On Receipt of AP 113D-0729-1
Destroy this Chap

Chapter 3

VOLTAGE REGULATOR, TYPE 32

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Voltage regulator, Type 32	*Stores Ref. 5UC/2899*
Carbon pile (42 mm.)	*Stores Ref. 5UC/3841*
Diverter resistor (20 ohms)	*Stores Ref. 5UC/3871*
Temperature compensating resistor	*Stores Ref. 5UC/3870*
Trimmer resistor (5 ohms)	*Stores Ref. 5UC/5082*
Regulator resistance (pile, with diverter and series resistors)	*1·5 to 12 ohms*
Shunt coil current	*0·75 amp.*
Shunt coil resistance	*10·5 ohms at 20 deg. C.*
Series coil turns and current	*1·3 turns, 40 amp.*

Introduction

1. This regulator is designed as a master regulator to maintain the bus-bar voltage, i.e., the general services supply, approximately constant at 28 volts, with Type P2 and P3 generators operated in parallel on multi-engined aircraft.

2. Each generator is controlled by its own regulator, Type 23, this regulator is described in Chapter 2. It will be noted that the Type 23 regulator is decompounded to give a falling volts/load characteristic of 27 per cent from no load to full load. The embodiment of such a steep falling volts/load characteristic ensures stable parallel operation. With a difference of setting of one volt on the individual regulators, the out-of-balance current will not exceed 25 amperes.

3. The variation in line voltage from no load to full load is, however, too wide for use on aircraft without some means of correction. The master regulator has been introduced for this purpose and operates in conjunction with the Type 23 regulators in the following manner.

Principle of operation

4. The carbon pile element of the master regulator is connected in series with the operating volt coils of the main regulator, Type 23. This operating coil is connected across the bus-bars, i.e., common supply

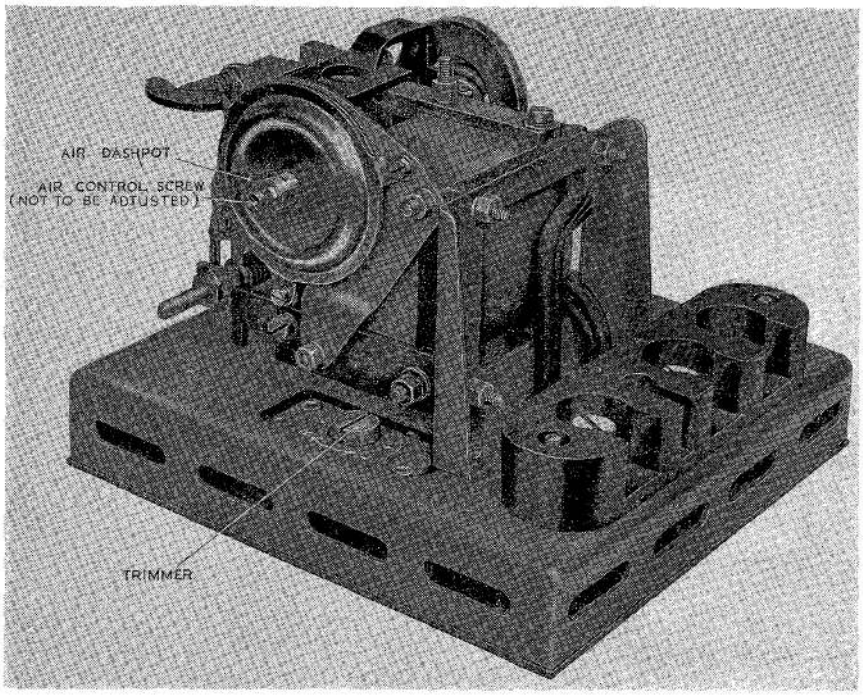

Fig. 1. Voltage regulator, Type 32

(*fig.* 5). It will be appreciated from this and the following paragraphs that the operation of this regulator is the reverse from normal. With the coil unexcited, the carbon discs of the pile are held in a state of decompression by the action of the spring, and pile resistance is therefore at a maximum. When the coil is energized, the pull of the magnet counteracts the tension of the spring, the pile is compressed, and its resistance is reduced.

