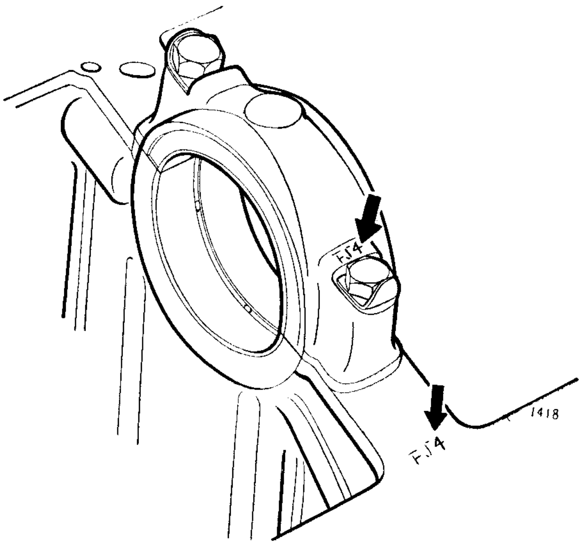


Fig. 8. Showing the corresponding numbers marked on the main bearing cap and crankcase.

FIT PISTONS AND CONNECTING RODS

Turn the engine on its side. Remove the connecting rod caps and fit the pistons and connecting rods to their respective bores from the top of the cylinder block, using a suitable piston ring compressor. The cylinder number is stamped on the connecting rod and cap, No. 1 cylinder being at rear.

Note: Semi-split skirt pistons MUST be fitted with the split opposite the thrust side, that is, with the split on the left-hand or exhaust side of the engine. To facilitate correct fitting the piston crowns are marked " Front ".

Fit the connecting rod caps to the connecting rods with the corresponding numbers together. Fit the castellated nuts and tighten to a torque of 37 lbs. ft. (5.1 kg./m.). Secure nut with split pins.

FIT CRANKSHAFT GEAR AND SPROCKET

Fit the Woodruff key and drive on the crankshaft gear with widest part of boss to the rear.

Fit the Woodruff key and drive on the crankshaft sprocket. Fit oil thrower, washer and distance piece.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C.

FIT DISTRIBUTOR AND OIL PUMP DRIVE GEAR

Fit the distributor drive shaft to the bush on front face of the cylinder block with the offset slot in the top of the shaft as in Fig. 9. Fit the thrust washer and drive gear to the drive shaft, noting that the gear is keyed to the shaft.

Fit the pegged tab washer with the peg in the keyway of the drive gear.

Fully tighten nut and secure with the tab washer. Check the end float of shaft which should be .004″ to .006″ (.10 to .15 mm.).

If no clearance exists fit a new oil pump/distributor driving gear which will restore the clearance.

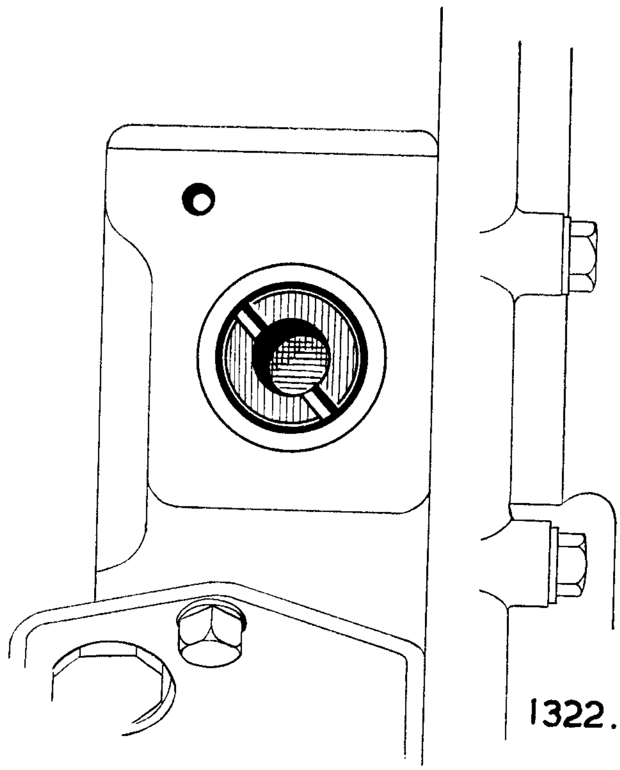


Fig. 9. Showing the position of the distributor drive shaft offset when No. 6 (front) piston is on Top Dead Centre.

FIT OIL PUMP AND PIPES

Fit the coupling shaft between the squared end of the distributor drive shaft and the driving gear of the oil pump. Secure the oil pump to the front main bearing cap by the three dowel bolts and tab washers. Check that there is appreciable end-float of the short coupling shaft. Fit the oil delivery pipe from the oil pump to the bottom face of the crankcase with a new ' O ' ring and gasket. Fit the suction pipe with a new ' O ' ring at the oil pump end.

TO ASSEMBLE TIMING GEAR

Fit the eccentric shaft to the hole in front mounting bracket. Insert the spring and locking plunger for the serrated plate to the hole in the front mounting bracket. Fit the serrated plate and secure with the shakeproof washer and nut. Fit the idler sprocket (21 teeth) to the eccentric shaft.

Fit the two intermediate sprockets (20 and 28 teeth) to their shaft with the larger sprocket forward and press the shaft through lower central hole in rear mounting bracket. Secure with the circlip at the rear of the bracket.

Fit the top timing chain (longer chain) to the small intermediate sprocket and the bottom timing chain (shorter chain) to the large intermediate sprocket.

Loop upper timing chain under the idler sprocket and offer up the front mounting bracket to the rear mounting bracket with the two chain dampers interposed between the brackets.

On the 3.4 litre model fit the intermediate damper to the bottom of the rear mounting bracket with two screwdriver slotted setscrews and shakeproof washer.

Pass the four securing bolts through the holes in the brackets, chain dampers and spacers noting that shakeproof washers are fitted under the bolt heads. Secure the two mounting brackets together with four stud nuts and shakeproof washers.

FIT TIMING GEAR

Turn the engine upside down. Fit the lower timing chain damper and bracket to the front face of the cylinder block with two set bolts and locking plate.

Turn the timing gear assembly upside down and offer it up to the cylinder block. Loop the bottom timing chain over the crankshaft sprocket and secure the mounting brackets to the front face of the cylinder block with the four long securing bolts and the two setscrews retaining the chain tensioner guide bracket. Do not fully tighten the guide bracket setscrews until the four main securing bolts are tight.

TIMING CHAIN TENSIONER

Place the timing chain tensioner, backing plate and filter in position so that the spigot on the tensioner aligns with the hole in the cylinder block. Fit shims, as necessary, between the backing plate and cylinder block so that the timing chain runs centrally along the rubber slipper. Fit the tab washer and two securing bolts. Tighten the bolts and tap the tab washers against the bolt heads.

It is important that no attempt is made to release the locking mechanism until the adjuster has been finally mounted in the engine WITH THE TIMING CHAIN IN POSITION.

Remove the hexagon head plug and tab washer from the end of the body. Insert the Allen key into the hole until it registers in the end of the restraint cylinder. Turn the key clockwise until the tensioner head moves forward under spring pressure against the chain. Do not attempt to turn the key anti-clockwise, nor force the tensioner head into the chain by external pressure.

Refit the plug and secure with the tab washer.

FIT TIMING COVER

Fit the circular oil seal to the recess in the bottom face of timing cover, ensuring that seal is well bedded in its groove.

Fit the timing cover gasket with good quality jointing compound and secure the timing cover to the front face of the cylinder block with the securing bolts. Do not forget to fit the dynamo adjusting link and distance piece, with the distance piece interposed between the link and the timing cover.

FIT OIL SUMP

Fit a new sump gasket to the bottom face of the crankcase. Fit the cork seal to the recess in the rear main bearing cap.

Fit the sump to the crankcase and secure with the twenty-six set screws, four nuts and washers.

Note: The short setscrew must be fitted to the right-hand front corner of the sump.

Fit the sump strainer cover in position at the bottom of the sump using new gaskets.

FIT FLYWHEEL AND CLUTCH

Turn the engine upright.

Check that the crankshaft flanges and the holes for the flywheel bolts and dowels are free from burrs.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C. and fit the flywheel to the crankshaft flange so

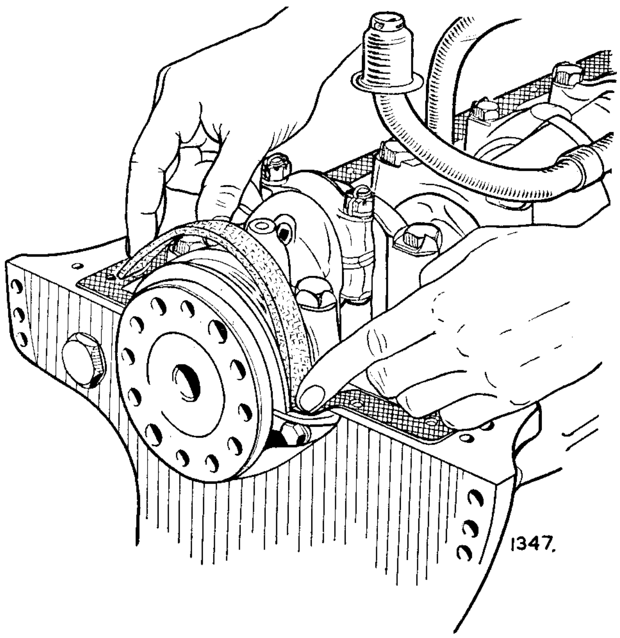


Fig. 10. Fitting the rear oil seal.

that the ' B ' stamped on the edge of the flywheel is at approximately the B.D.C. position. (This will ensure that the balance mark ' B ' on the flywheel is in line with the balance mark on the crankshaft which is a group of letters stamped on the crank throw just forward of the rear main journal).

Tap the two mushroom-headed dowels into position, fit the locking plate and flywheel securing set screws. Tighten the set screws to a torque of 67 lbs. ft. (9.2 kg./m.) and secure with the locking plate tabs. Assemble the clutch driven plate to the flywheel, noting that one side of the plate is marked " Flywheel Side ". Centralise the driven plate by means of a dummy shaft which fits the splined bore of the driven plate and the spigot bush in the crankshaft. (A constant pinion shaft may be used for this purpose). Fit clutch cover assembly so that the ' B ' stamped adjacent to one of the dowel holes coincides with the ' B ' stamped on the periphery of the flywheel. Secure the clutch assembly with the six set screws and spring washers, tightening the screws a turn at a time by diagonal selection. Remove the dummy shaft.

FIT CYLINDER HEAD

Before refitting the cylinder head it is important to observe that if the camshafts are out of phase with piston position fouling may take place between the valves and pistons. It is, therefore, essential to adhere to the following procedure before fitting the cylinder head :—

Check that the grooves in the front flanges of the camshafts are vertical to the camshaft housing face and accurately position by engaging the valve timing

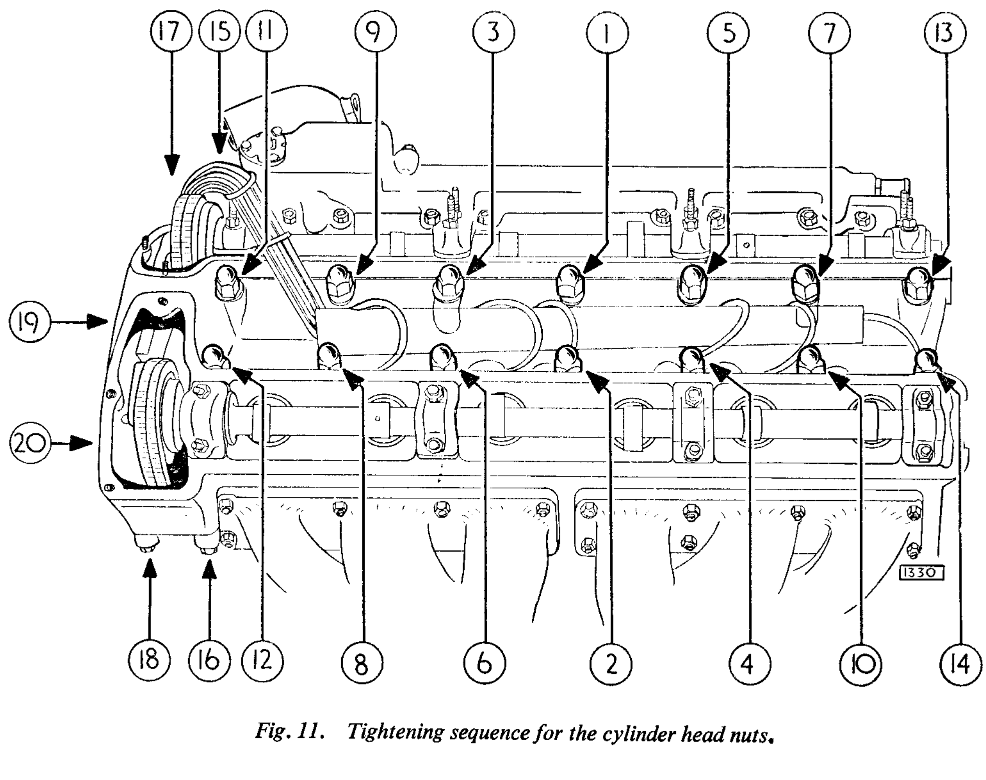


Fig. 11. Tightening sequence for the cylinder head nuts.

gauge. If it is found necessary to rotate one of the camshafts the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

Turn No. 6 (front) piston to the top dead centre position with the widest portion of the distributor drive shaft offset positioned as shown in Fig. 9.

Do NOT rotate the engine or camshafts until the camshaft sprockets have been connected to the camshafts. Fit the two camshaft sprockets complete with adjuster plates and circlips to the top timing chain and enter the guide pins in the slots in the front mounting bracket.

Fit the cylinder head gasket, taking care that the side marked " Top " is uppermost. Fit the cylinder head complete with manifolds to the cylinder block. Note that the second cylinder head stud from the front on the left-hand side is a dowel stud.

Fit the sparking plug lead carrier to the 3rd and 6th stud on the right-hand side. Fit plain washers to these and the two front stud positions and ' D ' washers to the remaining studs. Tighten the fourteen large cylinder head dome nuts a part of a turn at a time to a torque of 54 lbs. ft. (7.5 kg./m.) in the order shown in Fig. 11. Also tighten the six nuts securing the front end of the cylinder head.

VALVE TIMING

Check that the No. 6 (front) piston is exactly in the T.D.C. position.

Through the breather aperture in the front of the cylinder head slacken the lock nut securing the serrated plate.

With the camshaft sprocket on the flanges off the camshafts, tension chain by pressing locking plunger inwards and rotating serrated plate by the two holes in an anti-clockwise direction.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is the chain must not be dead tight. Release the locking plunger and securely tighten the locknut. Tap the camshaft sprockets off the flanges of the camshafts.

Accurately position the camshaft with the valve timing gauge, and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and pull the adjusting plates forward until the serrations disengage. Replace the sprockets on to the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note: It is most important that the holes are in exact alignment, otherwise when the setscrews are fitted the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly, the adjuster plates should be turned through 180°, which, due to the construction of the plate, will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible hole in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and timing in this order. Secure the four setscrews for camshaft sprockets with new lock wire.

FIT CYLINDER HEAD OIL FEED PIPE AND OIL FILTER

Fit the cylinder head oil feed pipe from the tapped hole in the main oil gallery to the two tapped holes in the rear of the cylinder head. Secure the pipe with the three banjo bolts with a copper washer fitted to both sides of each banjo.

Fit the oil filter to the cylinder block with the four setscrews and copper washers. New gasket(s) must always be fitted between the filter and cylinder block.

Note: Some engines are fitted with a blanking plate between the oil filter and the cylinder—refer to " The Oil Filter " on page 45.

FIT CRANKSHAFT DAMPER AND PULLEY

Fit a Woodruff key to the crankshaft and the split cone. Fit the split cone to the crankshaft with the widest end towards the timing cover. Fit the damper to the cone and secure with the flat washer, chamfered side outwards, and large nut. Retain the large nut with the locking plate and secure with two setscrews. Secure the setscrews with the tabs at each end of the locking plate.

FIT WATER PUMP

Fit the water pump to the timing cover with a new gasket and secure with six bolts, three nuts and spring washers.

FIT FAN

Fit the fan and pulley and secure with four set-screws and washers.

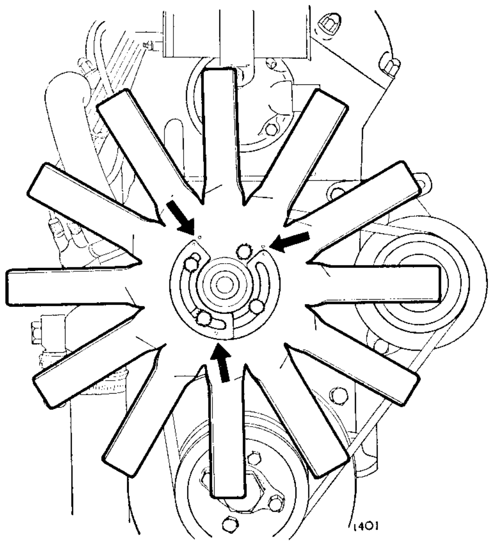


Fig. 12. The arrows indicate the balance piece location marks.

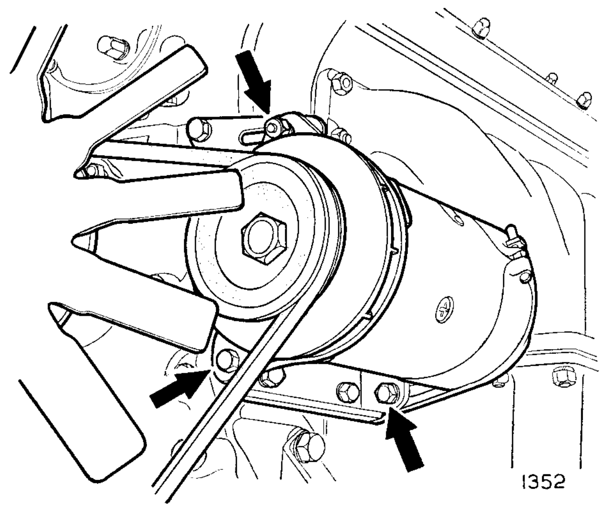


Fig. 13. The dynamo mounting bolts.

FIT DYNAMO AND FAN BELT

Slacken the setscrew securing the dynamo adjusting link to the timing cover and swing link upwards.

Fit the fan belt to crankshaft and fan pulleys. Offer up dynamo and engage fan belt with pulley. Secure dynamo with the two mounting bolts and the adjusting setscrew. Before finally tightening, adjust fan belt tension by pulling dynamo outwards until the belt can be flexed approximately $\frac{1}{2}''$ (12 mm.) either way in the middle of the vertical run. Tighten the adjusting setscrew and the two dynamo mounting bolts.

Note: Undue tension will create heavy wear of belt, pulleys, fan and dynamo bearings.

FIT DISTRIBUTOR AND SPARKING PLUGS

Fit the cork seal to the recess at the top of the hole for the distributor. Secure the distributor clamping plate to the cylinder block with the setscrew. Slacken the clamping plate bolt.

Set the micrometer adjustment in the centre of the scale.

Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor-arm until the driving dog engages with the distributor drive shaft.

Rotate the engine until the rotor-arm approaches the No. 6 (front) cylinder segment in the distributor cap.

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump.

Note: The crankshaft damper fitted to earlier cars did not have a timing scale and on these engines it will be necessary to set the timing by the number of flywheel teeth before top dead centre (see " Ignition Timing " on page 44). On all 3.4 litre engines and 2.4 litre engines on and after BB.2846 the top dead centre marks are visible through a hole in the bottom of the clutch housing (see Fig. 56) 2.4 litre engines prior to the above number have a hole in the left-hand side of the clutch housing.

Slowly rotate the distributor body until the points are just breaking.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

Fit the vacuum advance pipe from the distributor to the union on the front carburetter.

Fit the distributor cover and secure with the two spring clips. Fit the sparking plugs with new copper washers and attach high tension leads.

FIT CAMSHAFT COVERS

Fit each camshaft cover to the cylinder head using a new gasket. Fit the eleven copper washers and dome nuts to the cover retaining studs but do not tighten fully.

Fit the revolution counter adaptor and flanged plug to the rear of left-hand and right-hand camshaft covers respectively with the rubber sealing rings seated in the recesses provided. Fit two new half gaskets to the lower halves of the adaptor and sealing plug and secure with the setscrews and copper washers. Tighten fully the dome nuts securing the camshaft covers.

FIT STARTER

Fit the starter motor to the clutch housing with the two bolts, nuts and spring washers.

FIT GEARBOX

Fit the gearbox and clutch housing to the rear of the crankcase with setscrews and shakeproof washers.

Fit the support brackets to each side, at the bottom face of the crankcase with two bolts, nuts and spring washers, and to the clutch housing with three bolts, nuts and shakeproof washers.

DECARBONISING AND GRINDING VALVES

REMOVE CYLINDER HEAD

Remove the cylinder head as described on page 40.

REMOVE VALVES

With the cylinder head on the bench remove the inlet manifold, and the revolution cable adaptor.

Remove the four bearing caps from each camshaft and lift out the camshaft (note mating marks on each bearing cap).

Remove the twelve tappets and adjusting pads situated between tappets and valve stems. Lay out the tappets and pads in order, to ensure that they can be replaced in their original guides.

Obtain a block of wood the approximate size of the combustion chambers and place this under the valve heads in No. 1 cylinder combustion chamber. Press down the valve collars and extract the split cotters. Remove the collars, valve springs and spring seats. Repeat for the remaining five cylinders. Valves are numbered and must be replaced in the original locations, No. 1 cylinder being at the rear, that is the flywheel end.

DECARBONISE AND GRIND VALVES

Remove all traces of carbon and deposits from the combustion chambers from the induction and exhaust ports. The cylinder head is of aluminium alloy and great care should be exercised not to damage this

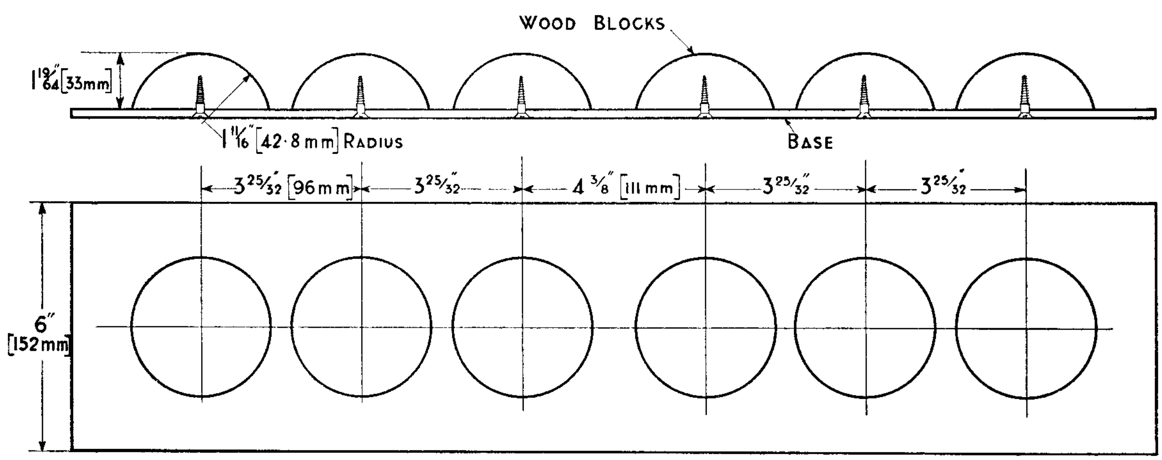


Fig. 14. Combustion chamber blocks for valve removal.

with scrapers or sharp pointed tools. Use worn emery cloth and paraffin only. Thoroughly clean the water passages in the cylinder head. Clean the carbon deposits from the piston crowns and ensure that the top face of the cylinder block is quite clean particularly round the cylinder head studs. Remove any pitting in the valve seats, using valve seat grinding equipment. Reface the valves if necessary using valve grinding equipment ; grind the valves to the seats, using a suction valve grinding tool.

Clean the sparking plugs and set gaps ; if possible use approved plug cleaning and testing equipment. Clean and adjust distributor contact breaker points.

VALVE CLEARANCE ADJUSTMENT

Thoroughly clean all traces of valve grinding compound from the cylinder head and valve gear. Assemble the valves to the cylinder head. **When checking the valve clearances the camshafts must be fitted one at a time as if one camshaft is rotated when the other camshaft is in position, fouling is likely to take place between the inlet and exhaust valves. Obtain and record all valve clearances by using a feeler gauge between the back of each cam and the appropriate valve tappet.**

Correct valve clearances are :—

Inlet	.004″ (.10 mm.).
Exhaust	.006″ (.15 mm.).

Adjusting pads are available rising in .001″ (.03 mm.) sizes from .085″ to .110″ (2.16 to 2.79 mm.) and are etched on the surface with the letter ' A ' to ' Z ', each letter indicating an increase in size of .001″ (.03 mm.). Should any valve clearance require correction, remove the camshaft, tappet and adjusting pad. Observe the letter etched on the existing adjusting pad and should the recorded clearance for this valve have shown say .002″ (.05mm.) excessive clearance, select a new adjusting pad bearing a letter two lower than the original pad.

As an example, assume that No. 1 inlet valve clearance is tested and recorded as .007″ (.18 mm.). On removal of the adjusting pad, if this is etched with the letter ' D ' then substitution with a pad bearing the letter ' G ' will correct the clearance for No. 1 inlet valve.

When fitting the camshafts prior to fitting the cylinder head to the engine it is most important that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face (use valve timing gauge) before tightening down the camshaft bearing cap nuts.

Tighten the camshaft bearing cap nuts to a torque of 15 lbs/ft (2.0 kg/m.).

REFIT CYLINDER HEAD

Before attempting to refit the cylinder head refer to the instructions given on page 41.

COMPRESSION PRESSURES

The compression pressures for all the six cylinders should be even and should approximate to the figures given below.

If one or more compressions are weak it will most probably be due to poor valve seatings when the cylinder head must be removed and the valves and valve seats refaced and reground.

COMPRESSION PRESSURES

7 to 1 compression ratio:	125 lbs per sq. in (8.79 kg/cm^2).
8 to 1 compression ratio:	155 lbs per sq. in. (10.90 kg/cm^2).
9 to 1 compression ratio:	180 lbs per sq. in. (12.65 kg/cm^2).

Pressures must be taken with all the sparking plugs removed, carburettor throttles wide open and the engine at its normal operating temperature (70°C approximately).

Note : When taking compression pressures ensure that the ignition switch is 'off'; rotate the engine by operating the push button on the starter solenoid.

On automatic transmission models it will first be necessary to remove the rubber and metal cover from the end of the solenoid to enable the switch to be operated. Check that the selector lever is in the P (Park) position before operating the starter. Replace the solenoid push button cover after the pressure tests have been taken.

THE CONNECTING ROD AND BEARINGS

The connecting rods are steel stampings and are provided with precision shell big-end bearings and steel backed phosphor-bronze small end bushes. A longitudinal drilling through the connecting rod provides an oil feed from the big end to the small end bush.

With effect from the following engine numbers lead indium big-end bearings are fitted in place of the white metal type.

2.4 litre	BE.1116
3.4 litre	KF.6219

Lead indium bearings can be used to replace white metal bearings fitted prior to the above numbers provided that they are replaced in complete sets.

REMOVAL

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top.

Proceed as follows :—

Remove Cylinder Head

Remove the cylinder head as described on page 40.

Remove Sump

Remove the sump as described on page 52.

Remove Piston and Connecting Rod

Remove the split pins from the connecting rod bolt nuts and unscrew the nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are on the same side. Remove the connecting rod bolts and withdraw the piston and connecting rod from the top of the cylinder block.

OVERHAUL

If connecting rods have been in use for a very high mileage, or if bearing failure has been experienced, it is desirable to renew the rod(s) owing to the possibility of fatigue.

The connecting rods fitted to an engine should not vary one with another by more than 2 drams (3.5 grammes). The alignment should be checked on an approved connecting rod alignment jig. Correct any misalignment as necessary. The big end bearings are of the precision shell type and under no circumstances should they be hand scraped or the bearing caps filed.

The small ends are fitted with steel-backed phosphor-bronze bushes which are a press fit in the connecting rod. After fitting, the bush should be reamed or honed to a diameter of .875″ to .8752″ (22.225 to 22.23 mm.). Always use new connecting bolts and nuts at overhauls.

REFITTING

Refitting is the reverse of the removal procedure. Pistons and connecting rods must be fitted to their respective cylinders (pistons and connecting rods are stamped with their cylinder number, No. 1 being at the rear) and the same way round in the bore.

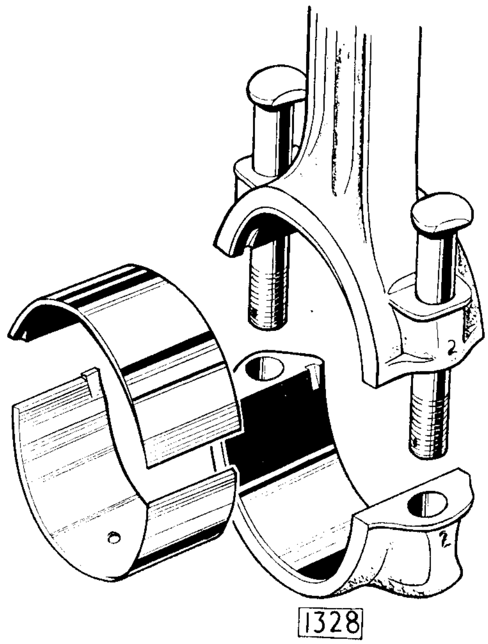


Fig. 15. The connecting rod and cap are stamped with the cylinder number.

The pistons must be fitted with split on the left-hand or exhaust side of the engine. To facilitate correct fitting the piston crowns are marked " Front ", see Fig. 36.

The cap must be fitted to the connecting rod so that the cylinder numbers stamped on each part are on the same side.

Tighten the connecting rod nuts to a torque of 37 lbs/ft (5.1 kg/m.).

BIG-END BEARING REPLACEMENT

The big-end bearings can be replaced without removing the engine from the car but before fitting the new bearings the crankpin must be examined for damage or for the transfer of bearing metal. The oilway in the crankshaft must also be tested for blockage.

Remove the sump as described on page 52.

Turn the engine until the big-end is approximately at the bottom dead centre position.

Remove the split pins from the connecting rod bolt nuts and unscrew the nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are on the same side.

Lift the connecting rod off the crankpin and detach the bearing shell.

If all the big-end bearings are to be replaced they are most easily replaced in pairs, that is, in pairs of connecting rods having corresponding crank throws.

THE CAMSHAFTS

The camshafts are manufactured of cast iron and each shaft is supported in four white metal steel backed bearings. End float is taken on the flanges formed at each side of the front bearing. Oil is fed from the main oil gallery to the camshaft rear bearing housings through an external pipe. Oil then passes through the rear bearing into a longitudinal drilling in the camshaft ; cross drillings which break into this oilway feed the three remaining bearings. On later engines a drilling is made through the base of each cam into the oilway to reduce tappet noise when starting from cold.

Warning : Before carrying out any work on the camshafts the following points must be observed to avoid possible fouling between (a) the inlet and exhaust valves and (b) the valves and pistons.

(1) Do NOT rotate the engine or the camshafts with the camshafts sprockets disconnected. If, with the cylinder head removed from the engine, it is required to rotate a camshaft, the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

(2) When fitting the camshafts to the cylinder head ensure that keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face (use valve timing gauge) before tightening down the camshaft bearing cap nuts.

If this operation is being carried out with the cylinder head fitted to the engine, rotate the engine until No. 6 (front) piston is on Top Dead Centre in the firing position, that is with the distributor rotor opposite No. 6 cylinder segment, before fitting the camshafts.

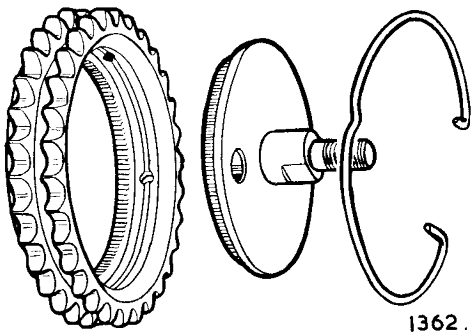


Fig. 16. Exploded view of the camshaft sprocket assembly.

REMOVAL

Remove the eleven dome nuts and copper washers securing each camshaft cover and lift off the cover.

Unscrew the two Allen setscrews attaching the right angled revolution counter drive to the right-hand side of the cylinder head, and the sealing plug from the left-hand side (note the copper washers under the heads of the setscrews and the half gaskets between the sealing plug and the cylinder head). Remove the circular rubber sealing rings.

Break the wire locking the camshaft adjuster plate setscrews.

Rotate the engine until No. 6 (front) piston is approximately on Top Dead Centre on compression stroke (firing position), that is, when the keyway in the front bearing flange of each camshaft is at 90° to the adjacent cover face (see Fig. 17).

Note the positions of the **inaccessible** adjuster plate setscrews and rotate the engine until they can be removed.

Turn back the engine to the T.D.C. position with No. 6 firing and remove the two remaining setscrews.

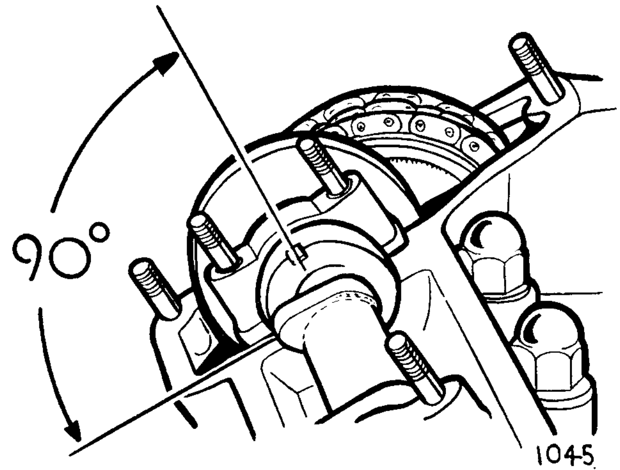


Fig. 17. When fitting a camshaft the keyway must be at 90° to the camshaft cover face.

Tap the sprockets off their respective camshaft flanges. Release the eight nuts securing the bearing caps a turn at a time. Remove the nuts, spring washers and ' D ' washers from the bearing studs.

Remove the bearing caps, noting that the caps and cylinder head are marked with corresponding numbers. Also note that the bearing caps are located to the lower bearing housings with hollow dowels.

If the same bearing shells are to be replaced they should be refitted to their original positions.

The camshaft can now be lifted out from the cylinder head.

REFITTING

Check that No. 6 (front) piston is exactly on T.D.C. on the compression stroke (firing position), that is, with the distributor rotor opposite No. 6 cylinder segment.

Replace the shell bearings—in their original positions if the same bearings are being refitted.

Replace each camshaft with the keyways in the front bearing flange at 90° to the adjacent cover face (using the valve timing gauge).

Refit the bearing caps to their respective positions and the ' D ' washers, spring washers and nuts.

Tighten down the bearing caps evenly a turn at a time. Finally tighten the nuts to a torque of 15 lbs/ft. (2.0 kg/m.).

Set the valve timing as described on page 65.

OVERHAUL

It is unlikely, except after very high mileages, to

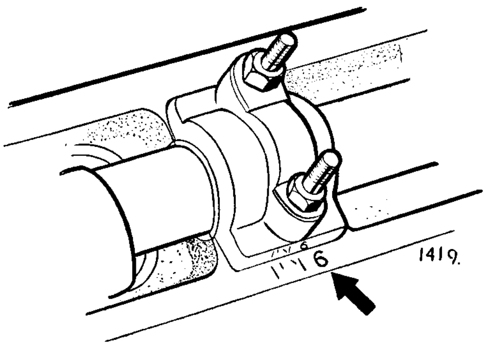


Fig. 18. Showing the corresponding numbers on the bearing cap and cylinder head.

find wear in the camshafts and camshaft bearings. The camshaft bearings are of the precision shell type and under no circumstances should these be hand scraped or the bearing caps filed. Undersize bearings are not supplied.

THE CRANKSHAFT

The counterbalanced crankshaft is of manganese molybdenum steel and is supported in seven precision shell bearings. End thrust of the crankshaft is taken on two semi-circular white metal faced steel thrust washers fitted in recesses in the centre main bearing cap. Except on early 2.4 litre cars a torsional vibration damper is fitted at the front end of the crankshaft.

Initially, the crankshaft is itself balanced both statically and dynamically and is then re-balanced as an assembly with the flywheel and clutch unit attached.

REMOVAL

Proceed as detailed under " Engine—To Dismantle " on page 21.

OVERHAUL

Regrinding of the crankshaft journals is generally recommended when wear or ovality in excess of .003″ (.08 mm.) is found. Factory reconditioned crankshafts are available on an exchange basis, subject to the existing crankshaft being fit for satisfactory reconditioning, with undersize main and big end bearings —.010″ (.25 mm.), —.020″ (.51 mm.), —.030″ (.76 mm.), and —.040″ (1.02 mm.).

Grinding beyond the limits of .040″ (1.02 mm.) is not recommended and under such circumstances a new crankshaft should be obtained.

New crankshaft thrust washers should be fitted, these being in two halves located in recesses in the centre main bearing cap. Fit the main bearing cap with a thrust washer, white metal side outwards, to the recess in each side of cap. Tighten down the cap and check the crankshaft end float, which should be .004″ to .006″ (.10 to .15 mm.). The thrust washers are supplied in two thicknesses, standard and .004″ (.10 mm.) oversize and should be selected to bring the end float within the required limits. It is permissible to fit a standard size thrust washer to one side of the main bearing cap and an oversize washer to the other. Oversize thrust washers are stamped .004″ on the steel face.

Ensure that the oil passages in the crankshaft are clear and perfectly clean before re-assembling. If the original crankshaft is to be refitted remove the Allen headed plugs in the webs (which are secured by staking) and thoroughly clean out any accumulated sludge with a high pressure jet followed by blowing out with compressed air.

After refitting the plugs, secure by staking with a blunt chisel.

REFITTING

Proceed as detailed under " Engine—To Re-assemble " on page 23.

CRANKSHAFT DAMPER AND PULLEY

Except on early 2.4 litre cars a torsional vibration damper is fitted at the front end of the crankshaft.

The damper consists of a malleable iron ring bonded to a thick rubber disc. An inner member also bonded to the disc is attached to a hub which is keyed to a split cone on the front extension of the crankshaft.

The crankshaft damper and pulley are balanced as an assembly and if they are to be separated mark each part before dismantling so that they can be refitted in their original positions.

REMOVAL

In order to remove the crankshaft damper it will first be necessary to remove the radiator. Remove the two setscrews securing the radiator at the sides and the nuts from the two mountings at bottom of the radiator. On cars fitted with a fan cowl remove the four nuts and hang the cowl on the fan. Lift out the radiator taking care not to damage the matrix on the fan blades.

Remove the fan belt after slackening the dynamo and pushing towards the engine.

On the 3.4 litre model remove the locking washer securing the damper bolt by knocking back the tabs and unscrewing the two setscrews. Unscrew the large damper securing bolt and remove the flat washer. Insert two levers behind the damper and ease it off the split cone—a sharp tap on the end of the cone will assist removal.

On the 2.4 litre model remove the locking washer securing the damper bolt by knocking back the tabs and unscrewing the two setscrews. Remove the four remaining setscrews when the pulley and damper can be removed.

OVERHAUL

Examine the rubber portion of the damper for signs of deterioration and if necessary fit a new one. Also examine the crankshaft pulley for signs of wear and renew if necessary. The drive should be taken on the ' V ' faces of the pulley ; renew the pulley if a new fan belt bottoms in the ' V ' groove.

REFITTING

Refitting is the reverse of the removal procedure. On the 2.4 litre model fit the damper to the hub so that the timing scale is at the same side as the keyway in the hub.

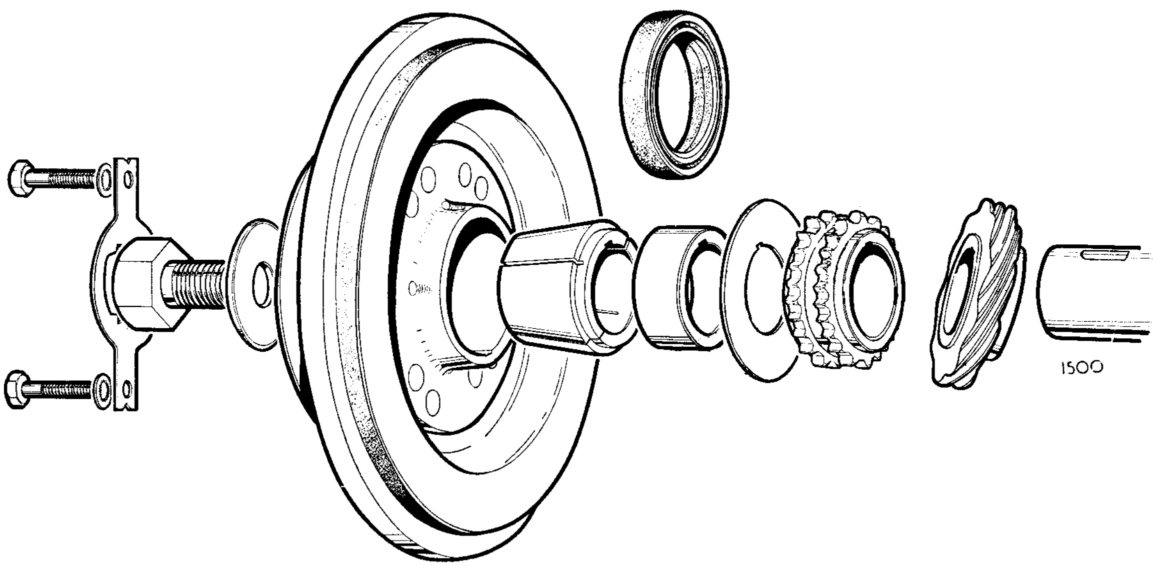


Fig. 19. The crankshaft damper (3.4 litre illustrated).

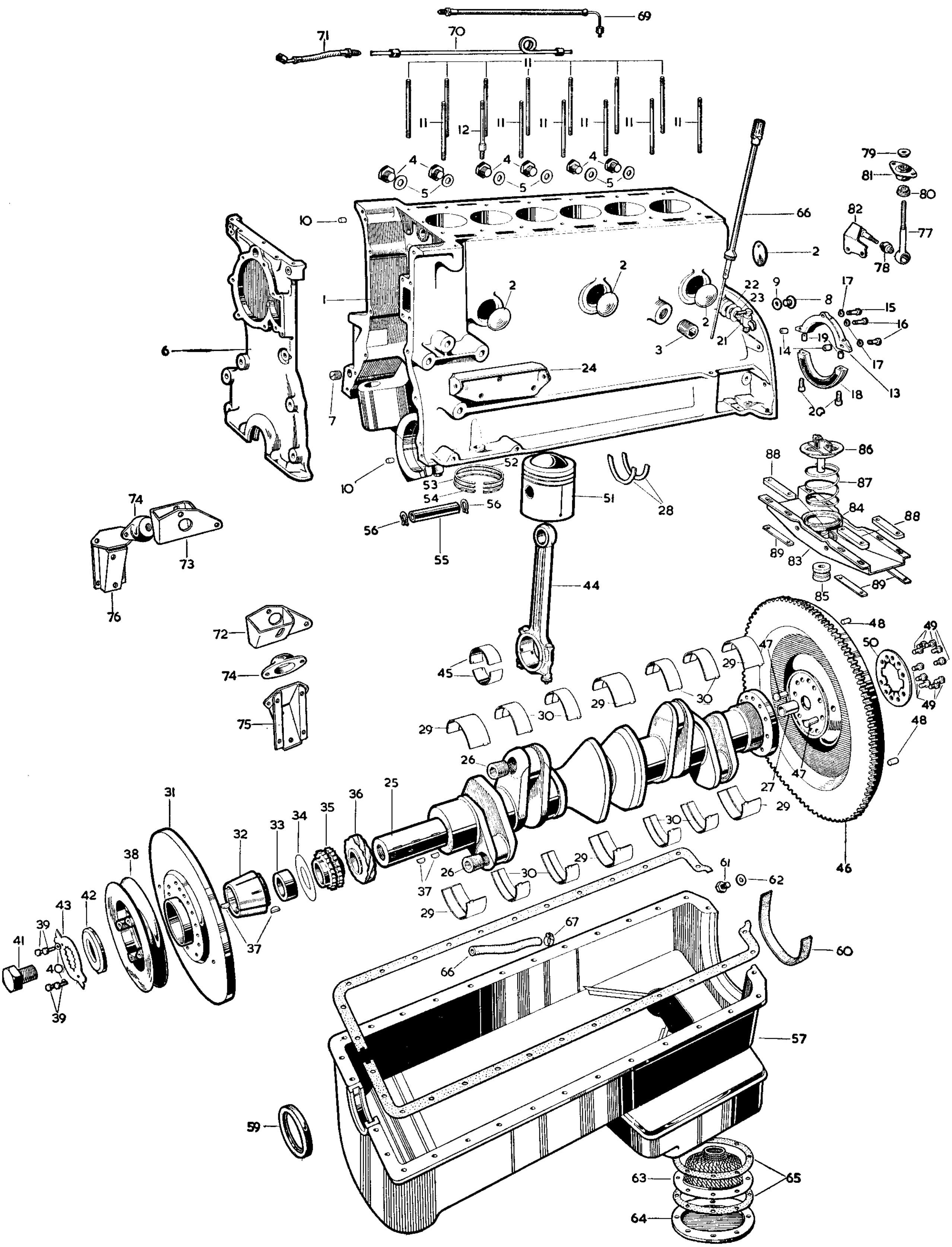


Fig. 20. Exploded view of the cylinder block assembly (3.4 litre illustrated).

Annotations For Fig. 20

1. Cylinder block
2. Core plug
3. Plug
4. Plug
5. Copper washer
6. Front timing cover
7. Plug
8. Plug
9. Copper washer
10. Dowel
11. Stud
12. Dowel stud
13. Cover
14. Ring dowel
15. Bolt
16. Bolt
17. Spring washer
18. Sealing ring
19. Ring dowel
20. Cap screw
21. Water drain tap
22. Copper washer
23. Fibre washer
24. Dynamo mounting bracket
25. Crankshaft
26. Screwed plug
27. Bush
28. Thrust washer
29. Main bearing (front, centre and rear)
30. Main bearing (intermediate)
31. Crankshaft damper
32. Cone
33. Distance piece
34. Oil thrower
35. Timing chain gear
36. Oil pump drive gear
37. Key
38. Pulley
39. Bolt
40. Shakeproof washer
41. Bolt
42. Washer
43. Tab washer
44. Connecting rod
45. Big end bearing
46. Flywheel
47. Dowel
48. Dowel
49. Setscrew
50. Locking plate
51. Piston
52. Pressure ring (upper)
53. Pressure ring (lower)
54. Scraper ring
55. Gudgeon pin
56. Circlip
57. Oil sump
58. Gasket
59. Seal
60. Cork rubber sea
61. Drain plug
62. Copper washer
63. Oil sump filter basket
64. Cover
65. Gasket
66. Hose
67. Clip
68. Dipstick
69. Flexible oil pipe from oil filter
70. Copper oil pipe to pressure gauge
71. Flexible oil pipe from copper oil pipe to pressure gauge
72. Front engine mounting bracket (left hand)
73. Front engine mounting bracket (right hand)
74. Front engine mounting
75. Flange support bracket (left hand)
76. Flange support bracket (right hand)
77. Stabilizing link
78. Bush
79. Stepped washer
80. Stepped bush
81. Stabilizer rubber mounting
82. Stabilizer mounting bracket on clutch housing
83. Channel support
84. Rubber spring seat
85. Rubber centre bush
86. Spring retainer
87. Coil spring
88. Packing block
89. Stiffening plate

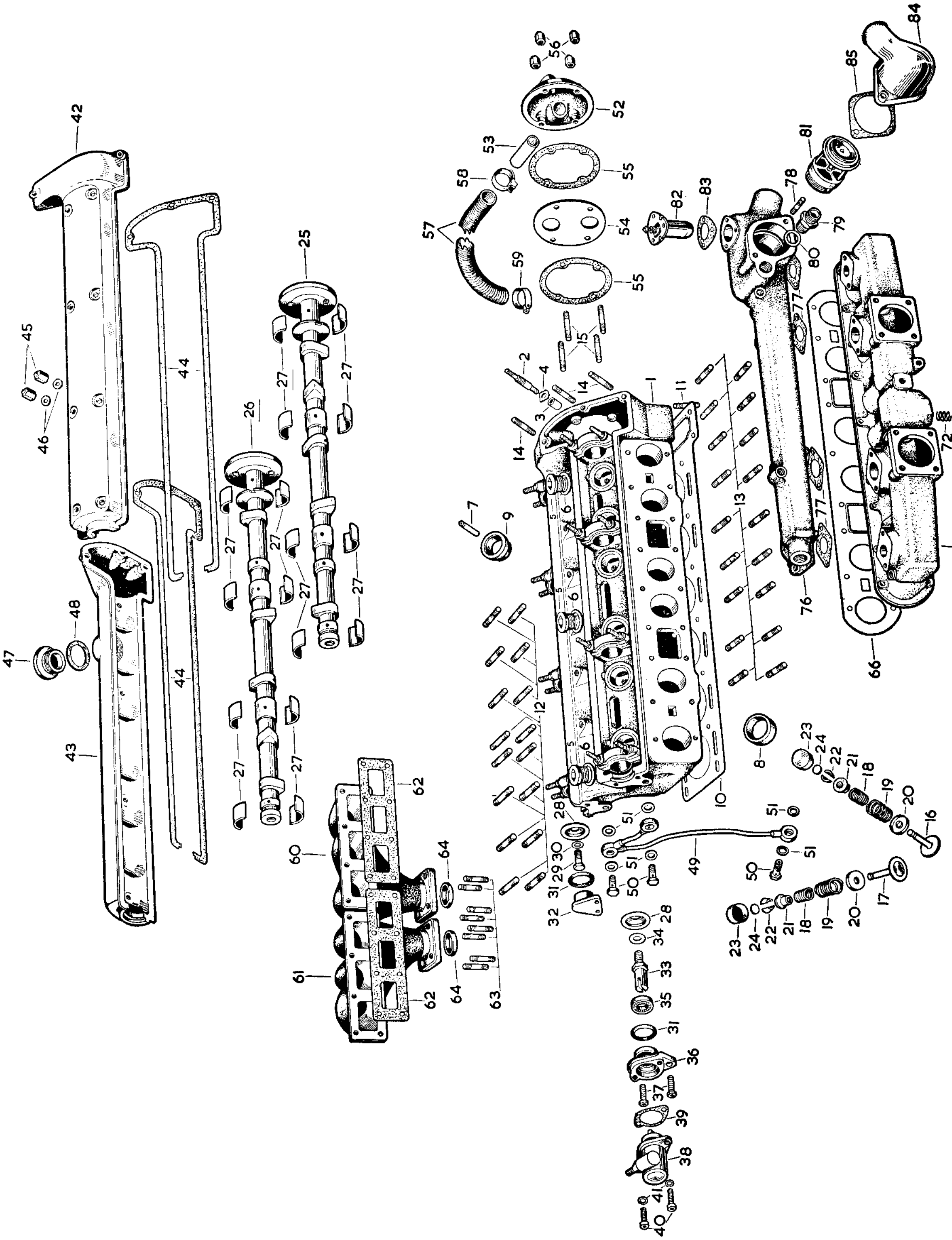


Fig. 21. Exploded view of the cylinder head assembly (3.4 litre illustrated).

Annotations For Fig. 21

1. Cylinder head
2. Stud
3. Ring dowel
4. ' D ' washer
5. Core plug
6. Copper washer
7. Inlet valve guide
8. Inlet valve insert
9. Tappet guide
10. Gasket
11. Stud (timing cover)
12. Stud (exhaust manifolds)
13. Stud (inlet manifold)
14. Stud (camshaft covers)
15. Stud (breather housing)
16. Inlet valve
17. Exhaust valve
18. Valve spring inner
19. Valve spring outer
20. Seat
21. Collar
22. Cotter
23. Tappet
24. Valve adjusting pads
25. Inlet camshaft
26. Exhaust camshaft
27. Camshaft bearing
28. Oil thrower
29. Setscrew
30. Copper washer
31. Sealing ring
32. Flanged sealing plug
33. Revolution counter drive shaft
34. Copper washer
35. Oil seal
36. Revolution counter shaft adaptor
37. Allen head screw
38. Revolution counter camshaft gearbox
39. Gasket
40. Allen head screw
41. Copper washer
42. Camshaft cover (right hand)
43. Camshaft cover (left hand)
44. Gasket
45. Dome nut
46. Copper washer
47. Oil filler cap
48. Fibre washer
49. Oil pipe
50. Banjo bolt
51. Copper washer
52. Breather housing
53. Pipe
54. Baffle
55. Gasket
56. Dome nut
57. Flexible pipe
58. Clip
59. Clip
60. Exhaust manifold (front)
61. Exhaust manifold (rear)
62. Gasket
63. Stud
64. Sealing ring
65. Inlet manifold
66. Gasket
67. Brake servo vacuum pipe flange
68. Gasket
69. Hose
70. Clip
71. Valve
72. Spring
73. Seat
74. Carburetter starting pipe
75. ' O ' ring
76. Water outlet pipe
77. Gasket
78. Stud
79. Adaptor
80. Copper washer
81. Thermostat
82. Carburetter automatic choke thermostat
83. Gasket
84. Water outlet elbow
85. Gasket

THE CYLINDER BLOCK

The cylinder block is of chromium iron and is integral with the crankcase. The main bearing housings are line bored and the caps are not interchangeable, corresponding numbers being stamped on the caps and the bottom face of the crankcase for identification purposes.

OVERHAUL

Check the top face of the cylinder block for truth. Check that the main bearing caps have not been filed and that the bores for the main bearings are in alignment. If the caps have been filed or if there is misalignment of the bearing housings the caps must be re-machined and the bearing housings line bored.

Reboring is normally recommended when the bore wear exceeds .006″ (.15 mm.). Reboring beyond the limit of .030″ (.76 mm.) is not recommended and when the bores will not clean out at .030″ (.76 mm.), liners and standard size pistons should be fitted.

The following oversize pistons are available : +.010″ (.25 mm.), +.020″ (.51 mm.) and .030″ (.76 mm.).

Following reboring the blanking plugs in the main oil gallery should be removed and the cylinder block oilways and the crankcase interior thoroughly cleaned. After cleaning, paint the crankcase interior with heat and oil resisting paint.

THE CYLINDER HEAD

The cylinder head is manufactured of aluminium alloy and has machined hemispherical combustion chambers. Cast iron valve seat inserts, tappet guides and valve guides are shrunk into the cylinder head castings.

Warning : Before carrying out any work on the cylinder head the following points should be observed to avoid possible fouling between (a) the inlet and exhaust valves, and (b) the valves and pistons.

(1) Do NOT rotate the engine or the camshafts with the camshaft sprockets disconnected.

If, with the cylinder head removed from the engine, it is required to rotate a camshaft, the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

(2) When fitting the camshafts to the cylinder head ensure that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face before tightening down the camshaft bearing cap nuts. If this operation is being carried out with the cylinder head fitted to the engine, rotate the engine until No. 6 (front) piston is on Top Dead Centre in the firing position, that is with the distributor rotor opposite No. 6 cylinder segment, before fitting the camshafts.

Note : As the valves in the fully open position protrude below the cylinder head joint face, the cylinder head must not be placed joint face downwards directly on a flat surface ; support the cylinder head on wooden blocks, one at each end.

REMOVAL

Drain the cooling system by turning the radiator drain tap remote control and opening the cylinder block drain tap. Conserve water if anti-freeze is in use.

Remove the bonnet by unscrewing the four setscrews, having previously marked the position of the hinges to facilitate adjustment on re-assembly.

Remove the battery and battery platform.

Remove the air cleaner and air intake pipe.

Disconnect the accelerator linkage at the throttle spindle and at the attachment to the inlet manifold.

Disconnect the distributor vacuum advance pipe from the front carburetter.

Disconnect the petrol feed pipe at the float chamber unions.

On the 2.4 litre models disconnect the mixture control wire from the carburetters. Remove the carburetters.

On the 3.4 litre model disconnect the leads from auxiliary starting carburetter solenoid. Remove the pipe between the auxiliary starting carburetter and the inlet manifold.

Disconnect the revolution counter cable at the union nut.

Disconnect the top water hose and by-pass hose from the front of the inlet manifold water jacket.

Remove the high tension leads from the sparking plugs and the lead carrier from the cylinder head studs.

Remove the clutch flexible pipe bracket from the rear of the cylinder head.

Disconnect the wires from the ignition coil and remove the coil.

Remove the sparking plugs.

Disconnect the engine breather pipe from the front of the cylinder head.

Disconnect the exhaust manifolds from the engine.

On the 2.4 litre models disconnect the exhaust down pipe bracket from the rear of the engine.

Disconnect the two camshaft oil feed pipe unions from the rear of the cylinder head.

Disconnect the heater hose from the rear of the inlet manifold water jacket.

Disconnect the heater pipe clips from the inlet manifold lower securing nuts.

Unscrew the water temperature gauge bulb from the inlet manifold water jacket.

Slacken the clip and disconnect the metal vacuum servo pipe from the rubber hose connection to the inlet manifold.

Remove the eleven dome nuts from each camshaft cover and lift off the covers.

Remove the four nuts securing the breather housing to the front of the cylinder head and withdraw housing observing the position of the baffle plate with the two holes vertical.

Release the tension on the top timing chain by slackening the nut on the eccentric idler sprocket shaft, depressing the spring-loaded stop peg and rotating serrated adjuster plate clockwise.

Break the locking wire on the two setscrews, securing camshaft sprockets to respective camshafts.

Remove one setscrew only from each of the camshaft sprockets ; rotate the engine until the two remaining setscrews are accessible and remove these screws.

Do NOT rotate the engine or the camshaft after having disconnected the sprockets.

The two camshaft sprockets may now be slid up the support brackets.

Slacken the fourteen cylinder head dome nuts a part of a turn at a time in the order shown in Fig. 11 until the nuts become free. Remove the six nuts securing the front of the cylinder head.

Lift off the cylinder head complete with the inlet manifolds. Remove and scrap the cylinder head gasket.

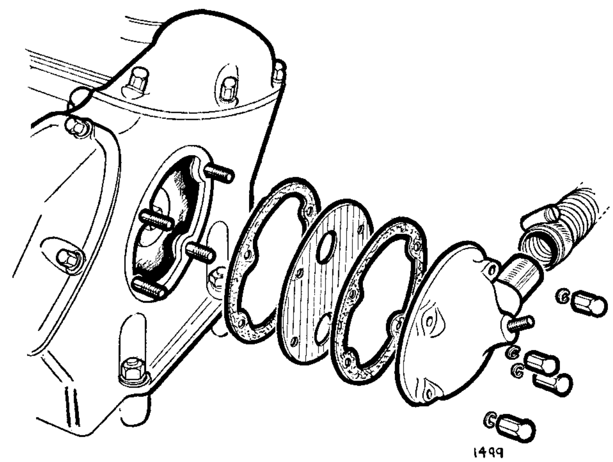


Fig. 22. Removal of the engine breather.

OVERHAUL

As the cylinder head is of aluminium alloy, great care should be exercised when carrying out overhaul work, not to damage or score the machined surfaces. When removing carbon do not use scrapers or sharply pointed tools—use worn emery cloth and paraffin only.

Check the bottom face of the cylinder head for truth.

Remove all traces of carbon and deposits from the combustion chambers and the inlet and exhaust ports and regrind the valve and seats if necessary, as described under " Decarbonising and Grinding Valves " on page 29.

If it is required to replace the valve guides, valve seat inserts or tappet guides, only the special replacement parts must be used. The replacement parts must be shrunk into the cylinder head in accordance with the instructions given under the appropriate headings in this section.

REFITTING

Fit Cylinder Head

Before refitting the cylinder head it is important to observe that if the camshafts are out of phase with piston position fouling may take place between the valves and pistons. It is, therefore, essential to adhere to the following procedure before fitting the cylinder head :—

Check that the keyways in the front flanges of the camshafts are vertical to the camshaft housing face and accurately position by engaging the valve timing gauge. If it is found necessary to rotate one of the camshafts the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

Turn No. 6 (front) piston to the Top Dead Centre position with the distributor rotor arm opposite No. 6 cylinder segment.

Do NOT rotate the engine or camshafts until the camshaft sprockets have been connected to the camshafts.

Fit the cylinder head gasket, taking care that the side marked " Top " is uppermost. Fit the cylinder head complete with manifolds to the cylinder block. Note that the second cylinder head stud from the front on the left-hand side is a dowel stud.

Fit the sparking plug lead carrier to the 3rd and 6th stud from the front on the right-hand side. Fit plain washers to these and the two front stud positions. Fit the clutch flexible pipe bracket to the two studs at the rear of the cylinder head. Fit ' D ' washers to the remaining studs.

Tighten the fourteen large cylinder head dome nuts a part of a turn at a time to a torque of 54 lbs/ft. (7.5 kg/m.) in the order shown in Fig. 11. Also tighten the six nuts securing the front end of the cylinder head.

Valve Timing

Check that No. 6 (front) piston is exactly in the T.D.C. position.

Through the breather aperture in the front of the cylinder head slacken the locknut securing the serrated plate.

With the camshaft sprocket on the flanges of the camshafts, tension chain by pressing locking plunger inwards and rotating serrated plate by two holes in an anti-clockwise direction.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is, the chain must not be dead tight. Release the locking plunger and securely tighten the locknut. Tap the camshaft sprockets off the flanges of the camshafts.

Accurately position the camshafts with the valve timing gauge and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and pull the adjusting plates forward until the serrations disengage. Replace the sprockets on to the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note : It is most important that the holes are in exact alignment, otherwise when the setscrews are fitted the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly, the adjuster plates should be turned through 180°, which, due to the construction of the plate, will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible hole in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and valve timing in this order. Secure the four setscrews for camshaft sprockets with new locking wire.

Fit Cylinder Head Oil feed Pipe

Fit the cylinder head oil feed pipe from the tapped hole in the main oil gallery to the two tapped holes in the rear of the cylinder head. Secure the pipe with the three banjo bolts with a copper washer fitted to both sides of each banjo.

Fit Camshaft Covers

Fit each camshaft cover to the cylinder head using a new gasket. Fit the eleven copper washers and dome nuts to the cover retaining studs but do not tighten fully.

Fit the revolution counter adaptor and flanged plug to the rear of left-hand and right-hand camshaft covers respectively with the rubber sealing rings seated in the recesses provided and secure with the setscrews and copper washers. Tighten fully the dome nuts securing the camshaft covers.

The remainder of the re-assembly is the reverse of the removal procedure.

THE EXHAUST MANIFOLDS

REMOVAL

Remove the eight brass nuts and spring washers securing the exhaust pipe flanges to the exhaust manifolds.

On 2.4 litre cars remove the nut, shakeproof and plain washers securing the exhaust pipe retaining strap to the clutch housing.

Remove the sixteen brass nuts and spring washers securing the exhaust manifolds to the cylinder head when the manifolds can be detached.

REFITTING

Refitting is the reverse of the removal procedure. Use new gaskets between the manifolds and the cylinder head and new sealing rings between the exhaust pipe and manifold flanges.

THE FLYWHEEL

The flywheel is a steel forging and has integral starter gear teeth. The flywheel is located to the crankshaft by two mushroom-headed dowels and is secured by ten setscrews retained by a circular locking plate.

REMOVAL

Remove the engine as described on page 19. Unscrew the four setscrews and remove the cover plate from the front face of the clutch housing.

Remove the bolts and nuts securing the clutch housing to the engine and withdraw the gearbox unit.

Unscrew the six setscrews securing the flange of clutch cover to the flywheel and remove clutch assembly. Note the balance marks ' B ' stamped on the clutch cover and on the periphery of the flywheel.

Knock back the tabs of locking plate securing the ten flywheel bolts. Unscrew the flywheel bolts and remove the locking plate. Remove flywheel from the crankshaft flange by gently tapping with a rawhide mallet.

OVERHAUL

If the starter gear is badly worn a new flywheel should be used, since the starter gear teeth are integral with the flywheel, and in this case it will be necessary to balance the flywheel and clutch as an assembly.

If a new flywheel is being fitted, check the flywheel and clutch balance as an assembly by mounting on a mandrel and setting up on parallel knife edges. Mark the relative position of clutch and flywheel. If necessary, remove the clutch and drill $\frac{3}{8}''$ (9.5 mm.) balance holes not more than $\frac{1}{2}''$ (12.7 mm.) deep at a distance of $\frac{3}{8}''$ (9.5 mm.) from the edge of the flywheel.

REFITTING

Turn the engine upright.

Check that the crankshaft flange and the holes for the flywheel bolts and dowels are free from burrs.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C. and fit the flywheel to the crankshaft flange so that the ' B ' stamped on the edge of the flywheel is at approximately the B.D.C. position. (This will ensure that the balance mark ' B ' on the flywheel is in line with the balance mark on the crankshaft which is a group of letters stamped on the crank throw just forward of the rear main journal).

Tap the two mushroom-headed dowels into position, fit the locking plate and flywheel securing setscrews. Tighten the setscrews to a torque of 67 lbs/ft. (9.2 kg/m.) and secure with the locking plate tabs. Assemble the clutch driven plate to the flywheel, noting that one side of the plate is marked " Flywheel Side ". Centralise the driven plate by means of a dummy shaft

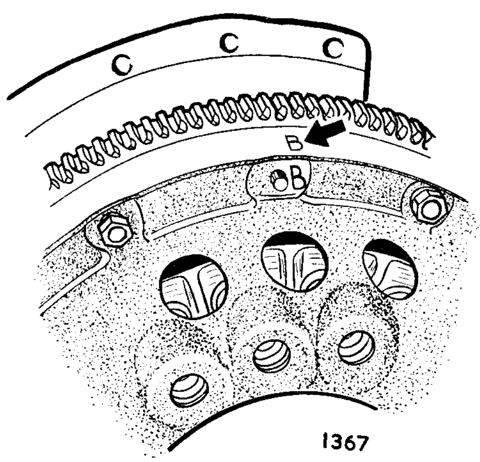


Fig. 23. Showing the balance marks " B " on the clutch and flywheel.

which fits the splined bore of the driven plate and the spigot bush in the crankshaft. (A constant pinion shaft may be used for this purpose). Fit clutch cover assembly so that the ' B ' stamped adjacent to one of the dowel holes coincides with the ' B ' stamped on the periphery of the flywheel. Secure the clutch assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Remove the dummy shaft.

IGNITION TIMING

Set the micrometer adjustment in the centre of the scale.

Rotate the engine until the rotor-arm approaches the No. 6 (front) cylinder segment in the distributor cap.

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump.

Ignition Settings

Note : The crankshaft damper fitted to earlier cars did not have a timing scale and on these engines it will be necessary to set the timing by the number of flywheel teeth before Top Dead Centre. On all 3.4 litre engines and 2.4 litre engines on and after BB.2846 the Top Dead Centre marks are visible through a hole in the bottom of the clutch housing (see Fig. 56) 2.4 litre engines prior to the above number have a hole in the left-hand side of the clutch housing.

Connect a 12 volt test lamp with one lead to the distributor terminal (or the CB terminal of the ignition coil) and the other to a good earth.

Slacken the distributor plate pinch bolt.

Switch on the ignition.

Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up with the fibre heel leading the appropriate cam lobe in the normal direction of rotation.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

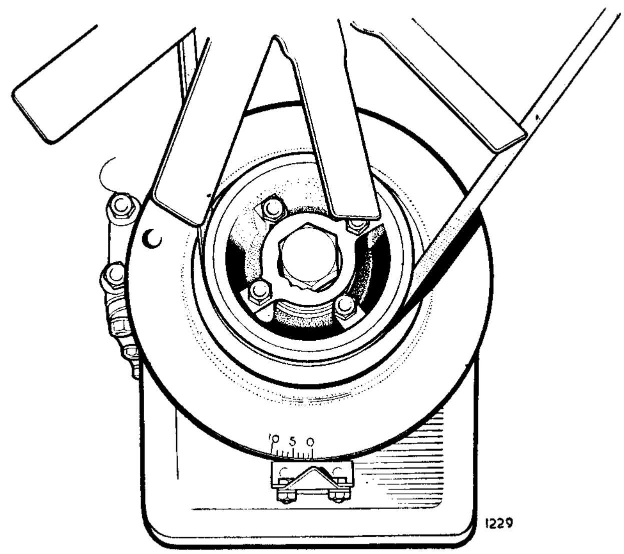


Fig. 24. Showing the timing scale marked on the crankshaft damper

Model	Compression Ratio	Setting	No. of Flywheel teeth
2.4 litre	7 to 1	4° B.T.D.C.	1⅓
2.4 litre	8 to 1	6° B.T.D.C.	1¾
3.4 litre	7 to 1	T.D.C.	-
3.4 litre	8 to 1	2° B.T.D.C.	⅔
3.4 litre	9 to 1	T.D.C.	-

THE INLET MANIFOLD

The inlet manifold is an aluminium casting and is water heated by the coolant from the cylinder head through cast-in passages. A water outlet pipe attached to the inlet manifold houses the thermostat and has the top water hose and by-pass hose connected at the front end.

REMOVAL

Drain the radiator.

Remove the carburetters as described in Section C. Slacken the clips and disconnect the top water hose and by-pass hoses from the inlet manifold water outlet pipe.

Unscrew the water temperature gauge bulb nut taking care not to twist the capillary tube ; two flats are provided to enable the bulb to be held against rotation.

On the 3.4 litre model disconnect the cable from the auxiliary starting carburetter switch. Disconnect the brake servo vacuum pipe from its connection at the inlet manifold. On early cars the connection is situated underneath the manifold ; on later cars the connection is at the rear of the manifold combined with the take-off for the windscreen washer.

Disconnect the rubber tube for the windscreen washer from the adaptor at the rear of the inlet manifold.

On the 2.4 litre model, detach the petrol feed line filter and tie up out of the way. Disconnect the heater hose from the connection at the rear of the manifold. Remove the split pin and detach the accelerator linkage from the pin in the manifold.

Remove the eighteen nuts and spring washers, detach the heater pipe clips from the lower studs when the inlet manifold can be withdrawn.

REFITTING

Refitting is the reverse of the removal procedure.

THE OIL FILTER

The oil filter is of the full-flow type and has a renewable felt element.

The oil pressure relief valve is incorporated in the oil filter head and is retained by a domed plug or banjo connection. On early 2.4 litre cars with an aluminium sump the return from relief valve is through a drilling in the crankcase. On cars with pressed steel sumps the return from the relief valve is taken via an external pipe to the oil sump ; on these engines either the crankcase is not drilled or the drilling through the crankcase is blanked off with a plate.

A balance valve fitted in the filter head provides a safeguard against the possibility of the filter element becoming so choked that oil is prevented from reaching the bearings.

The four conditions of oil filter and attachment arrangement are tabulated below and if new parts or gaskets are necessary they must be fitted in accordance with the details given to suit the particular engine.

	Fitted to Engine Numbers 2.4 litre	Fitted to Engine Numbers 3.4 litre	Oil Filter	Blanking Plate	Gasket	Oil Filter Bolts	Remarks
1st Condition	Engines with an aluminium sump only		C.9085 (FA.2705)	Not fitted	C.12177 1 off	NB.131/26D 1 off NB.131/10D 2 off NB.131/36D 1 off	
2nd Condition	BB.9001—9999 BC.1001—2255	KE.1001— KE.3053	C.12532 (FA.2705)	C.12381	C.12177 2 off	NB.131/11D 2 off NB.131/27D 1 off NB.131/37D 1 off	
3rd Condition	BC.2256—9999 BE.1001—1581	KE.3054—9999 KF.1001—7139	C.12776 (FA.2720)	C.12803	C.12177 (inner) 1 off C.13091 (outer) 1 off	NB.131/15D 2 off NB.131/27D 1 off NB.131/37D 1 off	
4th Condition	BE.1582 onwards	KF.7140 onwards	C.12776 (FA.2720)	Not fitted	C.13091 1 off	NB.131/13D 2 off NB.131/25D 1 off NB.131/35D 1 off	Use only copper washers under bolt heads

REMOVAL OF OIL FILTER

Drain the filter by unscrewing the flat headed plug at the bottom of the filter head.

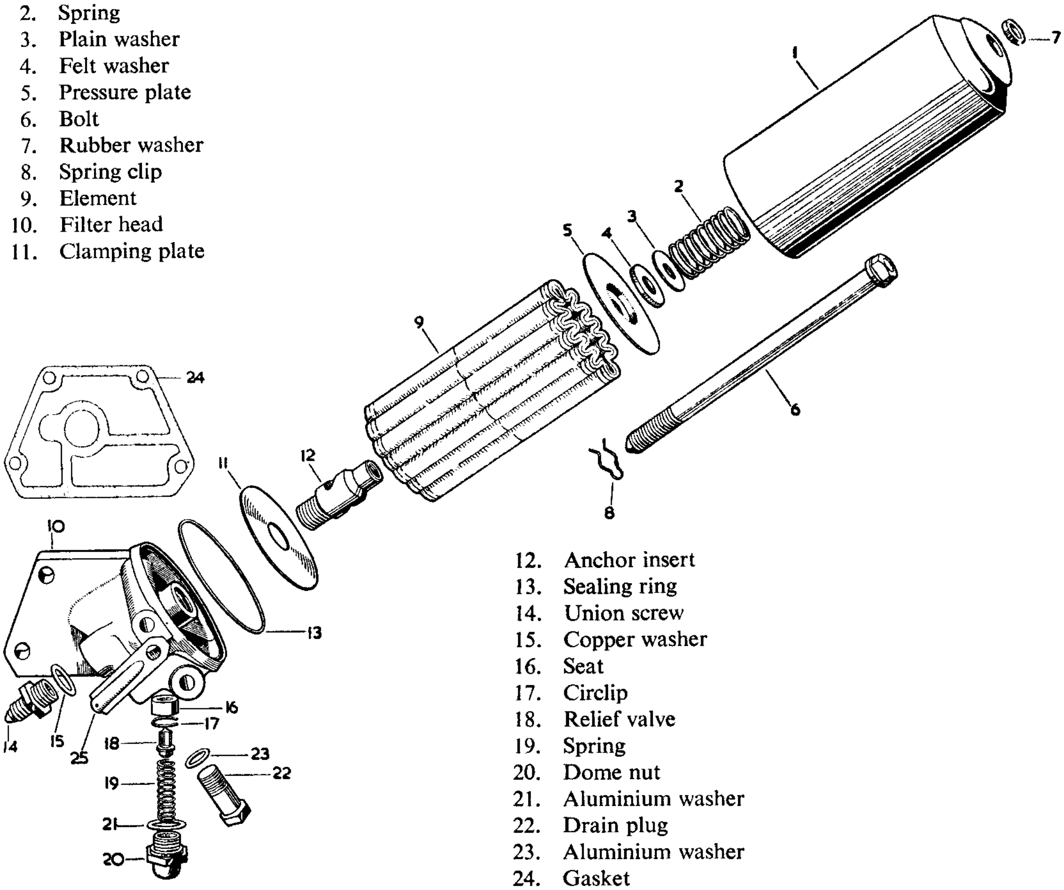
On the 2.4 litre model disconnect the throttle return spring from the bracket on the side of the oil filter.

Unscrew the oil gauge pipe union nut. On cars with a pressed steel sump, unscrew the clip and disconnect the hose from the connection in the filter head.

Remove the four bolts securing the filter to the cylinder block noting that they are of different lengths.

The filter (and blanking plate if fitted) can now be detached from the cylinder block.

1. Canister
2. Spring
3. Plain washer
4. Felt washer
5. Pressure plate
6. Bolt
7. Rubber washer
8. Spring clip
9. Element
10. Filter head
11. Clamping plate



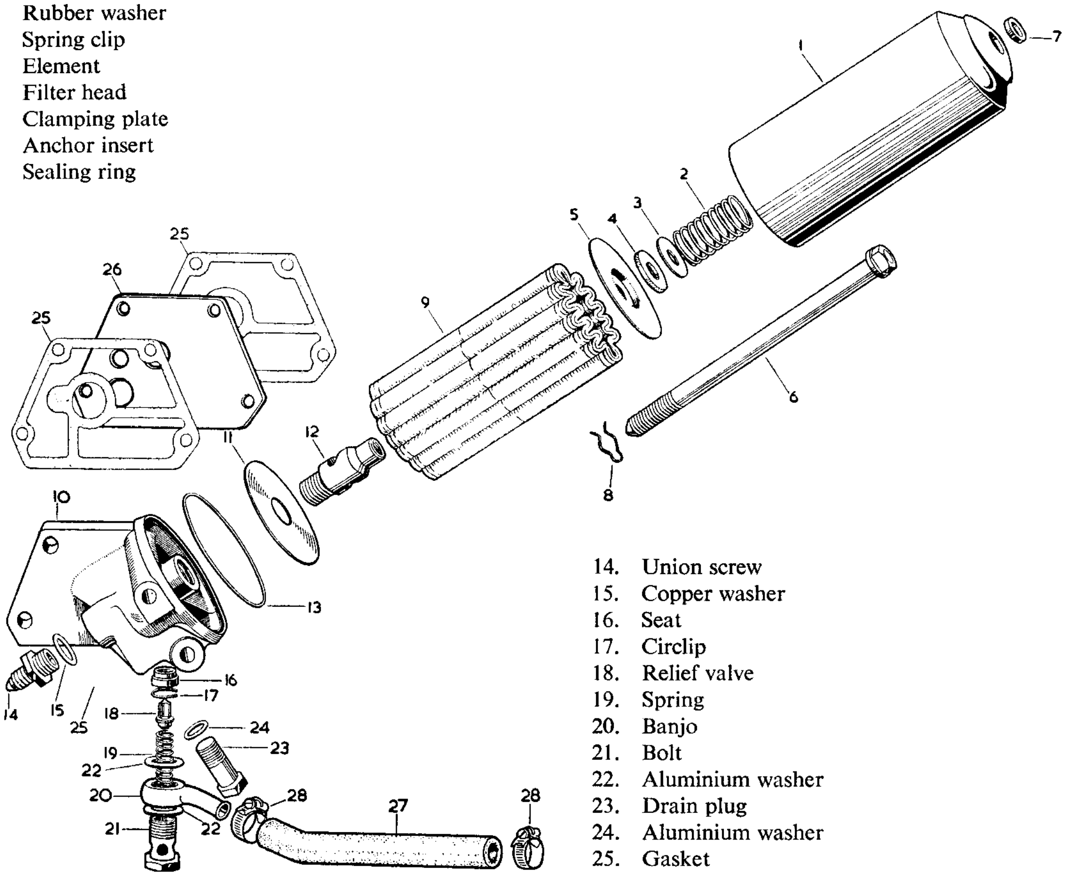
12. Anchor insert
13. Sealing ring
14. Union screw
15. Copper washer
16. Seat
17. Circlip
18. Relief valve
19. Spring
20. Dome nut
21. Aluminium washer
22. Drain plug
23. Aluminium washer
24. Gasket
25. Bracket

Fig. 25. Exploded view of oil filter (first type).

REFITTING THE OIL FILTER

Refitting is the reverse of the removal procedure. Always fit a new gasket(s) between the filter and the cylinder block. If a blanking plate is fitted ensure that it is refitted the correct way round ; the small hole (or " dimple ") in the plate must be aligned with the small hole in the cylinder block flange which will blank off the large hole drilled completely through the crankcase.

1. Canister
2. Spring
3. Plain washer
4. Felt washer
5. Pressure plate
6. Bolt
7. Rubber washer
8. Spring clip
9. Element
10. Filter head
11. Clamping plate
12. Anchor insert
13. Sealing ring



14. Union screw
15. Copper washer
16. Seat
17. Circlip
18. Relief valve
19. Spring
20. Banjo
21. Bolt
22. Aluminium washer
23. Drain plug
24. Aluminium washer
25. Gasket
26. Blanking plate
27. Hose
28. Clip

Fig. 26. Exploded view of oil filter (second type).

ELEMENT REPLACEMENT

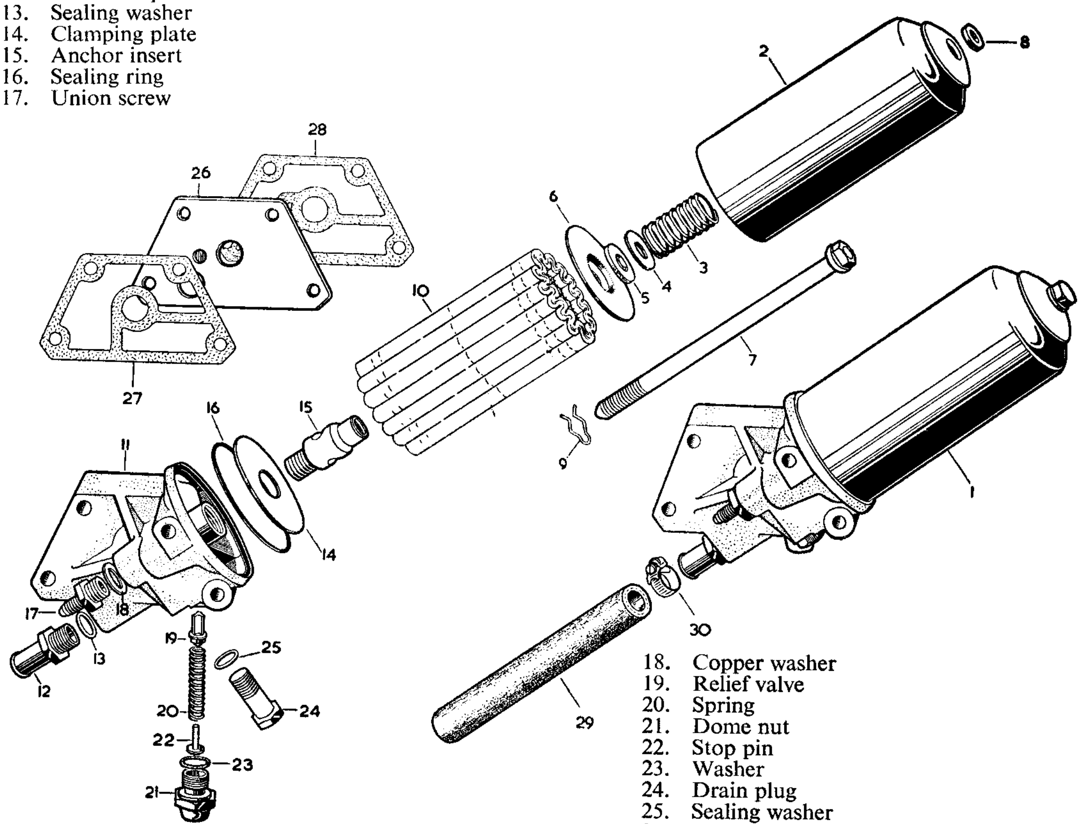
It is most important to renew the oil filter element at the recommended periods as after this mileage it will have become choked with impurities.

To guard against the possibility of the filter being neglected to the extent where the element becomes completely choked, a balance valve is incorporated in the filter head which allows unfiltered oil to by-pass the element and reach the bearings. This will be accompanied by a drop in the normal oil pressure of some 10 lb. per sq. in. and if this occurs the filter element should be renewed as soon as possible.

The oil filter is situated on the right-hand side of the engine and before removing the canister it will be necessary to drain the filter by removing the flat-headed drain plug situated at the bottom of the filter head ; do not disturb the domed plug as this retains the oil pressure relief valve. To gain access to the element, unscrew the central bolt when the canister complete with the element can be removed. Thoroughly wash out the cannister with petrol and allow to dry before inserting the new element.

Examine the circular rubber seal in the filter head and, if necessary, fit a new one.

1. Oil filter assembly
2. Canister
3. Spring
4. Plain washer
5. Felt washer
6. Pressure plate
7. Bolt.
8. Rubber washer
9. Spring clip
10. Element
11. Filter head
12. Outlet adaptor
13. Sealing washer
14. Clamping plate
15. Anchor insert
16. Sealing ring
17. Union screw



18. Copper washer
19. Relief valve
20. Spring
21. Dome nut
22. Stop pin
23. Washer
24. Drain plug
25. Sealing washer
26. Blanking plate
27. Gasket
28. Gasket
29. Hose
30. Clip

Fig. 27. Exploded view of oil filter (third type).

THE OIL PRESSURE RELIEF VALVE

The non-adjustable oil pressure relief valve is incorporated in the oil filter head and is retained by either a domed plug or a banjo connection (see Figs. 25, 26, 27).

The three types of oil pressure relief valve assemblies that have been fitted are detailed below. The first and second type relief valve assemblies have a separate seat which is retained in the filter head by a circlip ; the third type has the valve seat secured in the filter head casting by peening.

The third type relief valve assembly incorporates a stop pin (22 Fig. 27) which must only be fitted in conjunction with relief valve spring Part number 7315.

	Fitted to Engine numbers 2.4 litre	Fitted to Engine numbers 3.4 litre	Fitted to Oil Filter (Part No.)	Relief Valve (Part No.)	Relief Valve Spring (Part No.)	Free Length	Remarks
1st Type	BB.1001—9000 BB.9001—9999 BC.1001—2255	KE.1001 to 3053	C.9085 (FA.2705) and C.12532 (FA.2705)	2713	6462	2″ (50.8 mm.)	
2nd Type	BC.2256—3599	KE.3054 to 4855	C.12776 (FA.2720)	7310	6897*	$1\frac{3}{4}$″ (44.5 mm.)	* Can be replaced by Spring7315 and Stop pin 7357
3rd Type	BC.3600—9999 BE.1001—onwards	KE.4856—KE.9999 KF.1001—onwards	C.12776 (FA.2720)	7310	7315 (and Stop pin 7357)	$2\frac{1}{16}$″ (52.4 mm.)	

THE OIL PUMP

The oil pump is of the eccentric rotor type and consists of five main parts :— the body, the driving spindle with the inner rotor pinned to it, the outer rotor and the cover, which is secured to the main body by four bolts, finally being secured to the engine with additional dowel bolts. The inner rotor has one lobe less than the number of internal segments in the outer rotor. The spindle centre is eccentric to that of the

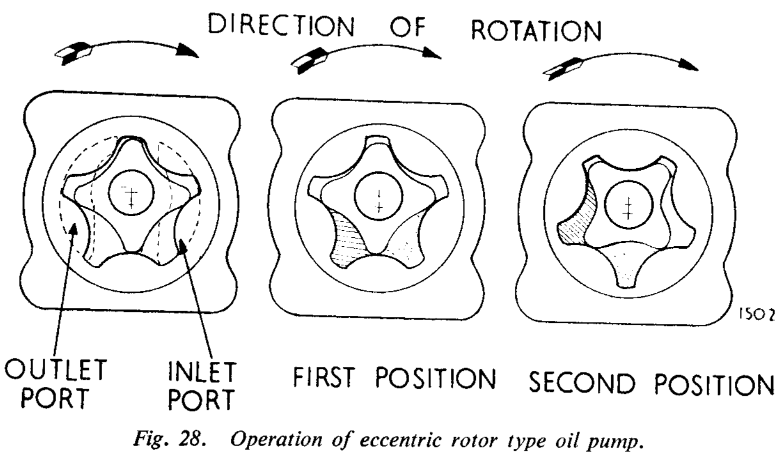


Fig. 28. Operation of eccentric rotor type oil pump.

bore in which the outer rotor is located, thus the inner rotor is able to rotate within the outer, and causes the outer rotor to revolve. The inlet connection is positioned in the pump cover, and the outlet connection in the body. These are both connected to the ports in the pump.

Consider the oil flow with the lobes of the inner rotor lying along the line of eccentricity. In this position oil is free to flow from the port into the space (dotted portion) between the rotors, and on the other side of the lobe (shaded portion) the oil is free to flow into the delivery port (see Fig. 28).

In the second position, the inner and outer rotors have rotated and caused the oil that was flowing from the inlet port into the space between them to be cut off from the port and transferred to the enclosed space between the ports. Similarly, the space which enclosed oil free to flow to the delivery port in the first position has decreased in size in the second position, and thus caused this oil to flow into the delivery port, The action of the pump is then a repetition of the above, oil flowing into the space between the rotors from the inlet port under atmospheric pressure and being discharged into the delivery port by reason of the space in which it is contained decreasing in size as it passes over the port.

REMOVAL

Remove the sump as described on page 52.

Detach the suction and delivery pipe brackets and withdraw the pipes from the oil pump.

Tap back the tab washers and remove the three bolts which secure the oil pump to the front main bearing cap.

Withdraw the oil pump and collect the coupling sleeve at the top of the drive shaft.

DISMANTLING

Unscrew the four bolts and detach the bottom cover from the oil pump.

Withdraw the inner and outer rotors from the oil pump body. The inner rotor is pinned to the drive shaft and must not be dismantled.

OVERHAUL

Check the clearance between lobes of the inner and outer rotors which should be .006″ (.15 mm.) maximum (see Fig. 29).

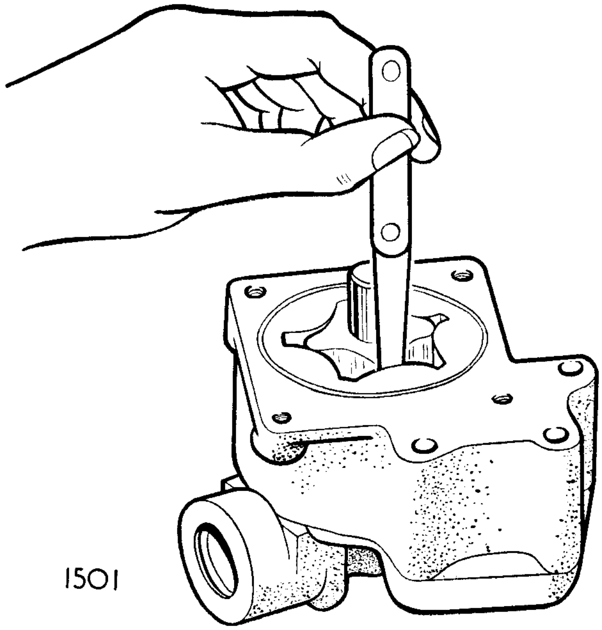


Fig. 29. Measuring the clearance between the inner and outer rotors.

Check the clearance between the outer rotor and the pump body (see Fig. 30) which should not exceed .010″ (.25 mm.).

Check the end-float of the rotors by placing a straight edge across the joint face of the body and measuring the clearance between the rotors and straight edge (see Fig. 32). This clearance should be .0025″ (.06 mm.) and in an emergency can be restored by lapping the pump body and outer rotor on a surface plate to suit the inner rotor.

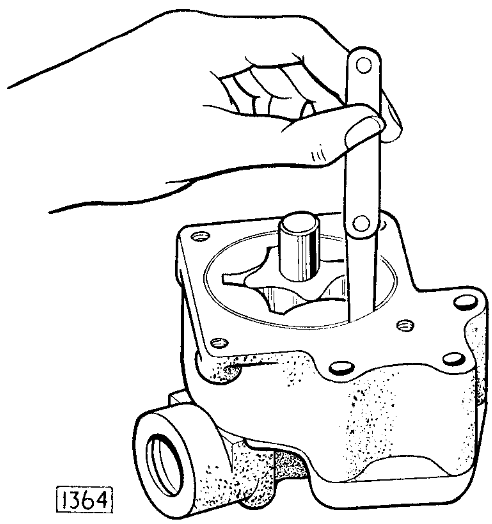


Fig. 30. Measuring the clearance between the outer rotor and the pump body.

1. Body
2. Rotor Assembly
3. Cover
4. Setscrew
5. Setscrew
6. Spring washer
7. ' O ' ring
8. Drive shaft
9. Bush
10. Washer
11. Helical gear
12. Key
13. Nut
14. Locking washer
15. Shaft
16. Dowel bolt
17. Tab washer
18. Oil delivery pipe
19. Gasket
20. Oil suction pipe
21. Clip
22. Suction pipe supporting strut
23. Suction pipe supporting strut
24. Hood
25. Spring
26. Split pin

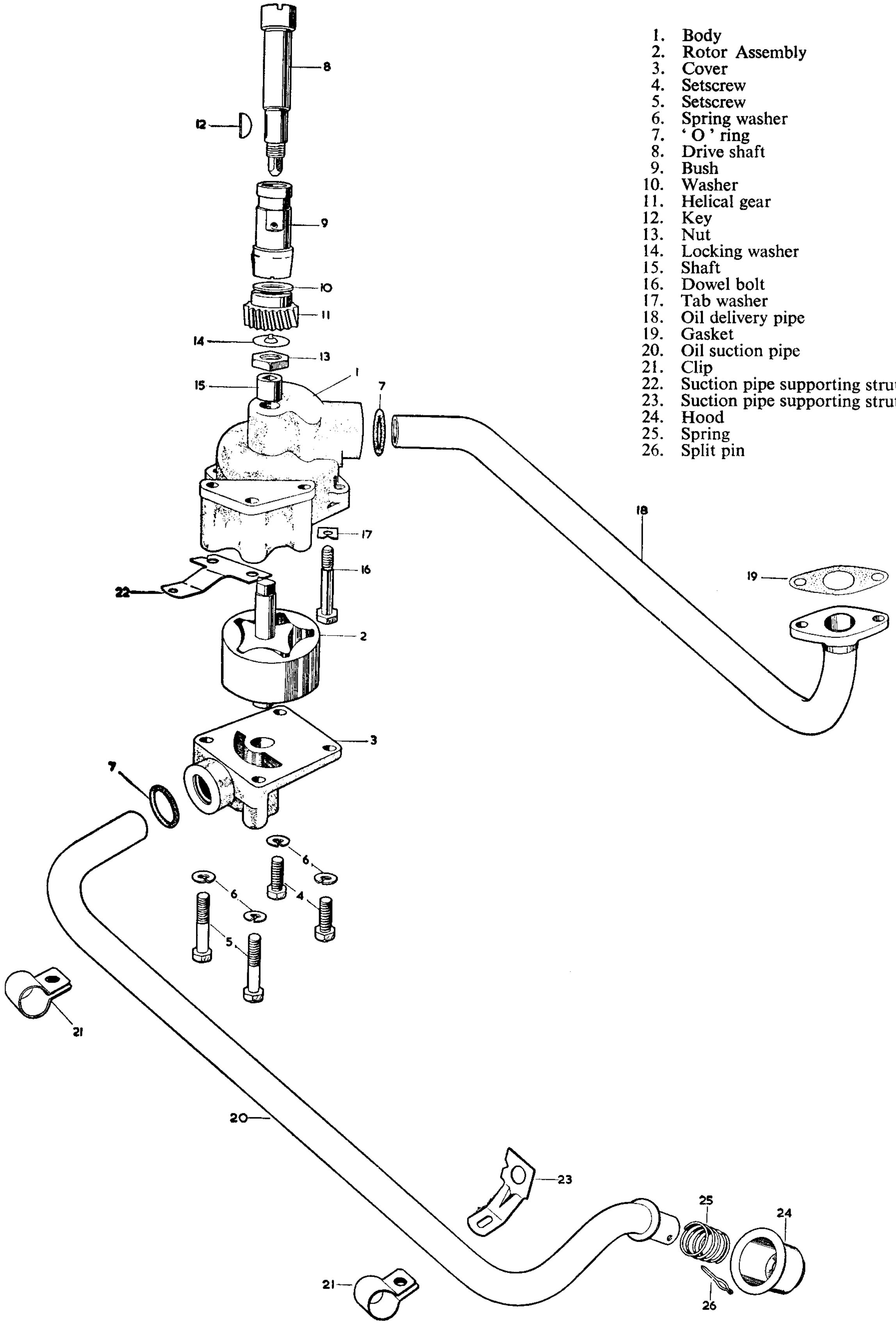


Fig. 31. Exploded view of the oil pump.

Examine the pump body and bottom cover for signs of scoring and the drive shaft bores for signs of wear ; fit new parts as necessary.

Place the drive shaft in a vice fitted with soft jaws and check that the inner rotor is tight on the securing pin.

Note that the drive shaft, inner and outer rotors are supplied only as an assembly.

RE-ASSEMBLING

Re-assembly is the reverse of the dismantling procedure but it is important when fitting the outer rotor to the pump body to insert the chamfered end of the rotor foremost.

Always fit new ' O ' rings to the suction and delivery pipe bores.

REFITTING

Refitting is the reverse of the removal procedure.

Do not omit to fit the coupling sleeve to the squared end of the drive shaft before offering up the oil pump.

After fitting of the oil pump, check that there is appreciable end-float of the coupling sleeve.

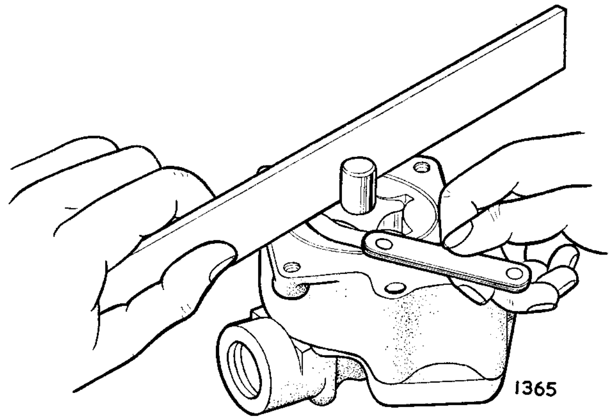


Fig. 32. Measuring the end float of the rotors.

THE OIL SUMP

Early 2.4 litre cars were fitted with an aluminium oil sump ; later 2.4 litre and all 3.4 litre cars are fitted with a pressed steel sump which has an external connection for the oil pressure relief valve return hose.

A gauze bowl-type strainer fitted to the bottom of the sump is accessible through a circular cover plate. At the recommended periods the strainer should be removed and washed with petrol.

REMOVAL

Drain the oil sump.

Remove the front suspension unit as described in Section ' J '.

Unscrew the twenty-six setscrews and four nuts and detach the sump from the cylinder block, noting that a short setscrew is fitted at the right-hand front corner of the sump.

REFITTING

Scrape off all traces of the old gaskets or sealing compound from the joint faces of the sump and crankcase.

Always fit new gaskets and a rear oil seal when refitting the sump. If time permits, roll the rear oil seal into a coil and retain with string for a few hours. This will facilitate the fitting of the seal to its semi-circular recess.

Ensure that the short setscrew is fitted to the right-hand front corner of the sump.

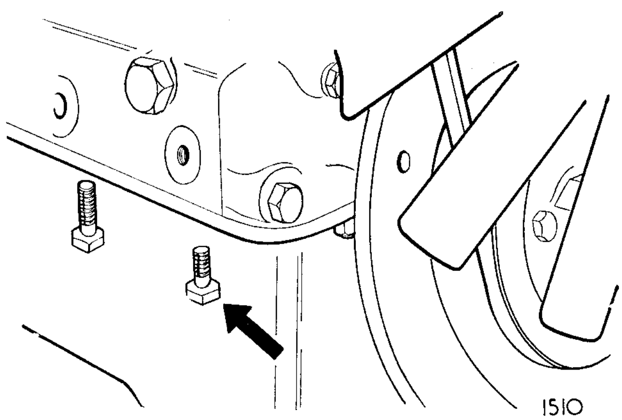


Fig. 33. Showing the location of the short setscrew.

PISTONS AND GUDGEON PINS

The pistons are made from low expansion aluminium alloy and are of the semi-split skirt type. Two compression rings and one control ring are fitted, the top compression ring being hard chrome plated; on the 3.4 litre model tapered periphery compression rings are fitted. The fully floating gudgeon pin is retained in the piston by a circlip at each end.

REMOVAL

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top. The connecting rod bolts should, however, be removed to allow the big end to pass easily through the bore. Proceed as follows :—

Remove Cylinder Head

Remove cylinder head as described on page 40.

Remove Sump.

Remove the sump as described on page 52.

Remove Piston and Connecting Rod

Remove the split pins from the connecting rod bolt nuts and unscrew nuts. Remove the connecting rod cap, noting the corresponding cylinder numbers on the connecting rod and cap. Remove the connecting rod bolts and withdraw the piston and connecting rod from the top of cylinder block.

OVERHAUL

Pistons are supplied complete with gudgeon pins which have been selectively assembled and are, therefore, not interchangeable one with another.

The pistons fitted to an engine should not vary one with another by more than 2 drams (3.5 grammes).

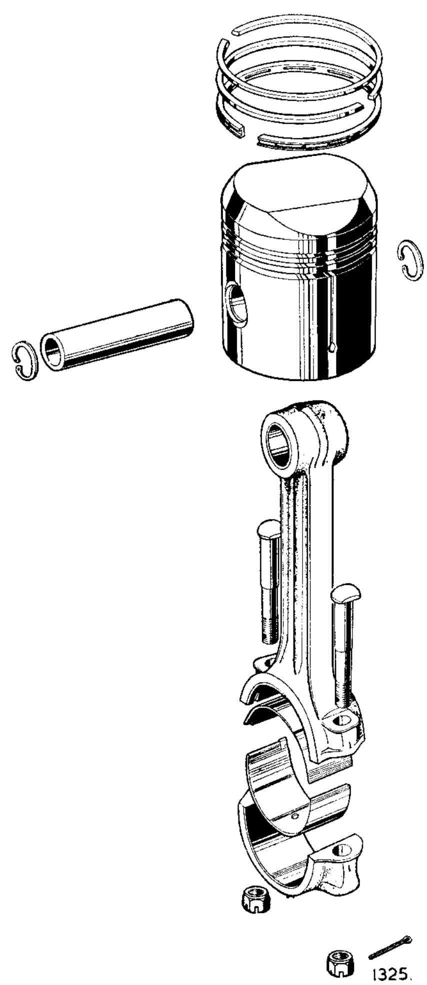


Fig. 34. Exploded view of piston and connecting rod.

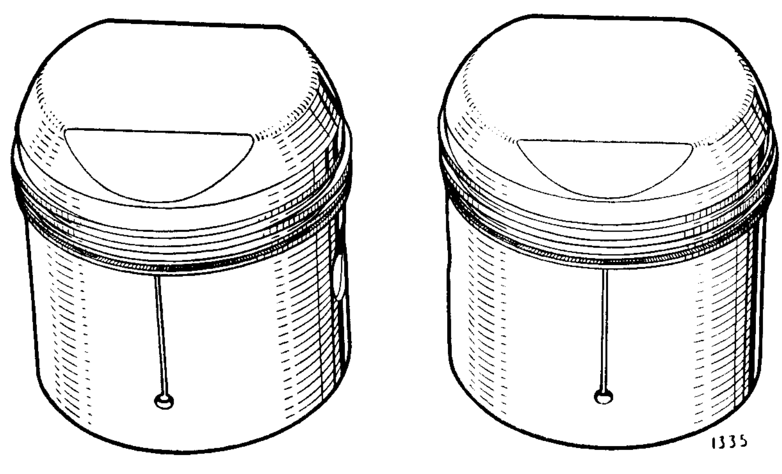


Fig. 35. 2.4 litre pistons.

Gudgeon Pin Fitting

Gudgeon pins are a double thumb push fit in the piston at normal room temperature 68°F (20°C).

When actually removing or refitting the gudgeon pin, the operation should be effected by immersing the piston, gudgeon pin and connecting rod little end in a bath of hot oil. When the piston and little end have reached a sufficient temperature (230°F, 110°C) the gudgeon pin can be moved into position. Always use new circlips on assembly.

When assembling the engine, centralise the small end of the connecting rod between the gudgeon pin bosses in the piston and ensure that the connecting rod mates up with the crankshaft journal without any pressure being exerted on the rod.

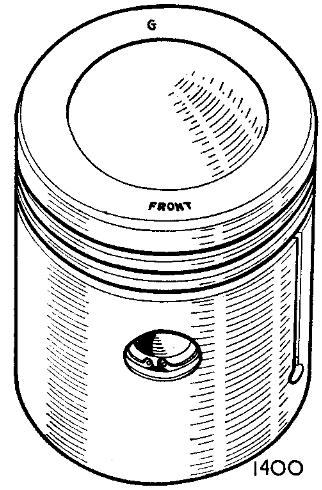


Fig. 36. Showing the markings on the piston crown.

Piston Grades

The following selective grades are available in standard size pistons only. When ordering standard size pistons the identification letter of the selective grade should be clearly stated. Pistons are stamped on the crown with the letter identification and the cylinder block is also stamped on the top face adjacent to the bores.

Grade Identification Letter	For cylinder bore size:
F	3.2673″ to 3.2676″ (82.989 to 82.997 mm.)
G	3.2677″ to 3.2680″ (82.999 to 83.007 mm.)
H	3.2681″ to 3.2684″ (83.009 to 83.017 mm.)
J	3.2685″ to 3.2688″ (83.020 to 83.027 mm.)
K	3.2689″ to 3.2692″ (83.030 to 83.037 mm.)

Oversize Pistons

Oversize pistons are available in the following sizes:-
+.010″(.25 mm.) +.020″(.51 mm.) +.030″(.76 mm.)

There are no selective grades in oversize pistons as grading is necessarily purely for factory production methods.

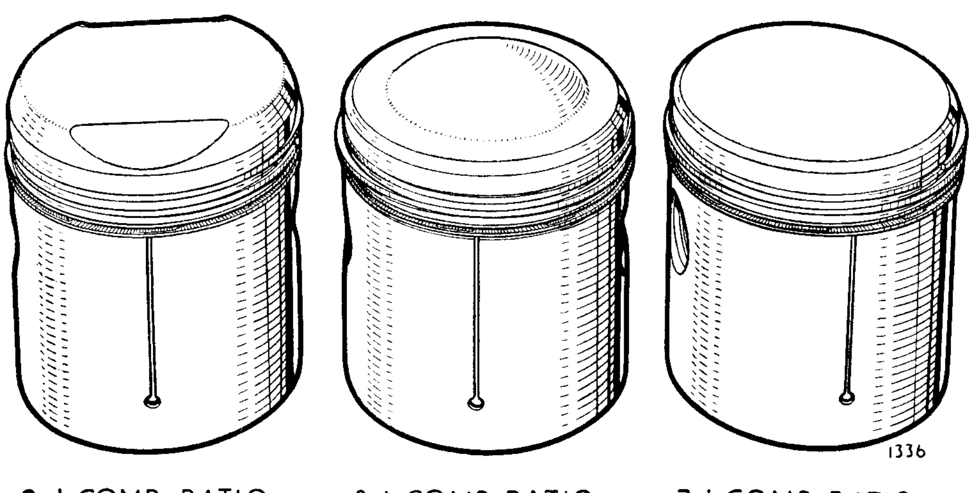


Fig. 37. 3.4 litre pistons.

Piston Rings

Check the piston ring gap with the ring as far down the cylinder bore as possible. Push the ring down the bore with a piston to ensure that it is square and measure the gap with a feeler gauge. The correct gaps are as follows :—

Compression rings .015″ to .020″ (.38 to .51 mm.)

Oil control rings .011″ to .016″ (.28 to .41 mm.)

With the rings fitted to the piston check the side clearance in the grooves which should be .001″ to .003″ (.025 to .076 mm.).

One of the compression rings is hard chrome plated and this ring must be fitted to the top groove in the piston.

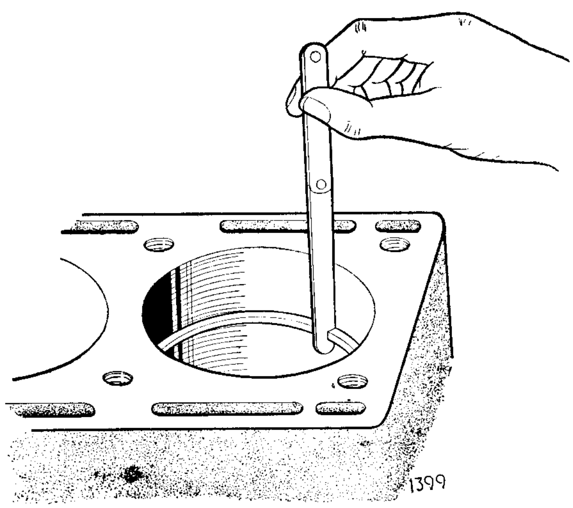


Fig. 38. Checking the piston ring gap.

Tapered Periphery Rings

The 3.4 litre model is fitted with tapered periphery compression rings which must be fitted the correct way up ; the oil control ring is not tapered and can be fitted either way up.

The narrowest part of the ring must be fitted uppermost ; to assist in identifying the narrowest face a letter ' T ' or ' Top ' is marked on the side of the ring to be fitted uppermost.

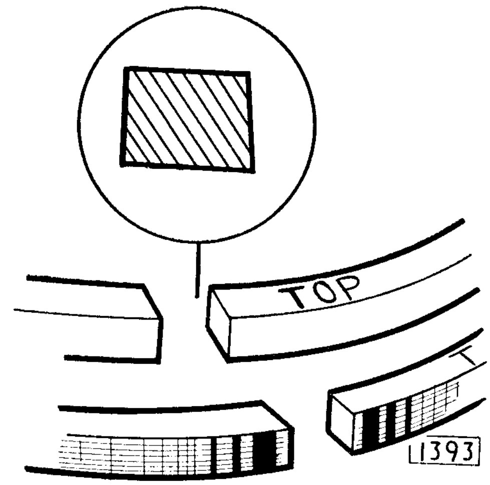


Fig. 39. Showing the identification marks on tapered periphery compression rings.

Refitting

Pistons and connecting rods must be fitted to their respective cylinders (piston and connecting rods are stamped with their cylinder number, No. 1 being at the rear) and the same way round in the bore.

The pistons must be fitted with split on the left-hand or exhaust side of the engine. To facilitate correct fitting the piston crowns are marked " Front ", see Fig. 36.

Use a piston ring clamp when entering the rings into the cylinder bore.

The cap must be fitted to the connecting rod so that the cylinder numbers stamped on each part are on the same side.

Tighten the connecting rod nuts to a torque of 37 lbs/ft. (5.1 kg/m.).

SPARKING PLUGS

SERVICE PROCEDURE

To maintain peak sparking plug performance, plugs should be inspected, cleaned and re-gapped at regular intervals of 2,500 miles. Under certain fuel and operating conditions, particularly extended slow speed town driving, sparking plugs may have to be serviced at shorter intervals.

Disconnect the ignition cables from all sparking plugs.

Loosen the sparking plugs about two turns anti-clockwise using the proper sized deep-socket wrench.

Blow away the dirt from around the base of each plug.

Remove the sparking plugs and place them in a suitable holder, preferably in the order they were in the engine.

ANALYSING SERVICE CONDITIONS

Examine the gaskets to see if the sparking plugs were properly installed. If the gaskets were excessively compressed, installed on dirty seats or distorted, leakage has probably occurred during service which would tend to cause overheating of the sparking plugs. Gaskets properly installed will have flat clean surfaces. Gaskets which are approximately one-half their original thickness will be satisfactory but thinner ones should be renewed.

Examine the firing ends of the sparking plugs, noting the type of the deposits and the degree of electrode erosion. The typical conditions illustrated may indicate the use of a sparking plug with an incorrect heat range or faulty engine and ignition system operation. Remember that if sufficient voltage is not delivered to the sparking plug, no type of plug can fire the mixture in the cylinder properly.

Normal Condition

Look for powdery deposits ranging from brown to greyish tan. Electrodes may be worn slightly. These are signs of a sparking plug of the correct heat range used under **normal** conditions, that is mixed periods of high speed and low speed driving. Cleaning and re-gapping of the sparking plugs is all that is required.

Normal Condition

Watch for white to yellowish powdery deposits. This usually indicates long periods of constant speed driving or a lot of slow speed city driving. These deposits have no effect on performance if the sparking plugs are cleaned **thoroughly** at approximately 2,500 miles intervals. Remember to " wobble " the plug during abrasive blasting in the Champion Service Unit. Then file the sparking surfaces vigorously to expose bright clean metal.

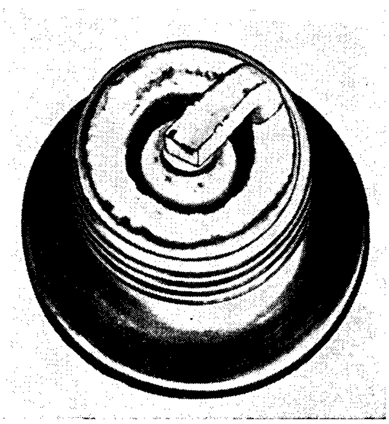


Fig. 40. Normal condition.

Oil Fouling

This is usually indicated by wet, sludgy deposits traceable to excessive oil entering the combustion chamber through worn cylinders, rings and pistons, excessive clearances between intake valve guides and stems, or worn and loose bearings, etc. Hotter sparking plugs may alleviate oil fouling temporarily, but in severe cases engine overhaul is called for.

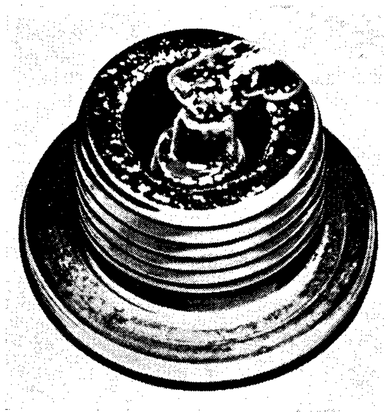


Fig. 41. Oil fouling.

Petrol Fouling

This is usually indicated by dry, fluffy black deposits which result from incomplete combustion. Too rich an air-fuel mixture, excessive use of the mixture

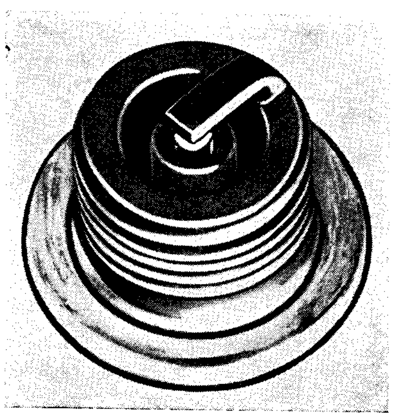


Fig. 42. Petrol fouling.

control or a faulty automatic choke can cause incomplete burning. In addition, a defective coil, contact-breaker points, or ignition cable, can reduce the voltage supplied to the sparking plug and cause misfiring. If fouling is evident in only a few cylinders, sticking valves may be the cause. Excessive idling, slow speeds, or stop-and-go driving, can also keep the plug temperatures so low that normal combustion deposits are not burned off. In the latter case, hotter plugs may be installed.

Burned or Overheated Condition

This condition is usually identified by a white, burned or blistered insulator nose and badly eroded electrodes. Inefficient engine cooling and improper ignition timing can cause general overheating. Severe service, such as sustained high speed and heavy loads, can also produce abnormally high temperatures in the combustion chamber which necessitate the use of colder sparking plugs.

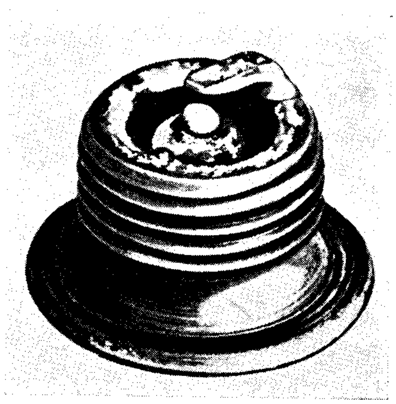


Fig. 43. Badly burned sparking plug.

File the sparking surfaces of the electrodes by means of a point file. If necessary, open the gaps slightly and file vigorously enough to obtain bright, clean, parallel surfaces. For best results, hold the plug in a vice.

Reset the gaps using the bending fixture of the Champion Gap Tool. Do not apply pressure on the centre electrode as insulator fractures may result. Use the bending fixture to obtain parallel sparking surfaces for maximum gap life.

Visually inspect all sparking plugs for cracked or chipped insulators. Discard all plugs with insulator fractures.

Test the sparking ability of a used sparking plug on a comparator.

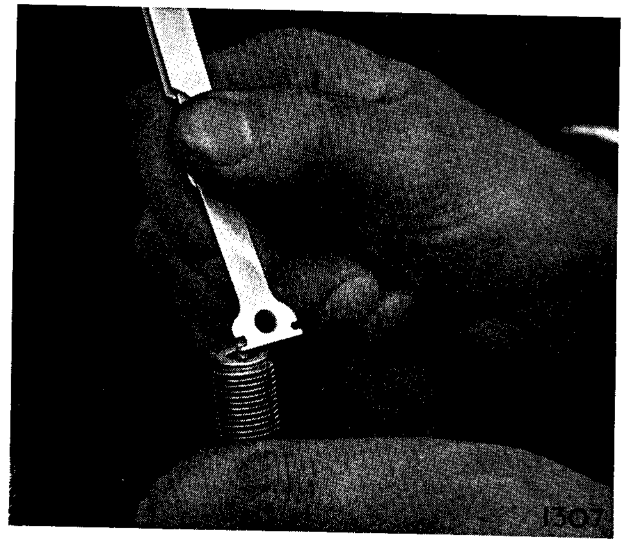


Fig. 44. Setting the gap with the special tool.

Clean the threads by means of wire hand or power-driven brush. If the latter type is used, wire size should not exceed .005″ diameter. Do not wire brush the insulator nor the electrodes.

Clean gasket seats on the cylinder head before installing sparking plugs to assure proper seating of the sparking plug gasket. Then, using a new gasket, screw in the plug by hand finger-tight.

Note : If the sparking plug cannot be seated on its gasket by hand, clean out cylinder head threads with a clean-out tap or with another used sparking plug having three or four vertical flutes filed in its threads.
Tighten the sparking plugs to a torque of 27 lbs./ft.

STANDARD GAP SETTING

The sparking plug gap settings recommended in this Service Manual have been found to give the best overall performance under all service conditions. They are based on extensive dynamometer testing and experience on the road, and are generally a compromise between the wide gaps necessary for best idling performance and the small gaps required for the best high speed performance.

All plugs should be reset to the specified gap by bending the side electrode only, using the special tool available from the Champion Sparking Plug Company.

TAPPETS, TAPPET GUIDES AND ADJUSTING PADS

The chilled cast iron tappets are of cylindrical form and run in guides made of austenitic iron which are shrunk into the cylinder head. A steel pad for adjustment of the valve clearance is sandwiched between the underside of the tappet and top of the valve stem. The pads are available in a range of thicknesses, rising in .001" (.025 mm.) steps, from .085" to .110" (2.16 to 2.79 mm.) and are etched on the surface with the letter ' A ' to ' Z ', each letter indicating an increase in size of .001" (.025 mm.).

REMOVAL OF TAPPETS AND ADJUSTING PADS

Remove the camshafts as described on page 33. The tappets can now be withdrawn with a suction valve grinding tool.

Remove the adjusting pads. If valve clearance adjustment is not being carried out the adjusting pads must be refitted to their original positions.

OVERHAUL

Examine the tappets and tappet guides for signs of wear. The diametrical clearance between the tappet and tappet guide should be .0008" to .0019" (.02 to .05 mm.).

Examine the adjusting pads for signs of indentation. Renew if necessary with the appropriate size when making valve clearance adjustment on re-assembly.

Tappet Guide Replacement

If it is found necessary to replace the tappet guides they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(1) Remove the old tappet guide by boring out until the guide collapses. Take care not to damage the bore for the guide in the cylinder head.

(2) Carefully measure the diameter of the tappet guide bore in the cylinder head at room temperature—68°F (20°C).

(3) Grind down the 1.643" (41.73 mm.) outside diameter of tappet guide to a diameter of .003" (.08 mm.) larger than the tappet guide bore dimension, that is to give an interference fit of .003" (.08 mm.).

(4) Also grind off the same amount from the " lead-in " at the bottom of tappet guide. The reduction in diameter from the adjacent diameter should be .0032" to .0057" (.08 to .14 mm.).

(5) Heat the cylinder head in an oven for half an hour from cold at a temperature of 300°F (150°C).

(6) Fit the tappet guide, ensuring that the lip at top of guide beds evenly in the recess.

(7) After fitting, ream tappet guide bore to a diameter of $1\frac{3}{8}'' \begin{smallmatrix} +.0007'' \\ -.0000'' \end{smallmatrix}$ $(34.925 \begin{smallmatrix} +.018 \text{ mm.}) \\ -.000 \text{ mm.}) \end{smallmatrix}$

Note : It is essential that, when reamed, the tappet guide bore is concentric with the bore of the valve guide.

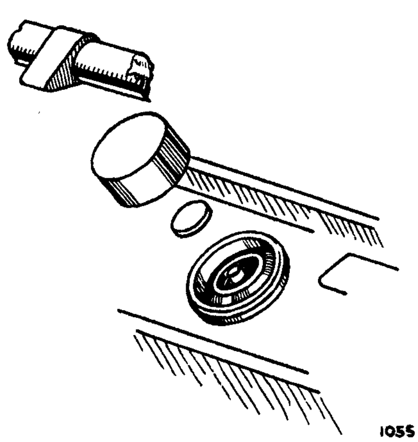


Fig. 45. Showing the tappet and adjusting pad.

THE TIMING GEAR

The camshafts are driven by Duplex endless roller chains in two stages.

The first stage or bottom timing chain drives the larger wheel of a double intermediate sprocket ; the second stage or top timing chain passes round the smaller wheel of the intermediate sprocket, both camshaft sprockets and is looped below an idler sprocket.

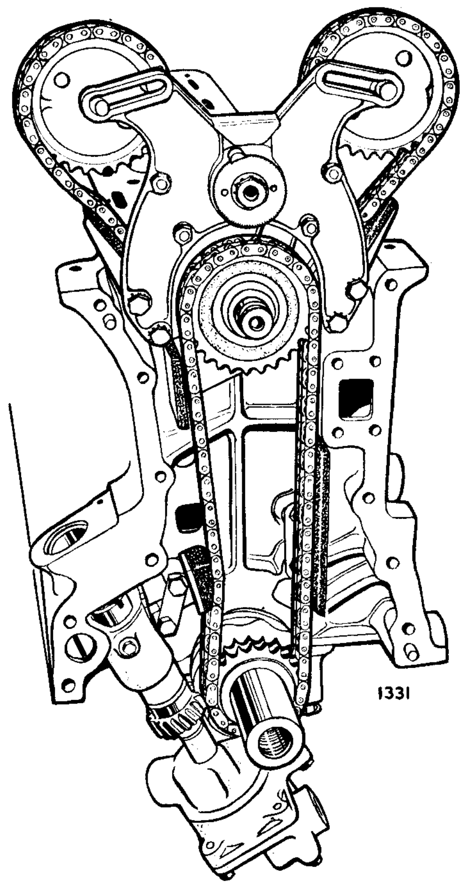


Fig. 46. Timing gear arrangement.

The idler sprocket has an eccentric shaft for top timing chain tension adjustment and the bottom chain is automatically tensioned by an hydraulic tensioner bolted to the cylinder block. Nylon or rubber vibration dampers are located at convenient points around the chains.

REMOVAL

Unscrew the four set bolts and remove the bonnet. Care should be taken to mark the original position of the bonnet to facilitate replacement.

Remove the battery, battery tray and drain tube. Remove the windscreen washer bottle from the wing valance.

Drain the water from the radiator and cylinder block.

Disconnect the top and bottom water hoses from the radiator.

Remove the two set bolts securing the sides of the radiator to the body.

Remove the two bottom radiator mounting nuts, washers and rubber mountings.

On the 3.4 litre model remove the nuts and washers securing the fan cowl and servo air cleaner to the radiator. Place the cowl over the fan and withdraw the radiator.

On early 2.4 litre models turn the four-bladed fan until the radiator and cowl can be withdrawn. On later models a twelve-bladed fan is fitted and a guard bolted to the top of the radiator. Remove the servo air cleaner secured to the fan guard on the right-hand side of the radiator. Unscrew the two nuts, serrated and plain washers securing the coil to the front of the cylinder head. Withdraw the radiator.

Remove the cylinder head as described on page 40.

Remove the front suspension as described in Section J.

Remove the damper as described on page 35.

Withdraw the split cone.

Remove the sump as described on page 52.

Unscrew the set bolts and nuts, and remove the water pump from the timing cover.

Note the gasket between the pump and the timing cover.

Remove the front cover as described on page 22.

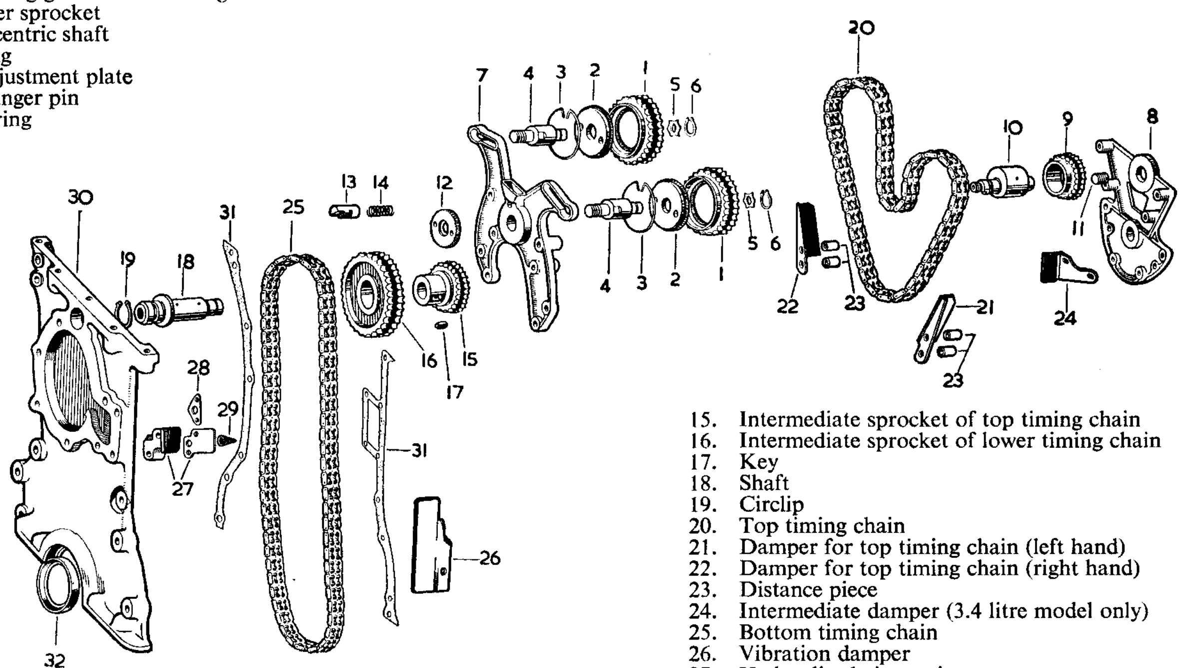
Remove the bottom timing chain tensioner as described on page 62.

Unscrew the four setscrews securing the front mounting bracket to the cylinder block.

Remove the two screwdriver slotted setscrews securing the rear mounting bracket ; on the 3.4 litre model these setscrews secure the intermediate damper bracket.

The timing gear assembly can now be removed.

1. Camshaft sprocket
2. Adjusting plate
3. Circlip
4. Guide pin
5. Star washer
6. Circlip
7. Timing gear front mounting bracket
8. Timing gear rear mounting bracket
9. Idler sprocket
10. Eccentric shaft
11. Plug
12. Adjustment plate
13. Plunger pin
14. Spring



15. Intermediate sprocket of top timing chain
16. Intermediate sprocket of lower timing chain
17. Key
18. Shaft
19. Circlip
20. Top timing chain
21. Damper for top timing chain (left hand)
22. Damper for top timing chain (right hand)
23. Distance piece
24. Intermediate damper (3.4 litre model only)
25. Bottom timing chain
26. Vibration damper
27. Hydraulic chain tensioner
28. Shim
29. Filter gauze
30. Front timing cover
31. Gasket
32. Oil seal

Fig. 47. Exploded view of the timing gear.

DISMANTLING

Remove the nut and serrated washer from the front end of the idler shaft, and withdraw the plunger and spring.

Remove the four nuts securing the front mounting bracket to the rear bracket. Withdraw the front bracket from the studs.

Remove the bottom timing chain from the large intermediate sprocket.

To remove the intermediate sprockets, remove the circlip from the end of the shaft in the mounting bracket. Press the shaft out of the bracket, and withdraw the sprockets from the shaft.

To separate the two intermediate sprockets, press the boss of the small sprocket from the bore of the large sprocket, noting that they are keyed together.

OVERHAUL

If the chains show signs of stretching or wear, new ones should be fitted. Replace any sprockets and dampers that show signs of wear.

ASSEMBLING

Fit the eccentric shaft to the hole in front mounting bracket. Insert the spring and locking plunger for the serrated plate to the hole in the front mounting bracket. Fit the serrated plate and secure with the shakeproof washer and nut. Fit the idler sprocket (21 teeth) to the eccentric shaft.

Fit the two intermediate sprockets (20 and 28 teeth) to their shaft with the larger sprocket forward and press the shaft through lower central hole in rear mounting bracket. Secure with the circlip at the rear of bracket.

Fit the top timing chain (longer chain) to the small intermediate sprocket and the bottom timing chain (shorter chain) to the large intermediate sprocket.

Loop the upper timing chain under the idler sprocket and offer up the front mounting bracket to the rear mounting bracket with the two chain dampers interposed between the brackets.

On the 3.4 litre model fit the intermediate damper to the bottom of the rear mounting bracket with two screwdriver slotted setscrews and shakeproof washer.

Pass the four securing bolts through the holes in the brackets, chain dampers and spacers noting that shakeproof washers are fitted under the bolt heads. Secure the two mounting brackets together with four stud nuts and shakeproof washers.

REFITTING

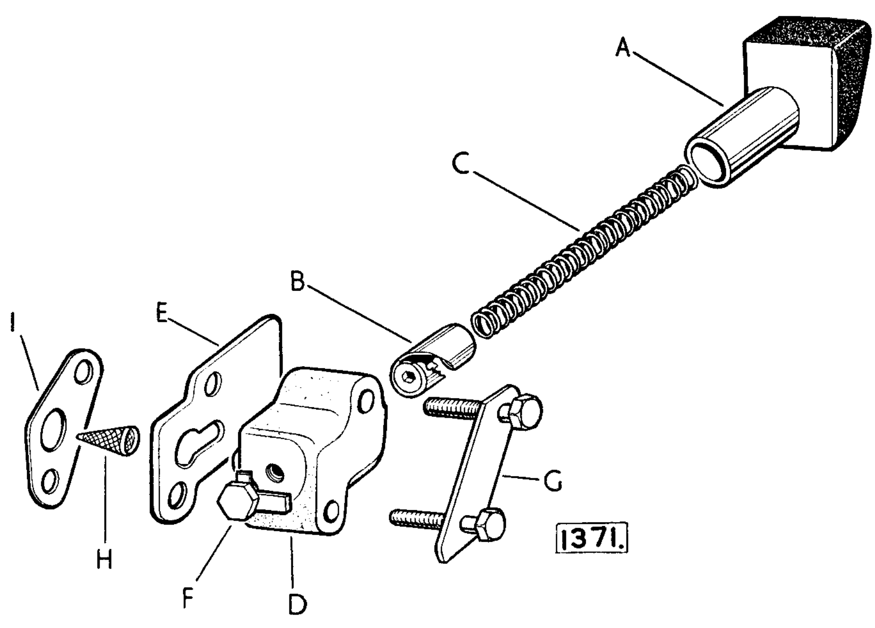
Refitting the remainder of the assembly is the reverse of the removal procedure.

When refitting the timing chain tensioner refer to page 62.

THE BOTTOM CHAIN TENSIONER

The bottom timing chain tensioner is of the hydraulic type and consists of an oil resistant rubber slipper mounted on a plunger (A, Fig. 48) which bears on the outside of the chain. The light spring (C) cased by the restraint cylinder (B) and the plunger, in combination with oil pressure holds the slipper head against the chain keeping it in correct tension.

Return movement of the slipper head is prevented by the limit peg at the bottom end of the plunger bore engaging the nearest tooth in the helical slot of the restraint cylinder. The oil is introduced into the adjuster body (D) via a small drilling in the locating spigot and passing through a hole in the slipper head lubricates the chain. The backing plate (E) provides a suitable face along which the slipper head can work.



A. Plunger
B. Restraint cylinder
C. Spring
D. Adjuster body
E. Backing plate
F. End plug and tab washer
G. Body securing bolts and tab washer
H. Gauze filter
I. Shim

Fig. 48. Exploded view of the bottom timing chain tensioner.

REMOVAL

Proceed as described under "Timing Gear—Removal" on page 59 until the chain tensioner is accessible.

Remove the bottom plug which provides access to the hexagonal hole in the end of the restraint cylinder. Insert an Allen key (.125"A/F) into this and turn the key in a *clockwise* direction until the slipper head remains in the retracted position. Remove the securing bolts and detach the adjuster. If a conical filter is fitted in the oil feed hole in the cylinder block this should be removed and cleaned in petrol.

REFITTING

Fit the conical filter to oil feed hole in the cylinder block. Early engines were not equipped with a filter but should have one fitted before the tensioner is re-assembled.

Fit shims, as necessary, between the backing plate and cylinder block so that the timing chain runs centrally along the rubber slipper.

Fit the tab washer and two securing bolts. Tighten the bolts and tap the tab washers against the bolt heads.

It is important that no attempt is made to release the locking mechanism until the adjuster has been finally mounted in the engine WITH THE TIMING CHAIN IN POSITION.

Remove the hexagon head plug and tab washer from the end of the body. Insert the Allen key into the hole until it registers in the end of the restraint cylinder. Turn the key clockwise until the tensioner head moves forward under spring pressure against the chain. Do not attempt to turn the key anti-clockwise, nor force the tensioner head into the chain by external pressure.

Refit the plug and secure with the tab washer.

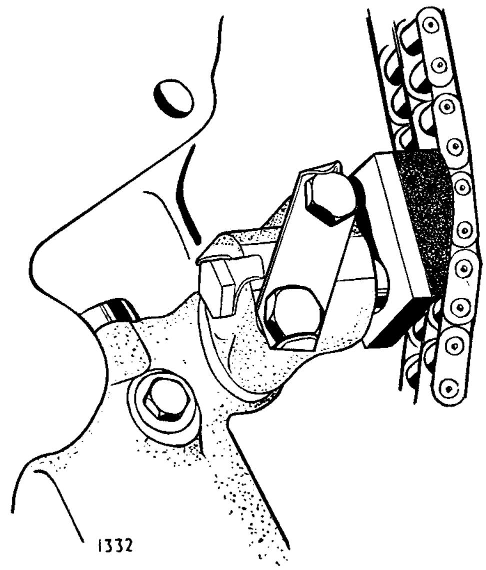


Fig. 49. Showing the bottom timing chain tensioner in position.

THE VALVES AND SPRINGS

The inlet valves are of silicon chrome steel and the exhaust valves are of austenitic steel. Double coil valve springs are fitted and are retained by a valve collar with split cotters.

Warning : As the valves in the fully open position protrude below the cylinder head joint face, the cylinder head must not be placed joint face downwards directly on a flat surface ; support the cylinder head on wooden blocks, one at each end.

REMOVAL

Remove the cylinder head as described on page 40.

Remove Valves

With the cylinder head on the bench remove the inlet manifold, and the revolution cable adaptor.

Remove the four bearing caps from each camshaft and lift out the camshafts (note mating marks on each bearing cap).

Remove the twelve tappets and adjusting pads situated between tappets and valve stems. Lay out the tappets and pads in order, to ensure that they can be replaced in their original guides.

Obtain a block of wood the approximate size of the combustion chambers and place this under the valve heads in No. 1 cylinder combustion chamber. Press down the valve collars and extract the split cotters. Remove the collars, valve springs and spring seats. Repeat for the remaining five cylinders. Valves are numbered and must be replaced in the original locations, No. 1 cylinder being at the rear, that is the flywheel end.

OVERHAUL

Valves

Examine the valves for pitting, burning or distortion and reface or renew the valves as necessary. Also reface the valve seats in the cylinder head and grind the valves to their seats using a suction valve tool. When refacing the valves or seat inserts do not remove more metal than is necessary to clean up the facings.

The valve seat angles are as follows :—

	Inlet	Exhaust
2.4 litre	30°	45°
3.4 litre	45°	45°

Renew valves where the stem wear exceeds .003″ (.08 mm.). The clearance of the valve stem in the guide when new is .001″ to .004″ (.025 to .10 mm.).

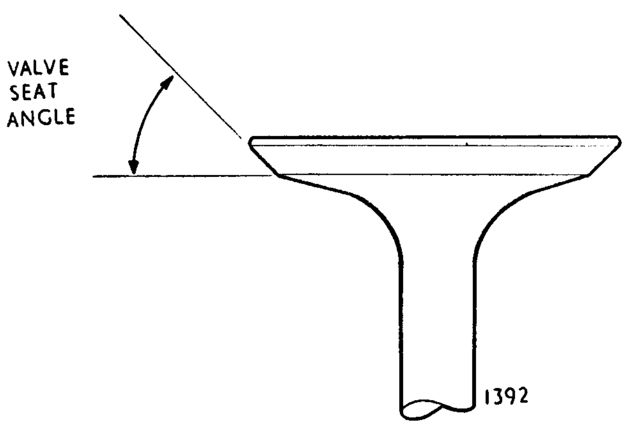


Fig. 50. Valve seat angle.

Valve Springs

Test the valve springs for pressure, either by comparison with the figures given in the " Valve Spring Data " or by comparison with a new valve spring.

To test against a new valve spring, insert both valve springs end to end between the jaws of a vice or under a press with a flat metal plate interposed between the two springs. Apply a load to partly compress the springs and measure their comparative lengths.

VALVE CLEARANCE ADJUSTMENT

When checking the valve clearances, the camshafts must be fitted one at a time as if one camshaft is rotated when the other camshaft is in position, fouling is likely to take place between the inlet and exhaust valves. Obtain and record all valve clearances by using a feeler gauge between the back of each cam and the appropriate valve tappet.

Correct valve clearances are :—

Inlet	.004″ (.10 mm.)
Exhaust	.006″ (.15 mm.)

Adjusting pads are available rising in .001″ (.03 mm.) sizes from .085″ to .110″ (2.16 to 2.79 mm.) and are etched on the surface with the letter ' A ' to ' Z ', each letter indicating an increase in size of .001″ (.03 mm.). Should any valve clearance require correction, remove the camshaft, tappet and adjusting pad. Observe the letter etched on the existing adjusting pad and should the recorded clearance for this valve have shown say .002″ (.05 mm.) excessive clearance select a new adjusting pad bearing a letter two lower than the original pad.

As an example, assume that No. 1 inlet valve clearance is tested and recorded as .007″ (.18 mm.). On removal of the adjusting pad, if this is etched with the letter ' D ' then substitution with a pad bearing the letter ' G ' will correct the clearance for No. 1 inlet valve.

When fitting the camshafts prior to fitting the cylinder head to the engine it is most important that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face before tightening down the camshaft bearing cap nuts.

Tighten the camshaft bearing cap nuts to a torque of 15 lbs/ft. (2.0 kg/m.).

REFITTING

Before attempting to refit the cylinder head refer to the instructions given on page 41.

THE VALVE GUIDES

The valve guides are of cast iron and are chamfered at the upper ends. The outside diameter of the guide is reduced at the upper end to provide a " lead-in " when fitting the guide to the cylinder head. The inlet and exhaust guides are of different lengths the inlet being the shorter of the two.

REPLACEMENT

Examine the valve guides for evidence of wear in the bore. The clearance between the valve stem and the guide when new is .001″ to .004″ (.025 to .10 mm.).

If it is found necessary to replace worn valve guides they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(1) Press out, or drive out with a piloted drift, the old valve guide from the top of the cylinder head.

(2) Ream the valve guide bore in the cylinder head to a diameter of

$$.505'' \begin{matrix} +.0005'' \\ -.0002'' \end{matrix} \quad (12.83 \text{ mm.} \begin{matrix} +.012 \text{ mm.}) \\ -.005 \text{ mm.}) \end{matrix}$$

(3) Heat the cylinder head by immersing in boiling water for 30 minutes.

(4) Coat the valve guide with graphite grease and press in, or drive in with a piloted drift, from the combustion chamber end. The correct fitted position for both inlet and exhaust guides is with the top of the guide (chamfered end) $\frac{5}{16}''$ (8 mm.) above the spot facing for the valve spring seat. (See Fig. 51).

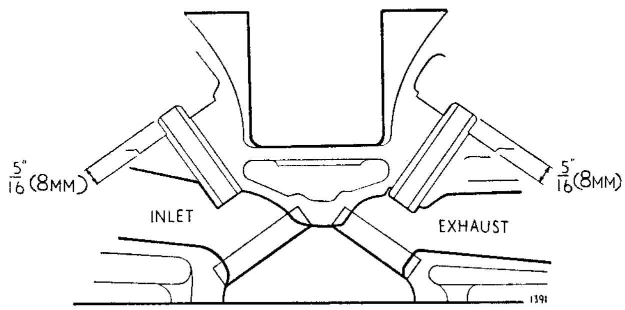


Fig. 51. Showing the fitted position of the valve guides.

THE VALVE SEAT INSERTS

The valve seat inserts are centrifugally cast iron and are shrunk into the cylinder head.

REPLACEMENT

If it is found necessary to replace the valve seat inserts they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(1) Remove the old valve seat insert by boring out until the insert collapses. Take care not to damage the recess for insert in the cylinder head.

(2) Carefully measure diameter of insert recess in cylinder head at room temperature 68°F. (20°C).

(3) Grind down outside of insert to a diameter of .003″ (.08 mm.) larger than recess dimension, that is, to give an interference fit of .003″ (.08 mm.)

(4) Heat the cylinder head in an oven for one hour from cold at a temperature of 300°F. (150°C).

(5) Fit insert, ensuring that it beds evenly in its recess.

(6) After the valve seat insert has been fitted the following instructions should be carried out to ensure that the valve clearance can be obtained within the range of the adjusting pads, that is, .085″ to .110″ (2.16 to 2.79 mm.).

(a) Assemble the camshafts to the cylinder head. Fit the appropriate valve to the insert in question and, with the valve seat faces touching, check the distance between the top of valve stem and the **back** of the cam. This should be .320″ (8.13 mm.) **plus** the appropriate valve clearance. (The figure of .320″ (8.13 mm.) includes an allowance for an adjusting pad thickness of .095″ (2.41 mm.) to .097″ (2.46 mm.) which will, if necessary, permit the fitting of thicker or thinner adjusting pads when making the final valve clearance adjustment.)

(b) If the distance is greater than the figure of .320″ (8.13 mm.), plus the appropriate valve clearance, grind the valve seat of the insert with suitable valve grinding equipment until the correct distance is obtained.

Example : Assume that the valve insert in question is an exhaust and the distance between the top of the valve stem and the back of the cam is found to be .344″ (8.74 mm.).

Adding the exhaust valve clearance of .006″ (.15 mm.) to .320″ (8.13 mm.) equals .326″ (8.28 mm.). In this case the valve seat of the insert will have to be ground down to reduce the distance between the top of valve stem and the back of the cam by .018″ (.46 mm.) that is, .344″ minus .326″ (8.74 minus 8.28 mm.).

(c) After assembling the cylinder head, check and adjust the valve clearances in the normal manner.

VALVE TIMING

Turn the engine so that No. 6 (front) piston is exactly in the T.D.C. position on compression stroke (firing position) that is, with the distributor rotor arm opposite No. 6 cylinder segment.

It is important to tension the top timing chain before attempting to check or set the valve timing. Proceed as follows :—

Through the breather aperture in the front of the cylinder head slacken the locknut securing the serrated plate (Fig. 52).

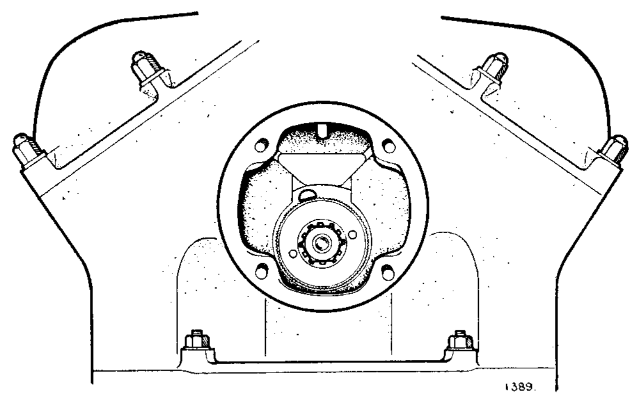


Fig. 52. Showing the serrated plate for adjustment of the top timing chain tension.

Tension the chain by pressing locking plunger inwards and rotating serrated plate by the two holes in an anti-clockwise direction. Turn the engine each way slightly and recheck the chain tension. When correctly tensioned there should be slight flexibility on both outer sides below the camshaft sprockets, that is, the chain must not be dead tight. Release the locking plunger and securely tighten the locknut.

Remove the locking wire from the setscrews securing the camshaft sprockets. Note the positions of the **inaccessible** setscrews and rotate the engine until they can be removed. Remove the setscrew from each sprocket and turn the engine back to the T.D.C. position with No. 6 firing and remove the remaining screws. Tap the camshaft sprockets off the flanges of the camshafts.

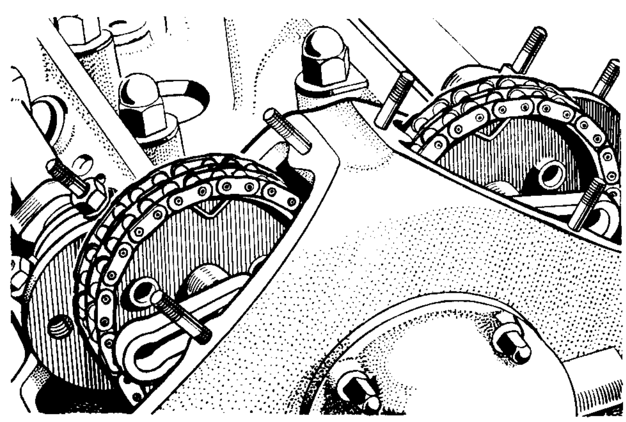


Fig. 53 Showing the camshaft sprockets disconnected from the camshafts.

Accurately position the camshafts with the valve timing gauge, and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and press the adjusting plates forward until the serrations disengage. Replace the sprockets on the flanges of camshafts and align the two holes in the adjuster plate with the two tapped

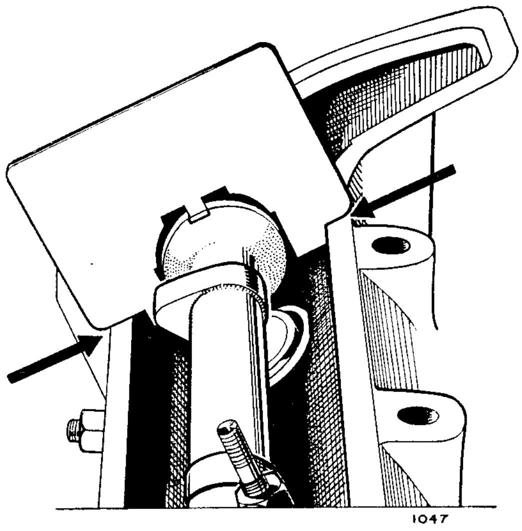


Fig. 54. The valve timing gauge in position. Ensure that the gauge is seated at the points indicated by the arrows.

holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note : It is most important that the holes are in exact alignment, otherwise when the setscrews are fitted, the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly the adjuster plates should be turned through 180°, which due to the construction of the plate will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible holes in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and valve timing in this order. Secure the four setscrews for camshaft sprockets with new locking wire.

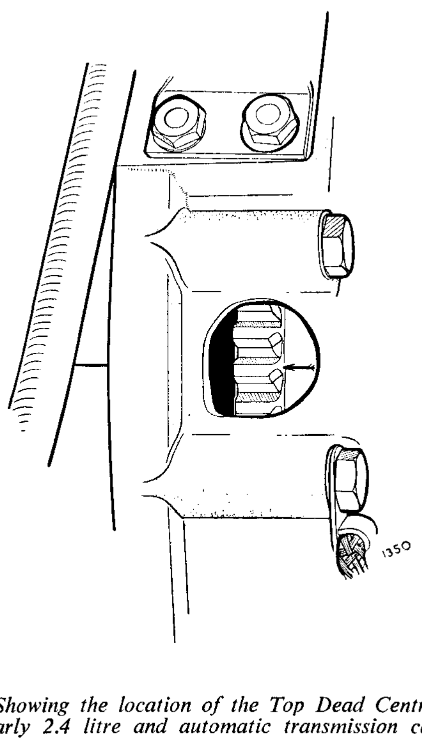


Fig. 55. Showing the location of the Top Dead Centre marks on early 2.4 litre and automatic transmission cars.

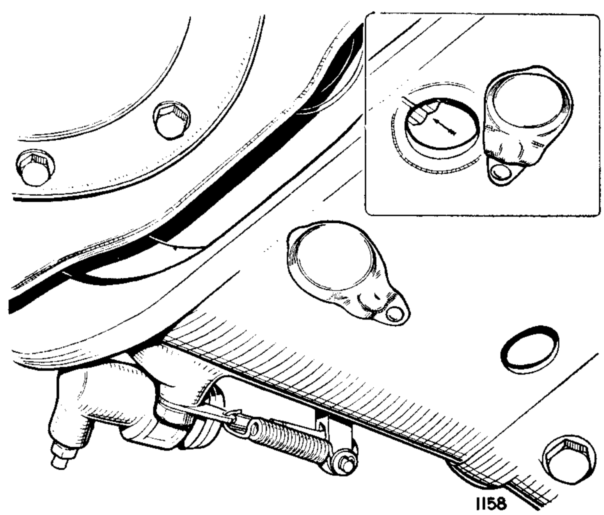


Fig. 56. Showing the location of the Top Dead Centre marks on later cars.

