A spring (7) keeps the rocker arm (10) in constant contact with the eccentric (9) to eliminate noise. The hand priming lever is indicated at (15).

Cleaning the filter

The filter must be examined every 150 running hours, and cleaned if necessary.

Access to the filter is gained by removing the screw securing the domed cover, when the filter gauze may be lifted off its seating.

Wash the filter gauze in clean petrol (gasoline), using a semi-stiff brush or an air jet if available. Renew the cork gasket under the filter cover if on assembly it is found to be broken or has become hardened.

Make certain on refitting the cover that the fibre washer is replaced under the head of the screw. Do not overtighten the cover retaining screw; sufficient to make a fuel-tight joint is all that is necessary.

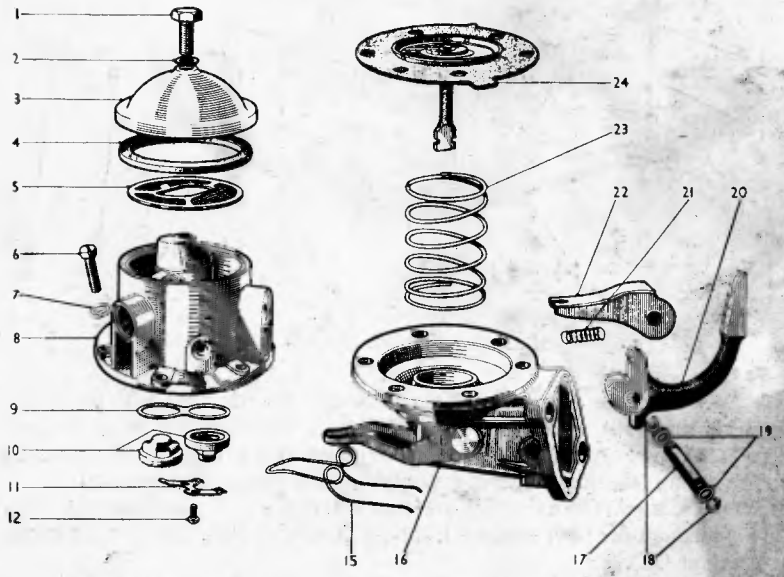

Fig. 31

The components of the fuel pump

Removing from the engine

Disconnect both pipe unions and then remove the two bolts with spring washers which secure the fuel pump to the engine crankcase; the pump and gasket may then be removed.

Dismantling the fuel lift pump

Before dismantling is commenced clean the exterior of the pump and make a file mark across the two flanges for guidance in reassembling in their correct relative positions. After separating the two main castings further dismantling of the components associated with each half is quite straightforward. The diaphragm and pull-rod assembly can be withdrawn by turning it through 90°. **No attempt should be made to separate the four diaphragm layers from their protective washers on the pull-rod as this is at all times serviced as a complete assembly and is permanently riveted together.**

Inspection of parts

Firstly, all parts (see Fig. 31) must be thoroughly cleaned to ascertain their condition. All parts in the locality of the valves should be washed in a clean paraffin (kerosene) bath.

The diaphragm and pull-rod assemblies should normally be renewed unless they show no signs of cracks or hardening and are generally in a perfectly sound condition.

Examine the upper and lower castings for cracks or damage. If the diaphragm or engine mounting flanges are distorted these should be lapped to restore their flatness.

Parts that are badly worn should be renewed. Very little wear should be tolerated in the rocker arm pin (17), the holes and engagement slot in the link (22), and the hole in the rocker arm (20). On the working surface of the rocker arm which engages with the camshaft eccentric slight wear is permissible, but on no account should it exceed ·010 in. (·254 mm.) in depth. Fuel pump valves (10) should be renewed if worn. The diaphragm spring (23) seldom requires renewing, but where necessary ensure that the replacement spring has the same identification colour and consequently the same strength as the original. Rocker arm springs (21) are occasionally found to be broken after service. All joint washers should automatically be renewed.

