#### BATTERIES

Models GTW7A/2, GTW9A/2, GT9A/2 and GTZ9A/2.

#### I. ROUTINE MAINTENANCE

Every 1,000 miles, or monthly (weekly in hot climates) examine the level of the electrolyte in the cells, and if necessary add distilled water to bring the level up to the top of the separators. A convenient method of adding the distilled water is by means of the Lucas Battery Filler, a device which automatically ensures that the correct level is attained. The action of resting the nozzle of the battery filler on the separators opens a valve and allows distilled water to flow into the cell, this being indicated by air bubbles rising in the filler. When the correct level has been reached air bubbles cease and the battery filler can then be withdrawn from the cell. A special nonspill nozzle prevents leakage from the filler.

#### 2. SERVICE DATA

(a) Capacity and Charging Rates

Some earlier batteries incorporated correctacid-level devices for ease of topping up. These consist of a central plastic tube with a perforated flange—one being located in each cell filler hole. The method of topping up is as follows :---

Pour distilled water into the perforated flange not down the central tube of the correct-acid-level device until no more water will enter the cell and the water begins to rise in the filling hole. This will happen when the electrolyte level reaches the bottom of the central tube and prevents further escape of air displaced by the topping-up water. Lift the tube slightly and allow the small amount of visible water in the filling hole to drain into the cell.

WARNING : Do not repeat these operations. The acid level will be correct and the rubber plugs can be refitted.

Battery Pla eac	No. of	Ampere-hour capacity		Volume of electrolyte	Initial Charging	Normal Recharge
	each cell	at 10 hour rate	at 20 hour rate	fill one cell	Current (Amps.)	Current (Amps.)
GTW7A/2	7	38	43	$\frac{3}{4}$ (Pint)	$2\frac{1}{2}$	4
GTW9A/2 GT9A/2 GTZ9A/2	9	51	58	l (Pint)	$3\frac{1}{2}$	5

#### (b) Specific Gravity of Electrolyte

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. beolw 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  $60^{\circ}F$ 

The temperature must be that indicated by a thermometer actually immersed in the electrolyte, and not the air temperature.

Home Trade 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.)		
Filling	Fully Charged	Filling	Fully Charged	
1.270	1.270—1.290	1.210	1.210—1.230	

# Climates normally<br/>below 80°F. (27°C.)Climates between<br/> $80^{\circ}-100^{\circ}F. (27^{\circ}-38^{\circ}C.)$ Climates frequently<br/>above 100°F. (38°C.) $100^{\circ}F. (38^{\circ}C.)$ $110^{\circ}F. (43^{\circ}C.)$ $120^{\circ}F. (49^{\circ}C.)$





Fig. 1

Topping up Battery.

N.B.—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.

Examine the terminals and, if necessary, clean them and coat them with petroleum jelly. 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.

#### 3. SERVICING

(a) 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 re-charging, a low state of charge can be expected. A fault in the dynamo 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.



Fig. 2 Taking Hydrometer Readings.

#### Hydrometer Tests

Measure the specific gravity of the acid in each cell in turn, with a hydrometer. The reading given by each cell should be approximately the same; if one cell differs appreciably from the other, an internal fault in that cell is indicated. This will probably be confirmed by the heavy discharge test described below.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives a useful indication of the state of the plates; if it is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

#### 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.

#### (b) Recharging from an External Supply

If the above 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 given in Para. 2(a)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 fallingoff 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 equal to its 10-hour rate. 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.

#### 4. PREPARING NEW UNFILLED, UNCHARGED BATTERIES FOR SERVICE

(a) Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging. Electrolyte of the specific gravity given in Para. 2 (b) is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1.835 S.G. The mixing must be carried out either in a lead-lined tank or in suitable glass or earthenware vessels. 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.

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 as described in Para. 2 (b)—and before pouring the electrolyte into the battery.

The total volume of electrolyte required can be estimated from the figures quoted in Para. 2(a).

#### (b) Filling the Battery

The temperature of the acid, battery and filling-in room must not be below  $32^{\circ}F$ .

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, and then add sufficient electrolyte to fill each cell to the top of the separators. Allow to stand for a further two hours and then proceed with the initial charge.

#### (c) Initial Charge

The initial charging rate is given in Para. 2 (a). 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 Para. 2 (d), 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.

#### 5. PREPARING GTZ "DRY-CHARGED "BATTERIES FOR SER-VICE

"Dry-charged" batteries are supplied without electrolyte but with the plates in a charged condition. No initial charging is required.

When they are required for service it is only necessary to fill each cell with sulphuric acid of the correct specific gravity. No initial charging is required. This procedure ensures that there is no deterioration of the efficiency of the battery during the storage period before the battery is required for use.

#### (a) Preparation of Electrolyte

The electrolyte is prepared by mixing together distilled water and concentrated sulphuric acid, usually of specific gravity 1.835. This mixing must be carried out in a lead-lined tank or a glass or earthenware vessel. The acid must be added slowly to the water while the mixture is stirred with a glass rod. NEVER ADD THE WATER TO THE ACID, as the resulting chemical reaction may cause violent and dangerous spurting of the concentrated acid.

The total quantity of electrolyte needed to fill the battery can be calculated by reference to para. **2** (a).

The specific gravity of the filling electrolyte depends on the climate in which the battery is to be used. If the temperature of the battery and its surroundings will not normally rise above 90°F. (32°C.), electrolyte of specific gravity 1.270 is required. Electrolyte of this specific gravity is prepared by adding I part (by volume) of 1.835 specific gravity sulphuric acid to 2.8 parts of distilled water.

On the other hand, in tropical climates where the temperature may frequently rise above 90°F., the electrolyte should be of specific gravity 1.210, and is prepared by adding 1 part of 1.835 acid to 4 parts of distilled water.

N.B.—All specific gravity figures are given for an electrolyte temperature of 60°F., which is adopted as a reference temperature. Hydrometer readings taken at other temperatures can be corrected to this reference temperature as follows :—

For every 5°F. BELOW 60°F., DEDUCT .002 from the observed reading to obtain true reading at 60°F. For every 5°F. ABOVE 60°F., ADD .002 to the observed reading to obtain true reading at 60°F.

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before pouring it into the battery.

#### (b) Filling the Cells

Remove the seals from the cell filling holes and fill each cell with correct specific gravity electrolyte to the top of the separators IN ONE OPERA-TION. The temperature of the filling room, battery and electrolyte 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.

(c) Batteries filled in this way are up to 90 per cent 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 last for no more than 4 hours at the normal re-charge rate of the battery.

> During the charge the electrolyte must be kept level with the top edge of the separators by the addition of distilled water. Check the specific gravity of the acid at the end of the charge; if 1.270 acid was used to fill the battery the specific gravity should now be between 1.270 and 1.290; if 1.210, between 1.210 and 1.230.

(d) Maintenance in Service

After filling, a dry-charged battery needs only the attention normally given to lead-acid type batteries.

#### 6. BATTERY CABLE CONNECTORS

When fitting the diecast cable connectors, smear the inside of the tapered hole with petroleum jelly and push on the connector by hand. Insert the self-tapping screw and tighten with medium pressure only; fill in the recess around the screw with more petroleum jelly.

If the connectors are fitted dry and driven home on the tapered battery posts too tightly, difficulty may be experienced when it is required to remove them.

#### **GENERATOR—MODEL C.39 PV/2**

#### I. GENERAL

The generator is a shunt-wound two-pole two-brush machine, arranged to work in conjunction with a compensated voltage control 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 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 overcharging. An increase in output is given to balance the current taken by lamps and other accessories when in use. Further, a high boosting charge is given for a few minutes immediately after starting.



Fig. 3 Commutator End Bearing Lubrication.

#### 2. ROUTINE MAINTENANCE

#### (a) Lubrication

Every 12,000 miles, inject a few drops of Oiline BBB, or any high quality medium viscosity (S.A.E.30) engine oil into the hole marked "oil" in the end of the bearing housing. On earlier models, unscrew the cap of the lubricator on the side of the bearing housing, lift out the felt pad and spring and about half-fill the lubricator cap with high melting point grease (H.M.P. Grease). Replace the spring and felt pad and screw the lubricator cap back into position.



Fig. 4 Checking Brush Gear.

#### (b) Inspection of Brush Gear and Commutator

At the same time, remove the metal band cover to inspect the brushgear and commutator. 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 petrolmoistened cloth. Be careful to replace brushes in their original positions in order to retain the "bedding."

In service, brush wear takes place and the brushes become shorter. If the brushes are permitted to wear down until the embedded ends of the flexible connectors are exposed at the running surface, serious damage can occur to the commutator. It is therefore important to measure from time to time the length of each brush. If this length, measured from the running surface to the top edge of the brush, has decreased to  $\frac{31}{32}$ " the brush (or brushes) should be replaced.

The commutator should be clean, free from oil or dirt and should have a polished appearence. If it is dirty, clean it by pressing a fine dry cloth against it while the engine is slowly turned over by hand. If the commutator is very dirty, moisten the cloth with petrol.

#### (c) Belt Adjustment

Occasionally inspect the generator driving belt. 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, which should have just sufficient tension 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 1.050-1,200 r.p.m. at 13 generator volts. Maximum output:—19 amps at 1,900-2,150 r.p.m. at 13.5 generator volts (on resistance load of 0.7 ohm). Field resistance 6.1 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. 2 (c)).
- (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". Check the earth connection to control box terminal "E".
- (iii) Switch off all lights and accessories, disconnect the cables from terminals of 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 other 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 there is no reading, check the brush gear as described in (vii) below. If there is a low reading of approximately  $\frac{1}{2}$ —1 volt, the field winding may be at fault (see Para. 4 (e)). If there is a reading of approximately half the nominal voltage the armature winding may be at fault (see Para. 4 (d)).

(vii)Remove the cover band and examine the brushes and commu-Hold back each brush tator. spring 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 the brush in its original position. If a brush has worn to  $\frac{11}{32}$ " in length a new brush must be fitted and bedded to the commutator.



Fig. 5 Testing Brush Spring Tension.

Test the brush spring tension with a spring scale. The tension of the springs when new is 22-25 oz. In service it is permissible for this value to fall to 15 oz. before performance may be affected. Fit new springs if the tension is low. If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the engine is turned slowly by hand cranking. Re-test the generator as in (vi); if there is still no reading on the voltmeter, there is an internal fault and the complete unit, if a spare is available, should be replaced. Otherwise the unit must be dismantled (see Para. 4 (b)) for internal examination.

(viii) 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".



Fig. 6 Dismantled View of Generator (Yoke cut away to show Interior).

- (b) To Dismantle
  - (i) Take off the driving pulley.
  - (ii) Remove the cover band, hold back the brush springs and remove the brushes from their holders.
  - (iii) Unscrew and withdraw the two through bolts.
  - (iv) The commutator end bracket can now be withdrawn from the generator yoke.
  - (v) The driving end bracket together with the armature can now be lifted out of the yoke.

(vi) 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) 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



Fig. 7 Showing the Correct and Incorrect Ways of undercutting Commutator Insulation.

badly worn commutator, mount the armature, with or without the 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 very fine glass paper. Undercut the insulators between the segments to a depth of  $\frac{1}{32}$ " with a hack saw blade ground down to the thickness of the insulator



Fig. 8 Method to be used when undercutting Commutator Insulation.

#### (d) Armature

The testing of the armature winding requires the use of a volt-drop test and growler. If these are not available the armature should be checked by substitution. No attempt should be made to machine the armature core or to true up a distorted armature shaft. 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 whilst pressing the armature shaft firmly home.

#### (e) 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 yoke. The ohm meter should read 6.1 ohms approximately. If an ohm meter is not available, connect a 12 volt D.C. supply with an ammeter in series between the field terminal and generator yoke. The ammeter reading should be approximately 2 amperes. No reading on the ammeter, or an infinite ohm meter reading, 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 6.1 ohms, it is an indication that the insulation of one of the field coils has broken down.

In either case, unless a substitute generator is available, the field coils must be replaced. To do this, carry out the procedure outlined below, using a wheel-operated screwdriver.

- (i) Drill out the rivet securing the field coil terminal block 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 contacting with the yoke.

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- (iii) Mark the yoke and pole shoes so that the latter can be fitted in their original positions.
- (iv) Unscrew the pole shoe retaining screws by means of the wheel-operated screwdriver.
- (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.



Fig. 9 Tightening Pole Shoe Retaining 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 connections and the yoke
  - (x) Resolder the field coil connections to the field coil terminal block and re-rivet to the yoke.

#### (f) Bearings

Bearings which have 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:---

(i) Remove the old bearing bush form the end bracket, the bearing should be removed by screwing a  $\frac{5}{8}$  inch 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. 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



SUPPORTING BLOCK

Fig. 10

#### Method of fitting Porous Bronze Bearing Bush.

the same diameter as the shaft which is to fit in the bearing) until the bearing is flush with the inner face of the bracket. Earlier models, fitted with screw-cap type lubricators, do not have a felt ring or aluminium disc in the bearing housing.

(ii) Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired. Before fitting the new bearing bush it should be allowed to stand for 24 hours completely immersed in thin engine oil; this will allow the pores of the bush to be filled with lubricant. In cases of extreme urgency, this period may be shortened by heating the oil to  $100^{\circ}$ C. for 2 hours, then allowing to cool before removing the bearing bush.

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.
- (ii) Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil 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.



Fig. 11 Exploded View of Drive End Bearing.

- (v) Locate the bearing in the housing and press it home. On earlier models the outer journal should be pressed home by means of a hand press.
- (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.

#### (g) Re-assembly

In the main, the re-assembly of the generator is a reversal of the operations described in Para. 4 (b). After reassembly, lubricate the commutator end bearing, referring to Para. 2 (a) for the correct procedure.

#### STARTING MOTOR-MODEL M418G

#### (Outboard Drive)

#### 1. GENERAL

The electric starting motor is a seriesparallel connected 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  $4\frac{1}{8}''$ .

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.

#### 2. ROUTINE MAINTENANCE

About every 12,000 miles take the cover band off the starting motor and carry out the following procedure :



Fig. 12 Internal Connections of the Starting Motor.

(a) Check that the brushes move freely in their holders by holding back the brush springs and pulling gently on the flexible connectors. If movement is sluggish, remove the brush from its holder and clean its sides with fluffless



Fig. 13 Checking Brush Gear.

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petrol-moistened cloth. Replace the brush in its original position. Brushes which are worn must be replaced, see Para. 4 (d) (i).

(b) Check the tension of the brush springs, using a spring scale. The correct tension is 30-40 oz. Fit new springs if the tension is low, see Para. 4 (d) (i).



Fig. 14 Testing Brush Spring Tension.

- (c) The commutator must be clean and have a polished appearance. If necessary clean it by pressing a fine dry cloth against it while the starter is turned by applying a spanner 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.
- (d) Keep all electrical connections clean and tight, any which may have become dirty must be cleaned and the contacting surfaces lightly smeared with petroleum jelly.

#### 3. PERFORMANCE DATA

Lock torque 17 lb./ft. with 440—460 amps at 7.4—7.0 volts.

Torque at 1,000 r.p.m., 8 lb./ft. with 250-270 amps at 9.4-9.0 volts.

#### 4. SERVICING

#### (a) Testing in Position

If the motor does not operate or fails to crank the engine when the starting button is used, switch on the lamps and again use the starting button.

#### (i) The lamps dim and the motor does not crank the engine :

Before examining the starter check by hand-cranking that the engine is not abnormally stiff.

Sluggish action of the starting motor may be due to a discharged battery. Check by disconnecting the existing cables and re-connecting the motor to a battery known to be fully charged.

If the starting motor now gives normal cranking of the engine the vehicle battery must be examined and the motor circuit cables checked for damaged insulation.

If the motor does not operate satisfactorily it must be removed from the engine for examination, see Para. 4 (b).

#### (ii) The lamps do not dim and the motor does not crank the engine :



Check by means of a voltmeter or low voltage test lamp that the circuit up to the supply terminal on the motor is in order.

If no voltage is indicated, check the circuit from battery to motor via the starter switch. Ensure that all connections are clean and tight.

A voltage at the supply terminal indicates that the motor has an internal fault and must be removed from the engine for examination, see Para. 4 (b).

If the motor operates but does not crank the engine, the drive mechanism is probably faulty.

#### (b) Bench-testing

#### (i) Removing the starting motor from the engine :

Disconnect the earth terminal on the battery to avoid any danger of short circuits. Remove the heavy cable from the starting motor.

Remove the mounting bolts and withdraw the starting motor from the engine.

# (ii) Measuring the light running current :

Secure the starting motor in a vice. Connect the motor in series with a starter switch, an ammeter capable of measuring 600 amperes and 12-volt voltage supply. Use cables of a similar size to those in the vehicle motor circuit. One of the fixing lugs on the drive end bracket is a suitable earthing point on the starting motor. Connect a voltmeter between the motor terminal and the yoke.

Operate the switch and note the speed of armature rotation, using a tachometer, and the readings given by the ammeter and voltmeter.

While the motor is running at speed, examine the brushgear and check if there is any undue sparking at the commutator or excessive brush movement.

### (iii) Measuring lock torque and lock current



#### Fig. 15 Method of measuring stall torque and current.

With the motor firmly clamped in a vice, attach a brake arm to the driving pinion. Connect the free end of this arm to a spring scale. Operate the switch and note the current consumption, voltage and the reading on the spring scale.

The measure of torque can be calculated by multiplying the reading on the spring scale in pounds by the length of the brake arm in feet.

If a constant-voltage bus-bar supply is used when carrying out the lock torque test, a higher lock voltage may be shown on the voltmeter than the appropriate value given in Para. 3. In this event a variable resistor of suitable current-carrying capacity should be connected in the battery circuit and adjusted until the lock voltage is the same as that given in Para. 3. Take readings of current and torque at this value.

#### (iv) Fault Diagnosis :

An indication of the nature of the fault or faults may be deduced from the results of the no load and lock torque tests.

SYMPTOM	PROBABLE FAULT		
Speed, torque and current consumption correct.	Assume motor to be in normal operating condition.		

(iv) Fault Diagnosis—(cont'd)

SYMPTOM	PROBABLE FAULT	
Speed, torque and current consumption low.	High resistance in brushgear, <i>e.g.</i> , faulty connections, dirty or burned commutator causing bad brush contact.	
Speed and torque low, current consumption high.	Tight or worn bearings, bent shaft, in- sufficient end play, armature fouling a pole shoe, or cracked spigot on drive end bracket.	
	Short-circuited armature, earthed armature or short-circuited field coils.	
Speed and current consumption high, torque low.	Short-circuited field coils.	
Armature does not rotate, no current con- sumption.	Open-circuited armature or field coils. If the commutator is badly burned there may be poor contact between brushes and com- mutator.	
Armature does not rotate, high current consumption.	Earthed field winding. Armature prevented mechanically from rotating.	
Excessive brush movement causing arcing at commutator.	Low brush spring tension, worn or out-of- round commutator. "Thrown" or high segment on commutator.	
Excessive arcing at the commutator.	Defective armature windings.	

If any fault is indicated, the motor must be dismantled, see Para. 4 (c) and a further check made.

#### (c) Dismantling

Remove the cover band, hold back the brush springs and lift the brushes from their holders.





Unscrew the terminal nuts from the field coil terminal post protruding from the commutator end bracket.

Unscrew the two through bolts from the commutator end bracket and remove the commutator end bracket from the yoke.

Remove the driving end bracket complete with armature and drive from the starting motor yoke.

#### (d) Bench Inspection

After the motor has been dismantled individual items must be examined, as follows :---

M

#### (i) Brushgear

Where necessary the brushes and brush-holders must be cleaned, using a fluffless petrol-moistened cloth.

To prevent damage to the commutator, brushes must be replaced when worn to  $\frac{5}{16}$ " in length. The flexible connectors can be removed by unsoldering, and the connectors of the new brushes secured in place by re-soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.



Fig. 17 Commutator End Bracket Brush Connections.

Check the brush springs, as in Para. 2 (b). To fit a new spring, prise open the spring anchor slot in the brush spring support post and lift the old spring away. Place the new spring in the slot in the same position as occupied by the old spring. Re-close the slot. Check the tension of the new spring and ensure that it makes contact with the centre of the brush.

#### (ii) Commutator

The commutator must be clean and have a polished appearance. If it is dirty it must be cleaned, using a fluffless petrol-moistened cloth or, if necessary, by polishing it with a strip of very fine emery cloth. To remedy a badly worn commutator, dismantle the starter drive and remove the armature from the end bracket. 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.

#### (iii) Armature

Check for lifted commutator segments and loose turns in the armature winding. These may be due to the starting motor having remained engaged while the engine is running, thus causing the armature to be rotated at excessive speed.

A damaged armature must always be replaced—no attempts should be made to machine the armature core or to true a distorted armature shaft. An indication of a bent shaft or a loose pole shoe may be given by scored armature laminations.

To check armature insulation, use an ohm meter or a 110-volt a.c. test lamp. A high reading should be shown on the meter when connected between the armature shaft and the commutator segments. If a test lamp is used, it must not light when connected as above. Faulty insulation will be indicated by a low ohmic reading or by lighting of the test lamp.

If a short circuit is suspected, check the armature on a "growler." The motor overheating may cause blobs of solder to short circuit the commutator segments.

If an armature fault cannot be located and remedied, a replacement armature must be fitted.

# 314



Fig. 18 Testing for Open Circuit in the field coils.

Connect a battery and suitable bulb in series with two pointed probes.

If the lamp fails to light in the following test an open circuit in the field coils is indicated and the defective coils must be replaced.

Place the probes on the brush tappings. The bulb should light. Lighting of the lamps does not necessarily indicate that the field coils are in order. It is possible that a field coil may be earthed to a pole shoe or to the yoke.

Insulation Test:

Connect an ohm meter or a 110-volt a.c. test lamp between the terminal post and a clean part of the yoke.

Lighting of the test lamp or a low ohmic reading indicates that the field coils are earthed to the yoke and must be replaced.

Replacing the field coils :

Unscrew the four pole-shoe retaining screws, using a wheeloperated screwdriver.

Remove the insulation piece which is fitted to prevent the inter-coil connectors from contacting with the yoke. Mark the yoke and poleshoes in order that they may be refitted in their original positions. 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. Ensure that the taping of the field coils is not trapped between the poleshoes and the yoke.

Locate the pole-shoes and field coils by lightly tightening the fixing screws.

Replace the insulation piece between the field coil connections and the yoke.

Finally, tighten the screws by means of the wheel-operated screwdriver.

#### (v) 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 :



Fig. 19

Method of fitting Bearing Bushes.

Press the bearing bush out of the end bracket.

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. M

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 should be completely immersed for 24 hours in clean, thin engine oil. In cases of extreme urgency this period may be shortened by heating the oil to 100°C. for 2 hours, then allowing to cool before removing the bearing bush.

#### (e) Re-assembly

This is, in the main, a reversal of the procedure given in Para. 4 (c) for dismantling.

Commutator end bracket replacement : The starting motor is designed for clockwise rotation, indicated by the arrow on the yoke. Press out the through bolt indentations marked "C" on the replacement bracket.

Press the locating dowel into the appropriate hole marked "C."

Insert the through bolts into the holes made in the bracket and tighten the bracket to the yoke.

#### STARTING MOTOR DRIVE

#### I. GENERAL

The drive embodies a combination of rubber torsion member and friction clutch in order to control the torque transmitted from the starter to the engine flywheel and to dissipate the energy in the rotating armature of the starter at the moment when the pinion engages with the flywheel.

It also embodies an overload release mechanism which functions in the event of extreme stress, such as may occur in the event of a very heavy backfire, or if the starter is inadvertently meshed into a flywheel, rotating in the reverse direction.

When the starter is energised, the torque is transmitted by two paths, one via the outer sleeve of the rubber coupling and through the friction washer to the screwed sleeve, while the other path is from the outer to the inner sleeve through the rubber coupling and then directly to the screwed sleeve. The torque through the rubber limits the total torque which the drive transmits and since the rubber is bonded to the inner sleeve, under overload conditions slipping will occur between the rubber bush and the outer sleeve of the coupling. Slipping does not take place under normal engagement conditions, when the rubber acts merely as a spring with a limiting relative twist on the two members of approximately 30°.

