Service Bulletin 1S-135

Date 1-1-67

Supersedes Bulletin 1S-135 Dated 5-2-60 And Bulletin 1S-130 Dated 4-4-51

Delco-Remy

Operation and Maintenance of Low Weight Splashproof

SERIES-PARALLEL AND COMBINED SERIES-PARALLEL AND MAGNETIC SWITCHES

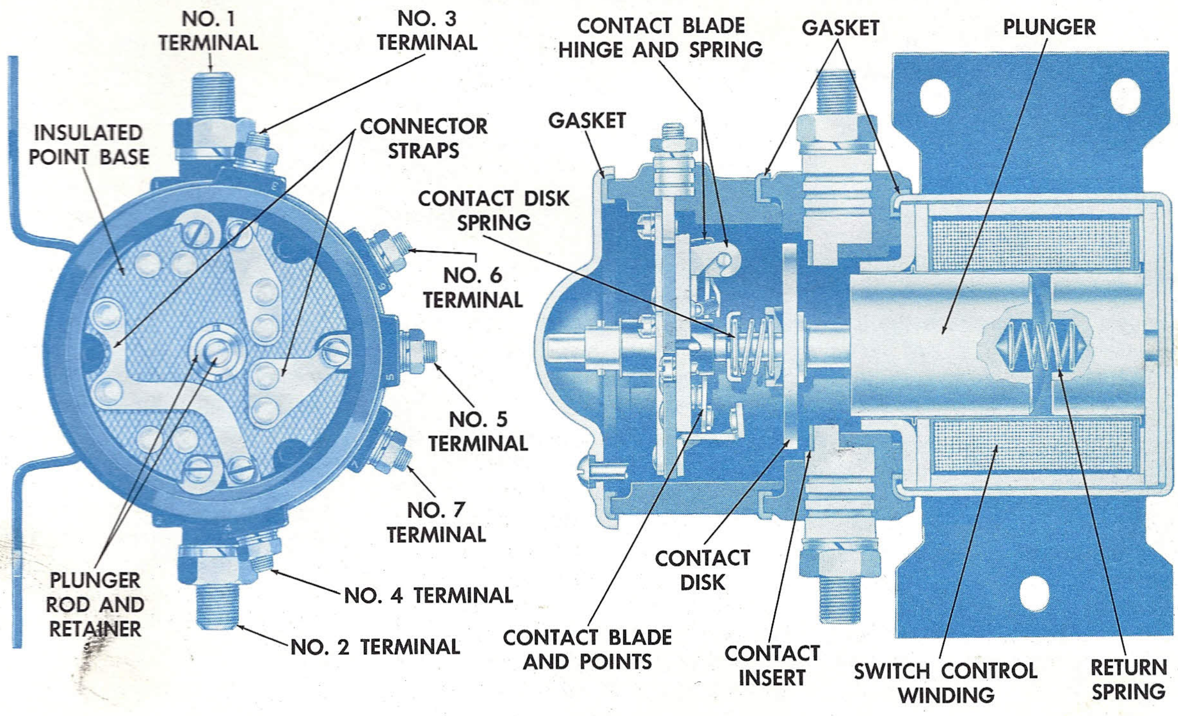

Figure 1—End and sectional view of solenoid operated series-parallel switch.

INTRODUCTION

Series-parallel switches are used in cranking circuits to connect two 12-volt batteries in series for 24-volt cranking, and in charging circuits to connect the same two batteries in parallel for 12-volt charging.

In Figure 1 is illustrated a low weight, splashproof, series-parallel switch that can be used with either a solenoid or separate magnetic switch controlled motor. In Figure 2 is shown a combined series-parallel and magnetic switch that is used with a Bendix drive or inertia drive type of motor. A third type of switch incorporating splash-proof features that can be used with either a solenoid or magnetic switch is shown in Figure 3. This switch when properly assembled should have the large contact disk located as shown by turning the shaft nut as required (Fig. 4).

OPERATING PRINCIPLES

A wiring circuit of the series-parallel system using a series-parallel switch with a solenoid operated motor during cranking is shown in Figure 5.

