

*Instructions to Drivers*  
*For Running and Tending*  
THE  
"SENTINEL"  
STEAM MOTOR WAGGON.

Sentinel Motor Waggon Works,  
Shrewsbury.

*Price 2/6*

**Instructions to Drivers for  
Running and Tending . .**

The \_\_\_\_\_

**“SENTINEL”**

**STEAM MOTOR WAGGON**

*Subject to alteration without notice.*



**Sentinel Motor Waggon Works**  
**SHREWSBURY,**

*Manufacturing Engineers, Contractors to H.M. Navy, War Dept.,  
H.M. Colonial Dept., and H.M. Office of Works.*

**Sale Agencies in London, Glasgow, Liverpool, Manchester, Leeds,  
Birmingham, Cardiff, Dublin, and in most of the  
Colonies and in Foreign Countries.**

Waggon No. 2537

Registration No. AW 4815

Boiler No. 9.14202

NOTE.—When ordering Replace Parts, please refer to above Waggon Number, and give also Part Number and Code Word given in Illustrated Parts List.

Date of Despatch from Makers' Works—

21-8-19.  
Owner's Name, C. W. Davies, Esq.

Address, 59 Heath Road  
Haisteg

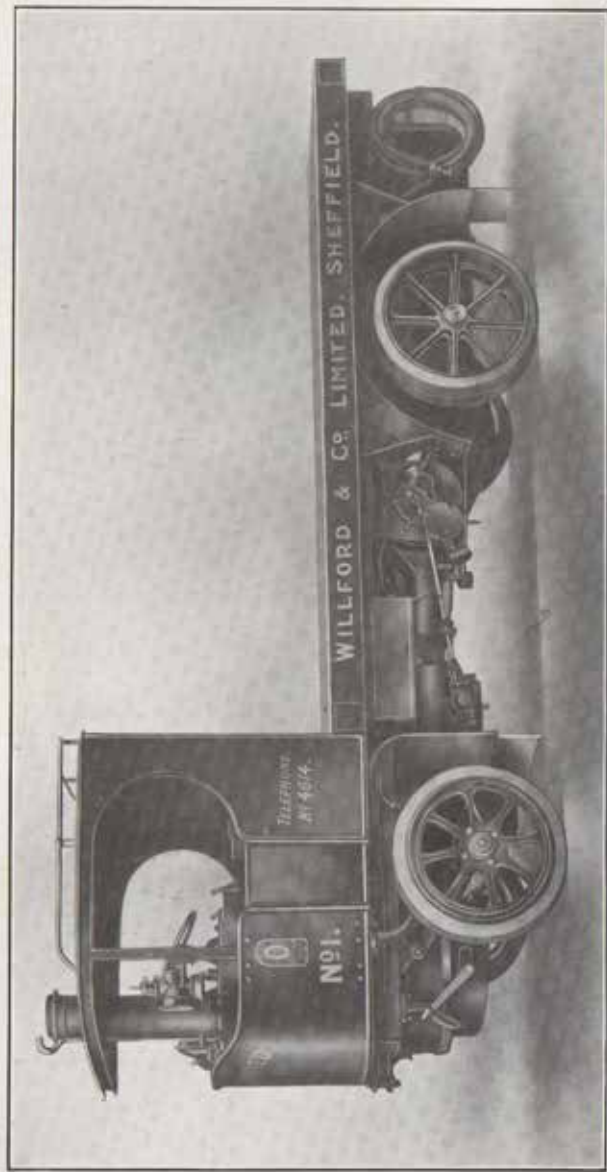
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A RUBBER-TYRED "SENTINEL" 4-TON STEAM WAGGON.

# THE "SENTINEL" STEAM MOTOR WAGGON.

## *Instructions to Drivers.*

### INTRODUCTION.

It must be borne in mind by both Motor Waggon owners and drivers that, however careful the design or perfect the material used by the manufacturer, the success of the Waggon is in the hands of the driver.

A Steam Waggon is really a Road Locomotive, and has a much harder life than the railway engine, because, instead of gliding upon smooth rails, it runs uphill and down, over cobbles and setts, and on roads rough and smooth.

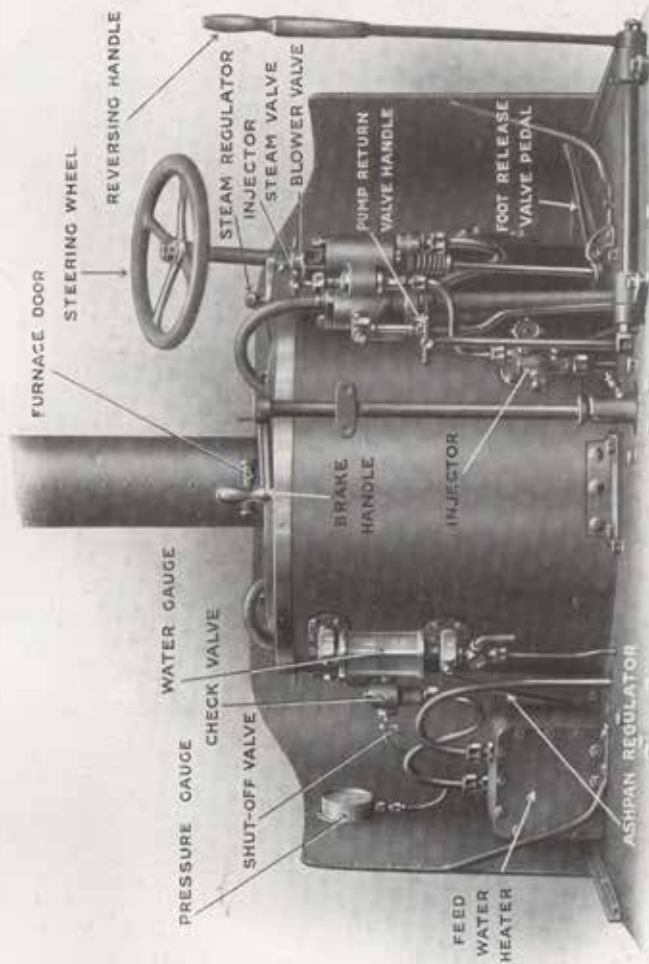
These road conditions can be met in great measure by the manufacturer, but the railway