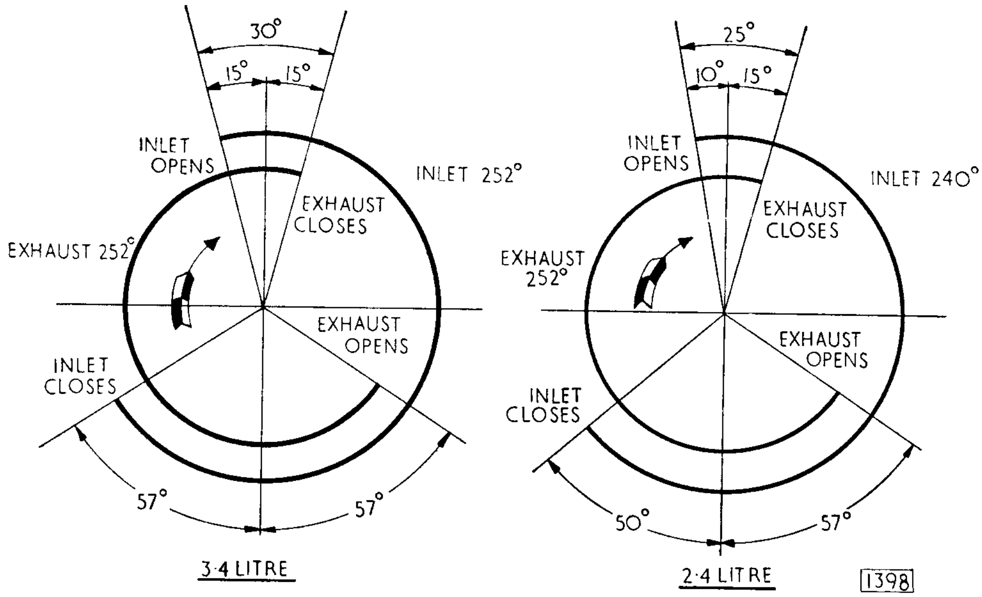


Fig. 57. Valve timing diagram.

ENGINE MOUNTINGS

The engine is supported at the front on two rubber mountings which are attached to brackets on the body underframe.

On standard transmission and overdrive cars the rear of the power unit is supported on a coil spring, mounted in a channel support which is bolted to the body floor. An extension of the spring retainer passes through a rubber bush in the channel support.

On automatic transmission cars the rear of the power unit is supported on two rubber mountings fitted between the rear extension case and a mounting bracket bolted to the body floor.

FRONT ENGINE MOUNTINGS

Removal

Either place a sling round the front of the engine or attach a lifting plate to the cylinder head. Unscrew the large set bolt, spring washer and plain washer securing the front engine mounting bracket to the mounting rubber. Repeat for the other side.

Raise the engine so that the front mounting brackets are just clear of the mounting rubbers.

Remove the two nuts, washers and bolts securing the front engine mounting rubber to the support bracket to the body underframe. Repeat for the other side.

Refitting

Refitting is the reverse of the removal procedure.

REAR ENGINE MOUNTING

(Standard Transmission and Overdrive Models)

The rear mounting coil springs fitted to standard transmission and overdrive models are of different lengths and must be fitted to their respective models ; the free lengths are as follows :

	Standard transmission models	Overdrive models
Free length	$3\frac{5}{32}''$ (80 mm.)	$3\frac{17}{32}''$ (90 mm.)

Removal

Place a jack under the gearbox to take the weight of the engine.

Place a large washer over the stem of the spring retainer protruding through the bottom of the channel support. Secure the large washer by inserting an $\frac{1}{8}''$ (3 mm.) diameter rod through the hole in the stem of the spring retainer.

Unscrew the eight bolts securing the channel support to the body. Remove the bolts, washers, stiffening plates and packing blocks. Remove the two bolts, nuts and washers securing the rear engine mounting plate to the gearbox.

Dismantling

Turn the assembly upside down and place on a press.

Compress the spring and remove the rod from the hole in the stem of the spring retainer.

Slowly release the pressure on the spring and remove the large washer.

Withdraw the spring retainer, spring, rubber spring seat and centre bush from the support channel bracket.

Re-assembling

When re-assembling the unit it is important that the correct type of spring is fitted in relation to the type of transmission.

Press the centre bush into the hole in the bottom of the channel support.

Apply adhesive to the recess in the channel support and press the rubber spring seat into position.

Place the spring in the rubber spring seat.

Place the spring retainer into position so that the stem protrudes through the centre of the spring and the washers welded to the two large lugs on the spring retainer are facing the side of the channel support which has an extra cut-away portion in the flange.

Compress the spring until the stem of the spring retainer protrudes far enough through the bottom of the channel support to allow a large washer to be placed over the stem and an $\frac{1}{8}''$ (3 mm.) rod to be inserted through the hole in the stem.

Refitting

Offer up the rear engine mounting assembly to the rear of the two lugs on the gearbox casing. There is an extra cut-away in one of the channel support flanges and this should be facing towards the front of the car.

Secure the spring retainer to the gearbox with two bolts, nuts and washers.

Jack up the gearbox until the channel support bracket holes line up with the holes in the body.

Insert the packing blocks between the body floor and the channel support bracket and secure with the four stiffening plates, eight set bolts and washers.

Remove the rod and the washer from the stem of the retainer.

Release the jack.

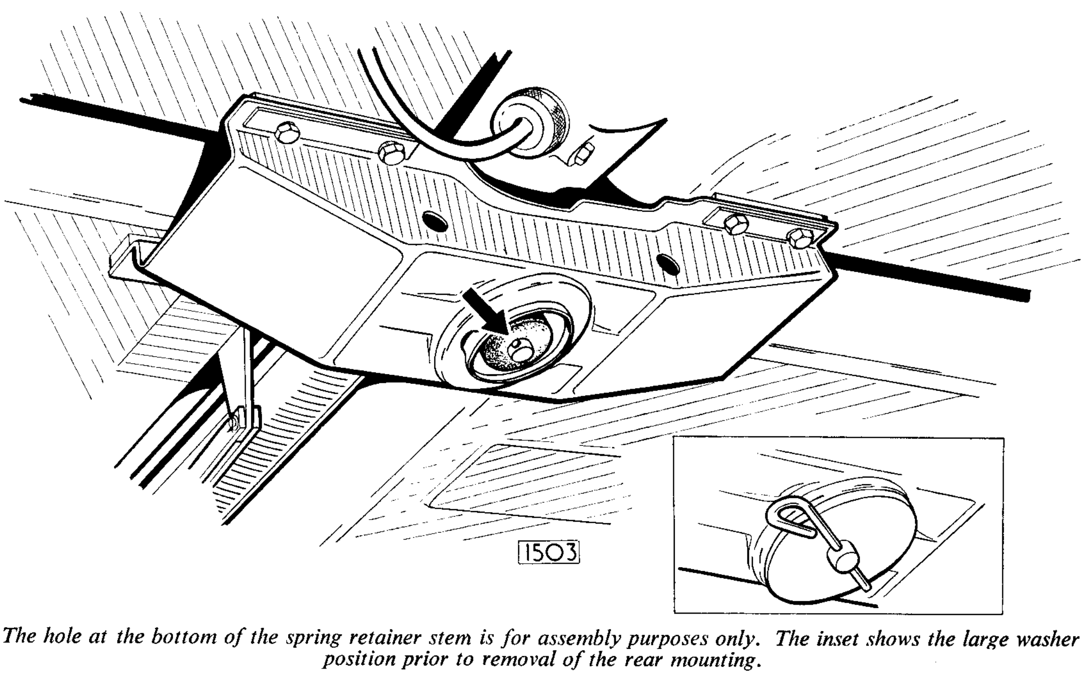


Fig. 58. The hole at the bottom of the spring retainer stem is for assembly purposes only. The inset shows the large washer and rod in position prior to removal of the rear mounting.

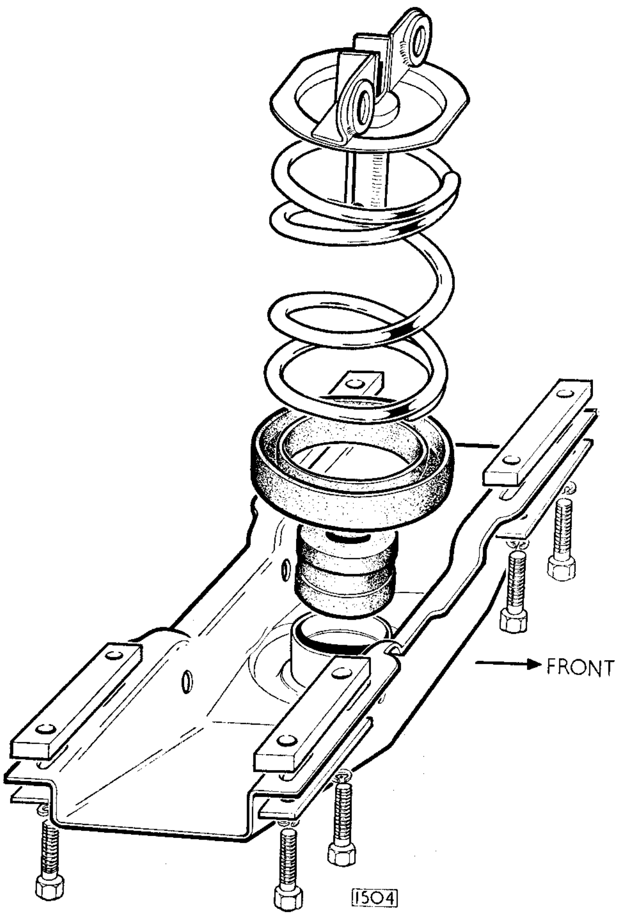


Fig. 59. Exploded view of the rear mounting assembly (standard transmission and overdrive models).

REAR ENGINE MOUNTING (Automatic Transmission Models)

Removal

Unscrew the six set bolts securing the ventilated cover plate to the bottom of the torque converter housing and remove cover plate. Place a piece of wood under the torque converter housing, taking care that it does not foul the torque converter.

Jack up under the piece of wood until the jack takes the weight of the engine.

Unscrew the self locking nut A Fig. 60 on the engine stabilizer and remove the upper flanged washer B.

Mark the positions of the rear engine mounting bracket relative to the body floor so that the bracket can be refitted in its original position.

Remove the six bolts and packing washers from the rear engine support bracket, care being taken to note the number and positions of the various packing washers fitted between the bracket and the body floor.

Remove the two nuts and shakeproof washers attaching the rear engine support bracket to the two mounting rubbers.

Lower the jack slightly to facilitate the removal of the nuts and shakeproof washers securing the two mounting rubbers to the bracket attached to the transmission unit.

Refitting

After refitting the rubbers and rear mounting plate adjust the engine stabilizer as follows :

1. Screw the lower flanged washer up the stabilizer pin until the flange contacts the bottom of the stabilizer mounting. The washer is slotted on its upper face and can be screwed up the pin by engaging a thin bladed screwdriver in the slot through the centre hole of the rubber mounting.
2. Fit the upper flanged washer and tighten down with the self-locking nut.

Failure to observe the above procedure may cause engine vibration and/or fouling of the transmission unit in its cowl due to the engine being pulled up on its mounting.

THE ENGINE STABILIZER

The engine stabilizer is situated at the rear of the engine and consists of a rubber/steel mounting attached to the body which is connected to brackets on the clutch housing via a rubber bushed link pin. The link pin is threaded at its upper end and is connected to the rubber mounting by means of flanged washers and a self-locking nut.

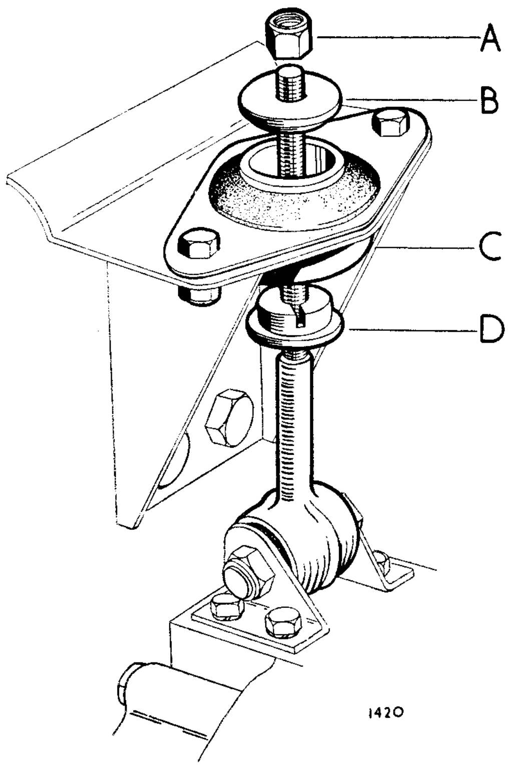


Fig. 60. The engine stabilizer.

ADJUSTMENT

It is MOST IMPORTANT that the stabilizer is assembled in the following manner as failure to observe this procedure may cause engine vibration and/or fouling of the gearbox in its cowl due to the engine having been pulled up on its mountings.

1. Screw the lower flanged washer (D, Fig. 60) up the stabilizer pin until the flange contacts the bottom of the stabilizer rubber mounting (C). The washer is slotted on its upper face and can be screwed up the pin by engaging a thin bladed screwdriver in the slot through the centre hole of the rubber mounting.
2. Fit the upper flanged washer (B) and tighten down with the self-locking nut (A).

AIR CLEANERS

2.4 litre Model

Early 2.4 litre cars are fitted with a wire-mesh type of air cleaner mounted across the cylinder head (see Fig. 63). Air is ducted to the cleaner through a large diameter hose connected to the grille in the left-hand front wing.

Later cars are equipped with an oil-bath type air cleaner mounted on top of the cylinder head (see Fig. 61).

Servicing instructions for both types of air cleaner are given in " Routine Maintenance " on page 15.

3.4 litre Model

Early 3.4 litre cars are equipped with a wire-mesh type air cleaner mounted across the cylinder head (see Fig. 64). Air is ducted to the cleaner through a large diameter hose connected to the grille in the left-hand front wing.

Later cars are fitted with an oil-bath type of air cleaner located underneath the left-hand wing. Air is ducted from the cleaner to the carburetters through a large diameter hose and an air silencer mounted across the cylinder head.

Servicing instructions for both types of air cleaner are given in " Routine Maintenance " on page 15.

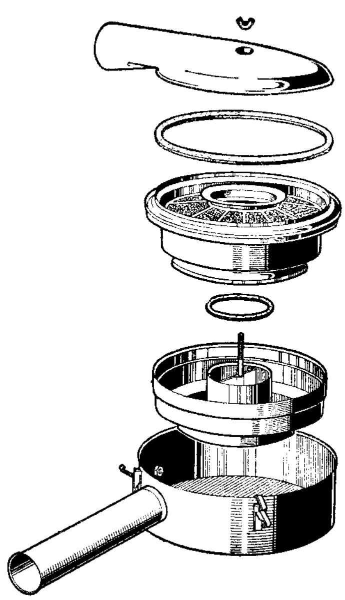


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Fig. 61. Oil bath air cleaner (2.4 litre model).

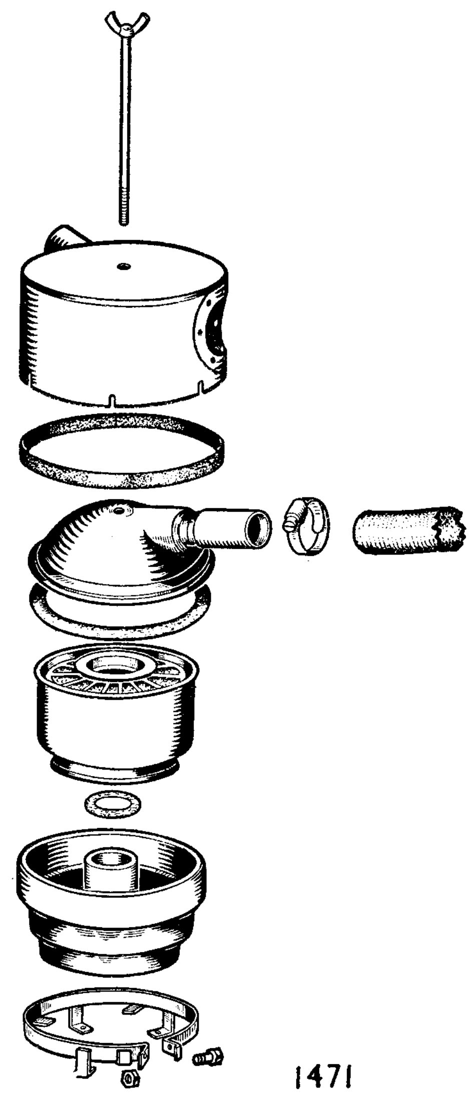

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Fig. 62. Oil bath air cleaner (3.4 litre model).

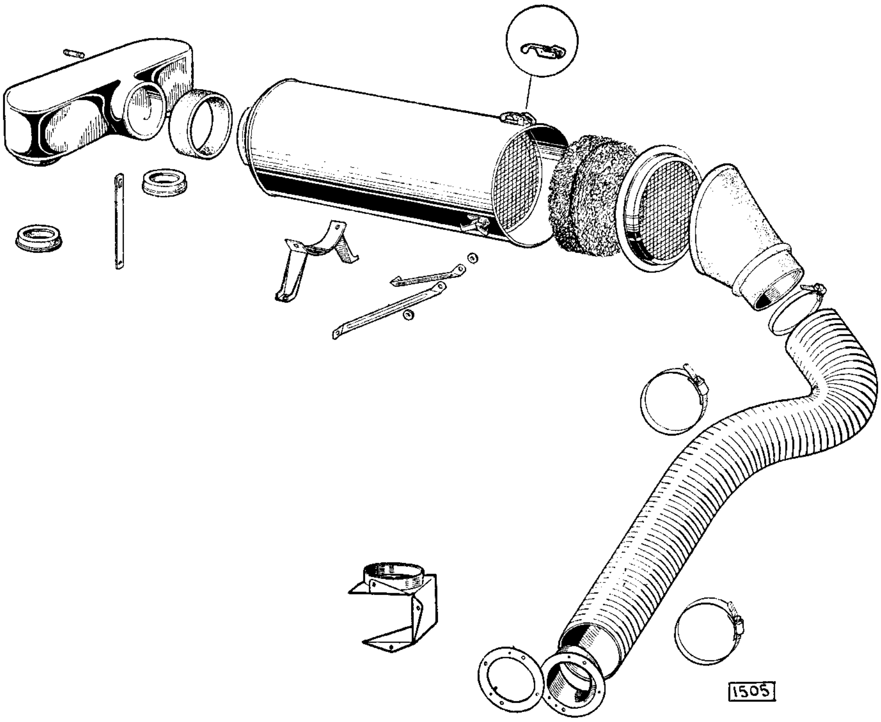

Fig. 63. Wire mesh type air cleaner (2.4 litre model).

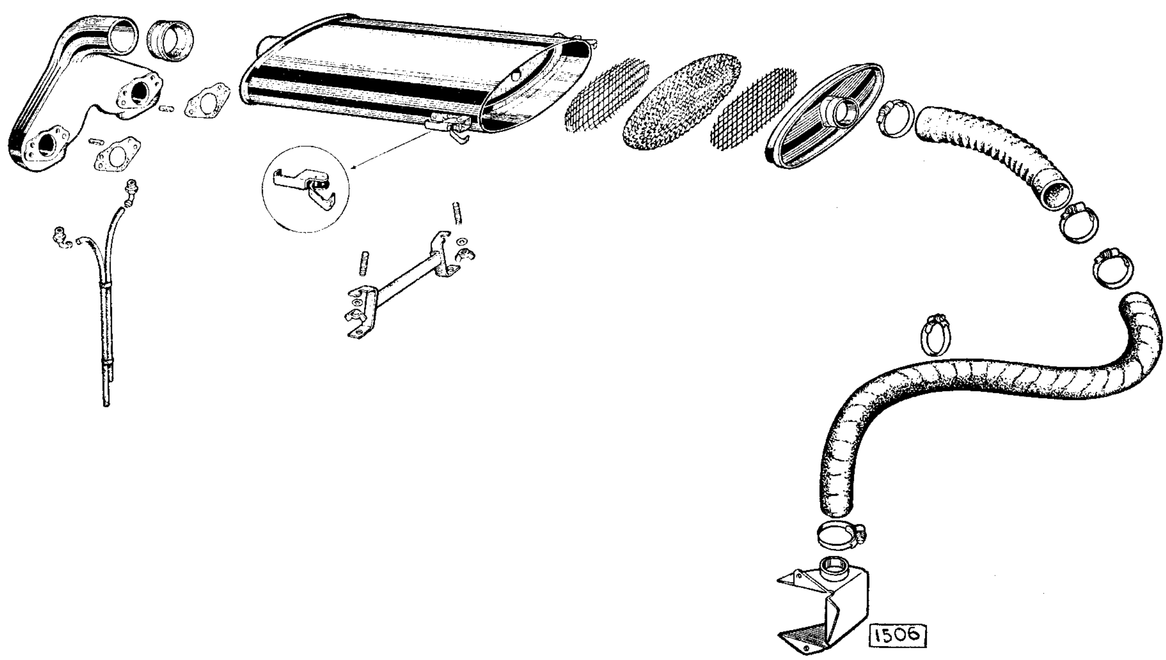

Fig. 64. Wire mesh type air cleaner (3.4 litre model).

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SECTION C

CARBURETTERS AND FUEL SYSTEM

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

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INDEX

CARBURETTERS
(2·4 litre)

INDEX *(continued)*

CARBURETTERS
(3·4 litre)

THE FUEL SYSTEM

CARBURETTERS AND FUEL SYSTEM

The 2.4 litre model is equipped with twin Solex B.32 PBI-5 type carburetters ; the 3.4 litre model is equipped with twin S.U. H.D.6 type carburetters. Each type of carburetter is dealt with separately in the following section.

An identical fuel system is fitted to both models except that later 2.4 litre cars are fitted with a glass bowl type filter in the fuel feed line.

CARBURETTERS
(2·4 litre)

DESCRIPTION

The 2.4 litre model is fitted with twin Solex B.32 PBI-5 type carburetters. This type of carburetter is fully dust-proofed and has a progressive starting device with fast idle ; it also incorporates an anti-percolation device and accelerator pump.

Dust-proofing

The carburetters are fully dust-proof, all air to the engine (ventilating the float chambers, starting, slow-running and main spraying circuits) is drawn through the air cleaner. This ensures maintenance of a balanced mixture and complete filtration of all inducted air, even if the air cleaner gradually becomes clogged in service.

The Starting Device

The starting device, operated by the facia control, ensures immediate starting from cold and quick drive-away.

The control in the full rich position supplies a very rich mixture, to enable starting at low temperatures.

After starting, the mixture control should be placed in the intermediate position (half-way). This supplies a weaker mixture of greater volume, and enables the car to be driven away immediately. This position can also be used when the engine is not stone cold.

During the warming up period of the engine the control should be moved gradually towards the off position, thus progressively reducing richness until the starting device is out of action.

Idling

For idling, the mixture is supplied to the engine past the butterfly and from the pilot jet and the pilot jet air bleed. Engine speed can be varied by the slow-running adjustment screw which opens or closes the throttle as required, whilst adjustment of the volume control screw varies the mixture strength and volume from the pilot jet and the pilot air bleed.

Main Circuit

For normal running, petrol is supplied from the float chamber through the main jet ; it is mixed in the main well with air metered through the air correction jet, and carried into the well via the emulsion tube. The mixture is then discharged from the main spraying well into the air stream passing through the choke tube.

Accelerating and Economy Pump

The pump unit attached to the float chamber is operated by inter-connected throttle linkage. The main components are a membrane and spindle, a return spring, an inlet valve and a spring controlled outlet valve. When the accelerator is released, the membrane is pushed back by the spring, thereby drawing in petrol via the inlet valve. When the accelerator is depressed, the membrane is pushed forward, and this causes the petrol in the pump to close the inlet valve, and calibrated through the pump jet, to be discharged into the main air stream via the injector tube.

The pump has the additional function of supplementing the output of the main jet for full power, the size of the latter being chosen for most economical cruising. For, when the throttle is held fully open the pump lever holds the membrane forward, which in turn keeps the outlet valve open, thus creating an open circuit through which petrol is drawn by engine depression via the injector tube. Easing the accelerator to return to cruising speed closes the outlet valve and stops the supplementary supply.

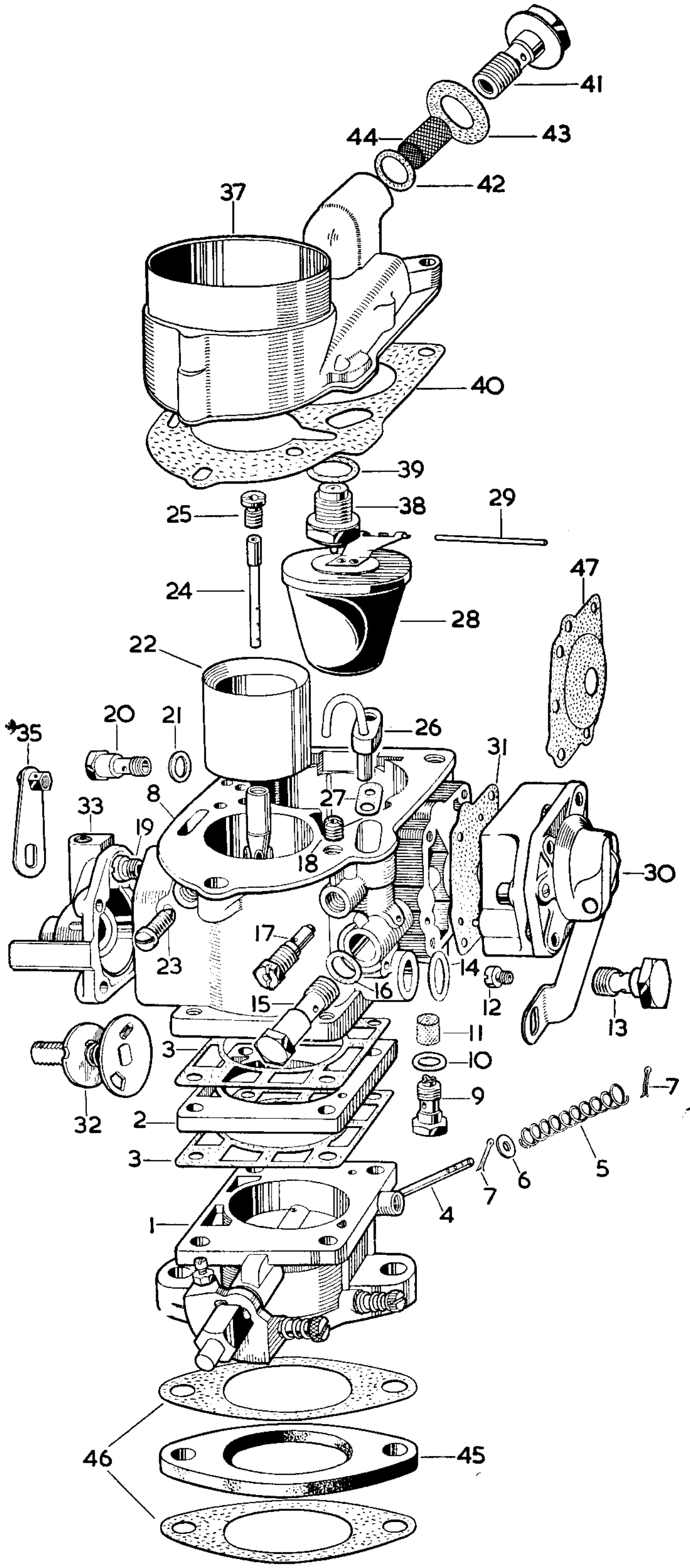
DATA

Type	Solex B.32 PBI-5 (twin)	
Choke and Jet Sizes	7 to 1 comp. ratio	8 to 1 comp. ratio.
Choke	23 mm.	24 mm.
Main jet	110	110
Air correction jet	200	180
Emulsion tube	14	14
Pump jet	55	55
Pilot jet	50	50
Pilot air bleed	1.2 mm.	1.2 mm.
Needle valve	1.5 mm.	1.5 mm.
Needle valve washer	1 mm.	1 mm.
Starter petrol jet	GS.105	GS.105
Starter air jet	GA.4.5	GA.4.5

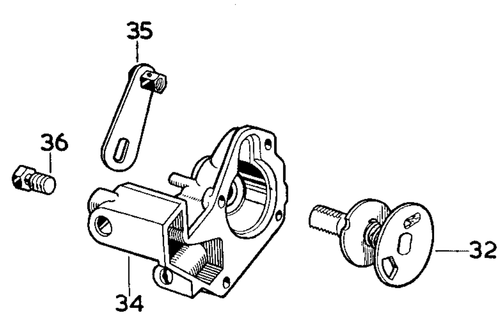
Note : Earlier carburetters may be fitted with different jets and choke tubes to those listed above. These earlier carburetters can be brought up to the latest settings if desired but a type 72 accelerator pump (Part number 6646) must also be fitted.

Adjustments Required for Altitude

If the car is operated between 5,000 and 10,000 ft., it is recommended that the main jets are reduced by one size, that is, from 110 to 105. Above 10,000 ft. reduce the main jets to 100.



1. Throttle chamber.
2. Nylon insulating washer.
3. Gasket.
4. Control rod.
5. Spring.
6. Washer.
7. Split pin.
8. Float chamber
9. Non-return valve.
10. Washer.
11. Filter.
12. Main jet.
13. Bolt.
14. Washer.
15. Pump jet.
16. Washer.
17. Pilot jet.
18. Air bleed.
19. Starter air jet.
20. Starter petrol jet.
21. Washer.
22. Choke tube.
23. Screw.
24. Emulsion tube.
25. Air correction jet.
26. Accelerator pump injector.
27. Gasket.
28. Float.
29. Float spindle.
30. Accelerator pump.
31. Gasket.
32. Starter valve.
33. Starter valve body (front carburetter).
34. Starter valve body (rear carburetter).
35. Starter valve lever.
36. Bolt.
37. Float chamber cover.



38. Needle valve.
39. Washer.
40. Gasket.
41. Banjo bolt.
42. Washer—small.
43. Washer—large.
44. Filter.
45. Insulating washer.
46. Gasket.

Fig. 1. Exploded view of the Solex carburetter.

ROUTINE MAINTENANCE

EVERY 2,500 MILES (4,000 KM.)

Check the slow running and adjust if necessary, as described under "Slow Running—Adjustment".

EVERY 5,000 MILES (8,000 KM.)

Carburetter Filters

Remove the bolts securing the petrol pipe banjo unions to the float chambers; withdraw the gauze filters from the banjo bolts. Clean the filters in petrol; do not use a cloth as particles will stick to the gauze.

Petrol Feed Pipe Filter

The filter is attached to the inlet manifold, and is of the glass bowl type with a flat filter gauze.

At the recommended intervals, or more frequently if the glass bowl shows signs of becoming full of sediment, slacken the locking nut, swing the retaining clip to one side and remove the bowl (4) (Fig. 2), sealing washer (3), and filter gauze (2).

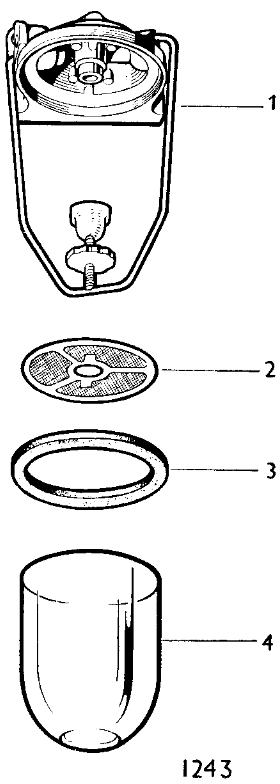


Fig. 2. Fuel feed line filter.

Clean the filter gauze and bowl by washing in petrol. Examine the sealing washer and if necessary fit a new one.

EVERY 10,000 MILES (16,000 KM.)

Petrol Pump Filter

The petrol pump is situated behind the trim panel on the left-hand side of the luggage compartment.

To gain access to the filter remove the base plate by unscrewing the six cheese-headed screws. Thoroughly clean the filter in petrol; do not use cloth as particles will stick to the gauze.

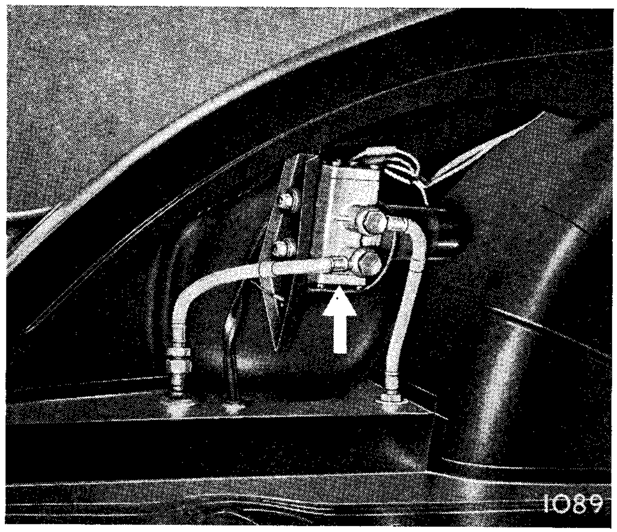


Fig. 3. Location of the petrol pump.

PERIODICALLY

Inlet Manifold Drain Tubes

Two drain tubes are fitted at the bottom of the inlet manifold and it is important that they are kept clear. Obstructions in the tubes will cause excess petrol to collect in the manifold which may result in difficult starting.

Periodically, the tubes and adaptors should, therefore, be removed and checked for being clear.

STARTING

Starting from Cold

For starting from cold the mixture control (marked Start) should be moved up to the fully rich (Cold) position.

Switch on the ignition and press the starter switch button but do not touch the accelerator. Release the starter button as soon as the engine fires—this is important. If for any reason the engine does not start, do not operate the starter switch again until both the engine and the starter motor have come to rest.

As soon as the engine speed increases slide the mixture control to the intermediate (Hot) position ; this position will be felt as a marked resistance in the slide.

Drive off at a moderate speed, progressively moving the mixture control to the off (Run) position until the knob is at the bottom of the slide and the red warning light is extinguished.

Starting in Moderate Temperature

In warm weather or if the engine is not absolutely cold, it is usually possible to start the engine with the mixture control in the intermediate (Hot) position by adopting the procedure given above.

Starting when Hot

Do not use the mixture control. If the engine does not start immediately, slightly depress the accelerator pedal when making the next attempt.

Do NOT pump the accelerator pedal as owing to the action of an accelerating pump in the carburetter an excessively rich mixture will be admitted into the engine.

Difficult Starting (engine hot)

On extremely hot days or when the engine is stopped after a fast climb, occasional difficulty may be experienced in starting immediately.

This may be due to a temporary richness of mixture. On no account pump the accelerator, but slowly depress it to about one-third of its travel, maintaining this position until the engine fires.

Use of the Mixture Control—Important

Use of the mixture control (marked " Start ") brings into operation a starting device which provides the richer mixture necessary for starting. Do NOT permit the starting device to remain in operation longer than is necessary but return the control to the (Run) position as soon as the engine will allow. Unnecessary use of the mixture control will result in increased cylinder bore wear.

A reminder that the starting device is in operation is provided by a red warning light immediately below the mixture control slide. When the control is returned to the (Run) position the starting device is taken out of action and the warning light is extinguished.

CARBURETTERS

Removal

Bend the rubber seal, joining the air intake pipe to the air cleaner, back on to the air cleaner flange. The air intake pipe can now be removed by applying a steady pressure under the centre, care being taken not to lose the two connecting sleeves from the top of the carburetters.

Disconnect the distributor vacuum feed pipe from front carburetter by unscrewing the union. Disconnect the petrol feed pipe by removing the banjo bolts. Disconnect the accelerator linkage from the carburetter. By removing the two retaining setscrews from the mixture control levers and also the outer cable retaining setscrew the control cable can be withdrawn from the carburetters. Remove the four carburetter flange securing nuts and washers and lift off the carburetters.

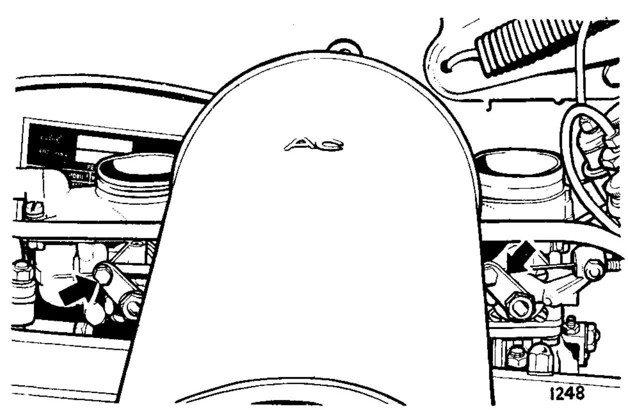


Fig. 4. The mixture control wire should be connected with the carburetter levers pushed fully forward and with the manual lever on the facia placed in the " Run " position.

Refitting

Refitting is the reverse of the removal procedure. Always fit two new joints to each flange on assembly, one on each side of the carburetter insulating distance piece. When refitting the mixture control ensure that the mixture lever inside the car is in the " Run " position and that the levers on the carburetters are as far forward as possible. Thread the control wire into position, remembering to replace the distance tube between the two choke levers (see Fig. 4).

DISMANTLING TO CLEAN

Remove the air cleaner. Unscrew banjo bolts (Bb) (Fig. 5) and remove filter gauzes.

Unscrew float chamber cover fixing screws and gently remove each cover (Fc). Needle valves (Nv) are now exposed for removal.

Lift and remove float toggles (Ft), spindles (Fs) and floats (F). Remove pilot (g), pump (Gp) and starter jets, the latter being situated at bottom left-hand side of starter box, then pump non-return valve and gauze, situated at base of pump chamber, plug (Gu) and main jets located in holders (T). The emulsion tubes may be lifted out with a matchstick after removing air correction jets (a) (before doing so, make sure that throttles are closed in case parts are accidently dropped).

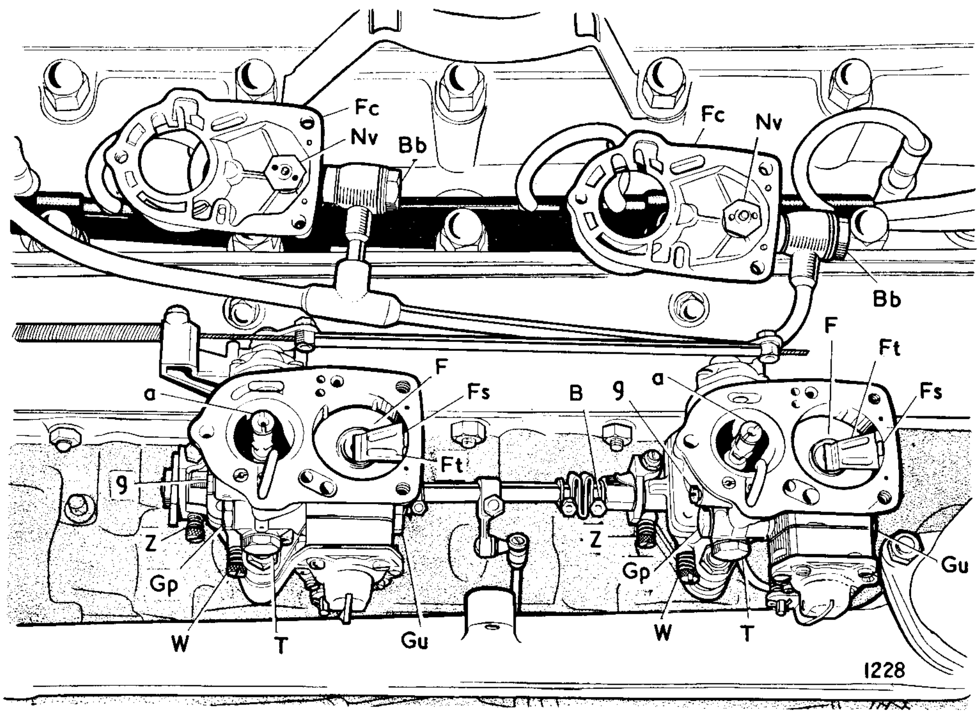
Cleaning and Inspection

Cleanliness during servicing is of the utmost importance, and rag should on no account be used for cleaning or drying the interior of the carburetters. A clean tray filled with petrol, a small stiff paint brush (no loose hairs) and compressed air for the dismantled instruments and parts, is desirable.

Sediment can be quickly removed by gentle brushing followed by swilling out with petrol.

The interior of the carburetters and exposed passages should be blown out, to ensure that all loose particles of foreign matter are cleared.

For cleaning jets use compressed air only ; never use wire as a probe, as this can easily result in increased petrol consumption, and a possible reduction in engine performance.



Bb Banjo bolt.
Fc Float chamber cover.
Nv Needle valve.
F Float.
Fs Float spindle.
Ft Float toggle.
g Pilot jet.
Gp Pump jet.
Gu Plug.
T Main jet holder.
a Air correction jet.
B Clamping bolt.
Z Slow running adjustment screw.
W Volume control screw.

Fig. 5. View of the carburetters with float chamber covers removed.

Floats

Inspect floats for leakage and dents. Leaking or dented floats should be renewed ; never repair except in cases of dire emergency, as the volume and weight of the floats are important.

Needle Valves

Thoroughly clean with petrol, blow out and check needles for quick drop and seal. Any tendency for a needle to stick can usually be cured by a short immersion in a degreasing tank, otherwise the unit should be renewed.

Should the occasion arise where the pump and starter units have to be dismantled, careful note should be made of the position of the various parts, as incorrect assembly will result in complete failure of either component.

It is stressed that the accelerating pump is specially set at the factory, therefore the unit should not needlessly be dismantled. However, should the membrane require replacing, they are not normally supplied separately but form part of an assembly.

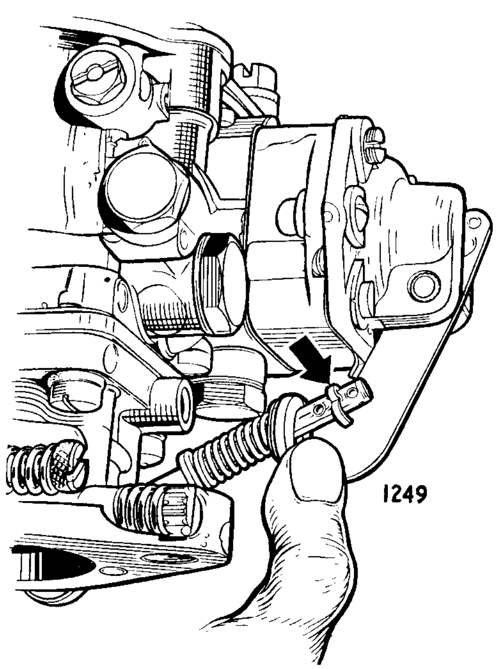


Fig. 6. Showing the position for the split pin in the accelerator pump control rod.

REASSEMBLING

Before reassembling, check all carburetter assembly screws and flange nuts for tightness ; do not use undue force.

When replacing petrol jets and needle valves, fit new fibre washers, using genuine parts only ; failure to do so may upset the calibration of the carburetter.

The nose of the pilot jet makes seating contact in the casting, therefore they should be screwed in tightly, but not with undue force or the seating will be damaged.

Refit toggles and spindles, taking care that toggles are fitted with the letters "TOP" uppermost and move freely on their spindles. Refit needle valves to float chamber covers, using the correct washers, as their thickness partly determine petrol level ; make a final check on needle stems for free movement.

Fit new gaskets to float chambers before replacing covers—the carburetters, being dustproof, require a seal at this joint. Refit petrol pipe and air cleaner.

Note :—If the carburetters have been lifted off the manifold, new flange joints must be used on reassembly. At the same time it is advisable to check the flatness of the face of the carburetter flanges before refitting them to the manifold, to eliminate any possibility of air leaks at this point.

SLOW RUNNING ADJUSTMENT

Adjustment and synchronisation of the carburetters is quite simple, but is dependent on cylinder compressions, valve clearances, the ignition setting, sparking plug gaps and contact breaker gap being set as laid down.

The idling must be set with a fully warmed up engine.

Each carburetter has two external adjustments, the slow-running adjustment screw (Z) (Fig. 5) and mixture volume control screw (W).

(1) Switch off the engine and loosen the clamping bolt (B) on the flexible link between the carburetters. Each instrument should now be separately adjusted. Starting with the front carburetter :—

(2) Unscrew the screw (Z), and ensure the throttle is closed by manual pressure on the slow running screw. Insert a .002″ feeler (or strip of paper) between screw (Z) and the casting stop, screw in (Z) until feeler or paper is lightly nipped. Remove feeler and screw in (Z) one further complete turn from this point.

(3) Gently screw the volume control screw (W) clockwise until light contact is made with the casting seat, then unscrew three-quarters of a turn.

Repeat the above adjustments to the rear carburetter.

(4) Start the engine and, watching the Rev. counter, adjust each slow running screw (Z) equally, until the engine is turning at 650 r.p.m. Then screw out each volume control screw (W) a quarter of a turn at a time, until a drop in r.p.m. is registered indicating richness.

(5) Carefully screw in each volume control screw (W) by quarter turns until the engine reaches the highest and steadiest idling speed, taking care not to go beyond this point where erratic running will be evident due to weakness.

(6) Should the engine speed now be other than 650 r.p.m., adjust the slow running adjustment screws (Z) as required, repeating the adjustments in order to obtain the required idling speed and synchronisation.

(7) Throttle connecting linkage between the carburetters should now be securely tightened, care being taken that both throttles are against their stops during the process.

FAULT FINDING

Sudden break in performance

This may be due to tiny particles of foreign matter or water escaping the filters in the carburetters and fuel pump, and blocking one or more of the petrol metering jets.

Poor slow running

Sudden failure to idle smoothly may be due to one or both pilot jets becoming obstructed and failing to meter the quantity of petrol required by the engine.

Pilot jets should then be removed and the metering orifices cleared by blowing through.

When replacing jets, screw in securely but do not use undue force.

Failure to respond to throttle opening (engine hot)

If the engine will idle but suddenly fails to respond to throttle opening, the main jets should be removed for cleaning. Main jets are assembled in holders, the heads of which are clearly marked " Main Jet Holder ". The latter are easily removed with an adjustable spanner, the jets then being exposed. Gripping the holder between the jaws of the spanner, the jets can be removed with a screwdriver and blown out. During this operation the float chamber will have drained, thereby carrying away impurities.

Important :—Do not probe the jet metering orifices with wire—disregard of this precaution may lead to increased petrol consumption and sub-standard performance.

Flat spot (engine hot)

Should the engine become reluctant to accelerate from slow to normal speeds the pump jets may be partly or completely obstructed and should be removed for cleaning. After replacing jets and priming the carburetters, pump action may be checked in the following manner. Remove air cleaner and open throttles. A discharge should then occur from each pump injector, visible in the choke tubes of the carburetters.

Difficult starting (engine cold)

Provided the carburetters contain petrol and the ignition spark is good, the engine should start immediately.

If it does not and there is no smell of petrol after considerable cranking, the starter petrol jets may need blowing out to clear obstructions.

Note :—When refitting main, petrol and starter jets make certain that each fibre sealing washer is undamaged and that the jets are securely tightened.

Deterioration of performance

This is usually due to wear after long use, therefore, when the time arrives for a major overhaul, due consideration must also be given to the condition of the carburetters as they will also have suffered the effects of general wear and tear. It is therefore recommended that full advantage be taken of the manufacturer's reconditioned carburetter service by fitting replacement units.

CARBURETTERS
(3.4 litre)

DESCRIPTION

The 3.4 litre model is fitted with twin S.U. H.D.6 type carburetters. The enrichment device for starting is in the form of an auxiliary carburetter attached to the front carburetter.

The H.D. type carburetter differs from the earlier type in that the jet glands are replaced by a flexible diaphragm, and idling mixture is conducted along a passage way, in which is located a metering screw, instead of being controlled by a throttle disc.

The jet (18) (Fig. 10), which is fed through its lower end, is attached to a synthetic rubber diaphragm (10) by means of the jet cup (9) and jet return spring cup (13), the centre of the diaphragm being compressed between these two parts ; at its outer edge it is held between the diaphragm casing (14) and the float chamber arm. The jet is controlled by the jet return spring (12) and the jet actuating lever (15), the latter having an external adjusting screw which limits the upward travel of the jet and thus controls the mixture adjustment ; screwing it in (clockwise) enriches the mixture, and unscrewing it weakens the mixture.

Throttle spindle glands.

Provision is made for the use of throttle spindle glands consisting of the cork gland itself (25) (Fig. 10), a dished retaining washer (28), a spring (27) and a shroud (26). This assembly should not require servicing and can only be removed by dismantling the throttle spindle and disc.

Idling

The carburetter idles on the main jet and the mixture is conducted along the passage way (8) (Fig. 10) connecting the choke space to the other side of the throttle disc.

The quantity of mixture passing through the passage way and, therefore, the idling speed of the engine is controlled by the " slow-run " valve (5), the quality or relative richness of the mixture being determined by the jet adjusting screw. It follows that when idling, the throttle remains completely closed against the bore of the carburetter.

Return Springs

Carburetters fitted to early 3.4 litre cars incorporated return springs on the throttle spindles and an individual full throttle stop for each carburetter. On later cars the throttle spindle return springs are replaced by a single return spring fitted between the operating lever on the rear carburetter and the air silencer ; a full throttle stop is fitted to the rear carburetter only.

DATA

Type	S.U. H.D.6 (twin)
Size	1¾″ (4.45 cm.)
Jet needle type—	
—wire mesh air cleaner	T.L.
—oil bath air cleaner	S.C.
Jet size	.10″ (2.54 mm.)
Auxiliary starting carburetter—needle type	425/8.

Note : The jet needle type is stamped on the side or top face of the parallel portion of the needle.
The auxiliary starting carburetter needle is stamped with the large number (e.g. 425) on the shoulder at the top of the needle and with the small number on the parallel portion of the needle.

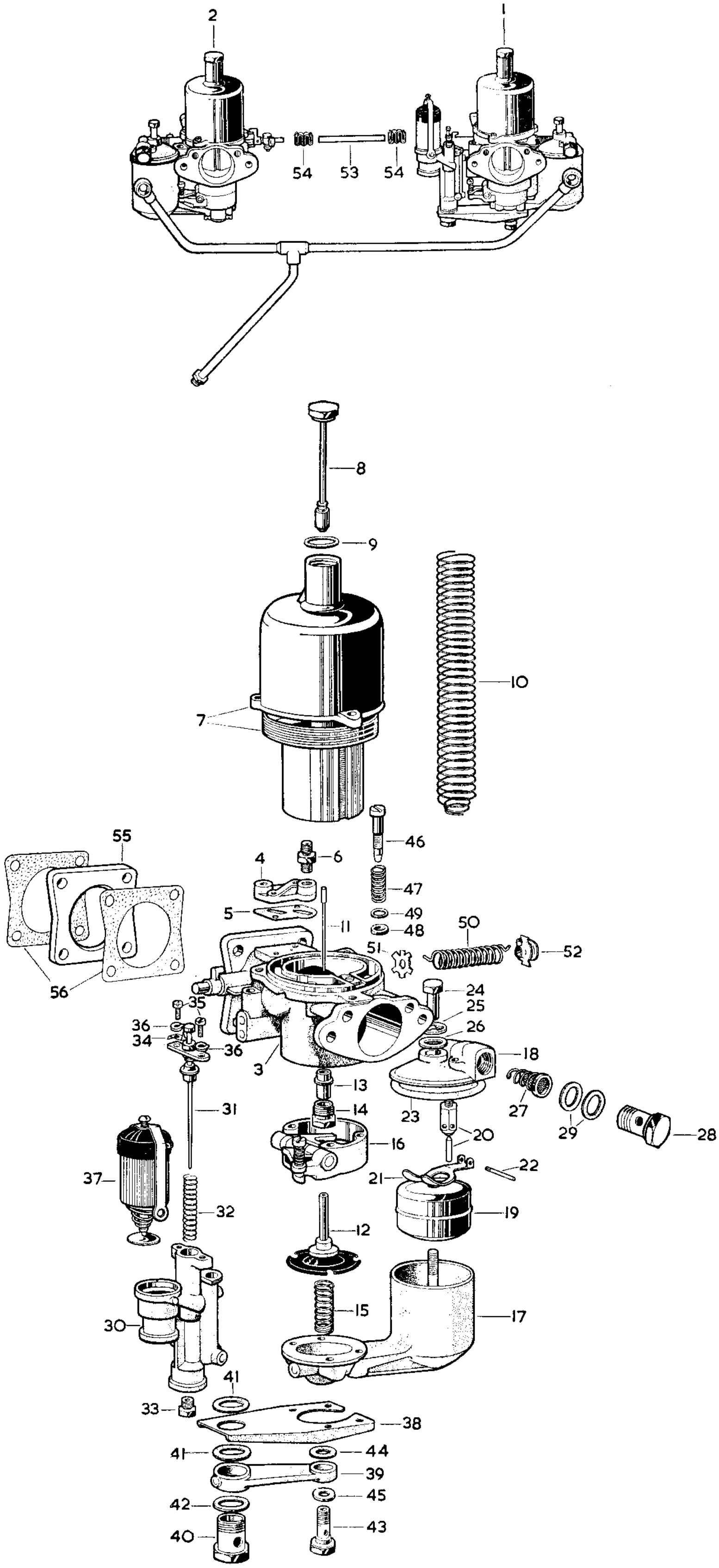


Fig. 7. Exploded view of the S.U. carburetter.

1. Front carburetter.
2. Rear carburetter.
3. Carburetter body.
4. Ignition union adaptor.
5. Gasket.
6. Ignition union.
7. Suction chamber and piston.
8. Damper.
9. Washer.
10. Spring.
11. Jet needle.
12. Jet.
13. Jet bearing.
14. Nut—jet bearing.
15. Spring.
16. Jet unit housing.
17. Float chamber.
18. Float chamber cover.
19. Float.
20. Float needle and seat.
21. Float needle lever.
22. Knurled pin.
23. Gasket.
24. Cap nut.
25. Fibre washer.
26. Aluminium washer.
27. Filter.
28. Banjo bolt.
29. Fibre washer.
30. Auxiliary starting carburetter body.
31. Auxiliary starting carburetter needle.
32. Spring.
33. Jet.
34. Spring clip.
35. Screw.
36. Double coil spring washer.
37. Solenoid.
38. Bracket.
39. Connecting arm.
40. Banjo bolt.
41. Fibre washer.
42. Fibre washer.
43. Banjo bolt.
44. Fibre washer.
45. Aluminium washer.
46. Slow running control valve.
47. Spring.
48. Neoprene washer.
49. Brass washer.
50. Throttle return spring (early cars).
51. Anchor plate.
52. Split pin.
53. Connecting rod.
54. Flexible coupling.

ROUTINE MAINTENANCE

Warning : If it is desired to clean out the float chamber, do not use compressed air as this may cause rupture of the rubber jet diaphragm.

EVERY 2,500 MILES (4,000 KM.)

Lubricate Carburetter Piston Damper

Each carburetter is fitted with an hydraulic piston damper which unless periodically replenished with oil, will cause poor acceleration and spitting back through the carburetter on rapid opening of the throttle.

To replenish with oil, unscrew the cap on top of suction chambers and lift out the damper valve which is attached to the cap. Fill the hollow piston spindle, which can be seen down inside the bore of the suction chamber, with S.A.E. 20 engine oil.

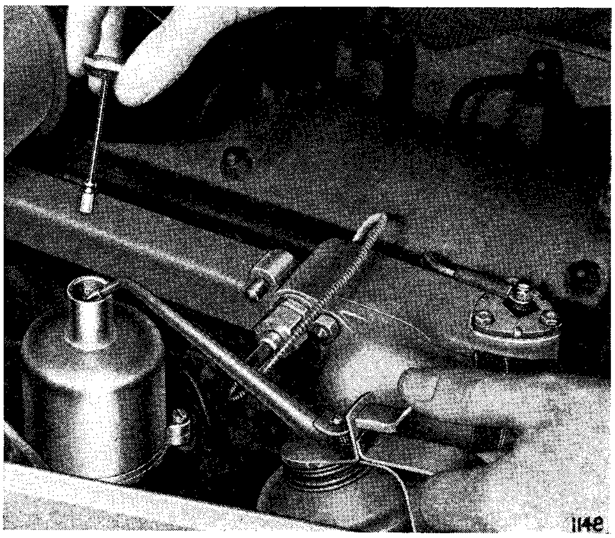


Fig. 8. Topping up a carburetter hydraulic piston damper.

Checking Carburetter Slow Running

The idling speed of the engine should be 500 r.p.m. when the engine is at normal working temperature.

If adjustment is required turn the two slow running volume screws (see Fig. 11) by exactly equal amounts until the idling speed, observed on the revolution counter instrument, is correct.

EVERY 5,000 MILES (8,000 KM.)

Cleaning Carburetter Filters

Removal of the bolt securing the petrol pipe banjo union to each float chamber will expose the filters. Remove the filters and clean in petrol ; do not use a cloth as particles will stick to the gauze.

When refitting, insert the filter with the spring first and ensure that the fibre washers are replaced one to each side of the banjo union.

EVERY 10,000 MILES (16,000 KM.)

Petrol Pump Filter

The petrol pump is situated behind the trim panel on the left-hand side of the luggage compartment.

To gain access to the filter remove the base plate by unscrewing the six cheese-headed screws. Thoroughly clean the filter in petrol ; do not use cloth as particles will stick to the gauze.

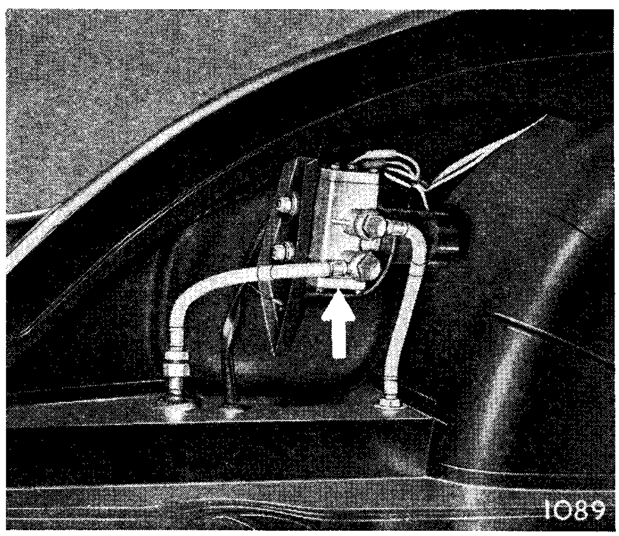


Fig. 9. Location of the petrol pump.

CARBURETTERS

Removal

Remove the bonnet. Remove the air silencer positioned across the cylinder head by slackening the two wing nuts securing the silencer to the mounting bracket and push the air silencer to the left of the engine until the grommet can be removed.

Remove the air intake pipe by unscrewing the setscrews attaching the pipe to the carburetters. Remove both banjo bolts and four fibre washers from the float chambers.

Lift off the accelerator control rod from the lever on the carburetter control rod ; slacken the end plug of the control rod if necessary.

Disconnect the accelerator return spring (if fitted) from the air silencer and the ball pin lever.

Disconnect the distributor vacuum pipe from the front carburetter. Remove the cover on the auxiliary starting carburetter solenoid at the side of the front carburetter and disconnect both electrical cables.

Remove the clip attaching the overflow pipes from the float chambers to the oil filter mounting setscrew.

Remove four nuts and spring washers securing each carburetter to the inlet manifold. The carburetters can now be removed from the inlet manifold.

Refitting

Refitting is the reverse of the removal procedure.

CLEANING THE SUCTION CHAMBER AND PISTON

This should be done at approximate intervals of every twelve months or if the carburetter is dismantled for any reason. After detaching, clean the main inside bore of the suction chamber and the two outside diameters of the piston with a rag moistened in petrol or thinners and then reassemble in a dry and clean condition with a few spots of thin oil on the piston rod only. Do NOT use metal polish to clean the suction chamber and piston.

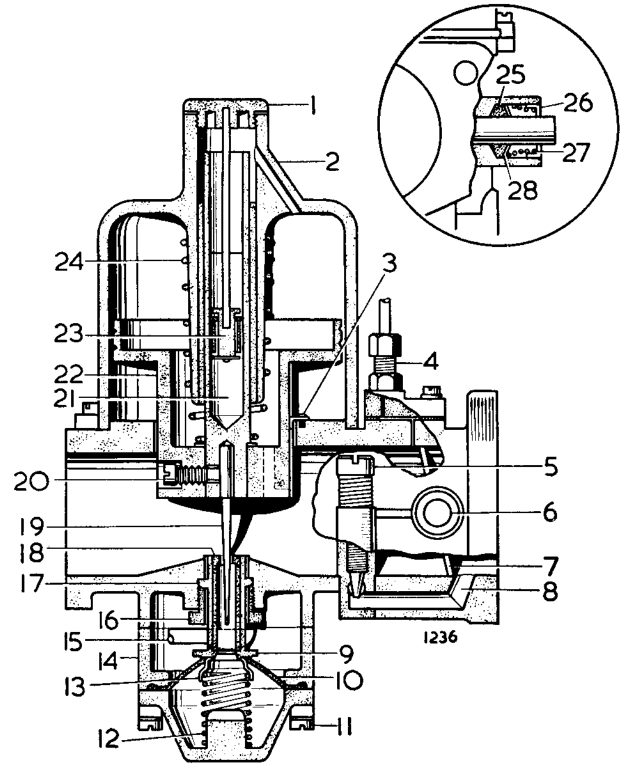


Fig. 10. *Sectioned view of the S.U. carburetter.*

1. Damper cap.
2. Suction chamber.
3. Piston guide.
4. Union for vacuum advance/retard.
5. Slow running volume screw.
6. Throttle spindle.
7. Throttle butterfly.
8. Slow run passage.
9. Jet cup.
10. Diaphragm.
11. Float chamber securing screw.
12. Jet return spring.
13. Return spring cup.
14. Jet unit housing.
15. Actuating lever.
16. Nut—jet bearing.
17. Jet bearing.
18. Jet.
19. Jet needle.
20. Needle retaining screw.
21. Oil reservoir.
22. Piston.
23. Damper.
24. Piston return spring.
25. Throttle spindle gland.
26. Shroud for spring.
27. Spring.
28. Washer.

CARBURETTER TUNING

It is useless to attempt carburetter tuning until the cylinder compressions, valve clearances, sparking plug gaps and contact breaker point gaps have been tested, checked and adjusted, if necessary. The distributor centrifugal advance mechanism and vacuum advance operation should be checked and ignition timing set to the correct figure. For final road test, adjustment of not more than six clicks of the micrometer adjustment at the distributor to either advance or retard is permitted. The ignition setting is important since if retarded or advanced too far the setting of the carburetters will be affected.

Only two adjustments are provided at the carburetters (i) The slow running volume screw (A) (Fig. 11) governing idling speed and (ii) the mixture adjusting screws (B) governing mixture strength. Correct setting of the mixture strength at idling speed ensures that the carburetters are correctly adjusted throughout their entire range.

Ensure that needles are correctly located in the pistons, that is, with the shoulder of the needles flush with the base of the pistons. Check over the carburetters and ensure that pistons are free in the suction chambers, petrol filters clean and hydraulic piston dampers topped up with the recommended grade of engine oil. Lubricate the throttle controls and check for free operation and full travel.

Before carrying out the instructions which follow it is desirable to ensure that the mixture strength of both carburetters is correct. To do this, screw out both mixture screws until the tops of the jets are flush with the jet bridge in each carburetter body ; this can be observed through the piston chamber after removal of the suction chamber and piston. Screw in the mixture screws until the jets start to move and then rotate screws a further $3\frac{1}{2}$ turns.

Slacken one clamp bolt on the coupling between the throttle spindles, check that both butterfly valves are fully closed by rotating both throttle spindles clockwise when viewed from the front. Tighten the coupling clamp bolt. Screw in (rotate clockwise) the slow running volume screws until they are down fully on their seatings. Unscrew each screw $2\frac{1}{2}$ turns.

Run the engine until the normal operating temperature is reached and check that both carburetters are sucking equally by placing one end of a length of rubber tube to the ear and the other end in the inside of each carburetter intake in turn. Rotate the slow running volume screws until the carburetters are synchronised, that is, are sucking equally and the engine is idling at approximately 500 r.p.m.

Recheck that both butterfly valves are fully closed by rotating the throttle spindles (in a clockwise direction looking from the front) and noting if any change in engine speed results ; no change in engine speed or note should result if the butterfly valves are fully closed.

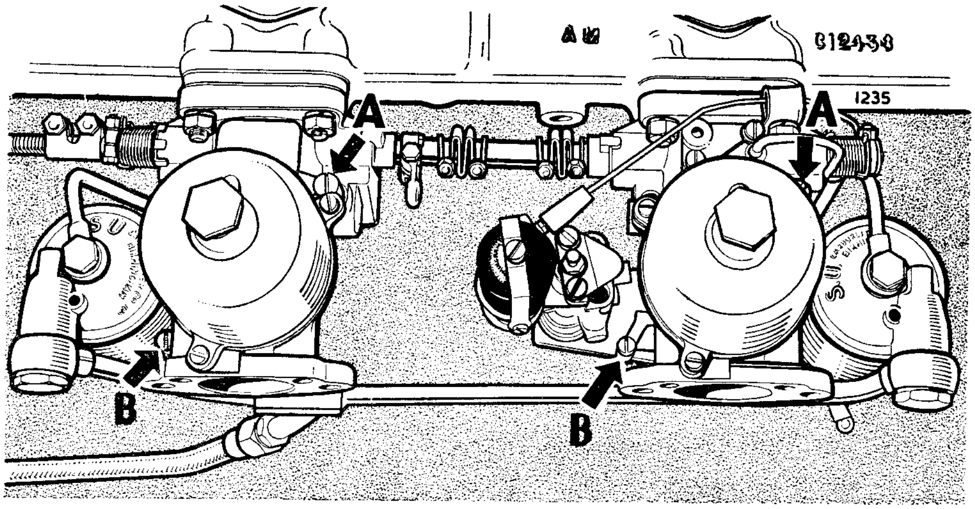


Fig. 11. "A"—Slow running volume screw. "B"—Mixture adjusting screw.

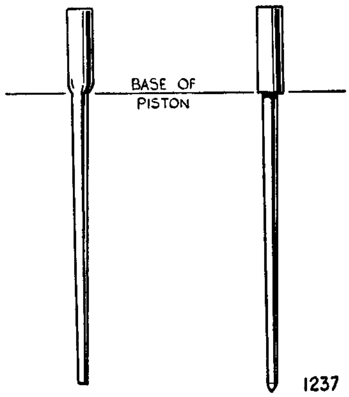


Fig. 12. The jet needle must be positioned with the shoulder flush with the bottom face of the piston.

Next check the mixture strength by lifting the piston (by means of the lifting pin—see Fig. 13) of the front carburetter by approximately $\frac{1}{32}''$ (.8 mm.) when, if

(a) the engine speed increases, this indicates that the mixture strength of the front carburetter is too rich.

(b) the engine speed immediately decreases, this indicates that the mixture strength of the front carburetter is too weak.

(c) the engine continues to run without change of speed, then the mixture strength of the front carburetter is correct.

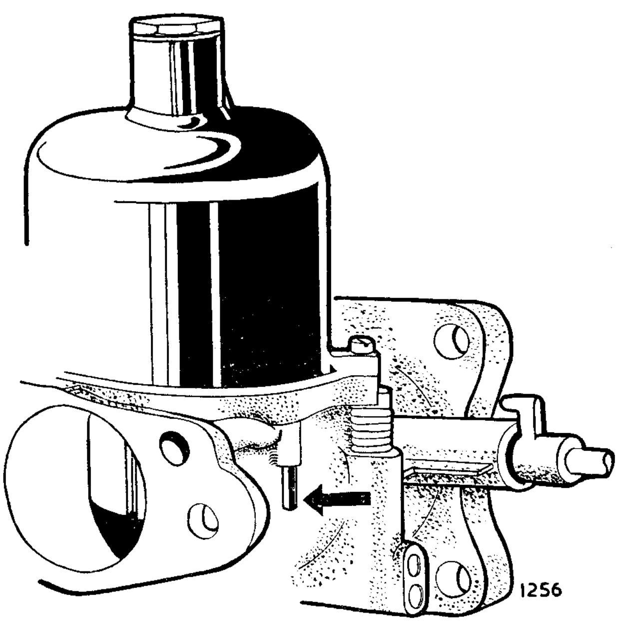


Fig. 13. The carburetter piston lifting pin; the first part of the movement is spring loaded free travel.

Repeat the operation at the rear carburetter to test its mixture strength and after adjustment recheck the front carburetter since the two carburetters are interdependent.

To enrich the mixture, screw in the adjustment screw, that is, rotate clockwise ; to weaken the mixture unscrew the adjustment screw, that is, rotate anti-clockwise.

Some slight adjustment of the slow running to maintain this at 500 r.p.m. may now be necessary following alteration to the mixture strength, in which case ensure that the two slow running screws are rotated by an exactly equal amount or the adjustment previously made will be upset.

Float Chamber Fuel Level

When the fuel level setting is correct a $\frac{7}{16}''$ (11.1 mm.) test bar will just slide between the lid face and the inside curve of the float lever fork when the needle valve is in the " shut-off " position (see Fig. 14).

If the float lever fails to conform with this check figure, it must be carefully bent at the start of the fork section, in the necessary direction for correction. Take care to keep both prongs of the fork level with each other and maintain the straight portion of the lever dead flat.

It is not advisable to alter the fuel level unless there is trouble with flooding ; although too high a level can cause slow flooding, particularly when a car is left ticking over on a steep drive, it should be remembered that flooding can also be caused by grit in the fuel jamming open the needle valve, undue friction in the float gear, excessive engine vibration, or a porous float.

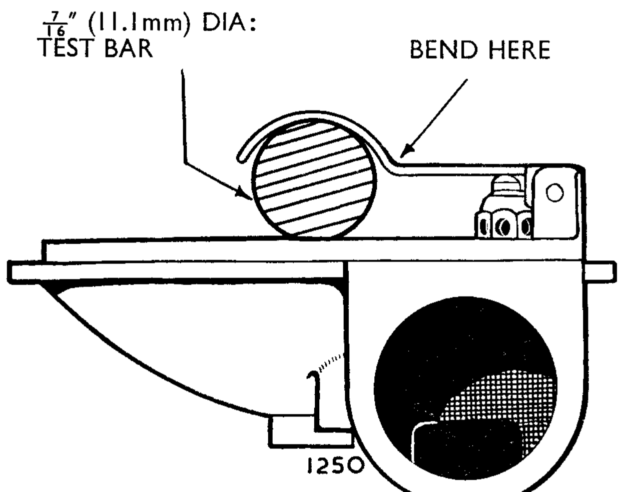


Fig. 14. Checking the float lever setting, which controls the fuel level in the float chamber.

CENTRING THE JET

Warning : Take care not to bend the carburetter needle when carrying out this operation.

Remove the carburetter from the engine as described in this section.

Remove the four setscrews securing the float chamber to the carburetter body. Remove the float chamber, jet housing and jet. Remove the hydraulic damper.

With a ring spanner slacken the jet locking nut approximately half a turn. Replace the jet and diaphragm assembly.

The jet is correctly centred when the piston falls freely and hits the jet " bridge " with a metallic click. To centre the jet, push the jet and diaphragm assembly as high as possible with the hand and with a pencil or rod gently press the piston down on to the jet bridge ; centralisation will be facilitated if the side of the carburetter body is tapped lightly. Tighten the jet locking nut.

The actual centring must be carried out with the setscrews holes in the jet diaphragm and carburetter in alignment. After tightening the jet locking nut the jet diaphragm must be kept in the same position relative to the carburetter body ; the simplest way to do this is to mark one of the corresponding jet diaphragm and carburetter body setscrew holes with a soft pencil. Failure to do this may cause the centralisation to be upset.

Check that the centralisation is correct by noting if there is any difference in the sound of the piston hitting the jet bridge with the jet in its highest and lowest positions. If there is any difference in the sound, the procedure for centralising the jet will have to be repeated.

If difficulty in centring the jet is encountered after carrying out the above procedure, the jet needle can be lowered slightly in the piston to make the centralising effect more positive. The needle must, however, be restored to the normal position when checking the centralisation.

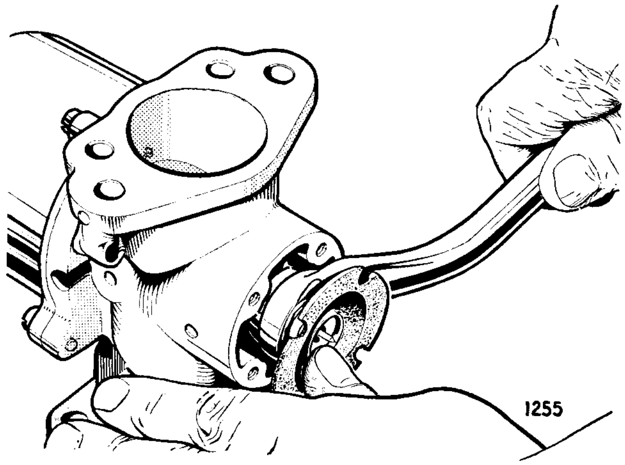


Fig. 15. Centring the jet.

THE AUXILIARY STARTING CARBURETTER

Description

The enrichment apparatus for starting is, in effect, an auxiliary carburetting system. The main body casting (1) containing a solenoid-operated valve and fuel metering system is illustrated as a separate unit attached by means of a ducted mounting arm to the base of the main carburetter fuel inlet.

The auxiliary carburetter forms, therefore, a separate unit additional to the normal float chamber retained by the hollow cross-drilled bolt.

Fuel is supplied to the base of the jet (9), which is obstructed to a greater or lesser degree by the tapered slidable needle (10).

When the device is in action air is drawn from atmosphere through the air intake (7) and thence through the passage (8), being carburetted with fuel as it passes the jet (9). The mixture is thence carried upwards past the shank of the needle (10) through the passage (14) and so past the aperture provided between the valve (3) and its seating (2). From here it passes directly to the inlet manifold through an external feed pipe.

The device is brought into action by energizing the winding of the solenoid (5) from the terminals (6). The centrally located iron core (4) is thus raised magnetically, carrying with it the ball-jointed disc valve (3) against the load of the small conical spring and thus uncovering the aperture provided by the seating (2).

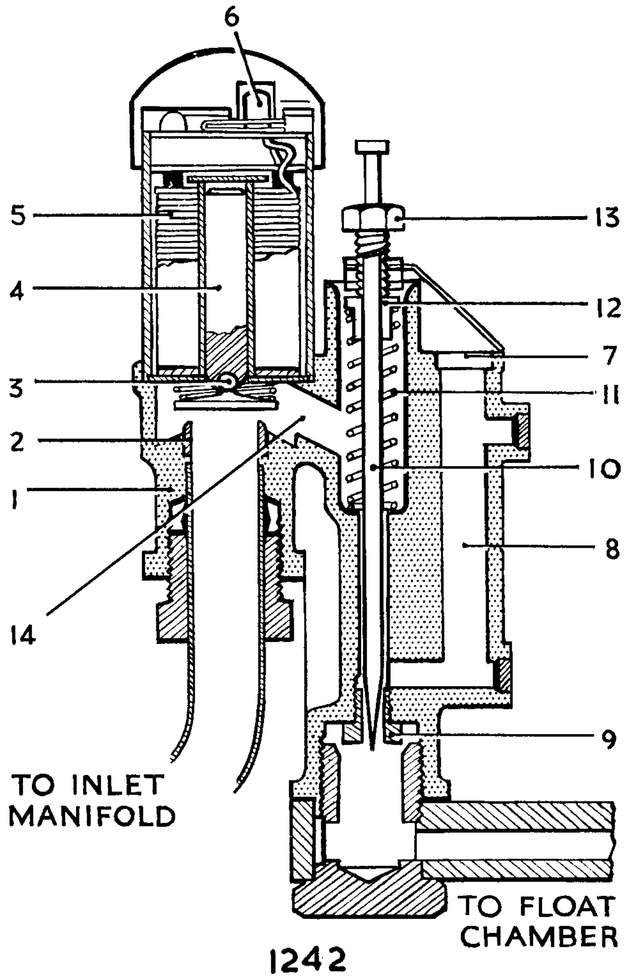


Fig. 16. Sectioned view of the auxiliary starting carburetter.

Considering the function of the slidable needle (10), it will be seen that this is loaded upwards in its open position by means of the light compression spring (11) which abuts against a disc (12) attached to the shank of the needle. The needle continues upwards through the vertically adjustable stop (13) in which it is slidable mounted and it finally terminates in an enlarged head.

Depression within the space surrounding the spring (11) is directly derived from that prevailing in the induction tract, and this exerts a downward force upon the disc (12), which is provided with an adequate clearance with its surrounding bore. This tends to overcome the load of the spring (11) and to move the needle downwards, thus increasing the obstruction afforded by the tapered section which enters the jet (9).

The purpose of this device is to provide two widely different degrees of enrichment, the one corresponding to idling or light cruising conditions and the other to conditions of open throttle or full-power operation. In effect, under the former conditions the high induction depression prevailing will cause the disc (12) to be drawn downwards, drawing the tapered needle into the jet (9), while under the latter, the lower depression existing in the induction tract will permit the collar to maintain its upward position with the needle withdrawn from the jet.

The tuning elements concerned in this device are the size and degree of taper of the lower end of the needle (10), the diameter of the disc (12), the load provided by the spring (11) and the degree of movement permitted to the needle assembly, as determined by the adjustment of the stop (13).

The solenoid (5) is energized by means of a thermostatically operated switch housed in the inlet manifold water jacket. This is arranged to bring the apparatus into action at temperatures below about 30—35°C. (86—95°F).

Adjustment

The engine must be at its normal running temperature before any attempt is made to tune the auxiliary enrichment device.

As it can generally be assumed that the tapered form of the needle (10), the strength of the spring (11), and the diameter of the disc (12) have already been appropriately chosen, tuning is generally confined to the adjustment of the stop screw (13). It will be appreciated that the main purpose of this adjustment is to limit the downward movement of the needle, the head of which abuts against the upper surface of the stop screw at the lower extremity of its travel. The final downward movement of this needle determines, as has been described, the degree of enrichment provided under idling conditions with the auxiliary carburetter in operation. An appropriate guide to its correct adjustment in this respect is provided by energizing the solenoid when the engine has already attained its normal temperature. The stop screw (13) should then be so adjusted that the mixture is distinctly although not excessively rich, that is to say, until the exhaust gases are seen to be discernibly black in colour, but just short of the point where the engine commences to run with noticeable irregularity.

Anti-clockwise rotation of the stop screw will, of course, raise the needle under these conditions and increase the mixture strength, while rotation in the opposite direction will have the opposite effect. In order to energize the solenoid under conditions when the thermostatic switch will normally have broken the circuit, it is merely necessary to short-circuit the terminal of the thermostatic switch directly to earth with a screwdriver and flick open the throttles when the starting device will be heard to come into operation with a pronounced hissing noise.

Thermostatic switch—Removal

The thermostatic switch which controls the operation of the auxiliary starting carburetter is situated at the front end of the inlet manifold water jacket.

Remove the electrical cable from the switch by removing the chrome plated domed nut.

If the radiator filler cap is securely tightened no appreciable amount of water will escape when the auxiliary starting carburetter switch is removed. Alternatively, a small amount of water can be drained from the radiator.

Remove the three securing setscrews and washers and withdraw the switch and the cork gasket.

Refitting

Refitting is the reverse of the removal procedure. A new cork gasket must be fitted when the switch is replaced. If any water has been drained from the radiator or has escaped during the removal of the switch, the radiator should be topped up to the correct level.

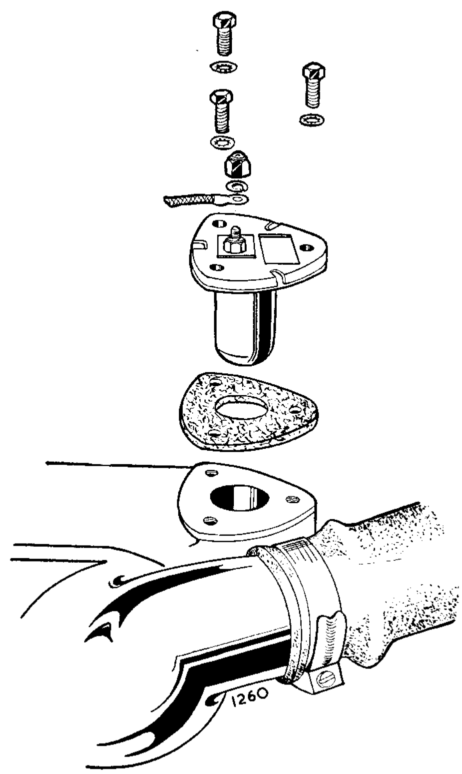


Fig. 17. Removal of the auxiliary starting carburetter thermostatic switch.

THE FUEL SYSTEM

THE PETROL PUMP

Description

The pump consists of three main assemblies—the body, the magnet assembly (sometimes also referred to as the coil housing assembly), and the contact breaker.

The body (A) (Fig. 19) is an aluminium die-casting, to which is attached by 2 B.A. screws, two identical lids (" B " the top and " C " the lower), the lower one retaining the filter. The top lid gives access to the cage " D " for the outlet valve " E ", and, when the cage is unscrewed, to the inlet valve " F " also. These inlet and outlet valves are thin brass discs and should be assembled smooth side downwards—the outlet valve can be extracted (rarely necessary) after the spring circlip has been detached, and care should be taken not to distort this circlip or the valve lift may be affected. A hole connects the space between the valves to the pumping chamber, which is a shallow depression in one face of the body casting. This space contains the diaphragm unit " J " which is clamped on its rim between the iron coil housing " K " and the main body " A ".

A bronze rod " L " is screwed to the centre of the armature " M ", to which the diaphragm is also fastened and it passes through the magnet core " N " to the trunnion " O " in the contact breaker. An armature return spring " P " is interposed between the armature and the end of the magnet coil.

The magnet consists of a cast-iron housing " K ", having an iron magnet core " N " on which is wound a coil of copper wire " Q " which energizes the magnet. Between the magnet coil housing " K " and the armature " M " are fitted eleven spherical-edged rollers " R ". These locate the armature centrally within the magnet and allow absolute freedom of movement in a longitudinal direction.

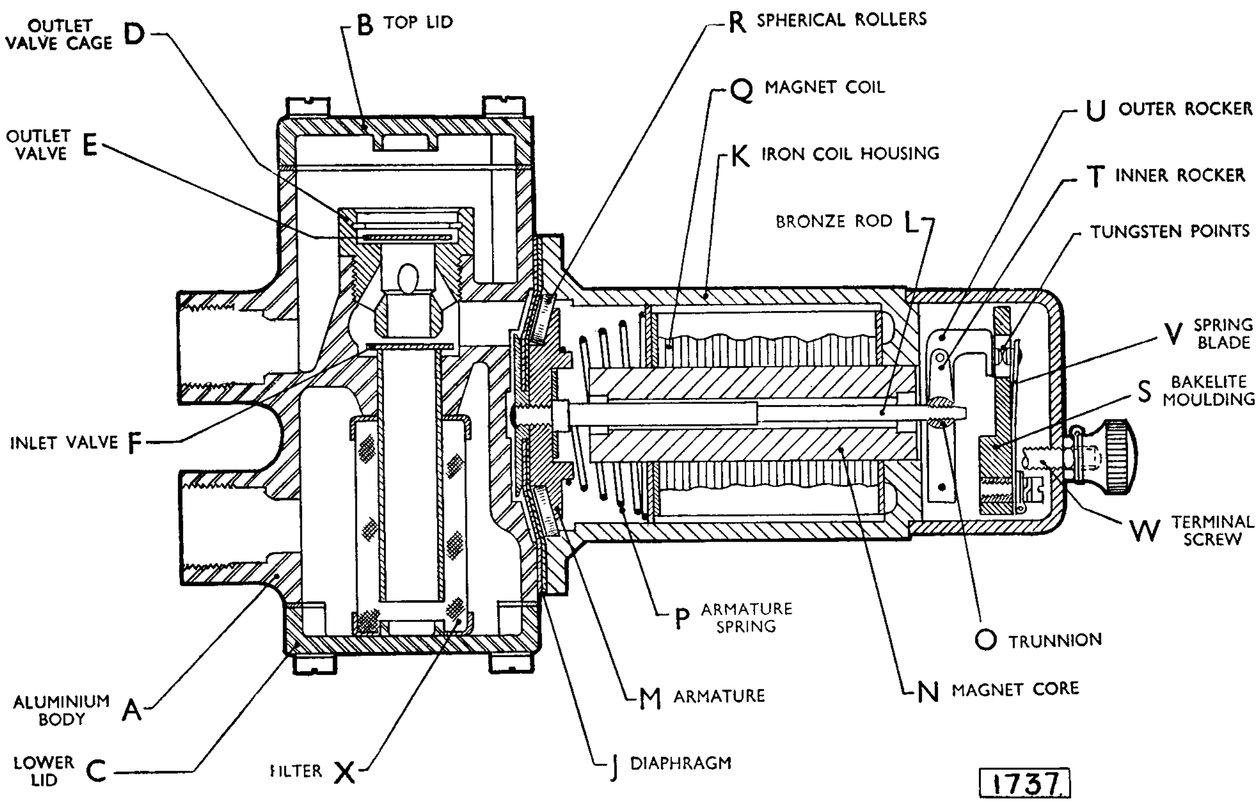


Fig. 18. Sectioned view of the petrol pump.

The contact breaker consists of a small bakelite moulding " S ", carrying two rockers, an inner rocker " T " and an outer rocker " U ", which are both hinged to the moulding at one end and connected together at their top end by two small springs arranged to give a " throw-over " action. A trunnion bearing " O " is fitted into the centre of the inner rocker, and the bronze armature sliding rod " L " is screwed into this.

The outer rocker is fitted with tungsten points, which make contact with corresponding points on spring blade " V ". This blade is connected to one end of the coil and the second coil end is connected to the terminal screw " W ".

A short length of flexible wire connects the outer rocker to one of the screws which holds the bakelite moulding, in order to provide a good earth.

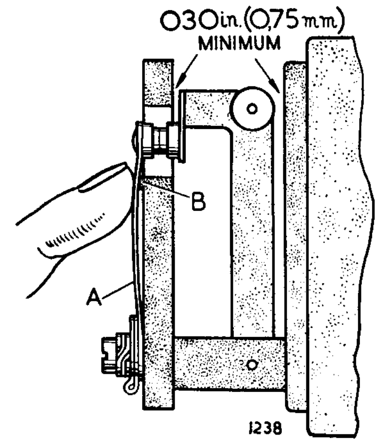


Fig. 19. *If the contact blade "A" is held against the projection "B" there should be* .030" (0.75 mm.) *gap between the white rollers and the body of the pump. If necessary, set the tip of the blade to obtain the correct clearance.*

Operation

When the pump is at rest the outer rocker lies in the outer position and the tungsten points are in contact. The current passes from the terminal, through the coil, back to the blade, through the points and to earth, thus energizing the magnet and attracting the armature. This comes forward, bringing the diaphragm with it, thus sucking petrol through the suction valve into the pumping chamber. When the armature has advanced nearly to the end of its stroke, the " throw-over " mechanism operates, and the outer rocker flies back, separating the points and breaking the circuit. The spring " P " then pushes the armature and the diaphragm back, forcing petrol through the delivery valve at a rate determined by the requirements of the engine. As soon as the armature gets near the end of this stroke, the " throw-over " mechanism again operates, the points again make contact and the cycle of operations is repeated.

The spring blade rests against a small projection on the bakelite moulding, and it should be set so that when the points are in contact it is deflected back from the moulding. The width of the gap at the points is approximately .030" (.75 mm.), when the rocker is pulled back against the face of the iron housing.

If the magnet is removed from the body for any reason, care should be taken that the rollers " R " do not drop out.

Removal

Remove both inlet and outlet pipes (12 and 13) (Fig. 24) from the side of the pump (11) by withdrawing the banjo bolts and washers. Disconnect the electrical feed cable to the pump by unscrewing the knurled knob on the end of the pump. Disconnect the earth cable from the side of the pump. Remove the two self locking nuts attaching the pump to the bracket and withdraw the two washers from each stud. The pump can now be withdrawn from the bracket leaving the two rubber grommets in position. The rubber grommets in the bracket should be examined for deterioration and replaced if necessary, otherwise excessive petrol pump noise may result.

Refitting

Refitting is the reverse of the removal procedure.

Re-setting the Diaphragm

If the armature and centre-rod have been unscrewed it will be necessary to re-set these. In order to do this the spring blade which carries the contact points must be swung to one side. The armature should be screwed inwards, until the " throw-over " ceases to operate, and should then be screwed back gradually a sixth of a turn (or one hole) at a time, and pressed in and out until it is found that when it is pushed in slowly and firmly (not jerkily) the " throw-over " mechanism operates. It should then be unscrewed a further turn (five to six holes). The six screws which hold the magnet to the body may now be screwed into place, but before tightening these down it is essential that the diaphragm should be stretched to the outermost position. This is most easily done by inserting a matchstick behind one of the white fibre rollers on the outer rocker, thus holding the points in

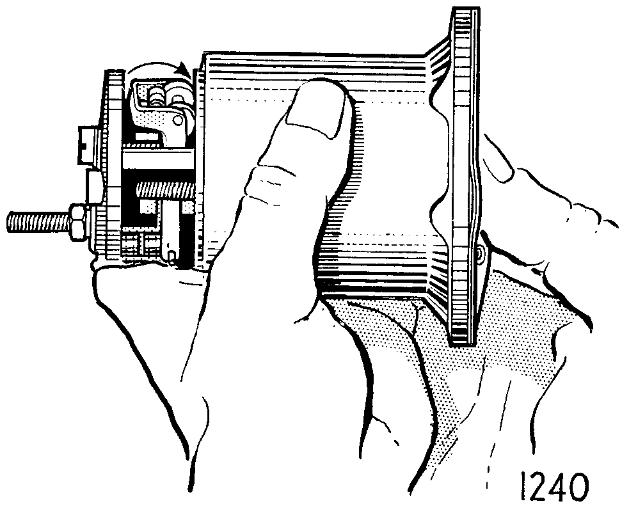


Fig. 20. Checking the " throw-over " of the toggle mechanism—depress the diaphragm slowly and firmly, not jerkily.

contact (after first re-positioning the spring blade back into its normal position). If a current is then passed through the pump, the magnet will be energized and will pull the armature and diaphragm forward, and while it is in this position the six screws should be tightened. While the diaphragm-stretching operation can be done quite effectively by the matchstick method, there is available a special but simple diaphragm stretching tool (see Fig. 21). This is a steel wedge which is inserted under the trunnion " O " in the centre of the inner rocker in order to stretch the diaphragm to its outermost position before tightening the six flange screws.

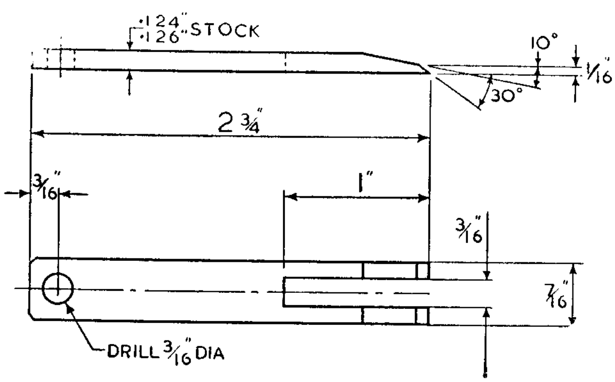


Fig. 21. Diaphragm stretching tool.

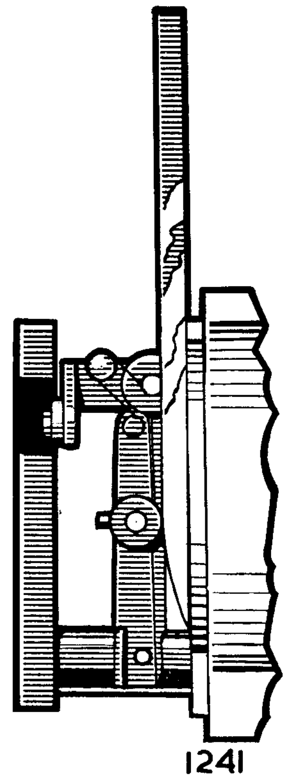


Fig. 22. Showing the tool in position for stretching the diaphragm when tightening the six securing screws.

Finally, check over that when the spring blade (previously swung to one side) has been replaced in its normal position, the clearance hole in this is so positioned around the locking screw, that each contact point, according to the operation of the outer rocker, WIPES OVER THE CENTRE LINE OF THE OTHER POINT, and that this wiping action is not all to one side of the centre on either contact.

Fault—Finding

First disconnect the delivery pipe to the carburetter, and if the pump then works, the most likely cause of the trouble is a sticking needle in the float chamber. Should the pump not work, however, disconnect the lead from the terminal and strike against the body of the pump to see if it sparks and, therefore, if any current is available. If the current is there, remove the bakelite cover and touch the terminal with the lead when the points are in contact—then if the pump still fails to work it may be due to dirt on the contact faces. This may be cleaned off by inserting a piece of thin card between them and sliding it to and fro. If, however, the pump still fails to work with dirt-free points, check that the bottom filter is not clogged, as this will stop a pump, although a rare happening. Next, slacken off the inlet pipe union, and if the pump then operates, the trouble is probably due to an obstruction in the pipe line to the tank which can possibly be cured by blowing down with a tyre pump.

If, however, with the inlet pipe union slackened off, the pump fails to work, or only works slowly and spasmodically, then the trouble is probably due to a fault in the pump itself, such as a stiffened up diaphragm, or undue friction in the rocker " throw-over " mechanism, or a combination of both.

To check over these two points, unscrew the six flange screws and detach the coil housing and rocker unit from the main body (taking care not to lose any of the eleven rollers under the diaphragm); and then by gently pressing the centre of the diaphragm assembly in and out observe whether the " throw-over " mechanism seems to operate freely. If it does not and there are traces of rust on any of the small steel spindles, lubricate sparingly with a spot of thin oil on a matchstick, where they pass through the brass rockers. Then turn to the diaphragm and in order to restore the original pliability of this, ruckle each of the two fabric layers vigorously between the thumb and fingers, after which it can be reassembled and carefully re-set for the " throw-over ", according to the instructions for this operation given in the paragraph headed " Re-setting the Diaphragm ".

If the pump becomes noisy, look for an air leak on the suction side. The simplest way to check for this is to disconnect the petrol pipe from the carburetter and allow the pump to pump petrol into a pint can. If the end of the pipe is then submerged in the petrol and bubbles come through, there must be an air leak, and it must be found and cured.

If the pump keeps beating without delivering any petrol, it is possible that a piece of dirt is lodged under one of the valves. These can be removed for cleaning by detaching the top rectangular lid and unscrewing the valve cage. A choked filter or an obstruction on the suction side will cause the pump to become very hot and eventually cause a failure.

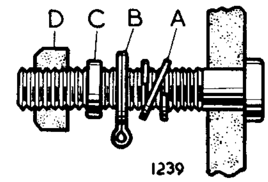


Fig. 23. *The terminal arrangement.*
A. *Double coil spring washer.*
B. *Cable tag.*
C. *Lead washer.*
D. *Countersunk nut.*

PETROL TANK

Removal

It is not essential to drain the petrol tank as it can be lowered vertically from its mounting. The car should be raised on a hoist to allow work to be carried out underneath.

Remove the three (two on the 2.4 litre) exhaust silencer mountings. Withdraw the bolt attaching the exhaust pipe to the rear of the body. The exhaust pipe will now fall away from the petrol tank.

Open the petrol filler door on the left-hand wing and remove the filler cap.

Disconnect the flexible petrol pipe (12) (Fig. 24) from the tank by unscrewing the union above the large grommet (6). Remove the petrol gauge tank unit cover from the left-hand side of the luggage compartment floor and disconnect the three electrical cables.

Withdraw the three self-locking nuts attaching the petrol tank to the body. Take off the three petrol tank mounting rubbers (7) and washers and lower the petrol tank from the body. Withdraw the remaining distance pieces (8), rubbers (7) and washers from the petrol tank mounting studs.

Refitting

Refitting is the reverse of the removal procedure. Ensure that the electrical cables for the petrol tank unit are drawn up through the cover plate aperture before the petrol tank is offered up to its mountings.

1. Petrol tank.
2. Filler cap.
3. Rubber grommet.
4. Filter.
5. Filter gasket.
6. Grommet in luggage compartment.
7. Petrol tank mounting pad.
8. Distance tube.
9. Petrol gauge tank unit.
10. Gasket.
11. Petrol pump.
12. Flexible petrol pipe—tank to pump.
13. Flexible petrol pipe—pump to feed pipe.
14. Nut.
15. Washer.
16. Petrol feed pipe—rear.
17. Petrol feed pipe—front.
18. Clips securing pipes.
19. Clip securing rear pipe.
20. Flexible pipe to carburetter feed pipe.
21. Carburetter feed pipe.

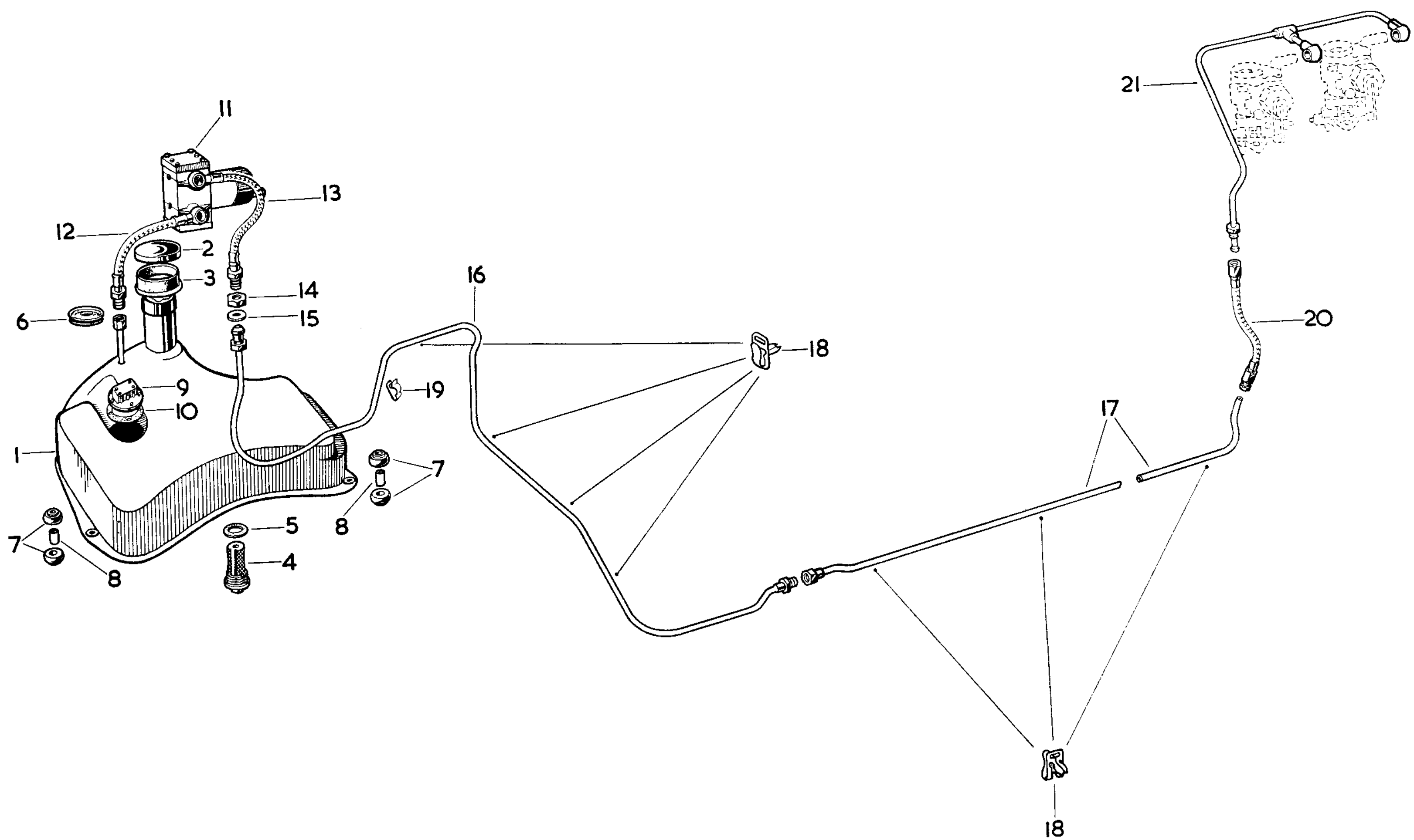


Fig. 24. The fuel system

PETROL GAUGE TANK UNIT

Removal

Roll back the luggage compartment floor covering to expose the tank unit cover plate on the left-hand side. Remove the cover plate by lifting the spring steel strip.

Disconnect the three electrical cables, green and black, green and yellow and a black earth wire from the unit.

Remove the six setscrews and twelve copper washers attaching the unit (9) (Fig. 24) to the petrol tank.

The seal can be broken by a sharp blow on one side of the unit.

Withdraw the unit complete with float, taking care not to bend the float arm.

Refitting

The existing gasket (10) should be scraped away from the boss on the petrol tank taking care that none falls into the petrol tank. Apply a suitable sealing compound to both sides of the new gasket which should be positioned on the petrol tank boss with the holes in line. Insert the element into the tank so that the float is towards the front of the car. Replace the twelve washers and six setscrews and tighten securely. Attach the green and yellow wire to the front of the unit and the green and black to the rear. Remove one of the screws on top of the element housing and secure the earth wire. Replace the unit cover plate and floor covering in the luggage compartment.

SECTION D

COOLING SYSTEM

2·4 and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone
COVENTRY 27677 (P.B.X.)

Code
BENTLEY'S SECOND

Telegraphic Address
"JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/D/4.

INDEX

INDEX *(continued)*

COOLING SYSTEM

The water circulation is assisted by an impeller type pump mounted on the front cover of the engine, the system being pressurised and thermostatically controlled. Water is circulated from the base of the radiator block via the water pump through the cylinder block and cylinder head water passages and returned to the radiator header tank via the inlet manifold water jacket. The radiator is of the film type and holds approximately $6\frac{3}{4}$ pints (3.85 litres) of water. A fan, mounted on the spindle of the water pump draws in air through the radiator block.

DATA

	2.4 litre	**3.4 litre**
Total capacity—including heater	20 pints (11.40 litres)	22 pints (12.55 litres)
Water pump—type	Centrifugal	
—drive	Fan belt	
Fan belt—angle of 'V'	36°	
Fan—no. of blades	4 (later cars 12)	12
Fan to engine speed ratio	0.9 : 1	
Cooling system control	Thermostat	
Thermostat data	See page D.9	
Radiator type	Film—10 fins/inch (4 fins/cm.)	
Radiator cap :		
Make and type	A.C.—relief valve	
Release pressure	4 lbs. per sq. in. (0.28 kg./cm.^{2})	
Release depression	$\frac{1}{2}$ lb. (0.23 kg.)	

Radiator flow figures : Water at 62° F. (17° C.)

lbs. per sq. in.	galls./min.	litres/min.
1	15.5	70.5
1.5	19.0	86.5
2	22	100.0
2.5	24.5	111.5
3	26.5	120.0
3.5	29.0	131.8
4	31.0	140.9

ROUTINE MAINTENANCE

DAILY

Checking Radiator Water Level

Every day, check the level of the water in the radiator and, if necessary, top up to the bottom of the filler neck.

Use water that is as soft as is procurable ; hard water produces scale which in time will affect the cooling efficiency of the system

PERIODICALLY

Care of the Cooling System

The entire cooling system should occasionally be flushed out to remove sediment. To do this, open the radiator block and cylinder block drain taps and insert a water hose into the radiator filler neck. Allow the water to flow through the system, with the engine running at a fast idle speed (1,000 r.p.m.) to cause circulation, until the water runs clear.

Since deposits in the water will in time cause fouling of the surfaces of the cooling system with consequent impaired efficiency it is desirable to retard this tendency as much as possible by using water that is as nearly neutral (soft) as is available. One of the approved brands of water inhibitor may be used with advantage to obviate the creation of deposits in the system.

When **refilling the cooling system** open the heater control tap by placing the temperature control on the facia in the **hot** position. Check the radiator water level after running the engine and top up if necessary.

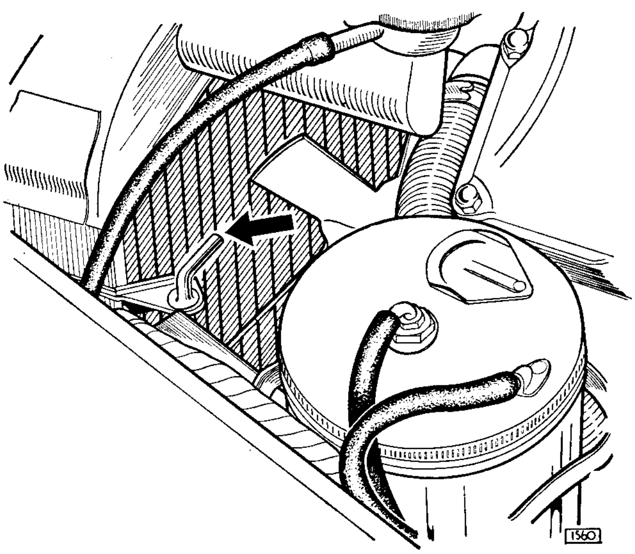


Fig. 1. Radiator drain tap remote control.

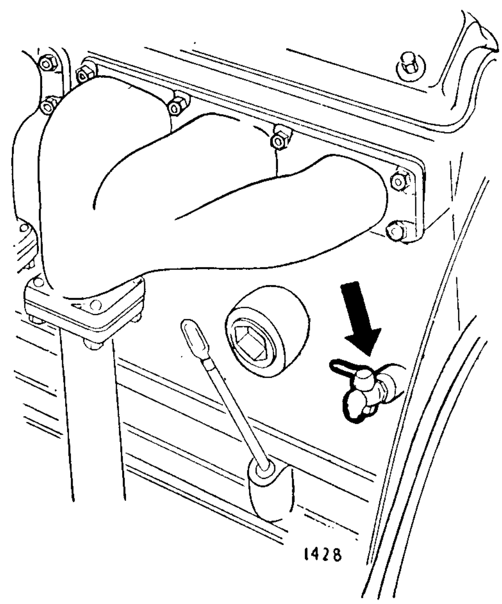


Fig. 2. Cylinder block drain tap.

FROST PRECAUTIONS

Anti-Freeze—Important

During the winter months it is strongly recommended that an anti-freeze compound with an inhibited Ethylene Glycol base is used in the proportions laid down by the anti-freeze manufacturers. It should be remembered that if anti-freeze is not used it is possible, owing to the action of the thermostat, for the radiator to " freeze-up " whilst the car is being driven, even though the water in the radiator was not frozen when the engine was started.

Before adding anti-freeze solution the cooling system should be cleaned by flushing.

The cylinder head gasket must be in good condition and the cylinder head nuts pulled down correctly, since if the solution leaks into the crankcase a mixture will be formed with the engine oil which is likely to cause blockage of the oil ways with consequent damage to working parts. Check the tightness of all water hose connections, water pump and manifold joints. To ensure satisfactory mixing, measure the recommended proportions of water and anti-freeze solution in a separate container and fill the system from this container, rather than add the solution direct to the cooling system.

When filling the cooling system, open the heater control tap by placing the temperature control on the facia in the HOT position. Check the radiator water level after running the engine and top up if necessary. If topping up is necessary during the period in which anti-freeze solution is in use, this topping up must be carried out using anti-freeze solution or the degree of protection provided may be lost. Topping up with water will dilute the mixture possibly to an extent where damage by frost will occur.

Engine Heater

Provision is made on the left-hand side of the cylinder block slightly forward of the engine dipstick, for the fitment of an American standard engine heater element No. 7, manufactured by James B. Carter Ltd., Electrical Heating and Manufacturing Division, Winnipeg, Manitoba, Canada, or George Bray & Co. Ltd., Leicester Place, Blackman Lane, Leeds 2, England.

RADIATOR

The radiator is of the film type having 10 cooling fins per inch (4 fins/cm.). It is pressurised by means of the radiator filler cap. This incorporates a pressure relief valve which is designed to hold a pressure of up to 4 pounds per square inch (0.28 kg./cm^2) above atmospheric pressure inside the system. When the pressure rises above four pounds the spring loaded valve lifts off its seat and the excess pressure escapes via the overflow pipe. As the water cools down again a small valve, incorporated in the centre of the pressure valve unit, opens and restores atmospheric pressure should a depression be caused by the cooling of the water.

By raising the pressure inside the cooling system, the boiling point of the coolant is raised by approximately six degrees thus reducing the risk of coolant loss from boiling.

Removal

Drain the radiator by operating the remote control at the top rear of the radiator header tank, and disconnect top and bottom radiator hoses.

On 3.4 litre cars fitted with a fan cowl, unscrew the four nuts securing the cowl and allow it to rest on the water pump housing behind the fan. Remove the split pin securing the control rod to the drain tap and unscrew the drain tap from the radiator block. Remove the two setscrews securing the sides of the radiator to the body. Remove the two securing nuts at the bottom of the radiator. Carefully lift out the radiator taking care not to damage the matrix on the fan blades. Remove the fan cowl.

On 2.4 litre cars fitted with a fan cowl it is not necessary to remove the cowl in order to lift out the radiator. The remainder of the removal procedure above applies for the 2.4 litre model.

Important: Always keep the radiator block in an upright position so that there is no danger of sediment which may have accumulated on the bottom of the tank passing into the narrow core passages and causing a blockage.

Cleansing the System

Periodically the cooling system should be flushed out and cleansed with a suitable cleansing compound. The procedure is as follows :

Drain the system by removing the two drain taps and when the engine has cooled flush the system with cold water. When this has drained away, replace the taps and fill the system to the normal level with a solution of suitable cleansing compound. Beware of splashing compound on to the paintwork as this would cause serious damage. The engine must now be run for the period prescribed by the makers of the compound after which the system must be drained, thoroughly flushed and refilled with soft water.

Refitting

Refitting is the reverse of the removal procedure.

FAN

Removal

Remove the radiator as described above.

Slacken the dynamo adjusting link bolt and the two dynamo bolts and nuts underneath the dynamo. Release the fan belt tension and remove the fan belt. Before removing the setscrews securing the fan to the hub, mark the positions of the semi-circular balance piece(s) relative to the fan and fan hub. (On initial assembly the ends of the balance piece(s) and fan are marked with a centre punch and a small hole is drilled through the balance piece(s), hub and fan to assist re-assembly.) Remove the fan from the hub by unscrewing the four setscrews fitted with shakeproof washers.

Refitting

Refitting is the reverse of the removal procedure, but attention should be paid to the removal notes in order to preserve the balance of the assembly.

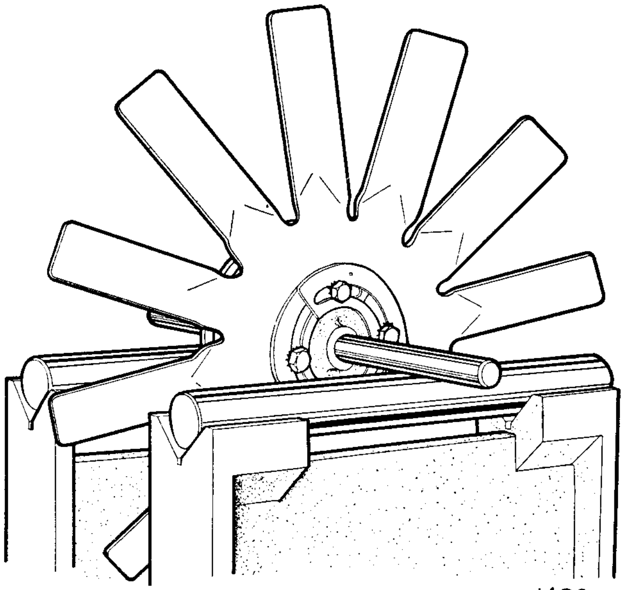


Fig. 3. Balancing the fan assembly.

If it becomes necessary to replace any part of the assembly then it should be rebalanced as shown in Fig. 3. Static balancing is effected by varying the position of the semi-circular balance piece(s) which are retained by setscrews securing the fan to the hub. These should be arranged so that the fan remains at rest in any position. After re-balancing, the ends of the balance piece(s) and the fan should be marked with a centre punch, a small hole drilled through the balance piece(s), hub and fan and the old hole filled in with solder.

Adjust the fan belt as described under " Fan Belt—Adjustment ".

FAN BELT

Adjustment

Slacken the two dynamo bolts and nuts underneath the dynamo and the adjusting link bolt. Pull the dynamo outwards until the fan belt can be flexed approximately $\frac{1}{2}''$ (12.7 mm.) either way, midway between the fan and dynamo pulleys. Tighten the adjusting link bolt and the dynamo mounting bolts.

Note: Slackness of the belt will cause slip with the possible result of a squealing noise from the belt, a reduced charging rate from the dynamo or overheating of the engine.
Too much tension will create undue wear of belt, pulleys, water pump and dynamo bearings.

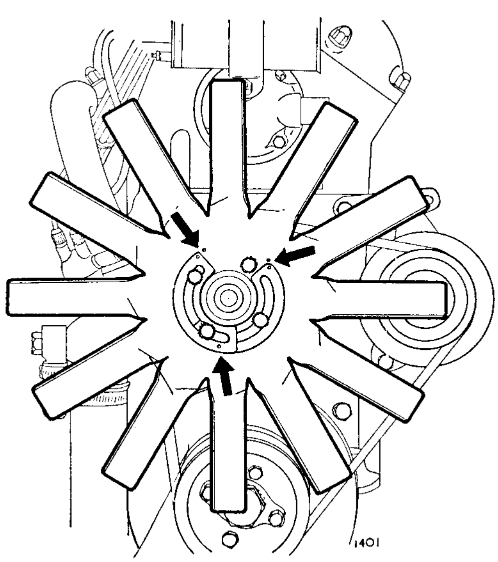


Fig. 4. Fan, showing balance pieces and location hole.

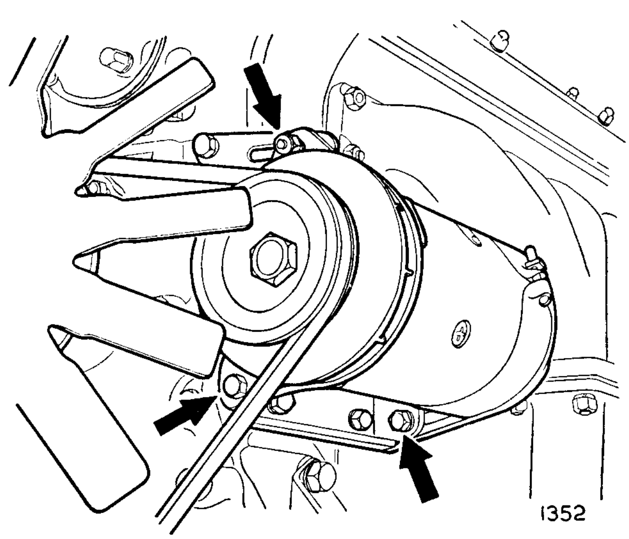


Fig. 5. To adjust the fan belt tension slacken the three dynamo mounting bolts and move the dynamo into the desired position.

Removal

Release the fan belt tension by slackening the two dynamo bolts and nuts underneath the dynamo and the adjusting link bolt. Swing the dynamo towards the engine until the fan belt can be removed from the pulley. Remove the belt from the crankshaft pulley and withdraw over fan.

Refitting

Refitting is the reverse of the removal procedure but it is important that the belt is not stretched over the pulleys by any means other than by hand. If a tool is used to lever the belt on or off, the endless cords in the belt may be broken.

THERMOSTAT

This is a valve incorporated in the cooling system which restricts the flow of coolant through the radiator until the engine has reached its operating temperature. When the engine temperature rises to a pre-determined figure (see " Thermostat Data ") the thermostat valve commences to open and allows the water to circulate round the radiator. The flow of water increases as the temperature rises until the valve is fully open. Included in the system is a water by-pass utilizing a slot in the thermostat housing integral with the water outlet pipe. This allows the coolant to by-pass the radiator until the thermostat opening temperature is attained, thus providing a rapid warming up of the engine and in cold weather an early supply of warm air to the interior of the car via the heater.

Removal

Drain sufficient water from the system to allow the level to fall below the thermostat by operating the remote control of the drain tap situated at the top left-hand side of the radiator block. Slacken the clip and remove the top water hose from the elbow pipe on the thermostat housing. Remove the two nuts and spring washers securing the water outlet elbow and remove elbow. Lift out the thermostat, noting the gasket between the elbow pipe and thermostat housing.

Checking

Thoroughly clean the thermostat and check that the small hole in the valve is clear. Check the thermostat for correct operation by immersing in a container of cold water together with a thermometer and stirrer. Heat the water, keeping it well stirred and observe if the characteristics of the thermostat are in agreement with data given under " Thermostat Temperatures ".

Refitting

Refitting is the reverse of the removal procedure.

Always fit a new gasket between the elbow pipe and the thermostat housing. Ensure that the recess in the thermostat housing and all machined faces are clean.

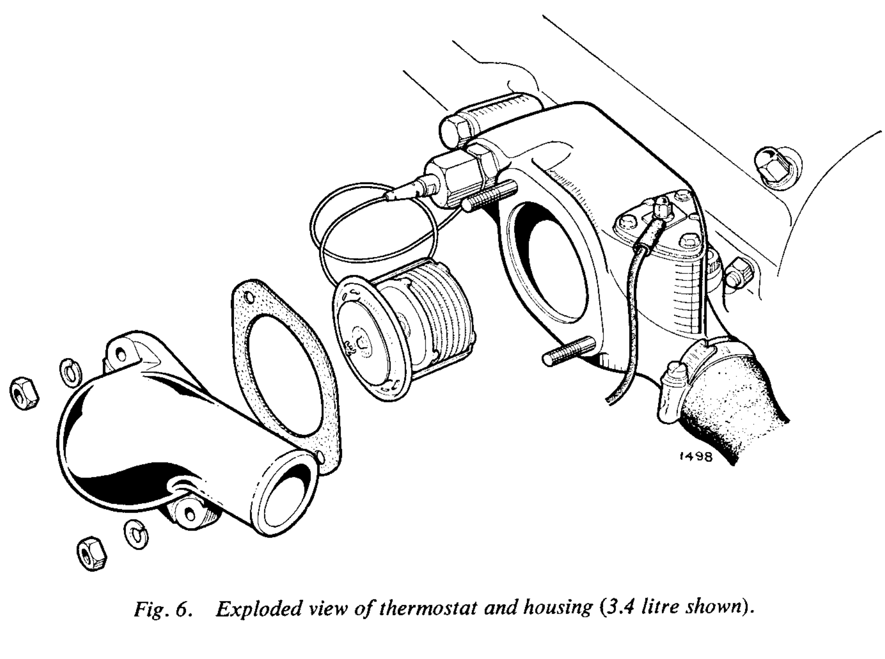


Fig. 6. Exploded view of thermostat and housing (3.4 litre shown).

Thermostat Data

Thermostat Identification Jaguar No.	Thermostat Identification Smiths No.	Fitted to Engine Numbers	Initial Opening Temperature °C.	Fully Open Temperature °C.	Remarks
C.3731/1	X.3570/5	2.4 litre BB.1001—BB.9999 and BC.1001—BC.4407 3.4 litre KE.1001—KE.5732	73 ±2	85—90	Must not be replaced by C.13944 or C.13944/1
C.13944	X.85025/74	Commencing BC.4408 (2.4 litre) KE.5733 (3.4 litre)	74 ±2	86—91	May be replaced by C.3731/1
C.13944/1	X.85025/80	May be fitted to BC.4408 (2.4 L) KE.5733 (3.4 L) onwards	80 ±2	92—97	High setting for extreme winter conditions. May be replaced by C.3731/1 or C.13944

The opening temperature figure and Smiths Part No. are stamped on each thermostat.

WATER PUMP

The water pump (Fig. 7) is of the centrifugal vane impeller type, the impeller being mounted on a steel spindle which in turn runs in a double row of ball bearings. These are sealed at their ends to exclude all dirt and to retain the lubricant. The main seal on the pump spindle is located in the pump housing by a metal cover and the carbon face maintains a constant pressure on the impeller by means of a thrust spring inside the seal. A hole drilled in the top of the casting acts as an air vent and lead into an annular groove in the casting into which stray water is directed by means of a rubber thrower on the pump spindle. A drain hole at the bottom of the groove leads away any water and prevents seepage into the bearing.

Removal

Remove the radiator as described on page D.6. Slacken off the dynamo bolts and pushing the dynamo towards the engine, remove the fan belt.

On the 2.4 litre model remove the locking washer securing the damper bolt by knocking back the tabs and unscrewing the two setscrews. Remove the four remaining setscrews when the pulley and damper can be removed.

Remove the fan and fan pulley as described on page D.6. Detach hose connections from the water pump.

Unscrew the set bolts and nuts and remove the water pump from the timing cover. Note the gasket between the pump and the timing cover.

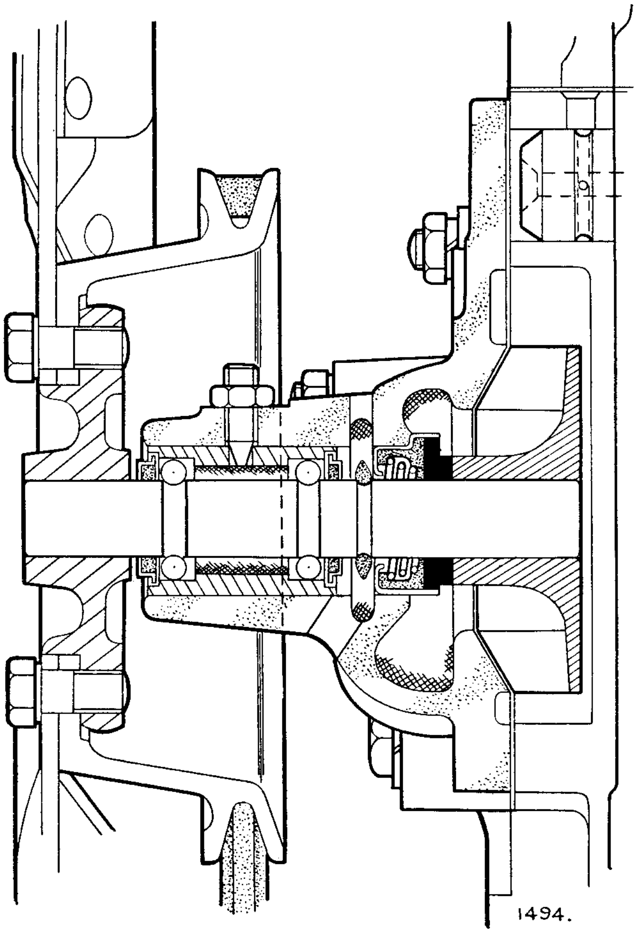


Fig. 7. Sectioned view of water pump.

Dismantling

Remove the fan hub by means of a suitable extractor as shown in Fig. 8. Slacken locknut and remove Allen head locating screw.

Withdraw the spindle and impeller assembly from the pump casting. This assembly must not be pushed out by means of the shaft or the bearing will be damaged. A tube measuring $1\frac{3}{32}''$ (27.77 mm.) outside diameter and $\frac{31}{32}''$ (24.61 mm.) inside diameter must be used to push out the assembly from the front of the pump.

Press out the spindle from the impeller as shown in Fig. 9 and remove seal and rubber thrower. The spindle and bearing assembly cannot be dismantled any further.

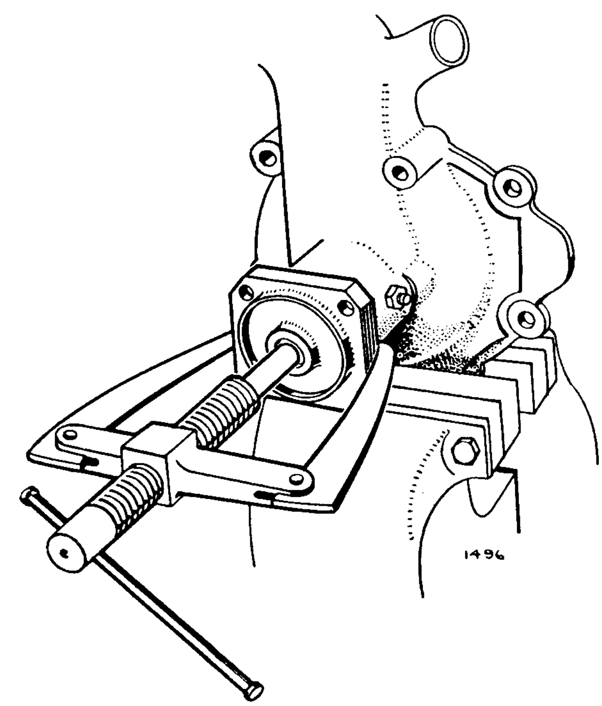


Fig. 8. Withdrawing fan hub from spindle.

Checking

Thoroughly clean all parts of the pump except the spindle and bearing assembly in a suitable cleaning solvent.

Note: The bearing is a permanently sealed and lubricated assembly and therefore must not be washed in the solvent.

Inspect the bearing for excessive end play and remove any burrs, rust or scale from the shaft with fine emery paper, taking the precaution of covering the bearing with a cloth, to prevent emery dust from entering the bearing. If there are any signs of wear or corrosion in the bearing bore or on the face in front of the impeller the housing should be renewed.

Re-assembly

Install shaft and bearing assembly into the pump body from the rear and line up the location hole in the bearing with the tapped hole in the body, Fit locating screw and locknut. Place the rubber thrower in its groove on the spindle in front of the seal. Coat the outside of the brass seal housing with a suitable water resistant jointing compound and fit into the recess in the pump casting. Push the seal into its housing with the carbon face towards the rear of the pump. Ensure that the seal is seated properly.

Press on impeller as shown in Fig. 10 until the rear face of the impeller is flush with the end of the spindle. In a similar manner press the fan hub on to the spindle until it is flush with the end.

Refitting

Refitting is the reverse of the removal procedure. Care should be taken to renew the pump to timing cover gasket, lightly smearing with grease before fitting.

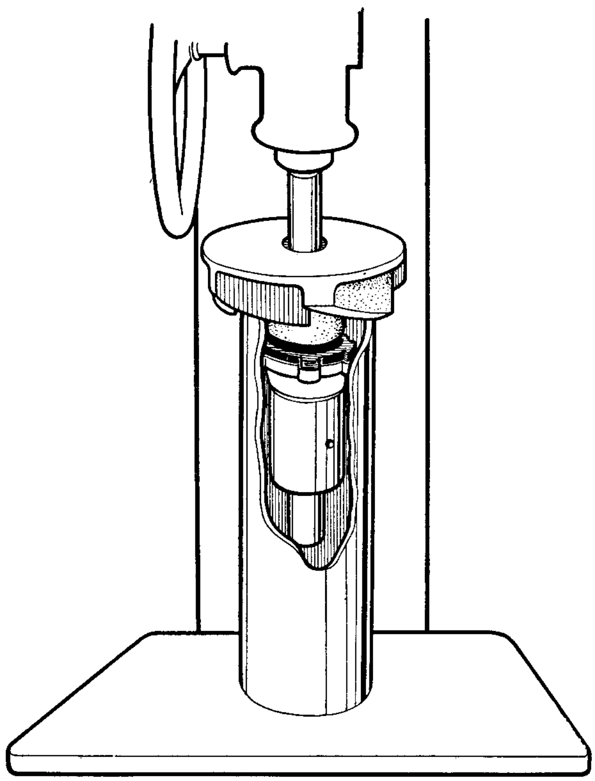


Fig. 9. Removing water pump impeller from pump spindle.

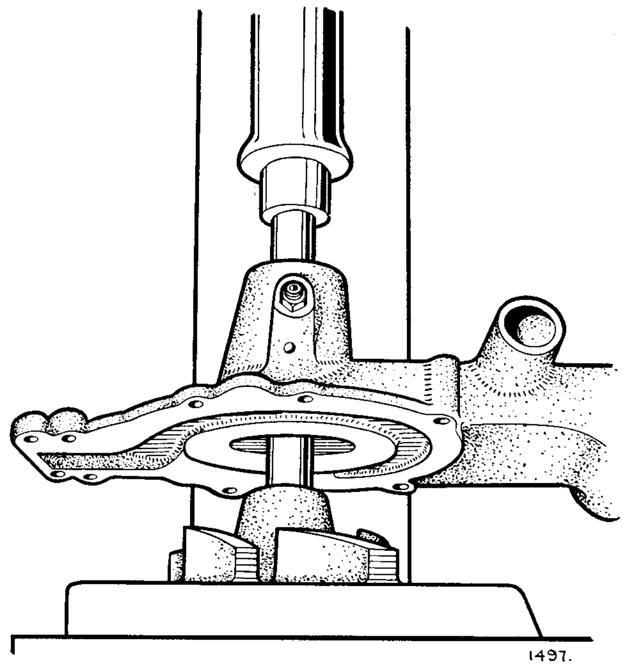
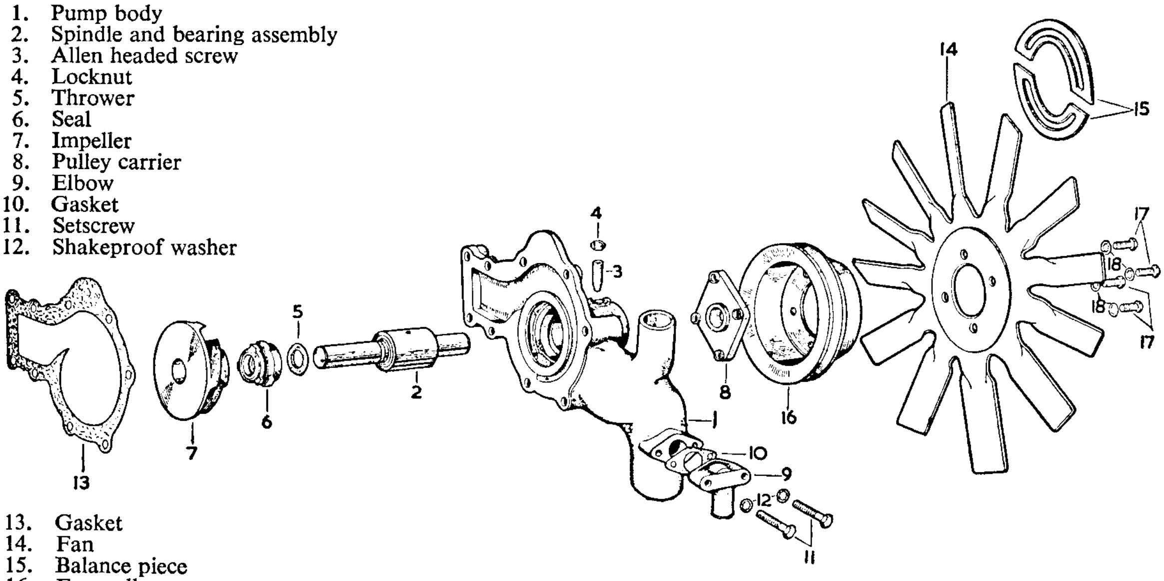


Fig. 10. Fitting impeller.

1. Pump body
2. Spindle and bearing assembly
3. Allen headed screw
4. Locknut
5. Thrower
6. Seal
7. Impeller
8. Pulley carrier
9. Elbow
10. Gasket
11. Setscrew
12. Shakeproof washer



13. Gasket
14. Fan
15. Balance piece
16. Fan pulley
17. Setscrew
18. Shakeproof washer

Fig. 11. Exploded view of water pump.

WATER TEMPERATURE GAUGE

Incorporated with the oil pressure gauge is the water temperature gauge calibrated in degrees Centigrade (30°—100°C.). This is connected by a capillary tube to a bulb located in the inlet manifold water jacket. The gauge, capillary tube and bulb are one unit and great care must be taken to ensure that the tube is not "kinked" or damaged in any way otherwise the whole unit will have to be replaced.

Removal

Partially drain the radiator. Unscrew the water temperature gauge bulb from the inlet manifold water jacket by holding the flats on the bulb and unscrewing the union nut. Remove the grommet at the rear of the engine compartment through which the oil gauge pipe and water temperature capillary tube pass. Release the water temperature capillary tube from its retaining clips, taking care not to bend the tube.

Remove the scuttle vent lever knob and remove all the screws from the dash casing. The casing can now be drawn outwards. Remove both thumb screws from the top of the facia panel. Take out the ignition keys and cigar lighter. Insert a piece of stiff wire into the hole in the side of the light switch to depress the plunger when the switch can now be withdrawn. Repeat for the wiper switch.

Remove the ash tray and remove both screws attaching the ash tray mounting bracket to the facia. Remove the two large screws from the underside of the facia panel. The facia panel can now be removed by sliding it over the remaining switches.

Mark with a pencil the relative positions of the three instrument panel securing bolts; remove the bolts. Ease the instrument panel forward into the car and unscrew the oil gauge union nut from the rear of the instrument. Remove the two screws securing the gauge to the instrument panel and withdraw the gauge into the car complete with the water temperature capillary tube.

Testing

If the instrument is thought to be faulty it can be checked simply by inserting the bulb into a can of water, heating up the water and checking the gauge reading against an accurate thermometer placed adjacent to the bulb in the water.

Refitting

Refitting is the reverse of the removal procedure. Care must be taken to see that the tube follows its original track and that it is not "kinked" when replacing it on the clips.

Printed in England by W. W. Curtis Ltd., Coventry

SECTION E

CLUTCH

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone
COVENTRY 27677 (P.B.X.)

Code
BENTLEY'S SECOND

Telegraphic Address
"JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/E/4.

INDEX

INDEX *(continued)*

CLUTCH

DESCRIPTION

The clutch is of the single dry plate type and consists of a spring loaded driven plate assembly, a cover assembly and a graphite release bearing. The operating mechanism consists of a pendant-type foot pedal, coupled by a push rod to an independent master cylinder, integral with which is a fluid reservoir. This is connected by piping and a flexible hose to a slave cylinder mounted on the clutch housing. Depressing the clutch pedal moves the piston in the master cylinder and imparts thrust to the slave cylinder piston which in turn, operates the graphite release bearing by means of a push rod and operating fork. The bearing is forced against the clutch release lever plate which causes the release levers to withdraw the pressure plate and thus release the clutch driven plate.

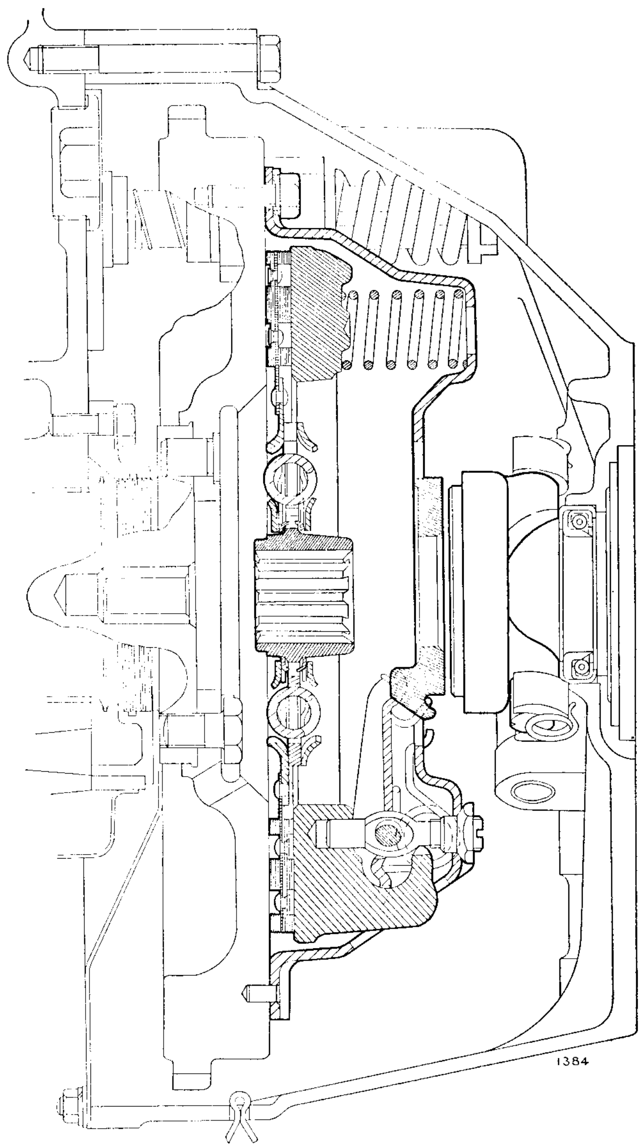


Fig. 1. Sectional view of clutch.

DATA

	2.4 litre	3.4 litre
Make	Borg and Beck	Borg and Beck
Model	9 A6-G	10 A6-G
Outside diameter	9.13″—9.16″	9.84″—9.87″
Inside diameter	6.12″—6.13″	6.75″—6.76″
Type	Single dry plate	Single dry plate
Clutch release bearing	Graphite	Graphite
Operation	Hydraulic	Hydraulic
Clutch thrust springs—number	9	12
—colour	6 Cream 3 Yellow/Light Green	Cream
—free length	2.68″	2.68″
Driven plate—type	Borglite	Borglite
Driven plate damper springs		
—number	6	6
—colour	White/Light Green	Red/Cream

ROUTINE MAINTENANCE

WEEKLY

Clutch Fluid Level

The clutch is operated hydraulically from a master cylinder situated at the rear of the engine compartment on the driver's side of the car. The hydraulic fluid is stored in a reservoir combined with the master cylinder and it is important that the level does not fall below the bottom of the filler neck.

EVERY 2,500 MILES (4,000 KM.)

Clutch Pedal Free Travel

There should be ¾″ (19 mm.) free travel or unloaded movement at the pedal pad before feeling the resistance of the clutch thrust springs.

The free travel is most easily felt by depressing the pedal pad by hand until a marked resistance is felt. If the adjustment is incorrect, rapid wear of the clutch withdrawal mechanism or other troubles may result.

Adjustment is effected by slackening the locknut and turning the operating rod between the slave cylinder and the clutch withdrawal lever. Screwing the rod into the knuckle joint will increase the pedal free travel ; screwing the rod out will decrease the free travel.

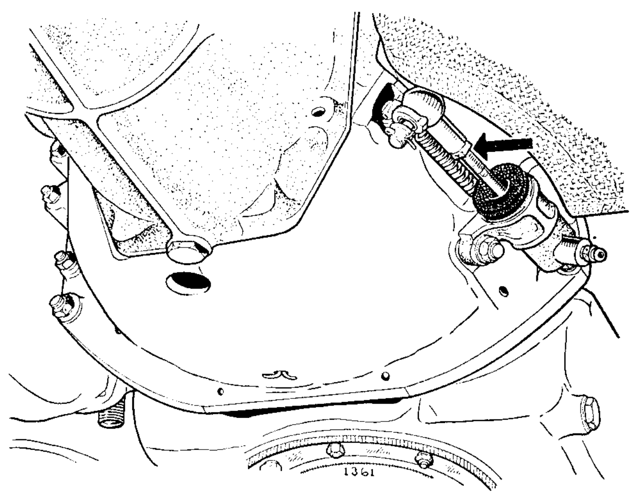


Fig. 2. Adjustment of clutch operating rod.

Recommended Hydraulic Fluids

Preferred Fluid

Lockheed No. 102 Heavy Duty Brake Fluid.

Alternative Fluids

Wakefield Crimson Hydraulic Brake Fluid.
Delco Special No. 11 Brake Fluid.
Chrysler MS 3511 Brake Fluid.
Wagner 21B Brake Fluid.

In countries where the above fluids are unobtainable use only a recognised brake fluid guaranteed to conform to the SAE specification 70 R.1.

In the event of deterioration of the rubber seals and hoses due to the use of an incorrect fluid, all the seals and hoses must be replaced and the system thoroughly flushed and refilled with one of the above fluids. (See " Flushing the System ").

HYDRAULIC SYSTEM—GENERAL INSTRUCTIONS

Should it be found necessary to dismantle any part of the clutch system (that is, master cylinder or slave cylinder), the operation must be carried out under conditions of scrupulous cleanliness. Clean the mud and grease off the unit before removal from the vehicle and dismantle on a bench covered with a sheet of clean paper. Do not swill a complete unit, after removal from the vehicle, in paraffin, petrol or trichlorethylene (trike) as this would ruin the rubber parts and, on dismantling, give a misleading impression of their original condition. Do not handle the internal parts, particularly rubbers, with dirty hands. Place all metal parts in a tray of clean brake fluid to soak ; afterwards dry off with a clean fluffless cloth, and lay out in order on a sheet of clean paper. Rubber parts should be carefully examined and if there is any sign of swelling or perishing they should be renewed ; in any case it is usually good policy to renew **all** rubbers. The main castings may be swilled in any of the normal cleaning fluids but all traces of the cleaner must be dried out before assembly. In the case of the master cylinder make sure that the by-pass port is clear by probing with a bent piece of wire not exceeding .018" (0.46 mm.) diameter.

If the by-pass port is clogged, rapid wear of the release bearing or clutch slip will result due to pressure being built up in the system.

All internal parts should be dipped in clean brake fluid and assembled wet, as the fluid acts as a lubricant. When assembling the rubber parts use the fingers only.

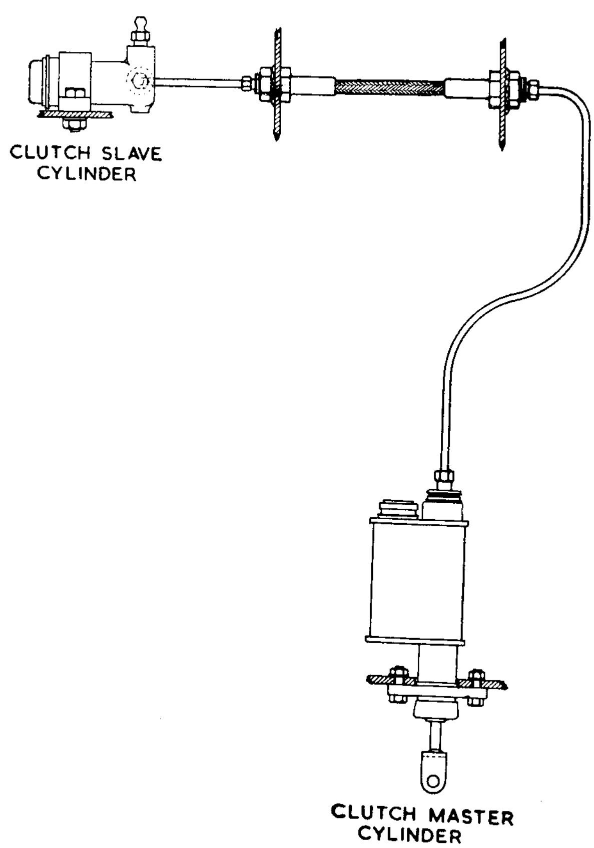


Fig. 3. Clutch hydraulic system.

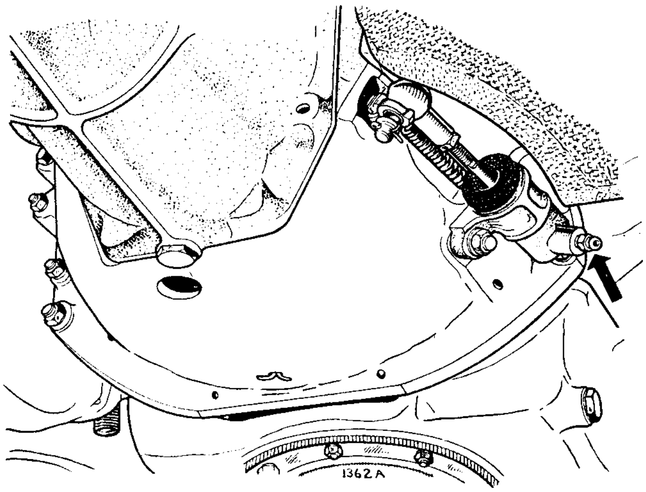


Fig. 4. Position of clutch bleed nipple.

BLEEDING THE SYSTEM

" Bleeding " the clutch hydraulic system (expelling air) is not a routine maintenance operation and should only be necessary when a portion of the hydraulic system has been disconnected or if the level of the fluid in the reservoir has been allowed to fall. The presence of air in the hydraulic system may result in difficulty in engaging gear owing to the clutch not disengaging fully.

The procedure is as follows :—

Fill up the master cylinder reservoir with brake fluid exercising great care to prevent the entry of dirt. Attach a rubber bleed tube to the nipple on the slave cylinder on the right-hand side of the clutch housing and allow the tube to hang in a clean glass jar partly filled with brake fluid. Unscrew the nipple one complete turn. Depress the clutch pedal slowly, **tighten the bleeder nipple before the pedal reaches the end of its travel** and allow the pedal to return unassisted.

Repeat the above procedure, closing the bleed nipple at each stroke, until the fluid issuing from the tube is entirely free of air, care being taken that the reservoir is replenished **frequently** during this operation, for should the level be allowed to drop below half-way air will enter the system.

On completion, top up the master cylinder reservoir to the bottom of the filler neck.

Do not on any account use the fluid which has been bled through the system to replenish the reservoir as it will have become aerated. Always use fresh fluid straight from the tin.

FLUSHING THE SYSTEM

Should the fluid in the system become thick or " gummy " after many years in service, or after a vehicle has been laid up for some considerable time, the system should be drained, flushed and re-filled. It is recommended that this should be carried out once every five years.

Pump all fluid out of the hydraulic system through the bleeder screw of the clutch slave cylinder. To the bleeder screw on the slave cylinder connect one end of a rubber tube, and allow the other end to fall into a container, slacken the screw one complete turn and pump the clutch pedal by depressing it quickly and allowing it to return without assistance ; repeat, with a pause in between each operation, until no more fluid is expelled. Discard the fluid extracted. When the pedal is being pumped the bleeder screw must be tightened before it reaches the end of its stroke.

Fill the supply tank with industrial methylated spirit and flush the system as described above. Keep the supply tank replenished until at least a quart of spirit has passed through the bleeder screw.

Remove the master cylinder and pour off any remaining spirit. Refit the master cylinder, re-fill with clean brake fluid and " bleed " the system.

NOTE: If the system has been contaminated by the use of mineral oil, etc., the above process will not prove effective. It is recommended that the various units, including the pipe lines, be dismantled and thoroughly cleaned and that all rubber parts, including flexible hoses, be renewed. The contaminated fluid should be destroyed immediately.

REMOVAL AND REFITTING A FLEXIBLE HOSE

In some cases, the cause of faulty clutch may be traced to a choked flexible hose. Do not attempt to clear the obstruction by any means except air pressure, otherwise the hose may be damaged. If the obstruction cannot be cleared the hose must be replaced by a new one.

Removal

To renew a flexible hose, adopt the following procedure :—

Unscrew the tube nut from the hose union, then unscrew the locknut and withdraw the hose from the bracket. Disconnect the hose at the other end.

Refitting

When re-fitting a hose, first ensure that it is not twisted or " kinked " (this is MOST IMPORTANT) then pass the hose union through the bracket and, whilst holding the union with a spanner to prevent the hose from turning, fit the locknut and the shakeproof washer ; connect up the pipe by screwing on the tube-nut.

THE MASTER CYLINDER

The clutch master cylinder is very similar to the one used for the brakes, the only internal difference being the omission of the check valve in order that, when the foot is off the clutch pedal, there shall be no residual line pressure between the cylinder and the clutch to cause clutch slip. Externally, the clutch master cylinder is identified by the grooved end plug in the barrel (in the case of the brake master cylinder the end-plug is not grooved).

The master cylinder consists mainly of a tank and barrel assembly (3 Fig. 5), the former surrounds the latter and is secured by soldering ; at one end of the barrel a fixing flange is mounted, and this is secured in the same manner. The tank is fitted with a filler cap (1) which incorporates a baffle and screws down against a seal (2). A piston (8) is contained within the barrel, and has a rubber main cup (10) spring loaded against its inner end ; between the cup and the piston a thin washer (9) is interposed to prevent the cup from being drawn into the small feed holes drilled around the piston head. The outer end of the piston carries a rubber secondary cup (7) and is formed with a depression to receive the spherical end of a push rod (6) which carries a piston stop and is retained by a circlip (5). A rubber boot (4), through which the push rod passes, is fitted on to the barrel to prevent the intrusion of dirt and moisture.

At the end opposite to the push rod, an end plug (14) screws down against a gasket (13) and forms the outlet connection.

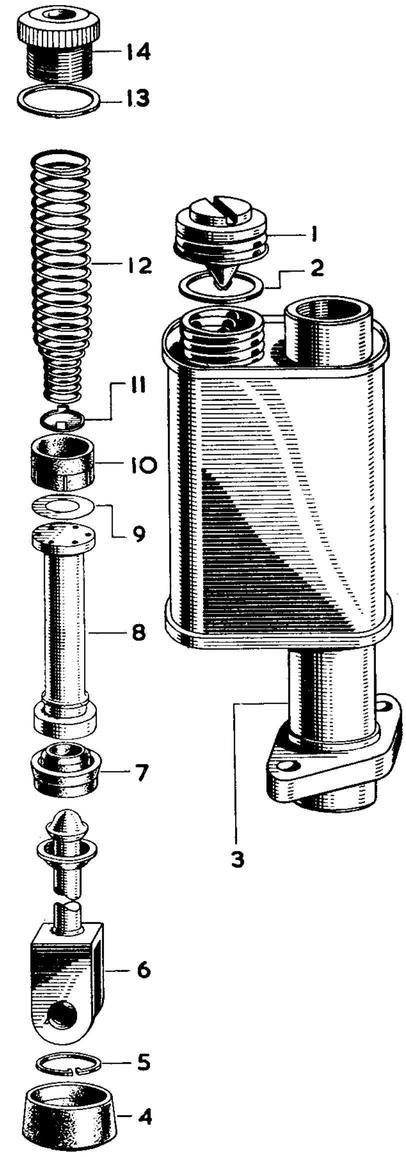


Fig. 5. Exploded view of the master cylinder

Principle of Operation

Depressing the clutch pedal causes the push rod to thrust the piston along the bore of the barrel, and the fluid thus displaced passes to the slave cylinder. Upon removal of the load from the clutch pedal, the return spring thrusts the piston back against its stop faster than fluid is able to return from the slave cylinder ; this creates a depression in the master cylinder which draws the edge of the main cup away from the head of the piston and allows fluid from the tank to flow through the feed holes thus uncovered to make up the temporary deficiency. Meanwhile fluid returning from the slave cylinder, under load from the operating fork return spring re-enters the master cylinder.

