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IGNITION SYSTEM

CIRCUIT DESCRIPTION

Two different types of ignition circuits were used in the TR250/TR6 range. From the '68 TR250 until sometime around the introduction of the '73 TR6, the ignition circuit utilized a non-ballasted type coil, operating with the full 12 volts applied to the coil whenever the ignition key was on. Beginning with the '73 model, a ballast resister was added, allowing the full 12 volts to be applied to the coil only while the starter was spinning the engine. After the engine started, and the starter was no longer engaged, the ballast resister was switched into the circuit, and the coil received a lower voltage, approximately 6 volts.

The addition of the ballast resister was, I believe, necessitated by the additional environmental controls being added at this time, making the engines harder and harder to start. When the starter is operating, it draws a LOT of current, so much so, in fact, that it can drag the battery voltage down considerably, reducing the voltage available to the ignition coil (see chapter 5, Batteries and Battery Charging, for more info on this). Reducing the coil voltage on an already hard to start engine is not a good thing to do.

So, what is the difference between the two types? Basically, a non-ballast coil is designed to produce full spark output with 12 volts on the input (+ terminal). A ballast coil is designed to produce the same spark output, but with only 6 volts or so on the input.

With a non-ballast coil, the input to the coil is the full battery voltage, whether the engine is running or being cranked by the starter motor. With a ballast coil, the ballast resister is by-passed when the starter motor is spinning the engine, and the full battery voltage is applied to the coil. Since the coil is designed to provide full spark with reduced voltage, the application of the full battery voltage, even if it is reduced by the starter current, produces a much hotter spark, which is an aid in starting. After the engine starts, and the starter motor is off, the coil voltage is dropped to the lower voltage, and the coil output is the same as for a non-ballast coil.

The first thought that comes to mind, is: "why not run the ballast resister coil with full battery voltage at all times? A hotter spark sure wouldn't hurt things." The reason the ballast type coil is not run at the full 12 volts all the time for a hotter spark is to prevent damage to both the coil and the points. At full voltage, the coil would seriously overheat, and the excessive coil current would destroy the points in a short time.

With a non-ballast coil, power is applied to the coil directly from the ignition switch, via a white wire. Power to the ballast coil comes from the ignition switch to the ballast resister, and then to the coil. When the starter is operating, power from the battery is routed directly to the coil through the contacts of the starter relay ('74 - '75 models) or through an extra contact on the starter solenoid ('73 and '76 models), as shown in **figures 1 through 6** below. This shorts out the resistor wire by placing 12 volts on both ends of the wire. With the same voltage on both ends, no current flows, so no heat is generated. The current flow is shunted around the resistor wire. This bypassing of the resistor wire places the full 12 volts on the coil.

DIAGRAMS

Figures 1 below illustrates the circuit configuration for '74 - '75 models

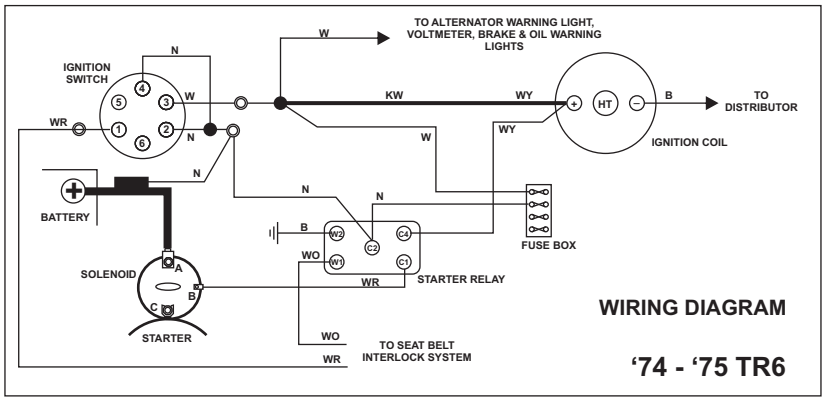


FIGURE 1

In **figure 2**, next page, we see the circuit in normal operation. The heavy lines represent normal current flow, while the dashed line for the ballast resister represents the lower current flow due to the ballast resistance. This current flow through the resister drops the coil voltage to around 6 volts.