engine is also very carefully tended and constantly examined. This care in the case of the Road Waggon depends entirely upon the driver.

A Railway Engine seldom breaks down because—

- 1st.—Both driver and fireman come on duty 30 minutes before their engine is due to start and thoroughly examine all parts, oil up, and attend to fire, etc.
- 2nd.—After the day's run both remain 30 minutes for another careful examination.
- 3rd.—The engine is then taken in charge by a cleaner and a lad who clean thoroughly every part, keep in boiler fire, and prepare everything for the next day's work.
- 4th.—Each engine has a "shed day" once a week, when the boiler is washed out and any repairs done.
- 5th.—A monthly examination of the boiler is made by a qualified man and a report of its condition sent to the superintendent.

The successful running of a Road Waggon depends upon similar care being given to it.



VIEW OF CAB FROM DRIVER'S SEAT. THIS SHOWS HOW CONVENIENTLY ALL MOUNTINGS AND CONTROL HANDLES ARE PLACED.

It is not necessary for the driver to be a skilled mechanic. The essentials are:—Common-sense, carefulness, cleanliness, and intelligent use of the hints given in this book.

The result will be seen in less trouble for the driver, and less expense for maintenance to the owner.

### INSTRUCTIONS FOR RAISING STEAM AND STARTING WAGGON.

**Filling Boiler.**—The working level is 3 in. from the bottom of the gauge glass. To fill the boiler, remove brass filling plug in shell on left hand side and fill with clean water to working level. Test working level as follows:—Turn the three gauge cock handles horizontal, turn the top and bottom handles back again vertical, then turn the middle handle vertical, when the water should rise to working level.

**Filling Bunker.**—Use the most suitable fuel to be obtained in your district. Good coke is usually best, but a good steam coal, such as "Pendar" or "Nixon's Navigation," will do equally well. Pass all coke over a sieve or riddle to get rid of dust and dirt before putting into bunker.

**Lighting Fire.**—Unhook ashpan, tilt firegrate, clean both and replace, half filling ashpan with water. Lift furnace door on boiler top, light some shavings or waste soaked in paraffin and throw down on to grate. Follow with plenty of firewood until there is a good blaze and a thick fire. Spread a layer of coke on top and when red hot add more slowly, spreading it well from time to time.

### TESTING VALVES AND HAND LEVERS.

See that the main steam regulator and the three auxiliary steam valves work freely. Try the reversing lever, and place it in Stop notch. Test the hand brake and steering gear.

**Raising Steam.**—Never use the Blower valve unless absolutely necessary, as this often spoils the fire for the whole day. With proper care steam may be raised from cold water in 50 minutes without the Blower.

**Filling Tank.**—Always endeavour to get pure and clean water. Use town or drinking water from the mains wherever possible. Fill the tank either by the water lifter through the suction hose with a strainer placed in a clean pail under a tap; or by a hose from the tap inserted into filling hole on top of tank.

**Testing Injector.**—Open water cock, turning handle horizontal. Open injector steam valve slowly till water is seen to run through overflow pipe. Open steam valve fully, slowly closing water cock a little until overflow ceases. Stop the injector by closing steam valve first and then always close water cock, to prevent any steam which may leak past the valve from going into water suction pipe.

**Lubrication.**—Before starting each morning see that all parts are well oiled, oil gauges full to within 1 in. from top of glass, stauffer and grease nipples well charged.

Full lubrication instructions are given later.

**Adjustments.**—Each day see that no nuts are working loose, not forgetting those on the bolts clamping front and rear bearing springs. See all glands, particularly those for engine piston rods, are properly packed and tight.

**Warming Cylinders.**—With reversing lever still in Stop notch, open engine drain valve by handle on front of bunker. Open stop valve gently and blow through cylinders for two minutes.

**Oiling Cylinders.**—While steam is blowing through cylinders work the small force feed oil pump by hand for about twenty strokes.

### LUBRICATION.

This is most important and must be looked to before starting on every journey.

See that all dirt and dust is carefully removed from oil boxes, etc., before oil is put in, or you will do endless damage.

**Front Axle Journals.**—Keep thoroughly well lubricated, inspecting daily. Fill grease cups on top pivots with mixture of oil and grease, using a larger proportion of grease in hot weather.

**Rear Axle Boxes.**—Unscrew plugs at side and fill baths weekly. Take the cover off each box every month (one cover each week) and clean pads and baths with paraffin, rinsing after with turpentine to remove paraffin.

