to change down from the high speed gear to the low, and it should be done as follows :

FROM 2nd SPEED TO 1st.

Close down the Throttle slightly, depressing the clutch pedal about half way at the same time, immediately pull the change speed lever over from the high to central or neutral position. Let the clutch in for a second, then depress again half way, and engage the slow or first speed by pulling the change speed lever towards you smartly. Raise clutch pedal and open the throttle as required.

ROUNDING THE CURVE.

When about to negotiate a sharp curve, slow up the train, otherwise derailment may occur.

If there be any doubt as to whether the train will take its load round the curve on its high gear, slow down before entering the curve and change from the high to the low gear, as already described.

RUNNING DOWN HILL.

Before descending a gradient, if doubtful, get into 1st speed, shut down the throttle, and if this does no reduce the speed sufficiently, apply your brakes.

Should the train be exceptionally heavy take care to reduce your speed before reaching the gradient, otherwise you may find the train getting out of control.

TO REVERSE.

When reversing, fully depress the clutch pedal, and when the clutch cone has ceased spinning pull over the reverse lever to the position as shewn on the quadrant and then re-engage the clutch by raising the pedal. Before endeavouring to reverse see that the locomotive is stationary.

STOPPING.

To stop the train, close throttle, de-clutch and apply brake. Place change speed lever in the neutral position and release clutch pedal.

Best braking effects are obtained just before skidding commences. If necessary, brake effect can be increased by applying sand to the rails.

SHUTTING DOWN.

When shutting down for the night it is only necessary to switch off, close the Petrol cock, and put the brakes on. If there is any likelihood of the temperature of the shed in which the Locomotive is housed getting down to freezing point, the water must be thoroughly drained from every part of the cooling system.

To do this, open the drain cocks (1) underneath the Radiator, (2) on the Radiator Piping, (3) underneath the water pump, (4) most important of all, see that the cock draining the water jacket of the cylinders is open and flowing freely. On some types of engine this drain cock is situated behind the Carburettor.

Starting Troubles and "How to Beat Them."

Where to find them.

Should the Engine refuse to start you may be sure that there is a reason for this, and when discovered will probably be found quite a simple one. Generally speaking, the trouble will be located either in the fuel supply (Carburettor and Fuel Tank Service), or in the Ignition (Magneto and Sparking Plug Circuit).

FUEL SERVICE.

Overhaul your fuel supply, first by examining the Fuel Tank and making sure that a supply of fuel is on hand. Try the Petrol cock to make sure that it is open. Examine the Filter Strainer and see that it is free from any obstruction which may prevent the petrol from reaching the carburettor. Take note if the float is working properly in the Carburettor and that no difficulty exists in flooding it with petrol.

After having tried to get the engine going with the throttle handle a "little more" or a "little less" open, if the Engine still refuses to start. then turn your attention to the

IGNITION SYSTEM.

See that the switch is on. Remove the sparking plugs from the cylinders and note if the points are free from carbon or soot. Examine the gap between the points of the spark and if necessary adjust the points so that the distance between them is say, 1/32 of an inch. Place sparking plugs on the cylinders with the wire attached to the Magneto, taking care that the heads of the Plugs, or the uninsulated ends of the high tension wires do not touch any metal.

Swing the engine round sharply and watch if a spark occurs at the points of the plugs. If good healthy sparks are obtained replace the plugs in the cylinders, first squirting a few drops of petrol through the plug holes ; the Engine should then start without further trouble after one or two turns.

Should you find that no spark occurs at the Plugs, see if the rocker arm on the contact breaker at the back of Magneto is working freely. If this is not the source of trouble it is advisable that the magneto should be examined by a qualified man and on no account be tampered with.

Sometimes starting troubles are occasioned by one of the Exhaust or Inlet Valves being hung up. This can be detected by the ease with which you can swing the Engine round, indicating loss of compression.

Remove the valve cover by wing nut. The remedy is then to oil the valve guides and work the valve up and down a few times with a lever.

In the event of the Engine refusing to start, even when it is thoroughly warmed up from recent working, and the Carburettor has been flooded (this should not be necessary if the Engine is heated) you may have set up the condition of having too much petrol vapour in proportion to the air ; resulting in your cylinders being filled with a non-explosive mixture. To remedy this condition open throttle fully and give Engine a few turns.

ENGINE LUBRICATION.