The series connection between the two batteries and the cranking motor is shown in solid red. The cranking motor solenoid circuit is shown in solid blue. The sequence that takes place as the switch closes is as follows: As the starting switch is closed, the solenoid coil within the series-parallel switch is energized (shown in dashed red) creating sufficient magnetic force to attract the series-parallel switch plunger. Movement of the plunger then closes the two main switch terminals and connects the two batteries in series with the cranking motor. At the same time, the cranking motor solenoid coil circuit is completed by a set of points mechanically closed by the series-parallel

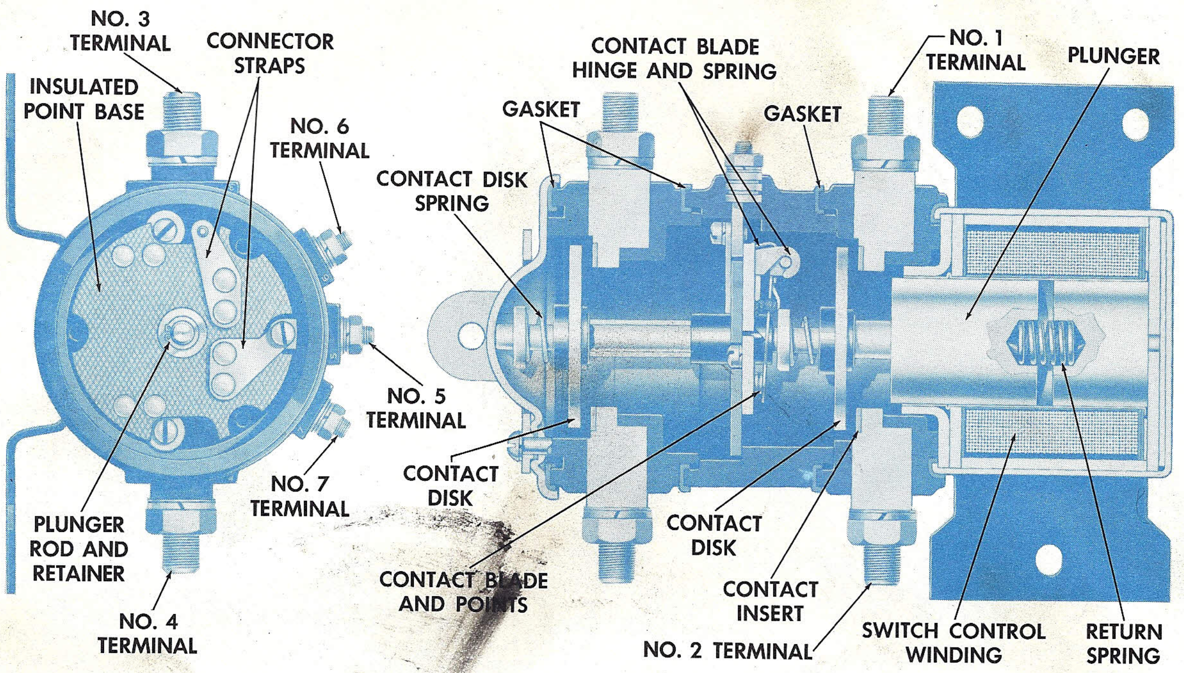

Figure 2—End and sectional view of solenoid operated combined series-parallel and magnetic switch.

switch plunger. This completes the battery to cranking motor circuit and allows cranking to take place.

After cranking has been accomplished and the starting switch is released, the two batteries again become connected in parallel with the series-parallel switch in its "at rest" position. This allows operation of the rest of the vehicle electrical equipment at a system voltage of 12 volts. Note that there are two circuit breakers or fuses in the circuit of the "B" battery. These should be used in the location shown.

In Figure 6 is illustrated a circuit with the series-parallel switch used with a magnetic switch operated motor. The switch is shown in the charging or "at rest" position. The current from the generator divides at the terminal of the series-parallel switch, half of it going to the "A" battery (as shown in solid red) with the other half of the current going to the "B" battery through the series-parallel switch (as shown in dashed red). Note also that an optional ammeter, as indicated, may be located in either of two positions. The preferred location is shown since this circuit carries only the charging current while the other circuit must also carry the magnetic switch energizing current. An ammeter sufficiently heavy to carry the magnetic switch current is generally unsatisfactory for reading small charging currents. In either position the ammeter will indicate how much current is entering the battery to the right, and if this is subtracted from the total shown on the main ammeter, the difference will be that which is entering the battery to the left.