5. The carbon pile of the master regulator is rated at 37 to 40 watts, and in conjunction with a diverter resistance is connected in series with the operating coils of the various subsidiary regulators, and regulates the coil current in these regulators according to the line voltage.

6. The regulator consists essentially of a carbon pile, the resistance of which is controlled by a magnet system sensitive to the line voltage of the aircraft. The state of compression of the carbon pile, and therefore its resistance, is determined by a magnet system which works in opposition to a spring.

7. Under normal conditions, when no current is flowing, the carbon pile, which consists of forty-two 1-mm. washers, is held in a state of decompression, i.e., maximum resistance. When voltage is applied to the operating coil the magnet armature is attracted against the pull of the spring, thus compressing the carbon pile and decreasing its resistance. When the voltage across the shunt coil reaches the correct figure at which the regulator has been pre-set, i.e., when the pile forces are in balance with the magnet force at all positions, the system is astatic and will consequently automatically set itself to whatever pile resistance is required to produce the correct voltage.

8. Any increase in line voltage above a predetermined level will result in increased excitation of the voltage coil of the master regulator, increased pile compression, and a corresponding decrease of resistance. This results in increased excitation of the voltage coils of the four Type 23 regulators, decompression of the piles, together with an increase of resistance in the generator field circuits which reduces the line voltage to the required level. As the master regulator coil is connected across the aircraft bus-bars, the magnet will respond to any fluctuation in the line voltage with a consequential compression or decompression of the carbon pile and the voltage is maintained at the correct level.

