SECTION N

ELECTRICAL SYSTEM

SERIES BN4

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End of section wiring diagram
GENERAL DESCRIPTION

The 12-volt electrical equipment incorporates compensated voltage control for the charging circuit. The positive earth system of wiring is employed.

Battery details may be found in "General Data".

The generator is mounted on the right of the cylinder block and driven by an endless belt from the crankshaft pulley. A rotatable mounting enables the belt tension to be adjusted.

The voltage control unit adjustment is sealed and should not normally require attention. The fuses are carried in external holders mounted in an accessible position on the right-hand side of the engine compartment together with spare fuses.

The starter motor is mounted on the flywheel housing on the right-hand side of the engine unit and operates on the flywheel through the usual sliding pinion device.

The headlamps employ the double-filament dipping system. Both lamps are fitted with double-filament bulbs, both dipping according to the regulations existing in the countries concerned.

NOTE:—Whenever booster charging of the battery or electric welding of the body is carried out, the battery earth lead must be disconnected to prevent damage to the electric system.

Section N.1

BATTERY MAINTENANCE

In order to keep the battery in good condition a periodical inspection should be made and the following carried out:

(1) Topping up

Remove the filler plug from each cell weekly and examine the level of the electrolyte. Add distilled water as required to bring the level of the electrolyte just above the top of the perforated plate covering the separators.

NOTE.—Do not use tap-water and do not use a naked light when examining the condition of the cells. Wipe away all dirt and moisture from the top of the battery.

(2) Testing the condition of the battery

At the recommended mileage examine the condition of the battery by taking hydrometer readings.

If the level of the electrolyte is too low for hydrometer readings to be taken top up with distilled water and recharge the battery for at least thirty minutes (to ensure thorough mixing of the electrolyte and newly added water) before taking hydrometer readings.

The specific gravity readings and their indications are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Home Trade and climates below 27° C. (80° F.)</th>
<th>Climates frequently above 27° C. (80° F.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell fully charged</td>
<td>1:270 to 1:290</td>
<td>1:210 to 1:230</td>
</tr>
<tr>
<td>Cell about half-discharged</td>
<td>1:190 to 1:210</td>
<td>1:130 to 1:150</td>
</tr>
<tr>
<td>Cell completely discharged</td>
<td>1:110 to 1:130</td>
<td>1:050 to 1:070</td>
</tr>
</tbody>
</table>

The figures given in the table are corrected to an electrolyte temperature of 16° C. (60° F.) and the hydrometer readings obtained must also be corrected to suit the temperature of the electrolyte.

For every 3° C. (5° F.) above 16° C. (60° F.) add -002.

For every 3° C. (5° F.) below 16° C. (60° F.) subtract -002.

The readings of all cells should be approximately the same. If one cell gives a reading which differs from the remainder by forty points (+040 S.G.) or more, an internal fault in that cell is indicated. The battery should then be checked by the nearest battery specialist. Should the battery be in a low state of charge, it should be recharged by taking the car for a long daytime run or by charging from external source of D.C. supply at a current rate of 5 amperes until the cells are gassing freely.

Fig. N.1.
When using the hydrometer to ascertain the condition of the battery take the reading at eye-level, ensuring that the float is free.

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After examining the battery check the vent plugs, making sure that the air passages are clear, and screw the plugs into position. Wipe the top of the battery to remove all dirt and moisture.

STORAGE

If a battery is to be out of use for any length of time it should first be fully charged and then given a freshening charge about every fortnight.

A battery must never be allowed to remain in a discharged condition as this will cause the plates to become sulphated.

Section N.2

INITIAL FILLING AND CHARGING
(Dry Uncharged Batteries)

1. Preparation of an electrolyte

When a new battery has been supplied dry it is necessary to fill the cells with electrolyte of the correct specific gravity.

The specific gravity of the filling-in solution should be the same as that required at the end of the charge (i.e. 1:260 for climates below 27°C (80°F.) and 1:210 for climates frequently above 27°C (80°F.).

The electrolyte is prepared by mixing distilled water and concentrated sulphuric acid 1:840 S.G. The mixing must be carried out in a lead-lined tank or a suitable glass or earthenware vessel. Steel or iron containers must not be used. 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 have dangerous consequences.

To produce electrolyte of the correct specific gravity use the following proportions of acid and distilled water:

Add 1 part by volume of

To obtain specific gravity 1:840 S.G. acid to distilled
(corrected to 16°C (60°F) water by volume as below

1:260
1:210
3:2 parts
4:3 parts

Heat is produced by the mixture of acid and water and the mixture should therefore be allowed to cool before it is poured into the battery, otherwise the plates, separators, and moulded container may be damaged.

2. Filling in and soaking

The temperature of the filling-in solution, battery, and charging room should be between 16° and 38°C. (60° and 100°F.).

Carefully break the seals in the filling holes and half-fill each cell in the battery with electrolyte of the appropriate specific gravity. The quantity of electrolyte required to half-fill a two-volt cell is 3/4 pint (28 litre).

Allow to stand for at least six to twelve hours then complete the filling of the cells by the addition of more electrolyte of the same specific gravity as before until the level reaches the bottom of the filling holes, and allow the battery to stand for at least another two hours before commencing the first charge.

3. Duration and rate of initial charge

Charge at a constant current of 3:5 amps. (4:5 amps. for 11-plate battery) until the voltage and temperature-corrected specific gravity readings show no increase over five successive hourly readings. This period is dependent upon the length of time the battery has been stored since manufacture, and will be from 40 to 80 hours.

Throughout the charge the electrolyte in each cell must be maintained level with the top of the perforated plate covering the separators by the addition of electrolyte of the same specific gravity as the original filling-in solution.

If, during charge, the temperature of the acid in any cell of the battery reaches the maximum permissible temperature, i.e. 38°C. (100°F.) in climates ordinarily below 27°C. (80°F.), 49°C. (120°F.) in climates frequently above 27°C. (80°F.), the charge must be interrupted and the battery temperature allowed to fall at least 5-5°C. (10°F.) before charging is resumed.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 16°C. (60°F.), 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 electrolyte as 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 separator guards.

Section N.3

INITIAL FILLING AND CHARGING
(Dry-charged Batteries)

Dry-charged batteries are supplied without electrolyte but with the plates in a charged condition. When required for service it is only necessary to fill each cell with sulphuric acid of the correct specific gravity. No initial charging is required.
Preparing the electrolyte
Prepare the electrolyte as detailed in Section N.2.

Filling the battery
Remove the tapes securing the filler plugs, unscrew the filler plugs, and fill each cell with electrolyte to the top of the separators, in one operation. The temperature of the filling room, battery, and electrolyte should be maintained between 16 and 38°C (60 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.

Putting into use
Measure the temperature and specific gravity of the electrolyte in each of the cells. Allow to stand for 20 minutes and then re-check. The battery is ready for service unless the electrolyte temperature has risen by more than 5°C (10°F), or the specific gravity has fallen by more than 10 points (010 S.G.). In this event, re-charge the battery at the normal re-charge rate until the specific gravity remains constant for three successive hourly readings and all cells are gassing freely. During the charge the electrolyte must be kept level with the top of the separator guard by the addition of distilled water.

Section N.4
Dynamo
Description
The dynamo 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 dynamo 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 dynamo gives only sufficient output to keep the battery in good condition without any possibility of overcharging. In addition, 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 up, thus quickly restoring to the battery the energy taken from it by the electric starting motor.

Section N.5
Dynamo maintenance
Lubrication
At the recommended mileage inject a few drops of oil to Ref. D (page Q.1) into the hole marked “oil” at the end of the bearing housing.

Inspection of Brushgear and Commutator
Periodically inspect the brush-gear and commutator. Access to the brushgear on earlier dynamos is gained by removing the metal band cover from around the yoke. Some dynamos are now produced without brushgear inspection windows in the yoke and it is necessary to unscrew the two through bolts and withdraw the commutator end bracket before access to the brushgear can be gained.

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 petrol-moistened cloth. Be careful to replace brushes in their original positions in order to retain the “bedding”. Brushes which have worn so that they will not “bed” properly on the commutator must be renewed.

The commutator should be clean, free from oil or dirt, and should have a polished appearance. 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.

Belt adjustment
Occasionally inspect the dynamo driving belt and adjust if necessary to take up any undue slackness by turning the dynamo on its mounting. Care should be taken to avoid overtightening the belt, which should have sufficient tension only to drive without slipping.

See that the generator is properly aligned, otherwise undue strain will be thrown on the bearings.