Figure 3 is a depiction of the circuit while starting. The starter relay is energized and power is applied directly to the coil through contact C4 of the relay. The coil now receives full voltage, and a draws a higher current than it draws during normal operation.

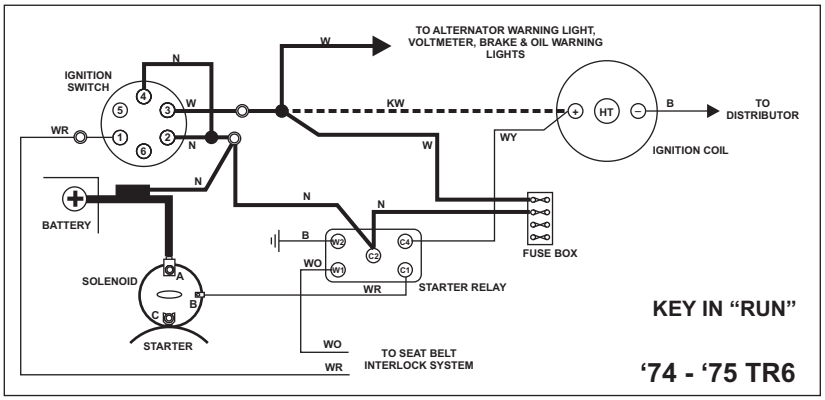


FIGURE 2

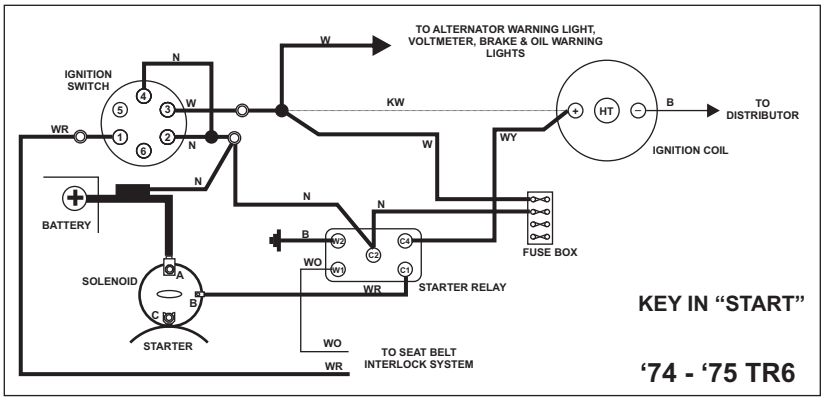


FIGURE 3

Figures 4, 5, and **6**, below and on the next page, depict the same as the previous figures, but for the '73 and the '76 models.