Figure 7 is the schematic wiring circuit of

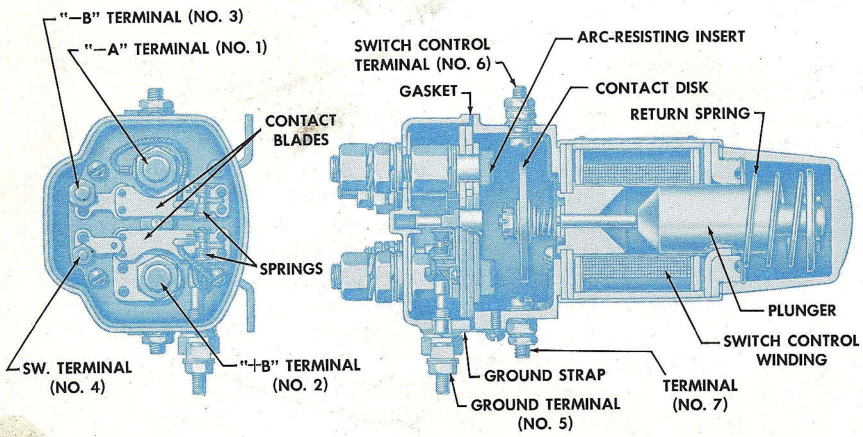

Figure 3—End and sectional views of solenoid-operated series-parallel switch.

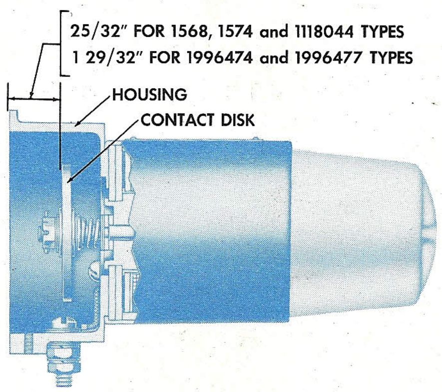

Figure 4—Adjustment of contact disk.

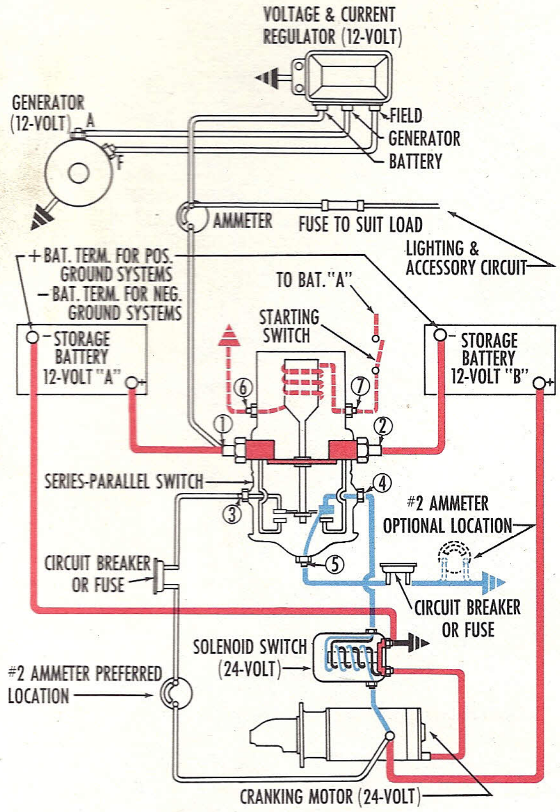

Figure 5—Circuit diagram of series-parallel system with switch completing series connections between batteries for 24-volt cranking motor operation. The cranking motor is operated and controlled by a solenoid.

