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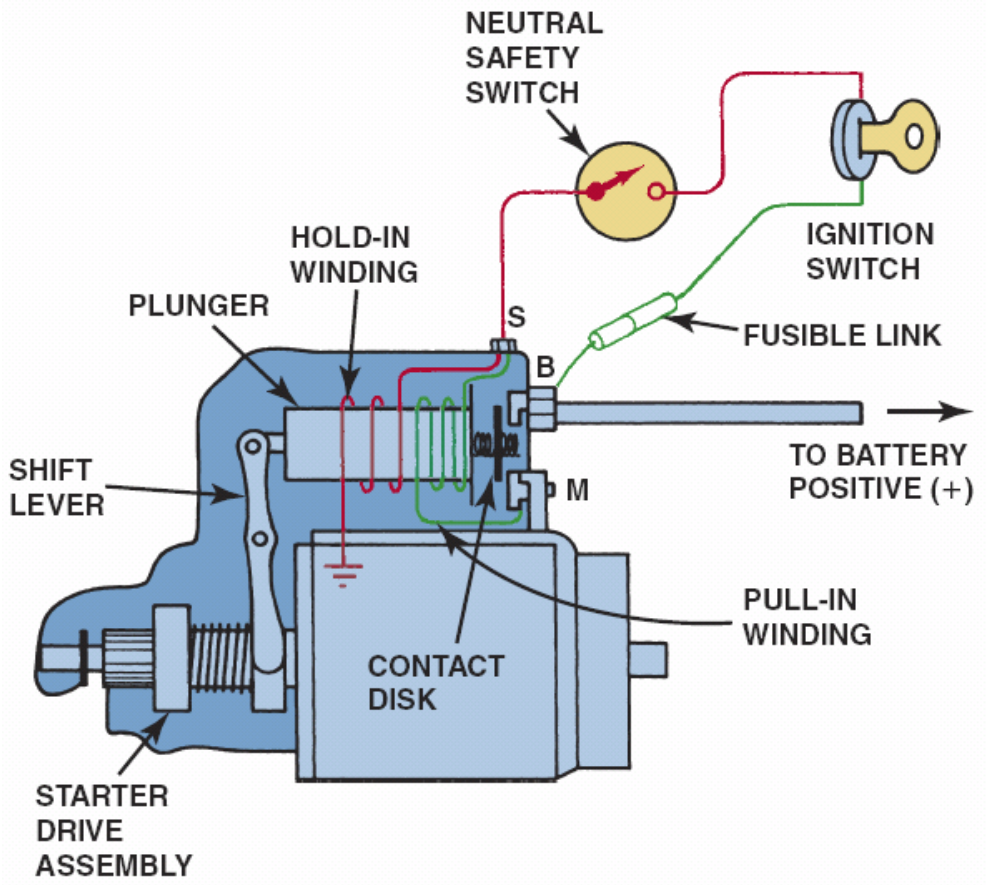
Starter Issues
Because of the nature of our product, attaching components from many different manufacturers, it is not surprising that we occasionally receive calls regarding starter problems.

Starter problems may be a symptom that something else is wrong.
Many years ago an unhappy customer called to say that his starter had stripped out and he was stuck on the road and what was I going to do about it. After calming him down I got the whole story: A "qualified mechanic" had installed the adapter for him. He had called the customer to tell him that he would be charging extra because he had to modify the adapter. He felt that the converter engagement into the front pump was not enough so he added shims. The customer agreed (without calling us) and then picked up the car to take a road trip which lasted about 500 miles before the starter failed.
I then contacted the "mechanic" who turned out to be a basically a non-certified shade tree mechanic working out of his garage without any business license. He had been correct to check the front pump engagement, as our instructions stated, but he had not measured correctly. That mistake led him to shimming the flexplate under the crankshaft bolts, another mistake. All of this was done without contacting Wilcap. The shims move the starter gear engagement out to below its limit and caused the pinion teeth to eventually strip. The shims under the flexplate also pushed the converter back, possibly out of the supporting boss of the hub spacer and could have caused an imbalance in the rotating assembly. It also could have caused the converter to make contact with the transmission pump housing, destroying the transmission pump and/or the thrust bearing of the engines' crankshaft. Not being able to see the work done meant I had to guess as to what was going on. Regardless the customer was stuck and he still thought his "mechanic" was right. To get him out of this mess of his own creation we modified a starter and sent it to him as a temporary fix and advised him to get the entire installation inspected before he proceeded. He ignored this advise and chose to continue his trip and sure enough his engine failed some 1000 miles later.

<u>We are not responsible for modifications to our product and the consequences. You must contact us immediately upon finding any issue or defect and we will not be responsible for any work performed without our written approval</u>. I am an ASE Certified Master Technician and will only authorize work performed by ASE certified technicians. And I do not care how many years of experience that "mechanic" has or who says he/she is in an expert. If they are an expert then taking the ASE test ought to be easy and they should do it. People who don't know what they are doing are dangerous but people who don't know what they are doing and claim to be experts are liars and criminals. If you are going to pay to have someone install your adapter then make sure that they are ASE certified.