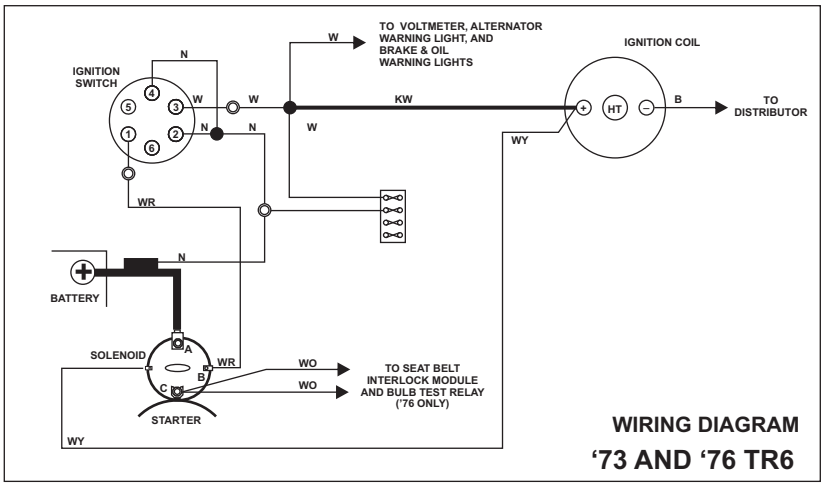


FIGURE 4

TROUBLESHOOTING

As much as I'm opposed to the "replace it and try" method of troubleshooting, that's just about all you can do with the ignition system. There are, however, a few tests you can make before you begin replacing components. You can, for example, make sure that your wiring is correct, and the coil is getting the correct voltage, and check to see that the ballast resister, if you have one, is being properly bypassed during starting.

IGNITION COMPONENTS

Step 1). Turn the ignition key to the run position, and, using your voltmeter or test lamp, check for the presence of voltage at the positive terminal of the coil. If your car doesn't have a ballast resister, the voltage check is straight forward - you have the full battery voltage or you don't. With a ballast resister, though, it's just a bit more complicated. If the ignition points are closed, you should read 6 volts (or the test lamp should glow at a lower brilliance than normal). If, on the other hand, your points are open, you will read full battery voltage even if the ballast resister is in good working order. Without the current through the coil, no voltage will be dropped across the resister, as neither the voltmeter, nor the test lamp draw enough current. To be sure, temporarily short the negative terminal of the coil to ground before measuring coil voltage.

If your car has a ballast resister, measure the voltage on the coil with the starter spinning. You should measure full battery voltage.

If you have the correct voltage on the coil during the proceeding tests, proceed to step 2. If not, there is a break or a bad connection in the white wire circuit from the ignition switch, the ballast bypass circuit is faulty, or the ignition switch is bad or not getting power from the battery. Go to the voltage testing section below.

Step 2). Locate the lead from the negative terminal of the ignition coil to the distributor, and disconnect it from the coil. If you are using a VOM, set it to the ohms scale. Connect one of the VOM leads to the engine block, and the other lead to the distributor/coil lead you just disconnected. If you are using a test lamp, connect the alligator clip to the positive post of the battery, and touch the tip of the test lamp to the wire you just removed. Have someone spin the engine, and watch the VOM or the test lamp. The VOM should alternate between zero ohms and infinity as the engine rotates, or the test lamp should flash on and off. If you get any result other than the above, go to step

3. Otherwise, go to step 4

Step 3). Remove the distributor cap and examine the points while spinning the engine. If the points are staying open or staying closed, you have a mechanical problem with the distributor, or the points are simply out of adjustment. Repair or adjust as needed. If the points seem to be opening and closing properly, but the test you just performed indicates that they are staying closed (lamp stays lit or the VOM gives a constant zero ohms reading), the most likely problem is with the plastic insulator that isolates the points from ground when they are open. See **photo 1** below for details. Often, this plastic piece gets distorted or damaged, and it is awfully hard to see the problem without taking the points out. If the previous tests indicated that the points were not closing, examine the points for pitting. Often, the pitting will prevent the points from making a good electrical contact. If in doubt, replace the points, although you might be able to file them smooth as a temporary repair.