Lubrication is a very important item for consideration. A defective lubricating system will lead to serious troubles. See that the Engine crankcase is kept filled to its proper level (See Page 2). There is no economy

in purchasing a cheap oil, as they invariably prove the most expensive in the long run. Our experience is always at the disposal of the customers should difficulty be found in selecting a suitable quality.

A brief description of the lubricating system will assist towards its being kept in proper working order.

A Rotary Oil Pump in the bottom of the crankcase is driven by skew gears from the camshaft. This pump delivers the oil under pressure to the main crankshaft bearings, any surplus being allowed to escape through a relief valve to the skew gears which drive the water pump and the magneto.

The oil which is forced into the mainshaft bearings is carried down the crankshaft through drilled ducts or channels to the big ends, from which a certain amount of oil is thrown off by centrifugal force, and serves to lubricate the cylinder walls and gudgeon pins. To ensure clean oil, a filter is provided, through which all the oil has to pass.

This filter can be removed by slackening the two thumb screws on the crankcase. Twist the filter head and it will spring out. This filter should be withdrawn every 3 days for cleaning. Although the filter is below the level of the oil, when it is removed a valve automatically springs into position which cuts off the oil and prevents it escaping from the crankcase.

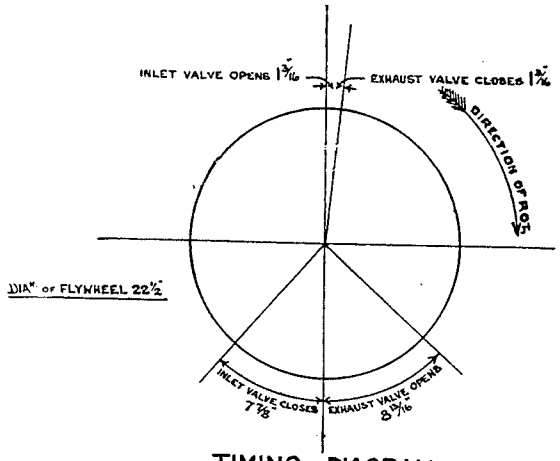
The oil should be drained by the plug hole in bottom of the crankcase, every month or so, according to the length of time the engine has been working, and fresh oil substituted. It is a common practice to pour the oil from the crankcase, after allowing the sediment to settle, into the gear box, where it would be found quite suitable, provided always it is free from any foreign matter.

There is little need to worry about the oil pump, unless it is found that there is no pressure recorded on the plunger indicator when the engine is running. The earlier types of Locomotives which are not fitted with plunger indicator can have the oil system tested by opening the test cock which is located on the side of the crankcase. If pump is working properly and no block occuring in the oil system, the oil will squirt out immediately the cock is opened.

VALVES.

Good compression assists towards making a good Engine. Let the valves lose their tightness and the power of the Engine drops heavily. In such case, remove the valves and examine the seats. If the valves appear to seat unevenly and show signs of pitting, grind them in. After grinding, see that the head of adjusting screw of valve presser is about 8/1,000th part of an inch clear of the valve stems when they are at rest, *i.e.*, rollers clear of cams. The above clearance is approximately equal to the thickness of a visiting card. Always see that the Valves are moving freely in the Valve Guides and are getting home to rest every time after being lifted. Sometimes they "hang up" through becoming overheated, or burnt oil may have been deposited on the valve stem causing undue fricton. If this happens it is only a matter of a few minutes to take the valve out, clean and replace it.

Should the camshaft at any time be removed, unless care is taken it will be necessary to re-time same. The accompanying illustration gives the correct setting of valves in relation to the fly wheel and crankshaft. At the points laid down—by the figures given—the respective Valves should be "just" beginning to open or close as the case may be.



TIMING DIAGRAM.

WATER CIRCULATION.

The Engine Cylinders are kept cool by means of water circulating in the jacket cast round each pair of cylinders.

The pump forces the water through the cylinder water jackets thence to the top of the Radiator through which it passes, being cooled on the way, leaving the Radiator at the bottom and returning to the Pump, where the process is repeated.

It will be necessary to tighten the gland nut of the water pump occasionally when the water begins to weep through the gland, but should it be found that the gland is screwed right home without preventing the water from escaping, it is evident that the pump spindle needs repacking.

Given that the water does not reach boiling point no trouble will be experienced with the running of the Engine, and in fact just below boiling point is the temperature to aim at. If by any means the water does boil, no harm can be done provided there is sufficiency of water.