**Engine and Crank Case.**—Open bottom drain cock daily and run off all water which has settled in bottom of case during the night. Examine oil level gauge Daily and pour new oil through crank case filler until oil level is 1 in. from top of glass.

**Cam Shaft Wheel Case.**—Drain off any water which may have collected at bottom and pour new oil through plug at top until oil level is 1 in. from top of glass. Keep this oil bath well supplied.

**NOTE.**—If the oil level gauge has become blocked, with thick oil in cold weather or in any other way, the gauge fitting must be taken off and cleaned.

**Differential Gear Box.**—Remove Plug at side and pour in a pint of new oil Fortnightly.

**Chain.**—Keep well oiled and clean.

**Reversing Gear.**—Oil all joints Daily.

**Grease Nipples and Stauffers.**—Force grease into all nipples Daily and give a turn to each of the six stauffers.

**IMPORTANT.**—On no account neglect the stauffer in hub of right hand rear road wheel.

**Steering Gear Screw.**—Turn the steering wheel as far as it will go to the right. Unscrew plug in steering column, see that hole in screw bath is in line with hole in steering column, and fill up screw bath Fortnightly.

## BEFORE STARTING.

Remember your license. Examine the waggon all over. See that your fire is bright; that your boiler water level is right; that you have about 200 lbs. steam; that your four lamps are in order; that you have all necessary tools, spares, packing, etc.

## RUNNING INSTRUCTIONS.

**Starting.**—Blow through cylinders as before, close drain valve, push reversing lever to Start, and when you have got under way pull lever to Fast and go ahead.

A common fault is to open the Stop valve too wide. Never give the engine more than just enough steam for the work you require it to do; if you do there will be no reserve of pressure when needed for a hill, and also an excessive blast is sent up the funnel, spoiling the fire, wasting water and fuel, and perhaps causing sparks.

With the Stop valve opening properly controlled, there is ample steam at all times and it is easy to keep a good clean fire.

**Speed.**—The legal limit in the United Kingdom is painted on the waggon frame, and must not



be exceeded on setts or uneven roads. Go dead slow over gutters, badly laid setts, and rough roads.

**Loads.**—The waggons are designed to carry without injury on a flat platform body the loads specified on maker's nameplate, and these stated loads must on no account be exceeded. Care should be taken that the load is evenly distributed over the platform.

**Lights.**—Between specified hours your lamps must be lighted. See that your tail lamp shines on the registration number. If any of your lights go out you are liable to be fined.

**Timid Horses.**—If a policeman or driver of a restive horse raises his hand, it is a signal that you must stop at once, and wait till the horse has got safely past.

**Accidents.**—Should an accident occur while you are in charge, you must, if possible, get the number of a policeman who may have seen it, and the names and addresses of at least two witnesses, and report at once on your return.

## TRAFFIC RULES.

1. Drive on left or near side of the road.
2. A vehicle is under "Town control" when it can be stopped in about 30 ft., and under "Close control" when it can be stopped in about 10 ft.
3. Vehicles in crowded traffic must always be driven under "Close control."
4. In turning corners to the right, curve out wide; turn those to the left close to the kerb, both under "Close control." Whenever the driver's view is limited, his control of his machine should be so complete that he can pull it up within half the distance that he can see ahead of him.
5. Vehicles meet—driver's right arm to driver's right arm.
6. Overtake on right or off side only.
7. Overtaking demands special care on the part of the driver of the overtaking vehicle. Give proper warning and overtake without undue delay.
8. When necessary to overtake at corners, bends in the road, crossings or street refuges, extra caution is required.

9. Meet or overtake a led animal so that the person in charge is between you and the led animal.

10. Go down hills under "Town control."

## II. Hand Signals—

STOP OR SLOW DOWN.—Right hand up.

COME ON.—Right hand waved forward and low.

TURNING TO RIGHT.—Right hand horizontal.

TURNING TO LEFT.—Right hand up, or left hand horizontal when it can be seen.

## CARE OF WAGGON ON THE ROAD.

**Management of Boiler.**—With a little practice a steady water level at about 3 in. from bottom of glass, and a steady steam pressure of about 200 lbs. are easily maintained. Care must be taken to keep the fire clean and bright and spread evenly all over firegrate. Put in fuel every 15 minutes or oftener when roads are heavy or when climbing hills, aiming always to keep a bright fire about 6 in. thick, and allowing enough space between fire and tubes for complete combustion. Keep ashpan closed as much as possible when running.

If steam pressure tends to rise, screw pump return to tank handle to the right and raise the water level. When standing, close ashpan and funnel damper; never let steam blow off in the street. If boiler steams badly look to the grate, and if clinker has gathered, break it up and draw it out from under the fire. Accumulation of dust on tubes causes bad steaming; this should be seen to on "Shed Day," or oftener if it proves necessary through using bad fuel. It should be removed as described elsewhere.

Be sparing with the steam, as previously explained.

Test safety valve daily by allowing it to blow off at 230 lbs. pressure.

**Climbing Hills.**—On approaching a hill see that you have at least 200 lbs. steam, water rather over 3 in. from bottom of glass, and a large bright fire. Use the Fast notch of your reversing lever, and if waggon slows or labours at all use the Start notch, regulating the Stop valve to suit. NOTE.—In going uphill water level shows higher in glass than it really is on level ground.