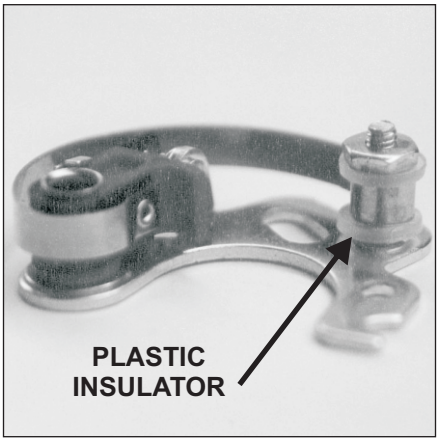


PHOTO 1

Step 4). Replace the lead from the distributor to the ignition coil. Pull the high tension lead from the center post of the coil, and insert a known good plug wire into the center post of the coil (this procedure removes the distributor cap and the rotor from the circuit, so you will be testing only the coil and condenser). Connect the other end of the spark plug lead to a known good spark plug. Hold the threaded portion of the spark plug tightly against the engine block (wearing gloves to prevent shock), and have someone spin the engine. You should see a strong spark from the plug. It's difficult to describe what a "strong" spark looks like, so you might want to perform this test on a running car first to get an idea. If you don't get a good spark, or you get no spark at all, either the coil or the condenser is bad. If you get no spark at all, it's "probably" the coil, but if you get a weak spark, it's "probably" the condenser, although there is no guarantee of this. Replace the coil or condenser. If you get a good spark, then your distributor cap or rotor is bad, or you have bad spark plug leads. Go to step 5.

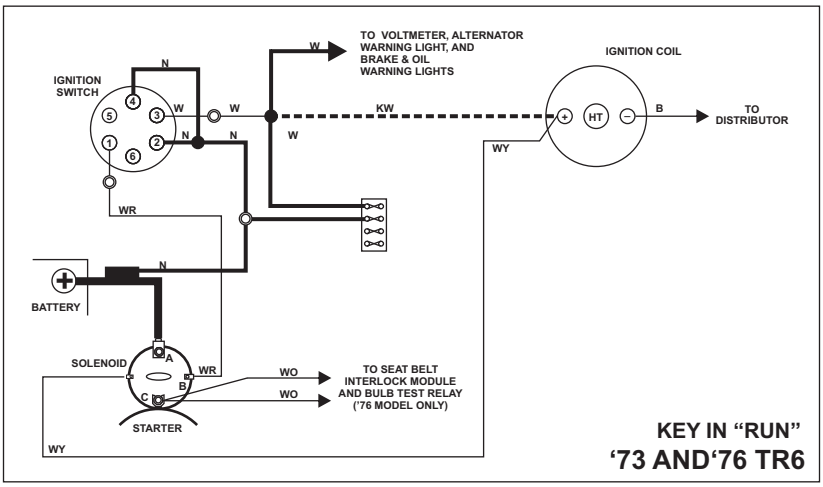


FIGURE 5

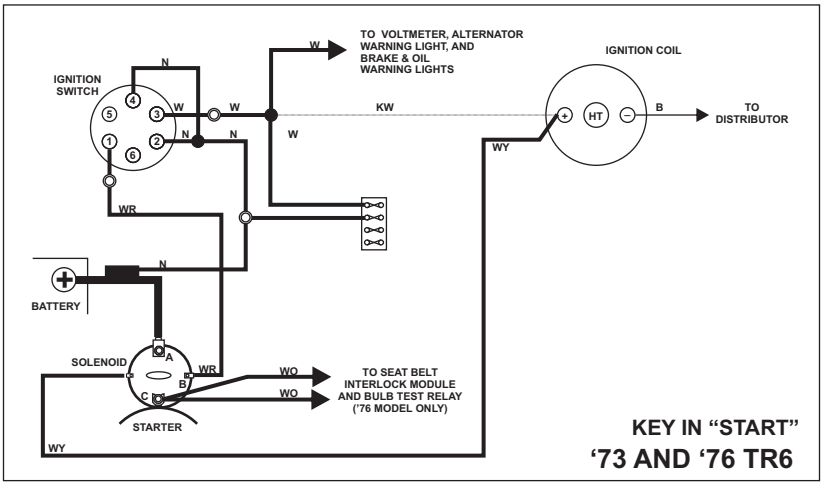


FIGURE 6

Step 5). Replace the rotor and distributor cap and reconnect the lead from the coil to the distributor, and start the engine. If it runs OK, your problems are solved. If not, remove one of the plugs, place the threaded portion of the plug tightly against the block wearing gloves to prevent a shock) and spin the engine and check for a good spark. If you don't get a good spark, your plug wires or the plugs themselves are bad. If you get a good spark, your problem is mechanical (fuel delivery, ignition timing, etc).

