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.

Initial charge

The initial charging rate is 2·5 amperes. Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 40 to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the generator output. **This charge should not be broken by long rest periods.** If, however, the temperature of any cell rises above the permissible maximum, i.e.

For climates below 90° F. (32° C.) .. 100° F. (37·8° C.),
For climates above 90° F. (32° C.) .. 120° F. (48·8° C.),

the charge must be interrupted until the temperature has fallen at least 10° F. (5·5° C.) below that figure. Throughout the charge the electrolyte must be kept level with the top of the separators by addition of acid solution of the same specific gravity as the original filling-in acid until specific gravity and charge 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. (15·6° C.) it lies between 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 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 over the tops of the separators.

Section N.4

DYNAMO

Testing on vehicle when dynamo is not charging

Make sure that belt slip is not the cause of the trouble. It should be possible to deflect the belt approximately ½ in. (13 mm.) with moderate hand pressure at the centre of its longest run between two pulleys. If the belt is too slack tightening is effected by slackening the two dynamo suspension bolts and then the bolt of the slotted adjustment link. A gentle pull on the dynamo outwards will enable the correct tension to be applied to the belt and all three bolts should then be tightened firmly.

Check that the dynamo and control box are connected correctly. The dynamo terminal 'D' should be connected to the control box terminal 'D' and the dynamo terminal 'F' connected to the control box terminal 'F'.

After switching off all lights and accessories disconnect the cables from the dynamo terminals marked 'D' and 'F' respectively.

Connect the two terminals with a short length of wire.

Start the engine and set to run at normal idling speed.

Clip the negative lead of a moving coil-type voltmeter calibrated 0–20 volts to one dynamo terminal and the other lead to a good earthing point on the dynamo yoke.

Gradually increase the engine speed: the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts. Do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

If there is no reading check the brush gear.

If the reading is low (approximately ½ to 1 volt) the field winding may be faulty.

If the reading is approximately 4 to 5 volts the armature winding may be faulty.

If the dynamo is in good order leave the temporary link in position between the terminals and restore the original connections, taking care to connect the dynamo terminal 'D' to the control box terminal 'D' and the dynamo terminal 'F' to the control box terminal 'F'. Remove the lead from the 'D' terminal on the control box and connect the voltmeter between this cable and a good earthing point on the vehicle. Run the engine as before. The reading should be the same as that measured directly on the dynamo. No reading on the voltmeter indicates a break in the cable to the dynamo. Carry out the same procedure for the 'F' terminal, connecting the voltmeter between cable and earth. Finally, remove the link from the dynamo. If the reading is correct test the control box (Section N.5).

Removing

To remove the dynamo disconnect the dynamo leads from the dynamo terminals.

Slacken all four attachment bolts and pivot the dynamo towards the cylinder block to enable the fan belt to be removed from the dynamo pulley. The dynamo can then be removed by withdrawing the two upper and one lower attachment bolts.

Dismantling

Remove the securing nut and take off the drive pulley.

Remove the Woodruff key from the commutator shaft.

Unscrew and remove the two through-bolts and take off the commutator end bracket. The driving end bracket, together with the armature and its ball bearing, can now be lifted out of the yoke. Unless the ball bearing is damaged or requires attention it need not be removed from the armature. Should it be necessary to remove the bearing, the armature must be separated from the end bracket by means of a hand press.

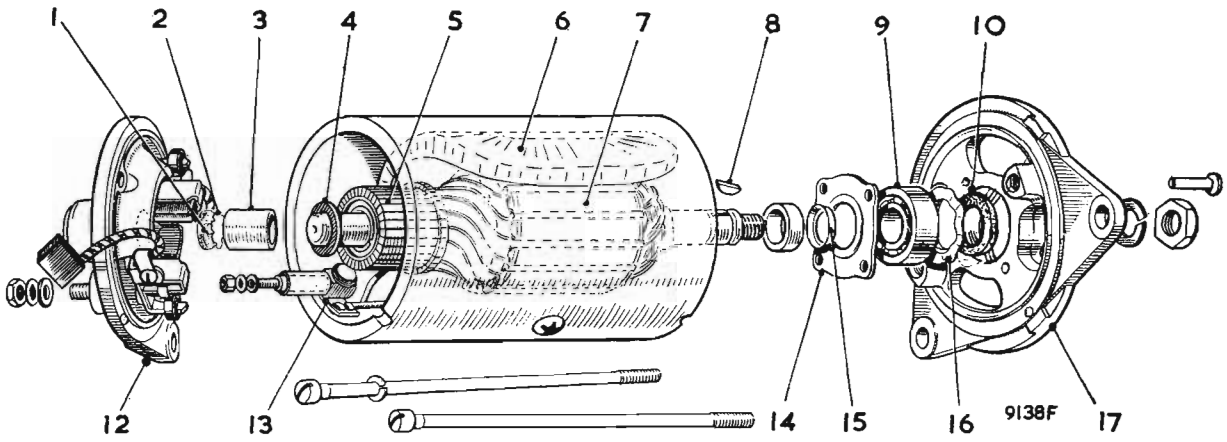


Fig. N.1

The windowless yoke dynamo

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

Servicing

Brushes

Lift the brushes up in the brush boxes and secure them in that position by positioning each brush spring at the side of the brush. Fit the commutator end bracket over the commutator and release the brushes. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing it on a smooth file. Always refit the brushes in their original positions. If the brushes are badly worn, new brushes must be fitted and bedded to the commutator. The minimum permissible length of brush is $\frac{11}{32}$ in. (8·8 mm.).

Test the brush spring tension, using a spring scale. The tension of the springs when new is 22 to 25 oz. (624 to 709 gm.). In service it is permissible for this value to fall to 15 oz. (425 gm.) before performance may be affected. Fit new springs if the tension is low.

Commutator

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a cloth moistened with fuel. If this is ineffective carefully polish with a strip of fine glass-paper while rotating the armature. To remedy a badly worn commutator mount the armature (with or without 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 mica insulation between the segments to a depth of $\frac{1}{32}$ in. (·8 mm.) with a hacksaw blade ground down to the thickness of the mica.

The most common armature faults are usually confined to open- or short-circuited windings. Indications of an open-circuited armature winding is given by burnt commutator segments. A short-circuited armature winding is easily identified by discoloration of the overheated windings and badly burnt commutator segments.

Field coils

Test the field coils with an ohmmeter without removing them from the dynamo yoke. The reading on the ohmmeter should be between 6·0 and 6·3 ohms. If this is not available connect a 12-volt D.C. supply with an ammeter in series between the field terminal and the dynamo yoke. The ammeter reading should be approximately 2 amps. If no reading is indicated the field coils are open-circuited and must be renewed.

If the current reading is much more than 2 amps. or the ohmmeter reading much below 6 ohms it is an indication that the insulation of one of the fields coil has broken down.

In either case, unless a substitute dynamo is available, the field coils must be renewed. To do this carry out the procedure outlined below.

Drill out the rivet securing the field coil terminal assembly to the yoke and unsolder the field coil connections.

Remove the insulation piece which is provided to prevent the junction of the field coils from contacting the yoke.

Mark the yoke and pole-shoes in order that they can be refitted in their original positions.

Unscrew the two pole-shoe retaining screws by means of a wheel-operated screwdriver.

Draw the pole-shoes and coils out of the yoke and lift off the coils.

Fit the new field coils over the pole-shoes and place them in position inside the yoke. Take care that the taping of the field coils is not trapped between the pole-shoes and the yoke.

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

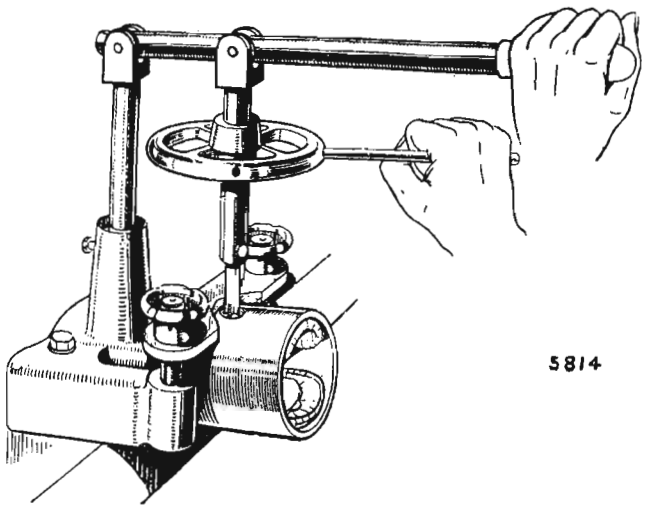


Fig. N.2

Using a wheel-operated screwdriver to remove the pole-shoe screws

Fully tighten the screws by means of a wheel-operated screwdriver and lock them by caulking.

