CHAPTER VII.

Water Cooling System.

Water Pump—Overheating—Radiator Shutters—Radiator Mounting—Water Level in Radiator—Mascots—Frost and Anti-freeze Mixtures—Fan.

Water Pump. The centrifugal water circulating pump is fitted with a special double packing gland designed to facilitate lubrication, and thereby reduce wear, and also to reduce the possibility of leakage.

A screw-down greaser is provided for lubricating the gland and bearings.

It should be given two or three turns every 2,000 miles, or four weeks, as directed on page 129, and re-filled with grease when screwed right down and therefore empty.

A sectional view of the gland is given in Fig. 27. The packings, **F** and **F1**, are separated by the rings **G** and **G1**, which telescope into one another and are pressed apart by the coil spring **S**. The latter maintains pressure on both halves of the packing, thereby automatically taking up wear and bedding-down of the packings, and rendering the gland self-adjusting.

It is improbable that any leakage or other trouble will be experienced over long intervals of running—provided always that the gland be properly and regularly lubricated, as instructed on page 129.

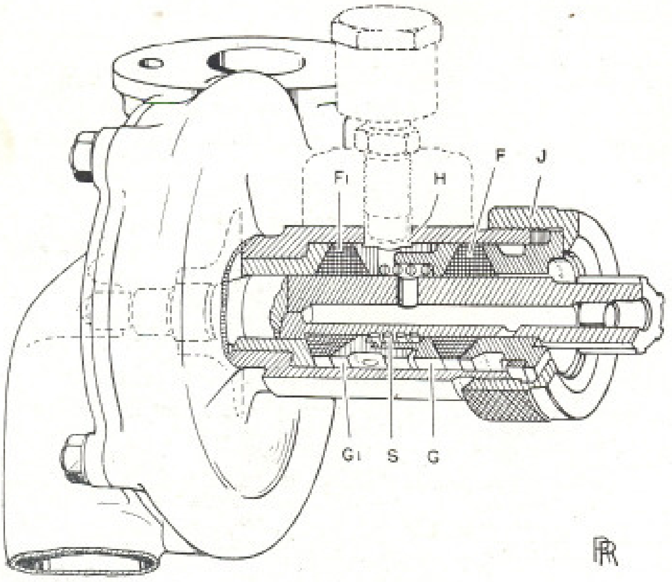

FIG. 27. SECTION OF WATER PUMP GLAND.

Overheating. Overheating may be due to one or more of the following causes :—

(*a*) The fan belt may need adjustment (see page 93).
(*b*) The hand ignition control may be too much retarded (see page 120).
(*c*) The continued ascent of a long steep gradient under adverse circumstances at full throttle and too high a gear. There will be less tendency to overheating if the gear be changed to the next lower and the throttle opening be reduced.
(*d*) The water level in the system may be too low.
(*e*) The bonnet ventilators require to be opened. (See following paragraph.)
(*f*) In hot weather or tropical climates the thermostats may be disconnected from the radiator shutters and the latter left wide open. (See following paragraph.)

Radiator Shutters. The thermostat which operates the radiator shutters is shown at T, in Fig. 28. It commences to open the shutters when the water reaches a temperature of about 60° C., and causes them to be wide open at about 90° C.