Reassembling the fuel lift pump

The following procedure should be adopted, dealing with the upper portion of the pump first:

Place the valve joint washer (9) in the pump upper casting (8).

Place the valves (10) in position.

Place the valve securing plate (11) in position and secure with the two screws (12).

Place the filter gauze (5) in position on top of the casting, making sure that it fits snugly.

Fit the cork washer, cover, and retaining screw as previously detailed under **'Cleaning the filter'** (see page 48).

To assemble the lower half of the pump proceed as follows:

Assemble link (22), packing washers (19), rocker arm (20), and rocker arm spring (21) in the body (16).

Insert the rocker arm pin (17) through the hole in the body, at the same time engaging the packing washers, link, and the rocker arm; then spring the retaining clips (18) into the grooves on each end of the rocker arm pin.

The rocker arm pin should be a tap fit in the body, and if, due to wear, it is freer than this, the ends of the holes in the body should be burred over slightly.

NOTE.—The fitting of the rocker arm pin can be simplified by first inserting a piece of ·240 in. (6 mm.) diameter rod through the pin hole in one side of the body far enough to engage the rocker arm washers and link and then pushing the rocker arm pin from the opposite side, removing the temporary rod as the pin takes up its proper position.

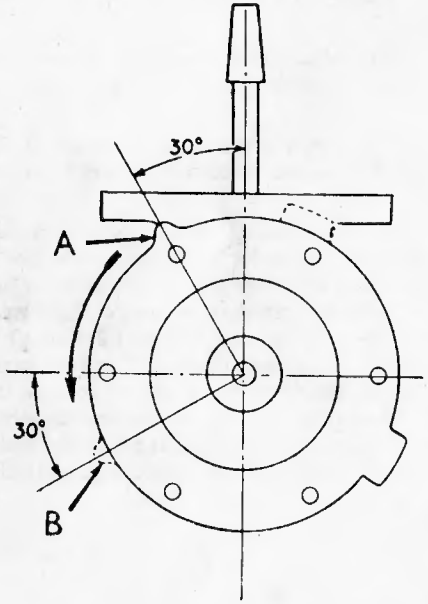

Fig. 32

Insert the diaphragm into the pump body with the locating tab in position (A). *Turn the diaphragm to the left until the tab arrives at position* (B). *At the same time engage the slots in the pull-rod with the fork in the connecting link*

To fit the diaphragm assembly to the pump body:

Place the diaphragm spring (23) in position in the pump body.

Place the diaphragm assembly (24) over the spring, the pull-rod being downwards, and centre the upper end of the spring in the lower protector washer.

Press downwards on the diaphragm, at the same time turning the assembly to the left in such a manner that the slots in the pull-rod will engage the fork in the link, ultimately turning the assembly a complete quarter-turn to the left. This will place the pull-rod in the proper working position in the link and, at the same time, permit the matching up of the holes in the diaphragm with those on the pump body flanges.

FUEL SYSTEM

FUEL LIFT PUMP

Maintenance and repair of the fuel lift pump

The A.C.-Sphinx fuel pump, type U, is mechanically operated from an eccentric on the engine camshaft. Fig. 30 gives a sectional view of the pump and an exploded view is shown in Fig. 31.