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

Resolder the field coil connections to the field coil terminal tags and rerivet the terminal assembly to the yoke.

Armature

The testing of the armature winding requires the use of a voltage 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 a distorted armature shaft.

Bearings

Bearings which are worn to such an extent that they will allow side-movement of the armature shaft must be renewed.

To renew the bearing bush in a commutator end bracket proceed as follows.

Remove the old bearing bush from the end bracket. The bearing can be withdrawn with a suitable extractor or by screwing a $\frac{3}{8}$ in. 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 damaging the 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 be fitted in the bearing, until the visible end of the bearing is flush with the inner face of the bracket. Porous bronze bushes should not be opened out after fitting or the porosity of the bush may be impaired.

NOTE.—Before fitting the new bearing bush it should be allowed to stand for 24 hours completely immersed in thin (S.A.E. 20) 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 212° F. (100° C.) for two hours, then allowing it to cool before removing the bearing bush.

The ball bearing is renewed as follows.

Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate. Press the bearing out of the end bracket and remove the corrugated washer, felt washer, and oil-retaining washer.

Before fitting the replacement bearing see that it is clean and pack it with high-melting-point grease.

Place the oil-retaining washer, felt washer, and corrugated washer in the bearing housing in the end bracket.

Press the bearing into the housing. The outer bearing journal is a light push-fit in the bearing housing.

Refit the bearing retaining plate, using rivets having the same dimensions as those originally fitted.

NOTE.—When fitting a drive end bracket to the armature shaft the inner journal of the bearing MUST be supported by a mild-steel tube—do not use the drive end bracket.

Reassembling

The reassembly of the dynamo is a reversal of the dismantling sequence.

If the end bracket has been removed from the armature in dismantling, press the bearing end bracket onto the armature shaft, taking care to avoid damaging the end plate and armature winding. When assembling the commutator end bracket the brushes must first be held clear of the commutator by partially withdrawing them from their boxes until each brush is trapped in position by the side pressure of its spring. The brushes can be released onto the commutator by a small screwdriver or similar tool when the end bracket is assembled to within about $\frac{1}{2}$ in. (12·7 mm.) of the yoke. Before closing the gap between the end bracket and the yoke see that the springs are in correct contact with the brushes.

Refitting

Refitting is a reversal of the removal procedure.

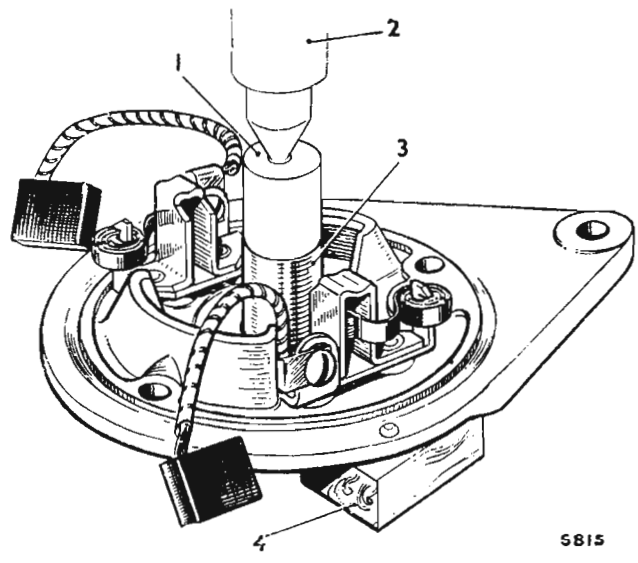


Fig. N.3

The method of pressing in the commutator end bracket bush

1. Shouldered mandrel.
2. Hand press.
3. Bearing bush.
4. Support block.

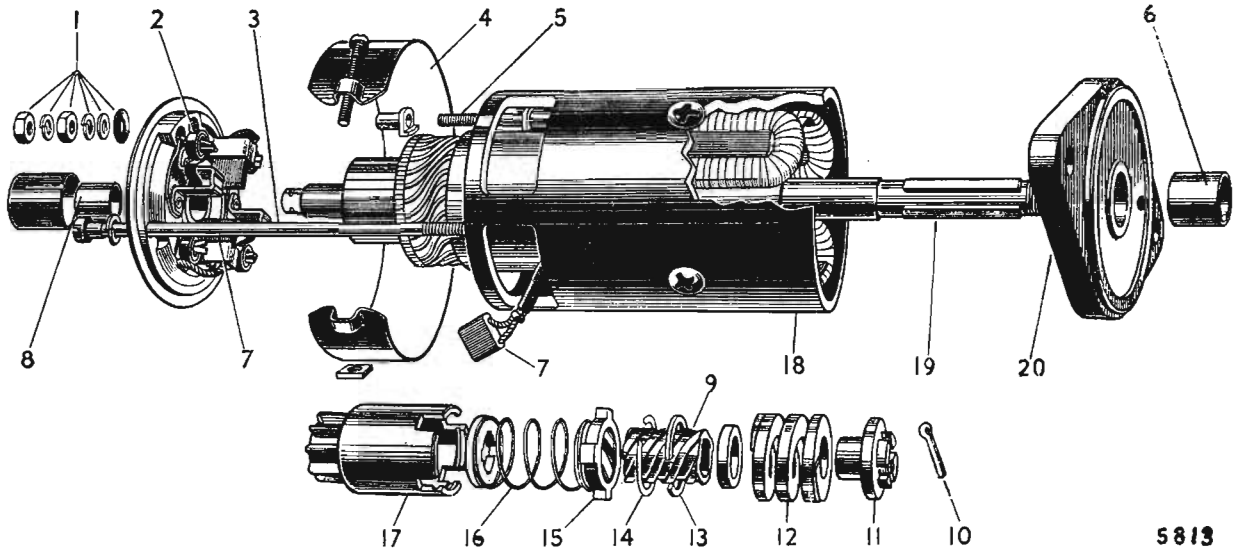


Fig. N.4

An exploded view of the starter motor and drive

1. Terminal nuts and washers.
2. Brush spring.
3. Through-bolt.
4. Band cover.
5. Terminal post.
6. Bearing bush.
7. Brushes.
8. Bearing bush.
9. Sleeve.
10. Split pin.
11. Shaft nut.
12. Main spring.
13. Retaining ring.
14. Washer.
15. Control nut.
16. Restraining spring.
17. Pinion and barrel.
18. Yoke.
19. Armature shaft.
20. Driving end bracket.

Section N.5

STARTER

Testing the vehicle

In the following test it is assumed that the battery is in a charged condition.

Switch on the lamps and operate the starter control. If the lights go dim, but the starter is not heard to operate, an indication is given that the current is flowing through the starter motor windings but that for some reason the armature is not rotating; possibly the starter pinion is meshed permanently with the geared ring on the flywheel. This could be caused by the starter being operated while the engine is still moving. In this case the starter motor must be removed from the engine for examination.

Should the lamps retain their full brilliance when the starter switch is operated, check that the switch is functioning. Next, if the switch is in order, examine the connections at the battery and starter switch, and also examine the wiring joining these units. Continued failure of the starter to operate indicates an internal fault in the starter, which must be removed for examination.

Sluggish action of the starter is usually caused by a poor connection in the wiring which causes a high resistance in the starter circuit. Check the wiring as described above.

Removing

Remove the distributor as described in Section B.

Release the starter cable from the terminal and unscrew the top starter securing bolt.

Working beneath the vehicle, release and withdraw the dirt deflector situated under the starter motor and unscrew the bottom starter securing bolt.

Manoeuvre the starter forward and lift clear of the engine.

Examination of commutator and brush gear

Remove the starter cover band and examine the brushes and commutator.

Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish remove the brush from its holder and ease the sides by lightly polishing with a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they no longer bear on the commutator, or if the brush flexible lead has become exposed on the running face, they must be renewed.

If the commutator is blackened or dirty, clean it by holding a fuel-moistened cloth against it while the armature is rotated.