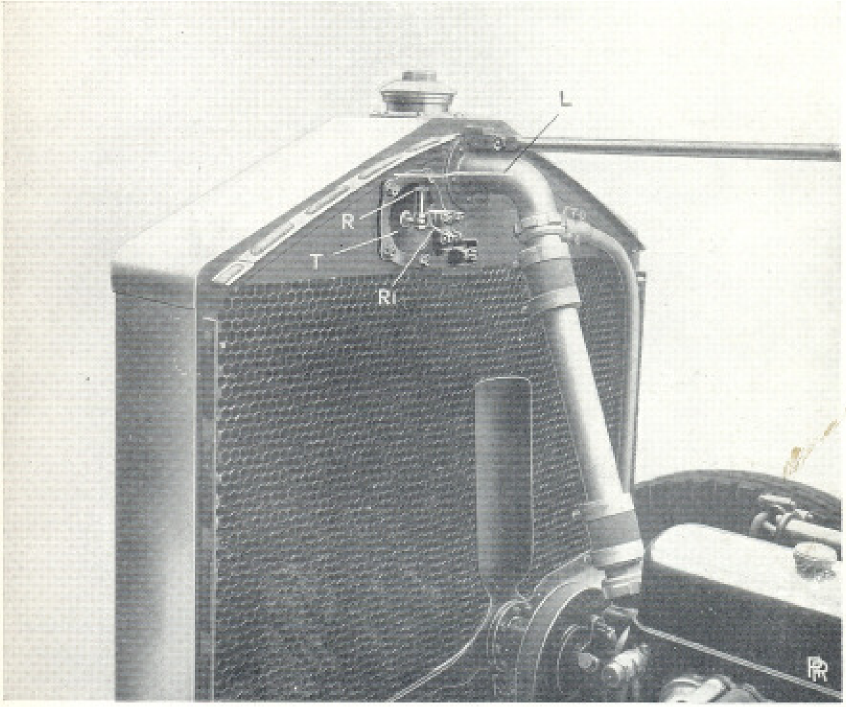

FIG. 28. THERMOSTAT CONTROL OF RADIATOR SHUTTERS.

Reference to the instrument board thermometer will indicate that the thermostat is operating correctly and that there is no shortage of water.

Ventilators are provided on the sides of the bonnet which should be left open in hot weather.

In the event of faulty operation of the thermostat, or in very hot atmospheric conditions, such as in tropical climates or exceptionally hot weather, the thermostat may be disconnected from the shutters. This is effected by raising the spring-loaded pin, **R**, and disengaging the end of the lever, **R1**, from the thermostat rod. The shutters should then be left wide open.

The joints of the shutter control mechanism and the bonnet ventilators should be lubricated with the oil can every 2,000 miles, or four weeks, as directed on page 129.

Radiator Mounting. The radiator is carried on two spherical supports which isolate it from stress due to frame distortion and permit free expansion and contraction of the radiator in all directions. These supports are lined with a special friction material and require no lubrication or other attention.

A tie rod from the dashboard secures the radiator in a fore and aft direction. It is important that this rod should not be disconnected without taking precautions to steady the radiator, especially if the upper water pipe be disconnected simultaneously. In such circumstances there is a risk that the radiator mountings may be strained.

Water Level in Radiator. The water level should be inspected daily and maintained half-way across the upper radiator water pipe, as shown by the white line **L**, Fig. 28 (except when using an anti-freeze mixture as described on page 91).

The level should not be allowed to get much below this point, and if much above it, water will be expelled from the overflow pipes when the car is running.

The overflow pipes are taken from an annular chamber in the filler spout, and communication between this chamber and the radiator is by way of a large, lightly spring-loaded valve in the filler cap. By these means, loss of water due to surging and splashing is reduced to a minimum. A second smaller valve opens inwards to destroy the partial vacuum which may occur as the system cools.

The water should be changed every 5,000 miles, or half-year, as directed on page 132, only clean, soft water being used.

The drain tap is situated on the outlet pipe from the bottom of the radiator. It is provided with a hexagon head having a slot which is in line with the port through the tap plug. Owing to the presence of the valve in the filler cap, the latter must be released a turn or so when the system is being drained.

Mascots. A heavy or cumbersome mascot should not be carried on the radiator filler cap, as it is liable to cause fracture of the joint between the filler spout and the top of the radiator.

A special mascot of a distinctive type, and designed exclusively for use on Rolls-Royce cars, can be obtained at an extra cost on application to the makers.

Frost and Anti-freeze Mixtures. When there is any likelihood of the car being exposed to a temperature below freezing point, the cooling system should be drained by opening the drain tap situated on the pump inlet pipe and releasing the radiator cap.

Before attempting to turn the crankshaft for starting after exposure to frost, *hot water should be poured over the water pump* to thaw any particles of ice which may be present in the casing, and which would probably damage the impeller. Hot water should also be used for filling up the radiator.

A suitable anti-freeze mixture may be provided by adding 33 per cent. of ethylene glycol ("Bluecol") or 44 per cent. of di-ethylene glycol to the system. The resulting mixture has a freezing point of about 0° F. or - 18° C. Glycerine must not be used, either pure or commercial. Many anti-freeze mixtures now on the market are largely, or in part, glycerine.

If di-ethylene glycol be used, care must be taken not to splash it on the wings or paint work, which it will injure.

When it is decided to use such a mixture, the system must be drained, and 1¼ gallons—or nearly 1¾ gallons in the case of di-ethylene glycol—of the compound thoroughly mixed with 1¼ gallons of soft water before being added to the radiator. The total capacity of the system being 3¾ gallons, a further 1¼ gallons, or ¾ of a gallon, of soft water will then be needed.