**Boiler Feeding.**—When the waggon is running the boiler is fed by the feed pump, the amount being controlled by the Pump Return to Tank Valve. The handle of this valve is screwed down for feeding, and unscrewed to return the water to the tank.

**Feed Check Valve.**—This is combined with a shut-off valve which must always be full open when the waggon is running. If the check valve sticks, through the use of bad water, stop the waggon, close shut-off valve, take off check valve cover and clean check valve and seat.

**CAUTION.**—The shut-off valve must be opened again fully before restarting the waggon, otherwise the feed pump will be smashed.

**Injector.**—This is used to feed boiler—

1. When the waggon is standing.
2. If pump fails to act.
3. To prevent safety valve blowing off in towns.

**Failure of Injector.**—If the injector will not start, the following are possible causes:—

1. **DRAWING AIR.** Test the water cock and the suction pipe couplings as follows—these must all be air-tight. Blank off injector suction pipe at tank end, also injector overflow, by unscrewing coupling nut and placing in it a coin or thin disc of metal of suitable size; then open water cock and injector steam valve, looking for leakages at all points.
2. **STEAM PRESSURE TOO HIGH.** Lower this to about 210 lbs.
3. **DIRT IN INJECTOR CONES.** Remove plugs on each side of injector, unscrew cones, and carefully clean all passages.
4. **INJECTOR CHECK VALVE STICKING.** If this valve in injector sticks, remove plug covering valve, clean valve and seat carefully.

**Failure of Pump.**—The use of bad water may cause the pump valves and feed check valves to stick. The gradual lowering of the water when running shows that pump is not acting.

Should this happen, stop and examine pump and check valves at once.

**Failure of Pump and Injector.**—The water level must never be allowed to go below bottom of glass. If water cannot be got into boiler and water level is very low, stop, close ashpan and damper. If steam keeps rising, damp fire with coke dust or even road scrapings. Do not draw out the fire: you can always depend on the fusible plug in extremities. Then find out the cause as already described above.

**Cylinder Lubrication.**—Test this at each stop to see all is working properly.

**Foot Release Valve.**—This is of great value, especially in manœuvring, though it serves other purposes.

By depressing the foot pedal steam is cut off quickly from the engine and sent up the funnel until steam regulator is shut.

In descending hills it is used to control the speed, with steam regulator shut and reversing lever in Reverse notch.

NOTE.—Foot pedal must always be depressed while moving reversing lever from "Forward" to "Reverse" or "Reverse" to "Forward."

**To Stop Slowly on the Level.**—Shut off steam, put reversing lever into Stop notch and allow waggon to roll to a standstill.

**To Stop more Quickly.**—Press foot pedal, put reversing lever into Reverse notch, shut off steam and release foot pedal. As soon as waggon is stopped put reversing lever into Stop notch and put on brake.

**To Stop Nearly Instantaneously at the Risk of Smashing the Engine.**—Press foot pedal, reverse engine, then gently take your foot off pedal, keeping steam still on.

NOTE.—This method should only be used to avoid a collision or to prevent anyone from being run over.

**Descending Steep Hills.**—Stop before going down. Turn the hand brake so that the band is close up to the drum as a precautionary measure.

Start as before described, and to check excessive speed close Steam Regulator Valve. Press down foot pedal and reverse engine. To further check speed let foot pedal rise

gradually, and if you want to stop take your foot off foot pedal, leaving reversing lever in Reverse notch.

**Hand Brake.**—This brake is used for ordinary work and should be screwed up ready for immediate use on approaching hills. It should always be put on when the waggon is standing.

**Filling Tank on the Road.**—As pure water is of the utmost importance, always use town drinking water from the mains wherever possible. This can usually be done by paying a small sum each year.

When drinking water cannot be had note carefully which stream or pond in your district yields the best water. When drawing water from a pond take care not to let the hose strainer touch the bottom. If possible, sink a pail to lay the strainer in or rest it on your fire shovel to prevent drawing in sand, weeds, etc. Open Water Lifter Valve and tank will be filled in about 6 minutes. Withdraw hose before closing steam valve, run any remaining water out and coil up hose.

If tank takes a long time to fill, and water gets hot, see that no air is being drawn

through suction hose, or that the passages in the water lifter are not choked.

**Clean Water.**—Though water is clear, do not be sure it is good; it may be full of mineral matter, which will hurt your boiler and clog your pump.

Never use water from streams or ponds which are contaminated by chemical works, soap, dye, or other factories.

**Leaving Waggon for the Night.**—Put reversing lever to Stop. Open engine drain valve, put hand brake hard on, fill boiler by injector well above glass, remove clinker from firegrate, if necessary, but do not draw out fire. Fill furnace, close ashpan and funnel damper, and shut off water gauge top and middle cocks in case gauge glass breaks. After a few trials it will be found easy to keep the boiler hot and with about 10 lbs. of steam until the morning. A small hole may be drilled in funnel damper to let a little air through if found necessary.

A few lbs. steam pressure should be showing in the morning, when the fire must be cleaned out and re-lit, and full steam pressure may be raised in about 30 minutes.

Always remember that the boiler must be heated slowly and cooled slowly and you will never have leaking joints or such troubles on the road.

Before leaving at night wash down and clean the waggon all over to remove mud before it hardens, but take care not to throw cold water on the boiler.

