SECTION N

ELECTRICAL EQUIPMENT

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GENERAL DESCRIPTION

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

The two 6-volt batteries, mounted to the rear of the seats, are accessible for examination and maintenance attention.

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

The control box is sealed and should not normally need attention. The fuses and spare fuses are carried in external holders.

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 dip according to the regulations existing in the country concerned.

Section N.1

BATTERY MAINTENANCE

In order to keep the batteries in good condition, a periodical inspection must be made.

Unscrew the five quick-release fasteners securing the panel immediately behind the seats and lift the panel away to obtain access to the batteries.

Topping up

Weekly, remove the filler plug from each cell and examine the level of the electrolyte. Add distilled water to bring the level of the electrolyte just above 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.

Testing the condition of the battery

Every 6,000 miles (10000 km.) examine the condition of the batteries by taking hydrometer readings. The hydrometer contains a graduated float on which is indicated the specific gravity of the acid in the cell from which the same is taken.

The specific gravity readings and their indications are as follows:

Climates below 27° C. (80° F.)

1·270 to 1·290	Cell fully charged.
1·190 to 1·210	Cell about half-discharged.
1·110 to 1·130	Cell fully discharged.

Climates frequently above 27° C. (80° F.)

1·210 to 1·230	Cell fully charged.
1·130 to 1·150	Cell about half-discharged.
1·050 to 1·070	Cell fully discharged.

These figures are given assuming an electrolyte temperature of 16° C. (60° F.). If the temperature of the electrolyte exceeds this, ·002 must be added to hydrometer readings for each 3° C. (5° F.) rise to give the true specific gravity. Similarly ·002 must be subtracted from hydrometer readings for every 3° C. (5° F.) below 16° C. (60° F.).

The readings of all the cells should be approximately the same. If one cell gives a reading very different from the rest it may be that the electrolyte has been spilled or has leaked from the cell or there may be an internal fault. Should a 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 an external source of D.C. supply at a current rate of 5 amperes until the cells are gassing freely.

After examining the battery, check the vent plugs, making sure that the air passages are clear.

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 remain in a discharged condition, as the plates will become sulphated.

Initial filling and charging

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

All batteries, including those having type suffix letter 'Z' (e.g. SGZ, etc.) and those having no additional suffix letter (e.g. SG, BT, etc.), are assembled with dry separators. The specific gravity of the filling-in solution depends upon the climate in which the battery is to be used (i.e. 1·260 for climates below 27° C. [80° F.] and 1·210 for climates frequently above 27° C. [80° F.]). For more details of the requirements of 'dry-charged' batteries see Section N.31.

The electrolyte is prepared by mixing distilled water and concentrated sulphuric acid 1·835 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 severity of the resulting chemical reaction may have dangerous consequences.

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

The temperature of the filling-in acid, battery and charging room should be above 0° C. (32° F.).

To produce electrolyte of the correct specific gravity:

To obtain specific gravity (corrected to 60° F.[16°C.])	*Add 1 part by volume of 1·835 S.G. acid to distilled water by volume as below*
1·260	3 parts
1·210	4 parts

Carefully break the seals in the filling holes and half-fill each cell in the battery with dilute sulphuric acid solution of the appropriate specific gravity (according to temperature). The quantity of electrolyte required to half-fill a two-volt cell is ½ pint (·28 litre). Allow to stand for at least six hours, then complete the filling of the cells by the addition of more diluted acid 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.

Charge at a constant current of 3·5 amps. 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, but usually not more than 60.

Throughout the charge the acid must be kept level with the tops of the separators in each cell by the addition of electrolyte of the same specific gravity as the original filling-in acid.

If, during charge, the temperature of the acid in any cell of the battery reaches the maximum permissible temperature of 38° C. (100° F.) in a climate below 80° F. (27° C.) or 49° C. (120° F.) in a climate frequently above 80° F. (27° C.), 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 first charge, i.e. when specific gravity and voltage measurements remain constant, carefully check the specific gravity in each cell to ensure that it lies within the limits specified. If any cell requires adjustment, the electrolyte above the plates must be siphoned off and replaced either with acid of the strength used for the original filling in, or distilled water, according to whether the specific gravity is too low or too high respectively. After such adjustment, the gassing charge should be continued for one or two hours to ensure adequate mixing of the electrolyte. Re-check, if necessary, repeating the procedure until the desired result is obtained.

