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STARTER

STARTER TYPES

Triumph used two different types of starters for the TR250/TR6 range: inertia and pre-engaged.

INERTIA: In this type starter, the solenoid is separate from the starter itself, and is only used to switch power from the battery to the starter, acting like a heavy duty relay. (See **figure 1**, below for a cutaway view of an inertia starter) When the motor starts, the armature spins, and the "inertia' of the spinning armature moves the drive gear forward, via mechanical action (Bendix), into contact with the teeth on the flywheel. The gear is already beginning to spin when contact is made with the flywheel.
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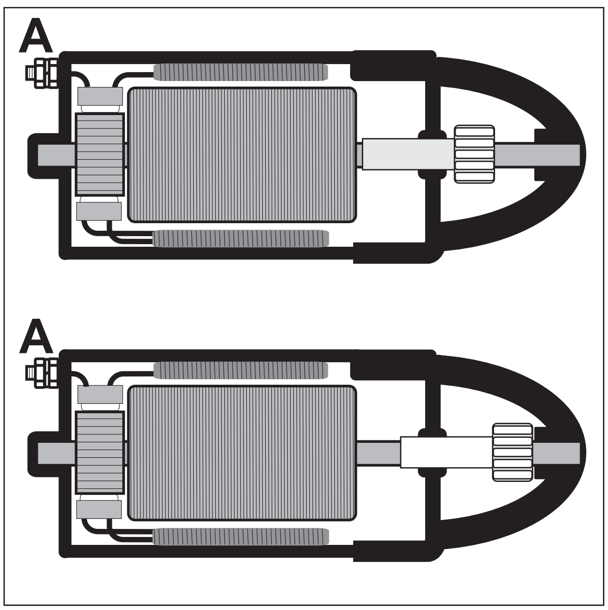


FIGURE 1

When the starter solenoid is energized, power is applied to terminal A in **figure 1**, energizing the starter motor. In the top cutaway, the motor is not energized, and the drive gear is shown in its rearward, or retracted position. In the bottom view, power has been applied, the armature is spinning, and inertia has forced the drive gear into position for contact with the flywheel.

PRE-ENGAGED: In this type starter (See **figure 2**, right), the solenoid is mounted on the starter itself, and serves a dual function. When the solenoid is energized, it first pulls a lever, which in turn moves the drive gear into contact with the flywheel. As the drive gear reaches the end of its travel, a contact on the solenoid bridges the gap between terminals A and B, and then the motor starts to turn. The motor doesn't turn until the drive gear is engaged, hence the term "pre-engaged."

In the top view of **figure 2**, the solenoid is de-energized, the spring in the solenoid has returned the lever to its rest position, and the electrical contacts are open. In the bottom view, power has been applied to solenoid terminal S, and the solenoid is now energized. In this position, the lever has moved the drive gear to its full engaged position, the contacts are closed, and power is applied from the battery, via terminal A, to the starter motor, via terminal B, and the starter is now turning.

