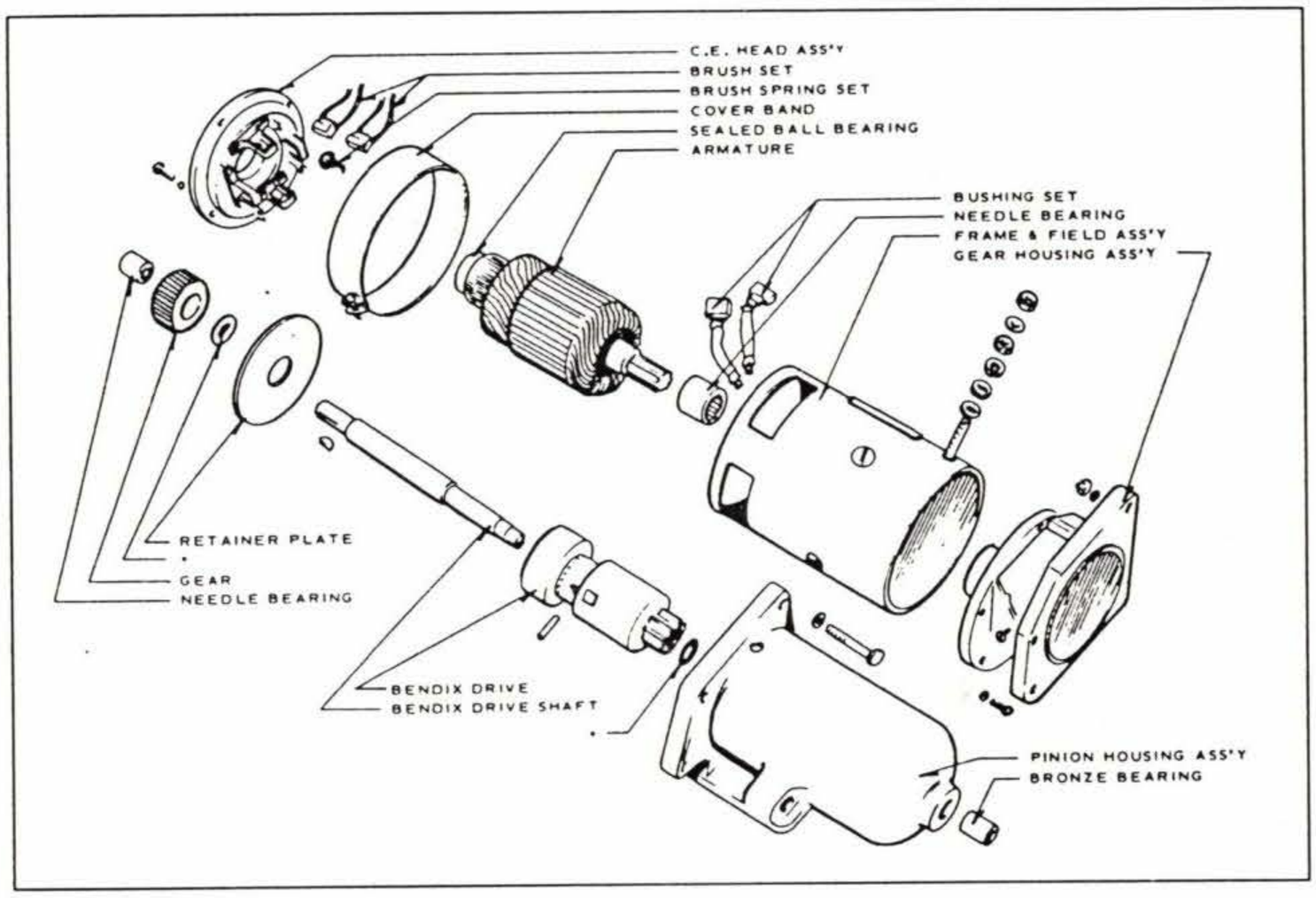
Slow Cranking: Causes and Cures

Slow cranking has been a persistent complaint of pilots from time immemorial, no doubt partly because aircraft batteries are so small, and partly because engine displacements are so large. And also partly because aviation oils (until recently) have tended to be molasseslike in consistency. Multivis oils have abated the latter problem somewhat, but the problem of slow cranking remains.

Easy answers are few. Wherever possible, aluminum battery cables should be replaced with copper ones (for less 'IR' drop), and it would no doubt help if tail-located batteries (as in the 182) could be relocated to the engine compartment, although weight-and-balance considerations preclude this for most operators.

Then too, some owners just need to up and face the fact that airplane batteries generally aren't good for more than two winters of (ab)use. A new battery will go a long way toward fixing many owners' complaints about slow cranking.

Unfortunately, some owners will find that even a new battery doesn't improve the FWF turnover rate. When the battery has been replaced and connections cleaned, and the engine *still* won't turn more than 30 or 40 rpm on startup, it's time to look at the starter motor (and *its* connections).



Exploded view of typical Prestolite starter motor with Bendix drive.

Starter TBOs

Pilots are often surprised to learn that there is no carved-in-stone TBO on starter motors. According to Prestolite and Delco (makers of the majority of units in current use), starter motors are—like alternators and generators—an 'IRAN' item (inspect and replace as necessary). This is because the frequency of use, the conditions under which the motor is operated, etc. vary so much from plane to plane.

As a rule, starter motors get overhauled on one of two occasions: (1) When the starter begins to show signs of disrepair; and (2) at the time of engine major overhaul. (The "major overhaul" price quoted to you by an engine shop should include a rebuilt starter motor.)