Section N.2

DYNAMO

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 ½ in. (13 mm.) at the centre of its longest run between two pulleys with moderate hand pressure. If the belt is too slack, loosen the two dynamo suspension bolts and then the bolt of the slotted adjustment link. A gentle pull on the dynamo outwards will enable the correct tension

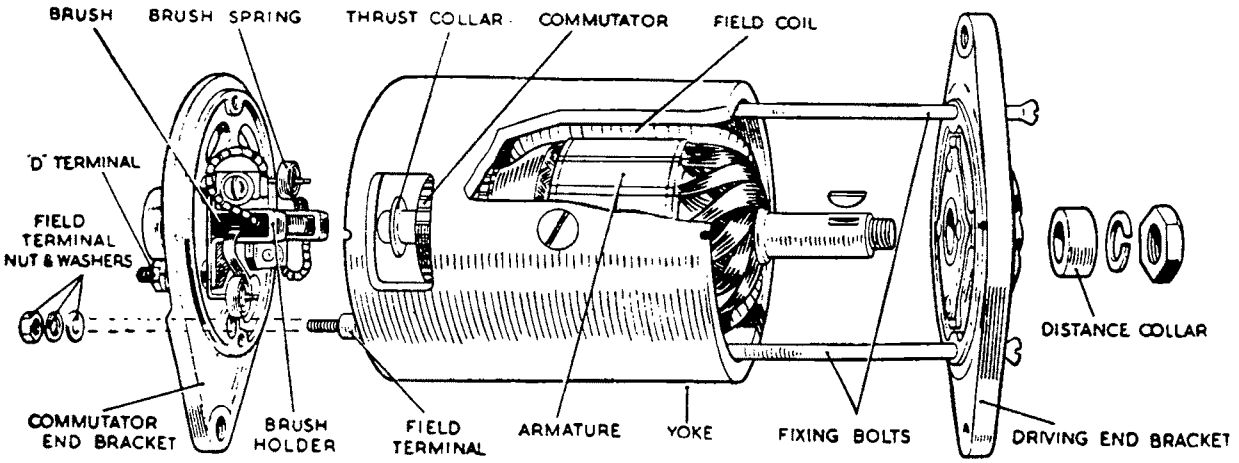

Fig. N.1

An exploded view of the dynamo

to be applied to the belt and all three bolts should then be tightened firmly.

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

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

(4) Connect the two terminals with a length of wire.

(5) Start the engine and set to run at idling speed.

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

(7) 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. Do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

If there is no reading, check the brush gear.

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

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

(8) Remove the dynamo cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing 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, new brushes must be fitted. 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; if there is still no reading on the voltmeter there is an internal fault and the complete unit should be renewed.

If the dynamo is in good order, leave the temporary link in position between the terminals and restore the original connections, taking care to connect the dynamo terminal 'D' to the control box terminal 'D' and the dynamo terminal 'F' to the control box terminal 'F'. Remove the lead from the 'D' terminal on the control box and connect the voltmeter between this cable and a good earthing point on the vehicle. Run the engine as before. The reading should be the same as that measured directly at the dynamo. No reading on the voltmeter indicates a break in the cable to the dynamo. Carry out the same procedure for the 'F' terminal, connecting the voltmeter between cable and earth. Finally remove the link from the dynamo. If the reading is correct test the control box (Section N.9).

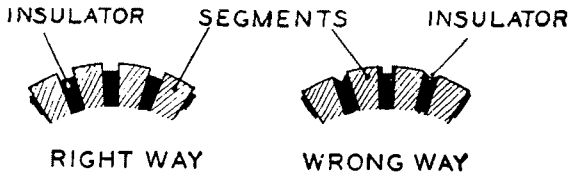

Fig. N.2

The correct method of undercutting the dynamo commutator

Section N.3

REMOVING AND REPLACING THE DYNAMO

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

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

Replacement of the dynamo is an exact reversal of this procedure.

Section N.4

DISMANTLING THE DYNAMO

Take off the dynamo pulley.

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

Unscrew the locknuts from the through-bolts at the commutator end. Withdraw the two through-bolts from the driving end.

Remove the nut, spring washer and flat washer from the smaller terminal (i.e. field terminal) on the commutator end bracket and remove the bracket from the dynamo yoke.

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

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, in which event the armature should be removed from the end bracket by means of a hand press.

Section N.5

SERVICING THE DYNAMO

Brushes

Test if the brushes are sticking. Clean them with petrol and, if necessary, ease the sides by lightly polishing with a smooth file. Replace the brushes in their original positions.

Test the brush spring tension with a spring scale if available. The correct tension is 20–5 oz. (567–709 gm.). Fit a new spring if the tension is low.

If the brushes are worn so that the flexible lead is exposed on the running face, new brushes *must* be fitted. Brushes are pre-formed so that bedding to the commutator is unnecessary.

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, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass-paper. Undercut the mica insulation between the segments to a depth of $\frac{1}{32}$ in. (·8 mm.) with a hacksaw blade ground down to the thickness of the mica.