Section N.6
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.

1. Inspect the driving belt and adjust if necessary.
2. Check that the dynamo and control box are connected correctly. The larger dynamo terminal must be connected to control box terminal “D”, and the smaller dynamo terminal to control box terminal “F”. Check the control box terminal “E” and associated earthing cable for tightness.
3. Switch off all lights and accessories, disconnect the cables from the dynamo terminals and connect the two terminals with a short length of wire.
(4) Start the engine and set to run at normal idling speed.

(5) Clip the negative lead of a moving coil voltmeter, calibrated 0 to 20 volts, to one dynamo terminal, and the other lead to a good earthing point on the yoke.

(6) Gradually increase the engine speed, when the voltmeter reading should rise rapidly 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 dynamo up to a speed of 1,000 r.p.m. If there is no reading, check the brushgear as described in (7) following.

If there is a low reading of approximately \( \frac{1}{2} \text{ to 1 volt, the field winding may be at fault (see "Field Coils"). If there is a reading of 4 to 5 volts, the armature winding may be at fault (see "Armature").}

**NOTE.** Excessive sparking at the commutator in the above test indicates a defective armature which should be replaced.

(7) Remove the cover band (when fitted) 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 on a smooth file. Always replace brushes in their original position.

If the brushes are badly worn, new brushes must be fitted and bedded to the commutator. The minimum permissible length of brush is \( \frac{3}{8} \text{ in.}

Test the brush spring tension with a spring scale. The tension of the springs when new is 36 to 44 oz. (1020 to 1247 gr.) In service it is permissible for this value to fall to 30 oz. (840 gr.) 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 dynamo as in (6); 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 for internal examination.

When reassembling a "windowless" yoke dynamo, the brushes must first be held clear of the commutator in the usual way, i.e., by partially withdrawing the brushes from their brush-boxes until each brush is trapped in position by the side pressure of its spring. The brushes can be released on to the commutator with a small screwdriver or similar tool when the end bracket is assembled to within about half-an-inch of the yoke. Before closing the gap between end bracket and yoke, see that the springs are in correct contact with the brushes.
(8) If the dynamo is in good order, remove the link from between the terminals and restore the original connections, taking care to connect the larger dynamo terminal to control box terminal "D", and the smaller terminal to control box terminal "F".

Fig. N.4. Undercutting the commutator.
"A" is the correct and "B" is the incorrect method.
1. Insulation.
2. Segments.

fan belt so that the latter can then be removed.

(5) Remove the setpin from the upper end of the sliding link and take out the nuts and bolts from the mounting bracket.

(6) Lift the dynamo clear of the engine.

(7) Unscrew the two nuts securing the coil to its bracket on the dynamo and remove the coil.

To Dismantle

(1) Take off the driving pulley.

(2) On earlier type dynamos, remove the cover band, hold back the brush springs and remove the brushes from their holders.

(3) Unscrew and withdraw the two through bolts.

(4) The commutator end bracket can now be withdrawn from the dynamo yoke.

(5) The driving end bracket together with the armature can now be lifted out of the yoke.

(6) 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.

Section N.7
DYNAMO ASSEMBLY

To remove

(1) Disconnect the two leads to the dynamo.

(2) Disconnect the high tension lead and the two low tension leads to the coil.

(3) Slacken the nut securing the sliding link and the two bolts holding the dynamo to its mounting bracket.

(4) Push the dynamo downwards to slacken the

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Section N.8

INSPECTION AND OVERHAUL

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 badly worn commutator mount the armature, with or without the drive end bracket, in a lathe, then 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 $\frac{1}{16}$ in. (8 mm.) with a hacksaw blade ground to the thickness of the insulator.

The most common armature faults are open or short-circuited windings. Indication 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 burned commutator segments.

If armature testing facilities are not available, an armature can be checked by substitution.

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, using a mild steel tube of suitable diameter, whilst pressing the armature shaft firmly home.

The mild steel tubes should be approximately 4 in. long and $\frac{1}{4}$ in. thick, the internal diameter being $\frac{3}{16}$ in.

Do not use the drive end bracket as a support for the bearing whilst fitting an armature.

Field Coils

Measure the resistance of the field coils, without removing them from the dynamo yoke, by means of an ohmmeter connected between the field terminal and the yoke.

The ohmmeter should read 6 ohms approximately.

If an ohmmeter is not available, connect a 12-volt d.c. supply with an ammeter in series between the field terminal and dynamo yoke. The ammeter reading should be approximately 2 amperes. Zero on the ammeter or an "Infinity" ohmmeter reading indicates an open-circuit in the field winding.

If the current reading is much more than 2 amperes, or the ohmmeter reading much below 6 ohms, it is an indication that the insulation of one of the field coils has broken down.

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

1. Drill out the rivet securing the field coil terminal assembly to the yoke, and unsolder the field coil connections.
2. Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.
3. Mark the yoke and pole shoes in order that they can be refitted in their original positions.
4. Unscrew the two pole shoe retaining screws by means of the wheel-operated screwdriver.
(5) Draw the pole shoes and coils out of the yoke and lift off the coils.

(6) Fit the new field coils over the pole shoe 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.

(7) Locate the pole shoes and field coils by lightly tightening the fixing screw.

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

(9) Replace the insulation piece between the field coil connections and the yoke.

(10) Re-solder the field connections to the field coil terminal tags and re-rivet the terminal assembly to the yoke.

**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:

1. Remove the old bearing bush from the end bracket. The bearing can be withdrawn with a suitable extractor or by screwing a tap into the bush for a few turns and pulling out the bush with the tap. Use an 1/8 in. tap. Screw the tap squarely into the bush to avoid damaging the bracket.

2. 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 the same diameter as the shaft which is to fit in the bearing, until the visible end of the bearing is flush with the inner face of the bracket. Porous bronze bushes must 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 100°C. (212°F.), for two hours then allowing to cool before removing the bearing bush.

The ball bearing at the driving end is replaced as follows:

1. Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

2. Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil retaining washer.
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(3) Before fitting the replacement bearing see that it is clean and pack it with high melting point grease.
(4) Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.
(5) Locate the bearing in the housing and press it home. The outer bearing journal is a light push-fit in the bearing housing.
(6) Refit the bearing retaining plate using rivets having the same dimensions as those originally fitted. Use Lucas No. 188739 for the end brackets.

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. This tube should be approximately 4 in. (100 mm.) long and ½ in. (3 mm.) thick, with an internal diameter of 1/2 in. (17 mm.). Do not use the drive end bracket as a support for the bearing when fitting an armature.

Section N.9
ASSEMBLING AND REPLACING

In the main the reassembly of the dynamo is a reversal of the dismantling procedure. Before refitting the dynamo, however, inject S.A.E.30 oil into the commutator end bracket as previously described. The replacement is the reverse of the procedure “To Remove” in Section N.7. Check the fan belt adjustment as described in Section C.

Section N.10
THE STARTER

To Test on Vehicle

(1) 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 current is flowing through the starter windings but that the starter pinion is meshed permanently with the geared ring on the flywheel. This was probably caused by the starter being operated while the engine was still running. In this case the starter must be removed from the engine for examination.
(2) Should the lamps retain their full brilliance when the starter switch is operated, check that the switch is functioning. If the switch is in order, examine the connections at the battery, starter switch and starter, and also check the wiring between these units. Continued failure of the starter to operate indicates an internal fault, and the starter must be removed from the engine for examination.

Sluggish action of the starter is usually caused by a poor connection in the wiring which produces a high resistance in the starter circuit. Check as described above. Damage to the starter drive is indicated if the starter is heard to operate but does not crank the engine.

Section N.11
SERVICING THE STARTER

To Remove and Replace

Release the starter cable from the terminal and unscrew the two starter securing bolts. Manoeuvre the starter forwards below the oil filter and lift clear of the engine.

Examination of Commutator and Brush Gear

(1) Remove the starter cover band and examine the brushes and the commutator.
(2) 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 on 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.
(3) If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.
(4) 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 and 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.

To Dismantle

(1) Take off the cover band at the commutator end, hold back the brush springs and take out the brushes.
(2) Extract the split pin at the driving end and remove the nut (left-hand thread), spring, washer, pinion and sleeve, restraining spring and collar and spring sleeve.
(3) Remove the terminal nuts and washers from the terminal post and screw out the two through-bolts.
(4) Remove the commutator end bracket, the attachment bracket and the armature.
Brushes
(1) Test the brush springs with a spring balance. The correct tension is 30 to 40 ozs. (850 to 1134 gm.). Fit a new spring if the tension is low.
(2) 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 (Fig. N.12) 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 pre-formed, so that bedding of the working face to the commutator is unnecessary.