Secure the body of the starter in a vice and test by connecting it with heavy-gauge cables to a 12-volt battery. One cable must be connected to the starter terminal, the other held against the starter body or end bracket. Under these light load conditions the starter should run at a very high speed.

If the operation of the starter is still unsatisfactory, it should be dismantled for detailed inspection and testing.

Dismantling

Hold back the brush springs and take out the brushes.

Extract the split pin at the driving end.

Unscrew the nut (R.H. thread) and take off the main

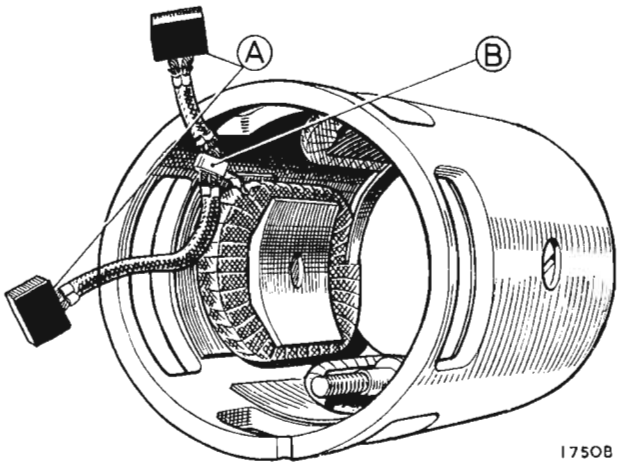


Fig. N.5

The starter brush connections

A. Brushes. B. Tapping on field coils.

spring. The complete drive can now be removed from the splined shaft by withdrawing it with a rotary movement.

Remove the terminal nuts and washers from the terminal post on the commutator end bracket.

Unscrew and withdraw the two through-bolts and take off the commutator end bracket.

Remove the driving end bracket complete with armature.

Brushes

Test the brush springs with a spring balance. The correct tension is 25 to 15 oz. (709 to 425 gm.). Fit a new spring if the tension is low.

If the brushes are worn so that they no longer bear on the commutator, or if the flexible connector has become exposed on the running face, they must be renewed. Two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket. The other two brushes are connected to tappings on the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in their place by soldering. The brushes are preformed so that bedding of the working face to the commutator is unnecessary.

Drive

If the pinion is tight on the screwed sleeve, wash away any dirt with paraffin (kerosene).

If any parts are worn or damaged they must be renewed.

Unscrew the nut (R.H. thread) and take off the main spring.

The complete drive can now be removed from the splined shaft by pulling it off with a rotary movement. Unscrew the screwed sleeve from the barrel assembly.

Further dismantling of the barrel assembly is carried out by removing the large retaining ring.

NOTE.—If the screwed sleeve is worn or damaged it is essential that it is renewed together with the control nut.

Reassemble by reversing the above procedure.

Commutator

A commutator in good condition will be smooth and free from pits and burnt spots. Clean the commutator with a cloth moistened with fuel. If this is ineffective, carefully polish with a strip of fine glass-paper while rotating the armature. To remedy a badly worn commutator, dismantle the starter drive as described above and remove the armature from the end bracket. Now mount the armature on a lathe, rotate it at high speed, and take a light cut with a very sharp tool. Do not remove any more metal than is absolutely necessary, and finally polish with very fine glass-paper.

The mica on the starter commutator **must not be undercut.**

Field coils

The field coils can be tested for an open circuit by connecting a 12-volt battery having a 12-volt bulb in one of the leads to the tapping-point of the field coils to which the brushes are connected and the field terminal post. If the bulb does not light there is an open circuit in the wiring of the field coils.

Lighting of the bulb does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole-shoe or to the yoke. This may be checked by removing the lead from the brush connector and holding it on a clean part of the starter yoke. Should the bulb now light, it indicates that the field coils are earthed.

Should the above tests indicate that the fault lies in the field coils, they must be renewed. When renewing the field coils carry out the procedure detailed in the dynamo section.

Armature

Examination of the armature will in many cases reveal the cause of failure, e.g. conductors lifted from the commutator due to the starter being engaged while the engine is running and causing the armature to be rotated at an excessive speed. A damaged armature must in all cases be renewed—no attempt should be made to machine the armature core or to true a distorted armature shaft.

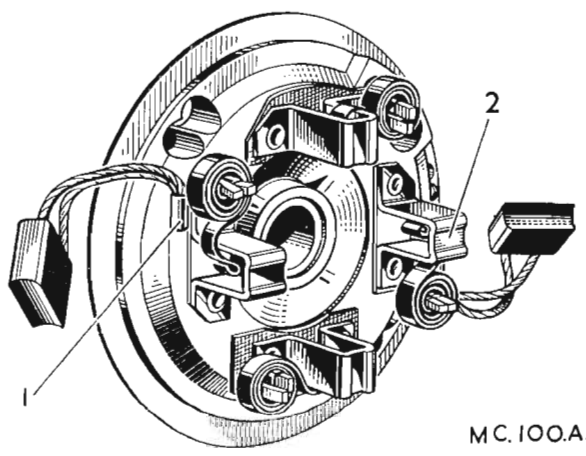


Fig. N.6

Commutator end bracket

1. Terminal eyelet. 2. Brush holder.

Bearings (commutator end)

Bearings which are worn to such an extent that they will allow excessive side-play of the armature shaft must be renewed. To renew the bearing bush proceed as follows.

Press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit into the bearing.

NOTE.—The bearing bush is of the porous phosphor-bronze type, and before fitting, new bushes should be allowed to stand completely immersed for 24 hours in thin engine oil in order to fill the pores of the bush with lubricant.

Reassembling

The reassembly of the starter is a reversal of the operations described in this section.

Refitting

Refitting is a reversal of the removal procedure.

Section N.6

CONTROL BOX

This unit contains the cut-out and voltage regulator. The regulator controls the dynamo output in accordance with the load on the battery and its state of charge. When the battery is discharged the dynamo gives a high output, so that the battery receives a quick recharge which brings it back to its normal state in the minimum time.

On the other hand, if the battery is fully charged the dynamo is controlled to give only a trickle charge, which is sufficient to keep it in good condition without any possibility of causing damage to the battery by over-charging.

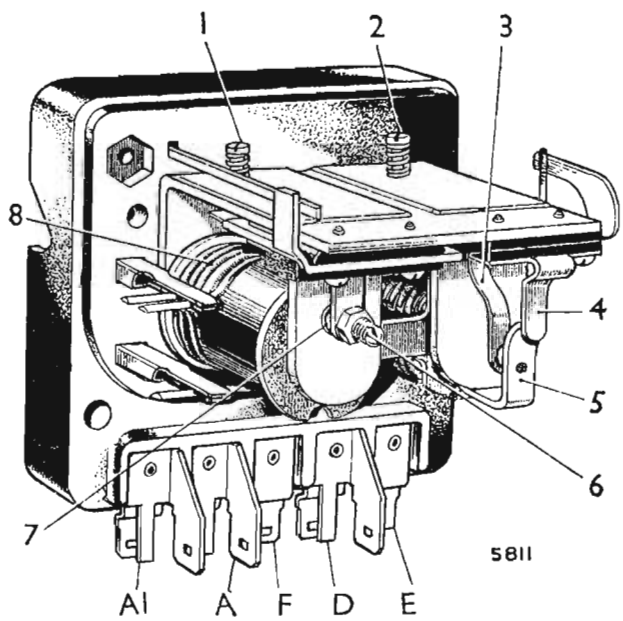


Fig. N.7

The control box

1. Regulator adjusting screw.
2. Cut-out adjusting screw.
3. Fixed contact blade.
4. Stop arm.
5. Armature tongue and moving contact.
6. Regulator fixed contact screw.
7. Regulator moving contact.
8. Regulator series windings.