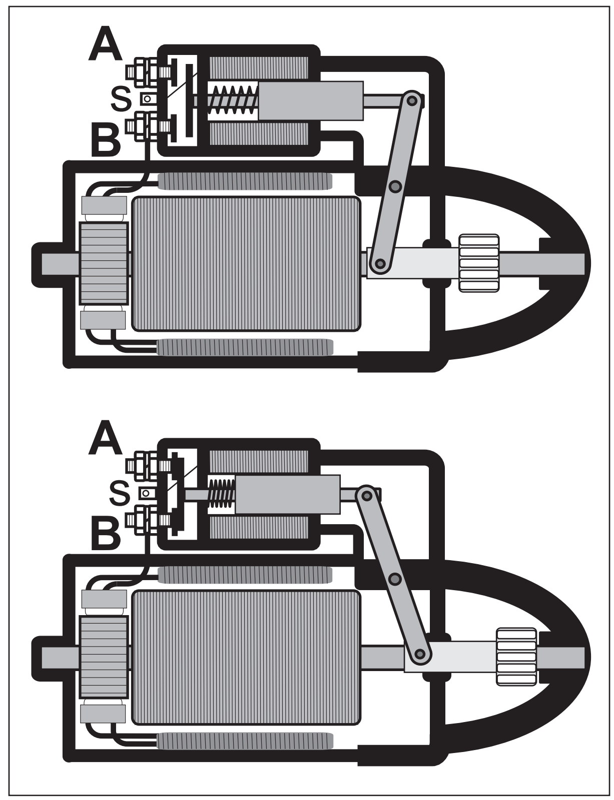


FIGURE 2

When the ignition key is released, and power is no longer applied to terminal S, the solenoid, lever, and contacts will all return to the normal state, with the motor off and the drive gear retracted from the flywheel.

ELECTRICAL CIRCUITS

Figure 3, overleaf, top, shows the wiring configuration for the TR250. The labels for the solenoid terminals in this diagram (and all others in this chapter), are purely arbitrary, as they are not often actually marked on the solenoids themselves.

Terminal A on the starter solenoid is used as a convenient junction point for routing battery power to other circuits in the car, as well as being the connection point for the starter power, thus all the "brown" wires radiating from it.

When the ignition switch is closed power is applied from the ignition switch to terminal S, energizing the solenoid. When the solenoid is energized, internal contacts close, connecting terminal A with terminal B, providing power to the starter itself. The starter, being of the inertial type, begins spinning, and the drive gear engages the flywheel, starting the engine.

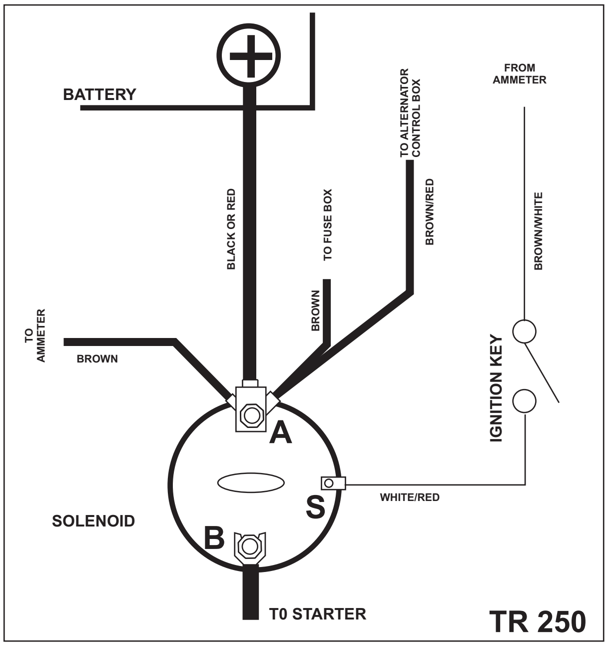


FIGURE 3

Figure 4, top right, is the circuit for a '69 through '72 TR6. Electrically, this circuit is the same as the TR250, except the solenoid is mounted directly on top of the starter, so there is only a very short piece of wire between it and the starter. Mechanically, there is quite a bit of difference between this setup and the TR250, in that this starter is the pre-engaged type.

Figure 5A, right, is the diagram for the '73 TR6 starter circuit. Beginning with this model year, Triumph added a ballast resistor for the ignition coil. The ballast resistor circuit is discussed in chapter 20, Ignition System, so only the starter portion of the circuit will be discussed here.

Figure 5B, right, shows the circuit in operation. With the exception of the I contact on the solenoid, which is used to bypass the ballast resistor, this circuit is identical to the earlier models. The I contact on the solenoid is connected internally to the A and the B contacts whenever the solenoid is energized.