Drive
(1) If the pinion is tight on the screwed sleeve, wash away any dirt with paraffin (kerosene).
(2) If any parts are worn or damaged they must be renewed.
(3) Remove the cotter pin from the shaft nut at the end of the starter drive. Hold the squared starter shaft extension at the commutator end by means of a spanner and unscrew the square shaft nut. Lift off the main spring, washer, screwed sleeve with pinion, collar, pinion restraining spring and spring restraining sleeve.

Commutator
A commutator in good condition will be smooth and free from pits and burned spots. Clean the commutator with a cloth moistened with petrol (gasoline). 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 in a lathe, rotate it at a 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 lamp does not light, there is an open circuit in the wiring of the field coils.

Lighting of the lamp 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 field coils carry out the procedure detailed in Section N.8.
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.

Bearings (Commutator End)
Bearings which are worn to such an extent that they will allow excessive sideplay 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 in 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 twenty-four hours in thin engine oil in order to fill the pores of the bush with lubricant.

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

NOTE.—When reassembling the starter drive the locating nut must be re-caulked to the armature shaft.

Section N.12
CONTROL BOX
This unit contains the cut-out and voltage regulator.
running, the output of the generator falls 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 generator. This is necessary because the battery would otherwise discharge through the generator with the engine stopped or running at low speed.

**Regulator Adjustment**

The regulator is carefully set during manufacture, and in general it should not be necessary to make any 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.

**Fig. N.14. 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 moving contact.
7. Fixed contact.
8. Regulator series windings.

Together. Connect the negative lead of a moving coil (0 to 20 volts) voltmeter to control box terminal “D” and connect the other lead to terminal “E”.

(2) 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 is outside these limits the regulator must be adjusted.

(3) Shut off the engine and remove the control box cover. Release the locknut securing the regulator.

**Fig. N.15. Regulator mechanical setting.**
1. Armature tension spring.
2. Armature securing screws.
3. Fixed contact adjustment screw.
4. Armature.
5. Core face and shim.
7. Lock nut.

**Fig. N.13. Checking brush spring tension.**
1. Brush spring.
2. Spring scale.

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 slipping of the generator belt.

**Checking and Adjusting the Electrical Setting**

The electrical setting can be checked without removing the cover from the control box.

1. Withdraw the cables from the terminals marked “A” and “A,1” at the control box and join them.

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adjusting screw and turn the adjusting screw in a clockwise direction to raise the setting, or in an anti-clockwise direction to lower the setting. Turn the screw a fraction at a time and tighten the locknut. Repeat this procedure until the desired setting is obtained.

(4) Adjustment of the regulator open circuit should be completed within 30 seconds otherwise overheating of the shunt winding will cause false settings to be made. 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. Remake the original connections.

Mechanical Setting

The mechanical settings of the regulator, shown in Fig. N.15 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:—

(1) Slacken the fixed contact locking nut (3), and unscrew the contact until it is well clear of the armature moving contact. Slacken the voltage adjusting screw locking nut (7) and unscrew the adjuster until it is well clear of the armature tension spring. Slacken the two armature assembly securing screws (2).

(2) Insert a .015 in. (.38 mm.) feeler gauge (which should be wide enough to completely cover the core face), between the armature and the core shim. Take care not to turn up, or damage the edge of the shim. Press the armature squarely down against the gauge and re-tighten the two armature securing screws.

(3) With the gauge still in position, screw the adjustable contact down until it just touches the armature contact. Tighten the locking nut 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:—

(1) Slacken the locknut of (2) Fig. N.14, securing the cut-out adjusting screw and turn the screw 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 and then tighten the locknut.

(2) 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.

(3) Adjustment of the drop-off voltage (8.5 to 11 volts) is effected by carefully bending the fixed contact blade. 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 renewal.

Fig. N.16. Internal connections of the control box.

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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:

1. Slacken the adjusting screw locking nut Fig. N.17, and unscrew the adjusting screw (5) until it is well clear of the armature tension spring (6). Slacken the two armature assembly securing screws (3).

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

3. Using a pair of round-nosed pliers, adjust the gap between the armature stop-arm and the armature tongue by bending the stop-arm. The gap must be 0.025 in. to 0.030 in. (6 mm. to 7 mm.) when the armature is pressed squarely down on the core face.

4. Similarly, the insulated 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 contact deflection of -0.010 in. (25 mm.) The contact gap, when the armature is in the free position must be -0.018 in. (45 mm.) minimum. 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, and with them 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. Do not use emery cloth or carborundum stone for cleaning the cut-out contacts.

Section N.13  FUSE UNIT

Description

The fuse unit, which is mounted on the bulkhead under the engine cowling, is an open insulated moulding carrying two single-pole cartridge-type fuses which are held by spring clips between grub-screw-type terminal blocks. Two spare fuses are carried in recesses in the fuse unit base and are positioned by a common retaining spring. The fuse which bridges the terminal blocks (A1—A2) is to protect general auxiliary circuits, e.g., the horn and interior lamps, which are independent of the ignition switch. The other fuse, bridging terminal blocks (A3—A4), is to protect ignition auxiliary circuits, e.g., the fuel gauge, windshield wiper motor and flashing indicators, which only operate when the ignition is switched on.

To Remove

1. Disconnect the cables from the battery.
2. Remove the two nuts securing the fuse unit to the bulkhead.
3. Slacken the terminal grub screws and withdraw the cables to release the fuse unit.

Cleaning Cut-out Contacts

If the contacts appear rough or burnt, place a strip of fine glass paper between, and with them closed by hand, draw the paper through. This should be done two or three times with the rough side towards each contact.
ELECTRICAL SYSTEM

To Replace
(1) Ensure all fuses are serviceable.
(2) Reconnect the cables to the appropriate terminals on the fuse unit in accordance with the colour code given in the wiring diagram.
(3) Secure the fuse unit to the bulkhead.
(4) Reconnect the battery cables and test the circuits concerned.

Section N.14
THE FLASHER UNIT

Description
The Lucas flasher unit is situated in the engine compartment and is operated by a self-cancelling steering column direction switch, a warning lamp being provided in the centre of the facia panel.

The unit is contained in a small cylindrical metal container, one end of which is rolled over on to 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 left or right, current flows through the actuating wire, ballast resistor and a coil wound on the central core and thence 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 grows 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 electromagnetic attraction of the armature to the core, due to the full lamp current now flowing through the coil, 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 wire, the latter cools down 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. A diagram of the flasher unit is shown in Fig. N.19.

Functions of Warning Lamp
The warning lamp not only serves to indicate that
the flasher unit is functioning correctly but also gives
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.

The Brake Switch Overriding Relay
When stop-light filaments are used also as direction
lights, it is essential that responses to the flasher unit
should override simultaneous applications of the brake
switch. In the event of simultaneous applications being
made, the relay shown in Fig. N.20 allows the appropriate
stop-light filament to flash and the other to remain
steadily illuminated as long as the brake pedal is
depressed.

Operation of the direction-indicator switch to right
or left first energises the appropriate relay operating coil
which effects movement of its associated armature in
the direction shown by the arrow (Fig. N.20 inset). By
this means, flasher unit terminal 'L' is connected to
relay terminals '2' and '3' (or '6' and '7') and, thus, to
the indicating lamps. As long as the relay coil remains
ergised, connection to the brake switch on the corre-
sponding side is interrupted.

Checking Faulty Operation
In the event of trouble occurring with a flashing
light direction-indicator system, the following procedure
should be followed:—

1. Check the bulbs for broken filaments.
2. Refer to vehicle wiring diagram and check all
   flasher circuit connections.
3. Switch on the ignition.
4. Check with a voltmeter that flasher unit terminal
   'B' is a battery voltage with respect to earth.
5. 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 replaced.
6. If the lamps do not light in test (5), check the
   brake switch overriding relay as follows:—
   (a) Temporarily link relay terminal 'I' to ter-
   minals '2' and '3'.
      The left-hand lamps should now flash.
   (b) Temporarily link relay terminal 'I' to ter-
   minals '6' and '7'.
      The right-hand lamps should now flash.
   (c) If the lamps do flash in test (6), the relay is
defective and requires either re-setting, see
   "Checking and Re-setting Air Gaps".
   (d) Direction-indicator switches are best checked
   by substitution.

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

The cover of the brake switch overriding relays
can be withdrawn for checking air-gap settings. No
further dismantling is possible. In the event of defective
coils or contacts occurring, relays must be replaced as
complete units, care being taken to reconnect as the
original.