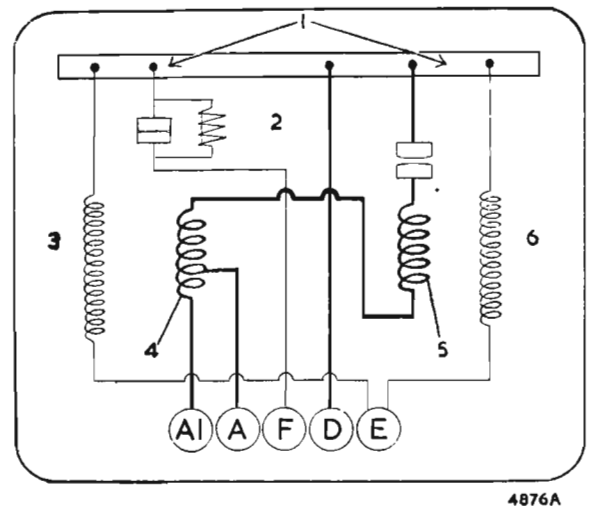


Fig. N.8

The control box (regulator and cut-out) internal connections

1. Regulator and cut-out frame.
2. Field resistance.
3. Shunt coil.
4. Tapped series coil.
5. Series coil.
6. Shunt coil.

The regulator also causes the dynamo to give a controlled boosting charge immediately after starting up, which quickly restores to the battery the energy taken from it when starting. After about 30 minutes' running, the output of the dynamo has fallen to a steady rate best suited to the particular state of charge of the battery.

The cut-out is an automatic switch for connecting and disconnecting the battery with the dynamo. This is necessary because the battery would otherwise discharge through the dynamo when the engine is stopped or running at a low speed.

Regulator adjustment

The regulator is carefully set to suit the normal requirements of the standard equipment before leaving the Works, and in general it should not be necessary to alter it. If, however, the battery does not keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged, it may be advisable to check the setting and, if necessary, to readjust.

It is important, before altering the regulator setting when the battery is in a low state of charge, to check that its condition is not due to a battery defect or to the dynamo belt slipping.

Checking and adjusting the electrical setting

The regulator setting can be checked without removing the cover of the control box.

Withdraw the cables from the terminals marked 'A' and 'A1' at the control box and join them together. Connect the negative lead of a moving-coil voltmeter (0 to 20 volts full scale reading) to the 'D' terminal on the dynamo and connect the other lead from the meter to a convenient chassis earth.

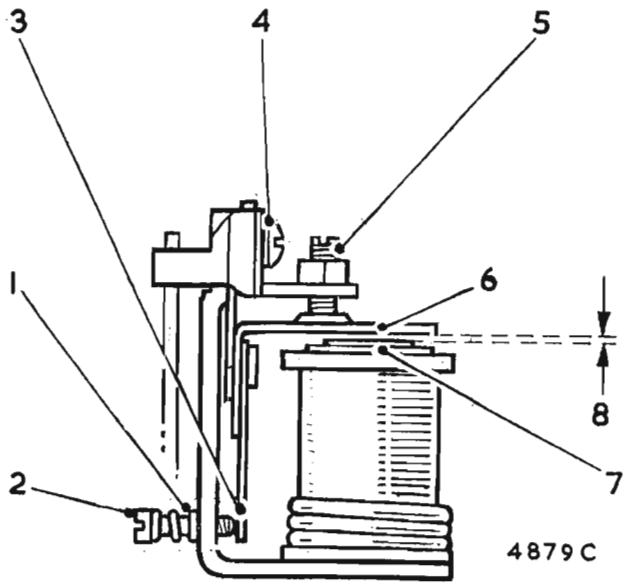


Fig. N.9

Mechanical setting of the regulator

1. Spring.
2. Voltage adjusting screw.
3. Armature tension spring.
4. Armature securing screws.
5. Fixed contact adjustment screw.
6. Armature.
7. Core face and shim.

Slowly increase the speed of the engine until the voltmeter needle 'flicks' and then steadies; this should occur at a voltmeter reading between the limits given for the appropriate temperature of the regulator.

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

Shut off the engine, remove the control box cover, and turn the adjusting screw (2) in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting. Turn the adjustment screw a fraction of a turn at a time until the setting is correct and then tighten the locknut.

When adjusting, do not run the engine up to more than half-throttle because, while the dynamo is in open circuit, it will build up to a high voltage if run at a high speed and in consequence a false voltmeter reading will be obtained.

Electrical settings of the regulator must be made as quickly as possible because of the temperature rise effects.

Mechanical setting

The mechanical settings of the regulator are accurately adjusted before leaving the Factory, 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 locknut and unscrew the contact until it is well clear of the armature moving contact. Slacken the two armature assembly securing screws.

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

Insert a ·015 in. (·38 mm.) feeler gauge between the armature and core shim. Take 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. Tighten the locknut and remove the feeler gauge. Reset the voltage adjusting screw as described under **'Electrical setting'.**

Cleaning regulator contacts

After periods of long service it may be found necessary to clean the regulator contacts. Fine carborundum stone or fine emery-cloth may be used. Carefully wipe away all traces of dust or other foreign matter, using a clean, fluffless cloth moistened with methylated spirits.

Cut-out 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 the 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 to 13·3 volts.

If operation of the cut-out takes place outside these limits it will be necessary to adjust. To do this, turn the cut-out adjusting screw (2) (Fig. N.7) in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw a fraction at a time. 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.

Adjustment of the drop-off voltage is effected by carefully bending the fixed contact blade. If the cut-out

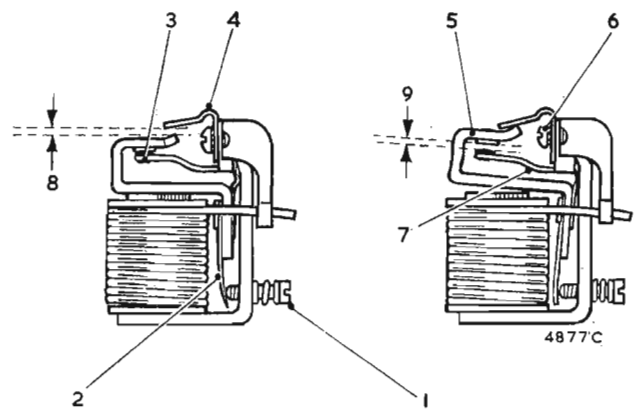


Fig. N.10

Mechanical setting of the cut-out

1. Cut-out adjusting screw.
2. Armature tension spring.
3. 'Follow through'—·010 to ·020 in. (·254 to ·508 mm.).
4. Stop arm.
5. Armature tongue and moving contact.
6. Armature securing screws.
7. Fixed contact blade.
8. ·025 to ·040 in. (·63 to 1·01 mm.).
9. ·010 to ·020 in. (·254 to ·508 mm.).

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 renewal.

Cut-out 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 reassembly. These can be obtained as follows.

Turn the adjusting screw until it is well clear of the armature tension spring. Slacken the two armature assembly securing screws (Fig. N.10). Press the armature firmly down against the copper-sprayed core face and retighten the two armature assembly securing screws.

Using a pair of round-nosed pliers, adjust the gap between the armature stop-arm and armature tongue by bending the stop-arm. The gap must be ·025 to ·040 in. (·635 to 1·016 mm.) when the armature is pressed squarely down on the core face.

Similarly, the insulated contact blade must be bent so that when the armature is pressed squarely down against the core face there is a 'follow through' or contact deflection of ·010 to ·020 in. (·254 to ·508 mm.). Reset the cut-out adjusting screw as described under **'Cut-out electrical setting'.**

Cleaning cut-out contacts

If the contacts appear rough or burnt place a strip of fine glass-paper between them, close them by hand, and draw the paper through. This should be done two or three times with the abrasive side towards each contact. Wipe away all dust or other foreign matter, using a clean, fluffless cloth moistened with methylated spirits.

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

Section N.7

FUSE UNIT

Description

The fuse unit, which is located on the right-hand side of the engine compartment, is an open, insulated moulding carrying two single-pole 35-amp. cartridge-type fuses which are held in spring clips between the Lucar connectors. Two spare fuses are carried in recesses in the fuse unit box and are positioned by retaining springs. The fuse which bridges the terminal blocks 'A1'—'A2' is to protect general auxiliary circuits, e.g. the horn, which is independent of the ignition switch. The other fuse, bridging terminal blocks 'A3'—'A4', is to protect the ignition and auxiliary circuits, e.g. the fuel gauge, windshield wiper motor, and flasher indicators, which only operate when the ignition is switched on.

Section N.8

LOCATION AND REMEDY OF FAULTS

Although every precaution is taken to eliminate possible causes of trouble, failure may occasionally develop through lack of attention to the equipment or damage to the wiring. The following pages set out the recommended procedure for a systematic examination to locate and remedy the causes of some of the more usual faults encountered.