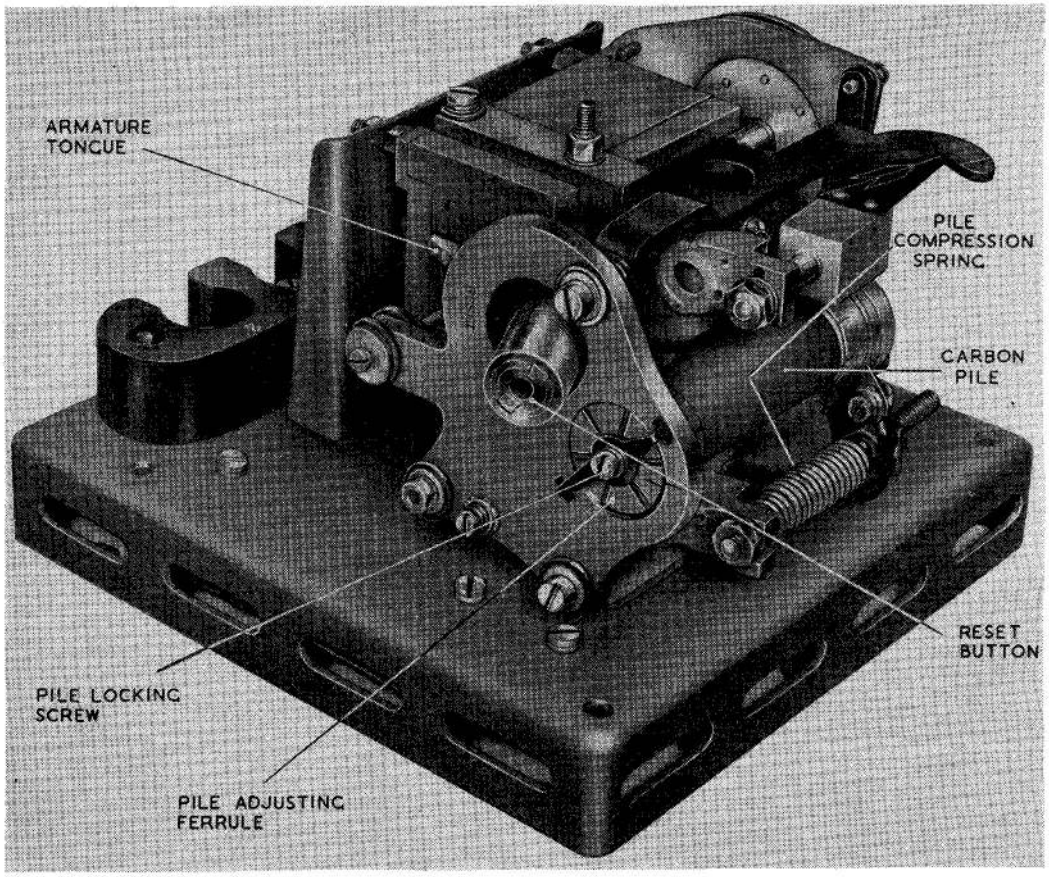

Fig. 2. Regulator, Type 32, showing carbon pile

DESCRIPTION

9. The magnet system of the regulator, which is illustrated in fig. 1 and 2, has two slots into which two armature tongues are attracted; these tongues are mounted on a Y-shaped clapper carried on cross-spring hinges, providing a frictionless bearing. The control spring is also attached to this clapper so as to decompress the pile and oppose the magnet pull. The armature is so tapered and shaped that the pull of the magnet on it at the correct voltage varies linearly with movement, so that the characteristic can be readily matched by that of the control spring; adjustment of the latter is carried out at the manufacturer's works and must not be subsequently interfered with.

10. In order to obtain temperature compensation the control spring is mounted on a bi-metal strip, which is clamped to the magnet system and deflects so as to strengthen or weaken the spring as may be required according to temperature change. Attached to the clapper is a balance weight to which is riveted a pointer or gauge; it has a white arrow scribed on it and there is a corresponding line on a fixed scale. Both are marked by the manufacturers when the regulator is set, and these two lines should register when the regulator is shut down, cold, and the press-button pushed home. This indicates that the regulator is in a correct state of adjustment.

11. An air compression diaphragm type dashpot is incorporated to ensure stability under conditions of rapid changes of load and speed. This is set by the manufacturers, and no attempt should be made to effect further adjustment. In the event of obvious

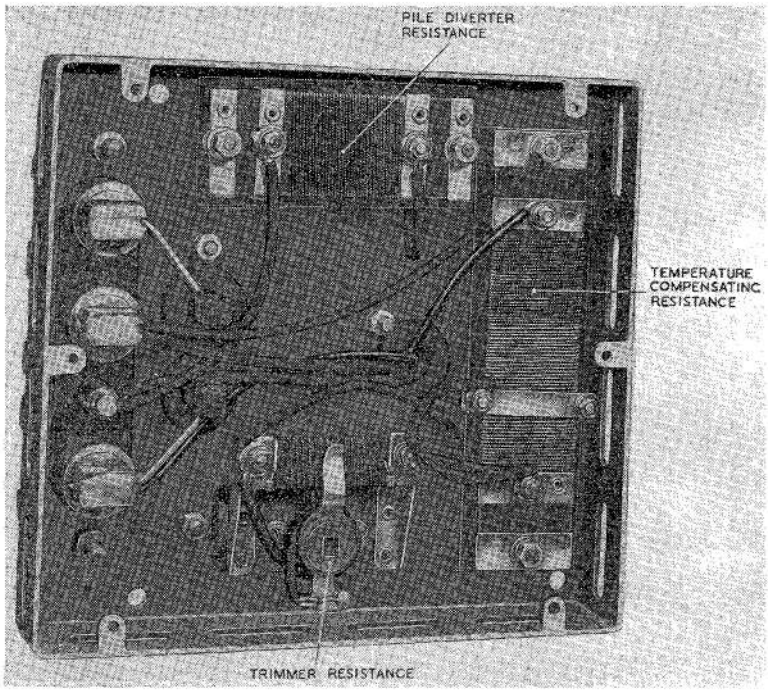

Fig. 3. View of regulator base

instability or hunting in the regulator movement, the dashpot may have sustained mechanical damage, in which event a complete new and adjusted dashpot should be substituted. A 20-ohm pile diverter resistance is connected across the pile to dissipate, in conjunction with the pile, 37–40 watts. This resistance, together with the trimmer resistance, is situated under the base as shown in fig. 3.