Under conditions of unduly severe overload which might cause damage to the drive or its mounting, the rubber slips in its housing so that a definite upper limit is set to the torque transmitted and to the stresses which may occur.

#### 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. CONSTRUCTION

The construction of the drive will be clear from the illustration. The pinion is carried on a barrel type assembly which is mounted on a screwed sleeve.

The screwed sleeve is secured to the armature shaft by means of a location nut and is also keyed to the inner sleeve of the rubber coupling by a centre coupling plate. A friction washer is fitted between the coupling plate and rubber assembly and the outer sleeve of the rubber coupling is keyed at the armature end of the starter by means of a transmission plate.

A pinion restraining spring is fitted in the barrel assembly to prevent the pinion vibrating into mesh when the engine is running.



ig. 20 Exploded view of Starter Motor Drive Assembly.

#### 4. DISMANTLING

Having removed the armature as described in the section dealing with starting motors, the drive can be dismantled as follows :— Remove the locating cover (A) and then withdraw the locating ring (B) from the starter shaft at the end of the starter drive.

Remove the retaining ring (C) from inside the end of the pinion and barrel assembly (D) and then withdraw the pinion and barrel assembly.

Take out the peg (E) securing the locating nut (F) to the shaft, hold the squared starter shaft extension at the commutator end by means of a spanner and unscrew the locating nut.

Withdraw the friction washer (G), restraining spring (H). Slide the sleeve (J) and control nut (K) off the splined shaft.

Finally remove coupling plate (L), friction washer (M) and rubber unit assembly (N).

NOTE : On some models the locating nut is secured by caulking the nut into the keyway provided in the shaft and therefore no peg (E) is fitted. When re-assembling it will be necessary to fit a new locating nut.

#### 5. RE-ASSEMBLY

The re-assembly of the drive is a reversal of the dismantling procedure.

#### DISTRIBUTOR-Model DM2

#### I. GENERAL

Mounted on the distributor driving shaft, immediately beneath the contact breaker, is a centrifugally operated timing control mechanism. It consists of a pair of springloaded governor weights, linked by lever action to the contact breaker cam. Under the centrifugal force imparted by increasing engine speed, the governor weights swing out against the spring pressure to advance the contact breaker cam and thereby the spark, to suit engine conditions at the greater speed.

A built-in vacuum-operated timing control is also included, designed to give additional advance under part-throttle conditions. The inlet manifold of the engine is in direct communication with one side of a springloaded diaphragm. This diaphragm acts through a lever mechanism to rotate the heel of the contact breaker about the cam, thus advancing the spark for part-throttle



Fig. 21 Exploded View of model DM2. P4 Distributor,

There is also a operating conditions. micrometer adjustment by means of which fine alterations in timing can be made to allow for changes in running conditions, e.g., state of carbonisation, change of fuel, etc.

A completely sealed metallised paper capacitor is utilised. This has the property of being self-healing; should the capacitor break down, the metallic film around the point of rupture is vaporised away by the heat of the spark, so preventing a per-Capacitor failure manent short circuit. will be found to be most infrequent.

The H.T. pick-up brush is of a composite construction, the top portion consisting of a resistive compound and the lower of softer carbon to prevent wear taking place on the rotor electrode. The resistive portion of this carbon brush which is in circuit between the coil and the distributor gives a measure of radio interference suppression. Under no circumstances must a short nonresistive brush be used as a replacement for one of these longer resistive brushes.

The Pre-tilted Contact Breaker Unit During 1955 an improved contact breaker unit was introduced on the DM2P4 distributor. Important features of this pre-tilted contact breaker unit are : improved sensitivity of vacuum control and elimination of any tendency for the moving contact breaker plate to rock at high cam speeds. Contact adjustment has also been simplified.

#### **ROUTINE MAINTENANCE** 2.

In general, lubrication and cleaning constitute normal maintenance procedure.

(a) Lubrication—every 3,000 miles Take great care to prevent oil or grease from getting on or near the contacts.

> Add a few drops of thin machine oil through the aperture at the edge of the contact breaker to lubricate the centrifugal timing control.

> Smear the cam with Mobilgrease No. 2.

> Lift off the rotor arm and apply to the spindle a few drops of Ragosine Molybdenised non-creep oil or thin machine oil to lubricate the cam



bearing. It is not necessary to remove the exposed screw, since it affords a clearance to permit the passage of oil. Replace the rotor arm carefully, locating its moulded projection in the keyway in the spindle and pushing it on as far as it will go.

#### (b) Cleaning—every 6,000 miles

Thoroughly clean the moulded distributor cover, inside and out, with a soft dry cloth, paying particular attention to the spaces between the metal electrodes. Ensure that the carbon brush moves freely in its holder.

Examine the contact breaker. The contacts must be quite free from grease or oil. If they are burned or blackened, clean them with very fine carborundum stone or emery cloth, then wipe with a petrol-moistened cloth. Cleaning is facilitated by removing the contact breaker lever. To do this, remove the nut, washer, insulating piece and connections from the post to which the end of the contact breaker spring is anchored. The contact breaker lever may now be removed from its pivot. Before refitting the contact breaker, smear the pivot post with Ragosine Molybdenised non-creep oil or Mobilgrease No. 2. After cleaning, check the contact breaker setting. Turn the engine by hand until the contacts show the maximum opening. This should measure 0.014" to 0.016". If the measurement is incorrect, keep the engine in the position

giving maximum opening, slacken the screw(s) securing the fixed contact plate and adjust its position to give the required gap. Tighten the screw(s). Recheck the setting for other positions of the engine giving maximum opening.

#### 3. DESIGN DATA

- (a) Firing angles :  $0^{\circ}$ ,  $90^{\circ}$ ,  $180^{\circ}$ ,  $270^{\circ}$ ,  $\pm 1^{\circ}$ . Closed period :  $60^{\circ} \pm 3^{\circ}$ . Open period :  $30^{\circ} \pm 3^{\circ}$ .
- (**b**) Contact breaker gap : 0.014" to 0.016".
- (c) Contact breaker spring tension, measured at contacts : 20---24 ozs.
- (d) Capacitor : 0.2 microfarad.
- (e) Rotation : Anti-clockwise.
- (f) Checking Automatic timing control:
  - (i) Advance due to centrifugal control:

Set to spark at zero degrees at minimum r.p.m.

Run distributor at 2,700 r.p.m. Advance should lie between  $13^{\circ}$  and  $15^{\circ}$ .

Check advance at following decelerating speeds :---

Advance
(degrees)
$12\frac{1}{2}$ - $14\frac{1}{2}$
$8\frac{1}{2}$ - 10 $\frac{1}{5}$
6 <u>1</u> 9
0 – 2

Part No(s). of auto advance springs : 421218, 421219.

(ii) Advance due to vacuum control : Apply a vacuum of 18" of mercury. Advance to lie between 6° and 8°. Check advance at the following points, as the vacuum is reduced : Vacuum (in hg.)  $9\frac{1}{2}$  5-7  $4\frac{3}{4}$  $\frac{1}{2}-2\frac{1}{2}$ 

No advance below 2" of mercury.

#### 4. SERVICING

Before starting to test, make sure that the battery is not fully discharged, as this will often produce the same symptoms as a fault in the ignition circuit.

#### (a) Testing in Position to Locate Cause of Uneven Firing

Run the engine at a fairly fast idling speed.

If possible, short circuit each plug in turn with the blade of an insulated screwdriver or a hammer head placed across the terminal to contact the cylinder head. Short circuiting the plug in the defective cylinder will cause no noticeable change in the running note. On the others, however, there will be a pronounced increase in roughness. If this is not possible, due to the sparking plug being fitted with a shrouded cable connector, remove each plug connector in turn. Again, removal of the connection to the defective cylinder will cause no noticeable change in the running note, but there will be a definite increase in roughness when the other plugs are disconnected. Having thus located the defective cylinder, stop the engine and remove the cable from the sparking plug terminal.

Restart the engine and hold the cable end about  $\frac{3}{16}$ " from the cylinder head. If sparking is strong and regular, the fault lies with the sparking plug, and it should be removed, cleaned and adjusted, or a replacement fitted. If, however, there is no spark, or only weak irregular sparking, examine the cable from the plug to the distributor cover for deterioration of the insulation, renewing the cable if the rubber is cracked or perished. Clean and examine the distributor moulded cover for free movement of the carbon brush. If a replacement brush is necessary, it is important that the correct type is used. If tracking has occurred, indicated by a thin black line between two or more electrodes or between one of the electrodes and the body, a replacement distributor cover must be fitted.

#### (b) Testing in Position to Locate Cause of Ignition Failure

Spring back the clips on the distributor head and remove the moulded cover. Lift off the rotor, carefully levering with a screwdriver if necessary.

Switch on the ignition and whilst the engine is slowly cranked, observe the reading on the car ammeter, or on an ammeter connected in series with the battery supply cable.

The reading should rise and fall with the closing and opening of the contacts if the low tension wiring is in order. When a reading is given which does not fluctuate, a short circuit, or contacts remaining closed, is indicated. No reading indicates an open circuit in the low tension circuit, or badly adjusted or dirty contacts.

Check the contacts for cleanliness and correct gap setting as described in Para. 2 (b). Ensure that the moving arm moves freely on the pivot. If sluggish, remove the arm and polish the pivot post with a strip of fine emery cloth. Smear the post with Ragosine Molybdenised non-creep oil or Mobilgrease No. 2, replace the arm. If the fault persists, proceed as follows:

#### (c) Low Tension Circuit — Fault Location

(i) No reading in ammeter test. Refer to wiring diagram and check circuit for broken or loose connections, including ignition switch. Check the ignition coil by substitution.

#### (ii) Steady reading in ammeter test

Refer to wiring diagram and check wiring for indications of a short circuit.

Check capacitor (either by substitution or on a suitable tester). Check ignition coil by substitution. Examine insulation of contact breaker.

#### (d) High Tension Circuit

If the low tension circuit is in order, remove the high tension lead from the centre terminal of the distributor cover. Switch on the ignition and turn the engine until the contacts close. Flick open the contact breaker lever whilst the high tension lead from the coil is held about  $\frac{3}{16}$ " from the cylinder block. If the ignition equipment is in good order, a strong spark will be obtained. If no spark occurs, a fault in the circuit of the secondary winding of the coil is indicated and the coil must be replaced.

The high tension cables must be carefully examined and replaced if the rubber insulation is cracked or perished, using 7 mm. rubber covered ignition cable.

The cables from the distributor to the sparking plugs must be connected in the correct firing order, *i.e.* 1.3.4.2.

#### (e) Dismantling

When dismantling, carefully note the positions in which the various components are fitted, in order to ensure their correct replacement on reassembly. If the driving dog or gear is offset, or marked in some way for convenience in timing, note the relation between it and the rotor electrode and maintain this relation when re-assembling the distributor. The amount of dismantling necessary will obviously depend on the repair required.

Spring back the securing clips and remove the moulded cover. Lift the rotor arm off the spindle, carefully levering with a screwdriver if it is tight.

Disconnect the vacuum unit link to the moving contact breaker plate and remove the two screws at the edge of the contact breaker base. The contact breaker assembly, complete with external terminal, can now be lifted off (see (i) below). Remove the circlip on the end of the micrometer timing screw and turn the micrometer nut until the screw and the vacuum unit assembly are freed. Take care not to lose the ratchet and coil type springs located under the micrometer nut.

The complete shaft assembly, with automatic timing control and cam foot can now be removed from the distributor body (see (**ii**) below).

#### (i) Contact Breaker

To dismantle the assembly further, remove the nut, insulating piece and connections from the pillar on which the contact breaker spring is anchored. Slide out the terminal moulding. Lift off the contact breaker lever and the insulating washers beneath it. Remove the screw(s) securing the fixed contact plate, together with the spring and plain steel washers and take off the plate. Withdraw the single screw securing the capacitor and, on earlier models, the contact breaker earthing lead. Dismantle the contact breaker base assembly by turning the base plate clockwise and pulling to release it from the moving contact breaker plate. On earlier models remove the circlip and star washer located under the base plate.

#### (ii) Shaft and Action Plate

To dismantle the assembly further, take out the screw inside the cam and remove the cam and cam foot. The weights, springs and toggles (when fitted) of the automatic timing control can now be lifted off the action plate. Note that a distance collar is fitted on the shaft underneath the action plate.

#### (f) Bearing Replacement

The single long bearing bush used in this distributor can be pressed out of the shank by means of a shouldered mandrel.

If the bearing has been removed the distributor must be assembled with a new bush fitted. The bush should 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  $100^{\circ}$ C. for two hours, then allowing to cool before removing the bush.

Press the bearing into the shank, using a shouldered, polished mandrel of the same diameter as the shaft.

Under no circumstances should the bush be overbored by reamering or any other means, since this will impair the porosity and thereby the effective lubricating quality of the bush.

#### (g) Re-assembly

The following instructions assume that **complete** dismantling has been under-taken.

- (i) Place the distance collar over the shaft, smear the shaft with Ragosine Molybdenised non-creep oil or clean engine oil, and fit it into its bearing.
- (ii) Refit the vacuum unit into its housing and replace the springs, milled adjusting nut and securing circlip.
- (iii) Re-assemble the centrifugal timing control. See that the springs are not stretched or damaged. Place the cam and cam foot assembly over the shaft, engaging the projections on the cam foot with the toggles, and fit the securing screw.
- (iv) Before re-assembling the contact breaker base assembly, lightly smear the base plate with Ragosine Molybdenised non-creep oil or Mobilgrease No. 2. On earlier distributors, the felt pad under the rotating contact breaker plate should be moistened with a few drops of thin machine oil. Fit the rotating plate to the contact breaker base plate and secure with the star washer and circlip. Refit the contact breaker base into the distributor body. Engage the link from the vacuum unit with the bearing bush in the rotating plate and secure with the split pin. Insert the two base plates securing screws, one of which also

secures one end of the earthing lead.

- (v) Fit the capacitor into position, on earlier models the eyelet on the other end of the contact breaker earthing lead is held under the capacitor fixing screw. Place the fixed contact plate in position and secure lightly with securing screw(s). One plain and one spring washer must be fitted under each of these screws.
- (vi) Place the insulating washers on the contact breaker pivot post and on the pillar on which the end of the contact breaker spring locates. Refit the contact breaker lever and spring.
- (vii) Slide the rubber terminal block into its slot.
- (viii) Thread the low tension connector and capacitor eyelets on to the insulating piece, and place these on to the pillar which secures the end of the contact breaker spring. Refit the washer and securing nut.
  - (ix) Set the contact gap to 0.014" to 0.016" and tighten the securing screw(s) of the fixed contact plate.
  - (x) Refit the rotor arm, locating the moulded projection in the rotor arm with the keyway in the shaft and pushing fully home. Refit the moulded cover.

#### (h) Replacement Contacts

If the contacts are so badly worn that replacement is necessary, they must be renewed as a pair and not individually. The contact gap must be set to 0.014'' to 0.016''; after the first 500 miles running with new contacts fitted, the setting should be checked and the gap reset to 0.014'' to 0.016''. This procedure allows for the initial "bedding-in" of the heel.

#### HEADLAMPS-MODEL F700 MK/VI

#### **1.** General Description

The lamps incorporate a combined reflector and front lens assembly known as the Lucas Light Unit. They are fitted with a "prefocus" bulb which ensures that the filament is always positioned correctly with respect to the focal point of the reflector.

#### (a) Light Unit

The construction of the Light Unit ensures that the reflector surface is



Fig. 23 Headlamp with Front Rim and Dustexcluding Rubber removed.

#### (b) Bulbs

The "prefocus" bulb eliminates the need for any focusing device in the lamp. The bulb cap is carried on a flange accurately positioned in relation to the filament during manufacture. A slot in the flange engages with a projection on the inside of the bulb holder at the back of the reflector,



Fig. 24



thus ensuring the correct positioning of the filament. A bayonet-fitting cap with spring-loaded contacts secures the bulb firmly in position and also carries the supply to the bulb contacts.

#### 2. BULB REPLACEMENT

Slacken the captive securing screw at the bottom of the front rim and remove the front rim and dust-excluding rubber. To remove the Light Unit assembly from the three spring-loaded screws, press the Unit inwards, turning it anti-clockwise to disengage the slotted holes in the seating rim from the setting adjustment screws. Disengage the bayonet fitting cap and withdraw the defective bulb from the Light Unit.

Re-assembly of the Light Unit to the lamp is a reversal of the above procedure.



(A) FRONT OF VEHICLE TO BE SQUARE WITH SCREEN

(B) VEHICLE TO BE LOADED AND STANDING ON LEVEL GROUND

(C) RECOMMENDED DISTANCE FOR SETTING IS AT LEAST 25 FT.

(D) FOR EASE OF SETTING ONE HEADLAMP SHOULD BE COVERED

Fig. 25 Diagram showing Headlamp Beam Setting.

3. SETTING

In overseas markets, lamps must be set to comply with local lighting regulations.

- (a) Ministry of Transport Lighting Regulations (United Kingdom) The Lighting Regulations state that a lighting system must be arranged so that it can give a light which is "incapable of dazzling any person standing on the same horizontal plane as the vehicle at a greater distance than twenty-five feet from the lamp, whose eye-level is not less than three feet six inches above that plane". The headlamp must therefore be set so that the main beams of light are parallel with the road and with each other.
- (b) Adjustment of Setting Slacken the captive securing screw at the bottom of the front rim and remove the rim and dust-excluding rubber. The spring-loaded adjustment screws are now accessible.

To adjust the vertical setting, turn the screw at the top of the lamp clockwise to raise the beam and anticlockwise to lower the beam. Adjustment in the horizontal plane is effected by turning the two spring-loaded screws at the sides of the Light Unit.



#### Fig. 26

Light Unit Replacement.

#### 4. RENEWAL OF LIGHT UNIT

Remove the Light Unit and bulb. Withdraw the three small screws from the unit rim to separate the unit rim and seating rim from the Light Unit.

Position the replacement Light Unit on the seating rim, taking care to see that the locating clips at the edge of the Light Unit fit into the slots in the rim. Ensure that the unit rim is correctly positioned before securing in position by means of the three small screws. Refit the bulb, adapter, etc

#### CONTROL BOX-Model RB106-1

#### I. GENERAL

The control box shown in Fig. 27, contains two units—a voltage regulator and a cutout. Although combined structurally, the regulator and cut-out are electrically separate. Both are accurately adjusted during manufacture, and the cover protecting them should not be removed unnecessarily. Cable connections are secured by grub screw terminals.



Fig. 27

#### The Regulator

The regulator is set to maintain the generator terminal voltage between close limits at all speeds above the regulating point, the field strength being controlled by the automatic insertion and withdrawal of a resistance in the generator field circuit. When the generator voltage reaches a predetermined value, the magnetic flux in the regulator core due to the shunt or voltage winding becomes sufficiently strong to attract the armature to the core. This causes the contacts to open, thereby inserting the resistance in the generator field circuit.

Control Box with Cover removed.

The consequent reduction in the generator field current lowers the generator terminal voltage and this, in turn, weakens the magnetic flux in the regulator core. The armature therefore returns to its original position, and the contacts closing allow the generator voltage to rise again to its maximum value. This cycle is then repeated and an oscillation of the armature is maintained.

As the speed of the generator rises above that at which the regulator comes into operation, the periods of contact separation increase in length and, as a result, the mean value of the generator voltage undergoes practically no increase once this regulating speed has been attained.

The series or current winding provides a compensation on this system of control, for if the control were arranged entirely on the basis of voltage there would be a risk of seriously overloading the generator when the battery was in a low state of charge, particularly if the lamps were simultaneously in use.

Under these conditions of reduced battery voltage, the output to the battery rises and, but for the series winding, would exceed the normal rating of the generator. The magnetism due to the series winding assists the shunt winding, so that when the generator is delivering a heavy current into a discharged battery the regulator comes into operation at a somewhat reduced voltage, thus limiting the output accordingly. As





Internal Connections.

shown in Fig. 28, a split series winding is used, terminal A being connected to the battery and terminal A1 to the lighting and ignition switch.

By means of a temperature compensation device the voltage characteristic of the generator is caused to conform more closely to that of the battery under all climatic conditions. In cold weather the voltage required to charge the battery increases, whilst in warm weather the voltage of the battery is lower. The method of compensation takes the form of a bi-metallic spring located behind the tensioning spring of the regulator armature. This bi-metallic spring, by causing the operating voltage of the regulator to be increased in cold weather and reduced in hot weather, compensates for the changing temperature-characteristics of the battery and prevents undue variation of the charging current which would otherwise occur.

The bi-metallic spring also compensates for effects due to increases in resistance of the copper windings from cold to working values.

#### The Cut-out

The cut-out is an electro-magnetically operated switch connected in the charging circuit between the generator and the battery. Its function is automatically to connect the generator with the battery when the voltage of the generator is sufficient to charge the battery, and to disconnect it when the generator is not running, or when its voltage falls below that of the battery, and so prevent the battery from discharging through and possibly damaging the generator windings.

The cut-out consists of an electro-magnet fitted with an armature which operates a pair of contacts. The electro-magnet employs two windings, a shunt winding of many turns of fine wire, and a series winding of a few turns of heavier gauge wire. The contacts are normally held open and are closed only when the magnetic pull of the magnet on the armature is sufficient to overcome the tension of the adjusting spring.

The operation of the cut-out is as follows : The shunt coil is connected across the generator. When the vehicle is starting, the speed of the engine, and thus the voltage of the generator, rises until the electro-magnet is sufficiently magnetised to overcome the spring tension and close the cut-out contacts. This completes the circuit between the generator and the battery through the series winding of the cutout and the contacts. The effect of the charging current flowing through the cutout windings creates a magnetic field in the same direction as that produced by the shunt winding. This increases the magnetic pull on the armature so that the contacts are firmly closed and cannot be separated by vibration. When the vehicle is stopping the speed of the generator is decreased until the generator voltage is lower than that of the battery. Current then flows from the battery through the cut-out series winding and generator in a reverse direction to the charging current. This reverse current through the cut-out will produce a differential action between the two windings and partly demagnetise the electro-magnet. The spring, which is under constant tension, then pulls the armature away from the magnet and opens the circuit. The contacts opening prevent further discharging of the battery through the generator.

Like the regulator, operation of the cut-out is temperature-controlled by means of a bi-metallic tensioning spring.

#### 2. SETTING DATA

#### (a) Regulator

Open-circuit setting at 20°C. and 1,500 dynamo r.p.m. : 15.6—16.2 volts.

Note : For ambient temperatures other than 20°C., the following allowances should be made to the above setting :

For every  $10^{\circ}$ C. (18°F.) above  $20^{\circ}$ C., subtract 0.3 volt.

For every 10°C. below 20°C., add 0.3 volt.

#### (b) Cut-out

Cut-in voltage : 12.7—13.3 Drop-off voltage : 8.5—10.0 Reverse current : 3.5—5.0 amp.

#### 3. SERVICING

(a) Testing in Position to Locate Fault in Charging Circuit

If the generator and battery are in order, check as follows :---

- (i) Ensure that the wiring between battery and regulator is in order. To do this, disconnect the wire from the A terminal of the control box and connect the end of the wire removed to the negative terminal of a voltmeter. Connect the positive voltmeter terminal to an earthing point on the chassis. If a voltmeter reading is given, the wiring is in order and the regulator must be examined.
- (ii) If there is no reading, examine the wiring between battery and control box for defective cables or loose connections.
- (iii) Re-connect the wire to terminal A.

#### (b) Regulator Adjustment

The regulator is carefully set during manufacture and, in general, it should not be necessary to make further adjustment. If, however, the battery does not 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 before altering the regulator setting to check that the low state of charge of the battery is not due to a battery defect or to slipping of the generator belt.