The rubber connections must be carefully examined and replaced if unsound, as glycol compounds have a searching action which is likely to open cracks in perished rubber. Also, the water level in the radiator should be lower; it should only just cover the upper tubes of the radiator core.

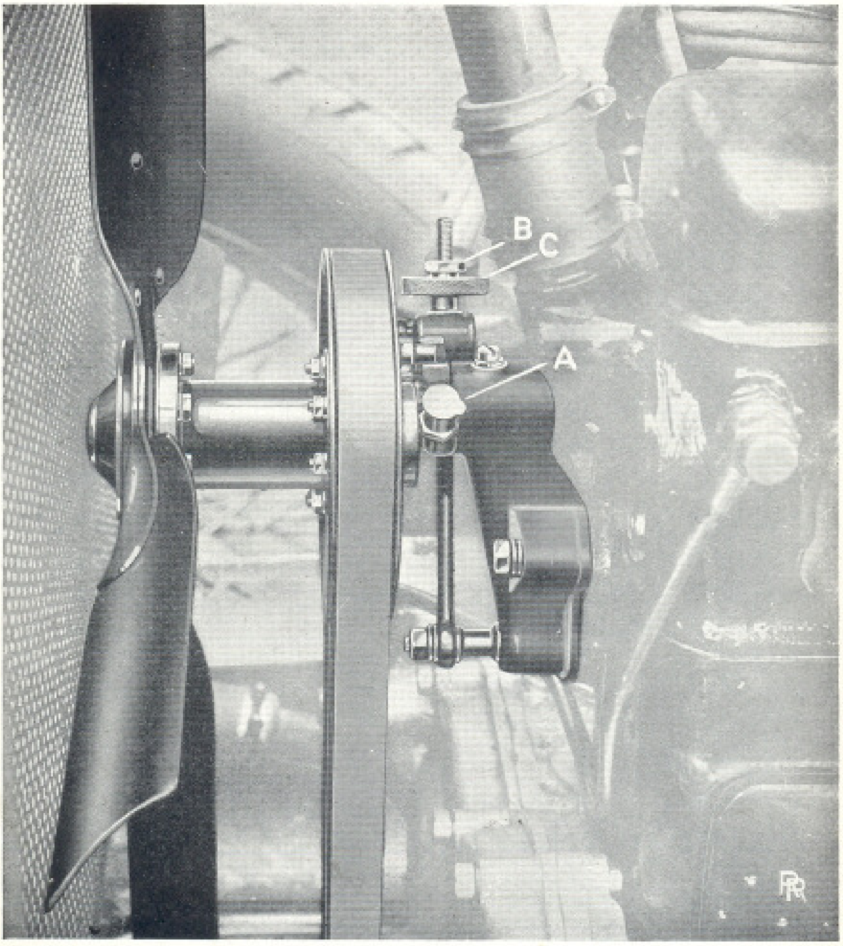

FIG. 29. FAN BELT ADJUSTMENT.

If plain water be used and the weather very cold, it is best to keep the engine running when the car is left standing out of doors ; it is also a good plan to throw a rug over the radiator when the car is at rest.

The fan belt may be dispensed with, provided the water does not boil.

Fan. The fan and its bracket are shown in Fig. 29. A spring-lid lubricator, **A**, is provided, into which a few drops of engine oil should be injected every 5,000 miles, or half-year, as directed on page 131. At the same time, the joints of the belt tensioning device should be lubricated with the oil can.

The tension of the endless rubber and canvas belt should be such that one side, at a point equidistant from the pulleys, may be moved transversely with the fingers about ¾″.

The adjustment should be tested every 2,000 miles or four weeks, as directed on page 130.

Adjustment is effected by slackening the hexagon lock-nut, **B**, with a spanner and screwing down the knurled nut, **C**, with the fingers until the correct tension is obtained, afterwards securely re-locking with a spanner by means of nut **B**.

When removing or replacing the belt, it is necessary to pull forward the shaft of the starting handle as far as possible when the small cover on the front cross member is open.

CHAPTER VIII.

Electric Lighting, Starting, and Ignition Systems.

General — Dynamo — Distribution Box — Switchbox — Ammeter — Battery and Connections—Battery Ignition—Magneto Ignition—Firing Order of Cylinders—Spark Plugs—Electric Horn—Electric Fuel Gauge—Addition of Electrical Apparatus—Starter Motor—Starter Motor Switch—Use of Starter Motor—Battery Discharge—Charging in Garage from External Source—Electrical Fault Location—Recommended Lamp Bulbs.