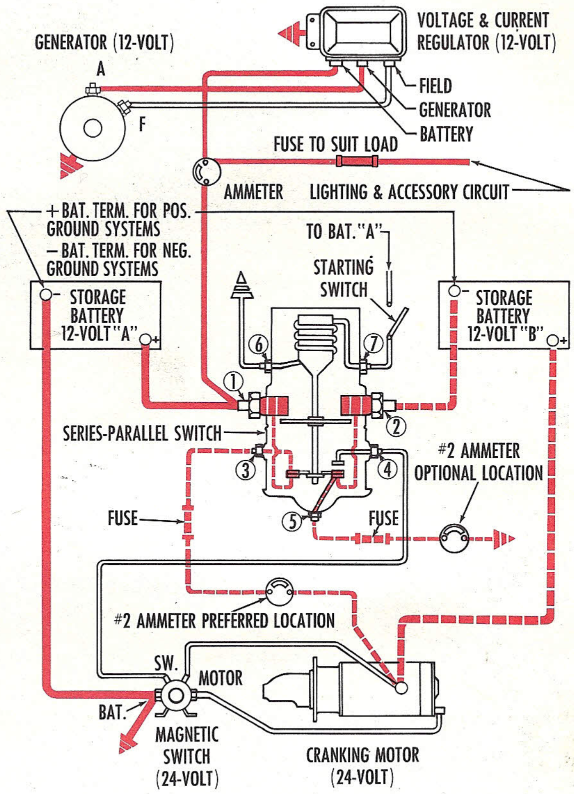

Figure 6—Circuit diagram of series-parallel system with switch completing parallel connections between batteries for normal operation of vehicle electrical equipment at 12 volts. The cranking motor is operated and controlled by a separately mounted magnetic switch.

the combination series-parallel magnetic switch used in conjunction with a magnetic switch operated cranking motor equipped with a Bendix Type Drive. As the starting switch is closed, the solenoid coil within the series-parallel switch is energized (shown in dashed red) creating sufficient magnetic force to attract the series-parallel switch plunger. The movement of the plunger then connects the two sets of large terminals (shown in solid red). This connects both batteries in series with the cranking motor in order that 24 volts can be supplied for cranking motor operation.

Figure 8 shows the same switch after the starting switch is released and the series-parallel switch is in its "at rest" or charging position. The solid red path indicates the charging circuit of the left hand or "A" battery. The dashed red shows the path of the charging circuit to the right hand or "B" battery.

Figures 9, 10, and 11 show alternate methods of making connections within the series-parallel system. Although some of the connections may be different, the circuit still operates in the manner just described.

A Delcotron® generator charging circuit may be used in place of the d.c. generator that is shown.

SERVICE PROCEDURES

Some of the problems that may be encountered in series-parallel systems are covered below.

Blown Fuse or Open Circuit Breaker

A complete check of the entire circuit should be made for evidence of shorts, grounds, or improper connections. Also, the fuse or circuit breaker should be checked for correct capacity. The fuse capacity should be 60 amperes or 55% of rated generator output, whichever is greater. The minimum circuit breaker rating should be 40 amperes or 55% of rated generator output, whichever is greater.

A pinion and ring gear tooth abutment on some types of solenoid operated cranking motors can cause a fuse to blow or a circuit breaker to open if the start switch is held on for an excessive period of time (Fig. 5). With the tooth abutment condition preventing the contact disk from connecting the solenoid "BAT" and "MOT" terminals, the high solenoid winding current can cause the circuit to open. To prevent this occurrence, the start switch should be immediately opened when a tooth abutment condition is encountered. If the pinion or ring gear teeth are badly burred, an abnormal tooth abutment condition may occur which can cause an open circuit.

A cranking motor that is grounded intern-

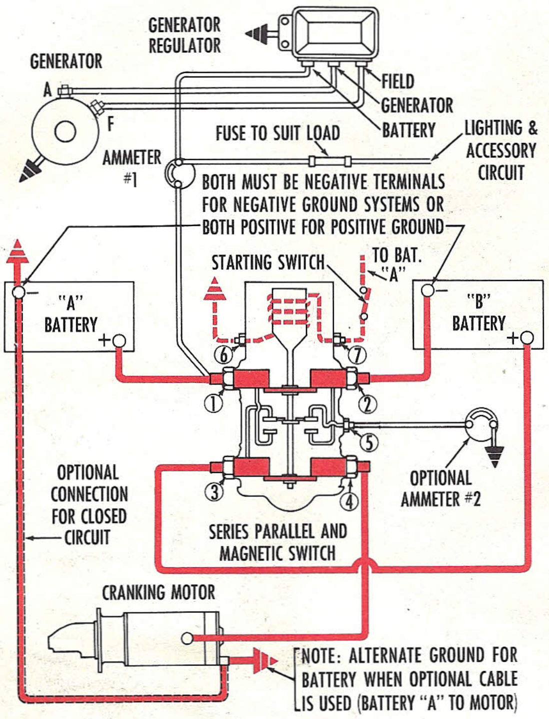

Figure 7—Circuit diagram of combination series-parallel and magnetic switch completing series connections between batteries for 24-volt cranking motor operation.