#### (i) Electrical Setting

It is important that only a good quality MOVING COIL VOLT-METER (0—20 volts) is used when checking the regulator. The electrical setting can be checked without removing the cover from the control box.

Withdraw the cables from terminals A and A1 at the control box and connect these cables together.



Fig. 29 Cut-out and Regulator Assembly.

Connect the negative lead of the voltmeter to control box terminal D and connect the other lead to terminal E.

Slowly increase the speed of the engine until the voltmeter needle "flicks" and then steadies. This should occur at a voltmeter reading between the appropriate limits given in Para, 2 (a) according to the ambient temperature.

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If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.



Fig. 30 Mechanical Setting of Regulator.

Shut off the engine and remove the control box cover.

Release locknut A (see Fig. 29) of adjusting screw B and turn the screw in a clockwise direction to raise the setting or in an anticlockwise direction to lower the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Repeat as above until the correct setting is obtained.

Adjustment of regulator opencircuit voltage should be completed within 30 seconds, otherwise heating of the shunt winding will cause false settings to be made.

Remake the original connections. A generator run at high speed on open circuit will build up a high voltage. Therefore, when adjusting the regulator, do not run the engine up to more than half throttle or a false setting will be made.

#### (ii) Mechanical Setting

The mechanical or air-gap settings of the regulator, shown in Fig. 30, are accurately adjusted before leaving the works and, provided that the armature carrying the moving contact is not removed, these settings should not be tampered with. If, however, the armature has been removed, the regulator will have to be reset.



WITH O.025" GAUGE BETWEEN ARMATURE SHIM & CORE, CONTACT GAP TO BE 0.002"-0.006.



With gauge in position, press back the armature against the regulator frame and tighten the two armature fixing screws. Remove the gauge and check the gap between the **shim** on the underside of the armature and the top of the core. This gap should be 0.012''-0.020''. If the gap is outside these limits, correct by carefully bending the fixed contact bracket. Remove the gauge and press the armature down, when the gap between the contacts should be 0.006''-0.017''.

#### (iii) Cleaning Contacts

After long periods of service it may be found necessary to clean the regulator contacts. The contacts are made accessible by slackening the screws securing the fixed contact bracket. It will be necessary to slacken screw C a little more than screw D (see Fig. 29) so that the contact bracket can be swung outwards. Clean the contacts by means of fine carborundum stone or fine emery cloth.

Carefully wipe away all traces of dust or other foreign matter with methylated spirits (de-natured alcohol). Re-position the fixed contact bracket and tighten the securing screws.

#### (c) Cut-out Adjustment

#### (i) Electrical Setting

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 locknut E (Fig. 29) and turn screw F 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 the temperature-rise effects. Tighten the locknut after making the adjustment. If the cut-out does not operate, there may be an open circuit in the wiring of the cut-out and regulator unit, in which case the unit should be removed for examination or replacement.

#### (ii) Mechanical Setting

If for any reason the cut-out armature has to be removed from the frame, care must be taken to obtain the correct air-gap settings on re-assembly (see Fig. 31). These can be obtained as follows :—

Slacken the two armature fixing screws, adjusting screw F and the screw securing the fixed contact Insert a 0.014" gauge between the back of the armature and the cutout frame. (The air gap between the core face and the armature shim should now measure 0.011" -0.015". If it does not, fit a new armature assembly.) Press the armature back against the gauge and tighten the armature fixing screws. With the gauge still in position, set the gap between the armature and the stop plate arm to 0.030"-0.034" by carefully bending the stop plate arm. Remove the gauge and tighten the screw securing the fixed contact. Insert a 0.025" gauge between the core face and the armature. Press the armature down on to the gauge. The gap between the contacts should now measure 0.002" to 0.006" and the drop-off voltage should be between the limits given in Para. 2 (b). If necessary, adjust the gap by carefully bending the fixed contact bracket.

#### (iii) Cleaning Contacts

If the cut-out contacts appear rough or burnt, place a strip of fine glass paper between the contacts—then, with the contacts closed by hand, draw the paper through. This should be done two or three times with the rough side towards each contact. Wipe away all dust or other foreign matter, using a clean fluffless cloth moistened with methylated spirits (de-natured alcohol).

Do not use emery cloth or a carborundum stone for cleaning cutout contacts.

#### WINDSCREEN WIPER CRT15

#### I. GENERAL

Normally the windscreen wiper will not require any servicing apart from the occasional renewal of the rubber blades. In the event of irregular working, first check for loose connections, chafed insulation, discharged battery, etc., before removing the gearbox or commutator covers.





# (a) To Detach the Cable Rack from the Motor and Gearbox

Remove the gearbox cover.

Lift off the connecting link.

Disengage the outer casing, cable rack and crosshead from the gearbox.

Replace the gearbox cover to prevent the ingress of foreign matter.

### (b) To Detach the Cable Rack from the Wheelboxes

Remove the wiper arms from the wheelbox spindles by slackening the collet nuts and continuing to rotate them until the arms are freed from the spindles. The cable rack can then be withdrawn from the outer casing for inspection. Before refitting the cable into the outer casing, see that the wheelbox gears are undamaged and thoroughly lubricate the cable rack with Duckham's HBB or an equivalent grease.

#### (c) Inspection of Commutator

Disconnect the wiper at its terminals and withdraw the three screws securing the cover at the commutator end. Lift off the cover. Clean the commutator, using a petrol-moistened cloth, taking care to remove any carbon dust from between the commutator segments.

#### (d) Inspection of Brush Gear

Check that the brushes bear freely on the commutator. If they are loose or do not make contact, a replacement tension spring is necessary. The brush levers must be free on their pivots. If they are stiff, they should be freed by working them backwards and forwards. Brushes which are considerably worn must be replaced.

#### (e) Motor Operates but does not Transmit Motion to Spindles

Remove the gearbox cover. A pushpull motion should be transmitted to the inner cable of the flexible rack. If the crosshead moves sluggishly between the guides, lightly smear a small amount of medium grade engine oil in the groove formed in the die-cast housing.

When overhauling, the gearbox must be lubricated by packing it with a grease of the zinc oxide base type.

#### 2. FLASHING LIGHT DIRECTION INDICATORS

In the event of irregular operation of the flasher system, the following procedure should be followed :---

- (a) Check the bulbs for broken filaments.
- (b) Refer to the wiring diagram and check all flasher circuit connections.
- (c) Switch on the ignition and :---
  - (i) Check with a voltmeter that flasher unit terminal B is at twelve volts with respect to the chassis.
  - (ii) Connect together flasher unit terminals B and L and operate the direction indicator switch.

If the lamps now light, the flasher unit is defective and must be replaced.

If the lamps do not light, the indicator switch is defective and must be replaced.

#### ELECTRIC WINDTONE HORNS -

#### Models WT614 and WT618

#### I. GENERAL

Windtone horns depend for their operation on the vibration of an air column, excited at its resonant frequency, or a harmonic of it, by an electrically energised diaphragm. The horns are fitted in pairs, one horn having a higher note than the other. The horns differ in note by an interval of a major third. Earlier fitment WT614 and later WT618 horns are recognisable from each other by the different shape of their trumpet flares. High and low note horns can be distinguished by the letters "H" or "L" marked inside the trumpet flares.

#### (a) Note of Horn Unsatisfactory or Operation Intermittent

(i) Check that the bolts securing the horn bracket are tight and that the body or flare of the horn does not foul any other fixture. See that any units fitted near the horn are rigidly mounted, and do not vibrate when the horn is blown. Examine the cables of the horn circuit, renewing any that are badly worn or chafed. Ensure that all connections are tight, and that the connecting eyelets or nipples are firmly soldered to the cables.





WT.618 Horn with Cover removed.

#### (ii) Adjustment

Adjustment of the horn does not alter the pitch of the note, but takes up wear of the moving parts which if uncorrected, would result in loss of power and roughness of tone.

The horn must not be used repeatedly when out of adjustment, as the resulting excessive current may damage it. The maximum current consumption of a horn in correct adjustment is  $6\frac{1}{2}$  amps. for WT614 horns and 8 amps. for WT618 horns (the total current, taken by both horns together, will naturally be twice the figure quoted).

If it is desired to check the current consumption of the horns, break the circuit at some convenient point and connect an ammeter, 0---30 or 0---50 amps., in series with the horns.

If the consumption is in excess of 13 amps. for WT614 horns or 16 amps. for WT618 horns, it will be necessary to adjust the horns, even if they are apparently operating correctly. Horns will normally be tested with the car stationary and the battery at roughly its nominal voltage, but under running conditions with the battery charging the voltage may be appreciably higher, and may overload the horns if the latter are not in correct adjustment.

If the horns are badly out of adjustment, it will be necessary to short circuit the horn fuse, A1-A2, as otherwise the excessive current taken by the horns during the process of adjustment might result in its repeated blowing.

Withdraw the cover securing screws and remove the covers. Disconnect the supply lead from one horn, taking care that it cannot touch any part of the car and so cause a short circuit.

Horns must always be securely bolted down when carrying out an adjustment, and if it is necessary to remove a horn from the car for testing, it must always be firmly clamped by its securing bracket for the test or adjustment to be effective.

Slacken the locking nut on the fixed contact and rotate the adjusting nut in a clockwise direction until the contacts are just separated, as indicated by the horn failing to sound. Turn the adjusting nut half a turn in the opposite direction, and hold it while tightening down the locking nut. Check the current consumption of the horn, if the current is incorrect, make further very fine adjustments to the contact breaker, turning the adjusting screw in a clockwise direction in order to decrease the current, and vice versa.

Adjust the other horn in a similar manner.

#### (b) Internal Faults

If the note cannot be improved by adjustment of the contact breaker, examine the movement for the following faults:

- (i) Contacts badly worn, so that correct adjustment is impossible. A new set of contacts, *i.e.*, moving contact and spring, and fixed contact and adjusting screw, must be fitted, and the horn adjusted as described above.
- (ii) Faulty resistance. To prevent excessive sparking as the horn contacts separate, a carbon resistance is connected across the horn coil. The correct resistance valve is 8 ohms. On model WT618 horns the contact breaker terminal block is manufactured from a resistance material and this serves as the spark suppressing resistance. If the resistance becomes open circuited the horn note will become rough and fierce sparking will occur as the horn contacts separate.

- (iii) Steel push rod stiff or jammed in its bush. Remove the contact breaker spring and work the push rod up and down to ease it. If necessary, clean the rod and bush with petrol to remove any accumulations of dirt or grease. The exposed portion of the rod should be smeared with a fairly thin grease (Duckham's H.B.B., or its equivalent), which will work down into the bush when the horn is blown.
- (iv) Push rod too slack, causing rattle when the horn is blown. This will be due to the push rod having run dry of grease, with consequent excessive wear. A new push rod must be fitted. If, due to wear of the bush, the new push rod is also slack, no repair is possible and the horn must be replaced.
- (v) Armature fouling base plate. There should be a clearance of approximately .020" between the armature and the base plate. If the armature touches the base plate at any point, slacken the six screws securing the base plate and move the armature until it is centrally placed in the aperture. It is advisable to fit shims round the armature to hold it central while the securing screws are tightened.

#### (c) Both Horns Fail to Operate

Examine the fuse protecting the horn circuit. If it has blown, examine the wiring and horns for evidence of a short circuit. Renew any damaged leads, covering them with extra protective sleeving if necessary, and fit a new fuse into position.

If the fuse still blows, it is possible that the adjustment of one or both horns is badly out, and that as a result the current consumption is very greatly increased.

#### (d) One Horn Fails to Operate

Disconnect one lead from the terminal block of the second horn, taking care that it is not allowed to touch any part of the car.

Remove the cover of the faulty horn and examine the movement for the faults enumerated in Para. (b).

Pay particular attention to the internal wiring of the horn, which may have broken or become unsoldered as a result of vibration, and see that chafed insulation does not cause a partial or complete short circuit.

Note—All joints in the internal wiring of the horn must be firmly soldered using a non-corrosive flux.

- (i) If the horns are removed for bench testing or adjustment, it is advisable to carry out an insulation test before replacement, testing between each terminal and the body with a 500-volt test set or similar equipment.
- (ii) Under no circumstances must the movement be dismantled. If, after carrying out the above testing procedure, the fault has not been located, a new horn must be fitted.



Fig. 34 Wiring Diagram.

### AUTOMATIC ADVANCE CURVE



Fig. 35

#### CONTROL BOX. MODEL RB106-2 I.

Later production cars were fitted with this control box, the function of which is identical to its predecessor, RB106/1.



### **GENERAL**

The control box, shown in Fig. 36, contains two units-a voltage regulator and a cutout. Although combined structurally, the regulator and cut-out are electrically separate. Both are accurately adjusted during manufacture, and the cover protecting them should not be removed unnecessarily. Cable connections are secured by grub screw type terminals.

#### The Regulator

The regulator is set to maintain the generator terminal voltage between close limits at all speeds above the regulating point, the field strength being controlled by the automatic insertion and withdrawal of a resistance in the generator field circuit. When the generator voltage reaches a predetermined value, the magnetic flux in the regulator core, due to the shunt or voltage winding, becomes sufficiently strong to attract the armature to the core. This causes the contacts to open, thereby inserting the resistance in the generator field circuit.

The consequent reduction in the generator field current lowers the generator terminal voltage, and this, in turn, weakens the magnetic flux in the regulator core. The armature therefore returns to its original position, and the contacts closing allow the generator voltage to rise again to its maximum value. This cycle is then repeated and an oscillation of the armature is maintained.

As the speed of the generator rises above that at which the regulator comes into operation, the periods of contact separation increase in length and, as a result, the mean value of the generator voltage undergoes practically no increase once this regulating speed has been attained.

The series or current winding provides a compensation on this system of control, for if the control were arranged entirely on the basis of voltage there would be a risk of seriously overloading the generator when the battery was in a low state of charge, particularly if the lamps were simultaneously in use.

Under these conditions of reduced battery voltage, the output to the battery rises and, but for the series winding, would exceed



CONTROL BOX Internal connections of Control Box. the normal rating of the generator. The magnetism due to the series winding assists the shunt winding, so that when the generator is delivering a heavy current into a discharged battery the regulator comes into operation at a somewhat reduced voltage, thus limiting the output accordingly. As shown in Fig. 37, a split series winding is used, terminal A being connected to the battery and terminal A1 to the lighting and ignition switch.

By means of a temperature compensation device, the voltage characteristic of the generator is caused to conform more closely to that of the battery under all climatic conditions. In cold weather the voltage required to charge the battery increases, whilst in warm weather the voltage required is lower. The method of compensation takes the form of a bi-metallic spring located behind the tensioning spring of the regulator armature. This bi-metallic spring, by causing the operating voltage of the regulator to be increased in cold weather and reduced in hot weather, compensates for the changing temperature-characteristics of the battery and prevents undue variation of the charging current which would otherwise occur.

The bi-metallic spring also compensates for effects due to increases in resistance of the copper windings from cold to working values.

#### The Cut-out

The cut-out is an electro-magnetically operated switch connected in the charging circuit between the generator and the battery. Its function is automatically to connect the generator with the battery when the voltage of the generator is sufficient to charge the battery, and to disconnect it when the generator is not running, or when its voltage falls below that of the battery, and so prevent the battery from discharging through and possibly damaging the generator windings. The cut-out consists of an electro-magnet fitted with an armature which operates a pair of contacts. The electro-magnet employs two windings, a shunt winding of many turns of fine wire, and a series winding of a few turns of heavier gauge wire. The contacts are normally held open and are closed only when the magnetic pull

Fig. 37

of the magnet on the armature is sufficient to overcome the tension of the adjusting spring.

#### The operation of the cut-out is as follows:

The shunt coil is connected across the generator. When the vehicle is starting, the speed of the engine and thus the voltage of the generator, rises until the electro-magnet is sufficiently magnetised to overcome the spring tension and close the cut-out contacts. This completes the circuit between the generator and the battery through the series winding of the cut-out and the contacts. The effect of the charging current flowing through the cutout windings creates a magnetic field in the same direction as that produced by the shunt winding. This increases the magnetic pull on the armature so that the contacts are firmly closed and cannot be separated by vibration. When the vehicle is stopping the speed of the generator falls until the generator voltage is lower than that of the Current then flows from the battery. battery through the cut-out series winding and generator in a reverse direction to the charging current. This reverse current through the cut-out will produce a differential action between the two windings and partly de-magnetise the electro-magnet. The spring, which is under constant tension, then pulls the armature away from the magnet and so separates the contacts and opens the circuit.

Like the regulator, operation of the cut-out is temperature-controlled by means of a bi-metallic tensioning spring.

#### 2. SETTING DATA

#### (a) Regulator

Open-circuit setting at 20°C. and 1500 dynamo r.p.m.: 15.6—16.2 volts.

NOTE: For ambient temperatures other than 20°C. the following allowances should be made to the above setting:—

> For every 10°C. (18°F.) above 20°C. subtract 0.3 volt.

For every 10°C. below 20°C. add 0.3 volt.

(b) Cut-out

Cut-in voltage :	12.7-13.3
Drop-off voltage :	8.5—11.0
Reverse current :	3.5— 5.0 amp.

#### 3. SERVICING

#### (a) Testing in position to locate fault in charging circuit

If the generator and battery are in order, check as follows :--

(i) Ensure that the wiring between battery and regulator is in order. To do this, disconnect the wire from control box terminal "A" and connect the end of the wire removed to the negative terminal of a voltmeter.

Connect the positive voltmeter terminal to an earthing point on the chassis. If a voltmeter reading is given, the wiring is in order and the regulator must be examined.

- (ii) If there is no reading, examine the wiring between battery and control box for defective cables or loose connections.
- (iii) Re-connect the wire 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. If, however, the battery does not 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 before altering the regulator setting to check that the low state of charge of the battery is not due to a battery defect or to slipping of the generator belt.

(i) Electrical Setting

It is important that only a good quality MOVING COIL VOLT-METER (0-20 volts) is used when checking the regulator. The electrical 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 negative lead of the voltmeter to control box terminal D, and connect the other lead to terminal E.

Slowly increase the speed of the engine until the voltmeter needle "flicks" and then steadies. This should occur at a voltmeter reading between the appropriate limits given in Para. 2 (a) according to the ambient temperature.

If the voltage at which the reading becomes steady occurs outside these limits, the regulator must be adjusted.

Shut off the engine and remove the control box cover.

Slacken the locknut of the voltage adjusting screw (see Fig. 38) and turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to



lower the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Repeat as above until the correct setting is obtained.

Adjustment of regulator opencircuit voltage should be completed within 30 seconds, otherwise heating of the shunt winding will cause false settings to be made. Re-make the original connections.

A generator run at high speed on open circuit will build up a high voltage. Therefore, when adjusting the regulator, do not run the engine up to more than half throttle or a false setting will be made.

#### (ii) Mechanical Setting

The mechanical or air-gap settings of the regulator, shown in Fig. 38, are accurately adjusted before leaving the works and, provided that the armature carrying the moving contact is not removed, these settings should not be tampered with. If, however, the armature has been removed, the regulator will have to be reset. To do this proceed as follows :

Slacken the fixed contact locking nut and unscrew the contact screw until it is well clear of the armature moving contact.

Slacken the voltage adjusting screw locking nut and unscrew the adjuster until it is well clear of the armature tension spring.

Slacken the two armature assembly securing screws.

Using a 0.015" thick feeler gauge, wide enough to cover completely the core face, insert the gauge between the armature and core shim, taking care not to turn up or damage the edge of the shim.

Press the armature **squarely** down against the gauge and retighten the two armature assembly securing screws.

With the gauge still in position, screw the adjustable contact down until it just touches the armature contact. Re-tighten the locking nut.

Reset the voltage adjusting screw as described under Para. **3** (**b**) (**i**).

#### (iii) Cleaning Contacts

After long periods of service it may be found necessary to clean the regulator contacts. Clean the
contacts by means of fine carborundum stone or fine emery cloth.

Carefully wipe away all traces of dust or other foreign matter with methylated spirits (de - natured alcohol).

#### (c) Cut-out Adjustment

#### (i) Electrical Setting

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 (see Fig. 39) and turn this screw in a





Cut-out Air-gap Settings.

clockwise direction to raise the voltage setting or in an anticlockwise 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. If the cut-out does not operate, there may be an open circuit in the wiring of the cut-out and regulator unit, in which case the unit should be removed for examination or replacement.

#### (ii) Mechanical Setting

If for any reason the cut-out armature has to be removed from the frame, care must be taken to obtain the correct air-gap settings on re-assembly. These can be obtained as follows :

Slacken the adjusting screw locking nut and unscrew the cut-out adjusting screw until it is well clear of the armature tension spring.

Slacken the two armature securing screws.

Press the armature **squarely** down against the copper-sprayed core face and re-tighten the armature securing screws.

Using a pair of suitable pliers, adjust the gap between the armature stop arm and the armature tongue by bending the stop-arm. The gap must be 0.025''-0.030'' when the armature is pressed squarely down against the core face.

Similarly, the fixed contact blade must be bent so that when the armature is pressed **squarely** down against the core face there is a **minimum** "follow through," or blade deflection, of 0.010".

The contact gap, when the armature is in the free position, must be 0.018<sup>r</sup> minimum.

Reset the cut-out adjusting screw as described under Para. 3 (c) (i).

#### (iii) Cleaning Contacts

If the cut-out contacts appear rough or burnt, place a strip of fine glass paper between the contacts—then, with the contacts closed by hand, draw the paper through. This should be done two or three times with the rough side towards each contact. Wipe away all dust or other foreign matter, using a clean fluffless cloth moistened with methylated spirits (de-natured alcohol).

Do not use emery cloth or a carborundum stone for cleaning cut-out contacts.

# Service Instruction Manual

BODY

NZ

SECTION N

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# BODY

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# BODY



Fig. 1 Body Mounting Points. For clarification the attachment details and packing are shown on one side only.

## t. BODY MOUNTING POINTS (Fig. 1)

- (a) Point at front of chassis. Two pads at each side.
- (b) Upper points in side brace. An aluminium block sandwiched between a thick and thin pad, each side.
- (c) Lower points in side brace. Aluminium block with pads either side, each side.
- (d) Along chassis side member and along side brace for approximately 2 inches. One strip laid each side.
- (e) On cruciform adjacent to clutch bell housing.

Two pads at each side.

(f) Along front cruciform member. One strip each side.

- (g) Front outrigger brackets. Four square pads each side.
- (h) Along rear cruciform member. One strip with hole each side.
- (i) Rear outrigger brackets. Four square pads each side.
- (j) Rear of rear wheel. Wing valance to chassis frame.A metal stay secured to wing and chassis frame bracket by bolts, nuts

and lock washers at each side.

(**k**) Rear end of chassis frame. One pad at each side.

# 2. TO REMOVE BODY

- (a) Working under the car.
  - (i) Remove centre tie rod assembly from drop arm.
  - (ii) Drain both hydraulic systems.
  - (iii) Drain petrol tank.
  - (iv) Disconnect petrol pipe at tank union.
  - (v) Free petrol vent pipe from clip at R.H. side chassis member.
- (b) Working under the bonnet.
  - (i) Disconnect and remove battery.
  - (ii) Disconnect oil pressure pipe.
  - (iii) Disconnect clutch hydraulic union.
  - (iv) Remove L.T. cable from ignition coil.
  - (v) Withdraw rev. counter drive.
  - (vi) Disconnect the brake stop light cable.
  - (vii) Remove dip stick from engine sump.
  - (viii) Disconnect electrical connections at L.H. wing valance and wires from steering column centre if the car is L.H.S.
    - (ix) Remove water temperature gauge and free capilliary tube from petrol pipe.
    - (x) Remove radiator stays from corners of radiator.
    - (xi) Disconnect electrical connections at R.H. wing valance and wires from steering column centre if the car is R.H.S.