Similarly, defective direction-indicator switches are
normally replaceable only as complete units.

Replacement of Flasher Unit
When replacing a flasher unit or installing a flashing
light system, it is advisable to test the circuits before
connections to flasher terminals 'L', 'B' and 'P' are made.
When testing, join the cables normally connected to
these terminals 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.
Flasher units must be handled with care. Factory-
made settings, though good for conditions of normal
automobile duty, can be thrown off balance by rough
handling.

Checking and Re-setting Relay Air-Gaps
Prise off the relay cover, noting the non-reversible
locating slot between terminals '6' and '7'.
Each armature controls three pairs of contacts, two
pairs being normally open and one pair normally closed.
For setting purposes three contacts can be identified as
follows:
Inner pairs, adjacent to bobbins, normally open.
Outer lower pairs, normally open.
Outer upper pairs, normally closed.
ELECTRICAL SYSTEM

When an inner pair of contacts is just touching, a relay in correct adjustment will have an armature-to-bobbin core gap of 0-010 in. to 0-015 in. (25 mm. to 38 mm.). In addition, when these contacts are separated by a 0-007 in. to 0-013 in. (2 mm. to 3 mm.) gap, the outer lower contacts must be separated by 0-012 in. to 0-018 in. (3 mm. to 4 mm.) gap. If the gaps are not within these limits, the relay must be re-set.

Adjustments are made by bending the fixed contact carriers with a suitably slotted bending tool. Setting is effected in three stages, as follows:—

1. Insert a 0-010 in. (25 mm.) gauge between one of the armatures and its bobbin core.
2. Press down the armature.
3. Adjust the height of the inner contact carrier until the inner pair of contacts is just touching.
4. Remove the gauge.
5. Insert the gauge between the inner pair of contacts and lightly press down the armature.
6. Adjust the outer lower contact carrier until the outer lower contacts are just touching.
7. Remove the gauge.
8. With the outer lower contacts just touching, adjust the upper contact carrier until a 0-015 in. (38 mm.) gauge is a sliding fit between the outer upper contacts.
9. Remove the gauge and refit the cover.

Section N.15
WINDSCREEN WIPERS

Maintenance
1. An inspection should be made of the rubber wiping elements which after long service become worn and should be renewed.
2. The rubber grommet or washer around the wheel-box spindle should be lubricated with a few drops of glycerine.
3. Methylated spirits (de-natured alcohol) should be used to remove oil, tar spots and other stains from the windscreen. It has been found that the use of some silicones and wax-based polishes for this purpose can be detrimental to the rubber wiping elements.
4. The gearbox and cable rack are packed with grease during manufacture and need no further lubrication.

Checking Switching Mechanisms
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 screen, 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 amp. 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. Replace any cables which are badly worn or chafed, if necessary 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 size. 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 petrol-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 cold is 14 amp., and hot is 8 amp.

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 0.008 in. (20 mm.) to 0.012 in. (30 mm.).

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 0.010 in. (26 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 re-assemble.

Pieces of carbon short-circuiting adjacent segments of the commutator will also cause excessive current consumption. The resistance between adjacent commutator segments should be 0.34 to 0.41 ohms. Cleaning the commutator and brushgear 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 much 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.

To Dismantle the Motor

(1) Withdraw the four screws securing the gearbox cover and remove the cover.
(2) Withdraw the terminal screws and the through bolts at the commutator end bracket.
(3) Remove the commutator end bracket clear of the yoke.
(4) 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.
(5) Access to armature and field coils can be gained by withdrawing the yoke.
(6) 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 replaced in their original holes.
(7) Press out the pole pieces 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.

To Dismantle the Gearbox Unit

Remove the circlip and washer from the crosshead connecting link pin and lift off the crosshead 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.

Reassembly

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

(1) 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.
(2) Armature shaft (commutator end). Apply S.A.E.20 engine oil sparingly.
(3) Felt lubricator in gearbox. Apply S.A.E.20 engine oil carefully.
(4) Worm wheel bearings, crosshead, guide channel, connecting rod, crank pin, eccentric coupling assembly, worm and final gear shaft. Grease liberally with grease.
(5) Cable rack and wheelboxes. Grease liberally with grease.
ELECTRICAL SYSTEM

To Test in the Vehicle
Test the ignition switch in the manner described in Section B.

To Remove
(1) Unscrew the locknut securing the switch to the instrument panel and release the electrical connections at the rear of the switch.
(2) Remove the switch from the instrument panel.

Section N.17
DIRECTION INDICATOR WARNING LAMP
To Remove and Dismantle
(1) Pull out the bulb holder with bulb from the rear of the warning lamp.
(2) Unscrew the bulb.
(3) To release the green lens unscrew the chrome retaining ring situated on the front of the facia panel.

To Reassemble and Install
The reassembly and installation is the reversal of the procedure ‘To Remove and Dismantle’.

Section N.18
PANEL LIGHT BULBS
To Remove
(1) Pull out the bulb holder with bulb from the rear of the warning lamp.
(2) Unscrew the bulb.

To Replace
The replacement of a panel light bulb is a reversal of the removal procedure.

Section N.19
HEADLAMP MAIN BEAM WARNING LIGHT BULB
For details see Section N.18.

Section N.20
IGNITION WARNING LIGHT BULB
For details see Section N.18.

Section N.21
FUEL GAUGE
To Remove
(1) Release the “T” and “B” terminals from behind the gauge.

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Section N.22

OVERDRIVE SWITCH

To Remove
(1) Unscrew the locknut securing the switch to the instrument panel.
(2) Withdraw the switch from its locating hole in the panel.
(3) Disconnect the cables from the instrument panel.

To Replace
The replacement of the overdrive switch is a reversal of the procedure “To Remove”. Reconnect the cables in accordance with the colour code given in the wiring diagram.

Section N.23

PANEL LAMPS SWITCH

To remove
(1) Unscrew the two screws securing the panel lamps switch to the underside of the instrument panel.
(2) Disconnect the cables from the switch terminals.
(3) Withdraw the switch from the instrument panel.

To Replace
The replacement of the panel lamps switch is a reversal of the procedure “To Remove”. Reconnect the cables in accordance with the colour code given in the wiring diagram.

Section N.24

WINDSCREEN WIPER SWITCH

To Remove
(1) Disconnect the switch knob from the switch by pushing in the retaining plunger and pulling the knob away from the instrument panel.
(2) Unscrew the nut on the outside of the switch body.
(3) Disconnect the cables from the switch terminals.
(4) Withdraw the switch from the instrument panel.

To Install
The installation of the windscreen wiper switch is a reversal of the procedure “To Remove”. Reconnect the cables in accordance with the colour code given in the wiring diagram.

Section N.25

LIGHTING SWITCH
The removal and installation of this switch is the same as that described for the windscreen wiper switch.

Section N.26

HEADLIGHT BULBS

To Remove
(1) Unscrew the screw securing the front rim and remove the rim from the headlight unit.
(2) Remove the dust-excluding cover to expose the three spring loaded adjustment screws.
(3) Press the light unit inwards against the tension of the adjusting screw springs and turn it in an anti-clockwise direction until the heads of the screws can be disengaged through the slotted holes in the light unit rim.

NOTE.—Do not disturb the screws as this will alter the lamp setting.
(4) Twist the adaptor in an anti-clockwise direction and pull it off.
(5) Remove the bulb.

To Replace
(1) Install the replacement bulb in the holder, taking care to locate it correctly.
(2) Engage the projections on the inside of the adaptor with the slots in the holder, press on and secure by twisting in a clockwise direction.
(3) Position the light unit so that the heads of the adjustment screws protrude through the slotted holes in the flange, press the unit in and turn in a clockwise direction.
(4) Replace the dust-excluding cover and refit the front rim.

Section N.27

HEADLAMP BEAM SETTING
The lamps should be set so that the main driving beams are straight ahead and parallel to one another, and parallel to the road surface. If adjustment to the setting is required, first remove the front rim and rubber as previously described. Set each lamp to the correct position in the vertical plane by means of the vertical adjustment screw at the top of the reflector unit. Turn the screw in a clockwise direction to raise the beam and in an anti-clockwise direction to lower it. Horizontal adjustment can be altered by turning the adjustment screws on each side of the light unit.
The setting of the lamps can best be carried out by placing the car in front of a blank wall at the greatest possible distance, taking care that the surface on which the car is standing is level and not sloping relative to the wall.

