ALTERNATOR MODELS 15ACR, 16ACR, 17ACR & 18ACR

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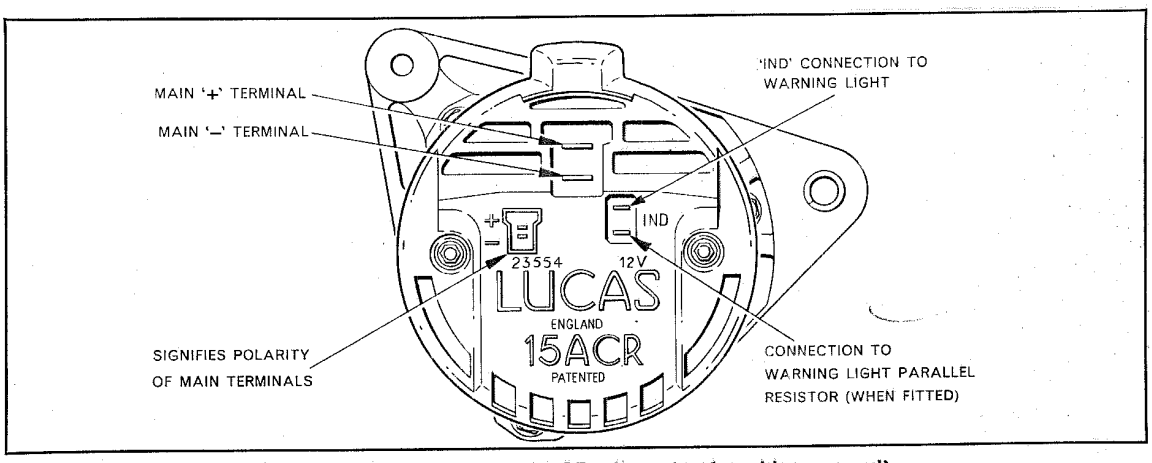

Fig. 1 Early production 15ACR alternator (machine-sensed)

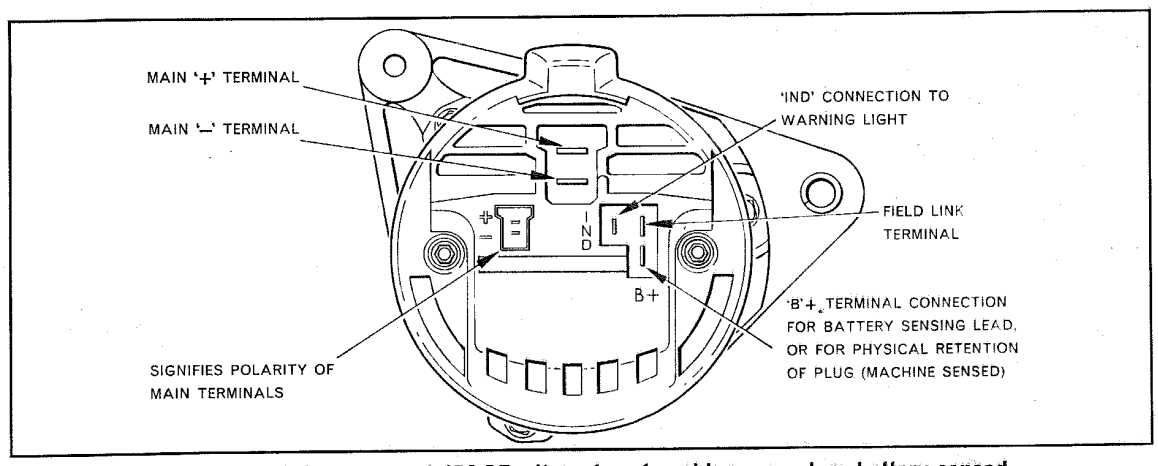

Fig. 2 15ACR, 16ACR and 17ACR alternators (machine-sensed or battery-sensed with standard terminations)

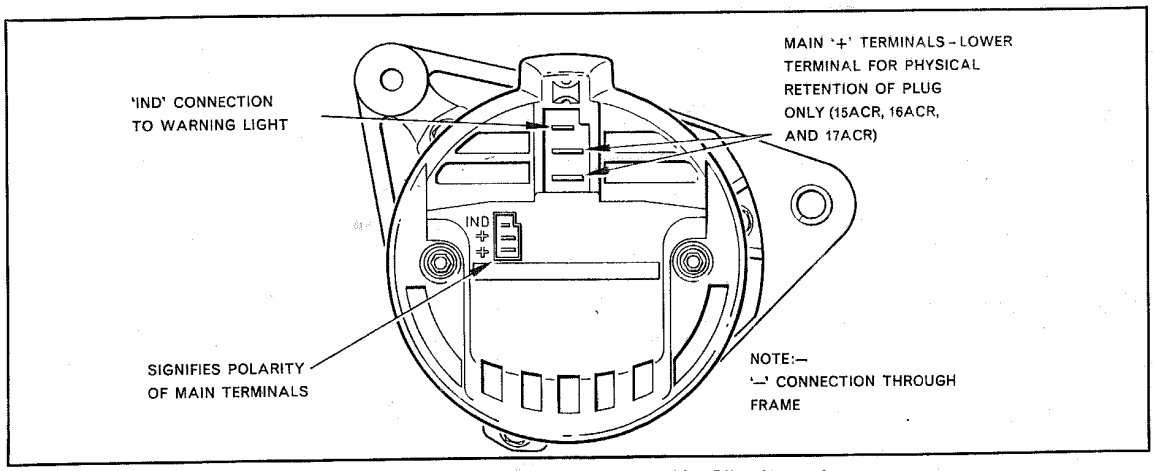

Fig. 3 15ACR, 16ACR, 17ACR and 18ACR alternators (machine-sensed European terminations)

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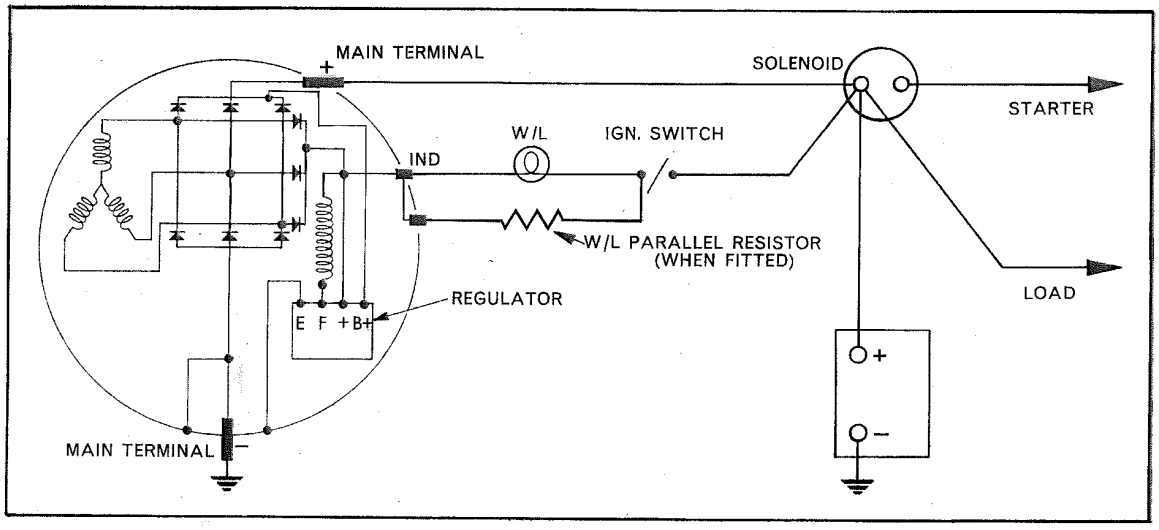


Fig. 4 Machine-sensing system, early production 15ACR alternators (terminal arrangement Fig. 1)

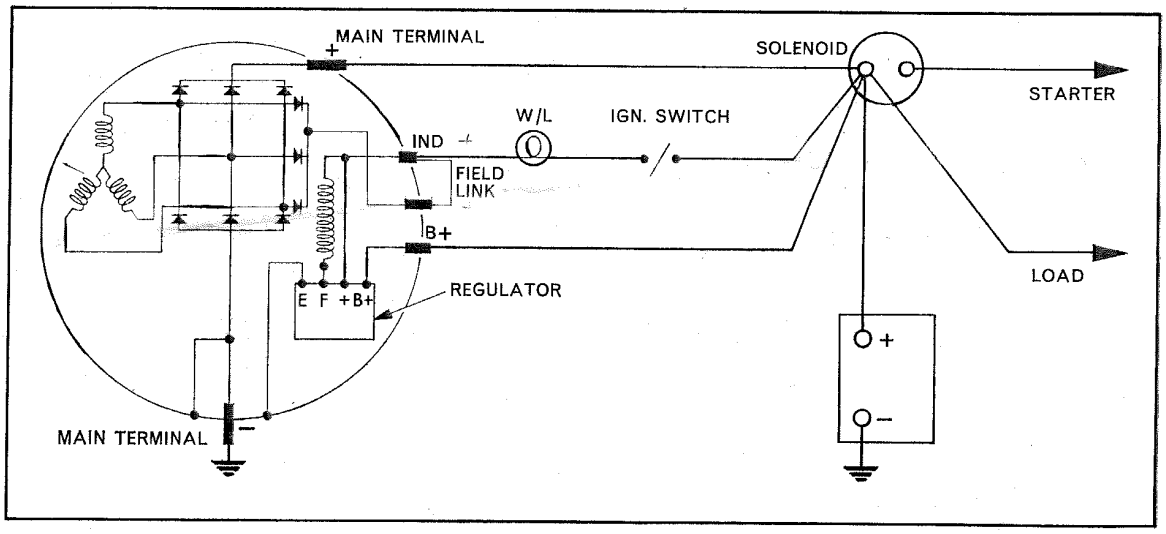


Fig. 5 Battery-sensing system, 15ACR, 16ACR and 17ACR alternators (standard terminations Fig. 2)

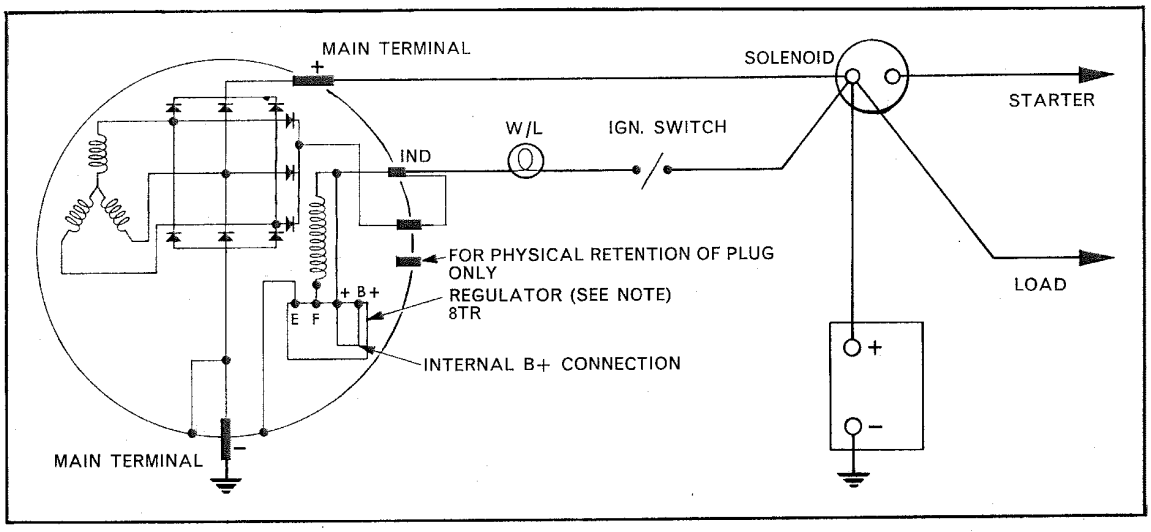


Fig. 6 Machine-sensing system, 15ACR, 16ACR and 17ACR alternators (standard terminations Fig. 2)

