

Testing Springs

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“It’s just a spring, and it feels OK.” You may have heard this before, or you may have even said it yourself. But in reality, there is a lot of science involved in making a spring. Each and every one is designed to provide exactly the right amount of pressure at just the right point on, what some of us might consider, a “more important part”.



Figure 1—A variety of springs from starters and alternators

Seldom do we question the condition of a spring or the amount of pressure it applies, unless it is broken or rusted away. Consequently, that “more important part” is sometimes blamed for a problem that was actually created by a spring - a spring that may have felt and looked OK, but it really wasn’t. Almost every alternator, starter and generator uses springs—brushless alternators being the sole exception. Yet, few rebuilders give springs the attention they deserve.

An interesting fact: Steel springs are one of the most efficient energy storage devices ever invented.

Most of the springs we use today are manufactured from steel alloys commonly known as *spring steel*. This steel can be either high-carbon or low-carbon, with the addition of nickel, silicon, chromium, manganese or phosphorus. The composition will differ depending upon the application. An object made of spring steel will return to its original shape, despite significant bending or twisting. However, if too great a force is applied, the spring will be deformed and become permanently damaged. **You cannot repair a deformed spring.**

Springs used in our industry come in many different shapes and sizes, depending on the amount of pressure required and to what and where that pressure must be applied. There is a wide variety, as you can see in *Figure 1*. In fact, some springs do not look much like springs at all. They all fall into one of the following six categories.

Compression Coil-Springs

Compression coil-springs are the most common type that rebuilders will see. They are loosely wound, and they are typically used to push something—like holding a brush against a slip ring or pushing a drive pinion out of the ring gear after an engine starts. The coils of compression springs may be wound in either a right-hand or left-hand configuration. You can identify the direction by standing the spring on its end. If the wire goes up from the bottom



Figure 2—Denso OSGR shafts and springs

toward the left, it is a left-hand spring. If it goes up from the bottom to the right, it is a right-hand spring (see *Figure 2*).

In most of the cases, it really does not matter in which direction the spring is wound. However, there are instances where it matters quite a bit—like when a spring is used to exert pressure on a shaft that has helical splines. Note the difference in the two Denso drive shafts in *Figure 2*. You

can see the CCW drive shaft on the left is used with a left-hand coil spring, and the CW drive shaft on the right uses a right-hand coil spring. This ensures that the spring is not unwound during compression, which would happen if these springs were interchanged. If the spring is unwound during compression, the diameter of the spring will enlarge. This will not only change the pressure being applied by the spring, but it might also allow the spring to slip over its keeper.

Extension Springs

Extension springs are similar to compression coil-springs, but their coils are wound tightly together, and they pull rather than push. They have been used on some generator and starter applications. On some heavy duty Delco Remy generators, extension springs are used to pull the brush holder towards the commutator. Tecumseh starters used tiny, long, extension springs that stretch around the back of each brush (see Figure 3).