Field coils

Test the field coils, without removing them from the dynamo yoke, by means of an ohmmeter. The reading on the ohmmeter should be between 6·0 and 6·3 ohms. If this is not available, connect a 12-volt D.C. supply with an ammeter in series between the field terminal and the dynamo yoke. The ammeter reading should be approximately 2 amps. If no reading is indicated the field coils are open-circuited and must be renewed. To test for earthed field coils, unsolder the end of the field winding from the earth terminal on the dynamo yoke and, with a test lamp connected from supply mains, test across the field terminal and earth. If the lamp lights, the field coils are earthed and must be renewed.

When fitting field coils, carry out the procedure outlined below, using an expander and wheel-operated screwdriver:

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

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

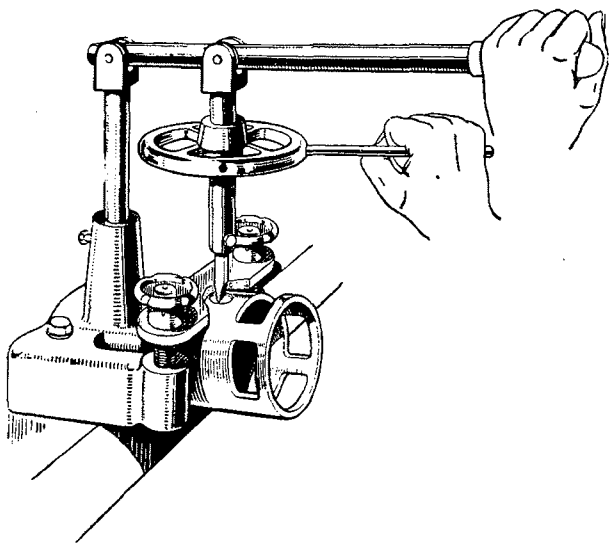

Fig. N.3

Showing the use of a wheel-operated screwdriver to remove the pole-shoe attachment screws

(*c*) Unscrew the two pole-shoe retaining screws by means of the wheel-operated screwdriver.

(*d*) Draw the pole-shoes and coils out of the dynamo yoke and lift off the coils.

(*e*) 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.

(*f*) Locate the pole-shoes and field coils by lightly tightening the fixing screw.

(*g*) Insert the pole-shoe expander, open it to the fullest extent and tighten the screws.

(*h*) Finally tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.

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

Armature

The testing of the armature winding requires the use of a voltage drop test and growler. If these are not available, the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

Bearings

Bearings which are worn to such an extent that they will allow side movement of the armature shaft must be replaced by new ones.

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

(*a*) Press the bearing bush out of the commutator end bracket.

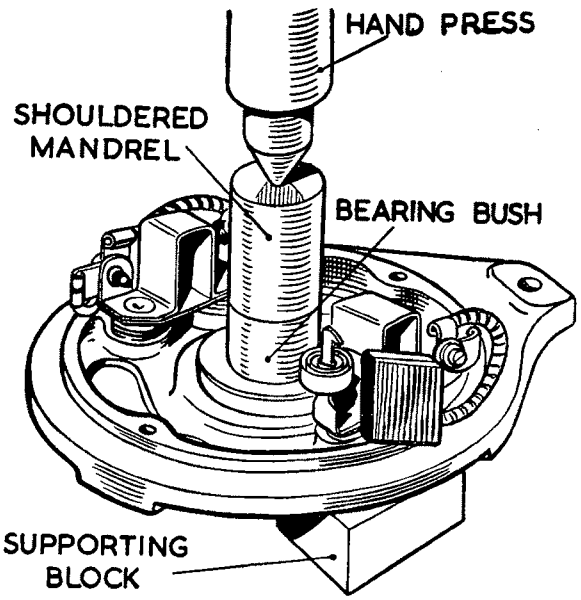

Fig. N.4

The method of pressing out the commutator end bracket bush is shown in this illustration

(*b*) 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.

Before fitting the new bearing bush allow it to stand completely immersed in thin engine oil for 24 hours, to fill the pores of the bush with lubricant.

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

(*a*) Knock out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

(*b*) Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil retaining washer.

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

(*d*) Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.

(*e*) Locate the bearing in the housing and press it home by means of a hand press.

(*f*) Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Reassembly

The reassembly of the dynamo is a reversal of the operations described in Section N.4

If the end bracket has been removed from the armature in dismantling, press the bearing end bracket onto the armature shaft, taking care to avoid damaging the end plate and armature winding.

Add a few drops of oil through the hole in the armature end cover.

Section N.6

THE STARTER

To test on vehicle

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.

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 or slow 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.7

REMOVING AND REPLACING THE STARTER

Release the starter cable from the terminal and unscrew the two starter securing bolts. Manœuvre the starter forwards below the oil filter, then rearwards and upwards.

Section N.8

SERVICING THE STARTER

Examination of commutator and brush gear

Remove the starter cover band (A) (Fig. N.5) and examine the brushes (C) (Fig. N.5) and the commutator. Hold back each of the brush springs (B) (Fig. N.5) and move the brush by pulling gently on its