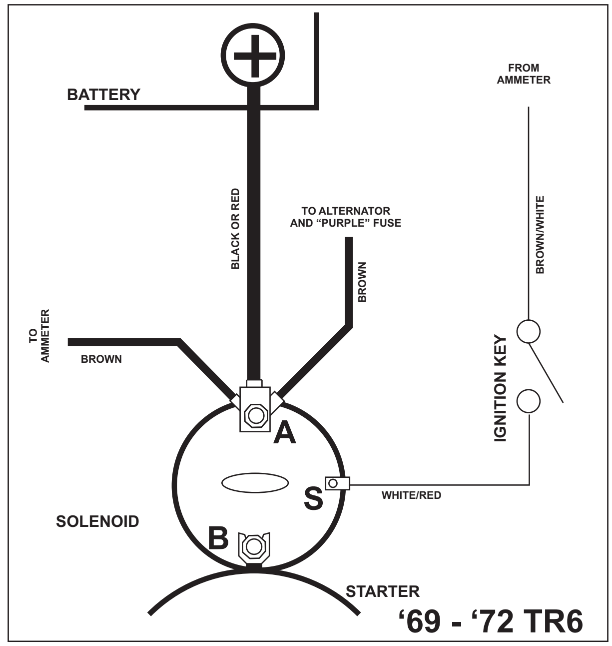


FIGURE 4

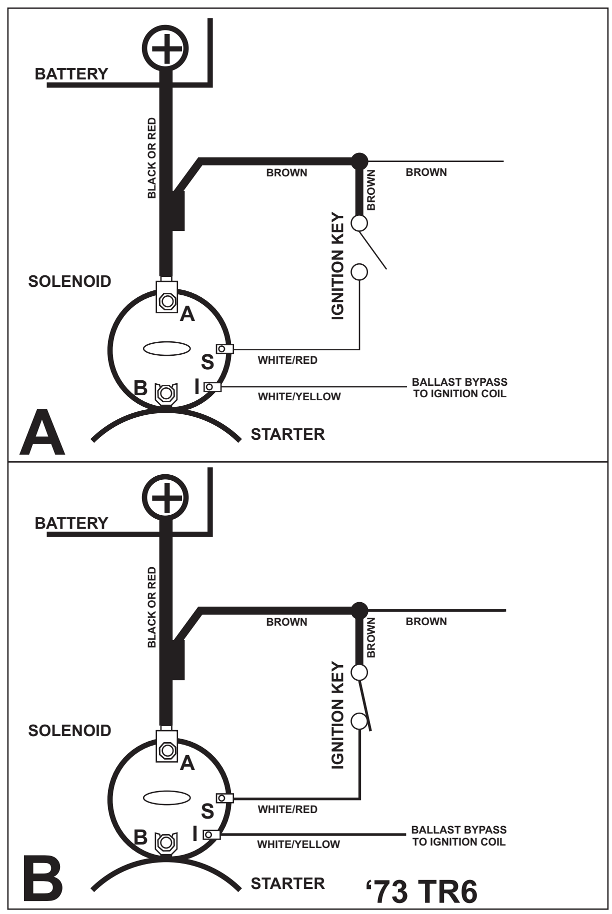


FIGURE 5

Figure 6A, opposite, is the diagram for the '74 - '75 TR6. For these two years, Triumph added a seat belt interlock module to the cars, in addition to the ballast resistor. The operation of the seat belt module is covered in chapter 24, Seat Belt Interlocks, and the ballast resister circuit is discussed in chapter 20, Ignition System, so only the starter portion of the circuit will be discussed here.