General. The equipment comprises a dynamo, distribution box with fuses and automatic cut-out, switchbox, ammeter, a 12-volt 50-ampère-hour accumulator in container, a starter motor, an electric horn with push-button at head of steering column, an electric fuel gauge (on certain chassis only), and battery ignition, consisting of non-trembler coil with ballast resistance, and combined low-tension contact breaker and high-tension distributor, and the necessary wiring encased in metal tubing. There is provision for the connection of additional accessory apparatus as later described.

Incorporated with the battery ignition is a governor, which effects automatic control of the battery ignition timing.

A magneto is provided as a stand-by.

The whole of this equipment, with the exception of the ammeter, battery, horn, fuel gauge, magneto, and electrical conductors, is of Rolls-Royce manufacture.

Each of the wiring diagrams (Figs. 30 and 31) has at the foot a list of chassis numbers to which it applies. These diagrams show the units with their electrical connections, the various wires being indicated

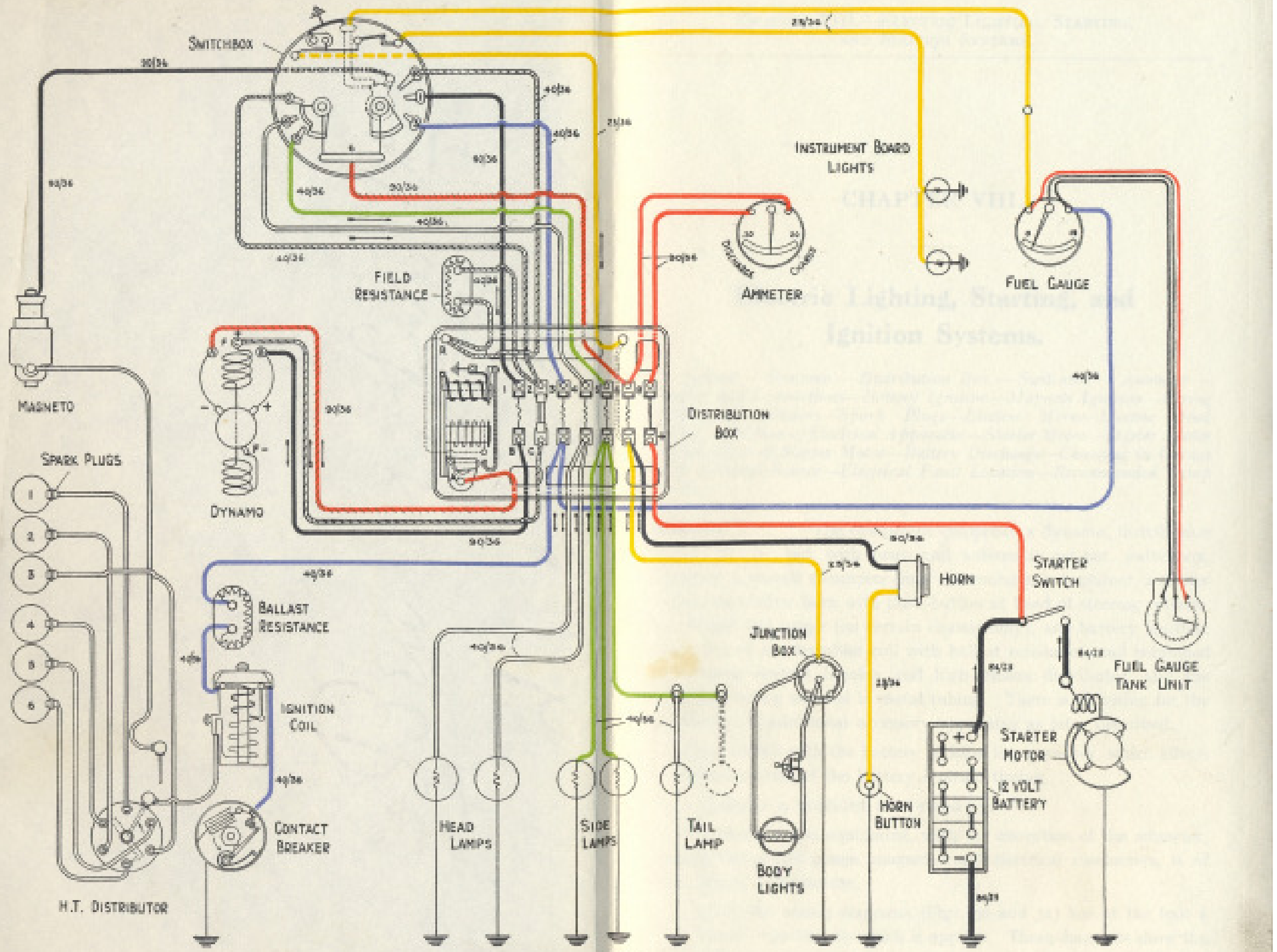

FIG. 30. ELECTRICAL WIRING DIAGRAM.
(CHASSIS NOS. GBT, GKT, GAU, GHU, GZU, GHW, GRW and GAW.)

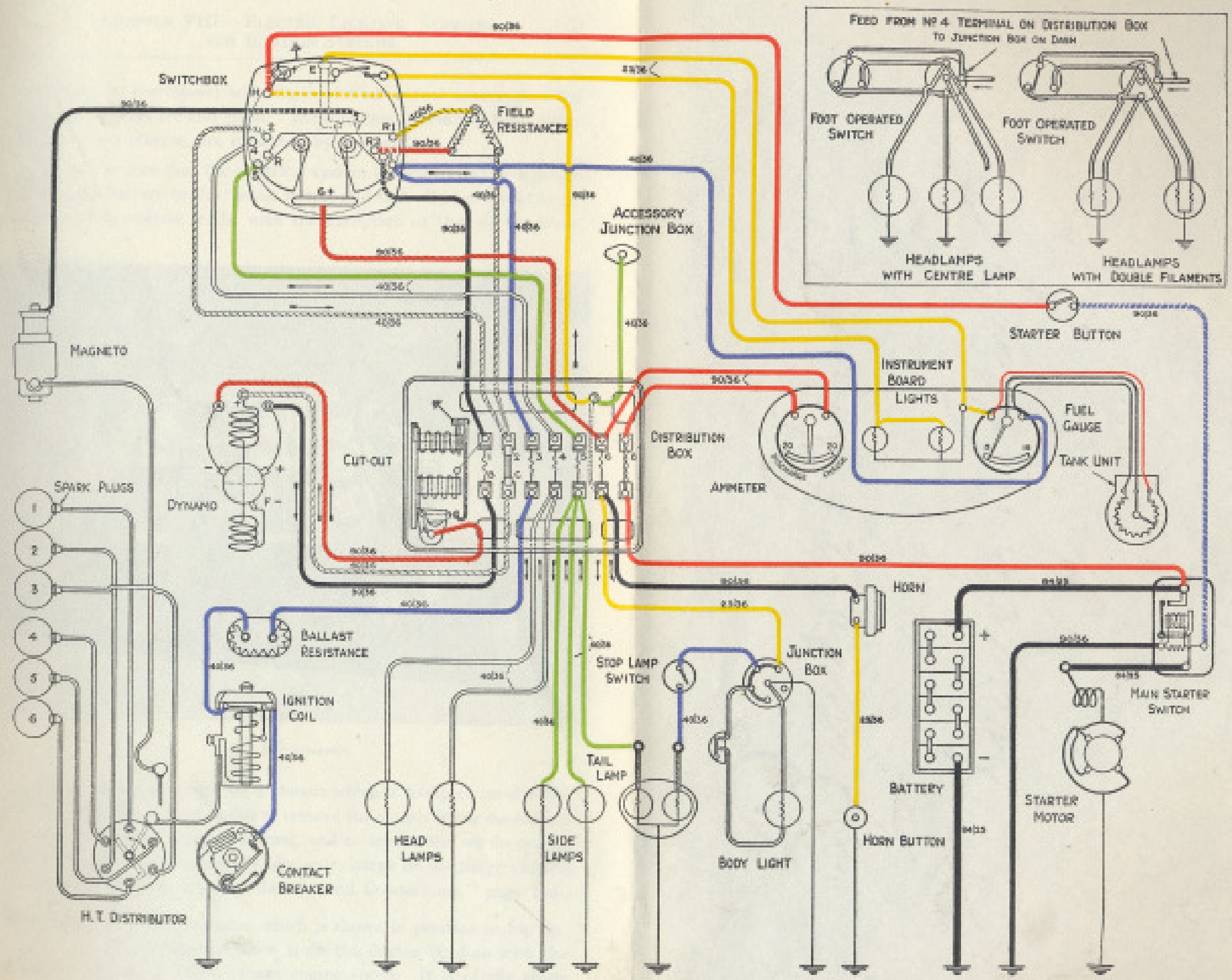

Fig. 31. Electrical Wiring Diagram.
(Chassis Nos. GEX, GWX, GDX, GSY and GLZ.)

in colours to correspond with those of their actual coverings. The sizes of the wires are also given. The directions of current flow, where these do not reverse, are indicated by arrows.