VOLTAGE TESTS

TR250 - '72 TR6: Voltage supply to the ignition system on these early models is very straight forward and simple, as shown in **figure 7**, next page. Voltage comes from the ignition switch to the fuse box, and then to the ignition coil, via

white wires. The "green" fuse is fed from the white wire, so if you have power on ***ANY*** of the green fuse loads, then power is getting to the green fuse. If you have power on the green fuse, but not on the ignition coil, there is a break in the wiring from the fuse box to the coil. If you don't have power on the green fuse, there is a break in the wiring from the ignition switch to the fuse box, a break in the brown wire from the battery to the ignition switch, or the switch itself is bad. Follow the procedures outlined in chapter 2, General Procedure, to resolve the voltage concern.

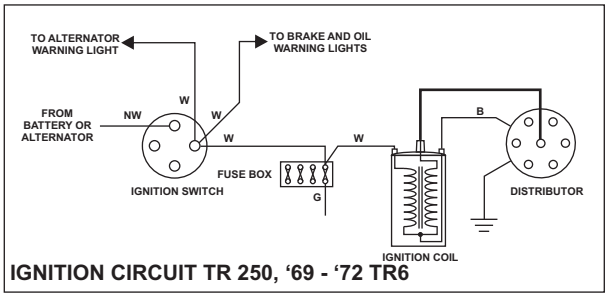


FIGURE 7

'74 - '75 TR6: The addition of a ballast resistor and ballast bypass relay complicates the voltage test for these years just a bit, but the testing is still reasonably simple.

Step 1). What were your symptoms when you performed step 1 of the ignition component testing above?

a). You had no voltage on the coil when the key was on, but had 12 volts when the starter was operating? Go to step 2.

b). You had 6 volts on the coil when the key was on, but didn't have 12 volts when the starter was operating? Go to step 3.

c). You had no voltage when the key was on, and had no voltage when the starter was operating? Go to steps 2 and 3.

Step 2) power to the ignition coil (via the ballast resistor) comes from the ignition switch on a white wire. See **figure 1**, page 85, and **figure 4**, page 84, for details. The white wire from the ignition switch also feeds the voltmeter, the alternator, brake and oil warning lights, and the "green" fuse. The green fuse feeds the WS wipers, WS washer, turn signals, heater fan, brake and back-up lights, and the gauges. If ANY of these items work, there is power on the white wire from the ignition switch- go to step 2. If NONE of these items work, the ignition switch is faulty, there is a break in the white wire from the switch, or there is a break in the brown wire to the switch. Refer to chapter 23, Power Distribution, and repair as needed.

Step 3). Locate the junction of the ballast wire (the pink/white wire, looking like a "shoelace") and the white wire, under the dash near the ignition switch (you may need to open up the wiring harness to get to this junction), and check for the presence of voltage at this junction, with the key in the run position. If you have 12 volts, the ballast resistor is bad, and will have to be replaced as outlined below in the ballast replacement section. If you don't have voltage here, there is a break or bad connection in the white wire from the ignition switch to the ballast wire (the other white wires should be OK).

Step 4).

'74 - '75: the same relay that is used to operate the starter also operates the ballast resistor bypass, so if the starter works, you know the relay works. Using your voltmeter or test lamp, check for the presence of voltage on the relay terminal with the white/yellow wire (should be C4, but could be C2 or C1), with the key in the start position. If you have voltage here, there is a break or a bad connection in the W/Y wire to the coil, which will need to be repaired. If you don't have 12 volts here, the relay is defective (even though it works for the starter circuit, the internal contacts for the W/Y wire are not making up properly). Repair or replace the relay.