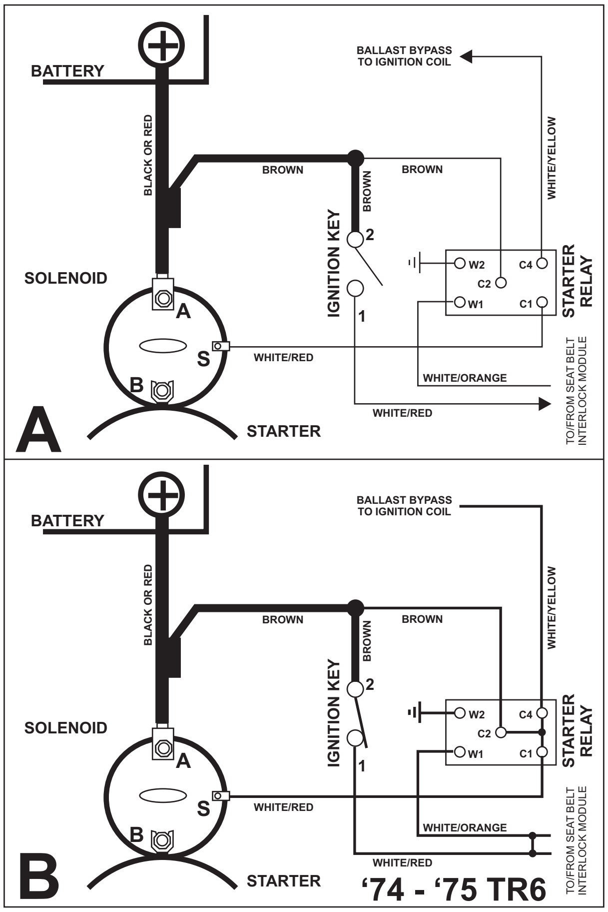


FIGURE 6

When the seat belt is fastened in the '74 model, the white/red wire from the start position of the ignition key is connected, inside the seat belt module, with the white/orange wire to the relay coil, terminal W1. If the ignition key is then turned to the start position, the relay is energized to operate the solenoid. The current path for this is shown in **figure 6B** above. If the seat belt isn't fastened, the two wires are ***NOT*** connected, and the relay does not operate, preventing the car from starting.

For the '75 model, after the Federal government dropped the starter interlock requirements, Triumph defeated the seat belt/starter interlock circuit. They did this by removing the white/red and the white/orange wires from the seat belt module and permanently connecting them together. If you are annoyed with this feature on your '74, you can do the same thing. Just cut the above mentioned wires and connect the two wires together, using an insulated connector, as the white/red wire will be hot when the key is in the start position. You don't want a hot wire hanging around under the dash!

Figure 7, below, is the diagram for the '76 TR6. The two white/orange wires have no impact at all on the operation of the starter, but I have shown them anyway, to prevent possible confusion, as they are there, and you might wonder why. Their purpose is to operate the "lamp test relay," which will be covered in chapter 21, Oil Brake and EGR warning lamps.

Excluding those two wires, this diagram looks remarkably like the original TR250 diagram. The only addition being the white/yellow wire from the I terminal on the solenoid. This wire is used to bypass the ballast resister, and its function is covered in chapter 20, Ignition System.

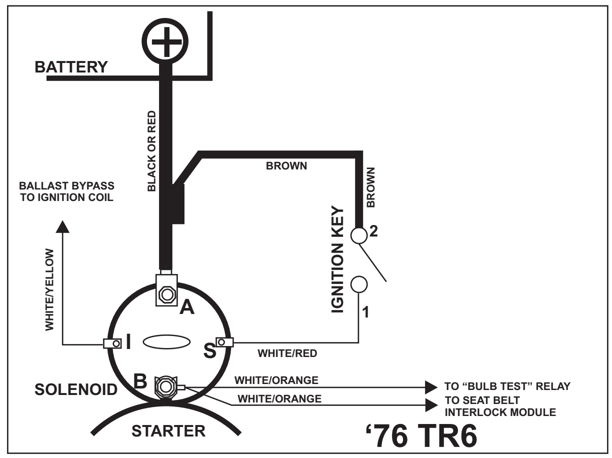


FIGURE 7

When the ignition key is turned to the start position, power is applied to the S terminal, energizing the solenoid, just as for the earlier models. When the solenoid is energized, all three of the other terminals - A, B, & I - are connected together inside solenoid, and power is then applied to both the starter motor and to the ballast bypass circuit.