Starter electrical circuit
When the starter solenoid winding are energized the solenoid plunger forces the pinion gear out and into contact with the ring gear. Once the plunger reaches its limit of travel the starter motor and the battery are connected and the motor starts to turn and the pull in winding is de-energized and the hold in winding stays energized until battery voltage is removed from the "S" terminal.

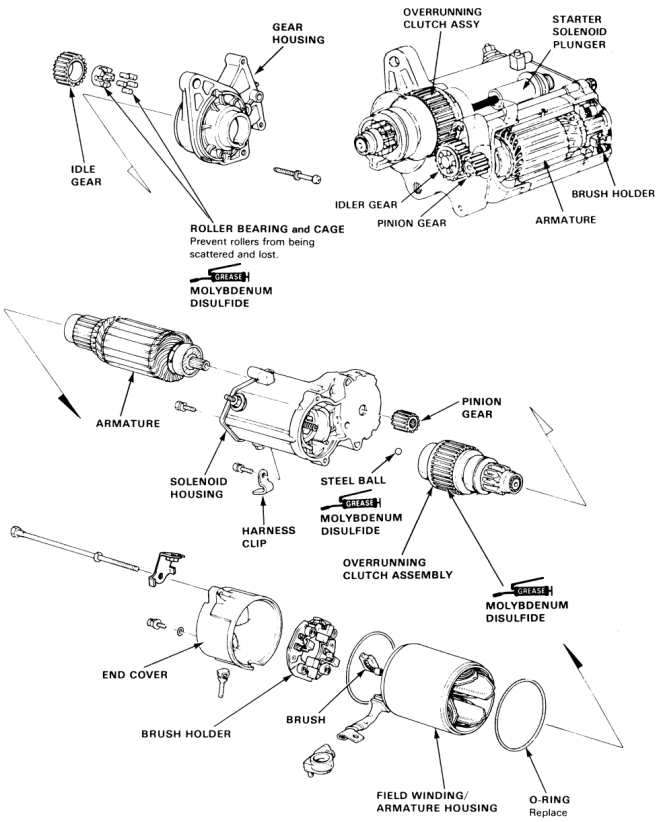
Starter Electrical Problems
If voltage (really amperage) is too low then the motor turns for only a split second then the resulting voltage drop causes the hold in winding to weaken it's magnetic field and the plunger springs back to the starting point. The available voltage is high again for a split second then and the cycle starts all over. This is the familiar "clicking" of the starter motor with a dead battery.



The voltage can drop for any number of reasons so the first thing to check is of course the battery. A starter battery should be at 12.6 volts (12 volts is only 25% charged) and be able to take a load test or ½ the cold cranking amps for 15 seconds without dropping below roughly 9.5 volts and should "bounce back" to 12.5 volts within 10 minutes.
Next would be the starter circuit. During cranking the voltage should drop or read no more than 1 volt with one lead on the voltmeter on the positive battery terminal

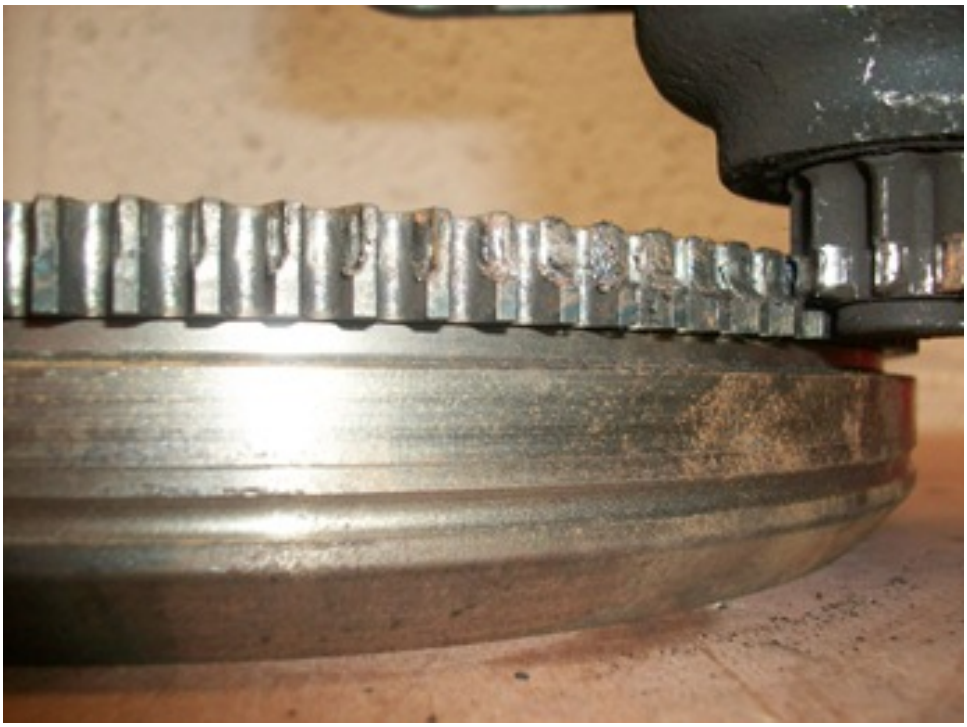
and the other on the “B” terminal of the starter. Same with the negative terminal and the starter body and even across the solenoid. Most of the problems are going to be on the positive battery cable to starter.
The “S” terminal wiring is next with the voltage drop being check between it and the + battery terminal. Drop should be less than 1 volt during cranking. Any more and you should look closely at the key and any relays between the “S” terminal and the battery.
Some good advice is to always use a neutral or clutch safety switch and to use a relay to power the “S” terminal.