SERVICING

12. General servicing instructions for this type of regulator are given in A.P.4343, Vol. 1, Sect. 6, Chap. 1. That chapter describes the fitting of a new pile stack and the preliminary mechanical adjustment for a regulator which is completely out of order. When any adjustment is made, the regulator must afterwards be subjected to full test.

Checking regulation system in aircraft

Type 23 regulator

13. Each regulator, Type 23, should be checked individually in the following manner:—

(1) Place the generator switch to the OFF position.

(2) A suitable voltmeter (e.g., testmeter, Type D or equivalent) should be connected in the voltmeter socket.

(3) Run the appropriate engine to give a generator speed of approximately 4,000 r.p.m.

(4) Check the voltage, and if necessary adjust by the trimmer on the Type 23 regulator to 24 volts.

Note . . .

This must be done with engine speed increasing to give the generator speed quoted.

(5) Restore the generator switch to the ON position.

Type 32 regulator

14. The Type 32 regulator should be checked as follows:—

(1) Open the battery isolating switch.

(2) Run both engines to give a generator speed of 4,000 r.p.m.

(3) Check the line voltage, and if necessary adjust by means of the trimmer on the Type 32 regulator to 28 volts.

(4) Close the battery isolating switch.

Note . . .

These instructions relate to an aircraft with two generators. When the system on an aircraft with three or four generators is being tested, the voltage quoted in para. 13, sub-para. (4) should be 22 instead of 24.