Should there be no apparent reason for the water boiling, such as climbing a long hill with a very heavy load, it may be that the Fan is not working properly, due to the belt slipping, or perhaps the centrifugal pump is not passing the required quantity of water; or again, perhaps the Engine has been running at top speed with the ignition fully retarded by mistake.

Faulty lubrication, or running with the brakes on will also tend to overheat the Engine. It can always be accepted as a certainty that there is some tangible reason for the water boiling in-as-much as ample surface is provided in the Radiator for dealing with the circulating water, and when trouble does occur in this direction it is advisable to look into the matter without delay.

In cases where the Engine has been running for some time on a short or boiling water supply and the Engine Cylinder Jackets have been unduly heated don't on any account fill up immediately with cold water, if you do, probably a cracked cylinder will result. Give the Engine time to cool down.

Provision is made for tightening the belt driving the Fan, and it is advisable that the belt should not be pulled more taut than is necessary.

CARBURETTOR.

The Carburettor is of the well-known Zenith Horizontal type provided with 2 jets, *i.e.*, one for running at normal speed and another which is immersed in a little well of petrol to facilitate starting and slow running.

The principles of the Carburettor is that when the Carburettor Throttle is closed, the Auxiliary or Starting and Slow running jet is brought into operation, and as the throttle valve is opened this jet is gradually cut out and the main jet brought into action.

The standard Carburettor setting is :—

Main Jet No. 115, Compensating Jet No. 110 and Choke Tube No. 26.

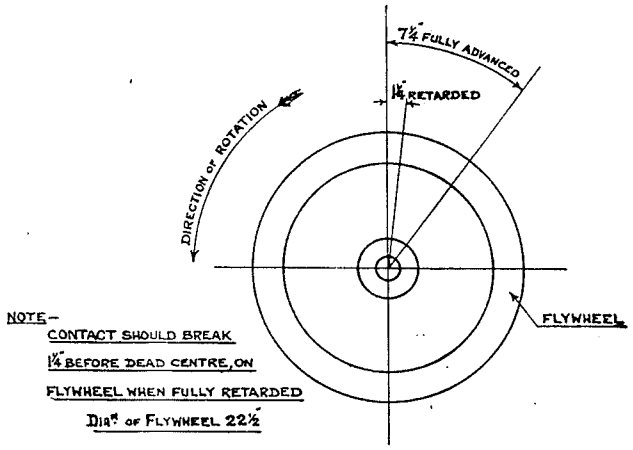
A Petrol Filter is introduced and fitted between the Petrol Tank and the Carburettor. It is advisable that the Filter should be examined from time to time and thoroughly cleaned, as this Filter is fitted with very fine gauze to intercept every particle of dirt. The Filter is so constructed that it also becomes a water trap to catch any drops of water that may have got into the Petrol Tank.

IGNITION.

The Ignition is taken care of by a High Tension Magneto which is driven from the cross-shaft on the Engine and coupled thereto by a flexible coupling. Should it be necessary at any time to remove the magneto from the driving shaft be very careful to note the position of the fly-wheel on the Engine and see also that the respective halves of the Magneto Couplings are marked. No. 1 Cylinder is that furthest from the fly-wheel.

To use this diagram, first find the top dead centre of No. 1 Cylinder which you will see is marked on the fly-wheel. Bring this line to the top of the fly-wheel, then move the fly-wheel backwards $1\frac{1}{4}$ inches. Retard the Magneto and then set same so that the gap of the contact breaker is just opening at this point.

The method of testing the Magneto for sparking has already been explained and we again repeat our recommendation that the Magneto should not be taken adrift except by someone who understands the work.



MAGNETO SETTING.

CLUTCH.

The friction Clutch is of the inverted cone type lined with "Ferodo," and situated in a heavy flywheel. As the "Ferodo" wears, the Clutch Cone will naturally tend to come outwards, and it will be necessary to make certain that the various parts of the Clutch operating gear are so adjusted as to permit of this outward cone movement.

If this cone movement is checked the Clutch will slip. For example, if there is no play left between the Clutch Jockey Ring and the Jockey levers, slip will occur.

The whole comfort of driving depends upon the adjustment of the Clutch Backstops, mounted on the Clutch Rocking Shaft, and fixed thereto with split ended bosses, held in place by tightening the bolt on the boss. These backstops, which are faced with " Ferodo," engage on the face of the clutch spider, so that when the clutch pedal is depressed, the clutch spider is first quite free, and then when the clutch pedal is further depressed, the backstop pads come into play and retard the spinning of the spider, so that the change speed gears can be conveniently engaged.