Starter Mechanical Issues
If all of this looks good then pull the starter to check for mechanical issues. The overrunning clutch should be stiff and only lock to the shaft in one direction only. The pinion can’t have any chipped teeth and should have to be pried out against the solenoid plunger spring.



Installation Issues
All starters except for the GM vertically bolted starters are designed to register or locate either into the engine or the transmission to set the pinion to ring gear center distance. Locating off of bolts holes is not enough. Having said that there is a lot of

variation between starter pinion gears and also ring gears. Still, if the register method is used then the two gears should engage correctly.
How much engagement and backlash is correct depends on the pitch of the gear teeth. Fine pitch teeth like the 12/14 pitch typically used on GM products have less clearance than the 10/12 pitch used on Chryslers. The greater the clearance the more chance that a tooth will be broken off. Too little clearance will result in teeth wearing prematurely and/or the pinion "hanging" or sticking into the ring gear and spinning at engine speed. With a 10 tooth pinion and a 130 tooth ring, the starter pinion rpm is 2600rpm at 200rpm of the engine. If the starter hangs and the engine revs to 1500 rpm the pinion is spinning at 19500 rpm and the overrunning clutch is not likely to be able to slip at that speed. The gear reduction and armature of the starter are likely to be destroyed.
To keep that condition from happening the starter not only uses the overrunning clutch but also the solenoid return springs and the pinion gear is made with a slight taper to it so that clearance is least at the base of the gear. By design the pinion gear is not supposed to travel the full width of the ring gear. ½ to 2/3 is sufficient and keeps the pinion gear from "hanging" or sticking. If you are skeptical of this look closely at a worn ring gear and you will see that the wear that shows is about ½ way across the face.



Problems with Adapting a Starter
The issues we deal with usually are a result of the parts we are adapting and almost always involve the axial or longitudinal engagement of the starter. Usually a customer pulls the pinion gear out and does not think that it is going across the ring gear far enough. Many times it is because they don't understand the standard engagement of ½ to 2/3 (see above) or they are not pulling the gear out far enough.

The Nippon Denso starter we primarily use is a tough, durable and inexpensive unit that has been used nearly unchanged for 30 years. The basic design has been scaled to work on every thing from lawn tractors to 6+ liter diesels. One of the secrets is in the overrunning clutch assembly. Inside is a stiff return spring and a scroll shaft. Once the armature motor spins the scroll shaft throws the pinion shaft out against the return spring. The faster it spins the farther it throws. Prying it out generally does not reach the full throw of the gear. It must be spinning. If you are not certain then mark the ring gear with a Sharpie, Dyechem or Prussian Blue and start it several time to check the engagement the entire wear pattern. Remember that the gear is tapered so the leading edge shows only a light wear pattern. If it is less than ½ across the ring gear then contact us.

If there is an issue it is possibly a result of tolerance "stack up". As the engine is assembled the slight differences in each part or tolerances begin to add up. If the crankshaft journal to journal length can vary +/-.010" and the thrust location in the block can vary +/-.010" and the flange thickness can vary .010" etc. pretty soon we can have .050" difference from engine to engine. Then add the other parts' variation, the ring gear, starter assembly, flexplate and hub spacer you can see that that this "stack up" of tolerances could quickly add up to .100" total. That 1/10" does not sound like much but when you consider that most ring gears are around .400" then and we are shooting to engage between .200" and .300" then -.100" on an assembly that is already at .200" leaves only .100" engagement, way too little. So once in a rare while we a encounter a situation where the axial engagement is not enough. At that point, if the other critical dimensions such as the converter engagement or "pull back" is correct then we can usually correct this with a modification of the starter.

We have also received calls regarding the radial engagement of the starter. In general these are because the customer is not locating the starter into the adapter plate correctly. The design is based on the outer edge of the starter contacting the edge of the starter hole in the adapter plate. The starter should be forced to the outside, away from the crankshaft, while the bolts are tightened. This will ensure that the starter registers correctly.

If you have or suspect you have a radial engagement problem contact us immediately. The design of our adapters, using the dowel pins on the engine and the starter register mean that if the starter is too close or too far then there might be an issue with crankshaft centerline. This has to be addressed since any concentricity problem could result in an imbalance condition or premature transmission pump failure.

Since we build our adapters based on engineered drawings on the latest CNC equipment and check them at every step there is very little chance that you will ever run into a starter engagement issue. But if you do or just have a question, please contact us a soon as possible.