When the piston is fully back against its stop, the main cup uncovers a small by-pass port in the barrel, and this allows the release of excess fluid to the tank, thus permitting the operating fork to return to the " fully engaged " position ; the by-pass port also compensates for contraction or expansion of the fluid, due to changes in temperature, allowing fluid to be drawn into or escape from the system. Should this port become blocked, the excess fluid would be unable to escape and the clutch would consequently slip.

Removal

The clutch master cylinder is identified by a grooved circular or hexagon end plug ; in the instance of the brake master cylinder this plug is a plain one.

Disconnect the outlet pipe from the end of the master cylinder, detach the push rod fork end from the clutch pedal, unscrew the fixing bolts and detach the master cylinder from the vehicle. Remove the filler cap (1 Fig. 5), drain the fluid into a clean container, and replace the cap.

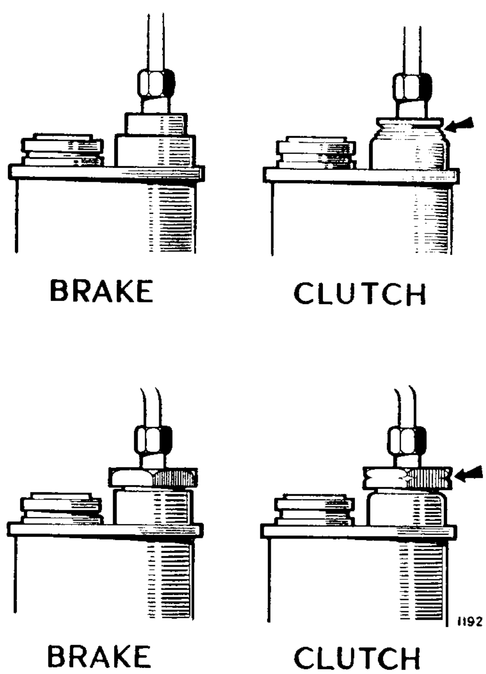


Fig. 6. A clutch master cylinder can be distinguished from a brake master cylinder by the groove around the end cap.

Dismantling

(1) Detach the rubber boot (4) from the end of the barrel, and move the boot along the push rod. Depress the push rod to relieve the spring load from the circlip (5), remove the circlip and withdraw the push rod, the piston (8), the piston washer (9), the main cup (10) and the spring (12). The end plug (14) should not normally need to be removed from the barrel.

(2) Remove the secondary cup (7) by stretching it over the end of the piston.

Assembling

(1) If previously removed, fit the end plug (14) and a new gasket (13).

(2) Fit the spring retainer (11) on to the small end of the spring ; if the retainer is new the ears are to be bent over to secure it on the spring.

(3) Insert the spring, large end leading, into the barrel. Follow up with the main cup (10), lip leading, taking care not to turn back or buckle the lip.

(4) Insert the piston washer (9) so that the curved edge is towards the cup.

(5) Using the fingers only, stretch the secondary cup (7) on to the piston, with the small end towards the head, (that is, the drilled end) and with the groove engaging the ridge ; gently work round the cup, with the fingers, to ensure correct bedding.

(6) Insert the piston into the barrel, with the head uppermost.

(7) If previously removed, stretch the rubber boot (4) on to the push rod, with the open end of the boot towards the spherical end of the push rod.

(8) Offer up the push rod to the barrel, push inwards and secure the piston stop, which is on the push rod, by fitting the circlip (5) at the end of the bore ; it is MOST IMPORTANT that the circlip be correctly fitted in its groove. Stretch the large end of the boot on to the end of the barrel and into its correct position.

(9) Fill the tank with clean brake fluid to within half an inch of the filler cap orifice, and refit the filler cap (1) together with the seal (2) ; ensure that the filler cap is securely tightened, using a coin. With the master cylinder upright, filler cap at the top, test by pushing the push rod and piston further into the bore and allowing it to return unassisted ; after one or two applications fluid should flow from the outlet connection.

Refitting

Secure the master cylinder to the vehicle by fitting the fixing bolts through the flange. Connect the pipe to the outlet connection, the push rod to the pedal, and bleed the system. Check for leaks by depressing the clutch pedal once or twice and examining all hydraulic connections.

THE SLAVE CYLINDER

The clutch slave cylinder consists of a body (4 Fig. 7) which incorporates two threaded connections and is bored to accommodate a piston (5) against the inner face of which a rubber cup (3) is loaded by a cup filler (2) and a spring (1) ; the travel of the piston is limited by a circlip (6) fitted in a groove at the end of the bore. A rubber boot (7) through which a push-rod passes, is fitted on to the body to prevent the intrusion of dirt or moisture.

One of the connections in the body receives a pipe from the clutch master cylinder, whilst the other is fitted with a bleeder screw ; the connection for the pipe is parallel to the mounting flange on the body.

Removal

To remove from the vehicle, disconnect the pipe, detach the rubber boot from the body and remove the fixing screws ; leave the push-rod attached to the vehicle. If the boot is not being renewed it may be left on the push-rod.

Dismantling

Remove the circlip (6) from the end of the bore and apply a **low** air pressure to the open connection to expel the piston (5) and the other parts ; remove the bleeder screw.

Assembling

Prior to assembly, smear all internal parts and the bore of the body with Rubberlube.

Fit the spring (1) in the cup filler (2) and insert these parts, spring uppermost, into the bore of the body (4). Follow up with the cup (3), lip leading, taking care not to turn back or buckle the lip ; then insert the piston (5), flat face innermost, and fit the circlip (6) into the groove at the end of the bore.

Refitting

Fit the rubber boot (7) on the push-rod, if removed previously, and offer up the slave cylinder to the vehicle, with the push-rod entering the bore. Secure the cylinder with the fixing screws and stretch the large end of the boot into the groove on the body. Fit into their respective connections the bleeder screw and the pipe from the clutch master cylinder.

" Bleed " the clutch as described on page 7.

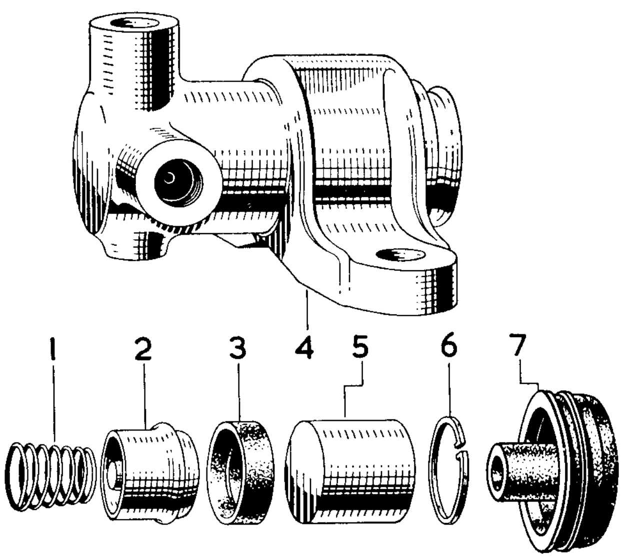


Fig. 7. Exploded view of clutch slave cylinder.

THE CLUTCH UNIT

The driven plate assembly (14, Fig. 8) is of the flexible centre type, in which a splined hub is indirectly attached to a disc and transmits the power and overrun through a number of coil springs held in position by shrouds.

The cover assembly consists of a pressed steel cover (1) and a cast iron pressure plate (3) loaded by thrust springs (2) the number of which vary with the model. Mounted on the pressure plate are release levers (4), which pivot on floating pins (9), retained by eye bolts (8). Adjustment nuts (10) are screwed on to the eye bolts and secured by staking. Struts (7) are interposed between lugs on the pressure plate and the outer end of the release levers. Anti-rattle springs (11) restrain the release levers and retainer springs (6) connect the release lever plate (5) to the levers.

The graphite release bearing (12) is shrunk into a bearing cup which is mounted on the throw-out forks and held by the release bearing retainer springs (13).

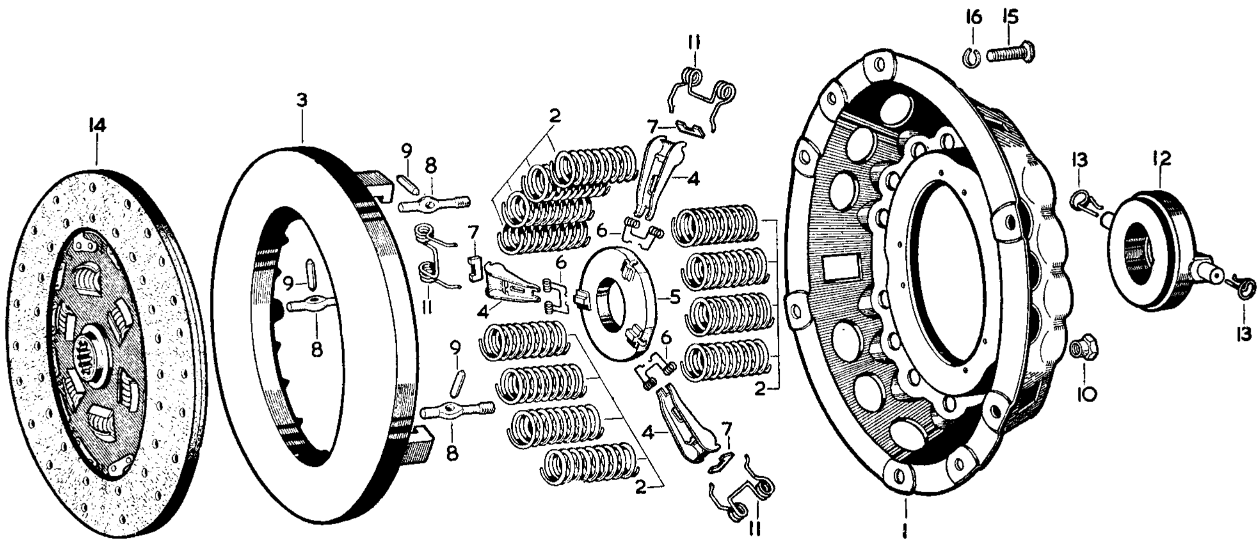


Fig. 8. Exploded view of clutch assembly.

1. Cover
2. Thrust spring
3. Pressure plate
4. Release lever
5. Release lever plate
6. Release lever retainer
7. Release lever strut
8. Release lever eyebolt
9. Eyebolt pin
10. Adjustment nut
11. Anti-rattle spring
12. Release bearing and cup assembly
13. Release bearing retainer
14. Driven plate assembly
15. Securing bolt
16. Spring washer

GENERAL INSTRUCTIONS

When overhauling the clutch the following instructions should be noted and carried out :—

Clutch Cover Assembly

Before dismantling the clutch, suitably mark the following parts so that they can be re-assembled in the same relative positions to each other to preserve the balance and adjustment ; clutch cover, lugs on the pressure plate and the release levers.

When re-assembling make sure that the markings coincide and, if new parts have been fitted which would affect the adjustment, carefully set the release levers (see page 14).

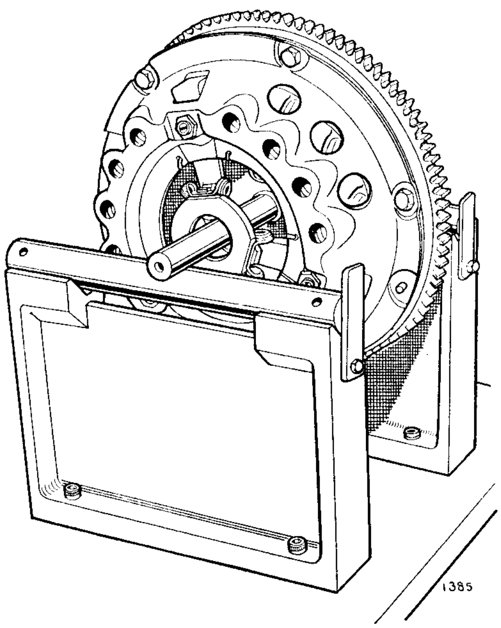


Fig. 9. Clutch and flywheel balance.

If a new pressure plate has been fitted, it is essential that the complete cover assembly should be re-balanced, for which reason it is not a practical proposition where special equipment is not available.

Before assembly, thoroughly clean all parts and renew those which show appreciable wear. A very slight smear of grease such as Lockheed Expander Lubricant or Duckham's Keenol K.O.12 should be applied to the release lever pins, contact faces of the struts, eyebolt seats in the clutch cover, drive lug sides on the pressure plate and the plain end of the eyebolts.

Release Bearing

If the graphite release bearing ring is badly worn it should be replaced by a complete bearing assembly.

CONDITION OF CLUTCH FACINGS

The possibility of further use of the friction facings of the clutch is sometimes raised, because they have a polished appearance after considerable service. It is natural to assume that a rough surface will give a higher frictional value against slipping, but this is not correct.

Since the introduction of non-metallic facings of the moulded asbestos type, in service, a polished surface is a common experience, but it must not be confused with a glazed surface which is sometimes encountered due to conditions discussed below.

The ideal smooth or polished condition will provide a normal contact, but a glazed surface may be due to a film or a condition introduced, which entirely alters the frictional value of the facings. These two conditions might be simply illustrated by the comparison between a polished wood, and a varnished surface. In the former the contact is still made by the original material, whereas in the latter instance, a film of dried varnish is interposed between the contact surfaces.

The following notes are issued with a view to giving useful information on this subject :—

(*a*) After the clutch has been in use for some little time, under perfect conditions (that is, with the clutch facings working on true and polished or ground surfaces of correct material, without the presence of oil, and with only that amount of slip which the clutch provides for under normal conditions) then the surface of the facings assumes a high polish, through which the grain of the material can be clearly seen. This polished facing is of mid-brown colour and is then in a perfect condition.

(*b*) Should oil in small quantities gain access to the clutch in such a manner as to come in contact with the facings it will burn off, due to the heat generated by slip which occurs under normal starting conditions. The burning off of this small amount of lubricant, has the effect of gradually darkening the facings, but, provided the polish on the facings remains such that the grain of the material can be clearly distinguished, it has very little effect on clutch performance.

(*c*) Should increased quantities of oil or grease obtain access to the facings, one or two conditions, or a combination of the two, may arise, depending upon the nature of oil, etc.

(1) The oil may burn off and leave on the surface facings a carbon deposit which assumes a high glaze and causes slip. This is a very definite, though very thin deposit, and in general it hides the grain of the material.

(2) The oil may partially burn and leave a resinous deposit on the facings, which frequently produces a fierce clutch, and may also cause a " spinning " clutch due to a tendency of the facings to adhere to the flywheel or pressure plate face.

(3) There may be a combination of (1) and (2) conditions, which is likely to produce a judder during clutch engagement.

(*d*) Still greater quantities of oil produce a black soaked appearance of the facings, and the effect may be slip, fierceness, or judder in engagement, etc., according to the conditions. If the conditions under (*c*) or (*d*) are experienced, the clutch driven plate should be replaced by one fitted with new facings, the cause of the presence of the oil removed and the clutch and flywheel face thoroughly cleaned.

ALIGNMENT

Faulty alignment will cause excessive wear of the splines in the hub of the driven plate, and eventually fracture the steel disc around the hub centre as a result of " swash action " produced by axial movement of the splined shaft.

PEDAL ADJUSTMENT

This adjustment is most important and the instructions given should be carefully followed; faulty adjustment falls under two headings :—

(*a*) Insufficient free (or unloaded) pedal travel may cause a partly slipping clutch condition which becomes aggravated as additional wear takes place on the facings, and this can result in a slipping clutch leading to burning out unless corrected. Over-travel of effective pedal movement only imposes undue internal strain and causes excessive bearing wear.

(*b*) Too much free pedal movement results in inadequate release movement of the bearing and may produce a spinning plate condition that is, dragging clutch rendering clean changes impossible.

REMOVAL

To remove the clutch, the engine and gearbox must first be removed (refer to Section B).

Slacken the clutch mounting screws a turn at a time by diagonal selection until the thrust spring pressure is released. Remove the set screws and withdraw the complete clutch assembly from the flywheel. Remove the driven plate assembly and take care to maintain the driven plate faces in a clean condition. Observe that the clutch and flywheel are balanced as an assembly. This location is indicated by balance marks 'B' stamped on the clutch and flywheel (Fig. 20).

DISMANTLING

Before dismantling, mark all the major components.

To dismantle the clutch, either bolt the assembly to the baseplate of the Churchill fixture, to a spare flywheel, or place the clutch on the bed of a press with blocks under the pressure plate in such a manner that the cover is free to move downwards when pressure is applied.

Having compressed the clutch in one of these various ways, unscrew the nuts (Fig. 10), (considerable torque is initially necessary in order to break off the squeezed-in portion of each nut), and slowly release the clamping pressure. Lift the cover and the thrust springs off the pressure plate and remove the release lever mechanism. Fig. 11 shows the method whereby the strut is disengaged from the lever, after which the threaded end of the eye-bolt and the inner end of the lever are held as close together as possible to enable the shank of the eye-bolt to clear the hole in the pressure plate.

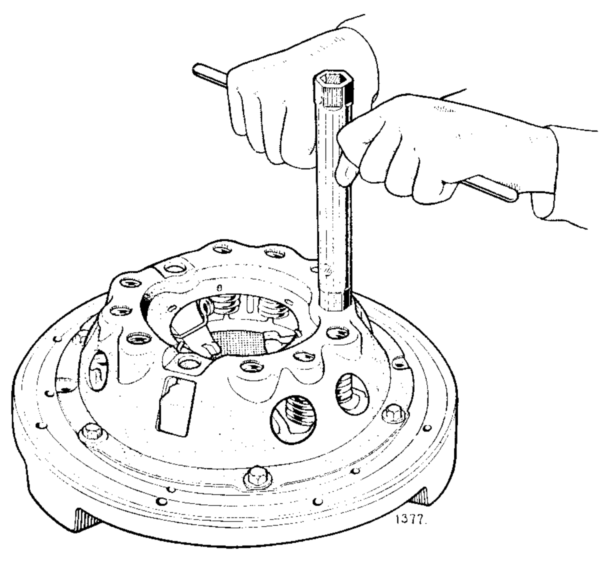


Fig. 10. Removal of the adjustment nuts.

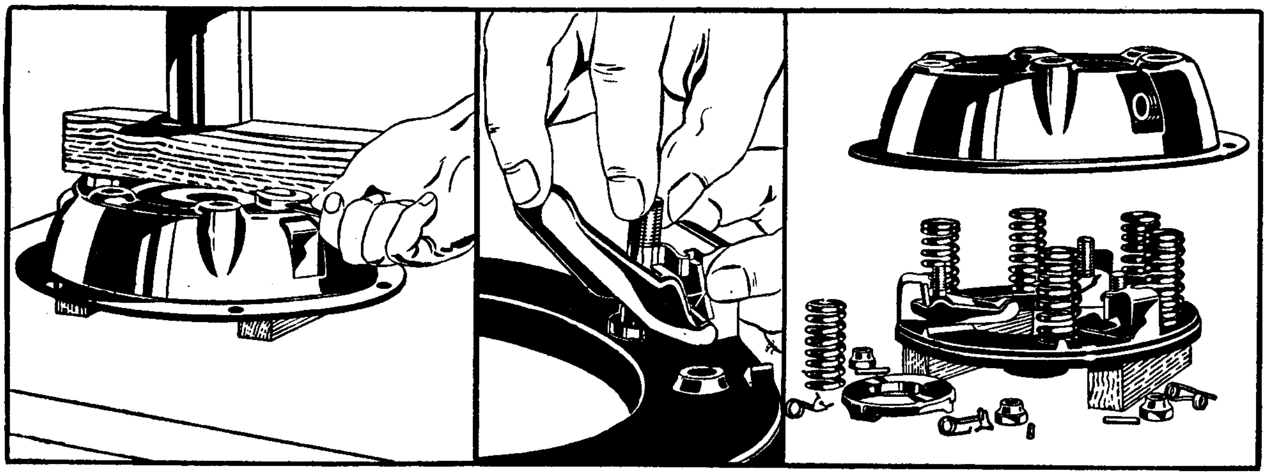


Fig. 11. Dismantling clutch assembly using ram press.

ASSEMBLING

It is essential that all major components be returned to their original positions if the balance of the assembly is to be preserved.

Fit a pin (9, Fig. 8) into an eyebolt (8) and locate the parts within a release lever (4). Hold the threaded end of the eyebolt and the inner end of the lever as close together as possible and, with the other hand, engage the strut (7) within the slots in a lug on the pressure plate, with the other end of the strut push outwards towards the periphery of the plate. Offer up the lever assembly, first engaging the eyebolt shank within the hole in the plate, then locate the strut within the groove in the lever. Fit the remaining levers in the same way, not forgetting to lubricate all contact faces.

Place the pressure plate on the baseplate of the Churchill fixture, on a spare flywheel, or on blocks on the bed of a press and position the thrust springs (2) on the bosses of the plate. Note particularly, that when all of the springs are not painted the same colour, they must be arranged in a symmetrical manner. Having arranged all the springs, and after ensuring that the anti-rattle springs (11) are fixed within the cover, rest the cover on the springs, carefully aligning the pressure plate lugs with the cover slots. If the Churchill fixture or a spare flywheel is being used, move the clutch to align the holes in the cover flange with the tapped holes in the flywheel or baseplate and then clamp the cover down with the fixing screws, turning them a little at a time to avoid distortion. If a press is being used, arrange a block across the cover and compress the assembly. Then screw the adjusting nuts (10) into an approximately correct position.

The release levers must now be set to the correct height, adopting any of the three methods elsewhere described after which the adjusting nuts should be locked by punching them into the eyebolt slots. After setting the levers, fit the release lever plate

ADJUSTING THE RELEASE LEVERS

To ensure satisfactory operation, correct adjustment of the release levers is essential. In service, the original adjustment made by the makers never needs attention and re-adjustment is only necessary if the clutch has been dismantled.

To facilitate the adjustment of the levers Messrs. Borg & Beck produce a series of gauge plates, of which the one shown in Fig. 12 is typical. Numerous gauge plates exist to cover most sizes of clutch, together with the various thicknesses of driven plate which may be employed (see chart on page 18).

An alternative method of lever adjustment is to use the universal fixture known as the No. 99 manufactured by V. L. Churchill & Co. Ltd., which caters for the 6¼"—11" clutch.

Finally, where neither a gauge plate nor Churchill tool is available the levers may be set using the actual driven plate as a gauge and these three methods are described below.

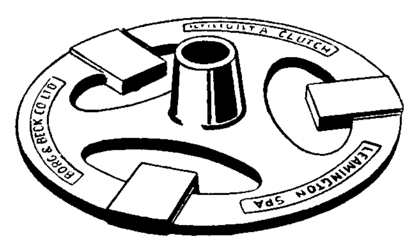


Fig. 12. The gauge plate.

(1) Using a Borg & Beck gauge plate (Fig. 13)

(*a*) Mount the clutch on the actual or a spare flywheel (1, Fig. 13) or alternatively clamp it down to a flat surface, with the gauge plate (4) occupying the position normally taken by the driven plate. The ground lands of the gauge plate should each be located under a release lever (5).

(*b*) Adjust the levers by turning the eyebolt nuts (6) until the levers are just in contact with a short straight edge resting upon the boss of the gauge plate.

(*c*) Having made a preliminary setting some attempt must be made to operate the clutch several times in order to settle the mechanism. Normally, this operation can be carried out in a drilling machine or light press having a suitable adaptor, arranged to bear upon the lever tips.

(*d*) Carry out a further check and re-adjust if necessary.

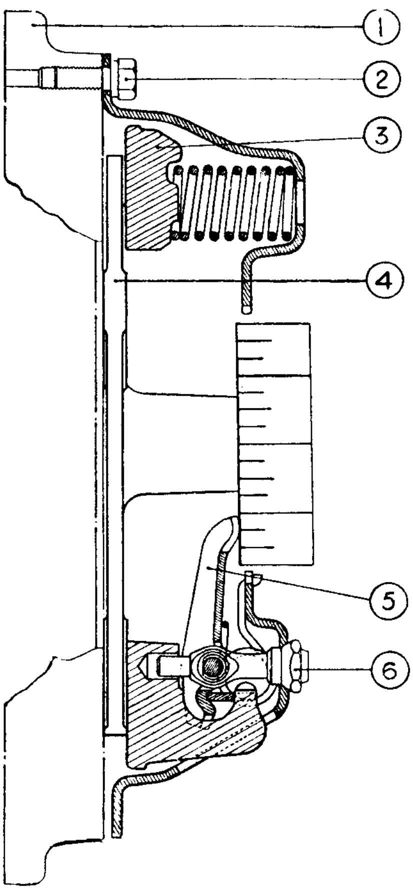


Fig. 13. Release lever adjustment.

(2) Using the Churchill Fixture

This tool, which is illustrated in Fig. 14 provides for the accurate adjustment of the levers ; additionally, it affords a convenient fixture upon which to dismantle and assemble the unit. A device is included to operate the clutch and thereby to settle the working parts after assembly. To use the tool, adopt the following procedure, which also indicates the additional operations when dismantling and assembling the clutch.

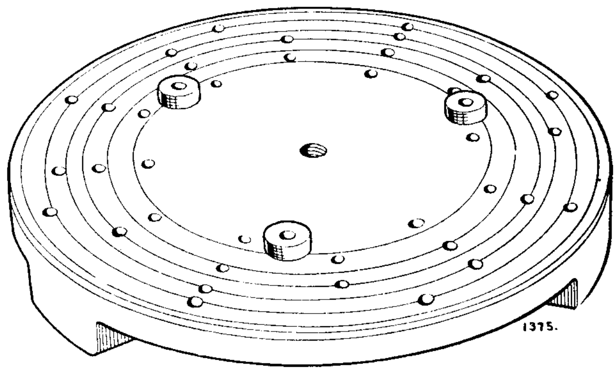


Fig. 14. The special base plate for clutch adjustment.

Remove from the box the gauge finger, the pillar and the actuator, as shown in Fig. 15 and consult the code card to determine the reference of the adaptor and the spacers appropriate to the clutch which is being serviced.

Rest the base plate on a flat surface, wipe it clean and place the spacers upon it in the positions quoted on the code card, as in Fig. 14. Place the clutch on the spacers, aligning it with the appropriate tapped holes in the base, arranging it so that the release levers are as close to the spacers as possible.

Screw the actuator into the centre hole in the base plate and press the handle down to clamp the clutch. Then screw the set bolts provided firmly into the tapped holes in the baseplate using a speed brace ; remove the actuator.

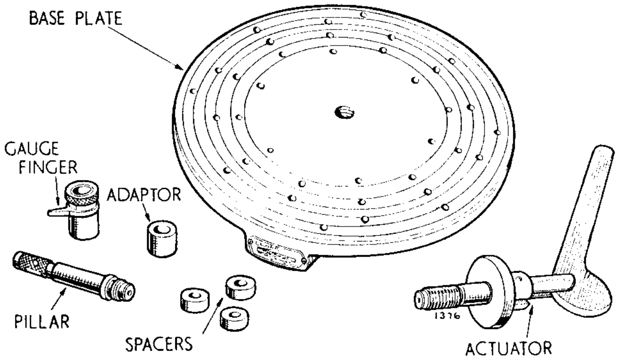


Fig. 15. The base plate and accessories.

Remove the adjusting nuts (Fig. 10) and gradually unscrew the set bolts to relieve the load of the thrust springs (Fig. 16). Lift the cover off the clutch and carry out whatever additional dismantling may be desired.

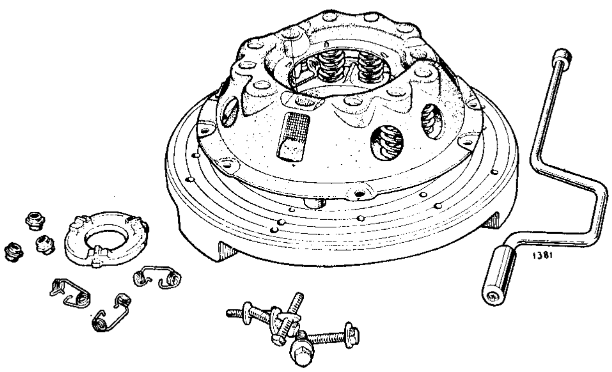


Fig. 16. Removing clutch cover assembly.

After carrying out the necessary servicing of the clutch components, re-assemble the parts on the clutch pressure plate, place the cover upon it and transfer the assembly to the base plate, resting on the spacers and aligned correctly.

Carefully bolt the cover to the base plate and screw the adjusting nuts on to the eyebolts until flush with the tops of the latter. Screw the actuator into the base (Fig. 17) and pump the handle a dozen times to settle the clutch mechanism. Remove the actuator. Screw the pillar firmly into the base and place upon it the appropriate adaptor, recessed face downwards, and the gauge finger.

Turn the adjusting nuts until the finger just touches the release levers, pressing downwards on the finger assembly to ensure that it is bearing squarely on the adaptor (Fig. 18).

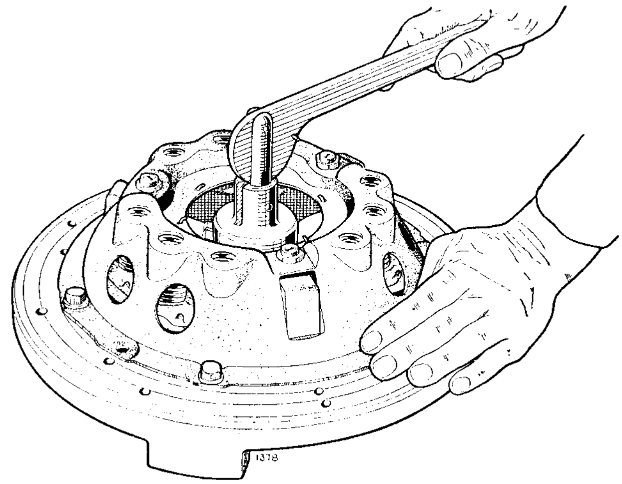


Fig. 17. Screwing actuator into base plate.

Remove the finger adaptor and pillar, replace the actuator and operate the clutch a further dozen times. Replace the pillar and check the lever setting, making any final correction.

Finally, lock the adjusting nuts. The cylindrical portion of the nut must be peened into the slot in the eyebolt, using a blunt chisel and hammer.

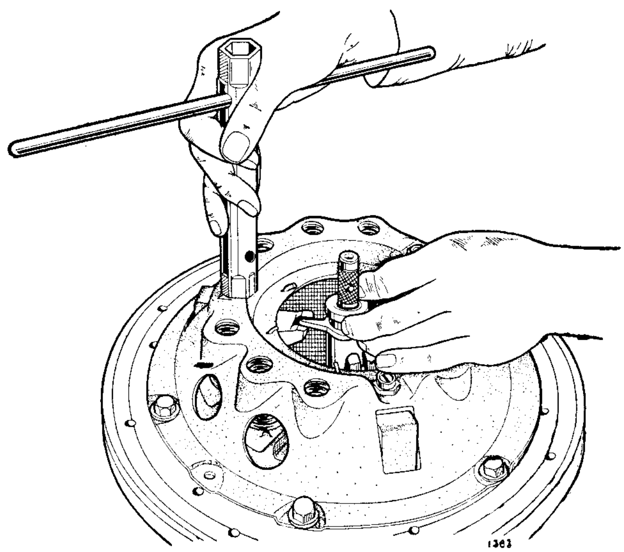


Fig. 18. Using finger assembly to adjust release levers.

(3) Using the Actual Driven Plate

This method of setting the levers is not highly accurate and should only be resorted to when neither a gauge plate nor Churchill Fixture is available. The drawback to this method lies in the fact that although the driven plate is produced to close limits, it is difficult to ensure absolute parallelism. Although the error in the plate is small, it is magnified some five-fold at the lever tip due to the lever ratio.

The method to be adopted is as follows :—

(*a*) Mount the clutch on the flywheel with the driven plate in its normal position or clamp the assembly to any flat surface having a hole within it to accommodate the boss of the driven plate.

(*b*) Consult the chart on page 18 to ascertain the height of the lever tip from the flywheel and adjust the levers until this dimension is achieved.

(*c*) Having made a preliminary setting slacken the clamping pressure, turn the driven plate through a right angle, re-clamp the cover and check the levers again as a safeguard against any lack of truth in the driven plate.

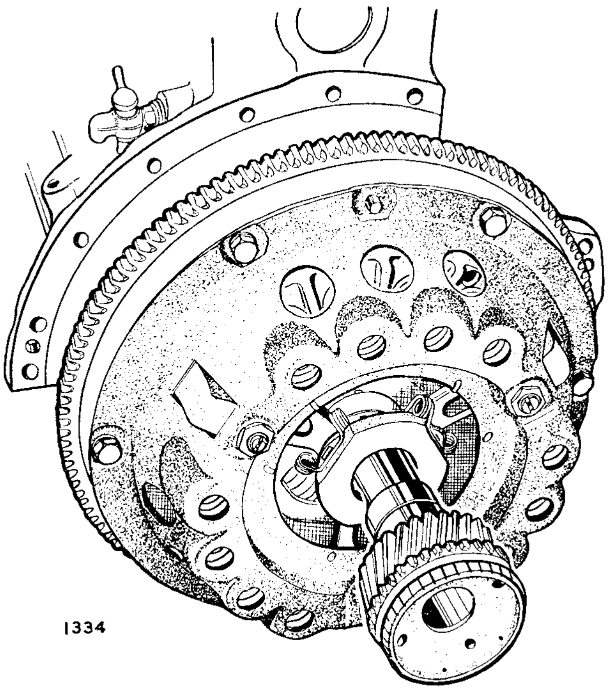


Fig. 19. Centralising driven plate.

REFITTING

Place the driven plate on the flywheel taking care that the larger part of the splined hub faces the gearbox. Centralise the plate on the flywheel by means of the dummy shaft (a constant pinion shaft may be used for this purpose, Fig. 19). Secure the cover assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Ensure that the 'B' stamped adjacent to one of the dowel holes coincides with the 'B' stamped on the periphery of the flywheel (Fig. 20). Do not remove the dummy shaft until all the setscrews are securely tightened, otherwise the driven plate will come off centre and difficulty will be met in engaging the constant pinion shaft into the bush in the rear end of the crankshaft.

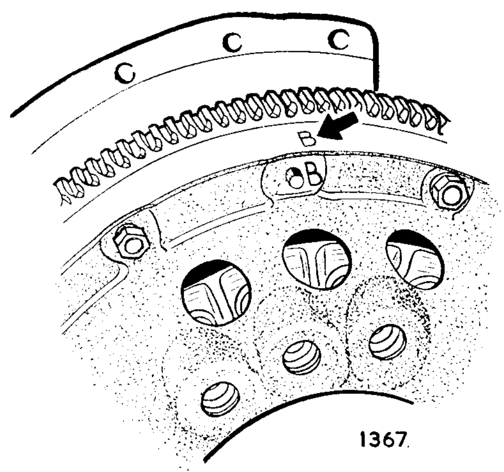


Fig. 20 Balance marks on the clutch and flywheel.

DATA FOR CLUTCH LEVER TIP SETTING

Clutch Model	Driven Plate	Gauge Plate Part No.	Lever tip height from flywheel face Dimension " A "	Gauge Plate Land Thickness Dimension " C "	Gauge Plate Dia.	Remarks
9″	Borglite	CG192	1.895″ (48.14 mm.)	0.330″ (8.381 mm.)	8.375″ (212.7 mm.)	Dimension "A" 2.40″ (60.95mm.) if taken with Release Lever Plate in position.
10″	Borglite	CG14322	1.955″ (49.65 mm.)	0.330″ (8.381 mm.)	8.375″ (212.7 mm.)	Dimension "A" 2.45″ (62.23mm.) if taken with Release Lever Plate in position.

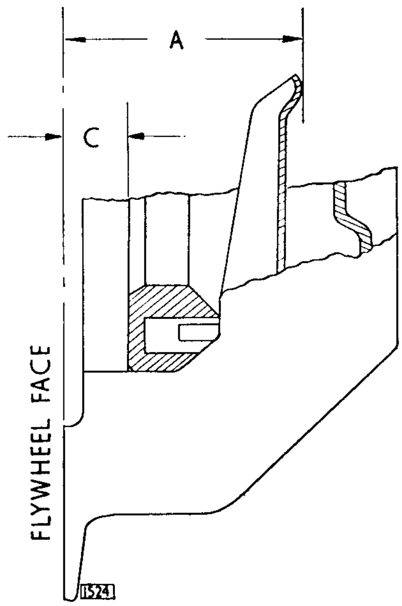


Fig. 21. Dimensions for clutch lever tip setting.

FAULT-FINDING

SYMPTOM	CAUSE	REMEDY
Drag or Spin	(a) Oil or grease on the driven plate facings	Fit new facings
	(b) Misalignment between the engine and splined clutch shaft	Check over and correct the alignment
	(c) Air in clutch system	" Bleed " system
	(d) Bad external leak between the clutch master cylinder and the slave cylinder	Renew pipe and unions
	(e) Excessive clearance between the release bearing and the release lever plate	Adjust to $\frac{1}{16}''$ (1.58 mm.) clearance
	(f) Warped or damaged pressure plate or clutch cover	Renew defective part
	(g) Driven plate hub binding on splined shaft	Clean up splines and lubricate with small quantity of high melting point grease such as Duckham's Keenol
	(h) Distorted driven plate due to the weight of the gearbox being allowed to hang on clutch plate during assembly	Fit new driven plate assembly using a jack to take overhanging weight of the gearbox
	(i) Broken facings of driven plate	Fit new facings, or replace plate
	(j) Dirt or foreign matter in the clutch	Dismantle clutch from flywheel and clean the unit, see that all working parts are free CAUTION: Never use petrol or paraffin for cleaning out clutch
Fierceness or Snatch	(a) Oil or grease on driven plate facings	Fit new facings and ensure isolation of clutch from possible ingress of oil or grease
	(b) Misalignment	Check over and correct alignment
	(c) Worn out driven plate facings	New facings required
Slip	(a) Oil or grease on driven plate facings	Fit new facings and eliminate cause of foreign presence
	(b) Failure to adjust at clutch slave cylinder to compensate for loss of release bearing clearance consequent upon wear of the driven plate facings ($\frac{1}{16}''$ (1.58 mm.) clearance is necessary between the release bearing and the release lever plate)	Adjust push rod as necessary
	(c) Seized piston in clutch slave cylinder	Renew parts as necessary
	(d) Master cylinder by-pass port choked	Clear with bent wire not exceeding 0.018″ (0.46 mm.) diameter

FAULT-FINDING *(continued)*

SYMPTOM	CAUSE	REMEDY
Judder	(a) Oil, grease or foreign matter on driven plate facings	Fit new facings or driven plate
	(b) Misalignment	Check over and correct alignment
	(c) Pressure plate out of parallel with flywheel face in excess of the permissible tolerance	Re-adjust levers in plane, and, if necessary, fit new eyebolts
	(d) Contact area of friction facings not evenly distributed. Note that friction facing surface will not show 100% contact until the clutch has been in use for some time, but the contact actually showing should be evenly distributed round the friction facings	This may be due to distortion, if so fit new driven plate assembly
	(e) Bent splined shaft or buckled driven plate	Fit new shaft or driven plate assembly
Rattle	(a) Damaged driven plate, broken springs, etc., (b) Worn parts in release mechanism (c) Excessive backlash in transmission (d) Wear in transmission bearings (e) Bent or worn splined shaft (f) Graphite release bearing loose on throw out fork	Fit new parts as necessary
Tick or Knock	Hub splines worn due to misalignment	Check and correct alignment then fit new driven plate
Fracture of Driven Plate	(a) Misalignment distorts the plate and causes it to break or tear round the hub or at segment necks	Check and correct alignment and introduce new driven plate
	(b) If the gearbox during assembly be allowed to hang with the shaft in the hub, the driven plate may be distorted, leading to drag, metal fatigue and breakage	Fit new driven plate assembly and ensure satisfactory re-assembly
Abnormal Facing Wear	Usually produced by overloading and by the excessive slip starting associated with overloading	In the hands of the operator

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SECTION F

GEARBOX AND OVERDRIVE

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone	Code	Telegraphic Address
COVENTRY 27677 (P.B.X.)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/F/4.

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INDEX *(continued)*

GEARBOX AND OVERDRIVE

The gearbox is of the four speed type with synchromesh on the second, third and top gears ; these gears are of single helical form and are in constant mesh. The first and reverse gears have spur teeth which slide into mesh.

The overdrive (fitted as an optional extra) is of the Laycock de Normanville type and is dealt with separately at the end of this section.

GEARBOX TYPES

The following table gives the details of the various types of gearboxes fitted to the 2.4 and 3.4 litre models.

GEARBOX

	Standard Ratio	Close Ratio	Intermediate Ratio
Gearbox Prefix	GB or GBN★	GB or GBN★	GB or GBN★
Gearbox Suffix	None or ' O '	' CR ' or ' MS '	' JS '
Gearbox Ratios			
Top (4th)	1 to 1	1 to 1	1 to 1
3rd	1.367 to 1	1.21 to 1	1.283 to 1
2nd	1.982 to 1	1.75 to 1	1.86 to 1
1st and Reverse	3.375 to 1	2.98 to 1	3.377 to 1

★ Letter ' N ' at the end of the prefix letter GB indicates that a mainshaft is fitted suitable for attachment of an overdrive unit.

The variations in construction of the different types of gearboxes are as follows :—

No Suffix, Suffix ' O ' or ' CR '

Layshaft—separate constant, 3rd and 2nd gear assembled on splined sleeve.
Constant pinion shaft bearing retained by circlip.

Suffix ' MS '

Layshaft—one piece cluster.
Constant pinion shaft bearing retained by circlip.

Suffix ' JS '

Layshaft—one piece cluster.
Constant pinion shaft bearing retained by nut and locknut.

Ordering Spare Parts

It is essential when ordering spare parts for an individual gearbox, to quote the prefix and suffix letters in addition to the gearbox number.

The gearbox number is stamped on a lug situated at the left-hand rear corner of the gearbox casing and on the top cover.

DATA

Second gear end-float on mainshaft—.002″ to .004″ (.05 to .10 mm.)
Third gear end-float on mainshaft—.002″ to .004″ (.05 to .10 mm.)
Layshaft end-float on countershaft—.002″ to .004″ (.05 to .10 mm.)

ROUTINE MAINTENANCE

EVERY 2,500 MILES (4,000 KM.)

Gearbox Oil Level

Check the level of the oil in the gearbox with the car standing on level ground.

A combined level and filler plug is fitted on the left-hand side of the gearbox. Clean off any dirt from around the plug before removing it.

The level of the oil should be to the bottom of the filler and level plug hole.

Overdrive Oil Level—Important

The oil for the lubrication and operation of the overdrive unit is fed from the gearbox casing and therefore checking the gearbox oil level will also check the level of the oil in the overdrive unit, but as this unit is hydraulically controlled, extra attention should be paid to exercising absolute cleanliness when replenishing with oil. It is also important that the oil level is not allowed to fall appreciably otherwise the operation of the overdrive may be affected.

EVERY 10,000 MILES (16,000 KM.)

Changing the Gearbox Oil

The draining of the gearbox should be carried out at the end of a run when the oil is hot and therefore will flow more freely. The drain plug is situated at the front end of the gearbox casing.

After all the oil has drained replace the drain plug and refill the gearbox with the recommended grade of oil through the combined filler and level plug hole situated on the left-hand side of the gearbox casing; the level should be to the bottom of the hole.

Overdrive—Oil Changing

The oil for the overdrive unit is common with that in the gearbox but draining the gearbox casing will not drain the oil from the overdrive unit. A large brass drain plug is provided in the base of the overdrive unit and when draining the gearbox this plug should also be removed.

Whilst this drain plug is removed, the overdrive oil pump filter should be cleaned. This filter is accessible through the drain plug and is secured by a central screw.

Thoroughly wash the filter gauze and allow to dry; when refitting do not omit to replace the tubular distance piece and washers on the securing screw.

Refill the gearbox and overdrive with oil through the gearbox filler and level plug hole. RECHECK THE LEVEL AFTER THE CAR HAS BEEN RUN as a certain amount of oil will be retained in the hydraulic system of the overdrive.

Particular attention should be paid to maintaining absolute cleanliness when filling the gearbox and overdrive with oil as any foreign matter that enters may seriously affect the operation of the overdrive.

Recommended Lubricants

Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent
Mobiloil A	Castrol XL	X-100 30	Esso Motor Oil 20W/30	Energol SAE 30	NOL 30	Havoline 30

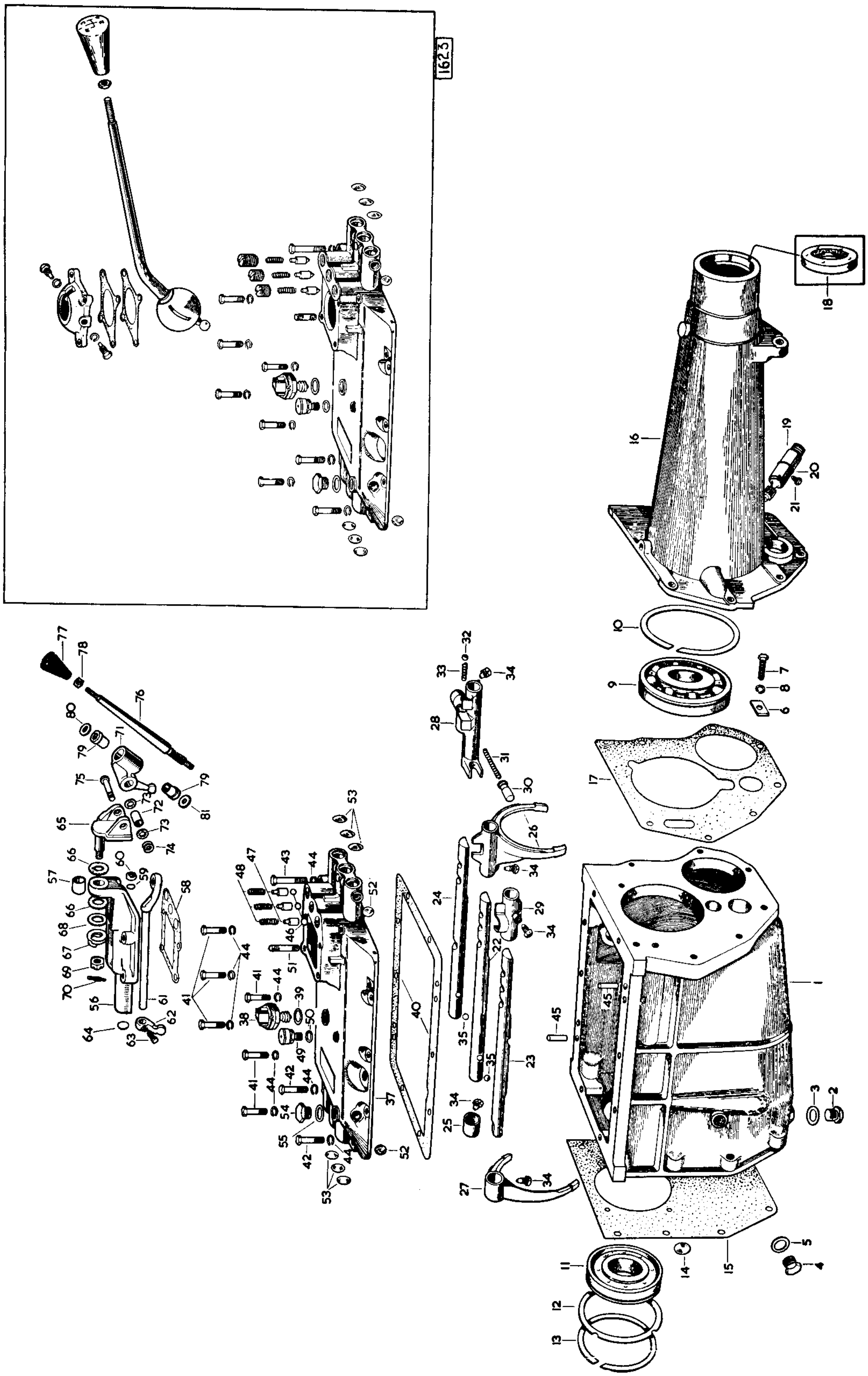
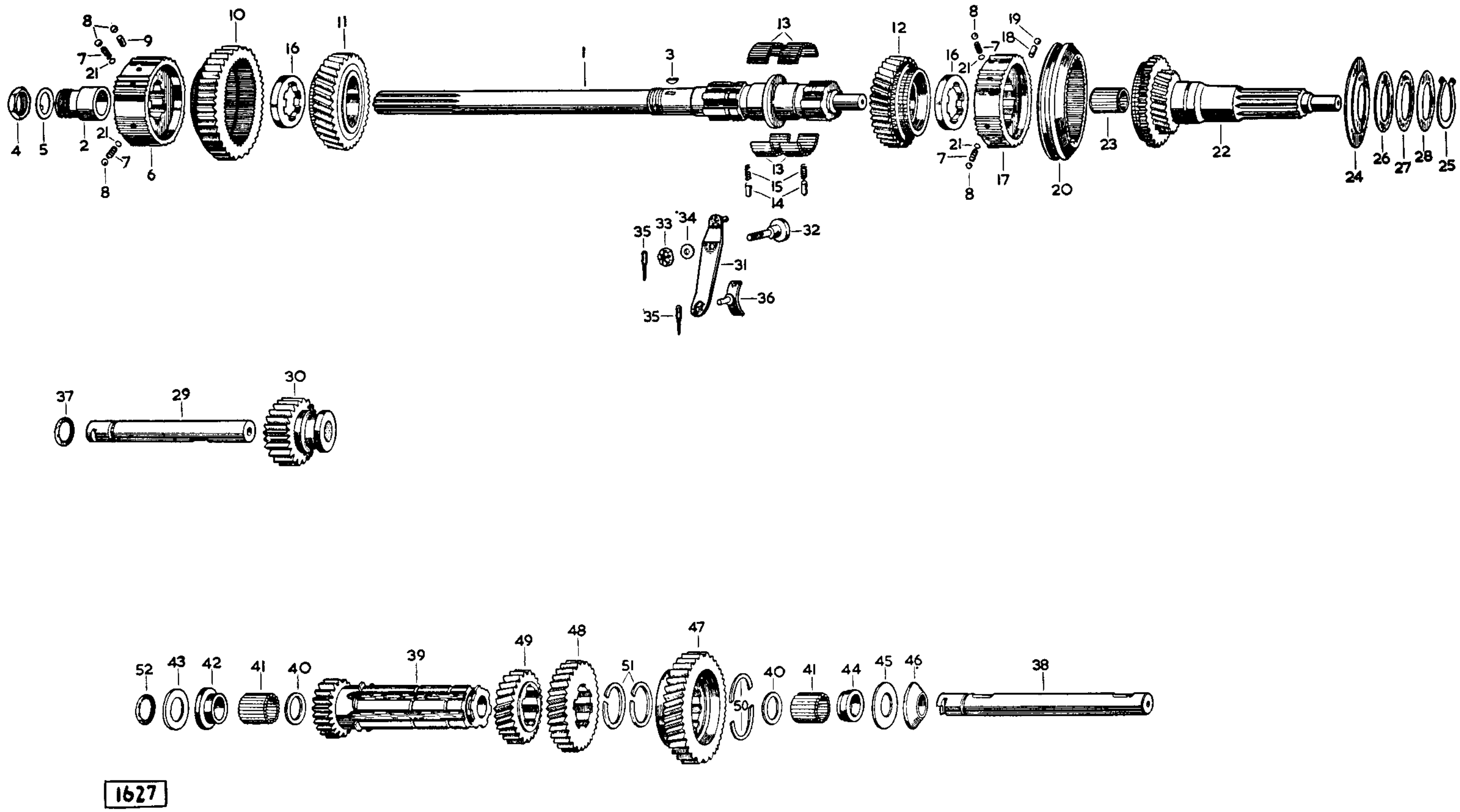


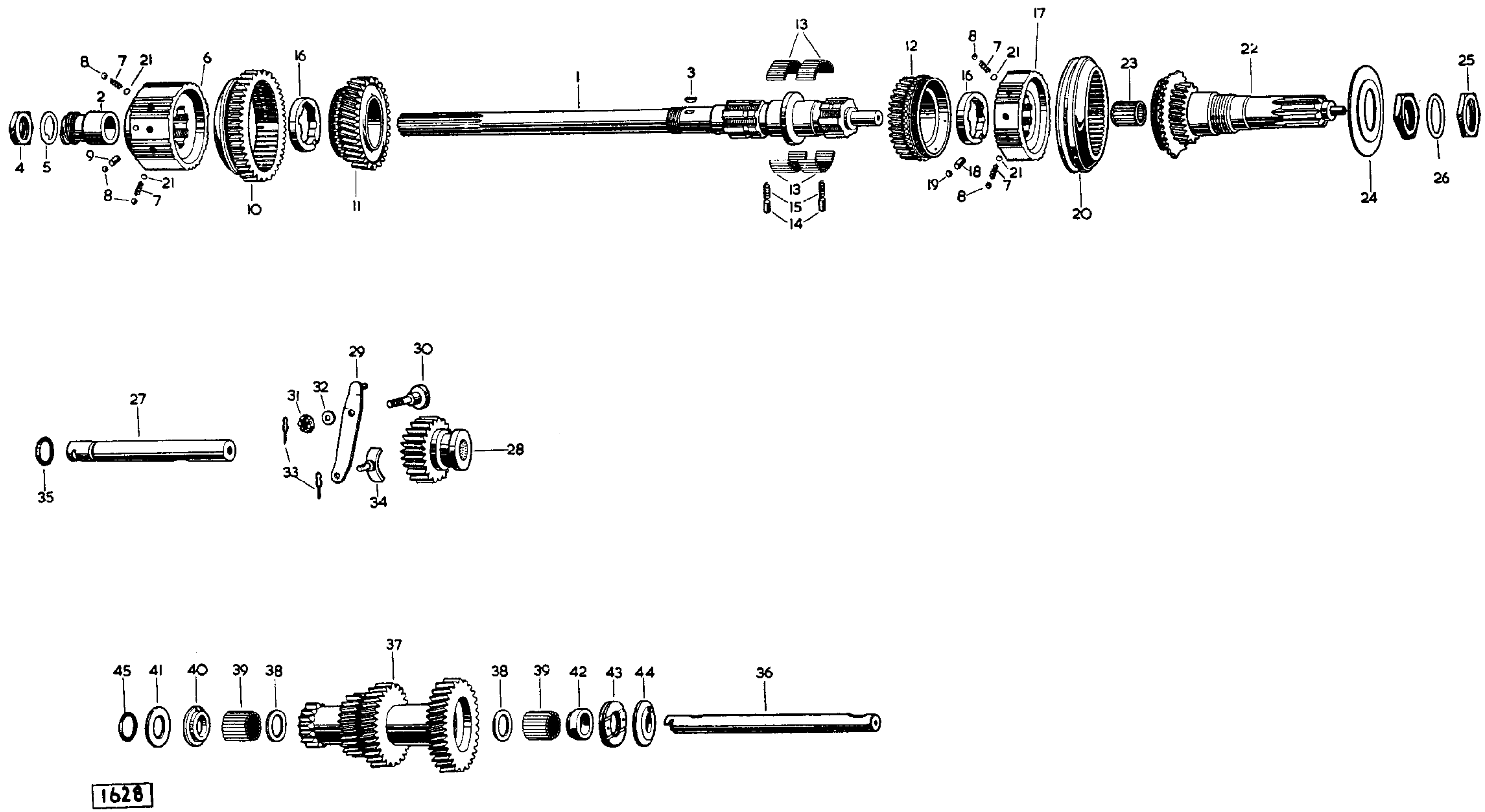
Fig. 2. Exploded view of gearbox casing and top cover. The inset shows the early type of top cover.

1. Gearbox case
2. Drain plug
3. Fibre washer
4. Oil filler plug
5. Fibre washer
6. Locking plate
7. Setscrew
8. Spring washer
9. Ball bearing
10. Circlip
11. Ball bearing
12. Collar
13. Circlip
14. Fibre washer
15. Gasket
16. Gearbox extension
17. Gasket
18. Oil seal
19. Speedometer drive gear
20. 'O' ring
21. Dowel screw
22. Striking rod, 1st/2nd gears
23. Striking rod, 3rd/top gears
24. Striking rod, reverse gear
25. Stop
26. Change speed fork, 1st/2nd gears
27. Change speed fork, 3rd/top gears
28. Change speed fork, reverse gear
29. Selector, 3rd/top gears
30. Plunger
31. Spring
32. Locking ball
33. Spring
34. Dowel screw
35. Ball
37. Top cover
38. Switch
39. Gasket
40. Gasket
41. Bolt
42. Bolt
43. Bolt
44. Spring washer
45. Dowel
46. Plunger
47. Spring
48. Grub screw
49. Grub screw
50. Breather
51. Fibre washer
52. Stud
53. Welch washer
54. Welch washer
55. Plug
56. Copper washer



1. Mainshaft
2. Speedometer driving gear
3. Key
4. Nut
5. Tab washer
6. 2nd speed synchronising sleeve
7. Spring
8. Ball
9. Plunger
10. 1st speed mainshaft gear
11. 2nd speed mainshaft gear
12. 3rd speed mainshaft gear
13. Needle rollers
14. Plunger
15. Spring
16. Thrust washer
17. 3rd/top speed synchronising sleeve
18. Plunger
19. Ball
20. Operating sleeve
21. Shim
22. Constant pinion shaft
23. Roller bearing
24. Oil thrower
25. Circlip
26. Washer
27. Shim
28. Shim
29. Reverse spindle
30. Reverse gear
31. Lever
32. Fulcrum pin
33. Slotted nut
34. Plain washer
35. Split pin
36. Reverse slipper
37. Sealing ring
38. Countershaft
39. 1st speed gear
40. Retaining ring
41. Needle rollers
42. Thrust washer
43. Thrust washer
44. Retaining ring
45. Thrust washer
46. Thrust washer
47. Constant wheel
48. 3rd speed countershaft gear
49. 2nd speed countershaft gear
50. Split ring
51. Circlip
52. Sealing ring

Fig. 2. Exploded view of gears used in units with no suffix " CR " or " MS " to gearbox number.



1. Mainshaft
2. Speedometer driving gear
3. Key
4. Nut
5. Tab washer
6. Synchronising sleeve 2nd gear
7. Spring
8. Ball
9. Plunger
10. 1st speed mainshaft gear
11. 2nd speed mainshaft gear
12. 3rd speed mainshaft gear
13. Needle roller
14. Plunger
15. Spring
16. Thrust washer
17. Synchronising sleeve
18. Plunger
19. Ball
20. Operating sleeve
21. Shim
22. Constant pinion shaft
23. Roller bearing
24. Oil thrower
25. Locknut
26. Tab washer
27. Reverse spindle
28. Reverse gear
29. Lever
30. Fulcrum pin
31. Slotted nut
32. Plain washer
33. Split pin
34. Reverse slipper
35. Sealing ring
36. Countershaft
37. Gear unit on countershaft
38. Retaining ring
39. Needle roller
40. Thrust washer
41. Thrust washer
42. Retaining ring
43. Thrust washer
44. Thrust washer
45. Sealing ring

Fig. 3. Exploded view of gears used in units with suffix "JS" to gearbox number.

GEARBOX—TO REMOVE AND REFIT

In order to remove the gearbox (and overdrive if fitted) it is necessary to remove the gearbox and engine as an assembly as described on page 19 of Section B " Engine ". As removal of the power unit entails lowering the assembly away from the car it will be necessary to first remove the front suspension assembly as described on page 9 of Section J " Front Suspension". The operation should, therefore, be carried out on a hoist preferably of the " four-poster " type or over a pit, with lifting tackle running overhead.

GEARBOX—TO DISMANTLE

Drain the gearbox by removing plug and fibre washer situated at base of the casing. Place gearbox in neutral and remove the ten setscrews with spring washers securing the top cover. Lift off top cover noting that this is located by two dowels fitted in the gearbox case. Remove and scrap the gasket.

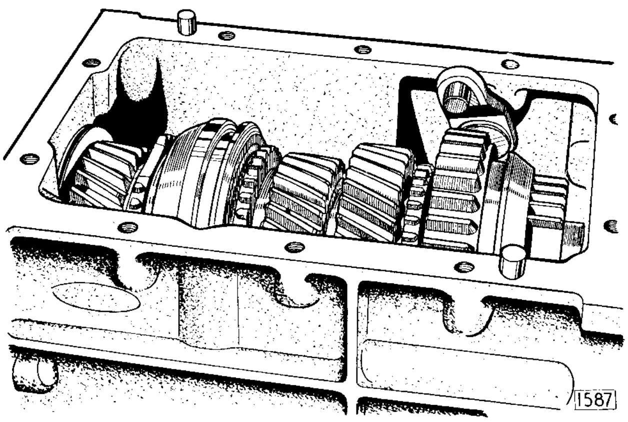


Fig. 4. The gearbox top cover removed showing the layout of the mainshaft gears.

Remove the clutch slave cylinder from the clutch housing. Detach the spring clips and remove the clutch release bearing. Release the locknut and remove the Allen headed screw securing the clutch fork to shaft. Withdraw shaft downwards and remove fork. From inside the clutch housing remove the locking wire from the two bolts and tap back the tabs on the locking washers. Unscrew the eight bolts and remove the clutch housing.

Remove the locking screw retaining the speedometer driven gear bush in the extension. Withdraw the driven gear and bearing.

Remove the fibre blank from the front end of the layshaft.

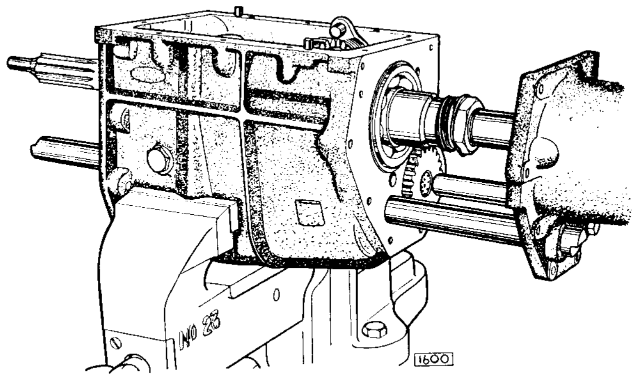


Fig. 5. Showing the removal of the extension; note the dummy countershaft inserted at the front end of the casing.

On non-overdrive gearboxes remove the seven setscrews securing the rear extension to the gearbox casing. (Do not disturb the layshaft/reverse idler locking plate). Withdraw the extension complete with shafts at the same time inserting a dummy countershaft into the countershaft bore at the front of the gearbox casing (see Fig. 5). The dummy shaft and countershaft must be kept in contact until the countershaft is clear of the casing.

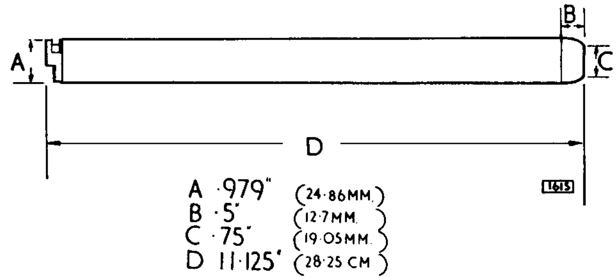


Fig. 6. Dummy countershaft dimensions.

Engage top and first gears. On non-overdrive gearboxes tap back the tab washer securing the locknut at the rear of the mainshaft and unscrew the locknut. Withdraw the speedo drive gear. Remove the woodruff key from the mainshaft. Withdraw the dummy countershaft allowing the layshaft gear unit to drop into the bottom of the casing.

On gearboxes equipped with an overdrive, remove the circlip, plain washer and shims from behind the gearbox rear bearing.

Rotate the constant pinion shaft until the two cutaway portions of the driving gear are facing the top and bottom of the casing. Tap the mainshaft to the front to knock the constant pinion shaft with ball bearing forward out of the case (see Fig. 7). Remove the constant pinion shaft and withdraw the roller bearing from the shaft spigot. Continue to tap mainshaft forward until free of the rear bearing. Tap the bearing rearward out of casing.

Push the reverse gear forward out of engagement to clear the mainshaft first speed gear. Lift the front end of the mainshaft upwards and remove complete with all mainshaft gears forward out of the casing leaving the layshaft in the bottom of the casing (see Fig. 8).

Draw reverse wheel rearwards as far as it will go to clear layshaft first speed gear. Lift out layshaft gear unit observing inner and outer thrust washers fitted at each end of the gears. Take care not to lose any needles which are located at each end of the gear unit.

Push reverse gear back into the case and remove through top. Note bush which is a press fit in reverse gear.

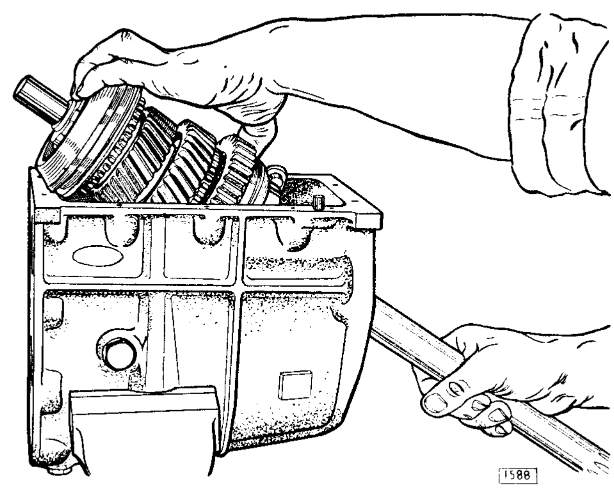


Fig. 8. Removing the mainshaft from the gearbox casing.

DISMANTLING THE MAINSHAFT

Withdraw the top/third gear operating and synchronising sleeves forward off the shaft. Press the operating sleeve off the synchronising sleeve and remove the six synchronising balls and springs. Remove the interlock plungers and balls from the synchro sleeve.

Withdraw the second gear synchronising sleeve complete with first speed gear rearwards off the shaft. Press the first speed gear off the synchronising sleeve and remove the six synchronising balls and springs. Remove the interlock ball and plunger from the synchro sleeve.

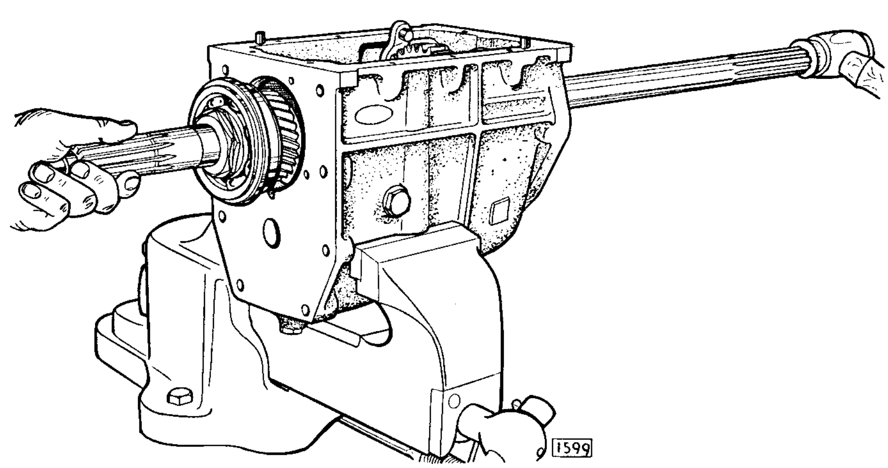


Fig. 7. The constant pinion shaft is removed by tapping the mainshaft forward.

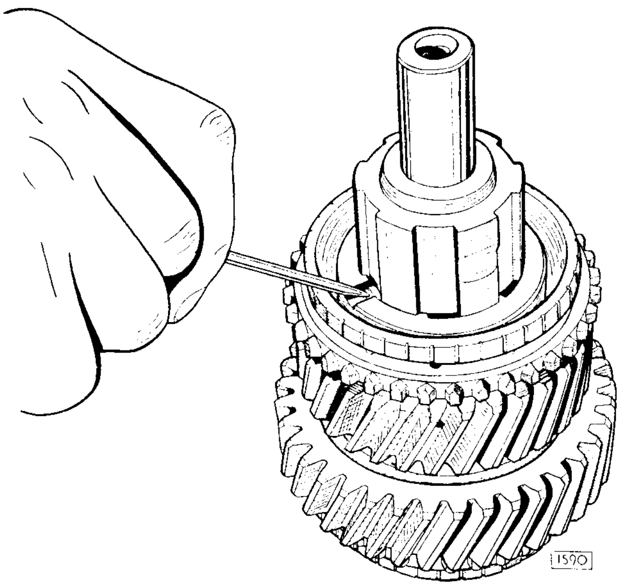


Fig. 9. Depressing the third speed thrust washer locking plunger.

Press in the plunger locking the third speed gear thrust washer (see Fig. 9) and rotate washer until splines line up, when washer can be withdrawn. Remove the washer forward off shaft followed by third speed gear, taking care not to lose any needles which will emerge as the gear is removed. Remove the spring and plunger.

Press in the plunger locking the second speed gear thrust washer (see Fig. 10) and rotate washer until splines line up, when washer can be withdrawn. Remove the washer rearwards off shaft followed by second speed gear, taking care not to lose any needles which will emerge as the gear is removed. Remove the spring and plunger.

DISMANTLING THE LAYSHAFT UNIT

On 'JS' and 'MS' suffix gearboxes the layshaft gear unit is a cluster. On other type gearboxes, second, third and top gears are mounted on a splined extension of first gear. To dismantle, remove circlip located behind the constant gear and push the gear as far as it will go up the shaft. Remove the split ring and draw off the constant mesh gear. Remove the circlip at the front of second and third gears and draw off gears.

DISMANTLING THE CONSTANT PINION SHAFT

Gearboxes with 'JS' Suffix

Knock back tab washer securing locknuts and remove locknuts (right-hand thread). Withdraw the bearing from the shaft and remove the oil thrower.

Other Gearboxes

Remove the circlip, packing washer and shims if fitted. Remove the collar and circlip from the bearing. Withdraw the bearing from the shaft and remove the oil thrower.

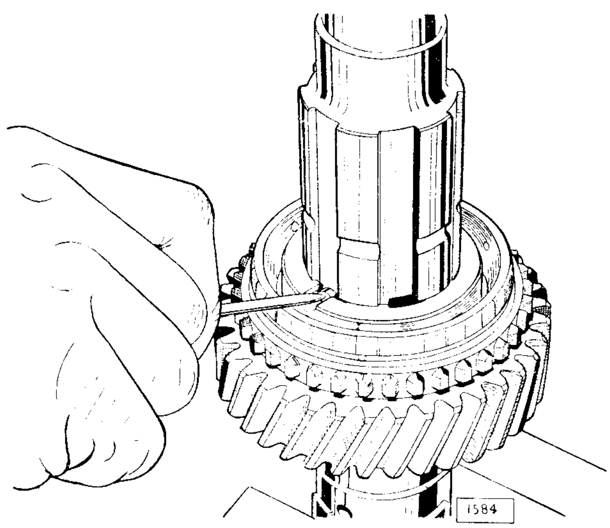


Fig. 10. Depressing the 2nd speed thrust washer plunger.

GEARBOX—TO RE-ASSEMBLE

ASSEMBLING THE LAYSHAFT GEAR UNIT

On the gearboxes with a built-up layshaft gear unit, press second and third gears on to splined extension of first gear and retain with the circlip. Fit the 2nd gear circlip below circlip groove. Press on constant mesh gear as far as possible. Fit the split ring and draw gear forward on to ring. Finally fit circlip behind the constant gear.

Fit the needle roller retaining rings into either end of the layshaft gear unit followed by the needle rollers (29 per end). Apply grease to the needle rollers to facilitate assembly. Fit the outer roller retaining ring at front end. Offer up inner and outer thrust washers at either end of gear unit and lower gears into case through the top and insert a dummy countershaft to located layshaft gear unit in place.

CHECKING LAYSHAFT END-FLOAT

Check the clearance between bronze thrust washer and the casing at rear of layshaft (see Fig. 11). The end-float should be .002″ to .004″ (.05 to .10 mm.). Thrust washers are available in thicknesses of .152″, .156″, .159″, .162″ and .164″ (3.86, 3.96, 4.04, 4.11 and 4.17 mm.) to provide a means of adjusting the end-float.

Note: The gearbox must not be gripped in a vice when checking the end float otherwise a false reading will be obtained.

Remove dummy countershaft and insert a thin rod in its place.

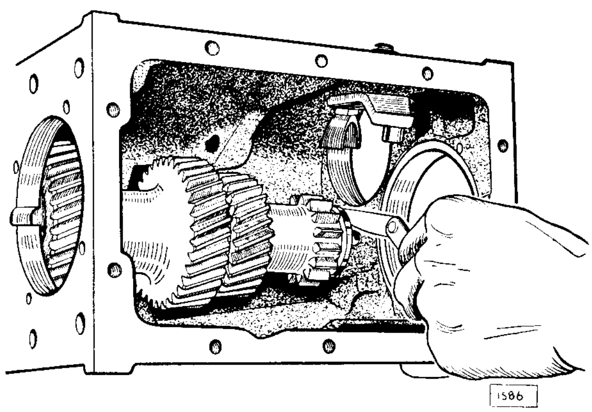


Fig. 11. Checking layshaft end float.

Place bushed reverse gear in slipper and draw gear rearwards as far as possible to give clearance for fitting layshaft gear unit.

ASSEMBLING THE MAINSHAFT

Fit the needle rollers (41 off) behind the shoulder on the mainshaft and slide the second speed gear, synchronising cone to rear, on to rollers. Apply grease to the needle rollers to facilitate assembly. Fit the second speed thrust washer spring and plunger into plunger hole. Slide thrust washer up shaft and over

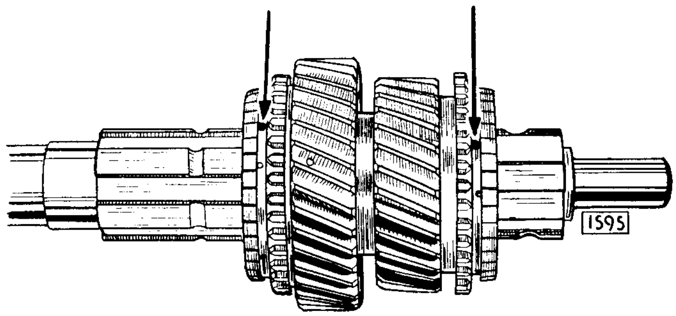


Fig. 12. Showing the holes through which the thrust washer locking plungers are depressed.

splines. Align large hole in synchro cone and with a steel pin compress plunger and rotate thrust washer into locked position with cutaway in line with plunger. Check the end-float of the second gear on the mainshaft by inserting a feeler gauge between the thrust washer and the shoulder on the mainshaft. The clearance should be .002″ to .004″ (.05 to .10 mm.). Thrust washers are available in the following thicknesses to enable the end-float to be adjusted :

.471″/.472″—(11.96/11.99 mm.)

.473″/.474″—(12.01/12.03 mm.)

.475″/.476″—(12.06/12.09 mm.)

Fit the needle rollers (41 off) in front of the shoulder on the mainshaft and slide the third speed gear, synchronising cone to front, on to rollers. Apply grease to the needle rollers to facilitate assembly. Fit the third speed thrust washer spring and plunger into plunger hole. Slide thrust washer down shaft and over splines. Align large hole in synchro cone and with a steel pin compress plunger and rotate thrust washer into locked position with cutaway in line with plunger. Check the end-float of the third gear on the mainshaft by inserting a feeler gauge between the thrust washer and the shoulder on the mainshaft. The clearance should be .002″ to .004″ (.05 to .10 mm.). Thrust washers are available in the following thicknesses to enable the end-float to be adjusted :

.471"/.472"—(11.96/11.99 mm.)
.473"/.474"—(12.01/12.03 mm.)
.475"/.476"—(12.06/12.09 mm.)

ASSEMBLING THE 2nd GEAR SYNCHRO ASSEMBLY

Fit the springs and balls (and shims if fitted) to the six blind holes in the synchro sleeve. Fit the 1st speed gear to the 2nd speed synchronising sleeve with the relieved tooth of the internal splines in the gear in line with the stop pin in the sleeve (see Fig. 13). Compress the springs by means of a hose clip or by inserting the assembly endwise in a vice and slowly closing the jaws. Slide the operating sleeve over the synchronising sleeve until the balls can be heard and felt to engage the neutral position groove.

It should require 62 to 68 lbs. (28 to 31 kg.) pressure to disengage the synchronising sleeve from the neutral position in the operating sleeve. In the absence of the necessary equipment to check this pressure, grip the operating sleeve in the palms of the hands and press the synchronising sleeve with the fingers until it disengages from the neutral position ; it should require firm finger pressure before disengaging. Shims can be fitted underneath the springs to adjust the pressure of the balls against the operating sleeve.

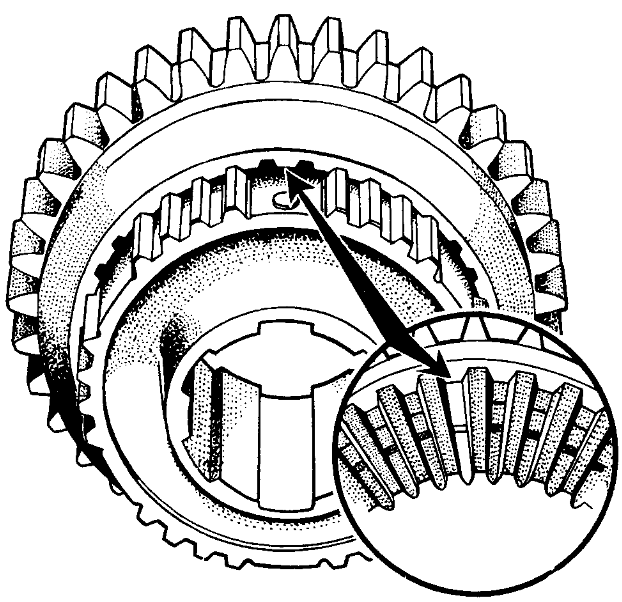


Fig. 13. When fitting the 1st speed gear to the 2nd speed synchro sleeve the relieved tooth on the internal splines must be in line with the stop pin in the sleeve.

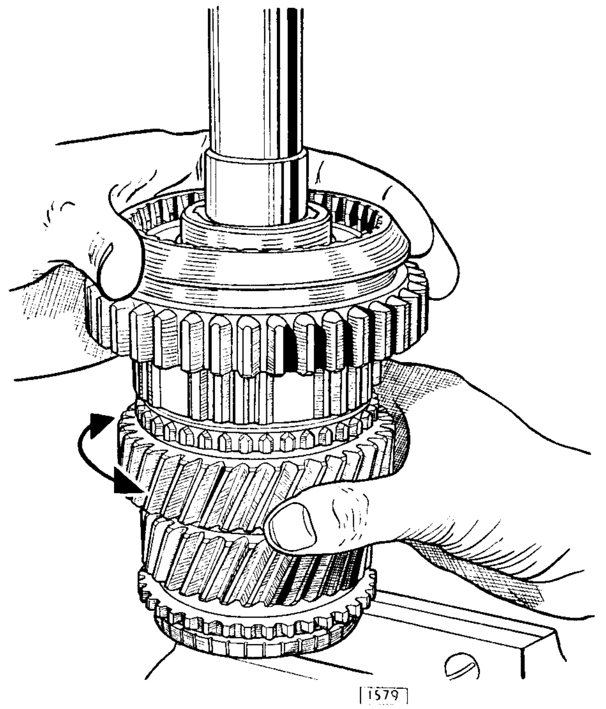


Fig. 14. With 1st gear engaged and slight downward pressure on the synchro assembly the 2nd speed gear should be free to rotate.

FITTING THE 2nd GEAR ASSEMBLY TO THE MAINSHAFT

Fit the 1st speed gear/2nd speed synchro assembly to the mainshaft (any spline) and check that the synchro sleeve slides freely on the mainshaft, when the ball and plunger is not fitted. If it does not, try the sleeve on different splines on the mainshaft and check for burrs at the end of the splines.

Remove the synchro assembly from the mainshaft, fit the ball and plunger and refit to the same spline on the mainshaft.

Check the interlock plunger as follows :—

Slide the outer operating sleeve into the first gear position as shown in Fig. 14.

With slight downward pressure on the synchro assembly the 2nd speed gear should rotate freely without any tendency for the synchro cones to rub.

If the synchro cones are felt to rub, a longer plunger should be fitted to the synchro sleeve. Plungers are available in the following lengths :—

.490", .495" and .500" (12.4, 12.52 and 12.65 mm.).

ASSEMBLING THE 3rd/TOP SYNCHRO ASSEMBLY

Fit the springs and balls (and shims if fitted) to the six blind holes in the inner synchronising sleeve. Fit the wide chamfer end of the operating sleeve to the large boss end of inner synchronising sleeve (see Fig. 15) with the two relieved teeth in operating sleeve in line with the two ball and plunger holes in the synchronising sleeve (see Fig. 16). Compress the springs by means of a hose clip or by inserting the assembly endwise in a vice and slowly closing the jaws. Slide the operating sleeve over the synchronising sleeve until the balls can be heard and felt to engage the neutral position groove.

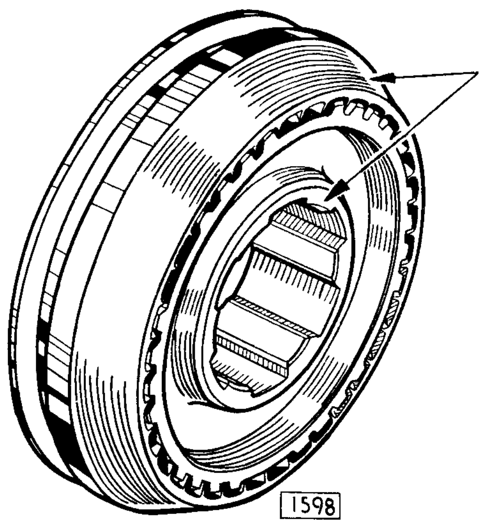


Fig. 15. The wide chamfer end of the operating sleeve must be fitted to the same side as the large boss of the inner synchro sleeve.

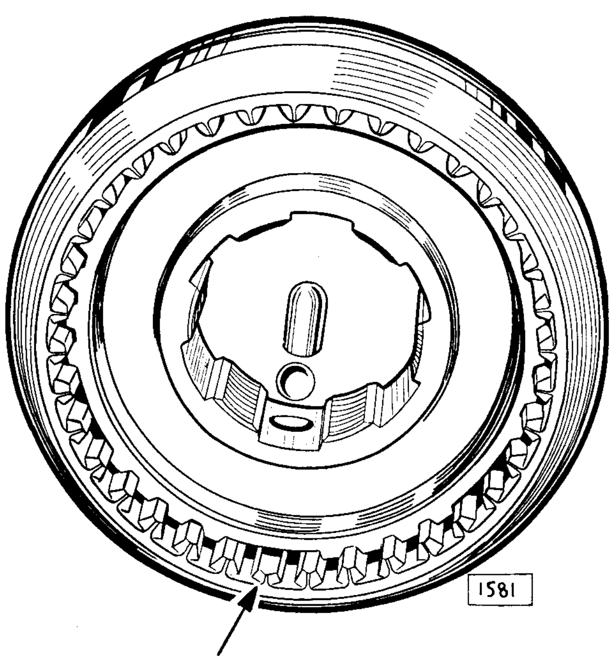


Fig. 16. The relieved teeth in the operating sleeve must be in line with the interlock plunger holes in the synchro sleeve.

It should require 52 to 58 lbs. (24 to 26 kg.) pressure to disengage the synchronising sleeve from the neutral position in the operating sleeve. In the absence of the necessary equipment to check this pressure grip the operating sleeve in the palms of the hands and press the synchronising sleeve with the fingers until it disengages from the neutral position ; it should require firm finger pressure before disengaging. Shims can be fitted underneath the springs and balls to adjust the pressure of the balls against the operating sleeve.

FITTING THE 3rd/TOP SYNCHRO ASSEMBLY TO THE MAINSHAFT

Fit the interlock balls and plungers, balls first, to the holes in the synchronising sleeve.

When fitting the 3rd speed/top gear synchro assembly to the mainshaft note the following points :—

(a) There are two transverse grooves on the mainshaft splines which take the 3rd/top synchro assembly and the relieved tooth at the wide chamfer end of the outer operating sleeve must be in line with the **foremost** groove in the mainshaft (Fig. 17). Failure to observe this procedure will result in the locking plungers engaging the wrong grooves thereby preventing full engagement of top and third gears.

(b) The wide chamfer end of the outer operating sleeve must be facing forward, that is, towards the constant pinion shaft end of the gearbox.

The inner sleeve must slide freely on the mainshaft, when the balls and plungers are not fitted. If it does not, check for burrs at the ends of the splines.

Fit the two balls and plungers to the holes in the inner synchro sleeve and refit the synchro assembly to the mainshaft observing points ' a ' and ' b ' above.

Check the interlock plungers as follows :—

Slide the 3rd/top operating sleeve over the 3rd speed gear dogs as shown in Fig. 18. With the 3rd gear engaged lift and lower the synchro assembly ; it should be possible to move the assembly approximately $\frac{3}{32}''$ (2.5 mm.) without any drag being felt. If it is found that the synchro assembly does not move freely a shorter 3rd speed plunger should be fitted ; looking

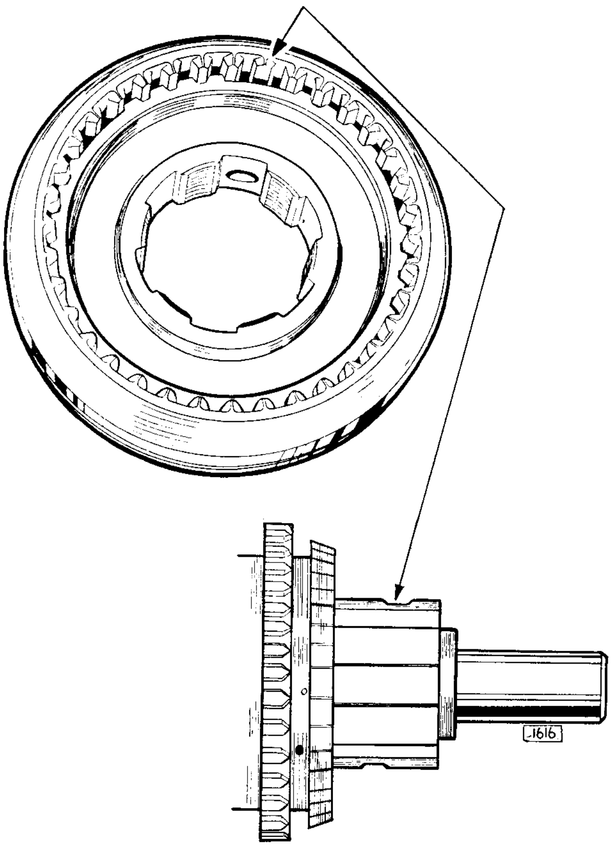


Fig. 17. The relieved tooth at the wide chamfer end of the outer operating sleeve must be in line with the foremost groove in the mainshaft.

at the wide chamfer end of the outer operating sleeve this is the plunger that is not opposite the relieved tooth in the operating sleeve.

Plungers are available in the following lengths :—
.490", .495" and .500" (12.4, 12.52 and 12.65 mm.).

Next slide the operating sleeve into the top gear position as shown in Fig. 19.

Lift and lower the synchro assembly ; it should be possible to move the assembly approximately $\frac{3}{16}$" (4.5 mm.) without any drag being felt. Also with slight downward pressure exerted on the synchro assembly the 3rd speed gear should be free to rotate without any tendency for the synchro cones to rub.

If it is found that the synchro assembly does not move freely a shorter top gear plunger should be fitted. If the 3rd gear synchro cones are felt to rub a longer top gear plunger should be fitted ; looking at the wide chamfer end of the outer operating sleeve, the top gear plunger is one in line with the relieved tooth in the operating sleeve.

Plungers are available in the following lengths :
.490", .495" and .500" (12.4, 12.52 and 12.65 mm.).

ASSEMBLING THE CONSTANT PINION SHAFT

'JS' Suffix Gearboxes

Fit the oil thrower followed by ball bearing on to shaft with circlip and collar fitted to outer track of bearing. Screw on nut (right-hand thread) and fit

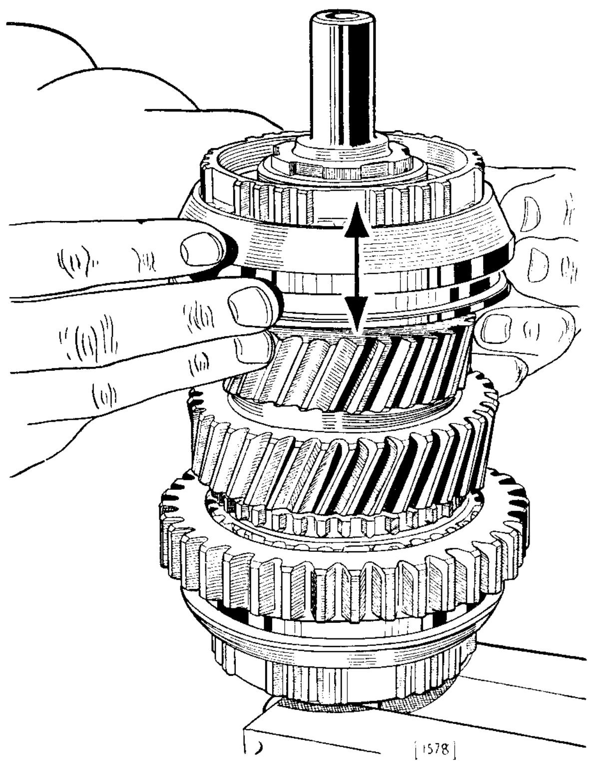


Fig. 18. Checking 3rd speed interlock plunger. With 3rd speed engaged there should be approximately $\frac{3}{32}$" (2.5 mm.) axial movement without drag.

tab washer and locknut. Fit the roller race into the shaft spigot bore.

Other Gearboxes

Fit the oil thrower followed by ball bearing with circlip and collar fitted to outer track of bearing. Fit shims, if necessary, to eliminate all end-float and secure with the circlip. Fit roller race into shaft spigot bore.

ASSEMBLING THE GEARS TO THE CASING

Enter the mainshaft through the top of the casing and pass to the rear through bearing hole in case. Fit a new gasket to the front face of casing. Offer up the constant pinion shaft at the front of the case with cutaway portions of toothed driving member facing the top and bottom of the casing. Tap the constant pinion shaft to the rear until the collar and circlip on the bearing butt against the casing. Holding the constant

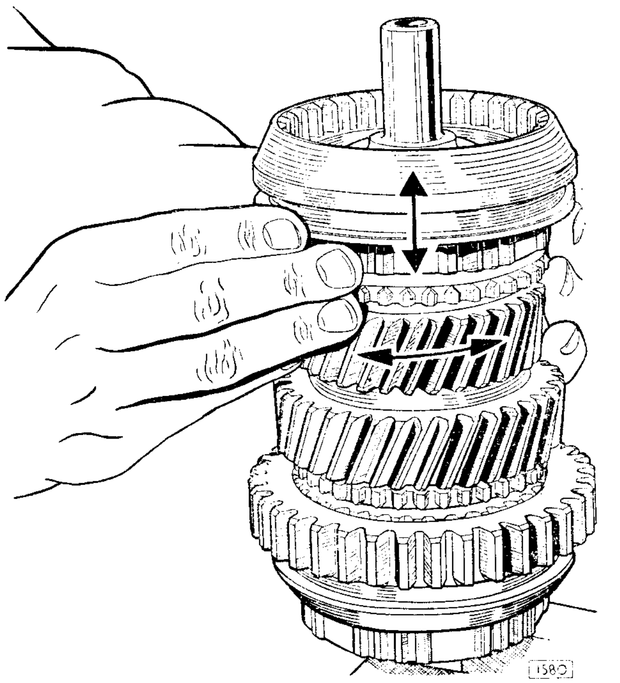


Fig. 19. Checking the 4th (top) gear interlock plunger. With the top gear engaged there should be approximately $\frac{3}{16}$" (4.76 mm.) axial movement without any drag. With top gear still engaged and with slight downward pressure exerted on synchro assembly the 3rd speed gear should be free to rotate.

pinion shaft in position tap in the rear bearing complete with circlip.

Lift the layshaft cluster into mesh with the thin rod and insert a dummy countershaft through the countershaft bore in front face of the casing, (see Fig. 20).

Engage top and first gears. On non-overdrive gearboxes fit the woodruff key and speedo drive gear

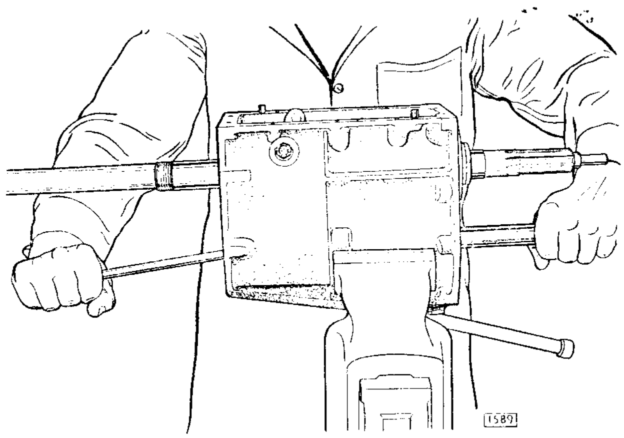


Fig. 20. Lifting the layshaft into mesh and inserting dummy countershaft.

to the mainshaft. Fit the tab washer and locknut and secure. Place gearbox in neutral.

On gearboxes equipped with an overdrive, fit the shim(s), plain washer and circlip behind the rear bearing. Fit as many shims as are necessary to eliminate all end-float from the mainshaft.

Fit the clutch operating fork and insert shaft. Fit the locking screw and locknut. Fit the release bearing and spring clips. Engage slave cylinder with operating rod and slide on to studs. Fit the spring anchor plate to lower stud and secure with the nuts. Fit the return spring.

FITTING THE TOP COVER

Fit a new gasket on to top face of case. Offer up the top cover, noting that this is located by two dowels

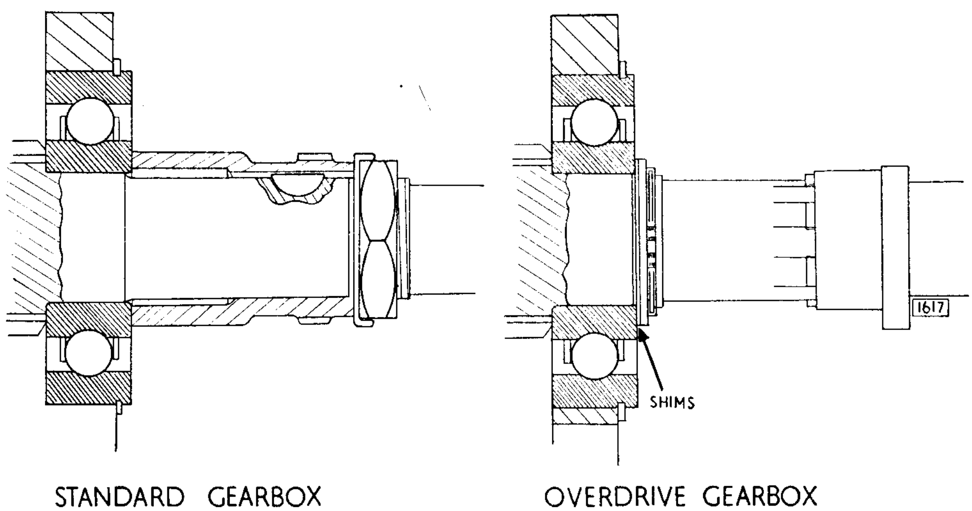


Fig. 21. Showing the rear bearing retaining arrangement.

and secure in position with ten setscrews and spring washers. (Two long screws at rear and two short screws at front.) Fit the gearbox drain plug and fibre washer.

FITTING THE EXTENSION

Fit a new gasket to the rear face of the gearbox casing. Offer up the extension complete with counter and reverse shafts and tap into position, driving the dummy countershaft forward out of the casing. Secure the extension with seven setscrews and spring washers.

Fit a new fibre washer at the front end of the countershaft. Fit the speedo driven gear and bearing to the extension.

FITTING THE CLUTCH HOUSING

Fit a new oil seal into the clutch housing, lip of oil seal facing the gearbox.

Fit the clutch housing and secure with the eight bolts and three tab washers and locking wire.

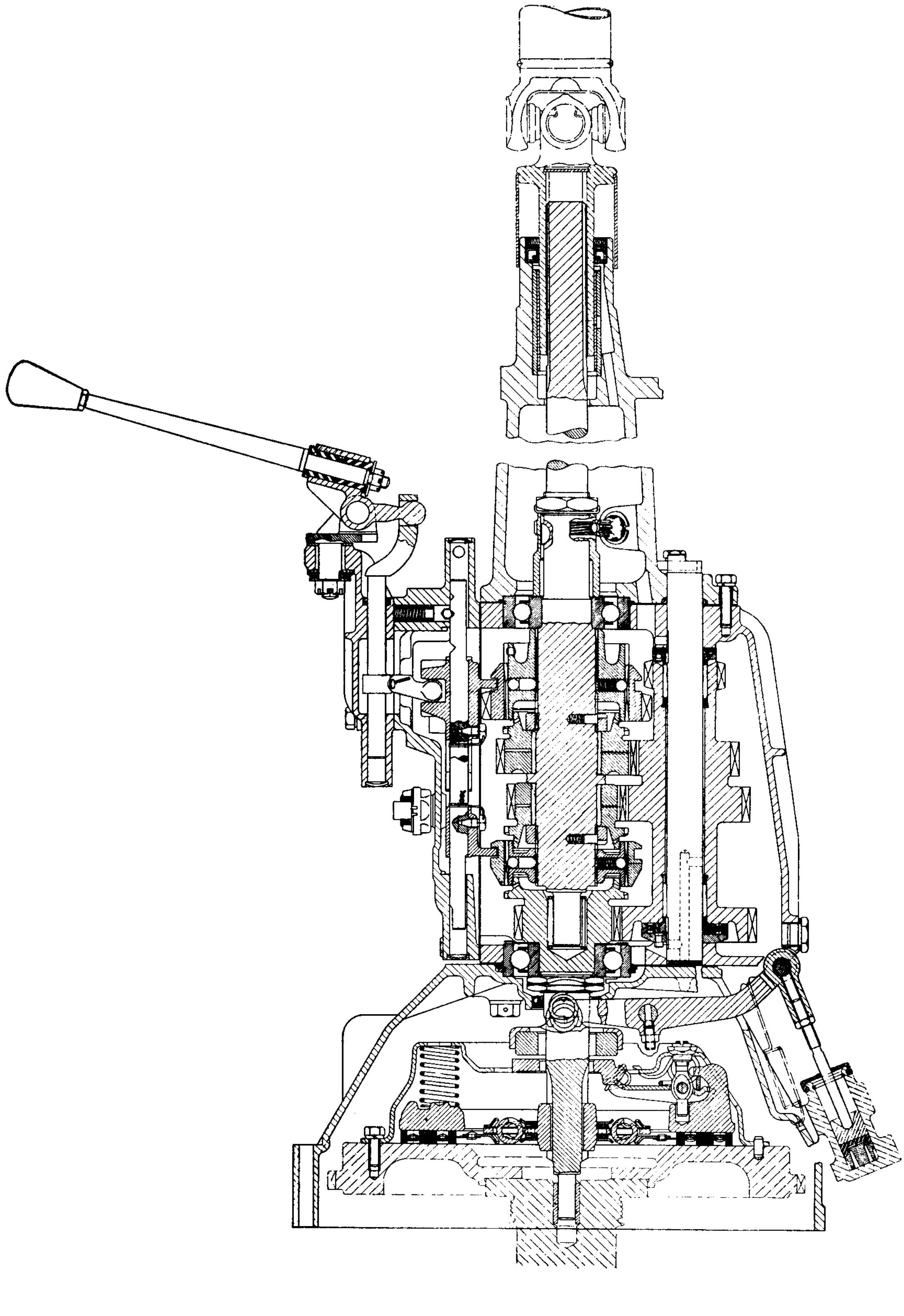


Fig. 22. Sectioned drawing of the gearbox showing the later type of gear selector.

OVERDRIVE

METHOD OF OPERATION

The Laycock de Normanville overdrive unit (fitted as an optional extra) comprises a hydraulically controlled epicyclic gear housed in a casing which is directly attached to an extension at the rear of the gearbox.

When brought into operation, the overdrive reduces the engine speed in relation to the road speed. This permits high road speeds with low engine revolutions resulting in fuel economy and reduced engine wear.

The synchromesh gearbox driven (or input) shaft is extended and carries at its end the inner member of a uni-directional clutch. The outer member of this clutch is carried in the combined annulus and output shaft. Also mounted on the input shaft are the planet carrier and a freely rotatable sun-wheel. Splined to a forward extension of the sun-wheel and sliding thereon is a cone clutch member, the inner lining of which engages the outside of the annulus, while the outer lining engages a cast-iron brake ring sandwiched between the front and rear parts of the unit housing.

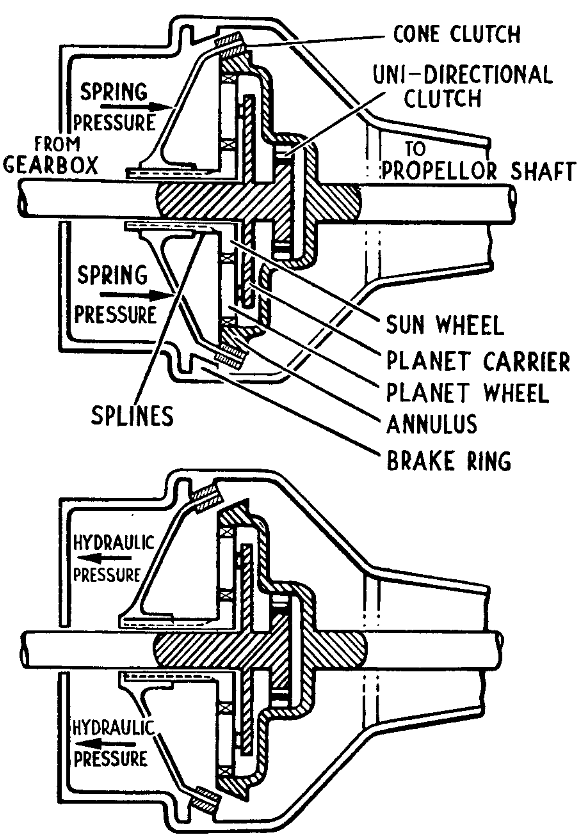


Fig. 23. Principle of operation.

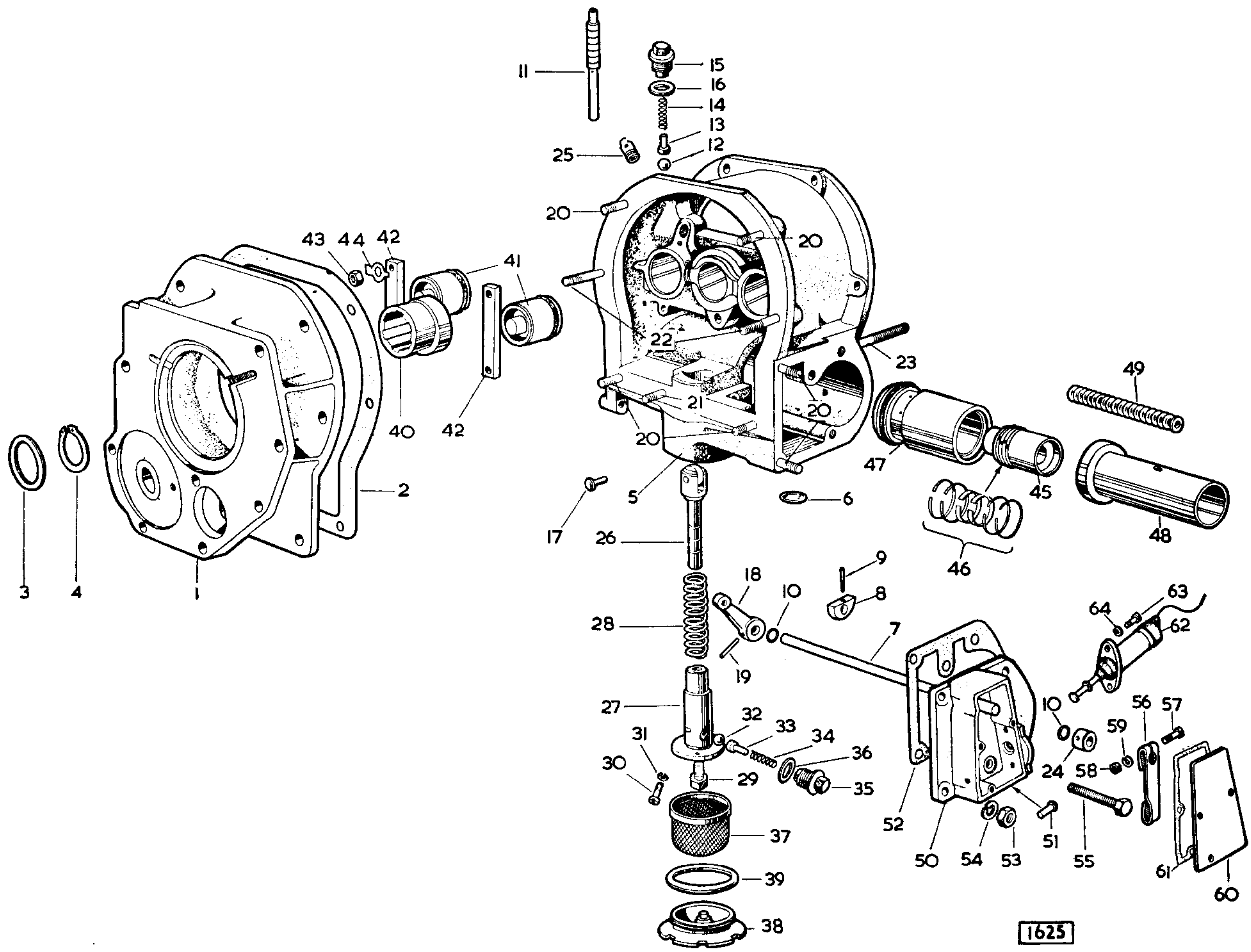
A number of compression springs are used to hold the cone clutch in contact with the annulus, locking the sun-wheel to the latter so that the entire gear train rotates as a solid unit, giving direct drive. In this condition the drive is taken through the uni-directional clutch, the cone clutch taking overrun and reverse torque since without it there would be a free-wheel condition.

The spring pressure can be overcome through the medium of two pistons, working in cylinders formed in the unit housing, supplied with oil under pressure from a hydraulic accumulator. This hydraulic pressure causes the cone clutch to engage the stationary brake ring and bring the sun-wheel to rest, allowing the annulus to overrun the uni-directional clutch and give an increased speed to the output shaft, i.e. " overdrive ".

When changing from overdrive to direct gear, if the accelerator pedal is released, as in change down for engine braking, the cone clutch being oil immersed, takes up smoothly. If the accelerator pedal is not released when contact between the cone clutch and brake ring is broken, the unit still operates momentarily in its overdrive ratio since engine speed and road speed remain unchanged. But the load on the engine is released and it begins to accelerate, speeding up the sun-wheel from rest, until, just at the instant when its speed synchronises with the speed of the annulus, the whole unit revolves solidly and the uni-directional clutch takes up the drive once more. The movement of the cone clutch is deliberately slowed down so that the uni-directional clutch is driving before the cone clutch contacts, ensuring a perfectly self-synchronised change.

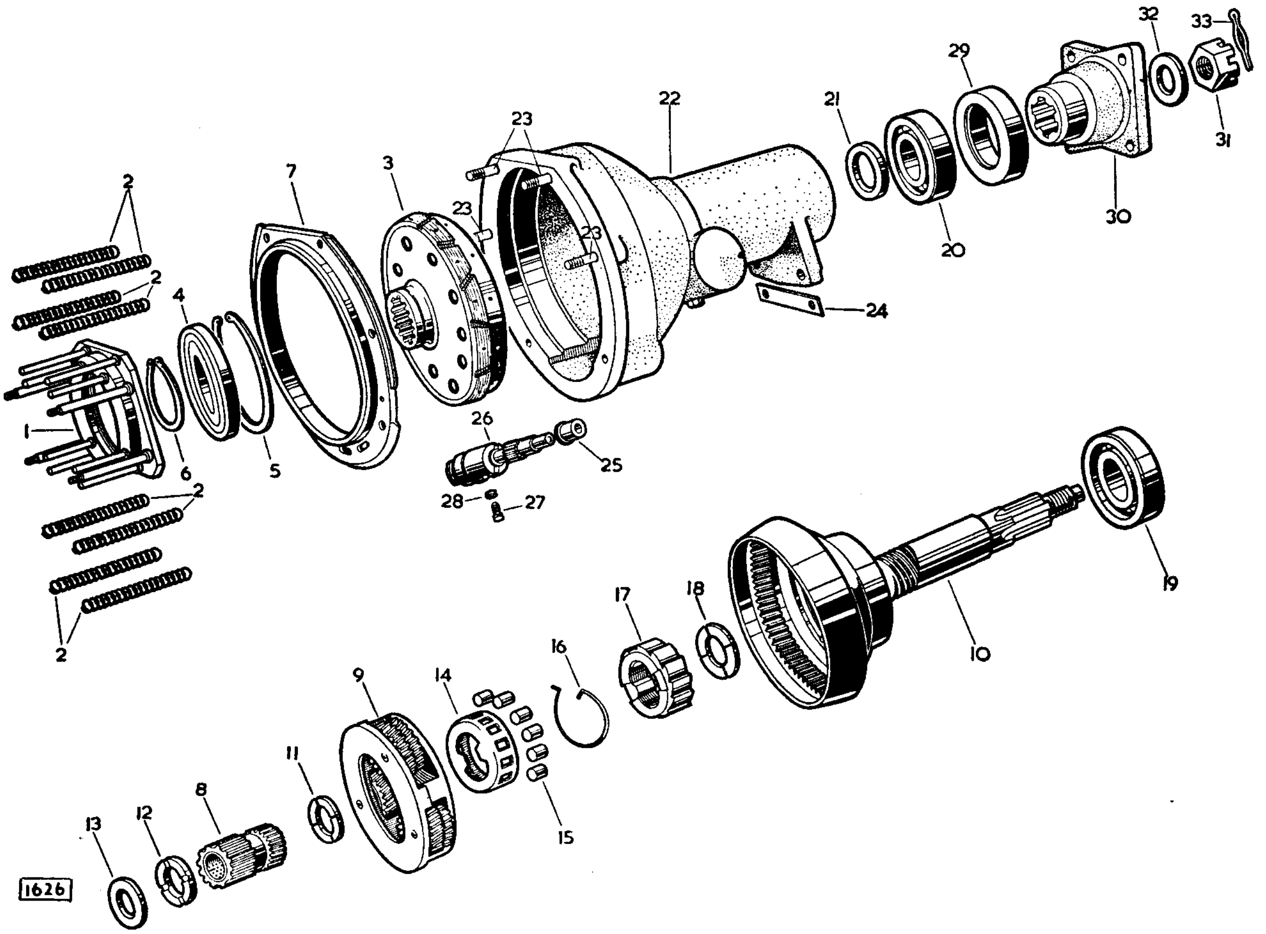
CONSTRUCTION

The driven shaft of the synchromesh gearbox is extended to carry first a cam operating the oil pump, and then a steady bearing with two opposed plain bushes carried in the front housing. Next is the sun-wheel of the epicyclic gear carried on a Clevite bush, and beyond this the shaft is splined to take the planet carrier and uni-directional clutch. The end of the shaft is reduced and carried in a plain bush in the output shaft. The latter is supported in the rear housing by two ball bearings. The clutch member slides on the splines of the sun-wheel extension to contact either the annulus or a cast-iron brake ring forming part of the unit housing. To the hub of the cone clutch member is



1. Gearbox extension
2. Gasket
3. Steel spacing washer
4. Circlip
5. Front casing assembly
6. Core plug
7. Shaft
8. Cam lever
9. Taper pin
10. ' O ' ring
11. Main operating valve
12. Ball
13. Plunger
14. Spring
15. Plug
16. Copper washer
17. Guide peg
18. Valve setting lever
19. Taper pin
20-23. Studs
24. Collar
25. Breather
26. Oil pump plunger assembly
27. Oil pump body
28. Spring
29. Plug
30. Setscrew
31. Spring washer
32. Ball
33. Plunger
34. Spring
35. Retaining plug
36. Copper washer
37. Oil pump filter
38. Drain plug
39. Fibre washer
40. Operating cam
41. Operating piston
42. Bridge piece
43. Nut
44. Tab washer
45. Accumulator piston assembly
46. Piston ring
47. Housing assembly
48. Spacing tube
49. Piston ring
50. Solenoid mounting bracket
51. Rubber stop
52. Gasket
53. Nut
54. Spring washer
55. Setscrew
56. Lever
57. Bolt
58. Nut
59. Spring washer
60. Cover plate
61. Gasket
62. Solenoid
63. Setscrew
64. Spring washer

Fig. 24. Exploded view of front casing assembly.



1. Clutch thrust ring assembly
2. Springs
3. Sliding member
4. Ball bearing
5. Circlip
6. Circlip
7. Brake ring
8. Sun wheel assembly
9. Planetary carrier assembly
10. Annulus assembly
11. Thrust washer (phosphor bronze)
12. Thrust washer (phosphor bronze)
13. Thrust washer (steel)
14. Cage for uni-directional clutch
15. Rollers
16. Spring
17. Inner member for uni-directional clutch
18. Thrust washer
19. Ball bearing
20. Ball bearing
21. Spacing washer
22. Rear casing assembly
23. Stud
24. Packing
25. Pilot bush
26. Speedometer drive assembly
27. Locking screw
28. Spring washer
29. Oil seal
30. Flange
31. Nut
32. Plain washer
33. Split pin

Fig. 25. Exploded view of rear casing assembly.

secured a ball bearing housed in a flanged ring. This ring carries on its forward face a number of pegs acting as guides to compression springs by which the ring, and with it the clutch member is held against the annulus. The springs prevent free-wheeling on overrun and are of sufficient strength to handle reverse torque. Also secured to the ring are four studs picking up two bridge pieces against which bear two pistons operating in cylinders formed in the unit housing. The cylinders are connected through a valve to an accumulator in which pressure is maintained by the oil pump. Both accumulator and operating pistons are fitted with special three-piece cast-iron rings. (Later operating pistons are fitted with one 'O' ring in place of the cast-iron rings.)

When the valve is open oil under pressure is admitted to the cylinders and pushes the pistons forward to overcome the springs and move the clutch member forward to engage the overdrive clutch.

Closing the valve cuts off the supply of oil to the cylinders and allows it to escape. Under the influence of the springs the clutch member moves back to engage direct drive position. The escape of oil from the cylinders is deliberately restricted so that the clutch takes about half a second to move over.

The planet pinions are of compound design, the larger diameter engaging the sun-wheel and the smaller diameter the annulus. Gear teeth are helical, the helix angles of each pair of mating gears being arranged to give an almost complete balance of end thrust. End thrust on the sun-wheel is taken by alternate bronze and steel thrust washers, lubricated by oil under pressure. These washers are stationary when in overdrive and only take a running load during the brief period of clutch slip when engaging overdrive. The sun-wheel and pinions are cyanide case-hardened and the annulus heat-treated. The pinions have needle roller bearings and run on case-hardened pins.

The outer ring of the uni-directional clutch is pressed and rivetted into the annulus member. The clutch itself is of the caged roller type, loaded by a clock-type spring made of round wire.

The hydraulic system is supplied with oil by a plunger type pump operated by a cam on the gearbox driven shaft. The pump body is pressed into the front housing and delivers oil through a non-return valve to the accumulator cylinder, in which a piston moves back against a compression spring until the required pressure is reached when relief holes are uncovered. From the relief holes the oil is led through drilled passages to an annular groove between the two steady bushes on the gearbox driven shaft. Radial holes in the shaft collect the oil and deliver it along an axial drilling to other radial holes in the shaft from which it is fed to the sun-wheel bush, thrust washers, planet carrier and planet pins.

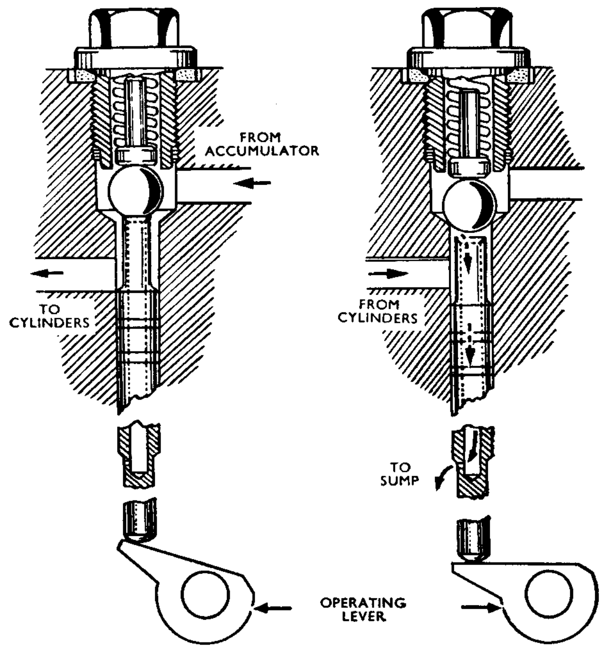


Fig. 26. Principle of the operating valve.

From the accumulator, oil under pressure is supplied to the operating valve chamber. This forms an enlargement at the top of a vertical bore and contains a ball valve, the ball seating downwards and preventing oil from circulating to the operating cylinders. The valve is a hollow spindle sliding in the bore, its top end reduced and carrying a seating for the ball so that when the valve is lifted it seats against the ball, which is then lifted, admitting oil to the operating cylinders and moving the pistons forward to engage the overdrive clutch.

When the valve is lowered the ball is allowed to come on to its seating in the housing, cutting off pressure to the cylinders. Further movement of the valve brings it out of contact with the ball, allowing the oil from the cylinder to escape down the inside of the valve to discharge into the sump. The cone member then moves back under the influence of the clutch springs.

DATA

	Dimensions—New 2.4 litre	Dimensions—New 3.4 litre	Clearances—New 2.4 litre	Clearances—New 3.4 litre
Pump				
Plunger diameter	.3742″/.3746″		.0002″/.0016″	
Bore for plunger in pump body	.3748″/.3758″			
Plunger spring fitted load at top of stroke	9.493 lb. at 1.137″			
Valve spring load	$2\frac{5}{8}$ lb. @ $\frac{19}{32}$ long			
Pin for roller	.2497″/.2502″ dia.		.0008″/.0023″	
Bore for pin in roller	.2510″/.2520″			
Gearbox Mainshaft				
Diameter at steady bushes	1.1544″/1.1553″		.0029″/.0048″	
Steady bush internal diameter	1.1582″/1.1592″			
Shaft diameter at sun-wheel bush	1.1544″/1.1553″			
Sun-wheel bush internal diameter	1.1582″/1.1592″		.0029″/.0048″	
Shaft diameter at rear steady bush	.6235″/.6242″			
Rear steady bush internal diameter	.6250″/.6260″		.0008″/.0025″	
Gear Train				
End float of sun-wheel			.008″/.014″	
Piston Bores				
Accumulator bore	1.1245″/1.1255″			
Operating piston bores	1.3745″/1.3755″			
Miscellaneous				
Clutch movement from direct to overdrive	.080″/.120″			
Hydraulic pressure	350/370 lb. per sq. in. (24.61/26.01 kg./cm².)	420/440 lb. per sq. in. (29.53/30.93 kg./cm².)		

OPERATING INSTRUCTIONS

When brought into operation, the overdrive reduces the engine speed in relation to the road speed. This permits high road speeds with low engine revolutions resulting in considerable fuel economy and reduced engine wear.

Operation

The overdrive operates in top gear only and is brought into operation by means of a switch mounted on the facia. Earlier cars were fitted with a transparent switch incorporating a warning light which lights up when overdrive is in operation.

Driving

Use of the clutch pedal when changing into or out of overdrive is unnecessary but to ensure maximum smoothness of operation, particularly when changing down from overdrive to top gear, the accelerator pedal should be slightly depressed.

For driving in towns, heavy traffic or hilly country when the maximum flexibility and low speed performance is required the overdrive manual switch should be placed in the 'OUT' position which will bring the drive into the normal top gear ratio.

For normal driving in open country the overdrive should be brought into operation when the required cruising speed has been obtained.

The following table gives the relationship between engine revolutions per minute to road speed in miles and kilometres per hour for top gear and overdrive top gears :

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE			
		2.4 litre Axle Ratio 4.55 : 1		3.4 litre Axle Ratio 3.77 : 1	
Kilometres per hour	Miles per hour	Top Gear 4.55 : 1	Overdrive 3.54 : 1	Top Gear 3.77 : 1	Overdrive 2.93 : 1
16	10	588	457	487	378
32	20	1176	914	974	756
48	30	1764	1371	1461	1134
64	40	2352	1828	1948	1512
80	50	2940	2285	2435	1890
96	60	3528	2742	2922	2268
112	70	4116	3199	3409	2646
128	80	4704	3656	3896	3024
144	90	5292	4113	4383	3402
160	100	5880	4570	4870	3780
176	110	—	—	5357	4158
192	120	—	—	—	4536

Note : The figures in the above table are theoretical and make no allowance for changes in tyre radius due to the effect of centrifugal force.

ROUTINE MAINTENANCE

Oil Level—Important

The oil for lubrication and operation of the overdrive unit is fed from the gearbox casing and therefore checking the gearbox oil level will also check the level of oil in the overdrive unit, but as this unit is hydraulically controlled extra attention should be paid to exercising absolute cleanliness when replenishing with oil. It is also important that the oil level is not allowed to fall appreciably otherwise the operation of the overdrive may be affected.

Oil Changing

The oil for the overdrive unit is common with that in the gearbox but draining the gearbox casing will not drain oil from the overdrive unit. A large brass drain plug is provided in the base of the overdrive unit and when draining the gearbox this plug should also be removed.

Whilst this drain plug is removed the overdrive oil pump filter should be cleaned. This filter is accessible through the drain plug hole and on early cars is secured by a central screw.

Thoroughly wash the filter gauze and allow to dry ; when refitting do not omit to replace the tubular distance piece and washers on the securing screw.

Refill the gearbox and overdrive with oil through the gearbox filler and level plug hole. **Recheck the level after the car has been run** as a certain amount of oil will be retained in the hydraulic system of the overdrive.

Particular attention should be paid to maintaining absolute cleanliness when filling the gearbox and overdrive with oil as any foreign matter that enters may seriously affect the operation of the overdrive.

Every 2,500 miles (4,000 km.)

Check the oil level of the gearbox and overdrive and top up if necessary through the dipstick hole.

Every 10,000 miles (16,000 km.)

Drain and refill the gearbox units. Two drain plugs, one for the gearbox and one for the overdrive unit, are situated at the base of their respective castings.

Both must be removed to drain the transmission completely. A common filler and level hole is situated on the left-hand side of the gearbox.

After draining the oil, remove the overdrive oil pump filter and clean the filter gauze by washing in petrol. The filter is accessible through the drain plug hole and on early cars is secured by a central screw.

After refilling the gearbox and overdrive with oil, recheck the level after the car has been run, since a certain amount of oil will be retained in the hydraulic system of the overdrive unit.

Recommended Lubricants

Mobil	Wakefield	Shell	Esso	B.P.	Duckham	S.A.E. Viscosity
Mobiloil A	Castrol XL	X-100 30	Esso Motor Oil 20W/30	Energol SAE 30	NOL 30	Havoline 30

Gearbox and Overdrive Oil Capacity

Imp. Pints	U.S. Pints	Litres
4	4¾	2¼

DISMANTLING AND RE-ASSEMBLING

If trouble should arise necessitating dismantling the unit further than is described in the previous section it will be necessary to remove the overdrive unit from the car. The engine, gearbox and overdrive unit are removed together. The removal instructions are given on page F.10. Remove the gearbox and clutch housing from the engine. Detach the clutch housing from the gearbox casing.

BEFORE COMMENCING ANY DISMANTLING OPERATIONS IT IS IMPORTANT THAT THE HYDRAULIC PRESSURE IS RELEASED FROM THE SYSTEM. DO THIS BY OPERATING THE OVERDRIVE 10-12 TIMES.

REMOVING THE OVERDRIVE FROM THE GEARBOX

1. The overdrive unit is separated from the gearbox at the joint between the gearbox rear extension and the overdrive front casing which are attached by seven studs **two of which are extra long.**
2. Remove the five nuts on the short studs before those on the longer studs are touched.
3. Slacken the two nuts on the long studs by equal amounts to release the compression of the clutch springs.
4. Remove the two nuts when the overdrive unit can be withdrawn off the mainshaft.

DISMANTLING THE OVERDRIVE

1. Remove the clutch springs from their pins, noting that the four inner springs **are shorter than the four outer springs.**
2. The two bridge pieces against which the operating pistons bear can now be removed. Each is secured by two $\frac{1}{4}''$ nuts locked by tab washers. Withdraw the two operating pistons.
3. The pump valve can be dismantled without removing the solenoid bracket from the housing and there is no need to disturb the latter unless it is necessary to remove the accumulator piston and spring.
4. Remove the six nuts securing the two halves of the housing and separate them, removing the brake ring which is spigotted into the two pieces. Lift out the planet carrier assembly. Remove the clutch sliding member complete with the thrust ring and bearing, the sun-wheel and thrust washers. Take out the inner member of the uni-directional clutch, the rollers, cage, etc.
5. If it is necessary to remove the planet gears from the carrier, the three Mills pins securing the planet bearing shafts must be extracted before the latter can be knocked out.
6. To remove the annulus, first take off the coupling flange at the rear of the unit, remove the speedometer gear, and drive out the annulus from the back. The front bearing will come away on the shaft leaving the rear bearing in the housing.

INSPECTION

Each part should be thoroughly inspected after the unit is dismantled and cleaned to ensure what parts should be replaced. It is important to appreciate the difference between parts which are worn sufficiently to affect the operation of the unit and those which are merely " worn-in ".

1. Inspect the front casing for cracks, damage, etc. Examine the bores of the operating cylinders and accumulator for scores and wear. Check for leaks from the plugged ends of the oil passages. Ensure that the blanking plug beneath the accumulator bore is tight and not leaking. Inspect the support bushes in the centre bore for leaks.
2. Examine the clutch sliding member assembly. Ensure that the clutch linings are not burned or worn. Inspect the pins for clutch springs and bridge pieces and see that they are tight in the thrust ring and not disturbed. Ensure that the ball bearing is in good condition and rotates freely. See that the sliding member slides easily on the splines of the sun-wheel.
3. Inspect the clutch springs for distortion.
4. Inspect the teeth of the gear train for damage. If the sun-wheel or planet bushes are worn the gears will have to be replaced since it is not possible to fit new bushes in service because they have to be bored to the pitch line of the teeth.
5. Inspect steel and bronze thrust washers.
6. Inspect the uni-directional clutch. See that the rollers are not chipped and that the inner and outer members of the clutch are free from damage. Make sure that the outer member is tight in the annulus. Ensure that the spring is free from distortion.
7. Inspect the ball bearings on the output shaft and see that there is no roughness when they are rotated slowly.

8. Inspect the mainshaft splines for nicks and burrs. See that the oil holes are open and clean.

9. Inspect the oil pump for wear on the pump plunger and roller pin. Ensure that the plunger spring is not distorted. Inspect the valve seat and ball and make sure that they are free from nicks and scratches.

10. Inspect the operating valve for distortion and damage and see that it slides easily in its bore in the front casing.

RE-ASSEMBLING THE OVERDRIVE

The unit can be re-assembled after all the parts have been thoroughly cleaned and checked to ensure that none are damaged or worn.

1. Assemble the annulus into the rear casing, not forgetting the spacing washer which fits between a shoulder on the shaft and the rear ball bearing. This washer is available in different thicknesses for selective assembly and should allow no end float of the annulus (output shaft) and no pre-loading of the bearings.

   Selective washers are furnished in the following sizes :

Jaguar Part No.	Size
C.5981	.146"±.0005" (3.70 mm.±0.013 mm.)
C.5694	.151"±.0005" (3.83 mm.±0.013 mm.)
C.5695	.156"±.0005" (3.95 mm.±0.013 mm.)
C.5696	.161"±.0005" (4.07 mm.±0.013 mm.)
C.5697	.166"±.0005" (4.20 mm.±0.013 mm.)

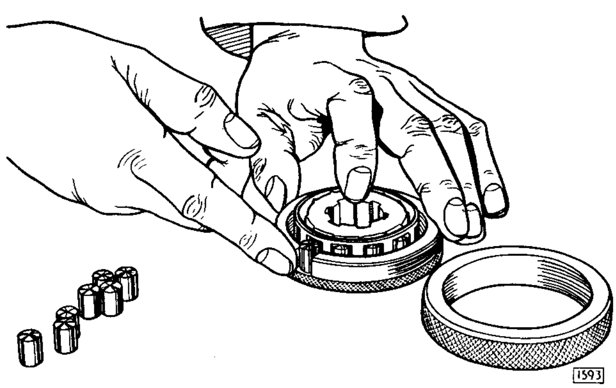


Fig. 27. Assembly of the uni-directional clutch (Tool No. L.178).

2. Replace the thrust washer and uni-directional clutch inner member with its rollers and cage. A fixture (Fig. 27) is needed for retaining the rollers in position when assembling the clutch. Ensure that the spring is fitted correctly, so that the cage urges the rollers up the ramps on the inner member.

3. Fit the pump cam on to gearbox mainshaft, offer up the front housing to the gearbox rear extension and secure temporarily with two nuts. In order to determine the amount of end float of the sun-wheel which should be .008" to .014" (.20 to .35 mm.), an extra thrust washer of known thickness should be assembled with the two normally used in front of the sun-wheel.

4. Fit the planet carrier, with its planet gears, over the sun-wheel with the marked teeth of the planets radially outwards as shown in Fig. 28 and with the assembly in this position offer it up to the annulus.

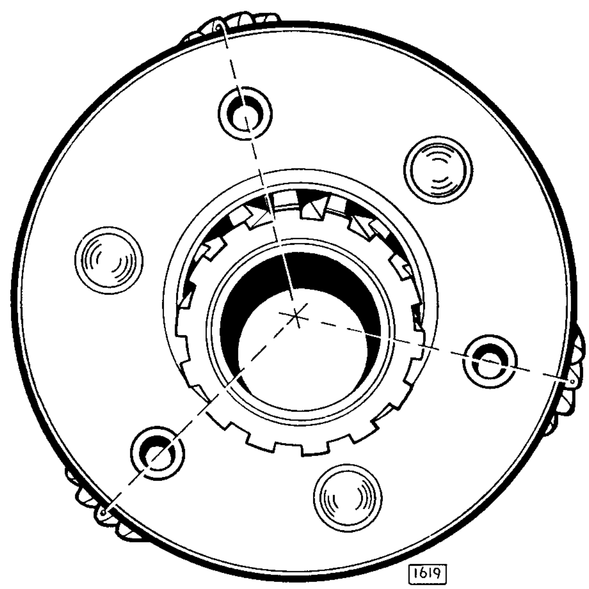


Fig. 28. Assembly of the planet gears—note the positions of the marked teeth.

5. Assemble the brake ring to the front casing, then offer up the front and rear assemblies, leaving out the clutch sliding member with its springs, etc. The gap between the flanges of the brake ring and rear casing should be measured. This gap will be less than the thickness of the extra thrust washer by the amount of end float of the sun-wheel. If this is between the limits specified the unit may be stripped down again and re-assembled without the extra thrust washer. The clutch sliding member, bridge pieces, etc., must then be replaced.

6. If the indicated end float is more or less than that required it must be adjusted by replacing the steel thrust washer at the front of the sun-wheel by one of less or greater thickness, as required. Washers of varying thicknesses are stocked for this purpose. Seven sizes are available, as follows :

Jaguar Part No.	Size
C.5943	.113"—.118" (2.87 mm.—2.99 mm.)
C.5944	.107"—.104" (2.71 mm.—2.64 mm.)
C.5945	.101"—.102" (2.55 mm.—2.58 mm.)
C.5946	.095"—.096" (2.41 mm.—2.44 mm.)
C.5947	.089"—.090" (2.25 mm.—2.28 mm.)
C.5948	.083"—.084" (2.10 mm.—2.13 mm.)
C.5949	.077"—.078" (1.95 mm.—1.98 mm.)

7. Care must be taken to ensure that the thrust washers at the front and rear of the sun-wheel are replaced in their correct positions. At the front of the sun-wheel the steel washers fit next to the head of the support bush in the housing and the bronze washer between the steel one and the sun-wheel. At the rear the steel washer is sandwiched between the two bronze washers. The latter are similar and their positions interchangeable. It is essential when assembling the gear train to ensure that the planets are turned to their correct relative positions as shown in Fig. 28.

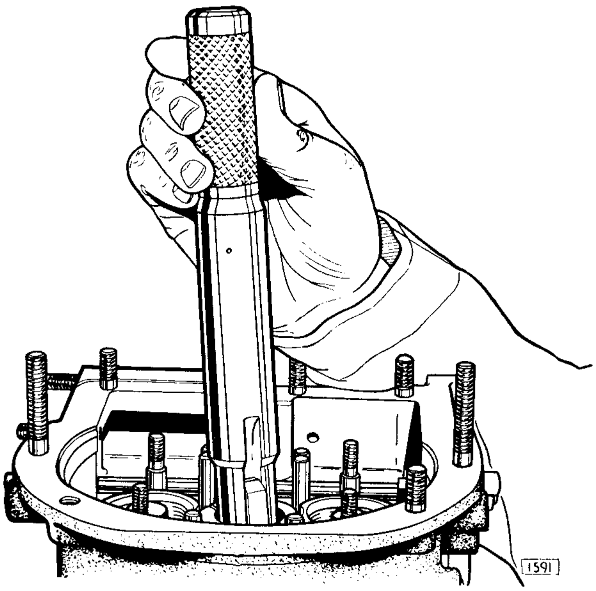


Fig. 29. Aligning the splines (Tool No. L.185).

REFITTING THE OVERDRIVE TO THE GEARBOX

1. Place the overdrive unit upside down in a vice.
2. Fit the oil pump operating cam on the gearbox mainshaft with the long plain end facing the gearbox, and with the back of the cam towards the bottom of the casing.
3. Ensure that the splines in the uni-directional clutch and planet carrier are in alignment. These splines are visible at the bottom of the bore in the overdrive unit. If alignment is necessary, use the dummy mainshaft as shown in Fig. 29.

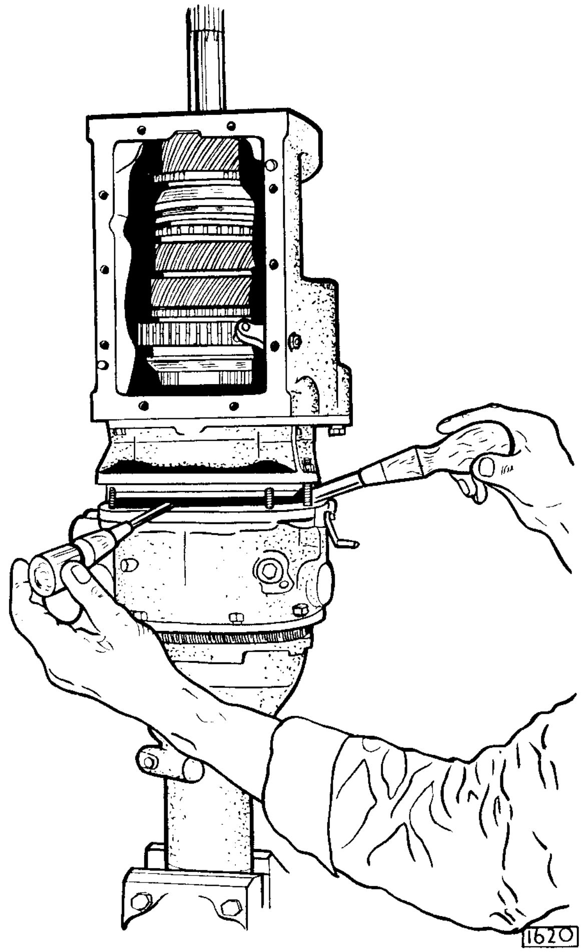


Fig. 30. When fitting the overdrive to the gearbox, compress the oil pump plunger and align the operating cam with the plunger roller.

4. Engage a gear, turn the gearbox up on end and enter the mainshaft into the overdrive unit. Turn the constant pinion shaft until the splines engage.
5. Ensure that clutch springs are over their respective bosses on the gearbox rear extension. Press the gearbox down to test the cushioning of springs.

6. Fit two nuts to the long studs and tighten up until there is approximately ¾″ (19.05 mm.) gap between the overdrive casing and the gearbox rear extension, meanwhile **ensuring that the oil pump cam does not drop down off the splines on the mainshaft.**
7. Enter two screwdrivers into the gap between the overdrive casing and the gearbox rear extension, with one, compress the oil pump plunger, and with the other, lever the cam down into alignment with the plunger roller (Fig. 30).
8. Tighten the two nuts on the long studs by equal amounts until the remaining five nuts can be started. Fully tighten the seven nuts by turning by equal amounts.

COMPONENTS

BEFORE COMMENCING ANY DISMANTLING OPERATIONS IT IS IMPORTANT THAT THE HYDRAULIC PRESSURE IS RELEASED FROM THE SYSTEM. DO THIS BY OPERATING THE OVERDRIVE 10—12 TIMES.

With the ignition switched on and the gear lever in top gear position operate the overdrive switch when the solenoid will be heard to energise.

THE OPERATING VALVE

Having gained access to the unit by removing the gearbox cowling unscrew the valve plug and remove the spring and plunger. The ball valve will then be seen inside the valve chamber (Fig. 31).

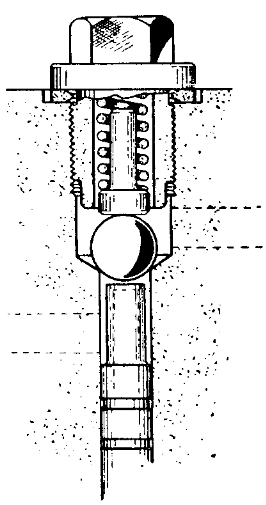


Fig. 31. The operating valve.

The ball should be lifted $\frac{1}{32}$″ (0.79 mm.) off its seat when the overdrive control is operated. If the ball does not lift by this amount the fault lies in the control mechanism. Located on the right-hand side of the unit, and pivoting on the valve operating cross shaft which passes right through the housing is a valve setting lever. In its outer end is a $\frac{3}{16}$″ (4.76 mm.) diameter hole which corresponds with a similar hole in the housing when the unit is in overdrive (i.e. when the ball is lifted $\frac{1}{32}$″ (0.79 mm.) off the valve seat). If the two holes do not line up it will be necessary to adjust the control mechanism.

To adjust, remove the solenoid bracket cover plate on the opposite side of the overdrive front casing. Slacken the clamp bolt securing the valve operating lever to the valve operating cross shaft. Rotate the shaft until the $\frac{3}{16}$″ (4.76 mm.) diameter rod can be inserted through the valve setting lever into the corresponding hole in the casing (Fig. 33) and tighten the clamp bolt. Check lift of ball after adjustment.

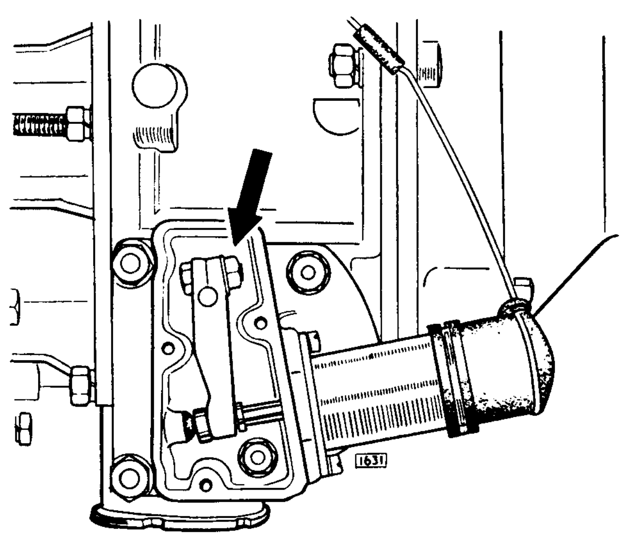


Fig. 32. Valve operating lever clamp bolt.

A small magnet will be found useful for removing the ball from the valve chamber. The valve can be

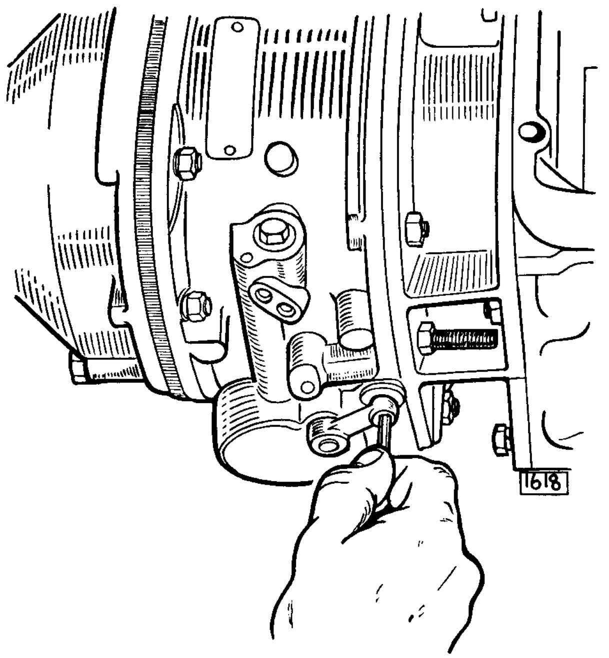


Fig. 33. Aligning the hole in the valve setting lever with the corresponding hole in the housing.

withdrawn by inserting the point of a pencil into the top, but care must be taken not to damage the ball seating at the end of the valve.

Near the bottom of the valve will be seen a small hole breaking through to the centre drilling. This is the jet for restricting the exhaust of oil from the operating cylinders. Ensure that this jet is not choked.

If the ball valve is not seating correctly the ball should be tapped sharply on to its seat using a copper drift for the purpose.

THE HYDRAULIC SYSTEM

If the unit fails to operate and the ball valve is found to be seating and lifting correctly check that the pump is functioning.

Jack up both rear wheels of the car, then with the engine ticking over and the valve plug removed, engage top gear. Watch for oil being pumped into the valve chamber. If none appears, then the pump is not functioning.

The pump (Fig. 34) is of the plunger type and delivers oil via a non-return valve to the accumulator. Possible sources of trouble are (1) failure of the non-return valve due to foreign matter on the seat or to a broken valve spring and (2) breakage of the spring holding the pump plunger in contact with the cam.

The pump is self-priming but failure to deliver oil after the system has been drained and refilled indicates

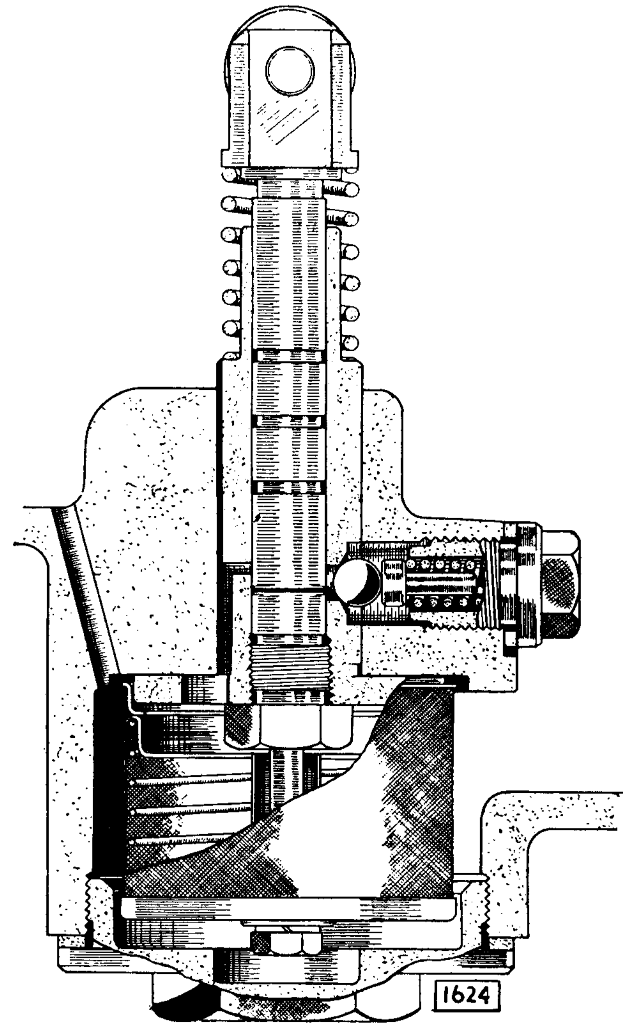


Fig. 34. The oil pump.

that the air bleed is choked, causing air to be trapped inside the pump.

In the unlikely event of this happening it will be necessary to remove the pump and clean the flat on the pump body and the bore of the casting into which it fits.

THE PUMP VALVE

Access to the pump is gained through a cover on the left-hand side of the unit. Proceed as follows :—

1. Remove drain plug and drain off oil.
2. Remove cover from solenoid bracket.
3. Remove solenoid body.
4. Slacken off clamping bolt in operating lever and remove lever complete with solenoid plunger.
5. Remove distance collar from valve operating shaft.

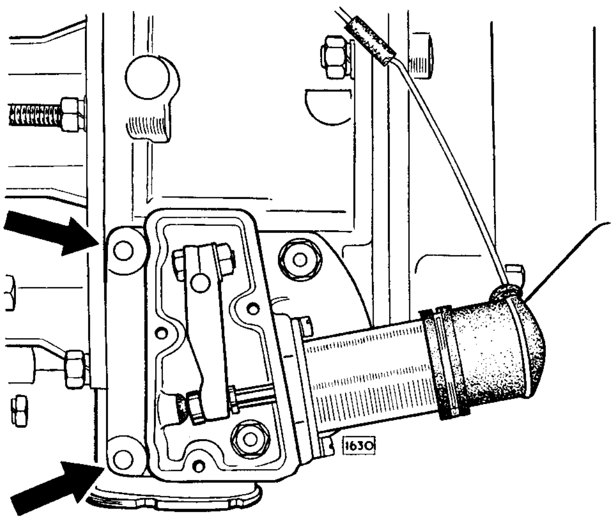


Fig. 35. Removing the solenoid bracket—remove the nuts from the studs before unscrewing the two setscrews.

6. The solenoid bracket is secured by two $\frac{5}{16}$" (7.94 mm.) diameter studs and two $\frac{5}{16}$" (7.94 mm.) diameter bolts, the heads of which are painted red (see Fig. 35). REMOVE THE NUTS FROM THE STUDS BEFORE TOUCHING THE BOLTS. THIS IS IMPORTANT. The two bolts should now be slackened off together, releasing the tension on the accumulator spring.
7. Remove the solenoid bracket.
8. Unscrew the valve cap and take out the spring, plunger and ball.

Re-assembly is the reverse of the above operations. Ensure that the soft copper washer between the valve cap and pump housing is nipped up tightly to prevent oil leakage.

Reset the valve operating lever, proceeding as follows: Before clamping up the valve operating lever and replacing the solenoid bracket cover, rotate the valve operating shaft until a $\frac{3}{16}$" (4.76 mm.) diameter pin can be inserted through the valve setting lever into the corresponding hole in the casing (Fig. 33). Leave the pin in position, locking the unit in the " overdrive " position. Lift the solenoid plunger up to the full extent of its stroke (i.e. to its energised position) and clamp up the operating lever.

Remove the pin through the setting lever and operate the lever manually to check that the control operates easily.

Check that when the solenoid is energised, the hole in the valve setting lever corresponds with the hole in the casing. After ensuring that the setting is correct, replace the cover of the solenoid bracket.

THE PUMP

Dismantling

1. Remove drain plug and drain off oil.
2. Remove pump valve as described above.
3. Remove the filter after unscrewing the securing bolt.
4. Take out the two cheese head screws securing the pump body flange and extract the pump body A special extractor tool (Fig. 36) is available for this purpose. This screws into the bottom of the pump body in place of the screwed plug.

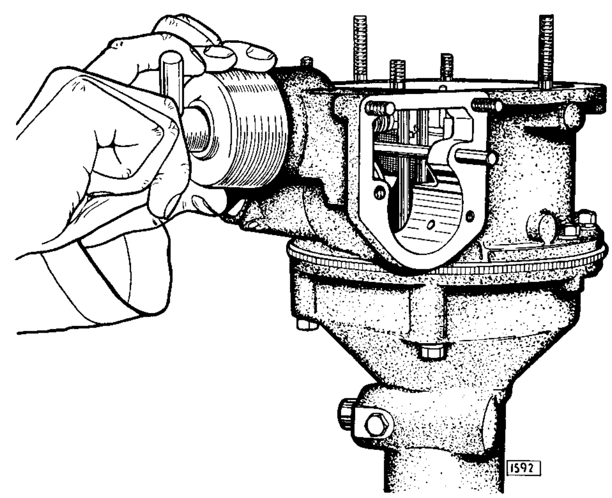


Fig. 36. Extracting the oil pump (Tool No. L.183).

Assembling

Replace the plug in the bottom of the pump body ensuring that it is screwed home tightly. Line up the pump body so that the inlet port and holes for

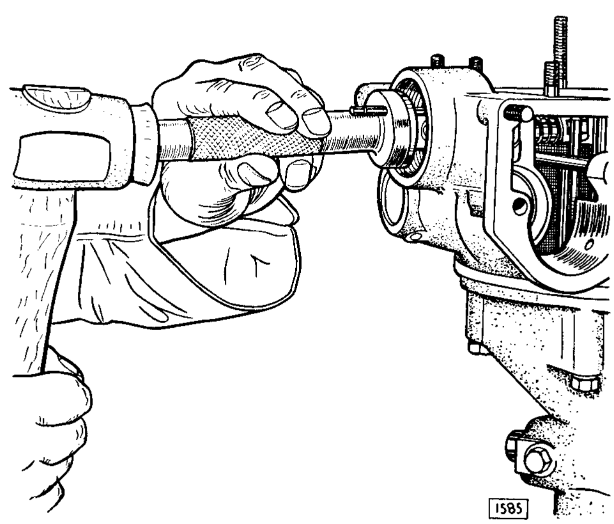


Fig. 37. Replacing the oil pump (Tool No. L.184).

the securing screw register with the corresponding holes in the housing and tap the pump body home.