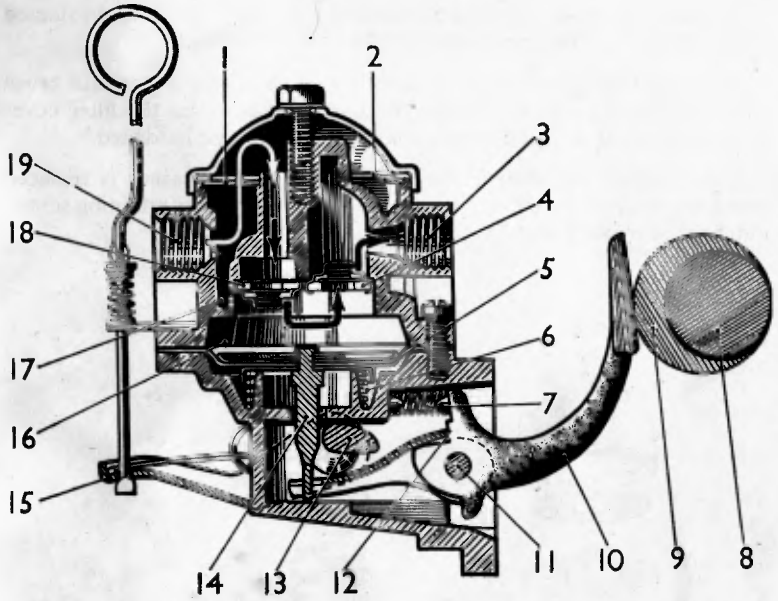

Fig. 30

A section through the fuel pump

As the engine camshaft (8) revolves, the eccentric (9) lifts the pump rocker arm (10), which is pivoted at (11). The rocker arm pulls the pull-rod (14) downwards, together with the diaphragm (5), against the pressure of a spring (6), thus creating a vacuum in the pump chamber (16).

Fuel is drawn from the tank and enters at (19) into the sediment chamber (17) through the filter gauze (1), the suction valve (18), and into the pump chamber (16).

On the return stroke the pressure of the spring (6) pushes the diaphragm (5) upwards, forcing fuel from the pump chamber (16) through the delivery valve (4) and port (3) to the main fuel filter.

When the main fuel filter is full pressure is created in the pump chamber (16) which holds the diaphragm (5) downwards against the pressure of the spring (6), and it will remain in this position until the main filter requires a further supply of fuel. The rocker arm (10) operates the connecting link by making contact at (12), and this construction allows idling movement of the rocker arm when there is no movement of the fuel pump diaphragm.

batteries should be kept clean and dry; care should be taken not to spill water on them when adjusting the level of the electrolyte or when taking specific gravity readings.

Storage

If the equipment is laid by for more than a month the batteries must be given a small charge from an independent source about once a fortnight in order to obviate any permanent sulphation of the plates. In no circumstances must the electrolyte be removed from the batteries and the plates allowed to become dry, as certain chemical changes take place which result in loss of capacity.

Testing the condition of the batteries

It is advisable to complete the inspection by measuring the specific gravity of the acid, and this gives a very good indication of the state of charge of the batteries.

A hydrometer of the type illustrated should be employed for the purpose. Voltmeter readings of each cell do not provide a reliable indication of the condition of the batteries unless special equipment is used.

When measuring the specific gravity of the electrolyte with a hydrometer ensure that the float is free and take the readings at eye level. Avoid taking a reading immediately after topping up the cells with distilled water.

The readings of all cells should be approximately the same.

If one cell gives a reading very different from the rest it may be that the electrolyte has spilled or leaked from the particular cell, or there may be an internal fault. In this case we advise the owner to have his batteries examined by a Lucas Service Depot to trace the cause and prevent the trouble from developing.

The specific gravity readings are: 1·280 to 1·300 when fully charged, about 1·210 when half-discharged, and about 1·150 when fully discharged. These figures are given assuming the temperature of the electrolyte is about 60° F. (16° C.).

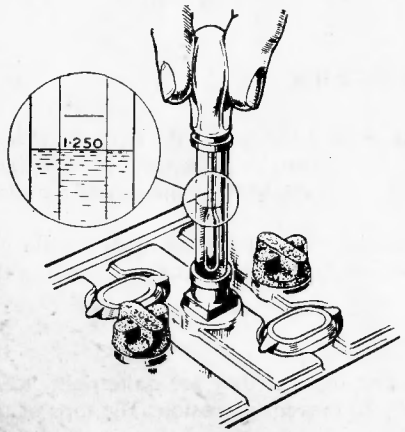

Fig. 29
The correct use of the hydrometer is shown here

When first inserting the diaphragm assembly into the pump body the locating 'tab' on the outside of the diaphragm should be at the 11 o'clock position. After turning the diaphragm assembly a quarter-turn to the left the 'tab' should be at the 8 o'clock position. These positions are shown in Fig. 32.

