

UV.380 VOLTAGE REGULATOR

The frame of the Westinghouse UV.380 voltage regulator is constructed of specially treated soft iron parts to obtain good magnetic characteristics. The armature which carries the moving carbon contact is supported by a stainless steel hinge spring which is spot welded to it. The armature rocks on two stainless steel balls which are pressed into the edge of the frame top plate. The two arms of the hinge spring fit over dowel pins in the top plate in order to accurately maintain the air gap between the bottom edge of the armature and the beveled bottom plate.

Two stationary silver contacts are supported by brackets mounted on the regulator base panel in such a manner that the carbon contact may move freely between them. The moving carbon contact is supported on an insulated mount which is fastened securely to the regulator armature. Current is carried to and from the moving contact by means of an insulated flexible shunt.

The regulator coil assembly comprise of two windings, a shunt winding having about 18 ohms resistance and a series winding of approximately 0.005 ohm resistance. The shunt winding is connected in series with a resistor directly across the generator output leads. The series winding is connected in series with the lead-acid battery carried on the vehicle.

The calibration spring has a hooked end which fits over a notched knife edge on the armature assembly. The combination of the knife edge and the ball pivots insures a friction-free

movement necessary for satisfactory regulator operation. Adjustments in the regulated voltage are made by turning a knurled nut which controls the tension of the calibration spring.

Description of Operation

The operator starts the M-G set by closing the M-G control switch on the front dash of the vehicle. This causes a contactor to pick up and connect the motor end of the M-G set to trolley voltage.

The M-G set will start to rotate, and at first the generator voltage will be below the setting of the regulator. Consequently, the regulator calibrating spring will hold the moving carbon contact against the right-hand stationary contact. The generator shunt field series resistor is short-circuited and the generator field will be at maximum strength. This is illustrated in Fig. 1.

As the generator speed increases, the output voltage will rise. This rising generator voltage is applied to the shunt coil of the voltage regulator through its series resistor. The magnetic field set up in the regulator will increase in strength until it is sufficiently strong to move the regulator armature against the pull of the calibrating spring. When the armature moves the carbon contact will leave the right-hand stationary contact and the series resistor will be inserted into the generator shunt field circuit. See Fig. 2.

Insertion of resistance into the generator field circuit will cause the output voltage to drop. The magnetic strength of the