The pump plunger is prevented from rotation when in position by a guide peg carried in the front casing. When assembling the pump, the plunger should be inserted with the flat on its head facing the rear of the unit. It is possible to guide it past the guide peg by means of a screwdriver inserted through the side of the casing.

HYDRAULIC PRESSURE

The required working oil pressures are 350/370 lbs. per sq. in. (24.62/26.01 kg./cm^2) for the 2.4 litre and 420/440 lbs. per sq. in. (29.53/30.93 kg./cm.^{2}) for the 3.4 litre. Hydraulic equipment is available from V. L. Churchill & Co. Ltd. (see page F.36). The pipe union should be screwed into the casing over the operating valve after removal of the plug.

Low pressure indicates leakage or possibly a broken accumulator spring.

THE ACCUMULATOR PISTON AND SPRING

Removal

1. Proceed as described in operations 1 to 7 in the paragraph headed " The Pump Valve ".
2. The spring, piston housing assembly and piston can now be withdrawn (see Fig. 38).

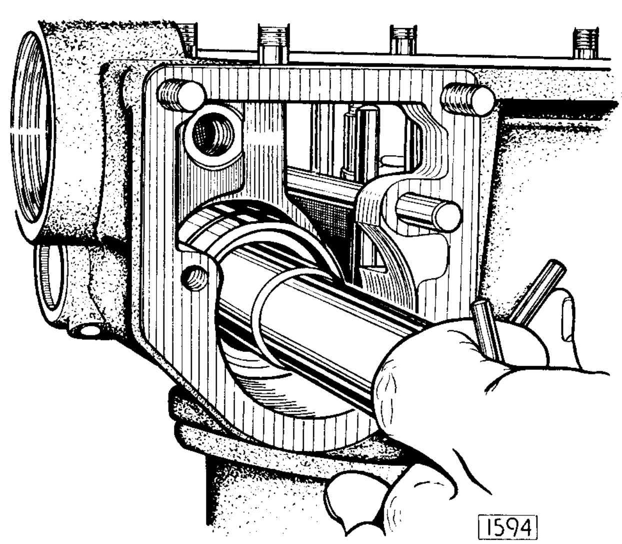


Fig. 38. Extracting the accumulator piston housing. (Tool No. L.182).

3. Withdraw the piston from the piston housing. It is important to appreciate that correct fitting of the piston rings is of vital importance to the efficient working of the unit. Check that the rings are not gummed up due to use of an unsuitable lubricant or have excessive clearance in the

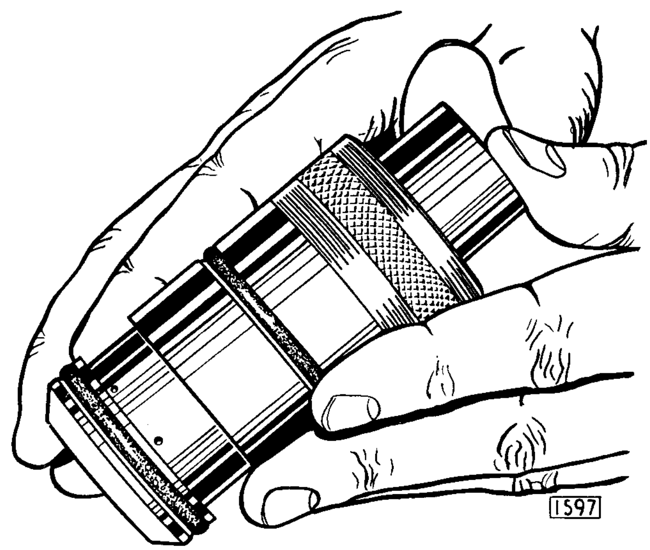


Fig. 39. Fitting the accumulator piston (Tool No. L.179).

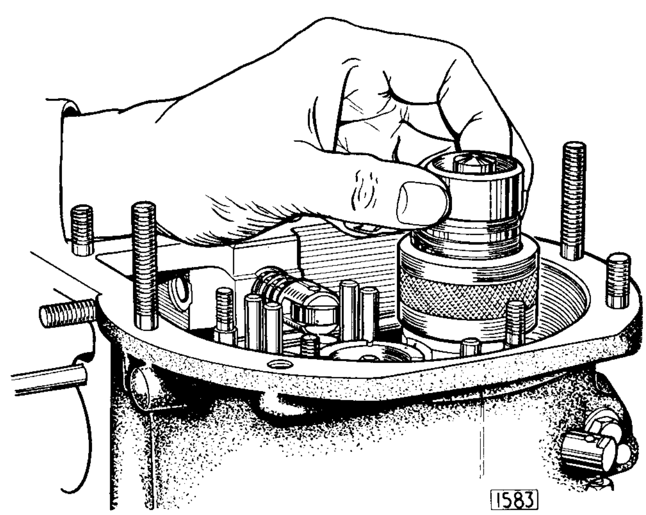


Fig. 40. Fitting an operating piston (Tool No. L.180).

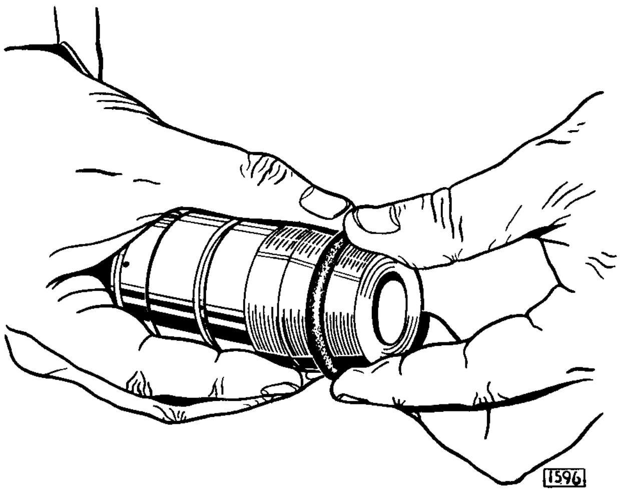


Fig. 41. Fitting an ' O ' ring to the accumulator piston. (Tool No. L.181).

grooves. Check also that the rubber ' O ' rings on the piston housing are not damaged. It is advisable to renew all ' O ' rings each time the unit is stripped down.

THE CONTROL SYSTEM

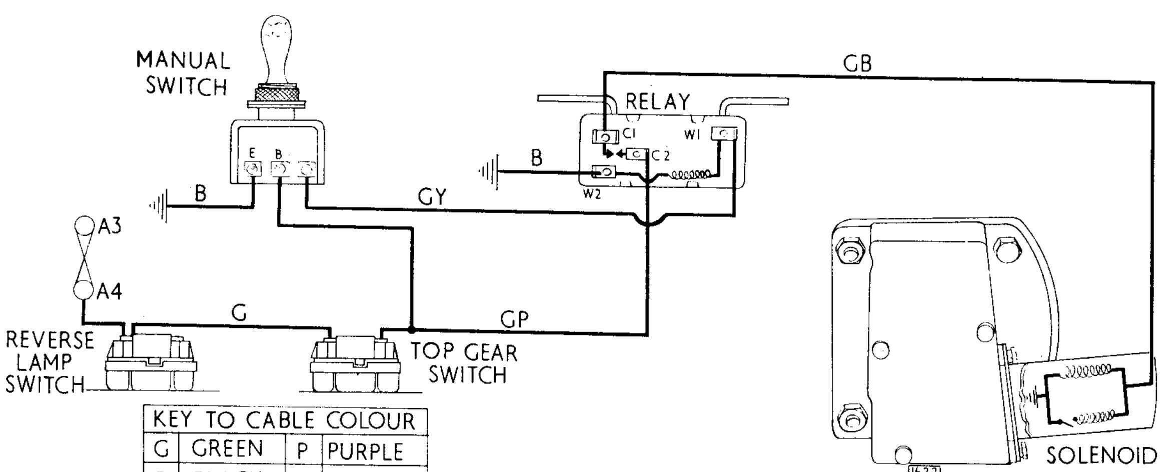
The solenoid, which actuates the overdrive, is controlled by two switches; a manual switch, mounted in the facia panel and a top-gear switch mounted on the gearbox cover.

On early cars the manual switch which incorporates a warning light and a transparent switch lever is connected in series with a relay. The top gear switch is closed only when top gear is engaged.

To enable a change into overdrive to be made:
(1). The car must be in top gear.
(2). The driver must operate the manual switch.

Circuit with Relay

When these conditions exist, the operating coil of the relay will be energised and its contacts will close. This relay will then connect to the supply, the solenoid, and the overdrive warning light. The solenoid, being energised, actuates a soft iron plunger which in turn lifts the operating valve of the overdrive unit, thereby effecting a change into overdrive.



KEY TO CABLE COLOUR			
G	GREEN	P	PURPLE
B	BLACK	Y	YELLOW

Fig. 42. Circuit diagram (with relay).

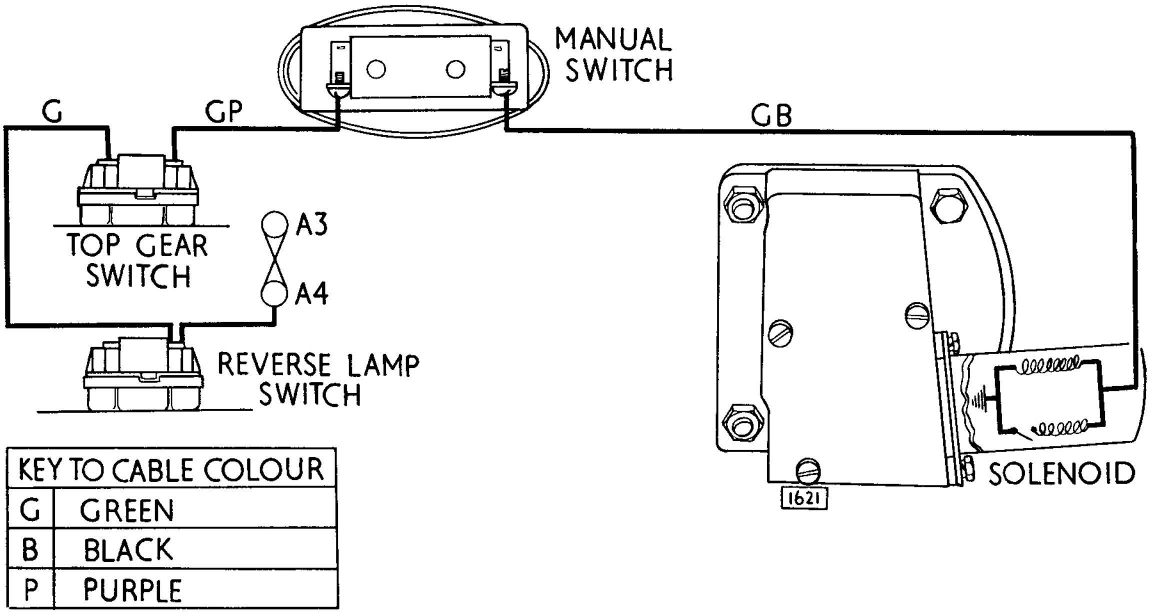


Fig. 43. Circuit diagram (without relay).

Circuit without Relay

This is a simple circuit where the control switch is connected in series between the top gear switch and the solenoid. The control switch does not incorporate a warning light and there is no relay in the circuit.

Operation of the solenoid is effected when the switches are closed.

Operating Solenoid

The solenoid is made up of a soft iron plunger, a holding coil of high resistance, a closing coil of low resistance and a pair of normally closed contacts. These contacts are connected in series with the closing coil.

When the contacts of the relay close or when both the manual switch and the top gear switch are closed, both coils in the solenoid become energised and actuate the soft iron plunger. Movement of the plunger opens the solenoid internal switch and cuts the low resistance closing coil, the magnetism due to the high resistance coil alone being sufficient to keep the plunger in the overdrive position.

Note : The normal current consumption of the system should be approximately 1.0—1.5 amperes. A defective solenoid will be accompanied by a current of approximately 18—20 amperes.

FAULT FINDING

When an overdrive unit does not operate properly it is advisable first to check the level of oil and, if below the low level mark, top up with fresh oil and test the unit again before making any further investigations.

Faulty units should be checked for defects in the order listed below.

Should the electrical control not operate the electrical circuits should be checked from the diagrams on page F.34, F.35.

Overdrive does not engage

1. Insufficient oil in the gearbox.
2. Electric control not operating.
3. Leaking operating valve due to foreign matter on ball seat or broken valve spring.
4. Pump not working due to choked filter.
5. Pump not working due to broken pump spring.
6. Leaking pump non-return valve due to foreign matter on ball seat or broken valve spring.
7. Insufficient hydraulic pressure due to leaks or broken accumulator springs.
8. Damaged gears, bearings or shifting parts within the unit requiring removal and inspection of the assembly.

Overdrive does not release.

IMPORTANT : If the overdrive does not release, do NOT reverse the car, otherwise extensive damage may be caused.

1. Electric control not operating.
2. Blocked restrictor jet in operating valve.
3. Sticking clutch.
4. Damaged parts within the unit necessitating removal and inspection of the assembly.

Clutch slip in overdrive.

1. Insufficient oil in gearbox.
2. Worn clutch lining.
3. Insufficient hydraulic pressure due to leaks.

Clutch slip in reverse or freewheel condition on overrun

1. Worn clutch lining.
2. Blocked restrictor jet in operating valve.
3. Insufficient pressure on clutch due to broken clutch springs.

SERVICE TOOLS

The following tools for servicing the overdrive unit are obtainable from V. L. Churchill & Co. Ltd., Great South West Road, Bedfont, Feltham, Middlesex.

Part No.	Description
L.176	Drive Shaft Oil Seal Remover.
L.177	Drive Shaft Oil Seal Replacer and cone clutch and spring thrust housing dismantling tool.
L.178	Freewheel Assembly Ring.
L.179	Piston and Ring Fitting Tool, $1\frac{1}{8}''$ (28.57 mm.) diameter.
L.180	Piston and Ring Fitting Tool, $1\frac{3}{8}''$ (34.9 mm.) diameter.
L.181	Accumulator 'O' Ring Fitting Tool.
L.182	Accumulator Piston Housing Remover.
L.183	Pump Barrel Remover.
L.184	Pump Barrel Replacer.
L.185	Dummy Drive Shaft.
L.186	Mainshaft Bearing Replacer.
L.188	Hydraulic Test Equipment.

Printed in England by W. W. Curtis Ltd., Coventry.

SECTION G

PROPELLER SHAFTS

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone	Code	Telegraphic Address
COVENTRY 27677 (P.B.X.)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/G/2.

INDEX

PROPELLER SHAFTS

DESCRIPTION

Hardy Spicer propeller shafts of the open type with needle roller universal joints are fitted.

Standard transmission cars are fitted with a fixed length propeller shaft with a universal joint at each end ; to cater for fore and aft movement of the rear axle a splined sleeve at the front of the shaft slides on a splined extension of the gearbox mainshaft.

Overdrive models are fitted with a normal propeller shaft having a universal joint at each end and a sliding spline at the front.

Automatic transmission models are fitted with a divided propeller shaft. The front shaft has a universal joint at the forward end and the rear end is supported in a ball bearing housed in a rubber mounted plate. The rear propeller shaft is of the normal type and incorporates a sliding spline to allow for fore and aft movement of the rear axle.

DATA

Dimension " A "		2.4 litre	3.4 litre
Cars fitted with synchro-mesh gearbox only		$37\frac{5}{8}''$ (95.55 cm.)	$36\frac{7}{8}''$ (93.65 cm.)
Overdrive model		$34\frac{25}{32}''$ (88.35 cm.)	$34\frac{1}{32}''$ (86.45 cm.)
Automatic transmission model	—front shaft	$10\frac{1}{2}''$ (26.65 cm.)	$10\frac{1}{2}''$ (26.65 cm.)
	—rear shaft	$27\frac{7}{8}''$ (70.5 cm.)	$27\frac{1}{8}''$ (68.9 cm.)

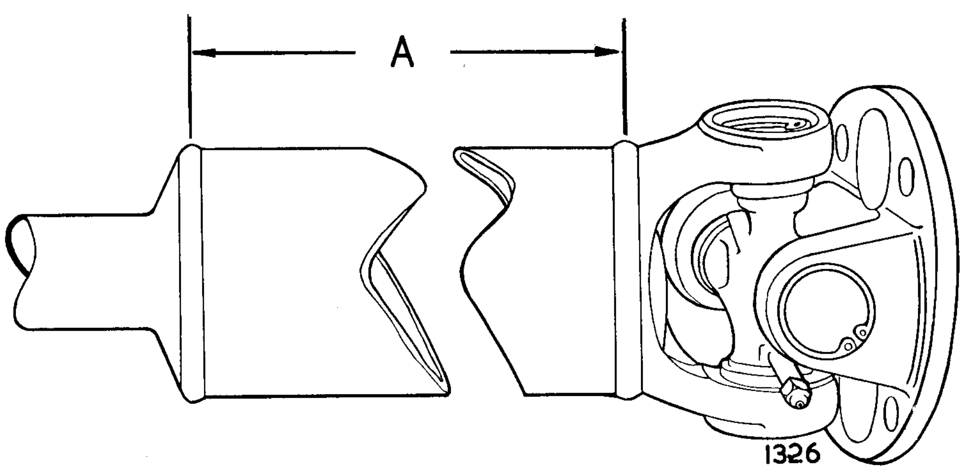


Fig. 1. Propeller shaft lengths

ROUTINE MAINTENANCE

EVERY 2,500 MILES (4,000 KM.)

Universal Joints

The two needle roller bearing universal joints (three joints on Automatic Transmission models) should be lubricated with the recommended grade of oil. Do not use grease at these points.

The nipples are accessible from underneath the car but it may be necessary to move the car slightly to bring the nipples to the required position.

Sliding Spline.

On cars fitted with automatic transmission or an overdrive the front end of the propeller shaft is fitted with a sliding joint which should be lubricated, with the recommended grade of grease, through the nipple situated at the rear of the universal joint yoke.

Recommended Lubricants

	Mobil	**Wakefield**	**Shell**	**Esso**	**B.P.**	**Duckham**
Propeller shaft— Universal joints	Mobilube C.140	Castrol D	Spirax 140 E.P.	Gear Oil 140	Energol 140	NOL E.P. 140
Propeller shaft— Spline	Mobilgrease MP	Castrolease Medium or WB	Retinax A or RB	Esso Grease or Esso High Temp. Grease	Energrease C.3 or N.3	LB.10 or HPG

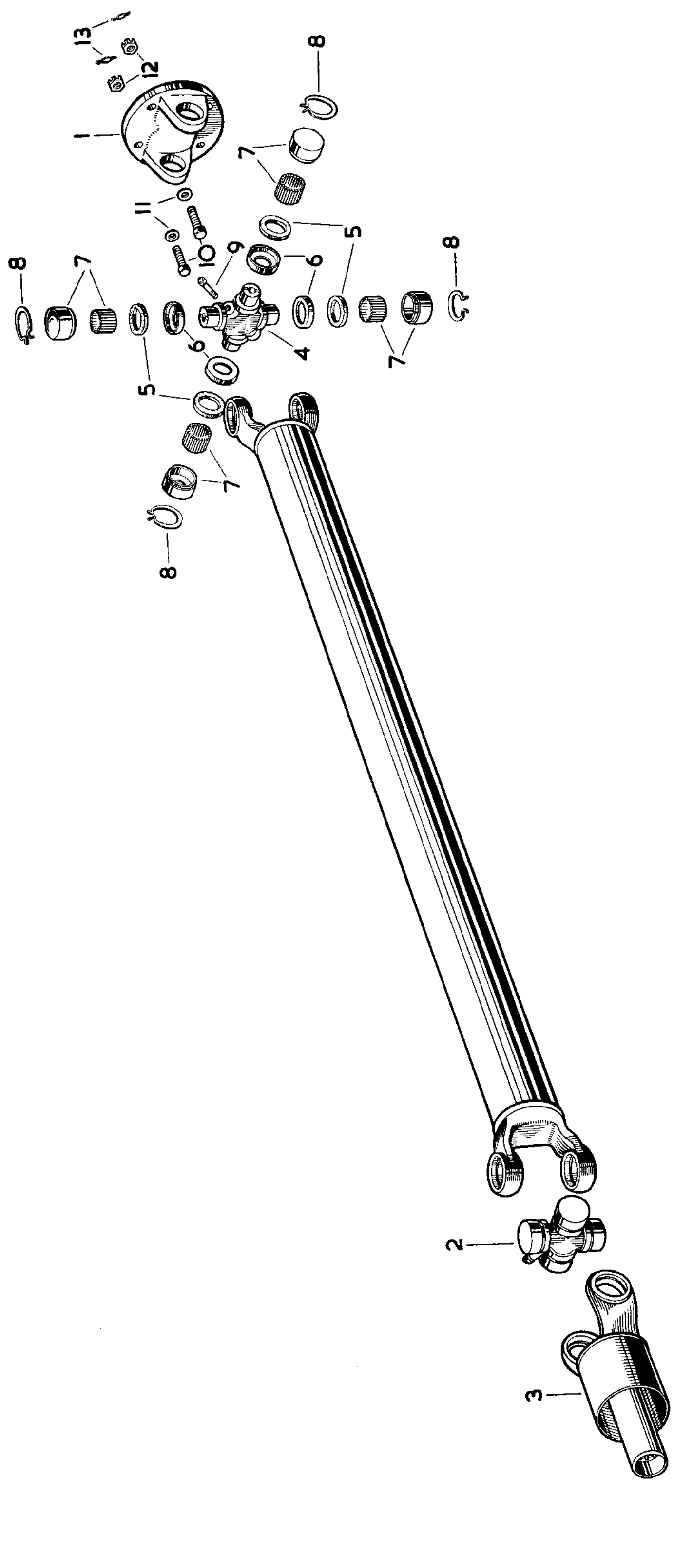


Fig. 2. Exploded view of propeller shaft assembly (Standard transmission propeller shaft illustrated).

1. Flange yoke.
2. Journal assembly.
3. Sleeve yoke assembly.
4. Journal spider.
5. Gasket.
6. Gasket retainer.
7. Needle bearing assembly.
8. Circlip.
9. Grease nipple.
10. Bolt.
11. Special washer.
12. Slotted nut.
13. Split pin.

PROPELLER SHAFT (Standard Transmission models)

Removal

Jack up one of the rear wheels clear of the ground to enable the propeller shaft to be rotated. Place blocks at each side of the other rear wheel.

Remove the split pins, nuts and washers from the four bolts attaching the propeller shaft to the rear axle flange.

Separate the two flanges and withdraw the propeller shaft from the splines at the rear of the gearbox mainshaft.

Refitting

Refitting is the reverse of the removal procedure.

PROPELLER SHAFT (Overdrive models)

Removal

Jack up one of the rear wheels clear of the ground to enable the propeller shaft to be rotated. Place blocks at each side of the other rear wheel.

Remove the split pins, nuts and washers from the flange attaching the propeller shaft to the gearbox flange. Remove the split pins, nuts and washers from the flange attaching the propeller shaft to the rear axle flange. Compress the sliding joint when the propeller shaft can be removed.

Refitting

Refitting is the reverse of the removal procedure.

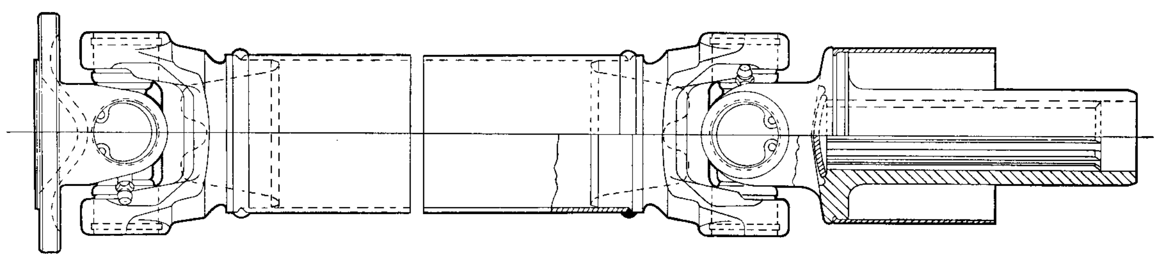


Fig. 3. Propeller shaft—Standard transmission model.

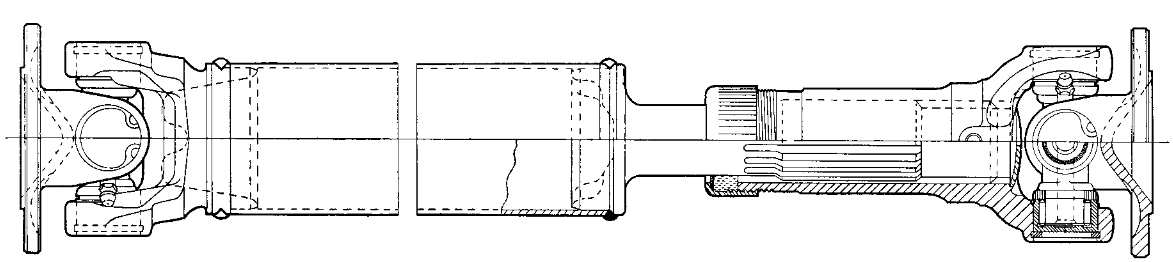


Fig. 4. Propeller shaft—Overdrive model.

PROPELLER SHAFTS (Automatic transmission models)

A divided propeller shaft is fitted to automatic transmission models. The rear of the front propeller shaft is supported in a ball bearing housed in a rubber mounted plate.

Removal of the Front Propeller Shaft

Remove the six set bolts securing the ventilated cover plate to the bottom of the torque converter housing. Place a piece of wood under the torque converter housing, taking care that it does not foul the torque converter.

Jack up under the piece of wood until the jack takes the weight of the engine and gearbox.

Mark the positions of the centre bearing and rear engine mounting brackets relative to the body floor so that the brackets can be refitted in their original positions.

Remove the six bolts and packing washers from the rear engine support bracket, care being taken to note the number and positions of the various packing washers fitted between the bracket and the body floor.

Remove the two nuts, plain shakeproof washers attaching the rear engine support bracket to the two mounting rubbers at the rear of the gearbox.

Jack up one of the rear wheels clear of the ground to enable the propeller shaft to be rotated.

Remove the four split pins, nuts and washers from the flange attaching the propeller shaft to the gearbox.

Remove the four split pins, nuts and washers from the flange attaching the front propeller shaft to the rear propeller shaft. Support the front end of the rear propeller shaft.

Remove the two set bolts and spring washers securing the propeller shaft centre bearing bracket to the body and remove the front propeller shaft.

Refitting the Front Propeller Shaft

Offer up the propeller shaft flange to the gearbox flange and secure with a bolt and nut.

Offer up the centre bearing mounting to the body and secure with two set bolts and spring washers.

Offer up the rear propeller shaft to the centre bearing flange and replace all the remaining nuts, washers and split pins in the flanges.

Refit the four washers and two nuts attaching the two rubbers on the rear of the gearbox to the mounting bracket.

Offer up the rear engine mounting bracket and refit the set bolts and spring washers with the packing washers interposed between the body and the engine rear mounting bracket.

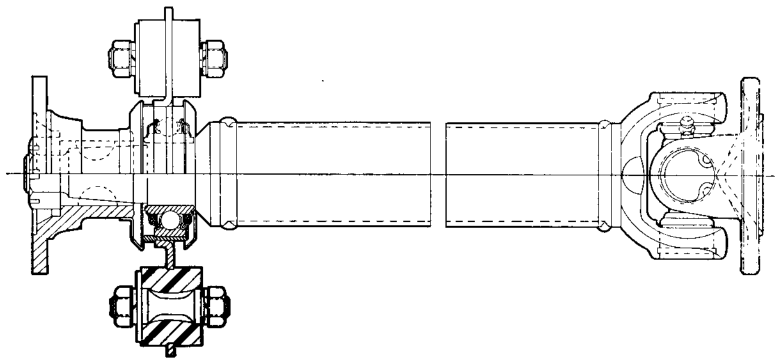


Fig. 5. Front propeller shaft and centre bearing—Automatic transmission model.

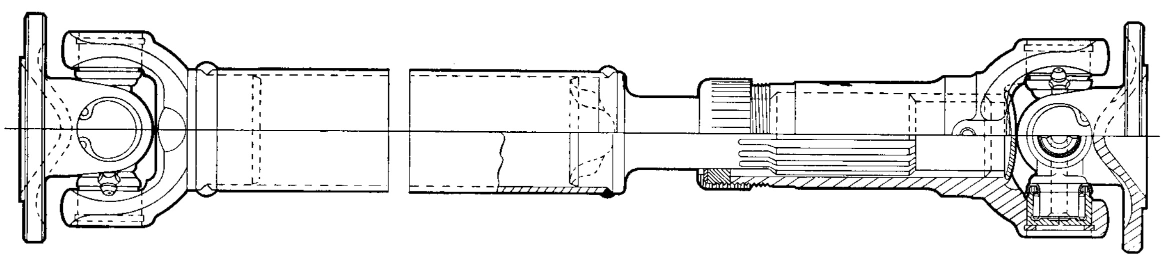


Fig. 6. Rear propeller shaft—Automatic transmission model.

Lower the jack under the converter housing and replace the cover plate and secure it with six set bolts and spring washers.

Note the procedure detailed under the heading " Divided Propeller Shaft Alignment".

Removal of the Rear Propeller Shaft

Remove the four split pins, nuts and washers attaching the rear propeller shaft to the front shaft.

Remove the four split pins, nuts and washers attaching the propeller shaft to the rear axle.

Compress the sliding joint and remove the propeller shaft.

Refitting the Rear Propeller Shaft

Offer up the rear propeller shaft to the rear axle flange and secure with four bolts, washers, nuts and split pins.

Offer up the sliding joint end of the propeller shaft to the front propeller shaft flange and secure with the four nuts, washers and split pins.

CENTRE BEARING

The centre bearing consists of a ball bearing pressed into a housing which has an oval shaped plate attached; this assembly is mounted on the tail of the propeller shaft with a dust shield interposed between the housing and the shaft tubing. The bearing is retained on the shaft by a flange coupling which is bolted to the companion flange on the rear propeller shaft.

Removal

Remove the front propeller shaft complete with centre bearing as described on page G.7.

Dismantling

The flange coupling is retained on the propeller shaft by two Woodruff keys and is secured by a slotted nut and split pin.

Remove the split pin and slotted nut. Draw off the flange coupling and remove the Woodruff keys.

Remove the outer dust cover. Drive the shaft through the bearing and housing. Press the bearing out of the housing.

Remove the two nuts and spring washers securing the body mounting bracket to the rubbers.

Press the rubbers out of the oval bearer plate. Remove the rubbers from the studs.

Reassembling

Reassembling is the reverse of the dismantling procedure.

Refitting

Refitting is the reverse of the removal procedure.

Note the procedure detailed under the heading " Divided Propeller Shaft Alignment ".

DIVIDED PROPELLER SHAFT ALIGNMENT

The alignment of the divided propeller shaft is most important and if removal of the engine or front propeller shaft has taken place, the following checks should be made on replacement. Failure to do so may result in transmission shudder when taking up the drive from a standing start.

NOTE :

Before carrying out any checking or rectification work :—

(a) Ensure that the engine stabilizer at the rear of the cylinder head is disconnected. To disconnect the engine stabilizer remove the self-locking nut and flanged washer from the top of the stabilizer and screw the lower washer down the centre pin by engaging a thin bladed screwdriver in the slot in the washer through the centre hole of the rubber mounting.

(b) Check that the rear engine mounting rubbers are not distorted.
Note that the holes in the rear engine mounting cradle are slotted and the holes in the bracket attached to the extension case are enlarged to allow the positions of the rubbers to be adjusted.

Check 1

Check the distance from the bottom of the front propeller shaft flange to the bottom faces of the longitudinal chassis side members. This distance should be $3\frac{11}{16}'' \pm \frac{1}{16}''$ (93.5 mm. ± 1.5 mm.). A simple checking jig can be made for checking this distance as shown in Fig. 7.

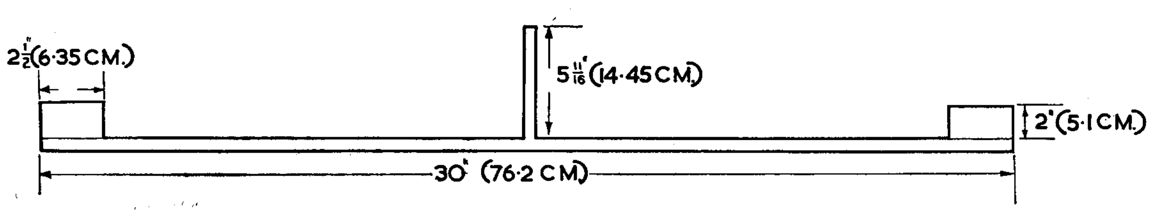


Fig. 7. Jig for checking the height of the front propeller shaft.

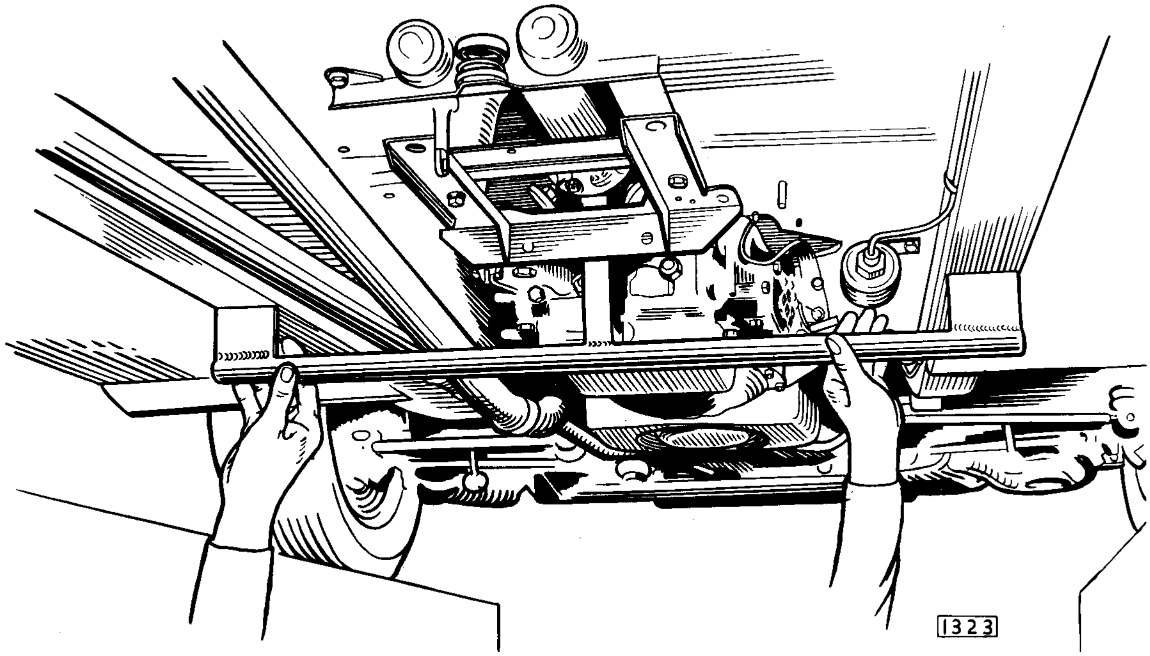


Fig. 8. Checking the height of the front propeller shaft.

Remedy

If the propeller shaft flange is too LOW suitable packings can be fitted between the rear engine mounting rubbers and the mounting brackets at the top or bottom of the rubbers.

If the propeller shaft is too HIGH suitable packing can be fitted between the rear engine mounting cradle and the body floor.

Check 2

Check that the front and rear propeller shafts are in a straight line.

The most convenient way to do this is to make up a simple jig as shown in Fig. 9. The jig consists of 3 pieces of flat bar 8″ × 1″ × $\frac{3}{16}$″ (20.5 cm. × 2.5 cm. × 4.75 mm.) which are welded exactly in line on to a piece of tube of $1\frac{1}{8}$″ (28.5 mm.) outer diameter at the distances shown in the sketch. The jig is then held against the front and rear propeller shafts, with the three bars vertical, when any mal-alignment will be evident. (see Fig. 10.)

An alternative method is to use three plumb bobs and sight along the three cords. Two cords should be positioned at the front and rear of the front propeller shaft tube and the remaining cord at the rear end of the rear propeller shaft tube.

Remedy

Alignment of the propeller shafts is carried out at the centre bearing bracket by elongating the two holes through which the set screws pass to secure the bracket to the body floor. The position of the centre bearing bracket can then be adjusted to allow the propeller shafts to be aligned.

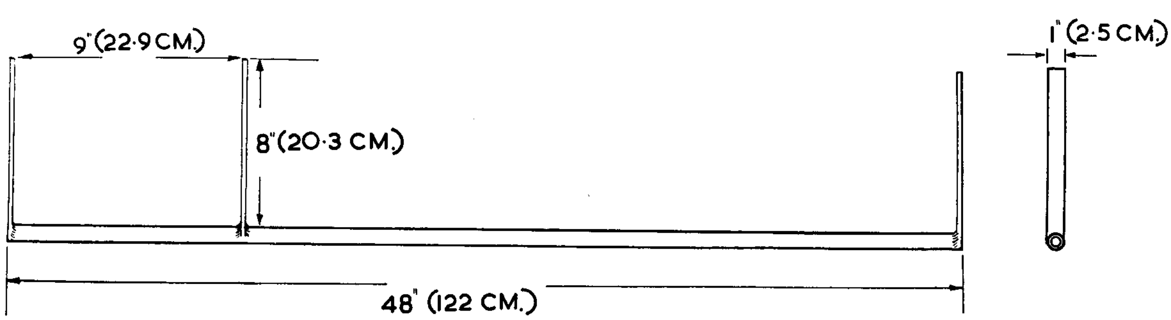


Fig. 9. Jig for checking the alignment of the front and rear propeller shafts.

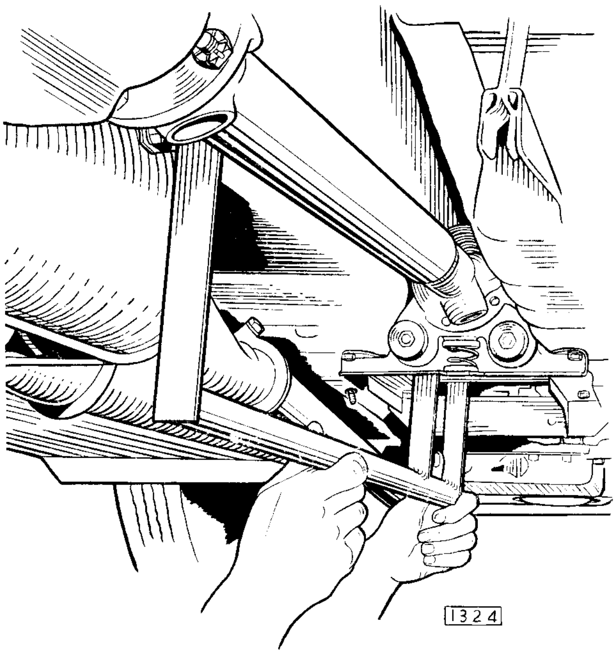


Fig. 10. Checking the alignment of the front and rear propeller shafts.

Adjustment of Engine Stabilizer

After having carried out the above procedure adjust the stabilizer as follows :—

1. Screw the lower flanged washer up the stabilizer pin **until the flange contacts the bottom of the stabilizer rubber mounting.** The washer is slotted on its upper face and can be screwed up the pin by engaging a thin bladed screwdriver in the slot through the centre hole of the rubber mounting.
2. Fit the upper flanged washer and tighten down with the self-locking nut.

Failure to observe the above procedure may cause engine vibration and/or fouling of the gearbox in its cowl owing to the engine being pulled up on its mountings.

THE UNIVERSAL JOINTS

Examine and check for Wear

The parts most likely to show signs of wear after long usage are the bearing races and spider journals. Should looseness in the fit of these parts, load markings or distortion be observed they should be renewed as a unit as worn needle bearings used with a new spider journal or new needle bearings with a worn spider journal will wear more rapidly, making another replacement necessary in a short time.

It is essential that the bearing races are a light drive fit in the yoke trunnion.

In the rare event of wear having taken place in the yoke cross holes, the holes will have become oval and the yokes must be removed.

In the case of wear of the cross holes in a fixed yoke, which is part of the tubular shaft, only in cases of emergency should these be replaced. They should normally be replaced by a complete assembly.

The other parts likely to show signs of wear are the splined sleeve yoke and splined shaft. A total of .004″ (.1 mm.) circumferential movement, measured on the outside diameter of the spline, should not be exceeded. If wear has taken place above this limit the complete propeller shaft should be replaced.

To Dismantle

To remove the sliding joint from the splined shaft, unscrew the dust cap and pull back the cork washer.

Clean the paint and dirt from the rings and top of bearing races. Remove all the snap rings by pinching together with a pair of pliers and prising out with a screwdriver. If a ring does not snap out of its groove readily, lightly tap end of bearing race to relieve the pressure against the ring.

Hold the joint in the hand and with a soft nosed hammer tap the yoke lug as shown in Fig. 11.

The top bearing will gradually emerge and can finally be removed with the fingers (see Fig. 12).

If necessary, tap the bearing race from inside with a small diameter bar, taking care not to damage the bearing race (see Fig. 13).

Repeat this operation for the opposite bearing. The splined sleeve yoke or flange yoke can now be removed. Rest the two exposed trunnions on wood or lead blocks, then tap yoke with a soft nosed hammer to remove the two remaining bearing races. Wash all parts in petrol.

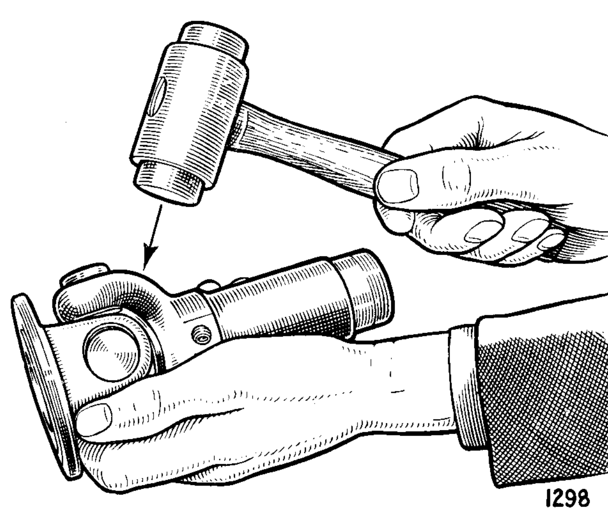


Fig. 11. Tapping the yoke to remove the bearing.

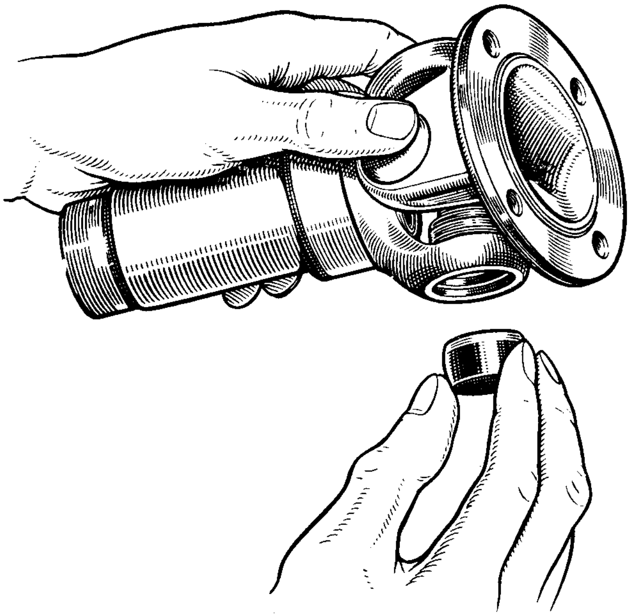


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Fig. 12. Withdrawing the bearing from the universal joint.

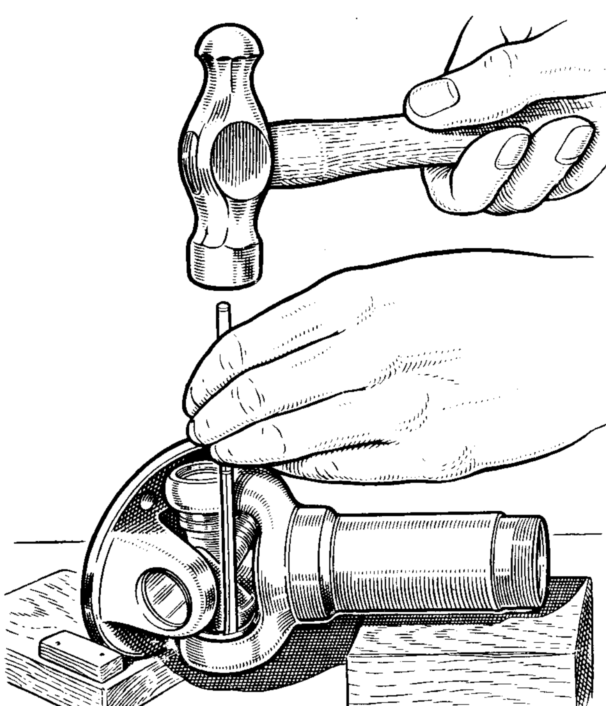

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Fig. 13. Tapping out a bearing with a small diameter bar.

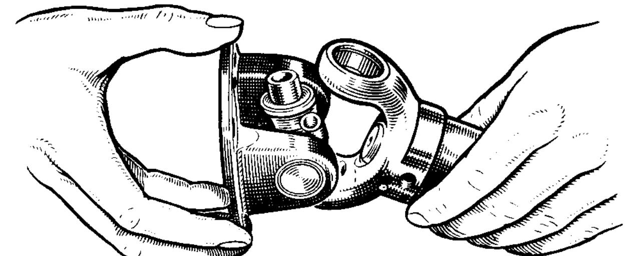

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Fig. 14. Separating the universal joint yokes.

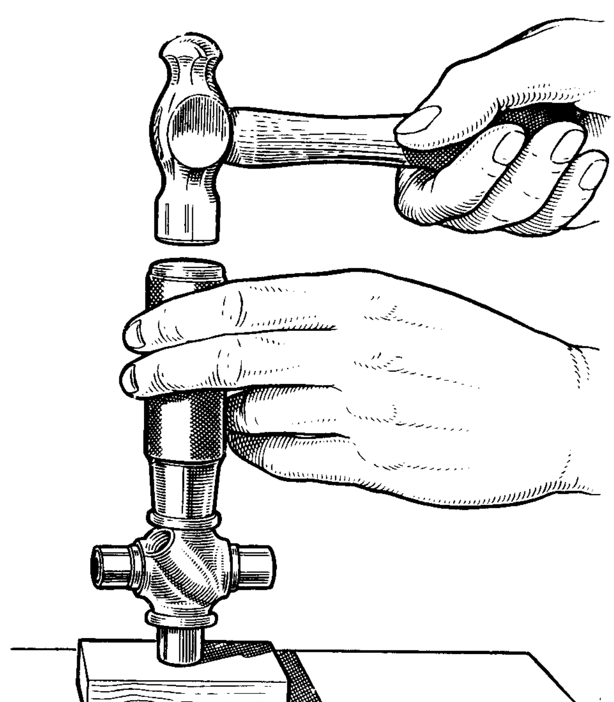

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Fig. 15. Replacing a gasket retainer with a hollow drift.

Assembling

Insert journal in yoke holes and using a soft round drift with a flat face about $\frac{1}{32}$" (.8 mm.) smaller in diameter than the hole in the yoke, tap the bearing into position. Repeat this operation for the other three bearings. Fit new snap rings and ensure that they are correctly located in their grooves. If joint appears to bind tap lightly with a wooden mallet, to relieve any pressure of the bearings on the end of the journal. **When replacing the sliding joint it must be refitted with its fixed yoke in line with the fixed yoke at the end of the propeller shaft tube. Arrows are stamped on the two parts to facilitate alignment. (See Fig 16.)**

Should any difficulty be encountered when assembling the needle rollers in the housing, smear the wall of the race with vaseline. It is advisable to install new cork gaskets and gasket retainers on the spider assembly, using a tubular drift as shown in Fig. 15.

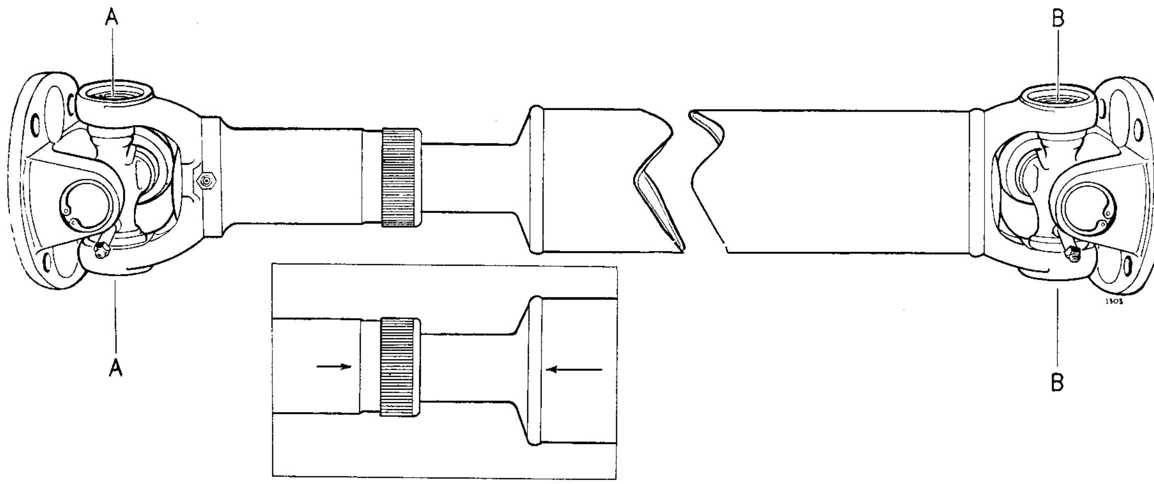

Fig. 16. When refitting the sliding joint to the drive shaft it is ESSENTIAL that the yokes A and B are in the same plane. The inset shows the arrows that are stamped on the two parts to facilitate alignment.

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SECTION H

REAR AXLE

(including Thornton "Powr-Lok" Differential)

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone	Code	Telegraphic Address
ALLESLEY 2121 (P.B.X.)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/H/4

INDEX

INDEX *(continued)*

Thornton "Powr-Lok" Differential

REAR AXLE

Both the 2.4 litre and the 3.4 litre models are fitted with a Salisbury axle ; the 2.4 litre axle is of the 3.HA type and the 3.4 litre is of the 4.HA type.

DESCRIPTION

The rear axle assembly (Fig. 1) is of the semi-floating type with shim adjustment for all bearings and meshing of the hypoid drive gear and pinion matched assembly. The axle shafts are splined at the inner ends, which engage splines in the differential side gears, while the outer ends have tapers and keys to fit the rear wheel hubs. The hubs are supported by taper roller bearings pressed on to the axle shafts and located in the ends of the axle tubes. Outward thrust on either wheel is taken by the adjacent hub bearing, whilst inward thrust is transmitted through the axle shafts and slotted axle shaft spacer to the opposite bearing. Thus, each hub bearing takes thrust in one direction only. A cover on the rear of the gear carrier housing permits inspection without dismantling the axle.

The axle gear ratio is stamped on a tag attached to the assembly by one of the rear cover-screws. The axle serial number is stamped on the gear carrier housing.

1. Drive pinion oil seal.
2. Drive pinion oil seal gasket.
3. Drive pinion oil slinger.
4. Gear carrier.
5. Hypoid drive pinion. } matched
6. Hypoid drive gear. } assembly.
7. Differential case.
8. Differential side gear.
9. Differential bearing shim.
10. Gear carrier cover.
11. Differential bearing.
12. Axle shaft spacer.
13. Pinion mate shaft.
14. Differential bevel pinion mate.
15. Pinion mate shaft lock pin.
16. Drive pinion bearing (inner).
17. Drive pinion bearing shim (inner).
18. Drive pinion bearing spacer.
19. Drive pinion bearing shim (outer).
20. Drive pinion bearing (outer).
21. Universal joint flange.

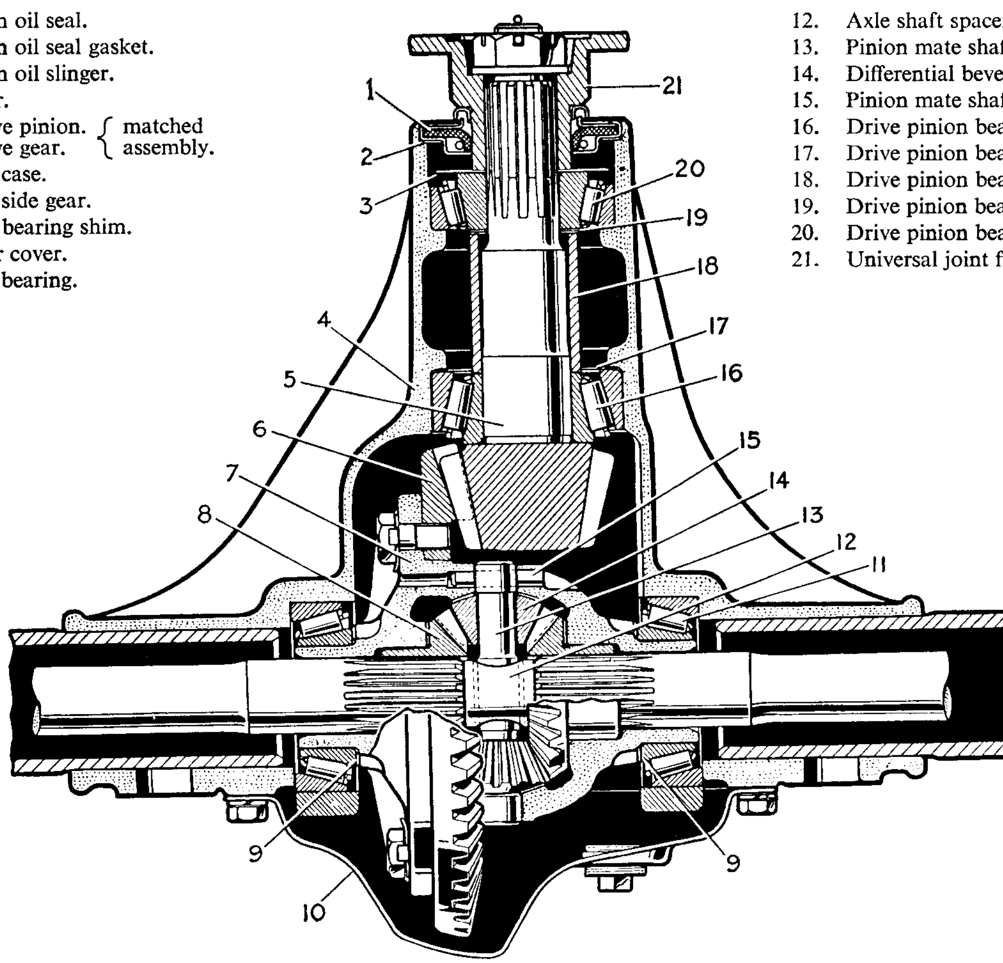


Fig. 1. Sectioned view of the differential.

DATA

Axle Shaft End Float —drum brake cars	.006″ to .008″ (.15 to .20 mm.)
—disc brake cars	.003″ to .005″ (.08 to .13 mm.)
Differential Bearing Preload	.005″ (.13 mm.) shim allowance
Pinion Bearing Preload	8 to 12 lbs/in. (.09 to .14 kg/m.)
Backlash	As etched on drive gear —minimum .004″ (.10 mm.)
Tightening Torque	
—Drive Gear Bolts	
$\frac{3}{8}$″ (9.5 mm.) diameter bolts	50 to 60 lbs/ft. (6.9 to 8.3 kg/m.)
$\frac{7}{16}$″ (11.1 mm.) diameter bolts	70 to 80 lbs/ft. (9.7 to 11.1 kg/m.)
—Differential Bearing Cap Bolts	60 to 65 lbs/ft. (8.3 to 9.0 kg/m.)
—Pinion Nut	120 to 130 lbs/ft. (16.6 to 18.0 kg/m.)
Thornton "Powr-Lok" Differential Bolts	35 to 45 lbs/ft. (4.8 to 6.2 kg/m.)

Axle Ratios

2·4 litre (Type 3.HA)	**3.4 litre** (Type 4.HA)
4.27 : 1 (47 × 11) Standard	3.54 : 1 (46 × 13) Standard
4.55 : 1 (50 × 11) Overdrive models	3.77 : 1 (49 × 13) Overdrive models

Note : 2.4 litre Standard transmission cars prior to 901582 R.H. Drive and 940606 L.H. Drive were fitted with 4.55 : 1 ratio rear axles.

Special Tools

For efficient servicing of the rear axle, the special tools listed below and illustrated in this section are necessary.

The tools are manufactured and supplied by V. L. Churchill & Co. Ltd., Great South West Road, Feltham, Middlesex.

	Churchill Tool No.
Axle Shaft Extractor	SL.13A
Pinion and Differential Bearing Cone Puller	SL.11PD/AB
Gear Carrier Stretching Fixture	SL.1
Pinion Bearing Cup Extractor	SL.12
Bearing Cup Installation Tool	SL.12
Pinion Cone Setting Gauge	SL.3P
Pinion Oil Seal Installation Collar	SL.4P/B
Rear Hub Extractor (for disc wheel hubs)	J.1

Reconditioning Scheme

Although full servicing instructions for the rear axle are given in this section it is recommended that, wherever possible, advantage is taken of the factory reconditioning scheme particularly in view of the intricate adjustments and the number of special tools required.

Reconditioned axles are supplied on an exchange basis and comprise an axle complete less hubs and brake details ; rear axles for overhaul should therefore be returned in this condition.

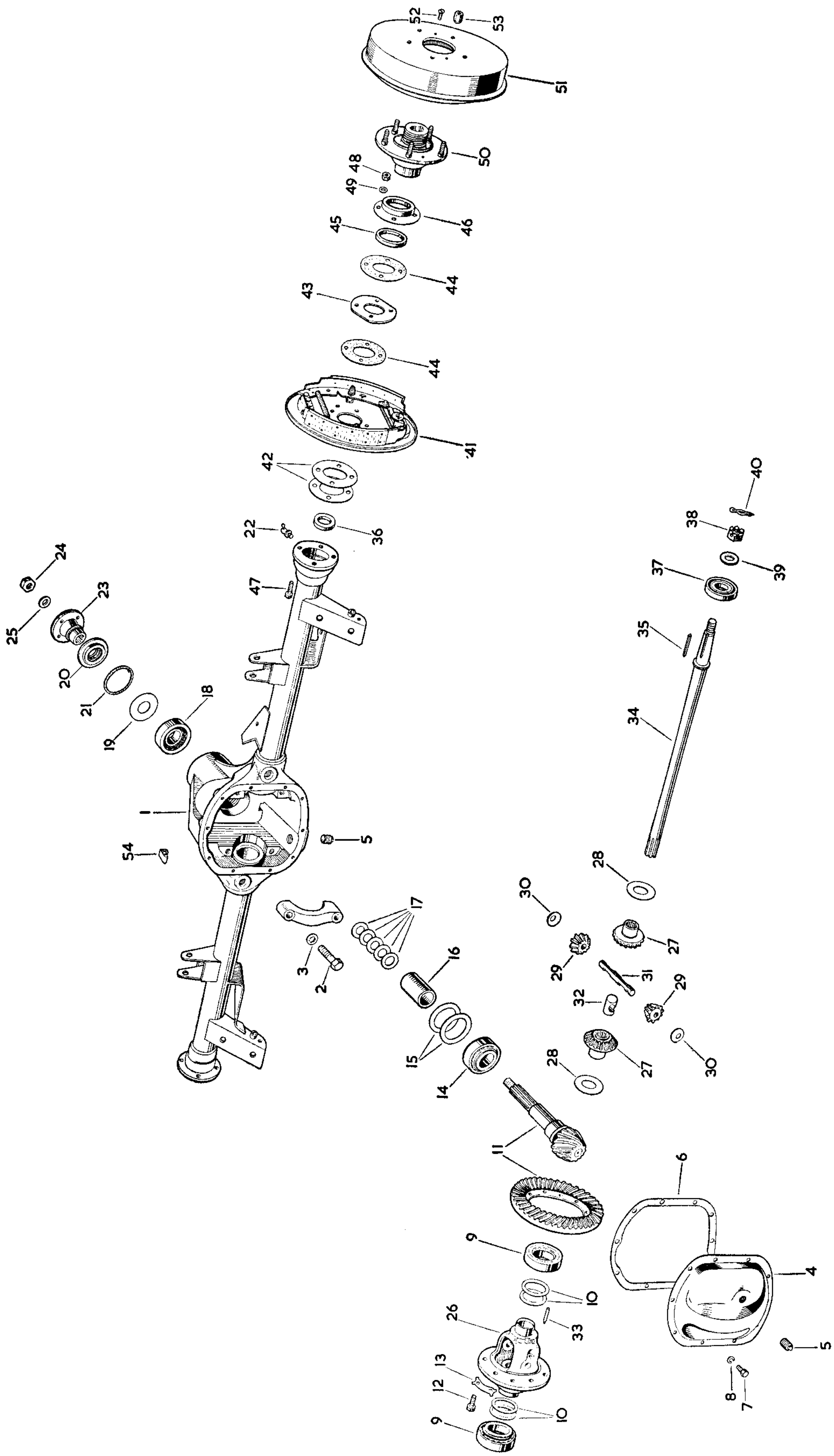


Fig. 2. Exploded view of the rear axle.

1. Carrier and tube assembly.
2. Setscrew.
3. Shakeproof washer.
4. Rear Cover.
5. Drain and filler plug.
6. Gasket.
7. Setscrew.
8. Lockwasher.
9. Roller bearing.
10. Shim.
11. Drive gear and pinion.
12. Setscrew.
13. Lockstrap.
14. Roller bearing.
15. Shim (inner)
16. Pinion bearing spacer (not fitted to all axles).
17. Shim (outer).
18. Roller bearing.
19. Oil slinger.
20. Oil seal.
21. Gasket
22. Grease nipple.
23. Universal joint flange.
24. Nut.
25. Washer.
26. Differential case.
27. Side gear.
28. Thrust washer.
29. Differential pinion mate gear.
30. Thrust washer.
31. Pinion mate gear shaft.
32. Spacer.
33. Pinion mate shaft lock pin.
34. Axle shaft.
35. Key.
36. Oil seal.
37. Taper roller bearing.
38. Slotted nut.
39. Washer
40. Split pin.
41. Rear brake assembly.
42. Shim.
43. Retainer.
44. Gasket.
45. Oil seal.
46. Oil seal retainer.
47. Bolt.
48. Nut.
49. Washer.
50. Wheel hub.
51. Brake drum.
52. Set Screw.
53. Nut.
54. Brake pipe retaining clip.

ROUTINE MAINTENANCE

Every 2,500 miles (4,000 km.) check the level of the oil in the rear axle when the car is standing on level ground. A combined level and filler plug is fitted to the cover plate. Top up, if necessary, to the bottom of this plug with the recommended grade of lubricant. Since hypoid oils of different brands may not mix satisfactorily, draining and refilling is preferable to topping up if the brand of oil in the axle is unknown.

Every 5,000 miles (8,000 km.) lubricate the rear wheel bearings sparingly with recommended lubricant through the nipples provided. The nipples are situated at the ends of the axle tubes. A bleed hole is provided in the axle casing opposite the nipple to indicate when sufficient lubricant has been applied.

Every 10,000 miles (16,000 km.) drain and refill with the recommended grade of lubricant. The drain plug is situated at the base of the differential. The oil will drain more readily if the operation is carried out at the end of a journey when the oil is hot and will therefore flow more freely.

Every 10,000 miles (16,000 km.) it is desirable at this mileage to check and correct, if recessany, the axle shaft end float.

Recommended Lubricants

	Mobil	Castrol	Shell	Esso	B.P.	Duckham	S.A.E. Viscosity
Rear Axle	Mobilube GX 90	Castrol Hypoy	Spirax 90 E.P.	Expee Compound 90	Energol EP 90	Hypoid 90	Hypoid 90
Rear wheel bearings	Mobilgrease MP	Castrolease LM	Retinax A	Esso Multi-Purpose Grease H	Energrease L2.	LB 10	

Capacities

	Imperial pints	U.S. pints	Litres
2.4 litre	$2\frac{1}{4}$	$2\frac{3}{4}$	1.3
3.4 litre	$2\frac{3}{4}$	$3\frac{1}{4}$	1.6

REAR AXLE

Removal

Jack up the car under the rear axle and place blocks forward of the road spring front mounting. Remove wheel spats, nave plates and road wheels. Release handbrake.

Disconnect the handbrake cables by removing the clevis pins at brake calipers.

Disconnect hydraulic pipes from the brake calipers and blank off open connections to ensure cleanliness when reassembling.

Remove the two bolts securing the brake caliper to caliper mounting plate and detach the caliper. Note the shims fitted between the caliper and mounting plate ; these must be refitted in their original positions otherwise the centralisation of the caliper will be upset.

Withdraw the split pin and slotted nut with washer securing each hub to axle shaft and draw off hubs with suitable extractor (see Fig. 3).

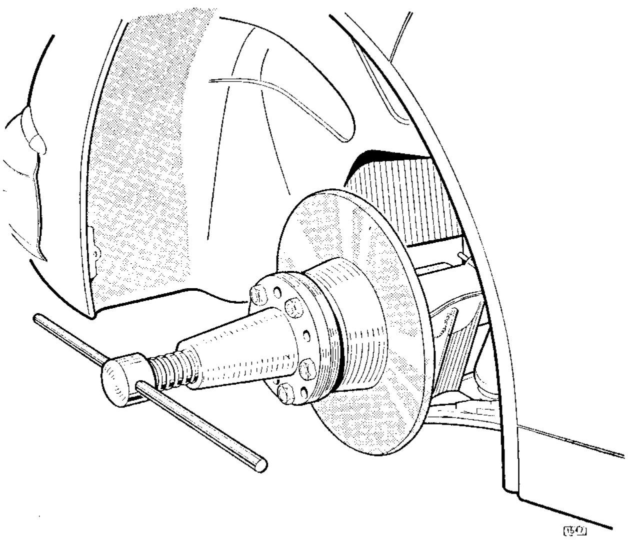


Fig. 3. Withdrawing the rear hub with an extractor

Remove split pins and four slotted nuts securing rear axle companion flange to propeller shaft. Withdraw bolts, spring propeller shaft out of register and place clear.

Remove the clips securing hydraulic pipes to the rear axle. Remove the bolt securing the three-way connection to the rear axle casing and tie up the hydraulic pipe to the body underframe.

Remove the two bolts securing the handbrake compensator assembly to the rear axle and remove compensator assembly and cables.

Remove the two nuts, the inner and outer washers and the rubber buffers from the damper attachment bracket on the rear axle. Compress the hydraulic damper clear of the rear axle.

Release the torque arms by removing the self-locking nuts from the bolts securing the arms to the rear axle ; remove the plain washers and drift out the bolts.

Remove the nuts securing the panhard rod to the rear axle and withdraw the rubber buffers and washers.

Lower the axle as far as possible on the jack before removing the spring eye bolts.

Remove the nuts securing the road spring eye bolts and drift out the bolts.

Slide axle assembly clear of the exhaust tail pipe(s). Lower to floor and withdraw from underneath the car.

Refitting

Refitting is the reverse of the removal procedure, but it will be necessary to check the centralisation of the brake calipers and bleed the hydraulic system, as described in section L " Brakes ".

Check the setting of the panhard rod as described in Section K " Rear Suspension ".

REAR AXLE (Drum brake cars)

Removal

Jack up the car under the rear axle and place blocks forward of the road spring front mounting. Remove wheel spats, nave plates and road wheels. Release handbrake.

Remove the two screws locating each brake drum to the hub and withdraw drums. Withdraw the split pin and slotted nut with washer, securing each hub to the axle shaft and draw off the hubs with suitable extractor.

At the rear of the back plates disconnect the hydraulic pipe unions to the wheel cylinders and remove the clevis pins securing the hand brake cables to the operating levers.

Remove the clips securing the hydraulic pipes to the rear axle. Remove the bolt securing the three-way connection to the rear axle casing and tie up the hydraulic pipe to body underframe.

Remove the four bolts and nuts securing each back plate to the ends of the axle casing and withdraw back plate.

Note the oil seal, bearing retainer plate and two gaskets at the front of each back plate, and the shims fitted between the back plate and the flange of the axle tube.

Remove the split pins and four slotted nuts securing the rear axle companion flange to propeller shaft. Withdraw bolts, spring propeller shaft out of register and place clear.

Remove the two bolts securing the handbrake compensator assembly to the rear axle and remove the compensator assembly and cables.

Remove the two nuts, the inner and outer washers and the rubber buffers from the damper attachment bracket on the rear axle. Compress hydraulic damper clear of the rear axle.

Release torque arms by removing the self-locking nuts from the bolts securing the arms to the rear axle ; remove plain washers and drift out the bolts.

Remove the nuts securing the panhard rod to the rear axle and withdraw rubber buffers and washers.

Lower the axle as far as possible on the jack before removing spring eye bolts.

Remove the nuts securing the road spring eye bolts and drift out bolts.

Slide the axle assembly clear of the exhaust tail pipe(s). Lower to floor and withdraw from underneath the car.

Refitting

Refitting is the reverse of the removal procedure, but it will be necessary to bleed the brake hydraulic system as described in Section L " Brakes " and to check the setting of the panhard rod as described in Section K " Rear Suspension ".

AXLE SHAFTS (Disc brake cars)

Removal

Jack up car and remove wing valance and road wheel.

At the rear of the brake calipers remove clevis pins securing handbrake cable to operating lever. Disconnect hydraulic pipes and blank off open connections to ensure cleanliness when reassembling.

Remove the two bolts securing the brake caliper to caliper mounting plate and detach the caliper. Note the shims fitted between the caliper and mounting plate ; these must be refitted in their original positions otherwise the centralisation of the caliper will be upset. Remove split pin and slotted nut and with a suitable extractor, withdraw the hub and disc from the axle shaft.

Before proceeding further check the combined end float of the axle shafts which should be .003" to .005" (.08 to .13 mm.) ; if necessary adjust end float when refitting by adding or subtracting shims between caliper mounting plate and end of axle tube.

Withdraw the axle shaft with its taper roller bearing from the end of the axle tube, using Tool No. SL.13A (see " Special Tools " on page H.5).

Examine the hub bearing and if a replacement is necessary withdraw the inner race from the axle using Tool No. SL.11 PD/AB (see "Special Tools" on page H.5).

Examine the oil seal which is pressed inside the axle tube and if necessary withdraw and fit a replacement.

Refitting

Refitting is the reverse of the removal procedure but it is important to observe the following points :—

Wash the hub bearing so that the axle shaft end float may be determined accurately. Install the shaft with the taper roller inner race taking care not to damage the oil seal. Assemble the bearing outer race, making absolutely sure that the race enters the housing squarely. Examine the hub oil seal and replace if necessary.

Check the axle shaft end float, as shown in Fig. 5, with a dial indicator, after gently tapping with a rawhide mallet on each axle shaft to ensure that the

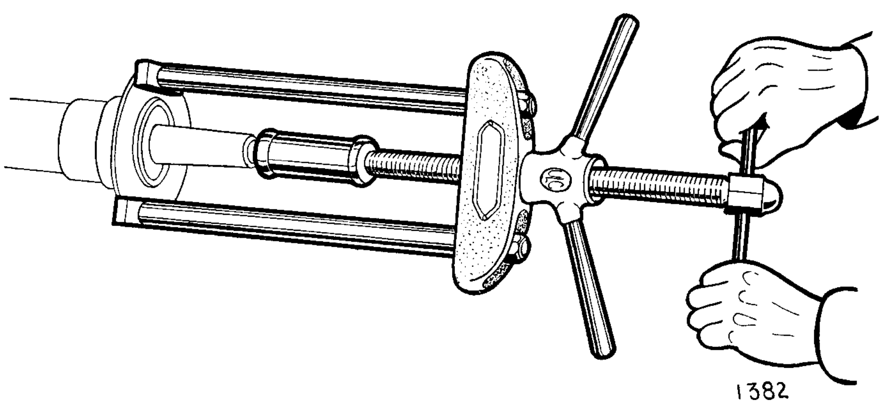


Fig. 4. Axle shaft removal.

bearing cups are butting against the caliper mounting plate.

Add or subtract adjusting shims available in thicknesses of .003", .005", .010" and .030" (.08, .13, .25 and .76 mm.) until the correct axle shaft end float of .003" to .005" (.08 to .13 mm.), which is just perceptible by hand, is obtained. Adding shims increases end float, subtracting shims decreases end float. Remove or install approximately an equal thickness of shims at each end of the axle in order to retain the axle shaft spacer in a central position.

Refit hubs and caliper assemblies ; reconnect hydraulic pipes and handbrake cables. Check the centralisation of the discs within the brake calipers and " bleed " hydraulic system as described in Section L " Brakes ".

Refit road wheels and wing valances. Grease hub bearings with the recommended lubricant until grease exudes from the bleed hole.

AXLE SHAFTS (Drum brake cars)

Removal

Jack up the car and remove the road wheel. Remove the split pins and slotted nut, and with a suitable extractor withdraw the hub from the axle shaft.

Before proceeding further check the combined end float of the axle shafts which should be .006" to .008" (.15 to .20 mm.) ; if necessary adjust end float when refitting by adding or subtracting shims fitted between back plate and end of axle tube.

At the rear of the back plate disconnect the hydraulic pipe from wheel cylinder. Remove the clevis pin securing the hand brake cable to the operating lever which protrudes through the back plate.

Remove the four bolts and nuts securing the back plate to the end of axle tube and withdraw back plate.

Note the bearing retainer plate, two gaskets and oil seal at the front of back plate and the shims fitted between the back plate and the flange of the axle tube. Do not lose or transpose these shims to the other side of the axle case as they control the end float of the axle shafts.

Withdraw the axle shaft with its taper roller bearing from the end of the axle tube, using Tool No. SL.13A (see " Special Tools " on page H.5).

Examine the hub bearing and if a replacement is necessary withdraw the inner race from the axle shaft using Tool No. SL.11PD/AB (see " Special Tools " on page H.5).

Examine the oil seal which is fitted inside the axle tube and if necessary withdraw and fit a replacement.

Refitting

Refitting is the reverse of the removal procedure but it is important to observe the following points :—

Wash the hub bearing so that the axle shaft end float may be determined accurately. Install the shaft with the taper roller inner race, taking care not to damage the oil seal. Assemble the bearing outer race, making absolutely sure that the race enters the housing squarely. Examine the hub oil seal and replace if necessary.

Fit the shims, back plate, bearing retainer plate with two new paper gaskets, and oil seal.

Check the axle shaft end float as in Fig. 5 with a dial indicator assembly, after gently tapping with a rawhide mallet on each axle shaft to ensure that the bearing cups are butting against the brake back plates or retaining plates.

Add or subtract adjusting shims available in thicknesses of .003", .005", .010" and .030" (.08, .13, .25 and .76 mm.) until the correct axle end float of .006" to .008" (.15 to .20 mm.), which is just perceptible by hand, is obtained. Adding shims increases end float, subtracting shims decreases end float. Remove or install approximately an equal thickness of shims at each end of the axle in order to retain the axle shaft spacer in a central position.

Reconnect the handbrake cable and hydraulic pipe connections. Refit hubs and brake drums ; " bleed " the hydraulic system as described in Section L "Brakes."

Refit road wheels and wing valances. Grease hub bearings with the recommended lubricant until grease exudes from the bleed hole.

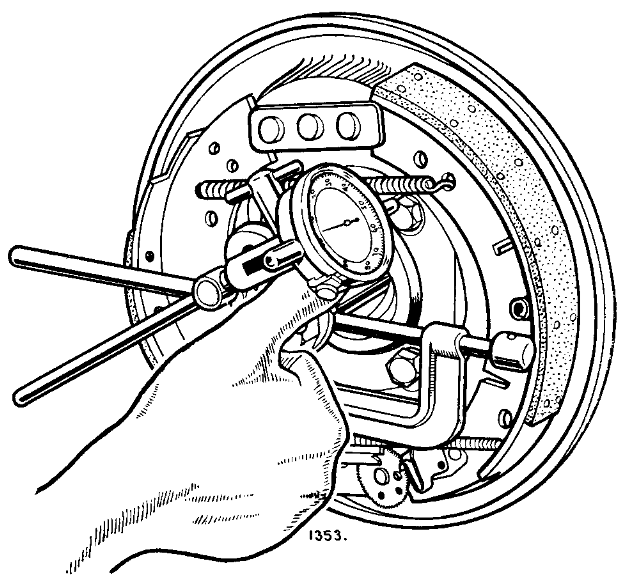


Fig. 5. Checking the axle shaft end float.

DISMANTLING THE DIFFERENTIAL ASSEMBLY

Remove the axle assembly as described on page H.9.
Remove the axle shafts as described on page H.10.

Removing the Differential with Service Tools

First drain the lubricant from the gear carrier housing and then remove the gear carrier rear cover. Flush out the unit thoroughly so that the parts can be carefully inspected.

To remove the differential, proceed as follows :—

(1) Withdraw the four bolts securing the two differential bearing caps and remove the two caps.

(2) Before attempting to remove the differential assembly, fit the stretching fixture, Tool No. SL.1. Fig. 6 (see " Special Tools " on page H.5).

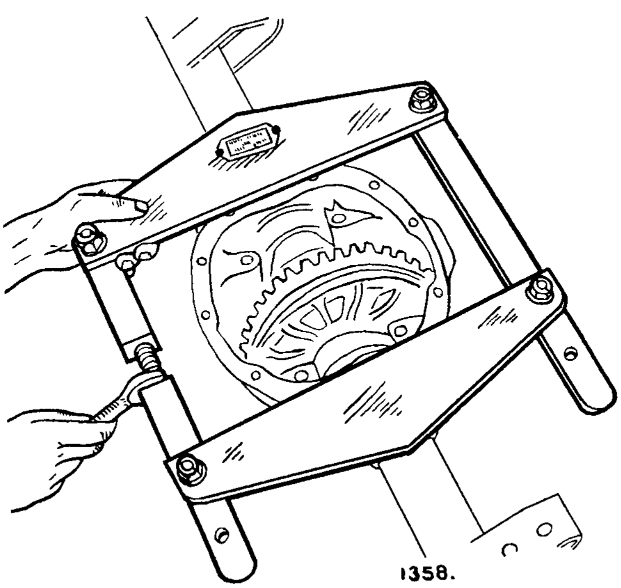


Fig. 6. Stretching the gear carrier prior to removing the differential.

The fixture should be adjusted to suit the model being serviced, a series of holes being provided in the member opposite the turn-buckle for this purpose. Open the fixture by means of the turn-buckle until it is hand tight, then spread the case by using a spanner. DO NOT OVER-SPREAD, OR THE AXLE CASING WILL BE DAMAGED BEYOND REPAIR. The correct spread does not exceed a half turn on the turn-buckle, and this figure should not be exceeded even if the differential is still stiff to remove.

(3) The differential assembly may now be prised out by means of two levers, one on each side of the differential case opening. During this operation use suitable packing between the levers and the gear carrier.

Removing the Differential—Emergency Method

First drain the lubricant from the gear carrier housing and then remove the gear carrier rear cover. Flush out the unit thoroughly so that the parts can be carefully inspected.

To remove the differential, proceed as follows :—

(1) Withdraw the four bolts securing the two differential bearing caps and remove the two caps.

(2) The differential assembly should now be prised out by means of two levers, one on each side of the differential case opening, taking care not to tilt the assembly and so wedge it more tightly than it is held by the preload. During this operation use suitable protective packing between the levers and the gear carrier.

Removing the pinion

(1) Remove the pinion nut and washer.

(2) Withdraw the universal joint companion flange with a suitable puller.

(3) PRESS the pinion out of the outer bearing. It is important that the pinion should be pressed and not driven out to prevent damage to the outer bearing. The pinion, having been pressed from its outer bearing, may now be removed from the gear carrier housing. Note : Keep all shims intact.

(4) Remove the pinion oil seal together with the oil slinger and outer bearing cone.

(5) Examine the outer bearing for wear and, if replacement is required, extract the bearing cup, using Tool No. SL.12 shown in Fig. 8.

(5a) If the correct tool is not available, and the old bearing cup is to be scrapped, it is possible to drive out the cup, the shoulder locating the bearing being recessed to facilitate the operation.

(6) Remove the pinion inner bearing cup, as shown in Fig. 8, using Tool No. SL.12 if the bearing requires replacement or adjustmentof the pinion setting is to be undertaken. Take care of the shims fitted between the bearing cup and the housing abutment face.

(6a) If the inner bearing is to be replaced it may be driven out, but the correct service tool should be used when the bearing is removed in order to carry out pinion setting adjustment.

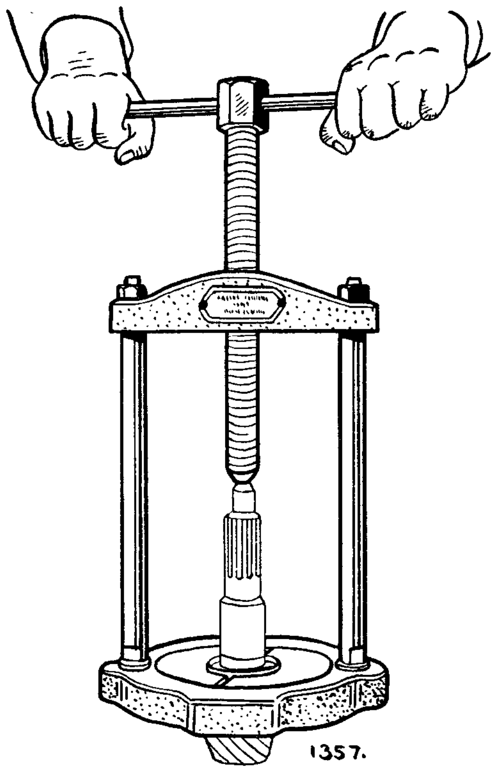


Fig. 7. Withdrawing the pinion inner bearing.

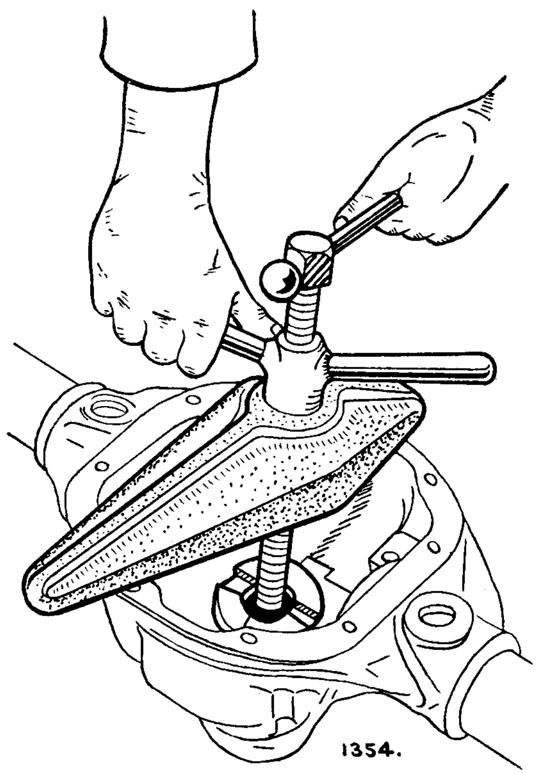


Fig. 8. Removal of the inner bearing cup.

Dismantling the Differential

(1) Bend down the tabs on the drive gear screws locking straps and remove the drive gear screws.

(2) Remove the drive gear from the differential case by tapping with a rawhide mallet.

(3) Using a small punch, drive out the pinion mate shaft locking pin, which is secured in place by peening the case, and remove the pinion mate shaft. Fig. 9 indicates the direction in which the

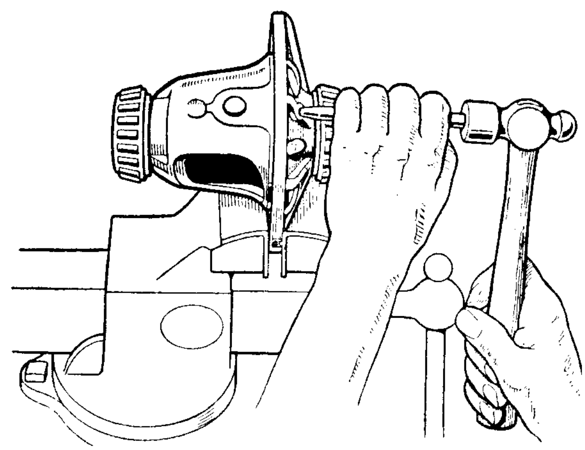


Fig. 9. Removal of the pinion mate shaft locking pin.

locking pin is removed; it is not possible to drift the pin in the opposite direction.

(4) Remove the axle shaft spacer.

(5) Rotate the side gears by hand until the pinions are opposite the openings in the differential case, then remove the differential gears, care being taken not to lose the thrust washers fitted behind them.

(6) If the drive gear setting is to be altered, it will be necessary to withdraw the differential bearings, using the extractor Tool No. SL.11PD/AB, to gain access to the shims located between the bearing and the abutment face on the differential case.

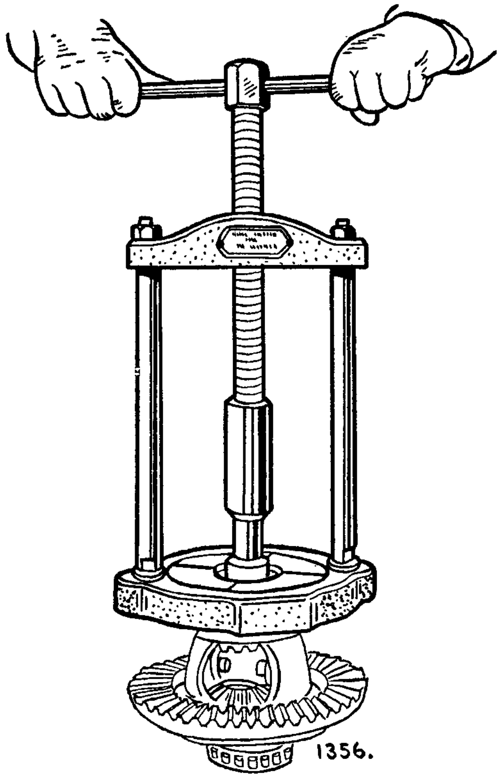


Fig. 10. Withdrawing a differential bearing.

ASSEMBLING THE DIFFERENTIAL

(1) Assemble the side gears with the thrust washers in position.

(2) Insert the differential pinions, through the openings in the differential case, and mesh them with the side gears. Hold the pinion thrust washers on the spherical thrust faces of the pinions whilst rotating the differential gear assembly into its operating position by hand.

(3) Line up the pinions and thrust washers, then install the pinion mate shaft with the axle shaft spacer in position.

(4) Line up the cross hole in the shaft with the hole in the differential case, then fit the pinion mate shaft lock pin.

(5) Using a punch, peen some of the metal of the differential case over the end of the lock pin to prevent its working loose and thereby causing extensive damage to the axle assembly.

(6) Clean the drive gear and differential case contacting surfaces and carefully examine same for burrs.

(7) Align the drive gear attaching bolt holes with those in the flange of the case, and gently tap the drive gear home on the case with a hide or lead hammer.

(8) Insert the drive gear bolts, with NEW locking straps and tighten them uniformly, preferably with a torque spanner to the reading given on page H.5.
Then bend the locking tabs round the bolt heads to prevent their working loose.

The procedure for fitting the differential case assembly into the gear carrier is given under the heading " Differential Bearing Adjustment ".

Differential Bearing Adjustment

The thickness of shims required in the installation of the differential bearings is determined as follows :—

(1) Fit the differential bearings, without shims, on the differential case, making sure that the bearing cones and cups and the housing are perfectly clean.

(2) Place the differential assembly, with the bearing cups in their housing, within the gear carrier, the pinion not being assembled.

(3) Install the dial indicator set on the gear carrier with the button against the back face of the drive gear.

(4) Inserting two levers between the housing and the bearing cups, move the differential assembly to one side of the carrier, as shown in Fig. 11.

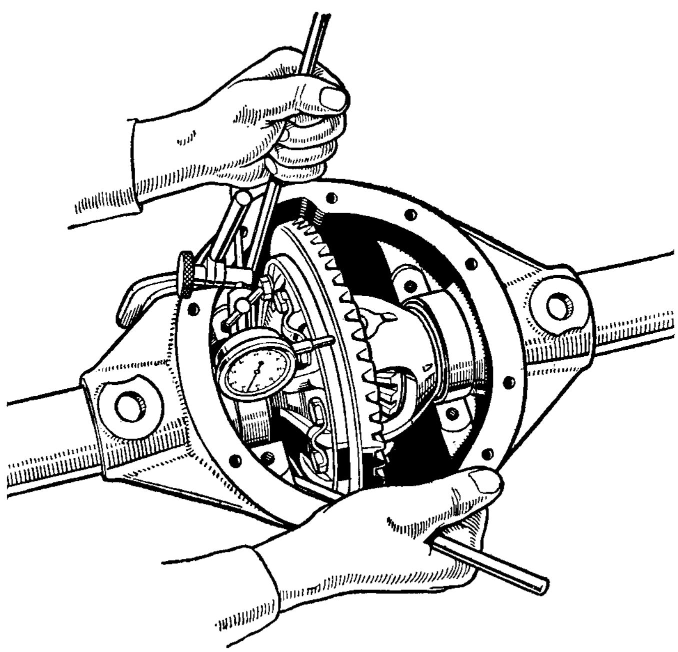


Fig. 11. Differential bearing adjustment.

(5) Set the indicator to zero.

(6) Move the assembly to the other side and record the indicator reading, which gives the total clearance between the bearings as now assembled and the abutment faces of the gear carrier housing.

Add .005″ (.13 mm.) more to the clearance reading to give preload ; this thickness of shims to be used in the installation of the differential bearings, the shims being divided to give the gear position with correct backlash as detailed under " Drive Gear Adjustment " on page H.17.

(7) Remove the differential assembly from the gear carrier.

Pinion Adjustment

Re-install the pinion outer bearing cup with Tool No. SL.12. Re-install the pinion bearing inner cup with the original adjusting shims positioning same. Press the inner bearing cone on the pinion, using an arbor press and a length of tube, contacting the inner race only and not the roller retainer.

The hypoid drive pinion should be correctly adjusted before attempting further assembly, the greatest care being taken to ensure accuracy.

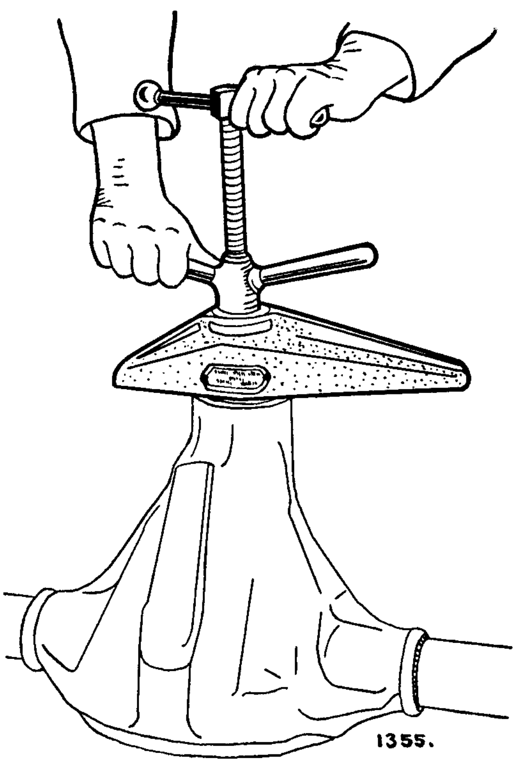


Fig. 12. Replacing the pinion bearing inner cup.

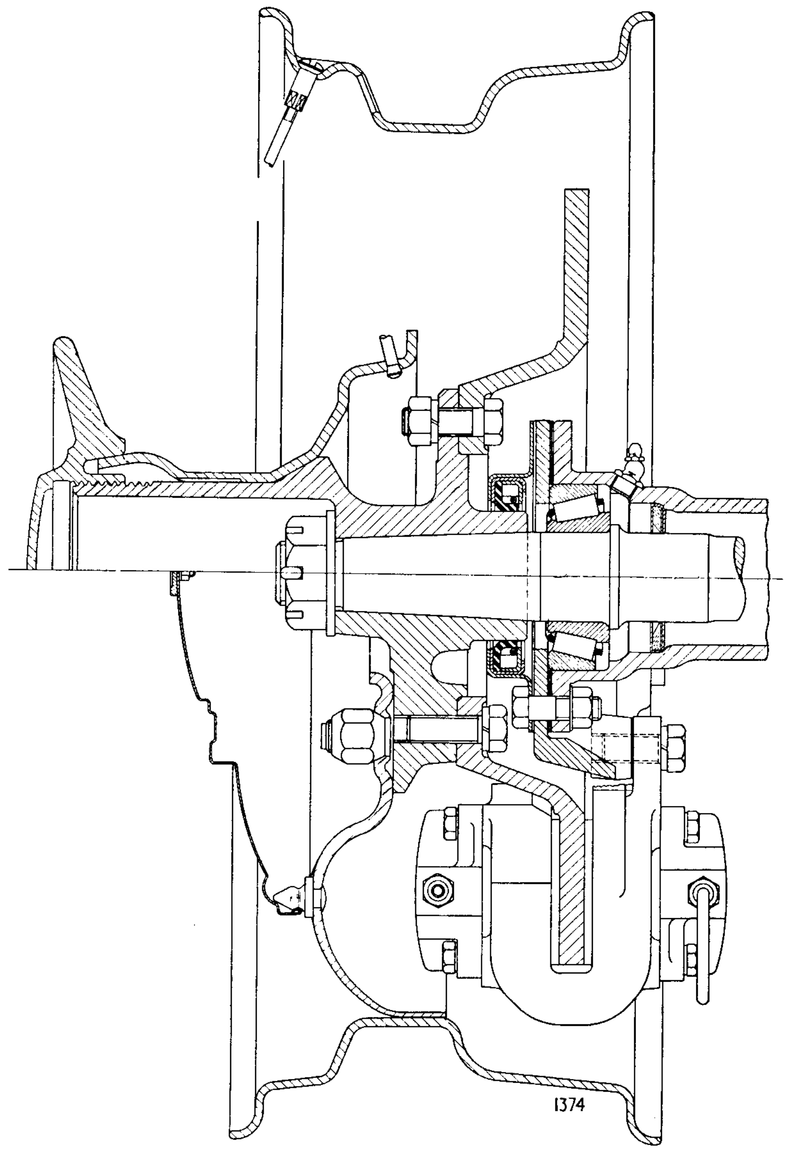


Fig. 13. Sectioned plan view of the disc brake hub arrangement. The upper half of the illustration shows a wire spoke wheel hub; the lower half shows a disc wheel hub.

The correct pinion setting is marked on the ground end of the pinion as shown in Fig. 14. The matched assembly serial number at the top is also marked on the drive gear, and care should be taken to keep similarly marked gears and pinions in their matched sets, as each pair is lapped together before despatch from the factory. The letter on the left is a production code letter and has no significance relative to assembly or servicing of any axle. The letter and figure on the right refer to the tolerance on offset or pinion drop dimension " A " in Fig. 15 which is stamped on the cover facing of the gear carrier housing.

The number at the bottom gives the cone setting distance of the pinion and may be Zero (0). Plus (+) or Minus (—). When correctly adjusted, a pinion marked Zero will be at the zero cone setting distance, dimension " B " in Fig. 15 from the centre line of the gear to the face on the small end of the pinion ; a pinion marked Plus two (+2) should be adjusted to the nominal (or Zero) cone setting plus .002″, and a pinion marked Minus two (—2) to the cone setting distance minus .002″.

The zero cone setting distances (" B " Fig. 15) for the various axles are given below.

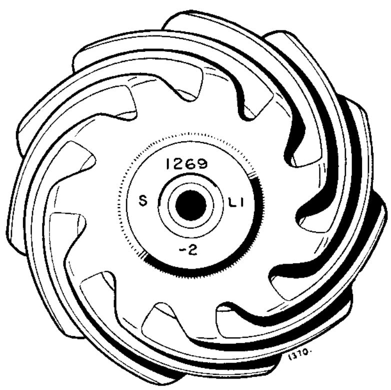


Fig. 14. Pinion setting marks.

Thus for a pinion marked Minus two (—2) the distance from the centre of the drive gear to the face of the pinion should be 2.623″ (that is, 2.625″—.002″) and for a pinion marked Plus three (+3) the cone setting distance should be 2.628″.

When the pinion bearing cups have been installed in the gear carrier, with the original pinion inner bearing adjusting shims, as described in the first paragraph of this section, proceed with pinion as follows :—

(1) Place the pinion, with the inner bearing cone assembled, in the gear carrier.

(2) Turn the carrier over and support the pinion with a suitable block of wood for convenience before attempting further assembly.

(3) Install the pinion bearing spacer if fitted on the unit under repair.

(4) Install the original outer bearing shims on the pinion shank so that they seat on the spacer or a shoulder on the shank, according to the construction of the unit.

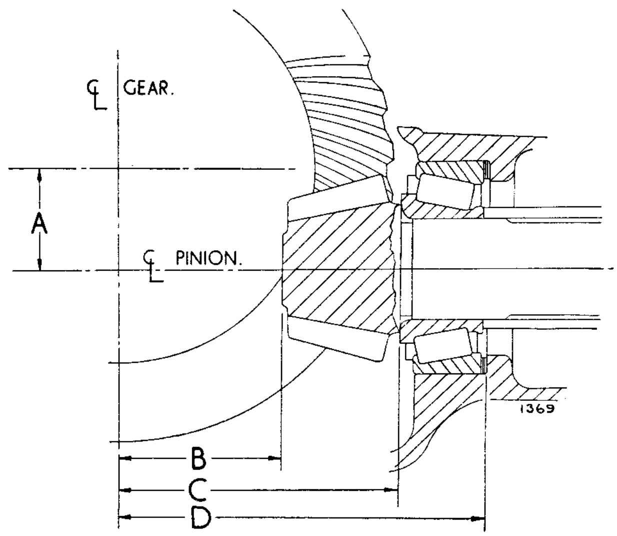


Fig. 15. Pinion setting distances.

			3 HA (2.4 litre)	4 HA (3.4 litre)
A.	Pinion Drop	-	1.375″ (34.92 mm.)	1.5″ (38.1 mm.)
B.	Zero Cone Setting	-	2.250″ (31.75 mm.)	2.625″ (66.67 mm.)
C.	Mounting Distance	-	3.937″ (100.00 mm.)	4.312″ (108.52 mm.)
D.	Centre Line to Bearing Housing	-	5.120″ (130.05 mm.) to 5.130″ (130.30 mm.)	5.495″ (139.57 mm.) to 5.505″ (139.83 mm.)

(5) Fit pinion outer bearing cone, companion flange, washer and nut only, omitting the oil slinger and oil seal assembly, and tighten the nut.

(6) Check the pinion cone setting distance by means of the gauge, Tool No. SL.3P, as shown in Fig. 16. The procedure for using the gauge is :—

(a) Adjust the bracket carrying the dial indicator to suit the model being serviced, then set the dial indicator to zero with the setting block.

(b) Place the dial indicator assembly on the fixed spindle of the gauge body.

(c) Fit the fixed spindle of the gauge body into the centre in the pinion head, slide the movable spindle into position, locating in the centre in the pinion shank with the gauge body underneath the gear carrier, and lock the spindle with the screw provided.

(d) Check the pinion setting by taking a dial indicator reading on the differential bore with the bracket assembly seated on the ground face on the end of the pinion. The correct reading will be the minimum obtained ; that is when the indicator spindle is at the bottom of the bore. Slight movement of the assembly will enable the correct reading to be easily ascertained. The dial indicator shows the deviation of the pinion setting from the zero cone setting and it is important to note the direction of any such deviation as well as the magnitude.

(7) If the pinion setting is incorrect it is necessary to dismantle the pinion assembly and remove the pinion inner bearing cup. Add or remove shims as required from the pack locating the bearing cup and re-install the shim pack and the bearing cup. The adjusting shims are available in thicknesses of .003″, .005″ and .010″. Then carry out the operations (1) to (6) detailed on page H.15.

(8) When the correct pinion setting has been obtained, check the pinion bearing preload, which should afford a slight drag or resistance to turning, there being no end play of the pinion. The correct preload for the pinion bearings gives a torque figure as listed in " Data " on page H.5. Less than the correct range will result in excessive deflection of the pinion under load, whilst too much preload will lead to pitting and failure of the bearings. To rectify the preload, adjust the shim pack between the outer bearing cone and

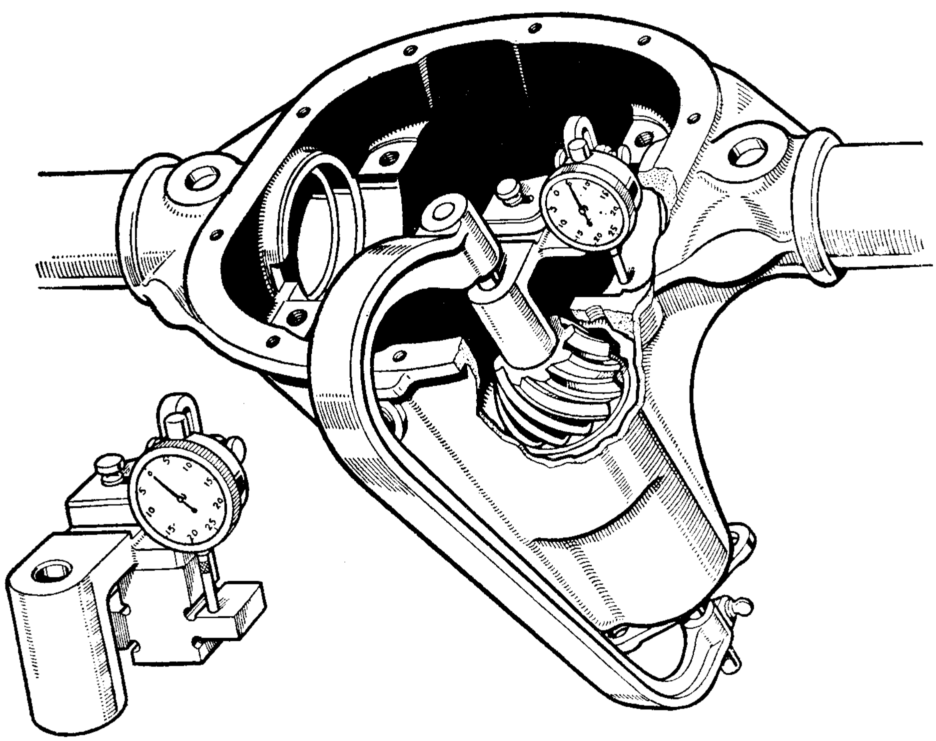


Fig. 16. Checking pinion cone setting.

the pinion shank or spacer, but do not touch the shims behind the inner bearing cup, which control the position of the pinion. Remove the shims to increase preload and add shims to decrease preload.

Installation of pinion oil seal assembly and oil slinger is usually effected after fitting differential assembly, see operations (1), (2) and (3) under " Final Assembly " on page H.19.

Drive Gear Adjustment

(1) Place the differential assembly with bearing cups, and less shims, in the housing, being sure that the bearing cones, cups and housing are perfectly clean.

(2) Install a dial indicator on the housing with the button on the back face of the drive gear as shown in Fig. 11.

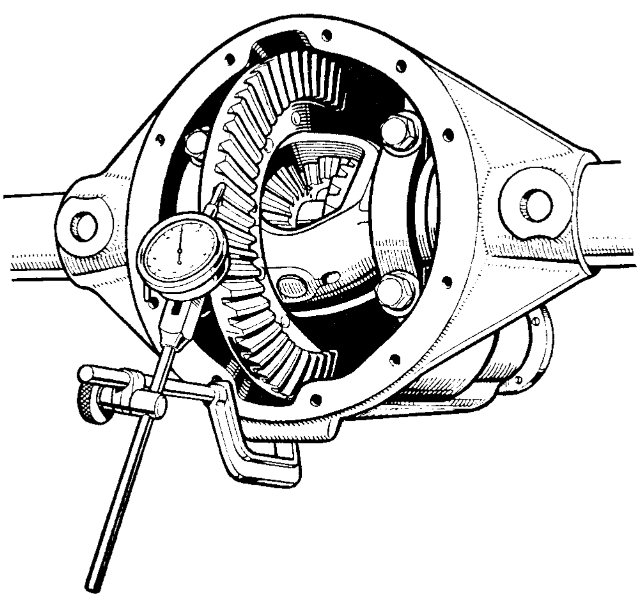


Fig. 17. Checking backlash between gears.

(3) Inserting two small levers between the housing and bearing cups, move the differential case and drive gear assembly away from the pinion until the opposite bearing cup is seated against the housing.

(4) Set the dial indicator to zero, then move the differential assembly towards the pinion until the drive gear is in metal to metal contact deeply in mesh with the pinion.

The indicator reading now obtained (clearance between drive gear and pinion) minus the backlash allowance as etched on the drive gear (e.g., B/L.007) denotes the thickness of shims to be placed between the differential case and the bearing cone on the drive gear side of the differential.

(5) Install the thickness of shims, determined in operation (4), on the drive gear side of the differential, taking the shims from the pack determined previously ; see " Differential Bearing Adjustment " on page H.14.

(6) Install the balance of the total shims required on the opposite side of the differential case.

As an example of differential and drive gear adjustment, assume that the total indicator reading obtained, as described under " Differential Bearing Adjustment ", is .080″. This figure, plus .005″ for the recommended preload, equals .085″, which denotes the total thickness of shims to be used. Also assuming the clearance between the drive gear and pinion to be .042″, determined as in operations (1) to (4) as above subtract the backlash as etched on the gear, say .007″, from the .042″ clearance. The .035″ difference denotes the thickness of shims to be placed between the differential case and bearing cone on the drive gear side of the differential. Then subtract the thickness of shims (.035″) inserted on the drive gear side of the differential case from .085″ and the .050″ difference denotes the thickness of shims to be installed on the opposite side of the case.

(7) To facilitate installation of the differential assembly, fit the stretching fixture as shown in Fig. 6. Stretch the gear carrier, being sure not to exceed the half turn specified on the turnbuckle or the axle casing will be damaged beyond repair.

(8) Lower the differential assembly into position, lightly tapping the bearings home with a hide hammer, whilst ensuring that the gear teeth are led into mesh with those of the pinion. Careless handling at this stage may result in bruising the gear teeth, and removal of the consequent damage can only be partially successful and result in inferior performance.

(7a) **Emergency Operation.** In an emergency it is possible to install the differential assembly by slightly tilting the bearing cups and tapping same lightly into position with a hide hammer. Naturally, this method increases the difficulty of avoiding damage to gear teeth, and extreme care is necessary to prevent damage to the differential bearings. This procedure is not recommended and should be strictly reserved for emergencies.

(8a) Install the differential bearing caps, taking care to ensure that the position of the numerals marked on the gear carrier housing face and the caps correspond, as indicated in Fig. 18. Finally tighten the bolts securing the bearing caps.

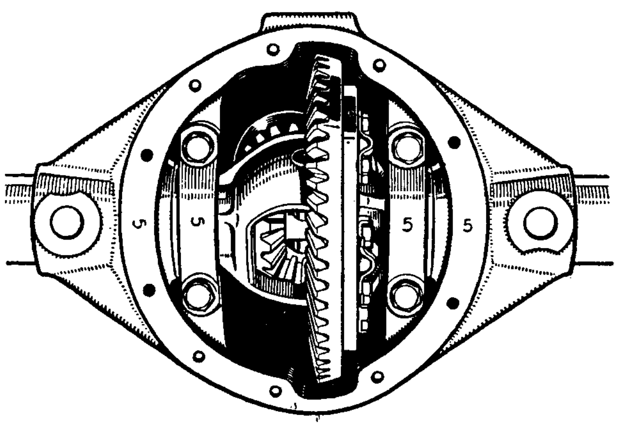


Fig. 18. Differential bearing cap markings.

(9) When refitting the bearing caps, be sure that the position of the numerals marked on the gear carrier housing face and the caps correspond as indicated in Fig. 18. Tighten the caps lightly, remove the stretching fixture, then finally tighten the bolts securing the bearing caps. Then continue with operation (10).

(10) Mount a dial indicator on the gear carrier housing with the button against the back face in a similar manner to that employed for differential bearing adjustment, as shown in Fig. 11. Turn the pinion by hand and check the run out on the back face, which should not exceed .005″ (.13 mm.). If there is excessive run out, strip the assembly and rectify by cleaning the surfaces locating the drive gear. Any burrs on these surfaces should be removed.

(11) Remount the dial indicator on the gear carrier housing with the button against one of the drive gear teeth, as nearly in line with the direction of tooth travel as possible (see Fig. 17). Move the drive gear by hand to check the backlash which should be as etched on the gear. If the backlash is not in accordance with the specification, transfer the necessary shims from one side of the differential case to the other to obtain the desired setting. To increase backlash, remove shims from the drive gear side of the differential and install on the opposite side. Backlash is decreased by transferring shims to the drive gear side from the opposite side of the differential case.

(12) After setting the backlash to the required figure, use a small brush to paint eight or ten of the drive gear teeth with a stiff mixture of marking raddle, used sparingly, or engineers blue may be used if preferred. Move the painted gear teeth in mesh with the pinion until a good impression of the tooth contact is obtained. The resulting impression should be similar to Fig. A in Fig. 20. Refer to the section on tooth contact and to Fig. 20 for instructions on correction of tooth contact if the impression obtained is not satisfactory.

Final Assembly

To complete the rebuilding of the unit :—

(1) Remove the drive pinion nut, washer and companion flange.

(2) Install the oil slinger, and then fit the pinion oil seal assembly, using Tool No. SL.4P/B, as shown in Fig. 19. Place the oil seal with the dust excluder flange uppermost (not omitting the oil seal gasket used with the metal case type seal on later models), fit the installation collar, Tool No. SL.4P/B, and then tighten down the pinion nut and washer to drive the assembly home. Remove the installation collar.

(3) Fit the companion flange, washer and pinion nut, tighten securely.

(4) Fit the rear cover gasket, renewing it if required, and rear cover, securing same with set bolts and lock washers, not omitting the ratio tag which is attached by one of the set bolts.

(5) Re-install the axle shafts and hub bearings, etc., as described on page H.10 under " Axle Shafts—Refitting ".

(6) Check that the drain plug is securely tightened, then fill with the appropriate quantity of one of the hypoid lubricants recommended on page H.8.

(7) Replace the filler plug and check that the cover set bolts are tight.

(8) Check for oil leaks at the cover, pinion oil seal and where the differential cap bolt holes break through.

(9) Finally grease the hub bearings.

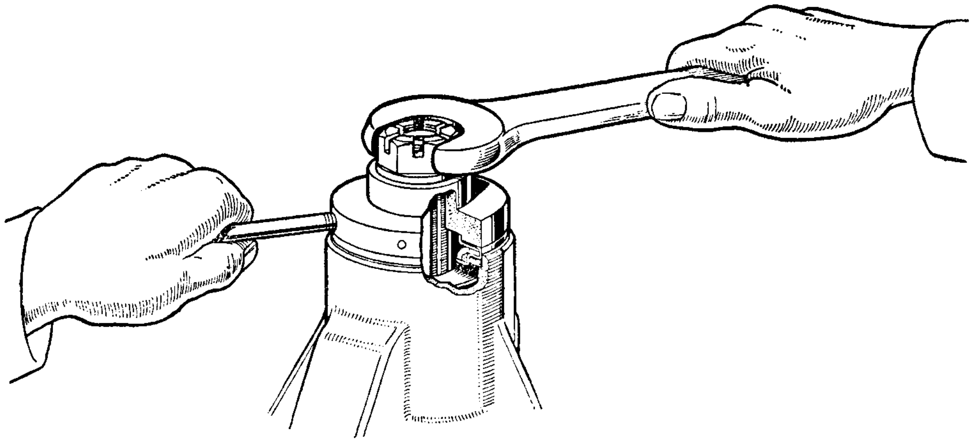


Fig. 19. Fitting the pinion oil seal.

TOOTH CONTACT

(Refer to Fig. 20)

The illustrations referred to in this section are those shown in Fig. 20 which indicates the tooth bearing impression as seen on the drive gear.

The HEEL is the large or outer end of the tooth.
The TOE is the small or inner end of the tooth.
The FACE top or addendum is the upper portion of the tooth profile.
The FLANK or dedendum is the lower portion of the tooth profile.
The DRIVE side of the drive gear tooth is CONVEX.
The COAST side of the drive gear tooth is CONCAVE.

(a) Ideal Contact

Fig. A. shows the ideal tooth bearing impression on the drive and coast sides of the gear teeth. The area of contact is evenly distributed over the working depth of the tooth profile and is located nearer to the toe (small end) than the heel (large end). This type of contact permits the tooth bearing to spread towards the heel under operating conditions when allowance must be made for deflection.

(b) High Tooth Contact

In Fig. B it will be observed that the tooth contact is heavy on the drive gear face or addendum, that is, high tooth contact. To rectify this condition, move the pinion deeper into mesh, that is, reduce the pinion cone setting distance, by adding shims between the pinion inner bearing cup and the housing and adding the same thickness of preload shims between the pinion bearing spacer, or the shoulder of the pinion shank and outer bearing cone. This correction has a tendency to move the tooth bearing towards the toe on drive and heel on coast, and it may therefore be necessary after making this change to adjust the drive gear as described in paragraphs (d) and (e).

(c) Low Tooth Contact

In Fig. C. it will be observed that the tooth contact is heavy on the drive gear flank or dedendum, that is, low tooth contact. This is the opposite condition from that shown in (b) and is therefore corrected by moving the pinion out of mesh, that is, increase the pinion cone setting distance by removing shims from between the pinion inner bearing cup and housing, and removing the same thickness of preload shims from between the pinion bearing spacer or the shoulder on the pinion shank and the outer bearing cone. This correction has a tendency to move the tooth bearing towards the heel on drive and toe on coast, and it may therefore be necessary after making this change to adjust the drive gear as described in (d) and (e).

(d) Toe Contact

Fig. D. shows an example of toe contact which occurs when the bearing is concentrated at the small end of the tooth. To rectify this condition, move the drive gear out of mesh, that is, increase backlash, by transferring shims from the drive gear side of the differential to the opposite side.

(e) Heel Contact

Fig. E. shows an example of heel contact which is indicated by the concentration of the bearing at the large end of the tooth. To rectify this condition move

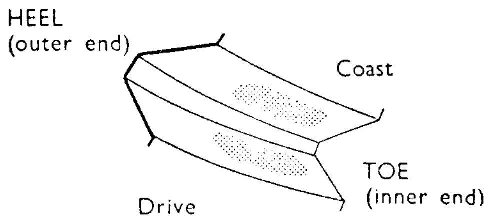
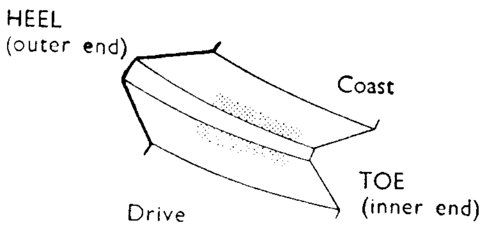
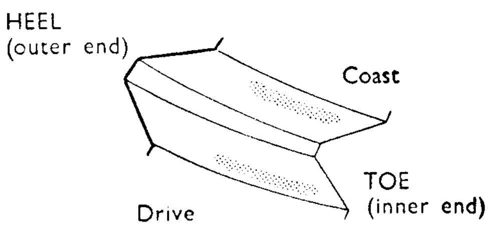
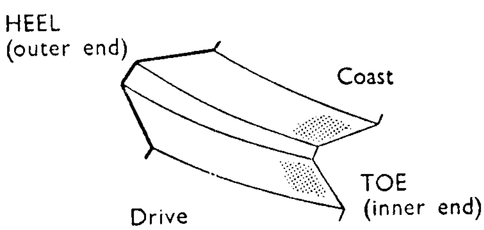
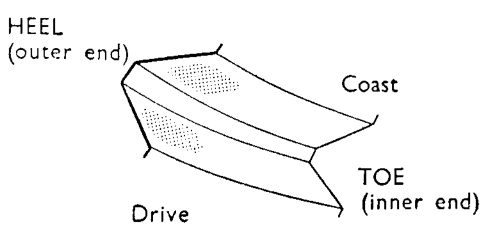
	TOOTH CONTACT (*DRIVE GEAR*)	CONDITION	REMEDY
A		IDEAL TOOTH CONTACT Evenly spread over profile, nearer toe than heel.	o — o
B		HIGH TOOTH CONTACT Heavy on the top of the drive gear tooth profile.	Move the DRIVE PINION DEEPER INTO MESH. *i.e.*, REDUCE the pinion cone setting.
C		LOW TOOTH CONTACT Heavy in the root of the drive gear tooth profile.	Move the DRIVE PINION OUT OF MESH. *i.e.*, INCREASE the pinion cone setting.
D		TOE CONTACT Hard on the small end of the drive gear tooth.	Move the DRIVE GEAR OUT OF MESH. *i.e.*, INCREASE backlash.
E		HEEL CONTACT Hard on the large end of the drive gear tooth.	Move the DRIVE GEAR INTO MESH. *i.e.*, DECREASE backlash *but* maintain minimum backlash as given in "Data"

Fig. 20. Tooth contact indication (contact markings on drive gear).

the drive gear closer into mesh, that is, reduce backlash, by adding shims to the drive gear side of the differential and removing an equal thickness of shims from the opposite side.

Note : It is most important to remember when making this adjustment to correct a heel bearing that sufficient backlash for satisfactory operation must be maintained. If there is insufficient backlash the gears will at least be noisy and have a greatly reduced life, whilst scoring of the tooth profile and breakage may result. Therefore, always maintain a minimum backlash requirement of .004″ (.10 mm.).

Backlash

When adjusting backlash always move the drive gear as adjustment of this member has more direct influence on backlash, it being necessary to move the pinion considerably to alter the backlash a small amount—.005″ (.13 mm.) movement on pinion will generally alter backlash .001″ (.025 mm.).

Gear and Pinion Movement

Moving the gear out of mesh moves the tooth contact towards the heel and raises it slightly towards the top of the tooth.

Moving the pinion out of mesh raises the tooth contact on the face of the tooth and slightly towards the heel on drive, and towards the toe on coast.

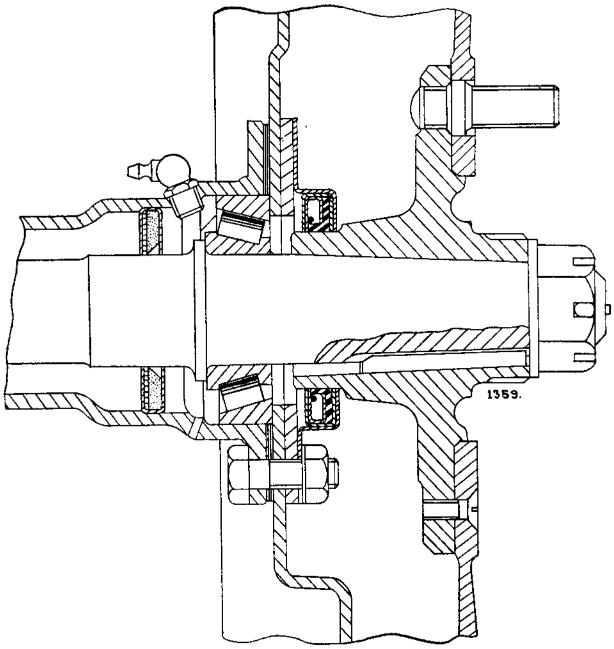


Fig. 21. Sectioned view of drum brake hub arrangement.

THORNTON "POWR-LOK" DIFFERENTIAL

GENERAL

The Thornton "Powr-Lok" limited slip differential is specified as an optional extra for the 4.HA type of axle as fitted to the 3.4 litre model.

Identification

New cars fitted with a Thornton differential have a metal tag stamped P/L attached to one of the rear axle cover bolts. If a tag is not fitted, remove the filler plug when if the differential case can be seen in close proximity to the filler hole it can be assumed that a Thornton differential is fitted.

Warning

When a car is equipped with a Thornton " Powr-Lok " differential the engine must NOT be run with the car in gear and one wheel off the ground otherwise, owing to the action of the differential, the car may drive itself off the jack or stand.

If it is desired to turn the transmission by running the engine with the car in gear **both** wheels must be jacked up clear of the ground.

DESCRIPTION

The limited slip differential has two pinion shafts with two mates to each shaft. The pinion shafts are mounted at right angles to each other but do not make contact at their intersection. Double ramps with flat surfaces at each end of the pinion shafts, mate with similar ramps in the differential case. Clearance in the differential case permits slight peripheral movement at the ends of the pinion shafts.

When a driving force is applied to the differential case, the pinion shafts, pinion mates and differential side gears splined to the axle shafts, rotate as a unit. Resistance to turning at the wheels forces the pinion shafts to slide up the differential case ramps, pushing the pinion shafts apart. As the pinion shafts move apart they apply load to the clutch plates thus restricting turning between the axle shafts and the differential case. Both axle shafts have now become clutched to the differential case to a varying degree dependent upon the amount of torque transmitted. This in effect locks the axle shafts to the differential case, in the normal straight ahead driving position, which prevents spinning of either rear wheel should it leave the road or encounter poor traction such as ice, snow, sand, loose gravel or oil patches.

Due to the lateral movement of the pinion shafts in the differential case, a little more backlash may be apparent in a limited slip rear axle. Slight chatter may also occur when one wheel is on a slippery surface, this is due to surge torque.

PRINCIPLE OF OPERATION

The conventional differential divides the load equally between both driving wheels. In this connection, it should be remembered that the conventional differential will always drive the wheel which is easiest to turn. This is a definite disadvantage under adverse conditions of driving where the traction of one wheel is limited.

The main purpose of the limited slip differential is to overcome this limitation. Many times the torque of the slipping wheel is provided to the driving wheel, thus permitting improved operation under all conditions of driving. The torque is transmitted from the differential case to the cross pins and differential pinions to the side gears in the same manner as torque is applied in the conventional differential.

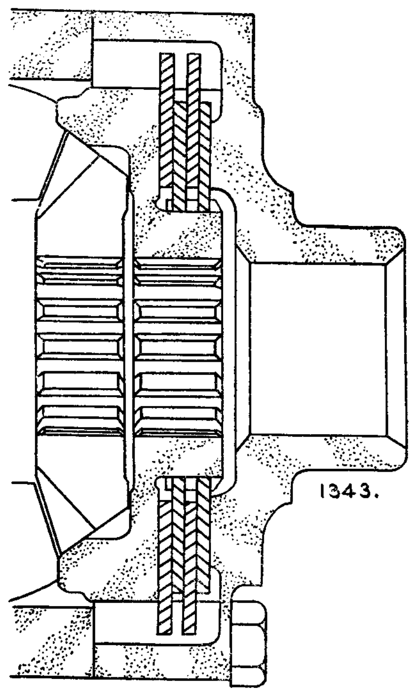


Fig. 22. Sectioned view showing friction discs and plates.

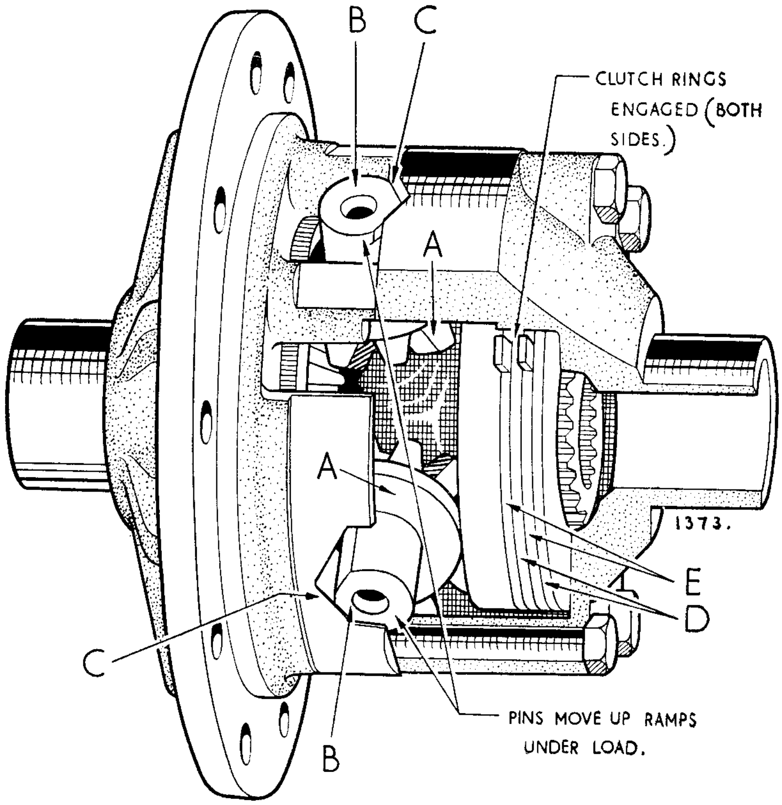


Fig. 23.

The driving forces moves the cross pins B, Fig. 22, up the ramp of the cam surfaces C, applying a load to the clutch rings D and restricts turning of the differential through the friction clutches E. This provides a torque ratio between the axle shafts which is based on the amount of friction in the differential and the amount of load that is being applied to the differential.

When turning a corner, this process is in effect partially reversed. The differential gears become a planetary set, with the gear on the inside of the curve becoming the fixed gear of the planetary. The outer gear of the planetary over-runs as the outside wheel on the curve has a further distance to travel. With the outer gear over-running and the inner gear fixed, the pinion mates A (see Fig. 24) are caused to rotate, but inasmuch as they are restricted by the fixed gear, they first must move pinion mate shafts B back down the cam surface C relieving the thrust loads on the plate clutches E. Thus when turning the corner, the differential, for all practical purposes, is similar to a conventional differential and the wheels are free to rotate at different speeds.

On straight driving, the clutches are engaged and thus prevent momentary spinning of the wheels when leaving the road or when encountering poor traction. In turning a corner, the load is relieved from the clutch surfaces so that wear is reduced to a minimum.

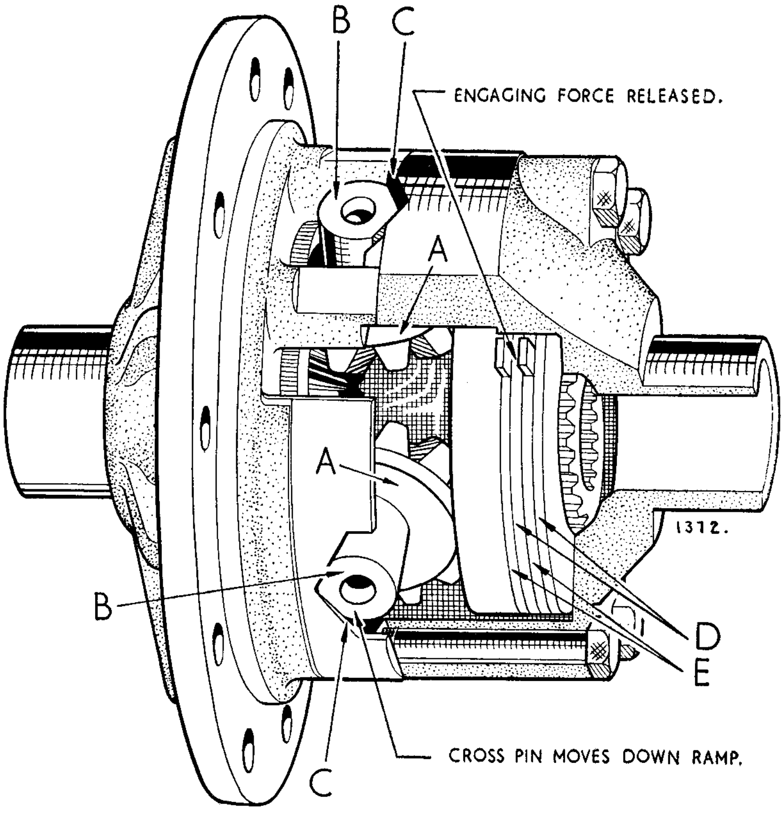
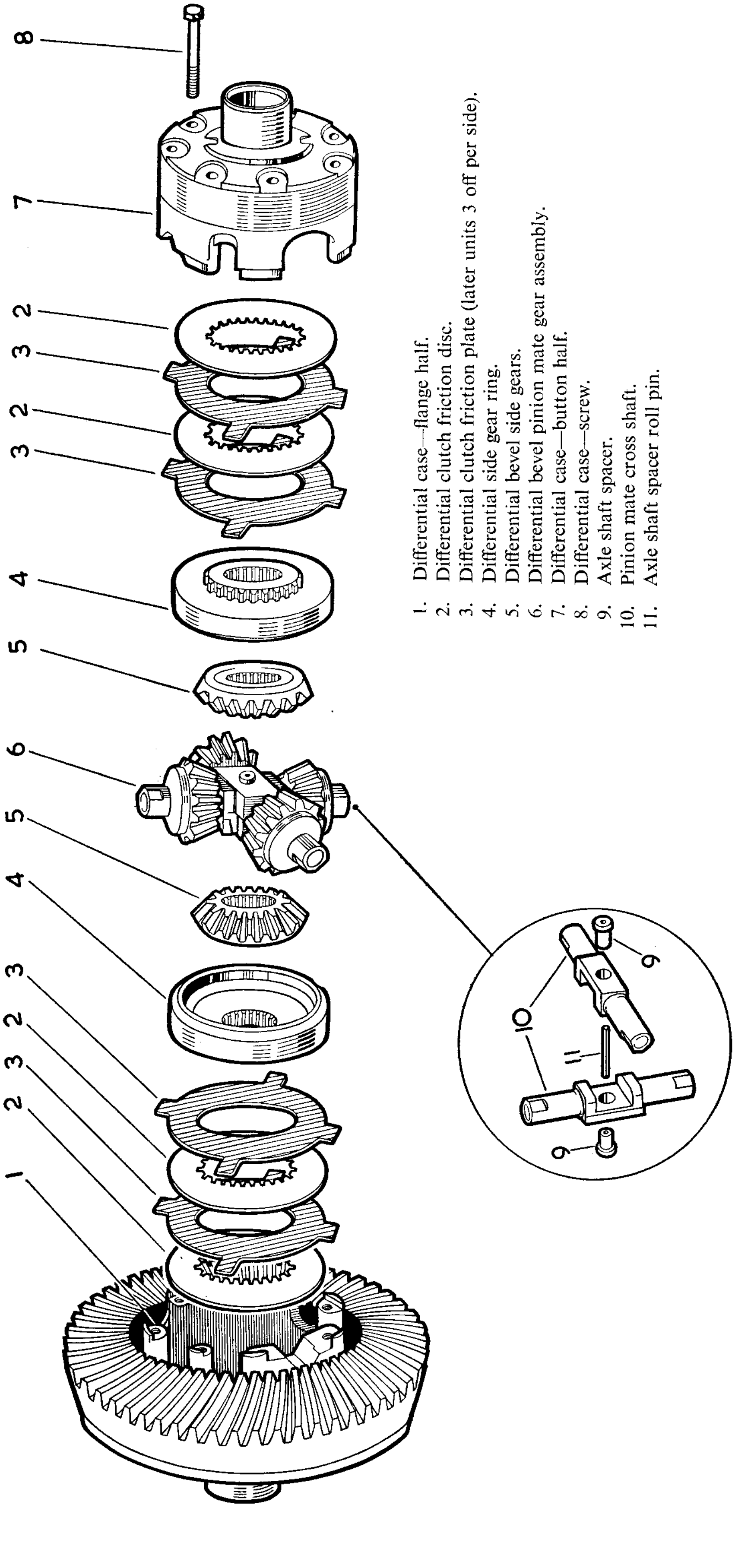


Fig. 24.



1. Differential case—flange half.
2. Differential clutch friction disc.
3. Differential clutch friction plate (later units 3 off per side).
4. Differential side gear ring.
5. Differential bevel side gears.
6. Differential bevel pinion mate gear assembly.
7. Differential case—button half.
8. Differential case—screw.
9. Axle shaft spacer.
10. Pinion mate cross shaft.
11. Axle shaft spacer roll pin.

Fig. 25. Exploded view of the Thornton " Powr-Lok " differential.

POWER FLOW IN FORWARD DRIVING

Under normal starting and operating conditions the torque or power flow in both the limited slip and conventional type differential is transmitted equally to each axle shaft and wheel. However, when sudden patches of ice, loose gravel or oil are encountered, the limited slip differential will not permit the wheel with the lesser traction to spin, gain momentum and swerve the car when a dry surface is regained.

POWER FLOW IN TURNS

In turning, the limited slip differential gives normal differential action and permits the outer wheel to turn faster than the inner wheel. At the same time the differential applies the major driving force to the inside rear wheel, improving stability and cornering.

POWER FLOW WITH POOR TRACTION

When traction conditions under the rear wheels are dissimilar, the driving force with an ordinary differential is limited by the wheel with the poorer traction. Typically, in this situation, the wheel with the poorer traction spins and the vehicle remains immobile. The limited slip differential enables the wheel with the better traction to apply the major driving force to the road.

ACTION ON ROUGH ROADS

Bumps do not adversely affect wheel action when wheels are controlled by the limited slip differential. The free wheel does not spin and gain momentum. There is no sudden wheel stoppage to cause car swerve or tyre scuffing and wheel hop is reduced.

REMOVAL FROM AXLE ASSEMBLY

The removal of the Thornton "Powr-Lok" differential from the rear axle is exactly the same as detailed in this section for the conventional type of differential.

DISMANTLING

Remove the eight bolts (8 Fig. 25) securing the two halves of the differential casing.

Split the casing and remove the clutch discs (2) and plates (3) from one side.

Remove the differential side gear ring (4).

Remove the pinion side gear (5) and the pinion mate cross shafts (6) complete with the pinion mate gears.

To separate the cross shafts (10) extract the shaft spacers (9) from the spacer roll pin (11).

Remove the remaining side gear and the side gear ring.

Extract the remaining clutch discs and plates.

REASSEMBLING

Refit the clutch plates and discs alternately into the flange half of the casing.

Fit the side gear ring so that the serrations on the gear mesh with the serrations in the two clutch discs.

Place one of the side gears into the recess of the side gear ring.

Fit the cross shafts together.

Enter one axle shaft spacer with a new spacer roll pin attached through the hole in the cross shafts and press the other spacer on to the roll pin.

Refit the pinion mate cross shafts complete with pinion mate gears ensuring that the ramps on the shafts coincide with the mating ramps in the differential case.

Assemble the remaining side gear and side gear ring.

Refit the remaining clutch plates and discs to the side gear ring.

Offer up the button half of the differential case to the flange half so that letters stamped on each half are opposite each other.

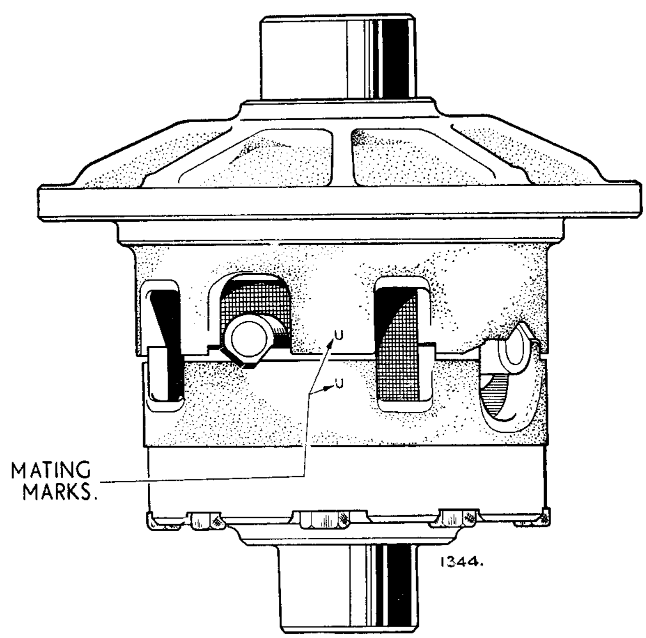


Fig. 26. Alignment marks on the differential case.

Position the tongues of the friction plates so that they align with the grooves in the differential case.

Assemble the button half to the flange half of the differential case and secure with the eight bolts.

Tighten the bolts to a torque of 35 to 45 lbs. ft.

CHECKING FOR WEAR

With one axle shaft and the drive pinion locked, the other axle shaft must not turn radially more than $\frac{3}{4}''$ measured on a 6″ radius.

ADJUSTMENTS

The bearing preload and drive gear and pinion adjustments for an axle fitted with a Thornton " Powr-Lok " differential are exactly the same as detailed in this section for the conventional type of differential.

SECTION I

STEERING

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone ALLESLEY 2121 (P.B.X.)

Code BENTLEY'S SECOND

Telegraphic Address "JAGUAR," COVENTRY. Telex 31/622

Publication No. E/120/I/3.

INDEX

INDEX (*continued*)

STEERING

DESCRIPTION

The Burman steering unit is of the high efficiency recirculating ball type in which motion is transmitted from the inner column worm to the rocker shaft by means of a nut running on a continuous train of steel balls. The main nut is prevented from rotating by a roller fitted to a spigot at the top of the nut, which runs in a slot machined in the cover plate.

The worm is supported at each end by a loose ball race. Adjustment of the ball races is by means of shims under the end plates at the top and bottom of the steering box.

The rocker shaft is supported in a single bush pressed into the steering box. End float of the rocker shaft is controlled by an adjusting screw and locknut fitted to the top cover plate.

The one piece drop arm is taper splined to the rocker shaft and secured by a large spring washer and nut.

The drop arm and idle lever are connected by an adjustable track rod with a rubber/steel bonded bush at each end. Extensions of the track rod ends are attached to the inner ball joints of the two steering tie rods. The outer ball joints of the tie rods are connected to steering arms which are bolted to the stub axle carriers.

DATA

Type	Recirculating ball
Number of turns—lock to lock	4
Turning circle	33′ 6″ (10.21 m.)
Diameter of steering wheel	17″ (43 cm.)
Front wheel alignment	Parallel to $\frac{1}{16}$″ (1.59 mm.) toe-in.

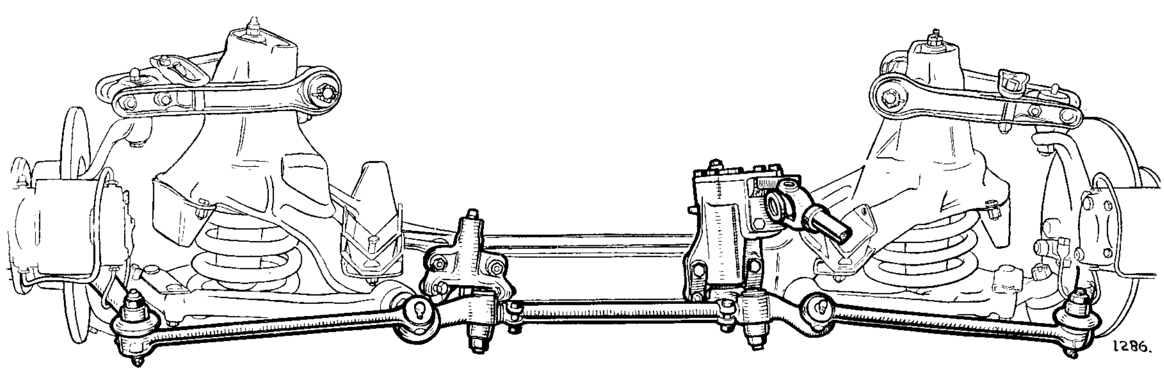


Fig. 1. Steering layout.

ROUTINE MAINTENANCE

EVERY 2,500 MILES (4,000 KM.)

Steering Unit

The steering unit is attached to the front suspension cross member ; the filler plug is situated in the top cover and is accessible from the engine compartment on the driver's side of the car. The filler plug has a plain head and should not be confused with the rocker shaft adjustment screw which is threaded externally. Top up the steering box with the recommended grade of lubricant until no more oil will enter.

Steering Idler Housing

The steering idler housing is attached to the front suspension cross member ; a nipple is provided in the top of the housing and is accessible from underneath the car.

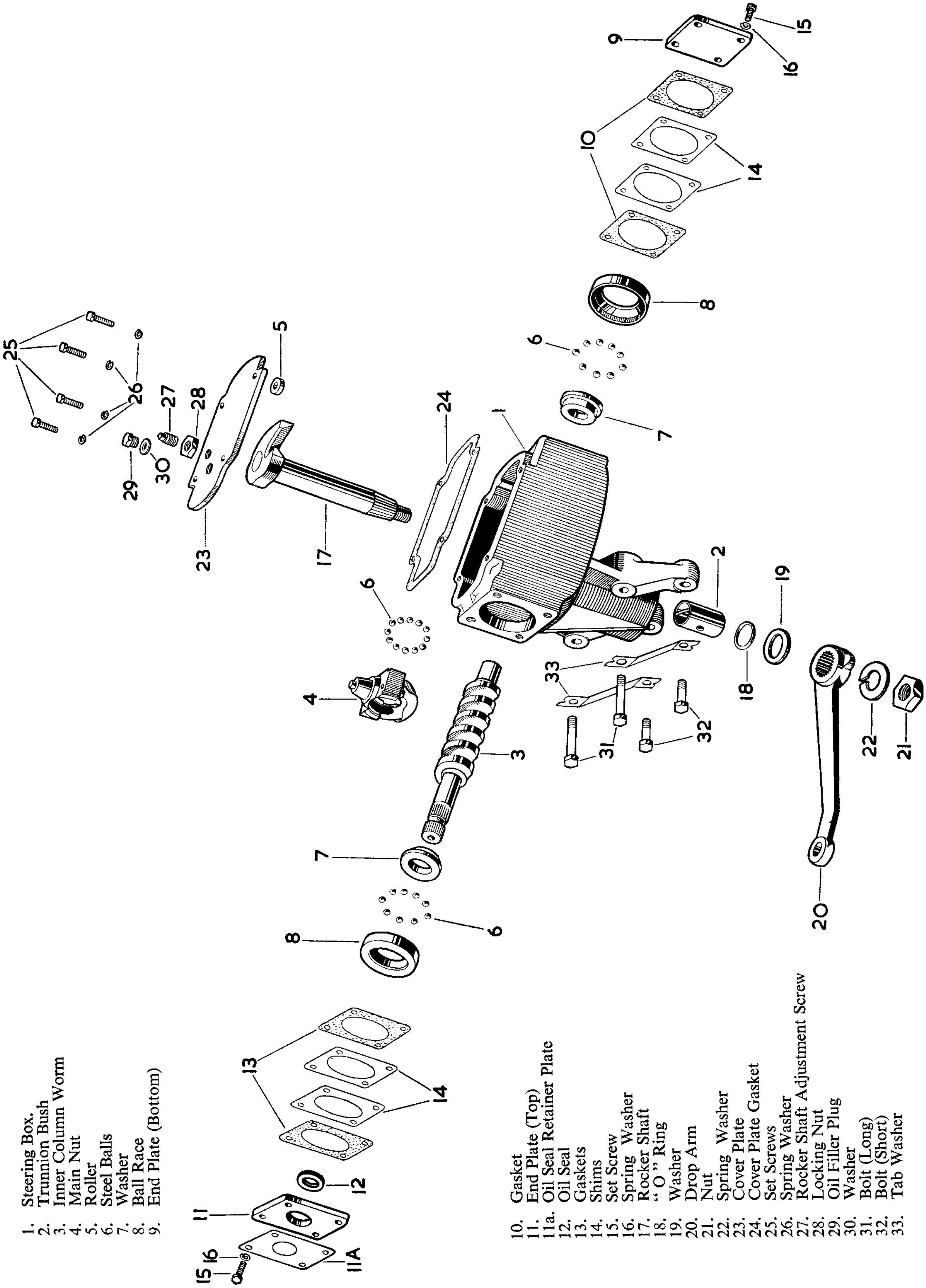
Steering Tie Rods

Lubricate the ball joints at the ends of the two steering tie rods with the recommended lubricant. The tie rods are situated at the rear of the front suspension cross member. When carrying out this operation examine the rubber seals at the ends of the ball housings to see if they have become displaced or split. In this event they should be repositioned or replaced, as any dirt or water that enters the ball joint will cause premature wear.

Do not over-lubricate the ball joints to the extent where grease escapes from the rubber seals.

Recommended Lubricants

	Mobil	Wakefield	Shell	Esso	B.P.	Duckham
Steering box	Mobilube C 140	Castrol D	Spirax 140 E.P.	Gear Oil 140	Energol 140	NOL EP 140
Steering idler housing Steering tie rods	Mobilgrease MP	Castrolease Medium or WB	Retinax A or RB	Esso Grease or Esso High Temp. Grease	Energrease C.3 or N.3	LB 10 or HPG



1. Steering Box.
2. Trunnion Bush
3. Inner Column Worm
4. Main Nut
5. Roller
6. Steel Balls
7. Washer
8. Ball Race
9. End Plate (Bottom)
10. Gasket
11. End Plate (Top)
11a. Oil Seal Retainer Plate
12. Oil Seal
13. Gaskets
14. Shims
15. Set Screw
16. Spring Washer
17. Rocker Shaft
18. " O " Ring
19. Washer
20. Drop Arm
21. Nut
22. Spring Washer
23. Cover Plate
24. Cover Plate Gasket
25. Set Screws
26. Spring Washer
27. Rocker Shaft Adjustment Screw
28. Locking Nut
29. Oil Filler Plug
30. Washer
31. Bolt (Long)
32. Bolt (Short)
33. Tab Washer

Fig. 2. Exploded view of the steering unit.

STEERING UNIT

Removal

Remove the two self tapping screws from the small piece of dash casing at the side of the upper steering column.

Detach all the wires leading from the multi-snap connector to the trafficator switch.

Detach the horn wire from the connector at the lower end of the upper column tube.

Remove the two set bolts attaching the upper steering column tube to the dash.

Remove the pinch bolt from the universal joint, and draw the universal joint off the splines on the steering unit.

Remove the self locking nut and washer which secure the track rod end to the drop arm. Drift out the track rod end from the drop arm in which it is a taper fit.

Tap back the tab washers and remove the four bolts attaching the steering unit to the front suspension cross member, when the unit can be removed.

Dismantling

Remove the four set bolts and spring washers securing the rocker shaft cover plate (23, Fig. 2) to the steering box. Remove the cover plate and gasket. Drain the oil into a suitable receptacle. Remove the roller from the top of the main nut.

Remove the nut (21) securing the drop arm (20) to the rocker shaft (17). Observe the line scribed on the drop arm and rocker shaft to ensure correct assembly.

Using a suitable extractor, draw the drop arm off the spline on the rocker shaft. (Under no circumstances must the drop arm be hammered off, otherwise indentation and damage will be caused to the ball tracks.)

Withdraw the rocker shaft.

Remove the " O " ring from the bottom of the box.

Remove the four set bolts and spring washers securing the upper end plate to the steering box. Remove the retainer plate, end plate, gasket, shims and the other gasket.

Push the worm shaft upwards and withdraw the outer race of the upper bearing. Collect the nine ball bearings.

Unscrew the worm through the main nut and withdraw from box.

Remove the four set bolts and washers attaching the end plate to the bottom of the steering box. Remove the gasket, shims and the other gasket. Withdraw the outer race of the lower bearing and collect the ball bearings.

Remove the two setscrews and tab washers retaining the transfer tube to the main nut and remove the clip, tube and twelve balls.

Assembling

Note : When assembling the steering unit carry out adjustment of the worm shaft and rocker shaft end float as described in this section.

Fit the transfer tube and clip to the main nut and secure with the two setscrews.

Fit the twelve recirculating balls into the nut ; use grease to retain the balls in position.

Fit the nine ball bearings to the bottom race with grease and assemble to the bottom of the steering box.

Fit the gaskets, shims and end plate to the bottom of the steering box and secure with four setbolts.

Screw the worm shaft into the main nut until the nut is half way along the worm. Fit an inner race to each end of the worm with the larger diameter towards the ball bearings.

Feed the worm shaft into the steering box through the top cover aperture.

Fit the nine ball bearings to the top race with grease and assemble to the top of the steering box.

Fit the shims with a gasket at each side to the top of the steering box.

Cover the serrations at the top of the worm shaft with a piece of brown paper or Sellotape to protect the oil seal when sliding the end plate over the worm shaft.

Carefully slide the upper end plate over the worm shaft and remove all traces of brown paper or Sellotape. Secure the end plate with the four setbolts.

Enter the rocker shaft into its bore in the steering box and engage the forked extension with the tapered portion of the main nut.

Fit the roller to the top of the main nut.

Fit the cover plate gasket.

Assemble the cover plate so that the roller runs in the slot in the plate. Secure the cover plate with the four setbolts.

Fit the drop arm to the rocker shaft ensuring that the scribed line on the rocker shaft matches the appropriate line on the drop arm, according to whether the steering unit is for Right-hand or Left-hand drive (see Fig. 3).

Refitting

Refitting is the reverse of the removal procedure. After refitting the steering unit to the front suspension cross member, first turn the road wheels to the straight ahead position and attach the track rod to the drop arm. Before connecting the lower column universal joint to the steering unit, position the steering wheel so that the head of the " Jaguar " is upright and one of the spokes is at the 12 o'clock position.