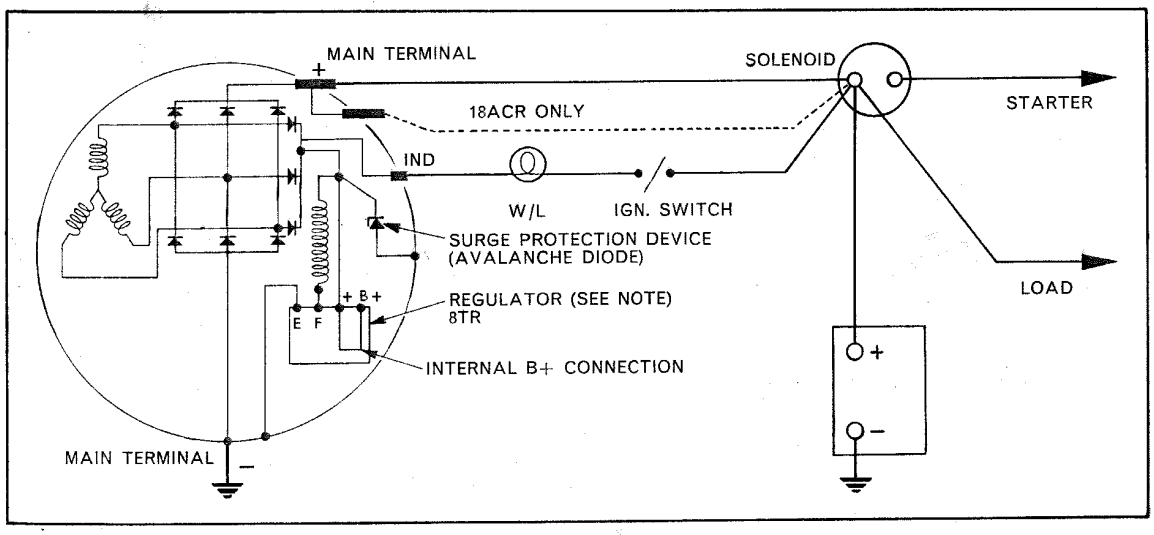


Fig. 7 Machine-sensing system, 15ACR, 16ACR, 17ACR and 18ACR alternators (European terminations Fig. 3)

Note:

If a 3-lead model 11TR regulator is fitted, the 'B+' terminal and internal link will not apply.

If a 2-lead model 8TRD regulator is fitted, the earth-connection will be via the regulator case.

If a later production 2-lead model 14TR regulator is fitted, the 'F' connection will be via the regulator case (connected to the brush box via a metal connector link) and the 'B+' terminal and internal link will not apply.

Alternator Models 15ACR, 16ACR, 17ACR & 18ACR

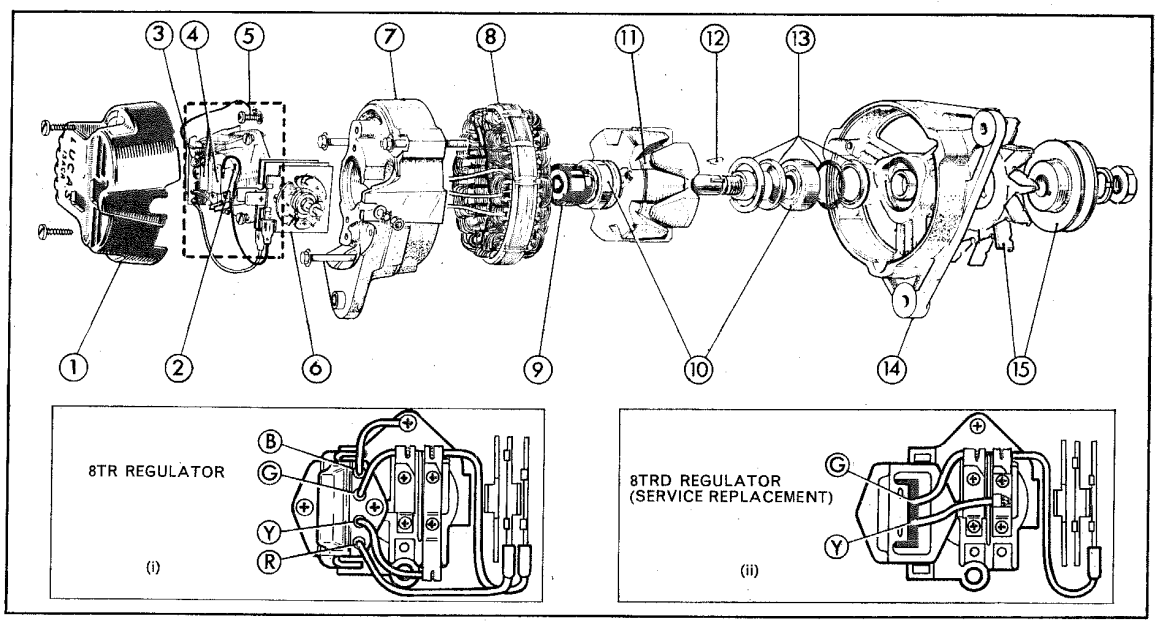


Fig. 8(a) Machine-sensing system, early production 15ACR alternators (reference Fig. 1 and 4)

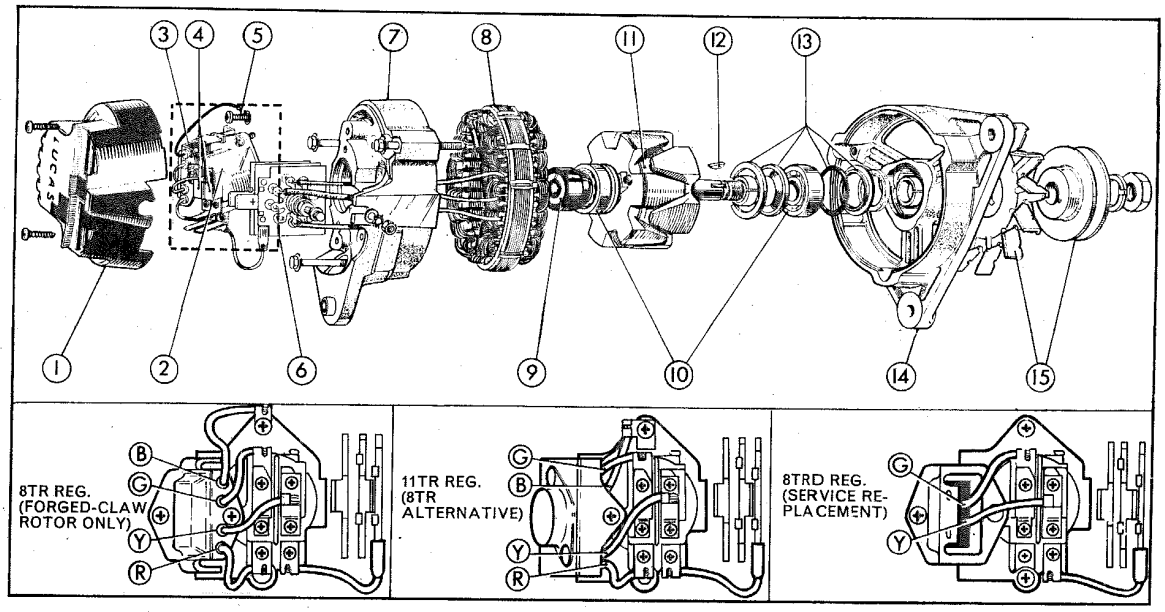


Fig. 8(b) Battery-sensing system, 15ACR, 16ACR and 17ACR alternators (reference Fig. 2 and 5)

Wiring Colour Code:

B — Black
G — Green
Y — Yellow
R — Red

1 Moulded cover (two fixing screws)
2 Brush box assembly, comprising item (4), (two fixing screws)
3 Regulator (two fixing screws)
4 Brush and spring assemblies (2)
5 Regulator earthing screw
6 Rectifier (fixing nut and washers)
7 Slip ring end bracket (three fixing bolts)

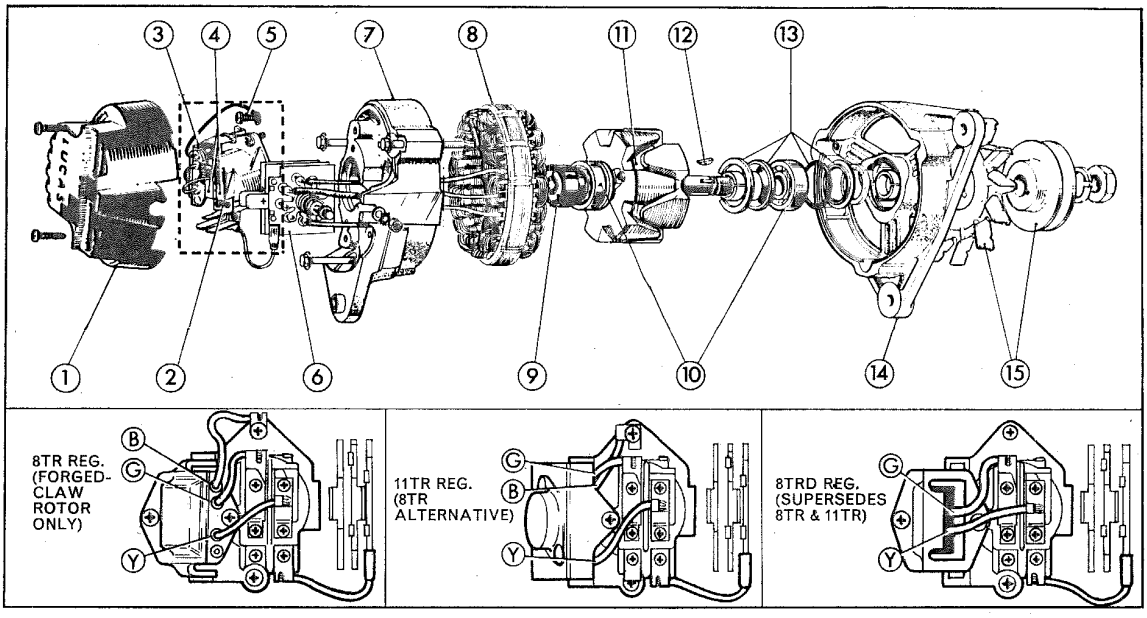


Fig. 8(c) Machine-sensing system, 15ACR, 16ACR and 17ACR alternators (reference Fig. 2 and 6)