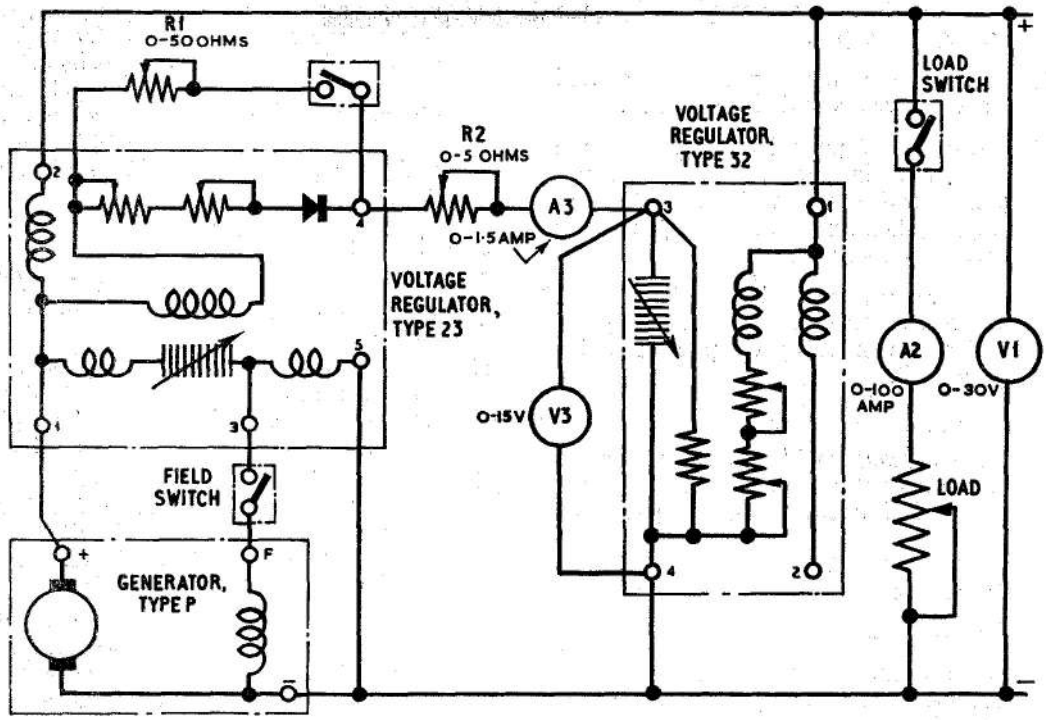

Fig. 4. Test circuit diagram

15. Experience has shown that when the regulation system on an aircraft has been adjusted in this manner, load balancing tests should not be necessary.

Setting up regulators on the bench

16. It has already been explained in the foregoing description that there is a pointer and a scale indicating the correct setting of the regulator. The carbon pile is apt to shrink slightly when in use, especially when first put into service. In order that the setting of the pile may be checked from time to time, and if necessary, re-adjusted, the magnet system is provided with a press-button and a calibrator. In order to check the setting, the regulator should be shut down, and the press-button should be pressed fully home so that the calibrated spring engages with the magnet clapper. This clapper has attached to it a pointer engaging with a scale, and if the pile is in correct adjustment the mark through the pointer will be exactly in line with the mark on the scale. If these marks are not in line, the fixed pile clapper should be re-adjusted in the manner described.

Adjustment of the pile clapper

17. With the regulator shut down and cold, the adjustments are as follows:—

(1) Push home and hold re-set button.

(2) Slacken the pile locking screw.

(3) Turn the pile adjusting ferrule until white scribe marks are in line.

(4) Re-tighten the pile locking screw.

(5) Release the re-set button.

Air dashpot

18. No attempt should be made to adjust the dashpot as this is carefully calibrated. If a dashpot is damaged it should be removed and a new one substituted. The method of renewal is as follows:—

(1) Release the ch/hd. screw and Grover washer holding dashpot plunger rod at the armature end.

(2) Release the three round nuts and Grover washers holding the dashpot to the dash-pot plate and withdraw the complete dashpot assembly.

(3) Take a new dashpot assembly from its container and place it in the same position as formerly occupied by the damaged dashpot.

(4) Replace the three round nuts and Grover washers and tighten them.

(5) Move the clapper by hand until the fixing hole in the end of the dashpot plunger rod coincides with the hole in the clapper, then fix it with the ch/hd. screw and Grover washer.

(6) The carbon pile should then be re-set in accordance with the instructions given under the heading of pile re-setting (*para.* 16).

Note . . .

Do NOT tamper with the air control screw as the air valve has been adjusted ready for use before leaving the manufacturers.

Regulation test

19. The regulation test is as follows:—

(1) Connect the regulator as shown in fig. 4, using a generator, Type P, connected to a regulator, Type 23.

◄ (2) Run the generator at a speed of 4000 r.p.m. on no load. With the trimmer resistor set in the mid position, vary the pile resistance, as indicated by V3/A3, smoothly from 10–1·5–10 ohms by means of resistor R1. Repeat the cycle and observe that the controlled voltage V1 does not vary by more than 1·0V, and is maintained within the limits of 26·5V to 28V. ►

Stability test

20. With the generator running at 6,000 r.p.m., the stability test must be made as follows:—

(1) With a pile resistance of 4·5, 6·0 and 10 ohms, switch the generator field on and off at least three times. The pile resistance is adjusted by the use of R_1.

(2) A load of 100 amp. indicated on A_2 should be switched on and off at least three times, with R_1 open-circuited and R_2 short-circuited. The pile resistance should be as sub-para. (1).

Under these conditions the regulator should show no tendency to hunt. When carrying out the test in sub-para. (1), it is important that there should be no battery connected in the test circuit.