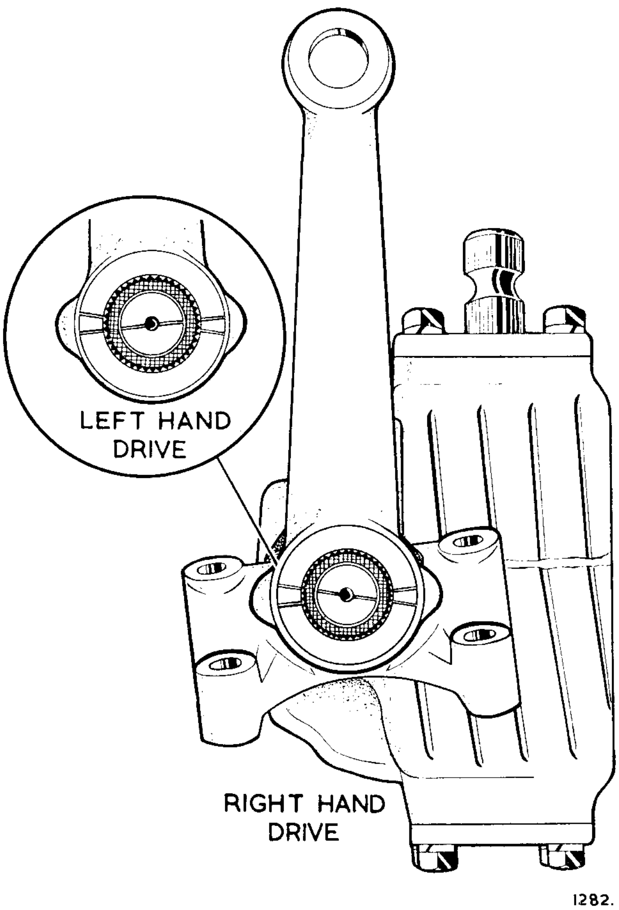


Fig. 3. Showing the alignment of the drop arm/rocker shaft marks for both right hand and left hand steering.

WORMSHAFT END FLOAT

The wormshaft bearings should be adjusted to a pre load of .002″ to .003″ (.05 to .08 mm.) by means of the shims and gaskets at each end of the steering box. The shims are .005″ (.13 mm.) thick ; the gaskets are .003″ (.08 mm.) thick.

Unscrew the rocker shaft adjustment screw so that no load exists on the shaft. Eliminate, or reduce to a minimum, the end float of the worm shaft by removing shims as necessary. Check that the worm shaft turns freely by rotating the shaft with the lower steering column.

Remove a shim and/or gasket to obtain the required pre-load. Always maintain a minimum of two gaskets at each end of the steering box, one at each side of the shim pack.

ROCKER SHAFT END FLOAT

To adjust the end float of the rocker shaft the shaft must be at the centre of its travel. If the steering unit is in position on the car, this is when the wheels are in the straight ahead position ; if the steering unit is off the car it will be necessary to halve the number of turns the worm shaft makes from " lock to lock " to obtain the centre position.

Slacken the locknut securing the square-ended screw in the cover plate. Screw down the adjuster screw by hand until it contacts the rocker shaft, so that all end float is eliminated.

Hold the adjuster screw firmly and tighten the locknut. Test the freedom of the movement of the worm shaft ; if tightness exists in the centre of its travel it will be necessary to re-adjust the rocker shaft end float.

STEERING WHEEL

Removal

Remove the four grub screws (27, Fig. 4) from the holes in the steering wheel hub. Withdraw the horn push assembly from the centre of the wheel and disconnect the horn wire contact by removing the eyelet.

Bend back the tab washer (26) and remove the nut (24) securing the steering wheel to the inner column shaft. Extract the tab washer and plain washer. Exert sudden pressure at the back of the steering wheel and withdraw it from the spline on the inner column shaft (12).

Remove the two cup washers (20 and 21) and telescopic dust cover (19).

Collect the two halves of the split cone (22).

Refitting

Compress the telescopic dust cover with the side of the hand. With two fingers of the same hand hold the split cone in place in the grooves of the inner column shaft, making sure that the narrowest part of the cone is towards the top of the column. With the other hand slide the steering wheel on to the column shaft splines so that a spoke is in the 12 o'clock position when the road wheels are pointing straight ahead. Push the steering wheel fully home on to the split cone. Fit the plain washer, tab washer and nut. After fully tightening the nut, secure by bending up one ear of the tab washer.

Refit the horn push with the head of the Jaguar upright.

UPPER STEERING COLUMN

Removal

Remove the two self tapping screws from the small piece of dash casing at the side of the upper steering column.

Detach all the wires leading from the multi-snap connector to the trafficator switch.

Detach the horn wire from the connector (37, Fig. 4) at the lower end of the upper column tube.

Remove the two set bolts attaching the upper steering column to the dash.

Remove the pinch bolt retaining the upper steering column to the rubber coupling jaw (3).

Pull the steering column into the car and collect the spacing collar (17) and rubber washer (18) adjacent to the rubber coupling.

On later cars, a jubilee clip secures the upper steering column tube to a flange on the body where the column protrudes through the toe-board.

Dismantling

Remove the steering wheel as described on page 8.

Remove the top of the trafficator control by unscrewing the four long screws from the underside of the assembly.

Remove the two screws from the back of the cowl on the trafficator control and remove the cowl.

Remove the two large cheese headed screws, attaching the trafficator control unit to the outer tube (6, Fig. 4).

Unscrew the telescopic adjustment nut (15) from the inner column (11).

Remove the spring clip (14) from the groove in the inner column retaining the stop button (13). The stop button can then be removed.

Withdraw the shaft (12) from inside the inner column (11).

Remove the screw, nut and washer holding the earth contact (28) to the bracket on the outer column.

Remove the bolt (38) and nut (39) holding the contact (37) to the contact holders (36).

From the lower end tap the inner column (11) out of the outer column (6).

Compress and remove the spring clip (10) when the retaining washers (9) and felt bearing (7) can be removed. Repeat for the other felt bearing (8).

To remove the horn contact cable (30) from inside the inner column (11) prise up the slotted ends of the slip ring (29) and withdraw from the splined end of the inner column. The rubber rotor left in place is in two halves (33 and 34). The bottom half (33) has a hole through it, into which the horn contact (31) and spring (32) fit. To remove the cable (30) hold the contact (31) and withdraw the cable (30) through the hole in the bottom rotor (33).

Reassembling

Pass the cable (30) through the spring (32) and then through the hole in the bottom rotor (33). Attach the plain end of the cable to a piece of stiff wire and feed the wire through the small hole in the inner column. The cable can then be drawn up inside the inner column (11). Care should be taken that the recessed edges of the top and bottom rotors (33 and 34) are towards the splined end of the inner column (11).

Before refitting the earth contact (28) clean off the bracket with an abrasive cloth to ensure a good electrical contact.

The remainder of the reassembly is the reverse of the dismantling procedure. It will be found advantageous to attach the steering wheel after the upper column has been refitted to the car.

Refitting

Refitting is the reverse of the removal procedure.

LOWER STEERING COLUMN

Removal

Remove the upper steering column as described in the foregoing paragraphs.

Remove the pinch bolt retaining the universal joint to the steering box shaft when the lower column can be removed.

Detaching the Rubber Coupling

Remove the four lock nuts (5, Fig. 4) and unscrew the four Allen headed screws (4) attaching the jaw (3) and the lower column (1) to the rubber coupling (2).

Refitting

Refitting is the reverse of the removal procedure.

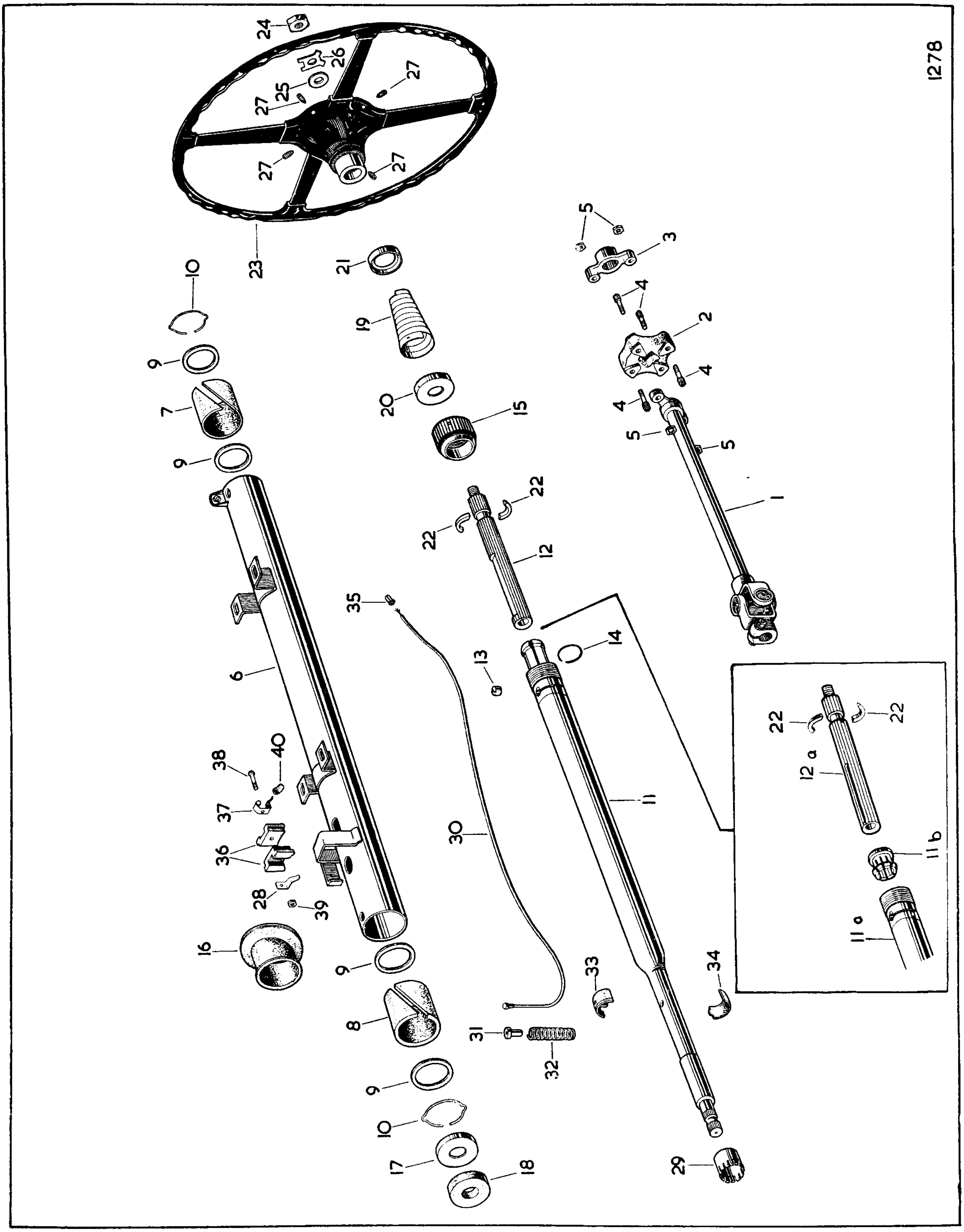
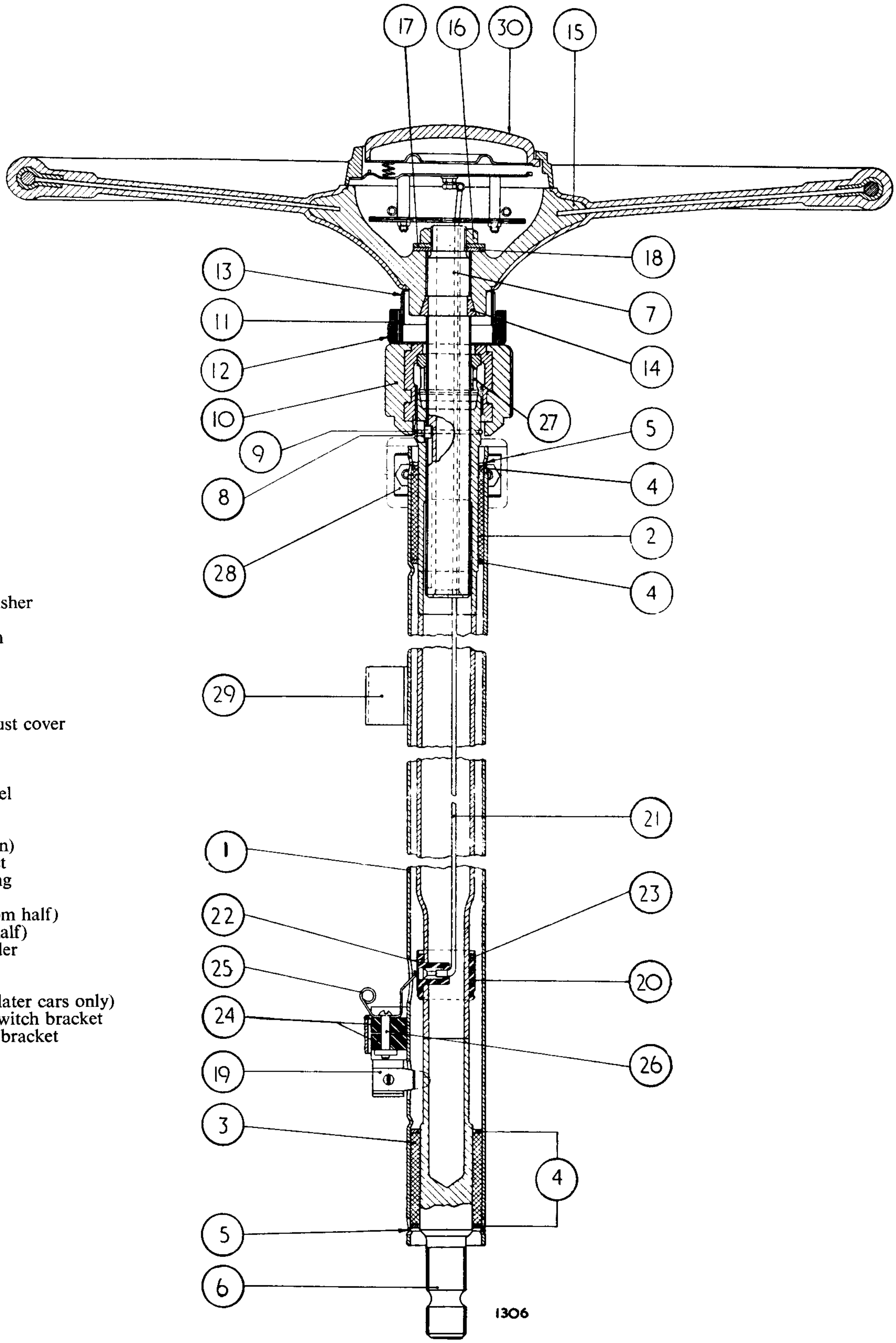


Fig. 4. Exploded view of the steering column assembly.

Annotations for Fig. 4.

1. Lower steering column
2. Rubber coupling
3. Jaw
4. Cap screw
5. Locking washer
6. Outer tube
7. Felt bearing (top)
8. Felt bearing (bottom)
9. Retaining washer
10. Spring clip
11. Inner column (early type)
11a. Inner column (later type)
11b. Collet
12. Shaft (early type)
12a. Shaft (later type)
13. Stop button
14. Spring clip
15. Lock nut
16. Rubber grommet
17. Spacing collar
18. Spacing washer
19. Telescopic dust cover
20. Cup (large)
21. Cup (small)
22. Split cone
23. Steering wheel
24. Nut
25. Washer
26. Tab washer
27. Grub screw
28. Earth contact
29. Slip ring
30. Cable
31. Contact
32. Spring
33. Rotor (bottom half)
34. Rotor (top half)
35. Eyelet
36. Contact holder
37. Contact
38. Bolt
39. Nut
40. Insulating rubber sleeve



1. Outer tube
2. Felt bearing
3. Felt bearing
4. Retaining washer
5. Spring clip
6. Inner column
7. Shaft
8. Stop button
9. Spring clip
10. Lock nut
11. Telescopic dust cover
12. Cup (large)
13. Cup (small)
14. Split cone
15. Steering wheel
16. Nut
17. Tab washer
18. Washer (plain)
19. Earth contact
20. Horn slip ring
21. Cable
22. Rotor (bottom half)
23. Rotor (top half)
24. Contact holder
25. Contact
26. Bolt
27. Split collet (later cars only)
28. Trafficator switch bracket
29. Attachment bracket
30. Horn push

Fig. 5. Sectioned view of the upper steering column.

STEERING IDLER ASSEMBLY

Removal

Remove the self locking nut and washer securing the track rod end to the idler lever. Drift out the track rod end from the idler lever in which it is a taper fit.

Remove the four bolts and spring washers attaching the steering idler bracket to the front suspension cross member, when the steering idler assembly can be detached.

Dismantling

Remove the self locking nut and washer attaching the idler lever to the fulcrum pin. With a suitable extractor withdraw the idler lever from the fulcrum pin on which it is a taper fit.

Unscrew the fulcrum pin from the bracket housing.

Remove the " O " ring from the bottom of the fulcrum pin bracket housing.

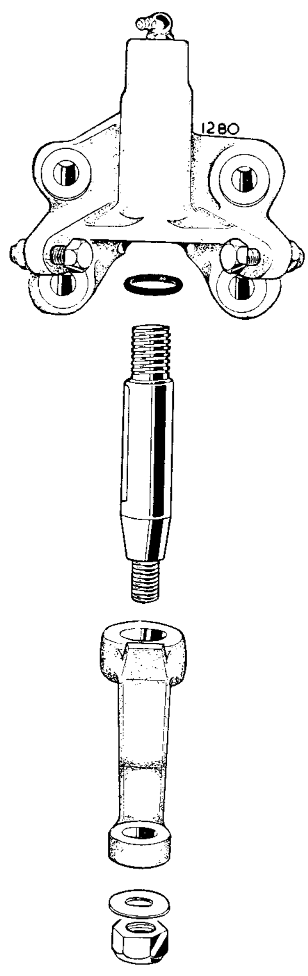


Fig 6. Exploded view of the steering idler assembly.

Assembling

Fit a new " O " ring to the groove at the bottom of the bracket.

Screw the fulcrum pin fully into the bracket housing until the top of the taper is $\frac{3}{16}''$ (4.5 mm.) from the bottom face of the idler housing as illustrated in Fig. 7.

Tap the idler lever on to the taper of fulcrum pin. Fit the washer and self locking nut and tighten securely, ensuring that the fulcrum pin does not turn during the process.

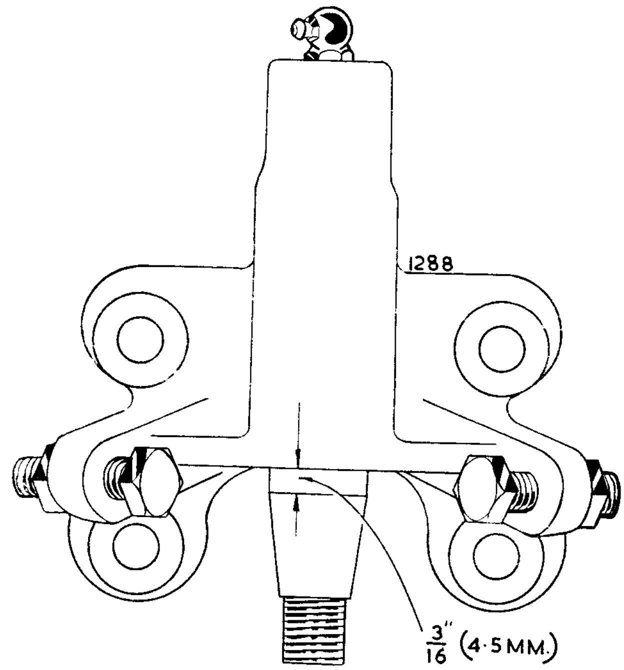


Fig. 7. Setting dimension for the steering idler fulcrum pin.

Refitting

Refitting is the reverse of the removal procedure, but it is important to ensure that the idler lever is in the straight ahead position, as illustrated in Fig. 8, before fitting the track rod end to the lever.

STEERING ARM

Removal

Raise the car by placing a jack under the front suspension cross member and remove the road wheel.

Remove the wheel hub as described in Section J " Front Suspension ".

Remove the self locking nut and plain washer securing the tie rod to the steering arm. Drift out the tie rod ball pin from the steering arm in which it is taper fit.

Unscrew the two self locking nuts and remove the bolts attaching the steering arm to the stub axle carrier, when the steering arm can be removed.

Refitting

Refitting is the reverse of the removal procedure. When refitting the hub bearing adjust the end float as described on page J.15 of the " Front Suspension " section.

TIE ROD

The tie rod ball joints cannot be dismantled and if worn a complete tie rod assembly must be fitted.

Removal

Remove the self locking nuts and plain washers securing the tie rod to the steering arm and track rod end.

Tap the tie rod ball pins out of the steering arm and track rod end in which they are a taper fit.

Refitting

Refitting is the reverse of the removal procedure.

TRACK ROD

The track rod ends incorporate rubber/steel bonded bushes which are not replaceable. If the bushes show signs of deterioration it will be necessary to change the complete track rod end.

Removal

Remove the self locking nuts and washers from the inner ball joint of each tie rod. Tap the ball pin out of each track rod end in which they are a taper fit.

Remove the self locking nuts and washers securing the track rod ends to the drop arm and idle lever.

Tap the track rod ends out of the drop arm and idle lever in which they are a taper fit.

Dismantling

To remove the track rod ends, slacken the clamp at each end of the centre tube ; unscrew each end from the tube noting that one end has a left-hand thread and the other a right-hand thread.

Assembling

When refitting the track rod ends to the centre tube, screw in each end **an equal number of turns.** The final setting of the track rod length must be carried out after the track rod has been refitted, as described under the heading " Front Wheel Alignment ".

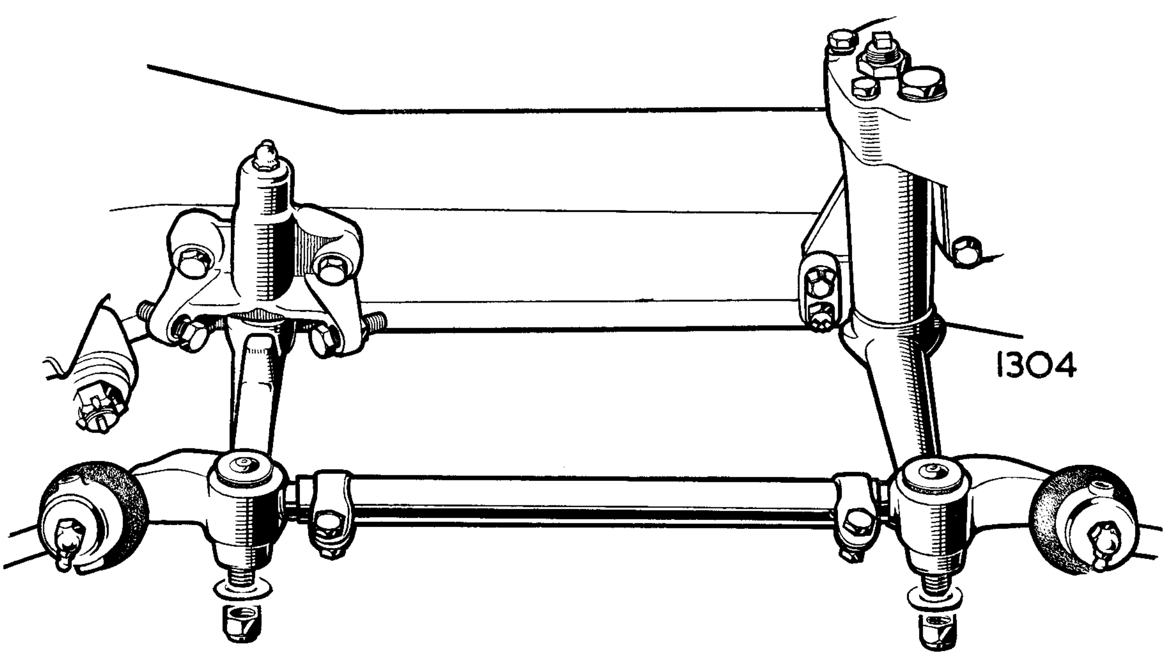


Fig. 8. When refitting the track rod, the drop arm and idler lever must be in the " straight ahead " position.

Refitting

As the track rod ends incoporate rubber bushes it is essential that the steering drop arm and idle lever are turned to the "straight ahead" position, as shown in Fig. 8, before refitting the track rod. It is also important that the pins are tapped into the tapers in the drop arm and idle lever to prevent the pins from turning when tightening the securing nuts.

Failure to observe this procedure will cause undue torsional loading of the rubber bushes resulting in a possible tendency for steering wander and premature failure.

FRONT WHEEL ALIGNMENT

Check that the car is full of petrol, oil and water. If not, additional weight must be added to compensate for, say, a low level of petrol (the weight of 10 gallons of petrol is approximately 80 lb.—36.0 kg.).

Ensure that the tyre pressures are correct and that the car is standing on a level surface.

With the wheels in the straight ahead position check the alignment of the front wheels with an approved track setting gauge.

The front wheel alignment should be :—

Parallel to $\frac{1}{16}''$ (1.59 mm.) 'toe in' (measured at the wheel rim).

Re-check the alignment after pushing the car forward until the wheels have turned half a revolution (180°).

If adjustment is required, slacken the clamp bolt at each end of the track rod and rotate the tube in the required direction until the alignment of the front wheels is correct. Tighten the clamp bolts and re-check the alignment.

LOCK STOP ADJUSTMENT

The lock stop bolts are screwed into the idler bracket and are retained in position by locknuts.

The lock stops are set at the factory to allow 35° travel of the drop arm and idler lever each side of the central (straight ahead) position.

The lock stops should not require adjustment but if attention is found to be necessary the lock stop bolts should be adjusted to obtain $1\frac{1}{4}''$ (4.2 cm.) clearance between the wheel rim and the lower wishbone at the front of the wheel when it is on full lock.

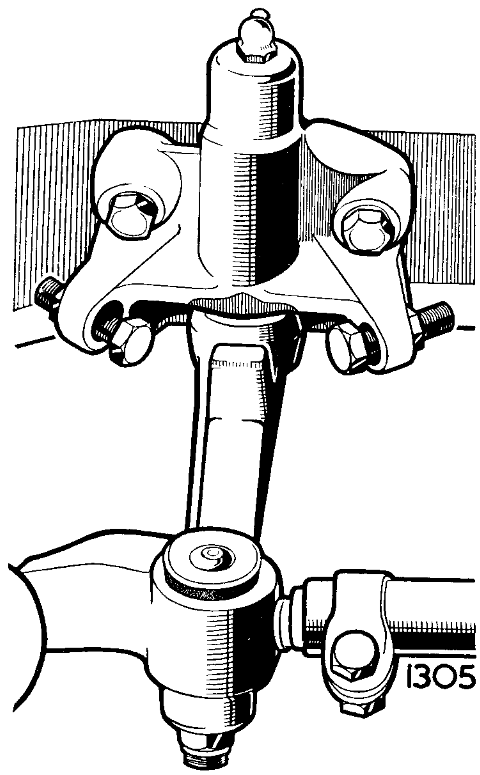


Fig. 9. Showing the steering lock stop bolts.

ACCIDENTAL DAMAGE

The following dimensioned drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off, and the dimensions checked and compared with those given in the appropriate illustration.

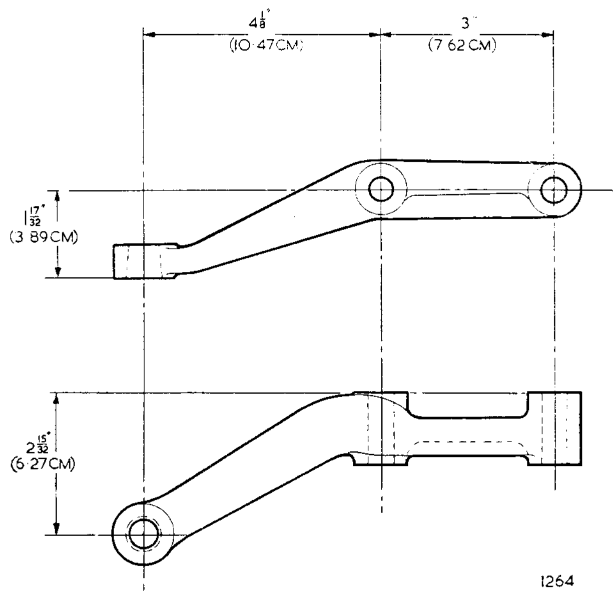


Fig. 10. Steering Arm.

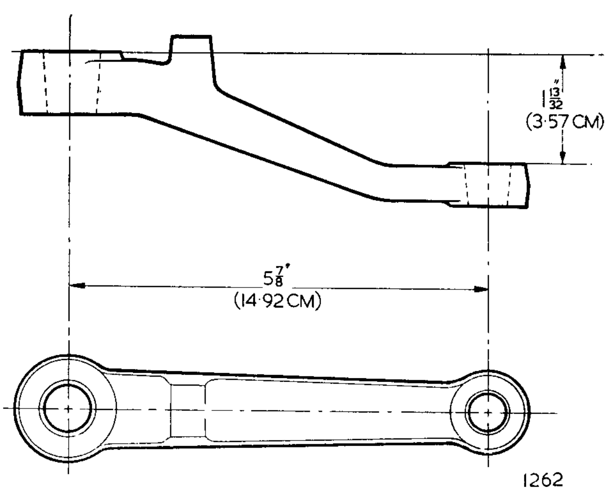


Fig. 11. Steering Idler Lever

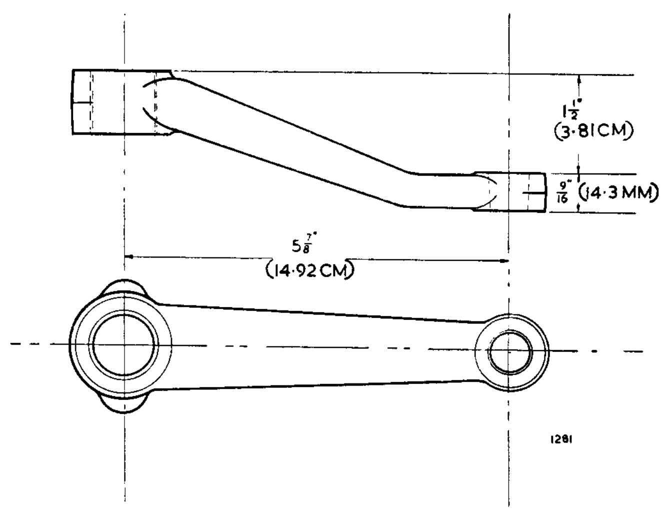


Fig. 12. Steering Drop Arm

NOTE: With effect from the undermentioned chassis numbers the 5⅞" (14.92 cm.) dimension of the steering idler lever and drop arm is reduced to 5½" (13.97 cm.).

	R.H. Drive	L.H. Drive
2.4 Litre	914564	943496
3.4 Litre	976917	991866

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SECTION J

FRONT SUSPENSION

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

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Publication No. E/120/J/4

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FRONT SUSPENSION

DESCRIPTION

The front suspension assemblies fitted to the 2.4 litre and 3.4 litre models are of similar construction but differ in respect of the coil springs.

The assembly comprises a fabricated pressed steel cross-member to which are attached the wishbones, stub axle carriers, coil springs and hydraulic dampers. The steering unit and idler assembly, together with the track rod and tie rods, are also attached to this cross-member.

The coil springs are housed in " turrets " at each end of the suspension cross-member and are retained at the lower ends by seat pans bolted to the lower wishbone.

Each coil spring is controlled by a telescopic direct acting hydraulic damper which is mounted in the centre of the spring. The top of the damper is attached directly to the cross-member turret ; the bottom of the damper is bolted to a mounting bracket which in turn is attached to the coil spring seat pan.

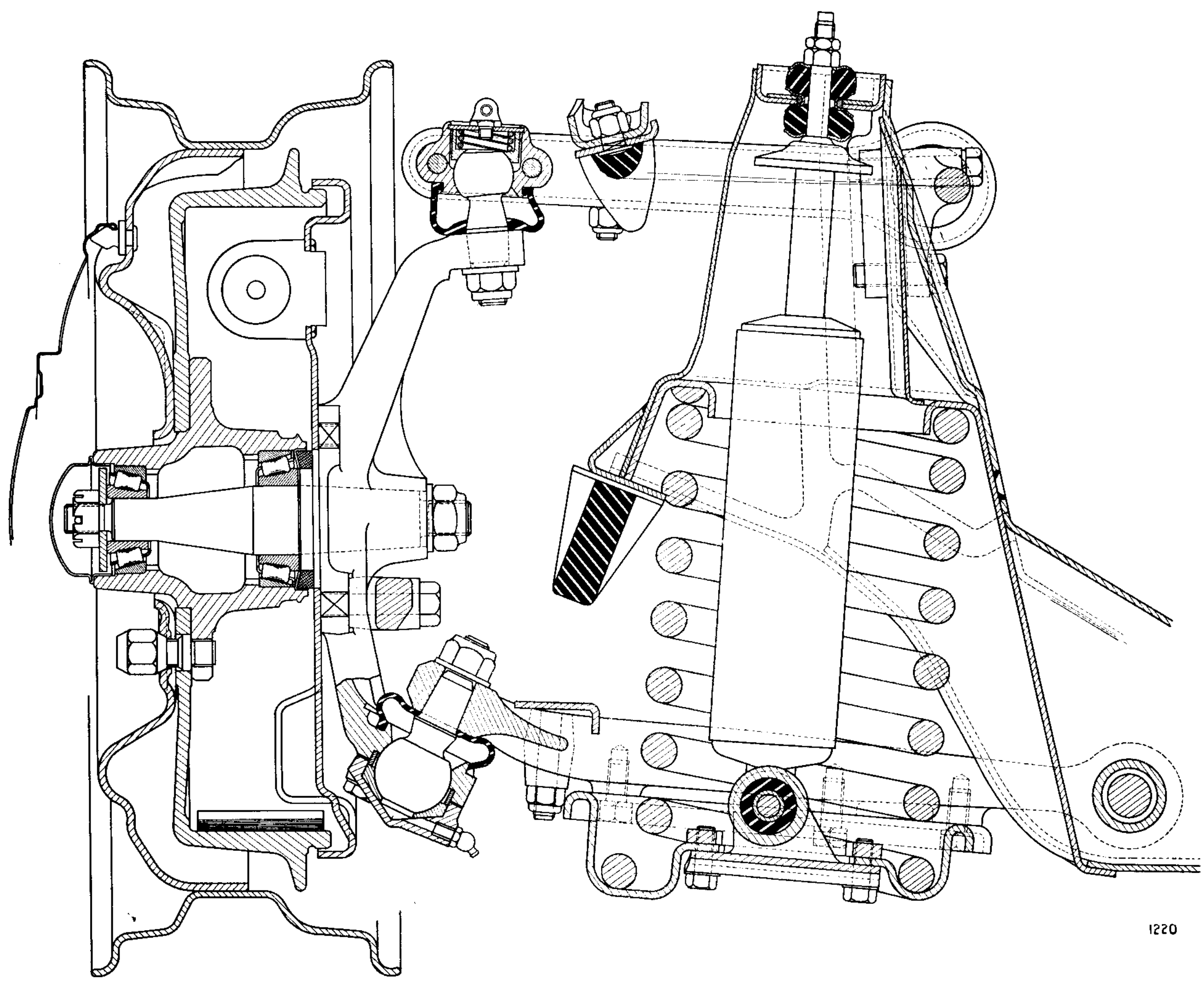

Fig. 1. Sectioned view of the Front Suspension Assembly.

The upper wishbone levers are of pressed steel and are mounted at the fulcrum shaft end on rubber/steel bonded bushes. The outer ends of the wishbone levers are bolted to the upper wishbone ball joint which in turn is attached to the stub axle carrier.

The lower wishbone is a one piece forging, the inner ends of which are mounted on rubber/steel bonded bushes. The outer end of the lower wishbone is bolted to the lower ball joint which in turn is attached to the stub axle carrier.

The wheel hub is supported on two tapered roller bearings the inner races of which fit on a shaft located in a tapered hole bored in the stub axle carrier.

An anti-roll bar fitted between the two lower wishbones, is attached to the chassis side members by rubber insulated brackets.

The front suspension assembly is attached to the body underframe at four points. The two longitudinal members are attached to brackets at the front end of the chassis side members via flat rubber/steel bonded mountings. The transverse member is attached to the chassis side members via two " V " shaped rubber/steel bonded mountings.

DATA

Type	Independent—Coil spring
Dampers	Telescopic hydraulic
Castor angle	$\frac{1}{2}$°—1° negative
Camber angle	$\frac{1}{2}$°—1° positive
Swivel inclination	$6\frac{3}{4}$°

	2.4 litre	3.4 litre
Coil spring—		
—free length (approx.)	14″ (35.5 cm.)	$14\frac{9}{16}$″ (37 cm.)
—no. of coils (approx.)	$6\frac{1}{2}$	$6\frac{1}{2}$
—diameter of bar	.63″ (16 mm.)	.635″ (16.13 mm.)

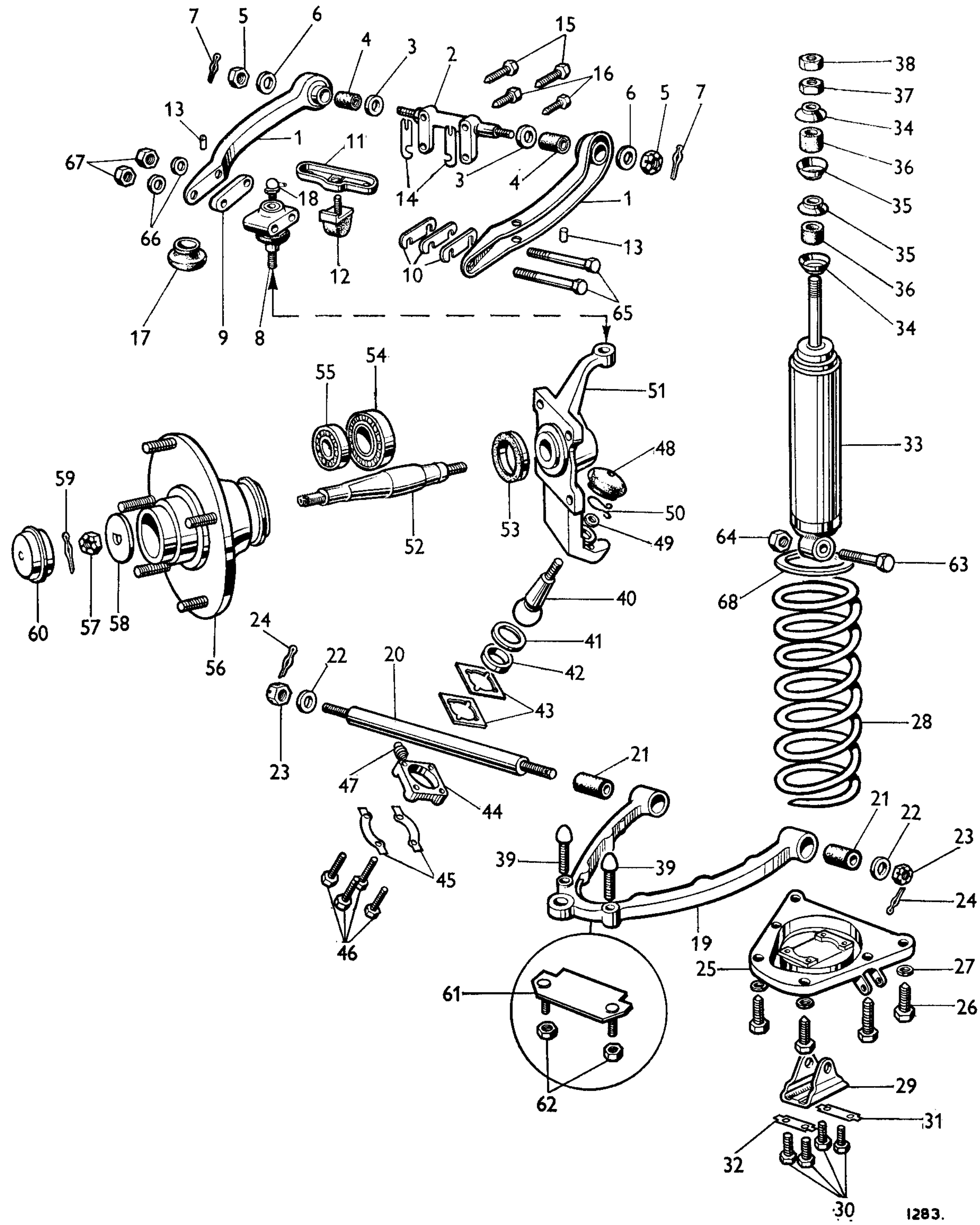

Fig. 2. Exploded view of the Front Suspension Assembly.

ANNOTATIONS FOR FIG. 2.

1. Upper Wishbone Lever.
2. Fulcrum Shaft.
3. Washer.
4. Rubber Bush.
5. Slotted Nut.
6. Washer.
7. Split Pin.
8. Upper Wishbone Ball Joint.
9. Castor Angle Packing Piece.
10. Castor Angle Shims.
11. Bracket
12. Rubber Rebound Stop.
13. Distance Piece.
14. Camber Shims.
15. Bolt (long).
16. Bolt (short).
17. Rubber Gaiter.
18. Grease Nipple.
19. Lower Wishbone Lever.
20. Fulcrum Shaft.
21. Rubber Bush.
22. Washer.
23. Slotted Nut.
24. Split Pin.
25. Coil Spring Seat.
26. Bolt.
27. Spring Washer.
28. Coil Spring.
29. Hydraulic Damper Bracket.
30. Bolt.
31. Tab Washer (long).
32. Tab Washer (short).
33. Hydraulic Damper.
34. Outer Washer.
35. Inner Washer.
36. Rubber Buffer.
37. Nut.
38. Locknut.
39. Bump Stop Rubbers (early type).
40. Ball Pin.
41. Spigot.
42. Socket.
43. Shims.
44. Cap (Lower Ball Pin).
45. Tab Washers.
46. Bolt.
47. Grease Nipple.
48. Rubber Gaiter.
49. Retainer (for Rubber Gaiter).
50. Clip.
51. Stub Axle Carrier.
52. Stub Axle Shaft.
53. Oil Seal (felt).
54. Inner Bearing.
55. Outer Bearing.
56. Front Hub.
57. Slotted Nut.
58. ' D ' Washer.
59. Split Pin.
60. Dust Cap.
61. Bump Stop Contact Plate (later type).
62. Self-locking Nut.
63. Bolt.
64. Nut.
65. Bolt.
66. Plain Washer.
67. Self-locking Nut.
68. Packing Piece (not fitted to all cars).

ROUTINE MAINTENANCE

The front suspension wishbone levers and anti-roll bar are supported in rubber bushes which do not require any attention ; the suspension coil springs also do not require maintenance attention.

Hydraulic Dampers

The hydraulic dampers are of the telescopic type and no replenishment with fluid is necessary or provided for.

EVERY 2,500 MILES (4,000 KM.)

Wheel Swivels

Lubricate the nipples (four per car) fitted to the top and bottom of the wheel swivels.

The nipples are accessible from underneath the front of the car.

Lack of lubrication at these points may cause stiff steering.

EVERY 5,000 MILES (8,000 KM.)

Wheel Bearings (Cars fitted with disc brakes)

To gain access to the front wheel bearing grease nipples (one per wheel) it is necessary to remove the road wheels.

Lubricate the wheel bearings sparingly with the recommended lubricant ; if over-lubricated, grease may find its way on to the brake friction pads. On cars with disc wheels a bleed hole is provided in the end cap of the hub to indicate when sufficient lubricant has been applied. On cars with wire spoked wheels an indication that sufficient lubricant has been applied is by the escape of grease past the outer hub bearing which can be observed through the bore of the splined hub.

EVERY 10,000 MILES (16,000 KM.)

Wheel Bearings (Cars fitted with drum brakes)

No grease nipples are fitted to the front wheel bearing hubs and therefore it is necessary, at the recommended intervals, to dismantle the front wheel hubs, thoroughly clean out and repack the taper roller bearings with one of the recommended high melting point greases.

Do NOT pack the hub with grease but apply a coating to the inside of the hub between the outer races of bearings. Apply a light coat of grease to the stub axle shaft ; do not fill the hub end cap.

When the hub has been refitted, adjust the bearing end float as described on page J.15.

Recommended Lubricants

	Mobil	Castrol	Shell	Esso	B.P.	Duckham
Wheel Swivels	Mobilgrease M.P.	Castrolease Medium or WB	Retinax A or RB	Esso Grease or Esso High Temp. Grease	Energrease C.3 or N.3	LB.10 or HPG
Front Wheel Bearings	Mobilgrease M.P.	Castrolease WB	Retinax A	Esso High Temp. Grease	Energrease N.3	LB.10

FRONT SUSPENSION ASSEMBLY

There are two methods of removing the front suspension assembly. One method entails supporting the body on stands and drawing out the assembly, less the road wheels, on a jack. This method is suitable when this operation is to be carried out on the floor.

The other method which can be carried out on a lift or on the floor entails removing the radiator and raising the body by means of lifting tackle attached to a cross-bar placed under the chassis side members ; the assembly is then rolled out from underneath the body on its road wheels.

Removal with car on floor

Jack up under the front suspension cross-member until the road wheels are clear of the ground. Remove the road wheels.

Support the weight of the car under the front jacking sockets by means of blocks not less than 16″ (40 cm.) in height, leaving the jack in position under the front cross-member.

Remove the two bolts securing the front suspension rear mountings to the chassis side members.

Remove the four nuts and bolts securing the front mountings to the brackets at the front ends of the chassis side members.

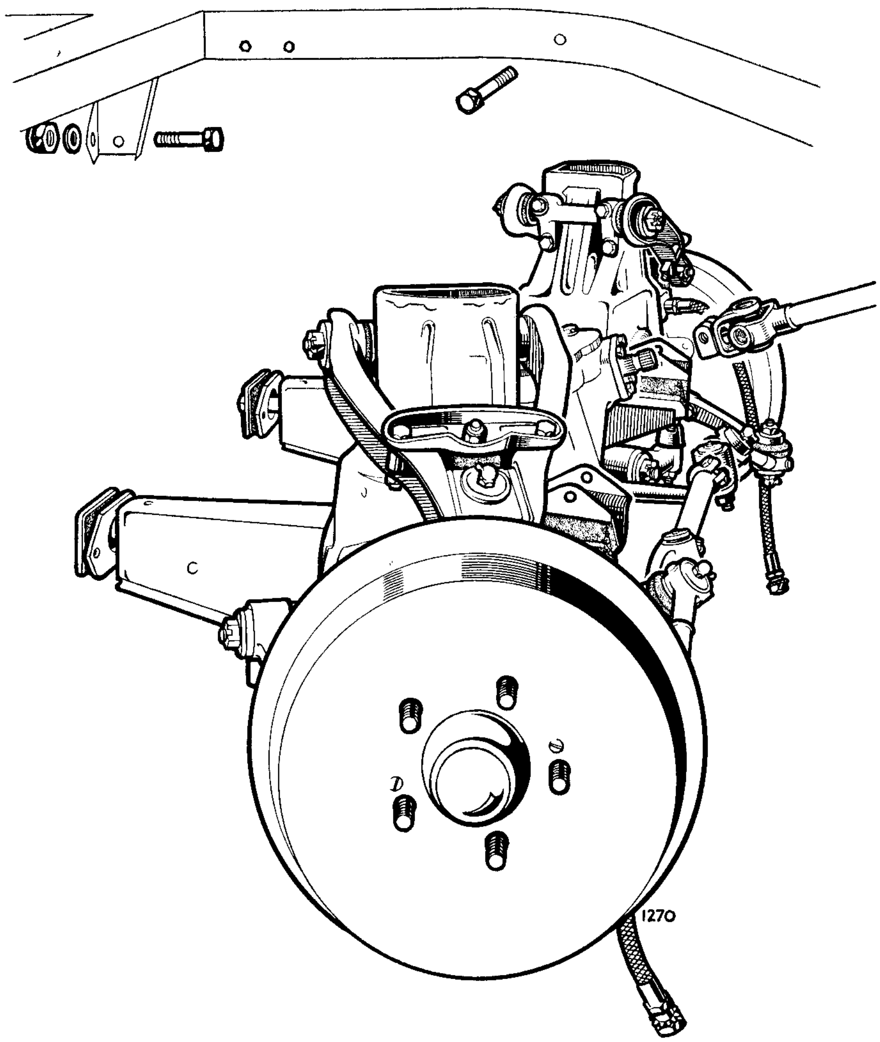

Fig. 3. Removal of the Front Suspension Assembly.

Disconnect the two anti-roll bar mountings from the body underframe members.

Disconnect the flexible brake hoses at the brackets on the body.

Remove the clamping bolt securing the steering column universal joint to the steering box shaft.

Lower the front suspension cross-member assembly on the jack until the front suspension assembly can be drawn forward.

Removal with car on lift

Mark the bonnet with the positions of the hinges to facilitate reassembly. Remove the four set bolts and washers attaching the bonnet to the hinges. Remove the bonnet.

Drain the radiator.

Remove the coil by unscrewing the two nuts and removing the shakeproof washers. Hang the coil on the side of the cylinder head.

On the 3.4 litre model remove the four nuts and washers attaching the fan cowl to the radiator. The drain tap remote control rod bracket at the top of the radiator should be refitted. Hang the fan cowl on the fan.

The fan cowl need not be removed on the 2.4 litre model as the cowl will clear the fan.

Slacken off the clips and remove the top and bottom hoses from the radiator.

Withdraw the set bolts and remove the shakeproof and plain washers, spacers and mounting rubbers from the top radiator mountings.

From underneath the car, unscrew the self-locking nut and withdraw the plain washer, spacer and mounting rubber from each of the lower radiator mountings. Collect the other two mounting rubbers when the radiator has been removed.

Tilt the top of the radiator towards the cylinder head and withdraw the radiator from its mountings, taking care not to foul the fan.

Place a bar under the chassis side members and attach the lifting tackle to it.

Remove the two bolts securing the front suspension rear mountings to the chassis side members.

Remove the four nuts and bolts securing the front mountings to the brackets at the front ends of the chassis side members.

Disconnect the two anti-roll bar mountings from the body underframe members.

Disconnect the flexible brake hoses at the brackets on the body.

Remove the clamping bolt securing the steering column universal joint to the steering box shaft.

Raise the front of the car by means of the lifting tackle and roll out the front suspension assembly from underneath the body.

Refitting

When refitting the front suspension cross-member assembly ensure that the brake drums are in the straight ahead position and that one of the steering wheel spokes is at the 12 o'clock position with the head of the Jaguar on the horn push upright.

After the front suspension assembly has been completely refitted it will be necessary to " bleed " the brake hydraulic system as described in section L—" Brakes."

SUSPENSION BUMP STOPS.

Two types of bump stops have been fitted to the front suspension unit.

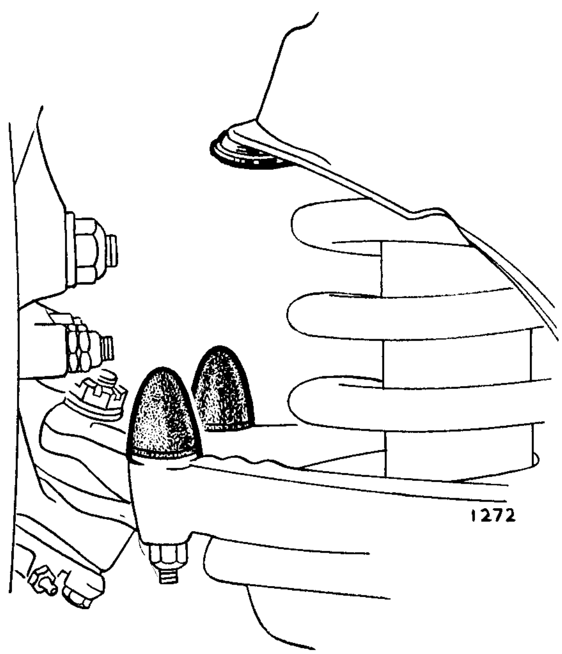

Fig. 4. The first type Bump Stop.

1st Type

The first type of bump stop consisted of two conical rubbers fitted to each lower wishbone and cups welded to the bottom flange of the suspension cross-member turret.

To remove the bump rubbers, unscrew the self-locking nuts and tap the studs upwards out of the holes in the lower wishbone.

2nd Type

Later cars were fitted with a progressive type of bump stop which consists of a tapered rubber block attached to a bracket welded to the bottom flange of each suspension cross-member turret. A contact plate is bolted to the lower wishbone levers using the holes in which the first type bump stop rubbers were fitted.

To remove the bump rubber, unscrew the two self-locking nuts when the rubber can be detached from the bracket.

To remove the contact plate, unscrew the self-locking nuts and tap the studs upwards out of the holes in the lower wishbone.

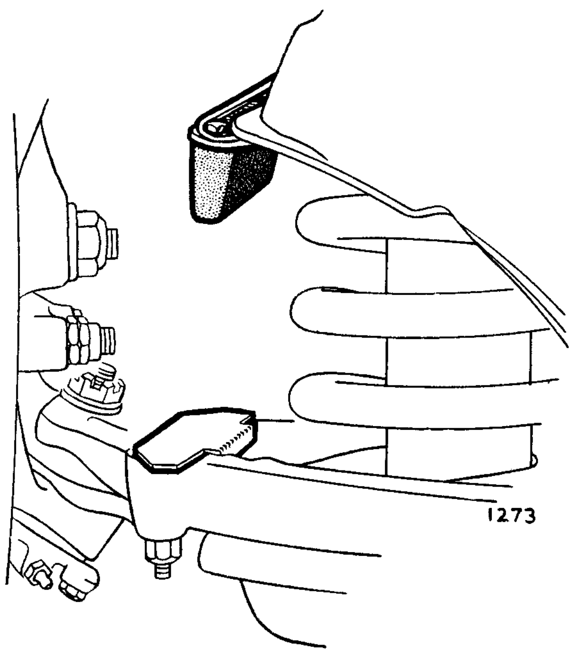

Fig. 5. The second type Bump Stop.

HYDRAULIC DAMPERS

The telescopic hydraulic dampers are of the sealed type with no provision for adjustment or " topping up "

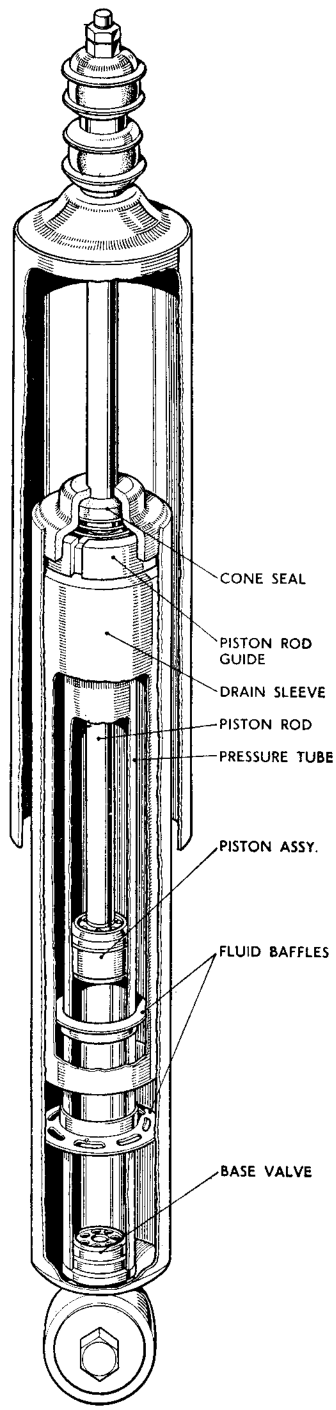

Fig. 6. Sectioned view of the Hydraulic Damper.

with fluid. Therefore, in the event of a damper being unserviceable a replacement must be fitted.

Before fitting a damper to a car it is advisable to carry out the following procedure to " bleed " any air from the pressure chamber that may have accumulated due to the damper having been stored in a horizontal position. Hold the damper in its normal vertical position with the shroud uppermost and make several short strokes (not extending more than halfway) until there is no lost motion and finish by extending the damper to its full length once or twice. Do not extend the damper fully until several short strokes have been made first. After the operation of "bleeding" the hydraulic dampers should be kept in their normal upright position until they are fitted to the car.

Removal

Removal of the hydraulic dampers will be facilitated if the wishbone levers are kept approximately horizontal, by either interposing a fibre packing piece between the upper wishbone levers and the cross-member turret (as illustrated in Fig. 8) or by placing a support under the brake drum and partly lowering the jack to compress the spring.

Jack up the car under the front suspension cross-member until the wheels are clear of the ground. Remove the road wheel.

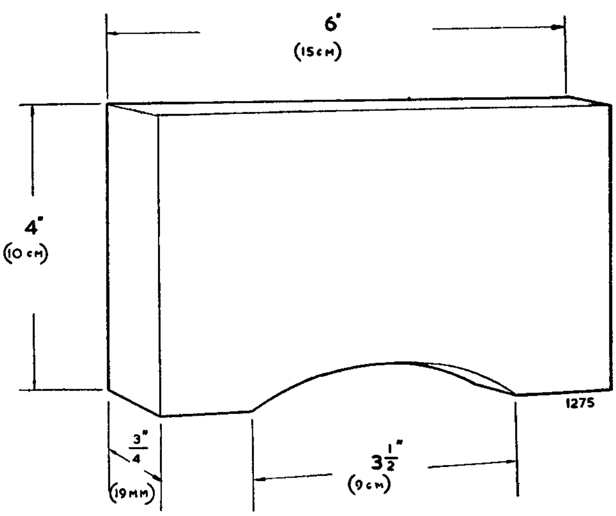

Fig. 7. Showing a fibre block which can be made up and used to support the Upper Wishbone Levers when carrying out certain operations on the Front Suspension Assembly.

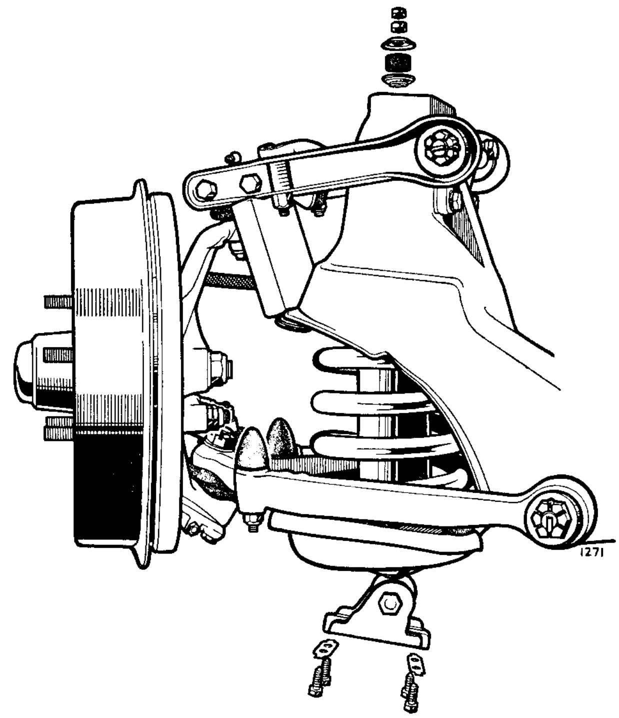

Fig. 8. Removal of the Hydraulic Damper.

Remove the locknut and nut from the top mounting of the damper and withdraw the outer washer, rubber buffer and inner washer ; note the difference between the inner and outer washer.
Note : A distance piece is fitted to the damper top mounting hole which may become displaced during the removal of the damper.

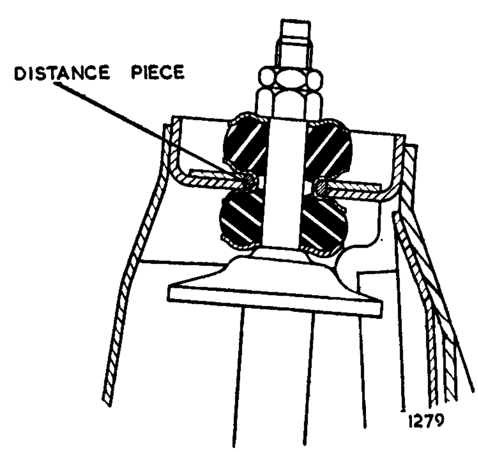

Fig. 9. When refitting an Hydraulic Damper ensure that the distance piece is in position.

Bend back the tab washers on the four set-bolts attaching the hydraulic damper mounting bracket to the coil spring seat. Remove the bolts when the damper can be withdrawn.

Refitting

Refitting is the reverse of the removal procedure. Ensure that the distance piece is in position in the top mounting hole in the cross-member turret.

COIL SPRINGS

The coil springs are marked with coloured paint strips (which may be covered by tape) to denote springs of the same static load. It is, therefore, important that the two front springs fitted to a car are of the same colour code.

The colour code also serves to distinguish the 2.4 litre spring from the 3.4 litre type (see under " Coil Spring Packing Piece ").

Removal

Remove the hydraulic damper as described on page J.12.

Insert a suitable coil spring compressor (Part number PL3477) through the centre of the spring and compress the spring sufficiently to relieve the load on the spring seat pan screws.

Remove the six setscrews and spring washers which secure the seat pan to the lower wishbone.

Release the coil spring compressor until the load of the spring is completely relieved. Completely unscrew the compressor when the coil spring and seat pan can be removed.

Note : On some cars a packing piece may be fitted at the top of the spring, see " Coil Spring Packing Piece " overleaf.

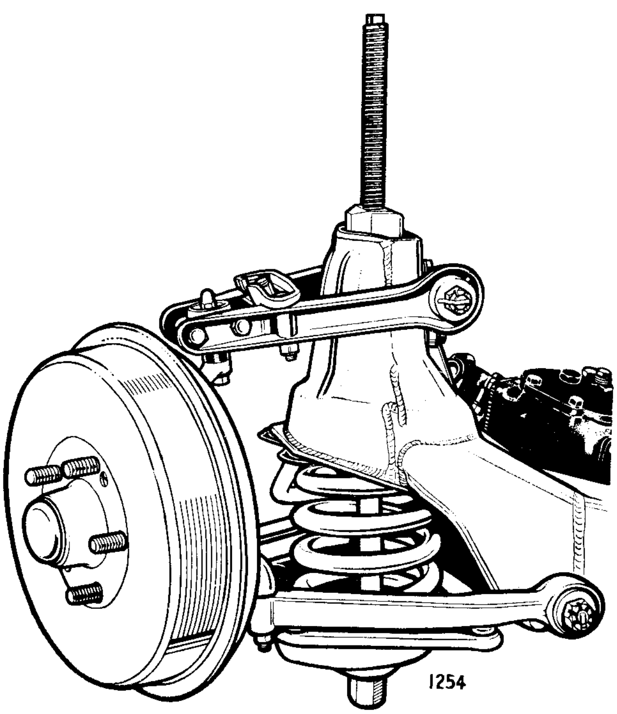

Fig. 10. Showing the compressor in position prior to the removal of the Coil Spring.

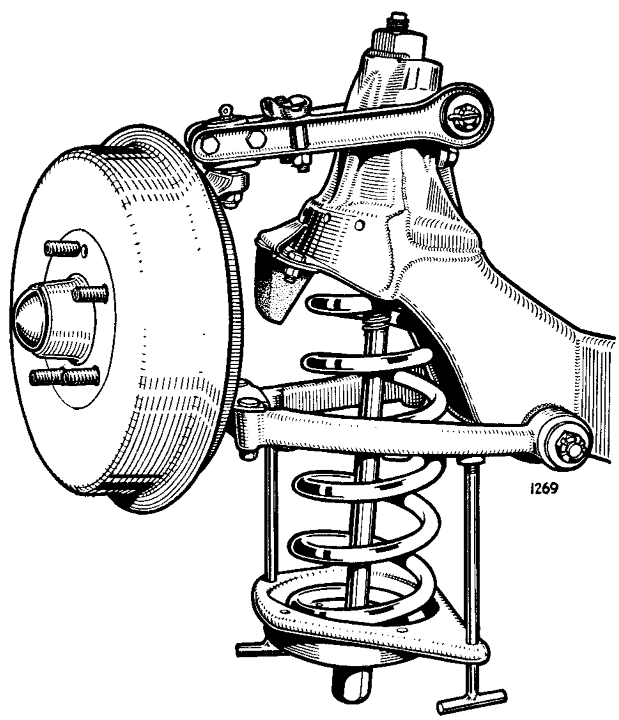

Fig. 11. Refitting the coil spring with a compressor; the pilot studs facilitate alignment of the seat pan securing bolt holes.

Refitting

Refitting is the reverse of the removal procedure. Alignment of the seat pan holes with the tapped holes in the lower wishbone will be facilitated if 8″ (20 cm.) long pilot studs (threaded $\frac{3}{8}$″ U.N.F.) are fitted as illustrated in Fig. 11.

Coil Spring Packing Piece

Effective from the following chassis numbers:

	R.H. Drive	L.H. Drive
2.4 litre	911033	943054
3.4 litre	973493	988794

a packing piece may be fitted at the top of the coil spring. The packing pieces are available in thicknesses of $\frac{1}{8}$″ (3.2 mm.) and $\frac{1}{4}$″ (6.4 mm.) and are fitted to compensate for slight manufacturing variations in the fitted lengths of the springs.

Colour code of springs.	Thickness of packing piece.
2.4 litre	
White	$\frac{1}{4}$″ (6.4 mm.)
Blue	$\frac{1}{8}$″ (3.2 mm.)
Green	No packing piece fitted
3.4 litre	
Red	$\frac{1}{4}$″ (6.4 mm.)
Yellow	$\frac{1}{8}$″ (3.2 mm.)
Purple	No packing piece fitted

Note: 2.4 litre cars prior to chassis numbers 900484 R.H. Drive and 940020 L.H. Drive were fitted with a $\frac{1}{4}$″ (6.4 mm.) packing piece irrespective of the spring colour code. Cars after these chassis numbers were fitted with spring a $\frac{1}{4}$″ longer and the use of the packing piece was discontinued until the chassis numbers given in paragraph 1.

WHEEL HUBS

Removal

Jack up the car and remove the road wheels.

On car with drum brakes remove the two countersunk screws and withdraw the brake drum. On cars with disc brakes remove the caliper, noting the shims fitted between the caliper and the mounting plate.

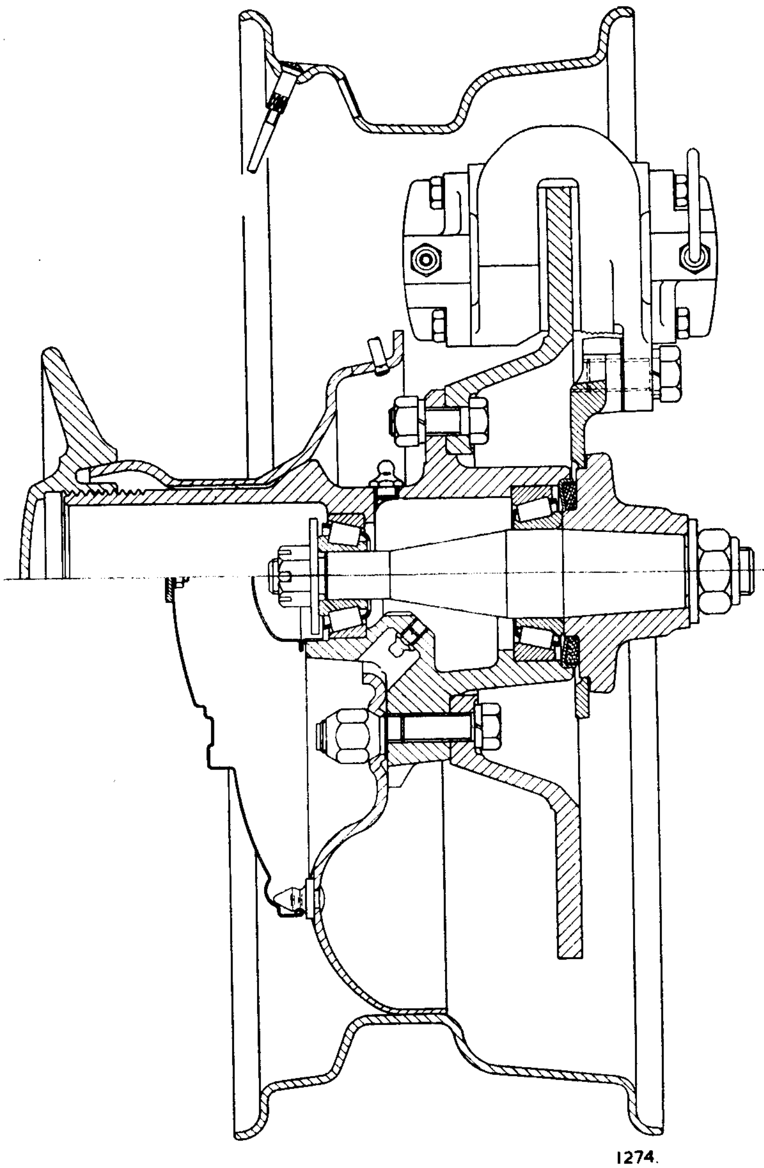

Fig. 12. Sectioned plan view of the disc brake hub arrangement. The upper half of the illustration shows a wire spoke wheel hub; the lower half shows a disc wheel hub.

Remove the split pin retaining the hub nut. On cars with disc wheels the split pin is accessible after prising off the end cap ; cars with wire spoke wheels are provided with holes in the side of the hub through which the split pin can be withdrawn.

Remove the slotted nut and plain washer from the end of the stub axle shaft. The hub can now be withdrawn by hand.

Dismantling

Extract the felt oil seal. Withdraw the inner races of the taper roller bearings. If new bearings are to be fitted the outer races can be drifted out, grooves being provided in the abutment shoulders in the hub.

Refitting

Refitting is the reverse of the removal procedure but it will be necessary to re-lubricate the bearings as detailed in " Routine Maintenance " at the beginning of this section and adjust the end float of the hub bearings as described in the following paragraph.

On cars with disc brakes bleed the hydraulic system as described in Section L " Brakes ".

Bearing end-float adjustment

The correct end-float of the wheel bearings is .003″ to .005″ (.07 mm. to .13 mm.). On cars with disc brakes it is particularly important that the end-float does not exceed .005″ (.13 mm.) otherwise the brakes may tend to drag and not function correctly.

The wheel bearing end-float can be measured with a dial indicator gauge, mounted with the plunger against the end of the hub. If a gauge is not available proceed as follows :—

Tighten the hub nut until there is no end-float, that is when rotation of the hub feels slightly " sticky ".

Slacken back the hub nut between one and two flats depending on the position of the split pin hole relative to the slots in the nut.

Temporarily attach the road wheel and check that the wheel spins freely.

If satisfactory, fit a new split pin and turn over the ends.

STUB AXLE CARRIERS

Removal

Jack up under the lower wishbone lever and remove the road wheel.

On cars with drum brakes, remove the wheel hub as described on page J.14. Detach the brake back plate ; draw the plate over the stub axle shaft and tie up out of the way ; do not allow the brake assembly to hang on the flexible hose.

On cars with disc brakes, remove the caliper assembly, noting the shims between the caliper and the mounting plate. Remove the wheel hub complete with brake disc as described on page J.14.

Remove the self-locking nut and plain washer securing the upper ball joint to the stub axle carrier. Drift out the ball pin from the stub axle carrier in which is a taper fit.

Remove the split pin (1) (Fig. 15), nut (2) and plain washer (3) which secure the ball joint to the lower wishbone.

Drift out the ball pin from the lower wishbone, in which it is a taper fit, when the stub axle carrier can be removed.

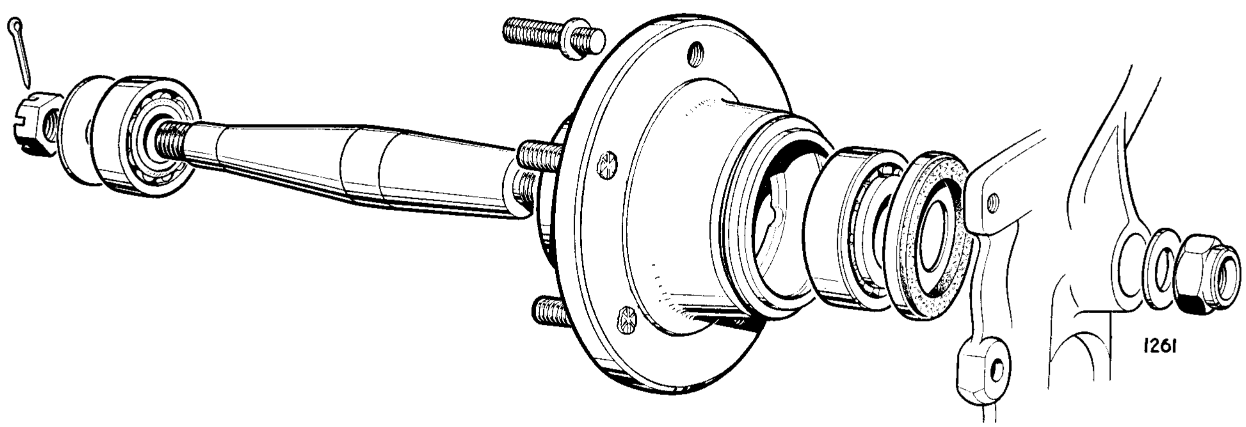

Fig. 13. Exploded view of the Wheel Hub.

Refitting

Refitting is the reverse of the removal procedure.

LOWER WISHBONE

Removal

Remove the coil spring as described on page J.13.

Remove the stub axle carrier as described on page J.15.

Withdraw the split pin, slotted nut and washer from one end of the lower wishbone fulcrum shaft. The shaft can now be drifted out.

Fitting the Rubber/Steel Bushes

Drift out or press out the bush from the wishbone eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of twelve parts of water to one part of liquid soap, is used.

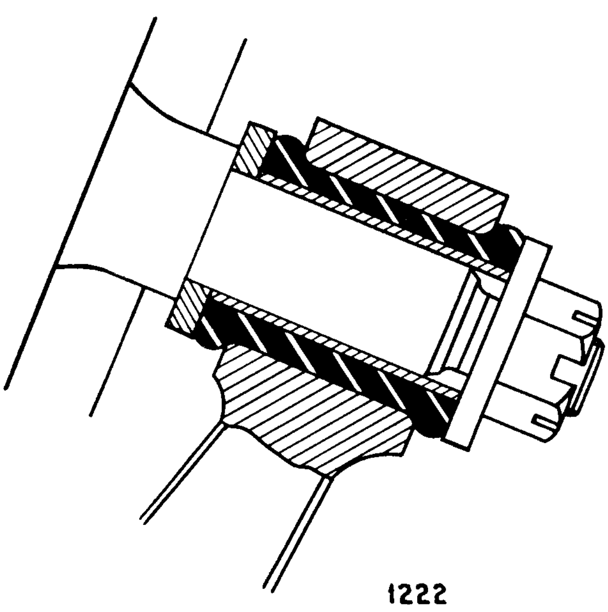

Fig. 14. Section through one of the lower wishbone rubber/steel mounting bushes.

Refitting

Refitting is the reverse of the removal procedure. When refitting the fulcrum shaft the car should be in the normal riding position before the nuts at each end of the shaft are fully tightened. Omitting to carry out this procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

LOWER WISHBONE BALL JOINT

Removal

Remove the stub axle carrier complete with the lower wishbone ball joint as described on page J.15.

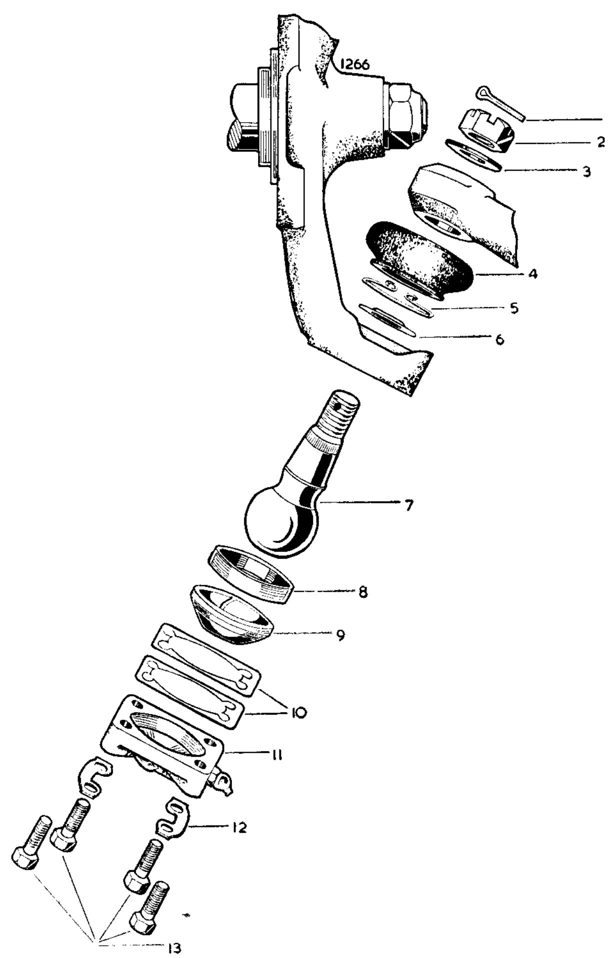

Fig. 15. Exploded view of the Lower Wishbone Ball Joint

Dismantling

Release the wire clip (5) (Fig. 15) and remove the rubber gaiter (4). Withdraw the retainer (6) from the top of the ball pin (7).

Tap back the tab washers (12) and unscrew the four setscrews (13) securing the ball pin cap (11) to the stub axle carrier.

Remove the cap (11), shims (10), ball pin socket (9), spigot (8) and ball pin (7).

Reassembling

Reassembling is the reverse of the dismantling procedure but, if necessary, re-shim the ball joint to obtain the correct clearance of .004″—.006″ (.10 mm.—.15 mm).

Note : Shims should not be removed to take up excessive wear in the ball pin and socket ; if these parts are badly worn, replacements should be fitted.

Adjustment of the ball joint

The correct clearance of the ball pin in its sockets is .004″—.006″ (.10 mm.—.15 mm.). Shims for adjustment of the ball joint are available in .002″ (.05 mm.) and .004″ (.10 mm.) thicknesses.

To adjust the ball pin clearance to the correct figure, remove shims one by one until, with ball cap fully tightened, the ball is tight in its sockets. Fit shims to the value of .004″—.006″ (.10 mm.—.15 mm.) which should enable the shank of the ball pin to be moved by hand.

Refitting

Refit the stub axle carrier complete with the lower wishbone ball joint as described on page J.16.

UPPER WISHBONE

Removal

Jack up under the lower wishbone and remove the road wheel.

Remove the two bolts, nuts and plain washers securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and shims as these control the castor angle. Alternatively, remove the self-locking nut and drift out the ball joint from the stub axle carrier. Tie-up the stub axle carrier to the suspension cross-member so that the flexible brake hose does not become extended.

Remove the four set bolts which secure the upper wishbone fulcrum shaft to the suspension cross-member turret. Note the relative positions of the shims as these control the camber angle.

The upper wishbone assembly can now be removed.

Dismantling

Remove the nuts, bolts and distance pieces securing the rebound stop bracket to the upper wishbone levers.

Extract the split pin and remove the slotted nuts and plain washers which secure the wishbone levers to the fulcrum shaft. The wishbone levers can now be removed from the fulcrum shaft.

Fitting the Rubber/Steel Bushes

Drift out or press out the bush from the wishbone eye. Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of twelve parts of water to one part of liquid soap, is used.

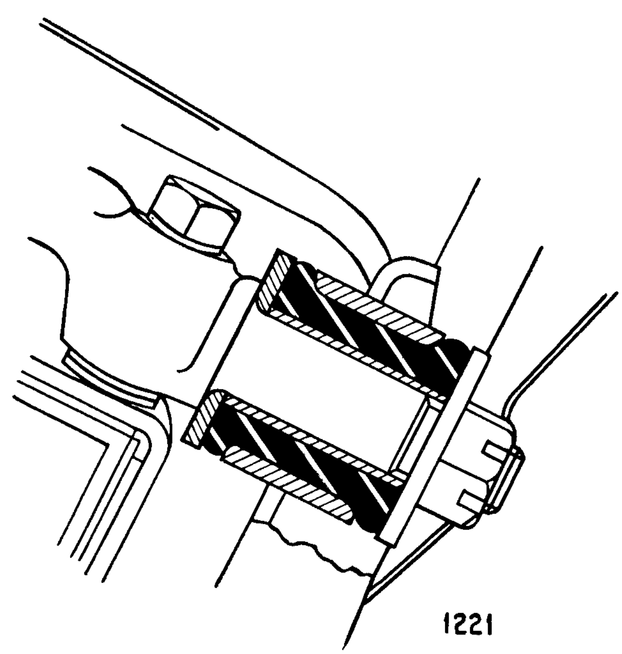

Fig. 16. Section through one of the upper wishbone rubber/steel mounting bushes.

Reassembling

The reassembly of the upper wishbone assembly is the reverse of the dismantling procedure but the slotted nuts securing the wishbone levers to the fulcrum shaft must not be tightened until the upper wishbone assembly has been refitted and the full weight of the car is on the suspension. Omitting to carry out the procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

Refitting

Refitting is the reverse of the removal procedure.

UPPER WISHBONE BALL JOINT

The upper wishbone ball joint cannot be dismantled and, if worn, the complete assembly must be replaced.

Removal

Jack up the car under the lower wishbone and remove the road wheel.

Remove the two bolts, nuts and plain washers securing the ball joint to the upper wishbone levers. Note the relative positions of the packing piece and shims as these control the castor angle.

Remove the self-locking nut and plain washer which secure the ball joint to the stub axle carrier.

The ball joint can now be drifted out of the stub axle carrier in which it is a taper fit.

Note : When carrying out the above operation do not allow the flexible brake hose to become extended ; tie up the stub axle carrier to the cross-member turret.

Refitting

Refitting is the reverse of the removal procedure. Ensure that the packing piece and shims are refitted in their original positions otherwise the castor angle will be upset.

CASTOR ANGLE ADJUSTMENT

Check that the car is full of petrol, oil and water. If not, additional weight must be added to compensate for, say, a low level of petrol (the weight of 10 gallons of petrol is approximately 80 lbs—36.0 kg.).

Ensure that the tyre pressures are correct and that the car is standing on a level surface.

Using an approved gauge, check the castor angle.

Castor Angle . . . . $\frac{1}{2}°$—1° negative.

Adjustment is effected by either transposing the shims from the rear of the upper wishbone ball joint to the front, or transposing the packing piece and shim(s).

To decrease negative castor, transpose shims from the rear to the front ; the holes in the shims are slotted and therefore it will only be necessary to slacken the two bolts securing the upper wishbone members to enable the shims to be removed.

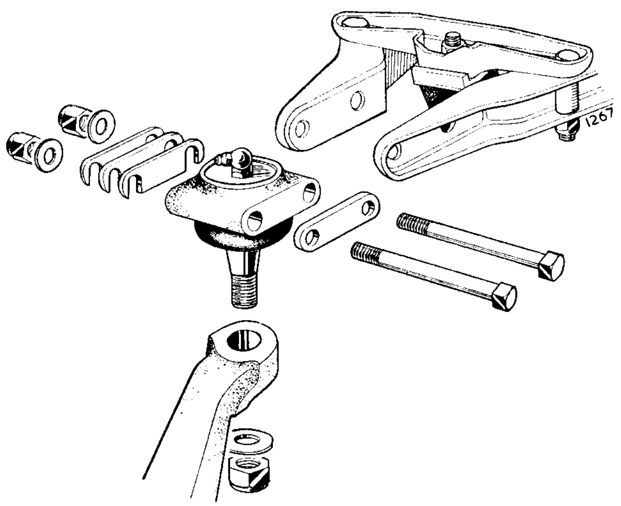

Fig. 17. Removal of the Upper Wishbone Ball Joint.

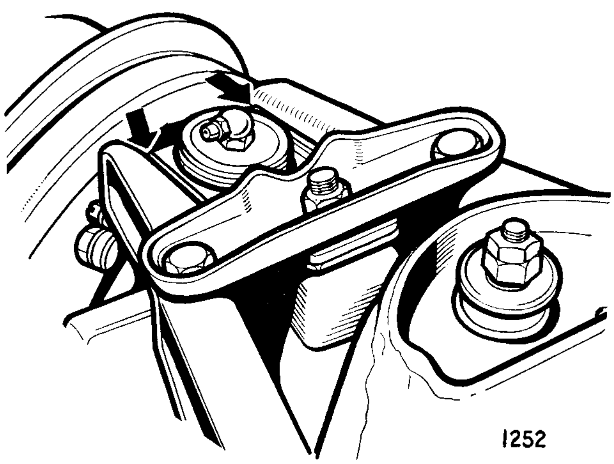

Fig. 18. The Castor Angle is adjusted by means of the shims and packing piece indicated by the arrows.

To increase negative castor or decrease positive castor, transpose the packing piece and shims as necessary. As the holes in the packing piece are not slotted it will be necessary to remove the two bolts after first having placed a support under the brake drum or lower wishbone.

The shims are $\frac{1}{16}''$ (1.6 mm) thick and it should be noted that $\frac{1}{16}''$ (1.6 mm.) of shimming will alter the castor angle by approximately $\frac{1}{4}°$.

The front of the car should be jacked up when turning the wheels from lock to lock during checking.

If any adjustment is made to the castor angle, the front wheel alignment should be checked and, if necessary, re-set.

Note : A packing piece and 3 shims must be always fitted between the wishbone levers and the upper ball joint ; their relative positions may, of course, not always be the same.

CAMBER ANGLE ADJUSTMENT

Check that the car is full of petrol, oil and water. If not, additional weight must be added to compensate for, say, a low level of petrol (the weight of 10 gallons of petrol is approximately 80 lbs.—36.0 kg.).

Ensure that the tyre pressures are correct and that the car is standing on a level surface.

Line up the front wheel being checked parallel to the centre line of the car. Using an approved gauge, check the camber angle. Rotate the wheel being checked through 180° and re-check.

Camber Angle . . . . $\frac{1}{2}°$—1° positive.

Adjustment is effected by removing or adding shims at the front suspension top wishbone bracket ; the holes in the shims are slotted and it is therefore only necessary to slacken the setscrews securing the bracket to enable the shims to be removed. Inserting shims decreases positive camber ; removing shims decreases negative camber or increases positive camber. Remove or add an equal thickness of shims from each position, otherwise the castor angle will be affected. Shims for the adjustment of camber are available in $\frac{1}{32}''$ (.8 mm.) $\frac{3}{64}''$ (1.2 mm.) and $\frac{1}{16}''$ (1.6 mm.) thicknesses and it should be noted that $\frac{1}{16}''$ (1.6 mm.) of shimming will alter the camber angle by approximately $\frac{1}{4}°$.

Check the other front wheel in a similar manner. If any adjustment is made to the camber angle, the front wheel alignment should be checked and, if necessary, reset.

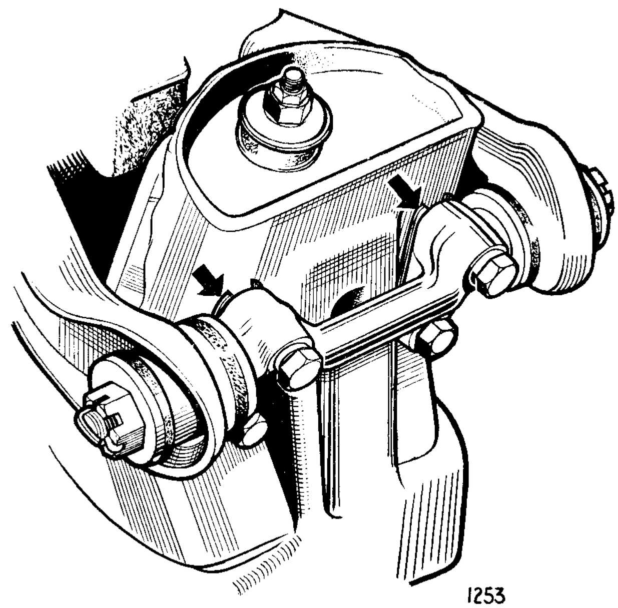

Fig. 19. The Camber Angle is adjusted by means of the shims indicated by the arrows. Remove or add an equal thickness of shims from each position.

ANTI-ROLL BAR

Removal

Raise the car on a lift to enable work to be carried out underneath. Remove the four bolts (2) (Fig. 20) from the anti-roll bar support brackets (3) on the chassis side members.

Remove the self-locking nut (5) and remove the bolt (6) attaching the link arm (7) to the coil spring seat. Repeat for the other side.

To separate the anti-roll bar (1) from the link arms (7) remove the self-locking nuts (9), upper cup washers and rubbers (10 and 11). Care should be taken to replace the spacer (12) when refitting.

The anti-roll bar bracket rubbers (4) are split to enable them to be removed.

Fitting the Link Arm Bush.

Drift out or press out the bush from the link arm eye.

Press the new bush into the eye, ensuring that the bush projects from each side by an equal amount. Fitting of the bush will be facilitated if a lubricant, made up of twelve parts of water to one part of liquid soap, is used.

Refitting

Refitting is the reverse of the removal procedure. It is important when attaching the support brackets to the chassis side members, to have the full weight of the car on the road wheels.

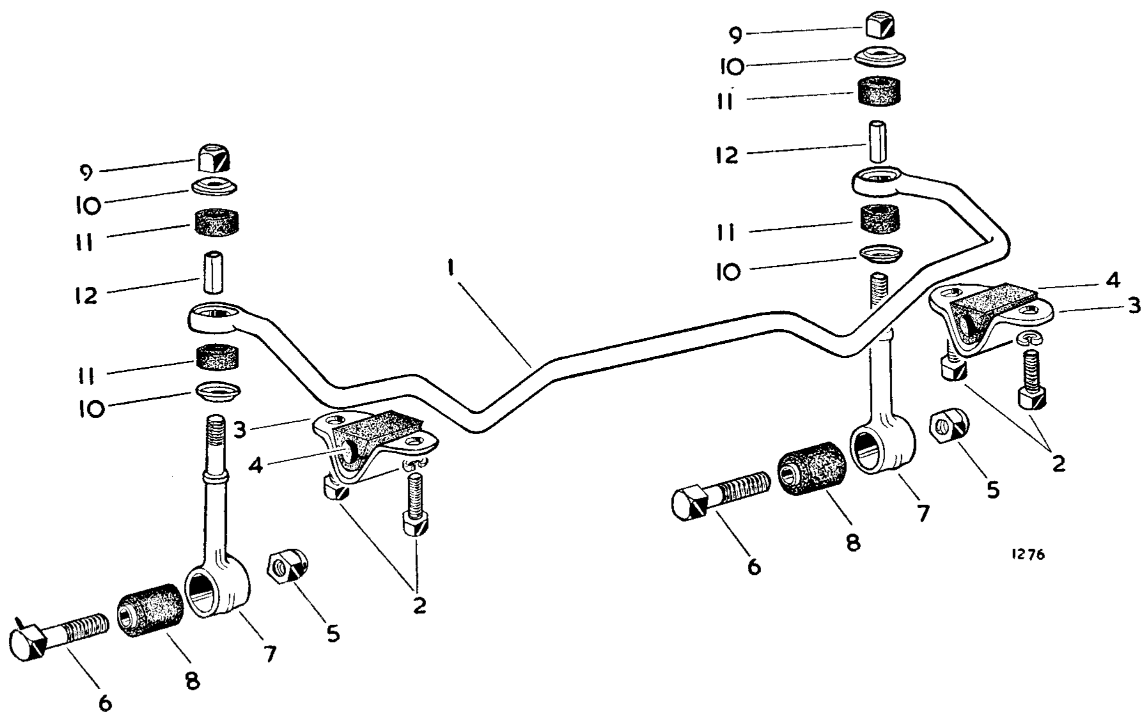

Fig. 20. Exploded view of the Anti-Roll Bar.

ACCIDENTAL DAMAGE

The following dimensioned drawings are provided to assist in assessing accidental damage. A component suspected of being damaged should be removed from the car, cleaned off, and the dimensions checked and compared with those given in the appropriate illustration.

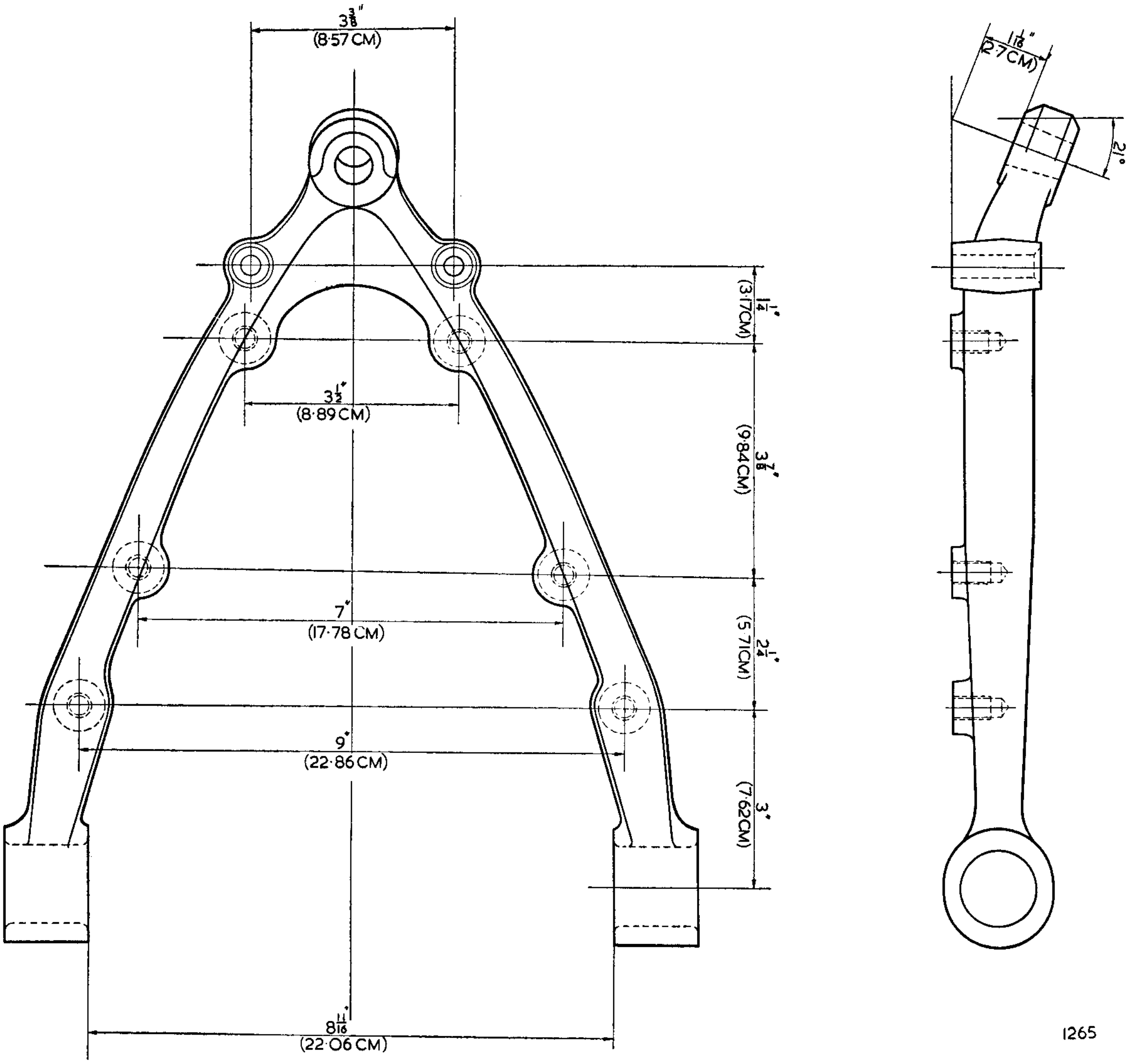

Fig. 21. Lower Wishbone.

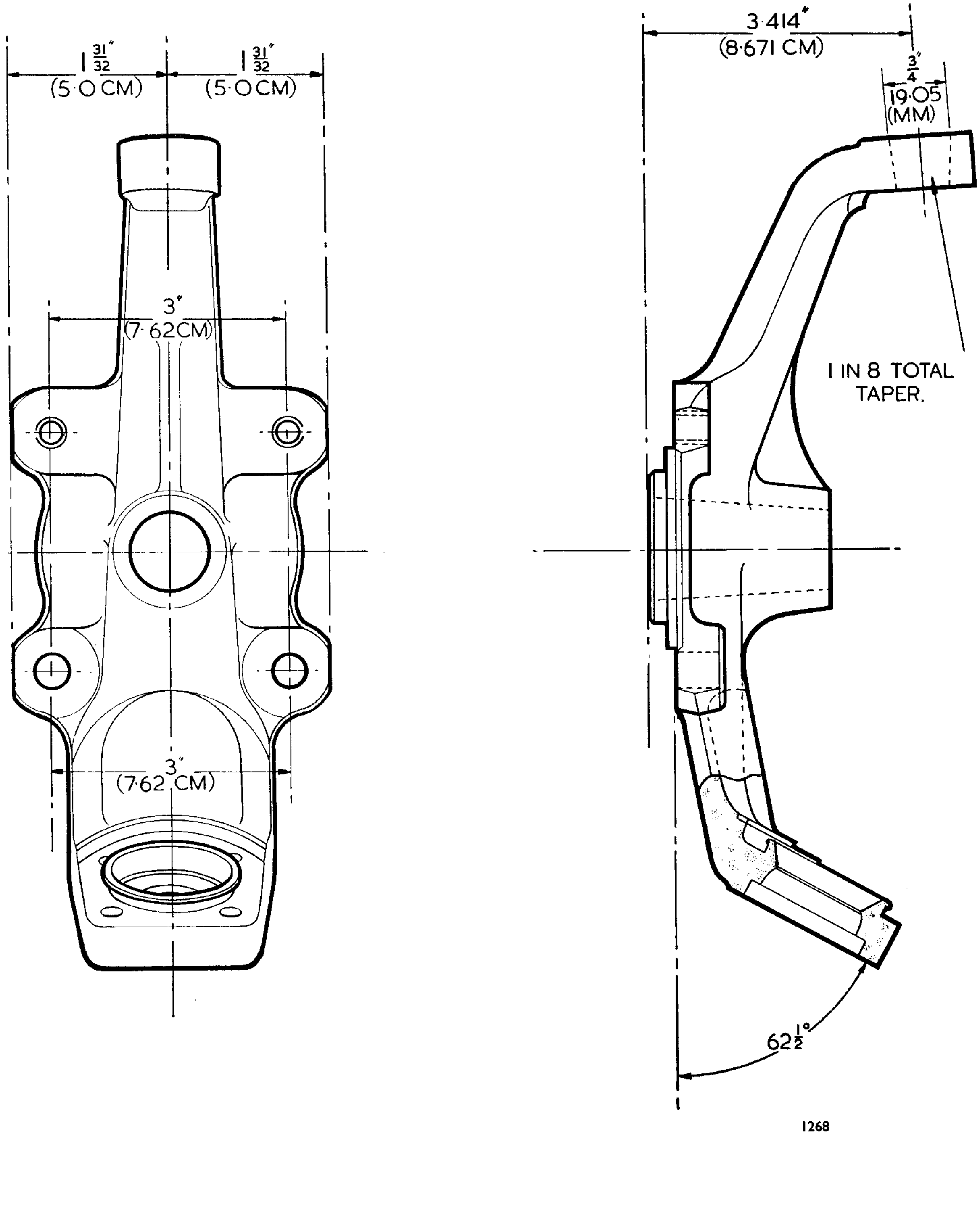

Fig. 22. Stub Axle Carrier

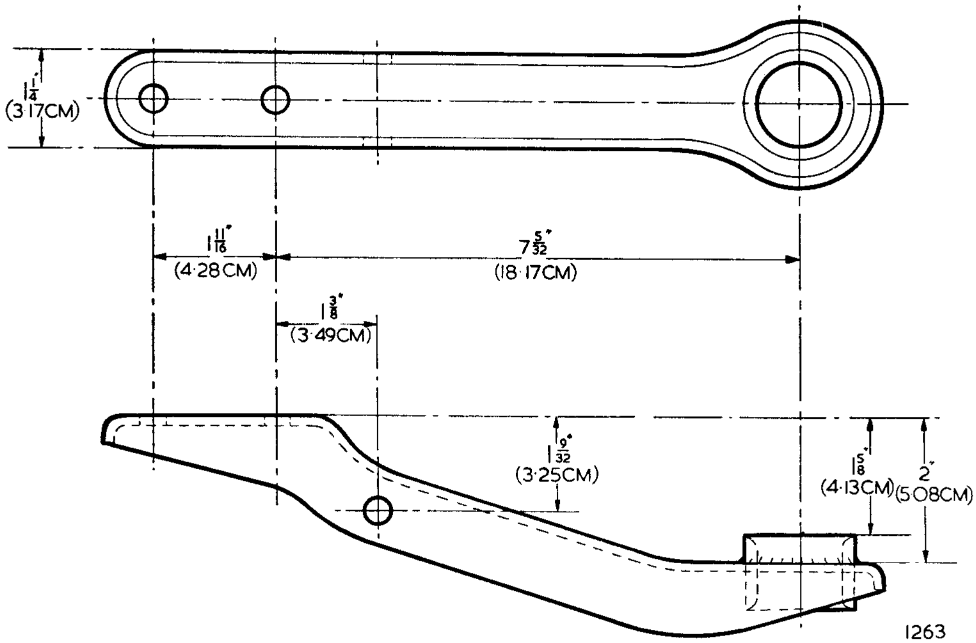

Fig. 23. Upper Wishbone Lever

Note: With effect from the undermentioned chassis numbers, the $1\frac{11}{16}''$ (4.28 cm) dimension is increased to $1\frac{3}{4}''$ (4.44 cm) and the $7\frac{5}{32}''$ (18.17 cm) dimension is reduced to $7\frac{1}{8}''$ (18.09 cm).

	R.H. Drive	L.H. Drive
2.4 litre with drum brakes	912622	943267
2.4 litre with disc brakes	912744	943288
3.4 litre	975232	990270

SECTION K

REAR SUSPENSION

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone	Code	Telegraphic Address
ALLESLEY 2121 (P.B.X.)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex 31/622

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INDEX

REAR SUSPENSION

DESCRIPTION

The rear springs are of the semi-elliptic cantilever type with rubber inserts between the ends of the spring leaves. At the rear end of the spring an eye is formed into which fits a rubber/steel bonded bush ; the spring eye is bolted to a bracket welded to the rear axle tube. The front end of the spring carries a circular rubber pad which bears directly on to an inclined plate attached to the chassis side member. The centre of the spring is fitted with rubber pads top and bottom which are clamped between plates in the box section at the rear of the chassis side member.

Torque arms with large rubber/steel bonded bushes at each end are fitted between brackets welded to the top of the rear axle and to a body cross-member at the back of the rear seat panel.

Lateral location of the suspension is by means of a rubber mounted panhard rod fitted between brackets on the rear axle and the right hand chassis side member.

Damping of the rear suspension is by telescopic hydraulic dampers located between brackets on the rear axle and the front of the luggage compartment floor. The dampers incorporate the bump and rebound stops which limit the movement of the rear suspension.

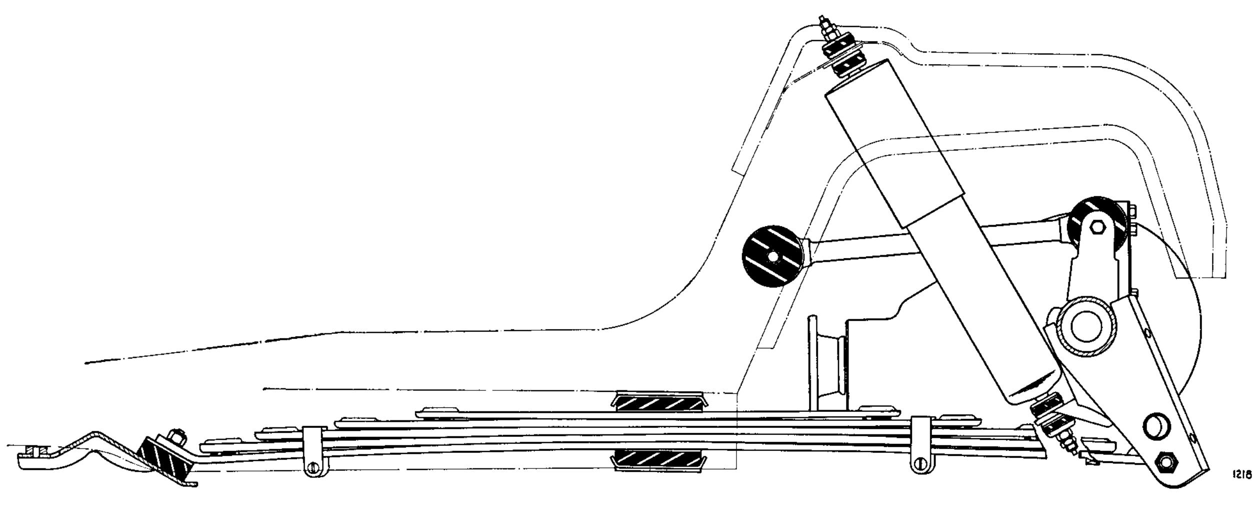


Fig. 1. Rear suspension arrangement.

DATA

	1st type C.10791	2nd type C.10791/1
Number of leaves	5	5
Width of leaves	2¼″ (57 mm.)	2¼″ (57 mm.)
Thickness of leaves		
—bottom three	9/32″ (7 mm.)	9/32″ (7 mm.)
—top two	¼″ (6.3 mm.)	¼″ (6.3 mm.)
—total thickness	1.11/32″ (34 mm.)	1.11/32″ (34 mm.)
Diameter of spring eye	1″ (25.4 mm.)	1″ (25.4 mm.)
Free Camber (see Fig. 2)	3.45″ (87.5 mm.)	3.45″ to 3.7″ (87.5 to 94 mm.)

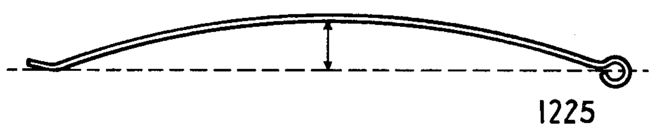


Fig. 2. Method of measuring free camber.

ROUTINE MAINTENANCE

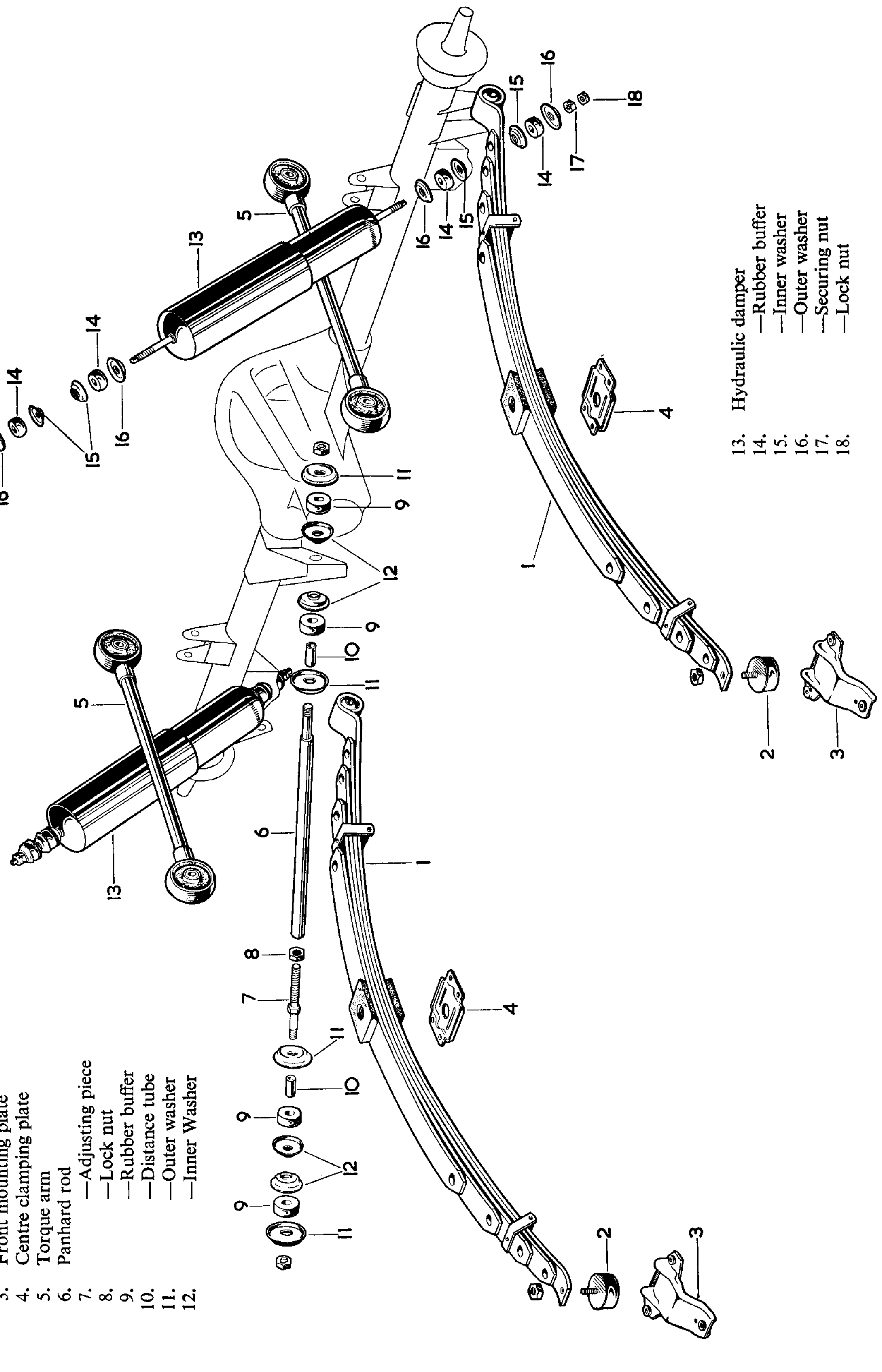
EVERY 5,000 MILES (8,000 KM.)

Rear Springs

Spray the rear spring leaves sparingly with penetrating oil keeping the oil away from the rubber mountings at the ends and centre of each spring.

Hydraulic Dampers

The hydraulic dampers are of the sealed type and no replenishment with fluid is necessary or provided for.



1. Rear road spring
2. Front mounting pad
3. Front mounting plate
4. Centre clamping plate
5. Torque arm
6. Panhard rod
7. —Adjusting piece
8. —Lock nut
9. —Rubber buffer
10. —Distance tube
11. —Outer washer
12. —Inner Washer
13. Hydraulic damper
14. —Rubber buffer
15. —Inner washer
16. —Outer washer
17. —Securing nut
18. —Lock nut

Fig. 3. Exploded view of rear suspension.

REAR SPRINGS

The rear road springs are rubber mounted at the front, centre and rear. When the springs are removed for any reason they should be examined for deterioration of the rubber mountings and replacement parts fitted if necessary.

When refitting the rear springs or torque arms, final tightening of the bolts securing the rubber/steel bonded bushes must be carried out with the car in its normal riding position, that is, with the full weight on the suspension. Omitting to carry out this procedure will result in undue torsional loading of the rubber bushes with possible premature failure.

Removal

Jack up the car under the rear axle and lower on to a stand placed under the chassis side member forward of the front mounting point of the rear spring. Insert a suitable wooden block between the body and the stand to distribute the load.

Place a bottle jack under the spring eye. Raise the jack to relieve the spring pressure on the centre mounting clamp plate. Detach the centre mounting clamp plate by removing the four nuts and bolts. Unscrew the nut and drift out the spring eye bolt and lower jack. The rear spring can now be withdrawn from the front mounting plate.

Dismantling

File off the peened over ends of the two spring clip setscrews. Hold the spring in a vice to compress the spring leaves.

Unscrew the spring clip setscrews and collect the distance pieces. Remove the nut and plain washer from the centre bolt. Drift out the centre bolt and detach the two rubber mountings ; collect the spacing washer from the recess in the main leaf.

Release the vice and separate the spring leaves ; collect the rubber inserts.

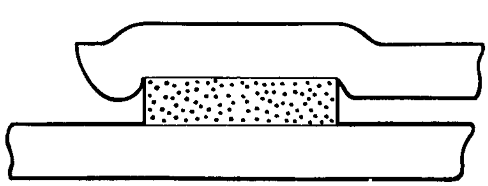


Fig. 4. Section through the end of a spring leaf showing the rubber insert.

Assembling

Assembling is the reverse of the dismantling procedure. Fit new setscrews to the spring clips, tighten fully and peen over the ends.

Refitting

Offer up the front end of the spring to the front mounting plate. Align the holes in the spring eye bush with the hole in the rear axle bracket. Fit the bolt but do not tighten nut. With a jack under the spring eye raise the rear spring until the centre mounting clamp plate can be fitted. With the full weight of the car on the road wheels tighten the spring eye bolt nut.

CENTRE MOUNTING RUBBERS

The centre mounting rubbers are bonded to plates which are attached to the top and bottom of the spring by the centre bolt.

Removal

Remove the rear spring as described above.

Hold the rear spring in a vice as close to the centre mounting rubbers as possible. Remove the nut and plain washer from the centre bolt. Drift out the centre bolt from the spring leaves when the two mounting rubbers can be detached from the spring. Collect the spacing washer from the recess in the main leaf.

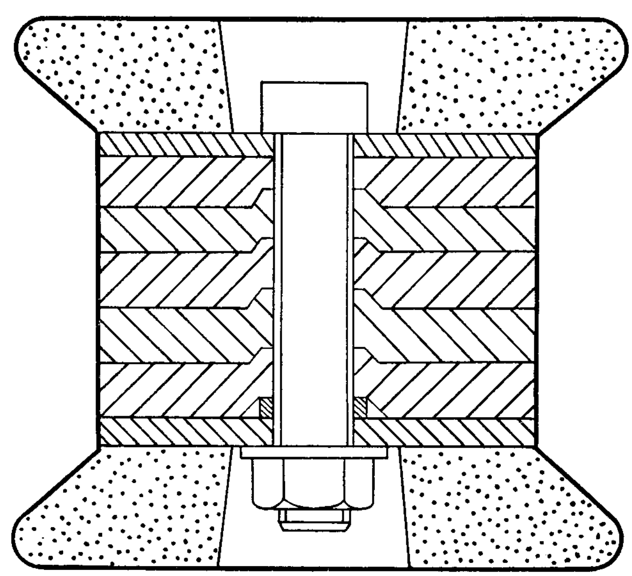


Fig. 5. Section through the spring centre bolt.

Refitting

Replace the rubber mountings at the top and bottom of the spring with the spacing washer interposed between the main leaf and the lower mounting. Refit the centre bolt, plain washer and nut ; tighten securely.

FRONT MOUNTING RUBBERS

Removal

Remove the rear road spring as described above. Unscrew the self-locking nut when the rubber mounting can be detached from the main leaf.

Refitting

Refitting is the reverse of the removal procedure.

TORQUE ARMS

Removal

Raise the car on a lift so that work can be carried out underneath the car.

Unscrew the self-locking nuts from the bolts securing the torque arms to the brackets on the rear axle and body ; remove the plain washers. Drift out the bolts and remove the torque arms.

Refitting

Refitting is the reverse of the removal procedure but the securing bolt nuts must only be tightened when the full weight of the car is on the road wheels.

SPRING EYE BUSH

Removal

Remove the rear road spring as described above.

Drift out or press out the rubber/steel bonded bush from the spring eye.

Refitting

Press the new bush into the spring eye ensuring that the bush projects from each side of the spring by an equal amount.

HYDRAULIC DAMPERS

The telescopic hydraulic dampers are of the sealed type with no provision for adjustment or " topping up " with fluid. Therefore, in the event of a damper being unserviceable a replacement unit must be fitted.

Before fitting a damper to a car it is advisable to carry out the following procedure to " bleed " any air from the pressure chamber that may have accumulated due to the damper having been stored in a horizontal position. Hold the damper in its normal vertical position with the shroud uppermost and make several short strokes (not extending more than halfway) until there is no lost motion and finish by extending the damper to its full length once or twice. Do not extend the damper fully until several short strokes have been made first. After the operation of "bleeding" the hydraulic dampers should be kept in their normal upright position until they are fitted to the car.

Removal

Open the luggage compartment lid and remove the floor covering when the top attachments of the hydraulic dampers will be visible. Remove the two nuts, inner and outer washers and rubber buffer from the top of the damper.

Raise the car on a lift so that work can be carried out underneath the car.

Remove the two nuts, the inner and outer washers and the rubber buffer from the damper attachment bracket on the rear axle.

Compress the hydraulic damper until it can be removed from its mountings and collect the remaining washers and rubber buffers.

Refitting

Refitting is the reverse of removal procedure.

PANHARD ROD

Removal

Raise the car on a lift so that work can be carried out underneath the car. Remove the securing nut at each end of the panhard rod and withdraw the rubber buffers and washers. Loosen the lock nut and screw along to the end of the threaded adjusting piece. Screw the adjusting piece into the panhard rod tube by means of the flats provided until the panhard rod can be disengaged from its mounting brackets.

Refitting

Screw the adjusting piece into the panhard rod tube. Fit one rubber buffer with a distance piece and inner and outer washers at each end of the panhard rod. Offer up the panhard rod to its mounting brackets and screw out the adjusting piece until the rod is retained in its brackets.

Ensure that the full weight of the car is on the wheels.

Fit the inner washer, rubber buffer and outer washer to the bracket at the rear axle end ; fit the nut but do not tighten fully.

Fit the inner washer, rubber buffer and outer washer at the body bracket end ; hold the adjusting piece securely with a spanner on the flats provided and tighten the securing nut.

Adjustment

Place a straight edge across one rear tyre and check the distance to the flange of the chassis side member at the point at which the rear spring centre clamping plate is bolted ; repeat for the other side. The point of the chassis side member flange at which the dimension should be taken is between the two bolts which secure the rear spring centre clamping plate.

The dimension at each side (A, Fig. 6) must be the same. If they are not, adjust the length of the panhard rod until the two dimensions are equal by rotating the panhard rod tube with a pair of grips. Fully tighten the securing nut at the rear axle bracket end and re-check the adjustment. Finally, tighten the nut locking the adjusting piece to the panhard rod tube.

Note: The rear tyres must be of the same type and set at the same pressure when carrying out this check.

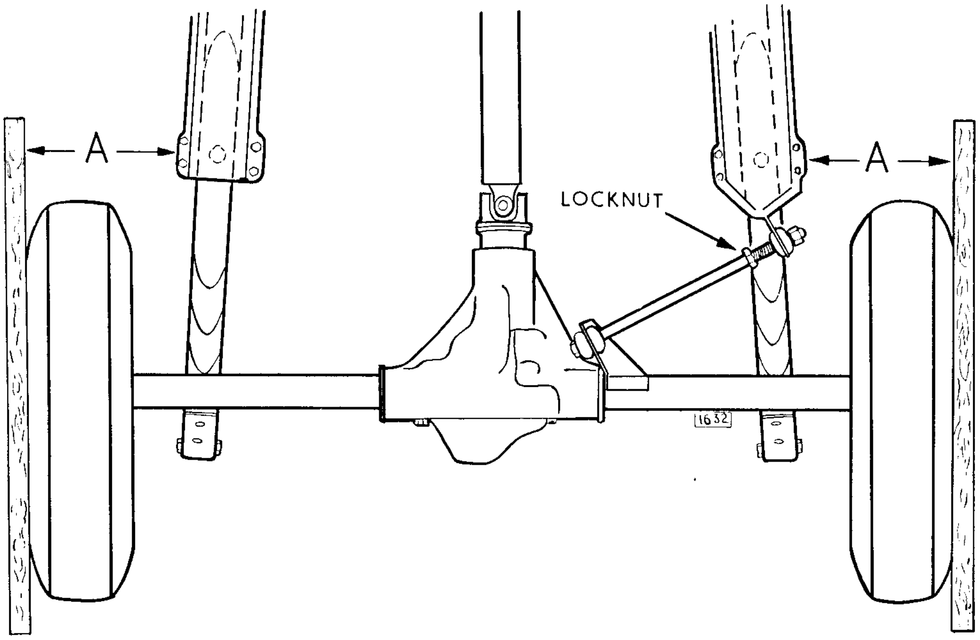


Fig. 6. Panhard rod adjustment. Dimension "A" must be the same at both sides.

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SECTION L

BRAKES

2·4 litre and 3·4 litre models

Additional information covering changes that have taken place since the issue of this section is contained in a separate supplement, "Supplement to Section L - Brakes"

ISSUED BY

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COVENTRY 27677 (P.B.X.)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex. 31/622

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Drum Brakes

INDEX *(continued)*

Disc Brakes

The $5\frac{1}{2}''$ Vacuum Servo Unit

The $6\frac{7}{8}''$ Vacuum Servo Unit

BRAKING SYSTEMS

Either of two braking systems may be fitted to the 2.4 litre and 3.4 litre models.

(i) The Lockheed " Brakemaster " system which has drum type brake assemblies.

(ii) The Dunlop system which has disc type brake assemblies.

Both systems are vacuum - servo assisted by one of two types of Lockheed servo units. These are dealt with individually at the end of this section.

The $5\frac{1}{2}''$ type servo unit was fitted only to cars with drum brakes up to, but not including, chassis numbers :—

	Right-hand Drive	Left-hand Drive
2.4 Litre - - -	909061	942677
3.4 Litre - - -	971732	987406

The $6\frac{7}{8}''$ type servo unit is fitted to all cars with disc brakes and also to cars fitted with drum brakes on and after the above chassis numbers.

BRAKES
(Drum type)

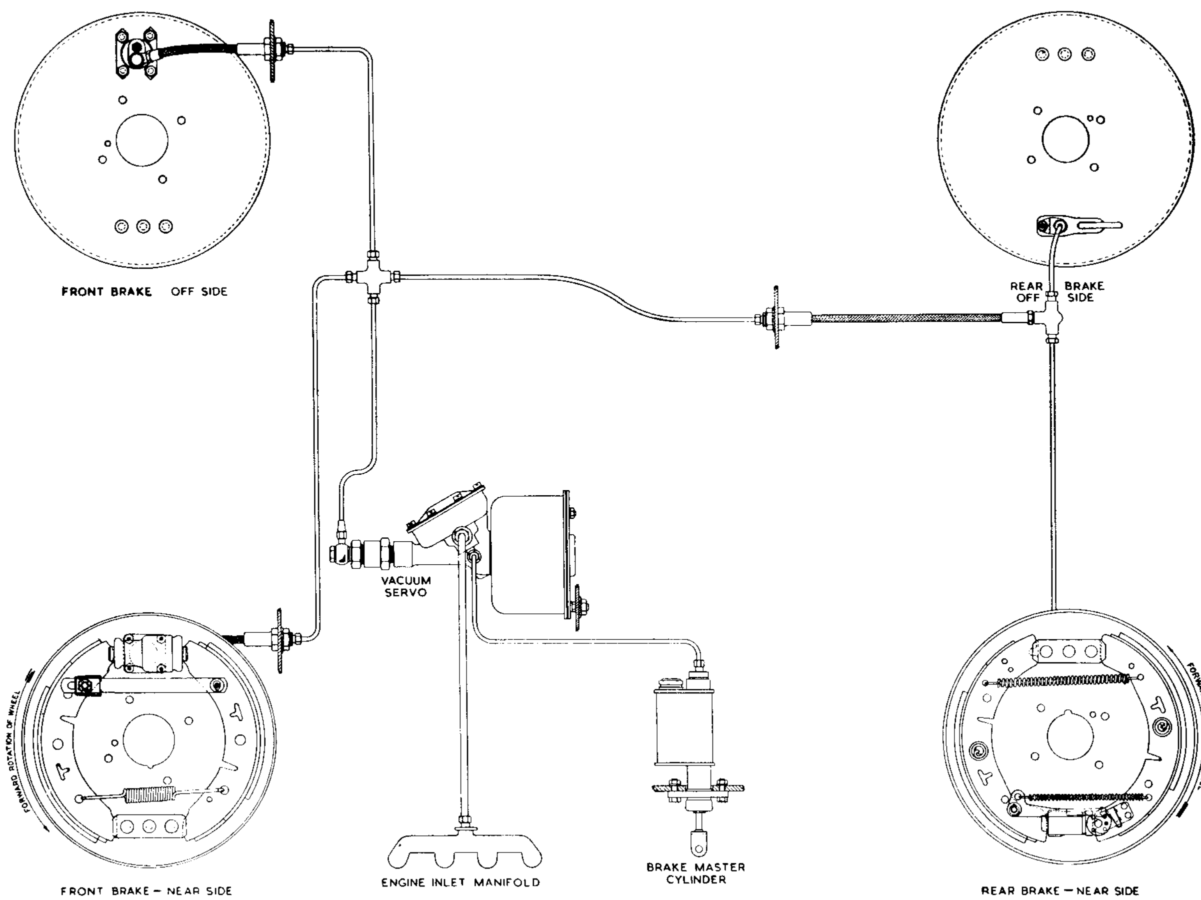


Fig. 1. Layout of system.

DESCRIPTION

The Lockheed " Brakemaster " system comprises a master cylinder, a vacuum - servo unit and automatically adjusted front and rear brake assemblies. The brake assemblies are of the leading and trailing shoe type and are designed to provide stable performance under all conditions. Each front brake incorporates a differential-area wheel cylinder arranged in such a way that the inherent inefficiency of the trailing shoe is counterbalanced due to the fact that the wheel-cylinder applies greater thrust to this shoe than to the leading shoe. Since, therefore, the work is shared equally by the two shoes in each front brake, lining wear is also substantially equal.

The master cylinder pressure used to apply the brakes is augmented by the servo unit (which derives its power from the vacuum existing in the inlet manifold of the engine).

As a safeguard against engine stall or other form of vacuum failure, the system has been so designed as to enable brake applications by unassisted foot pressure on the brake pedal should the need arise.

DATA

Make	Lockheed " Brakemaster "
Brake drum diameter	$11\frac{1}{8}''$ (28.25 cm.)
Brake linings—length	$8\frac{1}{2}''$ (21.6 cm.)
Brake linings—width	$2\frac{1}{4}''$ (57.1 mm.)
Brake linings—thickness	$\frac{1}{4}''$ (6.3 mm.)
Number of rivets per shoe	12
Size of rivets	$\frac{9}{64}''$ (3.6 mm.)
Master cylinder—diameter of bore	.75″ (19.05 mm.)
Front wheel cylinder—diameter of bore (small end)	.80″ (20.32 mm.)
Front wheel cylinder—diameter of bore (large end)	1.25″ (31.75 mm.)
Rear wheel cylinder—diameter of bore	.6875″ (17.46 mm.)
Brake linings—material (see note)	Ferodo MS3.
Brake linings—identification	2 blue and 2 yellow paint stripes on edge of lining.

Note : On 2.4 litre cars only, prior to Chassis Numbers 906508 Right-hand drive and 941994 Left-hand drive, Ferodo DM52 brake linings were fitted. This type of lining is identified by 5 blue and 5 yellow paint stripes on the edge of the lining. It is permissible to fit MS3 linings in place of the DM52 type, but the linings must be fitted to all four brakes.

ROUTINE MAINTENANCE

EVERY 2,500 MILES (4,000 KM.)

Handbrake Cable

Lubricate the two grease nipples (one nipple on cars fitted with scissors type handbrake compensator) on the handbrake cables with the recommended grade of lubricant. The nipples are accessible from underneath the car, one on each side of the propeller shaft.

Brake Fluid Level

The brakes are operated hydraulically from a master cylinder situated at the rear of the engine compartment on the driver's side of the car. The hydraulic fluid is stored in a reservoir combined with the master cylinder and it is **important** that the level does not fall below the bottom of the filler neck.

Brake Shoe Adjustment

Both the front wheel and rear wheel brakes are so designed that no manual adjustment for brake shoe lining wear is necessary, as this automatically takes place when the footbrake is applied.

Handbrake Adjustment (refer to Fig. 18)

(Cars fitted with yoke type compensator)

The automatic adjustment of the rear brakes will keep the handbrake in correct adjustment and no attention should be necessary. If, however, an excessive amount of handbrake lever travel is obtained, a means of adjustment is provided at the front end of the handbrake cable. Adjustment is effected by first fully releasing the handbrake lever and rotating the hexagon nut clockwise until all the slack is taken out of the cable, but ensuring that it is not under tension.

Finally, jack up each rear wheel in turn, rotate the wheel with the handbrake off and ensure that the brakes are not binding.

Handbrake Adjustment (refer to Fig. 19)

(Cars fitted with scissors type compensator)

The automatic adjustment of the rear brakes will keep the handbrake in correct adjustment and no attention should be necessary. If, however, an excessive amount of handbrake lever travel is obtained, a means of adjustment is provided at the front end of the handbrake cable. To adjust, first release the handbrake fully; remove the clevis pin securing the fork end to the operating link. Slacken the locknut and rotate the fork end in the desired direction so that with the clevis pin refitted there is no slack in any of the three cables, but ensuring that they are not under tension.

Finally, jack up each rear wheel in turn, rotate the wheel with the handbrake off and ensure that the brakes are not binding.

EVERY 5,000 MILES (8,000 KM.)

Brake Linings

At the recommended intervals remove the road wheels and brake drum and clean out any dust or dirt from the drums and brake assemblies.

At the same time examine the linings for the amount of wear; if the rivet heads are close to the friction face of the linings, replacement brake shoe assemblies or new linings should be fitted.

Brake Servo Air Cleaner ($6\frac{7}{8}''$ servo unit only)

At the recommended intervals the brake servo air cleaner, which is attached to the right-hand wing valance, should be removed and washed in **methylated spirits.** After drying out re-lubricate the wire mesh with **brake fluid.**

RECOMMENDED BRAKE FLUIDS

Preferred Fluid

Lockheed Super Heavy Duty Brake Fluid.

Alternative Fluids

Castrol/Girling Crimson Brake Fluid.
Dunlop Disc Brake Fluid.

In countries where the above fluids are unobtainable use only a recognised brake fluid guaranteed to conform to the S.A.E. Specification 70 R.3.

In the event of deterioration of the rubber seals and hoses due to the use of an incorrect fluid all the seals and hoses must be replaced and the system thoroughly flushed and refilled with one of the above fluids.

BLEEDING THE SYSTEM

Bleeding (*i.e.* expelling air) is not a routine operation and should be necessary only when some portion of the hydraulic equipment has been disconnected or when fluid has been drained off. The method detailed for bleeding the brake system is as follows :—

(1) The engine must not be running.

(2) Fill the brake master cylinder supply tank with brake fluid and keep at least a third full throughout the operation, otherwise air will be drawn in, necessitating a fresh start.

(3) Observe the position of the bleeder screws in the front brake assemblies ; if they are on the vertical centre-line, bleeding will be effected in the normal manner (see paras. 4-6). If, however, they are not on that centre-line (as is the case with early models), it will first be necessary to remove the front brake drums, back-off the adjustment and clamp the shoes in some manner to prevent the wheel-cylinder pistons moving outwards when the brake pedal is depressed. To back-off the adjustment, remove the circlip securing the adjuster bar at one end, prise the bar off the anchor pin and allow the pull-off spring to close the pistons. Ensure that the brake shoes are clamped before depressing the brake pedal.

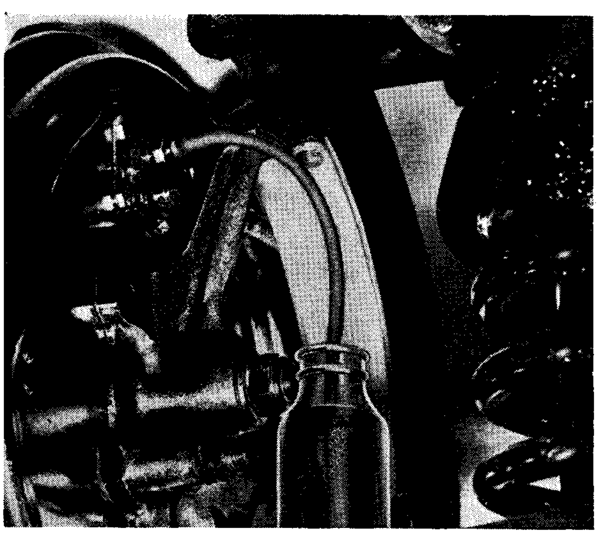


Fig. 2. Bleeding a front brake.

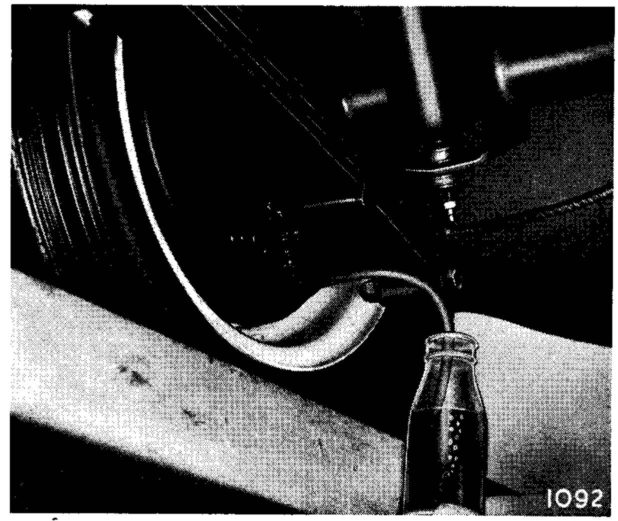


Fig. 3. Bleeding a rear brake. (On some brake assemblies the bleeder screw is at the top of the backplate).

(4) Attach a rubber tube to the bleeder screw on one of the wheel cylinders and allow the free end to be submerged in a little brake fluid in a clean glass jar. Open the bleeder screw one complete turn.

(5) Depress the brake pedal slowly, allowing it to return unassisted, repeating this pumping action with a slight pause between each operation. Watch the flow of fluid in the jar and when all air bubbles cease to appear, hold the pedal down firmly and securely tighten the bleeder screw.

(6) Repeat at all wheel cylinders. On completion of the bleeding procedure, replenish the master cylinder tank.

(7) If it was found necessary to remove the front brake drums, etc. (as detailed in para. 3), remove the clamps from the shoes and re-connect the adjuster bars to the anchor pins, securing them with the circlips ; refit the brake drums and the road wheels and pump the brake pedal a few times until the normal travel is restored.

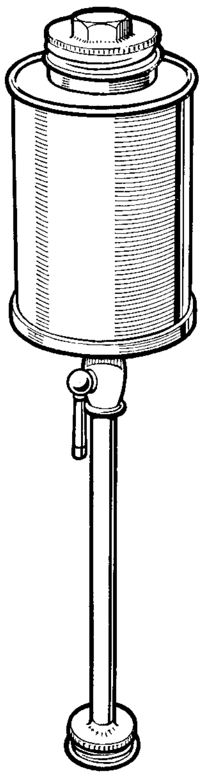


Fig. 4. Showing an auxiliary tank which can be made up and used to reduce the replenishment periods when bleeding the brakes. The pipe is soldered into a clutch or brake master cylinder filler cap (Part No. 6437) which can then be screwed on to the master cylinder during the bleeding operation.

BRAKE OVERHAUL—PRECAUTIONS

Should it be found necessary to dismantle any part of the braking system (*i.e.*, master cylinder vacuum servo or wheel cylinders) the operation must be carried out under conditions of scrupulous cleanliness. Clean the exterior of the unit before removal from the vehicle and dismantle on a bench covered with a sheet of clean paper. Do not swill a complete unit, after removal from the vehicle, in paraffin, petrol or trichlorethylene (trike) as this would ruin the rubber parts and, on dismantling, give a misleading impression of their original condition. Do not handle the internal parts, particularly rubbers, with dirty hands. Place all metal parts in a tray of clean brake fluid to soak ; afterwards dry off with a clean fluffless cloth, and lay out in order on a sheet of clean paper. Rubber parts should be carefully examined and if there is any sign of swelling or perishing they should be renewed ; in any case it is usually good policy to renew **all** rubbers. The main castings may be swilled in any of the normal cleaning fluids, but all traces of the cleaner must be dried out before assembly. In the case of the master cylinder, make sure that the by-pass port is clear by probing with a bent piece of wire not exceeding .018 in. diameter. If the by-pass port is clogged the brakes will drag due to pressure building up in the system.

All internal parts should be dipped in clean brake fluid and assembled wet, as the fluid acts as a lubricant. When assembling the rubber parts use the fingers only.

Stores departments should exercise special care in handling brake parts to ensure that no damage is caused which would affect their correct functioning. Rubber parts should be stored in a cold, dark place well removed from any fumes.

FLUSHING THE SYSTEM

Should the fluid in the system become thick or " gummy " after many years in service, or after a vehicle has been laid up for some considerable time, the system should be drained, flushed and refilled. It is recommended that this should be carried out every five years.

Pump all fluid out of the hydraulic system through the bleeder screw of each wheel cylinder. To each of the brake bleeder screws in turn connect one end of a rubber tube, and allow the other end to fall into a container, slacken the screw one complete turn and pump the brake pedal by depressing it quickly and allowing it to return without assistance ; repeat, with a pause in between each operation, until no more fluid is expelled. Discard the fluid extracted.

Fill the supply tank with industrial methylated spirit and flush the system as described above. Keep the supply tank replenished until at least a quart of spirit has passed through each of the bleeder screws.

Remove the master cylinder and pour off any remaining spirit. Refit the master cylinder, refill with clean brake fluid and bleed the system.

NOTE.—If the system has been contaminated by the use of mineral oil, etc., the above process will not prove effective. It is recommended that the various units, including the pipe lines, be dismantled and thoroughly cleaned and that all rubber parts, including flexible hoses, be renewed. The contaminated fluid should be destroyed immediately.

FLEXIBLE HOSES

In some cases the cause of faulty brakes may be traced to a choked flexible hose. Do not attempt to clear the obstruction by any means except air pressure, otherwise the hose may be damaged. If the obstruction cannot be cleared the hose must be replaced by a new one.

Removal

To renew a flexible hose, adopt the following procedure :—

Unscrew the tube nut (B) from the hose union (A), then unscrew the locknut (C) and withdraw the hose from the bracket. Disconnect the hose at the other end.

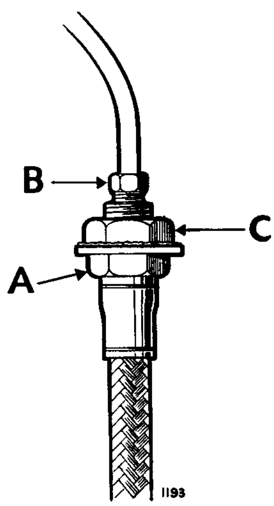


Fig. 5. Flexible hose removal.

Refitting

When refitting a hose, first attach it to the wheel cylinder (in the case of front brakes), the three-way connection (in the case of rear brakes), using a new gasket. Ensure that the hose is not twisted or " kinked " (this is MOST IMPORTANT), then pass the hose union (A) through the bracket and, whilst holding the union with a spanner to prevent the hose from turning, fit the locknut (C) and the shakeproof washer ; connect up the pipe by screwing in the tube nut (B).

THE MASTER CYLINDER

The brake system master cylinder consists mainly of a tank and barrel assembly (3), the former surrounds the latter and is secured by soldering ; at one end of the barrel a fixing flange is mounted, and this is secured in the same manner. The tank is fitted with a filler cap (1) which incorporates a baffle and screws down against a seal (2).

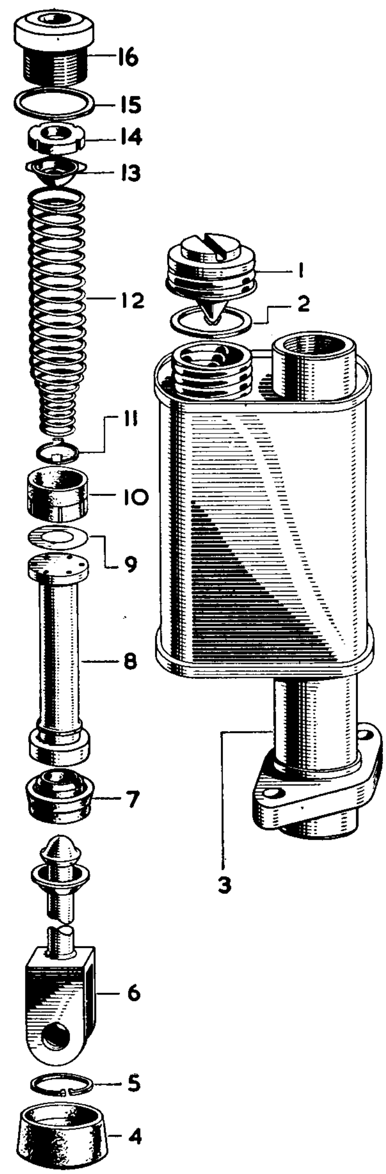


Fig. 6. Exploded view of the master cylinder.

A piston (8) is contained within the barrel, and has a rubber main cup (10) spring-loaded against its inner end ; between the cup and the piston a thin washer (9) is interposed to prevent the cup from being drawn into the small feed holes drilled around the piston head. The outer end of the piston carries a rubber secondary cup (7) and is formed with a depression to receive the spherical end of a push-rod (6) which carries a piston stop and is retained by a circlip (5). A rubber boot (4), through which the push-rod passes, is fitted on to the barrel to prevent the intrusion of dirt and moisture.

At the end opposite to the push-rod, an end plug (16) screws down against a gasket (15) ; this plug forms the outlet connection and its inner face provides a seat for a rubber washer (14) against which a check valve assembly (13) is loaded by the spring. The check valve comprises a dome-shaped metal body which is drilled with a number of holes and has a rubber seal riveted to its concave side.

Principle of Operation

Depressing the brake pedal causes the push-rod to thrust the piston along the bore of the barrel, and the fluid thus displaced lifts the seal away from the check valve body and passes to the brake wheel cylinders via the vacuum servo ; the servo boosts the pressure of this fluid to augment the driver's effort in applying the brakes.

Upon the removal of the load from the brake pedal, the return spring thrusts the piston back against its stop faster than fluid is able to return from the wheel cylinders ; this creates a depression in the master cylinder which draws the edge of the main cup away from the head of the piston and allows fluid from the tank to flow through the feed holes thus uncovered to make up the temporary deficiency. Meanwhile fluid returning from the wheel cylinders, being under load from the brake shoe pull-off springs, lifts the check valve away from its seat and re-enters the master cylinder.

When the piston is fully back against its stop, the main cup uncovers a small by-pass port in the barrel, and this allows the release of excess fluid to the tank, thus permitting the pull-off springs to return the brake shoes to the fully " off " position ; the by-pass port also compensates for contraction or expansion of the fluid, due to changes in temperature, allowing fluid to be drawn into or escape from the system. Should this port become blocked, the excess fluid would be unable to escape and the brakes would consequently drag.

The purpose of the check valve is to prevent the re-entry into the master cylinder of fluid pumped into the line during the bleeding operation ; this ensures a fresh charge of fluid at each stroke of the brake pedal and a complete purge of air from the system.

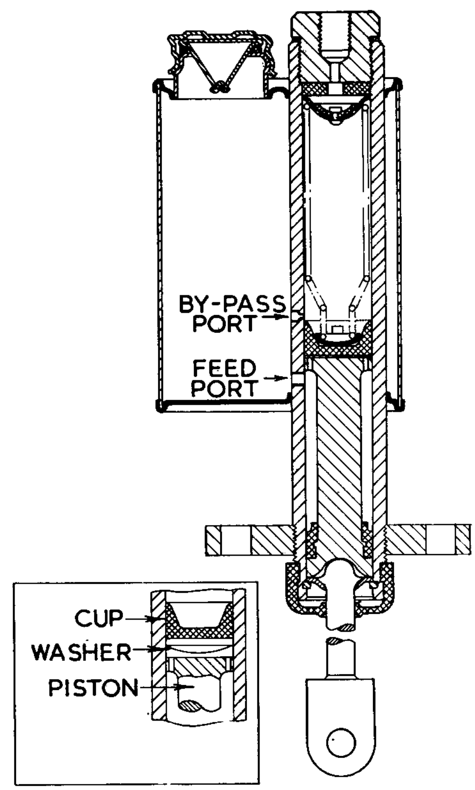


Fig. 7. Sectioned view of the master cylinder.

Removal

The brake master cylinder is identified by a plain circular or hexagon end plug ; in the instance of the clutch master cylinder this plug is grooved.

Disconnect the outlet pipe from the end of the master cylinder, detach the push-rod from the brake pedal linkage, unscrew the fixing bolts and detach the master cylinder from the vehicle. Remove the filler cap (1), drain the fluid into a clean container, and replace the cap.

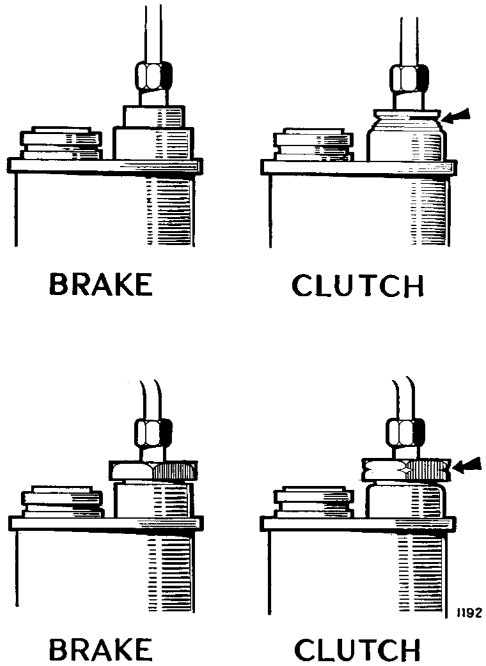


Fig. 8. A clutch master cylinder can be distinguished from a brake master cylinder by the groove around the end cap.

Dismantling

(1) Detach the rubber boot (4) from the end of the barrel, and move the boot along the push-rod. Depress the push-rod to relieve the spring load from the circlip (5), remove the circlip and withdraw the push-rod, the piston (8), the piston washer, the main cup (10), the spring, the check valve (13) and the rubber valve washer (14). The end plug (16) should not normally need to be removed from the barrel.

(2) Remove the secondary cup (7) by stretching it over the end of the piston.

Assembling

(1) If previously removed, fit the end plug (16) and a new gasket (15).

(2) Insert the rubber valve washer (14) into the bore and push down until it seats squarely against the end plug.

(3) Fit the check valve (13) into the large end of the spring, and the spring retainer (11) on to the small end ; if the retainer is new the ears are to be bent over to secure it on the spring.

(4) Insert the spring, valve leading, into the barrel. Follow up with the main cup (10), lip leading, taking care not to turn back or buckle the lip.

(5) Insert the piston washer (9), so that the curved edge is towards the cup.

(6) Using the fingers only, stretch the secondary cup (7) on to the piston, with the small end towards the head (*i.e.*, the drilled end) and with the groove engaging the ridge ; gently work round the cup, with the fingers, to ensure correct bedding.

(7) Insert the piston into the barrel, with the head innermost.

(8) If previously removed, stretch the rubber boot (4) on to the push-rod, with the open end of the boot towards the spherical end of the push-rod.

(9) Offer up the push-rod to the barrel, push inwards and secure the piston stop, which is on the push-rod, by fitting the circlip (5) at the end of the bore ; it is MOST IMPORTANT that the circlip be correctly fitted in its groove. Stretch the large end of the boot on to the end of the barrel and into its correct position.

(10) Fill the tank with clean Lockheed Brake Fluid to within half-an-inch of the filler cap orifice and refit the filler cap (1) together with the seal (2) ; ensure that the filler cap is securely tightened, using a coin. With the master cylinder upright, filler cap at the top, test by pushing the push-rod and piston further into the bore and allowing to return unassisted ; after one or two appplications fluid should flow from the outlet connection.

Refitting

Secure the master cylinder to the vehicle by fitting the fixing bolts through the flange. Connect the pipe to the outlet connection, the push-rod to the pedal linkage, and bleed the system. Check for leaks by applying a firm pressure to the brake pedal and inspecting the " line " and connections.

THE FRONT BRAKE ASSEMBLY

The front brake assembly is of leading and trailing shoe design, which makes it relatively insensitive to frictional changes in the brake linings and gives a highly stable brake with very good anti-fade properties.

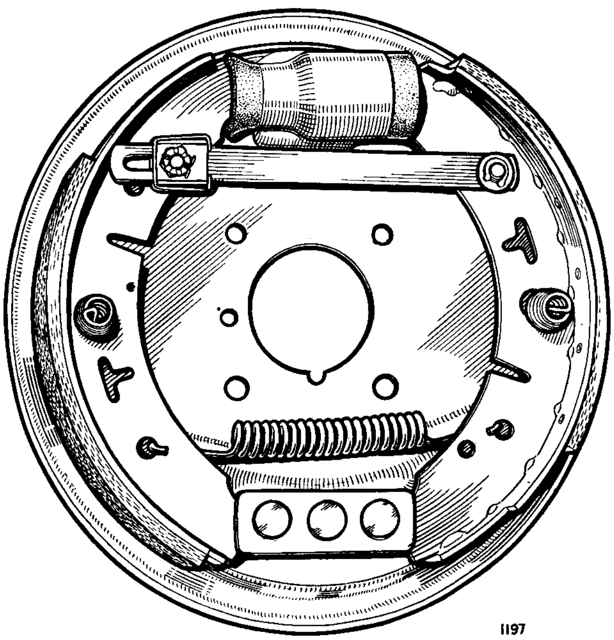


Fig. 9. The left-hand front brake assembly (the right-hand assembly is assembled the opposite way round).

The brake shoes are carried on a backplate to which a double piston wheel cylinder and an abutment are attached, the former by bolts and the latter by riveting. The wheel cylinder pistons are of different diameters, and are slotted to provide a location for the toe of the leading shoe (which is operated by the smaller piston) and the heel of the trailing shoe (which is operated by the larger piston) ; the opposite ends of the shoes are located in slots in the abutment ; as both shoes are free to float in the slots they are able automatically to centralise themselves when applied. For a given effort on the brake pedal, the load which the larger piston applies to the trailing shoe is approximately 2½ times that which the smaller applies to the leading shoe ; in this way, the drag which the shoes impose on the brake drum is more equally balanced, giving equal wear on the linings.