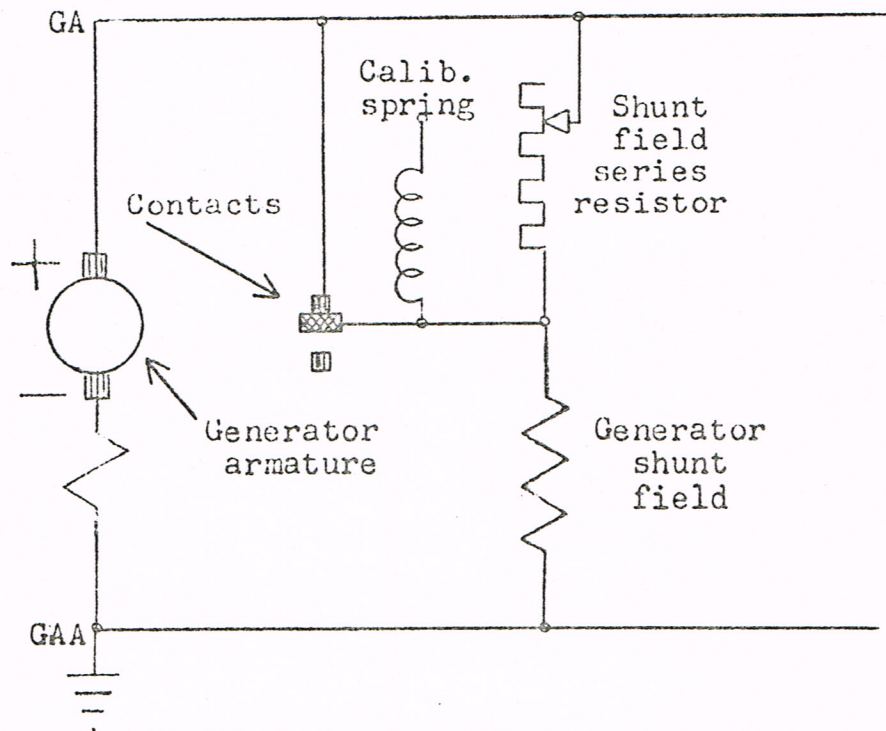


Figure 1

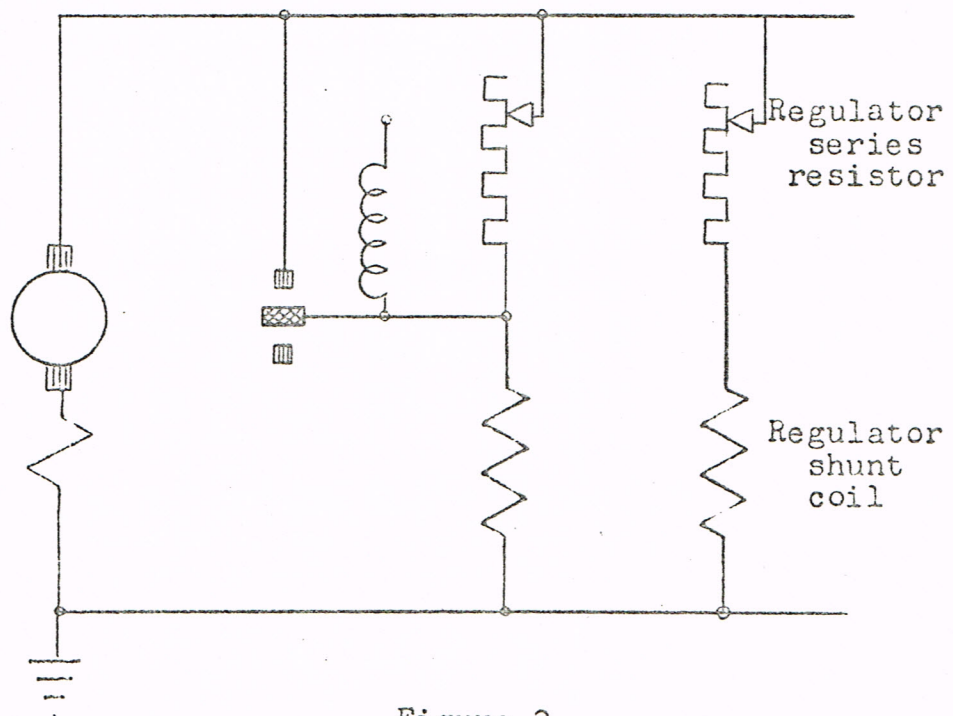


Figure 2

regulator coil will decrease and the calibration spring will pull the carbon contact against the right-hand stationary contact once more. The shunt field resistor is again short-circuited and the generator voltage will rise. The carbon contact will now move to and from the stationary contact, regulating the generator voltage to the value determined by the tension on the calibrating spring.

In the event of generator over-speed or minimum loading on the generator, the circuit described will not be sufficient to maintain the desired voltage. To provide control under these conditions, a resistor is connected between the left-hand stationary contact and GAA. As the carbon contact moves from the right-hand contact, resistance is placed in series with the generator field. Now, with this additional connection, resistance is shunted across the generator field, weakening it still more. The circuit will now be as in Fig. 3.

In actual practice, it was found that this arrangement of the regulator shunt operating coil and the associated resistors was not entirely satisfactory. Quite appreciable changes in generator voltage resulted as the moving contact oscillated or "hunted" between the two fixed contacts.

It was found that the addition of a fourth resistor would cause the moving contact to "flutter" against the stationary contacts. This may be explained by calculating the voltage at each end of the 1200 ohm resistor for the various contact positions, then