It will be seen that the electrical system is earthed on the negative side of the battery to the chassis frame, and that all hand-switching is done in the positive leads, with the exception of that of the horn.

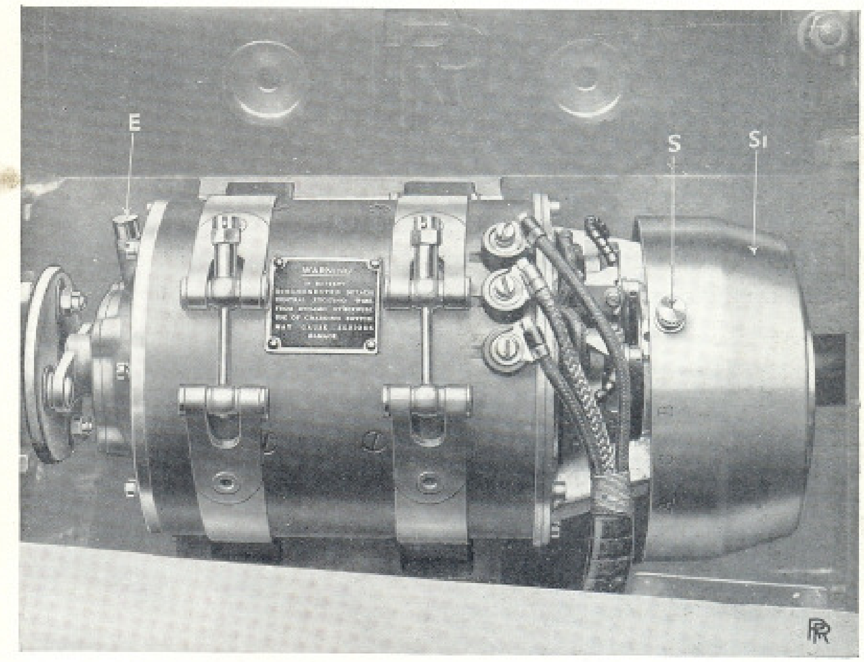

FIG. 32. DYNAMO.

Before doing any work on a chassis which is likely to involve the electrical system, it is advisable to remove the chassis frame connection from the negative battery terminal, and so render the whole system dead, but do not disconnect whilst any charge or discharge current is passing. (Also see under "Battery and Connections," page 102.)

Dynamo. The dynamo, which is shown in position in Fig. 32, is positively driven from the engine (in line with the magneto) at one-and-a-half times engine speed. It is of the single field winding and third brush type, which, when connected to a battery, is controlled by armature flux distortion to prevent undue increase of output at moderate and high speeds.

Two rates, or—on some chassis—three rates of dynamo output, are provided, namely, a maximum output, the normal output and, for certain chassis, a reduced output. The normal and reduced outputs are brought about by including one or two small resistances in the field winding circuit. These resistances are located just above the distribution box, as shown at Rd, in Fig. 33, and are arranged to be short-circuited in certain positions of the lighting and charging switches, as later described under "Switchbox," on page 100.

The positive terminal of the field winding is brought up, via a cartridge type fuse in the distribution box, to the switchbox for switching purposes. The negative end of the field winding is connected to the third brush, which is narrower in width than the main brushes. The arrangement involves the use of three leads between the dynamo and distribution box, the actual leads being coloured as follows :—

Lead.	*Colour.*	*Corresponding letter on Dynamo.*
Negative	Red and black ..	A
Positive	Black	B
Field	White and black ..	C

The bearings require little attention. When the chassis is overhauled, however, or the dynamo removed, they should be cleaned out and re-greased with only sufficient grease to occupy the spaces between balls and cage. Any excess is only melted out by heat, and may get on the commutator, or between the brushes and brush holders, causing brush sluggishness.

There is provision for additional lubrication at each bearing in the form of a small oil cup, one being shown at E (Fig. 32) and the other at S, the latter being normally within the cover S1.