The two sub-assemblies of the pump are now ready for fitting together, and this is carried out as follows:

Push the rocker arm (20) towards the pump until the diaphragm is level with the body flanges.

Place the upper half of the pump into the proper position as shown by the mark made on the flanges before dismantling.

Install the set screws and lock washers and tighten only until the heads of the screws just engage the washers.

Release and push the rocker arm away from the pump so as to hold the diaphragm at the top of the stroke and, while so held, tighten the set screws diagonally and securely.

Refitting to the engine

Reverse the procedure outlined for removal from the engine. Ensure that the rocker arm is correctly positioned against the eccentric on the camshaft as there is a possibility of inadvertently getting the rocker arm under the eccentric or to one side, when damage will result on tightening the bolts. After refitting to the engine the pump should be run for a short time and pipe unions and pump examined for the possibility of fuel leakage.

Testing the fuel lift pump

Disconnect the fuel outlet pipe from the pump and crank the engine, when there should be a well-defined spurt of fuel from the pump outlet at every working stroke of the pump, namely, once every two revolutions of the engine.

Reconnect the fuel pipe and bleed the fuel system. Finally, run the engine for a short period and check for leaks. After correcting any leaks the fuel system must be re-bled.

FUEL INJECTION PUMP AND INJECTOR NOZZLES

Removal and replacement of the C.A.V. fuel injection pump

Disconnect the fuel feed pipe, the four fuel delivery pipes, and the engine stop control from the injection pump.

Detach the main and auxiliary vacuum pipes from the pneumatic governor; disconnect the breather pipe from the air cleaner and remove the inlet manifold in accordance with the instructions on page 33.

Unscrew the four bolts which secure the injection pump to its mounting

bracket; withdraw the pump rearwards to disengage it from the drive coupling and lift it clear of the engine.

Replacement is a reversal of the above procedure but it will be necessary to set the injection timing in accordance with the instructions below. If the pump is a replacement or has been dismantled the camshaft chamber must be filled with engine oil (see page 28) and a tablespoonful of thin engine oil added to the governor via the breather orifice (see page 28).

It is imperative when reconnecting the stop control to the lever on the governor housing (see Fig. 14) that the lever is in its maximum forward position. This will mean that there is approximately ½ in. (13 mm.) free travel on the stop lever, which is necessary to allow the excess fuel device to operate.

Fig. 33
The arrows indicate two of the four decompressor screws

Timing the fuel injection pump

Before fitting the injection pump to the engine it is necessary to set the engine for injection timing with No. 1 piston on its compression stroke set at 28° B.T.D.C. This can be accomplished as follows:

(1) Slacken off the decompressor screws in the cylinder head (see Fig. 33) to permit the engine to be cranked more easily.

(2) Remove the valve rocker cover for observing the valve action.

(3) Turn the crankshaft slowly in its normal direction of rotation until the exhaust valve (No. 1) of No. 1 cylinder is just closing and the inlet valve (No. 2) of the same cylinder is just opening. This indicates that No. 1 piston is commencing to move downwards on its suction stroke.

Servicing the dynamo

Apart from lubricating the commutator end bearing every 150 hours, the dynamo is designed to give trouble-free service for long periods without attention.

At major overhauls, however, the dynamo should be dismantled and the brush gear and commutator checked and cleaned. Access to the brush gear is gained by unscrewing and removing the two through-bolts and withdrawing the commutator end bracket. Worn brushes must be renewed and the commutator may be cleaned with superfine sand-paper and afterwards wiped with a petrol- (gasoline-) damped rag. New brushes are preformed, so that bedding to the commutator is unnecessary.