'73 and '76: using your voltmeter or test lamp, check for the presence of voltage on the starter solenoid terminal with the W/Y wire. With the key in the start position, and while the starter is operating, there should be 12 volts on this terminal. If you have 12 volts, there is a break or bad connection in the W/Y wire to the coil. If not, the internal contacts in the solenoid are faulty, and the solenoid must be repaired or replaced.

BALLAST RESISTOR REPLACEMENT

If your ballast resistor is bad, rather than tearing open the wiring harness to replace it (if you can find a replacement), you might want to use a replacement unit from your local auto parts store. If so, just ask the counter man for a 1.5 - 1.6 ohm resistor, mount it in a location away from other components (it does get hot!), And wire it as shown in **figure 8** below. Cut the ballast wire near the coil, insulate it well, and tie it back away from any possible ground. Connect the new ballast resistor between the white wire at the fuse box and the positive post of the coil, using at least 14 gauge wire.

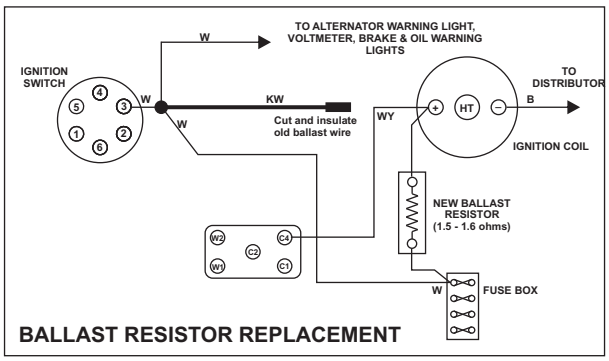
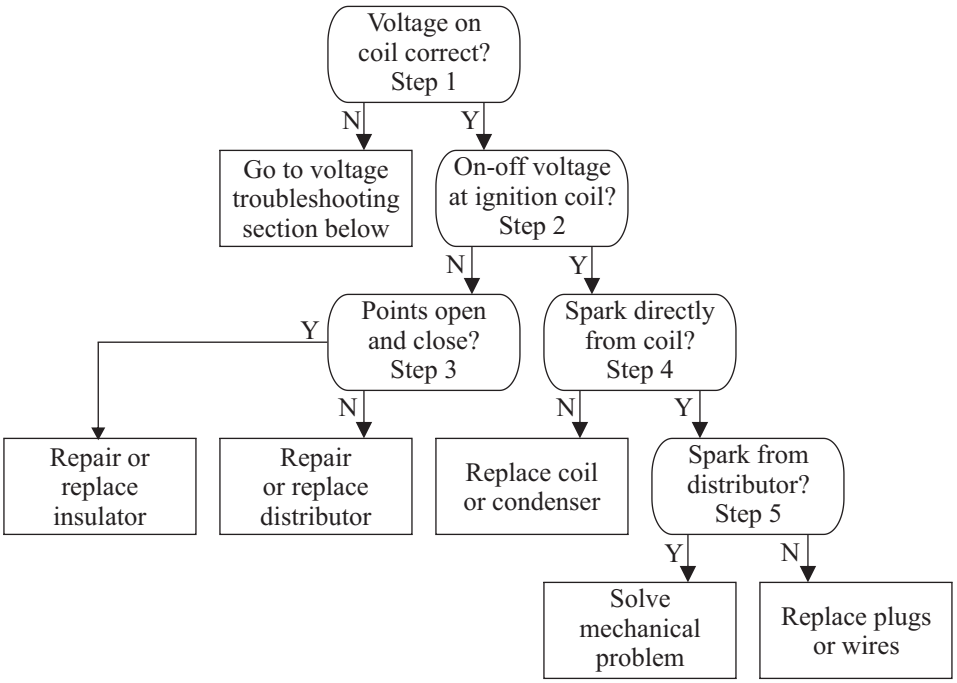


FIGURE 8

TROUBLESHOOTING FLOW DIAGRAMS

IGNITION COMPONENTS



VOLTAGE TESTS