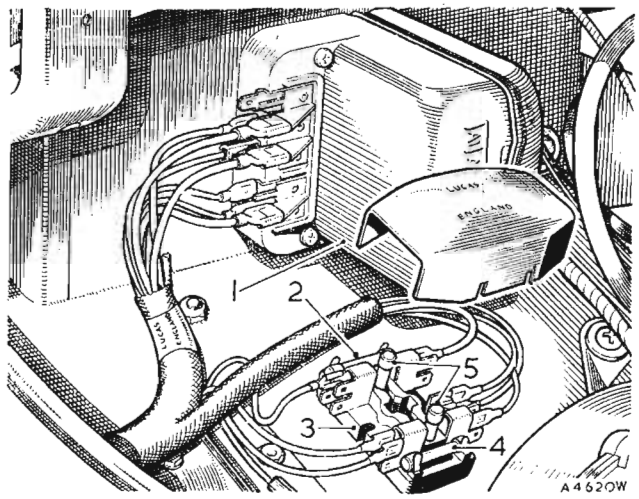


Fig. N.11

Regulator and fuse unit

1. Regulator cover.
2. AUX. IGN. fuse (35-amp.).
3. Fuse block.
4. AUX. fuse (35-amp.).
5. Spare fuses (B.M.C. Part No. 7H5067).

The sources of trouble are by no means always obvious, and in some cases a considerable amount of deduction from the symptoms is needed before the cause is disclosed.

For instance, the engine might not respond to the starter switch; a hasty inference would be that the starter motor is at fault. However, as the motor is dependent on the battery it may be that the battery is exhausted.

This in turn may be due to the dynamo failing to charge the battery, and the final cause of the trouble may be, perhaps, a loose connection in some part of the charging circuit.

If, after carrying out an examination, the cause of the trouble is not found the equipment should be checked by a Distributor or Dealer.

CHARGING CIRCUIT

1. Battery in low state of charge

(*a*) This state will be shown by lack of power when starting, poor light from the lamps, and the hydrometer readings below 1·200. It may be due to the dynamo not charging or giving low or intermittent output. The ignition warning light will not go out if the dynamo fails to charge, or will flicker on and off in the event of intermittent output.

(*b*) Examine the charging and field circuit wiring, tighten any loose connections, or renew any broken cables. Pay particular attention to the battery connections.

(*c*) Examine the dynamo driving belt; take up any undue slackness by swinging the dynamo outwards on its mounting after slackening the attachment bolts.

(*d*) Check the regulator setting, and adjust if necessary.
(*e*) If, after carrying out the above, the trouble is still not cured, have the equipment examined by a Distributor or Dealer.

2. Battery overcharged

This will be indicated by burnt-out bulbs, very frequent need for topping up the battery, and high hydrometer readings. Check the charge reading with an ammeter when the car is running. It should be of the order of only 3 to 4 amps.

If the ammeter reading is in excess of this value it is advisable to check the regulator setting, and adjust if necessary.

STARTER MOTOR

1. Starter motor lacks power or fails to turn engine

(*a*) See if the engine can be turned over by hand. If not, the cause of the stiffness in the engine must be located and remedied.
(*b*) If the engine can be turned by hand first check that the trouble is not due to a discharged battery.
(*c*) Examine the connections to the battery, starter, and starter switch, making sure that they are tight and that the cables connecting these units are not damaged.
(*d*) It is also possible that the starter pinion may have jammed in mesh with the flywheel, although this is by no means a common occurrence. To disengage the pinion rotate the squared end of the starter shaft by means of a spanner.

2. Starter operates but does not crank the engine

This fault will occur if the pinion of the starter drive is not allowed to move along the screwed sleeve into engagement with the flywheel, due to dirt having collected on the screwed sleeve. Remove the starter and clean the sleeve carefully with paraffin (kerosene).

3. Starter pinion will not disengage from flywheel when engine is running

Stop the engine and see if the starter pinion is jammed in mesh with the flywheel, releasing it if necessary by rotation of the squared end of the starter shaft. If the pinion persists in sticking in mesh have the equipment examined at a Service Depot. Serious damage may result to the starter if it is driven by the flywheel.

LIGHTING CIRCUITS

1. Lamps give insufficient illumination

(*a*) Test the state of charge of the battery, recharging it if necessary from an independent electrical supply.
(*b*) Check the setting of the lamps.
(*c*) If the bulbs are discoloured as the result of long service they should be renewed.

2. Lamps light when switched on but gradually fade out

As paragraph 1 (*a*).

3. Brilliance varies with speed of car

(*a*) As paragraph 1 (*a*).
(*b*) Examine the battery connections, making sure that they are tight, and renew any faulty cables.

Section N.9

FLASHER UNIT

Description

The Lucas flasher unit is situated in the engine compartment on the right-hand side and is operated by a switch centrally mounted on the fascia panel, a warning light being provided on the right-hand side of the fascia.

The unit is contained in a small cylindrical metal container, one end of which is rolled over onto an insulated plate carrying the mechanism and three terminals. The unit depends for its operation on the linear expansion of a length of wire which becomes heated by an electric current flowing through it. This actuating wire controls the movement of a spring-loaded armature attached to a central steel core and carrying a moving contact—the sequence of operation being as follows.

When the direction indicator switch is turned either to the left or right, current flows through the actuating wire, ballast resistor, and coil wound on the central core and hence to earth via the flasher lamp filaments. This current is limited by the ballast resistor to a value which will ensure that the flasher lamp filaments do not light at this stage. The actuating wire increases in length under the heating influence of the current and allows the armature to move inwards to its alternative position, thereby closing a pair of contacts in the supply circuit to the flasher lamps and at the same time short-circuiting the actuating wire. The increased electro-magnetic attraction of the armature to the core, due to the full lamp current now flowing through the coils, serves to hold the closed contacts firmly together. At the same time a secondary spring-loaded armature is attracted to the core and closes a pilot warning lamp circuit so that now both flasher lamps and warning lamp are illuminated.

Since, however, heating current no longer flows through the short-circuited actuating wire, the latter cools and consequently contracts in length. The main armature is therefore pulled away from the core, the contacts opened, and the light signals extinguished. The consequent reduction of electro-magnetism in the core allows the secondary armature to return to its original position and so extinguish the pilot warning light. The above sequence of operations continues to be repeated until the indicator switch is returned to the 'off' position.

Functions of warning lamp

The warning lamp not only serves to indicate that the flasher unit is functioning correctly but also gives a warning of any bulb failure occurring in the external direction indicator lamps—since a reduction in bulb current flowing through the coil reduces the electro-magnetic effect acting on the secondary armature and so prevents closure of the pilot light contacts.

Checking faulty operation

In the event of trouble occurring with a flashing light direction indicator system, the following procedure should be followed.

Check the bulbs for broken filaments.

Refer to the vehicle wiring diagram and check all flasher circuit connections.

Switch on the ignition.

Check with a voltmeter between the flasher unit terminal 'B' and earth that battery voltage is present.

Connect together flasher unit terminals 'B' (or 'X') and 'L' and operate the direction indicator switch. If the flasher lamps now light, the flasher unit is defective and must be renewed.

Maintenance

Flasher units cannot be dismantled for subsequent reassembly. A defective unit must therefore be renewed, care being taken to connect as the original.

Renewing flasher unit

When renewing a flasher unit or installing a flashing light system it is advisable to test the circuits before connections to flasher terminals are made. When testing join the cables normally connected to those terminals (green, green with brown, and light green) together and operate the direction indicator switch. In the event of a wrong connection having been made, the ignition auxiliaries fuse will blow but no damage will be done to the flasher unit.

Section N.10

WINDSHIELD WIPERS

Maintenance

Inspect the rubber wiping elements, which after long service become worn and should be renewed.

Lubricate the rubber grommet or washer around the wheelbox spindle with a few drops of glycerine.

Methylated spirits (denatured alcohol) should be used to remove oil, tar spots, and other stains from the windshield. It has been found that the use of some silicone- and wax-based polishes for this purpose can be detrimental to the rubber wiper blades.

The gearbox and cable rack are packed with grease during manufacture and need no further lubrication.

Checking switching mechanism

If the wiper fails to park or parks unsatisfactorily, the limit switch in the gearbox cover should be checked. Unless the limit switch is correctly set, it is possible for the wiper motor to overrun the open-circuit position and continue to draw current.