It will be found an advantage to cover one lamp while setting the other.

Fig. N.25. Headlamp exploded.

Section N.28
REPLACING A LIGHT UNIT

In the event of damage to either the front lens or reflector, a replacement light unit must be fitted as follows:—

1. Remove the light unit as already described.
2. Withdraw the three screws from the unit rim and remove the seating rim and unit rim from the light unit.
3. Position the replacement light unit between the unit rim and seating rim, taking care to see that the die cast projection at the edge of the light unit fits into the slot in the seating rim, and also check that the seating rim is correctly positioned. Finally secure in position by means of the three fixing screws.

NOTE.—In order to comply with the lighting regulations in certain States of America, a sealed beam unit must be fitted in place of the Lucas light unit.

Cars intended for the American market are fitted with special headlamp bulb adaptors and Ward and Goldstone sockets.

When replacing a Lucas Light Unit by a Sealed Beam Unit, it is only necessary when connecting up to withdraw the Lucas adaptor from the Ward and Goldstone socket. The socket can then be plugged directly to the Sealed Beam Unit.

Section N.29
HEADLAMP DIPPING SWITCH

To Remove
The switch is foot-operated and is mounted on a bracket welded to the floor assembly.

1. Remove the two screws securing the switch to the bracket and withdraw the switch.
2. Disconnect the three cables from the connectors.
3. Check the operation of the dip switch. Lightly smear the mechanism with petroleum jelly. A faulty switch must be renewed as a complete unit.

To Replace
The installation of the switch is a reversal of the procedure "To Remove". Reconnect the cables in accordance with the colour code given in the wiring diagram.

Section N.30
HORN-PUSH AND DIRECTION INDICATOR SWITCH

Description
The combined horn-push and direction indicator switch is mounted on the steering wheel hub and comprises a spring-metal push covering the hub with the indicator switch lever positioned in its centre. The switch cables pass through a long tube down the steering column shaft secured by an olive in the base of the


Fig. N.26. Rear view of the horn.
steering box. With an adjustable column the stator tube is in two parts, the shorter piece being attached to the horn quadrant. When the push is depressed, it is earthed through the steering column, thus completing the circuit.

To Remove

(1) Disconnect, at the nearest snap connections, the horn and flasher light cables protruding from the end of the stator tube.

(2) Where an adjustable type column is fitted remove the three grub screws in the steering wheel hub and withdraw the quadrant, together with the short stator tube and cables. The long part of the stator tube remains in the steering column.

NOTE.—The short stator tube has an indentation in it which fits in a slot in the long stator tube. The horn quadrant must be withdrawn without any twisting motion to avoid enlarging the slot in the long stator tube. Any enlargement of this slot will result in excessive movement of the horn quadrant after replacement.

(3) When a non-adjustable type column is fitted, remove the nut and olive at the bottom end of the steering box. This will free the stator tube, which in this case is in one piece. The horn quadrant can then be withdrawn into the interior of the car, complete with stator tube and cables.

Plug the hole left in the bottom of the steering box to prevent the oil draining out.

(4) Clean and examine the switch assembly, this can only be renewed as a complete assembly.

(5) Renew any cables which are damaged.

To Replace

The replacement of the horn button and indicator switch is the reversal of the procedure “To Remove”, reconnect the cables in accordance with the colour code given in the wiring diagram.

NOTE.—In order to facilitate the threading of the horn and flasher cables through the long tube it is advisable to tape the cable ends together.

Section N.31

COMBINED SIDE AND FLASHER LIGHTS BULB

To Remove

(1) Prise back the rubber lip and insert a screwdriver blade under the glass retaining collar.

(2) Lever the collar out from the lamp body.

(3) Remove the lamp glass and unscrew the bulb.

To Replace

The installation of a side lamp bulb is a reversal of the procedure “To Remove”.

Section N.32

COMBINED STOP, TAIL AND FLASHER LIGHT BULBS

For details see section N.31.

Section N.33

REAR NUMBER PLATE LIGHT BULB

To Remove

(1) Un螺丝 the screw securing the lamp cover and lift off the cover.

(2) Remove the bulb or bulbs as fitted.

To Replace

The installation of a stop/tail light bulb is a reversal of the procedure “To Remove”.

Section N.34

MODIFIED EUROPEAN LIGHT UNIT

Cars exported to Europe are now fitted with the new European-type headlamps. These lamp units are fitted...
with special bulbs and front lenses giving an asymmetrical
beam to the right-hand or left-hand side according to
the regulations prevailing in the country concerned.

Access to the bulb is gained in the same way as
described in Section N.26. The bulb, however, 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 (see Fig. N.28).

When replacing the bulb care must be taken to see
that the rectangular pip on the bulb flange engages the
slot in the reflector seating for the bulb.

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

The appropriate replacement bulbs are listed in
Section N.35. They are not interchangeable with those
used in conjunction with the Continental-type head-
lamps previously fitted.

**Section N.35**

<table>
<thead>
<tr>
<th>REPLACEMENT BULBS</th>
<th>Watts</th>
<th>B.M.C. Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headlamp R.H.D.</td>
<td>50/40</td>
<td>BFS 414</td>
</tr>
<tr>
<td>Headlamp L.H.D. (not Europe)</td>
<td>50/40</td>
<td>BFS 415</td>
</tr>
<tr>
<td>Headlamp L.H.D. (Europe, except France—early cars)</td>
<td>45/50</td>
<td>BFS 370</td>
</tr>
<tr>
<td>Headlamp R.H.D. and L.H.D. (Europe except France—European light units)</td>
<td>45/50</td>
<td>BFS 410</td>
</tr>
<tr>
<td>Headlamp L.H.D. (France only—yellow—European light units)</td>
<td>45/50</td>
<td>BFS 411</td>
</tr>
<tr>
<td>Pilot lamps (combined flashing indicators)</td>
<td>6/21</td>
<td>BFS 380</td>
</tr>
<tr>
<td>Stop/tail lamp</td>
<td>6/21</td>
<td>BFS 380</td>
</tr>
<tr>
<td>Number plate lamp</td>
<td>6</td>
<td>BFS 989</td>
</tr>
<tr>
<td>Warning and panel lights</td>
<td>2 2</td>
<td>BFS 987</td>
</tr>
</tbody>
</table>
### ELECTRICAL SYSTEM

#### KEY TO THE WIRING DIAGRAM

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>L.H. pilot lamp and front flasher</td>
<td>24.</td>
<td>Flasher warning lamp</td>
</tr>
<tr>
<td>2.</td>
<td>L.H. head lamp</td>
<td>25.</td>
<td>Lighting switch</td>
</tr>
<tr>
<td>4.</td>
<td>R.H. pilot lamp and front flasher</td>
<td>27.</td>
<td>Wiper motor</td>
</tr>
<tr>
<td>5.</td>
<td>Direction switch and horn push</td>
<td>28.</td>
<td>Dip switch</td>
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<tr>
<td>6.</td>
<td>R.H. horn</td>
<td>29.</td>
<td>Panel light</td>
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<tr>
<td>7.</td>
<td>Distributor</td>
<td>30.</td>
<td>Panel light</td>
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<tr>
<td>8.</td>
<td>L.H. horn</td>
<td>31.</td>
<td>Panel light</td>
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<tr>
<td>9.</td>
<td>Ignition coil</td>
<td>32.</td>
<td>Fuel gauge</td>
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<tr>
<td>10.</td>
<td>Stop lamp switch</td>
<td>33.</td>
<td>Petrol pump</td>
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<tr>
<td>11.</td>
<td>Starter</td>
<td>34.</td>
<td>Panel lamps switch</td>
</tr>
<tr>
<td>12.</td>
<td>Overdrive solenoid (when fitted)</td>
<td>35.</td>
<td>Wiper motor</td>
</tr>
<tr>
<td>13.</td>
<td>Gearbox switch</td>
<td>36.</td>
<td>High beam warning lamp</td>
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<tr>
<td>14.</td>
<td>Throttle switch (when fitted)</td>
<td>37.</td>
<td>No charge warning lamp</td>
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<tr>
<td>15.</td>
<td>Flasher relay</td>
<td>38.</td>
<td>Cigar lighter (when fitted)</td>
</tr>
<tr>
<td>17.</td>
<td>Control box</td>
<td>40.</td>
<td>12 volt battery</td>
</tr>
<tr>
<td>18.</td>
<td>Heater motor (when fitted)</td>
<td>41.</td>
<td>Tank unit</td>
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<tr>
<td>19.</td>
<td>Overdrive relay (when fitted)</td>
<td>42.</td>
<td>Battery master switch</td>
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<tr>
<td>20.</td>
<td>Starter solenoid</td>
<td>43.</td>
<td>L.H. stop and tail lamp and rear flasher</td>
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<tr>
<td>21.</td>
<td>Flasher unit</td>
<td>44.</td>
<td>Number plate lamp</td>
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<td>22.</td>
<td>Ignition switch</td>
<td>45.</td>
<td></td>
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<tr>
<td>23.</td>
<td>Starter switch</td>
<td>46.</td>
<td>R.H. stop and tail lamp and rear flasher</td>
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#### COLOUR CODE