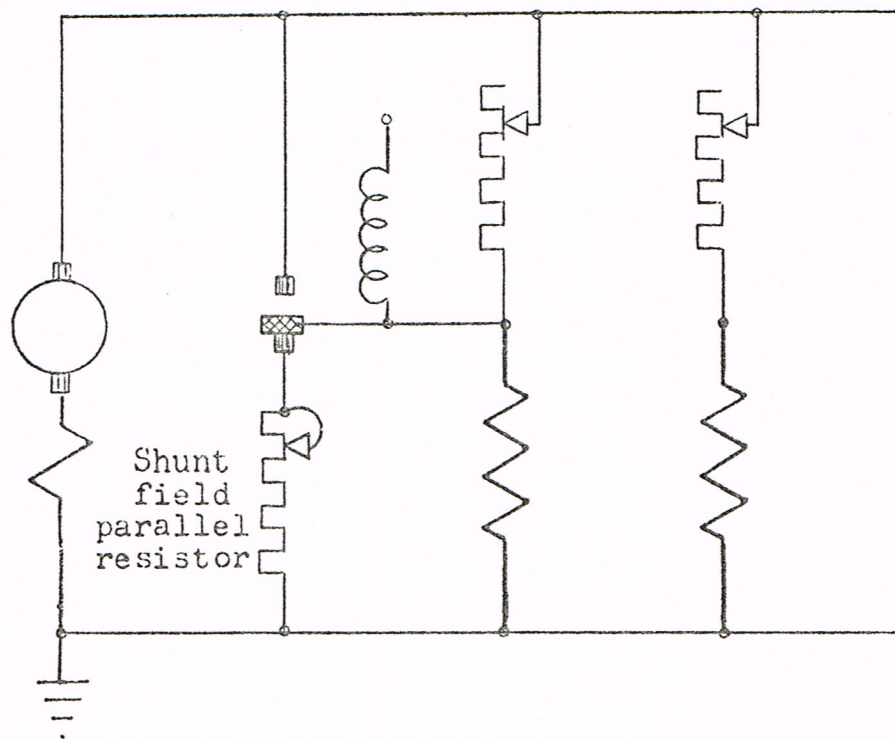


Figure 3

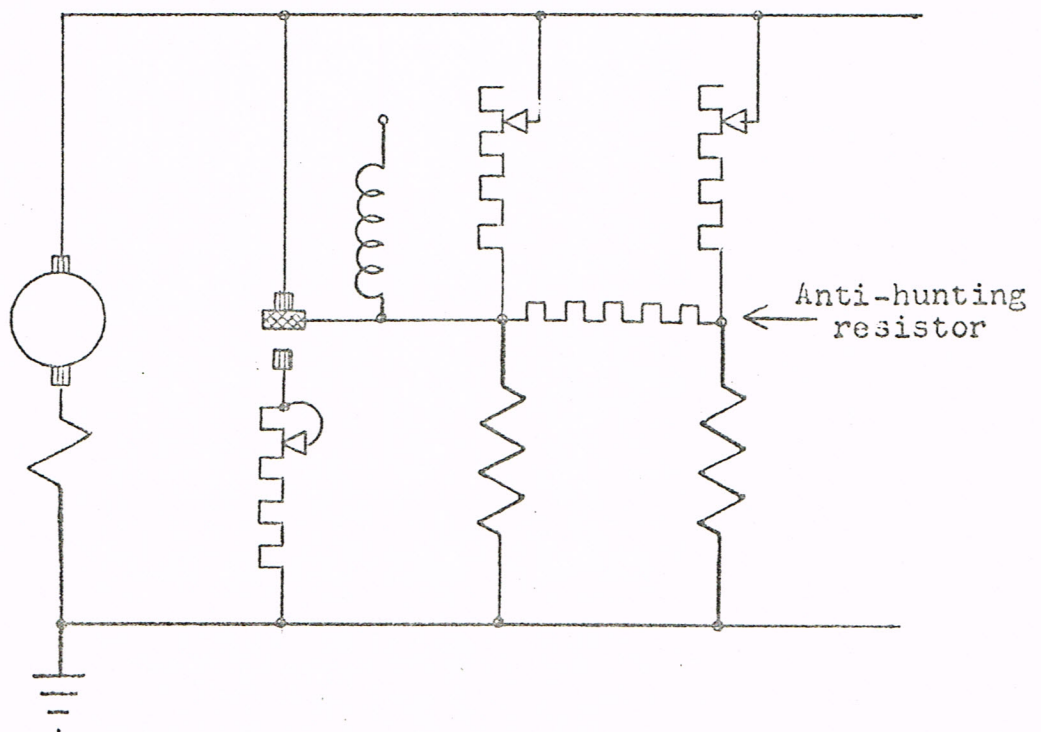


Figure 4

finding the current through it. This current will affect the magnetic strength of the operating coil. It will be seen that in each case, the change of current in the operating coil from contact made to contact broken on either side is such as to encourage the contacts to re-make.

The regulator as used on P.C.C. cars will have the moving contact vibrating lightly against one or the other of the stationary contacts. This vibration is evidenced by light sparking on the contact surface. The rate of vibration and the length of time during which the contacts touch is such that the average value of the field current is sufficient to maintain the generator voltage at the required value. Fig. 4 shows the anti-hunting resistor in circuit.

As stated previously, the regulator coil assembly has a low resistance winding which is connected in series with the car battery. This coil carries only the battery current and not any other load current.