Resetting the limit switch

Slacken the four screws securing the gearbox cover and observe the projection near the rim of the limit switch. Position the projection in line with the groove in the gearbox cover. Turn the limit switch 25° in an anti-clockwise direction and tighten the four securing screws. If the wiping blades are required to park on the opposite side of the windshield, the limit switch should be turned back 180° in a clockwise direction.

Checking current consumption

If the wiper fails to operate, or operates unsatisfactorily, switch on the wiper and note the current being supplied to the motor. The normal running current should be 2·3 to 3·1 amps. Use a 0 to 15 amps. moving-coil ammeter connected in the wiper circuit, then proceed as follows.

Wiper takes no current

Examine the fuse protecting the wiper circuit. If the fuse has blown, examine the wiring of the motor circuit and of all other circuits protected by that fuse. Renew, if necessary, any cables which are badly worn or chafed, fitting protective sleeving over the cables to prevent a recurrence of the fault.

If the external wiring is found to be in order, replace the fuse with one of the recommended rating. Then proceed as for the wiper taking an abnormally high current.

If the fuse is intact, examine the wiring of the motor circuit for breaks, and ensure that the wiper control switch is operating correctly.

When a current-operated thermostat is fitted test it by connecting an ohmmeter across its terminals in place of the two cables. If a closed circuit is indicated the thermostat is in order and the cables must be refitted. An open circuit means that the thermostat has operated but not reset. Check the thermostat by substitution. Adjustment of the thermostat must not be attempted.

If the thermostat is in order, proceed as for the wiper taking an abnormally high current.

Wiper takes abnormally low current

Check that the battery is fully charged. The performance of the motor is dependent on the condition of the battery.

Remove the commutator end bracket and examine the brush gear, ensuring that it bears firmly on the commutator. The tension spring must be renewed if the brushes do not bear firmly on the commutator. Brush levers must move freely on the pivots. If these levers are stiff they should be freed by working them backwards and forwards by hand.

Examine the commutator and, if necessary, clean with a fuel-moistened cloth. A suspected armature should be checked by substitution.

Wiper takes abnormally high current

If an abnormally high current is shown on the ammeter, this may be due to excessive load on the driving shaft. The stall current of the motor when cold is 14 amps. and when hot is 8 amps.

If there is no obvious reason for this, such as a sticking wiper blade, a check should be made at the gearbox.

Remove the gearbox cover and examine the gear assembly, checking that a blow on the gearbox end bracket has not reduced the armature end-float. The armature end-float adjusting screw must be set to give an armature end-play of ·008 in. to ·012 in. (·20 to ·30 mm.).

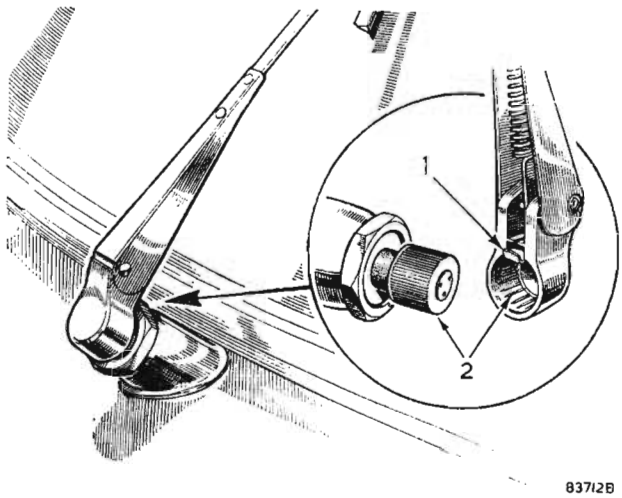


Fig. N.12

Removal and replacement of the windshield wiper arm

1. Retaining clip. 2. Splined drive.

Sluggish operation with excessive current consumption may be caused through frictional losses in badly positioned or defective connecting tubes. The connecting tubes can be checked, using a cable gauge. (Details of this gauge can be obtained from any Lucas Agent.) The gauge cable is similar in appearance to the driving rack but is ·010 in. (·25 mm.) larger in diameter and is less flexible. The gauge will not easily pass through connecting tubes having less than the minimum permissible curvature.

To check the tubing, using the gauge, it is necessary to remove the inner rack. Insert the gauge into the connecting tube as far as the first wheelbox and then withdraw it. Remove the tubing connecting the wheelboxes. Insert and withdraw the gauge. If the gauge moves freely the tubing is correctly installed. If the gauge does not move freely the tubing must be checked for sharp bends and obstructions. Check the wheelboxes for alignment and then reassemble.

Pieces of carbon short-circuiting adjacent segments of the commutator will also cause excessive current consumption. The resistance between adjacent commutator segments should be ·34 to ·41 ohm. Cleaning the commutator and brush gear removes this fault. When dismantling, check the internal wiring of the motor for evidence of short-circuiting due to chafed or charred insulation. Slip a new piece of sleeving over any charred connections, and arrange them so that they do not rub against sharp edges.

While the motor is dismantled check the value of the field resistance. If it is found to be lower than 12·8 to 14 ohms, a short circuit in the windings is indicated and a new field coil must be fitted. Other evidence of a short-circuit will be given by charred leads from the field coil.

Removing the rack and motor unit

Release the wiping arms from the spindles (see Fig. N.12), disconnect the union on the Bundy tube at the gearbox, and remove the nuts from the motor mounting bolts. Withdraw the motor and cable rack clear of the Bundy tube.

Dismantling the motor

Withdraw the four screws securing the gearbox cover and remove the cover.

Withdraw the terminal screws and through-bolts at the commutator end bracket.

Remove the commutator end bracket clear of the yoke.

The brush gear can be removed by lifting it clear of the commutator and withdrawing it as a unit. Care should be taken at this point to note the particular side occupied by each brush so that each may be replaced in its original setting on the commutator.

Access to the armature and field coils can be gained by withdrawing the yoke.

If it is necessary to remove the field coil, unscrew the two screws securing the pole-piece to the yoke. These screws should be marked so that they can be returned to their original holes.

Press out the pole-piece complete with field coil, marking the pole-piece so that it can be replaced in its correct position inside the yoke. The pole-piece can now be pressed out of the field coil.

Dismantling the gearbox unit

Remove the circlip and washer from the cross-head connecting link pin and lift off the cross-head and cable rack assembly. Then remove the circlip and washer from the final gear shaft located underneath the gearbox unit. Remove any burr from the circlip groove before lifting out the final gear. The armature and worm drive can now be withdrawn from the gearbox. All gear teeth should be examined for signs of damage or wear and, if necessary, new gears fitted.

Reassembling

Reassembly is a reversal of the above procedures. When reassembling, the following components should be lubricated, using the lubricants recommended.

Armature bearings

These should be lubricated with S.A.E. 20 engine oil—the self-aligning bearing being immersed in this for 24 hours before assembly.

Armature shaft (commutator end)

Apply S.A.E. 20 engine oil.

Felt lubricator in gearbox

Apply S.A.E. 20 engine oil.

Worm wheel bearings, cross-head, guide channel, connecting rod, crankpin, eccentric coupling assembly, worm, and final gear shaft

Grease liberally as for front hubs.

Cable rack and wheelboxes

Grease liberally as for front hubs.

Testing

Switch on the ignition and the wiper control. The two wiper areas should be approximately symmetrical on the windshield.

Fitting a blade to a wiper arm

Pull the wiper arm away from the windshield and insert the curved 'wrist' of the arm into the slotted spring fastening of the blade. Swivel the two components into engagement.

Fitting a wiper arm to the driving spindle

First ensure that the wiper spindles are in the correct parking position by switching on the ignition and turning the wiper control on and then off.

To fit the arms, press the headpieces onto the spindles at the correct parking angle until the retaining clip is heard to snap over the end of the spindle drum.

Switch off the wiper control. The arms should come to rest in the correct parking position.

Adjusting

Correct operation can be obtained by adjusting the position of the arms relative to the spindles. If necessary, the position of the arms may be adjusted by removing and re-engaging them with the splined driving spindles, the angular pitch of the splines being 5°.

Do not attempt to turn the arms whilst in position, but press back the retaining clip (Fig. N.12) in the headpieces and withdraw the arms from the driving spindles. Refit in the desired position. The above adjustment may affect the self-parking position. If so, it may be corrected by adjustment of the limit switch position as described previously.