To check the brush spring tension the yoke must be completely withdrawn from the armature and the commutator end bracket refitted to the shaft. Refit the brushes with the springs in position on top. A spring scale, if available, should be used to check the tension, which should be 20 to 25 oz. (567 to 709 gm.). Fit a new spring if the tension is low.

When reassembling the dynamo the brushes must first be held clear of the commutator in the usual way, i.e. by partially withdrawing the brushes from their brush boxes until each brush is trapped in position by the side pressure of its spring. The brushes can be released onto the commutator with a small screwdriver when the end bracket is assembled to within about half an inch of the yoke. Before closing the gap between the end bracket and yoke see that the springs are in correct contact with the brushes.

Voltage regulator and cut-out

The voltage regulator controls the dynamo charging rate and the cut-out automatically closes the charging circuit as soon as the dynamo voltage rises sufficiently above that of the batteries. When the dynamo voltage falls below that of the battery the cut-out opens and thereby prevents the battery from discharging itself through the dynamo.

The combined voltage regulator and cut-out are accurately set before leaving the Works and they must not be tampered with. Any attention to this unit should be entrusted to a Lucas Service Depot.

BATTERIES

Topping up

At least once a month the vent plugs in the top of the batteries should be removed and the level of the electrolyte examined. If necessary, distilled water should be added to bring the level to the top of the plate separators.

It is important when examining the cells that naked lights should not be held near the vents on account of the possible danger of igniting the gas coming from the plates.

Terminals

Examine the battery terminals and see that they are quite tight. Keep them smeared with petroleum jelly to prevent corrosion. The tops of the

Support the dynamo, completely remove the securing bolts, and lift it clear of the engine.

Replacement is a reversal of this procedure.

Adjusting the dynamo driving belt

The belt tension is adjusted by slackening the four bolts securing the dynamo and the adjusting link to the engine, moving the dynamo by hand

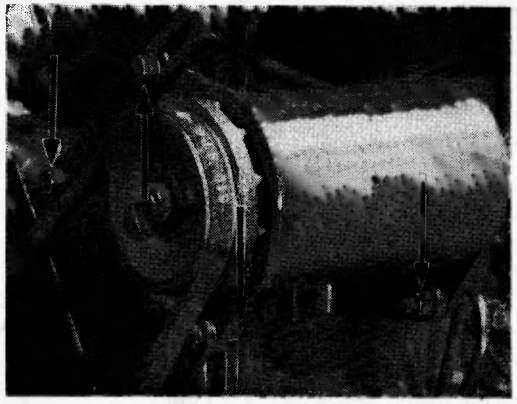

Fig. 27

The arrows indicate the four bolts which have to be slackened when adjusting the tension of the dynamo drive belt

away from the cylinder block the required amount, and retightening the bolts.

Do not overtighten the belt, otherwise undue strain will be thrown upon the dynamo bearings.

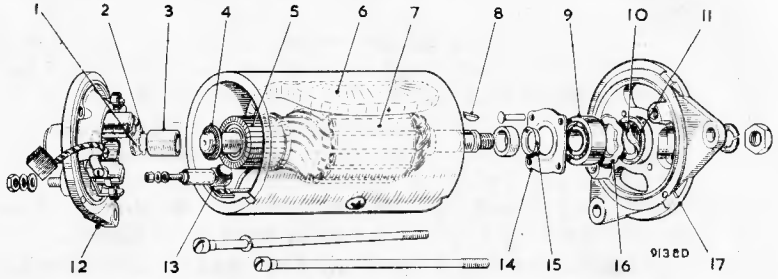

Fig. 28

The components of the dynamo

1. Felt pad.
2. Aluminium disc.
3. Porous bronze bush.
4. Fibre washer.
5. Commutator.
6. Field coils.
7. Armature.
8. Shaft key.
9. Bearing.
10. Felt washer.
11. Oil-retaining washer.
12. Commutator end bracket.
13. Field terminal post.
14. Bearing retaining plate.
15. Cup washer.
16. Corrugated washer.
17. Driving end bracket.