## WORKING A TRAILER WITH THE 6-TON WAGGON.

**Coupling the Draw Bar.**—When backing towards a trailer in order to couple the waggon thereto move very slowly to avoid accident to the person who has hold of the draw bar. With a "Sentinel" waggon you can move backwards or forwards an inch at a time as easily as a yard.

**Distributing the Load.**—Never divide the load equally between waggon and trailer, but put the greater proportion on the waggon.

**Carrying Capacity with a Trailer.**—With the 6-ton waggon loaded with 6 tons, an additional load of 4 tons may be carried on a trailer. With this load of 10 tons the waggon will climb gradients up to 1 in 10, provided that the road surface is good. When a trailer is used the legal speed of any vehicle is 5 miles an hour. When a waggon is fitted with guaranteed rubber tyres, the tyre-maker's consent to the use of a trailer must be obtained or the tyre guarantee becomes void.

**Descending Hills with a Trailer.**—Before descending hills take care to put on the trailer brake, otherwise the waggon will get completely out of control if you attempt to check its speed by braking in the manner described previously.

## SHED DAY.

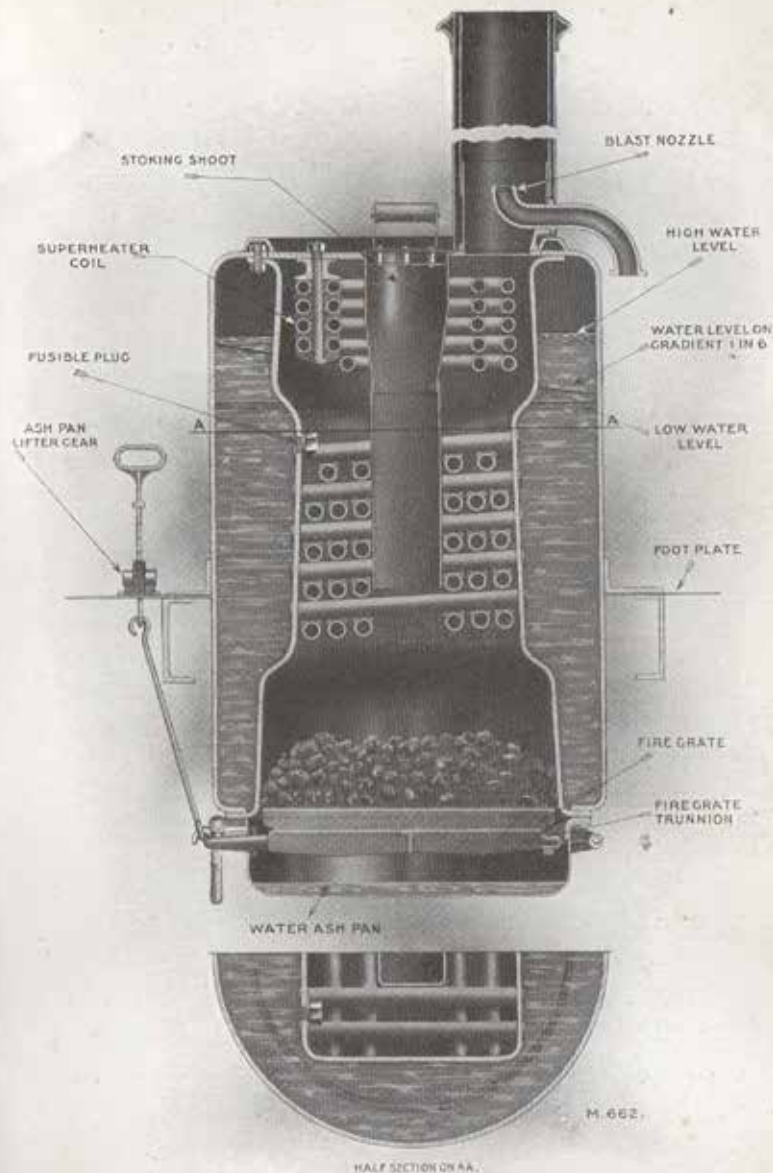
At least once a week, say, every Saturday forenoon, the waggon must be "stabled," and the following attended to at the periods stated:—

**Blowing Down Boiler.**—This should be done as often as convenient during the week to save work on "shed day." With a low steam pressure put on injector and open the blow-off cock to remove mud from the bottom of the boiler.

**Washing Out Boiler.**—Remove all fire and let steam pressure drop to about 10 lbs., slacken off the plugs in the side of boiler at bottom, open blow-off cock and remove plugs entirely. Allow boiler to cool gradually or the tubes will leak. While the empty boiler is becoming cold remove boiler top and fire-grate, then wash out thoroughly inside the boiler with clean water, inserting hose pipe in all plug holes top and bottom.

Thoroughly clean the outsides of the tubes and inside firebox, removing all soot, dust, and coke especially from the corners where the tubes cross.

**Cleaning by Steam Jets.**—Latest "Sentinel" Waggon has below the boiler top an



HALF SECTION ON A-A.