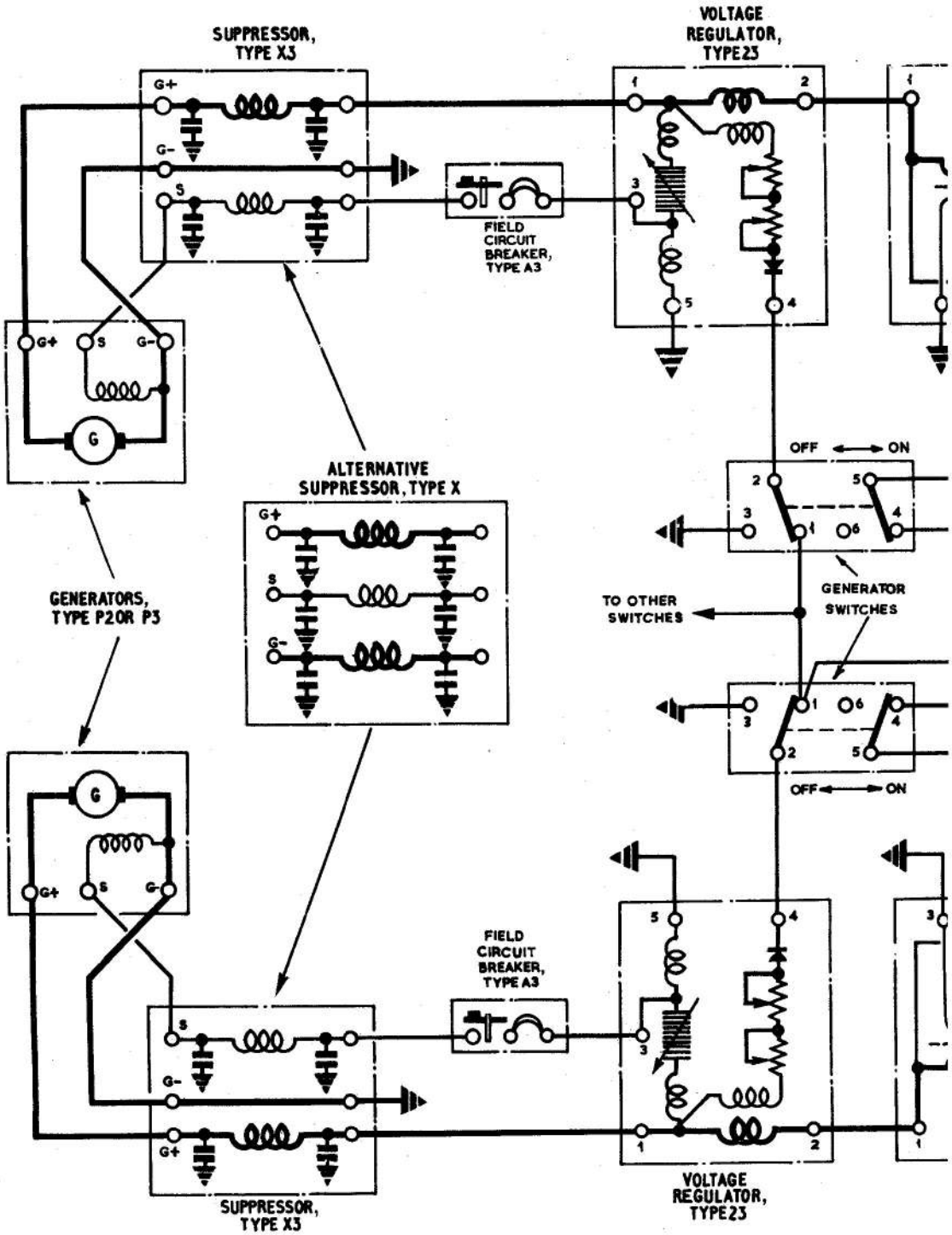

Fig. 5