(4) Continue to crank the engine slowly until the timing mark 'INJ. PUMP 1, 4' on the flywheel coincides with the pointer on the flywheel housing (see Fig. 34). No. 1 piston is now set at 28° B.T.D.C. on its compression stroke.

The injection pump can now be fitted to the engine in the following manner:

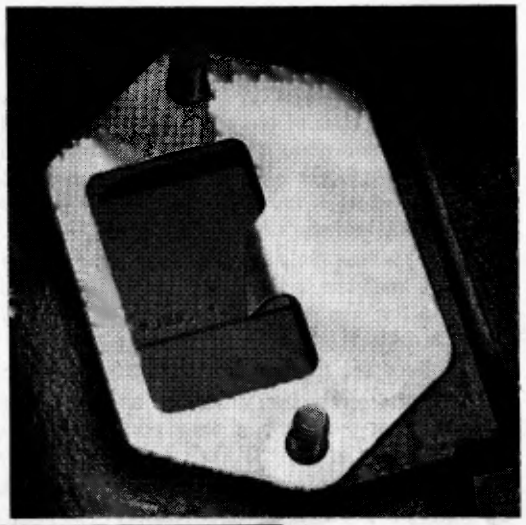

Fig. 34

The injection pump 1 and 4 timing marks opposite the T.D.C. pointer on the flywheel housing

Fig. 35

A view of the injection pump coupling showing the 3° divisions and one of the adjustment bolts

(5) Turn the pump coupling flange by hand until the line on the boss of the coupling is in line with the mark on the pump body end plate and place the pump on its mounting bracket.

(6) Place the coupling centre disc between the pump flange and the

drive flange and secure the pump to its mounting bracket, ensuring that a clearance of between ·005 and ·010 in. (·127 and ·254 mm.) exists between one side of the centre disc and either the driving or driven flange. Adjust by slackening the driving flange clamp bolt and moving the flange along the drive shaft. The pump flange will probably be moved during the process, thus disturbing the timing; this will be rectified later during the timing procedure.

Set the injection pump timing as follows:

(7) Slacken the two set bolts securing the drive flange adjustment to the claw plate.

(8) Turn the injection pump coupling flange by hand until the line on the boss of the coupling is in line with the mark on the pump body end plate. During the above procedure it is essential that the driving flange is not moved. The amount of adjustment is measured by means of the graduations, each division representing 3° on the pump camshaft (see Fig. 35).

Tighten the two set bolts to secure the driving flange adjustment. A final check should be made to ensure that No. 1 piston is still in the correct timing position of 28° B.T.D.C. on its compression stroke.

(9) Bleed the fuel system as described on page 58.

The timing procedure described above automatically sets the injection pump so that the point of 'inlet port closure' (spill cut-off) occurs when the pistons are at 28° B.T.D.C. on their compression strokes.

If for any reason there is no marking on the pump coupling flange or the end plate the point of 'inlet port closure' will have to be found to accomplish the timing procedure.

The term 'inlet port closure' (spill cut-off) refers to the instant when the flow of fuel through the barrel inlet port from the spill gallery is cut off by a pump plunger on its upward stroke and corresponds to the theoretical commencement of injection from that element of the pump. The flow of fuel to each element is cut off at two points during one complete revolution of the pump camshaft—one on the upward stroke, the other on the downward stroke, of the pump plunger. The correct cut-off point for timing is the one on the upward stroke of the plunger.

IMPORTANT.—For the purpose of standardization elements on all C.A.V. injection pumps are counted in numerical order, reading from left to right looking on the inspection cover.