<table>
<thead>
<tr>
<th>U</th>
<th>BLUE</th>
<th>GN</th>
<th>GREEN with BROWN</th>
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<tr>
<td>UR</td>
<td>BLUE with RED</td>
<td>GB</td>
<td>GREEN with BLACK</td>
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<tr>
<td>UW</td>
<td>BLUE with WHITE</td>
<td>V</td>
<td>YELLOW</td>
</tr>
<tr>
<td>W</td>
<td>WHITE</td>
<td>YG</td>
<td>YELLOW with GREEN</td>
</tr>
<tr>
<td>WR</td>
<td>WHITE with RED</td>
<td>N</td>
<td>BROWN</td>
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<tr>
<td>WG</td>
<td>WHITE with GREEN</td>
<td>NU</td>
<td>BROWN with BLUE</td>
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<td>NG</td>
<td>BROWN with GREEN</td>
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<td>WN</td>
<td>WHITE with BROWN</td>
<td>NP</td>
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</tr>
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<td>GREEN</td>
<td>R</td>
<td>RED</td>
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<td>GR</td>
<td>GREEN with RED</td>
<td>RW</td>
<td>RED with WHITE</td>
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<tr>
<td>GY</td>
<td>GREEN with YELLOW</td>
<td>B</td>
<td>BLACK</td>
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<tr>
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<td>GREEN with BLUE</td>
<td>BG</td>
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<tr>
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<td>LG</td>
<td>LIGHT GREEN</td>
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<tr>
<td>GP</td>
<td>GREEN with PURPLE</td>
<td>WU</td>
<td>WHITE with BLUE</td>
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</tbody>
</table>

*Austin-Healey 100-6/3000, Issue 2. (53761)*
SECTION NN
ELECTRICAL SYSTEM
SERIES BN6
Section No. NN.1 Battery

NOTE
This information should be used in conjunction with that contained in Section N.
Section NN.1

BATTERY

The Austin-Healey (Series BN.6) model is equipped with two 6 volt batteries mounted beneath the floor; both batteries are accessible for servicing from inside the car. Partly withdraw the spare wheel into the luggage compartment and raise the hinged lid located in the spare wheel floor behind the driver's and passenger's seats.

Servicing details are the same as given in Section N.

Fig. NN.1
Pull the two "Tenax" fasteners to release the straps securing the hinged lid to gain access to the batteries.
SECTION NNN

ELECTRICAL SYSTEM

Mk. I and II (SERIES BN7 and BT7)
AND Mk. II and Mk. III (SERIES BJ7 and BJ8)

Section No. NNN.1  Sealed beam light units
Section No. NNN.2  Dynamo
Section No. NNN.3  Control box
Section No. NNN.4  Windscreen wipers
Section No. NNN.5  Side, stop, tail and flasher lights
Section No. NNN.6  Headlamps (later type)
Section No. NNN.7  Replacement bulbs
Section No. NNN.8  Line fuse

NOTE
For details of the electrical system refer to Section N.
The battery arrangement of the BN7 is described in Section NN.
**Section NNN.1**

**SEALED BEAM LIGHT UNITS**

Cars exported to the U.S.A. are now fitted at the Works with headlamps incorporating sealed beam light units.

To change a sealed beam light unit, remove the headlamp rim and slacken the three retaining screws securing the light unit rim. Rotate the rim anti-clockwise to disengage the slotted holes from the heads of the retaining screws. Pull the light unit forward and disconnect the three-pin socket to release it from the back-shell.

**Section NNN.2**

**THE C42 DYNAMO**

**Testing**

*To test on vehicle when dynamo is not charging*

1. Make sure that belt slip is not the cause of the trouble. It should be possible to deflect the belt approximately ¼ in. (13 mm.) at the centre of its longest run between two pulleys with moderate hand pressure.

2. Check the Luarc connections on the commutator end bracket. The large connector carries the main dynamo output and should be connected to the control box terminal 'D'. The smaller connector carries the field current and should be connected to the control box terminal 'F'. Check the earth connections of the control box.

3. After switching off all lights and accessories pull off the connectors from the terminal blades of the dynamo and connect the two blades with a short length of wire.

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

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

6. 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 dynamo up to a speed of 1,000 r.p.m. If the voltage does not rise rapidly and without fluctuation the unit must be dismantled for internal examination.

---

Fig. NNN.1. Components of the dynamo

1. Output terminal 'D'.
2. Field terminal connections.
3. Commutator.
4. Armature.
5. Field coils.
6. Yoke.
7. Shaft collar.
8. Shaft collar retaining cap.
10. Shaft key.
12. Commutator end bracket.
14. Felt ring.
15. Felt ring retainer.
17. Felt thrust washer.
18. Through-bolts.
19. Pole-shoe securing screws.
20. Bearing retaining plate.
22. Corrugated washer.
23. Drive end bracket.
24. Pulley spacer.

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Excessive sparking at the commutator during this test indicates a defective armature.

If the armature capacitor is fitted between the output terminal and earth, disconnect the capacitor and retest the dynamo before dismantling. If a reading is now given on the voltmeter the capacitor is defective and must be renewed.

Servicing

Remove the dynamo from the car and dismantle it, using the methods given in Section N.8.

Brush gear

Having removed the commutator end bracket from the yoke, hold back each of the brush springs and move each 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 refit 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 \( \frac{1}{4} \) in. (6.35 mm.).

Test the brush spring pressures, using a spring balance held radially to the commutator. The correct pressures are 33 oz. (935 gm.) maximum when exerted on a new brush and 16 oz. (454 gm.) minimum on a brush worn to \( \frac{1}{4} \) in. (6.35 mm.). Fit new springs if the tension is low.

Commutator

A commutator in good condition will be smooth and free from pitting or burned spots.

The commutator is of fabricated construction and can be reskimmied during service, but care must be taken to ensure that the finished diameter is not less than 1-187 in. (30-16 mm.). The process of reskimming consists of rough-turning, undercutting, and diamond-turning—in this order. Whether or not rough-turning is carried out depends upon the severity and unevenness of the wear which may have taken place. If a commutator cannot be completely cleaned up without going below the specified diameter the armature must be renewed. The width of undercut slots must not exceed -060 to -065 in. (1.52 to 1.65 mm.) with a depth of \( \frac{3}{4} \) in. (8 mm.). It is important to see that the insulating material is cleaned from the sides of each slot to a minimum depth of -015 in. (381 mm.).

If a non-diamond-tipped tool is used for machining, the commutator must afterwards be lightly polished with very fine glass-paper. Do not use emery-cloth.

Armature

Indication of an open-circuited armature winding will be given by burnt commutator segments. If armature-testing facilities are not available, check the armature by substitution. To separate the armature shaft from the drive end bracket press the shaft out of the bearing. When fitting a new armature support the inner race of the ball bearing, using a mild-steel tube of suitable diameter, while pressing the armature shaft firmly home.

Field coils

Measure the resistance of the field coils, without removing them from the dynamo yoke, by means of an ohmmeter connected between the field terminal and the yoke. A reading of 4-5 ohms should be obtained.

If an ohmmeter 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 2.5 amps. A zero reading on the ammeter or an infinity ohmmeter reading indicates an open circuit in the field winding. If the current reading is much more than 2.5 amperes, or the ohmmeter reading is much below 4-5 ohms, it is an indication that the insulation of one of the field coils has broken down.