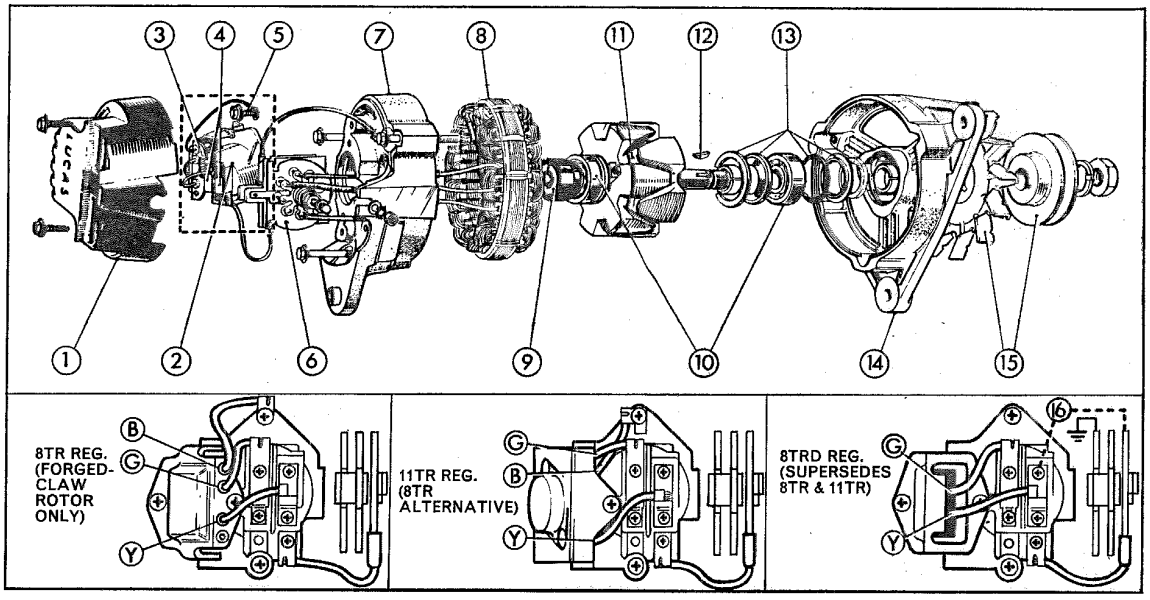


Fig. 8(d) Machine-sensing system, 15ACR, 16ACR, 17ACR and 18ACR alternators (reference Fig. 3 and 7)

8 Stator winding assembly
9 Slip ring moulding
10 Ball bearing(s)
11 Rotor and field winding
12 Woodruffe shaft key (fan and pulley fixing)
13 Bearing assembly parts
14 Drive-end bracket
15 Fan and pulley (fixing nut and spring washer)
16 Alternative connections for surge protection device (when fitted)

Wiring Colour Code:

B — Black
G — Green
Y — Yellow
R — Red

Alternator Models 15ACR, 16ACR, 17ACR & 18ACR

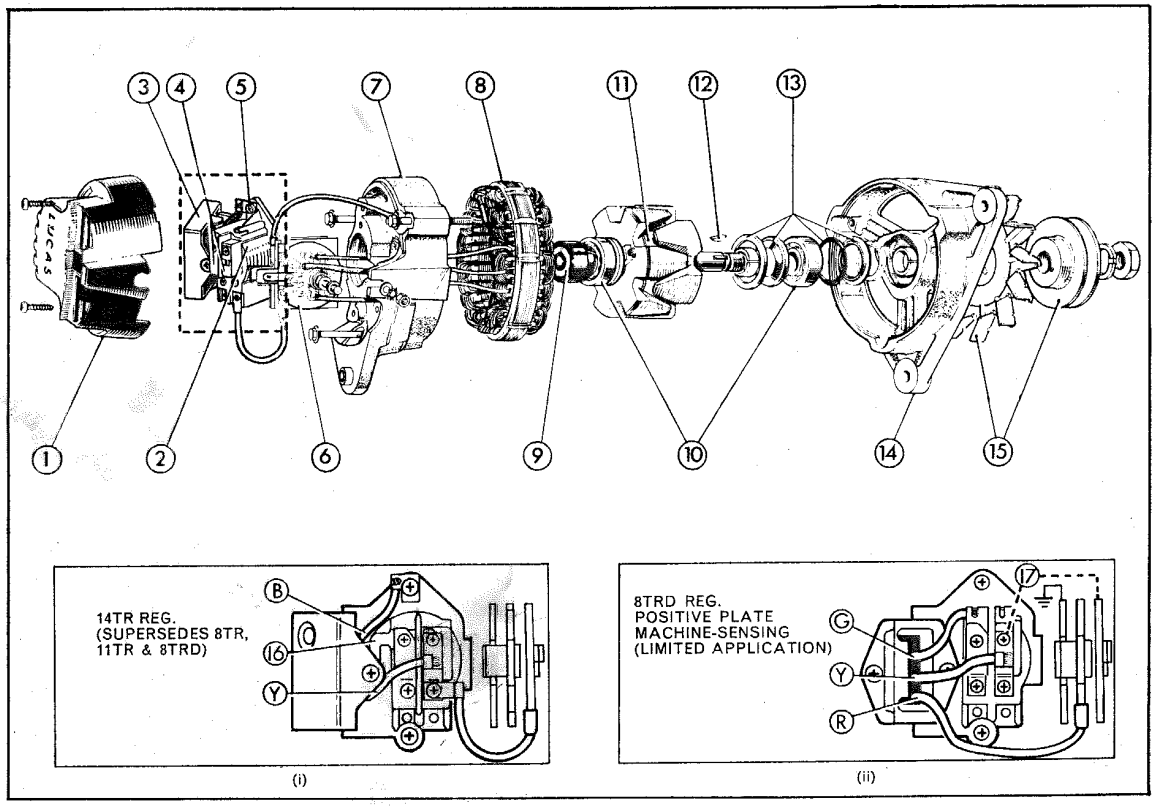


Fig. 8(e) Machine-sensing system

14TR regulator, 15, 16, 17 and 18ACR (reference Fig. 3 and 7)

8TRD regulator, 16, 17 and 18ACR (reference Fig. 3 and 7, but with regulator connections as Fig. 4, except for the earth connection 'E' which is via the regulator case)

1 Moulded cover (two fixing screws)
2 Brush box assembly
3 Regulator (two fixing screws)
4 Brush and spring assemblies (2)
5 Regulator earthing screw and brush box fixing screws (2)
6 Rectifier (fixing nut and washers)
7 Slip ring end bracket (three fixing bolts)
8 Stator winding assembly
9 Slip ring moulding
10 Ball bearing(s)
11 Rotor and field winding
12 Woodruffe shaft key (fan and pulley fixing)
13 Bearing assembly parts
14 Drive-end bracket
15 Fan and pulley (fixing nut and spring washer)
16 'F' terminal connector strip
17 Alternative connections for surge protection device (when fitted)

Wiring Colour Code: B — Black G — Green Y — Yellow R — Red

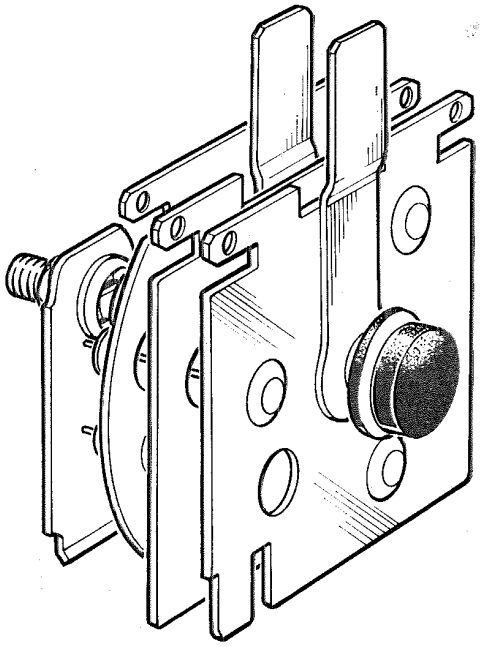
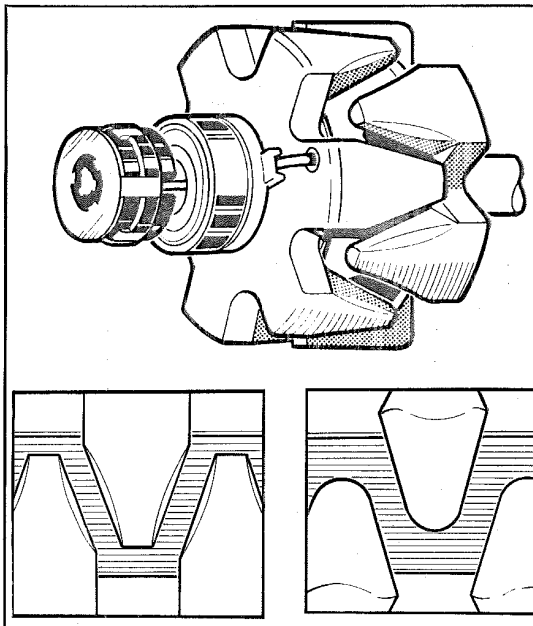


Fig. 9 Model 4DS5 rectifier 83192
15ACR early-production and standard terminations
(battery-sensed or machine-sensed)



(a) Forged-claw (early production)

(b) Pressed-claw (later production)

Fig. 11 Rotor assembly

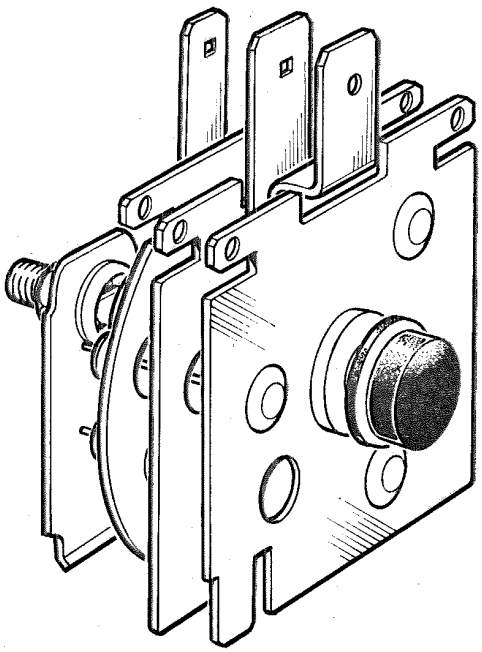


Fig. 10 Model 4DS5 rectifier 83166
(European terminations, machine-sensed)

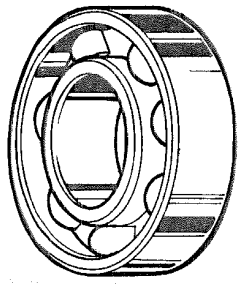


Fig. 12(a)
Standard bearing
(fitted to drive-end and slip-ring end; slip-ring end bearing shielded one side, facing slip-ring)

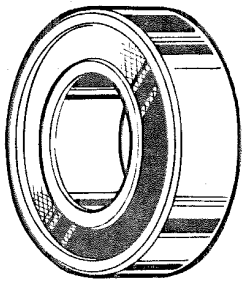


Fig. 12(b)
Fully-sealed bearing
(heavy-duty applications) (fitted to drive-end and slip-ring end)

Alternator Models 15ACR, 16ACR, 17ACR & 18ACR

1. GENERAL

(a) Variations in Alternator Design

The 15, 16, 17 and 18ACR range of alternators are similar in mechanical construction (see Figs. 8a to e). Overall length and end-bracket fixing centre dimensions of the 15ACR and 16ACR are approximately $\frac{1}{4}$" (0·25 in. or 6 mm) smaller than the 17ACR and 18ACR. Differences in rotor and stator windings provide alternative electrical performance characteristics (refer 3. TECHNICAL DATA).