The fitting of the injection pump to this engine is such that No. 4 element supplies fuel to No. 1 cylinder, No. 3 element supplies fuel to No. 2 cylinder, No. 2 element supplies fuel to No. 3 cylinder, and No. 1 element supplies fuel to No. 4 cylinder.

To set the injection timing in this manner proceed as follows:

(1) Set the engine with No. 1 piston at the position of 28° B.T.D.C. on its compression stroke as described previously.

(2) Before fitting the injection pump to the engine, set its approximate timing position by removing the pump inspection cover to observe the plunger action and turning the camshaft until No. 4 plunger

(9) The fitting of the solenoid unit to the drive end bracket can be facilitated by easing the drive assembly forward along the armature shaft. It must be fitted so that the copper link between the solenoid and the starter is connected to the solenoid terminal marked 'STA'.

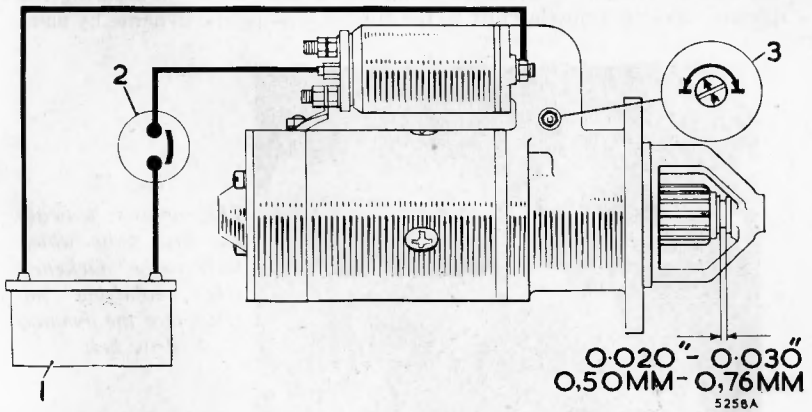

Fig. 26

Setting the starter pinion movement limit

1. 6-volt battery.
2. Starter switch.
3. Eccentric pivot pin.

(10) With the starting motor completely assembled, but before tightening the engagement lever pivot pin locknut, set the pinion movement as follows:

Connect the small centre terminal on the solenoid unit by way of a switch to a 6-volt supply and connect the other side of the supply to one of the solenoid fixing bolts (see Fig. 26).

Close the switch (this throws the drive assembly forward into the engaged position), and measure the distance between the pinion sleeve and the washer on the armature shaft extension. This measurement must be made with the pinion pressed lightly towards the armature to take up any play in the engagement linkage.

To adjust, rotate the eccentric pivot pin until the correct setting of between ·020 and ·030 in. (·508 and ·760 mm.) is obtained. It should be noted that the arc of the pivot pin adjustment is 180°, and the head of the arrow marked on the pivot pin must be set only between the heads of the arrow on the drive end bracket casting (see Fig. 26).

Removal and replacement of the dynamo

Disconnect the dynamo leads from the terminals. Slacken the three bolts securing the dynamo to the engine and the bolt securing the adjusting link to the cylinder block. Move the dynamo towards the cylinder block as far as possible and remove the belt from the dynamo pulley.

$\frac{7}{8}$ in. (22·22 mm.) in length and 16 lb. (7·26 kg.) to compress the spring to $\frac{1}{2}$ in. (12·7 mm.) in length.

(2) Check the slipping torque of the clutch as follows:

Fit the drive assembly onto the splined armature shaft and, using soft-metal jaw plates, clamp the armature in a vice.

Apply an anti-clockwise torque to the pinion with a suitable torque wrench fastened to the pinion teeth. The clutch should slip between 800 and 950 lb. in. (9·2 and 10·9 kg. m.). If the clutch slips at too low a torque figure dismantle it and add shims, or conversely, if the clutch does not slip when the maximum torque is applied remove shims until a figure within the above limits is obtained.