- (xii) Remove carburettors after disconnecting control linkage.
- (xiii) Remove cables from dynamo and starter motor.
- (xiv) Disconnect brake hydraulic union.
- (xv) Loosen steering column draught excluder clip.
- (c) Working inside the car.
  - (i) Remove the seat cushions followed by the seat frames.
  - (ii) Remove the carpets.
  - (iii) Disconnect the electrical control wires for the overdrive (if one is fitted).
  - (iv) Free the gear lever grommet and push the rim through the tunnel aperture.
  - (v) Remove the gearbox tunnel after withdrawing battery box drain pipe.
  - (vi) Remove speedometer drive.
  - (vii) Remove control head and steering wheel.
  - (viii) Loosen steering column bracing.
  - (ix) Remove brake handle grip and protect thread with tape to prevent damage when body is lifted.
- (d) Working at the front of the car.
  - (i) Remove front cowling. (See page 5.)
  - (ii) Rémove front bumpers.
  - (iii) Remove steering column. (See "Steering" Section G.)
- (e) Working at the rear of the car. Remove over-riders complete with brackets.
- (f) Ensuring that the hand brake is on, the body can be lifted when the securing bolts or screws as shown in Fig. 1 have been withdrawn.

# 3. TO FIT BODY

The fitting of the body is the reversal of the removal but the following points should be noted.

(a) New packing pieces as detailed in "Body Mounting Points" (page 1) should be used and positioned on the chassis frame as shown in Fig. 1, a smear of "Bostick" C or similar compound to adhere packings to chassis will assist this operation.

- (b) The thread of the handbrake lever should be protected with tape and the lever placed in the "On" position.
- (c) It may be considered desirable to feed guide pins through the extreme front and rear mounting points of the body before lowering it to the chassis. Attachment bolts and screws are shown in Fig. 1.
- (d) It is essential that sufficient sealing compound is used to effect a 100 % seal at the gearbox tunnel and floor inside the car.
- (e) Care must be taken to connect the overdrive electric cable correctly as damage will result if this instruction is not followed.
- (f) Both clutch and brake hydraulic systems must be bled at the completion of body replacement.
- (g) The twin carburettors will need tuning before the car can be used.

# 4. BATTERY BOX DRAIN (Fig. 2)

A battery box drain tube has now been incorporated in normal manufacture and was introduced at Commission No. TS 3288. Retrospective action can be taken on earlier cars if so desired as shown in the illustration.

# 5. TO REMOVE AND DISMANTLE FRONT BUMPER.

It is possible to remove the front bumper from its four support brackets without first removing the latter from the chassis.

- (a) Remove the over-riders by loosening the two nuts behind the inner support brackets. The over-riders can now be lifted free of the bolt head and the four mouldings collected.
- (b) Remove the loosened nut followed by the lock and plain washer. It is suggested that the bolt remains loose at this juncture.
- (c) The two outer support bracket nuts are now removed together with the lock and plain washers and the bolts withdrawn.



Fig. 2 Illustration giving details of Battery Box Drain for modifying cars prior to Commission No. T.S. 3288.

- (d) The bumper can now be lifted away from its support brackets and the four metal packings and the two centre bolts collected.
- (e) Withdraw two bolts from each pair of support brackets and chassis frame to release the four brackets. The two brackets on the steering column side have a secondary support from the lower steering column trunnion bracket bolt, and it may be necessary to loosen this bolt before the bumper support brackets on that side can be removed

# 6. TO FIT FRONT BUMPERS

Whilst it is possible to build the bumper assembly on the bench and then fit it to the car as a unit, it may be considered desirable to fit the support brackets to the chassis frame and then fit the bumper to the brackets.

The fitting procedure is the reverse of that for dismantling, but the following points should be noted.

(a) That an additional support is fitted to the brackets on the steering column side. This is a short plate with holes at each end. One end is fitted under the head of the lower steering column trunnion bracket bolt and the other end under the head of the front bumper support bracket bolt.

(b) The four strips of moulding should be placed between the contact edges of the over-riders and the bumper bar.

#### 7. TO REMOVE REAR OVER-RIDERS AND BRACKETS

- (a) Release the over-riders by loosening the nuts and then slide the over-riders off.
- (b) Hold the head of the lower attachment bolt under the car and remove the nut, lock and plain washer and bolt.
- (c) Hold the nut of the upper attachment bolt and withdraw bolt through the distance piece and support bracket. Collect the nut and plain washer and remove distance piece from body of car.

## 8. TO FIT REAR OVER-RIDERS

(a) Attach the support bracket to the chassis frame first at its bottom point by feeding the attachment bolt through the chassis frame into the bracket and attaching a plain and lock washer, but leave the nut loose at this juncture.

- (b) Position the distance piece in the car body. Feed the bolt through the support bracket and a plain washer and thence into the distance piece, following with a second plain washer and then secure with a nut.
- (c) The lower attachment can now be tightened.
- (d) The over-rider attachment bolts are positioned in the brackets together with the plain and lock washers and nuts. The over-rider has a "key-hole" shaped aperture to accommodate the head of the attachment bolt, the nut of which is tightened when the overrider is in position.

# 9. TO REMOVE FRONT WING

- (a) Jack up the car and remove the appropriate road wheel.
- (b) Withdraw the six bolts securing front wing to apron and the five bolts, the heads of which face the tyre tread.
- (c) Remove the six bolts from on top of the wing, these are situated just beneath the side of the bonnet lid.
- (d) Remove the door by withdrawing the seven bolts attaching the hinges to the door post and withdraw the nut and bolt from the door check strut. This gives access to six bolts at the extreme rear of the wing, these can now be removed.
- (e) Remove the rubber grommet from inside the car and withdraw the bolt from inside the aperture.
- (f) Remove the bulkhead sealer plate after withdrawing the five bolts from under the wing at rear of arch. Withdraw the three bolts situated underneath the sill and behind the arch opening.
- (g) Free the lower rear end of the wing by pulling outward, then lift to disengage the flange of the wing abutting the dash panel.

# **10. TO FIT FRONT WING**

This is the reversal of the removal but care should be taken to ensure all joints are watertight and that the door closes correctly. The sealing bead strip between the wing and apron is fitted with its hole uppermost.

# **11. TO REMOVE REAR WING**

- (a) Disconnect battery.
- (b) Remove rear light unit by withdrawing two fixing screws and disconnecting the wires at the snap connectors. These will need identification marks if the code colours of the harness are not distinguishable.
- (c) Jack up the car and remove the appropriate road wheel.
- (d) Withdraw nine bolts from inside the wing running from the top of the wing to the lower front edge.
- (e) Remove five bolts from inside the rear luggage compartment.
- (f) Release wing/chassis stay by removing nut, bolt, lock and plain washer.
- (g) Loosen three bolts on fixing flange of wing at extreme rear end.
- (h) The wing can now be removed in a backward direction and the sealing strip collected.

# 12. TO FIT REAR WING

This is the reversal of the removal but care should be taken when replacing the sealing strip and the electrical wires, the latter should be carried out with regard to the diagram in the "Electrical Equipment", Section M, or to the special identification markings.

# **13. TO REMOVE THE BONNET LID**

- (a) Release the bonnet locks either side by cable or by turning the Dzuz fastener and leave the bonnet resting in this lower position.
- (b) Remove the four nuts and washers (two to each hinge) from under the dash inside the car.
- (c) With an operator each side of the car lift the lid squarely upwards.

# 14. TO FIT THE BONNET LID

The fitting is the reversal of the removal. If the locks are cable operated the instructions on "Adjustment of Bonnet Locks", page 5, should be followed.

# 15. TO REMOVE FRONT APRON

- (a) Open the bonnet by releasing the locks from inside the car, or cars after Commission No. TS.4229 fitted with Dzuz fasteners at the forward corners of the bonnet lid by use of the carriage key. Prop the bonnet open and disconnect battery.
- (b) Remove four bolts (two each side), which secure the top apron reenforcement bar to the "U" brackets, situated on top of the front wings.
- (c) Disconnect the electrical wires at their snap connectors after suitably identifying them if the colours are not distinguishable.
- (d) If the car is earlier than Commission No. TS.4229, release the cable which connects the two locks from its clip. This clip is fitted at the centre of and forward of the apron re-inforcement bar. On cars later than TS.4229 this instruction can be disregarded.
- (e) Remove the twelve bolts (six each side) which secure the outer edges of the apron to the wings. These bolts are those which are fitted horizontally from inside the wheel arches. The other series of bolts, fitted vertically into the wheel arch, are **NOT** to be touched.
- (f) Remove the chassis frame to apron steady stay, at the apron end, by removal of the nut and bolt with lock washer.
- (g) Withdraw the bolt from the starting handle guide bracket. There is no necessity to remove the bracket itself.
- (h) The apron can now be removed by lifting the lower portion upward and forward to break the water seal and then lifting it bodily out of its brackets on top of the wing. The sealing beadings can now be removed.

# **16. TO FIT FRONT APRON**

The fitting is the reversal of its removal but care should be taken over the following points.

(a) The sealing beading is adhered to the apron in such a manner that the hole is adjacent to the uppermost hole of the

apron and the remaining slotted holes are adjacent to the lower holes.

- (b) The electrical wires are connected with regard to their colour identifications and the wiring diagram as found in the "Electrical Equipment", Section M, or the special identifications if the colours are not distinguishable.
- (c) On completion of the fitting the bonnet lid must be lowered gently to ascertain that the lock plungers and locks align correctly. (See notes below).

#### **17. ADJUSTMENT TO BONNET LOCKS**

On cars prior to Commission No. TS.4229 the bonnet locks were cable operated. It is essential when the bonnet lid or front apron have been removed that the bonnet locks are checked for alignment and the operating cables are correctly set.

- (a) It must be positively determined that when the bonnet release knob is operated the release levers of the locks are pulled clear of the plunger apertures. This can be ascertained by an operator in the car and an observer at the locks. If the release lever is not fully clear the cable must be adjusted.
- (b) Plunger centres and apertures must be identical. Longtitudal positioning of the plungers can be approximated by positioning on the lock centres. First attempt at closing the bonnet lid should be done with gentle pressure and the locking mechanism released. Any fouling of the plungers can be easily felt and adjustments made.

# **18. TO REMOVE WINDSCREEN**

- (a) Release the hood from the top of the windscreen.
- (b) Remove windscreen wiper blades and arms.
- (c) Turn the windscreen stanchion securing screws 90° anti-clockwise. Although these screws are spring loaded it may be necessary to ease the head outwards to ensure that the bolts are quite free.

(d) With operators each side of the car gently ease the windscreen assembly forward allowing the draught excluder to slide over the wiper blade spindles. The windscreen can be withdrawn and lifted from the car.

# **19. TO FIT WINDSCREEN**

This is the reversal of the removal but the following points should be noted.

- (a) The stanchion guides should be greased to prevent corrosion.
- (b) After fitting the screen ensure that the draught excluder are in good condition and position correctly.
- (c) Fit the windscreen wiper arms and blades and test for correct arcuate movement.

# 20. TO FIT AERO-WINDSCREEN

- (a) Remove winsdcreen as described on page 5. The steady bracket can also be removed if desired.
- (b) Withdraw the two chrome headed bolts on each side of the scuttle panel. Using these bolts attach the aero windscreen. The toe of the mounting bracket should point forward.
- (c) If it is so desired the normal windscreen can be replaced with the aero-screens still in position.

# 21. TO REMOVE DOOR

- (a) Withdraw the nut and bolt securing door check strap to the front door-post
- (b) Withdraw the screws securing the two hinges to the front door post, four in upper hinge, three in lower hinge.
- (c) The door can be lifted away.

# 22. TO FIT DOOR

The fitting of the door is the reversal of its removal but care should be taken to ensure that it hangs correctly and the lock engages with the dovetail on the rear post. It is suggested that the two hinges are not fully tightened and the door is closed slowly and gently. Any fouling will be immediately ascertained and the appropriate corrective action taken.

# 23. FRONT DOOR WATER SEALING

Additional water sealing at the top forward end of the doors was introduced in manufacture at Commission No. TS.5251. This sealing can be fitted to cars prior to this number. (Fig. 3)

This additional seal has been effected by the introduction of a rubber seal (Pt. No. 603257). This seal is fitted to the underside face of the front door post by six clips (Pt. No. 552901) in  $\frac{1}{4}$ " diameter holes drilled in this face .19" from the edge. A seventh and similar clip is fitted in the outward face of the pillar above the top of the hinge.

# 24. TO REMOVE DOOR LOCK

- (a) Withdraw four screws securing front side screen retainer bracket, identify the component and its position.
- (b) Remove upper end of trimmed lock pull strap by withdrawing screw.
- (c) Remove rear side screen retainer bracket and identify.
- (d) Remove dome nut from door lever and withdraw two screws to remove lock plate.
- (e) Withdraw the screws and cup washers from edge of door trim and remove trim.
- (f) The lock can be detached by removing the four screws holding the plate to the door frame.
- (g) The door check can be removed by first removing the nut and bolt attaching the strap to the door post. Then remove from the door by withdrawing the two attachment screws.

# 25. TO FIT DOOR LOCK

The fitting of the door lock is the reversal of the removal. The following points should be noted.

- (a) To ensure satisfactory operation of the lock it should be greased before fitting.
- (b) After fitting the lock to the door frame it should be set in conjunction with the striker dovetail.





Fig. 3

Front Door Water Sealing. For illustration purposes, only the right-hand door is shown.

(c) When fitting the side screen retainer brackets the correct position is only obtained by fitting them so that the heads of the locking screws face inwards. Having replaced the brackets it is a wise precaution to check the fitting of the side curtain.

# 26. REMOVAL OF GEARBOX TUNNEL

- (a) Lift out seat cushions and remove eight nuts from each seat. Lift out seats.
- (b) Remove front carpets and underfelts.
- (c) Release hand brake and speedo drive draught excluder and slide this up the brake lever.

- (d) Withdraw the sixteen fixing bolts around the flange of the tunnel. On early R.H.S. production cars it is necessary to remove the dipper switch and bracket (3 bolts).
- (e) If the car is fitted with overdrive disconnect the electric control wires at their snap connectors and feed them through the aperture in the tunnel.
- (f) Withdraw the drain pipe from front portion of tunnel.
- (g) Remove screws from gear lever grommet and push the rim of the grommet through the aperture.

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(h) The tunnel can now be removed by levering up the rear end to break the water seal.

# 27. TO FIT THE GEARBOX TUNNEL

The fitting is the reversal of the removal, but the following points should be noted.

- (a) It is essential that sufficient compound is used around the periphery of the tunnel to effect a good water seal.
- (b) If the car is fitted with overdrive it will be necessary to feed the control wires through the aperture in the tunnel before finally bolting the latter in position. These wires must be correctly matched.
- (c) On replacing the carpets an adhesive will be necessary.
- (d) The dipper switch will need replacing on early production cars.

# 28. TO REMOVE HOOD AND FITTINGS

- (a) Remove the hood by lifting the fasteners around the edge starting at the screen rail.
- (b) The metal frame can be removed by withdrawing the screws and fastener pegs and aluminium plate securing the webbing strap to the rear elbow rail.
- (c) Withdraw the two dome headed screws (one each side) securing the frame to the pivot bracket. The bracket can then be detached from the body by the withdrawal of four countersunk screws (2 each side).
- (d) The webbing strap can be removed by withdrawing the two screws and aluminium plate at each attachment point.
- (e) The frame is a riveted construction and unless any servicing is required the frame rivets should not be disturbed.
- (f) The fastener pegs may be withdrawn from the body by turning the hexagon head. The canopy fasteners can be withdrawn by removal of the nut on the inside of the canopy, utilising a forked tool.

# 29. TO FIT HOOD AND FITTINGS

The fitting is the reversal of removal, but care should be taken with the following points.

- (a) That the front draught excluder is in good condition.
- (b) All canopy fasteners are securely fitted and operate correctly.
- (c) All seams are fully watertight and if any new panels fitted or stitching carried out the stitching should be coated with "Everflex" Stitch Sealing Lacquer. See below.

# 30. WATER SEALING OF HOOD SEAMS

When panels have been replaced in the hood or tonneau cover it is essential that the stitching should be sealed. Failure to observe this instruction may cause water leaks not only at the seam itself but by the inner backing material acting as a wick and spreading the water to other parts of the component.

The sealing compound recommended is "Everflex" Stitch Sealing Lacquer. This is obtainable from our Spares Department in 4 oz. tins. It should be noted that the lacquer is highly inflammable and as such must comply with the limitations imposed upon transport and storing of such materials. The seams or stitching to be treated should be first carefully cleaned with a small nail brush using soap and water and then left to dry.

The "Everflex" Stitch Sealing Lacquer must be applied in a warm work shop, to dry material and to both sides of the seams. In no circumstances must it be allowed to come into contact with the transparent plastic windows owing to the solvent effect of this lacquer upon such material.

The lacquer should be applied by a brush with light even strokes and as it dries quickly excessive brushing must be avoided. Two coats are usually sufficient, allowing ten minutes drying time at room temperature between each coat.

Immediately upon completion of the lacquering the component should be heat treated to improve the bonding of the coating. Thirty minutes heat treatment at 220° F is recommended and should not be exceeded. The use of an infra red lamp should be avoided.

A lower temperature than that recommended in the previous paragraph may be used, or a hot air blast can be directed to the lacquer. If neither oven nor hot air blast is available the component can be left undisturbed in a warm atmosphere for 24 hours. Although reasonable sealing will be obtained by the instructions contained in this paragraph, the proper heat treatment at the higher temperature will provide the best possible water proofing.

## **31. ADJUSTMENT OF SIDE CURTAINS**

An aluminium wedge with two tapped holes is attached to each side screen support stay by a single screw which fits in slotted apertures providing the adjustment.

It is by moving these wedges up or down the support stays that adjustment is obtained. When adjustments have been completed ensure that the press studs of the curtain align with those on the door panel and the support stays are secured in their sockets by knurled screws.

# 32. TO PREPARE CAR FOR FIBRE-GLASS HARD TOP CANOPY

- (a) Remove hood and fittings as described on page 8.
- (b) Withdraw the screws securing the three cappings to the rear elbow rail and the fixing screw of the front petrol tank trim. Protect the exterior of the car adjacent to the elbow rail with masking tape.
- (c) Remove the millboard from the rear of the petrol tank by withdrawing the screws.
- (d) Assemble the windscreen bracket and bridge pieces to the canopy.
- (e) Position canopy on the windscreen and elbow rail of the car—windscreen *first*. Mark the position of the windscreen bracket holes on the flange.
- (f) Remove the canopy from the car and drill the windscreen beading. Transfer windscreen brackets from the canopy to the beading and secure with the fixing screws. (Fig. 4).



Fig. 4 Hard top Attachment Brackets fitted to Windscreen.

- (g) Reposition the canopy on the car and secure it to the windscreen. Check the position of the bridge pieces relative to the fixing holes in the elbow rail. If the holes do not align correctly it may be necessary to elongate the holes in the body. On cars previous to Commission No. TS.6820 these holes will need to be drilled. Mark the position of the brackets on the elbow rail and identify them to these positions. Release the canopy at the windscreen and remove from car.
- (h) Remove the bridge pieces from the canopy and secure them to the elbow rail with screws (in accordance with their position and identification markings) to a tapping plate fed in from the rear luggage compartment. (Fig. 5).

In order to simplify this operation it is suggested that the shank of a 2BA bolt is brazed to one end of a carburettor choke control cable or similar piece of wire.

To this assembly, when fed through a bridge piece toward the rear of the car, can be attached a tapping plate. The wire is now drawn back into the car until the plate is positioned under the elbow rail. The plate can now be secured to the bridge piece by one screw and the second screw fitted when the wire has been removed.

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Fig. 5 Bridge Pieces in position on Elbow Rail Channel.

- (i) Reposition the canopy on the car and secure to the windscreen brackets. Secure at the rear, setting the bridge pieces so that the bolts enter them correctly and obviating any possibility of cross threading
- (j) Remove canopy, rear end *first*. Pencil on the body protection tape lines which correspond to the threaded centres of the bridge pieces.
- (k) Position the cappings and transfer the markings on the body. On removing the capping drill a  $\frac{3}{8}''$  dia. hole on each line to align with the tapping of the bridge piece.
- (1) Fit the petrol tank trim in the rear luggage compartment. Remove protecting tape from the body of the car.
- (m) Fit the screw securing the front petrol tank trim and secure the three cappings to the elbow rail. Fit four counter sunk screws and chromium washers (two each side) in the holes previously accommodating the hood bracket screws.
- (n) Select the three norrow protection caps and position these on the rear cappings, aligning the apertures with the threaded centres of the bridge pieces: the  $\frac{3}{8}''$  dia. holes may need elongating to permit this adjustment. Drill the cappings through the protection caps. Secure with two screws each. The two larger caps are fitted similarly to the side elbow rails. (Fig. 6).



Fig. 6 Protection Plates in position on R.H. and Centre Cappings.

#### 33 TO FIT FIBREGLASS HARD TOP CANOPY

- (a) The canopy is positioned on the car and secured to the windscreen first.
- (b) The rear of the canopy is then secured to the elbow rail with five bolts. (Fig 7).



Fig. 7 Hard Top positioned on Elbow Rail at side and rear.

To position the canopy correctly it may be necessary to spring it over the rear elbow rail. This is permissible owing to the flexible nature of the fibreglass material.

(c) The sidescreens are adjusted (see page 9), so that their front edges fit inside the windscreen side beading and the top and rear edges fit as close to the canopy as possible.

On initial fitting of the fibreglass canopy it may be necessary to remove and reposition the sidescreen retainer brackets.

#### 34. TO REMOVE FIBREGLASS HARD TOP CANOPY

It is essential that the following instructions are carried out in the sequence mentioned, difficulty may be experienced if operations (b) and (c) are reversed.

- (a) Remove the side screens from the doors by loosening knurled nuts and lifting side screens.
- (b) Withdraw the five bolts securing the rear of the canopy to the elbow rail. These bolts are "waisted" to retain them in the mounting flange of the canopy and care must be exercised during their removal to ensure that the shank below the "waist" does not become locked in the mounting flange.
- (c) Similarly, withdraw the three bolts securing the front of the canopy to the windscreen flange.
- (d) With an operator either side of the car, lift the canopy and carry it rearwards to effect its final removal.

## 35. TO REMOVE LUGGAGE BOOT LID

Before dismantling, the hinges and carriage locks should be marked as they are handed.

- (a) The lid is opened and the two nuts and shakeproof washers removed from each hinge. The right-hand hinge also accommodates the boot lid stay rod. The lid is now moved clear.
- (b) The hinges can be removed by first removing the front trim of the luggage boot to gain access to their attachment nuts. Two nuts and shakeproof washers are removed to withdraw each hinge.
- (c) The two carriage locks are removed by withdrawing the two fixing screws each. These locks should be marked as they are handed.
- (d) The escutcheons are removed by withdrawing two screws from each.

(e) The centre lock is removed from the lid by first withdrawing the bolt securing the lock latch to the lock shaft and collecting shake proof washer, then removing the nut securing the lock barrel to the boot lid.

#### 36. TO FIT LUGGAGE BOOT LID

The fitting is the reversal of the removal but care should be taken over the following points.

- (a) The hinges and carriage locks are handed and should be fitted to their appropriate sides.
- (b) The aperture rubber seal should be in good condition. The drain pipes at the rearmost corners should also be inspected for condition. It is a wise precaution to feed a thin wire through these pipes to ensure that the passage way is clear.
- (c) On replacing the lid to the hinges the attachment nuts should be loose at this juncture. The lid should then be lowered into position to ascertain that it is central in its aperture.

The nuts are then fully tightened.

# 37. TO DISMANTLE SPARE WHEEL LID

- (a) The lid is removed by turning the carriage locks.
- (b) The locks are removed by withdrawing the four attachment screws (two to each lock). These locks should be marked as they are handed.
- (c) The escutcheon plates are removed by withdrawing four screws (two to each plate).
- (d) The wheel and tool securing straps are removed from inside the wheel compartment by withdrawing the two screws for each strap staple.

#### 38. TO ASSEMBLE SPARE WHEEL LID

The assembly and fitting of the spare wheel lid is the reversal of the removal and dismantling. The following points should be noted.