The circuit is so arranged that the series coil "aids" the regulator shunt coil. Current to the battery will therefore tend to lower or "droop" the generator voltage. Under normal operating conditions, the battery is "floated" across the generator and the current through the series coil will be small. This causes only a slight reduction in the regulated voltage. If, for any reason, the battery becomes abnormally discharged, the increased

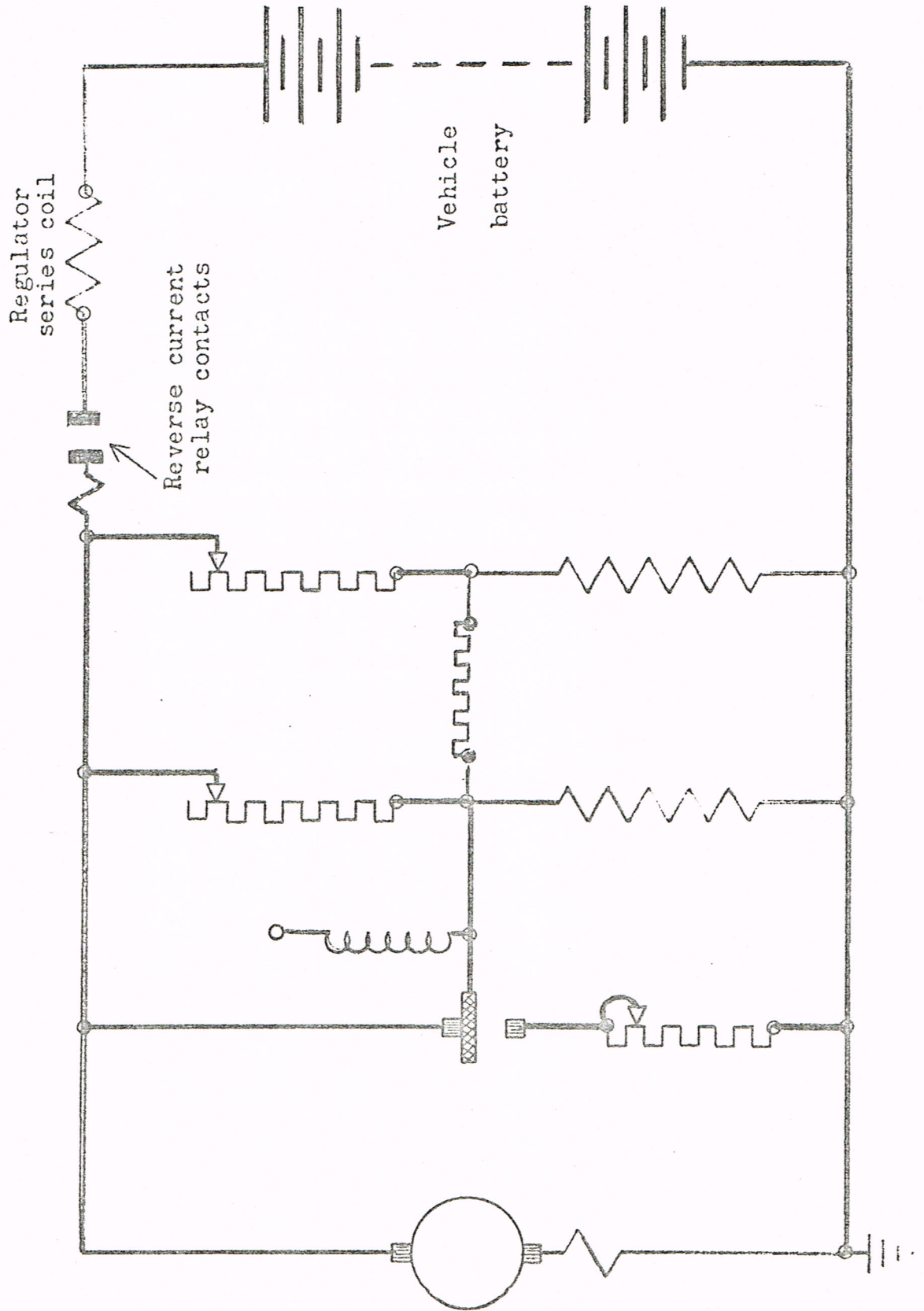


Figure 5

charging current will result in the droop coil lowering the regulated voltage enough to prevent battery damage. The regulator series coil connection is shown in Fig. 5.

Under normal operating conditions, the moving carbon contact will vibrate against the left-hand or field shunting contact. When the track brakes are applied, the heavy load will result in the carbon contact moving over and vibrating against the right-hand or field boosting contact. Unusually low trolley voltage will result in the M-G set running more slowly. Under these conditions, also, the carbon will flutter against the right-hand contact to maintain generator voltage.