TROUBLE SHOOTING

A. STARTER WORKS, BUT TURNS THE ENGINE OVER VERY SLOWLY:

There are two possible causes for this - mechanical or electrical. Mechanical problems could be from binding in the starter gear/flywheel interface, or something in the engine binding. Usually, if it is a mechanical problem, it is in the gear/flywheel interface, rather than in the engine, as an engine binding problem would most likely show up elsewhere and you would already be working on it. Quite often, though, the starter will be slightly out of alignment (usually after an engine rebuild/starter replacement), and the drive gear just binds up. Mechanical repairs are outside the scope of this manual, however.

If it's an electrical problem, the first thing to check is the condition of the battery. Before any other tests are made, the condition of the battery must be determined and corrections made if needed. Refer to chapter 5, Batteries and Battery Charging for information on batteries and battery testing.

If it's not the battery, it's most likely bad connections in the battery cables (especially the ground cable), the cables themselves are defective, or you have a bad solenoid. It is also possible that the wiring to the S terminal of the solenoid is bad. To determine which of these is the problem, you will need to bypass them as follows:

WARNING: FOR ALL OF THE FOLLOWING TESTS, MAKE SURE THE TRANSMISSION IS IN NEUTRAL, THE IGNITION KEY IS OFF, AND THE HANDBRAKE IS ON. IF THE ENGINE SHOULD START WHILE PERFORMING THESE TESTS, IT COULD BE FATAL TO YOU OR YOUR HELPERS.

Step 1) For the first test, connect one end of a battery jumper cable to the positive post of the battery, making a good, solid, connection. Then, very firmly connect the other end to terminal B on the starter solenoid. Don't be timid, really jam the jumper cable on there. If you press it on lightly, you will get a lot of sparks, and a lot of welding of the terminal. If the starter doesn't spin freely, your starter motor is bad (except for the TR250, with an inertia starter, the engine will not turn over during this test, as the solenoid is not being engaged - the jumper cable bypasses the solenoid). If the starter motor spins satisfactorily, the problem is either in the cables/connections/wiring, and they will have to be repaired or replaced as required, or the solenoid is bad.

Step 2) The next step is to test the wiring to the S terminal. To do this, remove the existing wire(s) to the S terminal. Connect one end of a piece of wire (at least 14 ga, 12 ga preferred) to the positive post of the battery, and the other end to the S terminal. If the starter now operates as it should, the problem is in the wiring to the S terminal. For details on evaluating this wiring, see part C

Step 3) If the starter still didn't operate as it should, we have one more test to make. Using your jumper cable, connect one end to the positive battery post and the other end to terminal A on the solenoid. Repeat the test just above, connecting a wire between the battery and the S terminal (this test must be repeated to make sure we don't have two problems - bad cables and bad wiring). If the starter works satisfactorily, the solenoid is OK. If not, the solenoid must be replaced.

B. ENGINE DOESN'T TURN OVER AT ALL:

This is just a more severe case of the symptoms of part A, so the testing will be similar, although the order will be a bit different. In this case, step 2 above should be the first step, followed by steps 1 and 3, depending on the results of step 2.
Step 1). Remove the existing wire(s) to the S terminal. Connect one end of a piece of wire (at least 14 ga, 12 ga preferred) to the positive post of the battery, and the other end to the S terminal. If the starter now operates as it should, the problem is in the wiring to the S terminal. For details on evaluating this wiring, see part C.

Step 2)If the starter didn't work, did you hear the solenoid engage? If not, the solenoid is bad. If the solenoid clicked, but the starter didn't operate at all, proceed with step 3.