- (a) The buckle end of the strap should always be fitted to the floor.
- (b) The locks are handed and should be fitted to the correct side.

BODY

#### TO FIT SMITHS CIRCULAR HEATER C.H.S. 920/4

The following procedure for carrying out this installation is recommended :—

- 1. Disconnect the battery lead.
- 2. Drain the cooling system and remove the two square headed plugs, one from the rear of the cylinder head and the other from the water pump housing.
- 3. Fit the taper threaded tap (28)(Fig. 16) into the tapped hole at the rear of the cylinder head and screw into the tap the special extension (27), so that this protrudes from the engine on the R.H. side of the unit (Fig. 8).





Fitting Tap Extension

- 4. Install the taper threaded end of the female adapter (32) into the back of the pump housing. Attach the metal return pipe (29) to this adapter with the olive and union nut. Secure the pipe steady bracket to the rear of the two ignition coil fixing bolts.
- 5. Remove the two plates and rubber washers —one from each side of the bulkhead after withdrawing the chamfer headed screws. Assemble the metal water pipe connecters (22) with their rubber washers (21) into these two apertures, securing each with two chamfer headed screws (Fig. 9).
- 6. Attach the two short lengths of rubber water hose (26) to the forward ends of these metal connecters, fitting the other ends of



Fig. 9 Assembling Water Pipe Connecters

these hoses to the previously installed tap adapter tube and the metal return pipe on the right and left sides of the car respectively.

- 7. Remove the trimmed glove casing after the withdrawal of the four P.K. screws.
- 8. Working underneath the dashboard, remove the four nuts, spring and plain washers—two from each side—those on the steering side of the car secure the "U" shaped steering bracket support rod.



Fig. 10 Releasing Steering Support Rod when fitting Demister Nozzle to steering side of car

It will be necessary to drop this support rod clear of the studs and this will be facilitated by slackening off the upper nuts on each arm of the "U" (Fig. 10). Locate the demister nozzles (1) on the two pairs of studs ensuring that they are above and clear of the screen wiper drive cable. Reposition "U" shaped rod and refit nuts and washers on the four studs and retighten with a suitable spanner.

9. At this point it is advisable to install the electrical control switch (Fig. 11), a hole for which is already provided in the dashboard. For the sake of appearance the hole in the dashboard is covered by trim material until it is required. This covering of trim can easily be cut away with a small sharp blade, after location of the hole with the tip of a finger, its position is approximately 4'' from the steering end of the dashboard at a point  $2\frac{5}{8}''$  from the lower edge of the dash panel.



Fig. 11 Showing location of Heater Control Switch.

- 10. One side of the control switch (13) should be connected to the live side (L.H.) of the windscreen wiper switch. Attach the length of wire (12) supplied at one end with a snap connecter nipple to the other side of the switch leaving the completion of the circuit until operation 16.
- 11. Attach the mounting bracket (15) to the heater unit securing it with three spring washers and nuts. Assemble the two longer lengths of water hose (20) on to the adapters on the heater and secure with clips (19). Fit and secure alloy elbow piece (5) to heater unit (Fig. 12).



Fig. 12 The Heater Unit ready for assembling into position

- 12. Working under the bonnet, remove the centrally positioned rubber grommet from above the battery.
- 13. Install the Heater Unit, after fitting the two P.K. spire nuts (16) on either side of the Heater Unit mounting bracket, and position the unit so that the stud on the forward stay of the bracket protrudes through the hole from which the grommet was removed (Operation 12), securing with nut and a spring washer (18). Next attach the transverse portion of the heater attachment bracket with the two bolts to the forward of two central slots in each of two panel stays.
- NOTE—When fitting this equipment to an early car which is equipped with an electrically operated overdrive ensure that the heater unit does not foul the overdrive relay and cause a short circuit. If such a condition arises suitably reposition the relay.
- 14. Assemble the free ends of the two longer hoses, already fitted to the heater unit, on



Fig. 13 Fitting Heater Hoses on water pipe connecters

their respective connecters (Fig. 13), *i.e.*, the hose on the L.H. side to the water pipe return connecter and that on the other side to the connecters for the feed hose, and secure with clips. These connecters were fitted in operation 5.

15. Fit the two lengths of demister hose (2)&(3) to the demister pipe "Y" shaped air duct (4) and install into the alloy elbow piece (5) (fitted in No. 11) on the heater unit (Fig. 14). The longer length of hose should be attached to the L.H. side demister nozzle and the shorter to the R.H. side demister nozzle.



Fig. 14

Heater Unit in assembled position

- 16. To complete the electrical circuit connect the nipple on the free end of the cable attached to the control switch into a snap connecter (11) on the feed wire (10) already attached to the heater unit. The earth wire (9) from the heater unit should then be secured to the L.H. dash bracket by one of its forward screws.
- 17. Replace the trimmed glove box casing.
- 18. Replenish cooling system, ensuring that the heater tap (28) is turned on and the cooling system drain taps are turned off.
- 19. Reconnect detached battery lead.
- 20. If, when the engine is warm, the heater and demister nozzles still blow cold air it is probably due to air in the water system. To overcome this it will be necessary to slacken off the water pipes one at a time from their connecters, working in the direction of circulation, increasing the revolutions of the engine occasionally to help circulate the water. This operation should be carried out with the radiator filler cap removed.



Fig. 15 Showing position of Delivery and Return water pipes

NOTE—The Heater Kit for this Model is supplied under Part No. 551877, and a copy of these instructions will be packed in each carton. BODY



Fig. 16 Exploded view of Heater kit

# NOTATIONS

Ret No	f. Description	Ref No.	Description
1.	Demister Nozzle (2 off).	18.	Nut with Spring Washer for secur-
2.	Demister Hose, R.H.		ing Forward Stay of Attachment
3.	Demister Hose, L.H.		Bracket.
4.	Demister Pipe "Y" shaped Air Duct.	19.	Large Diameter Pipe Clip (4 off).
5.	Alloy Elbow Piece.	20.	Long lengths of Heater Hose (2 off).
6.	Elbow Piece Securing Screw.	21.	Rubber Washer (2 off).
7.	Heater Unit.	22.	Metal Water Pipe Connecter (2 off).
8.	Securing Nuts for Attachment Bracket	23.	P.K. Spire Nuts, Small (4 off).
	(3 off), Spring Washers (3 off)	24.	P.K. Spire Screws (4 off).
9.	Earth Wire.	25.	Heater Pipe Clip, Small Size (4 off).
10.	Feed Wire to Heater Unit.	26.	Short length of Rubber Water Hose
11.	Snap Connecter.		(2 off).
12.	Feed Wire from Control Switch.	27.	Special Tap Extension.
13.	Control Switch.	28.	Taper threaded Tap.
14.	Feed Wire from Live Side of Windscreen	29.	Metal Water Return Pipe.
1	Wiper Switch.	30.	Union Nut.
15.	Heater Unit Mounting Bracket.	31.	Olive.
16.	P.K. Spire Nuts, Large (2 off).	32.	Taper threaded Female Adapter.
17.	P.K. Spire Bolts (2 off).		

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# Service Instruction Manual

# FUEL SYSTEM

**P]** 

SECTION P

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# FUEL SYSTEM

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# FUEL SYSTEM



Fig. 1

Exploded view of Petrol Tank and Pipe Lines.

NOTATION FOR Fig. 1				
Ref. No. Description	Ref. No. Description			
<ol> <li>Petrol tank</li> <li>Petrol tank strap</li> <li>Petrol tank strap fixing blot</li> <li>Drain plug</li> <li>Banjo bolt for vent pipe</li> <li>Fibre washer above banjo connection</li> <li>Fibre washer below banjo connection</li> <li>Vent pipe</li> <li>Cork washer</li> <li>Petrol tank gauge unit</li> <li>Petrol filler cap and neck assembly</li> <li>Upper hose clip</li> </ol>	<ul> <li>Rubber hose connection</li> <li>Lower hose clip</li> <li>Petrol pipe tank to connection</li> <li>Pipe connection</li> <li>Rubber grommet</li> <li>Petrol pipe (connection to stop tap)</li> <li>Flexible hose</li> <li>Stop tap outlet union nut</li> <li>Brass olive</li> <li>Petrol stop tap</li> <li>Plain washer</li> <li>Jam nut for top attachment</li> </ul>			

PI

# I. DATA AND DESCRIPTION

#### (a) Tank capacity

 $12\frac{1}{2}$  gallons (no reserve).

#### (b) Petrol Stop Tap

Situated on the left-hand side of the chassis frame and is connected to the petrol pump by a flexible hose.

#### (c) Petrol Pump

A.C. type "UE" camshaft driven situated on left-hand side of engine.

#### (d) Carburettors

Twin S.U. type H4 fitted to interconnected manifold on right-hand side of engine.

Standard needle FV.

For high speed and competition work GC needles.

#### (e) Air Cleaners

A.C. Shpinx type 7222575. Oil damped. One fitted to each carburettor.

The petrol tank is situated forward of the luggage boot and access is gained by removing the trim from the rear of the driver's cockpit. The filler cap is a press button release type centrally situated forward of the luggage boot. Looking forward from the rear, the vent pipe and capacity gauge tank unit are situated on the upper right-hand side of the tank and the pipe feed is taken from the lower right-hand side. Provision is made for draining, the plug being centrally situated on the underside of the tank.

The petrol feed pipe is brought forward and to the left-hand side of the chassis. As the level of the fuel is above that of the petrol pump union a petrol stop tap is incorportated in the pipe line. This will facilitate the disconnection of this union without first draining the petrol tank. The tap is fitted to a welded fork bracket on the left-hand chassis frame member. A flexible hose connects the tap to the fuel lift pump. From the petrol pump a metal pipe passes round the front of the engine, to the twin S.U. carburettors.

Each carburettor is fitted with an individual oil damped A.C. air filter.

#### 2. TO REMOVE PETROL TANK

- (a) Drain the petrol from the tank by the centrally situated drain plug in the underside of the tank.
- (b) Remove the centre capping of the rear elbow rail by withdrawing the securing screws. Slide this capping to one side until its other end is clear of the side capping. The centre can now be withdrawn.
- (c) Remove the carpet fixing screws and ease up carpet to withdraw tank cover board fixing screws, by removing the latter the board can be eased away from the side capping and the upper retaining clips.
- (d) Remove the rear cover board from inside the luggage boot. The lower fixing screws are under the front edge of the carpet.
- (e) Loosen hose clips on filler pipe assembly and unscrew filler cap. Ease the short hose from the filler neck of the tank. Remove banjo bolt securing vent pipe to tank.
- (f) Remove cable from petrol gauge tank unit.
- (g) Remove petrol feed pipe from underside of tank. This may have already been disconnected to facilitate draining.
- (h) Remove the four tank securing bolts and the lock washers followed by the tank straps and felts.
- (i) The tank can be removed from the car in a forward direction. Tape the opening of the tank as a precaution against the entry of dirt.

# 3. TO FIT PETROL TANK

After ensuring that the tank is perfectly sound and clean, it can be replaced in the car.

The recommended method of testing the tank is to clean the exterior with a wire brush, blank off the filler pipe and all but one union then connect to a compressed air line. Submerge the tank in water and slowly fill the tank with air. Faults will clearly be seen by escaping air.

The replacement of the tank is the reversal of the removal.

It is a wise precaution to run the engine for a short time to observe the connections for leaks before replacing the trim.

# 4. PETROL GAUGE

#### Description

The petrol gauge comprises two components, the dashboard meter and the tank unit.

The dashboard meter consists of a metal case, containing the coils and shaped knob pieces which operate the gauge, also a bezel with a calibrated dial and indicator needle.

The coils are wound on bakelite bobbins with soft iron cores and the shaped knob pieces exert a magnetic force on a pivotted iron armature which is attached to the indicator. The magnetic force of the two coils cause the armature to be deflected in accordance with the amount of petrol in the tank. The connections of these coils and a resistance mounted below the armature are shown in the wiring diagram, Fig. 2.



# Fig. 2 Theoretical circuit of Fuel Gauge, Tank Unit and Motor.

The voltage across each coil is varied according to the position of the tank unit float arm.

The tank unit consists of a float and float arm mounted in a zinc based die casting. The float arm carries a contact arm which travels over a resistance wound on a bakelite former. The contact arm takes up a position according to the quantity of petrol in the tank and so varies the current through to the meter.

#### 5. PRECAUTION WHEN CARRYING OUT TESTS

In no circumstances should the battery supply be connected directly to the terminal of the tank unit.

On no account should the float arm be bent or set to any other shape than that when it is supplied.

The float arm is provided with top. and bottom stops which prevent the contact arm over-riding the resistance.

#### 6. TO TEST DASH METER

The following tests will indicate whether the dash meter is functioning satisfactorily.

- (a) Disconnect the wire from terminal "T" and switch on ignition. The dash meter should read full.
- (b) With the wire to terminal "T" still disconnected, connect the wire to the car or connect to earth by a similar method. The meter should read empty when the ignition is switched on.

#### 7. TO TEST TANK UNIT

- (a) Remove unit from tank.
- (b) Check the float arm for freedom of movement.
- (c) Having checked the dash meter and found it to be satisfactory, connect terminal "T" of the tank to terminal "T" of the meter.
- (d) Connect tank unit body casting to body of dash meter.
- (e) Switch on ignition and the reading of the meter will vary according to the position of the float arm. If the dash meter indicates "full" irrespective to the position of the float arm, the tank unit is faulty and should be replaced.

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# FUEL SYSTEM

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SYMPTOM	CAUSE	REMEDY
No Reading	(1) Meter supply interrupted.	Reconnect wires.
	(2) Meter case not earthed.	Connect case or fix to earth
	(3) Tank unit cable earthed.	Replace cable.
Meter reads full.	(4) Tank unit cable broken or disconnected.	Reconnect.

#### 8. TO REMOVE FLEXIBLE PETROL FEED PIPE

In no circumstances must an attempt be made to remove this hose from the lift pump without first diconnecting it from the petrol stop tap.

- (a) Turn off petrol at the stop tap.
- (b) Loosen the union nut securing the flexible hose to the tap and withdraw its rigid end together with olive and union nut.
- (c) Remove hose from the pump by turning the entire length of the hose.

#### 9. TO FIT FLEXIBLE PETROL FEED HOSE

Do not attempt to twist the hose without allowing its entire length to turn.

- (a) Attach the hose to the petrol pump and secure to make a petrol tight joint.
- (b) To the rigid end feed on the union nut and the olive.
- (c) Position this rigid end in the petrol stop tap so that it reaches the bottom of its bore. Secure with union nut, the tightening of the union nut seat the olive and make a petrol tight joint.
- (d) Open petrol tap and using hand primer on the petrol pump prime the system to ensure carburettor float chambers are full.
- (e) Start engine and run for a little while observing the connections for leaks.

#### 10. PETROL STOP TAP Description

The tap, fitted at the end of the rigid petrol line, is secured to the chassis by a special welded fork bracket to the L.H. side chassis frame brace.

It is an Ewarts "pull and push" type which can be locked in the "on" position by turning the plunger head in an anticlockwise direction approximately  $\frac{1}{8}$ " of a turn.

The purpose of this tap is to facilitate the disconnection of the petrol pipe at the pump without first draining the petrol tank as the level of the petrol in the tank is above that of the pump.

# II. TO REMOVE PETROL STOP TAP

- (a) Drain the petrol tank.
- (b) Remove the union of the flexible hose and withdraw from outlet connection of the tap body.
- (c) Remove the union nut from the lower extremity of the tap and ease out the rigid petrol supply pipe.
- (d) Loosen the jam nut situated on the underside of the welded fork bracket. The tap can now be lifted out of the fork.

# 12. TO FIT PETROL STOP TAP

(a) To the threaded stem of the tap attach the securing nut and plain washer. Screw the nut until it is approximately  $\frac{1}{4}$ " from the abutment shoulder.

- (b) Fit the tap into the fork bracket so that the feed to the pump is uppermost. The two flats on the tap body will assist in locating its position. Secure the tap to bracket by tightening the jam nut.
- (c) Position the rigid petrol feed pipe from tank into lower portion of tap and ensure that the olive is seated before the union nut is attached and tightened.
- (d) Attach the flexible hose from pump to outlet connection of the tap and secure to give a petrol tight joint.
- (e) Fill petrol tank, open tap and prime pump by hand until the carburettor chambers are full.
- (f) Start the engine and allow it to run for a short time while inspecting the connections for leaks.

# **13. SERVICING THE PETROL STOP** TAP

In practice the tap will require little attention apart from a periodical inspection to ensure that it is leak proof.

The tap has a cork plunger which can be expanded to increase the interference and so improve the seal.

The cork is expanded by loosening the lock nut at the top of the plunger and the centre rod in an anti-clockwise direction, retighten the locknut. It will be noticed that increased resistance is felt when the tap is operated.

# 14. TO DISMANTLE PETROL STOP TAP

- (a) Loosen the round headed screw at the side of the tap body sufficiently to allow the plunger to be withdrawn.
- (b) Remove the lock nut in the head of the plunger. By turning the cork it can be removed together with the centre rod.
- (c) The cork can now be pushed off the centre rod.
- (d) Clean and inspect all parts and renew any that are believed to be defective.

- 15. TO ASSEMBLE PETROL STOP TAP
  - (a) Fit the cork seal on to the centre rod and screw the rod into the plunger head sufficiently to just nip the seal. Attach the lock nut to the centre rod protruding through the head of the plunger.
  - (b) Smear the cork and the inside of the tap body with a little oil or grease.
  - (c) Carefully feed the plunger into the tap body so that the groove in the plunger aligns with the round headed screw in the exterior of the body.
  - (d) Tighten the body screw so that the plunger is located in the tap body and has freedom of movement.
  - (e) Adjust the interference of the plunger to ensure that petrol will not seep past the cork seal. This is effected by turning the centre rod of the plunger anti-clockwise to increase or clockwise to decrease the interference.
  - (f) Lock the centre rod with the lock nut in the head of the plunger.

# 16. AC FUEL PUMP TYPE " UE "

#### Description (Fig. 3)

The AC fuel pump, type "UE", is operated mechanically from an eccentric (H) on the engine camshaft (G). The illustration gives a sectional view of the pump, the method of operation is as follows:—

As the engine camshaft (G) revolves, the cam (H) lifts pump rocker arm (D) pivoted at (E) which pulls the pull rod (F) together with the diaphragm (A) downward against spring pressure (C) thus creating a vacuum in the pump chamber (M).

Petrol is drawn from the tank and enters at (J) into sediment chamber (K) through filter gauze (L), suction valve (N) into the pump chamber (M). On the return stroke the spring pressure (C) pushes the diaphragm (A) upwards, forcing petrol from the pump chamber (M) through the delvery valve (O) and outlet (P) to the carburettor feed pipe.



Fig. 3

Section view of Petrol Pump.

When the carburettor float chambers are full the float will rise and shut the needle valve, thus preventing any flow of petrol from the pump chamber (M). This will hold diaphragm (A) downward against spring pressure (C), and it will remain in this position until the carburettors requires further petrol and the needle valve opens. The rocker arm (D) operates the connecting link by making contact at (R) and this turns passes into the lower body of the petrol pump below the diaphragm assembly and by action of the latter is pumped out by way of the breather hole.

To obviate this condition an oil seal is fitted round the diaphragm assembly push rod and is prevented from rising with the action of the push rod by a metal retainer staked to the lower pump body.

Petrol pumps fitted with this oil seal were fitted to engines after No. TS.2074E.

During dismantling this oil seal should not be removed unless it is known to be defective.

# **18. TO CLEAN THE PUMP FILTER**

The pump filter should be examined every 1,000 miles and cleaned if necessary.

Access to the filter is gained by loosening the thumb nut situated below the glass sediment chamber at the side of the petrol pump body and swinging the wire frame to

	NOTATION	FOR	Fig. 3.
Ref. No.	Description	Ref. No.	Description
A Dia C Dia D Roc E Roc F Dia G Eng H Fue J Inle K Sed L Filt M Pun	phragm assembly phragm spring cker arm cker arm fulcrum pin. phragm pull rod. gine camshaft. el pump cam on camshaft. et port. liment chamber. er gauze. np chamber.	N O P R S W X	Inlet or suction valve. Outlet or delivery valve. Outlet port Contact point between rocker arm and link lever. Rocker arm spring. Link lever. Oil seal and retainer. Petrol pump with this oil seal were fitted to engines after No. TS.2074E.

construction allows idling movement of the rocker arm when there is no movement of the fuel pump diaphragm.

Spring (S) keeps the rocker arm (D) in constant contact with cam (H) and eliminates noise.

# 17. PETROL PUMP OIL SEAL

During very fast cornering oil rises up the cylinder block walls and during right-hand

one side. The sediment chamber can be removed followed by the cork gasket and gauze filter.

The gauze filter should be cleaned by a blast of air or washing it in clean petrol. The cork gasket should be inspected for condition and replaced if broken or hard. The glass sediment chamber should be cleaned and its upper rim inspected for chips.



The replacement of the filter is the reversal of the removal. The thumb nut should be tightened sufficiently to make a good seal, overtightening tends to harden the seal which then looses its sealing properties. The hand priming pump should be used to fill the sediment chamber and carburettor float chambers. The engine should be started and run for a few minutes so that the pump may be observed for leaks.

# **19. TESTING WHILE ON ENGINE**

With the engine stopped and switched off, the pipe to the carburettor pipe should be disconnected at the pump and replaced by a shorter tube, leaving a free outlet from the pump. The engine is then turned over by hand, when there should be a well defined spurt of petrol at every working stroke of the pump, namely, once every two revolutions of the engine.

# 20. TO REMOVE PETROL PUMP FROM ENGINE

- (a) Turn off at petrol stop tap and remove the flexible hose from the tap first, then remove the hose from the pump.
- (b) Remove fuel feed from pump to carburettor at its pump connection.

- (c) Remove the two pump securing nuts and spring washers. Note the oil pressure pipe clip is attached to the rear stud.
- (d) The pump can be removed from the cylinder block, together with the packing.

# 21. TO FIT PETROL PUMP TO ENGINE

- (a) Place a new packing of correct thickness on the pump attachment studs followed by the pump. Secure with foremost nut and lock-washer finger tight.
- (b) Position on the rear stud the oil pressure pipe clip, secure with nut and lockwasher. Tighten both nuts
- (c) Attach the carburettor feed to pump and secure with union nut taking care to seat the pipe olive before attaching the union nut.
- (d) Attach the flexible hose to the forward end of the pump. Attach and secure the rigid end to the petrol stop tap.
- (e) Turn on petrol and prime pump with hand lever, until the glass sediment chamber and carburettor float chambers are full.
- (f) Start and run the engine for a few moments and examine the connections for leaks.

# 22. TO DISMANTLE PETROL PUMP

## For Notation see Fig 5.

- (a) Clean the exterior of the pump and with a file mark the two flanges with a small cut.
- (b) Loosen the thumb nut under the glass sediment chamber (6) and swing the frame (9) clear. The sediment chamber can now be lifted clear together with cork seal (4) and gauze filter (2).
- (c) The wire frame can now be lifted out of the upper body (1) of the pump.
- (d) Separate the two castings (1 and 16) by withdrawing the six securing screws (12) and lockwashers (13).

Ref. No.

1

2

3

4



Fig. 5 Showing the "UE" type Fuel Pump in exploded form.

(e) To remove the diaphragm assembly (10) first turn it through 90° in an anti-clockwise direction and lift out of engagement with link lever (22). Collect the diaphragm spring (11). No attempt should be made to separate the four layers of the diaphragm as it is a riveted assembly. The oil seal (15) and retainer (13) can be prised out if known to be defective.

# NOTATION FOR Fig. 5.

Description

Upper body. Gauze filter. Valve gasket. Cork seal

- 5\* Inlet and outlet valve assemblies.
- 6 Glass sediment bowl.
- 7 Valve retaining plate.
- 8 Screw for retaining plate.
- 9 Wire cage.
- 10 Diaphragm assembly.
- 11 Diaphragm spring.
- 12 Body securing screw.
- 13 Oil seal retainer.
- 14 Lock washer.
- 15 Oil seal.
- 16 Lower body.
- 17 Hand primer spring.
- 18 Cork washer.
- 19 Hand primer lever.
- 20 Hand primer lever shaft.
- 21 Rocker arm spring.
- 22 Link lever.
- 23 Rocker arm.
- 24 Retainer ring.
- 25 Washer.
- 26 Rocker arm pin.