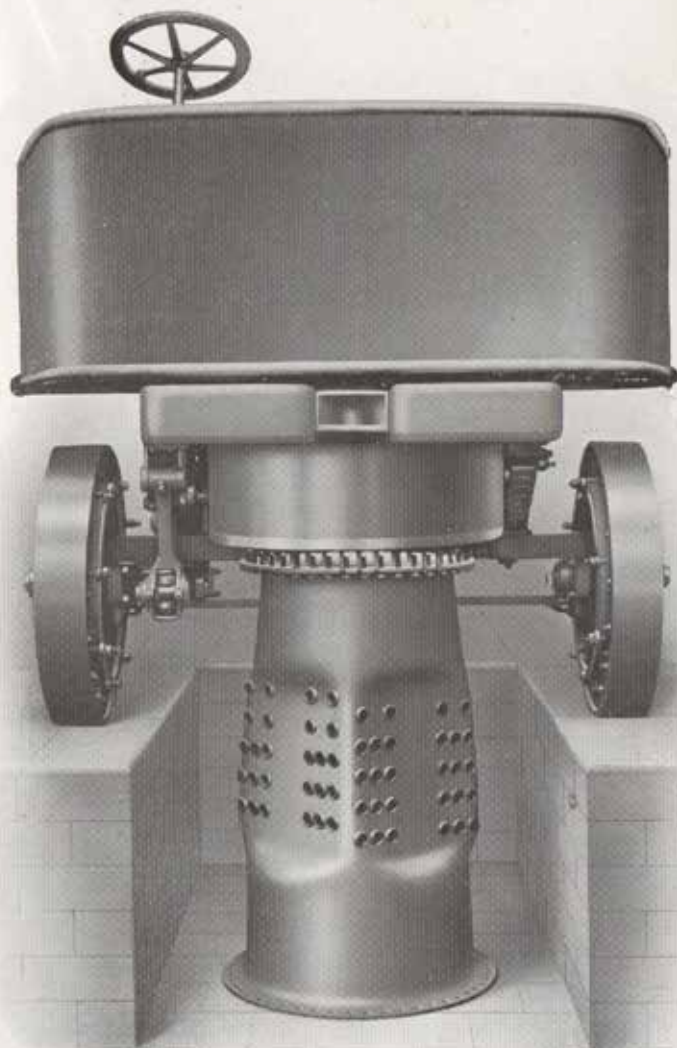
SECTION OF BOILER.

arrangement of jets placed to blow the dirt downwards from between the tubes. This ring of jets is supplied with boiler pressure steam by a small valve near the steering column.

When the fire has been drawn, two or three times a week open this valve wide for five minutes. The boiler pressure steam issuing through the ring of jets will clear away the accumulated dirt from around the tubes, though the tubes should also be inspected from below, removing with an iron rod any larger pieces of coke which may have become wedged between tubes.

NOTE.—Always see that steam jet valve is tightly closed after use. Steam continually passing through may condense upon the outside of the tubes and injure them, while also spoiling proper steaming.

**To Remove Scale from Boiler.**—If you are compelled to use hard or impure water, scale and deposit may be softened and removed from the boiler on “shed day” by putting a solution of washing soda, say, 2 lbs. to a pailful of water, into the full boiler, and keeping about 50 lbs. steam pressure for about an hour. Then reduce pressure, empty



M 663.

FIREBOX LOWERED.



boiler as above, allow it to cool gradually, and wash out thoroughly with clean water before re-filling.

If the water you use is very hard and causes a lot of hard deposit to almost fill the tubes, this can be prevented by putting, say, once a month, about a pound of washing soda dissolved in a pailful of water into the full tank and allowing this to be fed into the boiler. This should be done sparingly or it may cause priming in the boiler.

**To Remove Firebox.**—For thoroughly cleaning the inside of boiler the firebox must be lowered and all scale and deposit removed from the inside of the tubes and walls of the boiler. If pure water is used this need only be done about once a year; if very bad, hard, or dirty water is used the firebox should be lowered and cleaned every six months.

The waggon shed should be provided with a well-drained pit 3 ft. 3 in. wide by 3 ft. 3 in. deep, to permit of access to the engine, and especially the boiler firebox.

To remove firebox if there is no overhead lifting tackle handy: take off the stud cover and boiler top, remove superheater coil, fire-grate, and ashpan. Arrange a strong bar

across the top of boiler shell and another below bottom flange of firebox with lowering chains between them passing down through the centre of firebox.

Take off all nuts from both top and bottom joints and gently lower firebox, starting it by tapping with a heavy hammer, taking care to have a hardwood buffer between hammer and top of firebox. It may be found necessary to part the joints by driving in, say, half a dozen thin wedges at various points around.

SPECIAL CAUTION.—Never take hold of the tubes or hit or strain them in any way when lowering or lifting firebox.

**Fusible Plug in Firebox.**—This must be removed for inspection and cleaning at least once a month.

**Boiler Joints.**—With care the large joints at top and bottom will last a long time. Before replacing firebox always smear sides of each joint with graphite and grease, and before bolting up see that no dirt is on joints or metal surfaces.

**Boiler Mountings.**—Pass a wire through all passages in water gauge fittings Weekly. Examine check valves and clean out deposits,

if any. Remove pressure gauge pipe at intervals and see that it is clear. Test safety valve Daily by allowing it to blow at 230 lbs., and re-grind valve when required. Pack the steam regulator gland, when necessary, with "Palmetto" packing, and re-grind all the steam valves if they leak, however slightly.