Step 3). For this test, connect one end of a battery jumper cable to the positive post of the battery, making a good, solid, connection. Then, very firmly connect the other end to terminal B on the starter solenoid. Don't be timid, really jam the jumper cable on there. If you press it on lightly, you will get a lot of sparks, and a lot of welding of the terminal. If the starter doesn't spin, your starter motor is bad (except for the TR250, with an inertia starter, the engine will not turn over during this test, as the solenoid is not being engaged - the jumper cable bypasses the solenoid). If the starter motor spins satisfactorily, the problem is in either in the cables or the cable connections, and they will have to be repaired or replaced as required, or the solenoid is bad. Proceed to step 4.

Step 4). If the starter motor worked when you performed step 3, then either the cable from the battery to the solenoid is bad, the battery cable connections are bad, or the solenoid is bad. To determine which is the problem, connect one end of a battery jumper cable to the positive battery post, and the other end to the solenoid terminal A, and repeat test 1. If the starter now works properly, the problem was in the battery cable or the cable connections. If not, the solenoid is bad.

C. SOLENOID DOESN'T GET A START SIGNAL:

As shown in **figures 3, 4, 5, 6,** and **7**, power to the starter solenoid comes from the ignition switch. Power to the ignition switch comes directly from the battery. Power to the "green" fuse also comes directly from the ignition switch. Therefore, if ***ANY*** of the "green" fuse loads operate when the key is on, there is power to the ignition switch. Proceed with the following troubleshooting steps. If ***NONE*** of the "green" loads work, either the ignition switch is faulty or there is a problem in the wiring to the switch. Refer to chapter 23, Power Distribution, to resolve this problem.

Previous testing in A and B above have shown the starter to be operable, or have identified the problem so repairs can be made. If power were getting to the S terminal, there would be no need to proceed further, so we now need to find out why power isn't getting to the starter solenoid.

All models *except* '74 - '75:

Step 1). Locate the white/red wire coming from the ignition switch. With your voltmeter or test lamp, check for the presence of voltage on this wire (at the switch) as you turn the key to the start position. If you have voltage here, there is a break or bad connection in the W/R wire between the switch and the solenoid. If you don't have voltage here, the ignition switch is defective.

'74 - '75 models:

Step 1). Using your voltmeter or test lamp, check for voltage on the starter relay terminal with the white/orange wire on it (should be the W1 terminal, but could be the W2), as you turn the ignition key to the start position. If you have voltage here, proceed to step 2. If you don't have voltage, go to step 6.

Step 2). When you turned the key to the start position in step 1, did the relay click? If so, go to step 4. If not, go to step 3.

Step 3). Remove the black wire from the relay terminal W2 (could be W1, if the W/O wire is on W2), and, using a short test lead with alligator clips on each end, connect the relay terminal to a good ground, and turn the key to the start position again. Did the relay click? If so, the black wire (ground wire) is broken, or the connections are bad, and must be repaired. If the relay didn't click, the relay is bad, and must be replaced. Did the starter turn over when the relay clicked? If not, go to step 4.

Step 4). Check for power on the brown wire to terminal C2 of the starter relay (could be C1or C4). This wire should have power on it at all times, key on or off. If you have power here, proceed to step 5. If not, there is a break or bad connection in the brown wire, which will need to be repaired.

Step 5). Check for power on the white/red wire on terminal C1 (could be C2 or C4) of the relay, as you turn the key to the start position. If you have power, there is a break or a bad connection in the W/O or W/R wire to the starter solenoid. If not, the relay is bad, and must be replaced.

Step 6).

'74 models: If you didn't have power on the W/O wire in step 1, there is a break or a bad connection in the W/R wire to the seat belt module, or the module is defective. Pull the plug from the seat belt module (located on the left, just above the passenger's footwell), and connect the W/R and the W/O wire terminals together with test lead. Be sure to make a good connection, as the solenoid draws a good bit of current. Try to start the car again. If the starter now operates, the problem is in the module. It could be a defective module, or some of the input switches (seat belt or transmission neutral switch) are not operating properly. Go to Chapter 24, Seat Belt Interlocks to determine if it is the module or the switches. If all the switch test pass, it is the module that is the problem. Unless you are a real stickler for originality, I would recommend that you just connect the W/R and the W/O wires together permanently, rather than attempting to repair or find a replacement for the module. Triumph did just that for the '75 model year, so originality isn't sacrificed much by this modification.