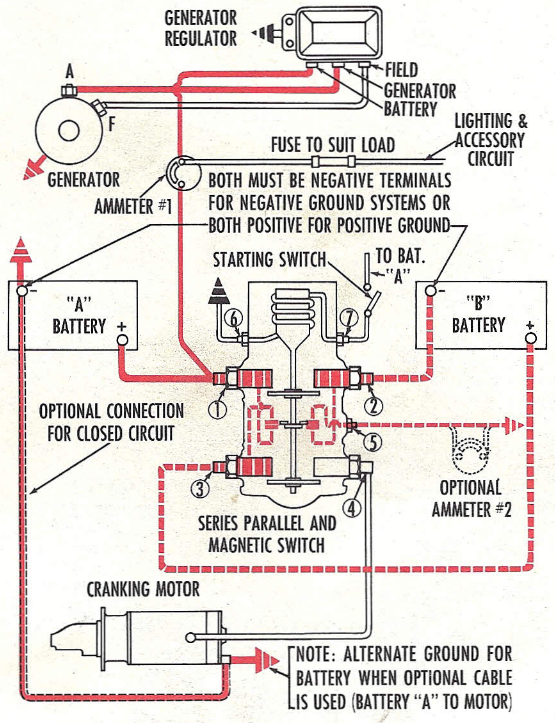

Figure 8—Circuit diagram of combination series-parallel and magnetic switch completing parallel connections between batteries for normal operation of vehicle electrical equipment at 12 volts.

ally will cause the fuses or circuit breakers to open when the switch is in the charging position (Fig. 6), since both batteries will be short circuited through the fuses or circuit breakers. The large contactor in the solenoid and the cranking circuit wiring will be severely damaged with the solenoid plunger in the crank position (Fig. 5).

One other condition that can cause the fuses or breakers to open is an improperly positioned contact disk in solenoids of the type shown in Figures 3 and 4. If the disk contacts the No. 1 and No. 2 terminals before the other internal circuits have opened, the batteries are directly shorted through the fuses or breakers and they will open.

An Oscillating Solenoid

Undercharged batteries can cause the cranking motor solenoid to oscillate when the system voltage decreases during cranking to the point where the solenoid hold-in winding can no longer hold the solenoid contacts closed. When the contacts open the cranking circuit is interrupted, the voltage increases and the cycle then repeats to cause oscillation and heavy damage to the contacts. Also, an open hold-in winding can cause the solenoid to oscillate.

Excessive resistance in the solenoid or series-parallel switch coil winding circuits, such as corroded contacts or connections, has the effect of lowering the voltage to the coil and causing the plunger to oscillate. This condition is aggravated by undercharged batteries.

An Undercharged "B" Battery

Using Figure 6 as an example, it should be noted that the "A" battery uses heavy cranking motor circuit cables during charging, and that the charging circuit for the "B" battery is much longer through the various contacts and connections in the series-parallel switch. With higher circuit resistance, it is normal for the "B" battery to tend somewhat toward undercharge. Maintaining clean and tight circuit connections, using batteries of the same type, size, and age, and occasionally switching the positions of the two batteries will alleviate this problem.

Referring to Figure 6 as an example, one method of checking electrically for excessive resistance in the "B" battery charging circuit is to proceed as follows:

1. Start engine and operate at moderate speed.
2. Connect a voltmeter capable of reading in tenths of a volt directly across the "B" battery terminals, and observe the reading.
3. Connect a heavy jumper cable from the series-parallel No.1 terminal to the "B" battery ungrounded terminal, and observe the voltmeter.
4. An appreciable voltage increase, say .5 volt or more, indicates excessive resistance in the circuit consisting of the series-parallel No. 1 and No. 3 terminals and contacts, the fuse or breaker and ammeter, and the motor terminal. No exact voltage can be specified due to different wiring sizes and lengths; a judgment based on experiences with the particular system involved must be made.