An adjuster bar links the shoes together and is carried on an anchor pin in the trailing shoe and a bolt in the leading shoe. The bolt passes through a slot in the bar and retains a friction pad and a pad plate on each side of the bar ; these parts are retained by a castle nut and are under load from a spring fitted on the bolt ; a ratchet spring surrounds the friction pad assembly and engages teeth on the adjuster bar. At the other end of the bar, the anchor-pin passes through a hole which is of larger diameter than the pin ; the clearance between the pin and the hole is utilised to create an adequate running clearance between the brake shoe linings and the drum when the brakes are released and the pull-off spring, which is hooked into both shoes, returns the shoes to the " off " position.

OPERATION OF ADJUSTMENT MECHANISM

When the brakes are " off," the anchor pin in the trailing shoe is abutting the inner edge of the hole in the adjuster bar through which it passes.

Upon applying the brakes, the initial movement of the brake shoes takes up the clearance between the anchor pin and the outer edge of the hole in the bar and brings the shoe linings into contact with the drum. Movement of the shoes beyond this point causes the anchor pin to drag the slotted end of the adjuster bar through the friction pads, the grip of which is sufficient to prevent the load of the pull-off spring from returning the bar through them when the brakes are released. Throughout the life of the linings the overall diameter of the brake shoes gradually increases to maintain the linings close to the drum and so compensate for wear.

When the brakes are released, the load of the pull-off spring moves the shoes away from the drum sufficiently to take up the clearance between the anchor pin and the hole through which it passes, until once more the pin is abutting the inner edge of the hole,

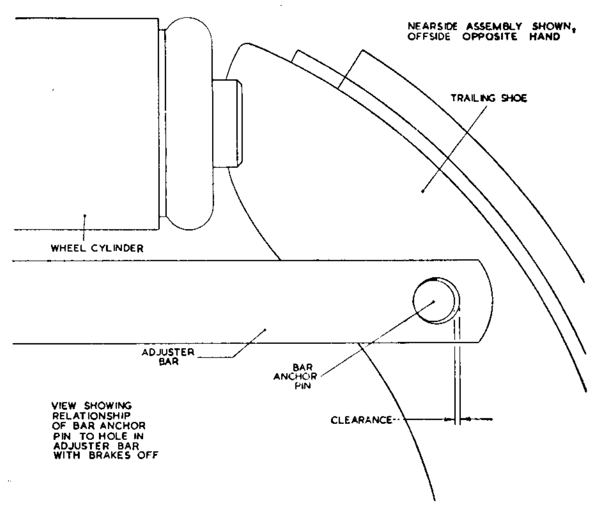


Fig. 10. Showing the clearance between the bar anchor pin and the hole in the adjuster bar.

thus creating an adequate running clearance between the linings and the drum.

The ratchet spring is fitted as a follow-up device and is a safety factor in the event of oil being present on the friction pads which might otherwise allow the adjuster bar to slip back ; the adjustment, however, if dependent upon the ratchet spring alone, would be much coarser owing to the formation of the ratchet teeth.

REMOVING THE BRAKE SHOES AND FRONT WHEEL CYLINDER

Apply the handbrake, jack up the front of the vehicle and remove the road wheel and the brake drum.

Remove the circlip and the castle nut securing the adjuster bar, and detach the bar from the shoes ; remove the pad plates and the friction pads and disengage the ratchet spring from the adjuster bar, exercising caution to avoid straining the spring.

Disengage the toe of the leading shoe from the wheel cylinder piston and pull the heel of the shoe out of its slot in the abutment ; on releasing the load on the pull-off spring the trailing shoe will fall away. It should not normally be necessary to remove the anchor pin from the trailing shoe.

Detach the flexible hose from the frame connector and then unscrew the hose from the banjo fitting in the wheel cylinder. (On earlier models the hose screws directly into the wheel cylinder.) Unscrew the banjo bolt and remove the banjo and the two gaskets. Remove the wheel cylinder fixing bolts and withdraw the cylinder from the backplate.

REFITTING THE FRONT WHEEL CYLINDER AND BRAKE SHOES

Offer up the wheel cylinder to the hole in the backplate, with the **smaller** rubber boot pointing in the direction of forward rotation of the wheel, and secure with the four bolts and the two locking plates ; bend the tabs of the locking plates up to the heads of the bolts.

Place the large gasket on the banjo bolt, followed by the banjo and the smaller gasket, and screw the banjo bolt into the inboard connection in the wheel cylinder ; screw the hose into the banjo using a new gasket (on earlier models the hose screws directly into the wheel cylinder) and connect the other end of the hose to the frame connector (holding the union with a spanner to prevent the hose from twisting whilst fitting the locknut). If previously removed, refit the bleeder screw in the other connection in the wheel cylinder.

It will be noticed that the linings on the brake shoes are shorter in length than the platforms to which they are attached ; the end at which the greater portion of liner platform is exposed is known as the " toe," the other end being called the " heel." When installed on the backplate, the toe of the leading shoe is to be adjacent to the smaller rubber boot on the wheel cylinder, whilst the toe of the trailing shoe engages a slot in the abutment.

Lay the shoes on the bench, with the toe of the leading facing the heel of the trailing. If, previously,

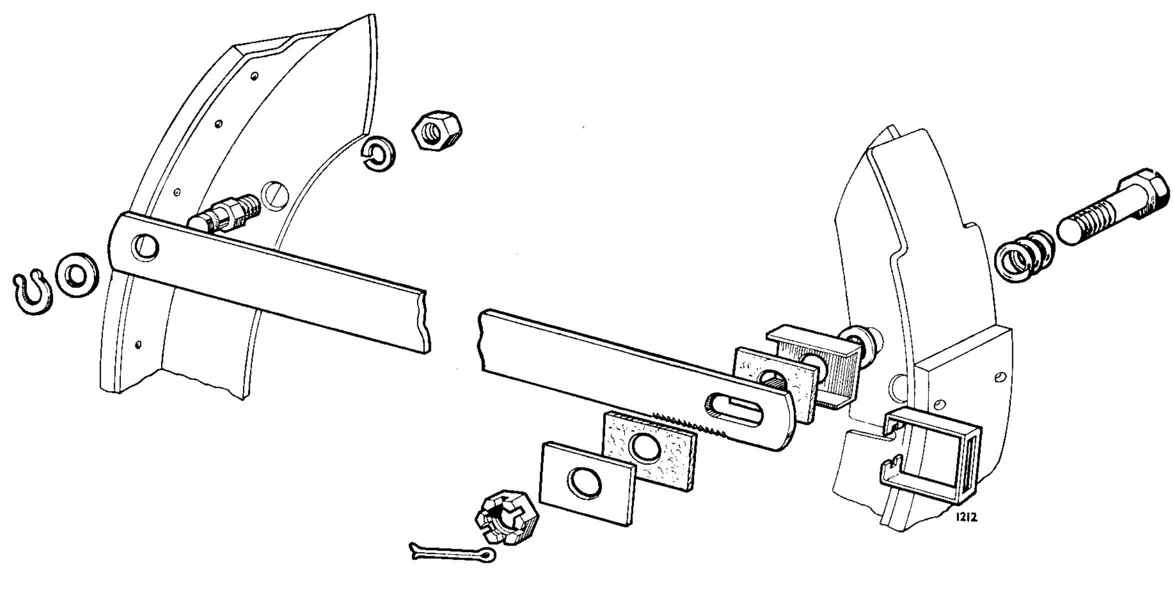


Fig. 11. Adjuster bar arrangement (right-hand brake illustrated).

the anchor pin was removed from the trailing shoe, it should now be refitted in the hole nearer to the heel, with the hexagon on the upper surface of the shoe ; secure with the nut and the spring washer. Place the small spring on the bolt and pass the bolt through the hole nearer to the toe of the leading shoe, with the head on the under surface of the shoe ; loosely fit the castle nut. Hook the pull-off spring into the appropriate holes, so that it is on the underside of the shoes.

Offer up the shoes to the backplate, with the pull-off spring innermost, and engage the tips of the shoes with their respective slots in the wheel cylinder pistons and in the abutment.

Engage the ratchet spring with the toothed end of the adjuster bar, with the open end of the spring towards the centre of the bar. Locate a friction pad between the sides of the inner pad plate, and position these parts within the ratchet spring, on the underside of the adjuster bar (the underside can be identified by remembering that, when the bar is installed on the shoes, the teeth are towards the centre of the brake). It will be noticed that the holes through the friction pads and pad plates are off centre ; these parts are to be fitted with the hole nearer to the closed end of the ratchet spring.

Position the other friction pad and the outer pad plate (the flat one) within the ratchet spring, on the upper side of the adjuster bar ; remove the nut from the bolt in the leading shoe and, after fitting the washer, engage the adjuster bar and friction pad assembly with the bolt, loosely refit the nut.

Ease the ratchet spring away from the teeth on the adjuster bar and adjust the position of the bar within the spring so that the anchor pin in the trailing shoe can enter the hole in the bar ; the pin must abut the inner edge of the hole. Fit the washer and the circlip to the anchor pin. Tighten the castle nut hard down, until the spring is solid, and then slacken back two flats (or one-third of a turn).

The operation of the adjuster should now be checked by pulling on the heel of the trailing shoe so that the anchor pin moves to the outer edge of its hole ; when released it is essential that the shoe returns promptly and unassisted to the fully " off " position. At the satisfactory conclusion of this check, secure the castle nut by fitting the split pin.

Fit the brake drum and the road wheel, bleed the system and pump the brake pedal a few times until the normal travel is restored.

FRONT WHEEL CYLINDER

The front wheel cylinder consists mainly of a body (5) bored to accommodate two different sized pistons (6, 10), the larger of these houses a piston end (2) which, like the smaller piston, is slotted at its outer end.

A rubber cup (7) is loaded against the inner face of the larger piston by a cup filler (8) and a taper spring (9) ; the smaller piston is recessed to receive the smaller end of the spring and is also grooved to carry a tapered rubber seal (11). The larger piston, cup and cup filler each has a hole in its centre to receive the stem of a piston pin (4) which is loaded by a spring (3) and retained in the piston by the piston end.

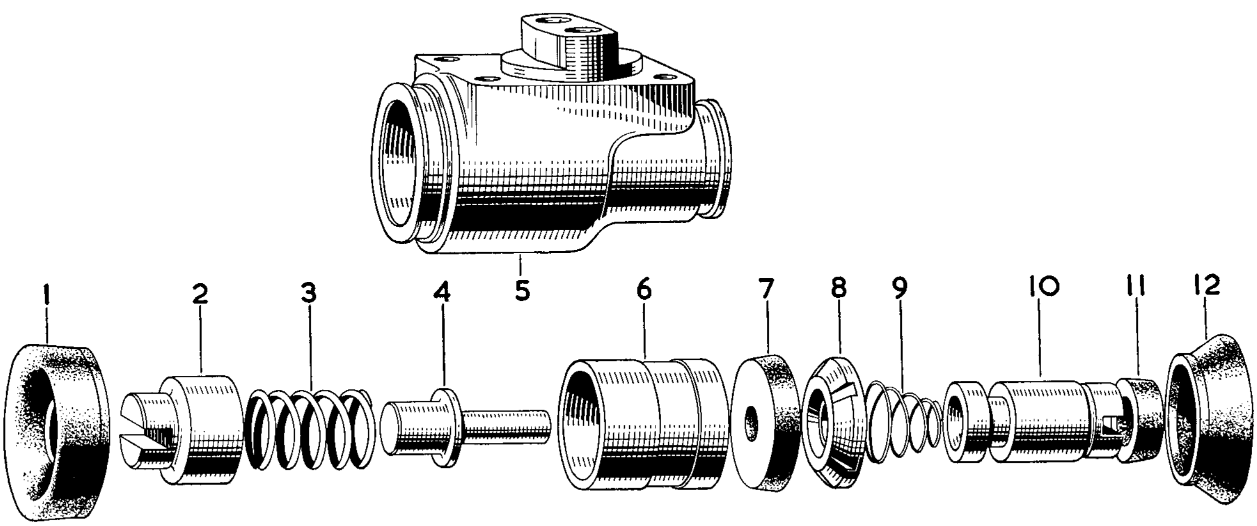


Fig. 12. Exploded view of front wheel cylinder.

Rubber boots (1, 12) are fitted to the piston end and the smaller piston respectively, and also fit on the body, to prevent the intrusion of dirt or moisture.

Dismantling

Disengage the larger rubber boot from the piston end (2) and from the wheel cylinder body, withdraw the piston end, the spring and the piston pin (4).

Disengage the other boot from the smaller piston (10) and the body, and push the piston through the bore to expel the larger piston, the cup (7), the cup filler (8) and the taper spring. Ease the taper seal (11) out of the groove in the smaller piston.

Assembling

Fit the larger end of the taper spring (9) into the cup filler (8) and enter these parts, spring leading, into the body. Follow up with the rubber cup (7), lip leading, taking care not to turn back or buckle the lip ; insert the piston, flat face leading, and pass the stem of the piston pin (4) through the piston, the cup and the cup filler. Locate the spring (3) on the piston pin and fit the piston end (2) to retain these parts ; stretch the larger rubber boot (1) on to the piston end and the body.

Ease the tapered rubber seal (11) into the groove on the smaller piston (10), with the larger end of the seal pointing away from the slotted end of the piston. Insert the piston into the body, with the slotted end outermost, taking care to ease the seal past the edge of the bore. Stretch the smaller rubber boot (12) on to the piston and the body. Refit the bleeder screw if removed previously.

THE REAR BRAKE ASSEMBLY

The rear brake assembly is of leading and trailing shoe design, the shoes being mounted on a backplate which mounts an abutment and is slotted to carry a wheel cylinder ; each of the shoes is retained by a steady spring which passes through the web of the shoe and hooks into a bracket riveted to the backplate.

A slot in the toe of the leading shoe accommodates a cam which abuts the piston in the wheel cylinder, the cam spindle carries a ratchet wheel and is mounted in a guide which is riveted to the shoe ; a spring pawl is riveted to the guide and engages with the teeth on the ratchet wheel.

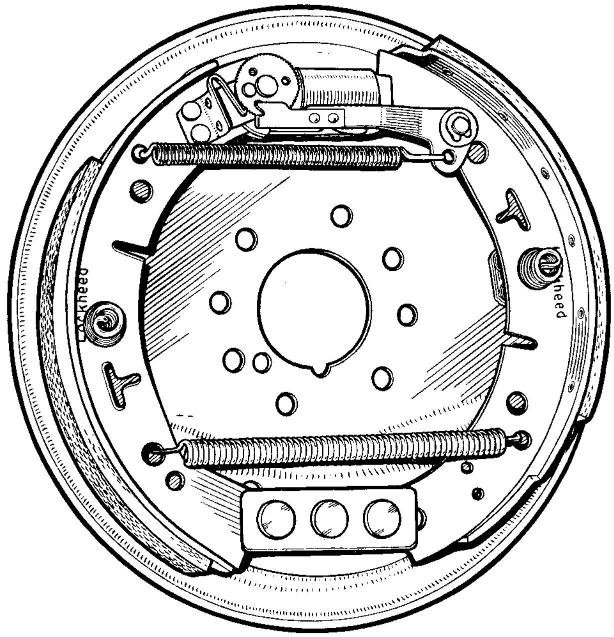


Fig. 13. The left-hand rear brake assembly (the right-hand assembly is assembled the opposite way round).

The abutment has slots at each end to carry the heel of the leading shoe and the toe of the trailing shoe ; the heel of the latter shoe is carried in a slot in the wheel cylinder body. Both shoes are free to float in the slots and are therefore able automatically to centralise themselves when the brakes are applied.

Two pull-off springs are fitted to the shoes to return them to the " off " position when the brakes are released ; the larger diameter spring is hooked into a hole in each of the shoes, whilst the other spring is hooked into a hole in the leading shoe and into a lever which is carried on a pin fitted in the trailing shoe. A lever pawl is riveted to the lever and is loaded by the smaller diameter pull-off spring to engage with the ratchet wheel teeth.

PRINCIPLE OF OPERATION

Adjustment of the brakes occurs automatically as the brake shoe linings wear and as the shoes return after an application, and is effected by the lever pawl rotating the ratchet wheel and cam ; the design is such that, when the brakes are "off," an adequate running clearance is created between the linings and the brake drum.

When the footbrake is applied, the inner piston in the wheel cylinder is displaced along the bore and thrusts on the outer piston, which takes the leading

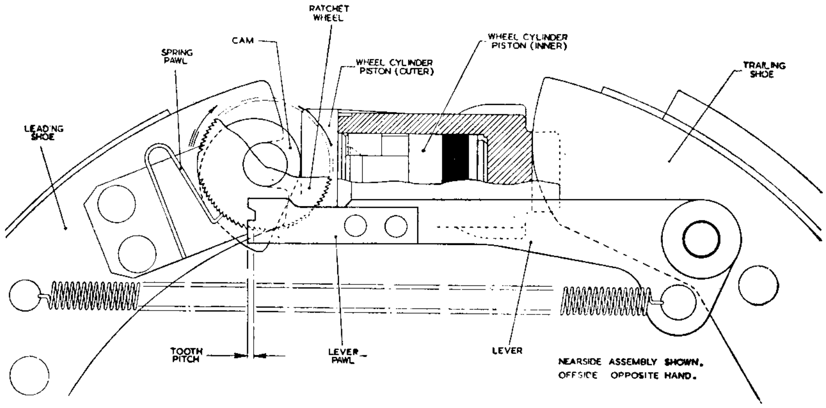


Fig. 14. Self adjusting mechanism—rear brakes.

shoe up to the drum, carrying the ratchet wheel and cam with it ; upon the leading shoe contacting the drum, the reaction causes the wheel cylinder to slide in its slot in the backplate and apply the trailing shoe, which drags the lever and pawl with it.

Provided that the total movement of the shoes does not exceed the pitch of the ratchet wheel teeth, the lever pawl will, when the brakes are released, return to its position in the tooth with which it was originally engaged. If, however, the total movement of the shoes (when the brakes are applied) exceeds the pitch of the ratchet teeth (due to lining wear) the lever pawl will click into position in a fresh tooth. Upon the brakes being released, the lever pawl will rotate the ratchet wheel and cam an amount equal to the pitch of one tooth in the direction of the arrow on the illustration ; the movement of the cam ensures that the shoes, whilst allowed to return to the " off " position, are moved a little nearer to the drum to compensate for the lining wear. The " lift " which the cam imparts to the shoes is much less than the pitch of the ratchet teeth, so that, with the brakes " off," the total running clearance between the linings and the drum will be equal to the tooth pitch less the cam " lift." When the useful life of the linings is at an end, a plain portion on the ratchet wheel prevents further outward adjustment of the shoes.

The spring pawl on the leading shoe is fitted as a safety device and engages with a tooth on the ratchet wheel to prevent the lever pawl from dragging the ratchet wheel with it when the brakes are applied.

With a handbrake application the outer piston in the wheel cylinder moves without disturbing the position of the inner piston.

REMOVING THE BRAKE SHOES AND REAR WHEEL CYLINDER

Place chocks under the front wheels (to prevent the vehicle from rolling), jack up the rear of the vehicle and disconnect the handbrake cable from the lever in the wheel cylinder ; remove the road wheel and the brake drum.

Pull on the tip of the adjustment lever to disengage it from the teeth on the ratchet wheel, and then allow the lever to swing outwards to relieve the tension of the spring attached to it ; unhook the spring from the lever and the brake shoe. Disconnect the circlip from the pin on which the lever is mounted, and take off the washer and the lever.

Disengage the two steady springs from the brackets on the backplate by depressing and then twisting them. Pull on the toe of the leading shoe and disengage the ratchet wheel and cam assembly from the shoe, lever the heel of the shoe out of its slot in the abutment ; the trailing shoe will fall away on releasing the tension of the pull-off spring. It should not normally be necessary to remove the pin from the trailing shoe.

Disconnect the pipe from the wheel cylinder, unscrew the bleeder screw and remove the rubber boot from the cylinder and the lever. Remove the wheel cylinder piston and slide the cylinder casting forward. Pivot the cylinder about its forward end and withdraw the rear end from the slot in the backplate ; a rearward movement of the cylinder will now bring its forward end clear of the backplate.

REFITTING THE REAR WHEEL CYLINDER AND BRAKE SHOES

Offer up the wheel cylinder to the backplate, with the lever through the slot, and with the piston pointing in the direction of forward rotation of the wheel. Engage the forward end of the cylinder in the slot and slide it well forward ; engage the rear end in the slot and slide the cylinder back to hold it in position. Fit the rubber boot to the lever and to the wheel cylinder body.

It will be noticed that the linings on the brake shoes are shorter in length than the platforms to which they are attached ; the end at which the greater portion of platform is exposed is known as the " toe," the opposite end being called the " heel." When installed on the backplate, the toe of the leading shoe is to be adjacent to the wheel cylinder piston, whilst the toe of the trailing shoe engages a slot in the abutment.

Lay the shoes on the bench, with the toe of the leading facing the heel of the trailing. If, previously, the pin was removed from the trailing shoe, it should now be refitted, with the hexagon on the upper surface of the shoe, secure with the nut and spring washer. Hook the larger pull-off spring into the appropriate holes in the shoes (the spring is to be on the upper surface).

Offer up the shoes to the backplate, with the pull-off spring outermost, and engage the tips of the shoes with the respective slots in the abutment and the wheel cylinder body. After inspection of the ratchet wheel to ensure that none of the teeth are damaged, slightly pull back the toe of the leading shoe and mount the ratchet wheel and cam assembly in the slots in the shoe and the guide ; the ratchet wheel is to be on the outside so that it engages the spring pawl, also the commencement of the cam form is to be adjacent to the wheel cylinder piston. Pass the stems of the steady springs through the centre holes in the brake shoes and engage with the backplate brackets by depressing and then twisting them.

Mount the adjustment lever on the pin in the trailing shoe so that it points outwards (as when dismantling), and secure to the pin, using the washer and the circlip. Hook the other spring into the appropriate hole in the leading shoe and also into the hole in the adjustment lever, and pull the lever into position so that it correctly engages the teeth on the ratchet wheel. Pull on the heel of the trailing shoe and ensure that, while doing this, the spring pawl prevents the ratchet wheel from rotating ; allow the lever pawl to click into position in a fresh tooth and check that, when the brake shoe is released, the ratchet wheel is rotated the appropriate amount. After carrying out this check, back-off the adjustment by pulling on the toe of the leading shoe and turning the ratchet wheel back to its original position.

Fit the brake drum and the wheel, fit the fluid pipe and the bleeder screw to the wheel cylinder (the pipe is fitted in the connection nearer to the lever), connect the handbrake cable to the wheel cylinder and bleed the system ; pump the brake pedal a few times until the normal travel is restored.

THE REAR WHEEL CYLINDER

The rear wheel cylinder consists of a body (3) which is bored to accommodate two pistons (7, 5), the former of these has a dust cover welded to it and is grooved to accommodate a rectangular section rubber seal (6) ; the other piston is fitted with a tapered rubber seal (4) and is slotted to receive the heel of a lever (1) which is retained in the body by a pin (8). When the wheel cylinder is installed on the backplate it is fitted with a rubber boot (2) through which the lever passes.

With a footbrake application the hydraulic pressure displaces the inner piston (5), which pushes the outer piston (7) before it, so taking the leading brake shoe up to the drum ; upon this shoe contacting the drum

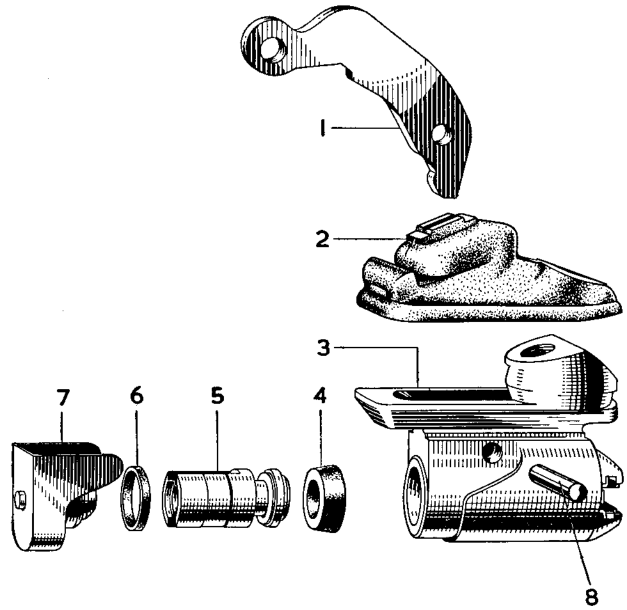


Fig. 15. Exploded view of rear wheel cylinder.

the reaction causes the wheel cylinder to slide within the slot in which it is housed in the backplate and so apply the trailing shoe ; during these operations the position of the lever (1) is undisturbed.

When the handbrake is applied, the linkage pulls on the lever which pivots about its pin and displaces the outer piston against the leading shoe without affecting the position of the inner piston ; the trailing shoe is again applied by the reactive movement of the wheel cylinder within its slot in the backplate.

Dismantling

Withdraw the outer piston (7), tap out the pin (8) and remove the lever (1). With the bleeder screw in position, apply a **low** air pressure to the fluid connection to expel the inner piston ; ease the seal out of the groove in each piston. The dust cover cannot be removed from the outer piston.

Assembling

Ease the rectangular section rubber seal (6) into the groove on the outer piston (7) and the tapered rubber seal (4) into the groove on the inner piston (5) ; the tapered seal is to be fitted with the larger end facing away from the slotted end of the piston.

Insert the inner piston into the body, so that the end fitted with the seal is innermost, and so that the widest part of the slot is adjacent to the slot in the body ; care must be taken to ease the seal past the edge of the bore. Place the lever (1) in position within the body and fit the pin (8). Insert the outer piston, turning the seal on to its side so that the edge which tends to protrude enters the bore last.

THE VACUUM CHECK VALVE (2.4 Litre)

The check valve is fitted in the vacuum line between the servo unit and the engine and is attached to the inlet manifold.

The purpose of the check valve is to retain a certain degree of vacuum in the servo should the engine stall.

Dismantling

Remove the four screws, lift the hose connection (1) off the body and collect the gasket. Shake the valve out of the body (5) and remove the seal (4).

Cleaning

Wash the metal parts in any recognised solvent and dry thoroughly with a clean, fluffless cloth ; the rubber seal should be discarded.

Assembling

Using the fingers only, carefully ease a new seal (4) into the recess in the valve (3). This operation will be facilitated if the seal is first soaked in brake fluid and assembled wet. Place the valve, seal downwards within the body, and attach the hose connection (1), fitting the gasket (2).

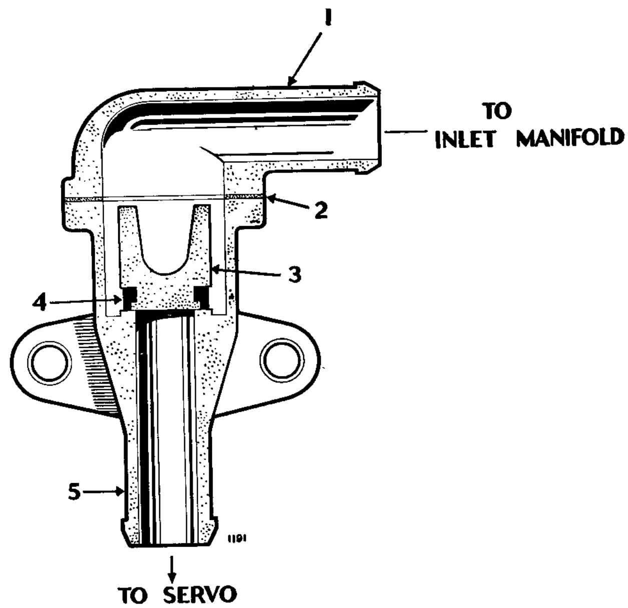


Fig. 16. Sectioned view of the 2.4 litre vacuum check valve.

THE VACUUM CHECK VALVE (3.4 Litre)

The vacuum check valve is housed in a hole bored in the underside of the inlet manifold and is retained by a flange plate through which the starting carburetter pipe also passes.

The purpose of the check valve is to retain a certain degree of vacuum in the servo should the engine stall.

Removal

Remove the ‘ U ’-shaped starting carburetter pipe by unscrewing the union nut at the connection beneath the starting carburetter solenoid, and pulling the pipe downwards at the flange plate end.

Remove the four nuts and spring washers securing the flange plate.

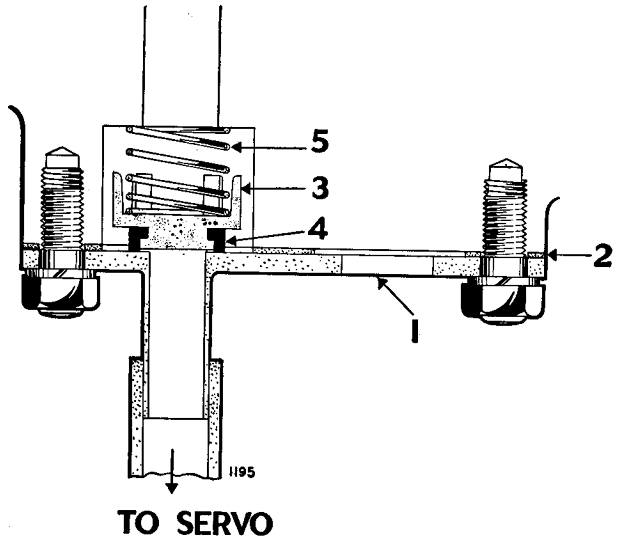


Fig. 17. Sectioned view of the 3.4 litre vacuum check valve.

Withdraw the flange plate (1), gasket (2), check valve (3) and spring (5). Also remove the ' O ' ring from the hole for the starting carburetter pipe.

Cleaning

Wash the metal parts in any recognised solvent and dry thoroughly with a clean, fluffless cloth ; the rubber seal should be discarded.

Refitting

Using the fingers only, carefully ease a new seal (4) into the recess in the valve (3). This operation will be facilitated if the seal is first soaked in brake fluid and assembled wet. Fit the spring, check valve (seal downwards) and starting carburetter pipe ' O ' ring into their respective holes and retain in position with the flange plate.

Push the end of the starting pipe up through the ' O ' ring and secure at the carburetter end by means of the union nut.

FAULT-FINDING

1 Pedal Travel Excessive

(*a*) External leak between master cylinder and servo, or between servo and wheel cylinders.
(*b*) Leakage past rubber cup on servo valve-operating piston, or between servo push-rod and push-rod seal.
(*c*) Master cylinder needs replenishing with fluid.
(*d*) System needs bleeding.
(*e*) Shoes need re-lining.
(*f*) Shoe lining wear not being compensated for due to faulty adjustment mechanism.

2 Pedal Feels Springy

(*a*) Linings not " bedded-in."
(*b*) Brake drums weak or cracked.
(*c*) Master cylinder loose on mounting.

3 Pedal Feels Spongy (does not hold pressure)

(*a*) Master cylinder main cup worn.
(*b*) Master cylinder secondary cup worn (air bubbles rise in supply tank).
(*c*) Leak at one or more points in the system.

4 Pedal Feels Hard

(*a*) Low vacuum from engine manifold.
(*b*) Collapsed, restricted or disconnected vacuum line from manifold.
(*c*) Faults in servo, as follows :—
   (i) Air valve and/or vacuum valve not seating properly.
   (ii) Air leak past leather cup or round-section seal, on vacuum piston.
   (iii) Faulty gasket under diaphragm or between slave cylinder and vacuum shell.
   (iv) Blockage of the slots through which air enters the rear end of the vacuum shell.

5 " Grabbing " Brakes

(*a*) Linings not " bedded-in."
(*b*) Grease or brake fluid on linings.
(*c*) Linings incorrect type.
(*d*) Scored drums.
(*e*) Excessive friction between servo vacuum piston and vacuum shell or between servo valve-operating piston and body.

6 Brakes Drag

(*a*) Shoe pull-off springs weak or broken.

(*b*) Pedal spring weak or broken.

(*c*) Handbrake mechanism seized.

(*d*) Wheel cylinder piston seized.

(*e*) Supply tank overfilled.

(*f*) Master cylinder by-pass port choked.

(*g*) Blockage of port through which air enters servo valve assembly.

(*h*) Blockage of the slots through which air enters the rear end of the servo vacuum shell.

(*j*) Faulty shoe adjustment mechanism.

7 Brakes Fail to Release

(*a*) Handbrake over-adjusted.

(*b*) Master cylinder by-pass port choked.

(*c*) Excessive friction between servo vacuum piston and vacuum shell, or between servo valve-operating piston and body.

(*d*) Excessive friction between wheel cylinder seals and wheel cylinder body.

8 Unbalanced Braking

(*a*) Grease or brake fluid on linings.

(*b*) Distorted drums.

(*c*) Front spring broken or loose at anchorage.

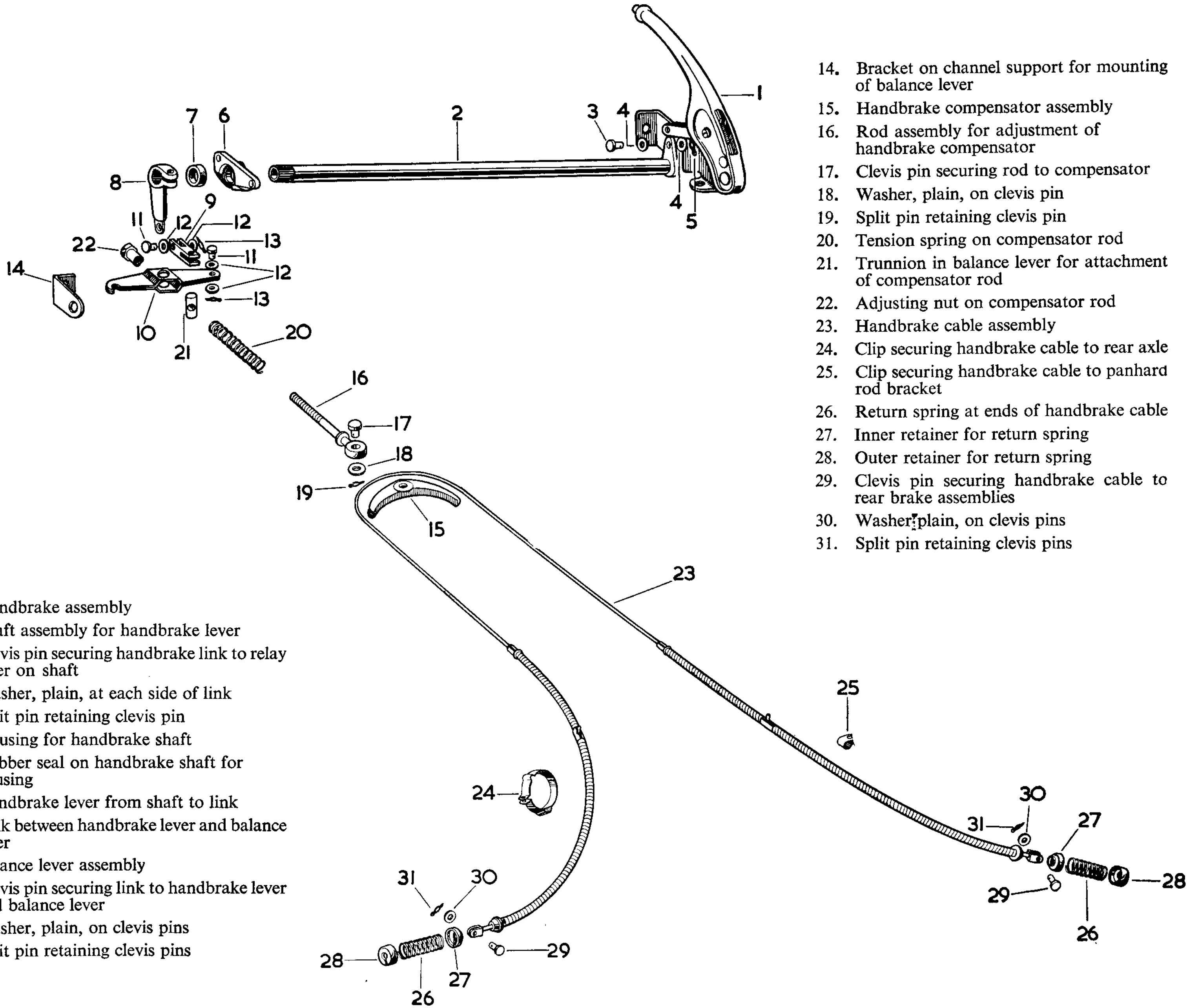
(*d*) Tyres unevenly inflated.

(*e*) Brake backplate loose on axle.

(*f*) Worn steering connections.

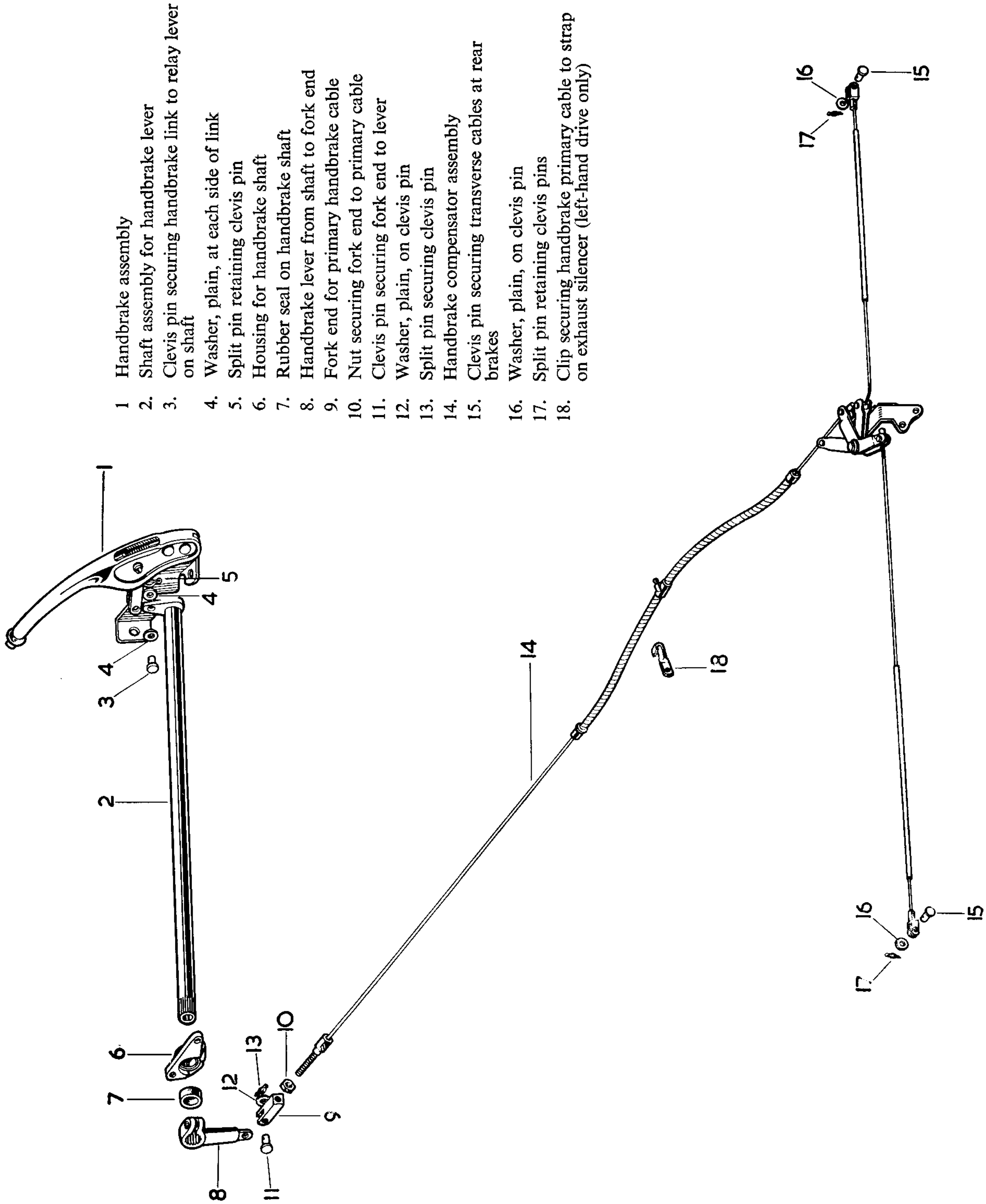
(*g*) Worn spring shackles.

(*h*) Different types or grades of linings fitted.



1. Handbrake assembly
2. Shaft assembly for handbrake lever
3. Clevis pin securing handbrake link to relay lever on shaft
4. Washer, plain, at each side of link
5. Split pin retaining clevis pin
6. Housing for handbrake shaft
7. Rubber seal on handbrake shaft for housing
8. Handbrake lever from shaft to link
9. Link between handbrake lever and balance lever
10. Balance lever assembly
11. Clevis pin securing link to handbrake lever and balance lever
12. Washer, plain, on clevis pins
13. Split pin retaining clevis pins
14. Bracket on channel support for mounting of balance lever
15. Handbrake compensator assembly
16. Rod assembly for adjustment of handbrake compensator
17. Clevis pin securing rod to compensator
18. Washer, plain, on clevis pin
19. Split pin retaining clevis pin
20. Tension spring on compensator rod
21. Trunnion in balance lever for attachment of compensator rod
22. Adjusting nut on compensator rod
23. Handbrake cable assembly
24. Clip securing handbrake cable to rear axle
25. Clip securing handbrake cable to panhard rod bracket
26. Return spring at ends of handbrake cable
27. Inner retainer for return spring
28. Outer retainer for return spring
29. Clevis pin securing handbrake cable to rear brake assemblies
30. Washer, plain, on clevis pins
31. Split pin retaining clevis pins

Fig. 18. Handbrake control assembly (with yoke type compensator).



1. Handbrake assembly
2. Shaft assembly for handbrake lever
3. Clevis pin securing handbrake link to relay lever on shaft
4. Washer, plain, at each side of link
5. Split pin retaining clevis pin
6. Housing for handbrake shaft
7. Rubber seal on handbrake shaft
8. Handbrake lever from shaft to fork end
9. Fork end for primary handbrake cable
10. Nut securing fork end to primary cable
11. Clevis pin securing fork end to lever
12. Washer, plain, on clevis pin
13. Split pin securing clevis pin
14. Handbrake compensator assembly
15. Clevis pin securing transverse cables at rear brakes
16. Washer, plain, on clevis pin
17. Split pin retaining clevis pins
18. Clip securing handbrake primary cable to strap on exhaust silencer (left-hand drive only)

Fig. 19. Handbrake control assembly (with scissor type compensator).

BRAKES
(Disc Type)

DESCRIPTION

The brake system consists of four caliper type disc brakes hydraulically controlled by means of a foot-operated master cylinder and a vacuum servo unit.

The front brakes have a larger piston area than the rear, otherwise they differ only in minor details. Separate parking handbrakes mounted on the rear calipers are mechanically operated on the rear discs.

Each wheel brake unit comprises a hub mounted disc rotating with the wheel, and a braking unit rigidly attached to the suspension member. The brake unit consists of a caliper which straddles the disc and houses a pair of cylindrical brake pads and pad carriers. Cylinder blocks are bolted to the outer faces of the caliper and house the operating cylinder assemblies. Ball and socket type contacts are arranged between the pistons and the carrier plates, and flexible rubber dirt excluders seal the cylinders and pistons from foreign matter, moisture, etc. Each cylinder block also accommodates two retractor pin assemblies which function as return springs and maintain a " brake off " working clearance of approximately 0.008″ to 0.010″ (.20-.25 mm.) between the pads and the disc throughout the life of the pads.

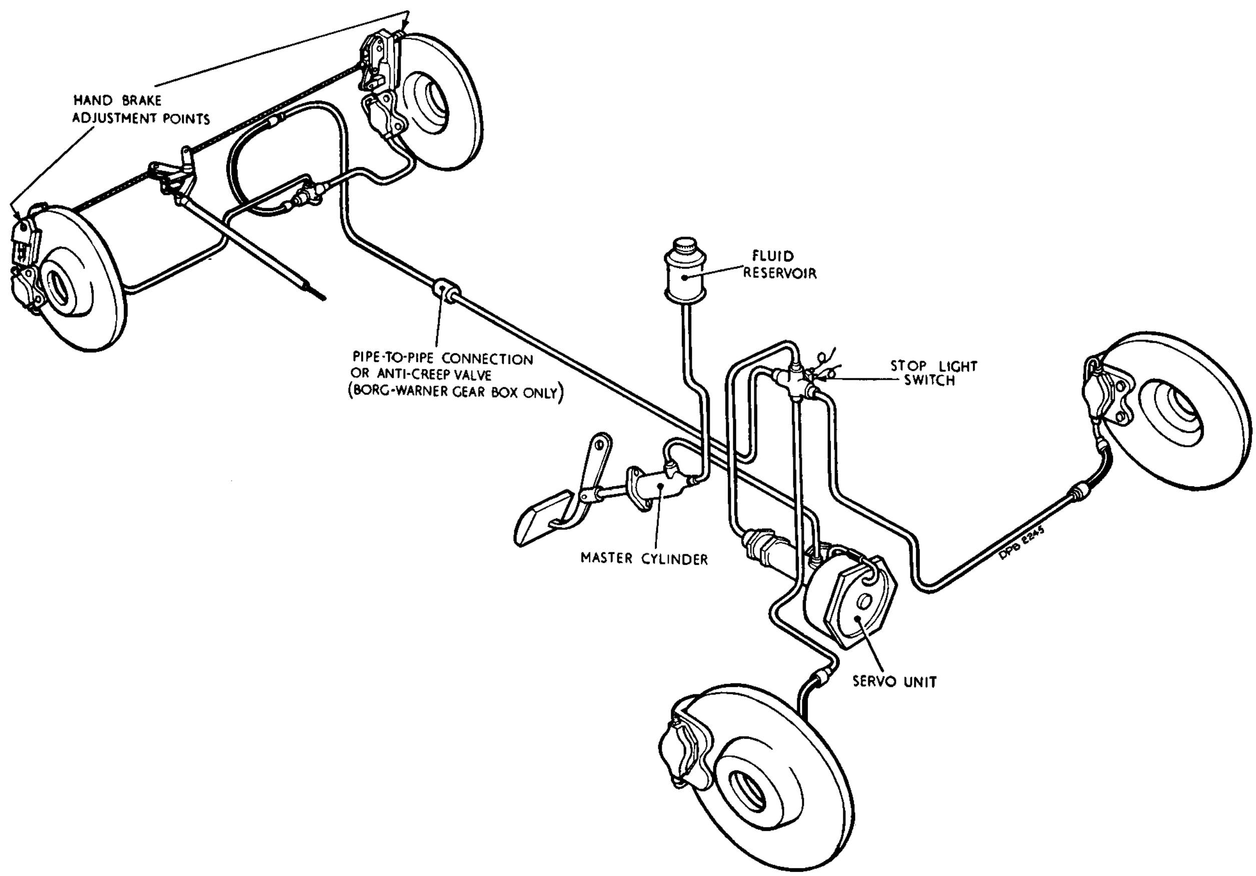


Fig. 20. Layout of system.

Handbrake

The mechanically actuated handbrakes are attached to the caliper bodies of the rear brakes by means of hinge bolts. Each brake consists of two carriers which locate astride the brake disc, and riveted to the inner face of each carrier is a friction pad. The free end of the inner carrier is equipped with a pivot seat to which is pinned a pair of side plates. A connecting link located between two spacers is secured between the eye ends of the side plates by means of a through bush, bolt, locknut and washers. A drilled hole at the inner end of the connecting link provides the attachment point for the fork end of the brake cable, while the opposite end is hinged between a pair of pivot links. These links are similarly connected to a pivot seat fitted to the fixed end of the carrier. A trunnion mounted between the pivot ends of the side plates carries a threaded bolt to which is fitted a locknut. This bolt passes through the carriers and terminates with a hemispherically formed head which seats in a similarly shaped recess in the outer carrier. Located around the bolt and registering in a counterbore in the inner carrier is a return spring retained under load by a nut. A spring plate riveted to the carrier locks the nut in position.

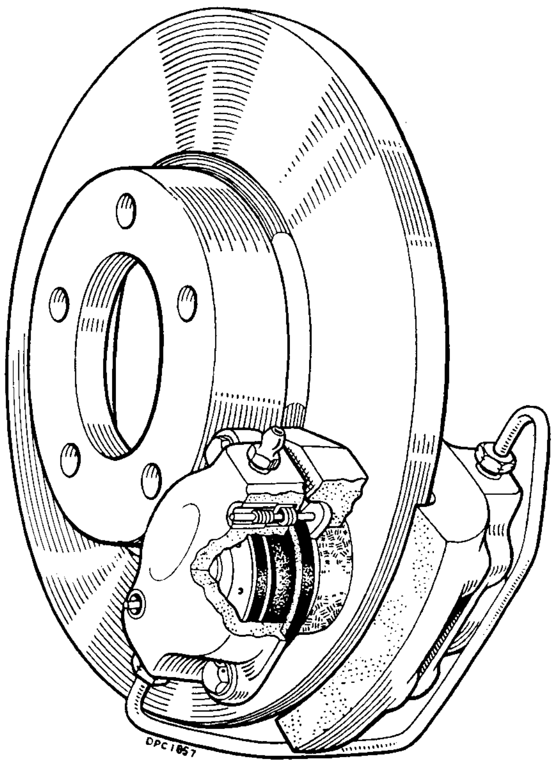


Fig. 21. The front brake assembly.

DATA

Make and type - - - - - - - - -	Dunlop Single Pad Disc
Brake disc diameter - - - - - - - -	$11\frac{3}{8}''$ (28.9 cm.)
Brake friction pad—diameter - - - - - - -	$2\frac{1}{4}''$ (57.1 mm.)
Master cylinder bore diameter - - - - - - -	$\frac{7}{8}''$ (22.22 mm.)
Master cylinder stroke - - - - - - - -	$1\frac{3}{8}''$ (35 mm.)
Brake cylinder bore diameter—front - - - - - -	$2\frac{1}{8}''$ (53.97 mm.)
Brake cylinder bore diameter—rear - - - - - - -	$1\frac{1}{2}''$ (38.1 mm.)
Servo unit type - - - - - - -	Lockheed $6\frac{7}{8}''$ (Suspended Vacuum Type)

ROUTINE MAINTENANCE

EVERY 2,500 MILES (4,000 KM.)

Handbrake Cable

Lubricate the grease nipple on the handbrake cable with the recommended grade of lubricant. The nipple is accessible from underneath the car and is adjacent to the rear axle.

Brake Fluid Level

The fluid reservoir for the hydraulic brake is attached to the wing valance on the driver's side and it is important that the level does not fall more than 1" (25.0 mm.) below the filler neck.

The level of the fluid should, therefore, be checked at the recommended intervals. If it is found that the fluid level falls rapidly, indicating a leak from the system, the car should be taken immediately to the nearest Jaguar Dealer for examination.

Footbrake Adjustment

Both the front wheel and rear wheel brakes are so designed that no manual adjustment to compensate for brake friction pad wear is necessary, as this automatically takes place when the footbrake is applied.

Handbrake Adjustment

The mechanically operated handbrakes are attached to the rear caliper bodies but form an independent mechanically actuated system carrying their own friction pads and individual adjustment.

To adjust the handbrakes to compensate for friction pad wear, which will be indicated by excessive handbrake lever travel, carry out the following procedure.

Unscrew the adjuster bolt and insert a .004" (.10 mm.) feeler gauge between the face of one handbrake pad and the disc. Screw in the adjuster bolt until the feeler gauge is just nipped. Withdraw feeler gauge and check disc for free rotation. Repeat for the other side.

If, after carrying out the above adjustment, satisfactory travel of the handbrake lever is not obtained, the handbrake cables should be adjusted as follows :—

Screw in the handbrake adjuster bolt at each rear brake until the handbrake pads are in hard contact with the brake discs

Fully release the handbrake lever. Remove the clevis pin securing the fork end to the operating link at the front end of the main cable. Slacken the locknut and adjust the position of the fork end so that with the clevis pin refitted there is no slack in the main cable and the two cross cables. It is, however, important to ensure that the cables are not under tension.

Reset the handbrake clearance with a .004" (.10 mm.) feeler gauge as described above.

EVERY 5,000 MILES (8,000 KM.)

Friction Pads—Examination for Wear

At the recommended intervals, or if a loss of braking efficiency is noticed, the brake friction pads (2 per brake) should be examined for wear.

As the friction pads wear the retractor pins are withdrawn into the cylinder block and can be used to determine the amount of pad wear. When the end of the pin is approximately $\frac{5}{16}$" (8 mm.) below the face of the cylinder block the pads need renewing.

NOTE.—A metal sleeve, which projects above the cylinder block, may be fitted around the retractor pin. In this case the sleeve, which is only a taper fit in the cylinder block, can be withdrawn with a pair of pliers. The sleeves need not be refitted as they are provided primarily for protection of the retractor pins during transit and handling of the caliper assemblies.

Brake Servo Air Cleaner

At the recommended intervals the brake servo air cleaner, which is attached to the right-hand wing valance, should be removed and washed in **methylated spirits.** After drying out re-lubricate the wire mesh with **brake fluid.**

RECOMMENDED BRAKE FLUIDS

Preferred Fluid

Dunlop Disc Brake Fluid.

Alternative Fluids

Lockheed Super Heavy Duty Brake Fluid.

Castrol/Girling Crimson Brake Fluid.

In countries where the above fluids are unobtainable use only a recognised brake fluid guaranteed to conform to the S.A.E. Specification 70 R.3.

In the event of deterioration of the rubber seals and hoses due to the use of an incorrect fluid all the seals and hoses must be replaced and the system thoroughly flushed and refilled with one of the above fluids.

BLEEDING THE BRAKE SYSTEM

The following procedure should be adopted either for initial priming of the system or to bleed in service if air has been permitted to enter the system. This latter condition may occur if connections are not maintained properly tightened, or if the master cylinder periodic fluid level check is neglected. During the bleeding operation it is important that the level in the reservoir is kept topped up to avoid drawing air into the system. It is recommended that new fluid be used for this purpose.

Check that all connections are tightened and all bleed screws closed.

Fill the reservoir with brake fluid of the correct specification.

Attach the bleeder tube to the bleed screw on the near side rear brake and immerse the open end of the tube in a small quantity of brake fluid contained in a clean glass jar. Slacken the bleed screw and operate the brake pedal slowly backwards and forwards through its full stroke until fluid pumped into the jar is reasonably free from air bubbles. Keep the pedal depressed and close the bleed screw. Release the pedal.

Repeat for each brake in turn.

Repeat the complete bleeding sequence until the brake fluid pumped into the jar is completely free from air bubbles.

Lock all bleed screws and finally regulate the fluid level in the reservoir.

Apply normal working load on the brake pedal for a period of two or three minutes and examine the entire system for leaks.

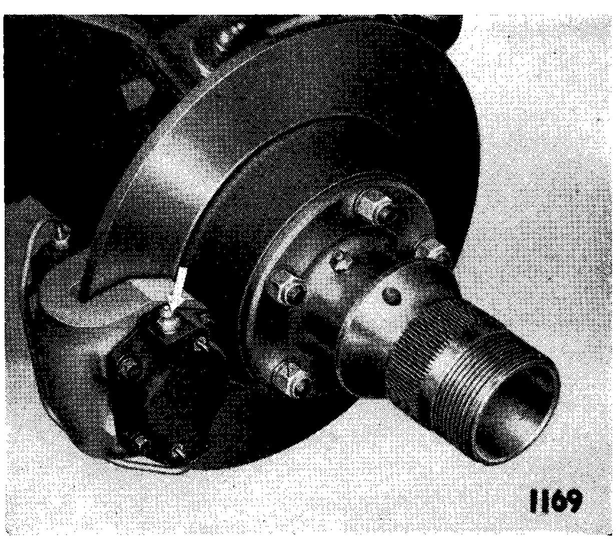


Fig. 22. Brake bleeder screw.

BRAKE OVERHAUL—PRECAUTIONS

The complete brake system is designed to require the minium of attention and providing the hydraulic fluid in the reservoir is not allowed to fall below the recommended level no defects should normally occur. Fluid loss must be supplemented by periodically topping up the reservoir with fluid of the same specification of that in the system. If the recommended brand of brake fluid is not available and it is intended to use one of the alternative approved brands, the complete system must be drained before the substitution of one fluid for another. It is not permissible to top up the reservoir with an alternative approved brand of fluid.

The inclusion of air in a system of this type will be indicated by sluggish response of the brakes and spongy action of the brake pedal. This condition may be due to air induction at a loose joint or at a reservoir in which the fluid has been allowed to fall to a very low level. These defects must be immediately remedied and the complete system bled. Similarly, bleeding the system is equally essential following any servicing operation involving the disconnecting of part or whole of the hydraulic system.

The following instructions detail the procedure for renewal of component parts and for complete overhaul of the disc brakes, handbrakes and master cylinder. The units should be thoroughly cleaned externally before dismantling. Brake system fluid should be used for cleaning internal components and, except where otherwise stated in these notes, the use of petrol, paraffin or chemical grease solvents should be avoided as they may be detrimental to the rubber components. Throughout the dismantling and assembling operation it is essential that the work bench be maintained in a clean condition and that the components are not handled with dirty or greasy hands. The precision parts should be handled with extreme care and should be carefully placed away from tools or other equipment likely to cause damage. After cleaning, all components should be dried with clean lint-free rag.

When it is not the intention to renew the rubber components, they must be carefully examined for serviceability. There must be no evidence of defects such as perishing, excessive swelling, cutting or twisting, and where doubt exists comparison with new parts may prove to be of some assistance in making an assessment of their condition. The flexible pipes must show no signs of deterioration or damage and the bores should be cleaned with a jet of compressed air. No attempt should be made to clear blockage by probing as this may result in damage to the lining and serious restriction to fluid flow. Partially or totally blocked flexible pipes should always be renewed. When removing or refitting a flexible pipe, the end sleeve hexagon (A, Fig. 23) should be held with the appropriate spanner to prevent the pipe from twisting. A twisted pipe will prove detrimental to efficient brake operation.

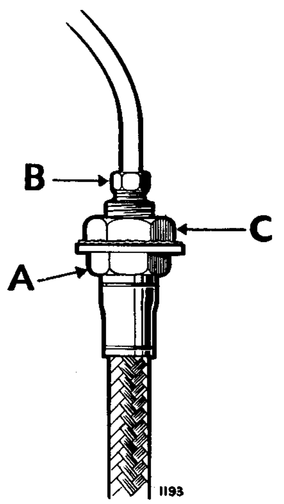


Fig. 23. Flexible hose connection. Hold hexagon ' A ' with spanner when removing or refitting locknut ' C.'

THE MASTER CYLINDER

The master cylinder is mechanically linked to the brake foot pedal and, at a ratio proportionate to the load applied, provides the hydraulic pressure necessary to operate the brakes. The components of the master cylinder are contained within the bore of a body which at its closed end has two 90° opposed integral pipe connection bosses. Integrally formed around the opposite end of the cylinder is a flange provided with two holes for the master cylinder attachment bolts. In the unloaded condition a spring loaded piston, carrying a rubber ' O ' ring in a groove, is held against the underside of a circlip retained dished washer at the head of the cylinder. A hemispherically ended push-rod seats in a similarly formed recess at the head of the piston. A fork end on the outer end of the push-rod provides for attachment to the pedal. A rubber dust excluder, the lip of which seats in a groove, shrouds the head of the master cylinder to prevent the intrusion of foreign matter.

A cylindrical spring support locates around the inner end of the piston and a small drilling in the end of the support is engaged by the stem of a valve. The larger diameter head of the valve locates in a central blind bore in the piston. The valve passes through the bore of a vented spring support and protrudes into the fluid passage from the inlet connection. Interposed between the spring support and an integral flange formed on the valve is a small coiled spring. A seal bush carrying an external rubber seal locates between the end of the cylinder body and the underside of the valve flange. This assembly forms a recuperation valve which controls fluid flow to and from the reservoir.

When the foot pedal is in the OFF position the master cylinder is fully extended and the valve is held clear of the base of the cylinder by the action of the main spring. In this condition the master cylinder is in fluid communication with the reservoir, thus permitting recuperation of any fluid loss sustained, particularly during the bleeding operation of the brake system.

When a load is applied to the foot pedal the piston moves down the cylinder against the compression of the main spring. Immediately this movement is in excess of the valve clearance the valve closes under the influence of its spring and isolates the reservoir. Further loading of the pedal results in the discharge of fluid under pressure from the outlet connection, via the pipe lines to the brake system.

Removal of the load from the pedal reverses the sequence, the action of the main spring returns the master cylinder to the extended position.

Renewing the Master Cylinder Seals

The following is the recommended procedure for renewal of the seals :—

Ease the dust excluder clear of the head of the master cylinder.

With suitable pliers remove the circlip ; this will release the push-rod complete with dished washer.

Withdraw the piston and remove the ' O ' ring.

Withdraw the valve assembly complete with springs and supports. Remove the valve sealing ring from the bush.

Lubricate the new seals with brake fluid, fit the valve seal around the bush and fit the ' O ' ring in the groove around the piston.

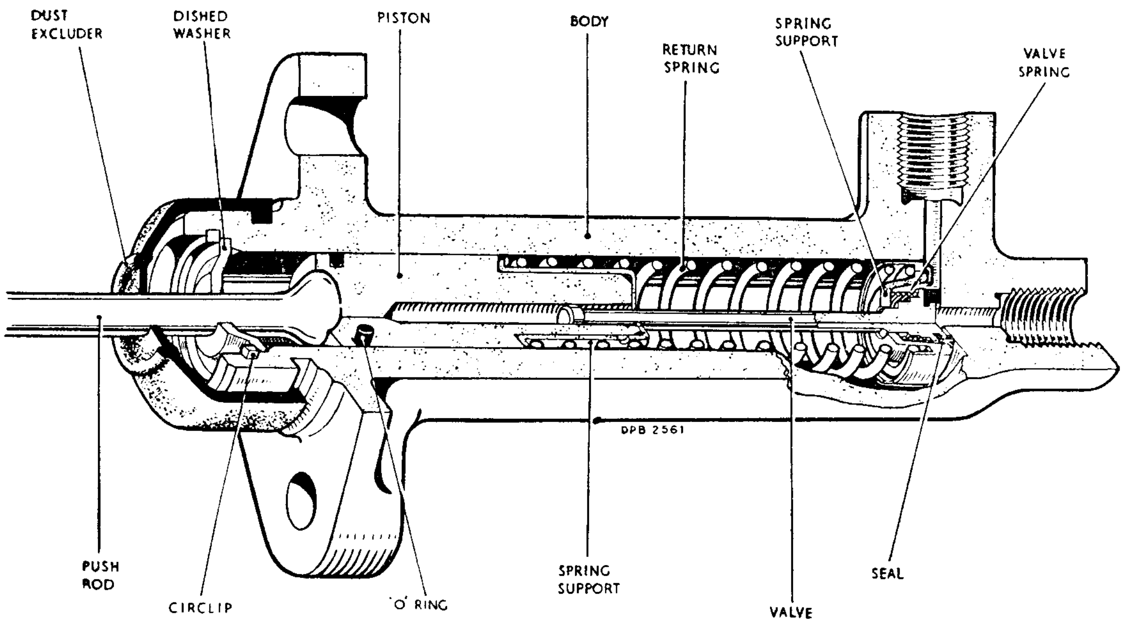


Fig. 24. Sectioned view of master cylinder.

Place the seal bush in position on the valve stem and insert the piston into the spring support, ensuring that the head of the valve engages the piston bore.

Slide the complete assembly into the cylinder body, taking particular care not to damage or twist the ' O ' ring.

Position the push-rod and depress the piston sufficiently to allow the dished washer to seat on the shoulder at the head of the cylinder. Fit the circlip and check that it fully engages the groove.

Fill the dust excluder with clean Wakefield No. 3 Rubber Grease.

Re-seat the dust excluder around the head of the master cylinder.

Master Cylinder Push-rod—Free Travel

When the brake pedal is in the " off " position it is necessary that the master cylinder piston is allowed to return to the fully extended position, otherwise pressure may build up in the system causing the brakes to drag or remain on.

To ensure that this piston returns to the fully extended position clearance is provided between the enlarged head of the push-rod, the piston and dished washer. As this washer also forms the return stop for the brake pedal, no means of adjustment is necessary.

The push-rod clearance will give approximately $\frac{1}{4}''$ (6 mm.) free movement at the brake pedal pad and can be felt if the pedal is depressed gently by hand.

THE BRAKE ASSEMBLY

Assembling

The assembly of the disc brake to the car should be carried out as follows :—

Secure the disc to the hub. Five bolts are provided secured by spring washers and nuts.

Fit the hub to the stub axle or half shaft, as applicable. Check the end-float of the wheel hub bearings which must be .003″ to .005″ (.07 to .13 mm.) for both front and rear hubs. It is most important that the end-float does not exceed .005″ (.13 mm.), otherwise the brakes may tend to drag and not function correctly. Adjustment of the front wheel bearings is effected by means of the hub nut at the end of the stub axle shaft. Adjustment of the rear wheel bearings is effected by the insertion or extraction of shims interposed between the flanges of the axle tubes and the brake caliper mounting plates.

Check the disc for true rotation by clamping a dial test indicator to the chassis so that the needle pad bears on the face of the disc. " Run-out " should not exceed 0.006″ (.15 mm.) gauge reading. Manufacturing tolerances on the disc and hub should maintain this truth and in the event of the " run-out " exceeding this value the components should be examined for damage.

Locate the caliper body (complete with cylinder assemblies) in position and secure with two bolts fitted with shakeproof washers.

Check the gap between each side of the caliper and the disc. The difference should not exceed 0.010" (.25 mm.) and shims may be fitted to centralise the caliper.

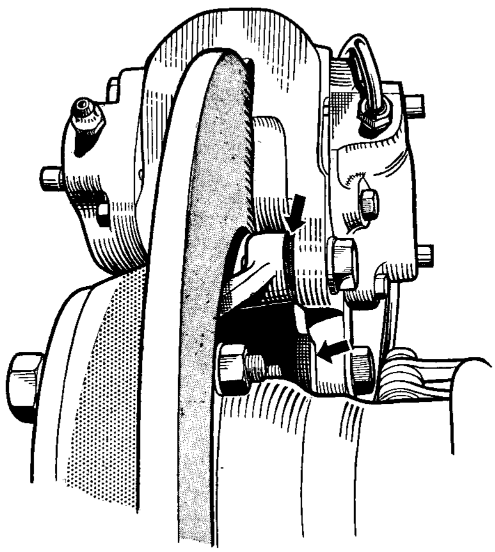


Fig. 25. Shims may be fitted at the points indicated by arrows to centralise the caliper.

If not already fitted fit the bridge pipe connecting the two cylinder assemblies. Connect the supply pipe to the cylinder block and ensure that it is properly secured.

Renewing the Friction Pads

Brake adjustment is automatic during the wearing life of the pads. As the pads wear, the outer ends of the retractor pins will withdraw into the cylinder block and can be used to gauge pad wear. When the end of the pin is approximately $\frac{5}{16}$" (8 mm.) below the face of the block the pads should be renewed.

NOTE.—A metal sleeve, which projects above the cylinder block, may be fitted around the retractor pin. In this case the sleeve, which is only a taper fit in the cylinder block, can be withdrawn with a pair of pliers. The sleeves need not be refitted as they are provided primarily for protection of the rectractor pins during transit and handling of the caliper assemblies.

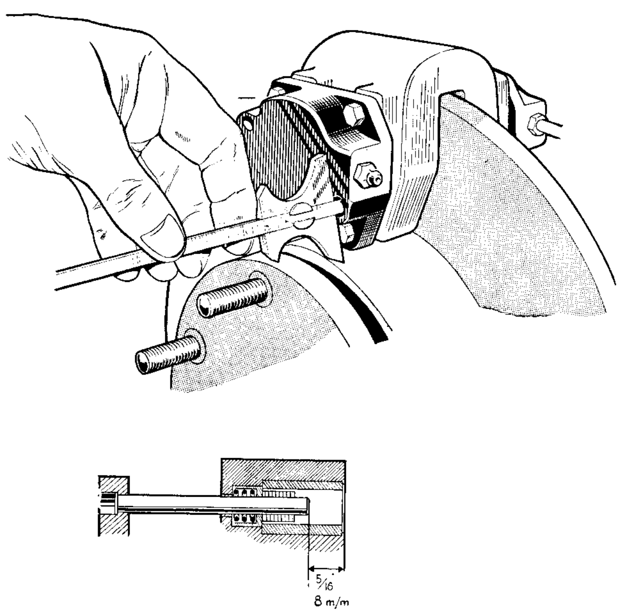


Fig. 26. Measuring the amount of friction pad wear. When the retractor pins are approximately $\frac{5}{16}$" (8 mm.) below the face of the cylinder block, the pads need renewing.

If checking is neglected, the need to renew the pads will be indicated by a loss of brake efficiency. To fit new pads proceed as follows :—

Remove the pipes, plug the open end of the supply pipe and drain the cylinder blocks.

Unscrew the securing bolts and remove the cylinder blocks complete with piston and pad assemblies.

Press the carrier plate and cylinder block firmly together to press the piston back into the cylinder, and reset the retractor pins. To do this, press the pin heads into their recesses in the carrier plate and, holding them in this position, ensure that the retractor bushes are pressed well home into their housings on the outer face of the block.

Carefully prise the pad from the carrier plate using a sharp knife, and clean away any traces of cement from the face of the plate. During this operation be careful not to twist the carrier plate relative to the block, as this may distort the retractor pins. Trichlorethylene may be used to clean the carrier plate. This fluid should be used sparingly and should not be allowed to contact the rubber components.

Lightly smear the annular face of the carrier plate with Dunlop General Purpose Cement. Do not smear the raised centre portion of the plate.

Press the pad firmly on to the plate, ensuring correct location of the alignment screw, and remove all traces of excess cement which may be squeezed out. Cement deposited on the caliper bore may impair brake efficiency.

Re-assemble the cylinder block to the caliper body, ensuring that the shakeproof washers are serviceable.

Fit the bridge pipes, connect the supply pipes and bleed the system.

Renewing the Brake Piston Seals

Leakage past the piston seals will be denoted by a fall in level in the fluid reservoir or by a spongy pedal travel. It is recommended that the dust excluder be renewed when fitting a new piston seal. Proceed as follows :—

Remove the cylinder block as described under " Renewing the friction pads."

Carefully press out the retractor pins using a $\frac{3}{32}''$ (2.5 mm.) parallel punch. (It is preferable to do this with a press, but if care is taken the pin may be removed by lightly tapping with a hammer.) Remove the carrier plate and temporarily return the pins to their housings.

Disengage the dust seal from the cylinder block and withdraw the piston assembly.

Carefully prise off the piston seal retaining washer (this washer is a press fit on the inner face of the piston) and remove the seal.

Remove the dust seal from the ball joint plug.

IMPORTANT.

On all brake assemblies the bridge pipe between the two cylinder blocks fitted to each caliper MUST be assembled so that the end of the pipe having the "hairpin" bend is connected to the INBOARD cylinder block, as illustrated in Fig. 21.

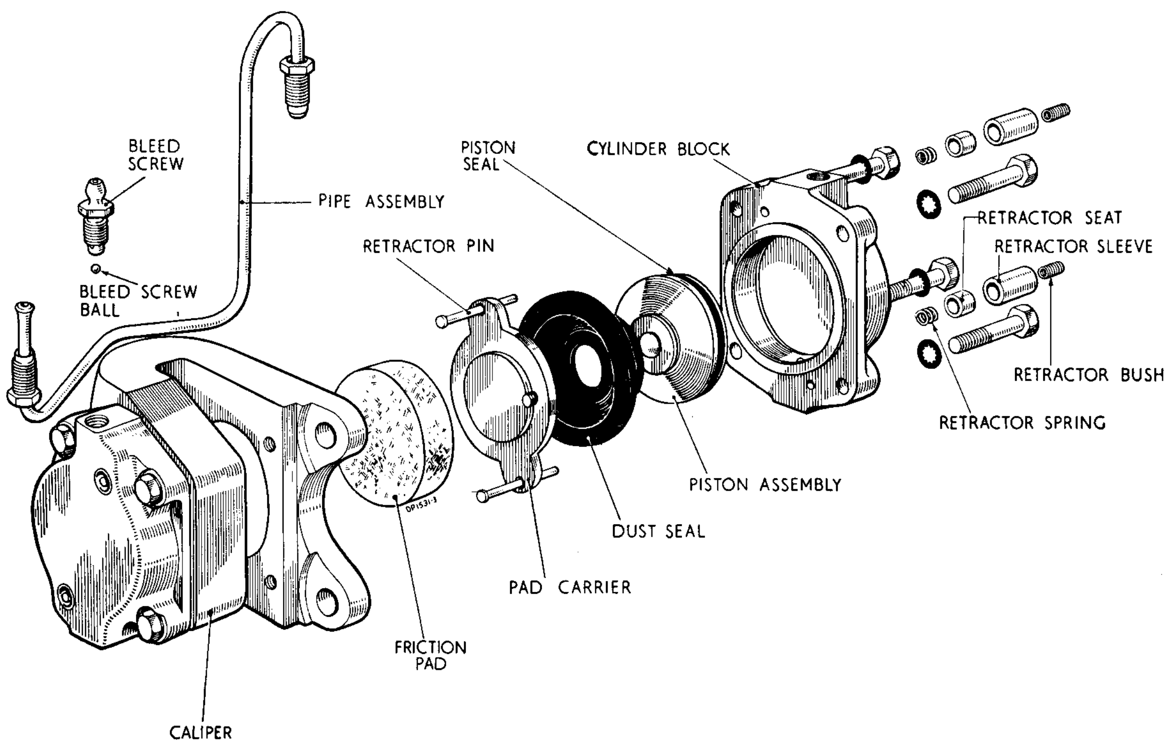


Fig. 27. Exploded view of front brake caliper.

Fit the new dust seal in position under the shoulder of the ball joint plug, taking care to avoid harmful stretching and to ensure that the rubber lip is not trapped or twisted.

Lightly lubricate a new piston seal with brake fluid and fit it to the piston. Press the retaining washer on to the piston and lightly peen over at three points.

Clean the cylinder bore and ensure that there are no scores which will damage the seal. Insert the piston into the cylinder and spring the outer rim of the dust seal into its housing.

Locate the carrier plate, refit the retractor pins and reset. To do this, press the pin heads into their recesses in the carrier plate and, holding them in this position, ensure that the retaining springs are pressed well home into their housings on the outer face of the block.

Complete re-assembly and bleed the system.

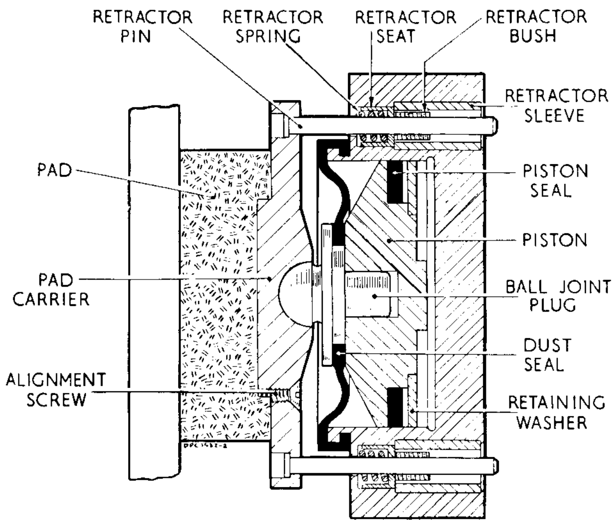


Fig. 28. Section through cylinder block and friction pad.

THE HANDBRAKE

Assembling

Slacken the carrier adjuster bolt, position the carriers in the rear caliper and secure them with the bolts and lockwashers. Set the brake clearance as described under " Handbrake Adjustment " in " Routine Maintenance " at the beginning of this sub-section.

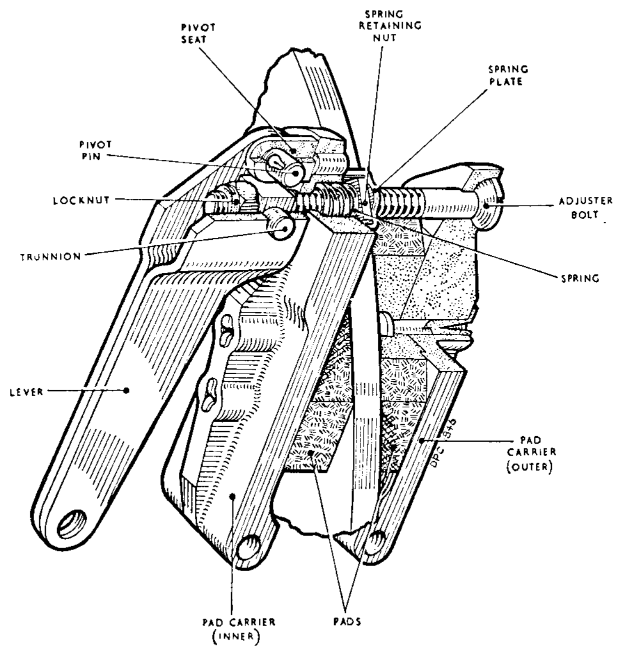


Fig. 29. Sectioned view of handbrake.

Re-lining the Handbrake

The recommended procedure for renewing the friction pads is as follows :—

Unscrew and remove the adjuster bolt and locknut and swing the pad carriers away from the disc.

Remove the split pin and withdraw the lever pivot pin. (See Fig. 29).

Remove the bifurcated rivets from both carriers and prise off the worn linings.

Place the new linings in position and secure them with new bifurcated rivets.

Place the lever against the inner carrier in the attitude shown in Fig. 30. Hold the locknut firmly against the outer face of the trunnion and screw in the adjuster bolt until three or four threads engage the locknut.

Align the holes in the lever and pivot seat, fit the pivot and lock it with the split pin.

Reset the clearance as described under " Hand-brake Adjustment " on page L.25

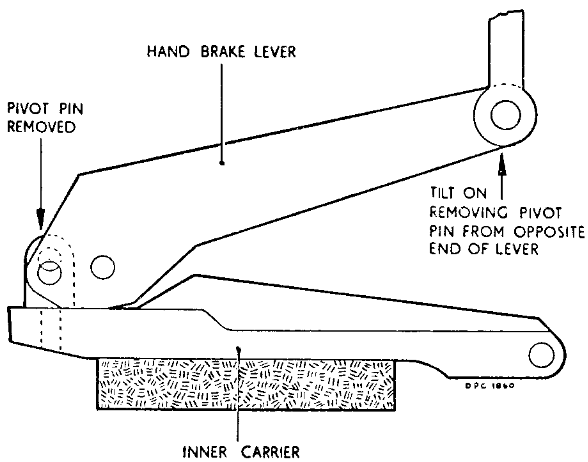


Fig. 30. Removing and refitting the handbrake mechanism.

Assembling

Using the fingers only, carefully ease a new seal (4) into the recess in the valve (3). This operation will be facilitated if the seal is first soaked in brake fluid and assembled wet. Place the valve, seal downwards within the body and attach the hose connection (1), fitting the gasket (2).

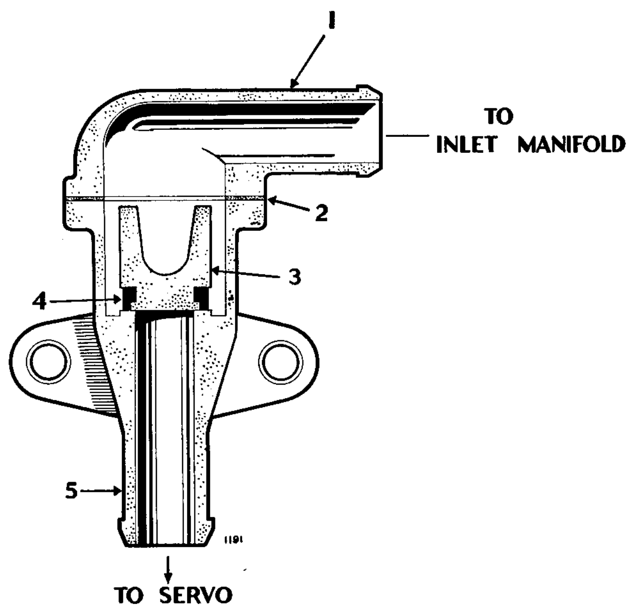


Fig. 31. Sectioned view of the 2.4 litre vacuum check valve.

THE VACUUM CHECK VALVE (2.4 litre)

The check valve is fitted in the vacuum line between the servo unit and the engine and is attached to the inlet manifold.

The purpose of the check valve is to retain a certain degree of vacuum in the servo should the engine stall.

Dismantling

Remove the four screws, lift the hose connection (1) off the body and collect the gasket. Shake the valve out of the body (5) and remove the seal (4).

Cleaning

Wash the metal parts in any recognised solvent and dry thoroughly with a clean, fluffless cloth ; the rubber seal should be discarded.

THE VACUUM CHECK VALVE (3.4 litre)

The vacuum check valve is housed in a hole bored in the underside of the inlet manifold and is retained by a flange plate through which the starting carburetter pipe also passes.

The purpose of the check valve is to retain a certain degree of vacuum in the servo should the engine stall.

Removal

Remove the ' U '-shaped starting carburetter pipe by unscrewing the union nut at the connection beneath the starting carburetter solenoid, and pulling the pipe downwards at the flange plate end.

Remove the four nuts and spring washers securing the flange plate.

Withdraw the flange plate (1), gasket (2), check valve (3) and spring (5). Also remove the ' O ' ring from the hole for the starting carburetter pipe.

Cleaning

Wash the metal parts in any recognised solvent and dry thoroughly with a clean, fluffless cloth; the rubber seal should be discarded.

Refitting

Using the fingers only, carefully ease a new seal (4) into the recess in the valve (3). This operation will be facilitated if the seal is first soaked in brake fluid and assembled wet. Fit the spring, check valve (seal downwards) and starting carburetter pipe ' O ' ring into their respective holes and retain in position with the flange plate.

Push the end of the starting pipe up through the ' O ' ring and secure at the carburetter end by means of the union nut.

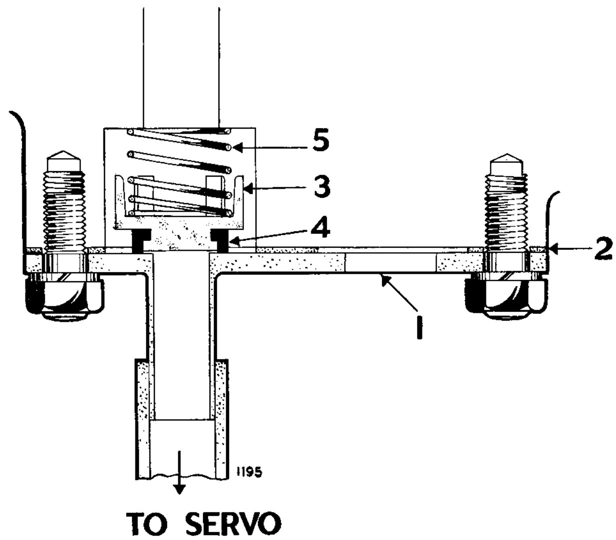


Fig. 32. Sectioned view of the 3.4 litre vacuum check valve.

THE $5\frac{1}{2}''$ VACUUM SERVO UNIT

The $5\frac{1}{2}''$ Servo Unit was fitted only to earlier 2.4 litre and 3.4 litre cars with drum brakes, that is, up to but not including chassis numbers :—

	Right-hand Drive	Left-hand Drive
2.4 litre - - -	909061	942677
3.4 litre - - -	971732	987406

On and after the above chassis numbers a $6\frac{7}{8}''$ servo unit is fitted which is dealt with in the subsequent sub-section.

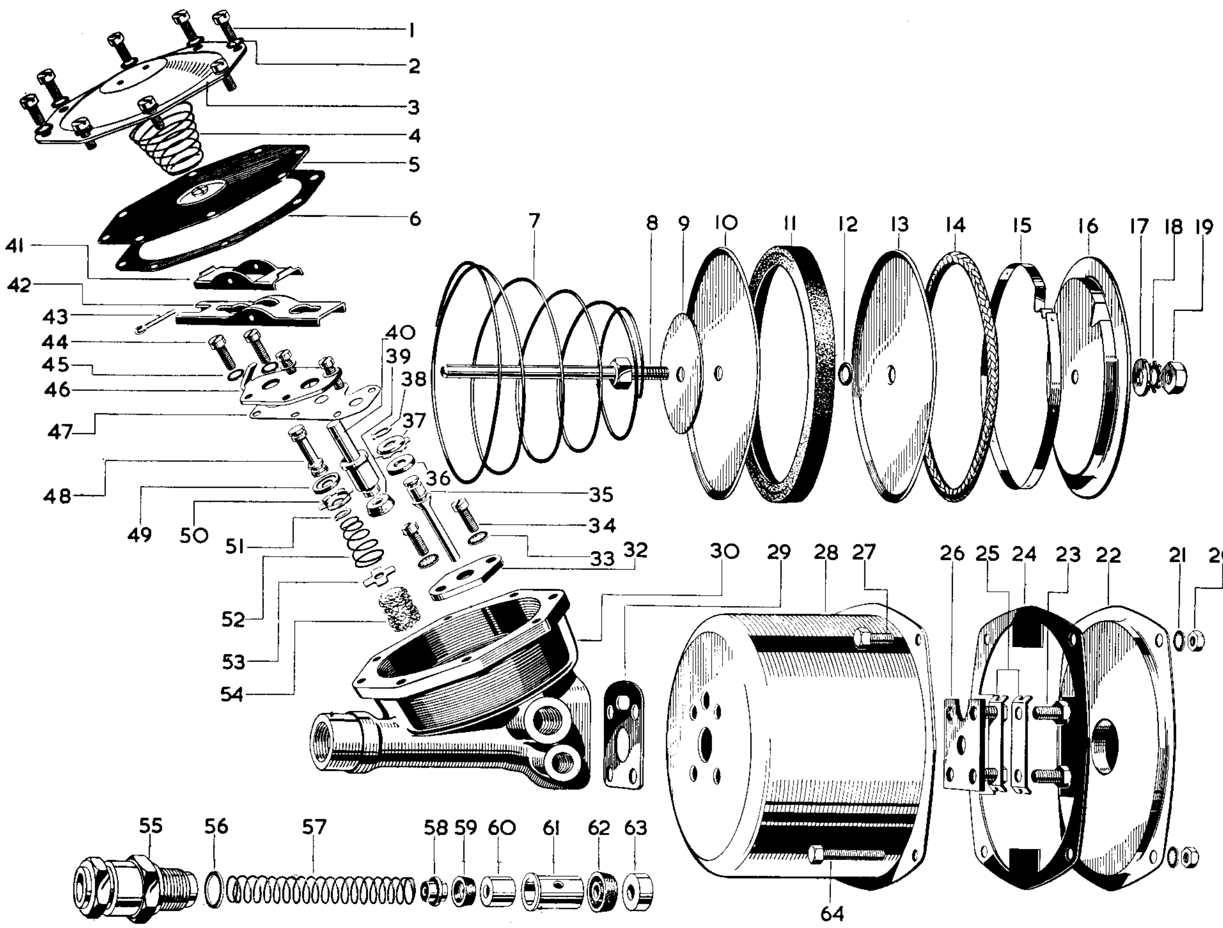


Fig. 33. Exploded view of the $5\frac{1}{2}''$ vacuum servo unit.

1. Setscrew
2. Shakeproof washer
3. Valve cover
4. Spring
5. Diaphragm
6. Gasket
7. Spring
8. Push-rod
9. Locating washer
10. Piston plate (inner)
11. Leather cup
12. Seal
13. Piston plate (outer)
14. Wick
15. Wick retainer
16. End stop
17. Backing washer
18. Shakeproof washer
19. Nut
20. Nut
21. Shakeproof washer
22. End cover
23. Bolt
24. Gasket
25. Locking plate
26. Abutment plate
27. Bolt (short)
28. Vacuum shell
19. Gasket
30. Slave cylinder body
32. Vacuum valve plate
33. Shakeproof washer
34. Setscrew
35. Vacuum-valve stem
36. Seal
37. Seal retainer
38. Circlip
39. Cup
40. Piston
41. Stem retainer
42. Balance arm
43. Split pin
44. Setscrew
45. Shakeproof washer
46. Air-valve plate
47. Gasket for valve plates*
48. Air-valve stem
49. Seal
50. Seal retainer
51. Circlip
52. Spring
53. Retainer plate
54. Wire-mesh air filter
55. Check-valve assembly
56. Gasket
57. Spring
58. Spring guide
59. Cup
60. Piston
61. Distance piece
62. Push-rod seal
63. Push-rod support
64. Bolt (long)

* On earlier units, separate gaskets were provided for the air-valve plate and the vacuum-valve plate.

DESCRIPTION

The vacuum servo comprises two main assemblies—a vacuum cylinder and a slave cylinder—which are held together by four bolts and have a gasket (29) interposed between ; the slave cylinder incorporates an integral valve device by means of which the servo is operated

A vacuum piston assembly (8—19) is contained within the vacuum cylinder shell (28) and is loaded by a spring (7) ; the piston carries a push-rod (8) and is retained by an end cover (22) which incorporates a wire-mesh air filter. Four bolts (27, 64) secure the cover to the shell, the two longer ones also serve to secure the servo to the car.

The slave cylinder body (30) is fitted with a spring-loaded piston (60) which is sealed by a rubber cup (59) and, when the servo is operating, is displaced by the vacuum piston push-rod ; this latter part passes through a support (63) and a seal (62) which is maintained in position by a distance piece (61). At the outer end of the body a check valve assembly (55) is fitted, comprising an end plug which is screwed into a valve housing and contains a dome-shaped valve body which is spring loaded against a rubber valve seat ; the body is drilled with a number of holes and has a rubber seal riveted to its concave side.

The control valve comprises a piston (40), an air valve assembly (48-51), a vacuum valve assembly (35-38), and a spring loaded diaphragm assembly (5), the latter being retained by the valve cover (3) ; a balance arm (42) is pivoted to the piston and carries the heads of the two valve stems (35, 48). The piston carries a rubber cup (39), whilst the valve stems are fitted with rubber seals (36, 49) and seal retainers (37, 50) which are kept in position by means of circlips (38, 51) ; a light spring (52) loads the air valve and seats on a plate (53) which retains a wire mesh air filter (54). Seating surfaces for the two valves are provided by an air valve plate (46) and a vacuum valve plate (32), the former of these is turned up at one end to provide a guide for the balance arm.

NOTE.—In some units the valve piston operates within a sleeve and carries a distance piece which limits its inward travel (refer to Fig. 34) ; a groove surrounding the outer end of the sleeve contains a rubber seal backed by a washer, these parts being retained by the air valve plate ; the sleeve is pressed into the body and cannot be removed.

There are two threaded connections at the side of the slave cylinder body, the smaller of these is connected to the master cylinder and communicates with the bore containing the piston (40) ; this bore is in turn communicated with the main bore of the slave cylinder

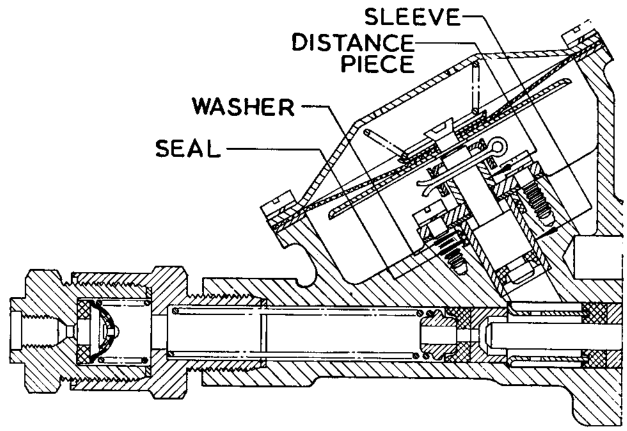


Fig. 34. Section view showing the hydraulic check valve at end of slave cylinder and alternative type of control valve assembly.

and breaks in at a point adjacent to the distance piece (61). The larger connection is communicated with the inlet manifold of the engine and also breaks into the bore which accommodates the vacuum valve. The control valve chamber and the vacuum shell are in communication by way of holes drilled in the jointing faces of the slave cylinder body and the shell.

PRINCIPLE OF OPERATION

Operation of the vacuum servo is portrayed, in purely diagrammatic form, on Figs. 35, 36, 37 which should be studied in conjunction with the following text. The diagrams closely follow the layout of the actual unit but, for convenience, the control valve is shown divorced from the slave cylinder (whereas it is actually an integral part of the cylinder) and the various channels are shown externally (whereas, on the actual unit, they are formed internally in the slave cylinder body and the vacuum shell).

When the brakes are " off " the servo is at rest, as illustrated on Fig. 35, and the following conditions obtain :—

(*a*) The valve operating piston and the vacuum piston are being held back by their respective springs.

(*b*) The air valve is under load from its spring and is attempting to tip the balance arm, thus holding the vacuum valve against its seat ; in addition the vacuum valve is being sucked on to its seat by the vacuum from the engine inlet manifold. The air valve cannot close on to its seat as its movement is limited by the balance arm.

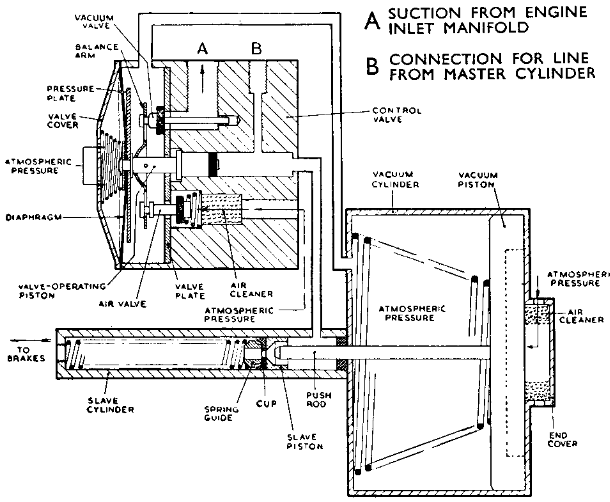


Fig. 35.

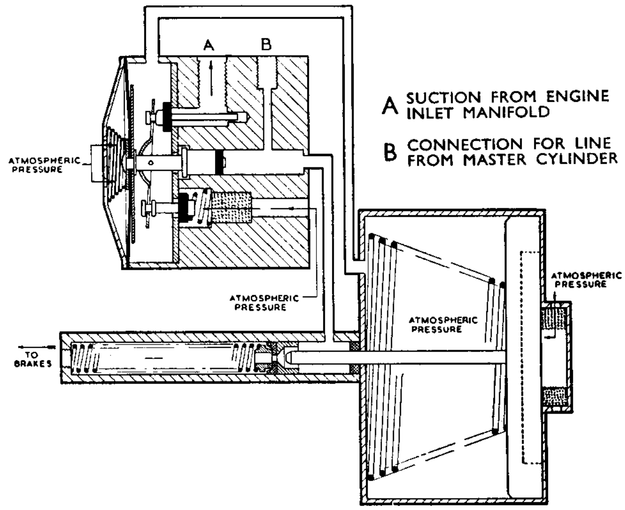


Fig. 36.

(*c*) As the air valve is off its seat, it allows atmospheric pressure to be admitted to the side of the vacuum piston at which the spring is located, and to the side of the diaphragm on which the pressure plate is located.

(*d*) Atmospheric pressure is also present on the other side of the vacuum piston and of the diaphragm, and is admitted by way of a slot in the vacuum shell end cover and holes in the valve cover respectively.

When the brake pedal is depressed, fluid is displaced from the master cylinder to the wheel cylinders, via the slave cylinder, and passes through the holes in the slave piston, the cup, the spring guide and the check valve body (the seal on the latter having been lifted away from the holes). Meanwhile the fluid pressure generated by the master cylinder is also felt upon the rear face of the valve operating piston in the servo, and creates the following conditions (refer to Fig. 36) :

(*a*) The valve operating piston is displaced, against the load of its spring, and tilts the balance arm, which causes the air valve to close on to its seat, thus preventing further flow of air past it.

(*b*) The vacuum valve is seated as with the unit at rest.

(*c*) The vacuum piston is being held back by its spring, and atmospheric pressure is present on each side of the piston and of the diaphragm.

When the air valve reaches its seat, continued movement of the piston causes the balance arm to pivot about the head of the valve, with the following results (refer to Fig. 37) :—

(*a*) The vacuum valve is lifted away from its seat and air is sucked from the spring side of the vacuum piston and from the pressure plate side of the diaphragm.

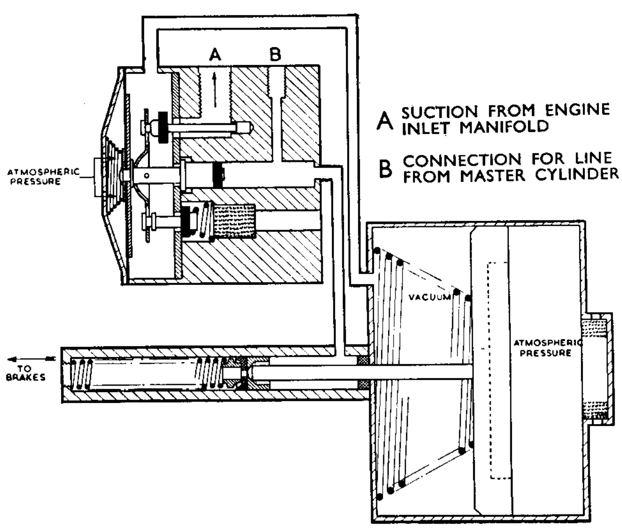


Fig. 37.

(*b*) The atmospheric pressure on the opposite side of the vacuum piston imposes a force which overcomes the spring loading and displaces the piston, causing the push-rod to move nearer to the cup and to seal-off the hole in its centre.

(*c*) As the push-rod has sealed off the hole in the cup, there is a locked " line " of fluid to the brakes ; continued load on the vacuum piston, generated by the pressure difference across it, boosts the pressure in the " line " to the wheel cylinders and so augments the driver's effort in applying the brakes.

Movement of the vacuum piston will continue until such time as the degree of vacuum (or suction) on the pressure plate side of the diaphragm is sufficient to overcome the load applied to the valve operating piston and to suck the diaphragm back to the position in which it is shown on Fig. 36. This movement of the diaphragm displaces the valve operating piston away from the valve plate, which causes the balance arm to tilt and the vacuum valve to resume its seat, so isolating the vacuum source and preventing further movement of the vacuum piston.

Further load on the brake pedal will re-open the vacuum valve and result in an increased thrust on the vacuum piston, giving a greater boost to the fluid pressure in the " line " to the brakes. When the pressure difference across the diaphragm is sufficient to overcome the load applied to the valve operating piston, the vacuum valve will again close, as already described. This proportioning of the output to the input pressure continues up to the limit of the depression given by the engine inlet manifold.

Upon the load being removed from the brake pedal, the servo returns to the state shown on Fig. 35, and the following conditions obtain :—

(*a*) The spring behind the diaphragm returns the valve operating piston to the " off " position.

(*b*) The vacuum valve is seated, sealing off the source of vacuum.

(*c*) The air valve opens and allows air to flow to the pressure plate side of the diaphragm and to the spring side of the vacuum piston. The spring is then able to return the vacuum piston to the " off " position.

(*d*) As the vacuum piston returns to the " off " position, the push-rod moves away from the cup in the slave cylinder and allows fluid, under the load of the brake shoe pull-off springs, to lift the check valve body off its seat and return from the brakes to the master cylinder.

(*e*) When the pressure in the brake " line " drops to a pre-determined value, the check valve body resumes its seat, due to the spring loading, so trapping the residual pressure between the servo and the brake assemblies. This pressure, whilst not sufficient to cause brake drag, ensures that the wheel cylinder piston seals are kept in close contact with the cylinder bores, hence precluding the entry of air into the system.

DISMANTLING

The following procedure is recommended to dismantle the vacuum servo :—

Remove the valve cover fixing screws, slackening them evenly and equally to take up the spring load, and detach the cover, the diaphragm and the gasket from the body.

Extract the split pin, detach the stem retainer, and remove the four screws securing the air valve plate.

Withdraw the balance arm together with the two valves and the plate, and extract the spring. Remove the two remaining screws, detach the vacuum valve plate and the gasket, and withdraw the piston. Disengage the valves from the balance arm, disconnect the circlip from each of the valve stems, take off the seal retainers and ease the seals off the stems ; ease the cup off the piston. Extract the retainer plate from the body.

Whilst holding the vacuum shell end cover in position against the load of the spring, remove the four nuts and bolts securing it to the shell ; withdraw the vacuum piston and the spring from the shell and disengage the gasket from the cover.

Remove the nut from the vacuum piston push-rod and take the various parts off the push - rod. Disengage the wick retainer, noting that there are barbs on it which stick into the wick.

Bend back the tabs of the two locking plates inside the vacuum shell and remove the four bolts which secure the abutment plate and the slave cylinder, disengage the cylinder from the shell and collect the gasket.

Withdraw the push-rod support from the slave cylinder body and, at the other end, unscrew the complete check valve assembly (this assembly must not be dismantled) ; withdraw the spring and the spring guide and extract the gasket. Insert a wooden rod into the threaded end of the bore and push out the remaining parts.

ASSEMBLY

The following procedure is recommended for assembling the vacuum servo, using new parts as necessary and new seals throughout :—

NOTE.—The leather cup used on the vacuum piston must be pliable.

Insert the distance piece, larger diameter innermost, into the plain end of the slave cylinder bore, followed by the push-rod seal, lip innermost, ensuring that the lip is not turned back or buckled; insert the push-rod support. Insert the piston, recessed face innermost, into the other end of the bore, follow up with the cup, flat face innermost, and push right down the bore with a wooden rod. Fit the gasket squarely at the bottom of the threaded portion of the bore ; place the spring guide in one end of the spring and insert the spring, with the guide innermost ; fit the check valve assembly and screw it firmly home.

Ensure that the push-rod support is still in position, then hold the slave cylinder with the jointing face uppermost and place upon it the gasket and the vacuum shell, correctly aligned. Locate the abutment plate and the two locking plates, in that order, inside the shell, fit the four bolts and bend up the ears of the locking plates.

Whilst taking care to avoid damage to the high surface finish of the push-rod, hold the rod vertically in the vice, gripping on the hexagon, with the threaded end uppermost. Place the locating washer on the push-rod, followed by the inner piston plate, with the lip facing downwards. Ease the round section rubber seal on to the push-rod and move it right up to the plate ; place the leather cup on the plate, with the lip uppermost. Locate the outer piston plate on the push-rod and inside the leather cup, with the lip of the plate facing downwards.

Fit the wick inside the cup, bend the wick retainer into a circular form (with the barbs outermost), locate the retainer inside the wick and engage the forked end with the tab.

Place the end stop on the push-rod, with the raised side downwards and with the cut-away portion over the bent end of the wick retainer. Fit the backing washer, the shakeproof washer and the nut, and screw the nut firmly home.

Remove the assembly from the vice.

Lightly smear the inside of the vacuum shell with an approved vacuum cylinder oil (we recommend Shell Tellus 33), taking care to ensure that this oil does not come into contact with any of the rubber parts. Hold the assembly with the slave cylinder pointing downwards and insert the spring, larger end innermost, into the shell, engage the vacuum piston with the small end of the spring and push inwards until the piston enters the shell, depress several times and allow to return unassisted to check that there is not excessive friction between the leather cup and the shell. Hold the piston against the spring load and fit the gasket and the end cover, using the four bolts, nuts and shakeproof washers. Note that the end cover is to be positioned so that, when looking from that end (with the large opening in the slave cylinder facing upwards), the slot at the side of the cover is on the right ; also the two shorter bolts are to be fitted on the same side as the opening in the slave cylinder.

Ease a seal into the appropriate groove in the air valve stem and the vacuum valve stem, so that the lip of each seal is pointing away from the circlip groove in the stem ; place a seal retainer on each of the seals and secure with a circlip. Ease the cup on to the piston, with the lip outermost, and gently work round the cup with the fingers, to ensure correct bedding ; insert the piston into the central hole in the slave cylinder body, easing the lip of the cup past the edge of the hole. Place the gasket (on earlier units separate gaskets were provided for the air valve plate and the vacuum valve plate) and the vacuum valve plate in position inside the body and secure the plate with two screws and shakeproof washers.

Hold the air valve plate with the turned over portion pointing upwards, and place upon it the balance arm, engaging the slotted end of that part with the turned over portion of the plate. Pass the stem of the air valve through both parts, using the hole nearer to the turned over end of the plate, and engage it with the slot in the balance arm ; engage the vacuum valve with the slot at the other end of the arm.

After ensuring that the wire mesh air filter is in position in the body, place the retainer plate on top of it and follow with the spring (with the larger end innermost).

Offer up the balance arm and valve assembly to the body, with the air valve engaging the spring ;

ensure that the stem of the vacuum valve enters the hole drilled across the larger connection in the body. Whilst holding the air valve plate against the body, adjust the position of the air valve so that it can move downwards and return freely, then fit the four screws and shakeproof washers to secure the plate. Place the stem retainer on the balance arm, align the split-pin holes in the retainer, the arm and the piston, fit the split pin through these parts and bend the legs over. Check again that the valves are able to move freely up and down.

Locate the gasket on the slave cylinder body and place the diaphragm upon it ; the larger plate on the diaphragm is to be innermost. Rest the smaller end of the spring on the centre plate of the diaphragm and fit the valve cover to the body, using the eight screws and shakeproof washers.

After refitting the vacuum servo to the vehicle it will be necessary to bleed the braking system.

THE SECOND TYPE SERVO UNIT

On cars with the following chassis numbers and onwards

	Right-hand Drive	Left-hand Drive
2.4 litre	908095	942483
3.4 litre	970948	986592

the servo unit is fitted with an adjustable type of push rod and a similar slave cylinder arrangement to that incorporated in the $6\frac{7}{8}''$ servo unit and which is illustrated in Fig. 40.

When assembling this type of servo unit it is important to ensure that .060″ to .070″ (1.5 to 1.8 mm.) clearance exists between the end of the push-rod and the piston (H, Fig. 40).

To check this clearance, completely assemble the slave cylinder except for the rubber cup, spring guide, spring and outlet adaptor (that is, items 57, 52, 53 and 55 in Fig. 41). Completely assemble the vacuum cylinder.

Insert the piston (51, Fig. 41) hollow end leading, into the slave cylinder, and push down the bore until it contacts the distance piece. Use a depth gauge to measure the distance between the outer face of the piston and the end of the bore, then pass the depth gauge through the hole in the piston and measure the distance between the end of the push-rod and the end of the bore ; the difference between these dimensions should be between 0.060″ and 0.070″ (1.5 to 1.8 mm.). If the clearance is not within these limits it will be necessary to remove the end cover and, after slackening the locknut, to adjust the push-rod by means of a screwdriver (see Fig. 38). Replace the end cover and once more check the clearance ; repeat this procedure, if necessary, until the correct figure is obtained, then tighten the locknut whilst holding the push-rod against rotation, and refit the end cover.

NOTE.—For one complete revolution, the end of the push-rod will travel .053″ (.9 mm.). Turning the screwdriver clockwise will reduce the clearance between the end of the push-rod and the piston ; turning the screwdriver anti-clockwise will increase the clearance.

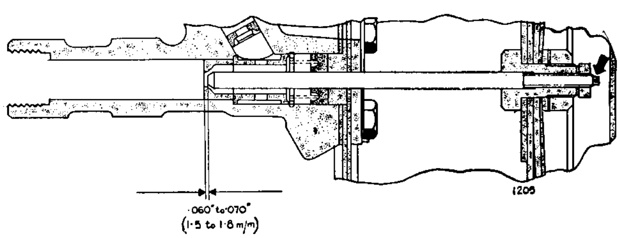


Fig. 38. When assembled there must be .060″ to .070″ (1.5 to 1.8 mm.) clearance between the end of the push-rod and the piston. The clearance is adjusted by means of a screwdriver at the point indicated by the arrow.

THE $6\frac{7}{8}''$ VACUUM SERVO UNIT

The $6\frac{7}{8}''$ Servo Unit is fitted to all 2.4 and 3.4 litre cars with disc brakes and also to cars fitted with drum brakes on and after the following chassis numbers :—

	Right-hand Drive	Left-hand Drive
2.4 litre - - -	909061	942677
3.4 litre - - -	971732	987406

Prior to the above chassis numbers, cars with drum brakes were fitted with a $5\frac{1}{2}''$ servo unit which is dealt with in the preceding sub-section.

NOTE : 1. There is a variation between the $6\frac{7}{8}''$ servo unit fitted to cars with disc brakes and the unit fitted to cars with drum brakes, in the connection at the end of the slave cylinder. For use on cars with disc brakes an outlet adaptor is fitted, whereas on cars with drum brakes the servo slave cylinder has an hydraulic check valve fitted. Fig. 39 illustrates the distinguishing features between the outlet adaptor and the early type hydraulic check valve. On later servo units the check valve is incorporated in the slave cylinder and is retained by an outlet adaptor.

2. In conjunction with the fitting of the $6\frac{7}{8}''$ servo unit on cars with drum brakes, a brake pedal of reduced ratio is fitted. The dimension between the centres of the pedal pivot hole and the hole for the master cylinder push-rod being increased from $2\frac{3}{8}''$ (60.3 mm.) to $2\frac{9}{16}''$ (65.1 mm.).

DESCRIPTION

The vacuum servo is a unit which provides the driver with a degree of assistance when applying the brakes, and is installed in the line between the master cylinder and the brake assemblies ; power for its operation is supplied by atmospheric pressure and by vacuum from the engine inlet manifold. The unit consists mainly of a booster piston, a slave cylinder and a control valve.

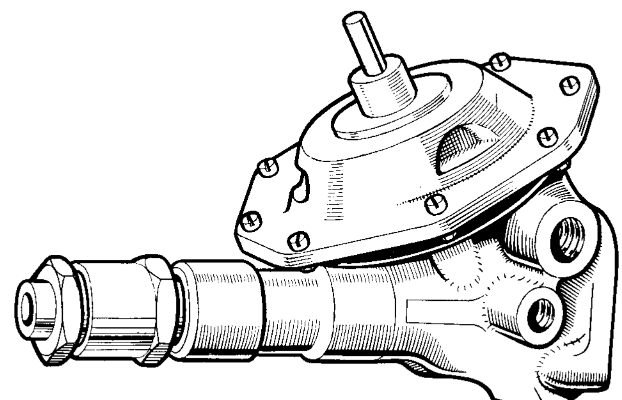
With the servo in the released condition, the piston is held " off " by means of a spring, and whatever degree of vacuum exists in the engine inlet manifold is also present on each side of the booster piston.

When the brake pedal is depressed, fluid pressure created by the master cylinder causes the control valve to admit atmospheric pressure which acts upon the rear face of the piston and drives it forward, so boosting the pressure within the slave cylinder and assisting the driver in applying the brakes.

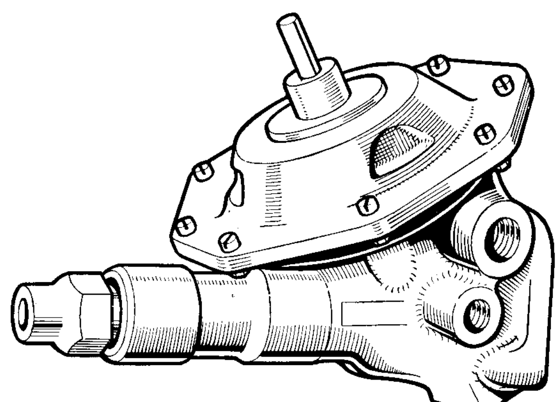
PRINCIPLE OF OPERATION

When the servo is at rest, the valve piston (D, Fig. 40) and the diaphragm (A) are in the normal position ; valve (B) is open and valve (C) is closed, the valves being maintained in position by a tapered spring.

A pipe connection communicates the slave cylinder (L) with the engine inlet manifold so that, when the engine is running, vacuum is present within chambers (P) and (Q). Additionally, whatever degree of vacuum exists within chamber (P) will also be present in chamber (N), via the opening in the centre of the diaphragm (A), and to chamber (R) via the pipe (F).



CHECK VALVE–DRUM BRAKES



OUTLET ADAPTER–DISC BRAKES

Fig. 39. Showing the distinguishing features between the check valve fitted to drum brake servo units and the outlet adaptor fitted to disc brake servo units. On later servo units the check valve is incorporated in the slave cylinder and is retained by an outlet adaptor.

Upon depressing the brake pedal, fluid is displaced from the master cylinder to the wheel cylinders, via the slave cylinder, and passes through the holes in the slave piston (H), cup (J), spring guide (K) and the adaptor (M).

Meanwhile the fluid pressure generated by the master cylinder is also felt upon the rear face of the valve piston (D) which is displaced against the load of the diaphragm spring ; this movement deflects the diaphragm (A) until it bears against the valve (B), and the seal thus formed isolates the suction source from chambers (N) and (R). Continued movement of the piston opens the air valve (C) permitting air to enter chamber (N) and to pass to chamber (R) via the external pipe.

This reduction in the degree of vacuum causes the vacuum piston to move forward, at the same time transmitting movement to the push-rod (E), allowing it to move nearer to the cup (J) and seal off the hole in its centre, thus creating a locked " line " of fluid to the brakes ; continued movement of the piston increases the pressure in the slave cylinder and the brake line, thereby assisting the driver in applying the brakes. The reduction of vacuum is, of course, also apparent within chamber (N), resulting in the creation of a pressure difference across the diaphragm in opposition to the force applied by the master cylinder pressure to the piston (D) ; when these opposing forces balance, the rearward deflection of the diaphragm allows the outer valve to close on its seat and prevent further entry of air.

Greater effort upon the brake pedal increases the thrust upon the piston (D) which reopens the outer valve and allows a greater amount of effort to be performed by the vacuum piston ; when opposing forces on the diaphragm are once more in balance the air valve will again close on to its seat. It will be apparent, therefore, that the diaphragm acts as a " proportioning " device, ensuring that the performance of the servo is substantially progressive. When the brake pedal is released, pressure is removed from the valve piston (D), allowing the diaphragm spring to push the diaphragm back to its original position and thereby re-connecting chambers (N) and (R) to the manifold. The spring is then able to return the vacuum piston to the " off " position, causing the push-rod (E) to move away from the cup in the slave cylinder and so permit the fluid to return from the brakes to the master cylinder.

DISMANTLING THE SERVO

Ease the flexible hose (18, Fig. 41) away from the joint in the pipe. Remove the six nuts (36) which secure the end cover to the vacuum cylinder, taking care to sustain the internal spring load, and remove the end cover.

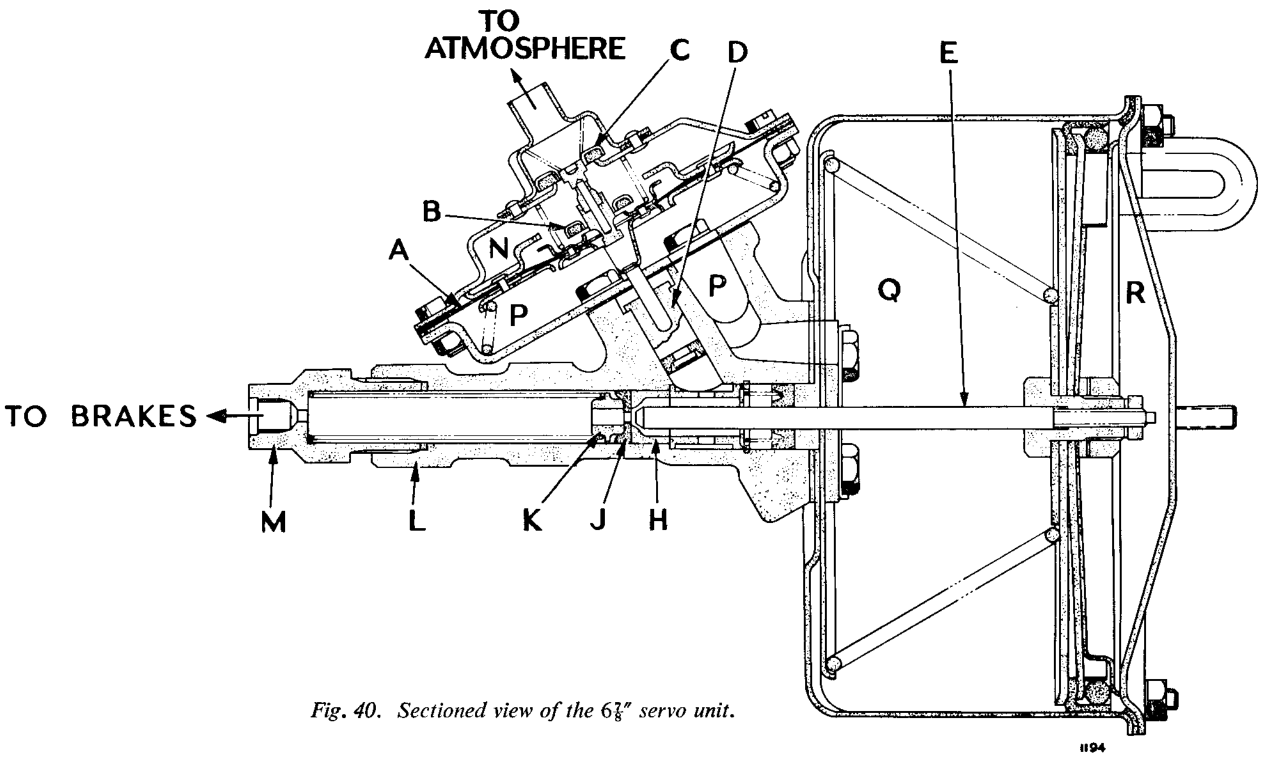


Fig. 40. Sectioned view of the $6\frac{7}{8}''$ servo unit.

The vacuum piston has an adjustable push-rod (19), the setting of which controls the space between the slave cylinder piston (51) and the push-rod. This adjustment should not be disturbed unnecessarily.

Withdraw the vacuum piston assembly from the cylinder. Grip the assembly in the vice by the hexagonal centre piece (21), unscrew the large nut (33) and lift off the various components.

Detach the slave cylinder (56) from the vacuum cylinder ; collect the spigot (48), the seal (60) and the coil spring (49). Unscrew the adaptor (55) and collect the gasket (54), the spring (53) and spring guide (52). Remove the circlip (59) and expel the remaining internal parts with the aid of a pencil, inserted through the threaded end of the cylinder bore.

Remove the eight screws to detach the control valve cover (2) and collect the diaphragm, gasket and springs ; the valves cannot be removed from the cover. Detach the housing (10) from the slave cylinder and expel the piston (14) with a bent piece of brass rod. Remove the seal (15) from the piston.

ASSEMBLING THE SERVO

Prior to assembly, examine all parts and make any necessary replacements. If the bore of the vacuum cylinder is slightly corroded, it may be polished with fine emery cloth and steel wool, but if pitting or scoring is present a new part should be fitted. Soak all rubber parts, including the hydraulic piston, in brake fluid before assembly, and ensure that the leather cup for the vacuum piston is pliable ; if not, it should be soaked in an approved vacuum cylinder oil, such as Shell Tellus 33.

NOTE.—When fitting the valve housing (10) and the slave cylinder (56) the retaining bolts are to be tightened to a torque reading of 100/120 and 150 lb. ins. respectively.

Commence assembly by engaging the seal (15) on the end of the air valve piston (14) ; insert the pistons into the appropriate bore of the slave cylinder body (56) and then attach the valve housing (10), position the spring (7), locate a gasket (6), the diaphragm assembly (5) and a further gasket (4) on the valve housing ; place the other spring (3) in the diaphragm and offer up and secure the control valve cover.

Position the distance piece (58) in the bore of the slave cylinder and fit the washer (50) and the circlip (59), the coil spring (49), the seal (60) and the spigot (48). Locate the gasket (16) on the spigot, aligned with the holes in the body, offer up the vacuum cylinder (45)

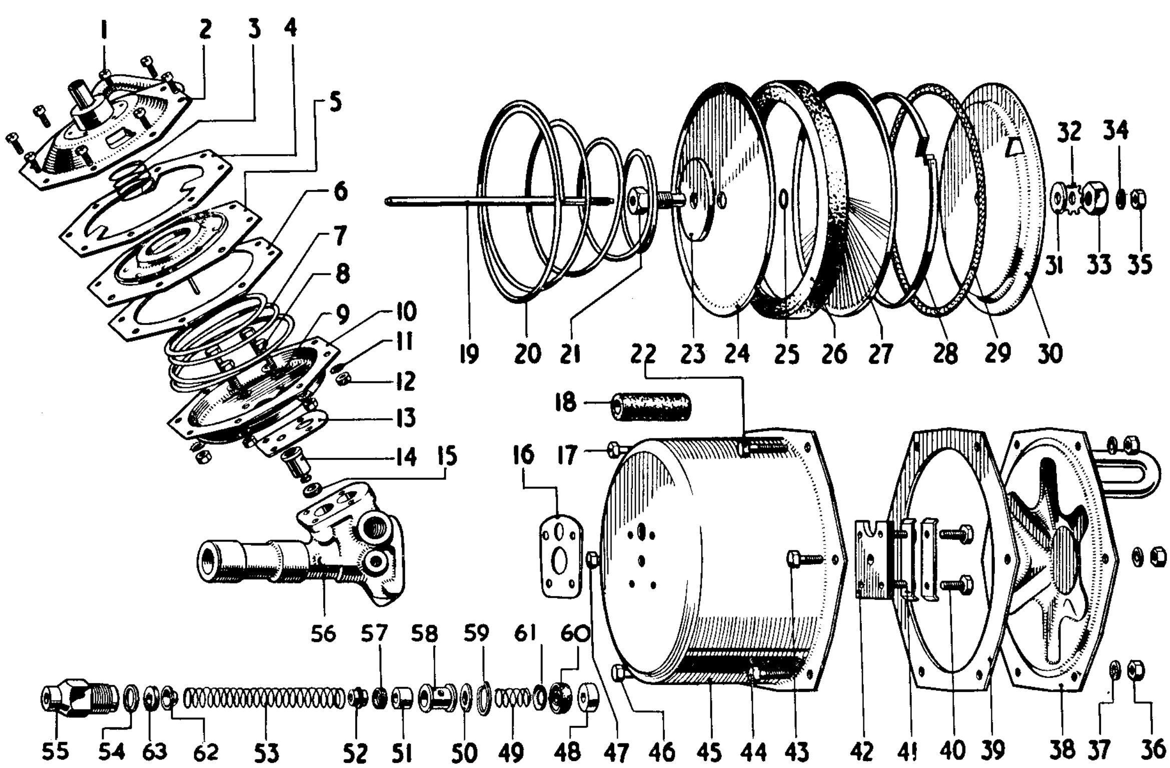


Fig. 41. Exploded view of the $6\frac{7}{8}''$ servo unit.

1. Setscrew
2. Valve cover
3. Spring
4. Gasket
5. Diaphragm
6. Gasket
7. Spring
8. Bolt
9. Shakeproof washer
10. Valve housing
11. Shakeproof washer
12. Nut
13. Gasket
14. Piston
15. Seal
16. Gasket
17. Bolt (short)
18. Rubber hose
19. Push-rod
20. Spring
21. Centre piece
22. Bolt (long)
23. Locating washer
24. Piston plate (inner)
25. 'O' section seal
26. Leather cup
27. Piston plate (outer)
28. Wick retainer
29. Wick
30. End stop
31. Backing washer
32. Shakeproof washer
33. Nut
34. Copper gasket
35. Locknut
36. Nut
37. Shakeproof washer
38. End cover
39. End cover gasket
40. Bolt
41. Locking plate
42. Abutment plate
43. Bolt (short)
44. Bolt (long)
45. Vacuum cylinder
46. Bolt (long)
47. Bolt (short)
48. Spigot
49. Spring
50. Washer
51. Piston
52. Spring guide
53. Spring
54. Copper gasket
55. Adapter
56. Slave cylinder body
57. Rubber cup
58. Distance piece
59. Circlip
60. Push-rod seal
61. Cup spreader
62. Check valve } (cars
63. Rubber seat } with drum brakes only).

followed by the plate (42), and secure the assembly with the locking plates and bolts.

Assemble the vacuum piston by gripping the push-rod (19) in the vice by the hexagonal portion of the centre piece (21). Fit the large plain washer (23) and the larger of the two piston plates—with the lip facing downwards.

Place the piston leather (26) on the plate (24) and pass the 'O' seal (25) over the centre piece. Fit the other piston plate (27) and arrange the felt wick (29) within the lip of the leather cup. Bend the spring steel wick retainer (28) into a circle, with the barbs facing outwards; locate the retainer within the wick and engage its forked end within the tab. Place the end stop (30) over the threaded end of the centre piece with its raised side downwards and with the cut away portion over the bent end of the wick retainer. Fit the plain washer (31), the shakeproof washer (32) and finally the nut (33).

Smear the bore of the vacuum cylinder with "Cosmolubic" 100 oil, or an approved equivalent. Mount the slave cylinder in the vice with the vacuum cylinder uppermost. Locate the return spring (20) within the cylinder and offer up the vacuum piston assembly, ensuring that the push-rod (19) passes cleanly through the parts in the slave cylinder bore. Place the gasket (39) in position and fit the end cover (38) securing it with the six bolts, shakeproof washers and nuts; centralise the flexible rubber hose (18) over the pipes.

Insert the piston (51), hollow end leading into the slave cylinder, and push it down the bore until it contacts the distance piece. Use a depth gauge to measure the distance between the outer face of the piston and the end of the bore, then pass the depth gauge through the hole in the piston and measure the distance between the end of the push-rod and the end of the bore; the difference between these dimensions should be between 0.060" and 0.070" (1.5 to 1.8 mm.). If the clearance is not within these limits it will be necessary to remove the end cover and after slackening the locknut, to adjust the push-rod by means of a screwdriver (see Fig. 42). Replace the end cover and once more check the clearance; repeat this procedure, if necessary, until the correct figure is obtained, then tighten the locknut whilst holding the push-rod against rotation, and refit the end cover.

NOTE.—For one complete revolution, the end of the push-rod will travel .035" (.9 mm.). Turning the screwdriver clockwise will reduce the clearance between the end of the push-rod and the piston; turning the screwdriver anti-clockwise will increase the clearance.

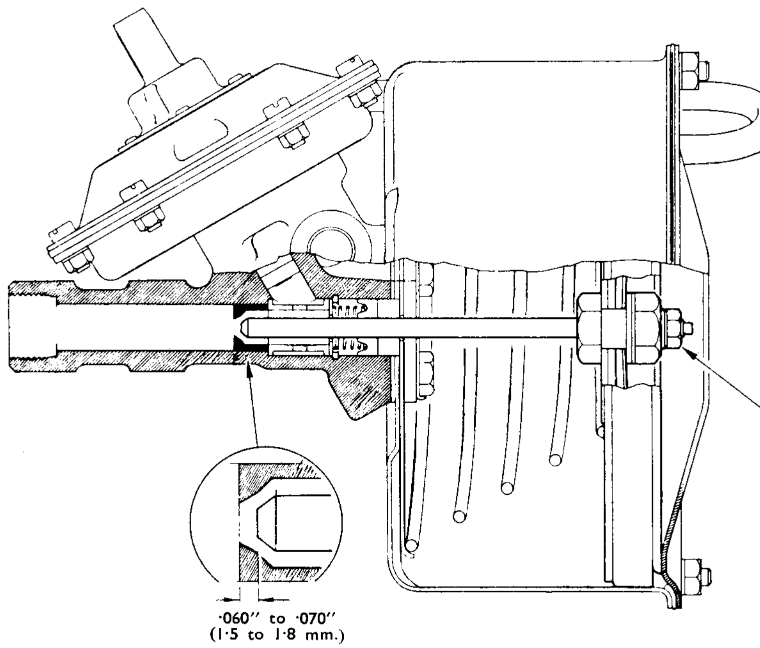


Fig. 42. When assembled there must be .060" to .070" (1.5 to 1.8 mm.) clearance between the end of the push-rod and the piston. The clearance is adjusted by means of a screwdriver at the point indicated by the arrow.

Insert the rubber cup (57) into the bore, flat face first, and position the copper gasket (54) on its seat at the end of the bore; locate the spring guide (52) in the end of the long coil spring and insert the assembly into the bore with the guide innermost; screw the adaptor (55) firmly home.

SUPPLEMENT TO

SECTION L

BRAKES

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone COVENTRY 62677 (P.B.X.) Code BENTLEY'S SECOND Telegraphic Address "JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/LS/4

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DISC BRAKES
(Quick Change Friction Pad Type)

This supplement deals with the following changes that have taken place since the issue of the " Brakes " section of the 2.4/3.4 litre Service Manual.

(i) Introduction of Bridge type calipers with quick change pads.

(ii) Introduction of a reservoir in the vacuum line between the servo unit and the inlet manifold.

Note : A vacuum check valve is attached to the reservoir which replaces the original types of check valve described on page L.32 of the " Brakes " section.

DESCRIPTION

Each wheel brake unit comprises a hub mounted disc rotating with the wheel, and a braking unit rigidly attached to the suspension member. The brake unit consists of a caliper which straddles the disc and houses a pair of rectangular friction pad assemblies, each comprising a pad and a securing plate. These assemblies locate between a keep plate bolted to the caliper bridge and two support plates accommodated in slots in the caliper jaw. Cylinder blocks bolted to the outer faces of the caliper accommodate piston assemblies which are keyed to the friction pad assemblies. A spigot formed on the outer face of each piston locates in the bore of a backing plate with an integral boss grooved to accommodate the collar of a flexible rubber dust seal. The outer rim of the seal engages a groove around the block face and so protects the assembly from intrusion of moisture and foreign matter. A piston seal is located between the piston inner face and a plate secured by peen locked screws. A counterbore in the piston accommodates a retractor bush which tightly grips the stem of a retractor pin. This pin forms part of an assembly which is peened into the base of the cylinder bore. The assembly comprises a retractor stop bush, two spring washers, a dished cap and the retractor pin ; it functions as a return spring and maintains a " brake-off " working clearance of approximately 0.008/0.010 in. (.20—.25 mm.) between the pads and the disc throughout the life of the pads.

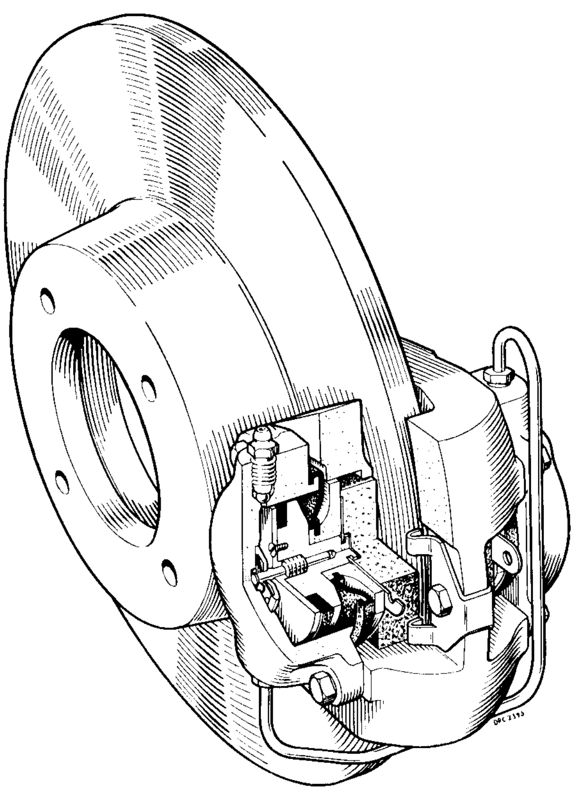

Fig. 1. Sectional view of front disc brake.

DISC BRAKES (2nd Type)

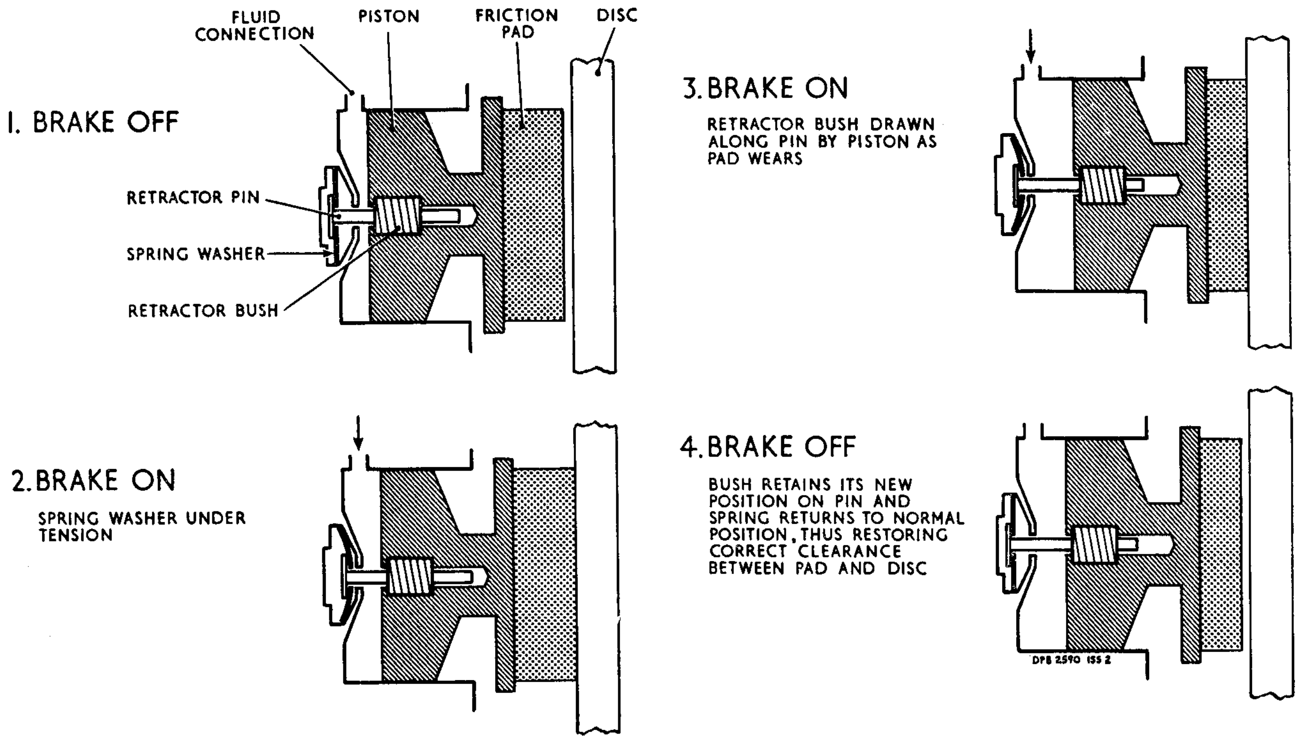

Fig. 2. Operation of self-adjusting mechanism.

DATA

Make	Dunlop.
Type	Bridge type calipers with quick change pads.
Brake disc diameter	$11\frac{3}{8}''$ (28.9 cm.)
Master cylinder bore diameter	$\frac{7}{8}''$ (22.22 mm.)
Master cylinder stroke	$1\frac{3}{8}''$ (35 mm.)
Brake cylinder bore diameter—front	$2\frac{1}{8}''$ (53.97 mm.)
Brake cylinder bore diameter—rear	$1\frac{1}{2}''$ (38.1 mm.)
Servo unit type	Lockheed $6\frac{7}{8}''$ (Suspended Vacuum Type)

Special Tools

Piston Re-setting Lever	Part Number 7840.

RENEWING THE FRICTION PADS

Brake adjustment is automatic during the wearing life of the pads. The pads should be checked for wear every 5,000 miles (8,000 km.) by visual observation and measurement ; when wear has reduced the pads to the minimum permissible thickness of $\frac{1}{4}''$ (7 mm.), the pad assemblies (complete with securing plates) must be renewed. If checking is neglected the need to renew the pads will be indicated by a loss of brake efficiency. The friction pads fitted have been selected as a result of intensive development, and it is essential at all times to use only factory approved material. To fit the new friction pad assemblies proceed as follows :—

Remove the nut, washer and bolt securing the keep plate and withdraw the plate.

With a suitable hooked implement engaged in the hole in the lug of the securing plate withdraw the defective pad assemblies.

Thoroughly clean the backing plate, dust seal, and the surrounding area of the caliper.

With the aid of the special tool press in the piston assemblies to the base of the cylinder bores as shown in Fig. 4.

NOTE : Before doing this, it is advisable to half empty the brake supply tank, otherwise forcing back the friction pads will eject fluid from the tank with possible damage to the paintwork. When all the new friction pads have been fitted, top up the supply tank to the recommended level.

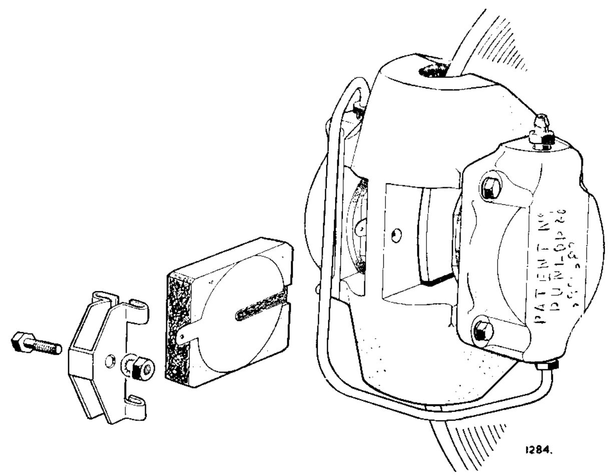

Fig. 3. Friction pad removal.

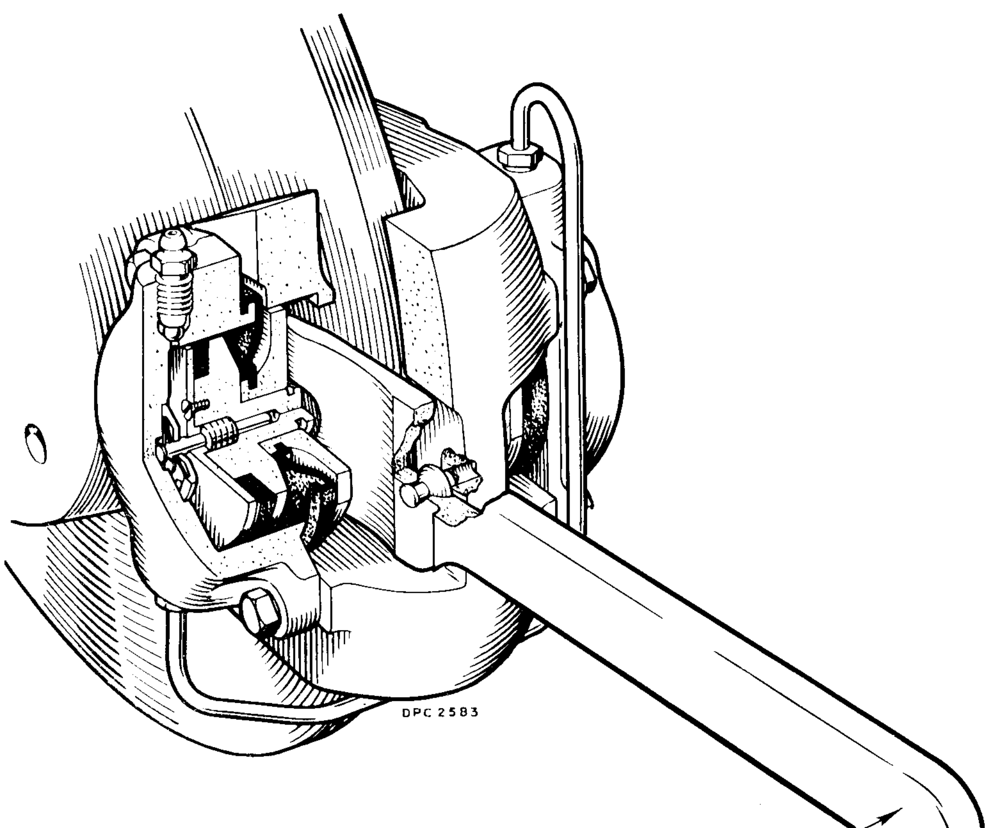

Fig. 4. Re-setting the pistons with special tool. (Part No. 7840).

Insert the forked end of the piston resetting lever into the space between the caliper bridge and one of the piston backing plates, with the fork astride the projecting piston spigot and its convex face bearing on the piston backing plate. Locate the spigot end of the lever pin in the keep plate bolt hole in the bridge. Pivot the lever about the pin to force the piston to the base of its cylinder. Insert the new friction pad assembly. Repeat this operation for the opposite piston assembly.

Replace the keep plate and secure it with the bolt, washer and nut.

RENEWING THE BRAKE PISTON SEALS

Leakage past the piston seals will be denoted by a fall in level in the fluid reservoir or by spongy pedal travel. It is recommended that the dust seal be renewed when fitting a new piston seal. Proceed as follows :—

Withdraw the brake pads as described in the previous paragraphs.

Disconnect and blank off the supply pipe and remove the bridge pipe.

Remove the mounting bolts securing the cylinder blocks to the caliper and withdraw the cylinder blocks. Thoroughly clean the blocks externally before proceeding with further dismantling.

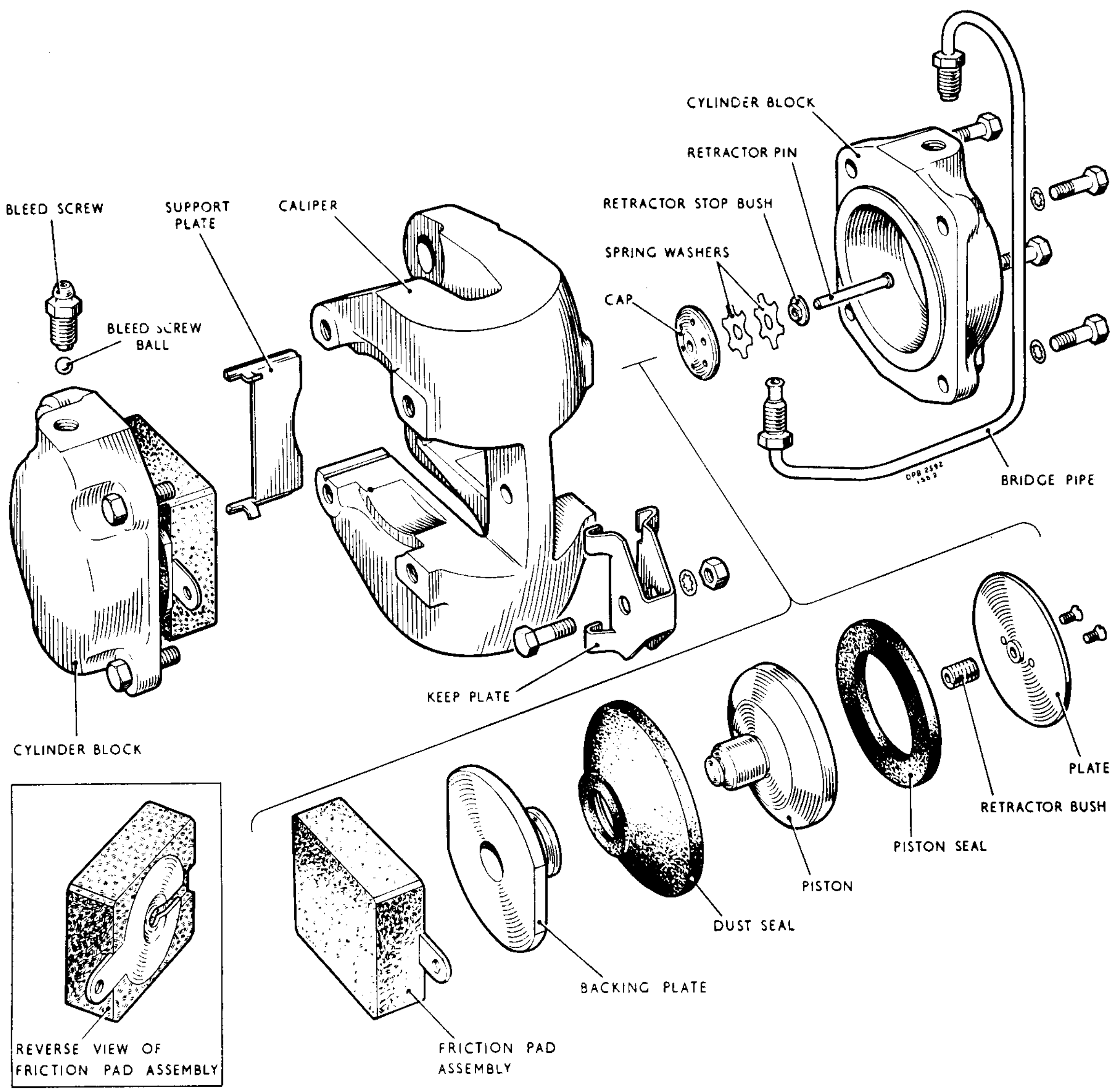

Fig. 5. Exploded view of front brake caliper.

Disengage the dust seal from the groove around the cylinder block face.

Connect the cylinder block to a source of fluid supply and apply pressure to eject the piston assembly.

Remove the screws securing the plate to the piston, lift off the plate and piston seal, withdraw the retractor bush from within the piston bore. Carefully cut away and discard the dust seal.

Support the backing plate on a bush of sufficient bore diameter to just accommodate the piston. With a suitable tubular distance piece placed against the end of the piston spigot and located around the shouldered head, press out this piston from the backing plate. Care must be taken during this operation to avoid damaging the piston.

Engage the collar of a new dust seal with the lip on the backing plate avoiding harmful stretching.

Locate the backing plate on the piston spigot and, with the piston suitably supported, press the backing plate fully home.

Insert the retractor bush into the bore of the piston. Lightly lubricate a new piston seal with brake fluid, and fit it to the piston face. Attach and secure the plate with the screws and peen lock the screws.

Check that the piston and the cylinder bore are thoroughly clean and show no signs of damage. Locate the piston assembly on the end of the retractor pin. With the aid of a hand press slowly apply an even pressure to the backing plate and press the assembly into the cylinder bore. During this operation ensure the piston assembly is in correct alignment in relation to the cylinder bore, and that the piston seal does not become twisted or trapped as it enters. Engage the outer rim of the dust seal in the groove around the cylinder block face. Ensure that the two support plates are in position.

Re-assemble the cylinder blocks to the caliper. Fit the bridge pipes ensuring that they are correctly positioned. Remove the blank and reconnect the supply pipe. Bleed the hydraulic system.

Important

It is essential that the bridge pipe is fitted with the " hairpin " bend end to the inboard cylinder block, that is, furthest from the road wheel (see Fig. 1). The bridge pipe carries a rubber identification sleeve marked " Inner Top ".

THE VACUUM RESERVOIR

The vacuum reservoir is incorporated in the vacuum line between the inlet manifold and the servo unit, and is located underneath the right-hand front wing forward of the wheel.

A vacuum check valve directly attached to the reservoir, replaces the original types of check valves described and illustrated on pages L.32 and L.33 of the " Brakes " section.

The rubber hoses must be connected to the vacuum check valve as follows : (see Fig. 6) :—

Hose from inlet manifold—to longer check valve connection.

Hose to servo—to shorter check valve connection.

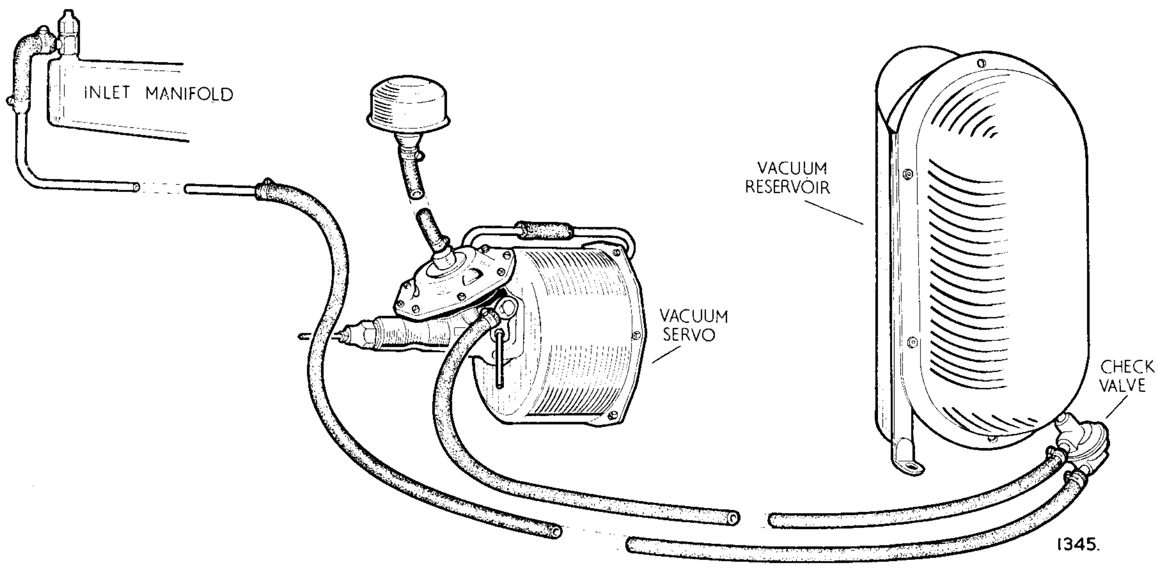

Fig. 6. Layout of vacuum servo system with reservoir.

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SECTION M

WHEELS AND TYRES

2·4 litre and 3·8 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone COVENTRY 27677 (P.B.X.) Code BENTLEY'S SECOND Telegraphic Address "JAGUAR," COVENTRY. Telex. 31/622

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TUBELESS TYRES

WHEELS AND TYRES

DESCRIPTION

Tubeless tyres are fitted to 2.4 litre cars with disc wheels and a conventional tyre and tube is used with wire wheels. Early 3.4 litre cars were fitted with R.S.3 type tyres but later models are fitted with the R.S.4 variety. Both R.S.3 and R.S.4 tyres are Known as Road Speed tyres and all tyres are of the 6.40 × 15 size.

Wire spoke wheels may be fitted to either model, as optional equipment, but early cars have sixty spokes per wheel, later cars have seventy-two spokes per wheel.

DATA

	2.4 litre	3.4 litre
Road Wheels - Type	Pressed steel discs or wire spoke (60 spoke or 72 spoke - see note)	
- Fixing (Disc)	5 studs, nuts	
(Wire spoke)	Centre lock, knock on hub cap	
- Rim section	Disc wheel $4\frac{1}{2}$J Wire wheels 5K	
- Rim diameter	15″ (381 mm.)	
Tyres - Make	Dunlop	
- Type	Tubeless (Disc wheels) Conventional (Wire wheels)	Road Speed (RS. 3 or RS. 4)
- Size	6.40 × 15″ (162.1 mm. × 381 mm.)	