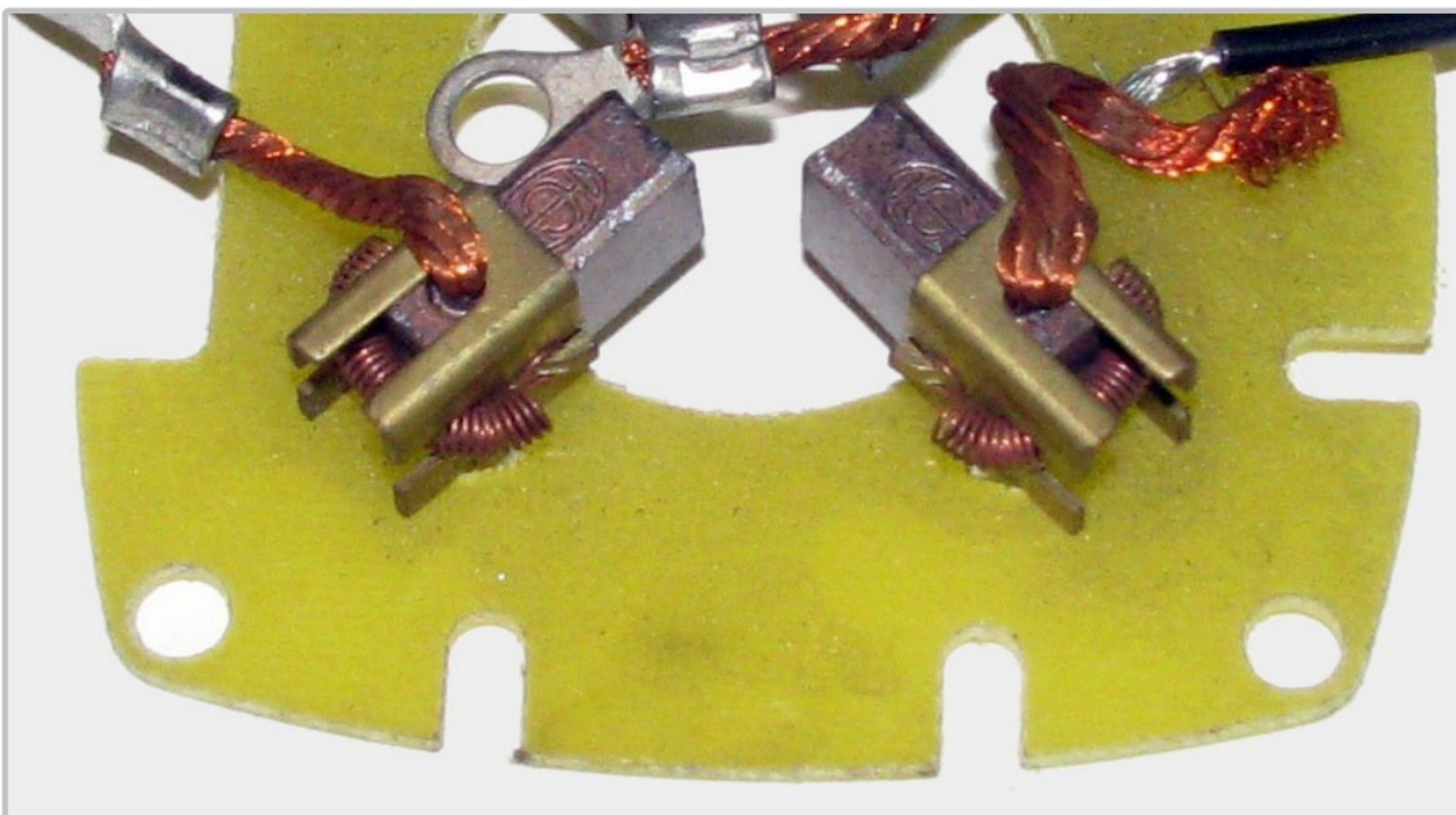


Figure 3—Extension springs on Tecumseh starter brush plate

Torsion Springs

Torsion springs are a little different, as they are made to compress by twisting one end against the other. They have been used in many generators and starters as brush springs. They also come in left-hand and right-hand configurations, but you won't be able to get them mixed up, because they fit only one way (see Figure 4).

Flat-Form Springs

Flat-form springs have been used in millions of Delco starters from the 1950s through the 1990s. They push the brushes towards the commutator on 5, 8, 10, 15, 20, 25, 27, 30 and 35MT starters. Ford MOD starters also used this type of spring (see Figure 5).

Wire-Form Springs

Wire-form springs are much less common in rebuilding. A good example we have all been exposed to is the spring used with Hitachi solenoids, which serves as both an indexing spring and a plunger spring. It accomplishes the dual role by applying pressure at the pivot point of the shift lever. This type of spring is difficult to test accurately (see Figure 6).