If the arms and blades are required to come to rest on the opposite side, the limit switch should be turned through 180°. It should be noted that the switch cover is designed for turning through a sector only and not through 360°. This feature prevents unnecessary twisting of the external flexible connections.

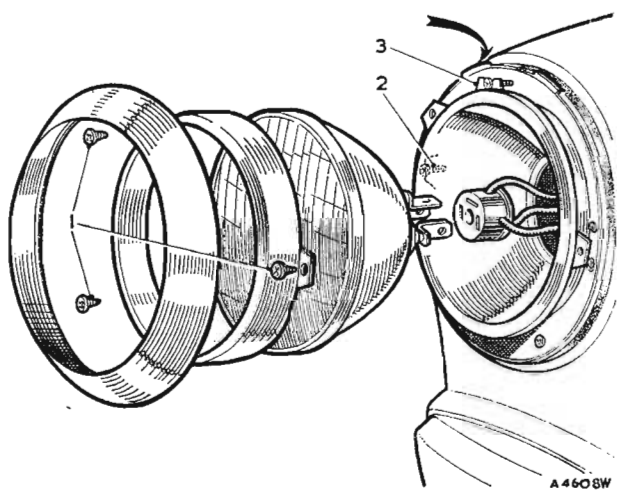


Fig. N.13

The sealed-beam headlamp

1. The light unit securing screws.
2. The light beam horizontal adjustment screw.
3. The light beam vertical adjustment screw.

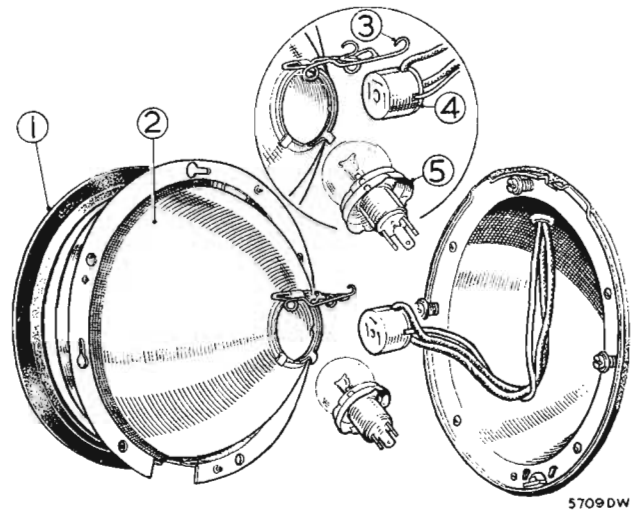


Fig. N.14

The headlamp light unit, showing the European-type bulb and socket

1. Rubber seal.
2. Reflector.
3. Bulb retainer.
4. Socket.
5. Bulb.

Section N.11

HEADLAMPS

Home and U.S.A. type

Headlamps fitted to vehicles operating on the Home or U.S.A. market are of the sealed-beam type and are serviced as complete units only.

European type

Headlamps fitted to vehicles exported to Europe are of the double-filament bulb type.

Certain countries have lighting regulations to which the foregoing arrangements do not conform, and cars exported to such countries have suitably modified lighting equipment.

Removing the light unit (Home and U.S.A. types)

The lamp rims are fitted with rubber dust excluders and rim retaining screws. Release the retaining screw at the bottom of the rim and the lamp body and lift away the lamp rim. Remove the inner rim securing screws and lift away the sealed-beam assembly after disconnecting the three-pin socket.

Removing the light unit (European type)

To remove the light unit for bulb replacement unscrew the retaining screw at the bottom of the plated lamp rim and lift the rim away from the dust-excluding rubber.

Remove the dust-excluding rubber, which will reveal the three spring-loaded screws. Press the light unit inwards against the tension of the springs and turn it in an anti-clockwise direction until the heads of the screws can pass through the enlarged ends of the keyhole slots in the lamp rim.

This will enable the light unit to be withdrawn sufficiently to give attention to the wiring and bulbs.

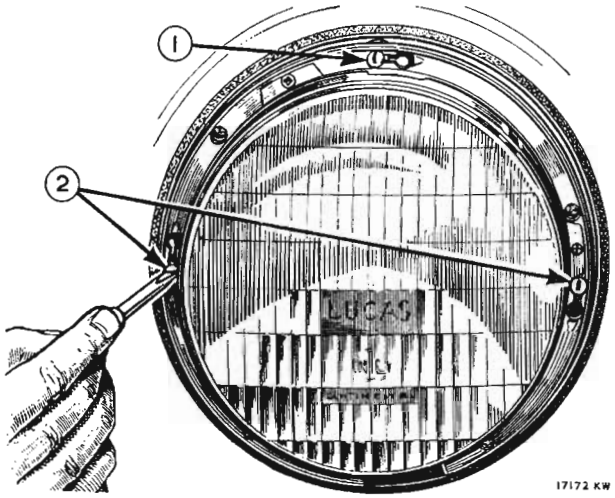


Fig. N.15

The headlamp setting screws

1. Vertical setting adjusting screw.
2. Horizontal setting adjusting screws.

Bulb replacement (European type)

The headlamps fitted to left-hand-drive cars for use in European countries are fitted with special front lenses giving an asymmetrical light beam to the right-hand side.

The bulb is released from the reflector by withdrawing the three-pin socket and pinching the two ends of the wire retaining clip to clear the bulb flange. When replacing the bulb make certain that the rectangular pip on the bulb flange engages the slot in the reflector seating.

Replace the spring clip with its coils resting in the base of the bulb flange and engaging the two retaining lugs on the reflector seating.

Refitting the light unit (Home and U.S.A.)

Refitting is the reverse of the removal procedure.

NOTE.—When refitting a headlamp rim make certain it is placed over the retaining lip at the top of the lamp body and held firmly in this position while refitting the lamp rim retaining screw.

Refitting the light unit (European type)

Position the light unit so that the heads of the adjusting screws coincide with the enlarged ends of the attachment slots. Push the light unit towards the wing to compress the springs and turn the unit to the right as far as it will go—that is, approximately $\frac{1}{2}$ in. (13 mm.).

Replace the dust-excluding rubber on the light rim with its flanged face forward and refit the plated rim.

Beam-setting (European type)

The lamps should be set so that the main driving beams are parallel with the road surface or in accordance with local regulations.

If adjustment is required this is achieved by removing the plated rim and dust-excluding rubber. Vertical adjustment can then be made by turning the screw at the top of the lamp in the necessary direction. Horizontal adjustment can be effected by using the adjustment screws on each side of the light unit (see Fig. N.15).

Beam-setting (Home and U.S.A. type)

The lamps should be set in the dip position, and should be adjusted to comply with the regulations in the country or state in which the vehicle is operating.

If adjustment is required, this is achieved by removing the headlamp rim. Vertical adjustment can then be made by turning the screw at the top of the lamp in the necessary direction. Horizontal adjustment can be effected by using the adjustment screw on the right-hand side of the lamp.

Section N.12

PANEL AND WARNING LAMPS

Access to the warning lamps for the ignition and headlamp beam is effected from under the fascia by withdrawing the push-in-type holders from the rear of the fascia panel.

A list of the correct types of bulbs for replacement purposes and their part numbers appears in Section N.16.

Section N.13

NUMBER-PLATE ILLUMINATION LAMP

The number-plate is illuminated by a separate lamp with twin bulbs.

The cover is removed by unscrewing the single attachment screw, which enables it to be withdrawn, giving easy access to the bulbs.

Section N.14

PILOT AND FLASHING DIRECTION INDICATOR LAMPS

Remove the two securing screws and lift away the plated rim and glass. An amber cover is fitted over the direction indicator bulb when the vehicle is operating in

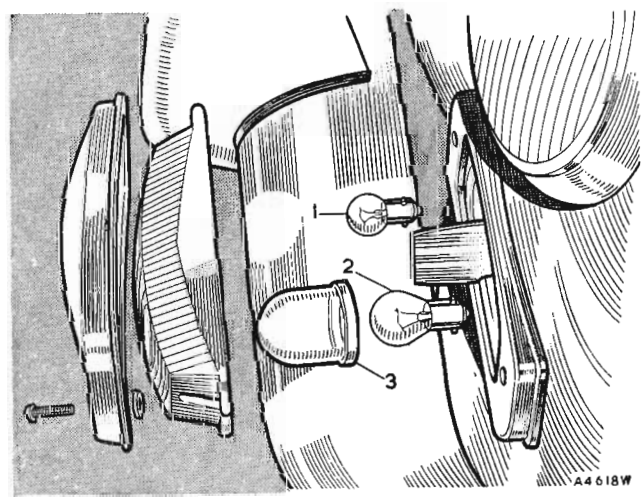


Fig. N.16

The side and direction indicator lamp

1. Sidelamp bulb.
2. Direction indicator bulb.
3. Amber direction indicator bulb cover.

countries where the lighting regulations require amber flashing indicators.