Note: 60 spoke and 72 spoke wheels should only be fitted to individual cars in complete sets.

INFLATION PRESSURES

	Front	Rear
2.4 litre		
Normal driving	24 lbs. per sq. in. (1.69 kg/cm.^{2})	22 lbs. per sq. in. (1.55 kg/cm.^{2})
Fast touring (that is, long distances at maintained speeds of over 85 m.p.h. (135 k.p.h.)	30 lbs. per sq. in (2.11 kg/cm.^{2})	28 lbs. per sq. in. (1.97 kg/cm.^{2})
3.4 litre		
Normal driving	25 lbs. per sq. in. (1.76 kg/cm.^{2})	22 lbs. per sq. in. (1.55 kg/cm.^{2})
Fast touring .. .. (that is, long distances at sustained speeds of over 100 m.p.h. (160 k.p.h.) with short bursts at maximum speed)	31 lbs. per sq. in. (2.18 kg/cm.^{2})	28 lbs. per sq. in. (1.97 kg/cm.^{2})
For when maximum cap speed abilities are likely to be exploited to the full.	34 lbs. per sq. in. (2.39 kg/cm.^{2})	31 lbs. per sq. in. (2.18 kg/cm.^{2})

Note: Pressures should be checked when the tyres are cold, such as after standing overnight, and not when they have attained normal running temperatures.

TYRES—GENERAL INFORMATION

CONSTRUCTION OF THE TYRE

One of the principal functions of the tyres fitted to a car is to eliminate high frequency vibrations. They do this by virtue of the fact that the unsprung mass of each tyre—the part of the tyre in contact with the ground—is very small.

Tyres must be flexible and responsive. They must also be strong and tough to contain the air pressure, resist damage, give long mileage, transmit driving and braking forces, and at the same time provide road grip, stability and good steering properties.

Strength and resistance to wear are achieved by building the casing from several plies of cord fabric, secured at the rim position by wire bead cores, and adding a tough rubber tread. (Fig. 1).

Part of the work done in deflecting the tyres on a moving car is converted into heat within the tyres. Rubber and fabric are poor conductors and internal heat is not easily dissipated. Excessive temperatures weakens the tyre structure and reduces the resistance of the tread to abrasion by the road surface.

Heat generation, comfort, stability, power consumption, rate of tread wear, steering properties and other factors affecting the performance of the tyres and car are associated with the degree of tyre deflection. All tyres are designed to run at predetermined deflections, depending upon their size and purpose.

Load and Pressure Schedules are published by all tyre makers and are based on the correct relationship between tyre deflection, tyre size, load carried and inflation pressure. By following the recommendations the owner will obtain the best results both from the tyres and the car.

INFLATION PRESSURES

Tyres lose pressure, even when in sound condition, due to a chemical diffusion of the compressed air through the tube walls. The rate of loss in a sound tyre is usually between 1 lb. and 3 lb. per week, which may average 10% of the total initial pressure.

For this reason, and with the additional purpose of detecting slow punctures, **pressures should be checked with a tyre gauge applied to the valve not less than once per week.** (See under " Data " for correct pressures.)

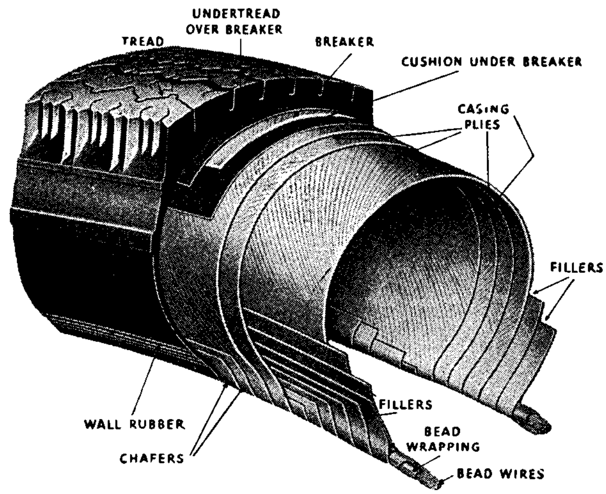

Fig. 1. Diagramatic illustration of the principle of tyre construction.

Any unusual pressure loss should be investigated. After making sure that the valve is not leaking the tube should be removed for a water test.

Do not overinflate, and do not reduce pressures which have increased owing to increased temperature. (See Section " FACTORS AFFECTING TYRE LIFE AND PERFORMANCE ".)

VALVE CORES AND CAPS

Valve cores are inexpensive and it is a wise precaution to renew them periodically.

Valve caps should always be fitted and renewed when the rubber seatings have become damaged after constant use.

TYRE EXAMINATION

Tyres on cars submitted for servicing should be examined for :

- Inflation pressures
- Degree and regularity of tread wear
- Misalignment
- Cuts and penetrations
- Small objects embedded in the treads, such as flints and nails
- Impact bruises
- Kerb damage on walls and shoulders
- Oil and grease
- Contact with the car

Oil and grease should be removed by using petrol sparingly. Paraffin is not sufficiently volatile and is not recommended.

If oil or grease on the tyres results from over lubrication or defective oil seals suitable correction should be made.

REPAIR OF INJURIES

Minor injuries confined to the tread rubber, such as from small pieces of glass or road dressing material, require no attention other than the removal of the objects. Cold filling compound or " stopping " is unnecessary in such cases.

More severe tread cuts and wall rubber damage, particularly if they penetrate to the outer ply of the fabric casing, require vulcanised repairs. The Dunlop Spot Vulcanising Unit is sold for this purpose and it is also suitable for all types of tube repairs.

Injuries which extend into or through the casing, except clean nail holes, seriously weaken the tyre. Satisfactory repair necessitates new fabric being built in and vulcanised. This requires expensive plant and should be undertaken by a tyre repair specialist or by the tyre maker.

Loose gaiters and " stick-in " fabric repair patches are not satisfactory substitutes for vulcanised repairs and should be used only as a temporary " get-you-home " measure if the tyre has any appreciable tread remaining. They can often be used successfully in tyres which are nearly worn out and which are not worth the cost of vulcanised repairs.

Clean nail holes do not necessitate cover repairs. If a nail has penetrated the cover the hole should be sealed by a tube patch attached to the inside of the casing. This will protect the tube from possible chafing at that point.

If nail holes are not clean, and particularly if frayed or fractured cords are visible inside the tyre, expert advice should be sought.

FACTORS AFFECTING TYRE LIFE AND PERFORMANCE

Inflation Pressures

Other things being equal there is an average loss of 13% tread mileage for every 10% reduction in inflation pressure below the recommended figure.

The tyre is designed so that there is minimum pattern shuffle on the road surface and a suitable distribution of load over the tyre's contact area when deflection is correct.

Moderate underinflation causes an increased rate of tread wear although the tyre's appearance may remain normal.

Fig. 2. Excessive tyre distortion from persistent underinflation causes rapid wear on the shoulders and leaves the centre standing proud.

Severe and persistent underinflation produces unmistakable evidence on the tread (Fig. 2). It also causes structural failure due to excessive friction and temperature within the casing. (Figs. 3 and 4).

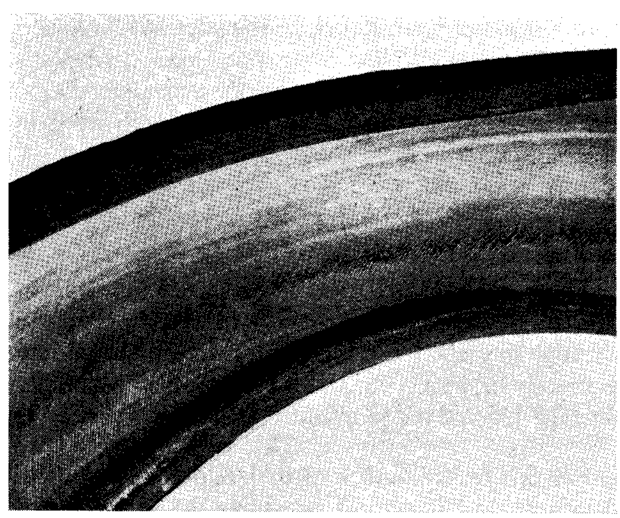

Fig 3 The case is breaking up due to over-flexing and heat generation.

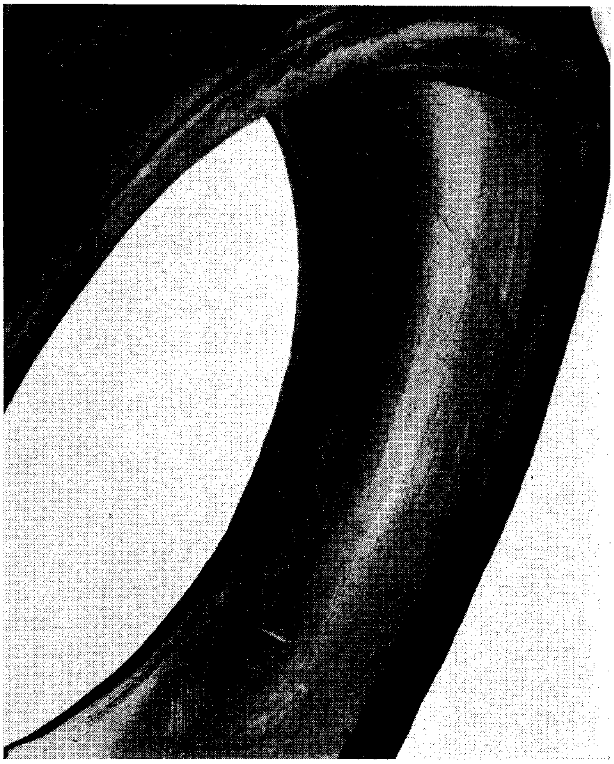

Fig. 4. Running deflated has destroyed this cover.

Pressures which are higher than those recommended for the car reduce comfort. They may also reduce tread life due to a concentration of the load and wear on a smaller area of tread, aggravated by increased wheel bounce on uneven road surfaces. Excessive pressures overstrain the casing cords, in addition to causing rapid wear, and the tyres are more susceptible to impact fractures and cuts.

Effect of Temperature

Air expands with heating and tyre pressures increase as the tyres warm up. Pressures increase more in hot weather than in cold weather and as the result of high speed. These factors are taken into account when designing the tyre and in preparing Load and Pressure Schedules.

Pressures in warm tyres should not be reduced to standard pressures for cold tyres. " Bleeding " the tyres increases their deflections and causes their temperatures to climb still higher. The tyres will also be underinflated when they have cooled.

Speed

High speed is expensive and the rate of tread wear may be twice as fast at 50 m.p.h. (80 k.p.h.) as at 30 m.p.h. (48 k.p.h.)

High speed involves :

1. Increased tyre temperature due to more deflections per minute and a faster rate of deflection and recovery. The resistance of the tread to abrasion decreases with increase in temperature.
2. Fierce acceleration and braking.
3. More tyre distortion and slip when negotiating bends and corners.
4. More " thrash " and " scuffing " from road surface irregularities.

Braking

" Driving on the brakes " increases rate of tyre wear, apart from being generally undesirable. It is not necessary for wheels to be locked for an abnormal amount of tread rubber to be worn away.

Other braking factors not directly connected with the method of driving can affect tyre wear. Correct balance and lining clearances, and freedom from binding, are very important. Braking may vary between one wheel position and another due to oil or foreign matter on the shoes even when the brake mechanism is free and correctly balanced.

Brakes should be re-lined and drums reconditioned in complete sets. Tyre wear may be affected if shoes are re-lined with non-standard material having unsuitable characteristics or dimensions, especially if the linings differ between one wheel position and another in such a way as to upset the brake balance. Front tyres, and particulary near front tyres, are very sentitive to any condition which adds to the severity of front braking in relation to the fear.

"Picking-up" of shoe lining leading edges can cause grab and reduce tyre life. Local "Pulling-up" or flats on the tread pattern can often be traced to brake drum eccentricity The braking varies during each wheel revolution as the minor and major axes of the eccentric drum pass alternately over the shoes. Drums should be free from excessive scoring and be true when mounted on their hubs with the road wheels attached.

Climatic Conditions

The rate of tread wear during a reasonably dry and warm summer can be twice as great as during an average winter.

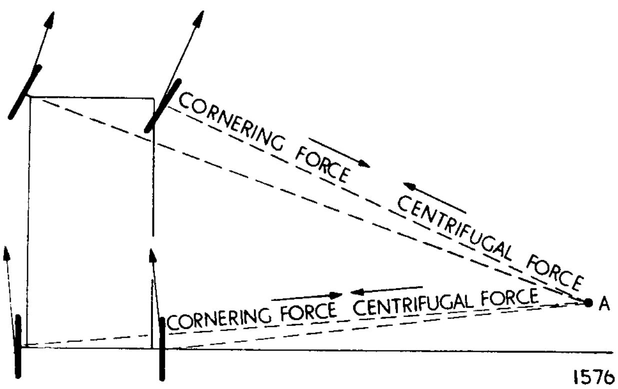

Fig. 5. Slip when cornering causes increased tyre wear.

Water is a rubber lubricant and tread abrasion is much less on wet roads than on dry roads. Also the resistance of the tread to abrasion decreases with increase in temperature. Increased abrasion on dry roads, plus increased temperatures of tyres and roads cause faster tyre wear during summer periods. For the same reason tyre wear is faster during dry years with comparatively little rainfall than during wet years.

When a tyre is new its thickness and pattern depth are at their greatest. It follows that heat generation and pattern distortion due to flexing, cornering, driving and braking are greater than when the tyres are part worn. Higher tread mileages will usally be obtained if new tyres are fitted in the Autumn or Winter rather than in Spring or Summer. This practise also tends to reduce risk of road delays because tyres are more easily cut and penetrated when they are wet than when they are dry. It is therefore advantageous to have maximum tread thickness during wet seasons of the year.

Road Surface

The extent to which road surfaces affect tyre mileage is not always realised.

Present day roads generally have a better non skid surface than formerly. This factor, combined with improved car performance, has tended to cause faster tyre wear, although developments in tread compounds and patterns have done much to offset the full effects.

Road surfaces vary widely between one part of the country and another, often due to surfacing with local materials. In some areas the surface dressing is coarser or of larger " mesh " than in others. The material may be comparatively harmless gravel or more abrasive crushed granite or knife edged flint. Examples of surfaces producing very slow tyre wear are smooth stone setts and wood blocks but their non-skid properties are poor.

Bends and corners are severe on tyres because a car can be steered only by misaligning its wheels relative to the direction of the car. This condition applies to the rear tyres as well as to the front tyres. The resulting tyre slip and distortion increase the rate of wear according to speed, load, road camber and other factors. (Fig. 5.)

The effect of hills, causing increased driving and braking torques with which the tyres must cope, needs no elaboration.

Road camber is a serious factor in tyre wear and the subject is discussed on page 11.

An analysis of tyre performance **must** include road conditions.

Impact Fractures

In order to provide adequate strength, resistance to wear, stability, road grip and other necessary qualities, a tyre has a certain thickness and stiffness. Excessive and sudden local distortion such as might result from striking a kerb, a large stone or brick, an upstanding manhole cover, or a deep pothole may fracture the casing cords. (Figs. 6 and 7.)

Fig. 6. Severe impact has fractured the casing.

Impact fractures often puzzle the car owner because the tyre and road spring may have absorbed the impact without his being aware of anything unusual ; only one or two casing cords may be fractured by the blow and the weakened tyre fails some time later ; there is usually no clear evidence on the outside of the tyre unless the object has been sufficiently sharp to cut it.

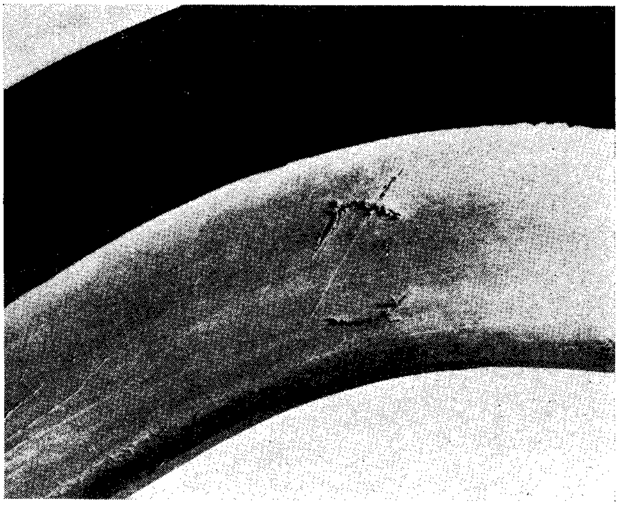

Fig. 7. A double fracture caused by the tyre being crushed between the rim and an obstacle, such as the edge of a kerb.

This damage is not associated solely with speed and care should be exercised at all times, particularly when drawing up to a kerb or parking against one.

" Spotty " Wear

Fig. 8 shows a type of irregular wear which sometimes develops on front tyres and particularly on near front tyres. The causes are difficult to diagnose although evidence of camber wear, misalignment, underinflation or braking troubles may be present.

Front tyres are at a disadvantage due to their fore and aft slip and distortion being in one direction. Front tyres are connected to the car through swivelling stub axles and jointed steering linkage and they are subjected to complicated movement resulting from steering, spring deflection, braking and camber. Load transfer during braking causes increased loading and pattern displacement on front tyres, and adds to the severity of front tyre operation.

Unbalance of the rotating assembly may also contribute to a special form of irregular wear with one half of the tyre's circumference more worn than the other half. Unbalance alone does not cause the type of " spotty " wear illustrated but the unbalance usually becomes progressively worse as the irregular or unequal wear develops.

The nature of " spotty-wear "—the pattern being much worn and little worn at irregular spacings round the circumference—indicates an alternating " slip-grip " phenomenon but it is seldom possible to associate its origin and development with any single cause.

It is preferable to check all points which may be contributory factors. The front tyre and wheel assemblies may then be interchanged, which will also reverse their direction of rotation, or better still the front tyres may be interchanged with the rear tyres.

Points for checking are :

(a) Inflation pressures and the consistency with which the pressures are maintained.

(b) Brake freedom and balance, shoe settings, lining condition, drum condition and truth.

(c) Wheel alignment.

(d) Camber and similarity of camber of the front wheels.

(e) Play in hub bearings, king pin bearings, suspension bearings and steering joints.

(f) Wheel concentricity at the tyre bead seats. S.M.M. & T. tolerances provide for a radial throw out exceeding $\frac{3}{32}''$ (2.38 mm.), but this may be affected by impact or other damage.

(g) Balance of the wheel and tyre assemblies.

(h) Condition of road springs and shock absorbers.

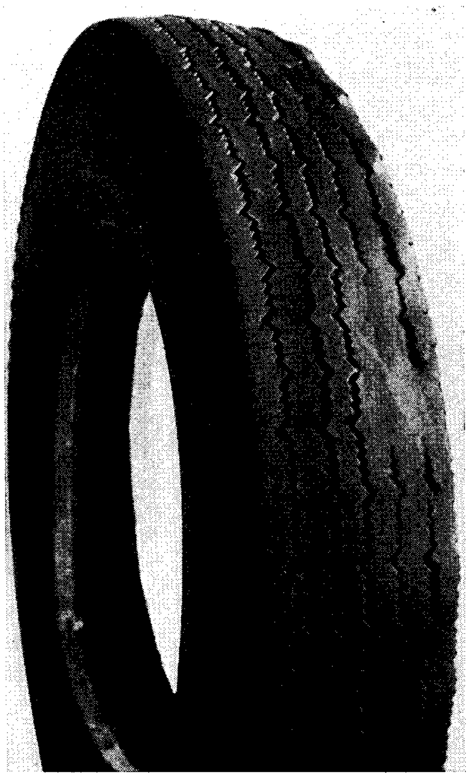

Fig. 8. Irregular " spotty " wear, to which a variety of causes may contribute.

Corrections which may follow a check of these points will not always effect a complete cure and it may be necessary to continue to interchange wheel positions and reverse directions of rotation at suitable intervals.

Irregular wear may be inherent in the local road conditions such as from a combination of steep camber, abrasive surfaces, and frequent hills and bends. Driving methods may also be involved. Irregular wear is likely to be more prevalent in summer than in winter, particularly on new or little worn tyres.

WHEEL ALIGNMENT AND ITS ASSOCIATION WITH ROAD CAMBER

It is very important that correct wheel alignment should be maintained. Misalignment causes a tyre tread to be scrubbed off laterally because the natural direction of the wheel differs from that of the car.

An upstanding sharp " fin " on the edge of each pattern rib is a sure sign of misalignment and it is possible to determine from the position of the " fins " whether the wheels are toed in or toed out. (Fig. 9.)

Fig. 9. Fins or feathers caused by severe misalignment.

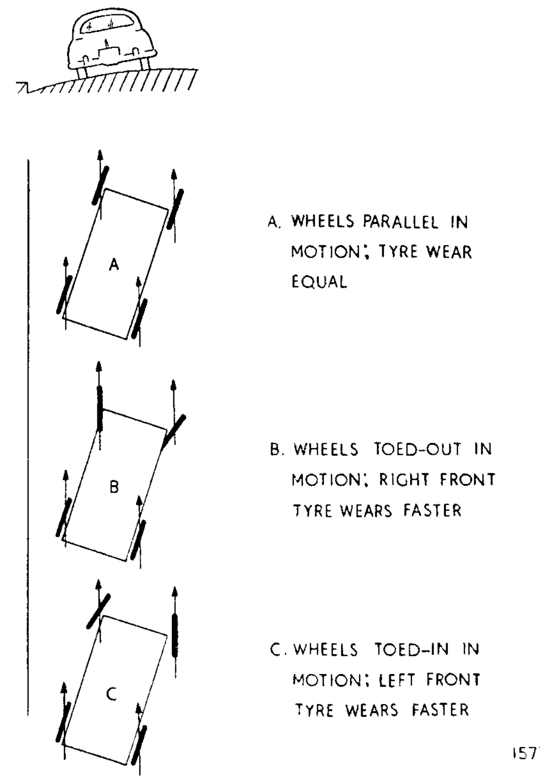

Fig. 10. Exaggerated diagram of the way in which road camber affects a car's progress.

" Fins " on the inside edges of the pattern ribs—nearest to the car—and particularly on the near side tyre indicate toe in. " Fins " on the outside edges, particularly on the offside tyre, indicate toe out.

With minor misalignment the evidence is less noticeable and sharp pattern edges may be caused by road camber even when wheel alignment is correct. In such cases it is better to make sure by checking with an alignment gauge.

Road camber affects the direction of the car by imposing a side thrust and if left to follow its natural course the car will drift towards the near side. This is instinctively corrected by steering towards the road centre.

As a result the car runs crab-wise, diagrammatically illustrated in an exaggerated form in Fig. 10. The diagram shows why near side tyres are very sensitive to too much toe in and offside tyres to toe out. It also shows why sharp " fins " appear on one tyre but not on the other and why the direction of misalignment can be determined by noting the position of the " fins ". Severe misalignment produces clear evidence on both tyres.

The front wheels on a moving car should be parallel. Tyre wear can be affected noticeably by quite small variations from this condition. It will be noted from the diagram that even with parallel wheels the car is still out of line with its direction of movement, but there is less tendency for the wear to be concentrated on any one tyre.

The near front tyre sometimes persists in wearing faster and more unevenly than the other tyres even when the mechanical condition of the car and tyre maintainance are satisfactory. The more severe the average road camber the more marked will this tendency be. This is an additional reason for the regular interchanging of tyres.

Precautions When Measuring Wheel Alignment

1. The car should have come to rest from a forward movement. This ensures as far as possible that the wheels are in their natural running positions.
2. It is preferable for alignment to be checked with the car laden.
3. With conventional base-bar tyre alignment gauges measurements in front of and behind the wheel centres should be taken at the same points on the tyres or rim flanges. This is achieved by marking the tyres where the first reading is taken and moving the car forwards approximately half a road wheel revolution before taking the second reading at the same points. With the Dunlop Optical Gauge two or three readings should be taken with the car moved forwards to different positions—180° road wheel turn for two readings and 120° for three readings. An average figure should then be calculated.

   Wheels and tyres vary laterally within their manufacturing tolerances, or as the result of service, and alignment figures obtained without moving the car are unreliable.

CAMBER, CASTOR AND KING PIN INCLINATION

These angles normally require no attention unless they have been disturbed by a severe impact or abnormal wear of front end bearings. It is always advisable to check them if steering irregularities develop.

Wheel camber, usually combined with road camber, causes a wheel to try to turn in the direction of lean, due to one side of the tread attempting to make more revolutions per mile than the other side. The resulting increased tread shuffle on the road and the off centre tyre loading tend to cause rapid and one sided wear. If wheel camber is excessive for any reason the rapid and one sided tyre wear will be correspondingly greater. Unequal cambers introduce unbalanced forces which try to steer the car one way or the other. This must be countered by steering in the opposite direction which results in still faster tread wear.

When tyre wear associated with camber results from road conditions and not from car condition little can be done except to interchange or reverse the tyres. This will prevent one sided wear, irregular wear and fast wear from developing to a maximum degree on any one tyre, usually the near front tyre.

Castor and king pin inclination by themselves have no direct bearing on tyre wear but their measurement is often useful for providing a general indication of the condition of the front end geometry and suspension.

TYRE AND WHEEL BALANCE

Static Balance

In the interests of smooth riding, precise steering and the avoidance of high speed " tramp " or " wheel hop " all Dunlop tyres are balance checked to predetermined limits.

To ensure the best degree of tyre balance the covers are marked with white spots on one bead, and these indicate the lightest part of the cover. Tubes are marked on the base with black spots at the heaviest point. By fitting the tyre so that the marks on the cover bead exactly coincide with the marks on the tube, a high degree of tyre balance is achieved. (Fig. 11.) When

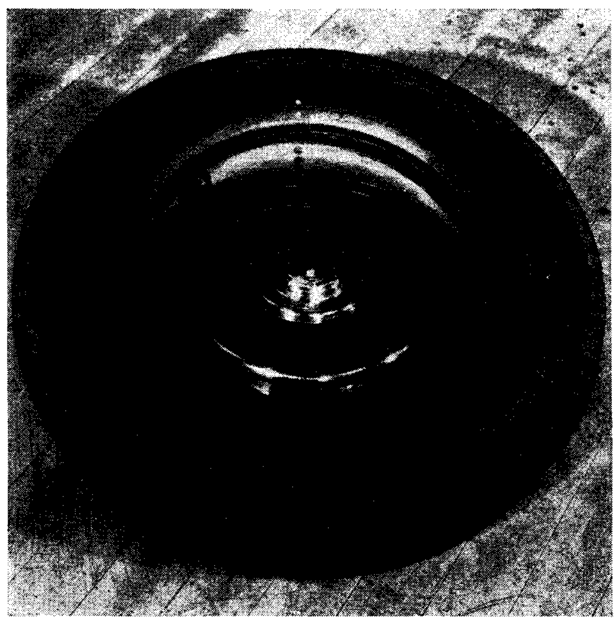

Fig. 11. Correct fitting relationship of Dunlop covers and tubes.

using tubes which do not have the coloured spots it is usually advantageous to fit the covers so that the white spots are at the valve position.

Some tyres are slightly outside standard balance limits and are corrected before issue by attaching special patches to the inside of the covers at the crown. These patches contain no fabric, they do not affect the local stiffness of the tyre and should not be mistaken for repair patches. They are embossed " Balance Adjustment Rubber ".

The original degree of balance is not necessarily maintained and it may be affected by uneven tread wear, by cover and tube repairs, by tyre removal and refitting or by wheel damage and eccentricity. The car may also become more sensitive to unbalance due to normal wear of moving parts.

If roughness or high speed steering troubles develop, and mechanical investigation fails to disclose a possible cause, wheel and tyre balance should be suspected.

A Tyre Balancing Machine is marketed by the Dunlop Company to enable Service Stations to deal with such cases.

If balancing equipment is used which dynamically balances the road wheels on the car, the following precaution should be observed.

In the case of the rear wheels always jack **both** wheels off the ground otherwise damage may be caused to the differential.

This is doubly important in the case of cars fitted with a Thornton " Powr-Lok " differential as in addition to possible damage to the differential, the car may drive itself off the jack or stand.

Dynamic Balance

Static unbalance can be measured when the tyre and wheel assembly is stationary. There is another form known as dynamic unbalance which can be detected only when the assembly is revolving.

There may be no heavy spot—that is, there may be no natural tendency for the assembly to rotate about its centre due to gravity—but the weight may be unevenly distributed each side of the tyre centre line. (Fig. 12.) Laterally eccentric wheels give the same effect. During rotation the offset weight distribution sets up a rotating couple which tends to steer the wheel to right and left alternately.

Dynamic unbalance of tyre and wheel assemblies can be measured on the Dunlop Tyre Balancing Machine (Fig. 13) and suitable corrections made when

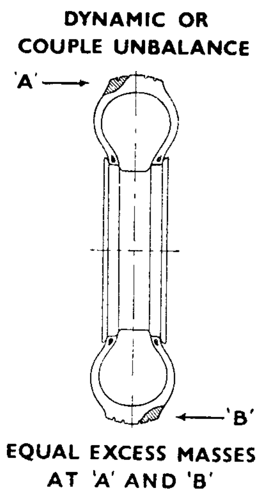

Fig. 12. Dynamic or couple unbalance.

cars show sensitivity to this form of unbalance. Where it is clear that a damaged wheel is the primary cause of severe unbalance it is advisable for the wheel to be replaced.

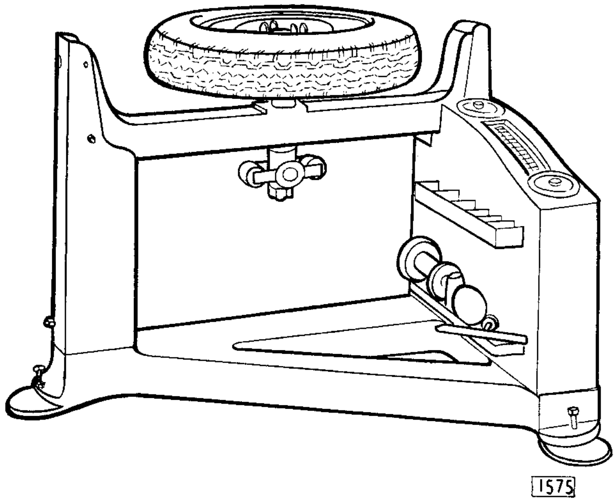

Fig. 13. The Dunlop tyre balancing machine.

CHANGING POSITION OF TYRES

There have been references to irregular tread wear which is confined almost entirely to front tyres and there may be different rates of wear between one tyre and another.

The causes may lie in road conditions, traffic conditions, driving methods and certain features of design which are essential to the control, steering and driving of a car. Close attention to inflation pressures and the mechanical condition of the car will not always prevent irregular wear.

It is therefore recommended that front tyres be interchanged with rear tyres at least every 2,500 miles (4,000 km.). Diagonal interchanging between near front and off rear and between off front and near rear provides the most satisfactory first change because it reverses the directions of rotation. (Fig. 14.)

Subsequent interchanging of front and rear tyres should be as indicated by the appearance of the tyres, with the object of keeping the wear of all tyres even and uniform.

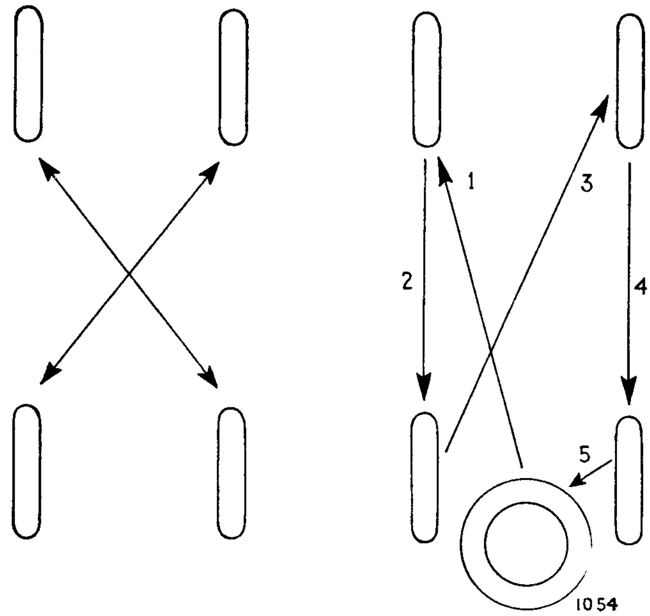

Fig. 14. Two methods of interchanging the road wheels. The second method introduces the spare wheel into the sequence.

TUBELESS TYRES

(Fitted to 2.4 litre models)

In the tubeless tyre the separate inner tube is replaced by a rubber liner moulded to the inside of the casing. The air chamber is completed by the rim itself.

This tyre has a slow rate of air loss, more resistance to the damaging effects of underinflation and impact, and it prevents road delays following the entry of nails because the special construction prevents the air from escaping round the nail.

FITTING AND INFLATION

Rim preparation:

1. Remove loose or excessive mud from the wheel, taking care not to damage the paint.
2. Hammer out any dents in the rim flanges.
3. Clean the rim bead seats and flanges thoroughly. Use emery cloth, steel wool, a wire brush or a file, depending on the amount of dirt, rust, rubber and surface irregularities to be removed. (Fig. 16.) Smooth paint need not be removed.
4. File or buff away any high spots at the welded join. (Fig. 15.)
5. Wipe clean with a moist rag.

Valve fitting:

The snap-in rubber valve, Fig. 17, is used by car

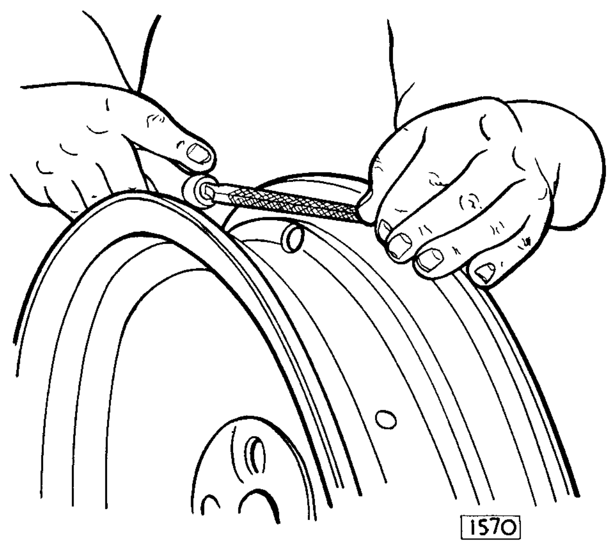

Fig. 15. Removing high spots from weld joint.

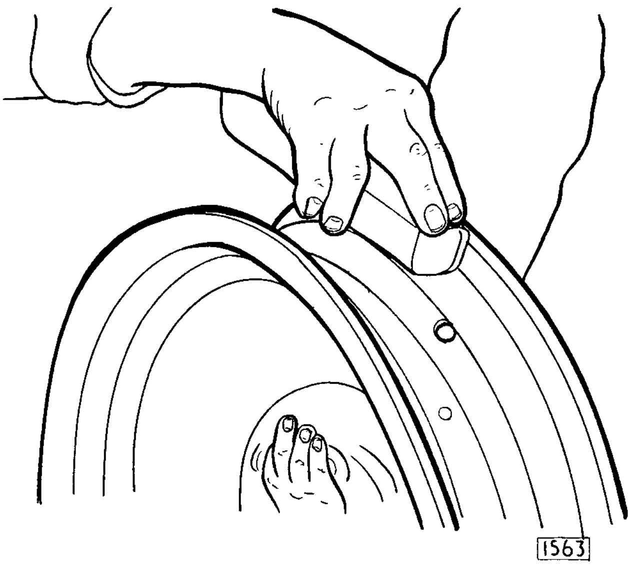

Fig. 16. Removing irregularities from rim.

makers for original equipment. This valve should never be refitted once it has been removed and it should be renewed every time a new tyre is fitted. The old valve can be cut out or pulled out.

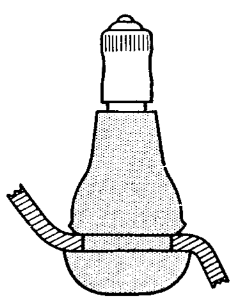

Fig. 17. Section through snap-in rubber valve.

A new snap-in rubber valve should be fitted by lubricating with soap solution and pulling through the rim hole from the inside until the flange on the rubber base is in full contact with the rim. If the valve is pulled too far, the base will be damaged or come right through the hole and another new valve must be fitted.

For fitting snap-in valves Schrader mounting tools No. 505 or 553 are available. If the valve is pulled through by pliers or an unsuitable tool, the threads or cap may be damaged.

Tyre fitting:

The tyre beads and their rubber surfaces must not be damaged during fitting. Do not use a hammer or mallet.

1. Wipe beads clean with a damp cloth.
2. Lubricate tyre beads, rim seats and fitting levers with Dunlop Tyre Bead Lubricant Code TBL/1 or a thin vegetable oil soap solution.
3. Fit tyre in a normal way with narrow levers in good condition and free from sharp edges, such as the Dunlop TL/12 spoon lever. Take small bites so as not to strain or damage the beads. Take particular care not to tear the rubber bead toes when they are lifted over the rim flanges. Fit the second bead so that the part of the bead nearest the valve goes over the rim flange last.

Note : The coloured balance spot near the tyre bead should be at the valve position.

Inflation:

1. Remove valve core.
2. Connect air line and with the valve core removed inflate with the wheel and tyre upright. If the first rush of air does not seal the beads, bounce the tread of the tyre at several points round its circumference with the air line attached. (Fig. 18.)

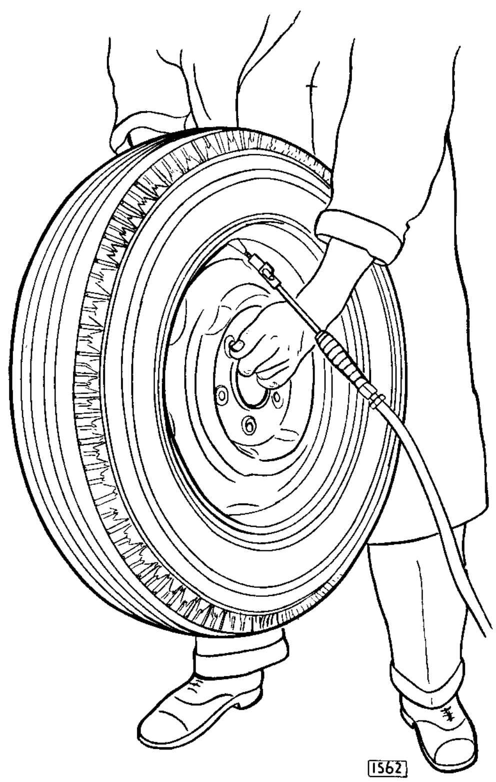

Fig. 18. Inflating and bouncing wheel to seal beads.

This will help to snap the beads on to the tapered rim seats. Continue to inflate until both beads obtain a hold on the rim seats.

3. Remove the air line and fit the valve core. Then inflate to 50 lbs. per sq. in. (3.44 kg/cm.^{2}). Do not inflate car tyres above 50 lbs. per sq. in. (3.44 kg/cm.^{2}). If a higher pressure is required to force the beads home against the rim flanges the tyre is not centralised on the rim. Deflate and centralise the tyre before re-inflating.

Note : If air continues to escape under the beads after bouncing and the tyre cannot be inflated, use one of the supplementary methods described on pages 16 and 17.

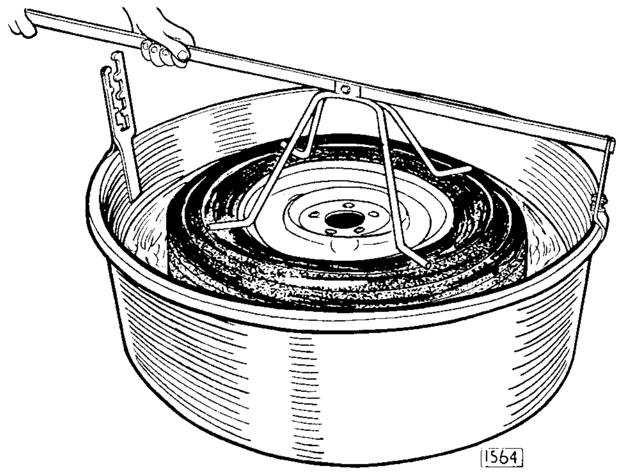

Fig. 19. Using Dunlop tank and submerging tool.

Testing for leaks:

A few minutes after inflation, immerse the tyre and wheel in a water tank and check for leaks.

A Dunlop Water Tank and Submerging tool are available for this purpose—WT/1 and ST/2. (Fig. 19.) If a water tank without submerging tool is being used, proceed as follows :

1. Place assembly in tank with valve uppermost. Submerge valve and check.
2. Release and allow assembly to float, with the channel between the rim flange and the tyres filled with water. Check carefully for air bubbles above the rim flange.
3. Turn wheel assembly over and submerge wheel rivets if they are not already under water. Check for leaks at rivets.
4. Submerge assembly to fill channel between flange and tyre and then allow to float.
   Repeat flange check as at 2.

If the Dunlop tank and submerging tool are used, the assembly can be held submerged on the bottom of the tank by locking the handle in one of the slots in the side bracket. Check for leaks at valve, rivets and each flange in turn.

To seal leaks:

1. Leak at top of rim flange.
   Mark on tyre and rim the position of leak and deflate tyre. The leak may be caused by dirt, rust, a high weld or chipped paint. By holding the bead away from the rim seat, the cause of the leak can often be detected and removed without removing the tyre. Make sure the rim is clean after treatment.
2. Leak at wheel rivet.
   Mark position of leak on rim. Deflate and remove tyre. The leak should be sealed by peening over the rivet head with a ball peen hammer, backed up by another hammer or a solid resistance such as an anvil. (Fig. 20.)

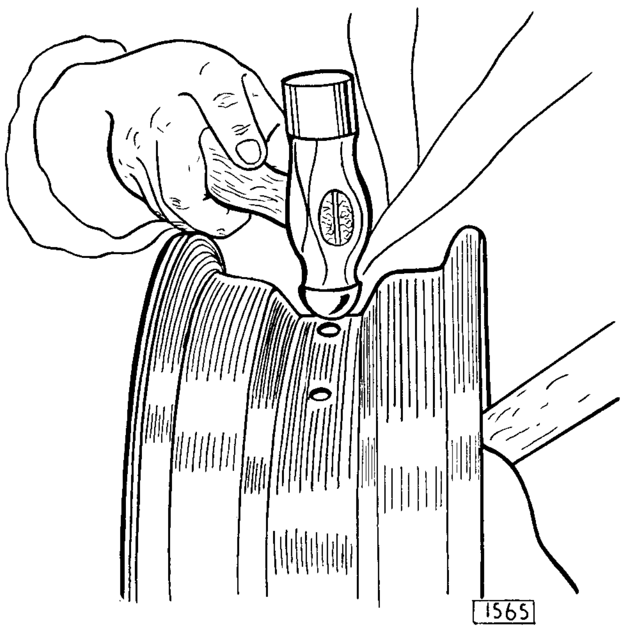

Fig. 20. Peening leaking rivets.

3. Leak at base of clamp-in valve.
   If the valve has been fitted correctly and the valve hole is in good condition, the leak can be stopped by tightening the nut.

Final inflation pressures:

Tubeless tyres require the same inflation pressures as normal covers and tubes. After testing at 50 lbs. per sq. in. (3.44 kg/cm.^{2}) make sure that the inflation pressure is adjusted to the correct running figure.

INFLATION AFTER FITTING

Employing a tourniquet:

The Dunlop Tubeless Tyre Tourniquet, Part No. TT/1, is very suitable for assisting the inflation of Tubeless tyres. Its purpose is to contract the centre of the tread so that the beads are forced outwards against the rim seats and so provide a partial seal for inflation.

1. With the tool in the open position, buckle the strap centrally round the tread of the deflated tyre and wheel assembly. Pull strap through buckle as tightly as possible. Strap must be threaded between buckle and teeth in clip, and not between clip and end of buckle.
2. Thread the loose end of the strap through gap between rivet and roller on the link mechanism and compress tread by pulling handle through 180° (Fig. 21).

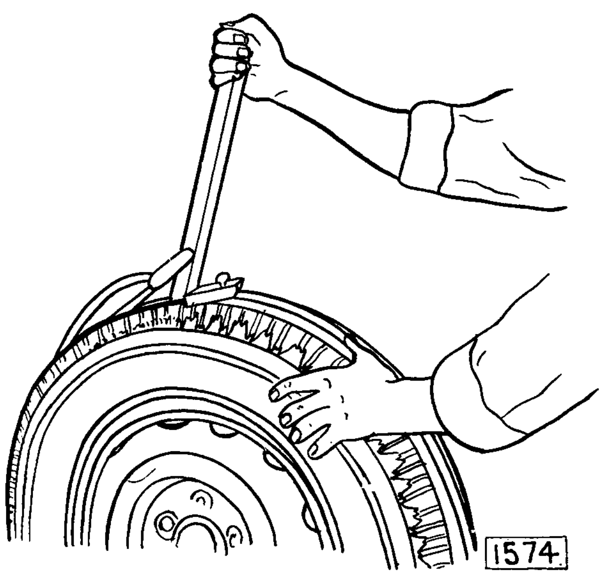

Fig. 21. Tightening tourniquet to seal beads.

3. With valve core removed, attach the air line and inflate until the beads are sealed against the flanges. If they fail to seal at the first attempt, move the handle back and re-tighten the strap. When the beads are home, disconnect the air supply and fit the valve core. Then remove the tourniquet before final inflation.
4. To remove the tourniquet, move the handle back and press the thumb on the end of the buckle—pushing the slider bar on the buckle inwards and upwards.
5. Inflate to 50 lbs. per sq. in. (3.44 kg/cm.^{2}) and test.

Note : When an air line is not available, the tourniquet enables Tubeless tyres to be inflated with an efficient foot or hand pump. In necessary cases, a tourniquet may be improvised from a piece of rope and a twisting bar.

Without a tourniquet:

This method is usually effective if other methods fail.

1. Fit tyre to rim dry, or if lubricated wipe tyre beads and rim seats dry afterwards.
2. Lean tyre and wheel against a wall at an angle as shown in Fig. 22. (See note below.)

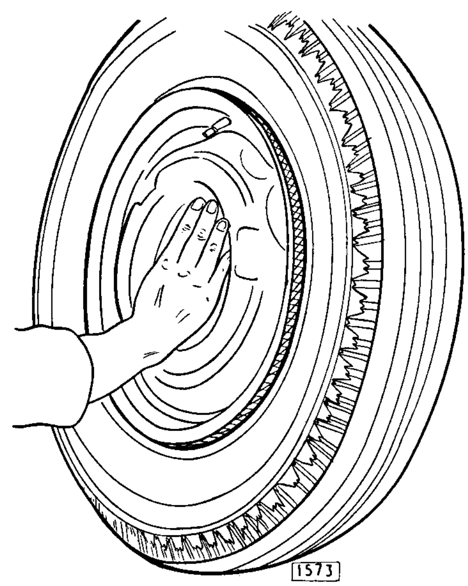

Fig. 22. Method of sealing bead without tourniquet.

3. Press wheel centre so that nearest bead obtains a hold on the rim seat. (Fig. 22.)
4. Reverse assembly, taking care not to dislodge first bead, and lean at a greater angle. (Fig. 23.)
5. With valve core removed attach air line. Whilst inflating, press gently against wheel centre to seal second bead. (Fig. 23.) Alternating hand pressure rather than continuous pressure may be found helpful. Continue to inflate until beads obtain a hold on the rim seats.
6. At this stage and before beads have gone home against the rim flanges allow lubricant to penetrate between tyre head and rim flange by brush or similar means.
7. Remove air line and fit valve core. Inflate to 50 lbs. per sq. in. (3.44 kg/cm.^{2}) and test.

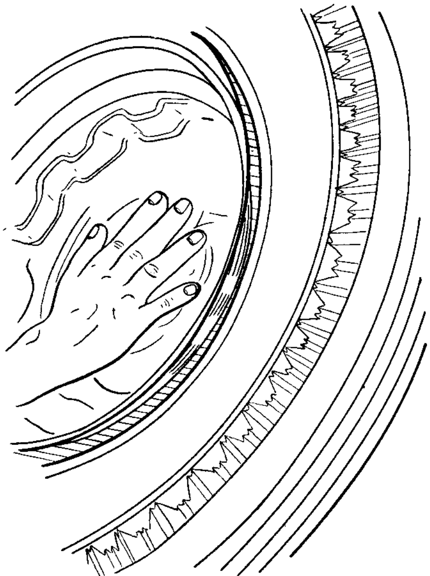

Fig. 23. *Seating the reverse bead.*

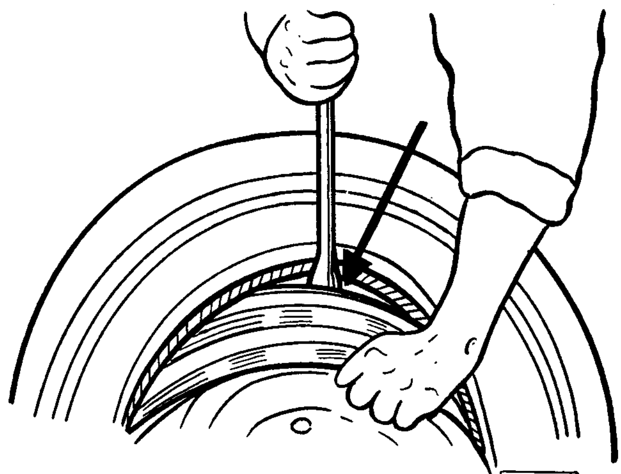

Fig. 24. *Insert tyre lever for depth of flange only.*

Do not inflate car tyres above 50 lbs. per sq. in. (3.44 kg/cm.^{2}). If a higher pressure is required to force the beads home against the rim flanges the tyre is not centralised on the rim. Deflate and centralise the tyre before re-inflating.

Note : Some rims have a wider seat on one side than on the other. When fitting to a rim with equal seats the first part of the operation (Fig. 22) should be carried out with the valve at the front. On other rims, the first operation should be carried out with the valve towards the wall and the wider rim seat to the front.

REMOVAL

Remove in exactly the same way as covers for use with tubes. Take particular care not to damage the bead surfaces when breaking the " stick " between the beads and rims and when lifting the beads over the rim flanges. Before lifting the beads over the rim flanges, apply lubricant (see page 15) to both tyre beads. When lifting the second bead over the flange insert tyre lever between bead and rim for the depth of the flange only (Fig. 24). These precautions will facilitate removal and avoid kinked beads. Damaged beads will cause air leaks and may also cause premature tyre failures.

Tyre levers and bead breaking tools must be of suitable type, have smooth contact faces in good condition and be used properly.

Levers should be kept moistened with the lubricant during use.

REPAIR OF SMALL PENETRATIONS

Dunlop "Reddiplug" method:

Normally, a tubeless tyre will not leak when the tread is penetrated by a nail or other normal puncturing object, provided that it is left in the tyre.

These objects should be withdrawn every 2,000 to 3,000 miles (3,200 km.—4,800 km.) at a time when loss of air will cause least inconvenience. If they are left in the tyre indefinitely, the original injuries may extend and cause a road delay, and possibly more serious tyre damage.

For a simple penetration through the tread, e.g. a nail, the Dunlop " Reddiplug " method is recommended. It does not require the tyre to be removed from the rim nor to be completely deflated. This method should not be used for sidewall penetrations.

The following instructions are included with each kit.

1. Extract the penetrating object and determine the direction of penetration by inserting the small wire probe through the hole and leave in position (Fig. 25). If the tyre is leaking and the puncturing object cannot be located by sight, it is necessary to immerse the inflated tyre in water.
2. Dip the needle into the flask of solution and after removing the probe insert the needle through the hole in the direction indicated by the probe.

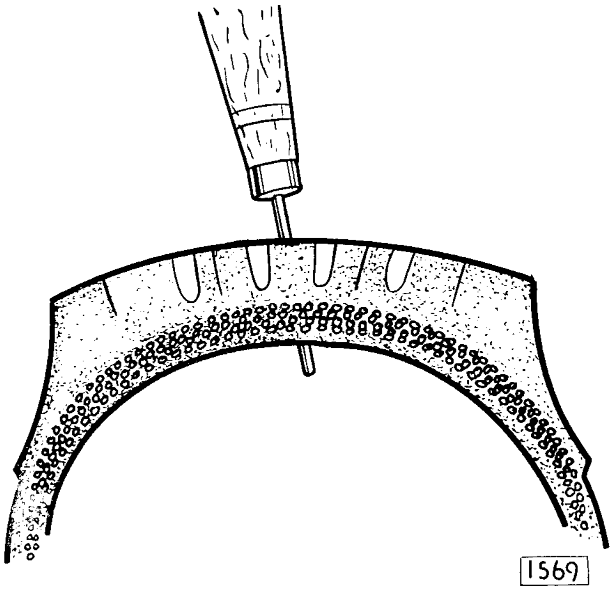

Fig. 25. Determining direction of penetration with probe.

When the needle eye is through the hole, work it up and down several times and then pull it out. Again dip the needle into the solution and repeat the process until the hole is well lubricated.

3. Select a suitable plug according to the size of the puncturing object and stretch and roll it into the eye of the needle leaving about $\frac{1}{4}''$ (6.35 mm.) of plug on one side of the needle. (Fig. 26.)

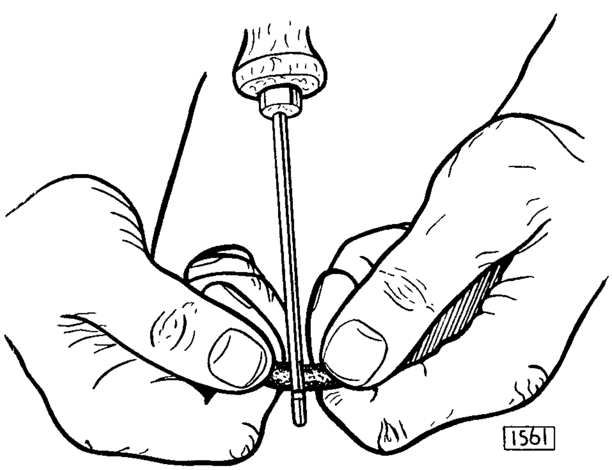

Fig. 26. Threading rubber plug into special needle.

4. After dipping plug into the solution, insert point of needle into hole and push through tyre until a sudden release in pressure is felt indicating that the double thickness is completely through the hole.

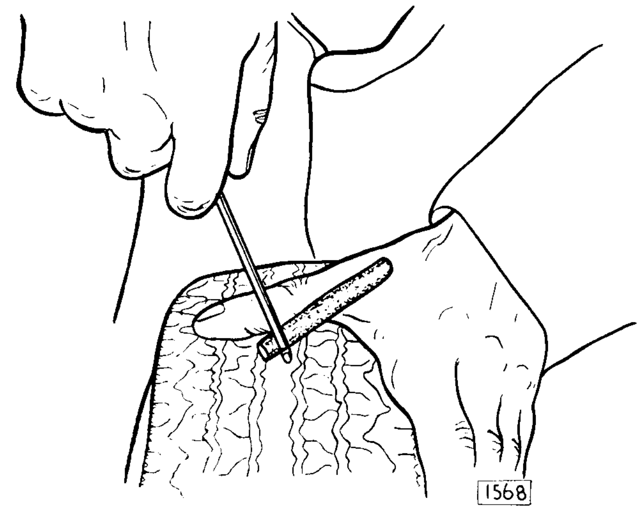

Fig. 27. Forcing plug into puncture.

Stop pushing as soon as this release in pressure is felt. (Figs. 27 and 28.) Do not rotate the needle during this operation.

Note : The plug must follow the direction of original penetration to seal the hole.

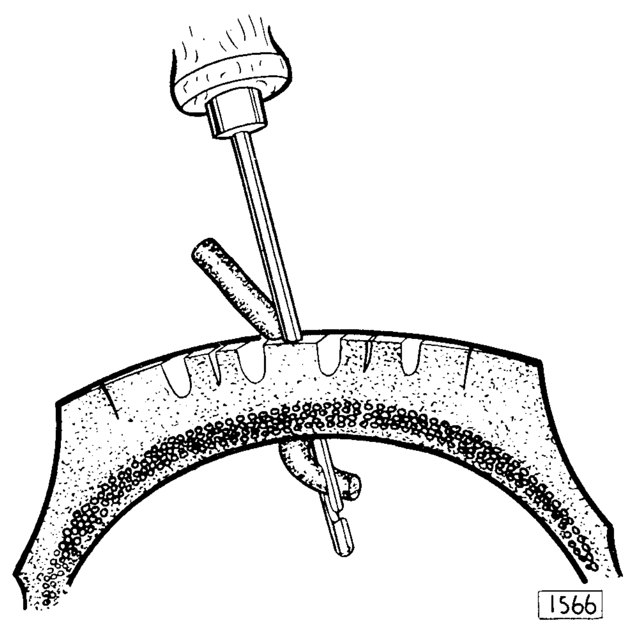

Fig. 28. Release needle by further downward movement then withdraw.

5. Withdraw the needle and cut off surplus plug about $\frac{1}{8}''$ (3.17 mm.) from surface of tread (Fig. 29.) Tyre can be inflated and used immediately.

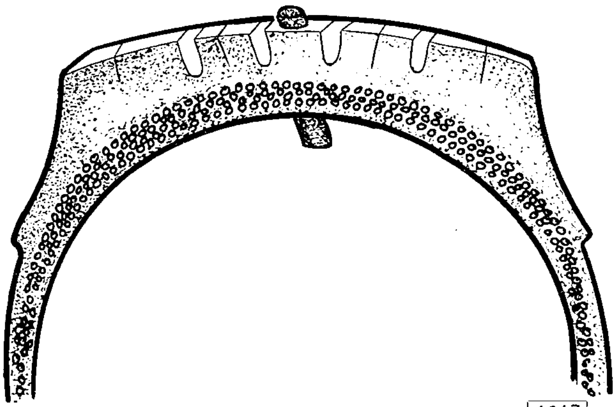

Fig. 29. Section showing repair completed.

Repairs outside scope of "Reddiplug" method

To repair all small penetrations through the side-walls, and tread penetrations which are larger than caused by nails or other small penetrating objects and do not exceed $\frac{1}{4}''$ (6.35 mm.) diameter, remove the tyre and :

1. Roughen the rubber liner for about 1″ (25.39 mm.) around the injury.
2. Clean and solution around the injury. Using the Dunlop "Reddiplug" needle as a prodder press uncured cushion compound into the hole. Trim off surplus compound on the inside.
3. Apply one coat of vulcanising solution to the roughened liner and allow to dry. Then fit a patch of $\frac{1}{16}''$ (1.58 mm.) uncured cushion compound.
4. Vulcanise.

Note : As a temporary "get-you-home" measure, in the absence of vulcanising equipment, fit a patch such as Dunlop "Vulcafix" patch on the inside of the casing. A vulcanised repair should be effected as soon as possible.

MAJOR REPAIRS

For larger injuries the acceptance limits are the same as for outer covers and the same processes should be followed, with these additions :

1. After the reinforcing patch has been fitted, solution its exposed surface and allow to dry. Apply and roll down $\frac{1}{16}''$ (1.58 mm.) uncured cushion compound over the patch and the prepared area around it to replace the original inner liner.
2. After filling the cut out external cavity, cure in a normal manner but increase the curing time to allow for the thickness of the new liner over the patch.
3. During cure protect the beads from possible damage by the bead plates with strips of cured rubber.

BEAD REPAIRS

Superficial rubber damage to the beads should be repaired in the following way if vulcanising is not possible.

1. Buff the damage carefully and solution with one coat.
2. Fill with tread repair compound so that it stands proud.
3. Trim until nearly flush with a sharp wet knife and then smooth down accurately to the original profile with emery cloth kept wet with naphtha.
4. Allow to stand for at least 12 hours and then dust with chalk. Avoid damage when refitting the tyre because the repair is not vulcanised.

RETREADING

Acceptance limits and processes are the same as for tubed cover. Use tread repair compound for bead rubber repairs if bead to bead moulds are used. If a repair patch is being cured with the retread add 10% to the time to allow the replaced section of inner liner.

IMPORTANT

During repair or retreading the whole of the inner liner and bead surfaces should be examined for damage, however small, which may cause pressure loss or air seepage into the casing.

After repair or retread always test the inflated tyre in a water tank.

SECTION N

BODY & EXHAUST SYSTEM

2·4 litre and 3·4 litre models

ISSUED BY

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INDEX

BODY

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EXHAUST SYSTEM

REMOVAL OF THE CENTRE FACIA PANEL

Removal of the Dash Casing

Unscrew the scuttle vent lever knob and remove all the screws from the casing. The casing can now be withdrawn.

Removal of the Facia Panel

Remove both thumb screws (A, Fig. 1) from the top of the facia panel. Withdraw the ignition keys and cigar lighter (B). Insert a piece of stiff wire into the hole in the side of the light switch knob (C) to depress the plunger at the same time withdrawing the switch knob.

Repeat for the wiper switch knob (D). Withdraw the ash tray (E) and remove both screws (F) attaching the ash tray mounting bracket (G) to the facia. Remove the two large headed (H) screws from the underside of the facia panel.

The facia panel can now be removed by sliding it over the remaining switches.

REMOVAL OF THE SCREEN RAIL

Remove the centre facia panel as described above. Remove the four nuts and washers securing the screen rail to the body (see Fig. 2).

If the car is fitted with either an overdrive or intermediate speed hold switch on the screen rail unscrew the knurled bezel in the middle of the escutcheon.

The screen rail can now be lifted off.

REMOVAL OF THE RIGHT-HAND GLOVEBOX

Remove the centre facia panel and screen rail as described in the previous paragraphs.

On the 2.4 litre model remove the mixture control cable by slackening the pinch bolts on the carburetter mixture levers and the outer cable. This will allow the mixture control cable to be withdrawn when the glovebox is removed.

Remove the two screws (A, Fig. 3) securing the glovebox to the dash and the nut (B) and washer from the securing bracket at the rear of the glovebox.

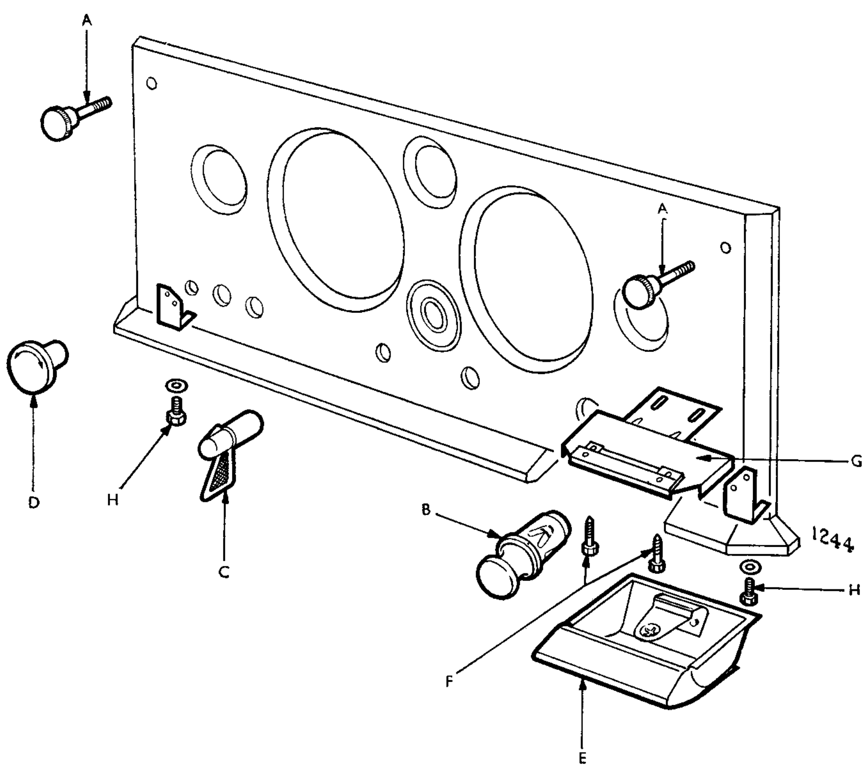

Fig. 1. Removal of centre facia panel.

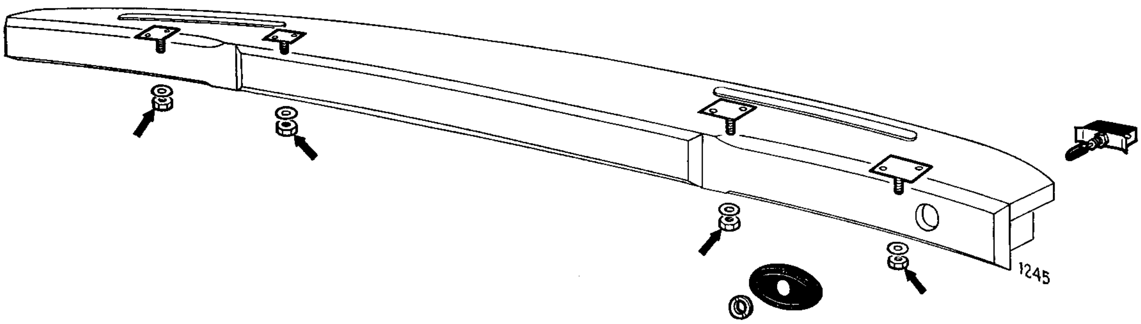

Fig. 2. Removal of screen rail.

If the steering column is on the right-hand side, fully extend the steering wheel and remove the two bolts attaching the steering column bracket to the dash.

The glovebox can now be withdrawn.

REFITTING THE RIGHT-HAND GLOVEBOX

On the 2.4 litre model feed the choke control wire back through the grommet to the carburetter choke levers, not forgetting to replace the spacer tube.

Replace both screws securing the glovebox to the bulkhead and refit the nut and washer on the mounting at the back of the glovebox.

On the 2.4 litre model place the choke control lever on the glovebox in the " COLD " position and place the levers on the carburetters towards the rear of the engine. Tighten both bolts on the choke lever, and the bolts securing the conduit casing to the carburetter. Replace the two bolts securing the steering column to the bulkhead.

REMOVAL OF THE LEFT-HAND GLOVEBOX

Remove the centre facia panel and screen rail as described in the previous paragraphs.

Slacken the pinch bolts securing the heater control wire to the control valve situated at the rear of the engine compartment ; also slacken the pinch bolt securing the outer cable. This will allow the cable to

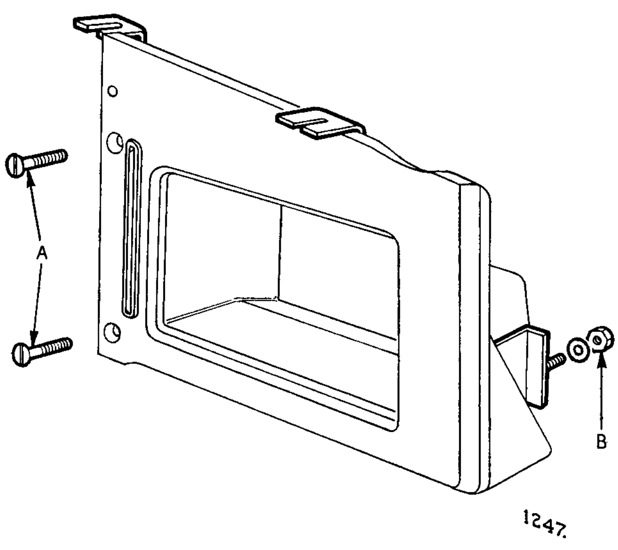

Fig. 3. Removal of right-hand glovebox.

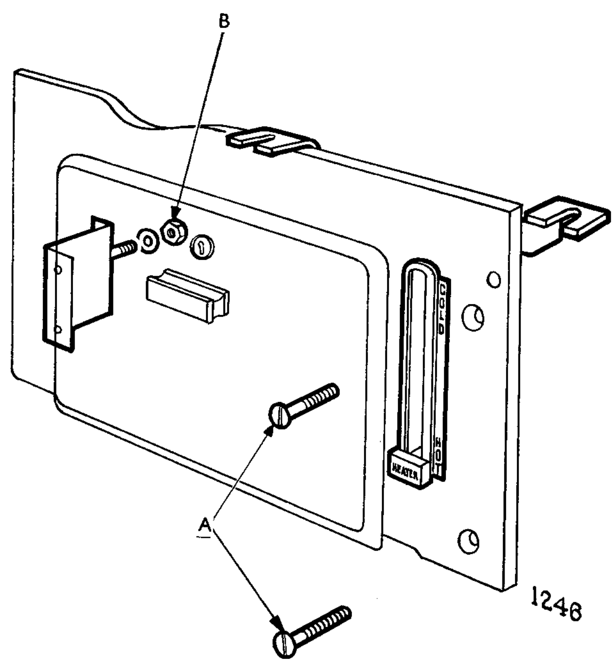

Fig. 4. Removal of left-hand glovebox.

be withdrawn when the glovebox is removed.

Remove the two screws (A, Fig. 4) securing the glovebox to the dash and the nut (B) and washer from the securing bracket at the rear of the glovebox.

If the steering column is on the left-hand side, fully extend the steering wheel and remove the two bolts attaching the steering column bracket to the dash.

The glovebox can now be withdrawn.

REFITTING THE LEFT-HAND GLOVEBOX

Feed the heater control wire through the grommet to the heater control tap. Replace both screws securing the glovebox to the bulkhead, and refit the nut and washers on the mounting at the back of the glovebox.

When adjusting the heater control place the heater control lever on the glovebox in the " HOT " position; rotate the heater control tap in the engine compartment anti-clockwise as far as possible and secure the cable by tightening the screw. Tighten the bolt securing the conduit to the tap.

BONNET REMOVAL

To open the bonnet pull the control knob, situated under the facia panel on the right-hand side. This will release the bonnet which will still be retained by the safety catch.

Insert the fingers under the nose of the bonnet and lift the safety catch upwards when the bonnet may be raised.

The bonnet is automatically retained in the fully open position by the action of the hinge springs.

Mark the position of the hinge brackets on the bonnet to facilitate refitting.

Remove the four setscrews and washers securing the bonnet to each hinge and lift off the bonnet.

REFITTING

Refitting is the reverse of the removal procedure. Position hinges on marks made before removal.

REMOVAL OF MASCOT

Raise the bonnet and remove the two setscrews, plain and serrated washers securing the mascot to the bonnet.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF CHROME STRIPS ON BONNET

The chrome strips along the sides of the bonnet are secured with clips. Straighten the prongs of the clips and withdraw the chrome strip.

To remove the chrome strip in the centre of the bonnet, insert a screwdriver between the strip and the top of the bonnet and prise off the chrome strip taking care not to damage the paintwork.

REFITTING

When refitting the chrome strip to the centre of the bonnet renew the clips.

Refitting is the reverse of the removal procedure.

REMOVAL OF THE LUGGAGE COMPARTMENT LID AND HINGES

Open the luggage compartment lid and disconnect the four electrical connections in the reverse lamp.

Remove the setscrew securing the earth wire to the luggage compartment lid.

Withdraw the harness from the luggage compartment lid. Remove the two metal straps securing the reverse lamp cable to the right-hand hinge. Mark the positions of the hinges on the luggage compartment lid.

Remove the eight setscrews, plain and serrated washers and remove the luggage compartment lid.

Mark the positions of the hinges and remove the eight setscrews, plain and serrated washers securing the hinges to the body.

Remove the luggage compartment lid hinges.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF THE BONNET LOCK ASSEMBLY

To remove the bonnet catch slacken the locknut at the top of the peg. Insert a screwdriver into the slot in the peg and unscrew the peg complete with locknut, two washers and spring.

Remove the two setscrews securing the closing plate which joins the front wings under the radiator grille opening. Withdraw the plate.

Remove the setscrew, plain and serrated washers and cup securing the badge boss to the body.

From underneath unscrew the five nuts, plain and serrated washers and remove the small angle brackets securing the radiator grille to the body. Remove the radiator grille.

Slacken the nut securing the bonnet release cable and withdraw the cable from the release lever.

Remove the two setscrews securing the striker plate, catch plate and base plate to the body.

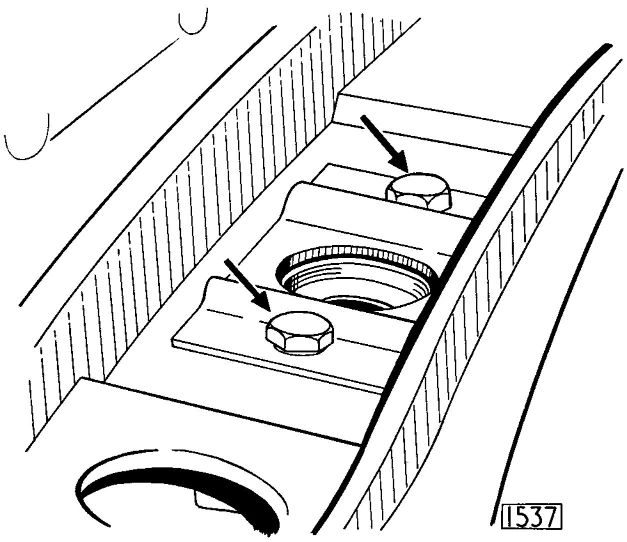

Fig. 5. Showing the two setscrews which secure the bonnet catch striker plate.

Remove the striker, catch and base plates, spacers and spring.

Remove the drive screws securing the dash casing. Unscrew the locknut securing the bonnet release cable abutment to the bonnet lock reinforcement panel.

Withdraw the release cable.

Adjustment of the Bonnet Lock

Slacken the locknut on the striker peg and rotate the peg with a screwdriver, until there is approximately $\frac{1}{16}''$ (1.5 mm.) movement between the catch plate and the peg. This is to ensure that the catch plate will fully engage the peg. Tighten the locknut on the striker peg.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF THE WINDSCREEN

Removal of the Dash Casing

Remove the scuttle vent lever knob and all the screws from the casing. The dash casing can now be withdrawn from under the facia panel; also remove the small piece of casing from the other side of the steering column.

Removal of the Centre Facia Panel

Remove the centre facia as described on page 4.

Removal of the Screen Rail

Remove the screen rail as described on page 4.

Removal of the Instrument Panel

(This need only be done if the car has three demister nozzles). It is important to ensure that the positive earth terminal on the battery is removed before proceeding. To facilitate re-assembly of the instrument panel, mark on the panel the positions of the three bolts ; unscrew the three bolts from the panel. The instrument panel can now be pulled away slightly to enable the oil gauge pipe to be disconnected. Remove the two screws from the mileometer trip remote control cable, situated just above the heater vent flaps at the back of the gearbox cover. Repeat for the remote control of the clock.

Remove the revolution counter cable from the engine side by unscrewing the connection on the right angled drive from the camshaft. The top of the instrument panel can now be pulled forward.

Removal of the Glovebox

Remove the gloveboxes as described on page 4.

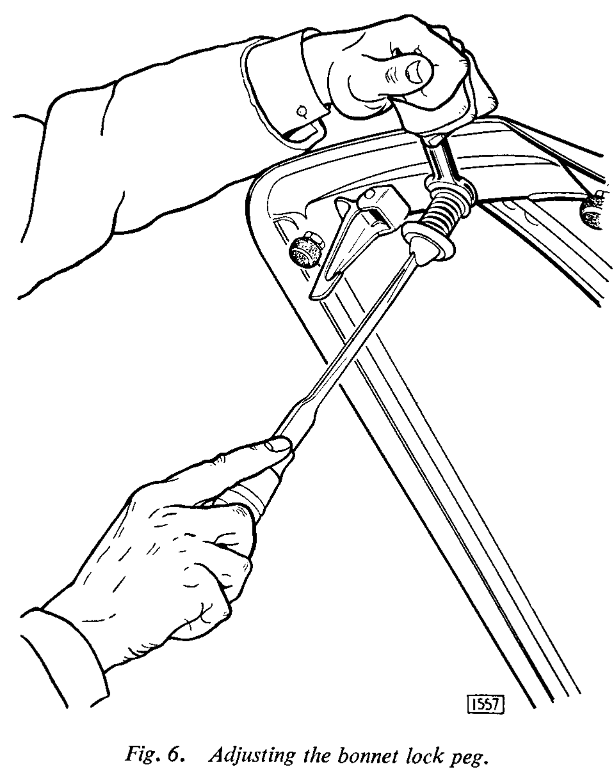

Fig. 6. Adjusting the bonnet lock peg.

Removal of the Wood Fillets and Tacking Fillets

Remove the two screws securing the polished wood fillet to the windscreen pillar. Withdraw the fillet and tap back the trimming. The tacking fillets can now be withdrawn by removing the two drive screws. Repeat for the other side.

Removal of the Sun Visors

Remove the three screws and the packing washers from the visor mounting bracket on the headlining fillet at the front of the roof panel. Remove the visor from the clip mounting and withdraw the rubber from the clip, then withdraw the screw and remove the clip from its mounting, taking care not to lose the packing washer. Repeat for the other side. Remove the headlining fillet at the front of the roof panel by inserting a screwdriver under the fillet and releasing the spring clips. Remove the headlining from the windscreen rubber.

Removal of the Mirror

Remove the three screws securing the mirror to the roof panel. The mirror can then be withdrawn.

Moving Demister Nozzles

Remove the two screws from each demister nozzle. (Early models had three demisters attached by three screws.) The demisters can then be bent away from their mountings.

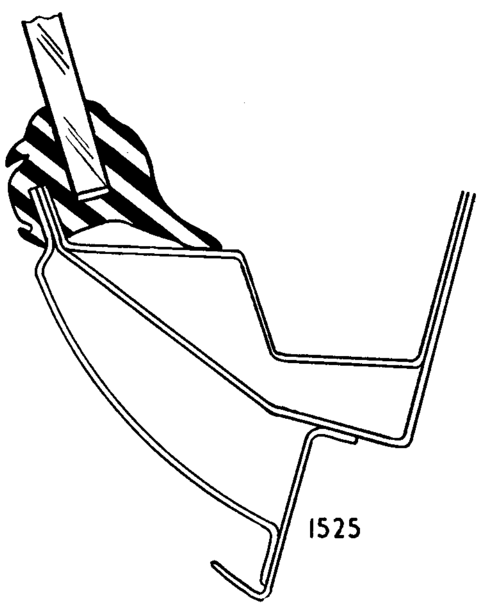

Fig. 7. Section through windscreen glass and sealing rubber.

Removing the Windscreen

Prise the chrome finisher from the rubber seal around the windscreen.

Run a suitable thin bladed tool around the windscreen to break the seal between the rubber and the windscreen aperture flange.

From the outside of the car insert a piece of flat metal between the top of the windscreen aperture flange and sealing rubber. Place a block of wood on to the glass and using the block as a fulcrum and the piece of metal as a lever force the windscreen inwards. Repeat this process along the top edge of the windscreen and withdraw the windscreen into the car.

REFITTING

Remove the old sealer from the windscreen flange. If the same windscreen rubber is to be used all the small particles of glass should be removed and the rubber thoroughly cleaned. If the glass was of the laminated type and was not broken by a projectile, the windscreen aperture flange should be examined for a bump in the metal. If this is found, it should be filed away or the glass may break again.

The rubber should now be attached to the new windscreen with the flat side of the rubber towards the rear, and the join in the rubber preferably at the bottom. Thread some strong cord (blind cord) around the rubber groove into which the flange of the windscreen aperture is fitted, leaving the two loose ends at the top of the windscreen, that is to say, the narrow end.

From inside the car, offer up the windscreen to the aperture, top edge foremost. It is essential that the

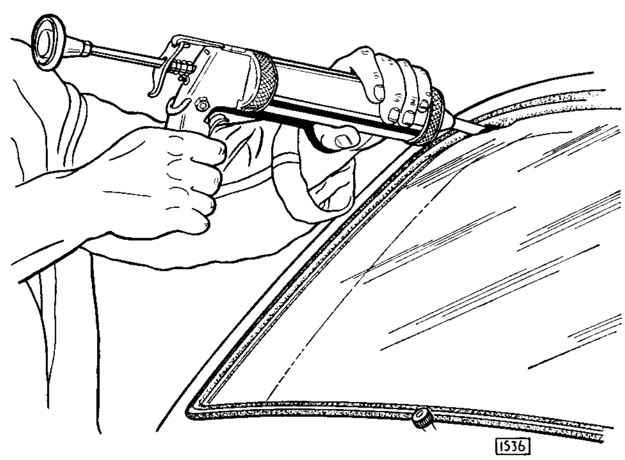

Fig. 8. Using a gun to inject sealing compound between the surround rubber and the glass.

screen should be kept as low down at the back of the instrument panel as possible. Exert steady hand pressure at each side of the screen and by pulling the cord, lip the edge of the rubber over the flange.

It is important that the screen should be fitted equally. DO NOT fit one end and then try to fit the other. From inside the car, exert a sudden pressure around the edge of the glass. This has the effect of seating the glass and rubber on to the flange. Great care must be taken when fitting laminated glass. Using a pressure gun filled with a sealing compound, and fitted with a copper nozzle (so that the glass will not be scratched), apply the gun to the metal flange by pushing the nozzle of the gun between the rubber and the flange and filling with sealing compound. Repeat between the glass and rubber. Remove excess sealing compound with a rag soaked in white spirit. DO NOT USE THINNERS as this will damage the paintwork. Fit the chrome strip on top of windscreen rubber and bend to suit contour, if necessary. Coat inside of chrome strip with a liberal layer of Bostik 1251, and allow to become tacky. Place chrome strip on rubber

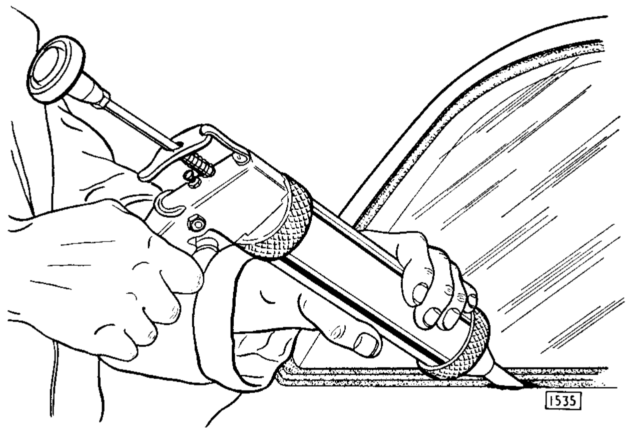

Fig. 9. Using a gun to inject sealing compound between the rubber and windscreen aperture.

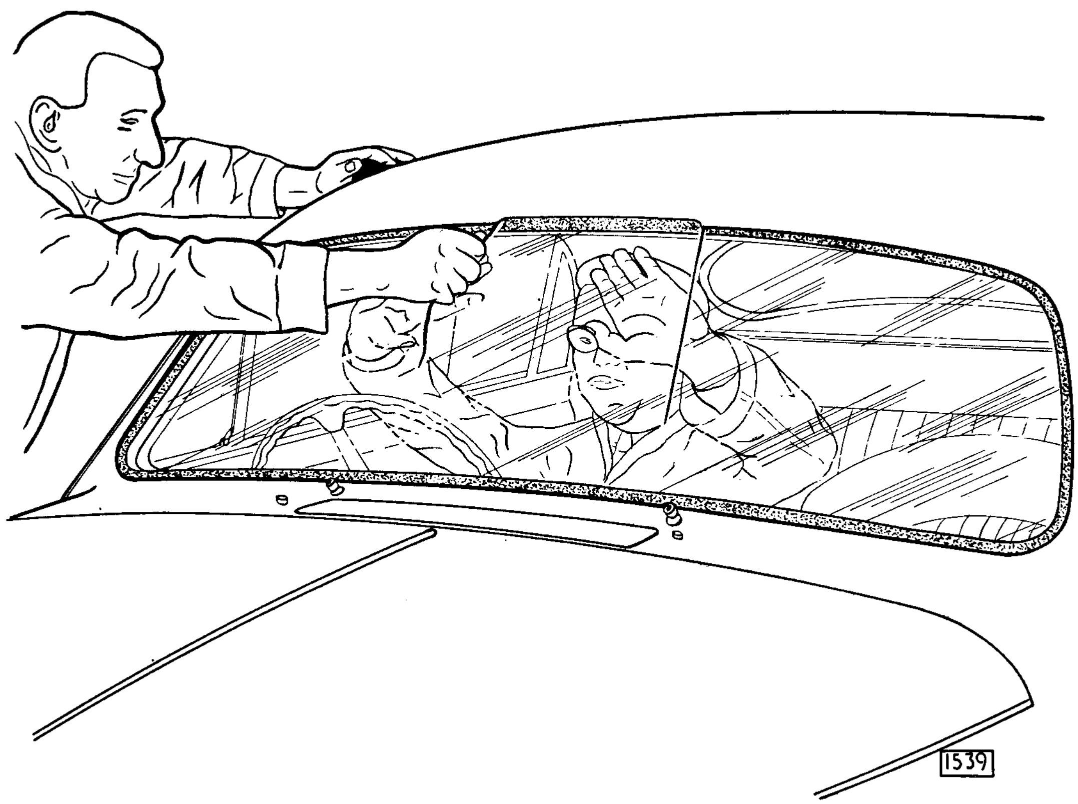

Fig. 10. Lipping the surround rubber over the windscreen aperture flange.

and with a hook insert the strip and continue all the way round. The centre chrome clips may now be fitted. Again, apply some Bostik 1251, and place in position lifting the rubber as before. Ensure that the more acute bend on each centre clip is facing away from the glass.

The remainder of the refitting is the reverse of the removal procedure.

REMOVAL OF THE REAR BUMPER

Remove the four setscrews, plain and serrated washers securing the bumper to the two side mounting brackets.

Remove the two large setscrews, plain and serrated washers securing the bumper to the two rear bumper mounting rubbers. Remove the rear bumper.

Remove the nuts and shakeproof washers securing the rear bumper mounting rubbers to the wings and reinforcement panels.

Detach the sealing rubber from the rear bumper.

REFITTING

Refitting is the reverse of the removal procedure.

To refit the sealing rubber, press the rubber over the rear bumper and tap on the sixteen spring clips. When refitting the side bumper brackets ensure that the largest side of the bracket is towards the top.

REMOVAL OF FRONT BUMPER

Remove the two chrome bolts, nuts, plain and spring washers securing the front bumper to the angle brackets.

Remove the two nuts, plain and spring washers securing the over-riders and the bumper to the inner brackets supporting the bumper.

Slacken the nut securing one of the angle brackets to the outer bracket. Turn the angle bracket through ninety degrees. This will allow the bumper to be withdrawn.

REFITTING

Refitting is the reverse of the removal procedure. When refitting over-riders replace the beading between the over-riders and the bumper.

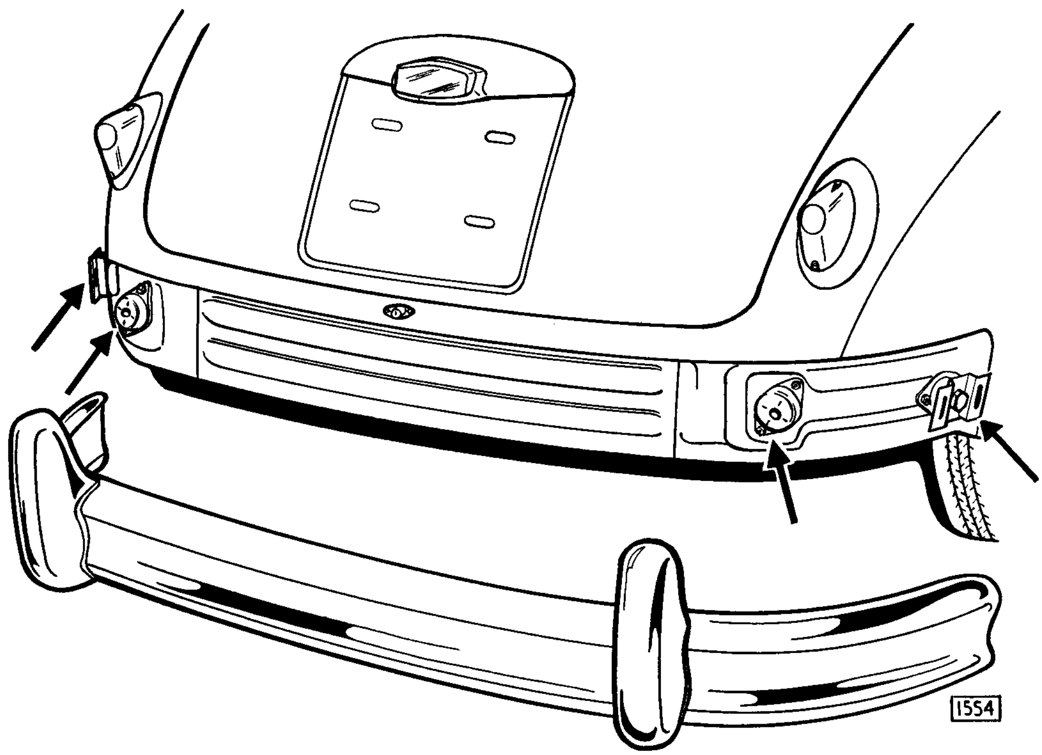

Fig. 11. Showing the location points of the rear bumper

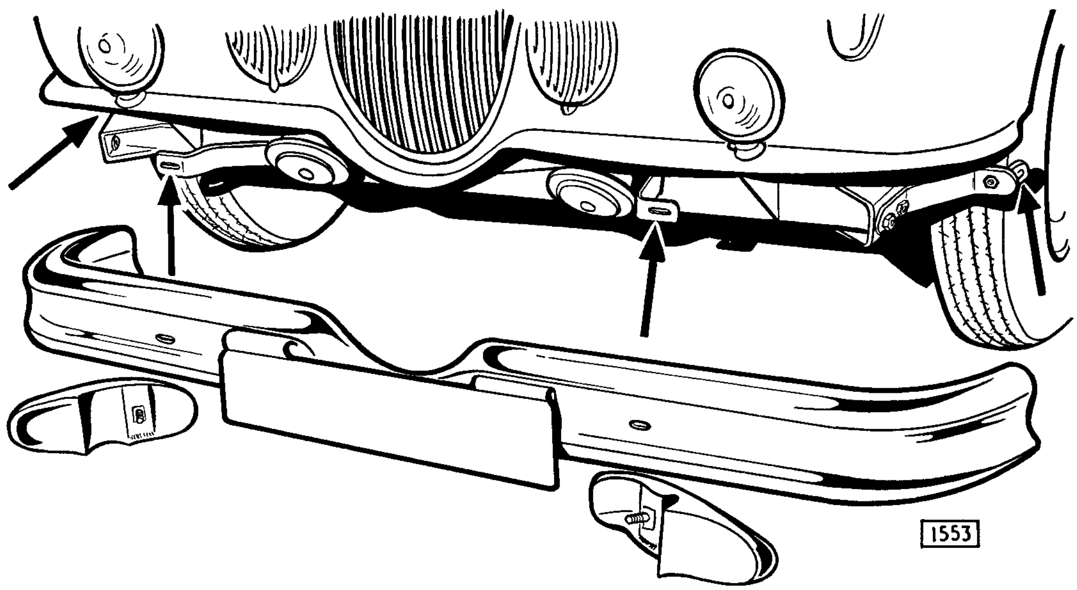

Fig. 12. Showing the location points of the front bumper.

REMOVAL OF THE FRONT DOORS AND HINGES

Remove the split pin and clevis pin on the door check strap bracket situated on the door hinge pillar.

Mark the positions of the hinges on the door. Remove the six bolts securing the hinges to the door side and remove the door.

Remove the scuttle side casing by unscrewing the three drive screws. Remove the two screws securing the loud speaker aperture blanking plate. Unscrew the door courtesy light switch from the bottom hinge recess. Pull out the electrical connection at the rear of the switch.

To remove the hinges unscrew the four cross headed screws and two bolts inside the hinge recess.

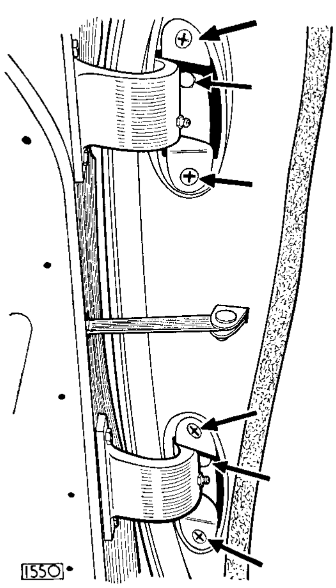

Fig. 13. Showing the screws which secure the front door hinges.

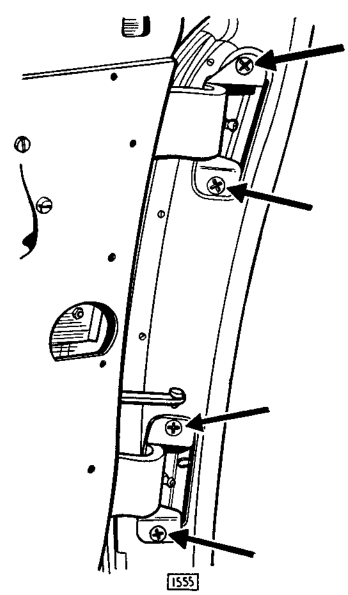

Fig. 14. Showing the four screws which secure the rear door hinges.

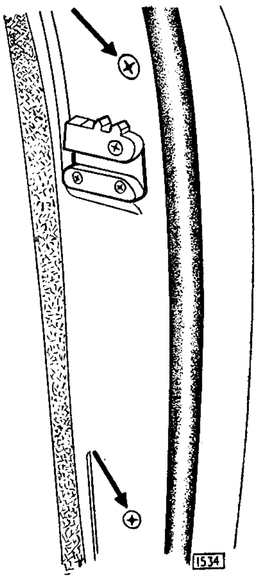

Fig. 15. Showing the two screws which secure the rear door hinges at the front of the centre pillar.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF THE REAR DOORS AND HINGES

Remove the split pin and clevis pin on the door check strap bracket situated on the door hinge pillar.

Mark the positions of the hinges on the door.

Remove the six bolts securing the hinges to the door side and remove the door.

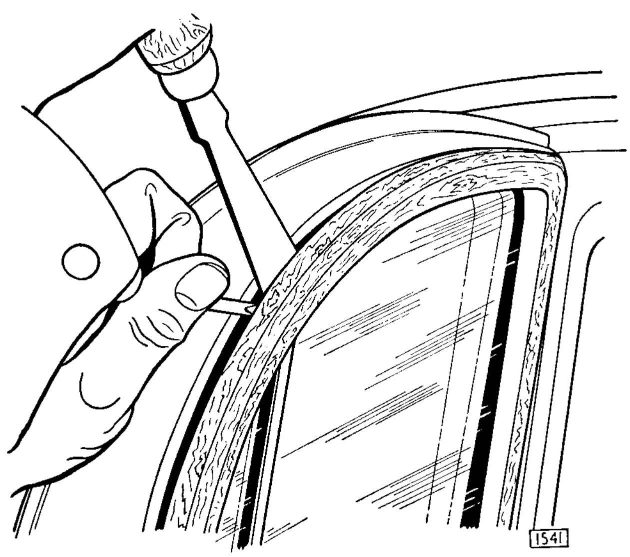

Fig. 16. Removal of the door window capping.

Remove the four cross headed screws securing the hinges to the rear door side of the centre pillar.

Remove the two cross headed screws from the front door side of the centre pillar. Withdraw the hinge.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF FRONT AND REAR DOOR TRIM CASINGS

Using a very thin bladed screwdriver, insert the blade between the door frame and the window surround capping. There are five clips securing the capping. Prise off the capping.

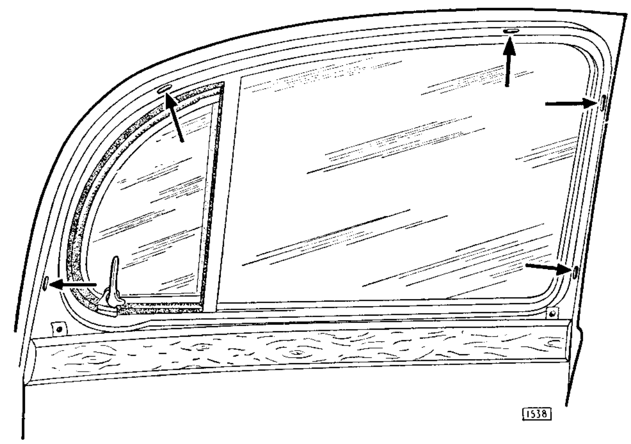

Fig. 17. Showing the location of the door window capping clip holes.

Remove the two screws securing the waist rail capping to the door, and lift off the waist rail.

First ensure that the winding window is completely closed, then insert a screwdriver between the handle and the spring cap and press the cap inwards (see

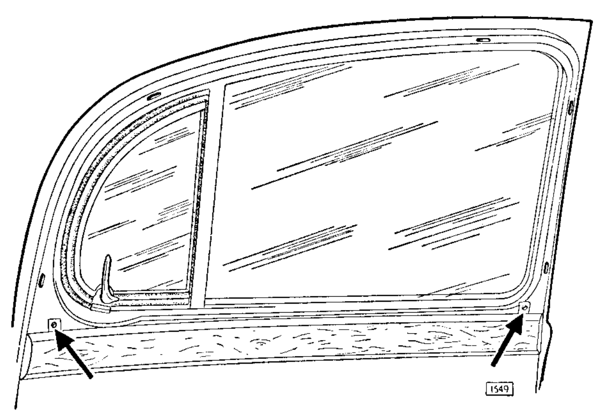

Fig. 18. Showing the screws which secure the waist-rail capping.

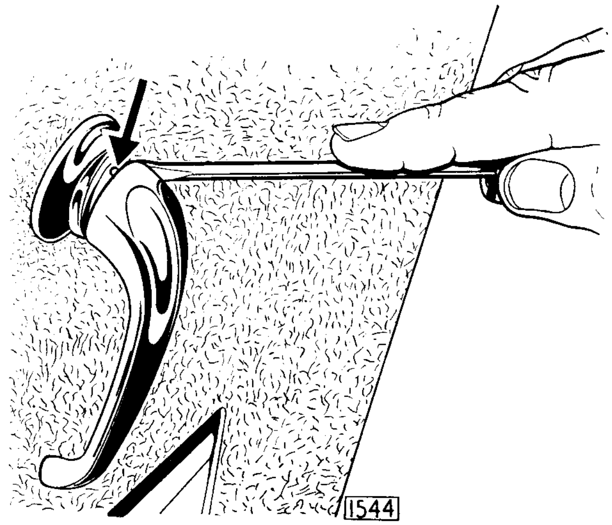

Fig. 19. Showing the location of the interior door lock handle retaining pin.

Fig. 19). This will expose the retaining pin which should be tapped out. The handle, spring clip and escutcheon can now be removed.

Repeat the procedure for the window winder handle. Remove the two drive screws and washers securing the arm-rest to the door. Remove the arm-rest by lifting upwards.

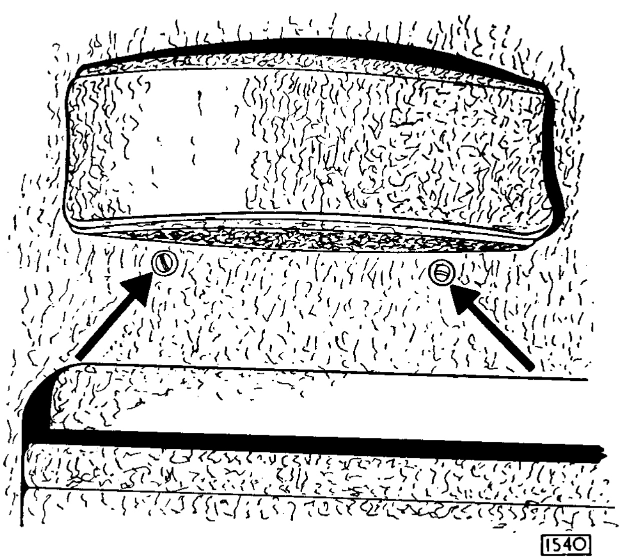

Fig. 20. Showing the screws which secure the door arm rest.

The covering for the door casing is attached to the door frame at the bottom of the window aperture with upholstery solution. Pull the covering away from the door frame.

Remove the four drive screws securing the mill board casing to the front door frame. There are three drive screws securing the mill board casing on the rear door.

Insert a thin bladed screwdriver between the door casing and the door frame. Prise off the door casing which is secured by nineteen spring clips.

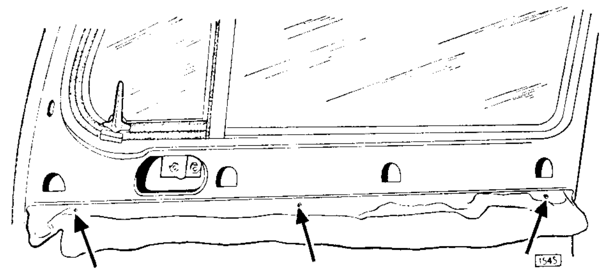

Fig. 21. Showing the screws which secure the top of the door trim casing.

REFITTING

Refitting is the reverse of the removal procedure.

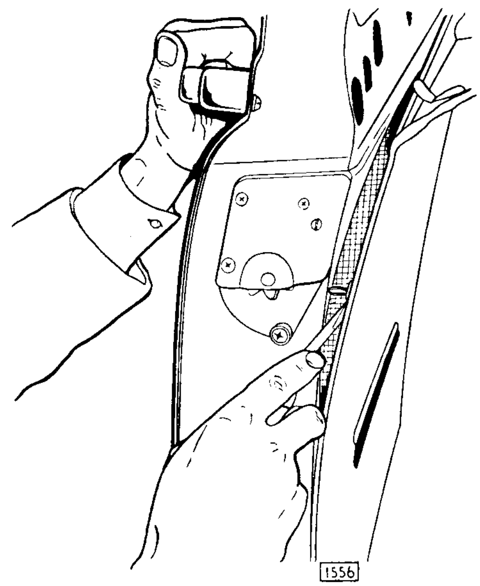

Fig. 22. Removal of the door trim casing.

REMOVAL OF THE RADIATOR GRILLE

Remove the two setscrews securing the closing plate between the front wings under the radiator grille opening and remove the plate.

Remove the setscrew, plain and serrated washers and cup securing the badge boss to the body.

Unscrew the five nuts, plain and serrated washers

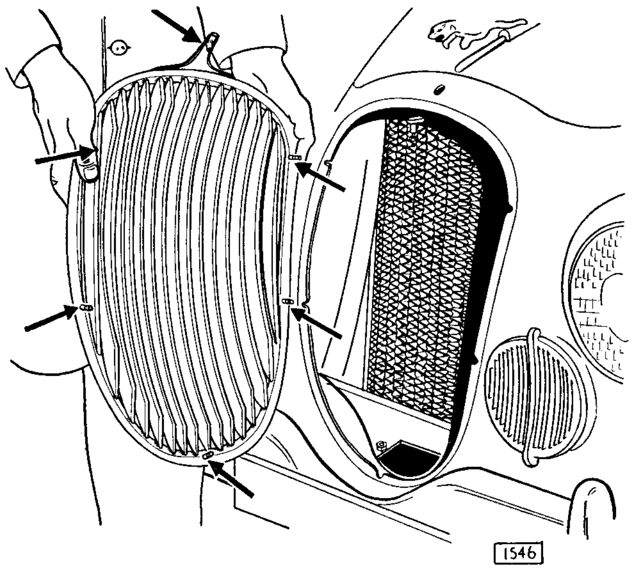

Fig. 23. Showing the location points of the radiator grille.

and remove the small angle brackets securing the radiator grille to the body. On early 2.4 litre cars the radiator grille was secured by six nuts. Withdraw the radiator grille.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF FRONT DOOR GLASS AND FRAME

Remove the door casing as described on page 12.

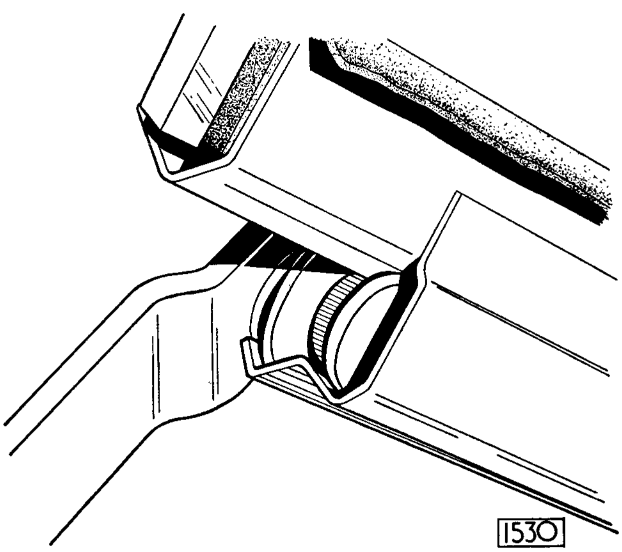

Fig. 24. Showing the window regulator arm and channel.

Open the " no draught " ventilator (N.D.V.).

Partially remove the N.D.V. rubber.

Remove the three drive screws securing the N.D.V. frame to the door window frame (see Fig. 25).

Remove the screw securing the upper glass velvet channel at the end nearest to the top of the chrome N.D.V. channel. Prise away the clips and withdraw the channel from the door frame.

Remove the front glass channel securing bolt, situated at the bottom of the channel just above the door map pocket.

Wind down the window and prise away the inner and outer velvet strip between the glass and the door.

Remove the screw securing the N.D.V. chrome channel to the door.

Pull the N.D.V. channel towards the rear of the car and withdraw the N.D.V. and the frame.

Slide the window glass forwards from the roller and withdraw the glass from the door.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF THE REAR NO DRAUGHT VENTILATOR

Using a very thin bladed screwdriver insert the blade between the door frame and the window surround capping which is secured by five spring clips. Prise off the capping.

Remove the two screws securing the waist rail

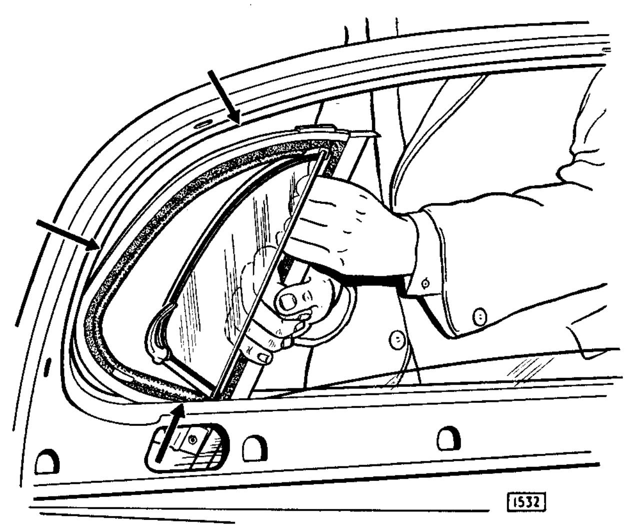

Fig. 25. Removing the rear door N.D.V.—the arrows indicate the location of the securing screws.

capping to the door and lift off the waist rail.

The covering for the door casing is attached to the door frame at the bottom of the window aperture with upholstery solution. Pull the covering away from the door frame.

The no draught ventilator adjustment and securing mechanism is visible through a small aperture in the door.

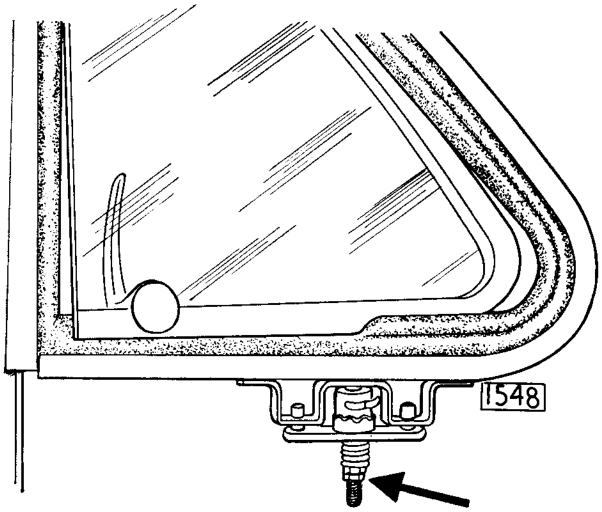

Fig. 26. Showing the nuts for frictional adjustment of the front N.D.V.

Remove the two nuts and serrated washers clamping the N.D.V. post to the N.D.V. outer frame.

Carefully spring the N.D.V. away from its mounting. Withdraw the N.D.V.

REFITTING

Refitting is the reverse of the removal procedure. To adjust the frictional loading on the N.D.V. tighten the two nuts clamping the plate against the N.D.V. post until it will withstand high speed wind pressure and yet operate freely.

REMOVAL OF THE FRONT NO DRAUGHT VENTILATOR

Using a very thin bladed screwdriver, insert the blade between the metal window frame and the window surround capping which is secured by five spring clips. Prise off the capping.

Remove the two screws securing the waist rail capping to the door.

Lift the waist rail upward and off.

The covering for the door casing is attached to the door frame at the bottom of the window aperture with

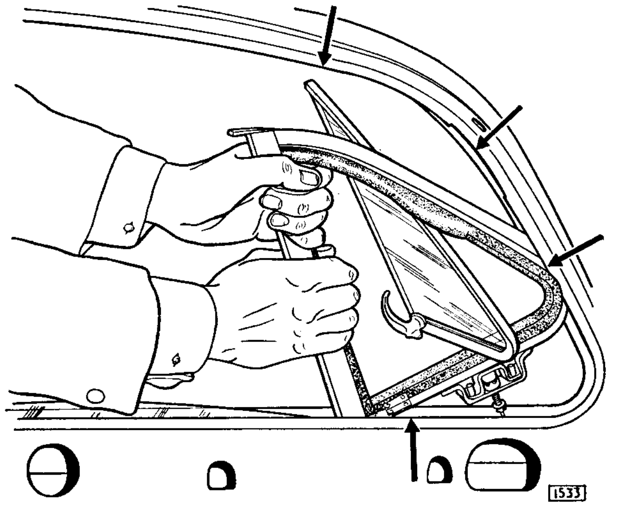

Fig. 27. Removal of the front door N.D.V.—the arrows indicate the location of the securing screws.

upholstery solution. Pull the covering away from the door frame.

The no draught ventilator adjustment and securing mechanism is visible through a small aperture in the door.

Remove the two nuts, washer, spring and quadrant on the N.D.V. post at the bottom of the N.D.V. glass.

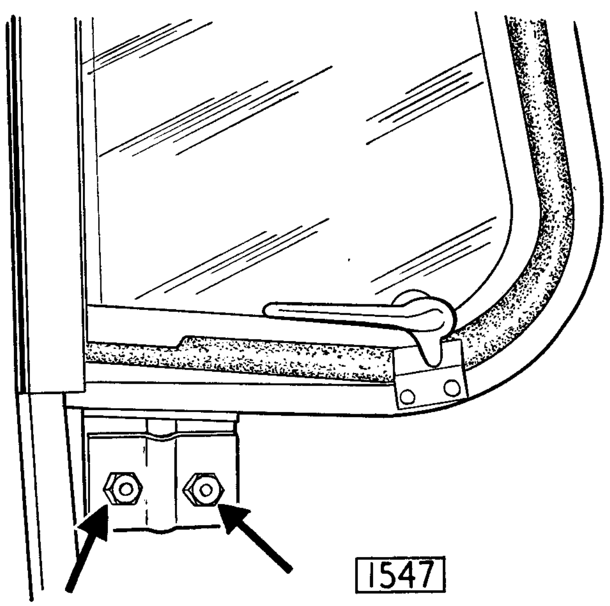

Fig. 28. Showing the nuts for frictional adjustment of the rear N.D.V.

Remove the split pin and segment on the N.D.V. post.

Unscrew the N.D.V. securing pin on the top mounting and withdraw the N.D.V.

REFITTING

Refitting is the reverse of the removal procedure. Tighten the adjustment nut on the N.D.V. post until there is a positive feel between the segment and the quadrant when the N.D.V. is moved to any of its three positions.

REMOVAL OF REAR DOOR GLASS AND FRAME

Remove the door casing as described on page 12.

Open the "no draught ventilator" (N.D.V.). Partially remove the N.D.V. rubber.

Remove the two drive screws securing the N.D.V. frame to the door frame.

Remove the screw securing the upper glass velvet channel at the end nearest the top of the chrome N.D.V. channel. Prise away the clips and withdraw the channel from the door frame.

Remove the front glass channel securing bolt, situated at the bottom of the channel just above the door map pocket.

Wind down the window, prise away and withdraw the inner and outer velvet strip between the glass and the door.

Remove the screw securing the N.D.V. chrome channel to the door.

Pull the N.D.V. channel towards the front of the car and withdraw the N.D.V. and frame.

Partially wind up the window and withdraw the glass from the door.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF REAR SEAT CUSHION AND SQUAB

Lift the rear seat cushion upwards, off the two locating pins on the rear seat pan and remove the rear seat.

Remove the two screws, plain and serrated washers securing the bottom of the rear seat squab to the seat pan.

Lift the rear seat back to disengage the two hooks which secure it to the metal frame and remove the seat back.

REFITTING

When refitting the seat back it is important that it is located on to the locating pins of the seat pan.

Refitting is the reverse of the removal procedure.

REMOVAL OF SEAT AND SLIDES

Remove the cushion from the front seat.

Slide the seat fully rearward.

Remove the two bolts and plain washers securing the front of the seat runners to the body floor.

Slide the seat forwards and remove the two long screws and spring washers securing the rear of the seat runners to the body floor ; remove the seat.

Disconnect the two slide springs and push the seat slides forward exposing the bolts securing the rear of the seat slides to the seat.

Remove the bolts and spring washers.

Push the seat slides to the rear exposing the front bolts securing the seat slides to the seat.

Unscrew the bolts and remove the slide.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF FRONT WINDOW REGULATOR

Remove the door casing and window as described on pages 12—14.

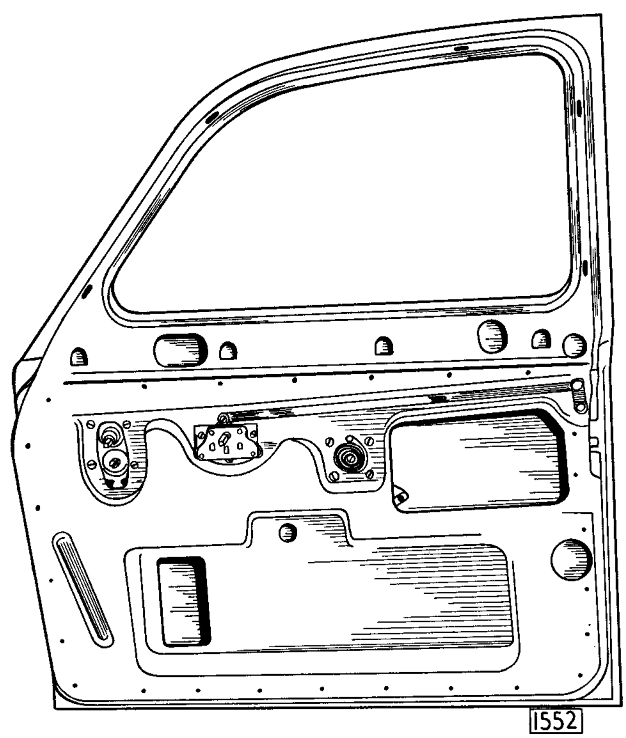

Fig. 29. View of front door showing the window winding and door lock mechanisms.

Remove the piece of felt placed over the window regulator spindle.

Remove the four screws and serrated washers securing the window regulator to the door frame.

Remove the four screws and serrated washers securing the window regulator spring to the door frame under the door lock control.

Withdraw the window regulator mechanism.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF REAR WINDOW REGULATOR

Removal

Remove the door casing and window as described on pages 12—14.

Remove the piece of felt placed over the window regulator spindle.

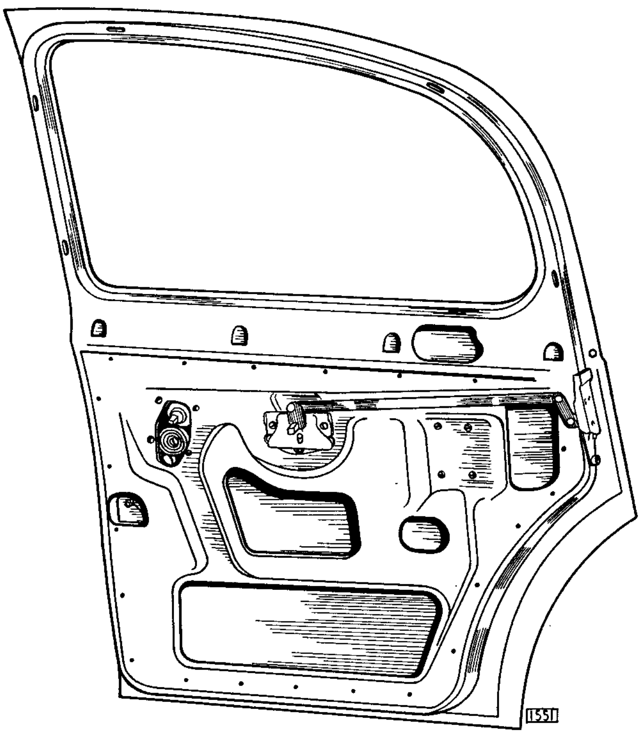

Fig. 30. View of rear door showing the window winding and door lock mechanisms.

Remove the four screws and serrated washers securing the window regulator mechanism to the door frame.

Withdraw the window regulator mechanism.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF DOOR LOCKS

Remove the door casing as described on page 12.

Withdraw the connecting link, which is retained by a spring, from the dowel at the rear of the lock between the door frame.

Remove the four cross headed screws securing the lock to the end of the door frame.

Remove the three screws securing the door lock remote control to the door frame.

Withdraw the lock mechanism from the door frame.

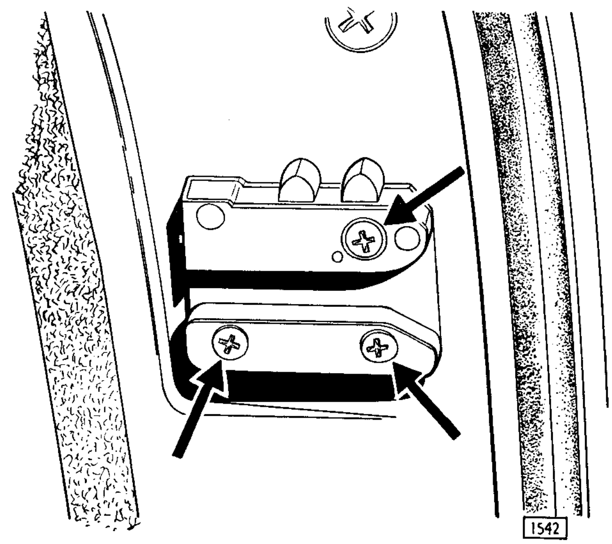

Fig. 31. Location of the door striker plate securing screws.

Unscrew the nut and screw inside the door retaining the outside push button handle to the door.

Do not remove the striker unit unless it is necessary to fit a replacement or make adjustment. To remove the striker unit remove the three screws.

REFITTING

At first the lock and remote control units should be loosely fitted to the door. Note : On rear remote control units a shorter screw is fitted in the foremost elongated hole (J, Fig. 32.) The four cross headed type screws holding the lock unit should be tightened first, then the remote control unit aligned by sliding its elongated holes as far as possible towards the lock unit. The operating lever (K) will then be in contact with the lock case as illustrated. Finally, tighten down the three securing screws.

The plunger housings on the outside handles are stamped " N.S." (near side) or " O.S." (off side).

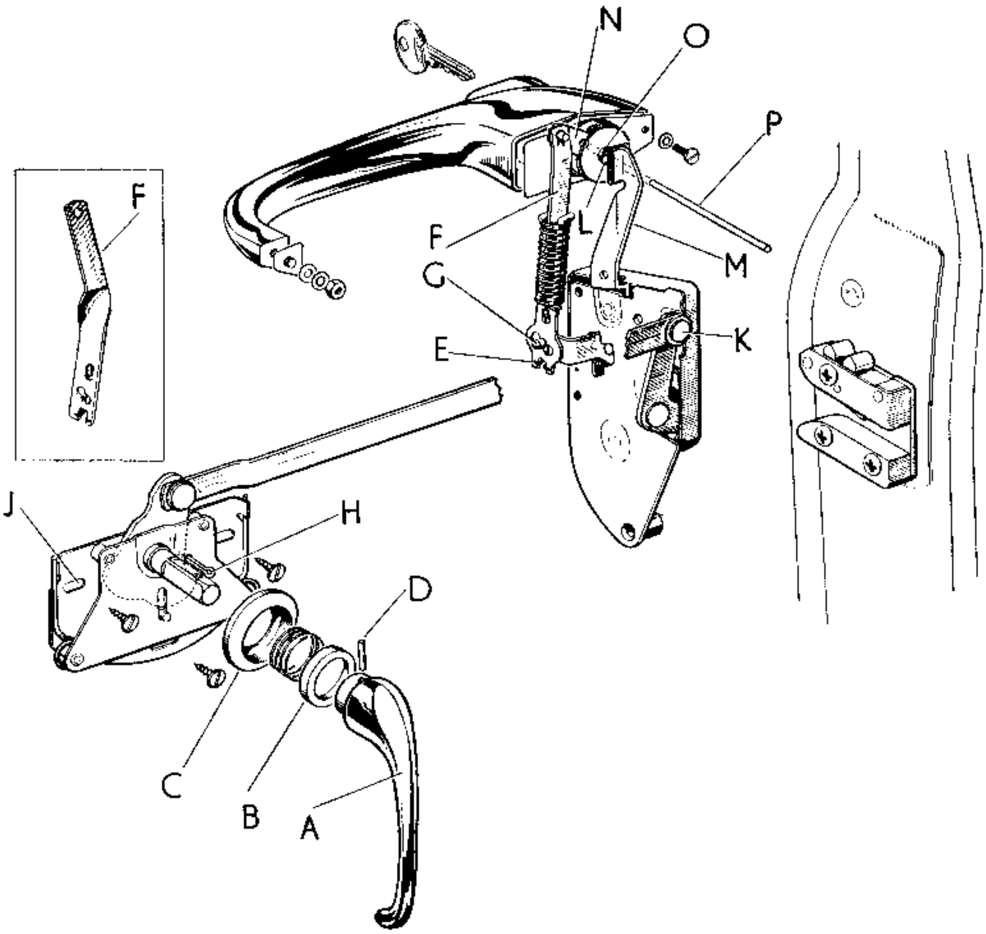

Fig. 32. Showing the door lock mechanism.

The appropriate handle with its two seatings washers should be held in position on the door panel and the clearance between the push button plunger (L) and the lock contractor (M) checked through the aperture in the inner door panel. Do not check the clearance by depressing the push button as this may be deceptive. The clearance should be $\frac{1}{32}''$ (.8 mm.).

However, before making any adjustments turn the plunger operating lever (N) to the unlocked position so that depression of the push button moves the plunger through its housing. In this position, release the locknut (O), screw the plunger bolt (L) in or out as required and re-tighten the locknut before releasing the push button.

Before finally fitting the handle to the door, the extendable connecting link (F) (rigid type (Fa) on rear doors) should be attached to the plunger operating lever (N) and retained by a circlip. The link must be fitted so that the bent position at the top is inclined towards the outside handle.

Manoeuvre the connecting link through the handle aperture so that it hangs downwards inside the door, then the handle with its seating washers can be finally fixed to the door.

The plunger operating lever (N) should then be turned to the locked position, that is, until the location holes in the operating lever and plunge housing are in line. To maintain operating lever in this position insert a short length of $\frac{1}{8}''$ (3.2 mm.) dia. rod (P), via the appropriate aperture in the inner door panel, through the locating holes. Since the window channel in the front doors may partially obscure the plunger housing it is advantageous to slacken off the nut which holds the bottom of the rearmost window channel to a bracket in the door. This is accessible through a small round aperture in the inner door panel with a No. 10 A.N.F. (2 B.A.) box spanner.

The window channel can then be detached from its bracket and held out of the way.

Ensure that the remote control cam is set in the locked position and in the case of front doors, retained in the locked position by the peg (H).

It will be observed that one of the holes in the bottom of the connecting link (F or Fa) can be aligned with the dowel (G) on the intermediate lever. The connecting link is simply pressed on, being automatically retained by the spring (E).

Attach the striker unit loosely to the door pillar with the three screws which pass into the adjustable tapping plate inside the door pillar. Move the unit to the desired position, bearing in mind that it must be retained at right angles to the door hinges, and tighten the securing screws.

REMOVAL OF THE POLISHED WOOD CAPPINGS

Upper and Lower Cappings on the Door Pillar

Insert a thin bladed screwdriver between the trim casing and the centre door pillar. Prise off the casing which is retained by metal clips.

Remove the screw securing the wooden cappings to the casing.

Windscreen Side Capping

Remove the two screws and washers securing the wooden capping strip at the side of the windscreen.

Remove the capping strip.

Wooden Window Surround

Insert a thin bladed screwdriver between the window surround and the door frame. Carefully prise off the wooden surround.

Waist Rail

Prise off the window surround as described on page 12. Remove the two screws securing the waist rail capping to the door and lift off the waist rail.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF THE REAR LIGHT GLASS

Prise off the chrome finisher on the rear light rubber. Insert a screwdriver between the rubber and the windscreen aperture and draw it completely around the rubber moulding to break the seal. Repeat operation on the inside of the car.

Insert a screwdriver between the rubber and the glass at the side. Exert sudden pressure on the glass and force the screen outwards from inside the car.

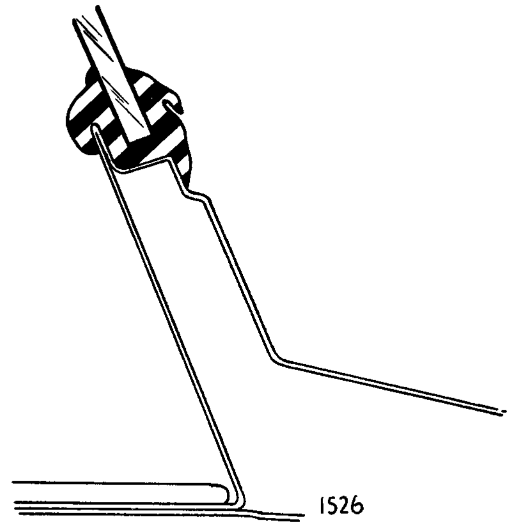

Fig. 33. Section through rear light glass and sealing rubber.

REFITTING

Clean any excess sealing compound from the rubber surround and body aperture.

Place the new or original rubber, depending on its condition, around the glass without any sealing compound at this stage.

Obtain a length of strong cord slightly longer than the length of the rubber moulding and pass the end through a short length of $\frac{1}{4}''$ (6.3 mm.) dia. tubing. Insert the tube into the body aperture channel in the rubber.

Run the tube round the entire length of the rubber, leaving approximately one foot at either end for pulling purposes.

Employing two operators, one inside and another outside the car, offer up the rear light glass complete with rubber. From inside the car pull the cord slowly so that the lip of the rubber is guided over the edge of the flange aperture. Slowly pull the ends of the cord alternately whilst the operator on the outside of the car exerts pressure, or strikes the glass smartly with the flat of the hand to assist in the operation, especially as the corners are approached.

No difficulty should be experienced if reasonable care is exercised.

If, however, the cord is pulled directly against the rubber, tearing of the rubber may result.

Using a pressure gun, with a copper nozzle to avoid scratching the glass, filled with a suitable sealing compound, place the nozzle between the glass and the rubber on the outside of the car and run the sealer completely around the glass.

A similar operation must also be carried out between the screen rubber and the body aperture.

Apply sealing compound to the rear of the chrome finisher. Carefully insert the chrome finisher into the rear light rubber. Clean off the excess sealing compound.

BOOT LOCK ADJUSTMENT

Slacken the four setscrews securing the boot lid lock striker to the boot lid (see Fig. 34). Move the striker in the elongated holes until the lock operates correctly and does not rattle. Tighten the retaining setscrews.

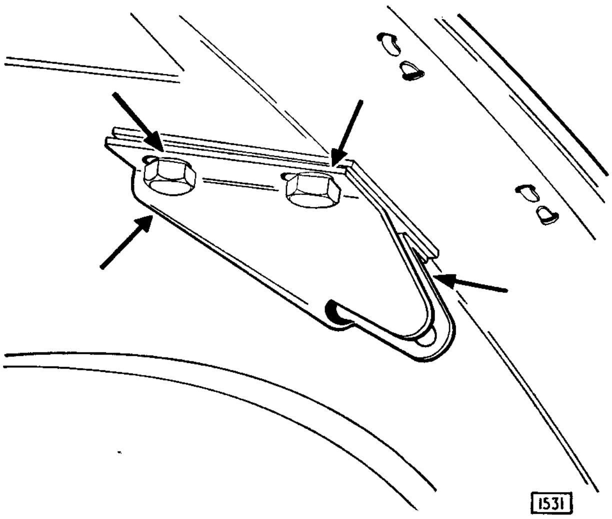

Fig. 34. Showing the screws for adjustment of the boot lid striker.

REMOVAL OF PETROL FILLER LID

Remove the return spring. Unscrew the two setscrews and washers securing the lid and hinge to the inner wall of the petrol filler cap compartment.

Remove the two setscrews and washers securing the lid to the hinge.

REFITTING

Refitting is the reverse of the removal procedure. When refitting the lid, retain it by screwing the setscrews finger tight in the elongated holes, then align the lid to fit into the recess of the body panel. Tighten the setscrews securely.

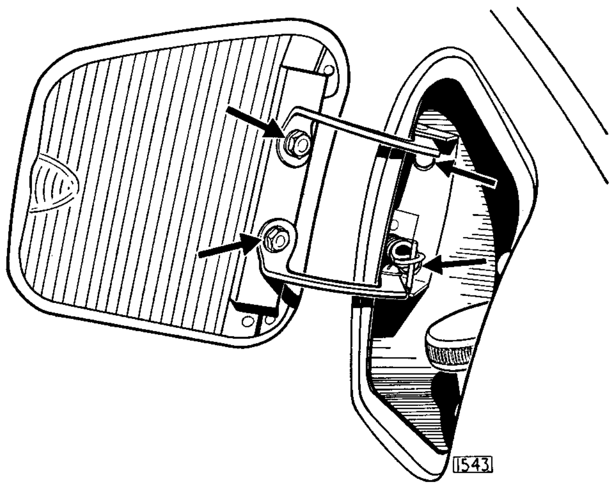

Fig. 35. Removal of fuel filler lid.

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Fig. 36. Body panels.

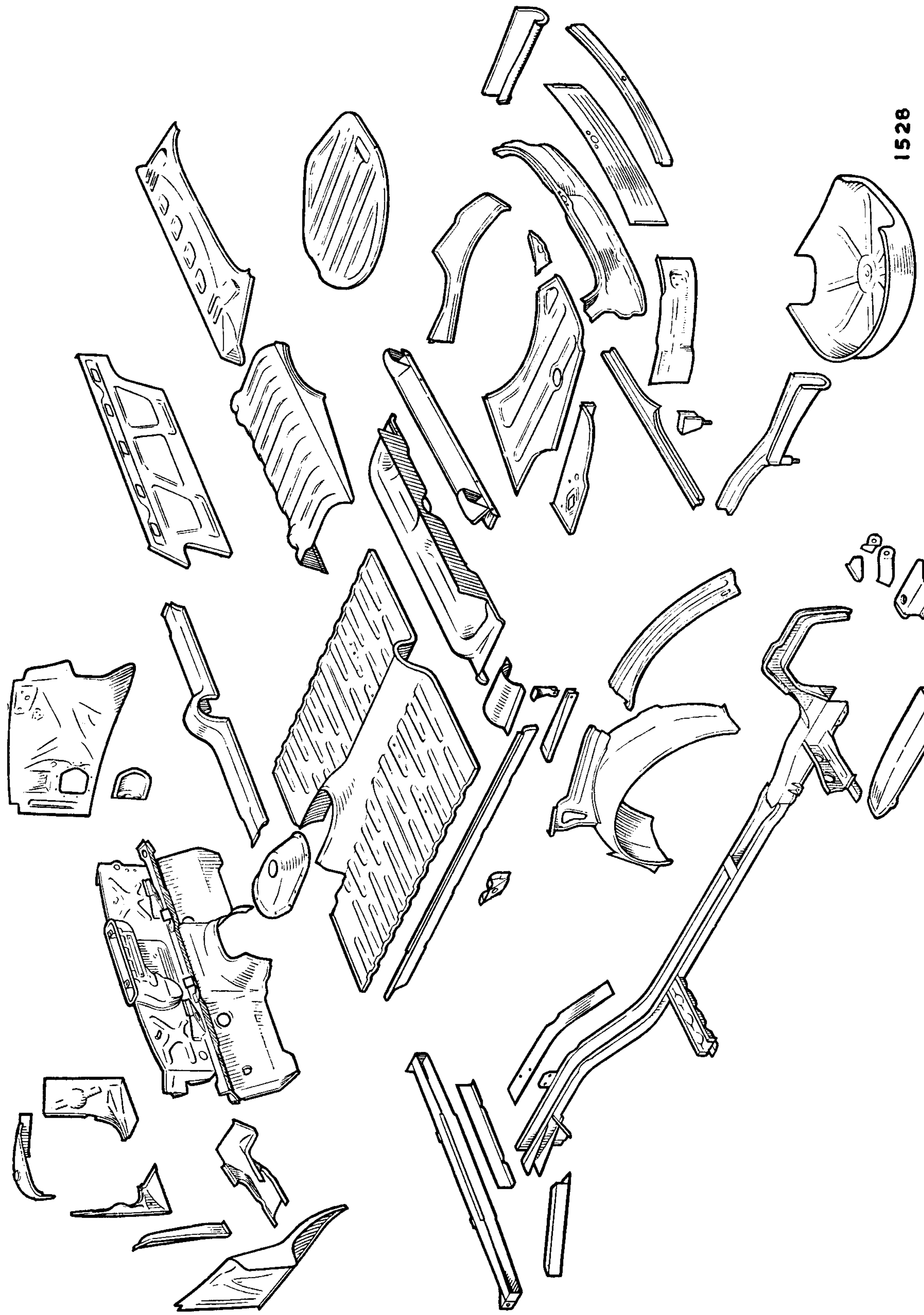

Fig. 37. Body underframe components.

ACCIDENTAL DAMAGE

The repair of integral construction bodies varies in some degree, depending on the extent of the damage, to that of separate body and chassis construction.

Superficial damage can be effected in a similar manner to that employed on " all steel " bodies which is familiar to all body repairers.

Repairs to rectify extensive damage affecting the main members of the underframe must be carried out so that when the repair is completed the main mounting points for the engine, front and rear suspensions, etc., are in correct relation to each other.

When checking for or rectifying distortion in the main underframe members, reference should be made to the diagrams in the section headed " Checking Body Underframe Alignment " which gives the important dimensions to be observed.

Replacement Body Panels

Where the existing panels or members are badly damaged and it is not possible to effect a satisfactory repair in position, the affected panels will have to be cut out and replacement panels welded in their place.

It will frequently be found advantageous to use only a part of a given panel so that the welded joint can be made in a more accessible position. Great care must, of course, be taken when cutting the mating portions of the panel to ensure that perfect matching is obtained.

For example, if damage to a front wing is confined to the forward end a simpler and quicker repair can be effected by cutting the front wing off between the wheel aperture and the wing valance. If the replacement front wing is then cut to match, a simple butt weld can be made and after cleaning down with a sanding disc and filling with plumber's lead the joint should be invisible.

Any unused portions of replacement panels should be retained as it will often be found that they can be used for some future repair job.

Where a replacement panel to be fitted forms part of an aperture such as for a door or the luggage boot lid, an undamaged door or lid should be temporarily hinged in position and used as a template to assist location while the replacement panel is clamped and welded in position.

Similarly, an undamaged radiator grille can be used as a template to accurately form the aperture when fitting a replacement front wing or wings.

Before any dismantling takes place after accidental damage a check of the underframe alignment should be carried out.

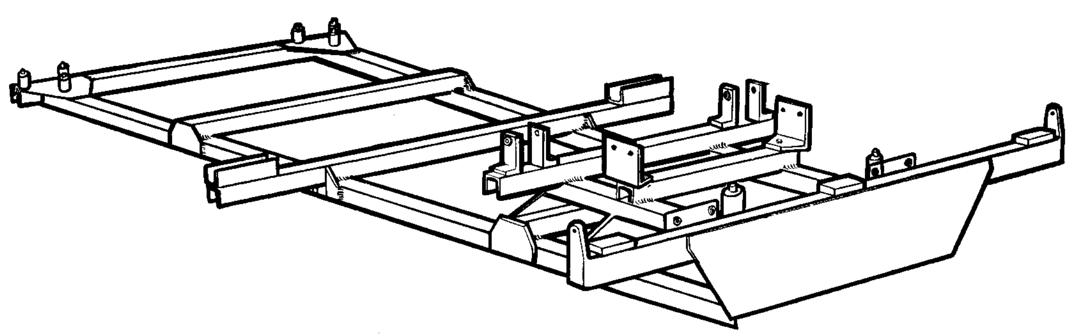

Fig. 38. Body underframe alignment jig, TFA.1329.

CHECKING BODY UNDERFRAME ALIGNMENT

Checking for Distortion in the Horizontal Plane

The plan view of the body on page 25 provides the important dimensions for checking for distortion in the underframe. These dimensions can be measured actually on the underside of the body or by dropping perpendiculars from the points indicated by means of a plumb-bob on to a clean and level floor. If the latter method is adopted the area directly below each point should be chalked over and the position at which the plumb-bob touches the floor marked with a pencilled cross.

Checking for Distortion in the Vertical Plane

For checking the underframe for distortion in the vertical plane the side elevation gives the details of the important dimensions from a datum line.

If the relative distance between two points **above** the datum line is required one dimension should be subtracted from the other.

If the relative distance between a point above the datum line and the straight section of the chassis side member is required, add the dimension " D " —$3\frac{13}{16}$" (9.7 cm.)—to the dimension above the datum line.

If it is required to check the dimensions from ground level raise up the car at the front and rear and insert four blocks or stands of exactly equal height between the ground and the straight section of the chassis side members.

The blocks should be positioned at the front end to the rear of the jacking tube and at the rear end immediately in front of the rear spring front mounting bracket—**do not allow the weight of the car to rest on the blocks, use them only as test pieces.**

The distance from the ground to any given check point will be : height of blocks + " D " ($3\frac{13}{16}$"—9.7 cm.) + distance from datum line to check point.

KEY TO ALIGNMENT DIAGRAM

Symbol	Measurement taken from	Dimension
A	Forward face of front cross-member to centre of front wheel	$22\frac{1}{2}$" (57.15 cm.)
B	Centre of front wheel to centre of rear wheel (wheelbase)	$107\frac{3}{8}$" (272.75 cm.)
C	Centre of rear wheel to rear panel of luggage compartment	$36\frac{21}{32}$" (93.05 cm.)
D	Datum line to straight section of chassis side member	$3\frac{13}{16}$" (9.70 cm.)
E	Datum line to underside of front cross-member	1" (2.55 cm.)
F	Datum line to centre of tube in chassis side member for front suspension cross-member mounting	$2\frac{3}{16}$" (5.55 cm.)

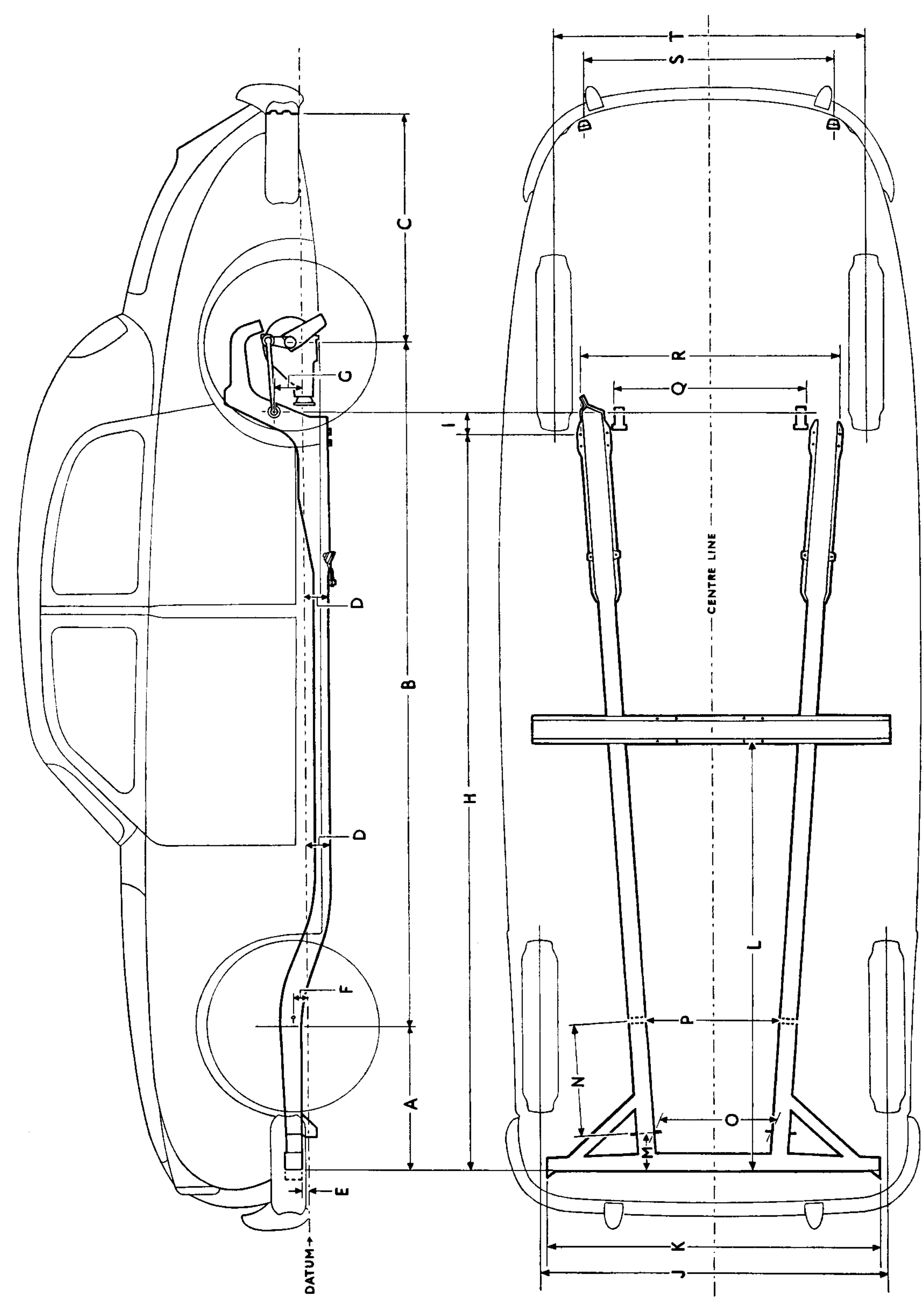

Fig. 39. Underframe alignment diagram.

KEY TO ALIGNMENT DIAGRAM continued

Symbol	Measurement taken from	Dimension
G	Datum line to centre of hole in rear torque arm bracket	$3\frac{7}{8}''$ (9.85 cm.)
H	Forward face of front cross-member to centre of outside rear hole of rear spring centre mounting (measured parallel to centre line of car)	$114\frac{13}{16}''$ (291.60 cm.)
I	Centre of outside rear hole of rear spring centre mounting to centre of hole in rear torque arm bracket (measured parallel to centre line of car)	$3\frac{7}{16}''$ (8.75 cm.)
J	Front Track	$54\frac{5}{8}''$ (138.75 cm.)
K	Outer ends of front cross-member	$50''$ (127.00 cm.)
L	Forward face of front cross-member to centre line of front holes for the rear engine mounting support channel (measured parallel to centre line of car)	$67\frac{31}{32}''$ (172.65 cm.)
M	Forward face of front cross-member to forward face of front suspension cross-member mounting bracket (measured along chassis side member)	$5\frac{25}{32}''$ (14.70 cm.)
N	Forward face of front suspension cross-member mounting bracket to tube in chassis side member for front suspension cross-member mounting	$17\frac{27}{32}''$ (45.30 cm.)
O	Inner faces of chassis side members at joints with front suspension cross-member mounting brackets	$18\frac{23}{32}''$ (47.55 cm.)
P	Inner faces of chassis side members at front suspension cross-member mounting tubes	$21\frac{1}{32}''$ (53.40 cm.)
Q	Outer faces of rear torque arm brackets	$29\frac{9}{64}''$ (74.00 cm.)
R	Outer rear holes of rear spring centre mounting brackets	$40\frac{1}{16}''$ (101.75 cm.)
S	Centres of rear bumper mountings	$40\frac{1}{32}''$ (101.65 cm.)
T	Rear Track	$50\frac{1}{8}''$ (127.30 cm.)

WELDING METHODS

The following are the principal methods of welding used in the assembly of the body and underframe panels. The instructions given below for breaking the different types of welds should be adhered to when removing a damaged panel as this will facilitate the assembly of the new panel.

Spot Welding

This type of welding is used for the joining of two or more overlapping panels and consists of passing electric current of high amperage through the panels by means of two copper electrodes.

This results in complete fusion of the metal between the electrodes forming a " spot " weld which is frequently repeated along the length of the panels to be joined. Spot welds can easily be recognised by slight indentation of the metal.

Lap joints on the outer body panels which are spot welded together are usually lead filled and in this case it will be necessary to direct the flame of an oxy-acetylene torch on to the lead so that the filling can be melted and wiped off by means of a piece of cloth.

Breaking Spot Welds

Spot welds cannot be broken satisfactorily other than by drilling ; any attempt to separate the panels by using a chisel will result in the tearing of the metal in the vicinity of the spot welds.

Use a $\frac{3}{16}''$ (4.7 cm.) diameter drill and carefully drill out each weld. There is no necessity to drill completely through both panels ; if the " spot " is drilled out of one of the panels the weld can be completely broken by inserting a thin sharp chisel between the two panels and tapping lightly with a hammer.

Where possible, drill the spot welds completely out of the panel that is to be left in position on the body. This will allow the new panel to be joined to the mating panel on the body by gas welding through the holes in the overlapping flange. (This does not apply if spot welding equipment is available.)

If this is not possible, and the holes have to be drilled out in the damaged panel, new holes can be drilled in the replacement panel and the same type of weld effected.

Gas Welding

This type of welding is carried out by means of oxy-acetylene equipment and is used for the joining of overlapping panels or the butt welding of the edges of two panels.

Breaking Gas Welds

Gas welds may be broken either by means of a sharp chisel or by cutting through with a hacksaw ; welding can be removed by grinding with a pointed emery wheel.

EXHAUST SYSTEM

REMOVAL OF THE 3.4 LITRE EXHAUST SYSTEM

Remove the nut, bolt and washer securing the tail pipe under the rear bumper on the right-hand side to the bracket on the body.

Slacken the two clips securing the exhaust downpipes to the silencer.

Remove the nut, bolt and washer securing the front of the silencers to the body.

Remove the two bolts, nuts and washers securing the middle of the silencers to the body.

Lower the tail pipes and withdraw the silencers from the downpipes.

Remove the four nuts and washers securing each downpipe to the exhaust manifolds on the engine, when the downpipes can be removed. Collect the exhaust manifold to downpipe sealing rings.

REFITTING

Refitting is the reverse of the removal procedure. Renew the copper sealing rings when refitting the exhaust downpipes to the exhaust manifolds.

REMOVAL OF THE 2.4 LITRE EXHAUST SYSTEM

Remove the nut, bolt and washer securing the tail pipe under the rear bumper on the right-hand side to the bracket on the body.

Slacken the clip securing the exhaust downpipe to the silencer.

Remove the two nuts, bolts and washers securing the silencers to the body.

Withdraw the silencer and tail pipe.

Remove the four nuts and washers securing each downpipe to the exhaust manifolds on the engine. Remove the copper sealing rings.

Remove the nut, bolt and washer securing the down-pipes to the bell housing bracket. The downpipe can now be removed.

REFITTING

Refitting is the reverse of the removal procedure. Renew the copper sealing rings when refitting the exhaust downpipes to the manifolds.

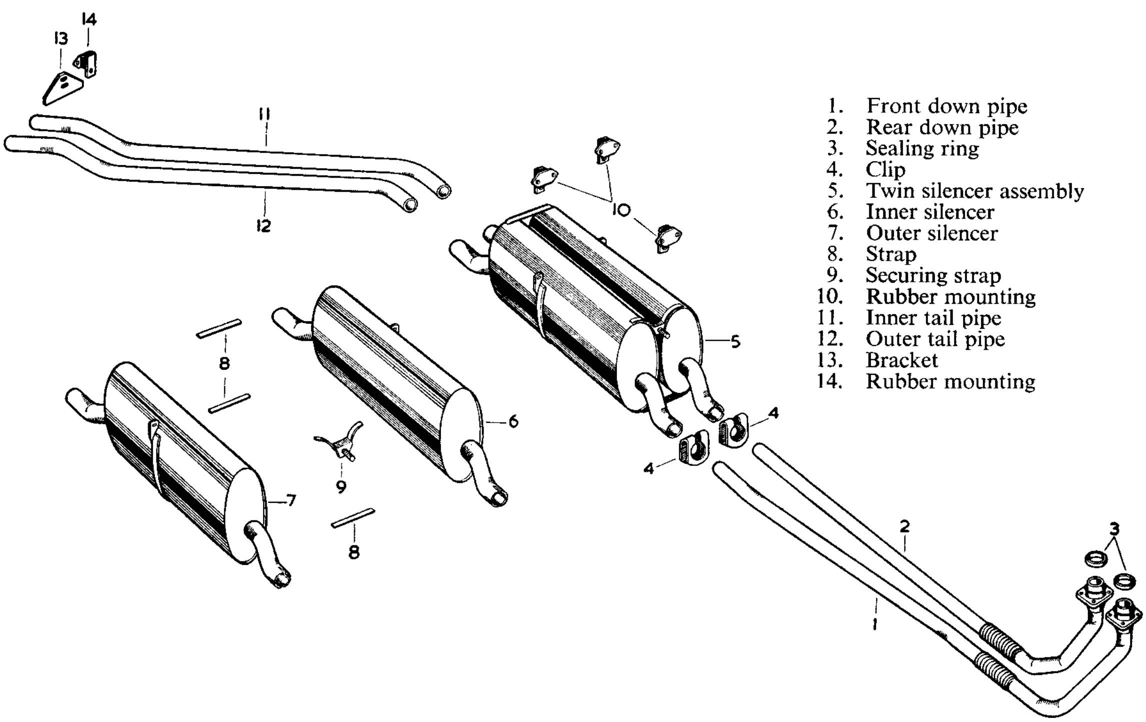

Fig. 40. 3.4 litre exhaust system components.