When the foot is resting lightly on the Clutch Pedal, the correct position for these clutch backstop pads is that they should be $^3/_{16}$" to $\frac{1}{4}$" away from the face of the clutch cone. Adjustment in these items is generally found to require a little more attention at first until such time as the " Ferodo " on the cone and on the pads has been well worked in.

The two grease cups on the clutch should be replenished every day.

GEARBOX.

The Gearbox is a self-contained unit, totally enclosed with gears running in oil. It consists of a special formation of accurately machined spur gears, engaged by means of dog clutches. It is operated by two levers. One, the reverse lever, which is operated by placing the lever opposite the arrow indicating direction in which it is desired to travel. The second lever is the change speed lever and has three positions, viz. : low gear, neutral, and top gear. The gearbox gives equal speeds in both directions. It is advisable to open the inspection cover of the gearbox every two months to ascertain if further oil is required. The correct level of the oil is when it is just touching the bottom of the lower shaft

CHAIN DRIVE.

On the lower shaft of the gearbox is mounted the Twin Chain Sprocket Wheel from which the chains pass to the Sprocket Wheels on the driving axles.

Spring tension rods are fitted which serve both to relieve the strain on the chains in the case of sudden start or jerk, and also to adjust the chains as they stretch. To do this latter operation slack back all lock nuts and tighten up the outside nuts until the required tightness is attained, taking care to keep the axles parallel. When the desired tension is obtained, tighten up the inner nuts, so that the tension of the spring comes on the nuts and not constantly on the chain, then tighten all lock nuts.

AXLE BOXES.

The axle boxes on the Locomotive driving axles are adapted for oil lubrication, it being only necessary to pour oil through the front cover into the base. The lubricating pads or wicks absorbing the oil and the pads in turn are pressed by springs against the journals. The complete wick can be pressed down and removed through the front of the cover at any time. To remove the axle box bearing, jack up the frame a couple of inches, pull out the key plate on the top of the bearing, then lift the bearing half-an-inch, and remove it. The operation is simple and obviates the necessity of taking the axle boxes to pieces.

BRAKE GEAR.

This is of the usual Locomotive screw down type. When requiring adjustment, slacken the back nuts on the pull rod and tighten up the turn buckle.

To renew Brake Blocks it is only necessary to remove the nut at the end of the brake cross bar, pull off the old block and push on the new one. When replacing the nut which holds the block in position do not forget to first insert the spring washer.

PARAFFIN LOCOMOTIVE.

The handling of the Paraffin Locomotive is precisely as described in connection with the Petrol Locomotive except as regards the working of the Carburettor.

The Engine is started up in the ordinary way on Petrol, and when the vapouriser becomes sufficiently heated (say in about five minutes' running), shut the Petrol off and turn on the Paraffin tap.

The temperature at which to change over to paraffin can quickly be learned from observation, and the vapouriser should be hot enough to prevent the engine spitting back, while the exhaust gasses should issue from the silencer clear and with absence of blue smoke.

Do not allow the engine to run idly, so slowly as to permit cooling down with the consequent smoky exhaust.

In order to have the Carburettor filled with petrol for re-starting, it is important to change over to Petrol for two or three minutes before shutting down.

There is no reason against the Locomotive taking up a load immediately on starting and while on Petrol, as this will heat up the engine quickly and permit of an earlier change over to paraffin.

The use of paraffin renders it necessary to give certain features slightly more attention.

VALVES.

Paraffin is rather more destructive to the valves and will entail these requiring more frequent grinding in.

LUBRICATING OIL.

If the vapouriser is not kept hot the Paraffin will condense in the cylinder heads and work past the pistons, diluting the oil in the engine sump and spoiling its lubricating properties. No condensation will occur if the vapouriser is kept hot.

AIR LEAKS.

If the carburettor and induction pipe joints are not air tight, the explosive mixture will be diluted with air so that engine will start badly and refuse to run slowly.

INDUCTION PIPE.

At the lower end of the induction pipe from the vapouriser to the cylinders it is possible for fuel to collect, and it is necessary to clear this by opening the drain tap occasionally.

LOSS OF POWER.

The haulage power of the Locomotive is reduced 20% when run on Paraffin as compared with Petrol or Benzol.

CARBURETTOR JETS FOR PARAFFIN.

Use Main Jet No. 135.