The complete motor-generator and voltage regulator circuit is shown in Fig. 6.

Technical Data

Shunt field resistor..... 17 ohm resistor tapped at 15 ohms
Regulator series resistor... 78 ohm resistor tapped at 65 ohms
Shunt field parallel
resistor..... 5 ohm resistor tapped at 3 ohms
Anti-hunting resistor..... 1200 ohms (non-adjustable)
Generator shunt field..... 9 ohms
Regulator shunt coil..... 18 ohms
Regulator series coil..... 0.005 ohm

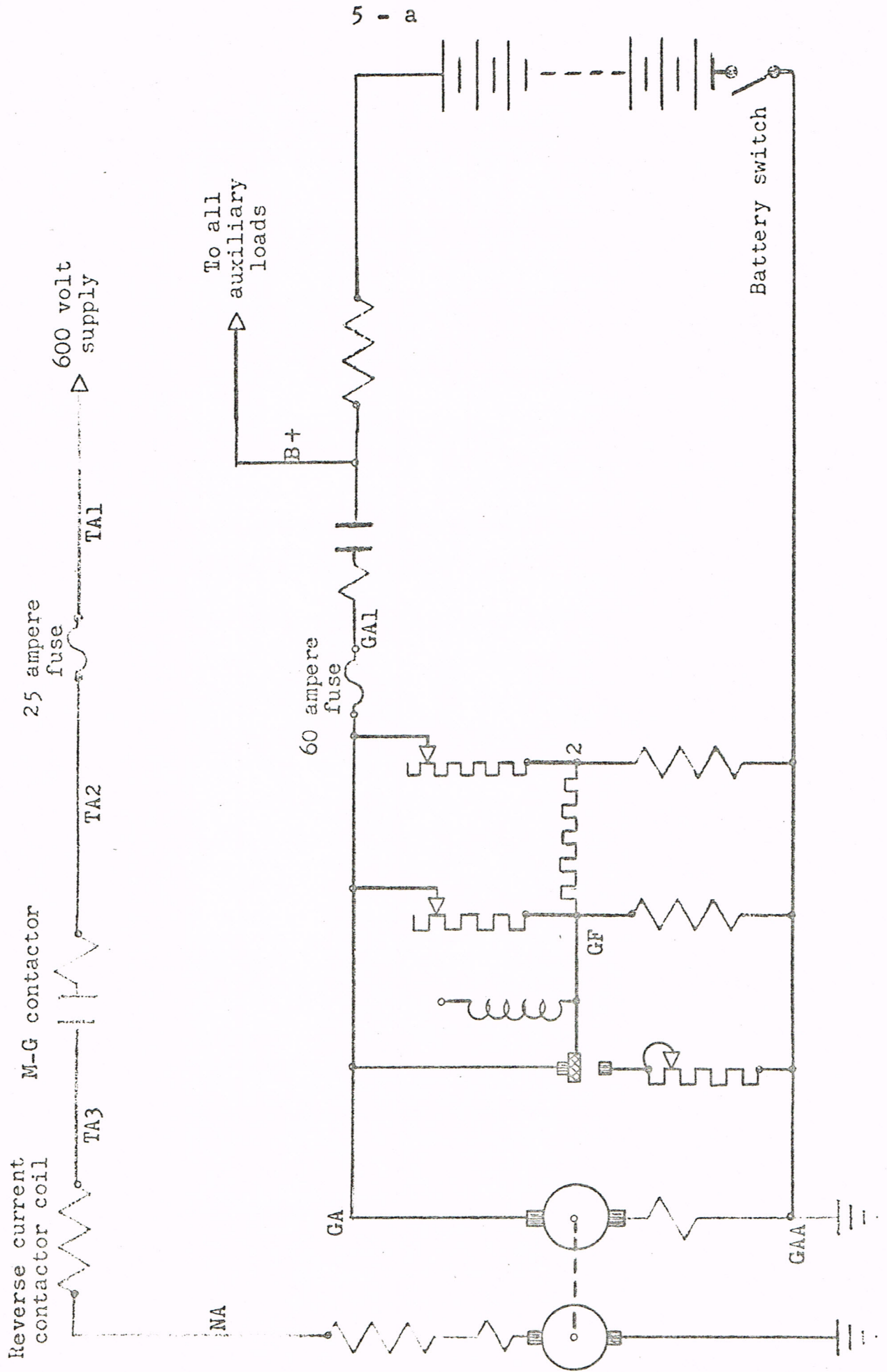


Figure 6