Terminal Arrangement

(i) Early-Production 15ACR (see Fig. 1).
(ii) Standard Terminations (see Fig. 2).
(iii) European Terminations (see Fig. 3).

Alternator Output Control

Integral electronic voltage regulator unit of micro-circuit construction.

(i) 8TR or 11TR 4-lead regulator (see Figs. 8a & b).
(ii) „ „ „ 3-lead „ (see Figs. 8c & d).
(iii) 8TRD 2-lead regulator (see Figs. 8a to d).
(iv) „ 3-lead „ (see Fig. 8e ii).
(v) 14TR 2-lead „ (see Fig. 8e i).

Rectifier

Plate-type rectifier pack comprising nine silicon diodes, three field diodes and six main output diodes.

(i) Standard termination rectifier model 4DS5 Pt. No. 83192 (see Fig. 9).
(ii) European termination rectifier model 4DS5 Pt. No. 83166 (see Fig. 10).

Rotor

Forged-claw or pressed-claw types (see Figs. 11a & b).

(i) Forged-claw rotor: 18ACR alternators and other early-production alternators.
(ii) Pressed-claw rotor: Later-production alternators.
(iii) Pressed-claw rotor (de-rated): 17ACR alternators fitted to 'Combine Harvesters'.

Note: Combine Harvesters work under adverse conditions of excess dust, chaff etc., which enters the alternator via the ventilating slots in the slip-ring end cover moulding. Over a period of time this foreign matter builds up inside the alternator and around the ventilating slots in the end brackets and if the alternator were of standard specification it would overheat and eventually fail. Overheating of the 17ACR alternator fitted to Combine Harvesters is avoided by using a de-rated rotor (fewer windings than a standard rotor) which limits the 17ACR alternator output to 25A (normally 36A). This reduces the working temperature of the alternator below the normal limit, so providing a tolerance to counteract any adverse increase in heat due to restricted air-flow through the alternator.

Surge Protection Device

The surge protection device is a special avalanche-diode, fitted to the outer-face of the slip-ring end bracket (not to be confused with a suppression capacitor, similarly fitted in the end bracket). The avalanche-diode is connected between terminal 'IND' and frame and its purpose is to protect the regulator from damage by absorbing high transient voltages which occur in the charging system due to faulty cable connections, or if the cables are temporarily disconnected at the battery whilst the engine is running. (The surge protection device is intended to provide limited protection for the regulator under normal working conditions and therefore the service precaution not to disconnect any of the charging system cables, particularly those at the battery, while the engine is running, should still be observed).

(b) Operation of the Alternator

When the ignition switch (or the equivalent control switch for diesel engines) is switched 'ON', a small current flows from the battery and through the rotor field winding, the circuit being completed via the warning light, alternator terminal(s) 'IND' and the carbon brushes contacting the rotor slip-rings, the alternator regulator and earth. At this stage, the warning light is illuminated and the rotor is partially-magnetised.

When the engine is started and the partially-magnetised rotor rotates within the stator windings, 3-phase alternating current (a.c.) and rapidly rising voltage is generated.

A small portion of generated alternating current (a.c.) is rectified to direct current (d.c.) by the three field diodes incorporated in the rectifier pack. Output current from the field diodes supplements the initial current flowing through the rotor field winding from the battery, causing an increase in the magnetic influence of the rotor and resulting in self-excitation of the alternator. As rotor speed and generated current and voltage increases, the rotor field current increases correspondingly until the alternator becomes fully-excited.

During the rise in generated output voltage (reflected at terminal 'IND') the rising voltage influences the warning light so that it functions as a 'Charge-Indicator Warning Light', as follows: When the generated voltage applied to one side of the warning light (via the 'IND' terminal) rises above the battery voltage applied to the other side of the warning light, the warning light is extinguished and this normally indicates that the alternator is developing its main battery-charging current.

The main battery-charging current is rectified from a.c. to d.c. by the other six diodes in the rectifier pack (main output diodes) which function in a full-wave bridge rectifier circuit.

Alternator output is controlled by a voltage-sensing regulator unit, attached to the brushbox

moulding and the outer-face of the slip-ring end bracket. The regulator functions as an electronic control switch in the earth-side of the rotor field winding circuit, switching the circuit 'OFF' and 'ON' at very high frequency to maintain the alternator output voltage (and so the current) at a predetermined and safe working limit. The alternator-controlled voltage, measured at the battery terminals, is normally 13·6–14·4V. There are two systems of alternator output control (i) Battery-Sensing and (ii) Machine-Sensing.

(i) Battery-Sensing: The regulator senses the system voltage, direct from the battery, via a battery-sensing cable connected between the 'B+' terminal of the alternator and the insulated side of the battery (see Fig. 5).

(ii) Machine-Sensing: The regulator senses the alternator generated output voltage, via the regulator connections inside the alternator.

(a) Terminal 'IND' machine-sensing: See Figs. 6 and 7.

(b) Positive plate machine-sensing: See Fig. 4. Also later-production alternators, similar to Fig. 4 except European terminations and the regulator earth-connection is via the case (see also Fig. 8e ii). Later-production alternators with positive plate machine-sensing can be identified by the regulator, model 8TRD 3-lead marked 37587.

(c) Service Precautions

(i) Ensure that no connection in the charging circuit, including the battery, is made or broken while the engine is running.

(ii) Observe correct polarity when refitting the vehicle battery, using a slave battery to start the engine, or when using a battery charger (connect positive to positive, negative to negative).

2. ROUTINE MAINTENANCE

Occasionally check the general condition and tightness of the fan belt. If necessary, the fan belt tension should be adjusted to obtain approximately $\frac{5}{8}$″ (0·6 in. or 16 mm) deflection of the belt when pressed at the longest point between pulleys.

Note: When adjusting the fan belt, leverage must only be applied to the alternator drive-end bracket and the lever should preferably be wood.

3. TECHNICAL DATA

(i) Earth polarity: Negative

(ii) Nominal voltage: 12V

(iii) Nominal d.c. output (hot, at 14V and 6,000 rev/min.):

15 ACR	*16 ACR*	*17 ACR*	*18 ACR*
28A	34A	36A	45A
Combine Harvesters 25A (*17ACR*)			

(iv) Alternator controlled voltage (measured across the battery terminals with alternator current stabilised below 10A): 13·6–14·4V

(v) Max. permissible speed: 15,000 rev/min.

(vi) Rotor field winding resistance (approx.):
- 4·3 ohms (15ACR & 16ACR rotors with PINK windings).
- 3·3 ohms (15ACR & 16ACR rotors with PURPLE windings).
- 4·2 ohms (17ACR rotors with PINK windings).
- 3·2 ohms (17ACR rotors with GREEN windings).
- 3·3 ohms (17ACR de-rated rotors with GOLD windings).
- 3·2 ohms (18ACR rotors with GREEN windings).

(vii) Brush spring pressure (measured with brush depressed flush with brushbox moulding): 9–13 ozf (255–368 g or 2·5–3·3N)

(viii) New brush length: $\frac{1}{2}$″ (0·5 in. or 12 mm)
Renew when worn to: $\frac{5}{16}$″ (0·3 in. or 8 mm)

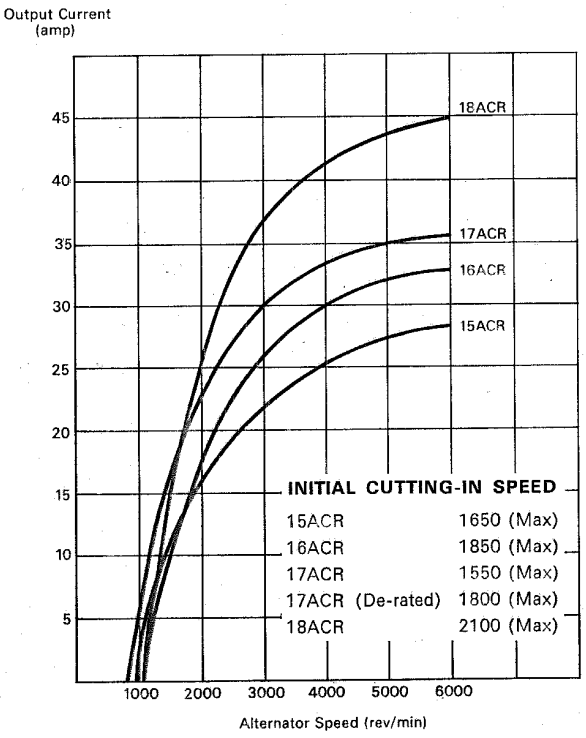


Fig. 13 Typical performance curve (alternator hot)

4. SERVICING

(a) Checking the Charging System

(i) Eliminate the Battery

Check with a hydrometer the specific gravity of the electrolyte in each of the battery cells. If the cell readings vary by more than 40 points (0.040), the battery is suspect. Specific gravity readings should be:

State of charge	Specific gravity readings correct to 15°C (60°F)	
	Climates normally below 25°C (77°F)	Climates normally above 25°C (77°F)
Fully-charged	1.270 – 1.290	1.210 – 1.230
70% charged	1.230 – 1.250	1.170 – 1.190
Discharged	1.100 – 1.120	1.050 – 1.070

Electrolyte Temperature Correction

For every 10°C (18°F) *below* 15°C (60°F) *subtract* 0.007.
For every 10°C (18°F) *above* 15°C (60°F) *add* 0.007.

If the battery is found to be discharged it should be independently recharged, renewed, or substituted for the following tests. If the battery is found to be satisfactory, check for tightness of its terminal connections.

(ii) Observe Operation of the Warning Light

Switch on the ignition switch, or equivalent control switch for diesel engines (do not at this stage start the engine). **The warning light should be fully illuminated.** If the warning light is not illuminated, check the bulb. If the bulb is not the cause of the fault, proceed direct to para. iv.