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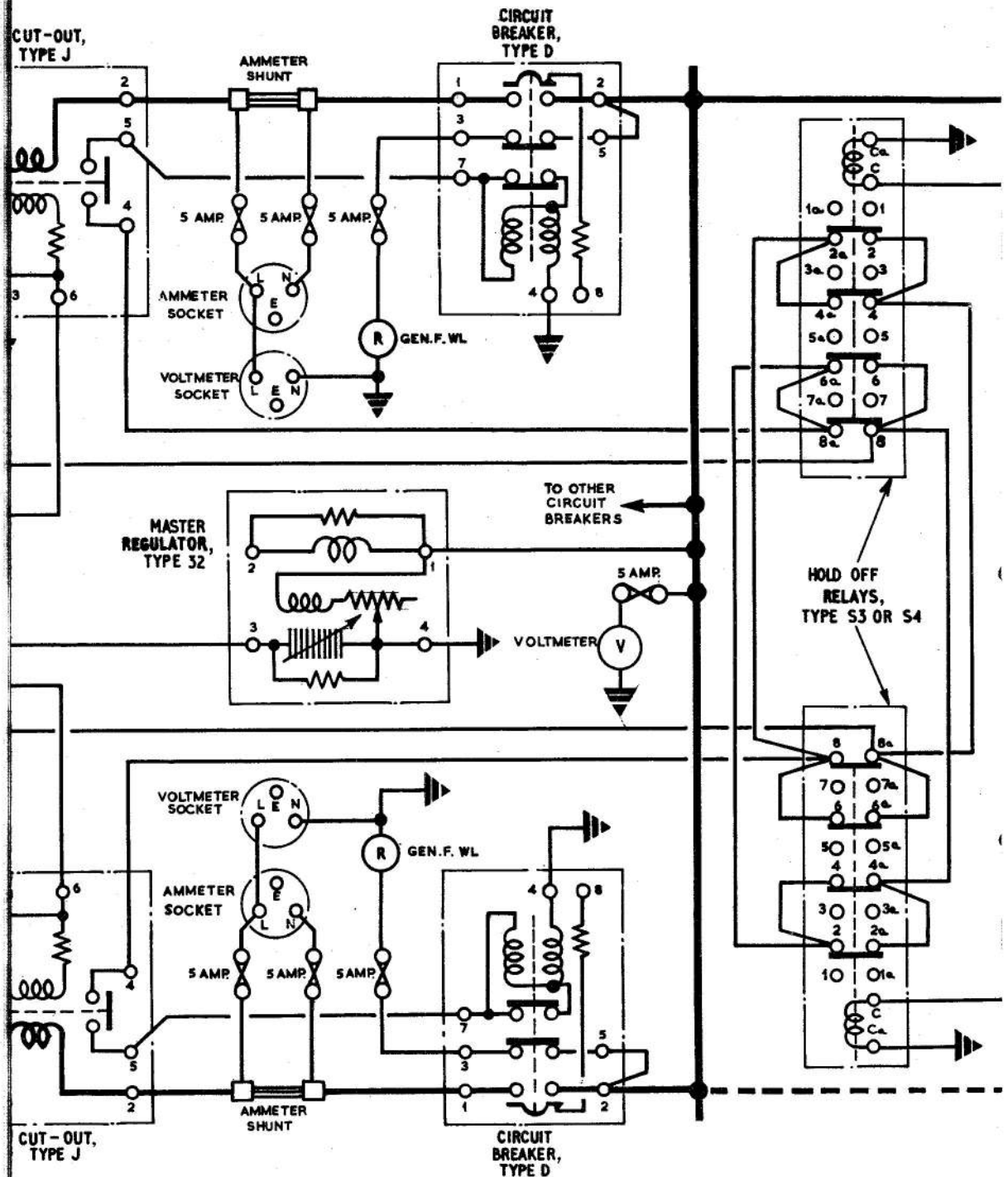