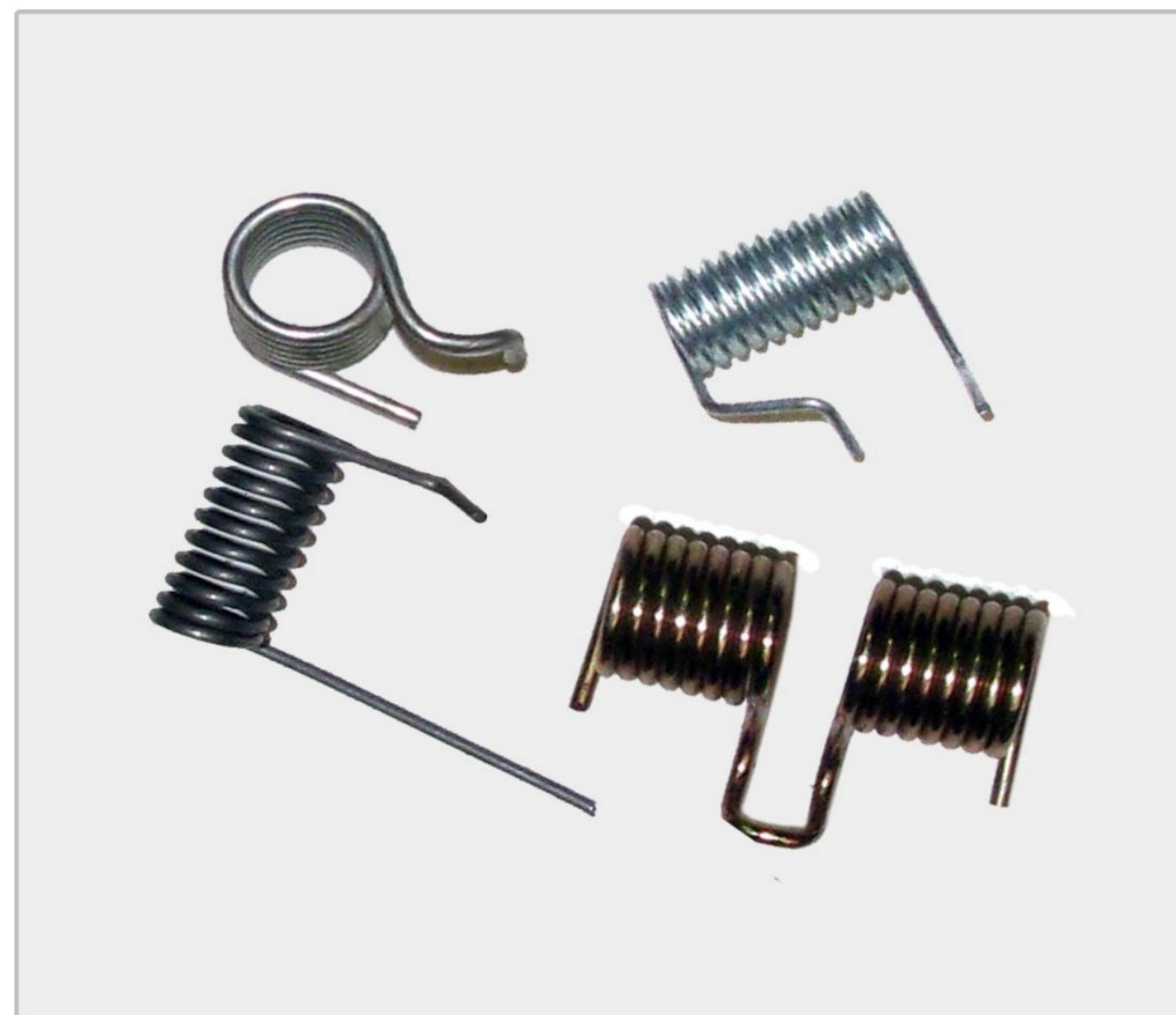


Figure 4—Assorted torsion springs

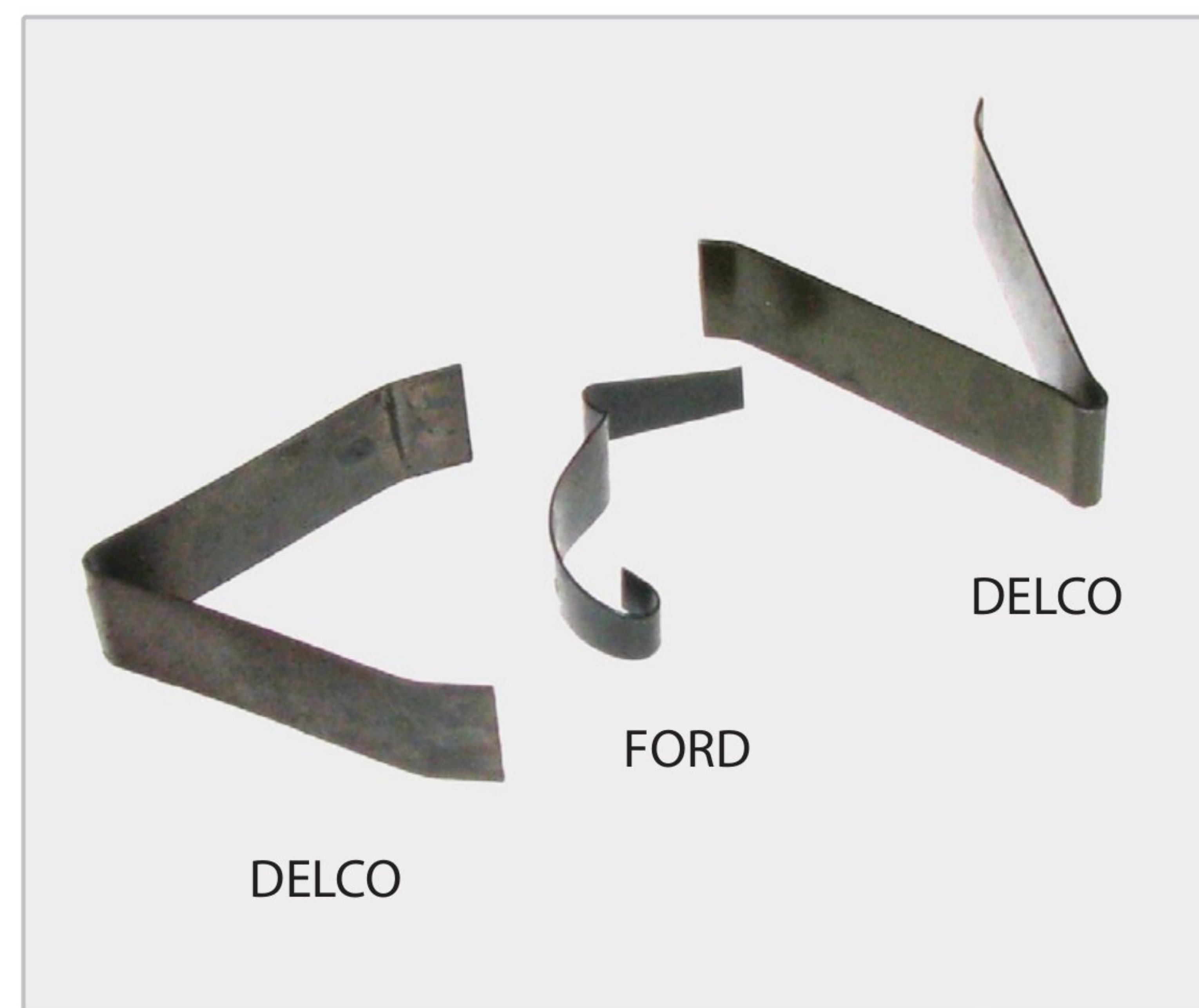


Figure 5—Delco and Ford flat-form starter brush springs

Constant-Pressure Springs

Constant-pressure springs are a fairly recent development in brush-spring technology. A constant-pressure spring is made of a tightly wound coil of steel ribbon (see Figure 7). Delco first used them in 22SI alternators (see Figure 8). Prior to that constant-pressure springs had been used in DC motor applications. The advantage they offer is providing a fixed amount of pressure on a brush throughout the brush's wear life. A traditional compression coil-spring can't do that. Did you ever notice how long a 22SI brush is? That length would not be possible if Delco had used a compression coil-spring.

You may be thinking that you can't really test springs, but in fact, the tool you need to do this is readily available and fairly inexpensive. If you are an avid fisherman, you may already have one. It is called a *spring scale*, and it is designed