1. Exhaust down pipe.
2. Flexible pipe
3. Sealing ring
4. Adaptor mounting plate
5. Exhaust silencer
6. Rubber mounting
7. Clip
8. Bolt
9. Washer
10. Nut
11. Tail pipe
12. Rubber mounting

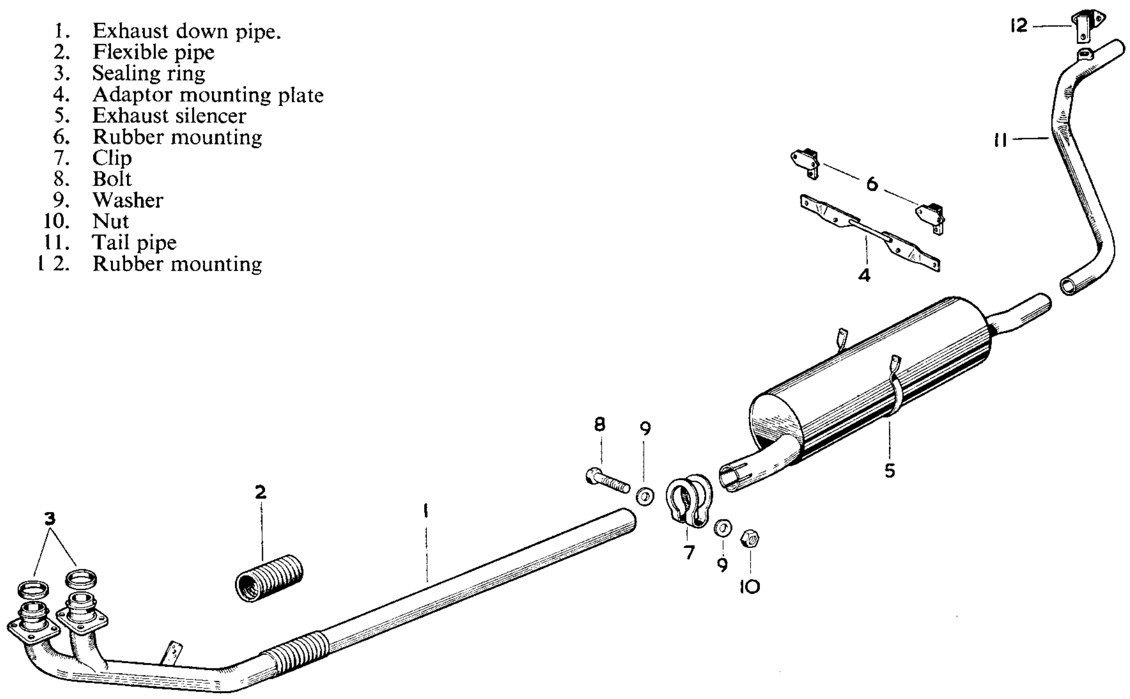

Fig 41. 2.4 litre exhaust system components.

SECTION O

HEATING & WINDSCREEN WASHING EQUIPMENT

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone	Code	Telegraphic Address
COVENTRY 27677 (P.B.X.)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex. 31/622

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CAR HEATING AND VENTILATING SYSTEM

WINDSCREEN WASHING EQUIPMENT

HEATING AND WINDSCREEN WASHING EQUIPMENT

CAR HEATING AND VENTILATING SYSTEM

The car heating and ventilating equipment consists of a heating element and an electrically driven fan mounted on the engine side of the scuttle. Air from the heater unit is conducted :—

(a) To a built-in duct fitted with two doors situated under the instrument panel.

(b) To vents at the bottom of the windscreen to provide demisting and defrosting.

Either fresh air or the air from the interior of the car can be introduced into the system at the will of the driver.

FRESH AIR is introduced into the system by opening the scuttle ventilator and switching on the fan. Air from the interior of the car can be RE-CIRCULATED by closing the scuttle ventilator and switching on the fan.

TEMPERATURE CONTROL

The lever controlling the flow of water from the engine cooling system to the heating element is situated at the left-hand side of the instrument panel.

When the lever knob is placed in the fully upward (Cold) position, the supply of hot water from the engine is completely cut off ; placed in the fully downward (Hot) position the maximum possible amount of hot water from the engine is allowed to pass through the heater element. By placing the lever knob in intermediate positions the temperature of the air from the heater can be varied between these two extremes.

FAN SWITCH

The switch for the heater fan (marked " Fan ") is situated at the left of the instrument panel and is of the " push-push " type. If the fan is off, pressing the button will switch on the fan ; pressing the button a further time will switch off the fan.

The following directions for heating the car interior in cold weather and cooling the car interior in hot weather are given as a guide. To obtain rapid heating of the car interior and/or demisting and defrosting of the windscreen, the re-circulation system should be used.

COLD WEATHER

To obtain re-circulated air heating, de-misting and de-frosting

(a) CLOSE scuttle ventilator.
(b) Set temperature control to the DESIRED POSITION.
(c) Switch ON fan.
(d) OPEN heater doors.

To obtain fresh air heating, de-misting and de-frosting

(a) OPEN scuttle ventilator.
(b) Set temperature control to the DESIRED POSITION.
(c) Switch ON fan.
(d) OPEN heater doors.

To obtain rapid de-misiting or de-frosting

(a) CLOSE scuttle ventilator.
(b) Set temperature control to HOT.
(c) Switch ON fan.
(d) CLOSE heater doors.

HOT WEATHER

To obtain ventilation and de-misting

(a) OPEN scuttle ventilator.
(b) Set temperature control to COLD.
(c) Switch ON fan.
(d) OPEN heater doors.

To obtain rapid de-misting

(a) OPEN scuttle ventilator.
(b) Set temperature to COLD.
(c) Switch ON fan.
(d) CLOSE heater doors.

HEATER UNIT

Removal

Drain the water from the radiator and the cylinder block. Remove the bonnet.

Slacken the small nut and bolt clamping the heater control wire to the control tap.

Slacken the bolt securing the conduit casing to the heater control tap.

Withdraw the cable from the control tap.

Unscrew the clip securing the heater hose to the connection on the side of the heater housing and withdraw the heater hose.

Unscrew the clip securing the heater hose to the heater control tap and remove the hose.

Remove the two bolts and washers securing the heater housing to the scuttle.

Disconnect one of the battery terminals. Remove electrical connection from fan motor.

Withdraw the heater from its mountings.

Refitting

Refitting is the reverse of the removal procedure. It is essential that the earth wire from the boost fan is secured to the bottom mounting bolt on the heater.

Before fitting the heater housing, coat the edge of large aperture in the scuttle with a sealing compound.

HEATER WATER CONTROL TAP

Removal

Drain the water from the radiator and the cylinder block.

Slacken the locknut and setscrew securing the heater tap control cable to the tap.

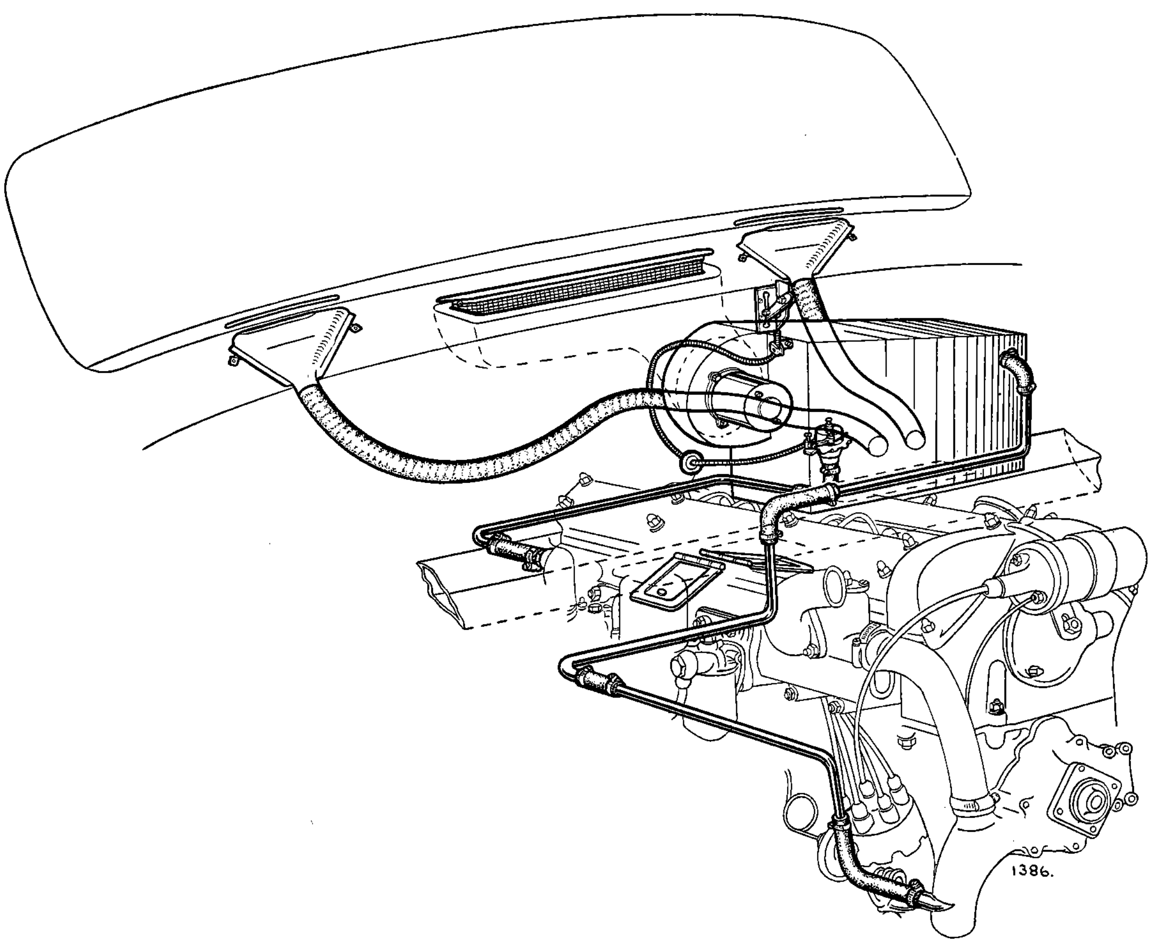

Fig. 1. Layout of heating and ventilating equipment.

Slacken the setscrew securing the heater tap control conduit. Withdraw the conduit and cable from the heater control tap.

Slacken the clip securing the water hose to the bottom of the heater control tap and remove the hose.

Remove the two screws and washers securing the heater control tap to the heater box.

Withdraw the heater control tap and grommet.

Refitting

Refitting is the reverse of the removal procedure. Ensure the grommet is in position before replacing the water control tap.

REMOVAL OF THE FAN SWITCH

Remove the facia panel as described in Section P " Electrical ". Remove one of the battery terminals.

From the front of the instrument panel unscrew the locking ring securing the fan switch to the panel.

Withdraw the switch from the rear of the panel and disconnect the wires.

Refitting

Refitting is the reverse of the removal procedure.

WINDSCREEN WASHING EQUIPMENT

The windscreen washer is vacuum-operated and comprises a glass water container mounted in the engine compartment which is connected to jets at the base of the windscreen. Water is delivered to the jets by a vacuum operated pump incorporated in the water container cap. One pipe is connected to the inlet manifold via a control button on the instrument panel; the other pipe is connected to the two jets at the base of the windscreen.

OPERATION

The windscreen washer should be used in conjunction with the windscreen wipers to remove foreign matter that settles on the windscreen.

Press the chromium plate control button, to the left of the lighting switch, for a few seconds. Release button, when two fine jets of water will strike the windscreen at points one or two inches below the upper edge and in the centre of the arc of wipe provided by each windscreen wiper.

In the summer the washer should be used freely to remove insects before they dry and harden on the screen.

The washer should not be used in sub-zero conditions as the fine jets of water spread over the screen by the blades will tend to freeze up. Do not add radiator anti-freeze solution to the water as this is detrimental to the washer mechanism.

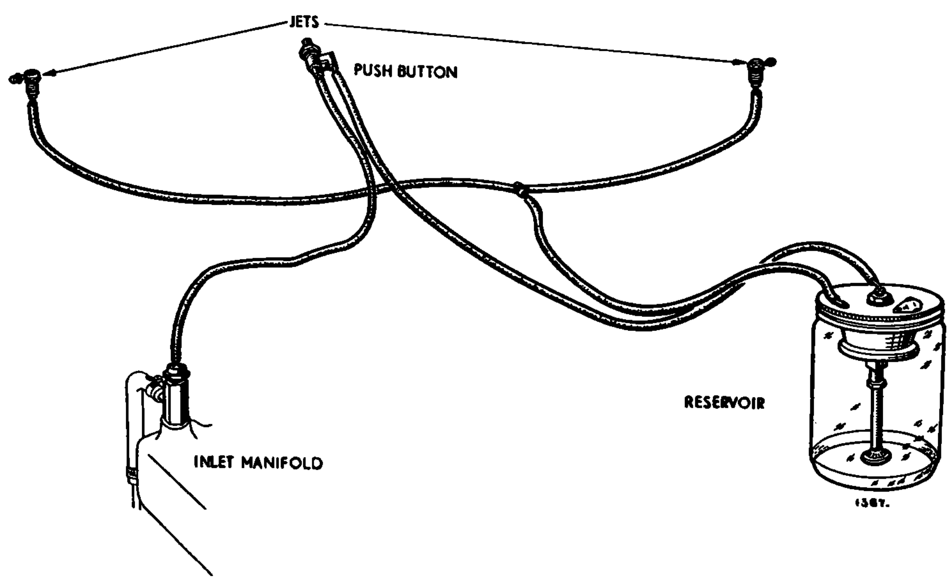

Fig. 2. Layout of the windscreen washing equipment.

CHARGING THE WATER CONTAINER

Push the cover plate, covering the filler hole in the water container cap, to one side. Fill container three quarters full with clean water. Refit cover plate.

WINDSCREEN WASHER SOLVENT

It is recommended that " Trico Windscreen Washer Solvent " No. XAW.30 is used throughout the year. In summer 1 ounce of the solvent should be added to each charge of water and during extremely cold conditions this should be increased to 2 ounces. The main purpose of the solvent is to improve windscreen wiping performance, particularly in dry weather when insects and other foreign matter settle on the screen, and in winter weather when the screen becomes spattered with mud thrown up by other vehicles.

The solvent is also designed to prevent breakage of the glass jar in sub-zero conditions, in that it does not permit solid freezing of the liquid in the jar. This obviates the trouble of having to empty the jar in extreme low temperature conditions.

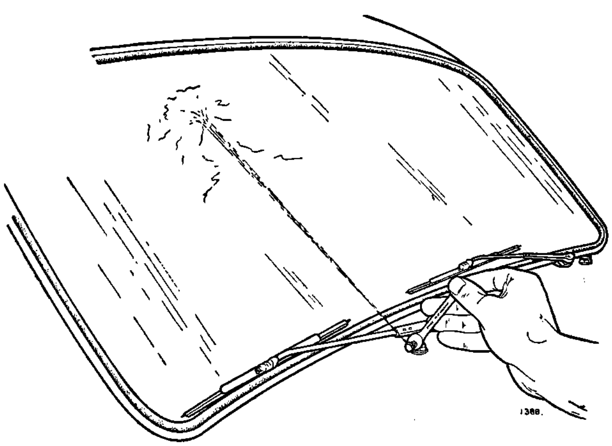

Fig. 3. Showing the adjustment of the windscreen washing jets.

Do NOT add anti-freeze solution to the water as this is detrimental to the water mechanism.

CLEANING THE JETS

Clean one jet at a time only. Unscrew the knurled cap at the end of the jet not more than one turn ; do not remove the cap completely. Operate the washer to allow the water to flow freely through the jet assembly, thus removing particles of dirt (with the knurled cap unscrewed, it will not squirt).

Tighten the knurled cap, finger tight, taking care not to damage the plastic washer. Repeat the operation for the other jet if necessary.

ADJUSTMENT OF THE JETS

The main body and jet assembly is secured to the scuttle with a wing nut at the underside and adjustment in relation to the axis of the car should not be required. The angle at which the jet of water strikes the windscreen can be adjusted by turning the jet, which has a tapered thread fitting, in the side of the main body assembly. The jets of water should strike the windscreen one or two inches below the upper edge.

PIPE CONNECTIONS TO WATER CONTAINER

The two rubber pipes must be attached to the correct connections on the water container cap otherwise water will be drawn into the engine. The suction pipe must be attached to the central connection and the pipe to the jets attached to the side connection as illustrated in Fig. 2.

If there is any doubt run the engine with the two rubber pipes disconnected from the water container cap.

Operate the button on the instrument panel and have another person place their finger over the end of each pipe to establish which pipe is under suction.

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SECTION P

ELECTRICAL AND INSTRUMENTS

2·4 litre and 3·4 litre models

ISSUED BY

JAGUAR CARS LIMITED, COVENTRY, ENGLAND

Telephone	CODE	Telegraphic Address
ALLESLEY 2121 (P.B.X.)	BENTLEY'S SECOND	"JAGUAR," COVENTRY. Telex. 31/622

Publication No. E/120/P/4.

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INDEX (*continued*)

Windscreen Wiper

Miscellaneous

Instruments

BATTERY

The battery is of the semi-linkless type, the short intercell connectors being partially exposed, to enable testing of individual cells to be carried out. Batteries models GTW9A and GT9A are supplied dry and uncharged, and battery model GTZ9A supplied dry but with its plates in a charged condition. Routine maintenance is the same for all three models.

DATA

Type	GTW9A, GT9A or GTZ9A
Voltage	12
Number of plates per cell	9
Capacity—at 10 hour rate	51 ampere hour
—at 20 hour rate	58 ampere hour

ROUTINE MAINTENANCE

Wipe away any foreign matter or moisture from the top of the battery, and ensure that the connections and the fixings are clean and tight.

About once a month, or more frequently in hot weather, examine the level of the electrolyte in the cells. If necessary add distilled water to bring the level up to the top of the separators.

The use of a Lucas battery filler will be found helpful in this topping-up process, as it ensures that the correct electrolyte level is obtained automatically and also prevents distilled water from being spilled over the battery top.

Distilled water should always be used for topping-up. In an emergency however, drinking water, clean rain water or melted snow may be used. Salt water, chlorinated water, chemically softened water and stagnant water must not be used.

NOTE : Never use a naked light when examining a battery, as the mixture of oxygen and hydrogen given off by the battery when on charge, and to a lesser extent when standing idle, can be dangerously explosive.

REMOVAL

Mark the positions of the bonnet hinges relative to the bonnet. Remove the four set-bolts securing the bonnet to the hinges.

Release the two spring clips and remove the battery cover.

Remove the two securing screws and detach the terminals from the lugs.

Unscrew the two battery securing bolts and detach the retaining band and rubber.

Lift out the battery from the tray.

REFITTING

Refitting is the reverse of the removal procedure. Before refitting the cables clean the terminals and coat with petroleum jelly.

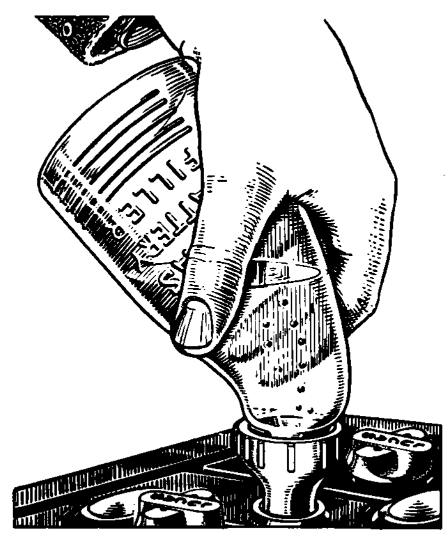


Fig. 1. Lucas battery filler.

BATTERY PERSISTS IN LOW STATE OF CHARGE

First consider the conditions under which the battery is used. If the battery is subjected to long periods of discharge without suitable opportunities for recharging a low state of charge can be expected. A fault in the generator or regulator, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

Vent Plugs

See that the ventilating holes in each vent plug are clear.

Level of Electrolyte

The surface of the electrolyte should be level with the tops of the separators. If necessary, top up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

Cleanliness

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

Hydrometer Tests

Measure the specific gravity of the acid in each cell in turn with a hydrometer. To avoid misleading readings, do not take hydrometer readings immediately after topping-up.

The readings given by each cell should be approximately the same. If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives a useful indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60°F., which is adopted as a reference temperature. The method of correction is as follows:—

For every 5°F. **below** 60°F. **deduct** .002 from the observed reading to obtain the true specific gravity at 60°F.

For every 5°F. **above** 60°F. **add** .002 to the observed reading to obtain the true specific gravity at 60°F.

The temperature must be that indicated by a thermometer actually immersed in the electrolyte, and not in the air temperature.

Compare the specific gravity of the electrolyte with the values given in the table and so ascertain the state of charge of the battery.

If the battery is in a discharged state, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply, as described under " Recharging From An External Supply ".

Discharge Test

A heavy discharge tester consists of a voltmeter, 2 or 3 volts full scale, across which is connected a shunt resistance capable of carrying a current of several hundred amperes. Pointed prongs are provided for making contact with the inter-cell connectors.

Press the contact prongs against the exposed positive and negative terminals of each cell. A good cell will maintain a reading of 1.2—1.5 volts, depending on the state of charge, for at least 6 seconds. If, however, the reading rapidly falls off, the cell is probably faulty and a new plate assembly may have to be fitted.

State of Charge	Home and Climates Ordinarily Below 90°F. (32°C.) Specific Gravity of Electrolyte (Corrected to 60°F.)	Climates Frequently Over 90°F. (32°C.) Specific Gravity of Electrolyte (Corrected to 60°F.)
Fully charged	1.270—1.290	1.210—1.230
About half discharged	1.190—1.210	1.120—1.150
Completely discharged	1.110—1.130	1.050—1.070

RECHARGING FROM AN EXTERNAL SUPPLY

If the foregoing tests indicate that the battery is merely discharged, and is otherwise in a good condition, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply.

If the latter, the battery should be charged at the rate of 5 amperes until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the tops of the separators by the addition of distilled water.

A battery that shows a general falling-off in efficiency, common to all cells, will often respond to the process known as " cycling ". This process consists of fully charging the battery as described above and then discharging it by connecting to a lamp board, or other load, taking a current of 5 amperes. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1.8. If the battery discharges in a shorter time, repeat the " cycle " of charge and discharge.

PREPARING NEW UNFILLED, UNCHARGED BATTERIES (MODELS GTW9A AND GT9A) FOR SERVICE

Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging.

Electrolyte of the specific gravity required is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1.835 specific gravity. The mixing must be carried out either in a lead-lines tank or in suitable glass or earthenware vessel. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid,** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The approximate proportions of acid and water are indicated in the following table :

	Specific Gravity of Acid Required When Filling	
Battery	Home and Climates Ordinarily Below 90°F (32°C.) Specific Gravity of Acid (Corrected to 60°F.)	Climates Frequently Over 90°F. (32°C.) Specific Gravity of Acid (Corrected to 60°F.)
GTW9A	1.340	1.290
GT9A	1.270	1.210

To obtain Specific Gravity (corrected to 60°F.) of :	Add 1 vol. of acid of 1.835 S.G. (corrected to 60°F.) to :
1.340	2.0 volumes of water
1.290	2.7 volumes of water
1.270	2.9 volumes of water
1.210	4.0 volumes of water

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings—unless a thermometer is used to measure the actual temperature, and a correction applied to the reading and before pouring the electrolyte into the battery.

Filling the Battery

The temperature of the acid, battery and filling-in room must not be below 32°F.

Carefully break the seals in the filling holes and **half-fill** each cell with electrolyte of the appropriate specific gravity. Allow the battery to stand for at least six hours, in order to dissipate the heat generated by the chemical action of the acid on the plates and separators. Allow to stand for a further two hours and then proceed with the initial charge.

Initial Charge

The initial charging rate is 3.5 amperes.

Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 40 to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the generator output.

This charge should not be broken by long rest periods. If, however, the temperature of any cell rises above the permissible maximum quoted in table, the charge must be interrupted until the temperature has fallen at least 10°F. below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separators by the addition of acid solution of the same specific gravity as the original filling-in acid, until specific gravity and voltage readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 60°F., it lies within the specified limits. If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced either by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate mixing of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any electrolyte above the tops of the separators.

PREPARING NEW "DRY-CHARGED" BATTERIES, MODEL (GTZ9A) FOR SERVICE.

Filling the Cells

Carefully break the seals in the filling holes and fill each cell with correct specific gravity acid to the top of the separators in one operation. The temperatures of the filling room, battery and acid should be maintained at between 60°F. and 100°F. If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

Freshening Charge

Batteries filled in this way are up to 90% charged, and capable of giving a starting discharge one hour after filling. When time permits however, a short freshening charge will ensure that the battery is fully charged.

Such a freshening charge should be 5 amperes for not more than 4 hours.

During the charge the electrolyte must be kept level with the top of the separators by the addition of distilled water. Check the specific gravity of the electrolyte at the end of the charge ; if 1.270 acid was used to

Maximum Permissible Electrolyte Temperature During Charge	
Home and Climates normally below 90°F. (32°C.)	Climates frequently over 90°F. (32°C.)
100°F. (37.7°C.)	102°F. (48.8°C.)

fill the battery, the specific gravity should now be between 1.270 and 1.290 ; if 1.210 acid, between 1.210 and 1.230.

Maintenance in Service

After filling, a dry-charged battery needs only the attention normally given to all lead-acid type batteries.

Specific Gravity of Acid Required When Filling Battery	
Home and Climates Ordinarily Below 90°F. (32°C.) Specific Gravity of Acid (Corrected to 60°F.)	Climates Frequently Over 90°F. (32°C.) Specific Gravity of Acid (Corrected to 60°F.)
1.270	1.210

DISTRIBUTOR

REMOVAL

Spring back the clips and remove the distributor.

Disconnect the low tension wire from the distributor terminal.

Disconnect the vacuum pipe by unscrewing the union nut at the vacuum advance unit.

Slacken the distributor plate pinch bolt and withdraw the distributor.

REFITTING

Refitting is the reverse of the removal procedure, but it will be necessary to reset the ignition timing as follows :—

Ignition Timing

Set the micrometer adjustment in the centre of the scale.

Connect the low tension wire to the terminal on the distributor body.

Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor-arm until the driving dog engages with the distributor drive shaft.

Rotate the engine until the rotor-arm approaches the No. 6 (front) cylinder segment in the distributor cap.

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump. (see Data).

Note : The crankshaft damper fitted to earlier cars did not have a timing scale and on these engines it will be necessary to set the timing by the number of flywheel teeth before top dead centre. On all 3.4 litre engines and 2.4 litre engines on and after BB.2846 the top dead centre marks are visible through a hole in the bottom of the clutch housing (see Fig.3) 2.4 litre engines prior to the above number have a hole in the left-hand side of the clutch housing.

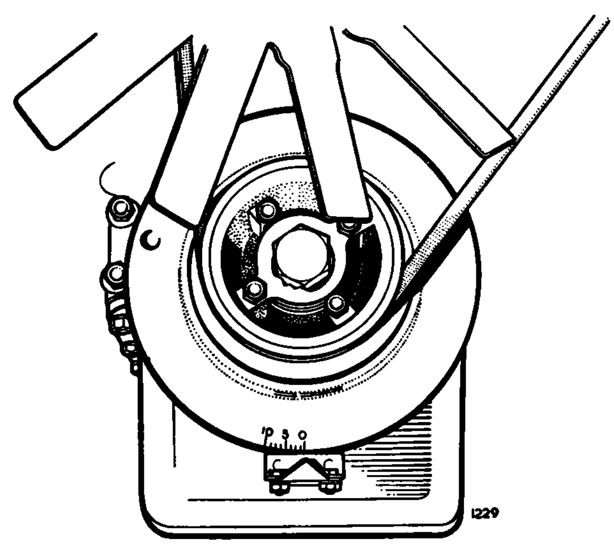


Fig. 2. Ignition timing scale on crankshaft damper.

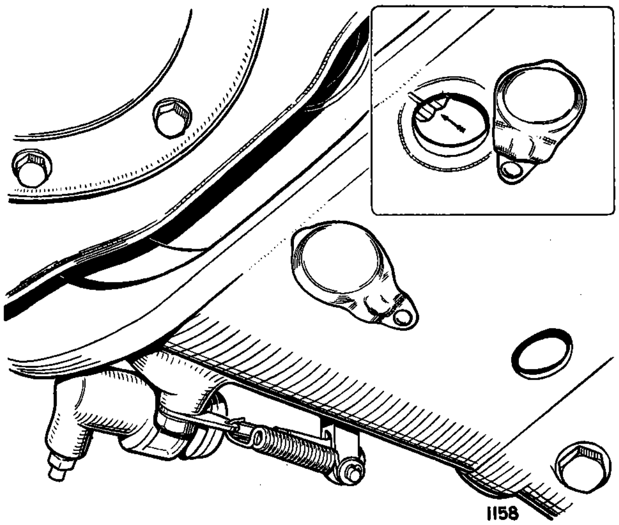


Fig. 3. Top dead centre marks at the bottom of the clutch housing.

Connect a 12 volt test lamp with one lead to the distributor terminal (or the CB terminal of the ignition coil) and the other to a good earth.

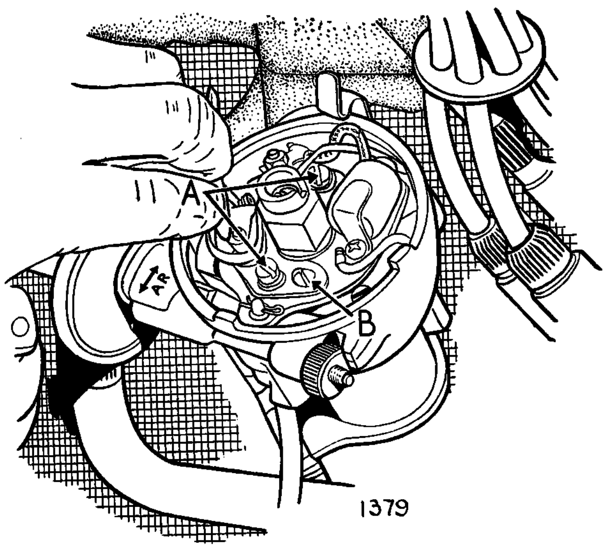
Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

ROUTINE MAINTENANCE

After first 500 miles (of new distributor or contact set) and every 2,500 miles check the contact breaker gap. This should measure 0.014″—0.016″ when fully open.



A. Screws securing fixed contact plate.
B. Eccentric headed adjusting screw.

Fig. 4. Checking distributor point gap.

Lubrication—Every 2,500 miles

Remove the moulded cover and withdraw the rotor arm. A tight rotor arm can be withdrawn using a pair of suitable levers carefully applied at opposite points below the rotor moulding—never against the metal electrode.

Important : Do not allow oil or grease on or near the contacts when carrying out the following lubrication.

Cam Bearing

To lubricate the cam bearing, inject a few drops of thin machine oil into the rotor arm spindle (A. Fig. 5.) Do not remove or slacken the screw located inside the spindle—a space is provided beneath the screwhead to allow the lubricant to reach the cam bearing.

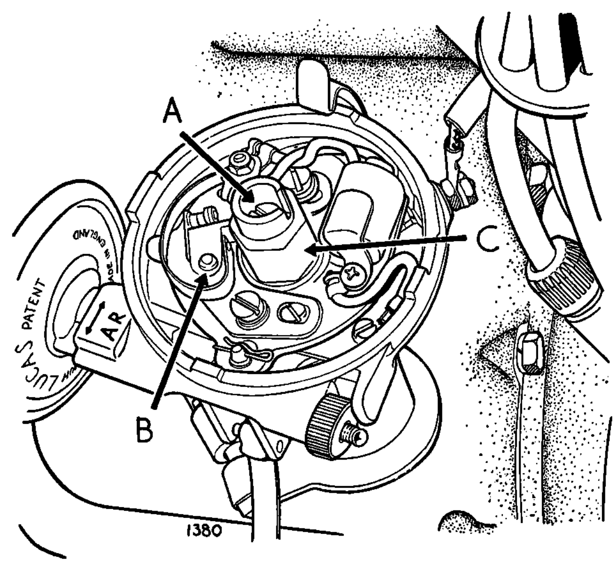


Fig. 5. Distributor lubrication points.

Cam

Lightly smear the faces of the cam (C. Fig. 5) with Mobilgrease No. 2 or high melting point grease.

Centrifugal Timing Control

Inject a few drops of thin machine oil through a convenient aperture in the contact breaker base plate.

Cleaning

Clean the moulded cover inside and outside with a soft dry cloth. Pay particular attention to spaces between the terminals. Check that the small carbon brush inside the moulding can move freely in its holder.

Whilst the rotor arm is removed, examine the contact breaker. Rough, burned or blackened contacts can be cleaned with fine carborundum stone or emery cloth. After cleaning remove any grease or metallic dust with a petrol-moistened cloth.

Contact cleaning is facilitated by removing the lever to which the moving contact is attached. To do this, remove the nut, insulating piece and electrical connections from the post to which the contact breaker spring is anchored. The contact breaker lever can then be lifted off the pivot post and the spring from the anchor post.

After cleaning and trimming the contacts, smear the pivot post (B. Fig. 5) with Ragosine Molybdenised Non-creep Oil or with Mobilgrease No. 2. Reassemble the contact breaker and check the setting.

Refit the rotor arm, carefully locating its moulded projection in the spindle keyway and pushing it on as far as it will go.

Refit the moulded cover and spring the two side clips into position.

DATA

	2.4 litre	**3.4 litre**
Type	DMBZA	DMBZA
Lucas Service Number (Stamped on distributor body)		
7 to 1 compression ratio	40557	40578
8 to 1 compression ratio	40528	40576
9 to 1 compression ratio	—	40617

Contact breaker gap .. .. .014″ to .016″ (.36—.41 mm.)

Cam dwell angle .. .. 35° ± 2°

Contact breaker spring tension (measured at contacts) .. .. 18—24 ozs. (512—682 gms.)

Note: Early 7 to 1 compression ratio 2.4 litre cars were fitted with a 40528 type distributor and the ignition timing set at 1° B.T.D.C.

Ignition Timing

Model	**Compression Ratio**	**Setting**	**No. of Fly-wheel teeth**
2.4 litre	7 to 1	4°B.T.D.C	$1\frac{1}{3}$
2.4 litre	8 to 1	6°B.T.D.C.	$1\frac{3}{4}$
3.4 litre	7 to 1	T.D.C.	-
3.4 litre	8 to 1	2°B.T.D.C.	$\frac{2}{3}$
3.4 litre	9 to 1	T.D.C.	-

CENTRIFUGAL TIMING ADVANCE TESTS.

DMBZ6A 40528

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii) Decelerate and check at the following points :—

R.P.M.	Advance
2500	18°—20°
1700	14°—16°
1100	11°—13°
800	8°—11°
450	½°—3½°

No advance below 300 r.p.m.

DMBZ6A 40557

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii) Accelerate to 3,500 r.p.m.
Advance to be 24°—26°

(iii) Decelerate and check at the following points :—

R.P.M.	Advance
2500	22°—24°
1650	17°—19°
1400	15°—17°
950	8°—10°
500	1°— 3°

No advance below 300 r.p.m.

DMBZ6A 40576

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii) Accelerate to 3,200 r.p.m.
Advance to be 17°—19°

(iii) Decelerate and check at the following points :—

R.P.M.	Advance
2250	15°—17°
1000	10°—12°
800	7½°—10½°
450	½°—3½°

No advance below 275 r.p.m.

DMBZ6A 40578

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii Accelerate to 3,500 r.p.m.
Advance to be 16°—18°

(iii) Decelerate and check at the following points :—

R.P.M.	Advance
2400	14°—16°
1300	10°—12°
1100	7°—10°
650	½°—3½°

No advance below 400 r.p.m.

DMBZ6A 40617

(i) Mount distributor in auto advance test rig and set to spark at zero degrees at 100 r.p.m.

(ii) Accelerate to 2,000 r.p.m.
Advance to be 12°

(iii) Decelerate and check at the following points :—

R.P.M.	Advance
850	7°— 9°
450	0°—2½°

No advance below 325 r.p.m.

VACUUM TIMING ADVANCE TESTS

Distributor	Vacuum in inches of Mercury	Advance in degrees	No advance below
DMBZ6A 40528	18 11½ 7½ 4	11—13 10—12½ 5½—9 0—4	2½″ of Mercury
DMBZ6A 40557 & 40578	20 13 9½ 6½	10—12 9½—11½ 6—8½ 1½—5	4″ of Mercury
DMBZ6A 40576	20 12 8½ 6½	8—10 6—8 3—5 ½—3	5″ of Mercury
DMBZ6A 40617	20 13 9 7½	7—9 6—8½ 2½—5½ 0—3	6″ of Mercury

SERVICING

Dismantling

When dismantling, note carefully the position in which the various components are fitted in order to simplify their re-assembly.

Bearing Replacement

The ball bearing at the upper end of the shank can be removed with a shouldered mandrel locating on the inner journal of the bearing.

When fitting a new ball bearing, the shouldered mandrel must locate on both inner and outer journals of the bearing.

The bearing bush at the lower end of the shank can be driven out with a suitable punch.

A bearing bush must be prepared for fitting by allowing it to stand completely immersed in medium viscosity (S.A.E. 30—40) engine oil for at least 24 hours. In cases of extreme urgency, this period of soaking may be shortened by heating the oil to 100°C. for 2 hours and then allowing to cool before removing the bush.

The bush is pressed into the shank with a shouldered mandrel. The mandrel should be hardened and polished and approximately 0.0005" greater in diameter than the distributor shaft. To prevent subsequent withdrawal of the bush with the mandrel, a stripping washer should be fitted between the shoulder of the mandrel and the bush.

Under no circumstances should the bush be over-bored by reamering or by any other means, since this will impair the porosity and therefore the lubricating quality of the bush.

Reassembly

When reassembling, Ragosine molybdenised non-creep oil or (failing this) clean engine oil, should be smeared on the shaft and, more lightly, on the contact breaker bearing plate.

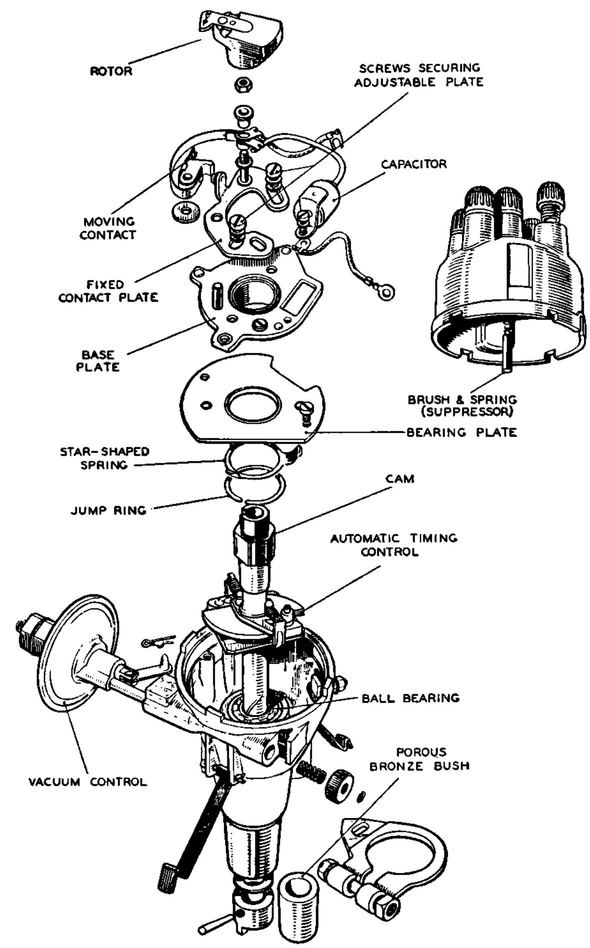


Fig. 6. Exploded view of distributor.

FLASHER UNITS

Flasher Unit model FL3 was fitted to early 2.4 litre cars but was later superseded by model FL5 which is also fitted to the 3.4 litre saloon.

The flasher unit is housed in a small cylindrical container. Inside a switch is operated automatically by the alternate heating and cooling of an actuating wire. Also incorporated is a small relay to flash the switch warning light when the system is functioning correctly. Failure of this light to flash will indicate a fault. In the event of trouble occurring, the following procedure should be followed :—

(i) Check the bulbs for broken filaments.

(ii) Refer to the wiring diagram and check all flasher circuit connections.

(iii) Switch on the ignition.

(iv) Check with a voltmeter that flasher unit terminal 'B' is at 12 volts with respect to earth.

(v) Connect together flasher unit terminals 'B' and 'L' and operate the direction-indicator switch. If the flasher lamps now light, the flasher unit is defective and must be replaced.

The direction-indicator switch is best checked by substitution. It is important that only bulbs of the correct wattage rating (i.e. 21 watts) are used in the flasher lamps.

The side/flasher and rear/stop/flasher lamps are fitted with a double filament bulb. This is the Lucas No. 380 12-volt 21/7-watt non-reversible small bayonet cap bulb.

Special contacts in the direction-indicator switch ensure that responses to the flasher unit take precedence over any simultaneous application of the brake switch.

The switch warning light is Lucas No. 280 12-volt 1.5-watt lilliput Edis on screw cap.

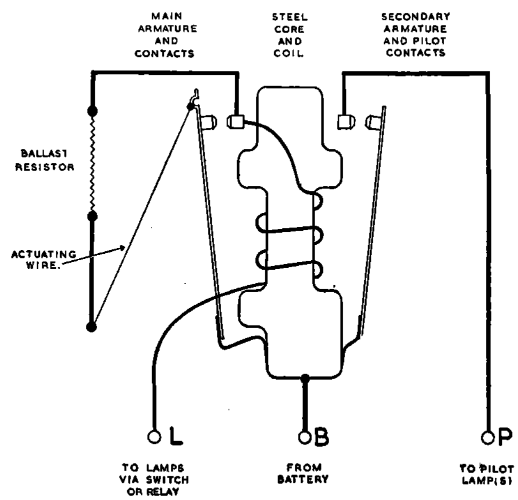


Fig. 7. Flasher unit wiring diagram.

FUSE UNIT

Model SF6 Fuse Unit carries two live glass cartridge type fuses and two spare fuses. Originally, 35-amp fuses were fitted but were later superseded by 50-amp fuses.

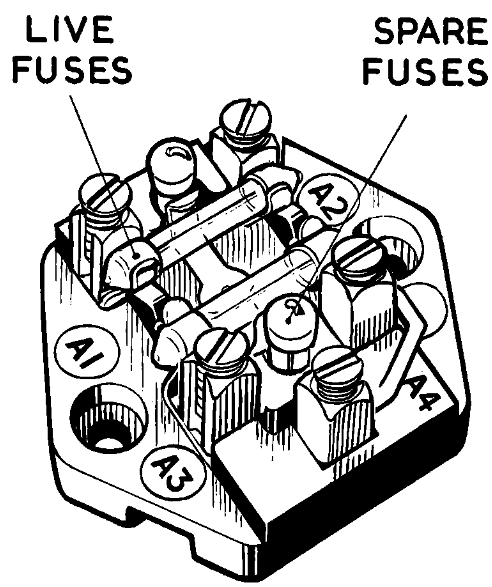


Fig. 8. Fuse unit.

GENERATOR — TYPE C.45. PV-5.

(Fitted to 2.4 litre Models.)

REMOVAL

Disconnect the cables from the two terminals at the rear of the dynamo noting that they are of different sizes.

Remove the nut and bolt securing the adjusting link to the dynamo.

Remove the two nuts and bolts securing the dynamo to the mounting bracket when the dynamo can be lifted out.

Remove the fan belt.

REFITTING

Refitting is the reverse of the removal procedure. When the fan belt has been refitted move the dynamo to a position where it is possible to depress the belt about ½″ (12 mm.) midway between fan and dynamo pulleys.

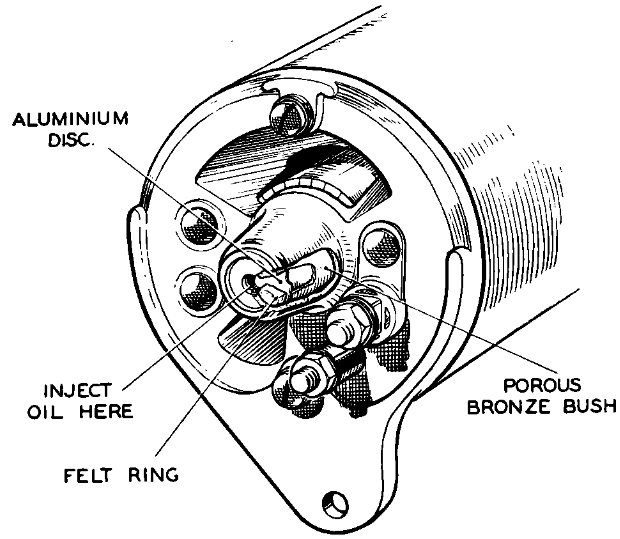


Fig. 9. Generator bush lubrication hole.

1. GENERAL

The generator is a shunt-wound two-pole two-brush machine, arranged to work in conjunction with a Lucas regulator unit. A fan, integral with the driving pulley, draws cooling air through the generator, inlet and outlet holes being provided in the end brackets, of the unit.

The output of the generator is controlled by the regulator unit and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the generator gives a high output, whereas if the battery is fully charged, the generator gives only sufficient output to keep the battery in good condition without any possibility of over-charging. An increase in output is given to balance the current taken by lamps and other accessories when in use.

2. ROUTINE MAINTENANCE

(a) **Lubrication**

Every 10,000 miles, inject a few drops of high quality medium viscosity (S.A.E. 30) engine oil into the hole marked " OIL " at the end of the bearing housing.

(b) **Inspection of Brushgear**

Every 10,000 miles the brushgear should be checked as detailed in paragraph 4.C.

(c) **Belt Adjustment**

Occasionally inspect the generator driving belt, and, if necessary, adjust to take up any undue slackness by turning the generator on its mounting. Care should be taken to avoid overtightening the belt, the tension needed being just enough to drive without slipping. See that the machine is properly aligned, otherwise undue strain will be thrown on the generator bearings

3. PERFORMANCE DATA

Cutting-in Speed:	1100—1250 r.p.m. at 13.0 generator volts.
Max. Output:	22 amp. at 1700—1900 r.p.m. at 13.5 generator volts and a resistance load of 0.61 ohms.
Field Resistance:	6.0 ohms.

4. SERVICING

(a) **Testing in position to Locate Fault in Charging Circuit**

In the event of a fault in the charging circuit, adopt the following procedure to locate the cause of the trouble.

i. Inspect the driving belt and adjust if necessary (see Para. 2c).

ii. Check that the generator and control box are connected correctly. The larger generator terminal must be connected to control box terminal " D " and the smaller generator terminal to control box terminal "F ".

iii. Switch off all lights and accessories, disconnect the cables from the terminals of the generator and connect the two terminals with a short length of wire.

iv. Start the engine and set to run at normal idling speed.

v. Clip the negative lead of a moving coil type voltmeter, calibrated 0—20 volts, to one generator terminal and the positive lead to a good earthing point on the yoke.

vi. Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts and do not race the engine in an attempt to increase the voltage. It is sufficient to run the generator up to a speed of 1,000 r.p.m.

If the voltage does not rise rapidly and without fluctuation the unit must be dismantled (see Para. 4b) for internal examination.

Excessive sparking at the commutator in the above test indicates a defective armature which should be replaced.

NOTE : If a radio suppression capacitor is fitted between the output te minal and earth, disconnect this capacitor and re-test the generator before dismantling. If a reading is now given on the voltmeter, the capacitor is defective and must be replaced.

If the generator is in good order, remove the link from between the terminals and restore the original connections, taking care to connect the larger generator terminal to control box terminal " D " and the smaller generator terminal to control box terminal " F ".

(b) **To Dismantle**

i. Take off the driving pulley.

ii. Unscrew and withdraw the two through bolts.

iii. Withdraw the commutator end bracket from the yoke.

iv. Lift the driving end bracket and armature from the yoke. Take care not to lose the fibre thrust washer or collar.

v. The driving end bracket, which on removal from the yoke has withdrawn with it the armature and armature shaft ball-bearing, need not be separated from the shaft unless the bearing is suspected and requires examination, or the armature is to be replaced ; in this event the armature should be removed from the end bracket by means of a hand press.

(c) **Brushgear**

i. Lift the brushes up into the brush boxes and secure them in that position by positioning the brush spring at the side of the brush.

ii. Fit the commutator and bracket over the commutator and release the brushes.

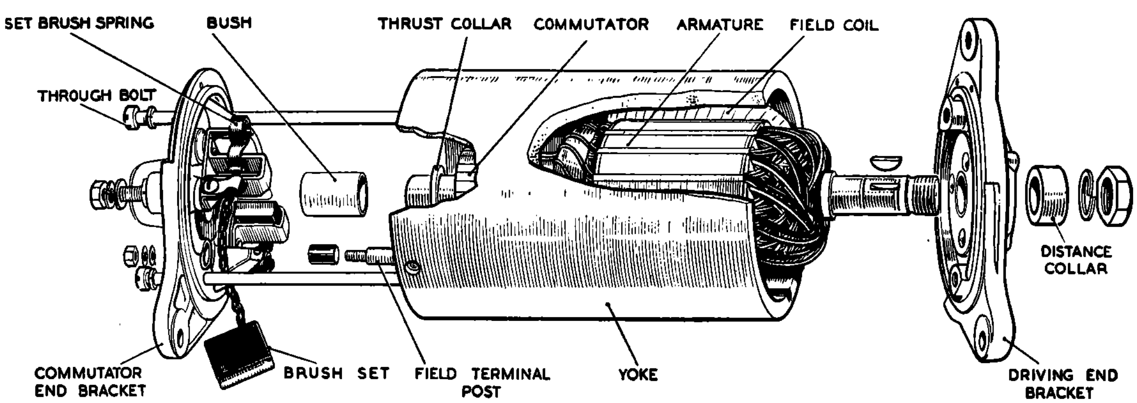


Fig. 10. Exploded view of generator.

iii. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always refit brushes in their original positions. If the brushes are badly worn, new brushes must be fitted and bedded to the commutator. The minimum permissible length of brush is $\frac{7}{16}''$.

iv. Test the brush spring tension using a spring scale. The tension of the springs when new is 36—44 oz. In service, it is permissible for this value to fall to 30 oz. before performance may be affected. Fit new springs if the tension is low.

(d) **Commutator**

A commutator in good condition will be smooth and free from pits or burned spots.

Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper while rotating the armature. To remedy a badly worn commutator, mount the armature, with or without drive end bracket, in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with a very fine glass paper. Emery cloth must not be used on the commutator. Undercut the insulators between the segments to a depth of $\frac{1}{32}''$ with a hack saw blade ground to the thickness of the insulator.

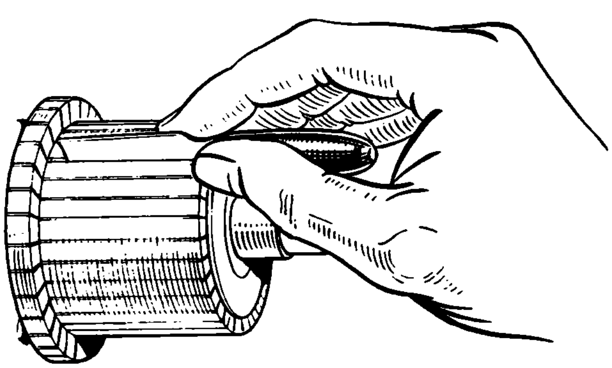


Fig. 11. Undercutting the commutator insulation.

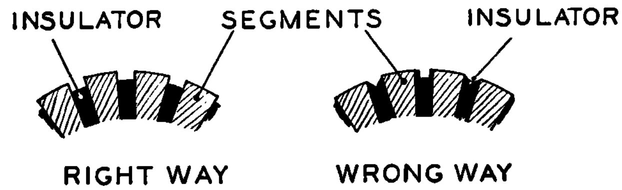


Fig. 12. Showing the correct and incorrect way of undercutting the commutator insulation.

(e) **Armature**

Indication of an open-circuited armature winding will be given by burnt commutator segments. If armature testing facilities are not available, an armature can be checked by substitution.

To remove the armature shaft from the drive end bracket and bearing, support the bearing retaining plate firmly and press the shaft out of the drive end bracket.

When fitting the new armature, support the inner journal of the ball bearing, using a mild steel tube of suitable diameter, whilst pressing the armature shaft firmly home (see also Para. 4h).

(f) **Field Coils**

Measure the resistance of the field coils, without removing them from the generator yoke, by means of an ohm meter connected between the field terminal and the yoke. Field resistance is 6.0 ohms.

If an ohm meter is not available, connect a 12-volt d.c. supply between the field terminal and generator yoke with an ammeter in series. The ammeter reading in each case should be approximately 2 amperes. Zero reading on the ammeter or an " Infinity " ohm meter indicates an open circuit in the field winding.

If the current reading is much more than 2 amperes, or the ohm meter reading much below 6 ohms, it is an indication that the insulation of one of the field coils has broken down.

In either event, unless a substitute generator is available, the field coils must be replaced. To do this, carry out the procedure outlined below :—

(i) Drill out the rivet securing the field coil terminal assembly to the yoke, and unsolder the field coil connections.

ii. Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.

iii. Mark the yoke and pole shoes so that the latter can be refitted in their original positions.

iv. Unscrew the two pole shoe retaining screws by means of a wheel-operated screwdriver.

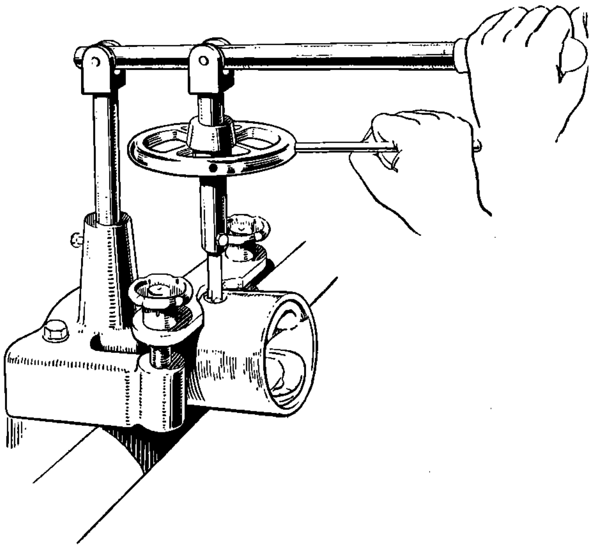


Fig. 13. Tightening the pole shoe retaining screws.

v. Draw the pole shoes and coils out of the yoke and lift off the coils.

vi. Fit the new field coils over the pole shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

vii. Locate the pole shoes and field coils by lightly tightening the fixing screws.

viii. Fully tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.

ix. Replace the insulation piece between the field coil terminal and re-rivet the terminal assembly to the yoke.

(g) **Bearings**

Bearings which are worn to such an extent that they will allow side movement of the armature shaft must be replaced.

To replace the bearing bush in a commutator end bracket, proceed as follows :—

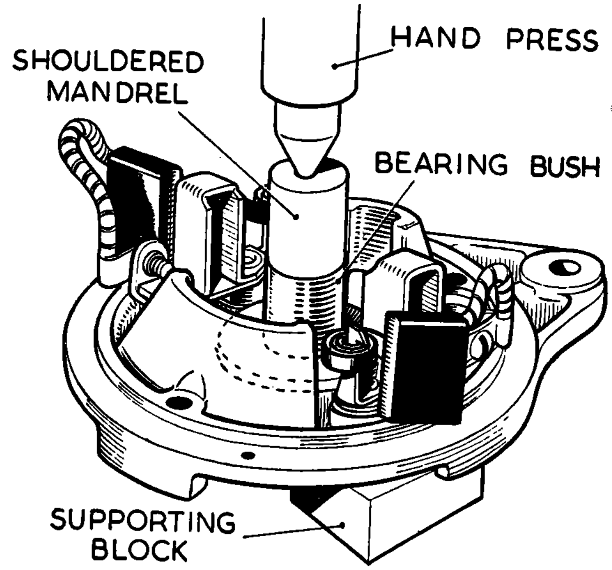


Fig. 14. Method of fitting the porous bronze bush.

i. Remove the old bearing bush from the end bracket. The bearing can be withdrawn with a suitable extractor or by screwing an $\frac{11}{16}$" tap into the bush for a few turns and pulling out the bush with the tap. Screw the tap squarely into the bush to avoid damage to the bracket.

ii. Insert the felt ring and aluminium disc in the bearing housing, then press the new bearing bush into the end bracket, using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing, until the visible end of the bearing is flush with the inner face of the bracket.
Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

Note : Before fitting the new bearing bush, it should be allowed to stand for 24 hours completely immersed in a good grade thin engine oil ; this will allow the pores of the bush to be filled with lubricant.

The ball bearing at the driving end is replaced as follows :—

i. Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

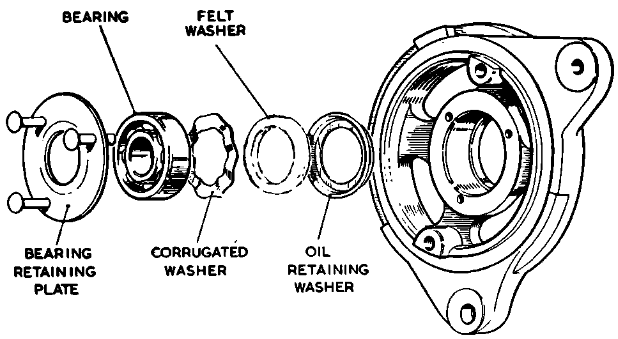


Fig. 15. Exploded view of drive end bearing.

ii. Press the bearing out of the end bracket and remove the corrugated washer, felt washer and retaining washer.

iii. Before fitting the replacement bearing, see that it is clean and pack it with high melting point grease.

iv. Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.

v. Locate the bearing in the housing and press it home.

vi. Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

(h) **To Reassemble**

i. Fit the drive end bracket to the armature shaft. The inner journal of the bearing must be supported by a tube, approximately 4″ long $\frac{1}{8}$″ thick and internal diameter $\frac{11}{16}$″. Do not use the drive end bracket as a support for the bearing whilst fitting an armature.

ii. Fit the yoke to the drive end bracket.

iii. Lift the brushes up into the brush boxes and secure them in that position by positioning the brush spring at the side of the brush.

iv. Fit the commutator end bracket on the armature shaft until the brush boxes are partly over the commutator. Place a thin screwdriver on top of each brush in turn and press the brush down on the commutator.

The brush springs should then position themselves on top of the brushes.

v. Fit the commutator end bracket to the yoke so that the projection on the bracket locates in the yoke.

vi. Refit the two through bolts.

After reassembly lubricate the commutator end bearing (see Para. 2a).

GENERATOR — TYPE C.45. PVS-5.

(Fitted to 3.4 litre Models.)

REMOVAL

Remove the windscreen washer bottle and cage, noting the respective positions of the rubber pipes.

Disconnect the cables from the two terminals at the rear of the dynamo noting that they are of different sizes.

Remove the nut and bolt securing the adjusting link to the dynamo.

Remove the two nuts and bolts securing the dynamo to the mounting bracket when the dynamo can be lifted out.

Remove the fan belt.

REFITTING

Refitting is the reverse of the removal procedure. When the fan belt has been refitted move the dynamo to a position where it is possible to depress the belt about ½" (12 mm.) midway between fan and dynamo pulleys.

Except for the differences described below, the instructions given for C.45.PV-5 generator fitted to the 2.4 litre model apply equally to C.45.PVS-5. The essential differences between the two generators concern :

(i) Brushgear inspection.
(ii) Commutator end bearings.

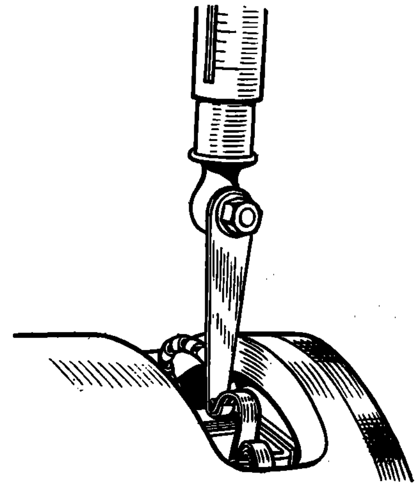


Fig. 16. Testing the brush spring tension.

BRUSHGEAR INSPECTION

The yoke is provided with " windows " and a band cover. The instructions given for model C.45.PV-5 under Para. 4(c) (i-iii) need not, therefore be followed in order to gain access to the brushes for inspection and spring testing—it being only necessary to slacken a single clamping screw and release the band cover.

COMMUTATOR END BEARING

A ball bearing is fitted at the commutator end of the armature shaft. Details are shown in the illustration. The bearing is secured to the shaft by a thrust screw and can be withdrawn with an extractor after the screw has been removed.

When replacing a defective bearing see that the new bearing is clean and packed with high melting point grease. It must be pressed home against the shoulder on the shaft and secured with the thrust screw.

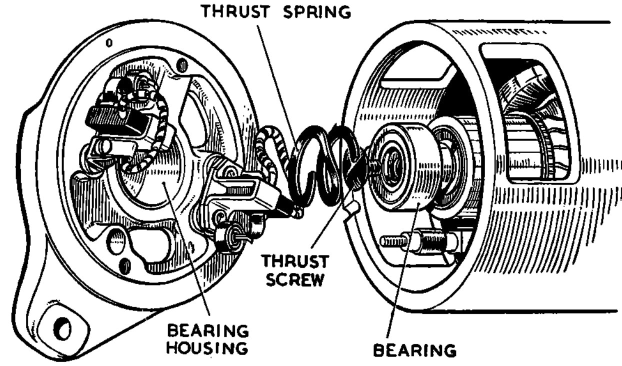


Fig. 17. Showing the commutator end plate removed.

HORNS

It is important to keep the horn mounting bolts tight and to maintain rigid the mountings of any units fitted near the horns. Electrical connections and cabling should be checked occasionally and rectified as required.

Adjustment

A horn in correct adjustment will pass 3.5—4.0 amperes at 12 volts. Adjustment does not alter the note but serves to take up wear of the moving parts which if not corrected will result in loss of power and roughness of tone.

When adjusting, use a first grade 0—10 moving coil ammeter and turn the horn adjustment screw clockwise to increase the current, or anti-clockwise to decrease the current.

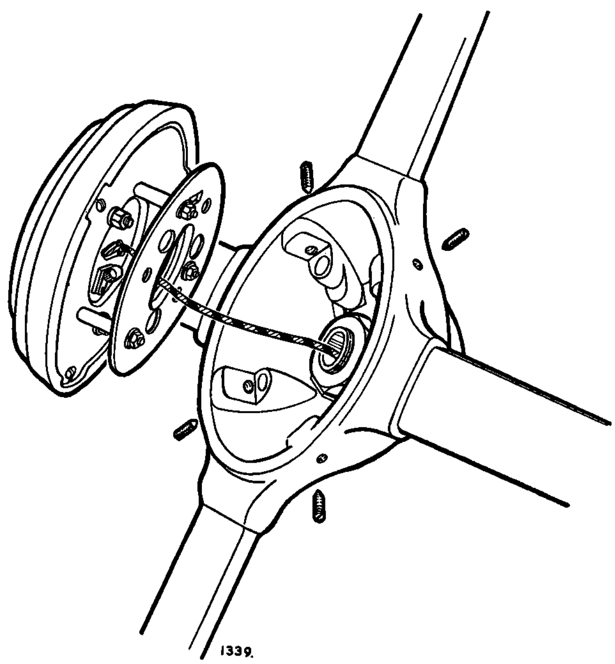


Fig. 18. Horn push removal.

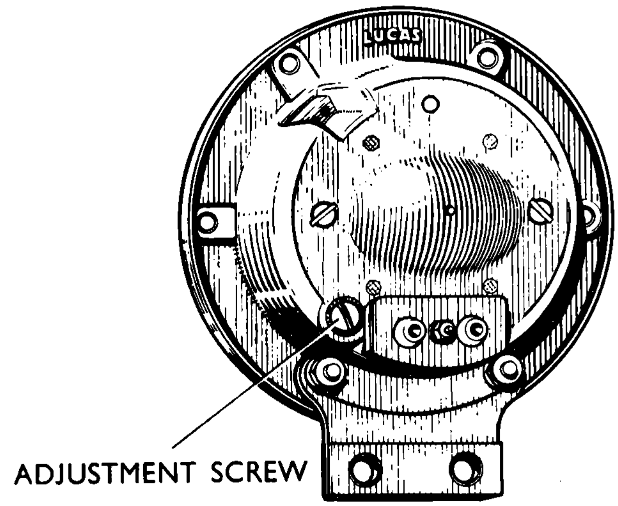


Fig. 19. Horn adjustment screw.

LAMPS

LAMP BULBS

LAMP	LUCAS BULB No.	VOLTS	WATTS	APPLICATION
Headlamp				
Early cars	354	12	42/36	Home and R.H.D. Export
Early cars	355	12	42/36	L.H.D. Export
Later cars	404	12	60/36	Home and R.H.D. Export
Later cars	405	12	60/36	L.H.D. Export
	370	12	45/40	Continental
Yellow	372	12	45/36	France
	350	12	35/35	Germany, Norway and Sweden,
	Sealed beam units			U.S.A. and Canada.
Side/Flasher	380	12	6/21	—
Rear/Stop/Flasher	380	12	6/21	—
Number plate & Boot	222	12	4	—
Reverse	382	12	21	—
Fog	323	12	48	—
Interior light	254	12	16	—
Panel Warning Lights— Ignition, Headlamp Petrol Level Carburetter Mixture	987	12	2.2	—
Flasher Warning Light	280	12	1.5	—

HEADLAMPS

The headlamps comprise two Lucas light units with pre-focus double-filament bulbs, (excepting U.S.A. export models, which are provided with an adaptor to accept American Sealed Beam Units) front rims and dust excluding rubber rings.

Since the spread of light and its position on the kerbside in the dipped position is a function of lensing and bulb design, special light units and bulbs are fitted to suit lighting regulations of the country in which a car is used. Special care should therefore be taken when replacing a bulb to see that the correct replacement is fitted.

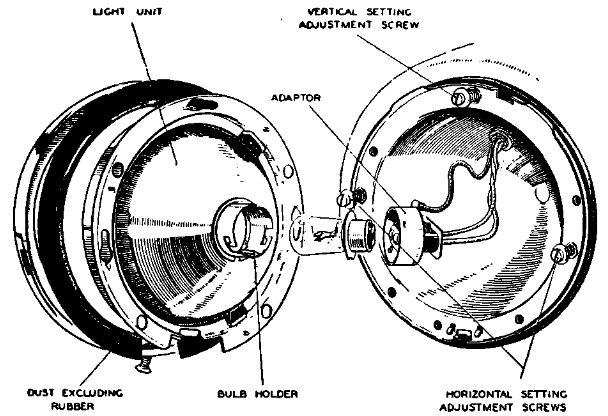


Fig. 20. Showing the headlamp adjustment screws and bulb location.

Bulb Replacement

Slacken the single rim securing screw and withdraw the rim and dust excluding rubber ring.

Press the light unit inwards against the three spring-loaded adjustment screws and turn it anti-clockwise to disengage it through the keyhole slots.

Release the bayonet adaptor with a press-in anti-clockwise motion and withdraw the defective bulb.

Note that a notch in the flange of the bulb is arranged to locate with a ridge in the bulb-holder.

Fit the new bulb and refit the adaptor, light unit, dust excluder and front rim.

After fitting, the headlamp setting should be checked.

Headlamp Setting

The headlamps should be set so that when the car is carrying its normal load the driving beams are projected parallel with each other and parallel with the road. (see Fig. 21.).

When setting, remove the lamp rims and dust excluding rubber rings. Cover one lamp whilst adjusting the other.

Vertical trimming is effected by screwing in (or out) the top spring-loaded screw. Horizontal trimming is effected with the two side screws.

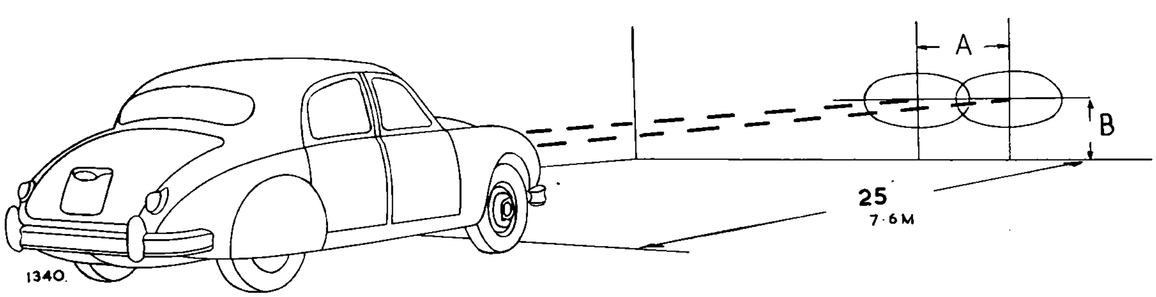


Fig. 21. Headlamp beam setting. 'A' is the distance between the centres of the headlamps. 'B' is the height of the centres of headlamps from the ground.

SIDE/FLASHER BULB—REPLACEMENT

Remove the two screws at the front of the lamp and detach the glass.

To remove the bulb from the holder, press inwards and rotate anti-clockwise. When replacing the bulb note that the pins are offset.

REAR/STOP/FLASHER BULB—REPLACEMENT

Remove the two screws securing the glass. To remove the bulb, press upwards and rotate anti-clockwise. To ensure that the bulb filaments are correctly positioned in relation to the holder, the pins of the bulb are offset.

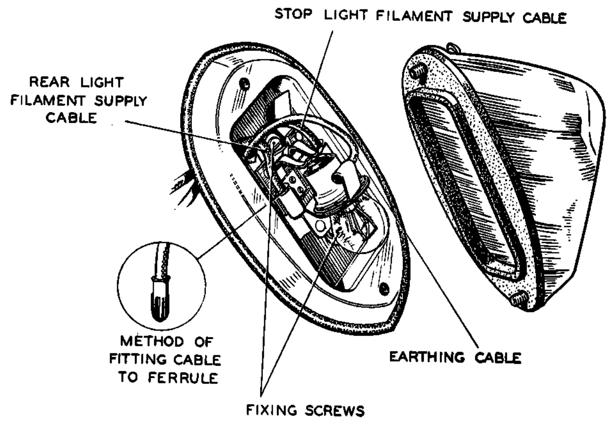


Fig. 22. Rear/Stop/Flasher lamp.

REVERSE, NUMBER PLATE, AND LUGGAGE BOOT BULBS—REPLACEMENT

The reverse light bulb, the two number plate bulbs and the boot light bulb are retained in a holder accessible from the under-side of the luggage boot lid. To remove the holder unscrew the two cheese-headed screws when the holder can be withdrawn ; all the bulbs are retained in the holder by bayonet fixings. The luggage boot light is accessible without having to remove the holder.

FOG LAMP BULB—REPLACEMENT

Remove the screw and clamp from the bottom of lamp, and withdraw the light unit. Remove the adaptor by rotating anti-clockwise and withdraw the bulb from the back of the reflector. When replacing the bulb note that the groove in the bulb plate must be aligned with its register in the rear of the reflector. (Fog lamps are not fitted on cars for U.S.A.).

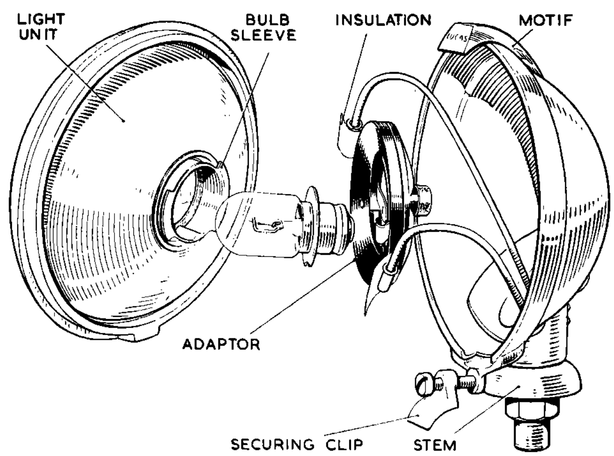


Fig. 23. Fog lamp showing method of bulb replacement.

RB 106 VOLTAGE REGULATOR

(EARLY 2·4 LITRE CARS.)

(a) CHECKING CONTINUITY BETWEEN BATTERY AND CONTROL BOX

If the generator and battery are known to be in order, disconnect the cable from control box terminal ' A ' and connect it to the negative terminal of a good quality 0—20 moving coil voltmeter.

Connect the positive voltmeter terminal to an earthing point on the chassis. If the voltmeter registers battery voltage, i.e., 12 volts, the wiring is in order and the regulator should be checked.

If there is no reading, examine the wiring between battery and control box for defective cables or loose connections.

Re-connect the cable to control box terminal ' A '

(b) REGULATOR ADJUSTMENT

The regulator is carefully set during manufacture and, in general, it should not be necessary to make further adjustment. However, if the battery fails to keep in a charged condition or if the generator output does not fall when the battery is fully charged, the setting should be checked, and if necessary, corrected.

It is important to check before altering the regulator setting that the low state of charge of the battery is not due to a defective battery or to slipping of the generator belt. Only a good quality MOVING COIL VOLTMETER (0—20 volts) must be used when checking the regulator. The open circuit setting can be checked without removing the cover from the control box.

Withdraw the cables from control box terminals ' A ' and ' A1 ' and connect these cables together.

Connect the voltmeter to control box terminals ' D ' and ' E '.

The regulator should be at ambient temperature, i.e., as measured in its immediate vicinity, and adjustment should be completed within thirty seconds, otherwise heating of the shunt coil by the energising current may cause false settings to be made.

Run the engine up until the generator speed reaches 3,000 r.p.m., (2,100 engine r.p.m.) when the open circuit voltage reading should lie within the following limits :—

Regulator Temperature	Voltage Setting
50°F. (10°C.)	16.1—16.7
68°F. (20°C.)	16.0—16.6
86°F. (30°C.)	15.9—16.5
104°F. (40°C.)	15.8—16.4

If the voltmeter reading is outside the appropriate limits slacken the locknut of the voltage adjusting

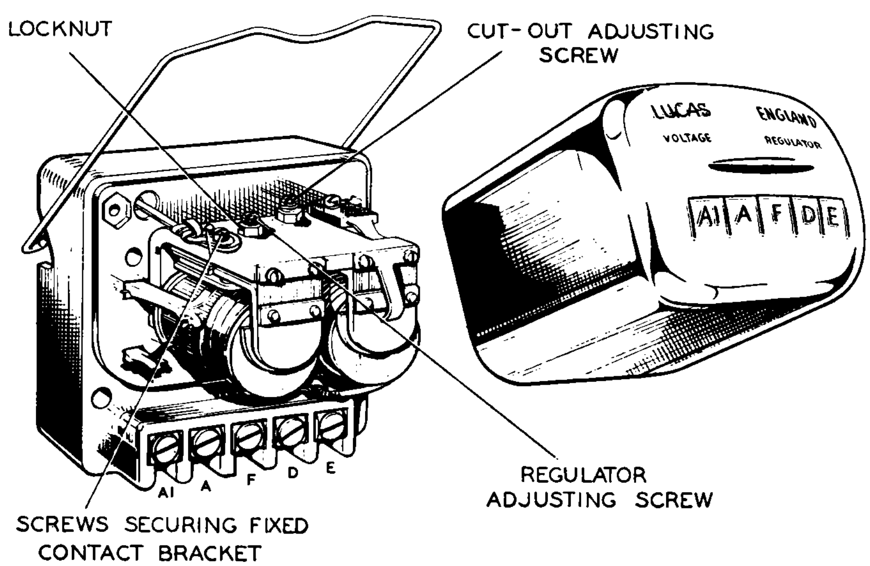


Fig. 24. The RB106/1 control box.

screw and turn screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained. Retighten the locknut.

Check the setting by switching off and then again raising the generator speed to 3,000 r.p.m.

(c) CLEANING REGULATOR CONTACTS

After long periods of service it may be found necessary to clean the regulator contacts. These may be cleaned with fine carborundum stone or fine emery cloth. All traces of metal dust or other foreign matter must be removed with methylated spirits (de-natured alcohol).

(d) CUT-OUT ADJUSTMENT

If the regulator is correctly set but the battery is still not being charged, the cut-out may be out of adjustment. To check the voltage at which the cut-out operates, remove the control box cover and connect the voltmeter between terminals 'D' and 'E'. Start the engine and slowly increase its speed, until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be 12.7—13.3 volts.

If operation of the cut-out takes place outside these limits, it will be necessary to adjust. To do this slacken the locknut securing the Cut-out Adjusting Screw and turn this screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out like the regulator, must be made as quickly as possible because of temperature-rise effects. Tighten the locknut after making the adjustment.

(e) CLEANING CUT-OUT CONTACTS

After long periods of service it may be found necessary to clean the cut-out contacts. These may be cleaned with fine glass paper. All traces of metal dust or other foreign matter must be removed with methylated spirits (de-natured alcohol).

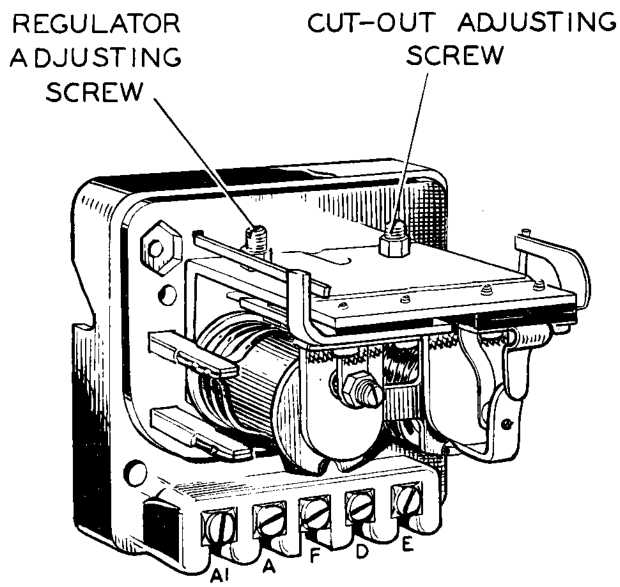


Fig. 25 The RB106/2 control box.

RB 310 VOLTAGE AND CURRENT REGULATOR

(LATER 2·4 LITRE CARS AND ALL 3·4 LITRE CARS.)

(a) CHECKING CONTINUITY BETWEEN BATTERY AND CONTROL BOX

If the generator and battery are in order, disconnect the cable from control box terminal ' B ' and connect it to the negative terminal of a good quality 0—20 moving coil voltmeter.

Connect the positive terminal of the voltmeter to an earthing point on the chassis. If the meter registers battery voltage, i.e., 12 volts, the wiring is in order and the control box settings should be checked.

If there is no reading, re-connect the cable to terminal ' B ' and examine the wiring between battery and control box for defective cables or loose connections.

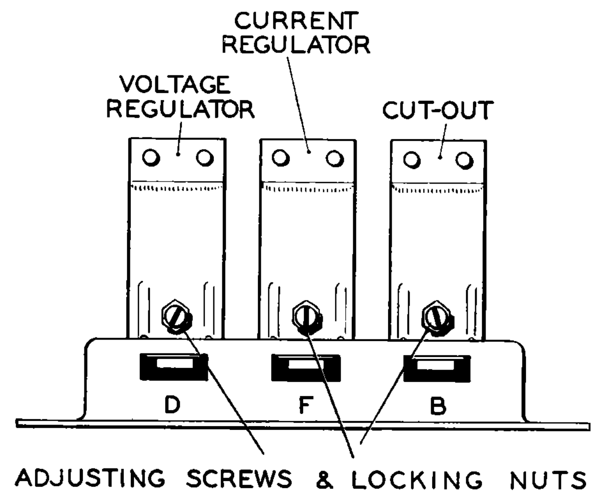


Fig. 26. The RB310 control box.

(b) VOLTAGE REGULATOR ADJUSTMENT

The regulator is carefully set during manufacture and, in general, it should not be necessary to make further adjustment. However, if the battery fails to keep in a charged condition or if the generator output does not fall when the battery is fully charged, the setting should be checked and, if necessary, corrected.

It is important to check before altering the regulator setting that the low state of charge of the battery is not due to a defective battery or to slipping of the generator belt. Only a good quality MOVING COIL VOLTMETER (0—20 volts) must be used when checking the regulator. The open circuit setting can be checked without removing the cover from the control box.

Disconnect the cable from the control box terminal ' B '.

Connect the voltmeter to control box terminal ' D ' and a good earthing point.

The regulator should be at ambient temperature, i.e., as measured in its immediate vicinity, and adjustment should be completed within thirty seconds, otherwise heating of the shunt coil by the energising current may cause false settings to be made.

Run the engine up until the generator speed reaches 3,000 r.p.m., (2,000 engine r.p.m.) when the open circuit voltage reading should lie within the following limits :—

Regulator Temperature	Voltage Setting
50°F. (10°C.)	15.1—15.7
68°F. (20°C.)	14.9—15.5
86°F.(30°C.)	14.7—15.3
104°F. (40°C.)	14.5—15.1

If the voltmeter reading is outside the appropriate limits, slacken the locknut of the voltage regulator adjusting screw and turn (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained. Re-tighten the locknut. Check the setting by switching off and then raising the generator speed to 3,000 r.p.m.

(c) CURRENT REGULATOR ADJUSTMENT

When setting the current regulator on the vehicle, the generator must be made to develop its full rated output, regardless of the state of charge of the battery at the time of setting. The voltage regulator must therefore be rendered inoperative. To do this, the voltage regulator contacts should be short-circuited with a crocodile clip placed between the insulated fixed contact bracket and the voltage regulator frame.

Disconnect the cable from terminal ' B ' and connect a 0—40 first grade moving coil ammeter between this cable and terminal ' B '.

Start the engine and run the generator at about 4,000 r.p.m. (2,700 engine r.p.m.). The ammeter should register 21—23 amperes. If necessary slacken the locknut of the current adjusting screw which is the centre screw of the three. Turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting.

When the correct setting is obtained, tighten the locknut and re-check.

Restore the original connections.

(d) CLEANING REGULATOR CONTACTS

After long periods of service it may be found necessary to clean the contacts of the voltage and current regulators. These may be cleaned with fine carborundum stone or fine emery cloth. All traces of metal dust or other foreign matter must be removed with methylated spirits (de-natured alcohol).

(e) CUT-OUT ADJUSTMENT

If the regulator is correctly set but the battery is still not being charged, the cut-out may be out of adjustment. To check the voltage at which the cut-out operates, remove the control box cover and connect the voltmeter between terminals ' D ' and ' E '. Start the engine and slowly increase its speed until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be 12.7—13.3 volts.

If operation of the cut-out takes place outside these limits, it will be necessary to adjust. To do this, slacken the locknut securing the cut-out adjusting screw and turn this screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out, like the regulator, must be made as quickly as possible because of temperature-rise effects. Tighten the locknut after making the adjustment.

(f) CLEANING CUT-OUT CONTACTS

After long periods of service it may be found necessary to clean the cut-out contacts. These may be cleaned with fine glass paper. All traces of metal dust or other foreign matter must be removed with methylated spirits (de-natured alcohol).

STARTER MOTOR

REMOVAL

Disconnect one of the battery cables.

Disconnect the cable from the terminal at the end of the starter motor.

Remove the two nuts securing the starter motor to the crankcase and clutch housing. Access to the top bolt is gained through an aperture (covered by a circular plate) in the right-hand side of the gearbox cowl.

Note : Early cars did not have this aperture and a suitable hole should be made in the gearbox cowl in the position shown in Fig. 27. This hole can be covered by a metal plate and secured with three self-tapping screws.

Remove the two starter securing bolts, which are connected by a metal strap, when the starter can be withdrawn.

REFITTING

Refitting is the reverse of the removal procedure.

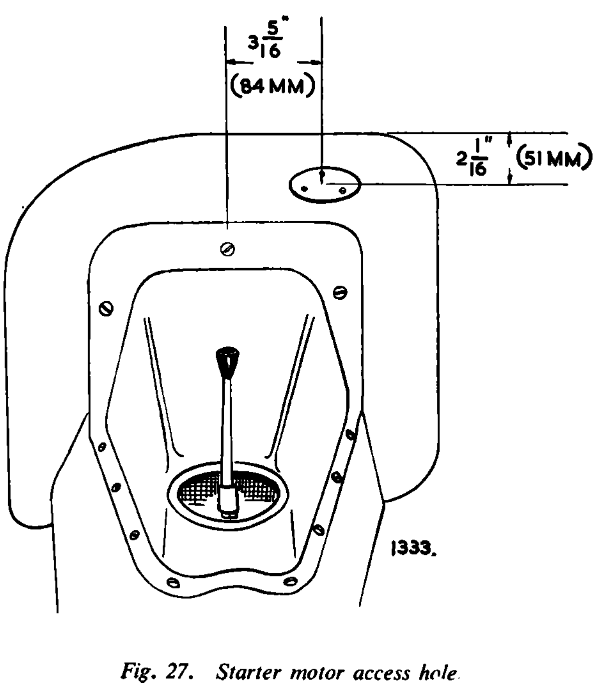


Fig. 27. Starter motor access hole.

1. GENERAL

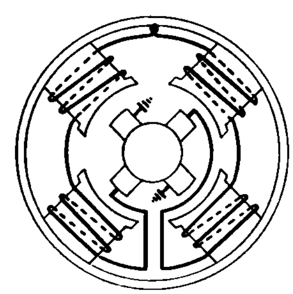
The electric starting motor is a series-wound four-pole four-brush machine having an extended shaft which carries the engine engagement gear, or starter drive as it is more usually named. The diameter of the yoke is $4\frac{1}{2}$".

The starting motor is of similar construction to the generator except that heavier copper wire is used in the construction of the armature and field coils. The field coils are parallel-connected between the field terminal and the insulated pair of brushes.

2. ROUTINE MAINTENANCE

The only maintenance normally required by the starting motor is the occasional checking of brush-gear and commutator. About every 10,000 miles, remove the metal band cover. Check that the brushes move freely in their holders by holding back the brush springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol-moistened cloth. Be careful to replace brushes in their original positions in order to retain " bedding ". Brushes which have worn so that they will not " bed " properly on the commutator or have worn less than $\frac{5}{16}$" in length must be renewed.

The commutator should be clean, free from oil or dirt and should have a polished appearance. If it is dirty, clean it by pressing a fine dry cloth against it while the starter is turned by hand by means of a spanner applied to the squared extension of the shaft. Access to the squared shaft is gained by removing the thimble-shaped metal cover. If the commutator is very dirty, moisten the cloth with petrol.



MODELS M45G & M418G

Fig. 28. Showing the internal connections of the starter motor.

3. **PERFORMANCE DATA**

2.4 Litre
(Type M.418.G)

Lock torque. 17 lb. ft. with 440—460 amps at 7.4—7.0 volts. Torque at 1,000 r.p.m. 8.0 lb. ft. with 250—270 amps at 9.4—9.0 volts. Light running current. 45 amperes at 7,400—8,500 r.p.m.

3.4 Litre
(Type M.45.G)

Lock torque. 22 lb. ft. with 430—450 amps at 7.8—7.4 volts. Torque at 1,000 r.p.m. 8.3 lb. ft. with 200—220 amps at 10.2—9.8 volts. Light running current. 45 amperes at 5,800—6,800 r.p.m.

4. **SERVICING**

(a) **TESTING IN POSITION**

(i) Switch on the lamps and operate the starter control. If the lights go dim, but the starter motor is not heard to operate, an indication is given that current is flowing through the starting motor windings but that the armature is not rotating for some reason ; possibly the pinion is meshing permanently with the geared ring on the flywheel. In this case the starting motor must be removed from the engine for examination.

(ii) Should the lamps retain their full brilliance when the starter switch is operated, check the circuit for continuity from battery to starting motor via the starter switch, and examine the connections at these units. If the supply voltage is found to be applied to the starting motor when the switch is operated, an internal fault in the motor is indicated and the unit must be removed from the engine for examination.

(iii) Sluggish or slow action of the starting motor is usually due to a loose connection causing a high resistance in the motor circuit, Check as described above.

(iv) If the motor is heard to operate, but does not crank the engine, indication is given of damage to the drive.

(b) **BENCH TESTING AND EXAMINATION OF BRUSHGEAR AND COMMUTATOR**

(i) If it is necessary to remove the starting motor from the engine, proceed as follows :—
Disconnect one of the battery cables at the battery, to avoid any danger of causing short circuits.
Disconnect the cable from the starter motor,

(ii) After removing the starting motor from the engine secure the body in a vice and test by connecting it with heavy gauge cables to a

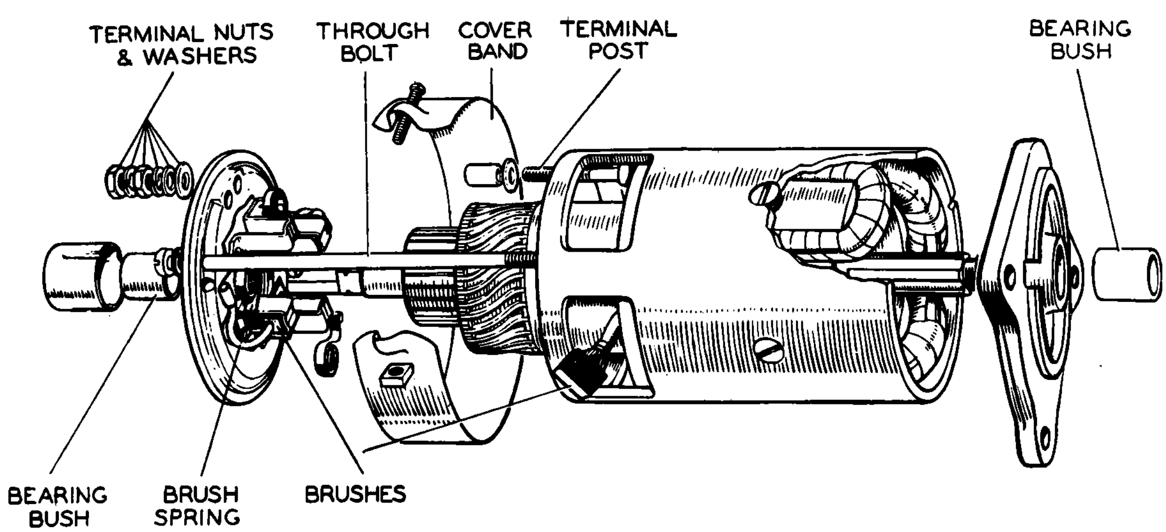


Fig. 29. Exploded view of starter motor.

battery of the appropriate voltage. One cable must be connected to the starter terminal and the other held against the body or end bracket. Under these light load conditions, the starter should run at a very high speed (see Para. 3.) without excessive noise and without excessive sparking at the commutator.

(iii) If the operation of the starting motor is unsatisfactory, remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they will not bear on the commutator, or if the brush flexible is exposed on the running face, they must be replaced (see Para. 4D).

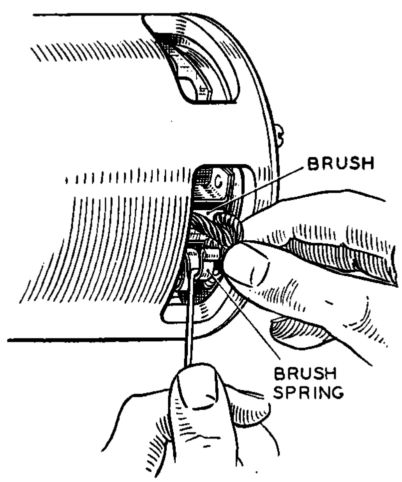


Fig. 30. Checking the brush gear.

Check the tension of the bush springs with a spring scale. The correct tension is 30—40 ozs. New springs should be fitted if the tension is low.

If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

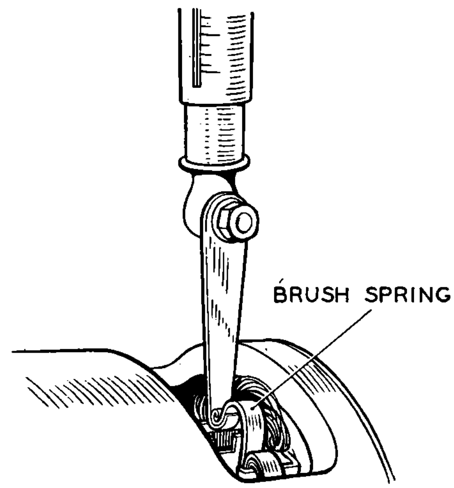


Fig. 31. Testing the brush gear tension.

(iv) Re-test the starter as described under (ii). If the operation is still unsatisfactory, the unit can be dismantled for detailed inspection and testing as follows :—

(c) **TO DISMANTLE**

(i) Remove the cover band, hold back the brush springs and lift the brushes from their holders.

(ii) Remove the nuts from the terminal post which protrudes from the commutator end bracket.

(iii) Unscrew the two through bolts from the commutator end bracket. Remove the commutator end bracket from the yoke.

(iv) Remove the driving end bracket complete with armature and drive from the starting motor yoke. If it is necessary to remove the armature from the driving end bracket, it can be done by means of a hand press after the drive has been dismantled.

(d) **REPLACEMENT OF BRUSHES**

If the brushes are worn to less than $\frac{5}{16}''$ in length, they must be replaced.

Two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket and two are connected to the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in their place by soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.

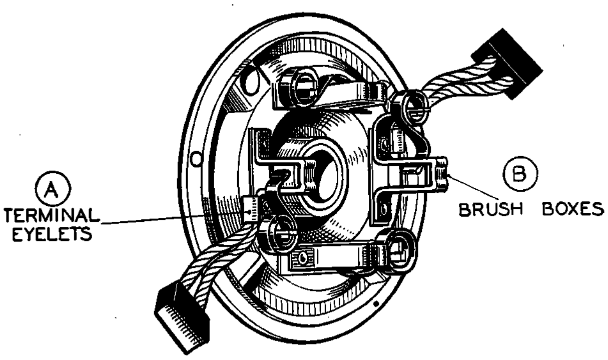


Fig. 32. Commutator end bracket brush connections.

(e) COMMUTATOR

A commutator in good condition will be smooth and free from bits and burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper, while rotating the armature. To remedy a badly worn commutator, dismantle the starter drive and remove the armature from the end bracket. Now mount the armature in a lathe, rotate at a high speed and take a light cut with a very sharp tool. Do not remove any more metal than is necessary. Finally polish with very fine glass paper.

The insulators between the commutator segments MUST NOT BE UNDERCUT.

(f) ARMATURE

Examination of the armature may reveal the cause of failure, e.g. conductors lifted from the commutator due to the starter motor being engaged while the engine is running and causing the armature to be rotated at an excessive speed. A damaged armature must always be replaced—no attempt should be made to machine the armature core or to true a distorted armature shaft.

(g) FIELD COILS

(i) Test the field coils for continuity by connecting a 12-volt test lamp between the starting motor terminal and to each field brush in turn.

(ii) Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole-shoe or to the yoke. This may be checked with a 110-volt test lamp, the test leads being connected between the starting motor terminal and a clean part of the yoke. If the lamp lights, defective insulation of the field coils or of the terminal post is indicated. In this event, see that the insulating band is in position and examine the field coils and terminal connections for any obvious point of contact with the yoke. If from the above tests the coils are shown to be open-circuited or earthed and the point of contact cannot be readily located and rectified, either the complete starting motor or the field coils must be replaced. If the field coils are to be replaced, follow the procedure outlined below, using a wheel-operated screwdriver.

Remove the insulation piece which is provided to prevent the intercoil connectors from contacting with the yoke.

Mark the yoke and pole shoes so that the latter can be re-fitted in their original positions.

Unscrew the four pole shoe retaining screws with the wheel-operated screwdriver.

Draw the pole shoes and coils out of the yoke and lift off the coils.

Fit the new field coils over the pole shoes and place them in position inside the yoke.

Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

Locate the pole shoes and field coils by lightly tightening the fixing screw.

Fully tighten the screws with the wheel operated screwdriver.

Replace the insulation piece between the field coil connections and the yoke.

(h) BEARINGS

Bearings which are worn to such an extent that they will allow excessive side-play of the armature shaft must be replaced. To replace the bearing bushes proceed as follows :—

(i) Press the bearing bush out of the end bracket.
(ii) Press the new bearing bush into the end bracket using a shouldered, highly polished

mandrel of the same diameter as the shaft which is to fit in the bearing. Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

Note : Before fitting a new porous bronze bearing bush it must be completely immersed for 24 hours in clean thin engine oil.

(j) REASSEMBLY

The reassembly of the starting motor is a reversal of the dismantling procedure.

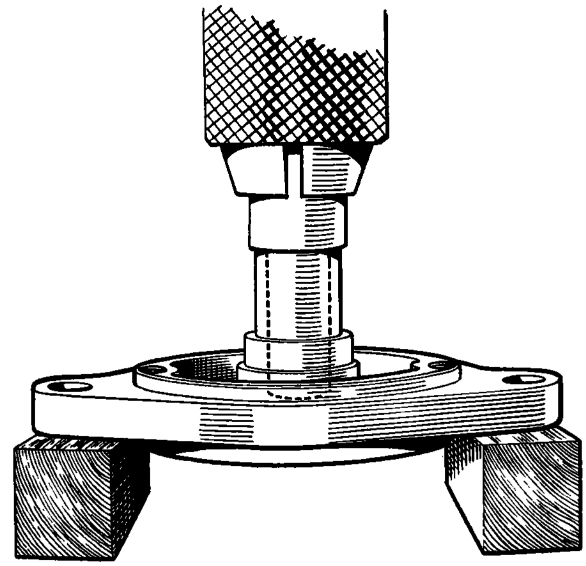


Fig. 33. Method of fitting bush.

STARTER DRIVE

1. GENERAL

The pinion is mounted on a threaded sleeve which is carried on splines on the armature shaft, the sleeve being arranged so that it can move along the shaft against a compression spring so as to reduce the shock loading at the moment engagement takes place.

When the starter switch is operated, the shaft and screwed sleeve rotate and, owing to the inertia of the pinion, the screwed sleeve turns inside the pinion causing the latter to move along the sleeve into engagement with the flywheel ring. The starter will then turn the engine.

As soon as the engine fires and commences to run under its own power, the flywheel will be driven faster by the engine than by the starter. This will cause the pinion to be screwed back along the sleeve and so thrown out of mesh with the flywheel teeth. In this manner the drive safeguards the starter against damage due to being driven at high speeds by the engine.

A pinion restraining spring is fitted over the starter shaft to prevent the pinion being vibrated into contact with the flywheel when the engine is running.

2. ROUTINE MAINTENANCE

If any difficulty is experienced with the starting motor not meshing correctly with the flywheel, it may be that the drive requires cleaning. The pinion should move freely on the screwed sleeve ; if there is any dirt or other foreign matter on the sleeve it must be washed off with paraffin.

In the event of the pinion becoming jammed in mesh with the flywheel, it can usually be freed by turning the starter motor armature by means of a spanner applied to the shaft extension at the commutator end.

This is accessible by removing the cap which is a push fit.

3. DISMANTLING AND REASSEMBLY

Having removed the armature as described in the section dealing with starting motors the drive can be dismantled as follows :—

Remove the split pin (A) from the shaft nut (B) at the end of the starter drive. Hold the squared starter shaft extension at the commutator end by means of a spanner and unscrew shaft nut (B). Lift off the main spring (C), washer (D), screwed sleeve with pinion (E), collar (F), pinion restraining spring (G) and restraining spring sleeve (H).

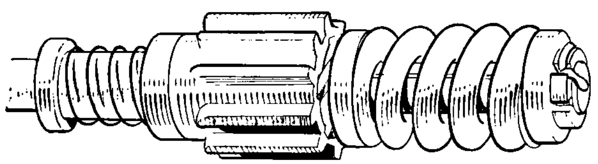


Fig. 34. Showing the starter drive assembled.

Note : If either the screwed sleeve or pinion are worn or damaged they must be replaced as a pair, not separately.

The reassembly of the drive is a reversal of the dismantling procedure.

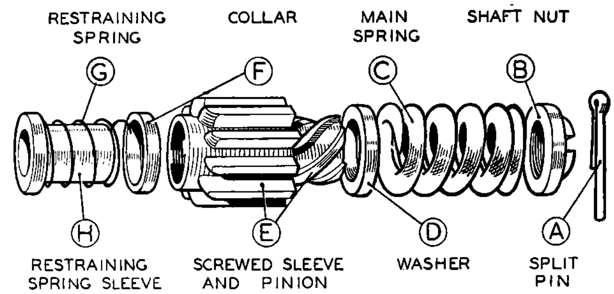


Fig. 35. Exploded view of the starter drive assembly.

WINDSCREEN WIPER

REMOVAL OF WIPER MOTOR AND CABLE

Withdraw the wiper arms from the spindles.

Unscrew the large nut connecting cable guide to the wiper motor.

Remove the single screw securing the plate covering the electrical connections on the wiper motor. Withdraw the electrical cables from the wiper motor complete with the rubber retainer.

From the underneath of the right hand front wing remove the three screws securing the wiper motor to the wing valance.

The wiper motor cable can now be removed as an assembly by drawing the cable through the guide tube.

Disconnecting the Cable

Remove the four small set bolts from the gear cover.

Lift off the cover, remove the circlip from the post in the gear wheel.

Remove the washer, spring, shaped washer and connecting link from the post. Lift out the connecting link from the crosshead.

Lift out the cable ferrule from the gear casing.

REFITTING

Refitting is the reverse of the removal procedure.

REMOVAL OF WHEELBOXES

Remove the centre facia as described on page 40.

Remove the screen rail as decribed on page 40.

Withdraw both wiper arms from the spindles.

From outside the car unscrew the large nuts securing the wheelboxes to the scuttle.

Remove the chrome distance pieces and rubber seals.

Remove the backplates from the wheelboxes by removing the two screws.

Pull the cable away from the worm wheels and slide off the spacer tubing.

From inside the car withdraw the wheelboxes and spacers.

REFITTING

Refitting is the reverse of the removal procedure.

DATA

Wiping Speed	
Normal :	45—50 cycles per minute
High :	60—70 cycles per minute
Light Running Current	
Normal Speed :	2.7—3.4 amperes
High Speed :	2.6 (or less) amperes
Stall Current	10—11 amperes (DR3) 8—9 (DR1)
Control Switch	PRS7
Pressure of Blades against Windscreen	
Arms with leaf type springs :	4.5—7.5 ounces
Arms with coil type springs :	5.5—7.5 ounces
Maximum permissible force to move cable rack in protective tubing with motor, arms and blades disconnected	6.0 lbs.

DESCRIPTION

The windscreen wiper is a two-speed, thermostatically protected, self-parking, cable rack unit.

The cable rack comprises a flexible inner core of steel wire wound with a wire helix. The rack passes through protective tubing from an underbonnet mounted motor to a pair of scuttle mounted wheelboxes. A reciprocating motion is imparted to the rack by a crank in the wiper gearbox and transmitted to the wiper arm spindles by engagement of the rack with a gear in each wheelbox.

The motor is controlled by a switch giving Park, Normal and High speed operation. The higher speed is intended to be used when driving fast through heavy rain or light snow. It should not be used in heavy snow or with a dry or drying windscreen. If overloaded, the motor windings will overheat and cause the thermostat to trip and isolate the motor from the supply. Provided the obstruction or other cause of excessive heating is removed, normal working resumes automatically when the temperature falls to a safe value.

MAINTENANCE

Efficient wiping is dependent upon having a clean windscreen and wiper blades in good condition.

Use methylated spirits (de-natured alcohol) to remove oil, tar spots and other stains from the windscreen. Silicone and wax polishes should not be used for this purpose.

Worn or perished wiper blades are readily removed for replacement.

When necessary, adjustments to the self-parking mechanism can be made by turning the knurled nut near the cable rack outlet. Turn the nut only one or two serrations at a time and test the effect of each setting before proceeding.

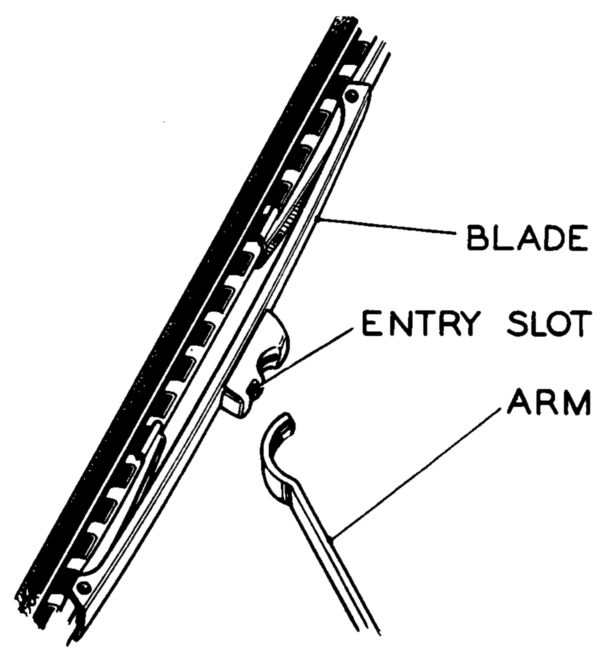


Fig. 36. Wiper blade to arm attachment.

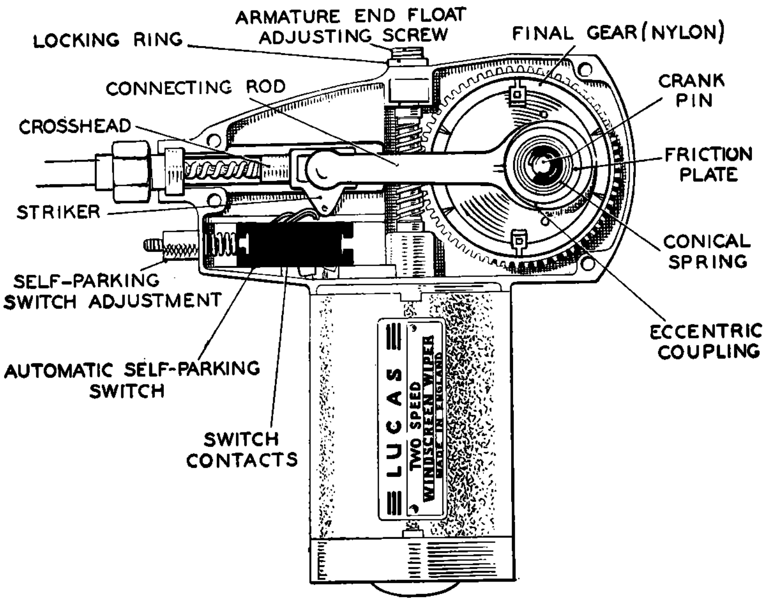


Fig. 37. Showing the DR1 wiper motor with cover plate removed.

FAULT DIAGNOSIS

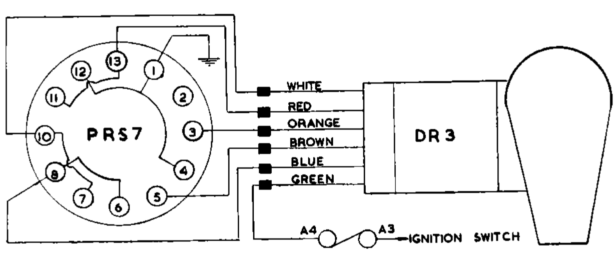
Poor performance can be electrical or mechanical in origin and not necessarily due to a faulty motor, for example :-

Low voltage at the motor due to poor connections or to a discharged battery ;

Cable rack binding in protective tubing ;

Eccessive loading on the wiper blades ;

Wheelboxes loose, out of alignment or spindles binding in the bearing housing.



DR3 SCREENWIPER WITH PRS7 SWITCH.

Fig. 38. Wiring connections switch to wiper.

TESTING

Unless the origin of the fault is apparent, proceed as follows to determine the cause of failure.

Measuring Supply Voltage :

Using a first grade moving coil voltmeter, measure the voltage between the motor supply terminal (to which the green cable is connected) and a good earthing point. This should be 11.5 volts with wiper working normally. If the reading is low, check the battery, switch (by substitution), cabling and connections.

Measuring Light Running Current :

If the normal running terminal voltage is correct, disconnect the cable rack at the wiper gearbox and measure the light running current with a first grade moving coil ammeter connected in the supply cable.

As this involves removing the gearbox cover, the opportunity can be taken to observe the speed of operation by counting the revolutions per minute of the final gear.

The light running current must not exceed 3.4 amperes at Normal speed (45—50 c.p.m.). If it does, fit a new windscreen wiper motor.

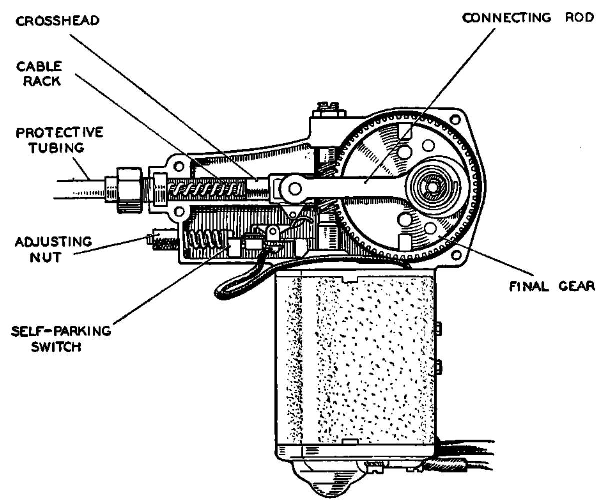


Fig. 39. Showing the DR3 wiper motor with cover plate removed.

Checking Cable Rack and Tubing

The maximum permissible force to move the cable rack in its protective tubing is 6 pounds with the wiper arms, blades and motor disconnected. The measurement can be made by hooking a spring balance in the hole in the cross-head (into which a pin on the connecting rod is normally located) and withdrawing the rack with the balance.

Binding of the rack can be due to kinked or flattened tubing or to faulty installation. Minor faults can be cleared with a suitable tested mandrel sold specifically for checking wiper installations. Badly kinked or flattened tubing must be renewed. Any bends of less than 9″ radius must be reformed.

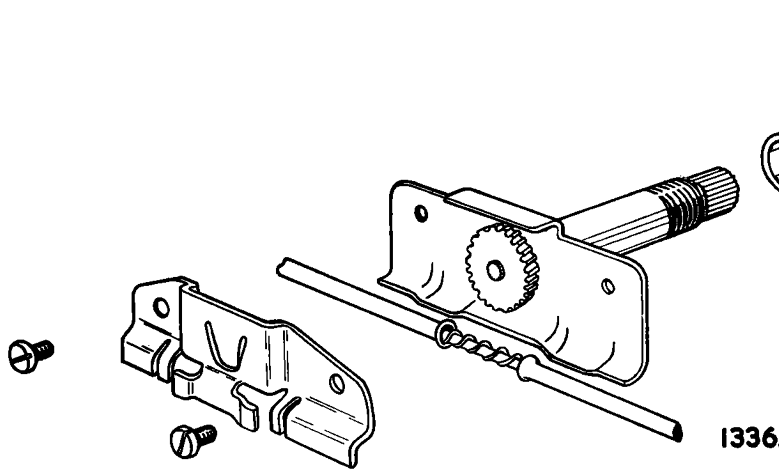


Fig. 40. Exploded view of wheelbox.

At the wheelboxes the flared ends of the intermediate tubing should be located in the inner wide slots of the wheelbox clamp plates but the end of the main tubing should be located in the outer narrow slot.

The cable rack should be well lubricated with Duckhams HBB grease.

Checking Wheelboxes :

Check the wheelboxes for misalignment or looseness and rectify as required.

Renew seized wheelboxes.

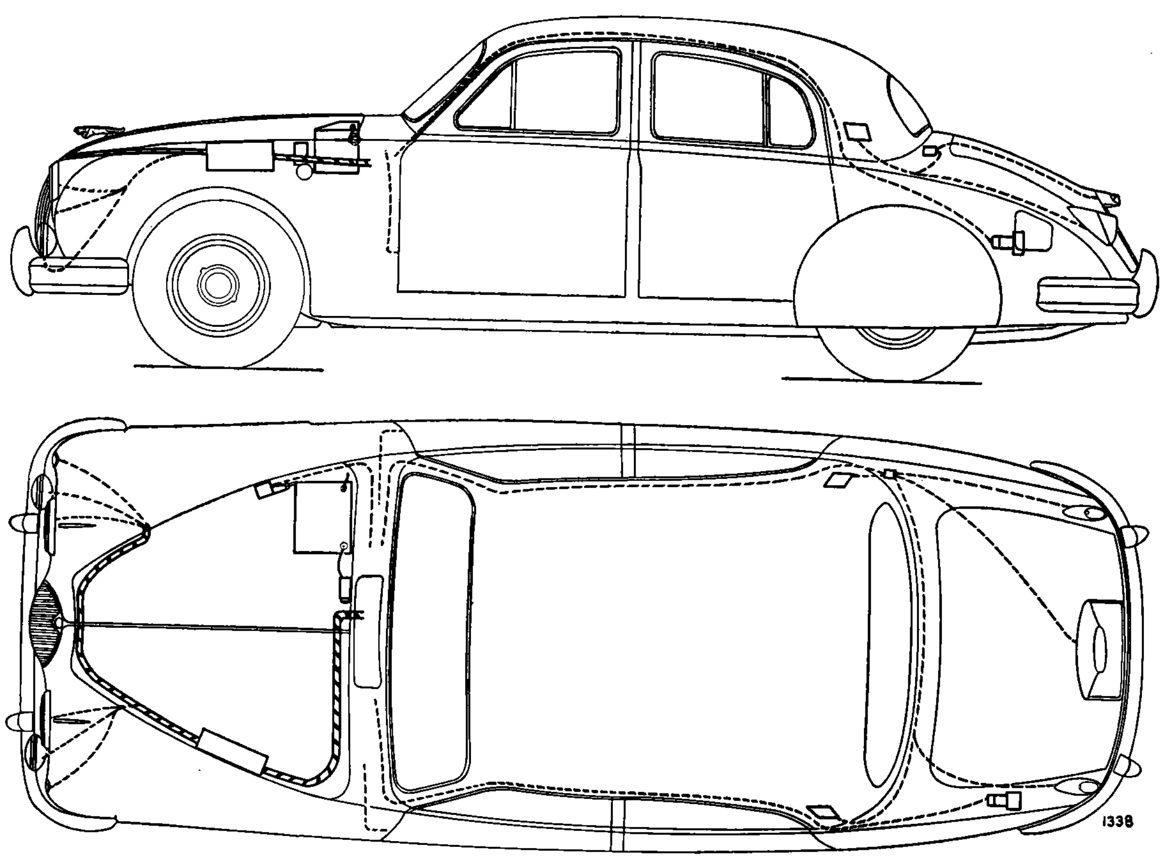


Fig. 41. Layout of wiring harnesses.

MISCELLANEOUS

ELECTRIC CLOCK

Removal

Remove the revolution counter from the instrument panel as described under " Removal of Instrument Panel Components ". Disconnect the feed wire to the electric clock by removing the screw.

Remove the two screws securing the flange of the clock to the rear of the instrument and lift out the clock.

Adjustment

At the back of the time clock is a small screw surrounded by a semi-circular scale. If the clock is gaining, turn the screw towards the minus sign (—) : if the clock is losing, turn the screw towards the positive sign (+).

Note : The action of setting the hands automatically restarts the clock.

Refitting

Refitting is the reverse of the removal procedure.

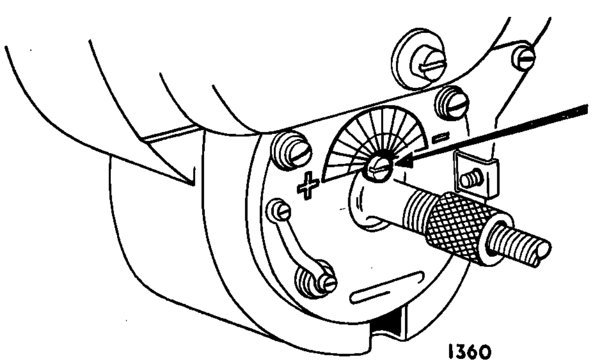


Fig. 42. Adjustment screw for clock.

MIXTURE CONTROL WARNING LIGHT (2.4 Litre Model)

Replacement

Remove the dash casing by unscrewing the scuttle vent knob and removing all the securing screws. This will allow the warning light holder and bulb to be withdrawn from the rear of the socket.

OVERDRIVE AND INTERMEDIATE SPEED HOLD SWITCHES

Removal

Remove the screen rail as described on page 40.

At the front of the screen rail unscrew the locking ring which secures the switch and escutcheon, when the switch can be withdrawn from the back of the rail.

Note : On early cars the overdrive switch was situated at the side of the glovebox. In this case remove the dash casing, unscrew the knurled nut and push the switch through the hole in the glovebox; the connecting wires are long enough to allow the overdrive switch to be drawn below the bottom of the glove-box.

Refitting

Refitting is the reverse of the removal procedure.

FLASHING INDICATOR CONTROL

Removal

Remove the dash casing by unscrewing the scuttle vent knob and removing all the securing screws.

Pull out the wires from the multi-snap connector leading to the indicator control.

Remove the four screws from the underside of the switch and remove the top cover.

Remove the two screws securing the cover which conceal the two indicator control mounting screws, directly below the steering column telescopic control.

Remove the two large screws securing the switch to the steering column and detach the flashing indicator control.

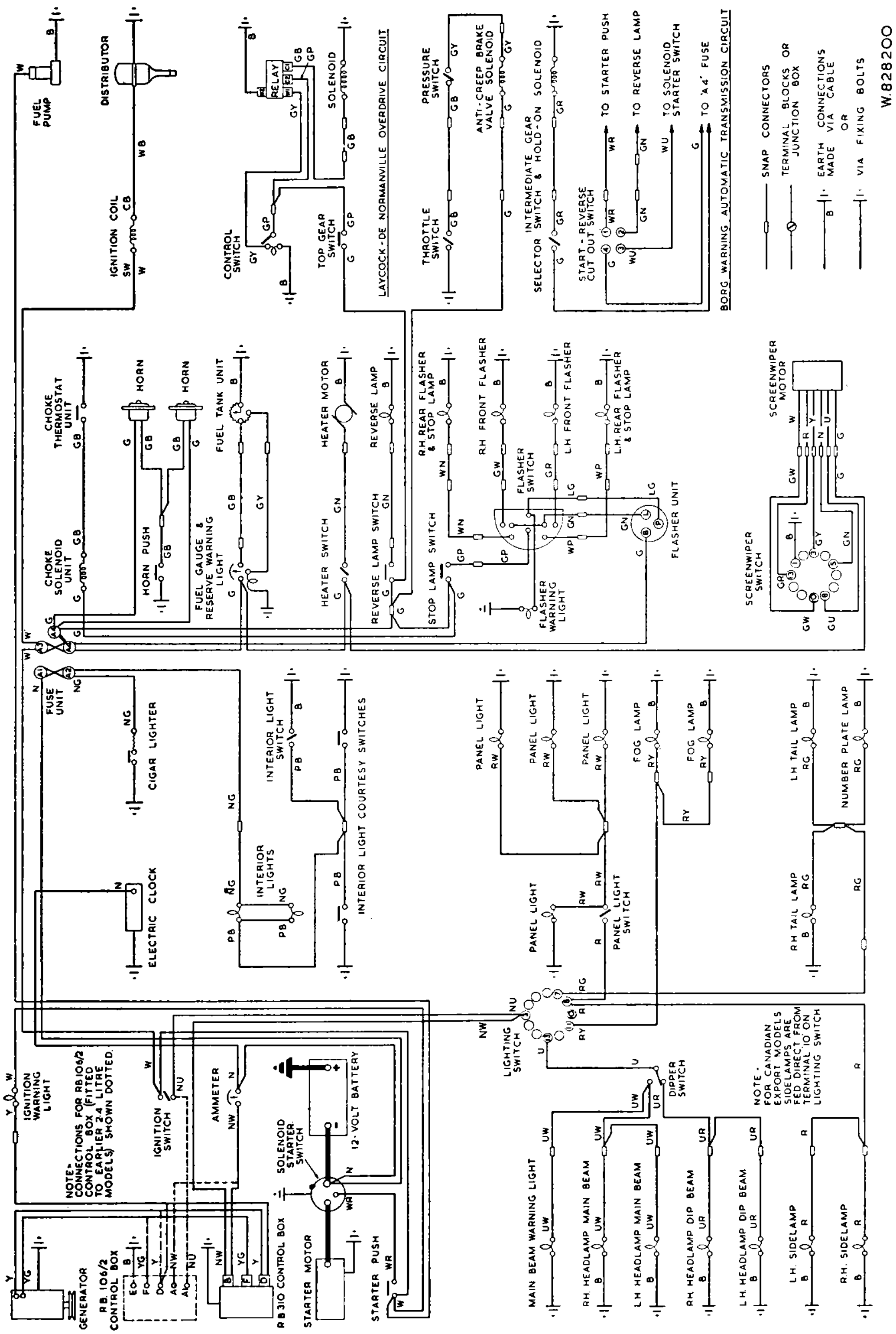
Refitting

Refitting is the reverse of the removal procedure. Insert the wires into the multi-snap connector so that similar coloured wires are opposite each other.

FLASHING INDICATOR WARNING LIGHT BULB

Replacement

Remove the four screws from the underside of the switch and remove the top cover. Remove the small piece of rubber from around the bulb and unscrew the bulb.



CABLE COLOUR CODE

B	BLACK	P	PURPLE	Y	YELLOW
U	BLUE	G	GREEN	D	DARK
N	BROWN	S	SLATE	L	LIGHT
R	RED	W	WHITE	M	MEDIUM

When a cable has two colour code letters, the first denotes the main colour and the second denotes the tracer colour.

Fig. 43. Wiring diagram for 2.4 litre and 3.4 litre models.

INSTRUMENTS

REMOVAL OF THE CENTRE FACIA PANEL

Removal of the Dash Casing

Remove the scuttle vent lever knob and remove all the screws from the casing. The casing can now be drawn downwards.

Removal of the Facia Panel

Remove both thumb screws (A) Fig. 44. from the top of the facia panel. Take out the ignition keys and cigar lighter (B). Insert a piece of stiff wire into the hole in the side of the light switch (C) to depress the plunger when the switch can be withdrawn. Repeat for the wiper switch (D).

Remove the ash tray (E) and remove both screws (F) attaching the ash tray mounting bracket (G) to the facia. Remove the two screws (H) from the underside of the facia panel.

The facia panel can now be removed by sliding it over the remaining switches.

REMOVAL OF THE SCREEN RAIL

Remove the centre facia panel as described above. Remove the four nuts and washers from underneath the screen rail (see Fig. 45).

If the car is fitted with either an overdrive or intermediate speed hold switch on the screen rail unscrew the knurled bezel in the middle of the escutcheon.

The screen rail can now be lifted off.

REMOVAL OF THE RIGHT-HAND GLOVEBOX

Remove the centre facia panel and screen rail as described in the previous paragraphs.

On the 2.4 litre model remove the mixture control by slackening the pinch bolts on the carburetter mixture levers and the outer cable. This will allow the cable to be drawn through when the glovebox is removed.

Remove the screws (A Fig. 46) securing the glovebox to the dash and the nut (B) and washer from the bracket at the rear of the glovebox.

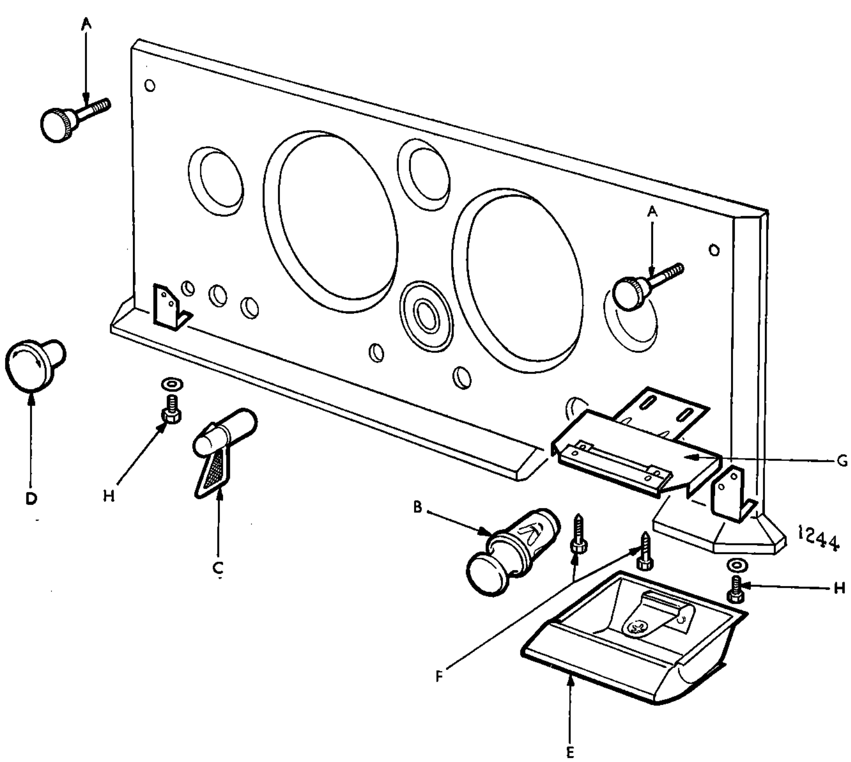


Fig. 44. Centre facia panel, removal.

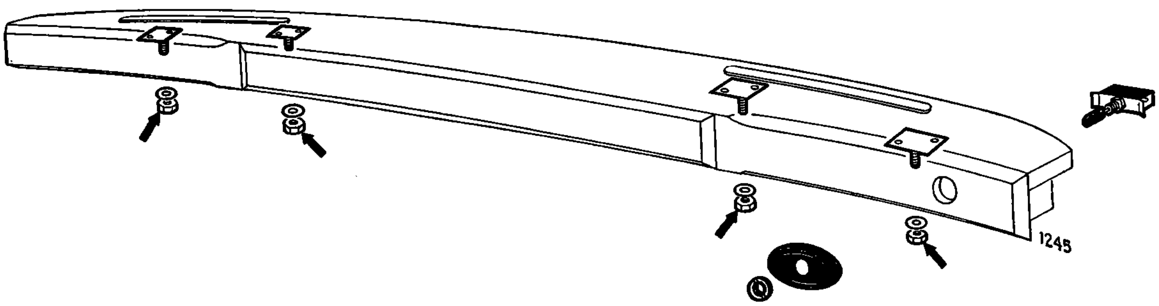


Fig. 45. Screen rail removal.

If the steering column is on the right-hand side, fully extend the steering wheel and remove the two bolts attaching the steering column bracket to the dash.

The glovebox can now be removed.

REMOVAL OF THE LEFT-HAND GLOVEBOX

Remove the centre facia panel and screen rail as described in the previous paragraphs.

Slacken the pinch bolts securing the heater control wire to the control valve situated at the rear of the engine compartment ; also slacken the pinch bolt securing the outer cable. This will allow the cable to be drawn through when the glovebox is removed.

Remove the screws (A Fig. 47.) securing the glovebox to the dash and the nut (B) and washer from the bracket at the rear of the glovebox.

If the steering column is on the left-hand side, fully extend the steering wheel and remove the two bolts attaching the steering column bracket to the dash.

The glovebox can now be removed.

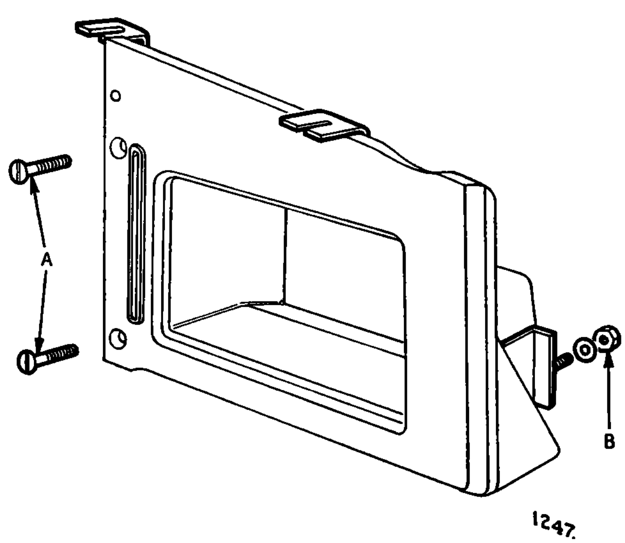


Fig. 46. Right-hand glovebox removal.

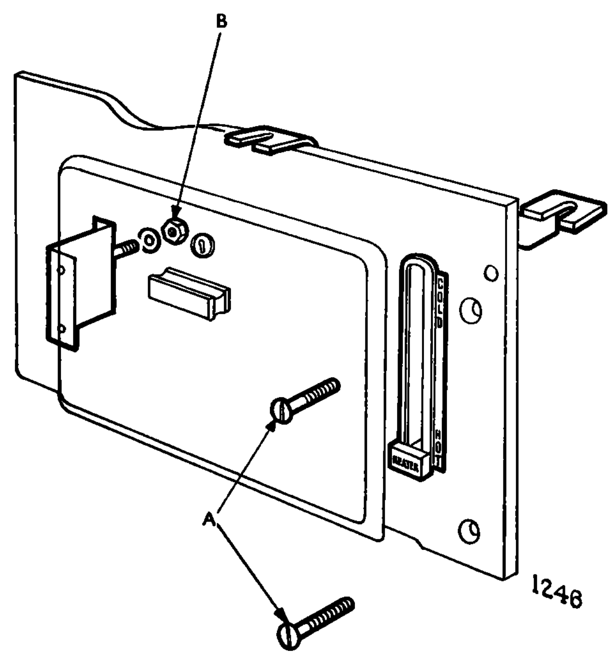


Fig. 47. Left-hand glovebox removal.

REMOVAL OF THE INSTRUMENT PANEL COMPONENTS

Remove the centre facia panel as described on page 40.

Remove one of the battery terminals.

Note: On early 2.4 litre cars the instruments were mounted from the rear of the instrument panel. On these cars it will be necessary to pull the instrument panel forward and disconnect the speedometer and revolution counter cables, the remote control cables and the oil pressure gauge pipe. This will enable the panel to be pulled forward sufficiently to allow access to the instrument retaining screws.

Revolution Counter

Remove the two screws securing the clock adjuster cable at the front of the gearbox cowl adjacent to the left-hand heater door.

Mark with a pencil the relative positions of the three instrument panel securing bolts ; remove the bolts.

Ease the instrument panel forward into the car and unscrew the flexible cable from the rear of the rev. counter instrument.

From above unscrew the pipe connection from the rear of the oil gauge.

Disconnect the cable from the electric clock.

Unscrew the three screws securing the rev. counter to the instrument panel and remove the instrument from the front of the panel.

Speedometer

Remove the two screws securing the mileometer trip cable at the front of the gearbox cowl adjacent to the right-hand heater door.

Mark with a pencil the relative positions of the three instrument panel securing bolts ; remove the bolts.

From the above unscrew the pipe connection from the rear of the oil gauge.

Ease the instrument panel forward into the car and unscrew the flexible cable from the rear of the speedometer.

Withdraw the two warning light bulb holders from the rear of the instrument.

Unscrew the three screws securing the speedometer to the instrument panel and remove the instrument from the front of the panel.

Petrol Gauge

Unscrew the two screws securing the petrol gauge to the instrument panel.

Pull the gauge forward out of the panel and disconnect the wires at the rear of the instrument noting their respective positions.

Ammeter

Unscrew the two screws securing the ammeter to the instrument panel.

Pull the ammeter forward out of the panel and disconnect the wires at the rear of the instrument noting their respective positions.

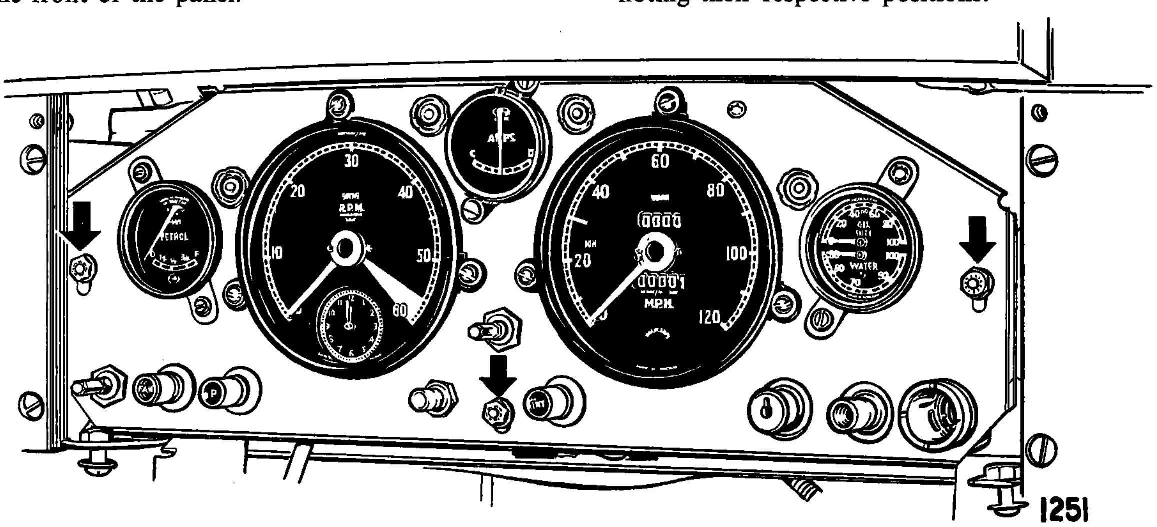


Fig. 48. Instrument panel securing screws.

Oil Pressure and Water Temperature Gauge

Partially drain the radiator.

Unscrew the water temperature gauge bulb from the inlet manifold water jacket by holding the flats on the bulb and unscrewing the union nut.

Remove the grommet at the rear of the engine compartment through which oil gauge pipe and water temperature capillary tube pass.

Release the water temperature capillary tube from its retaining clips taking care not to bend the tube.

Mark with a pencil the relative positions of the three instrument panel securing bolts; remove the bolts.

Ease the instrument panel forward into the car and unscrew the oil gauge union nut from the rear of the instrument.

Remove the two screws securing the gauge to the instrument panel and withdraw the gauge into the car complete with the water temperature capillary tube.

Cigar Lighter

Remove the nut and washers from the centre screw and disconnect the feed wire.

Remove the nut and washers securing the bridge piece and withdraw the bridge.

Withdraw the lighter-holder from the front of the instrument panel.

Unscrew the nut and washer and remove the insulating washer and earth wire plate.

Important : Refitting is the reverse of the removal procedure but it is essential that the earth wire plate and insulating washer are fitted correctly otherwise a short-circuit may take place.

Firstly, fit the earth wire plate next to the holder so that the holes in the plate engage with the projections in the holder.

Secondly, fit the insulating washer so that the two holes also engage with the projections in the holder ; secure with the flat washer, shakeproof washer and nut.

Fit the bridge piece and secure with the flat washer, shakeproof washer and nut.

Connect the feed wire and fit the remaining flat washer, shakeproof washer and nuts.

Switches

From the front of the instrument panel unscrew the nut or locking ring securing the switch to the panel.

Withdraw the switch from the rear of the panel and disconnect the wires, noting their respective positions.

SPEEDOMETER CABLE

Removal

Remove the centre facia panel as described on page 40. Mark with a pencil the relative positions of the three instrument panel securing screws.

Remove the three bolts attaching the instrument panel to the mounting brackets. This will allow the instrument panel to be drawn forward a sufficient amount to allow the speedometer cable connection to be unscrewed from the instrument.

Unscrew the speedometer cable connection from the back of the gearbox or overdrive. Detach the cable from the retaining clips.

Remove the grommet at the rear of the engine compartment through which the speedometer cable passes, when the cable can be withdrawn.

Refitting

Refitting is the reverse of the removal procedure, but it is important to follow the correct run as illustrated in Figs. 49 and 50.

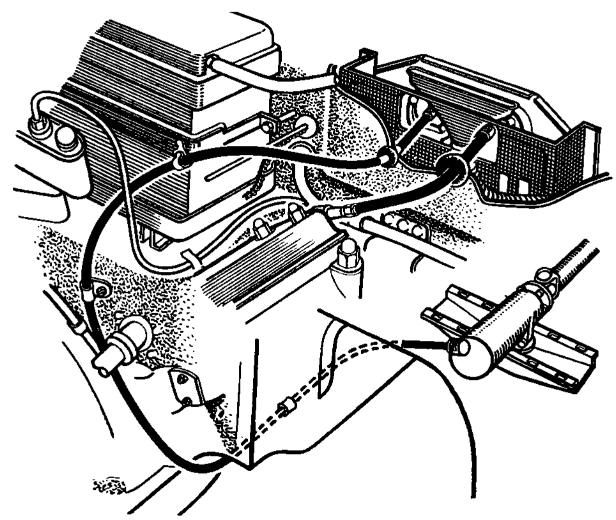


Fig. 49. Showing run of speedometer and revolution counter cables on standard transmission cars.

REVOLUTION COUNTER CABLE

Removal

Remove the dash casing and facia panel as described on page 40.

Remove the three bolts attaching the instrument panel to the mounting brackets. This will allow the instrument panel to be drawn forward a sufficient amount to allow the rev. counter cable connection to be unscrewed from the instrument.

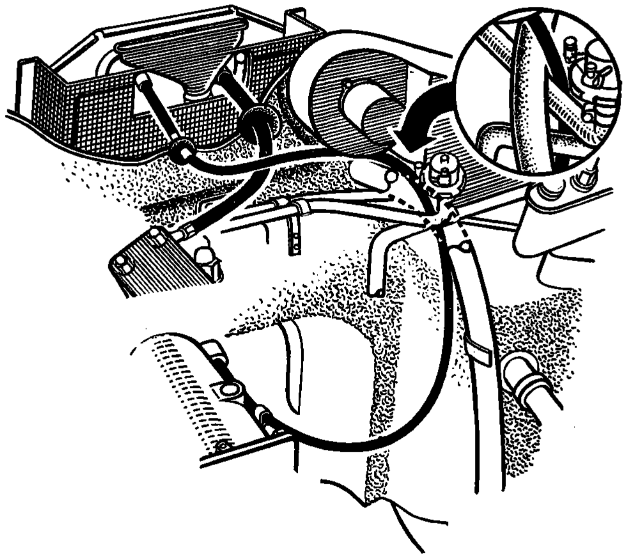


Fig. 50. Showing run of speedometer and revolution counter cables on automatic transmission cars.

Remove the rev. counter cable from the rear of the cylinder head by unscrewing the cable connection from the right angled drive.

Remove the large grommet from the rear of the engine compartment through which the speedometer cable passes and withdraw the cable.

Refitting

Refitting is the reverse of the removal procedure, but it is important to follow the correct run as illustrated in Figs. 49 and 50.

SPEEDOMETER AND REVOLUTION COUNTER CABLES—GENERAL INSTRUCTIONS

Flexible cable condition to a great extent affects performance of speedometers and revolution counters. Poor installation or damage to the flexible drive will show up as apparent faults. It is most important that the flexible drive should be correctly fitted and maintained as illustrated in the following diagrams.

1. **Smooth Run.**

   Run of flexible drive must be smooth. Minimum bend radius 6″. No bend within 2″ of connections.

2. **Securing**

   Avoid sharp bends at clips. If necessary change their position. Do not allow flexible drive to flap freely. Clip at suitable points.

3. **Securing**

   Avoid crushing flexible drive by over-tightening clip.

4. **Connection**

   Ensure tightness of outer flex connections. They should be finger tight only. It may be necessary to clean thoroughly the point of drive before the connection can be screwed completely home.

5. **Connection of Inner Flexible Shaft**

   Where possible slightly withdraw inner flex and connect outer first. Then slide inner into engagement.

6. **Removal of Inner Shaft**

   Most inner flexes can be removed by disconnecting instrument end and pulling out flex. Broken inner flex will have to be withdrawn from both ends.

7. **Examination of Inner Flexible Shaft**

   Check for kinked inner flexible shaft by rolling on clean flat surface. Kinks will be seen and felt.

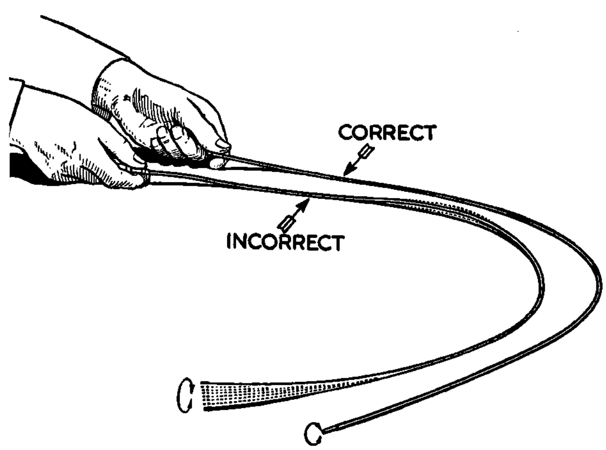


Fig. 51. Checking inner flex for kinks.

8. **Lubrication Every 10,000 Miles**

   Withdraw inner flexible drive (see paragraph 6). Place blob of grease on end of outer cable and insert flex through it, carrying grease inside. Use Esso T.S.D.119 or equivalent. Do NOT use oil.

9. **Excessive Lubrication**

Avoid excessive lubrication. If oil appears in flexible drive, suspect faulty oil-seal at point of drive.

10. **Inner Shaft Projection**

Check $\frac{3}{8}''$ projection of inner flex beyond outer casing at instrument end. This ensures correct engagement in instrument and point of drive.

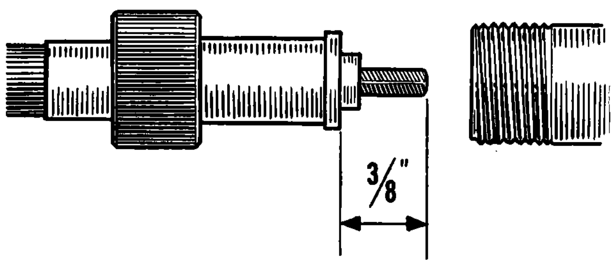


Fig. 52. Showing the amount the inner flex must protrude from outer cable.

11. **Concentric Rotation**

Check that inner flex rotates in centre of outer cable.

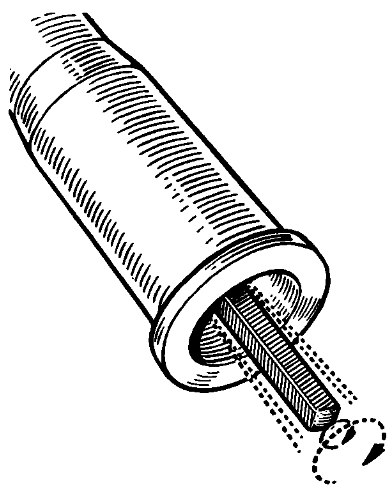


Fig. 53. Checking inner flex for "run out."

12. **Damaged Inner Shaft**

Examine inner flex ends for wear or other damage. Before fitting new flex, ensure instrument main spindle is free.

13. **Damaged Drive End Connections**

Examine point of drive for damage or slip on gears in gearbox.

14. **Ensuring Correct Drive Fitted**

When ordering, state Make, Year and Model of vehicle. State also length of drive required when alternatives are shown.

SPEEDOMETERS AND REVOLUTION COUNTERS—GENERAL INSTRUCTIONS

Speedometer or revolution counter performance is dependent on the flexible drive, and apparent faults in the instrument may be due to some failure of the drive. Before returning a speedometer or revolution counter for service, the flexible drive should be checked, as described in the previous paragraphs. The following diagrams show you how to check the instrument performance.

15. **Instrument Not Operating**

Flexible drive not properly connected (see paragraph 5). Broken or damaged inner flexible shaft or fault at point of drive (see paragraphs 12 and 13), in which case remove and replace flex (see paragraphs 6 and 8) or rectify point of drive fault. Insufficient engagement of inner shaft (see paragraph 10). Defective instrument—return for service.

16. **Instrument Inaccurate**

Incorrect speedometer or revolution counter fitted. Check code number.

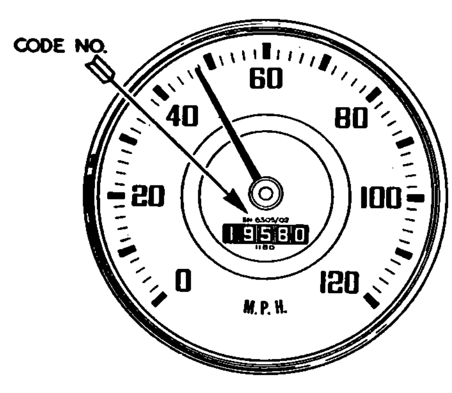


Fig. 54. Showing the code number on face of instrument.

17. **Speedometer Inaccurate**

Check tyre pressures. Inaccuracy can be caused by badly worn tyres. Non-standard tyres fitted. Apply to Smiths for specially calibrated instrument.

18. **Speedometer Inaccurate**

Rear-axle ratio non-standard. Drive ratio in vehicle gearbox non-standard. A rapid and simple check is obtained by entering in the formula the figures found in the test (see paragraph 19.).

$$\frac{1680\ N}{R} = \text{T.P.M. No.}$$

Where N = Number of turns made by the inner shaft for 6 turns of rear wheel and R = Radius of rear wheel in inches measured from centre of hub to ground.

Example

Cardboard pointer on inner shaft (see 19) rotates $9\frac{1}{8}$ times as vehicle is pushed forward 6 turns of rear wheel. Rear wheel radius $12\frac{1}{4}''$.

Flex turns per mile :

$$\frac{1680 \times 9\frac{1}{8}}{12\frac{1}{4}} = \frac{15330}{12\frac{1}{4}} = 1251 = \text{T.P.M. No.}$$

19. **Gearing Test**

Disconnect flexible drive from Speedometer. With the gears in neutral, count the number of turns of the inner shaft for six turns of the rear wheels when the vehicle is pushed forward in a straight line. Measure rolling radius of rear wheels —centre of hub to ground. Apply figures in formula (see paragraph 18).

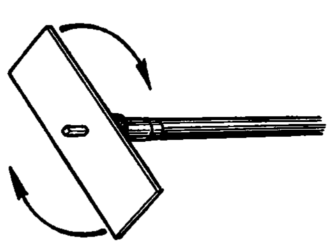


Fig. 55. Cardboard pointer on inner flex for checking the number of turns.

20. **Correct Speedometer**

Number illustrated should correspond within 25 either way with the number obtained from paragraphs 18 and 19. If it does not, apply to Smiths for specially calibrated instrument, giving details of test and vehicle.

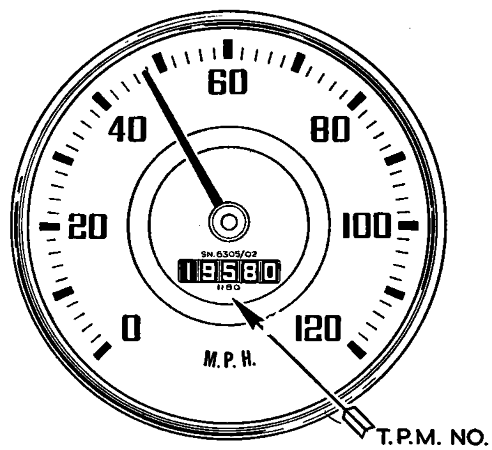


Fig. 56. Showing the turns per mile on face of instrument.

21. **Pointer Waver**

Oiled up instrument. Replace oil seal if necessary, clean and lubricate flexible drive (see paragraph 8). Return instrument for replacement.

22. **Pointer Waver**

Inner flexible shaft not engaging fully. Check 10, then try 4. Also check 12.

23. **Pointer Waver**

Kinked or crushed flexible drive. Check 7 and 3. For withdrawal of inner shaft see paragraph 6. Bends of too small radius in flexible drive, Check 1.

24. **Pointer Waver**

If 21, 22 and 23 show no sign of trouble, instrument is probably defective. Return for replacement.

25. **Noisy Installation**

Tapping noises. Check 5 and 2. Flexible drive damaged. Check 7 and 12 (also see paragraph 6), check lubrication is sufficient. Check 10 and 11.

26. **Noisy Installation**

General high noise level. Withdraw inner shaft (see paragraph 6) and reconnect outer flex. If noise continues at lower level then source of noise is in vehicle point of drive. Fitting new P.V.C. covered flexible drive with nylon bush on inner shaft and instrument with rubber mounted movement should overcome this trouble.

27. **Noisy Installation**

Regular ticking in time with speedometer decimal distance counter. Return speedometer for replacement.

28. **Noisy Installation**

Loud screeching noise more prevalent in cold weather. Return instrument for replacement.

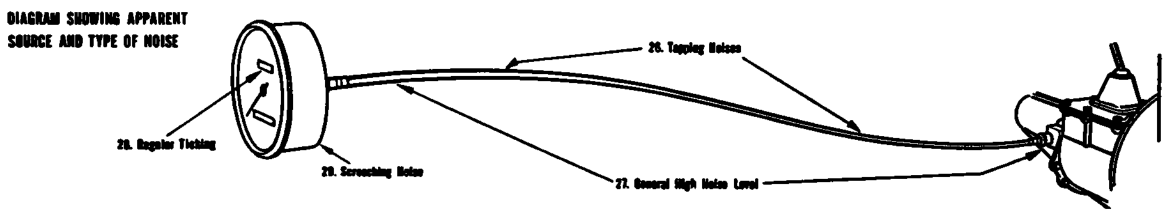


Fig. 57.