A little engine oil should be injected at each lubricator every 2,000 miles or four weeks, as directed on page 129.

Every 5,000 miles, or half-year, as directed on page 132, the dynamo end cover, S1, should be removed, so exposing the commutator and brushes. After withdrawing the brushes from their holders, deposits of brush dust, moisture or oil should be removed by means of a rag moistened with petrol, the commutator itself being similarly treated.

Cleanliness of the commutator and freedom of the dynamo brushes in their holders are the most important points in the maintenance of this unit. It should also be observed whether the brushes have worn appreciably.

Premature failure, or excessive wear, however, indicates some definite fault in the machine, which should be returned for correction. In normal circumstances the brushes should last until the chassis is returned for general overhaul. In the event, however, of a new set of brushes being required, application should be made to Rolls-Royce Ltd.

The fitting of new brushes requires expert knowledge and care. Consequently, the work should be done by Rolls-Royce Ltd. Emphasis is laid on this point, as cases have arisen of faulty operation of the dynamo due to inexpert fitting of brushes.

If it be necessary to run the engine with the dynamo end cover, **S1**, removed, the latter may be held clear of the magneto drive shaft by turning it until a hole is found, by which it may be secured on the lubricator by means of the lubricator cap, **S**, as shown in Fig. 32.

When it is necessary to disconnect the wires to the dynamo, care must be taken to ensure their correct replacement, which is facilitated by the colouring and lettering adopted. The same remarks apply to the disconnection of dynamo wires at the distribution box.

Distribution Box. The distribution box containing the cut-out, or automatic charging switch, together with a series of fuses, is shown with the cover removed in Fig. 33. The cut-out and fuses are easily accessible on removing the cover.

The cut-out is operated when the dynamo speed rises high enough for the dynamo to be excited up to battery voltage, because its shunt coil is connected across the main terminals of the dynamo. This closes the cut-out contacts, which make connection, via the cut-out series coil, between the negative (dynamo) terminal, through the chassis frame to the battery negative, and thus allows the main charging

FIG. 33. DISTRIBUTION BOX, WITH COVER REMOVED, AND DYNAMO FIELD RESISTANCE.

current to flow from the dynamo positive terminal through the battery to the chassis frame, returning through the series coil and the contacts to the negative terminal of the dynamo.

The series coil is so connected that, when carrying the charging current, it assists the shunt coil in holding the contacts firmly together.

When the dynamo slows down, and its voltage falls below that of the battery, the current reverses through the series coil, and the effect of the shunt winding becomes neutralised, which results in the contacts falling apart.

The automatic cut-out is carefully adjusted by Rolls-Royce Ltd. in the first instance, and should only be touched in exceptional circumstances.

The fuses in the distribution box, with the exception of the battery emergency fuse **V** (Fig. 33), and dynamo field fuse **T**, which is of the cartridge type, are all of a single strand of 30 S.W.G. copper wire. Spare wire of this size is provided on a reel **U**, in the inside of the box cover.

The emergency fuse **V** should be three strands of this wire, neatly twisted together, and is only intended to be an emergency protection against dead earths on the wiring.

The cartridge type field fuse contains a No. 38 S.W.G. tinned copper fuse wire, and affords some protection (see page 103) against damage to the dynamo, automatic cut-out, ignition ballast resistance and coil, in the event of the battery not being properly connected to the system or to the dynamo in the event of dirty or gritty cut-out contacts.

Three spare cartridge type field fuses are supplied with the chassis, one of these being clipped to the distribution box cover, as shown at **T1**.

The dynamo cannot be excited or connected to the system if this fuse is removed or melted.

Special care should be taken that all fuses are gripped firmly in their holders, as a loose contact may in itself cause the fuse to melt or prevent the dynamo from exciting.

Be certain particularly that the emergency fuse is in order.

Switchbox. Carried on the right-hand end of the instrument board, this unit includes :—

(*a*) Lamp switch.

(*b*) Ignition and charging switch.

(*c*) Push-button for dash lamp.

(*d*) Socket for inspection lamp plug.

(*e*) A lock which can be locked and the key withdrawn with the switches in only two positions :—

(1) When both ignition and lamp switches are at the off position.

(2) When ignition is at the off position, but the lamp switch is at the **S** and **T** position.

Do not try to lock the switch in other positions.