If the warning light is illuminated, start the engine and run above idling speed. **The warning light should be extinguished.** If the warning light is not extinguished, the driving belt may be broken or slipping (refer para. iii). If the driving belt is not the cause of the fault, remove the alternator 'IND' field-terminal connector plug, or 'IND'/MAIN terminal connector plug (European termination alternators). If warning light remains illuminated, check for short-circiut to frame between the 'IND' cable-end and warning light. If warning light is now extinguished, refit alternator connector plug and proceed direct to para. v.

(iii) Check the Driving Belt

Check whether the driving belt is broken or slipping. With the driving belt depressed by hand at the longest point between pulleys, deflection of the belt should be approximately $\frac{5}{8}$" (0·6 in. or 16 mm).

(iv) Check the Alternator Plug Connections

Note: A moving-coil voltmeter 0–20V range is required.

Alternators with either Fig. 1 or Fig. 2 terminal arrangements

Move ignition switch or equivalent control switch to 'ON'.

Remove rotor field-winding connector plug from alternator terminals marked 'IND', or 'IND B+', and connect voltmeter between each cable-end in turn and the frame (negative-side of voltmeter to frame). **Battery voltage should be registered.**

Remove main connector plug from alternator terminals marked '+' and '—' and connect voltmeter between cable-ends (negative side of voltmeter to cable-end coloured BLACK). **Battery voltage should be registered.**

If the test is unsatisfactory, in either case, the continuity fault in the external cable circuit(s) must be traced and remedied (refer circuit diagrams Figs. 4, 5 & 6).

If the test is satisfactory, in both cases, refit connector plugs to the alternator and proceed direct to next test para. v.

Alternators with Fig. 3 terminal arrangements

Move ignition switch or equivalent control switch to 'ON'.

Remove connector plug from alternator and connect voltmeter between each cable-end in turn and the frame (negative-side of voltmeter to frame). **Battery voltage should be registered.**

If the test is unsatisfactory, the continuity fault in the external cable circuit(s) must be traced and remedied (refer circuit diagram Fig. 7).

If the test is satisfactory, refit connector plug to the alternator and proceed to next test para. v.

(v) Check Alternator Charging Current, and Alternator Controlled Voltage at the Battery Terminals

Note: In addition to the voltmeter used in the previous test (para. iv), unless the vehicle is fitted with an ammeter, it will be necessary to connect a test-ammeter, 0–60A range, in series with the cable(s) connected to the main output '+' terminal of the alternator. (This can be achieved by connecting the ammeter in series with the brown-coloured 'eyeleted' alternator cable(s) attached to the main input terminal of the starter solenoid. Connect ammeter negative-side to solenoid terminal and positive-side to cable eyelet).

Connect the voltmeter across the battery terminals, so that battery voltage is registered.

Start engine, increase speed (ignore voltmeter at this stage) and observe the ammeter reading.

If ammeter registers zero amps, the alternator is faulty and must be removed from the vehicle for individual testing (proceed to 4(b) 'Bench Testing').

If ammeter registers a charging current in excess of 10A continue running the engine until ammeter reading falls below 10A, and observe the voltmeter reading. **13·6–14·4V should be registered** (alternator-controlled voltage), in which case the charging system is working normally.

If the voltmeter reading exceeds 14·4V, the alternator should be removed from the vehicle and the regulator renewed, otherwise the battery will be subjected to overcharging and the alternator will be overworked and damaged.

If voltmeter reading is below 13·6V, a faulty alternator (regulator) or a high-resistance fault in the external connections of the charging system is indicated. Proceed to para. (vi) 'Charging Circuit Volt Drop Testing'. If the volt drop tests are satisfactory, remove the alternator from the vehicle and proceed to 4(b) 'Bench Testing'.

(vi) Charging Circuit Volt Drop Testing

Check for a high resistance fault in the charging system, by carrying out two separate volt drop tests on the insulated-side and earth-side of the charging circuit. The tests must be carried out with all the alternator cables connected. (The connector plug is open-ended to facilitate testing). Switch on the headlamps to load the charging system and run the engine at a fairly high speed (simulating normal working speed), and connect the voltmeter as follows:

Insulated-side volt drop test

Connect voltmeter between the alternator main output '+' terminal(s) and the '+' terminal of the battery. (Voltmeter red lead to alternator and black lead to battery). **The test is satisfactory if the voltmeter registers 0–0·5V.**

If the test is unsatisfactory, a high-resistance fault between the positive side of the battery and the alternator '+' terminal(s) must be traced and remedied.

Earth-side volt drop test

European termination alternators (Fig. 3):

Connect voltmeter between the alternator frame and the '—' (earth) terminal of the battery. (Voltmeter black lead to alternator and red lead to battery).

Other alternators (Figs. 1 & 2):

Connect voltmeter between the alternator main output '—' terminal and the '—' (earth) terminal of the battery. (Voltmeter black lead to alternator and red lead to battery).

In either case the test is satisfactory if the voltmeter registers 0–0·25V.

If the test is unsatisfactory, a high-resistance fault on the earth-side of the charging circuit must be traced and remedied.

(b) Bench Testing

Note: The test rig must be capable of varying the alternator speed from zero to 6,000 rev/min. To avoid overheating of the alternator it should be fitted with a fan and driven in the correct direction-of-rotation. (Correct rotation of the alternator can be determined by an arrow marking on the face of the fan or, alternatively, by the angle of the fan blades which are inclined in the opposite direction to that in which the alternator must be rotated when viewed from the drive-end). Wiring used in the test circuit must be of equivalent grade to that used in vehicle alternator installations, 14/010 (14/0·25 mm) grade for the 'IND' field circuit cables and 120/012 (120/0·30 mm) grade for the main terminal(s) and earth cables. Connect two 120/012 grade cables to the main output '+' terminals of 18ACR alternators with European terminations (Fig. 7).

Clamp the alternator in the test rig, with the alternator moulded slip-ring end cover removed to expose the regulator connections. Connect a test circuit, similar to one of the applicable circuits shown in Figs. 4, 5, 6 & 7 (depending on alternator terminal arrangement) but using direct connections between the alternator, warning light (12V 2·2W), and the test battery.

Include in the test circuit: a 0–60A moving-coil ammeter in series with the alternator main output '+' cable(s) and connect in parallel across the battery terminals a 0–20V moving-coil voltmeter and a 15 ohm 35A variable load resistor. **The warning light should be illuminated,** in which case proceed direct to first test para. (i) 'Alternator Output Test with Regulator Inoperative'.

If the warning light is not illuminated (providing the warning light bulb is known to be good), non-continuity of the rotor field winding circuit is indicated. Check in the following order: regulator, brushes-and-springs and rotor slip-rings, rotor field-winding continuity.

Regulator

Connect the regulator 'F' terminal to alternator frame. If this results in the warning light now being illuminated, the regulator is faulty and it must be renewed.

In all cases except a model 14TR regulator, the regulator 'F' terminal is a green coloured lead. In the case of a 14TR regulator, the 'F' terminal connection is via the regulator case, connected to the brushbox by a metal connecting strip (see Fig. 8e (i), item 16).

Brushes-and-springs and rotor slip-rings

Remove the brushbox moulding. Check whether brushes and slip-rings are free of oil or grease. If necessary, the brushes and springs can be cleaned with a petrol-moistened cloth. Check brush-and-spring assemblies for freedom-of-movement in the brushbox moulding. If the visible length of the brushes in the free position is less than $\frac{1}{4}$" (0·25 in. or 6 mm), this is the probable cause of non-continuity of the field circuit. In any case, the brush-and-spring assemblies should now be renewed if the overall length of the brushes has become worn to $\frac{5}{16}$" (0·3 in. or 8 mm).

While the brushbox moulding is removed, check rotor field winding continuity.

Rotor field winding continuity

Check the rotor field winding continuity, by connecting a battery-operated ohmmeter or a 12V battery test-lamp between each of the rotor slip-rings. **The ohmmeter should register a reading or the test lamp should light.**

If the test is unsatisfactory, renew the rotor (refer 4(c) 'Dismantling') and then proceed to para. (i) 'Alternator Output Test with Regulator Inoperative'.

(i) **Alternator Output Test with Regulator Inoperative**

Make the regulator inoperative, by linking its green lead ('F' terminal) to alternator frame. A

FAULT SYMPTOMS

Warning Light	Alternator			Probable Fault (Associated Damage)
	Temperature	Noise	Output	
Illuminated at stand-still, extinguished at cut-in speed (1,500 rev/min) but at higher speeds becomes partially illuminated again and gets progressively brighter.	High	Normal	Higher than normal at 6,000 rev/min. Approximately: 35A 15ACR 40A 16ACR 38A 17ACR 50A 18ACR	Live-side main output diode open-circuit. (May damage rotor field winding and regulator, overheat brushboxes, and fuse warning light bulb).
Not illuminated between zero and 1,500 rev/min.	High	Excessive	Very low at 6,000 rev/min. Approximately: 10A (all models).	Live-side main output diode short-circuit. (May damage associated 'field' diode).
Illuminated at stand-still, dims appreciably at cut-in speed (1,500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds.	Normal	Excessive	Poor at low speed. Slightly below normal at 6,000 rev/min. Approximately: 26A 15ACR 32A 16ACR 30A 17ACR 40A 18ACR	Earth-side main output diode open-circuit.
Illuminated at stand-still, dims appreciably at cut-in speed (1,500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds.	Normal	Normal	Lower than normal at 6,000 rev/min. Approximately: 23A 15ACR 29A 16ACR 29A 17ACR 35A 18ACR	'Field' diode open-circuit.
Illuminated at stand-still, dims at cut-in speed (1,500 rev/min) and remains dim, but may be extinguished at very high speeds.	Normal	Excessive	Very low at all speeds above cut-in (1,500 rev/min). Approximately: 7A (all models).	Earth-side main output diode short-circuit, or stator winding short-circuit to earth.
Illuminated at stand-still, dims at cut-in speed (1,500 rev/min) and remains dim, but may be extinguished at very high speeds.	Normal	Excessive	Very low at 6,000 rev/min. Approximately: 7A (all models).	'Field' diode short-circuit.

model 14TR regulator does not incorporate a green lead (the 'F' terminal being via the regulator case), in which case connect the regulator case to alternator frame.

Run the alternator in the test rig at a slowly-increasing speed. **At the cutting-in speeds indicated in Fig. 13, the warning light should be extinguished.**

If the warning light is not extinguished, the suppression capacitor and/or surge protection device (when fitted) should be proved by repeating the test with each of these items disconnected in turn.

If the result is still unsatisfactory, the alternator is faulty and must be dismantled for detailed inspection to determine and rectify the fault. (Proceed to 4(c) 'Dismantling, Inspection and Electrical Testing of Components').

Providing the first half of the test is satisfactory (warning light extinguished), increase alternator speed to 6,000 rev/min and adjust the variable load resistor until the voltmeter registers 13·6V. **The ammeter should register the maximum rated output of the alternator.** (Refer 3. TECHNICAL DATA).

If this second half of the test is unsatisfactory, the suppression capacitor and/or surge protection device (when fitted) should be proved by repeating the test with each of these items disconnected in turn.

If the result is still unsatisfactory, the alternator is faulty and it must be dismantled for detailed inspection to determine and rectify the fault. (Refer 4(c) 'Dismantling, Inspection and Electrical Testing of Components').