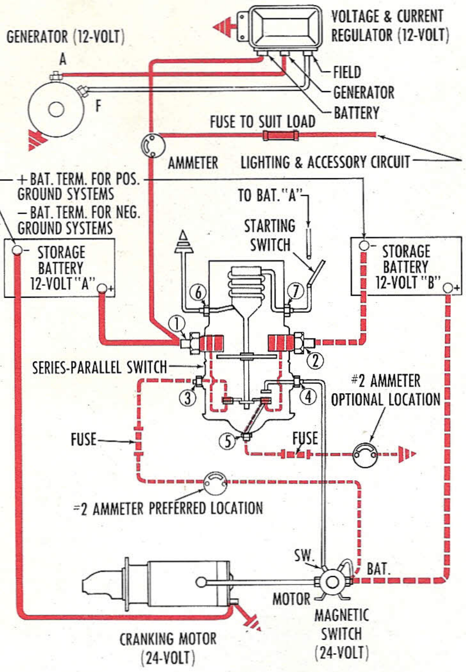

Figure 9—Alternate connections to magnetic switch and motor.

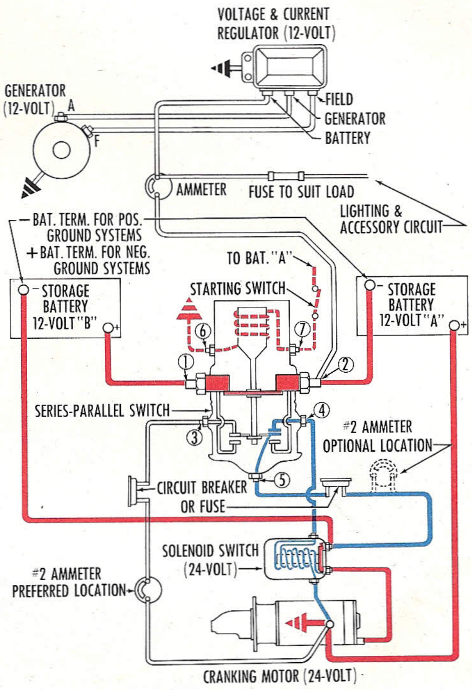

Figure 10—Alternate connections to solenoid switch and motor.

5. If only a very small voltage increase is obtained, connect the jumper cable from the "B" battery grounded terminal to a good ground on the engine, and observe the voltmeter.

6. An appreciable voltage increase indicates excessive resistance in the circuit consisting of the series-parallel No. 2 and No. 5 terminals and contacts, the fuse or breaker and optional ammeter if used.

SUMMARY

In order to obtain satisfactory service in series-parallel systems, it is important to maintain all wiring and connections in good condition. Some of the effects of excessive resistance have been covered in the previous paragraphs. Also, battery tops should be cleaned periodically and otherwise maintained as covered in Delco-Remy Service Bulletins 7D-100 and 7D-100E. The other units, generator, regulator and cranking motor, are covered in separate Delco-Remy service bulletins.

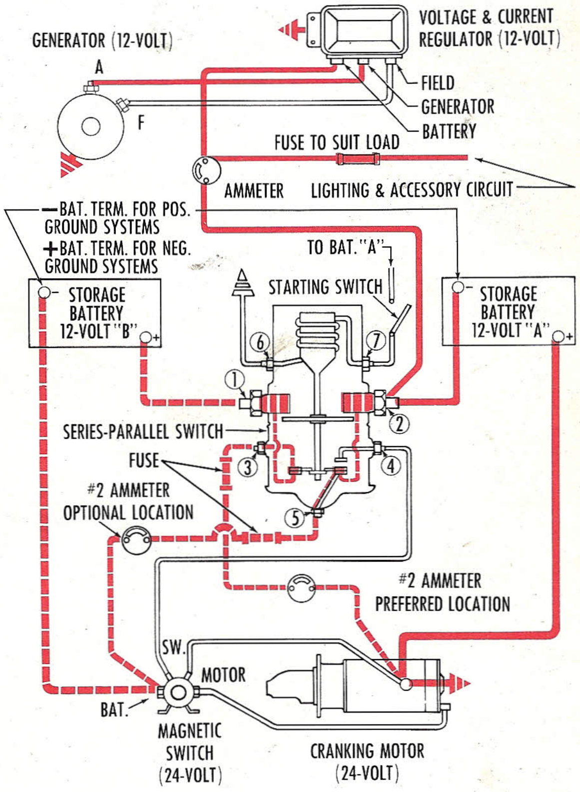

Figure 11—Alternate connections to batteries, magnetic switch, and motor.