Figure 6—Hitachi wire-form solenoid spring



Figure 7—Constant-pressure springs

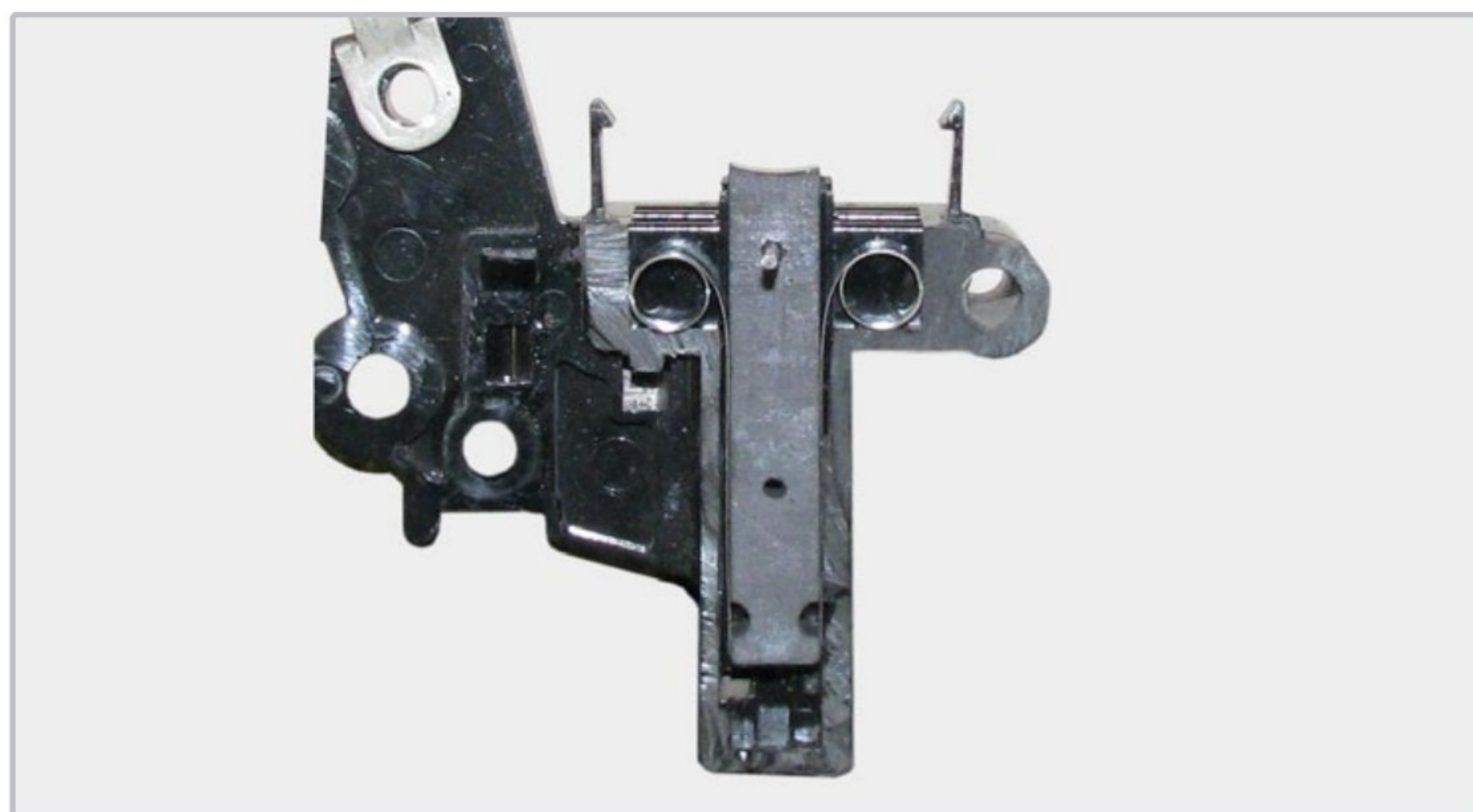


Figure 8—Cut-away 22SI brush holder w/constant-pressure springs

to measure the weight of an object—usually a fish. However, with a little ingenuity, you can use it to measure the amount of pressure a spring will apply when collapsed a specific distance.

Make Your Own Tester

You will need to make a device to hold and collapse a compression coil-spring. We made ours mostly out of parts found lying around a rebuilding shop:

- a 10" piece of aluminum bar stock
- a ruler
- a couple of brackets from a JIMCO conversion kit¹
- an assortment of bolts, nuts and washers.