\*These values are identical, but on fitting them to the upper body the spring of the inlet value is pointing towards the diaphragm and the spring of the outlet value away from the diaphragm, as shown in the illustration.

- (f) Prise off hand primer lever (19) collecting cork washers (18) and hand lever spring (17) only if the hand primer is known to be defective. Drift out hand primer lever shaft (20).
- (g) Remove circlips (24) from either end of rocker arm pin (26). Drift out rocker arm pin (26), collecting washers (25), rocker arm (23), link lever (22) and rocker arm spring (21).
- (h) Invert the upper casting (1) and withdraw two valve retaining plate screws
  (8) followed by the retaining plate
  (7) valves (5) and valve gasket (3).

## TO ASSEMBLE PETROL PUMP

- (a) Place the figure of eight gasket (3) in position on the valve ports in the upper body (1). Position the inlet valve assembly (5) in the off centre and shallower port, with the spring of the valve pointing towards diaphragm. The outlet valve (5) is positioned in the centre port with the spring of the valve inside the port itself. The valve retainer (7) is secured, holding both valves in place, with two screws (8).
- (b) Fit the diaphragm rod oil seal (15) and retainer (13) in the lower body (16) and stake over the wall of the seal recess. Position the hand primer shaft (20) with the offset uppermost and with its tongue pointing toward the pump mounting flange. Fit the cork washers (18) to the protruding ends of the shaft, on each side of the body (16).
- (c) Fit the hand primer lever (19) and then peen over the ends of the shaft (20) to retain the lever (19).
- (d) With the loops of the lever spring (17) upwards, feed the legs of the spring between the lever and the pump body so that it settles in its position on the upper side of the lever. The two legs are positioned above the lower body web adjacent to the outside of the pump mounting flange.
- (e) Feed the rocker arm pin (26) partially into the pump body (16). Position one packing washer (25) on the pin following with one flange of the link lever (22).
- (f) With the mounting flange uppermost position the rocker arm spring (21) on the cone-like protrusion in the pump body. The rocker arm (23) is fitted into the link lever and a protrusion allowed to engage the coil spring.
- (g) The pin (26) is pressed through the link lever (22), the rocker arm (23) and a washer (25) situated between the second flange of the link lever (22) and the pump body (16). A retaining ring (24) is fitted when the pin (26) protrudes through the pump body (16).

(h) Position the diaphragm spring (11) on its base and fit the diaphragm (10) (with the tab toward the engine) by inserting the rod through the oil seal into the slot of the link lever (22) and turning it a quarter turn to the right (Fig. 6).



Fig. 6 Fitting the Diaphragm to the Pump Body.

- (i) The upper and lower bodies are secured with six bolts and lock washers, in such a manner that the sediment chamber (6) is on the opposite side to the diaphragm tab, or in accordance with the file marks.
- (j) Position the gauze filter (2) in its housing, followed by the cork seal (4) and the glass sediment bowl (6). The wire cage (9) is attached and the thumb nut is tightened sufficiently to effect a petrol tight seal. Overtightening of this seal (4) will only harden the seal and destroy its properties.

# 24. INSPECTION OF PARTS

# For Notation see Fig. 5.

Firstly, all parts must be thoroughly cleaned to ascertain their condition. Wash all parts in the locality of the valves in a clean paraffin bath separate from that employed for the other and dirtier components. Diaphragm and pull rod assemblies should normally be replaced unless in entirely sound condition without any signs of cracks or hardening.

Upper and lower castings should be examined for cracks or damage, and if diaphragm or engine mounting flanges are distorted these should be lapped to restore their flatness.

All badly worn parts should be replaced, and very little wear should be tolerated on rocker arm pins (26), the holes and engagement slot in links (22), holes in rocker arm (23). On the working surface of the rocker arm (23) which engages with the engine eccentric, slight wear is permissible but not exceeding .010" in depth.

The valve assemblies (5) should not be replaced unless in perfect condition. Diaphragm springs (11) seldom call for replacement, 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 gaskets and joint washers should be replaced as a matter of routine. This also applies to oil seal (15) held in position by retainer (13).

# 25. AC AIR CLEANERS

# Description

This cleaner is the wire gauze fitted metal canister type and is oil damped. The oil damping is carried out as a servicing operation.

Each carburettor has its own air cleaner functioning in such a manner that air drawn in by the engine first passes through the oiled gauze before entering the carburettor and so prolongs the life of the engine. Whenever the air cleaners are being replaced it is essential that the holes adjacent to the setscrew holes are uppermost so that they will align with those holes in the carburettor flange.

# 26. TO REMOVE AIR CLEANERS

This is required each time the carburettors are tuned or to service the cleaner itself.

- (a) Loosen the cap nut on the top of the carburettor float chamber and turn the splash overflow pipe away from the air filter.
- (b) Withdraw the two bolts securing the air cleaner to its mounting flange.
- (c) The air cleaner and joint washer can now be removed.

# 27. TO FIT AIR CLEANERS TO CARBURETTORS

- (a) Adhere the joint washer to the body of the air cleaner with a smear of grease.
- (b) Ensuring the splash overflow pipe does not foul the air cleaner, offer the cleaner to the carburettor in such a manner that the holes adjacent to the setscrew holes are uppermost so that they will align with those holes in the carburettor flange.
- (c) Secure air cleaners to carburettors with two setscrews and lockwashers each.
- (d) Position the splash overflow pipe so that the open end is close to the filtering media and tighten the cap nut in centre of float chamber.

# 28. SERVICING AIR CLEANERS

Unless operating in a very dusty climate the AC air cleaners need only be serviced every 5,000 miles. It is suggested that in dusty climates, the cleaners are serviced at 2,500 miles and this period increased or diminished according to the dirt removed. The cleaners should be washed in a bowl containing a mixture of paraffin and petrol until free from dirt.

After a thorough washing the units should be allowed to dry in clean air. When dry they should be filled with engine oil and the surplus oil allowed to drain in clean air. The cleaners must be dried and drained in clean air that is as free from dust as possible to ensure maximum cleanliness.

#### 29. DISCONNECTION OF CARB-URETTOR CONTROLS

There are nine throttle or carburettor control connections and it may be necessary to disconnect one or more to make adjustments, to effect removal of the carburettors or manifolds.

- (a) The folding coupling on the throttle butterfly spindle. One pinch bolt.
- (b) The outer Bowden cable at the front jet lever link. One pinch bolt.
- (c) The inner Bowden cable at the cable swivel pin fitted to the front carburettor jet lever. One setscrew.
- (d) Jet lever connection rod fitted between the two jet levers. The front fork end of the rod connects with the upper hole in the front jet lever. Clevis pin and split pin.
- (e) The rear coupling of the long link rod assembly is attached to bulkhead lever assembly. Nut and washer.
- (f) Front throttle and short rod assembly. Nut and Washer.
- (g) On inlet manifold, pivot for bell crank. Setscrew and lock washer.
- (h) Bell crank pivot. Washer and split pin.

#### **30. TO REMOVE ACCELERATOR PEDAL, R.H.S.** (Fig. 7)

- (a) Remove the nut from the rear attachment of the long link rod assembly for the carburettor and withdraw end from lever assembly at the bulkhead.
- (b) Release the spring from the lever assembly and drift out mills pin, utilising a thin shanked drift. The lever can now be withdrawn from the operating shaft.
- (c) Withdraw the four self tapping screws securing the bearing housing to the bulkhead, collect housings and nylon bush bearing.
- (d) From inside the car release the jam nut of the pedal limit stop and remove the screw stop from the fulcrum bracket on the toe board. Remove also the remaining three setscrews. The accelerator pedal assembly can now be withdrawn from inside the car.
- (e) The L.H. Fulcrum bracket, double coil spring washer and plain washer can now be threaded off the operating shaft.

(f) By removal of the two split pins the R.H. fulcrum bracket can be withdrawn in a similar manner.

# **31. TO FIT ACCELERATOR PEDAL, R.H.S.** (Fig. 7)

- (a) Feed the right-hand fulcrum bracket on to the pedal shaft so that the mounting flange points towards the pedal pad, followed by two plain washers, a coil spring washer and the second mounting bracket, the mounting flange of which points away from the pedal. Fit the two split pins through the two holes in the shaft **between** the two plain washers.
- (b) The pedal shaft is fed through the bulkhead bearing from inside the car. The assembly is secured to the toe board of the car by three bolts and lock washers, the lower right-hand fixing point is a pedal limit stop and jam nut.
- (c) Feed a half bearing housing on to the pedal assembly shaft protuding into the engine compartment, followed by the nylon bearing and second half bearing housing. Secure bearing housings to bulkhead with four self tapping screws.
- (d) The lever assembly is secured to the shaft by a mills pin from inside the engine compartment and the return spring is attached to the lever shank.
- (e) The long link rod assembly is attached to the lever assembly by a nut and spring washer.
- (f) Adjust pedal limit stop screw.

## 32. TO REMOVE ACCELERATOR PEDAL, L.H.S. (Fig. 7)

- (a) Remove the nut from the rear attachment of the long link rod assembly and withdraw end from lever assembly at the bulkhead.
- (b) Release the spring from the lever assembly.
- (c) Drift out the two mills pins adjacent to the left-hand bearing.
- (d) Remove the two bolts and lockwashers securing the support bracket to the bulkhead.



Fig. 7

Exploded view of R.H. and L.H.S. Accelerator Pedal Assemblies.

NOTATION FOR Fig. 7.			
Ref. No. Description	Ref. No. Description		
<ol> <li>R.H.S. pedal assembly.</li> <li>Fulcrum bracket.</li> <li>Double coil washer.</li> <li>Split pins.</li> <li>Plain washers.</li> <li>Attachment bolts.</li> <li>Pedal limit stop bolt.</li> <li>Jam nut.</li> <li>Shaft bearing.</li> <li>Bearing housings.</li> <li>Self tapping screw.</li> <li>Lever assembly.</li> <li>Mills pin.</li> </ol>	<ul> <li>14 Lever return spring.</li> <li>15 L.H.S. pedal assembly.</li> <li>16 Pedal shaft.</li> <li>17 Connecting bush.</li> <li>18 Mills pin.</li> <li>19 Support bracket.</li> <li>20 Lever assembly.</li> <li>21 Double coil spring.</li> <li>22 Mills pin.</li> <li>23 Shaft bearing.</li> <li>24 Bearing housings.</li> <li>25 Self tapping screws.</li> </ul>		

(e) Push the rod to the left of the car, this will eject the accelerator pedal in to the interior of the car and also free the shaft from its right-hand bearing. On drawing the shaft to the right it can be freed from the left-hand bearing.

(f) The bearings and housings can be removed by withdrawing the eight self tapping screws (four each bearing). (g) The shaft can now be dismantled by drifting out the mills pin securing the lever assembly to the shaft and collecting a double coil washer and mounting bracket. The split pin locating the bracket on

the shaft can also be withdrawn.

33. TO FIT ACCELERATOR PEDAL L.H.S. (Fig. 7)

- (a) Position the nylon bearing between the half housings and secure both to the bulkhead with eight self tapping screws (four each bearing).
- (b) It will be observed that the shaft is drilled at each end; the single hole end is on the left-hand side and the end with two holes is the right-hand end.
- (c) Fit the lever assembly to the righthand end, with lever on left-hand side, and secure with a mills pin to the outer or extreme right-hand hole.
- (d) Feed on the shaft the double coil spring washer followed by the support bracket, mounting holes to the left. Apply pressure to the support bracket to compress the spring and feed split pin through hole in shaft to position bracket.
- (e) Feed metal bush on to left-hand end of shaft (larger end first). Feed shaft and bush into the left-hand bearing already fitted to car. Position fulcrum of lever assembly in the right-hand bearing, it may be necessary to withdraw the shaft from the left-hand bearing, and secure mounting bracket to bulkhead, utilising two bolts and lock washers. Secure the bush to the shaft by a mills pin, supporting bush and shaft with a small anvil.
- (f) From inside the car feed the accelerator pedal into the bush and similarly secure with a mills pin.
- (g) Couple up long carburettor link rod and secure with nut and lock washer.

#### 34. TO REMOVE CARBURETTOR FROM MANIFOLD

- (a) Remove air cleaners as described on page 9.
- (b) Disconnect petrol supply pipe, taking care not to damage the conical filter

and spring situated in the top of each float chamber body.

- (c) Withdraw the split pin from the clevis pin at the rear end of the mixture control link and remove clevis pin.
- (d) Disconnect the throttle spindle at the rear folded coupling by loosening the clamping bolt.
- (e) By removing the two nuts at the mounting flange of the rear carburettor it can be removed from the manifold together with an asbestos insulating washer and two packings.
- (f) Disconnect the Bowden inner cable from the swivel pin of the jet lever and the outer cable from the front jet lever link by loosening a clamp bolt.
- (g) Remove the nut and lock washer of the short link rod assembly and disconnect the control linkage from the carburettor throttle lever.
- (h) Remove the two nuts securing the carburettor to the manifold and remove carburettor together with the asbestos insulating washer and two packings.

# 35. TO FIT CARBURETTORS TO MANIFOLD

- (a) Ensure that the joint washers and asbestos insulating washers are in good order. Fit two joint washers, one to each manifold flange, followed by an asbestos insulating washer and a second joint washer.
- (b) Offer up and secure the rear carburettor to its mounting and secure with plain washers, lock washers and nuts.
- (c) Ensure that the folding connection of the throttle spindle connecting rod will not foul the front carburettor when the latter is offered up to its position.
- (d) Attach and secure front carburettor to its mounting, utilising plain and lock washers and nuts.
- (e) Connect the outer Bowden cable to the front jet lever link.
- (f) Connect the short link rod assembly to the throttle lever of the front carburettor.
- (g) The inner cable, the throttle rods and jet levers are left disconnected until after the carburettors have been tuned. See page 23.


### FUEL SYSTEM

### THE S.U. CARBURETTOR

NOTATION	FOR Fig. 8.
Ref.	Ref.
No. Description	No. Description
<ol> <li>Throttle butterfly and spindle.</li> <li>Throttle butterfly stop and adjusting screw</li> <li>Piston.</li> <li>Suction chamber.</li> <li>Jet bore.</li> <li>Needle.</li> <li>Needle locking screw.</li> <li>Spring.</li> <li>Float chamber needle valve.</li> <li>Float.</li> <li>Float lever.</li> <li>Float chamber attachment bolt.</li> <li>Jet bush. Top half.</li> <li>Jet bush. Bottom half.</li> </ol>	<ul> <li>15 Jet locking nut.</li> <li>16 Compression spring.</li> <li>17 Sealing gland.</li> <li>18 Jet adjusting nut.</li> <li>19 Sealing gland.</li> <li>20 Conical washer.</li> <li>21 Jet head.</li> <li>22 Loading spring.</li> <li>23 Jet lever.</li> <li>24 Jet lever link.</li> <li>25 Jet lever return spring.</li> <li>26 Damper piston.</li> <li>27 Ignition connection union.</li> <li>28 Bridge piece.</li> </ul>

### **36. THE S.U. CARBURETTOR**

#### (a) Description

The S.U. carburettor is of the automatically expanding choke type, in which the cross sectional area of the main air passage adjacent to the fuel jet, and the effective orifice of the jet, is variable. The variation takes place in accordance with the demand of the engine as determined by the degree of the throttle opening, the engine speed, and the load against which the engine is operating.

The distinguishing feature of the type of carburettor is that an approximately constant air velocity, and hence an approximately constant degree of depression, is at all times maintained in the region of the fuel jet. This velocity is such that the air flow demanded by the engine in order to develop its maximum power is not appreciably impeded, although good atomisation of the fuel is assured under all conditions of speed and load

The maintenance of a constant high air velocity across the jet, even under idling conditions, obviates the necessity for an idling jet. A single jet only is employed in the S.U. carburettor.

### (b) Construction

### For Notation see Fig. 8 and 8A.

The main constructional features of the carburettor in its simplest form are shown

in Figs. 8 and 9, which illustrate the horizontal-type carburettor. The diagrams illustrate the main body, butterfly throttle, automatically expanding choke and variable fuel-jet arrangement. They also indicate the means whereby the jet is lowered by a manual control to effect enrichment of the mixture for starting and warming up. A float chamber of the type employed is illustrated in Fig. 8a.

Turning to Fig. 8 it will be seen that a butterfly throttle mounted on the spindle (1) is located close to the engine attachment flange, at one end of the main air passage, and that an adjustable idling stop screw (2)is arranged to prevent complete closure of the throttle, thus regulating the flow of mixture from the carburettor under idling conditions with the accelerator released. At the outer end of the main passage is mounted the piston (3), its lower part constituting a shutter, restricting the crosssectional area of the main air passage in the vicinity of the fuel jet (5) as the piston This component is enlarged at its falls. upper end to form a piston of considerably greater diameter which moves axially within the bore of the suction chamber (4) and at the bottom of the piston is mounted the tapered needle (6) which is retained by means of the setscrew (7).

The piston component (3) is carried upon a central spindle which reciprocates and is mounted in a bush fitted in the central boss, forming the upper part of the suction chamber casting

An extremely accurate fit is provided between the spindle and the bush in the suction chamber so that the enlarged portion of the piston is held out of contact with the bore of the suction chamber, within which, nevertheless, it operates with an extremely fine clearance. Similarly, the needle (6) is restrained from contacting the bore of the jet (5) which it is seen to penetrate, moving axially therein to correspond with the rise and fall of the piston.

It will be appreciated that, as the piston rises, the air passage in the neighbourhood of the jet becomes enlarged, and passes an additional quantity of air. Provided that the needle (6) is of a suitably tapered form, its simultaneous withdrawal from the jet (5) ensures the delivery to the engine of the required quantity of fuel corresponding to any given position of the piston and hence to a given air flow.

The piston, under the influence of its own weight and assisted by the light compression spring (8) will tend to occupy its lowest position, two slight protuberences on its lower face contacting the bottom surface of the main air passage adjacent to the jet. The surface in this region is raised somewhat above the general level of the main bore of the carburettor, and is referred to as the "bridge" (28).

Levitation of the piston is achieved by means of the induction depression, which takes effect within the suction chamber, and thus upon the upper surface of the enlarged portion of the piston through drillings in the lower part of the piston which make communication between this region and that lying between the piston and the throttle. The annular space beneath the enlarged portion of the piston is completely vented to atmosphere by ducts not indicated in the diagram.

It will be appreciated that, since the weight of the piston assembly is constant, and the augmenting load of the spring (8) approximately so, a substantially constant degree of depression will prevail within the suction chamber, and consequently in the region between the piston and the throttle, for any given degree of lift of the piston between the extremities of its travel.

It will be clear that this floating condition of the piston will be stable for any given airflow demand as imposed by the degree of throttle opening, the engine speed and the load; thus, any tendency in the piston to fall momentarily will be accompanied by an increased restriction to air flow in the space bounded by the lower side of the piston and the bridge, and this will be accompanied by a corresponding increase in the depression between the piston and throttle, which is immediately communicated to the interior of the suction chamber, instantly counteracting the initial disturbance by raising the piston to an appropriate extent.

The float chamber, which is shown in Fig. 8A, is of orthodox construction, comprising a needle valve (9) located within a separate seating which, in turn, is screwed in the float chamber lid, and a float (10), the upward movement of which, in response to the rising fuel level, causes final closure of the needle upon its seating through the medium of the hinged fork (11).

The float-chamber is a unit separate from the main body of the carburettor to which it is attached by means of the bolt (12), suitable drillings being provided therein to lead the fuel from the lower part of the float chamber to the region surrounding the jet. It is steadied at its upper extremity by a suction chamber attachment screw.

The buoyancy of the float, in conjunction with the form of the lever (11) is such that a fuel level is maintained approximately  $\frac{1}{8}$  below the jet bridge (see page 23). This can easily be observed after first detaching the suction chamber and suction piston, and then lowering the jet to its full rich position. The level can vary a further  $\frac{1}{4}$  downwards without any ill effects on the functioning of the carburettor. The only parts of importance in Figs. 8 and 8A not so far described are those associated with the jet.

Under idling conditions the piston is completely dropped, being then supported by the two small protuberances provided on its lower surface, which are in contact with the bridge (28); the small gap thus formed between piston and bridge permits the flow of sufficient air to meet the idling demand of the engine without, however, creating enough depression on the induction side to raise the piston.

The fuel discharge required from the jet is very small under these conditions, hence the diameter of the portion of the needle now obstructing the mouth of the jet is very nearly equal to the jet bore. Initial manufacture of the complete carburettor assembly to the required degree of accuracy to ensure perfect concentricity between the needle and the jet bore under these conditions is impracticable, and an individual adjustment for this essential centralisation is therefore provided.

It will be seen that the jet is not mounted directly in the main body, but is housed in the parts (13) and (14) referred to as the jet bushes, or jet bearings.

The upper jet bush is provided with a flange which forms a face seal against a recess in the body, while the lower one carries a similar flange contacting the upper surface of the hollow hexagon locking nut (15).

The arrangement is such that tightening of the hollow hexagon locking screw will positively lock the jet and jet bushes in position. Some degree of lateral clearance is provided between the jet bushes and the bores formed in the main body and the locking screw. In this manner the assembly can be moved laterally until perfect concentricity of the jet and needle is achieved, the screw (15) being slackened for this purpose. This operation is referred to as " centring the jet", on completion the jet locking nut (15) is finally tightened. See page 19.

In addition to this concentricity adjustment, an axial adjustment of the jet is provided for the purpose of regulating the idling mixture strength.

Since the needle tapers throughout its length, it will be clear that raising or lowering the jet within its bearing will alter the effective aperture of the jet orifice, and hence the rate of fuel discharge. To permit this adjustment the jet is a variably mounted within its bearings and provided with adequate sealing glands. A compression spring (16) which, at its upper end, serves to compress the small sealing gland (17) and thus prevents any fuel leakage between the jet and the upper jet bearing.

At its lower end this spring abuts against a similar sealing gland, thus preventing leakage of fuel between the jet and the lower jet bearing.

In both locations a brass washer is interposed between the end of the spring and the sealing gland to take the spring thrust. A further sealing gland (19), together with a conical brass washer (20) is provided, to prevent fuel leakage between the jet screw (15) and the main body.

It will be seen from the diagram that the upward movement of the jet is determined by the position of the jet adjusting nut (18) since the enlarged jet head (21) finally abuts against this nut as the jet is moved upwards towards the "weak" or running position.

The position of the nut (18) therefore determines the idling mixture ratio setting of the carburettor for normal running with the engine hot, and is prevented from unintentional rotation by means of the loading spring (22).

The cold running mixture control mechanism comprises the jet lever (23) supported from the main body by the link member (24) and attached by means of a clevis pin to the jet head (21). A tension spring (25) is provided, as shown, to assist in returning the jet-moving mechanism to its normal running position. Connection is made from the outer extremity of the jet lever (23) to a control situated within reach of the driver.

Drillings in the float-chamber attachment bolt (12), the main body of the carburettor, the jet (5) and slots in the upper jet bearing (13) serve to conduct the fuel from the float-chamber to the jet orifice.

It will be seen that the spindle upon which the piston (3) is mounted is hollow, and that it surrounds a small stationary damper piston suspended from the suction chamber cap by means of the rod (26). The hollow interior of the spindle contains a quantity of thin engine oil, and the marked retarding effect upon the movement of the main piston assembly, occasioned by the resistance of the small piston, provides the momentary enrichment desirable when the throttle is abruptly opened. The damper piston is constructed to provide a one-way valve action which gives little resistance to the passage of the oil during the downward movement of the main piston.