In either case, unless a substitute dynamo is available the field coils must be renewed in accordance with the following procedure:

1. Drill out the rivet securing the field coil terminal assembly to the yoke and remove the insulating sleeve from the terminal blade to protect it from the heat of soldering.
2. Unsolder the terminal blade and earthing eyelet.
3. Remove the insulating piece which is provided to prevent the junction of the field coils from contacting the yoke.
4. Mark the yoke and pole-shoes so that the latter can be refitted in their original positions.
5. Unscrew the two pole-shoe retaining screws by means of a wheel-operated screwdriver (see Fig. N.6).
6. Draw the pole-shoes and coils out of the yoke and lift off the coils.
7. 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.
8. Locate the pole-shoes and field coils by lightly tightening the fixing screws.
9. Fully tighten the screws by means of the wheel-operated screwdriver.
10. Solder the original terminal blade and earthing eyelet to the appropriate coil ends.
11. Refit the insulating sleeve and re-rivet the terminal assembly to the yoke.
12. Refit the insulation piece behind the junction of the two coils.
ELECTRICAL SYSTEM

Bearings

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

To fit a new bearing at the commutator end of the dynamo proceed as follows:

1. Remove the old bearing brush from the end bracket. The bearing can be withdrawn with a suitable extractor or by screwing a 3/16 in. tap into the bush a few turns and pulling out the bush with the tap. Screw the tap squarely into the bush to avoid damaging the bracket.

2. Withdraw and clean the felt ring retainer and felt ring.

3. Insert the felt ring and felt ring retainer in the bearing housing. Press the new bearing bush into the end bracket until it is flush with the inner face of the bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit in the bearing. Porous bronze bushes must not be opened out after fitting or the porosity of the bush may be impaired.

NOTE.—Before fitting the new bearing bush allow it to stand completely immersed in S.A.E. 30 engine oil for 24 hours to fill the pores of the bush with oil.

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

5. Place the felt ring and corrugated washer in the bearing housing in the end bracket.

6. Locate the bearing in the housing and press it home.

7. Fit the bearing retaining plate. Insert the new rivets from the pulley side of the end bracket and open them over the plate by means of a punch to secure the plate rigidly in position.

Reassemble the dynamo, following the instructions given in section N.8.

Section NNN.3

CONTROL BOX MODEL RB340

General description

The RB340 control box operates on the current-voltage system of dynamo output regulation. Three units are housed in the control box: two separate vibrating armature-type single-contact regulators and a cut-out relay. One regulator is responsive to changes in current and the other to changes in voltage.

The voltage regulator and cut-out relay are temperature-compensated to allow for operating changes in the circuit resistance and for climatic variations in battery voltage. The effect of temperature fluctuation on control box settings is further minimized by the use of a swamp resistor connected in series with the shunt coils of the voltage regulator and cut-out relay.

For adjustment purposes toothed cams are carried on the front limb of each magnet frame to enable voltage and current settings to be made with a special tool (see Fig. NNN.3).

The control box settings are accurately adjusted during manufacture and the cover should not be removed unnecessarily.

Preliminary checking of charging circuits.

Before disturbing any electrical adjustments examine the items mentioned below to ensure that the fault does not lie outside the control box.

Check the battery by substitution or with a hydrometer and a heavy discharge tester. Inspect the dynamo driving belt. This should be just taut enough to drive without slipping. Check the dynamo by substitution, or by disconnecting the cables from the dynamo terminals and linking the large terminal 'D' to the small terminal 'F', connecting a voltmeter between this link and earth, and running the dynamo up to about 1,000 r.p.m., when a rising voltage should be shown.

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Inspect the wiring of the charging circuit and carry out continuity tests between the dynamo, control box, and ammeter.

Check the earth connections, particularly that of the control box.

In the event of reported under-charging, ascertain that this is not due to low mileage.

**Voltage regulator**

**Method of adjustment**

Checking and adjusting should be completed as rapidly as possible to avoid errors due to heating of the operating coil. Withdraw the cables from the control box terminal blades 'B'. To enable the engine to be started, it will be necessary to join the ignition and battery feeds together with a suitable lead. Connect a first-grade 0-20 moving-coil voltmeter between control box terminal 'D' and a good earthing point. A convenient method of making this connection is to withdraw the ignition warning light feed from the control box terminal 'WL' and to clip the voltmeter lead of appropriate polarity to the small terminal blade thus exposed, this terminal being electrically common with terminal 'D'. Start the engine and run the dynamo at 4,500 r.p.m. The voltmeter reading should be steady and lie between the appropriate limits shown below according to the temperature.

<table>
<thead>
<tr>
<th>Ambient temperature</th>
<th>Voltage setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>10° C. (50° F.)</td>
<td>14-9 to 15-5</td>
</tr>
<tr>
<td>20° C. (68° F.)</td>
<td>14-7 to 15-3</td>
</tr>
<tr>
<td>30° C. (86° F.)</td>
<td>14-5 to 15-1</td>
</tr>
<tr>
<td>40° C. (104° F.)</td>
<td>14-3 to 14-9</td>
</tr>
</tbody>
</table>

An unsteady reading may be due to dirty contacts. If the reading is steady but occurs outside the appropriate limits an adjustment must be made. Proceed as follows.

Stop the engine and remove the control box cover. Restart the engine and run the dynamo at 4,500 r.p.m. Using a suitable tool (see Fig. NNN.3), turn the voltage adjustment cam until the correct setting is obtained. Turn the tool clockwise to raise the setting or anticlockwise to lower it. Check the setting by stopping the engine and then again raising the generator speed to 4,500 r.p.m. Restore the original connections and refit the cover.

**Current regulator**

**On-load setting**

The current regulator on-load setting is equal to the maximum rated output of the dynamo, which is 30 amperes.

**Method of adjustment**

The dynamo must be made to develop its maximum rated output, whatever the state of charge of the battery might be at the time of setting. The voltage regulator must therefore be rendered inoperative, and to achieve this the bulldog clip shown in Fig. NNN.3 is used to keep the voltage regulator contacts together.

Remove the control box cover and, using a bulldog clip, short out the contacts of the voltage regulator.

Withdraw the cables from the control box terminal blades 'B' and connect a first-grade 0-40 moving-coil ammeter between these cables and one of the terminal blades 'B'. It is important that terminal 'B' should carry only this one connection. All other load connections, including the ignition coil feed, must be made to the battery side of the ammeter. Switch on all lights and accessories, start the engine, and run the dynamo at 4,500 r.p.m. The ammeter pointer should be steady and indicate a current of 29-31 amperes. An unsteady reading may be due to dirty contacts. If the reading is too high or too low an adjustment must be made. Proceed as follows.

Using a suitable tool (see Fig. NNN.3), turn the current adjustment cam until the correct setting is obtained. Turn the tool clockwise to raise the setting or anti-clockwise to lower it. Stop the engine, restore the original connections, and refit the control box cover.

**Cut-out relay**

**Cut-in adjustment**

Checking and adjusting should be completed as rapidly as possible to avoid errors due to heating of the operating coil.

Connect a first-grade 0-20 moving-coil voltmeter between control box terminal 'D' and a good earthing point. A convenient method of making this connection is to withdraw the ignition warning light feed from control box terminal 'WL' and to clip the voltmeter lead of appropriate polarity to the small terminal blade thus exposed, this terminal being electrically common with terminal 'D'. Switch on an electrical load such as the headlamps, start the engine, and gradually increase the engine speed. Observe the voltmeter pointer. The voltage should rise steadily and then drop slightly at the instant of contact closure. The cut-in voltage is that which is indicated immediately before the pointer drops back and should be within the limits 12.7 to 13.3 volts. If the cut-in occurs outside these limits an adjustment must be made. In this event proceed as follows.

Remove the control box cover. Using a suitable tool (see Fig. NNN.3), turn the cut-out relay adjustment cam until the correct setting is obtained. Turn the tool clockwise to raise the setting or anti-clockwise to lower it. Stop the engine, restore the original connections, and refit the cover.
Drop-off adjustment
Withdraw the cables from control box terminal blades 'B'. To enable the engine to be started it will be necessary to join the ignition and battery feeds together with a suitable lead. Connect a first-grade 0-20 moving-coil voltmeter between control box terminal 'B' and a good earthing point. Start the engine and run up to approximately 4,500 r.p.m.

Slowly decelerate and observe the voltmeter pointer. Opening of the contacts, indicated by the voltmeter pointer dropping to zero, should occur between 9-5 and 11 volts. If the drop-off occurs outside these limits an adjustment must be made. Proceed as follows:

Stop the engine and remove the control box cover. Adjust the drop-off voltage by carefully bending the fixed contact bracket. Reducing the contact gap will raise the drop-off voltage and increasing the gap will lower it. Retest, and if necessary readjust until the correct drop-off setting is obtained. This should result in a contact 'follow through' of blade deflection of 010 to 0.20 in. (254 to 508 mm.). Restore the original connections and refit the cover.

Adjustment of air gap settings
Air gap settings are accurately adjusted during manufacture and should require no further attention. If the original settings have been disturbed, it will be necessary to make adjustments in the manner described below.