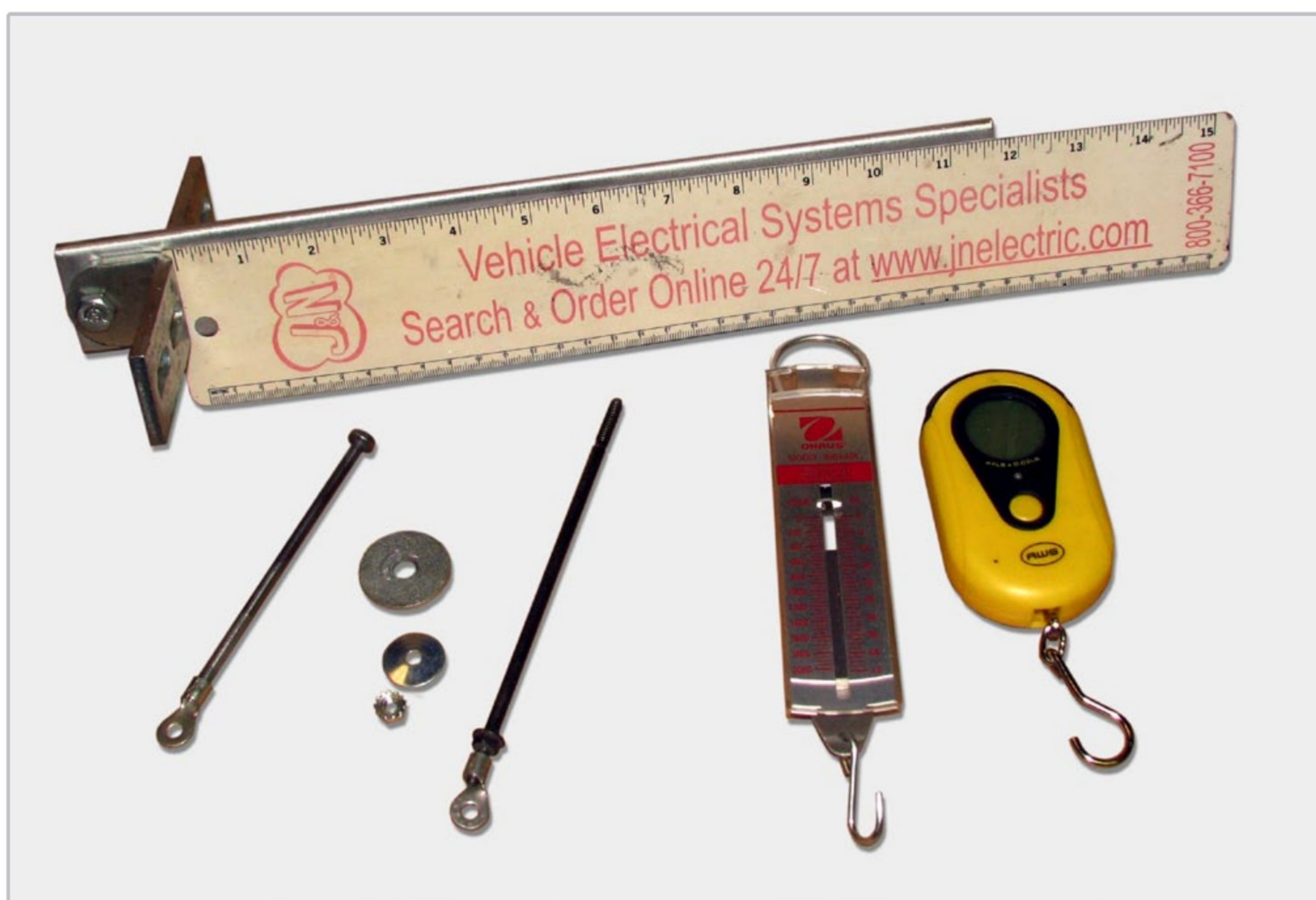


Figure 9—Testing fixture and scales

We used a tap to thread the barrel of a 10-gauge ring terminal so that it could be threaded on to the end of a 5MT thru bolt. We also have two spring scales. One can measure up to 40 pounds, and the other is capable of measuring fractions of an ounce. Between the two scales, you can test any spring you will encounter (see Figure 9).

Before testing, estimate how far the spring will be compressed in the actual application. Then measure it compressed at that distance (see Figure 10). Aside from spring specifications published in Delco service manuals, there is very little information available on what spring tension should be. Your best option is to compare the readings from several different springs if you have them, at least one being a known good original equipment spring.

Generator and starter torsion springs can be tested in the brush holder as shown in Figure 11. Test with new brushes, and measure the force that is required to just lift the spring off the brush. You can test Delco or Ford flat torsion-springs using a homemade hook (see Figure 12).

Spring Tension Matters!

So why is brush spring tension so important? The pressure holding a brush against a commutator or slip ring must be just right. Too much pressure creates friction and heat which will wear the brush out and overheat the commutator or slip ring. Too little pressure causes excessive arcing, which is actually worse. The arcing burns the brush, along with the commutator or slip ring. Arcing is responsible for worn out slip rings and commutators with flat spots. A compression coil-spring will always provide the most pressure with a new brush and the least with a worn brush that is near the end of its travel distance. That is why a constant-pressure spring is such a big improvement.

We are not suggesting that you must test every single spring—they very seldom go bad, unless they are rusted or have been heated excessively. However, we are suggesting that you keep an open mind, and that you pay attention whenever you remove or replace a spring. Take care when you replace an OE spring with a new aftermarket spring. Don't judge a spring by its looks alone. When you encounter a problem with any unit, don't overlook the springs.

¹JIMCO sell the kit bracket part shown separately. Order part 630-B2003Z. www.jimcotest.com



Figure 10—Using the test fixture



Figure 11—Testing a starter torsion-spring



Figure 12—Testing a flat starter torsion-spring