Circuit diagram of typical installation

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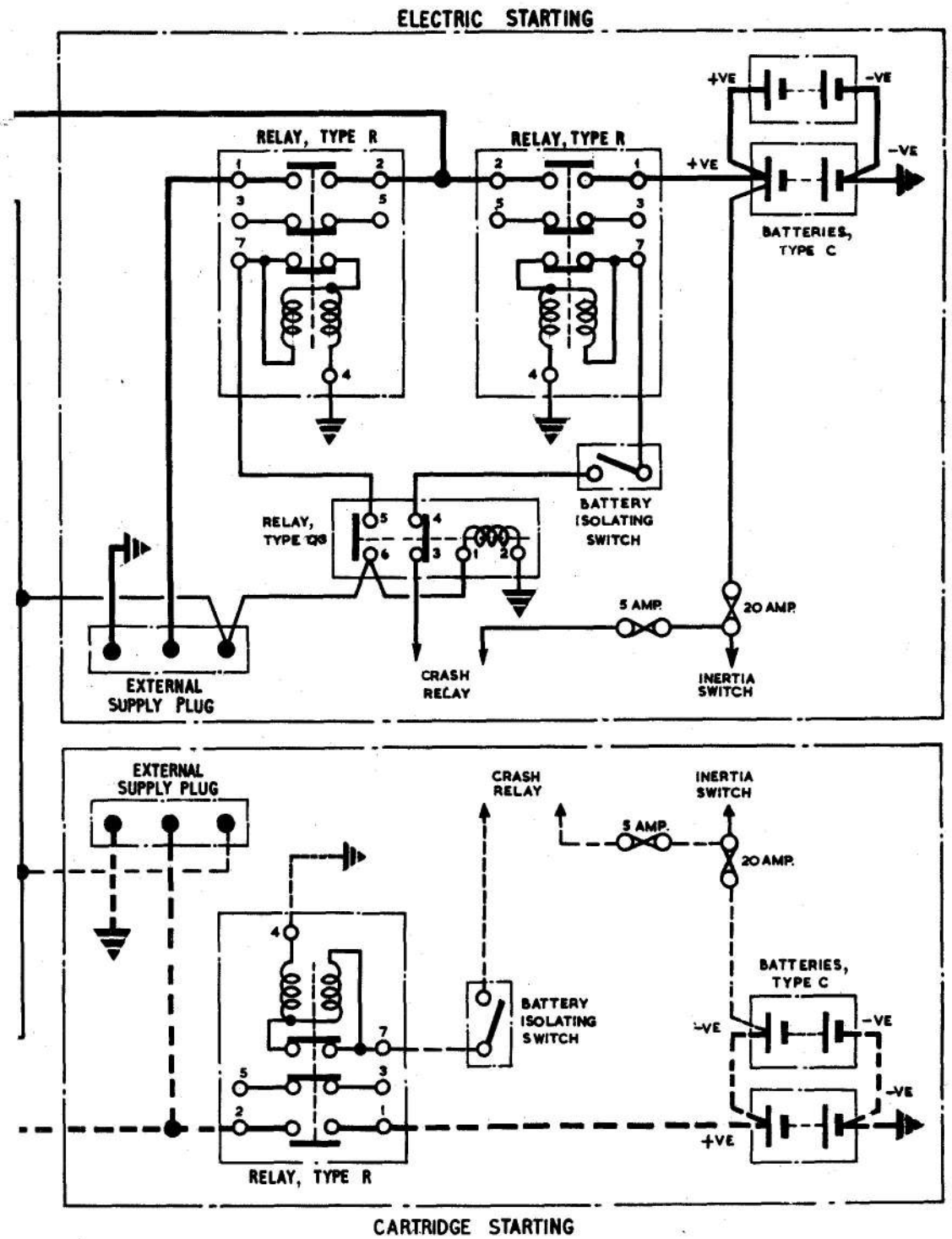

Fig. 5

(A.L. I, Aug. '57)