Armature-to-bobbin core gaps of voltage and current regulators
Disconnect the battery. Using a suitable tool (see Fig. NNN.3) turn the adjustment cam of the regulator being adjusted, to the point given minimum lift to the armature tensioning spring (by turning the tool to the fullest extent anti-clockwise). Slacken the appropriate contact locking nut and unscrew the contact. Insert a feeler gauge of 0.056 in. (1.42 mm.) thickness between the armature and the regulator head, as far back as the two rivets heads on the underside of the armature. With the gauge in position press squarely down on the armature, screw in the contact until it just touches the armature contact. Tighten the locknut and withdraw the gauge. Repeat this procedure on the remaining regulator.

Note: On earlier type regulators having a copper shim on the regulator head, the air gap setting is .045 in. (1.15 mm.) and care must be taken not to damage the copper shim.

Carry out the electrical setting procedure.

Contact 'follow through' and armature-to-bobbin core gap of cut-out relay
Press the armature squarely down against the copper separation on the core face. Adjust the fixed contact bracket to give a 'follow through' or blade deflection of the moving contact of 0.10 to 0.20 in. (254 to 508 mm.).

Fig. NNN.3. The control box with cover removed
1. Adjustment cam.
2. Setting tool.
5. Voltage regulator contacts.

Adjust the armature back stop to give a core gap of .035 to .045 in. (0.89 to 1.147 mm.).

Check the cut-in and drop-off voltage settings.

Cleaning contacts
Regulator contacts
To clean the voltage or current regulator contacts use fine carborundum stone or silicon-carbide paper, followed by methylated spirits (denatured alcohol).

Cut-out relay contacts
To clean the cut-out relay contacts use a strip of fine glass-paper—never carborundum stone or emery-cloth.

Section NNN.4
WINDSCREEN WIPER
Apart from the renewal of perished wiper blades, the windscreen wiper requires no periodic maintenance. Efficient operation of the wiper blades is, however, dependent upon the cleanliness of the windscreen, and oil and tar spots should be removed, using methylated spirits (denatured alcohol). Do not use silicone- or wax-based-polishes for this purpose.

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.

The gearbox and cable racks are packed with grease during manufacture and need no further lubrication.
Fitting a blade to a wiper arm
Pull the wiper arm away from the windscreen and insert the end of the arm into the slotted spring fastening of the blade. Push home until the raised portion of the arm engages the hole in the blade.

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

Resetting the limit switch
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.
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 wiper blades are required to park on the opposite side of the windscreen, the limit switch should be turned back 180° in a clockwise direction.

Testing on a vehicle
If the wiper fails to operate, or operates unsatisfactorily, connect a 0-15 moving-coil ammeter in the wiper circuit, switch on the wiper, and note the current being supplied to the motor. The normal running current should be 2.7 to 3.4 amps.

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-play. The armature end-play adjusting screw must be set to give an armature end-play of .008 to .012 in. (20 to 30 mm.).

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 remove the motor and 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.

Removing the motor, gearbox, and wheelboxes

The motor and gearbox is located beneath the passenger's side of the fascia panel and is mounted on a bracket secured to the bulkhead panel by three screws.

The cable rack connected to the cross-head in the gearbox passes through outer casings which connect the gearbox to the first wheelbox and the first wheelbox to the second wheelbox.

Disconnect the wiper arms, the electrical connections from the motor, and the outer cable from the gearbox housing. Remove the three screws securing the bracket to the bulkhead panel and withdraw the motor, bracket, and cable rack from beneath the fascia panel.

Slacken the cover screws in each wheelbox and remove the cable rack outer casings.

Remove the nut, front bush, and washer from the front of each wheelbox and remove the wheelbox together with the rear bush and spindle tube from beneath the fascia panel.

Replacement is a reversal of the removal sequence, but care must be taken to ensure that the wheelboxes are correctly lined up and that the cable rack engages the gear and spindle assemblies.

Dismantling the motor

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

Withdraw the connectors 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.

Pieces of carbon short-circuiting adjacent segments of the commutator will also cause excessive current consumption. The resistance between adjacent commutator segments should be .04 to .01 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.

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.

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

Section NNN.5
SIDE, STOP, TAIL AND FLASHER LAMPS

To remove
Unscrew the two screws, lift off the lens, and withdraw the bulb.

To replace
Replacement is the reverse of the above procedure.

The pilot and direction indicator lamps have single filament bulbs and may be fitted either way round.

The tail and stop lamp bulbs have twin filaments, and an offset bayonet fixing to ensure correct replacement.

Section NNN.6
HEADLAMPS (Later type)

To remove
Unscrew the retaining screw at the bottom of the lamp rim and withdraw the rim.

Unscrew the three Phillips screws securing the light unit retaining plate. Remove the plate, lift the light unit forward, and pull off the three-pin plug from the back of the light unit.

To replace
Reverse the removal procedure, but ensure that the lugs moulded on the back of the lens engage in the slots of the back shell.

Section NNN.8
FUSES

An additional 10 amp fuse protects the number plate lamp circuit.

The fuse is located in a nylon tube situated in the boot wiring loom to the right of the boot floor catch.

To renew the fuse, twist and release the end of the tube and withdraw the fuse.
## ELECTRICAL SYSTEM

### Section NNN.7

<table>
<thead>
<tr>
<th>REPLACEMENT BULBS</th>
<th>Watts</th>
<th>BMC Part No.</th>
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<tbody>
<tr>
<td>Pilot lamps</td>
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</tr>
<tr>
<td>Except Germany and Sweden</td>
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<td>BFS 207</td>
</tr>
<tr>
<td>Germany and Sweden</td>
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<tr>
<td>Stop and tail lamps</td>
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<td></td>
</tr>
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<td>BFS 380</td>
</tr>
<tr>
<td>Germany and Sweden</td>
<td>18/4</td>
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<tr>
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<td>BFS 382</td>
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<td>Germany and Sweden</td>
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## Key to the Wiring Diagram

### (Early cars)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dynamo</td>
<td>30</td>
<td>L.H. Rear flasher lamp</td>
</tr>
<tr>
<td>2</td>
<td>Control Box</td>
<td>31</td>
<td>L.H. Rear flasher lamp</td>
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<td>3</td>
<td>Battery</td>
<td>32</td>
<td>Heater motor switch</td>
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<tr>
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<td>Starter solenoid</td>
<td>33</td>
<td>Heater motor*</td>
</tr>
<tr>
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<td>Starter motor</td>
<td>34</td>
<td>Fuel gauge</td>
</tr>
<tr>
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<td>Lighting switch</td>
<td>35</td>
<td>Fuel gauge tank unit</td>
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<td>Headlight dip switch</td>
<td>36</td>
<td>Windscreen wiper motor switch</td>
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<td>8</td>
<td>R.H. Headlamp</td>
<td>37</td>
<td>Windscreen wiper motor</td>
</tr>
<tr>
<td>9</td>
<td>L.H. Headlamp</td>
<td>38</td>
<td>Ignition/starter switch</td>
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<tr>
<td>10</td>
<td>Main-beam warning light</td>
<td>39</td>
<td>Ignition coil</td>
</tr>
<tr>
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<td>R.H. pilot lamp</td>
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<td>Distributor</td>
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<td>L.H. pilot lamp</td>
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<td>Panel light switch</td>
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<td>15</td>
<td>Number-plate illumination lamp</td>
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<td>16</td>
<td>R.H. Stop and tail lamp</td>
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<td>46</td>
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<td>Radio*</td>
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<td>48</td>
<td>Flasher relay</td>
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<td>20</td>
<td>Horns</td>
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<td>Line fuse*</td>
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<td>53</td>
<td>Overdrive gear switch*</td>
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<td></td>
<td>54</td>
<td>Overdrive throttle switch*</td>
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<td>55</td>
<td>Battery cut off switch</td>
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<tr>
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<td>Revolution counter</td>
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### Cable Colour Code

<table>
<thead>
<tr>
<th>B</th>
<th>BLACK</th>
<th>R</th>
<th>RED</th>
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<tbody>
<tr>
<td>U</td>
<td>BLUE</td>
<td>W</td>
<td>WHITE</td>
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<tr>
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<td>BROWN</td>
<td>Y</td>
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<tr>
<td>G</td>
<td>GREEN</td>
<td>LG</td>
<td>LIGHT GREEN</td>
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<tr>
<td>P</td>
<td>PURPLE</td>
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When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

All items marked * fitted as optional extra, circuits shown dotted.
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