An ignition connection (27 in Fig. 8 or 33 in Fig. 9) is provided for use in conjuction with suction-operated ignition advance mechanism, and is fitted to the front carburettor only.

### 37. THROTTLE AND MIXTURE CONTROL INTERCONNECTION Fig. 9

A direct connection is provided between the jet movement and the throttle opening. Such an interconnection ensures that the engine will continue to run when the mixture is enriched by lowering the jet, without the additional necessity of maintaining a greater throttle opening than is normally provided by the setting of the slow-running screw (2).



Fig. 9 Throttle and Mixture Control interconnection. Movement of the jet lever in the direction of enrichment is thus accompanied by an upward movement of the extremity of the lever (31) which, in turn, abuts against the adjustable screw (30) and this opens the throttle to a greater degree than the normal slow-running setting controlled by the slow-running stop screw (2). The screw (30) should be so adjusted that it is just out of contact with the lever (31) when the jet has been raised to its normal running position, and the throttle is shut back to its normal idling condition, as determined by the screw (2).

### 38. EFFECT OF ALTITUDE AND CLIMATIC EXTREMES ON STANDARD TUNING

The standard tuning employs a jet needle which is broadly suitable for temperate climates at sea level upwards to approximately 3,000 ft. Above this altitude it may be necessary, depending on the additional factors of exteme climatic heat and humidity, to use a weaker tuning than standard.

The factors of altitude, extreme climatic heat, each tend to demand a weaker tuning, and a combination of any of these factors would naturally emphasise this demand. This is a situation which cannot be met by a hard and fast factory recommendation owing to the wide variations in the condition existing and in such cases the owner will need to experiment with alternative weaker needles until one is found to be satisfactory.

If the carburettor is fitted with a springloaded suction piston, the necessary weakening may be affected by changing to a weaker type of spring or by its removal.

### **39. CARBURETTOR JET NEEDLES**

Two jet needles are available for fitting to the carburettors of the TR2.

- (a) FV. For normal motoring.
- (b) GC. For high speed motoring and competition driving.

### 40. TO REMOVE JET NEEDLE

- (a) Remove the air-cleaner. See page 10.
- (b) Remove the damping piston from the top of the suction chamber.
- (c) Withdraw the three suction chamber securing screws and move the carburettor float chamber support arm to one side.
- (d) Lift the suction chamber and remove coil spring and washer from piston head.
- (e) Remove the piston with jet needle attached from the body of the carbburettor and empty away oil in the reservoir.
- (f) Loosen screw in base of piston and withdraw jet needle.

### 41. TO FIT NEEDLE (Fig. 8B)

- (a) Ensure that the jet head is loose in the main body of the carburettor by loosening clamp ring.
- (b) Ascertain that the jet needle is perfectly straight and position it so that the shoulder is flush with the base of the piston, tighten screw to grip needle. Feed the needle into its recess in the jet head.
- *NOTE*: On no account should the piston with the needle attached be laid down so that it rests on the needle. Failure to observe this point may cause carburation defects due to a bent needle.
- (c) Position the washer and the spring on top of the piston and the suction chamber over the piston.
- (d) Secure with the three attachment screws with the foremost accommodating the float chamber support arm.
- (e) Fill the piston reservoir with thin oil and fit the damper to the suction chamber.
- (f) Centralise the jet as described on this page.
- (g) Tune the carburettors as described on page 23.

### 42. CENTRALISATION OF JET (Fig. 8)

- (a) Disconnect the throttle linkage to gain access to the jet head (21) and remove damper (26).
- (b) Withdraw the jet head (21) and remove adjusting nut (18) and spring (22). Replace nut (18) and screw up to its fullest extent.
- (c) Slide the jet head (21) into position until its head rests against the base of the adjusting nut.
- (d) The jet locking nut (15) should be slackened to allow the jet head (21) and bearings (13 and 14) assembly to move laterally.
- (e) The piston (3) should be raised, access being gained through the air intake and allowing it to fall under its own weight. This should be repeated once or twice and the jet locking nut (15) tightened.
- (f) Check the piston by lifting to ascertain that there is complete freedom of movement. If "sticking" is detected operation (d) and (e) will have to be repeated.
- (g) Withdraw jet head (21) and adjusting nut (18).
- (h) Replace nut (18) with spring (22) and insert the jet head (21).
- (i) Check oil reservior and replace damper (26).
- (j) Tune the carburettors as described on page 23.

### 43. TO ASSEMBLE THE CARBURETTOR(S)

Having ensured the cleanliness and the servicability of all component parts, it is suggested that the carburettor(s) are assembled in the following sequence.

The front carburettor differs from that of the rear insomuch that there are certain additions. As and when the additions occur they will be specifically mentioned.

- (a) Fit the ignition union to the front carburettor, this utilises the tapped bore which breaks through into the mixture passage.
- (b) Position the throttle spindle in the body in such a manner that the spindle protrudes *less* on the left-hand side looking at the air cleaner ends.



### FUEL SYSTEM

Ref. Ref.	
No. Description No. Description	
1 Body assembly. 45 Return spring	
2 Suction chamber and piston assembly 46 End clip	
3 Damper assembly 47 Throttle lever	
4 Washer 48 Pinch bolt	
5 Jet needle 40 Nut for 48	
6 Needle locking screw 50 Float chamber	
7 Piston spring	
8 Securing screw 52 Needle and sect assembly	
0 Shake proof washer 52 Hingad lavor	
10 Let head 57 Din for hinged lower	
10 Jet field. J4 Fill for filliget level.	
12 Wosher 55 Float chamber cover.	
12 Washer. 13 Pottom half ist hearing 57 Datasl in lat filter	
15 Bottom nam jet bearing. 57 Petrol mier mier.	
14 Washer. 50 Banjo Doll	
15 Cork gland washer. 59 Fibre washer.	
10 Copper gland washer. 00 Cap nut.	
17 Spring between gland washers. 61 Aluminium washer.	
18 Jet locking nut. 62 Float chamber support arm.	
19 Sealing ring. 63 Float chamber attachment bo	lt.
20 Cork washer. 64 Fibre washer.	
21 Jet adjusting nut. 65 Washer.	
22 Loading spring. 66 Jet control connecting rod.	(Between
23 Jet lever. (Front carburettor.) front and rear jet levers.)	
24 Jet lever. (Rear carburettor.) 67 Fork end.	
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- (c) Feed the throttle disc into the slot of the spindle and secure with two countersunk screws. These screws have split shanks which are now opened by the insertion of the screw driver blade.
- (d) Position the throttle stop with the two adjusting screws on the shorter end of the throttle spindle of the front carburettor body and secure with the taper pin; to the rear carburettor, fit the throttle stop with the single adjusting screw.

- (e) Feed the rocker lever bolt through the double coil washer and the rocker lever so that the platform of the lever is on the left viewing the bolt head. This assembly is fitted to the front carburettor with a plain washer between it and the carburettor. Ensure that the rocker lever moves freely.
- (f) Fit the throttle spindle return spring anchor plate on the longer end of the spindle and anchor it on the web provided. Follow it with the spring and the end clip then adjust the tension and lock the end clip with the pinch bolt.
- (g) To the bottom half of the jet bearing position the copper washer followed by the jet adjusting sealing nut (threaded portion uppermost) spring and secure with the jet adjusting nut. Position the alloy sealing ring, flatter side downwards, and the cork washer over the thread of the jet adjusting nut.
- (h) Insert the jet assembly through the jet adjusting nut and bottom half of the jet bearing from below. Position the cork gland washer, the copper gland washer, spring, a second gland washer and cork gland washer on the head of the jet assembly.
- (i) Position a copper washer on the shoulders of the upper half jet bearing and, with the shoulder uppermost, balance the top half bearing on the cork gland washer of the jet assembly.
- (j) Feed the assembly mentioned in (h) and (i) into the carburettor body and secure with the sealing nut.
- (k) Fit the float to the pillar of the float chamber, this is symmetrical and can be fitted either way up.
- (1) The needle valve body is secured in the float chamber cover, position valve needle and hinge lever and insert pin. Adjust as described on page 23.
- (m) Assemble the splash overflow pipe to the cap of carburettor float chamber with a washer interposed between.
- (n) Fit the float chamber cover to the float chamber and attach cap nut as assembled in operation (m). The nut is left loose at this juncture.

- (o) Fit the jet needle to the piston assembly and ensure that its lower shoulder is flush with that of the piston.
- (**p**) The piston and jet needle is now fitted to the body assembly so that the brass dowel in the carburettor body locates the longitudinal groove in the piston.
- (q) With the smaller diameter of the coil spring downwards, position the spring over the polished stem of the piston.
- (r) Fit the suction chamber over the spring and piston stem allowing the spring to position itself outside the suction chamber centre.
- (s) The suction chamber is secured to the carburettor body by three screws, these are fitted but left loose at this juncture.
- (t) The float chamber is now attached to the carburettor body by the float chamber attachment bolt. Two large bore fibre washers with a brass washer between are positioned between the bolt head and the float chamber and a small bore washer between the float chamber and the carburettor body. With the washers so placed the float chamber is attached to the carburettor body, the attachment bolt is left loose at this juncture.
- (u) Looking at the intake end of the carburettor body remove the righthand suction chamber securing screw (left loose in operation (s)). With a shakeproof washer under its head feed the bolt through the float chamber steady bracket and replace to secure suction chamber. The three screws can now be fully tightened, the cap nut is, however, still left loose. The cap nut of the cover is tightened to secure the splash overflow pipe for tuning purposes when fitted to the car. Attach the jet lever return spring to the position provided betweeen jet assembly and float chamber.
- (v) The jet and jet needle are now centralised. See page 19.
- (w) The damper assembly is fitted to the suction chamber dry. The oil reservior is not filled until the carburettors are fitted to the car.

- (x) Select the jet lever of the front carburettor, identified by having two holes at the extremity of the longer arm. This is attached to the jet assembly by a clevis pin and split pin, position the second end of the lever return spring to the jet lever.
- (y) Feed the upper end of the tension link through the rocker lever of the front carburettor from behind and the second end through the jet lever. Secure both ends with split pins.
- (z) Select the front carburettor jet lever link, this is distinguished by the pinch bolt at one end. This is attached to the lug at the rear of the jet assembly and again to the elbow of the jet lever in such a manner that the pinch bolt end of this link points to the rear. Both attachments are made by clevis pins and split pins.

The assembly of the jet lever and jet lever link to the rear carburettor is very similar. Both components are shorter than those fitted to the front carburettor.

- 44. TO ADJUST THE FUEL LEVEL IN THE FLOAT CHAMBER Fig II. The level of the fuel in the float chamber is adjusted by setting the fork lever in the float chamber lid. It is suggested that the following procedure for its adjustment
  - (a) Remove the banjo bolt of the fuel connection and collect the two fibre washers and filter.



Fig. 11

is adopted.

Adjusting the Fuel Level.

- (b) Loosen the screw securing the float chamber support arm to the carburettor body.
- (c) Withdraw the cap nut from the centre of the float chamber lid and remove washers and splash overflow pipe.
- (d) Swing the support arm clear to lift the lid of the float chamber and joint washer.
- (e) The set of the forked lever is correct when, with the lid of the float chamber inverted and the shank of the fork lever resting on the needle of the delivery valve, it is possible to pass a  $\frac{7}{16}$ " diameter rod between the inside radius of the forked lever and the flange of the lower face of the cover.

### 45. CARBURETTOR TUNING Fig. 8.

This should be carried out without the Air Cleaners as it is found they have no effect on balance or performance but their removal considerably faciliates the operation. One clamping bolt of a throttle rod folding coupling should be loosened, the jet connecting rod should be disconnected at one of its fork end assemblies and the choke control cable released.

The rich mixture starting control linkage should also be disconnected by removing one of the clevis pins. This will enable each carburettor to be adjusted independently.

The suction chamber (4) and piston (3) should be removed and the jet needle (6) position checked. The needle shoulder, as shown in the illustration, should be flush with the base of the recess in the piston. The chamber and piston are now replaced.

The oil reservoir should be full and damping affect should be felt when replacing piston when the securing nut is  $\frac{1}{4}$ " from the top of the suction chamber.

It is recommended that the adjusting nut (18) is screwed fully home and then slackened back two and a half turns (fifteen flats) as an initial setting.

The throttle adjusting screw (2) on each carburettor should be adjusted until it will just hold a thin piece of paper between the screw and the stop when the throttle is held in the closed position. The throttle butterfly (1) on each carburettor should then be opened by one complete turn of the adjusting screw. The engine is now ready for starting and, after thoroughly warming up, the speed should be adjusted by turning each throttle adjusting screw an equal amount until the idling speed is approximately 500 R.P.M. The synchronisation of the throttle setting should now be checked by listening to the hiss of each carburettor, either directly or by means of a piece of rubber tubing held near the intake.

The intensity of the noise should be equal and if one carburettor is louder than the other its throttle adjusting screw should be turned back until the intensity of hiss is equal.

After satisfactory setting of the throttle, the mixture should then be adjusted by screwing the jet adjusting nuts up or down on each carburettor until satisfactory running is obtained. The lever tension spring should be connected during this operation. This mixture adjusting may increase the engine idling speed and each throttle adjusting screw must be altered by the same amount in order to reduce speed to 500 R.P.M. and the hiss of each carburettor again compared.

The balance of the mixture strength should be checked by independently lifting the piston of each carburettor no more than  $\frac{1}{32}$ ". The mixture is correct when this operation causes no change in engine R.P.M. When the engine slows down with this operation it indicates the mixture is too weak and it should be enriched by unscrewing the jet adjusting nut. An increase of engine speed during this operation indicates that the mixture is too rich and, consequently, it should be weakened off by screwing up the jet adjusting nut. The mixture setting should now give a regular and even exhaust beat, it is irregular with a "splashy" type of misfire and a colourless exhaust, the mixture is too weak. A regular or rhythmical type of misfire in the exhaust note, possibly with a blackish exhaust, indicates the mixture is too rich.

The jets of both carburettors should be held against the adjusting nuts before replacing the mixture control linkage, which should be adjusted as necessary, and similarly the throttle should be held tight against their respective idling stops before retightening the folding coupling clamp bolt.

### **46. CARBURATION DEFECTS**

In the case of unsatisfactory behaviour of the engine, before proceeding to a detailed examination of the carburettor, it is advisable to carry out a general condition check of the engine, in respects other than those bearing upon the carburation.

Attention should, in particular, be directed towards the following :---

The ignition system.

Incorrectly adjusted contact breaker gap. Dirty or pitted contact breaker points, or other ignition defects.

Loss of compression of one or more cylinders.

Incorrect plug gaps.

Oily or dirty plugs.

Sticking valves.

Badly worn inlet valve guides.

Defective fuel pump, or chocked fuel filter.

Leakage at joint between carburettors and induction manifold, or between induction manifold flanges and cylinder head.

If these defects are not present to a degree which is thought accountable for unsatisfactory engine performance, the carburettor should be investigated for the following possible faults.

### (a) Pistons Sticking. Fig. 8.

The symptoms are stalling and a refusal to run slowly, or lack of power and heavy fuel consumption.

The piston (3) is designed to lift the jet needle (6) by the depression transferred to the top side from the passage facing the butterfly. This depression overcomes the weight of the piston and spring (8). The piston should move freely over its entire range and rest on the bridge pieces (28) when the engine is not running.

This should be checked by gently lifting the piston with a small screwdriver and any tendency for binding generally indicates one of the following faults :—

(i) The damper rod may be bent causing binding and this can be checked by its removal. If the piston is now free the damper rod should be straightened and refitted. (ii) The piston is meant to be a fine clearance fit at its outer diameter in the suction chamber and a sliding fit in the central bush. The suction chamber should be removed, complete with piston, and the freedom of movement checked after removal of the damper rod. The assembly should be washed clean and very lightly oiled where this slides in the bush and then checked for any tendency of binding. It is permissible to carefully remove, with a hand scraper, any high spots on the outer wall of the suction chamber, but no attempt should be made to increase the clearance by increasing the general bore of the suction chamber or decreasing the diameter of the piston. The fit of the piston in its central bush should be checked under both rotational and sliding movement.

### (b) Eccentricity of Jet and Needle Fig. 8.

The jet (14) is a loose fit in its recess and must always be centred by the needle before locking up the clamping ring (15).

(i) The needle should be checked in the piston to see that it is not bent. It will be realised that it does not matter if it is eccentric as the adjustment of the jet allows for this, but a bent needle can never have the correct adjustment. For "Centralisation of Jet", see page 19.

### (c) Flooding from Float Chamber or Mouth of Jet. Fig. 8a.

This can be caused by a punctured float (10) or dirt on the needle valve (9) or its seat. These latter items can be readily cleaned after removal of the float chamber lid.

### (d) Leakage from Bottom of Jet adjacent to Adjustment Nut.

Leakage in this vicinity is most likely due to defective sealing by the upper and lower sealing gland assemblies There is no remedy other than removing the whole jet assembly after disconnecting the operating lever and cleaning or replacing the faulty parts. It is very important that all parts are replaced in their correct sequence, as shown in the illustration, and it must be realised that centralisation of the jet and needle and re-tuning will be necessary after this operation.

### (e) Dirt in the Carburettor

This should be checked in the normal way by examining and cleaning the float chamber, but it may be necessary if excessive water or dirt is present to strip down and clean all parts of the carburettor with petrol.

### (f) Failure of Fuel Supply to Float Chamber

If the engine is found to stop under idling or light running conditions, notwithstanding the fact that a good supply of fuel is present at the float chamber inlet union (observable by momentarily disconnecting this), it is possible that the needle has become stuck to its seating. This possibility arises in the rare cases where some gummy substance is present in the fuel system. The most probable instance of this nature is the polymerised gum which sometimes results from the protracted storage of fuel in the tank. After removal of the float chamber lid and float lever, the needle may be withdrawn, and its point thoroughly cleaned by immersion in alcohol.

Similar treatment should also be applied to the needle seating, which can conviently be cleaned by means of a matchstick dipped in alcohol. Persistent trouble of this nature can only be cured properly by complete mechanical cleansing of the tank and fuel system. If the engine is found to suffer from a serious lack of power which becomes evident at higher speeds and loads, this is probably due to an inadequately sustained fuel supply, and the fuel pump should be investigated for inadequate delivery, and any filters in the system inspected and cleansed.

### (g) Sticking Jet

Should the jet and its operating mechanism become unduly resistant to the action of lowering and raising by means of the enrichment mechanism, the jet should be lowered to its fullest extent, and the lower part thus exposed should be smeared with petroleum jelly, or similar lubricant. Oil should be applied to the various linkage pins in the mechanism and the jet raised and lowered several times in order to promote the passage of the lubricant upwards between the jet and its surrounding parts.

# Service Instruction Manual

## SPECIALISED TOOLS

QJ

SECTION Q

### SPECIALISED TOOLS

### SPECIALISED TOOLS POLICY

Considerable time and care has been taken in the preparation of specialised tools for servicing our Models, as it is realised that efficient servicing is not possible without the correct tools and equipment.

Messrs. V. L. Churchill & Co. Ltd. have designed and are manufacturing on our behalf and this Company has already circulated information concerning these tools, for many have similar applications on the Vanguard, Renown, Mayflower and Eight and Ten H.P. Models. As the necessity for further tools becomes apparent they will be manufactured, and our agents will receive notice of such items as and when they are introduced.

### PARTICULARS OF TOOLS

Brief particulars of approved tools which have been produced are given below. The tool in question should be ordered direct from Messrs. V. L. Churchill & Co. Ltd., Great South West Road, Bedfont, Feltham, Middlesex. Telephone : Feltham (Middx.) 5043. Telegrams : Garaquip, Feltham.

### GENERAL

Press and Slave Ring			S 4221
ENGINE			
Cylinder Sleeve Retainers	•••••		S 138
Sparking Plug Wrench	••••••		20SM 99
Connecting Rod Alignment Ji	g		335
Valve Spring Compressor		•••••	S 137
Stud Extractor	•••••	•••••	450
COOLING SYSTEM			
Universal Puller		•••••	6312
Water Pump Refacer	•••••		S126 and 6300
Water Pump Impeller Remove	r & Rep	lacer	FTS 127*
CLUTCH			
Clutch Assembly Fixture			99A
Clutch Plate Centraliser		•••••	205 72
FRONT SUSPENSION A	ND S	FEERI	NG
Front Road Spring Compresso	o <b>r</b>		M 50
Steering Wheel Puller		•••••	20SM 3600
Hub Remover for Disc Wheel	s		M 86
Knock on Wheels			S 132†
Hub Replacer (both types)	•••••		S 125
Electronic Wheel Balancer			120
Drop Arm Remover			M 91
Wheel Lock Protractors	•••••		121U

\* Used in conjunction with S 4221 press. † Used with S 4221 frame and slave ring.

### SPECIALISED TOOLS

### GEARBOX

Mainshaft Remover	•••••	•••••	20SM 1
Mainshaft Circlip Installer	•••••	•••••	20SM 46
Front Oil Seal Protecting Sleeve		•••••	20SM 47
Gearbox Extension Remover	•••••	·····	20S 63
Constant Pinion Shaft Remover		·····	20SM 66A
Countershaft Needle Roller			
Retainer Ring Driver	•••••	•••••	20SM 68
Mainshaft Circlip Remover	•••••	•••••	20SM 69
Countershaft Assembly Pilot	••••••		20SM 76
Countershaft Assembly Needle I	Roller		
Retainer	•••••	*****	20SM 77
Gearbox Rear Bearing Replacer	•••••		205 78
Gearbox Mainshaft Rear Oil Sea	l Repla	cer	20S 87A
Constant Pinion and Mainshaf	t Beari	ng	
Remover and Replacer	•••••	••••••	S 4615†
Two-way Circlip Pliers	•••••		7065
Front Cover Oil Seal Replacer		•••••	20SM 73A

### **REAR AXLE**

Half Shaft Bearing Remover		S 4615
Half Shaft Bearing Replacer		M 92
Differential Case Spreader	•••••	S 101
Propeller Shaft Flange Wrench		20SM 90
Pinion Bearing Outer Ring Remover	•••••	20SM FT 71
Pinion Bearing Outer Ring Replacer	•••••	M 70
Pinion Oil Seal Replacer	•••••	M 100
Pinion Head Bearing Remover & Repl	acer	TS 1†
Differential Bearing Remover		S 103*
Differential Bearing Replacer		M 89
Pinion Setting Gauge and Dummy Pin	nion	M 84
Pinion Bearing Preload Gauge		20SM 98
Rear Hub Extractor (Disc Wheels)		M 86*
Rear Hub Extractor (Knock-on Wheel	s)	S 132†
Rear Hub Replacer (both type Wheels)	)	S 125
Rear Hub Oil Seal Replacer		M 29
Backlash Gauges	•••••	M 4210

\* Used in conjunction with S 4221 press.

† Used with S 4221 frame and slave ring.

# Service Instruction Manual

# BRAKES

RI

SECTION R

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### BRAKES

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## BRAKES

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Exploded view of Hydraulic Pipe Lines and Connections.

RI

### I. DESCRIPTION

Lockheed Hydraulic Brakes are fitted to all four wheels. Two leading shoe type are used on the front wheels and leading and trailing shoe type on the rear wheels.

A foot pedal operates the brakes hydraulically on all four wheels simultaneously, whilst the handbrake operates the rear brakes only by means of a cable.

The foot pedal is coupled by a push rod to the master cylinder bore in which the hydraulic pressure of the operating fluid is originated. The second bore of the master cylinder is connected to the clutch operating mechanism.

A supply tank, integral with the master cylinder, provides a fluid reservoir for both cylinders, a pipe line consisting of tube, flexible hose and unions connect the master cylinder bore to the wheel cylinders.

The pressure created in the master cylinder, by application of the foot pedal, is transmitted with equal force to all wheel cylinders simultaneously. This moves the piston which in turn forces the brakes shoes outward and in contact with the brake drum. An independent mechanical linkage, actuated by a hand lever, operates the rear brakes by mechanical expanders attached to the rear wheel cylinder and acts as a parking brake. The handbrake is situated in the centre of the car on the right-hand side of the gearbox tunnel. It is operated by pulling the grip rearwards and operating the push button on top by the thumb; when the button is depressed the lever will remain in that rearward position. To release the handbrake it is only necessary to pull the lever rearward sharply and then let it travel forward.