(3) The assembled clutch unit and lever mechanism must be capable of being pushed to the full extent of the set travel and it must move along the armature shaft extension smoothly and freely but without slackness.

(4) Before fitting the drive assembly lightly smear the armature shaft and pack the space between the bearings inside the helical splined sleeve with a bentonite-based grease such as Ragosine Bentone. If at any time the operation of the drive assembly becomes sluggish it should be removed and the bearings cleaned and lubricated as above.

(5) Lubricate the intermediate bracket bearing with Ragosine Molypad molybdenized non-creep oil.

(6) Check the brushes for wear and freedom of movement in their holders. If the brushes are worn to, or approaching, $\frac{5}{16}$ in. (8 mm.) in length they must be renewed. Two of the brushes are connected to the brush boxes on the commutator end bracket and two are connected to tappings on the field coils.

To renew the brushes disconnect the flexible connectors by unsoldering and secure the connectors of the new brushes in their place by soldering. The brushes are preformed so that bedding to the commutator is unnecessary.

A brush which is inclined to stick in its holder can be freed by cleaning its sides with a petrol- (gasoline-) moistened cloth.

(7) Clean the commutator with a petrol- (gasoline-) moistened cloth. If the commutator is burned or pitted spin the armature and polish the commutator with superfine glass-paper; remove all abrasive dust with a dry air blast. **Do not undercut the insulators between the commutator segments.**

In the event of the commutator being badly worn, return the armature to your B.M.C. Marine Dealer for servicing.

(8) Check the bearings for excessive side-play, and if necessary, return the starter to your B.M.C. Marine Dealer and have the bearings renewed.

is just commencing to rise. With the pump set in this position connect the drive coupling and secure the pump to its bracket.

(3) Disconnect the pressure pipe from No. 4 delivery valve holder. Unscrew the valve holder and remove the delivery valve, spring, and peg.

(4) Reconnect the delivery valve holder and fit spill test pipe 18G501 (see Fig. 36).

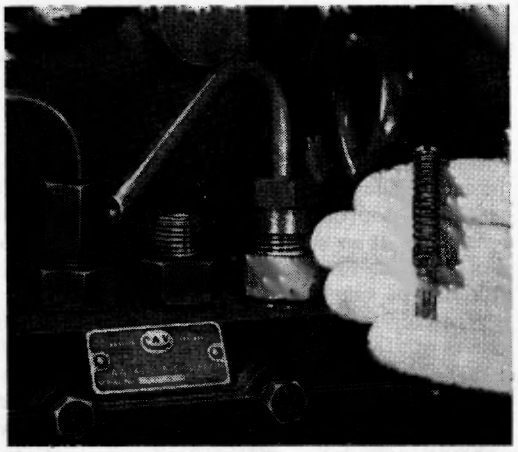

Fig. 36
The spill test pipe in position with the delivery valve, spring, and peg removed

(5) If any of the engine controls are connected ensure that the engine stop control is right home in the normal starting position so that the injection pump control rod is in the full power position. If the controls are not connected the governor spring will automatically position the control rod in the required position.

(6) Slacken the two set bolts securing the drive flange adjustment to the claw plate.

(7) Prime the fuel system by using the priming lever on the lift pump and bleed the filter and the injection pump of air (see page 58).

(8) Continue to operate the fuel lift pump priming lever, and as the fuel flows from the test pipe turn the injection pump coupling flange slowly by hand in its direction of rotation. No. 4 element plunger will now commence to rise from its B.D.C. position, and as the element inlet port is progressively closed by the rising plunger the fuel issuing from the test pipe will gradually diminish. Turn the pump flange very slowly in the final stages; the instant of 'inlet port closure' (spill cut-off) will be observed when there is no drip for a period of 14 to 15 seconds.

During the above procedure it is essential that the drive flange is not moved.

Tighten the two set bolts securing the driving flange adjustment.

A final check should be made to ensure that the flywheel is still in its injection timing position.