If the starter doesn't operate, there is a break or a bad connection in either the W/R or the W/O wire, which will need to be found and fixed. Go to step 7.

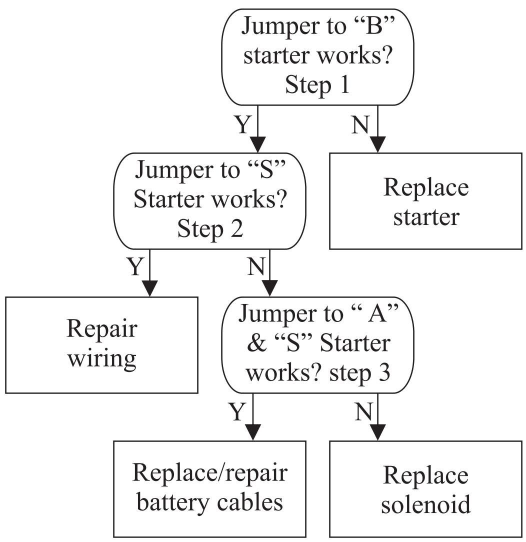
'75 models: for the '75 model year, the factory pulled the W/O and the W/R wire from the seat belt module and connected them together; therefore, if the starter still doesn't work at this point, there is a break or a bad connection in either the W/R or the W/O wire, which will need to be found and fixed. Go to step 7.

Step 7). To determine which wire is at fault, the W/O or the W/R, place your voltmeter or test lamp module plug pin with the W/R wire (with the plug removed) if you have a '74 model, or at the connection of the W/R and the W/O wire near the module if you have a '75 model. Turn the key to the start position. If you have voltage, the problem is in the W/O wire. If not, the problem is in the W/R wire. Go to step 8.

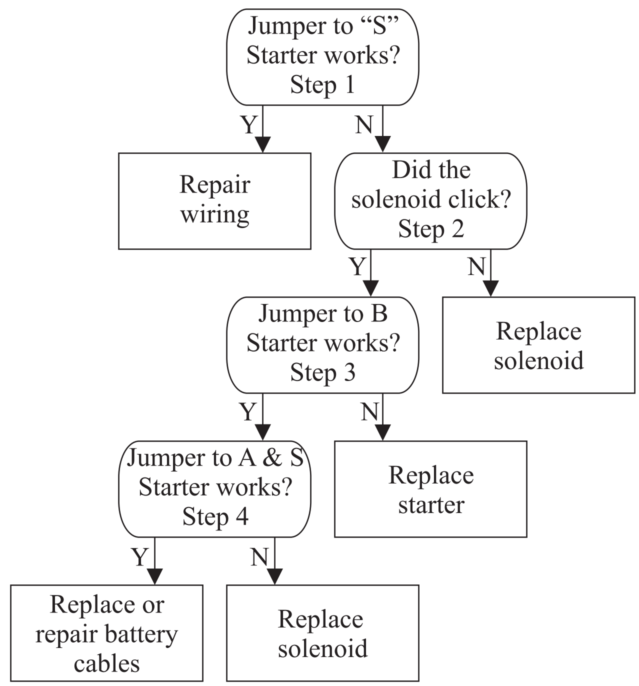
Step 8). Locate the W/R wire as it leaves the ignition switch, and check for power on this wire when the key is turned to the start position. If you have power, there is a break or a bad connection in the W/R wire. If not, the ignition switch is defective, and must be replaced.

TROUBLESHOOTING FLOW DIAGRAMS

STARTER OPERATES POORLY



STARTER DOESN'T OPERATE



SOLENOID DOESN'T GET START SIGNAL ('73 - '75 models)