### 2. ROUTINE MAINTENANCE

Examine the fluid level in the master cylinder periodically and replenish if necessary to keep the level  $\frac{1}{2}$ " below the underside of the cover plate.

Do not fill completely. The addition of fluid should only be necessary at infrequent intervals and a considerable fall in fluid level, indicates a leak at some point in the system, which should be traced and rectified immediately.

Ensure that the air vent in the filler cap is not choked, blockage at this point will cause the brakes to drag.

Adjust the brakes when the pedal travels to within 1" of the toe board before solid resistance is felt. If it is desired, adjustment may be carried out before the linings have become worn to this extent.

### 3. BRAKE LINING IDENTIFICATIONS

To afford maximum braking efficiency brake linings of an improved material have been progressively introduced. To enable identification linings are colour marked at their edges.

The following tabulation will give these identification marks and also the Commision number of the car on which they were first used.

LINING	IDENTIFICATION	INCORPORATION	REMARKS
DM.7 Front and Rear	3 narrow blue striped markings on lining edges.	<b>FT.</b> TS.1 to TS.3247 <b>R.</b> TS.1 to TS.3219	
DM.8	2 narrow blue and 1 wide blue marking, with alu- minium coloured metal impregnation of lining.	<b>FT.</b> TS.3248 to TS.5216 <b>R.</b> TS.3220 to TS.5480	
M.20 Front only. (DM.8 fitted on rear brakes).	5 green stripe markings with bronze coloured metal impregnation	TS.5217 to TS.5480	For 10" brake only.
M.20 Front and Rear	As above.	TS.5480 and future.	Introduction of 10" brakes for rear wheels

### BRAKE LINING IDENTIFICATIONS

### 4. DATA

Front Brakes  $10'' \times 2\frac{1}{4}''$ 

Rear Brakes  $9'' \times 1\frac{3}{4}''$  up to Commission No. TS.5481. Rear Brakes  $10'' \times 2\frac{1}{4}''$  after TS.5481.

Transverse rear brake cable lengths:

Right-hand  $12.97'' \pm .06'' \ 12.47'' \ 10''$ 

Left-hand  $26.85'' \pm .06'' \quad 26.35'' \int brakes.$ These lengths are measured from pin

centre of each fork end. Front brake shoes are interchangeable with

one another providing they have the same lining.

Rear brake shoes are interchangeable with one another providing they have the same lining and also interchangeable with front brake shoes of the same diameter and lining type.

### 5. FRONT BRAKE SHOE ADJUSTMENT

- (a) Apply the brakes hard while the car is stationary to position the shoes centrally in the brake drum, then release brake.
- (b) Jack up front of car, remove nave plates and road wheels.
- (c) Rotate hub until hole provided in brake drum coincides with screwdriver slot in micram adjuster.
- (d) Insert screwdriver in slot and turn the adjuster until brake shoes contact the drum, then turn adjuster back one notch.
- (e) Repeat operations (c) and (d) with second micram adjuster.
- (f) Repeat operations (c), (d) and (e) with second wheel.
- (g) Replace wheels and nave plates. Lower car to ground and remove jacks.
- (h) Road test car in a quiet thoroughfare.

### 6. REAR BRAKE SHOE ADJUSTMENT

- (a) Chock front wheels and release hand brake. Apply brakes hard to position brake shoes centrally in drums and release.
- (b) Jack up rear of car, remove nave plate and road wheels.
- (c) Rotate hub until hole provided in the brake drum coincides with screwdriver slot in micram adjuster.

- (d) Insert screwdriver in slot and turn the adjuster until brake shoes contact brake drums then turn adjuster cam back one notch.
- (e) Repeat operations (c) and (d) with second wheel.
- (f) Replace road wheels and nave plates Lower car to ground and remove jack
- (g) Road test car in a quiet thoroughfare.

### 7. HANDBRAKE ADJUSTMENT

Adjustment of the brakes shoes already described automatically readjusts the hand-brake mechanism.

The cables are correctly set during assembly and only maladjustment will result from altering the mechanism.

From the compensating linkage to the brake levers mounted on the wheel cylinders are transverse cables which are of a set length when leaving the works. They are however adjustable at their inner ends and should these have been tampered with it is necessary to check the following:

The cable assembled to the right-hand cylinder lever is  $12.97'' \pm .06''$  between centres.

The left-hand is  $26.85'' \pm .06''$ , this gives the correct angle of the compensator lever as  $17^{\circ}$ . Only when a complete overhaul is necessary should the handbrake cables require resetting.

To carry out this operation, the brake shoes should be locked up in the brake drums with the handbrake in the "off" position. Any slackness that is in the cable from compensator to handbrake lever should be removed at the handbrake lever end.

### 8. TO BLEED HYDRAULIC SYSTEM

Except for periodic inspection of the reservoir in the master cylinder, no attention should be required. If, however, a joint is uncoupled at any time, or air has entered the system the system must be bled in order to expel the air which has been admitted. Air is compressible and its presence in the system will affect the working of the brakes. The method detailed hereafter is suitable only for the braking system; the procedure to be adopted when bleeding the clutch is detailed in the "Clutch Section".

- (a) Ensure an adequate supply of Lockheed Brake Fluid is in the reservoir of the Master Cylinder Unit and keep the level at least half full throughout the operation. Failure to observe this point may lead to air being drawn into the system and the operation of bleeding will have to be repeated.
- (b) Clean the bleed nipple on one of the wheel cylinders and fit a piece of rubber tubing over it, allowing the free end of the tube to be submerged in a glass jar partly filled with clean Lockheed Brake Fluid.
- (c) Unscrew the bleed nipple one full turn. There is only one bleed nipple to each brake.
- (d) Depress the brake pedal completely and let it return without assistance. Repeat this operation with a slight pause between each depression of the pedal. Observe the fluid being discharged into the glass jar and when all air bubbles cease to appear hold the brake pedal down and securely tighten the bleed nipple. Remove rubber tubing only when nipple is tightened.
- NOTE: Check the level of the fluid in the master cylinder frequently and do not allow the level to fall below half full. Seven or eight strokes of the brake pedal will reduce the fluid level from full to half full.
- (e) Repeat the operation for the remaining three wheels.
- (f) Top up master cylinder with Lockheed Brake Fluid and road test car.

### 9. LEAKAGE OF FLUID FROM MASTER CYLINDER

Leakage of fluid from the reservoir of the master cylinder can be explained as follows :

(a) Overfilling which allows fluid to be trapped in the filler cap and leak through the breather hole. The fluid level should never be higher than 1" measured from the top of the filler orifice or  $\frac{1}{2}$ " measured from the underside of the cover plate.

- (b) The breaking up of the filler seal due to foreign matter between it and the rim of the orifice.
- (c) Leakage has been traced to jets of fluid from one of the cylinder recuperating holes finding its way past a defective filler cap sealing ring or via the breather hole.

The latter condition can be corrected by removing the cover plate and turning it  $180^{\circ}$  so that the filler cap is no longer directly above the jets.

### 10. BRAKE AND CLUTCH PEDAL ADJUSTMENT

The pedal adjustment is set when the car is assembled and should not require attention unless the assembly or adjustment has been disturbed.

A minimum clearance of .030" is necessary between each push rod and the piston which it operates, this free movement can be felt at the pedal pad when it is depressed gently by hand.

The movement at the pedal pad will be magnified owing to the length of the lever and this movement will become between  $\frac{1}{2}''$  to  $\frac{5}{5}''$ . Should this free movement not be apparent, first check that the pedals are free on their shaft and not prevented to return by some other fault than insufficient clearance between push rod and piston.

### 11. ADJUSTING THE BRAKE PEDAL

- (a) Loosen the jam nut on the shank of the pedal limit stop screw and screw it anti-clockwise approximately  $\frac{1}{8}''$  away from the master cylinder support bracket.
- (b) Push the operating push rod end into the master cylinder until it just contacts the piston. Screw up limit stop screw to meet the push rod fork end, but do not allow the rod to be pushed further into the piston. Screw the jam nut so that it makes contact with the master cylinder support bracket.
- (c) Unscrew the pedal limit stop screw together with the jam nut so that a .030" feeler gauge will pass between nut and support bracket.

- (d) Holding the pedal limit stop screw turn the jam nut to the support bracket and tighten.
- *NOTE*: The clutch pedal is set in a similar way but it must be remembered that adjustment at the slave cylinder may also be necessary to obtain the correct free pedal movement.

### 12. TO REMOVE FRONT LEFT-HAND FLEXIBLE HOSE

- (a) Open bonnet and disconnect battery and wires to stop light switch.
- (b) Drain the hydraulic system of fluid. Hold hexagon of hose near its bracket.
- (c) Withdraw the banjo bolt from the banjo connection. The stop light switch attached to this bolt need not be removed.
- (d) Holding the hexagon on the outside of the bracket with a spanner, remove the larger sized locking nut and shake proof washer.
- (e) The hose can be withdrawn from its bracket and now removed from the wheel cylinder. Care should be taken to ensure that the entire length of hose is turned whilst it is being removed from the wheel cylinder.

### **13. TO FIT FRONT LEFT-HAND FLEXIBLE HOSE**

Clean all components so that dirt does not enter system.

- (a) Secure hose to wheel cylinder.
- (b) Thread end of hose through chassis frame bracket and feed on shake proof washer and locknut.
- (c) Set hose by holding hexagon with a spanner, tighten locknut to bracket assembly whilst still holding hexagon with spanner.
- (d) Fit the larger diameter gasket to the banjo bolt and feed bolt through banjo connection, fit smaller diameter gasket to bolt. Feed bolt into hose end attached to bracket and secure finger tight. It will be seen that there is a gasket between the head of the banjo bolt and the banjo connection and a second gasket between the connection and the thread of the hose protruding through the bracket.

- (e) Holding the hexagon of the flexible hose at the outside of the bracket, tighten the banjo bolt.
- (f) Screw stop light switch into head of banjo bolt, *still holding* the hexagon of the hose.
- (g) Replenish hydraulic reservoir with fresh fluid.
- (h) Bleed all brakes as described on page 3.
- (i) Check the system for fluid leakage by applying firm pressure to the pedal and inspect the line and connections.

### **14. TO REMOVE FRONT RIGHT-HAND FLEXIBLE HOSE**

- (a) Drain hydraulic system.
- (b) Holding the banjo bolt of the two-way connection with one spanner remove the Bundy tubing union with a second.
- (c) Grip the hexagon of the flexible hose on the outside of the bracket and remove the bolt passing through the centre of the two-way connection.
- (d) Still gripping the hexagon of the hose remove locknut and shake proof washer. The flexible hose may now be withdrawn from its bracket.
- (e) Remove the flexible hose from the wheel cylinder. Care should be taken to ensure that the entire length of hose is turned whilst it is removed from the wheel cylinder.

### 15. TO FIT FRONT RIGHT-HAND FLEXIBLE HOSE

Clean all parts and ensure no dirt enters the hydraulic system.

- (a) Secure the flexible hose to the wheel cylinder.
- (b) Thread end of the hose through chassis frame bracket and feed on shake proof washer and locknut.
- (c) Set hose by holding hexagon with a spanner, tighten locknut securely to bracket whilst still holding hexagon with spanner.
- (d) Fit the larger diameter gasket to the banjo bolt and feed bolt through two-way connection, fit smaller diameter gasket to bolt and secure bolt to end of hose protruding through chassis bracket.

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- (e) Hold the hexagon of the flexible hose at the outside of the bracket and tighten the banjo bolt, at the same time ensuring that the two-way connection is not allowed to turn.
- (f) Reconnect the Bundy tubing to the head of the connection bolt.
- (g) Replenish hydraulic reservoir with fluid.
- (h) Bleed all brakes as described on page 3.
- (i) Check the system for fluid leakage by applying firm pressure to the pedal and inspect the line and connections.

### 16. TO REMOVE THE REAR FLEXIBLE HOSE

The hose is first disconnected at its front end adjacent to the right-hand shock absorber bracket.

- (a) Drain the hydraulic system of fluid.
- (b) Holding the hexagon at the front end of the flexible hose remove the Bundy tubing union nut.
- (c) Still holding the hexagon of the hose remove the locknut and shake proof washer. The hose can now be removed from the bracket.
- (d) Disconnect hose from three way connection on rear axle. Care should be taken to ensure that the entire length of hose is turned whilst it is removed from the three way connection.

### **17. TO FIT REAR FLEXIBLE HOSE**

Clean all parts thoroughly and ensure that no dirt is allowed to enter the hydraulic system.

- (a) Position a gasket on the end of the flexible hose, secure to the three way connection in the rear axle.
- (b) Feed foremost end of hose through bracket welded to chassis frame, attach shake proof washer and locknut to end of hose, finger tight.
- (c) Holding the hexagon of the hose with a spanner, set it so that the hose is free from any obstructions. Still holding the hexagon secure hose to bracket, with the locknut.
- (d) Continuing to hold the hexagon of the hose attach the Bundy tubing and tighten union nut.

- (e) Replenish the hydraulic reservoir with fluid.
- (f) Bleed all four brakes as described on page 3.
- (g) Check the system for fluid leakage by applying firm pressure to the pedal and inspect the line and connections.



Fig. 2 Sectional view of Brake Master Cylinder. To prevent fluid leakage the cover plate is turned 180° (the dotted outline of the filler cap shows this condition) on later production cars.

### NOTATION FOR Fig. 2.

- 1 Valve seat
- 2 Valve body
- 3 Rubber cup
- 4 Return spring
- 5 Spring retainer
- 6 Rubber cup
- 7 Piston washer
- 8 Secondary cup
- 9 Piston
- 10 Gasket
- 11 Boot fixing plate
- 12 Large boot clip
- 13 Rubber boot
- 14 Small boot clip
- 15 Push rod
- 16 Cover plate
- 17 Filler cap
- 18 Gasket
- X Port in cylinder bore

### **18. TWIN BORE MASTER CYLINDER**

### Description

This unit consists of a body which has two identical bores, one connected to the brakes and the second to the clutch. Each of the bores accommodates a piston having a rubber cup loaded into its head by a return spring; in order that the cup shall not tend to be drawn into the holes of the piston head, a piston washer is interposed between these parts. At the inner end of the bore connected to the brakes, the return spring also loads a valve body, containing a rubber cup, against a valve seat; the purpose of this check valve is to prevent the return to the master cylinder of fluid pumped back into the line whilst bleeding the brake system, thereby ensuring a charge of fresh fluid being delivered at each stroke of the brake pedal and a complete purge of air from the system.

During normal operation, fluid returning under pressure and assisted by the brake shoe pull-off springs, lifts the valve off its seat, thereby permitting fluid to return to the master cylinder and the brake shoes to the "off" position.

There is no check valve fitted in the bore connected to the clutch, this precludes the risk of residual line pressure which would tend to engage the clutch, or keep the ball release bearing in contact with the release levers.

The by-pass ports, which break into each bore, ensure that the systems are maintained full of fluid at all times and allow full compensation for expansion and contraction of fluid due to change of temperature.

They also serve to release additional fluid drawn into the cylinder through the small holes in the piston after a brake or clutch application. If this additional fluid is not released to the reservoir, due to the by-pass port being covered by the main cup, as a result of incorrect pedal adjustment, or to the hole being choked by foreign matter, pressure will build up in the systems and the brakes will drag, or the clutch tend to disengage.

### **19. TO REMOVE MASTER CYLINDER**

- (a) Drain hydraulic system of operating fluid.
- (b) Remove the square panel under the dash, which forms the rear wall of the master cylinder pocket from inside the car. Remove also the rubber grommet, from the inside wall of the pocket, to facilitate the withdrawal of the rear master cylinder attachment bolt.
- (c) Disconnect the Bundy tubing from the connections at the rear of the master cylinder. Care must be exercised when removing the clutch Bundy tubing; this is connected first to an adapter and then to the cylinder body. It will be necessary to hold the adapter with one spanner, whilst loosening the Bundy tubing nut with a second. The connection for the brake operation is made direct to the master cylinder.
- (d) Withdraw the clevis pins from the lever push rod fulcrums by removing the split pins, plain washers and double coil spring washers.
- (e) Remove the nuts, lock and plain washers, from the master cylinder attachment bolts and withdraw the bolts, the rearmost one being passed through the aperture in the wall of the pocket into the car.
- (f) The master cylinder is now free to be lifted from its support bracket. Empty any fluid that may still be in the reservoir.

### 20. TO FIT MASTER CYLINDER

- (a) Ensure that the connection adapter is secure in the left-hand (clutch) outlet of the master cylinder.
- (b) Place the assembly in the master cylinder support bracket, connections to the rear, and secure at the front end, with the attachment bolt and washers, but leave the nut finger tight at this juncture.
- (c) The rear attachment bolt is fed in from inside the car, through the aperture in the pocket wall. This bolt passes through two adjustment brackets, one

either side of the support bracket. With the washers in place screw on nut finger tight.

- (d) Connect the Bundy tubing to the master cylinder connections through the aperture at the rear of the master cylinder. The clutch operating pipe is fitted to the adapter on the left and the brake operating pipe, which is on the right, direct to the master cylinder.
- (e) Attach the piston rod fork ends to the pedals so that the heads of the clevis pins are nearest the centre line of the master cylinder assembly. Secure clevis pins with new split pins after fitting double coil spring and plain washers.
- (f) Loosen the jam nuts of the adjusting brackets, at both sides of the support bracket, and turn the front nut in a clockwise direction to bring the master cylinder assembly forward to its fullest extent.
- (g) Secure master cylinder to support bracket by tightening nuts of securing bolts. Lock up jam nuts to the adjusting bracket.
- (h) Adjust pedal clearance as described on page 4.
- (i) Replenish fluid reservoir with clean Lockheed Brake Fluid. Bleed brakes as described on page 3. Bleed clutch as described in "Clutch Section" D.
- (j) Check the system for fluid leaks by applying firm pressure to the foot pedals and inspecting the line and connections for leaks.
- (k) Replace rubber grommet in wall of master cylinder pocket and the cover at the rear of the pocket.

### 21. TO DISMANTLE THE MASTER CYLINDER (Fig. 3)

- (a) Remove the circlip and rubber boot from the master cylinder body and withdraw them together with the push rod fork assembly.
- (b) Remove the circlip and boot from the fork end assembly.
- (c) Remove cover plate and joint washer from top of master cylinder body, also remove filler cap.

- (d) Detach the boot fixing plate and joint washer.
- (e) Withdraw pistons and washer.
- (f) By applying low air pressure to the bypass ports blow out the rubber cups.
- (g) Tip out the springs and the check valve from the brake operating cylinder.
- (h) Remove the valve seat from the bottom of the bore.
- (i) Ease the cup out of the valve body and the secondary cups off the piston.
- (j) Remove the adapter from the master cylinder body.

### 22. TO ASSEMBLE THE MASTER CYLINDER (Fig. 3)

Ensure absolute cleanliness during the assembly of these components. Assemble parts with a generous coating of clean Lockheed Brake Fluid.

- (a) Fit the secondary cups to the pistons so that the lip of the cup faces the head of the piston. Gently work the cup round the groove with the fingers to ensure that it is properly seated.
- (b) Looking at the open piston bores of the master cylinder, place a valve seal in the bottom of the left-hand (brake operating) bore.
- (c) Ease the rubber cup into the valve body and fit the body in one end of a return spring, fit a spring retainer on the other end of the spring and insert the assembly, valve leading, into the bore which has the valve seat.
- (d) Fit the second spring retainer on the second return spring and insert the spring, plain end leading, into the right-hand bore.
- (e) Insert the main cup, lip leading, into each bore taking care not to damage, or turn back the lip of the cup. Follow with the two piston washers, ensuring that the curved washers are toward the rubber cups.
- (f) Insert the two pistons, exercising care not to damage the rubber cups.
- (g) Depress the two pistons, and fit the boot fixing plate, ulitising a new joint washer and securing plate with two screws and shake proof washers.

BRAKES



Fig. 3

Exploded view of Twin Bore Master Cylinder.

NOTATION FOR Fig. 3					
Ref. No.	Ref. No.				
<ol> <li>Body</li> <li>Cover plate</li> <li>Joint washer</li> <li>Filler cap and baffle</li> <li>Cover plate attachment screw</li> <li>Shake proof washer</li> <li>Valve seat</li> <li>Valve seat</li> <li>Valve cup</li> <li>Brakes only</li> <li>Valve body</li> <li>Valve return spring</li> <li>Spring retainer</li> <li>Main cup</li> <li>Washer between main cup and piston</li> <li>Piston secondary cup</li> <li>Boot fixing plate</li> </ol>	<ul> <li>17 Gasket between plate and body</li> <li>18 Plate attachment screw</li> <li>19 Shake proof washer</li> <li>20 Push rod assembly</li> <li>21 Push rod boot</li> <li>22 Large clip (Boot to fixing plate)</li> <li>23 Small clip (Boot to push rod)</li> <li>24 Slave cylinder pipe adapter (clutch)</li> <li>25 Gasket</li> <li>26 Bracket assembly</li> <li>27 Jam nut</li> <li>28 Master cylinder attachment bolt.</li> <li>29 Plain washer. (On front bolt only)</li> <li>30 Nut</li> <li>31 Lock washers under nuts</li> </ul>				

- (h) Position the cover plate on the body in such a manner that the filler cap is nearer the outlet ports. This will ensure the jets of fluid from the cylinder will impinge upon the plate and so avoid possible leakage through the filler cap. Ensure that the joint washer and filler cap sealing ring are in good order and that the vent hole is clear.
- (i) Test the assembly by filling the tank with Lockheed Hydraulic Brake Fluid to within 1" of the filler orifice top. Then push the piston inward and it should return without any assistance; after a few aplications fluid should be ejected from the outlet connections.



Fig. 4 Sectional view of Front Brake Cylinder.

### 23. FRONT WHEEL CYLINDERS

### Description

The front wheel slave cylinders are mounted rigidly to the back plates inside the brake drums and between the ends of the brake shoes. One cylinder is mounted at the front and the other cylinder at the rear of each brake plate and each cylinder operates one shoe only. They are connected by a bridge pipe.

A single piston in each cylinder acts on the leading tip of its respective shoe, whilst the trailing tip of the shoe finds a floating anchor by utilising the closed end of the actuating cylinder of the other shoe as its abutment.

Between the piston and the leading tip of each shoe is a "Micram" adjuster which is located in a slot in the shoe. Each front wheel cylinder consists of a body formed with a blind bore to accommodate a piston : a rubber cup, mounted in a cup filler, is loaded upon the piston by a spring which is located in the recess formed in the cup filler.

### 24. TO REMOVE FRONT WHEEL CYLINDERS

- (a) Jack up car, drain off hydraulic fluid, remove nave plate, wheel, and brake drum.
- (b) Pull one of the brake shoes against the load of the pull-off springs away from its abutment on the wheel cylinders. Slide the micram mask off the piston cover of the operating piston. On releasing the tension of the pull-off springs the opposite brake shoe will fall away.
- (c) Remove the flexible hose as described on page 5.
- (d) Unscrew the bridge pipe tube nuts from the wheel cylinders and remove the bridge pipe.
- (e) Remove the fixing bolts and lock washers to withdraw wheel cylinders from back plate.

### NOTATION FOR Fig. 5

#### Ref. No.

- 1 Front brake plate
- 2 Wheel cylinder
- 3 Wheel cylinder body
- 4 Spring in body
- 5 Cup filler
- 6 Cup
- 7 Piston assembly
- 8 Rubber seal
- 9 Wheel cylinder attachment bolt
- 10 Lock washer
- 11 Bleed screw
- 12 Bridge pipe
- 13 Brake shoe assembly
- 14 Micram adjuster
- 15 Micram adjuster mask
- 16 Brake shoe pull off spring
- 17 Hub grease catcher
- 18 Brake drum