Note: Failure of one or more of the diodes will be indicated by the effect on alternator output, and in some instances by abnormally high alternator temperature and noise level. The fault symptom table shows how diode failure will influence alternator output test results, and para. c (iii) gives information on testing the diodes.

(ii) Regulator Test (in situ)

Note: This test assumes the alternator output test (para. i) has previously been carried out and found to be satisfactory.

Remove the variable load resistor from the battery terminals and also the test link connecting the regulator 'F' terminal connection to alternator frame.

Run the alternator at 6,000 rev/min, until the ammeter registers less than 10A. **If the voltmeter registers 13·6–14·4V,** the regulator is working normally. If the voltmeter reading is outside the limits specified, the regulator must be renewed.

(c) Dismantling, Inspection and Electrical Testing of Components

(i) Preliminary dismantling

The following information covers minimum dismantling of the alternator to enable the brushgear and slip-rings to be inspected, and the rotor and stator-windings and rectifier diodes to be electrically tested. If inspection and testing determines the need to extend dismantling in order to renew a faulty part, refer (c) iv 'Further Dismantling'.

Remove the moulded slip-ring end cover (if not already removed).

Note the arrangement of the stator winding connections to the rectifier diode connecting pins, and then using a thermal shunt (see Fig. 20) and a light-weight soldering iron (e.g. 25-watt) unsolder the connections to the rectifier.

Refer to Figs. 8a to e and identify the arrangement of the cable connections to the rectifier plates. (This ensures correct refitting of the rectifier cables during reassembly). These cables can now be disconnected from the rectifier.

Remove the three hexagon-headed screws, securing the brushbox moulding and regulator to the end-face of the slip-ring end bracket. The brushgear-and-regulator sub-assembly can now be detached from the rest of the alternator.

Slacken the rectifier securing nut and detach the rectifier from the rest of the alternator.

The alternator is now sufficiently dismantled to allow inspection and electrical testing of components as detailed in the following paras. (ii) and (iii).

(ii) Inspection of brushgear and rotor slip-rings

Brushgear

Renew the brush-and-spring assemblies if the overall length of the brushes are worn to, or approaching, $\frac{5}{16}$" (0·3 in. or 8 mm). If the brushes are satisfactory but require cleaning, use a petrol-moistened cloth.

Check the brush spring pressure. With the brush-and-spring assemblies fitted in the brushbox moulding, apply a push-type spring gauge to the end-face of each brush in turn until the end-face of the brush is flush with the moulding. The spring pressure should then be 9–13 ozf (255–368 g or 2·5–3·6 N).

Rotor slip-rings

The slip-rings should be clean and smooth. If necessary, clean the slip-rings with a petrol-moistened cloth. If the slip-rings are burnt and require refinishing, use very fine glass paper (not emery cloth, or similar abrasives) and afterwards wipe clean with a petrol-moistened cloth.

NOTE: It is essential that the refinishing glass paper is sufficiently fine to produce a highly-polished slip-ring surface, otherwise excessive brush wear will occur.

(iii) Electrical testing of components

Note: For clarity, illustrations of electrical testing show the components separated from the rest of the alternator.

Rotor field winding

Check field winding continuity and resistance simultaneously, by connecting either a battery-operated ohmmeter (see Fig. 14) or a 12V battery and moving-coil ammeter (see Fig. 15) between the slip-rings. **The ohmmeter should indicate the appropriate resistance given in 3. TECHNICAL DATA, or the ammeter should indicate a current approximate to the figure obtained by dividing the appropriate resistance of the rotor into the battery voltage (12).**

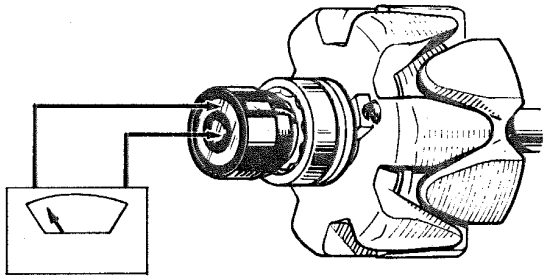


Fig. 14 Measuring rotor winding resistance with ohmmeter

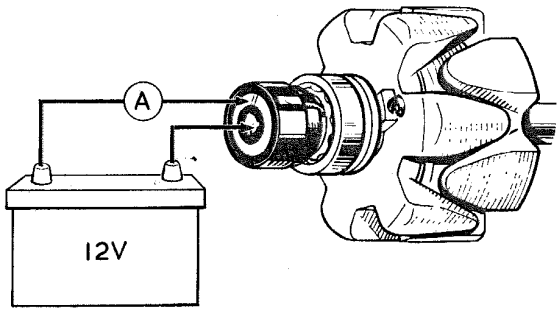


Fig. 15 Measuring rotor winding resistance with battery and ammeter

Check for satisfactory field winding insulation, by connecting a 110V a.c. 15-watt test lamp (see Fig. 16) between either of the slip-rings and the rotor body. **The lamp should not light.**

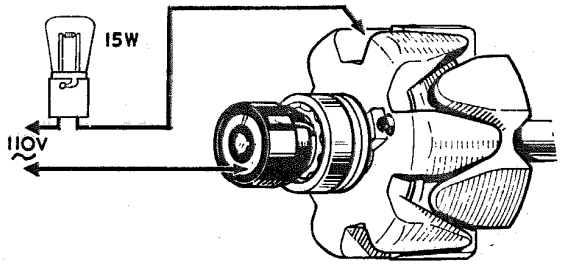


Fig. 16 Insulation test of rotor winding

Stator windings

Due to the very low resistance of the stator windings, a practical test to determine the presence of short-circuited turns cannot be carried out without the use of special instruments. However, in practice inter-winding short-circuiting is usually indicated by obvious signs of burning of the insulating varnish covering the windings. If this is the case, renew the stator assembly without the need for further testing.

Check continuity of stator windings, by first connecting any two of the three stator winding connecting cables in series with a 12V battery-operated test lamp, of not less than 36-watts (see Fig. 17). **The test lamp should light.** If not, renew the stator assembly. Providing the first part of the test is satisfactory, transfer one of the test lamp leads to the other (third) cable. **Again the test lamp should light.** If so, proceed to insulation test.

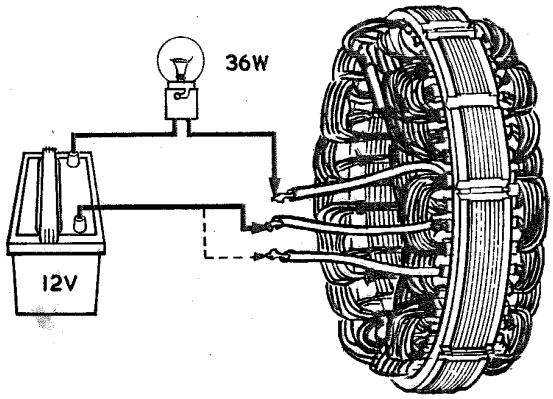


Fig. 17 Stator winding continuity test

Check insulation of stator windings, by connecting a 110V a.c. 15-watt test lamp between the stator laminations and any one of the three connecting cables (see Fig. 18). **The lamp should not light.**

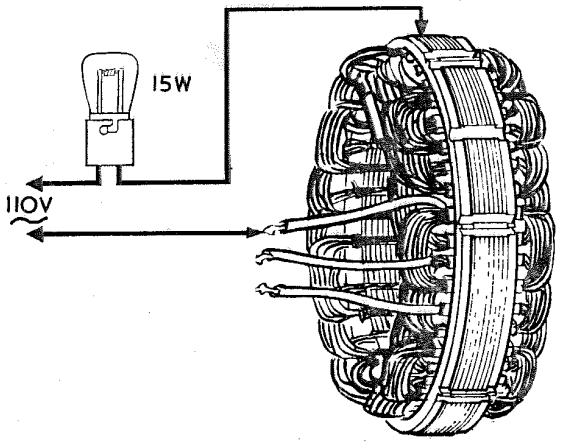


Fig. 18 Stator winding insulation test

Rectifier diodes

Test each of the nine diodes separately, as follows.

Connect a 12V battery and a 1·5-watt bulb in series with one of the diodes, one test lead being applied to the diode connecting pin and the other to the particular heat sink plate in which the diode undergoing test is soldered (see Fig. 19). Note whether lamp lights, then reverse the test lead connections. **The lamp should light during one half of the test only.** If any one diode test is unsatisfactory, renew the rectifier assembly.

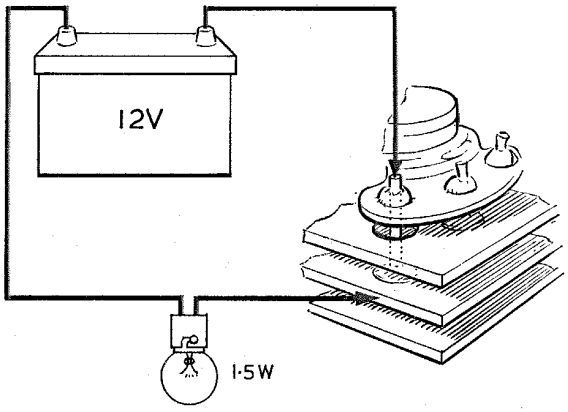


Fig. 19 Simple test for diodes

Note: During reassembly of the alternator, use only 'M' grade 45–55 resin-cored solder to attach the stator cables to the diode connecting pins. Carry out the operation as quickly as possible, using a thermal shunt to avoid damaging the diode(s). (Long-nosed pliers are suitable as a thermal shunt, see Fig. 20).

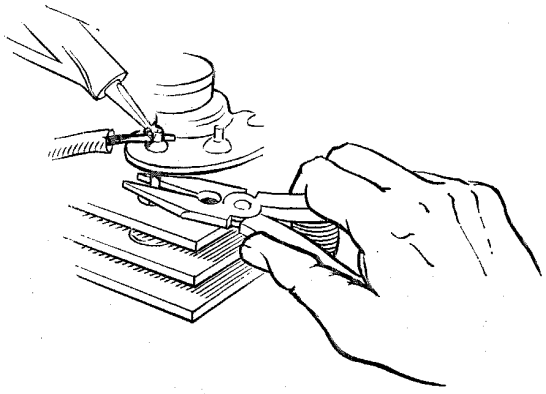


Fig. 20 Use of thermal shunt when soldering diode connections

Regulator

Individual testing of the regulator can only be carried out with special test equipment and unless this is available the regulator must be proved by substitution.

Surge protection device (avalanche diode) and suppression capacitor, (when fitted)

Both these components should be proved by disconnecting them in turn during bench testing. If the alternator then performs satisfactorily, the component should be renewed.

(iv) Further dismantling

In reference to preliminary dismantling para. (i), if it is necessary to extend dismantling to enable the bearings or other faulty parts to be renewed, proceed as follows:

Remove the three through bolts.

Grip both ends of the alternator in the hands, pull apart the end brackets from the stator laminations and separate the alternator into three major parts.