Refitting is a direct reversal of the removal procedure.

Section N.15

TAIL AND STOP AND DIRECTION INDICATOR LAMPS

The tail lamp bulbs are of the double-filament type, the second filament giving a marked increase in brilliance when the brakes are applied.

Access to the bulbs is gained by extracting the securing screws from the outer face of the lamp lens to release the lens.

The tail and stop lamp bulbs must be fitted one way only; offset retaining pegs ensure that they are replaced correctly.

The lamp body can be removed when the lens is taken off as indicated in Fig. N.17 and the three screws located in the lamp body withdrawn. When refitting the glass to the body make certain that it is seating correctly over the sealing rubber.

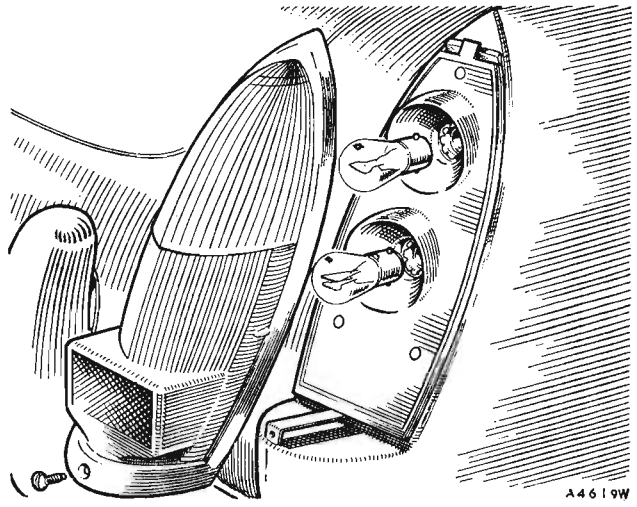


Fig. N.17

The tail, stop, and direction indicator lamps

Section N.16

REPLACEMENT BULBS

	Volts	*Watts*	*B.M.C. Part No.*
Headlamps—United Kingdom only	12·8	60/45	13H496
Headlamps—L.H.D. except U.S.A. and Europe	12	42/36	3H1893
Headlamps—L.H.D. Europe except France	12	45/40	13H138
Headlamps—France only	12	45/40	13H139
Headlamps—Sweden only	12	45/40	13H138
Sidelamps	12	4	1D9081
Sidelamps, direction indicator lamps—North America and Italy	12	6/21	1F9026
Direction indicator lamps (front)	12	21	1F9012
Direction indicator lamps (rear)	12	21	1F9012
Tail and stop lamps	12	6/21	1F9026
Number-plate illumination lamp	12	6	2H4817
Panel and warning lights	12	2·2	2H4732

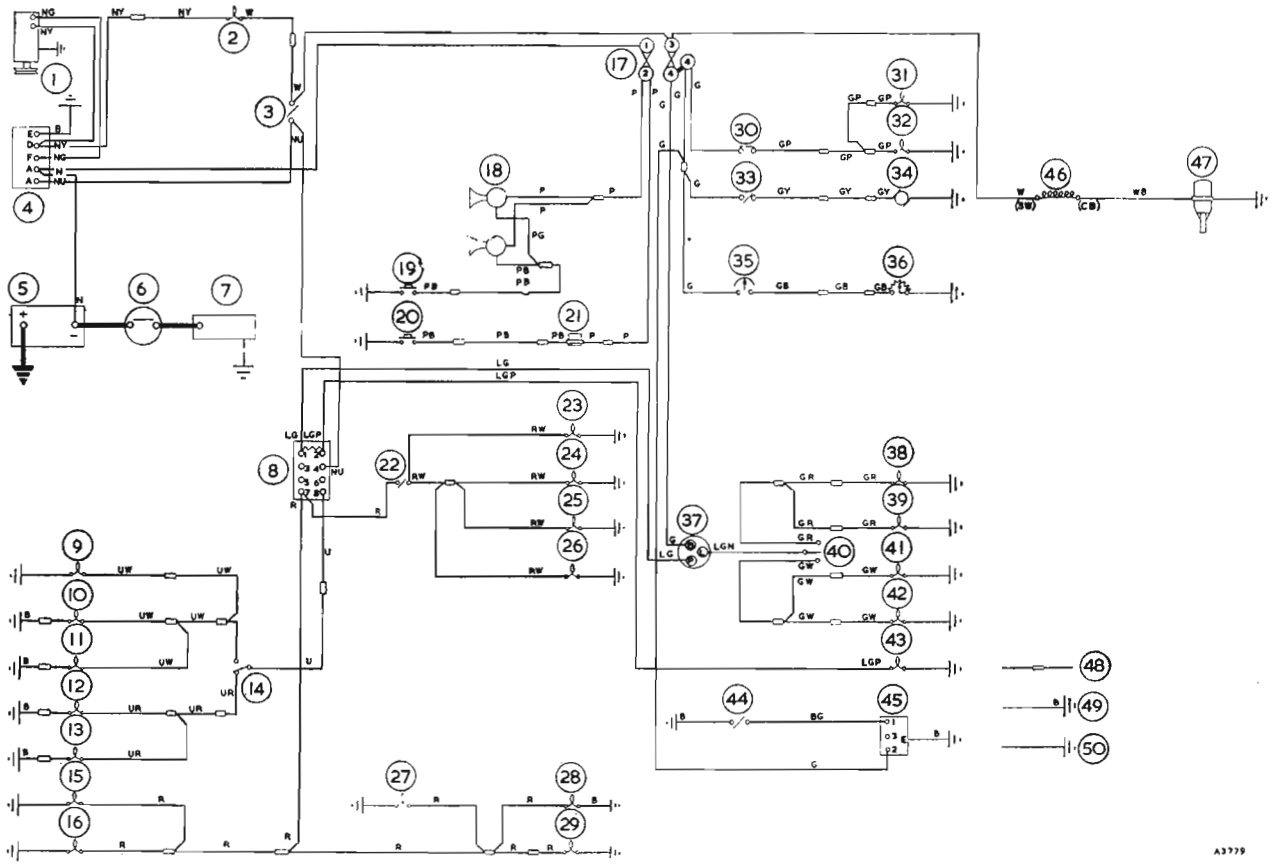


Fig. N.18

Wiring diagram

1. Dynamo.
2. Ignition warning light.
3. Ignition switch.
4. Control box.
5. Battery.
6. Starter switch.
7. Starter motor.
8. Lighting switch.
9. Main beam warning light.
10. R.H. headlamp main beam.
11. L.H. headlamp main beam.
12. R.H. headlamp dip beam.
13. L.H. headlamp dip beam.
14. Dipper switch.
15. L.H. sidelamp.
16. R.H. sidelamp.
17. Fuse unit.
18. Twin horn. } (when fitted).
19. Horn-push }
20. Horn-push.
21. Horn.
22. Panel light switch.
23. Panel light.
24. Panel light.
25. Panel light.
26. Tachometer light (when fitted).
27. R.H. tail lamp.
28. Number-plate lamp.
29. L.H. tail lamp.
30. Stop lamp switch.
31. L.H. stop lamp.
32. R.H. stop lamp.
33. Heater switch.
34. Heater motor (when fitted).
35. Fuel gauge.
36. Fuel gauge tank unit.
37. Flasher unit.
38. L.H. front flasher.
39. L.H. rear flasher.
40. Flasher switch.
41. R.H. rear flasher.
42. R.H. front flasher.
43. Flasher warning light.
44. Windshield wiper switch.
45. Windshield wiper motor.
46. Ignition coil.
47. Distributor.
48. Snap connectors.
49. Earth connections made via cable.
50. Earth connections made via fixing bolts.

CABLE COLOUR CODE

B.	Black	P.	Purple	Y.	Yellow
U.	Blue	R.	Red	L.	Light
N.	Brown	S.	Slate	D.	Dark
G.	Green	W.	White	M.	Medium

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.