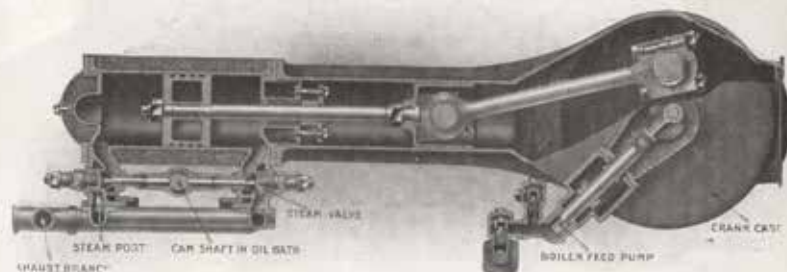
**Engine.**—During the first week's running adjust the piston rod and pump ram glands every other day, afterwards examine them Weekly to see that they are tight. Pack when necessary, using pure asbestos  $\frac{1}{2}$  in. square for piston rods, and tallow hemp  $\frac{1}{2}$  in. square for pump ram.

Remove crank case back door Monthly and see chamber is clean. Drain off all water and oil, filtering the latter before using again. Fill up with fresh oil to proper level in gauge and treat cam box the same way.

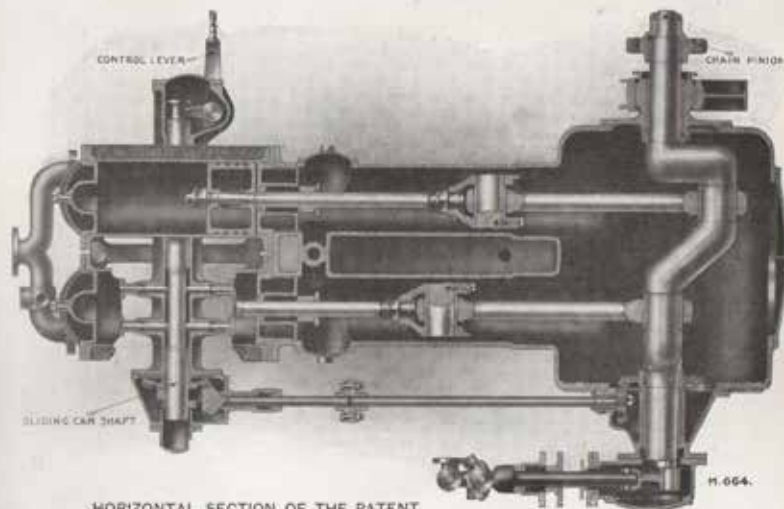
Examine feed pump valves Weekly, clean and re-grind if necessary.

**Testing Engine Valve Setting.**—Do not meddle with this while all goes well, but if the engine "thumps" when running, test valves as follows:—

First inspect and tighten all reversing gear joints to see there is no play here, or



VERTICAL SECTION THROUGH CYLINDER AND FEED PUMP OF THE PATENT "SENTINEL" ENGINE, SHOWING VALVE GEAR AND HOW THE CYLINDERS ARE AUTOMATICALLY DRAINED.



HORIZONTAL SECTION OF THE PATENT "SENTINEL" ENGINE, SHOWING CAM SHAFT DRIVE SECTION OF ENGINE.

where levers are fixed to shafts. Then remove small cover A O 21 from end of gear box on left hand side of waggon, place reversing lever in "Start" notch, and measure how far end of cam shaft stands within the bevel wheel upon it. For waggons No. 236 and after it should be  $\frac{1}{8}$  in.; if it is not, alter the length of reversing link, coupling wyper lever to control box lever, to suit.

To time engine valves, keep reversing lever in "Start" notch and remove driving chain. While your assistant turns engine crankshaft—by a spanner on chain pinion nut, tending to screw it on—try if all valves are properly seating. This is done by observing the clearance between valve stem and push rod at the moment when the opposite valve is being lifted. When a valve is properly seated there should be up to  $\frac{1}{8}$  in. clearance between the end of its stem and the push rod. If there is too much clearance the valve stem can be drawn out, and if there is no clearance the valve stem must be shortened slightly. Make quite sure the cam is not touching the push rod you think needs clearance before you shorten stem.

Having seen all valve stems have a little clearance, remove left hand trunk door and

also the inside valve cover at each end of that left hand side cylinder. While your assistant slowly turns crankshaft (still tending to screw on pinion nut) watch piston rod as it reaches the end of its stroke. When it has returned  $\frac{1}{2}$  in. the steam valve (the inside valve that end) should open.

To find out the moment it opens, place your finger inside the valve and try to turn it; while on its seat you can hardly do so, but immediately it opens the valve is very easily turned.

If the valve is opening too early or too late it is easily put right by slackening the bolts fastening together the discs on the shaft running along left hand side of engine and turning the disc nearest cam shaft outwards or inwards to suit.

All clearances being right, if one valve is timed right all eight are correct. All four steam valves should, however, be tested to check time of opening of each.

The four inside valves are steam valves, the four outside valves are exhaust valves.

Make sure that cam box is firmly fixed. Try bolts holding cam box plates to cylinders.

**Chain.**—Take it off Monthly, immerse it in paraffin, get rid of all grit, then put it in a bath of hot oil.

It is a great advantage to keep a spare chain, so that one can be thoroughly cleaned and oiled while the other is in use. This adds much to their life.