Slip-ring end bracket
Stator laminations-and-windings
Sub-assembly comprising:

Fan and pulley
Drive-end bracket and bearing
Rotor complete with slip-ring end bearing

If difficulty is experienced in separating the above parts, suspend the alternator gripped by the pulley in one hand and apply a series of light blows with a hide, plastic, or wooden mallet in turn to the shoulders of the through bolt housings of the slip-ring end bracket.

Separate the rotor assembly from the drive-end bracket. First remove the driving pulley, fan and shaft key, then press the rotor shaft from the bearing in the bracket. Alternatively, use the open jaws of a vice to support the bracket and carefully drive the rotor shaft from the bearing by a series of light blows applied to the end of the shaft with a hide, plastic, or wooden mallet. (Open the jaws of the vice sufficient only to clear the rotor poles, position the bracket offset to the centre of the top of the vice to avoid the slip-ring moulding fouling the bottom of the vice, and temporarily fit the shaft nut flush with the end of the shaft to avoid damage to the shaft threads by the mallet).

If it is necessary to renew either the slip-ring moulding assembly or slip-ring end bearing, the slip-ring moulding assembly can be withdrawn from the keyway in the rotor shaft after the field winding connections have been unsoldered. (Use a light-weight soldering iron, e.g. 25-watt, and for re-soldering the connections use only resin-cored solder).

Bearings

Check whether the bearings need renewing. Determine this by first inspecting the rotor and stator poles for signs of rubbing. If so, excessively worn bearings are indicated and both should be renewed. If there is no visible evidence of worn bearings, check whether the bearings are worn to the extent of allowing perceptible side movement of the rotor shaft and if so the bearing(s) should be renewed.

Renewing the bearings

After removing the slip-ring moulding from the rotor shaft (refer para. prior to the heading 'Bearings'), the slip-ring end bearing can be removed from the rotor shaft and then either renewed or if otherwise satisfactory re-packed with grease lubricant (refer 'Lubrication of bearings'). Position the two halves of the support plate of a hand-operated power press beneath the shoulder of the nylon distance-piece and press the rotor shaft from the bearing. Alternatively, use a suitably-sized claw-type bearing extractor tool (position claws behind the shoulder of the nylon distance-piece) and pull the bearing from the shaft. NOTE: **When refitting the bearing, ensure the shielded side of the bearing faces the slip-ring moulding.**

After removing the bearing retaining circlip and plate, the drive-end bearing can either be pressed or carefully tapped from the bracket with a suitably-sized mandrel inserted in the outer-face aperture of the bearing housing. NOTE: **When refitting the bearing, ensure correct sequence of assembly of sundry parts associated with the bearing.** (See Figs. 8a to e, Alternator dismantled).

Lubrication of bearings

During major overhaul of the alternator, providing the bearings have been checked and found not to be excessively worn, 'standard-type' bearings (see Fig. 12a) can be serviced by re-packing with Shell Alvania 'RA' grease lubricant, or equivalent.

To re-pack the slip-ring end bearing with grease it will be necessary to gain access to the unshielded (open) side of the bearing, by removing first the slip-ring moulding and then the bearing from the rotor shaft (slip-ring moulding removal is dealt with in the paragraph prior to the heading 'Bearings' and bearing removal is dealt with under the heading 'Renewing the bearings').

Note: Heavy-duty alternators are fitted with fully-sealed bearings (see Fig. 12b). This type of bearing cannot be serviced by re-packing with grease but providing the bearing is not worn to the extent of allowing perceptible side movement of the rotor shaft, and providing also the bearing rotates smoothly, it should be allowed to continue in use, (except when the alternator has been dismantled for the purpose of fully-reconditioning it for a further period of long service, in which case it is then advisable to renew the bearings).

A fully-sealed bearing should not be confused with a 'standard-type' shielded bearing fitted to the slip-ring end of alternators of standard specification. A standard-type shielded bearing incorporates a metal shield in one side of the bearing only (facing slip-ring moulding), whereas a fully-sealed bearing incorporates a plastic shield in both sides of the bearing.

(d) Reassembly

Reassembly of the alternator is simply a reversal of the dismantling procedure.

However, it should be noted that the sub-assembly comprising rotor and drive-end bracket, stator assembly and slip-ring end bracket (secured by three through bolts) can be incorrectly assembled in two of three alternative ways which causes mis-alignment of the alternator fixing lugs of each end bracket.

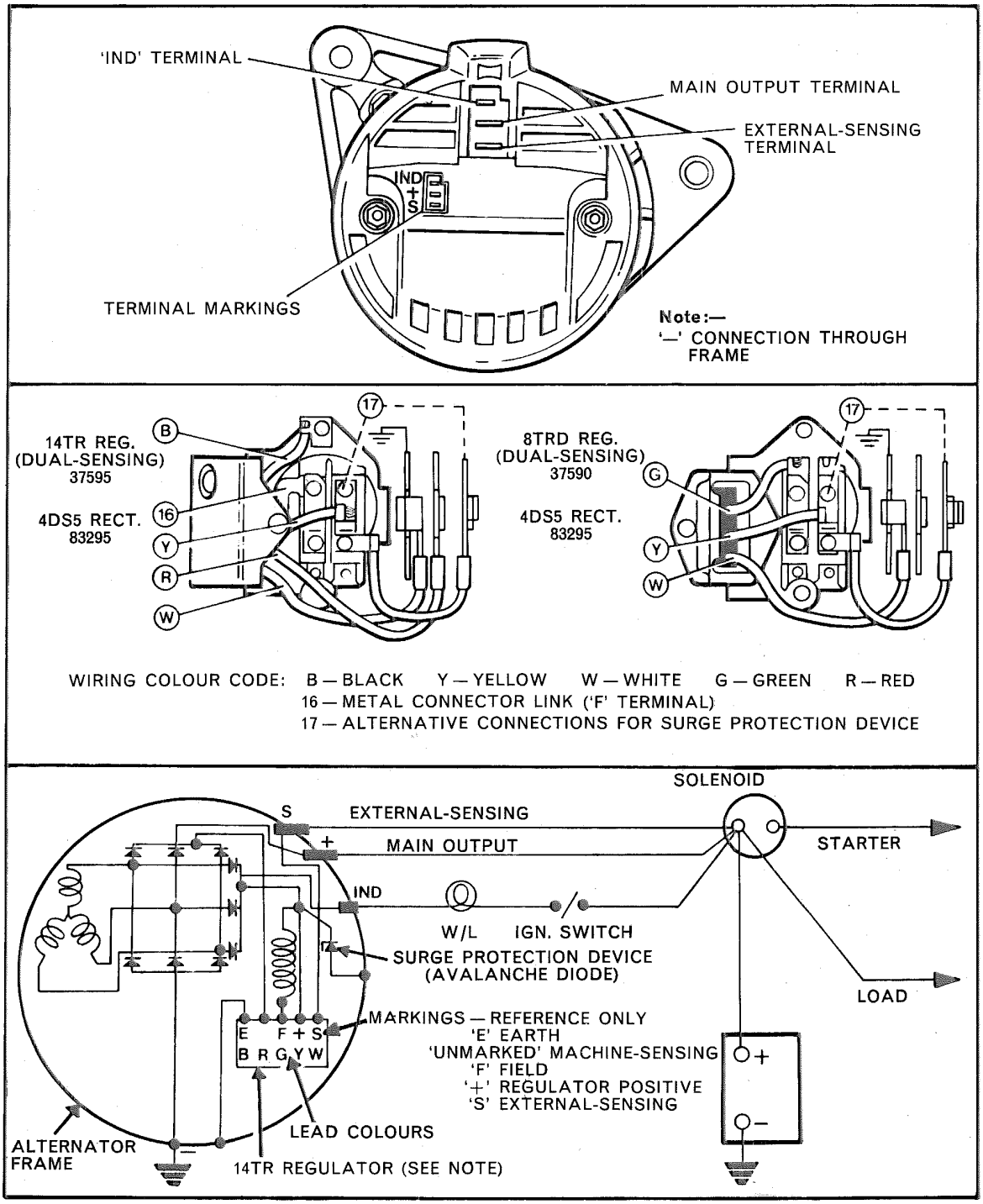
Assuming the rotor assembly to be already fitted in the drive-end bracket, mis-alignment of the end brackets previously referred to can be avoided by first fitting the stator assembly correctly in the drive-end bracket. (In preference to first fitting the stator assembly in the slip-ring end bracket).

Fit the stator assembly in the drive-end bracket so that the stator connecting leads are positioned between and in line with the alternator fixing lugs, then assemble the slip-ring end bracket to the stator laminations and finally secure into a sub-assembly by fitting the through bolts.

Avoid overtightening the through bolts, the maximum tightening torque is 55 lbf in (6·215 Nm).

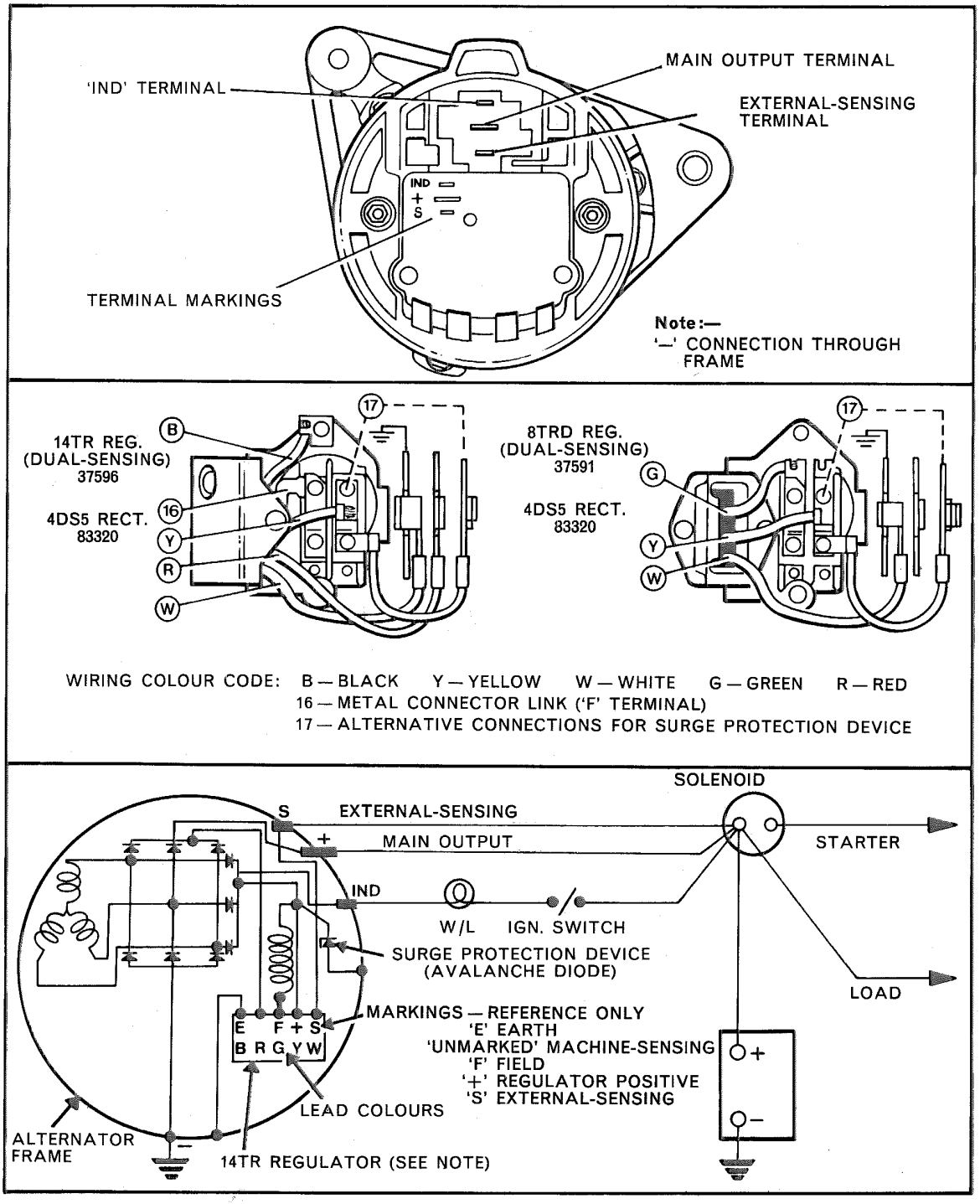
ALTERNATOR MODELS 16ACR & 17ACR, EXTERNAL-SENSED, AND B.S.E. TERMINATIONS

(INCORPORATING DUAL-SENSING 'FAIL-SAFE' FEATURE)



Note: If an 8TRD regulator is fitted:— earth lead 'E' will be a connection via the regulator case, machine-sensing lead 'unmarked' will not apply (its function being catered for in the regulator design), and field connector link 'F' will be a green lead.