The switches (*a*) and (*b*) are operated by thumb levers, and for chassis to which Fig. 30 wiring diagram applies (refer to list of chassis numbers on the wiring diagrams), the various combinations controlled by each are indicated as follows :—

OFF.—No circuits in action.

S and **T**.—Side and tail lamps on.

H, **S** and **T**.—Head, side and tail lamps on.

Both above "on" positions of lamp switch also provide automatically for maximum dynamo output when the ignition and charge switch is in the **I** and **C** position as below.

I.—Ignition on (battery or magneto, as the case may be), and fuel gauge in action.

I and **C**.—Ignition on, fuel gauge on, and connections closed to enable the dynamo to charge the battery or to supply maximum output when head lamps and /or side lamps are on. The switch in this position permits excitation of the dynamo field, which excitation is reduced normally by the inclusion of the field resistance and provides the normal output rate for charging the battery until or unless the lamp switch is put in either on position, **S** and **T** or **H**, **S** and **T**, when such resistance becomes short-circuited and maximum dynamo output is given.

This is the position of the switch recommended for ordinary running.

For chassis to which Fig. 31 wiring diagram applies, the various combinations controlled by switches (*a*) and (*b*) are indicated as follows :—

OFF.—No circuits in action.

S and **T**.—Side and tail lamps on and one of the two field resistances short-circuited to provide a dynamo output equivalent to that with the charge switch in the Winter position.

H, **S** and **T**.—Head, side and tail lamps on and both field resistances short-circuited to provide maximum dynamo output.

I and **C** (Summer).—Ignition on (battery or magneto, as the case may be), fuel gauge on, and connection closed to enable the dynamo to charge the battery at a reduced rate suitable for Summer conditions, both resistances being in series with the field circuit.

I and **C** (Winter).—The same as **I** and **C** (Summer) except that one of the two field resistances is out of action, the dynamo therefore charging the battery at an increased rate, suitable for Winter conditions.

It will thus be seen that the two field resistances provide for three different dynamo outputs, namely :—

(1) A maximum rate with neither resistance in use. This can only occur with the lighting switch in the **H**, **S** and **T** position, and is not affected by the position of the charge switch.

(2) A normal or Winter rate, one resistance being in series with the field. This occurs—

  (*a*) with the lighting switch in the **S** and **T** position and is not then affected by the position of the charge switch, and

  (*b*) when the charge switch is in the Winter position and the lighting switch is off.

(3) A reduced or Summer rate, both resistances being in series with the field. This only occurs with the charge switch in the Summer position, and the lighting switch off.

Ammeter. The ammeter is an instrument with a central zero and 20-ampére range.

Electrically, it is so connected as to indicate all current passing in or out of the battery, except the heavy current for the starter motor, a needle deflection to the right indicating Charge, and left Discharge. Thus the dynamo output, less the current required to operate the battery ignition, is exactly indicated if no other consuming apparatus be switched on ; and if the dynamo be off, the current being consumed by the lamps, etc., together with that for the ignition, is shown. If both dynamo and lamps or other apparatus be on, the reading gives the balance in or out of the battery.

Should the ammeter not show any charging current with the charging switch on, lamps off, and dynamo running, confirm that the battery connections are sound, by inspection, and by trying the head lamps with the charging switch off, and if no irregularity be found, inspect the fuses, and replace with spare fuse wire or cartridge fuse provided as necessary.

In the unlikely event of no charging now taking place, the fault must lie in the dynamo or dynamo connections, and it will be necessary to inspect these carefully. One cause of failure to charge would be the existence of a break on the field positive or armature positive leads from switchbox via distribution box to dynamo ; another, want of freedom of dynamo brushes in their holders, preventing them from properly making contact with the commutator.

An unnoticed reversal of the ammeter connections causes the charge and discharge indication to be reversed.

Battery and Connections. (For detailed instructions concerning the battery as a unit see the battery makers' pamphlet inserted at the end of this book.)

The necessary care must be taken to secure clean and sound electrical connections of cable terminals to battery terminals. To clean terminals, use paraffin (not abrasives), and afterwards again vaseline thoroughly. To remove corrosion, use a solution of ammonium carbonate in the first instance, applying this with a rag.

It is of great importance not to attempt to light lamps or operate any part of the electrical system direct from the dynamo, the battery being either intentionally or unintentionally disconnected, e.g., by removal of the battery or failure of the emergency fuse. In these circumstances, though no current is indicated by the ammeter, the voltage of the system rises above normal.