**Chain Adjustment.**—On waggons having a central radius rod to the brake bridge in addition to the main rear axle radius rods, special care must be taken when adjusting the length of the latter (for tightening or slackening driving chain) to see that this central radius rod is adjusted to the same extent as the others. If this is not done an unfair strain will be thrown upon rear springs and axle boxes which may cause trouble.

**Water Tank.**—Remove the manhole door and wash-out plugs in bottom at intervals according to the quality of water used, and wash out all deposit with a hose.

**Water Filter.**—Clean Weekly. Remove cover and take out mantle, cleaning this thoroughly with hose pipe.

**Road Wheels (with Steel Tyres).**—The nuts on the bolts, which serve to tighten the oak felloes,

must be tried occasionally to see that they are not loose. On no account screw these nuts up hard, and do not touch them unless they are really loose.

**Bearing Spring Fastenings.**—It is of course necessary that the front and rear axle bearing springs should be kept firmly clamped in position. Every day for a fortnight, or longer if necessary, after the waggon has first started running, and Weekly afterwards, the nuts on the front and rear spring clamp bolts must be screwed hard down if they are found to be in the least degree loose. They must only be tightened when the waggon is unloaded.

**Proper Care of Rubber Tyres.**—Test wheels periodically to see that all wheels are in perfect alignment with the chassis and with each other.

Don't let the tyres stand in oil or grease.

Remove all flints, nails or glass, etc., picked up by tyres, and all stones from between twin tyres, after each journey.

Have minor injuries, cuts or flats, repaired promptly, as neglect will make them grow worse.

Take care not to run on tramway rails, points or crossings.

Do not drive over loose road metal, or edges of kerbstones, etc. If you must, then drive very slowly.

Don't apply brakes very suddenly, except in an emergency.

**Frosty Weather.**—If there is no heating apparatus in waggon shed during frost the following precautions must be taken to avoid burst pipes, etc.:—

Empty water tank by removing plug in bottom. Open engine drain valve. Remove pump delivery valve and take out plug in bottom of valve chest, and the one at the bottom of ram cylinder, also the plug in bottom of steam pipe below engine cylinders. The boiler must be emptied if fire cannot be damped and kept in.

On waggons having hydraulic tipping gear the hydraulic cylinder and the steam pump must be carefully drained and all cocks left open.

**After Frost.**—See that there are no obstructions of ice in any pipes, valves, etc., before restarting.

The water delivery pipe from feed pump to check valve on boiler is one of the most likely to be choked, and may be thawed by closing shut-off valve on boiler, removing check valve, then replacing check valve cover and gently opening shut-off valve, thus admitting hot water from the boiler to this pipe.

### HINTS ON THE CHOICE OF FUEL AND STORES.

**Fuel.**—The boiler is suitable for burning either coke or Welsh coal. We recommend that, by preference, coke should be used, as coal causes a deposit of soot on the tubes, which thus require more frequent cleaning than when coke is used.

**Coke.**—We ourselves use gas coke, costing about 25/ per ton, with quite satisfactory results. Furnace coke is better, but it costs considerably more; by its use the fire requires less frequent stoking. Whatever quality is used, all dust and dirt should be separated out by passing the coke over a sieve before filling the bunkers. Keep the fire thick when burning coke. Wide-spaced firebars must be used for coke.

**Coal.**—If coke cannot be obtained we recommend “Nixon’s Navigation” “Dowlais Merthyr” or a similar Welsh steam coal. Anthracite is unsuitable, as it soon gets reduced to powder and clogs the grate. Coal should be used in small lumps, dust and slack are useless, and the fire must be kept thin.

**Grease.**—So little grease is used for the nipples and stauffers of the “Sentinel” waggon that it is false economy to use cheap stuff. We use a good quality of vaseline, which we can supply in  $\frac{1}{2}$  cwt. kegs, at about 9d. per lb.

**Lubricating Oil.** — The “Sentinel” waggon having nearly all parts running in oil baths is kept well lubricated with far less trouble than any other waggon, but the oil used must be good and suitable.

If thick oil is used this becomes a stiff paste, blocking up the oil ways and leading to seized bearings. If an oil is used which, when mixed with condensed steam, forms an acid, as many oils do, then the surfaces of all working parts are corroded, become black and rough, and readily wear away.

The safest way to avoid all troubles, and the cheapest in the end, is to use “Sentinel” waggon oil, which we can supply

in 40 gallon casks, at about 5/6 per gallon. This oil we have specially made for us, and it is the result of much experiment and research. When condensed steam leaks into this oil the mixture still forms a good lubricant, entirely free from acid or anything which would injure the surface of the metals.

**Clean Oil and Grease Necessary.**—It is of the utmost importance that for all purposes your oil and grease should be perfectly free from grit and chips. Keep the vessels containing lubricants closely sealed, and when drawing off oil allow it to run through a strainer before using on the waggon.

### GUARANTEE.

For claims under our GUARANTEE, broken parts must be returned to the makers of the Waggon.

The GUARANTEE does not cover any breakage by driver’s fault, accident, or frost; nor does it involve any other liability than the replacement, f.o.r. Shrewsbury, of the defective part.

No claim for free replace parts under our GUARANTEE is allowed if the Waggon has been loaded beyond its stated capacity or driven at more than the maximum legal speed.

Our Guarantee does not apply to Rubber Tyres, Speedometers or other parts or accessories not of our manufacture.