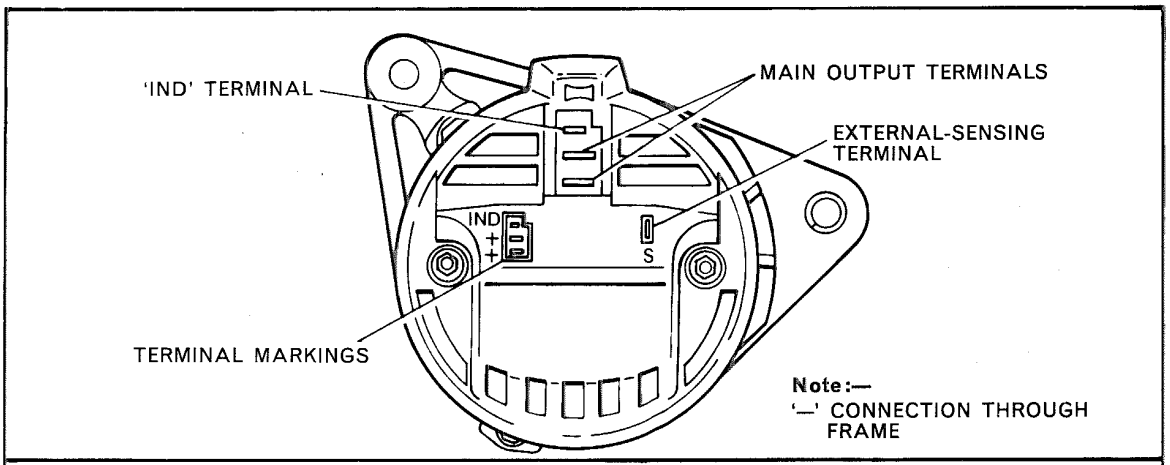
ALTERNATOR MODEL 18ACR, EXTERNAL-SENSED, AND B.S.H. TERMINATIONS
(INCORPORATING DUAL-SENSING 'FAIL-SAFE' FEATURE)

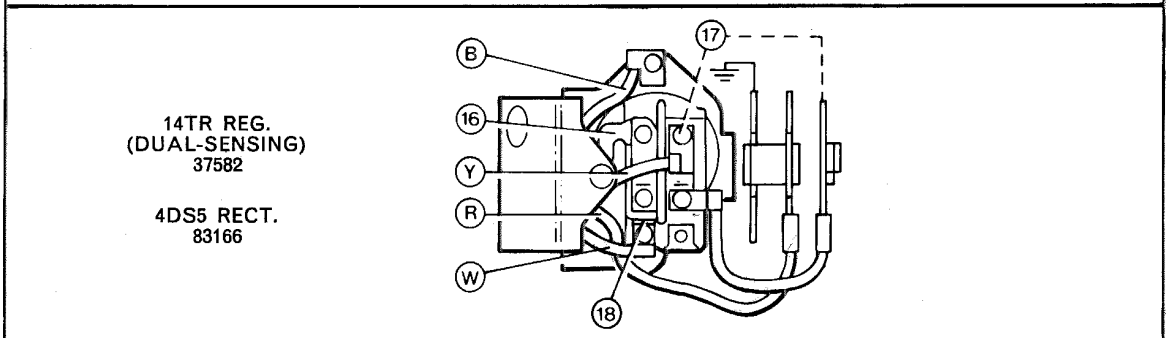


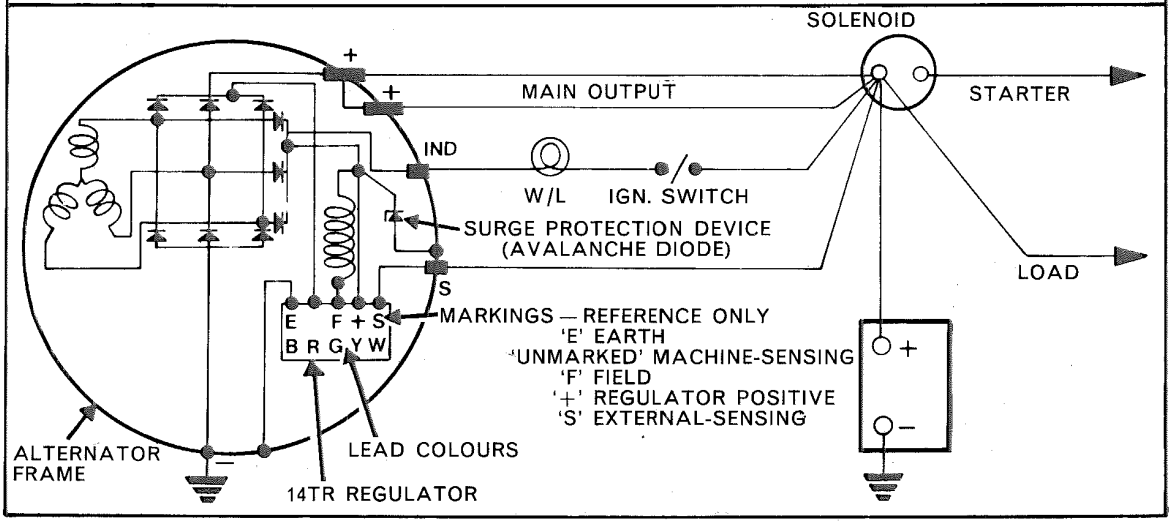
Note: If an 8TRD regulator is fitted:— earth lead 'E' will be a connection via the regulator case, machine-sensing lead 'unmarked' will not apply (its function being catered for in the regulator design), and field connector link 'F' will be a green lead.

ALTERNATOR MODEL 18ACR, EXTERNAL-SENSED, EUROPEAN TERMINATIONS AND ADDITIONAL 'S' TERMINAL

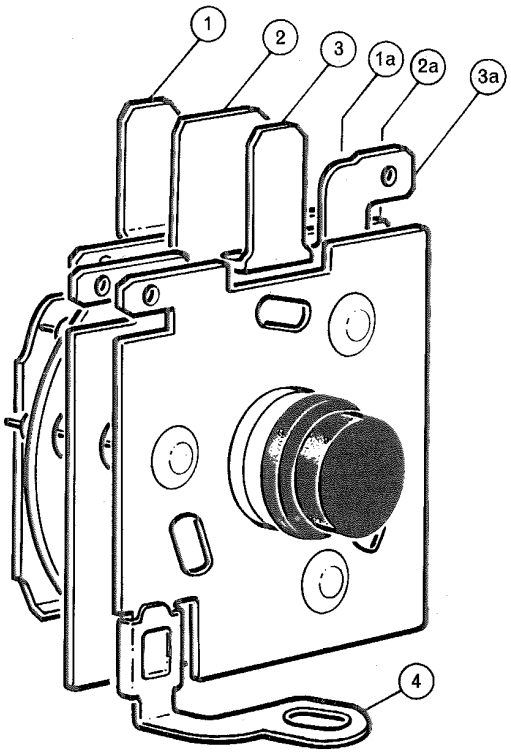
(INCORPORATING DUAL-SENSING 'FAIL-SAFE' FEATURE)



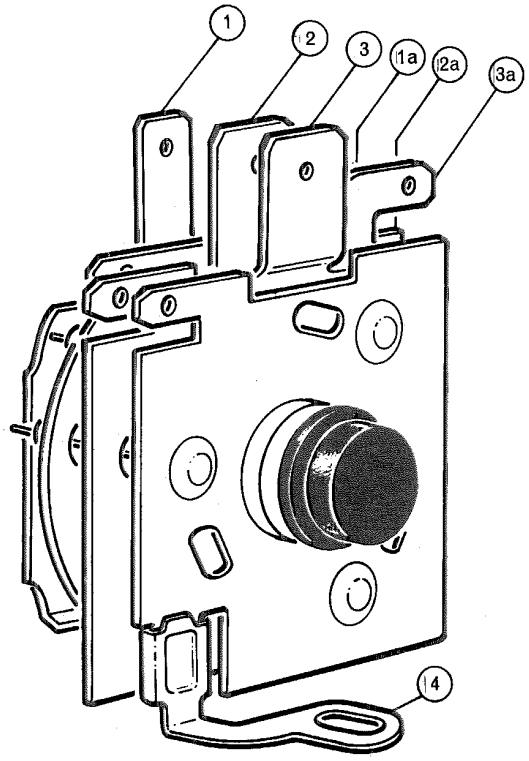




MODEL 4DS5 RECTIFIERS
(ALTERNATOR MODELS 16ACR, 17ACR & 18ACR, EXTERNAL-SENSED)



PT. No. 83320
(B.S.H. TERMINATIONS)
18ACR



PT. No. 83295
(B.S.E. TERMINATIONS)
16ACR & 17ACR

Note: PT. No. 83166 (EUROPEAN TERMINATIONS), AS FIG. 10, PAGE 7, MAIN ISSUE. APPLICABLE TO 18ACR WITH ADDITIONAL 'S' TERMINAL.

1. Field Terminal 'IND'

(a) Associated rectifier plate take-off terminal (internal connections to brushbox and regulator '+', via orange and yellow leads, respectively).

2. Main Output Terminal '+'

(a) Associated rectifier plate take-off terminal (internal connection for positive plate machine-sensing, regulator 'unmarked connection' red lead). Reference dual-sensing 'fail-safe' feature.

3. External-Sensing Terminal 'S'

(a) Associated rectifier plate take-off terminal (internal connection for external-sensing, regulator 'S' connection white lead).

4. Rectifier Earth Connection