Before assuming your starter motor is the actual culprit in a slow-cranking episode, you should make a few precautionary checks. (We have known many owners who've paid for costly starter overhauls only to find out later that their slow cranking

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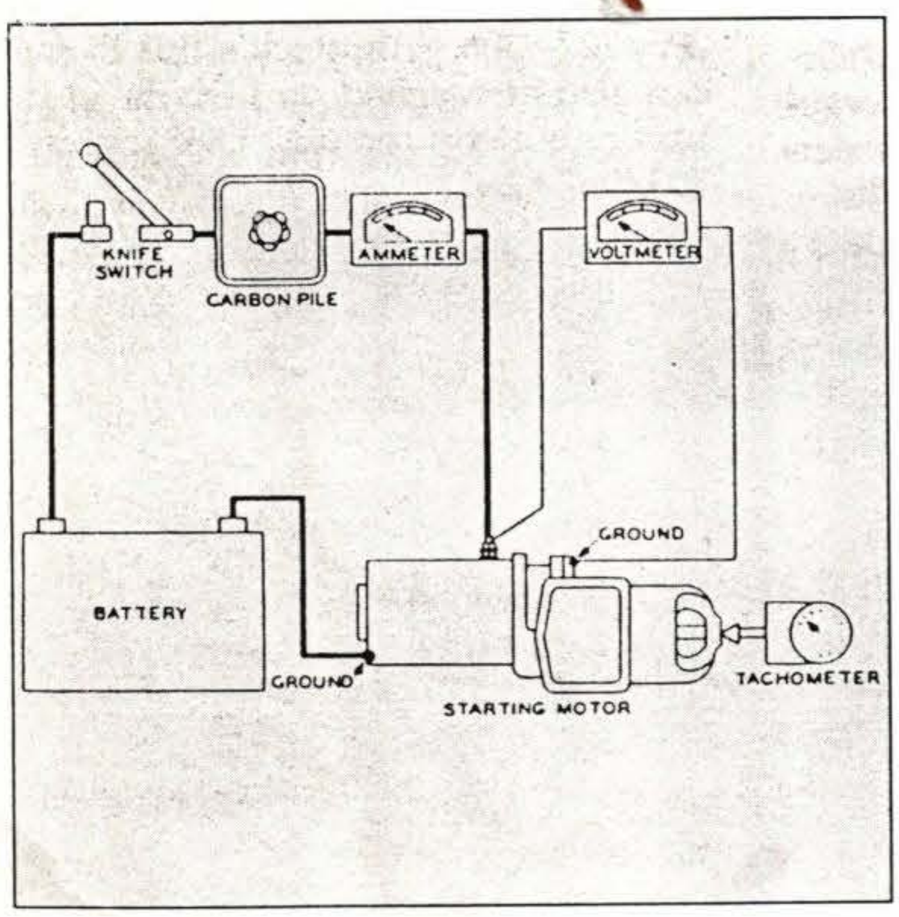
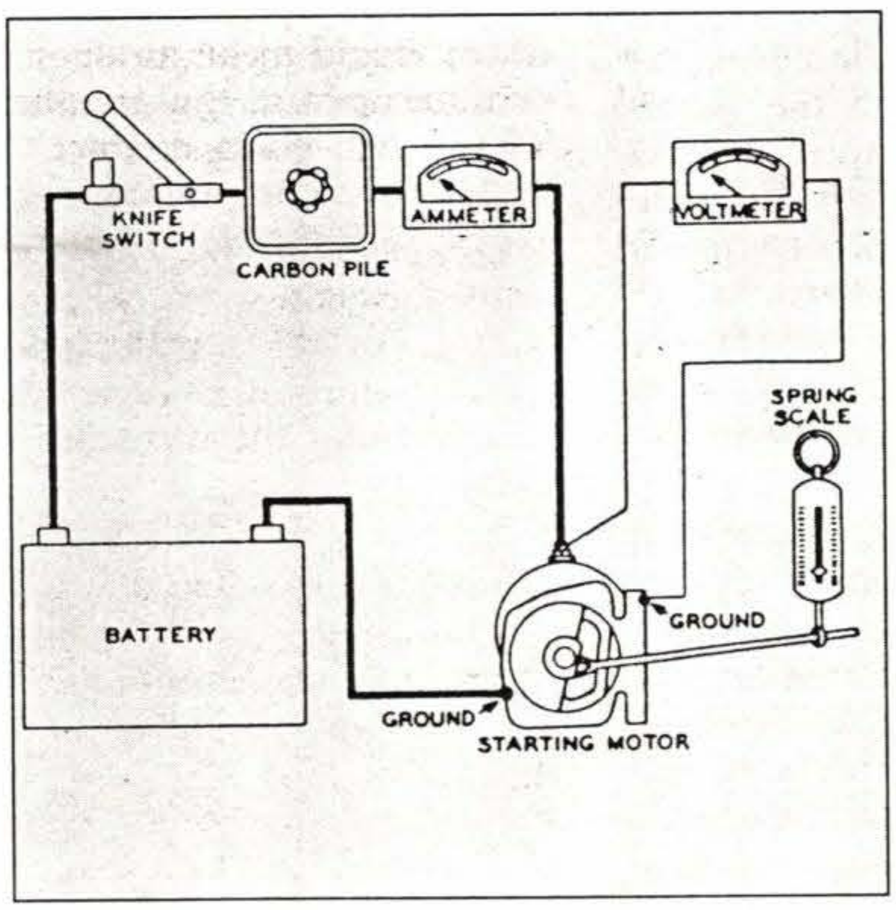


No-load test components.



Static torque test components.

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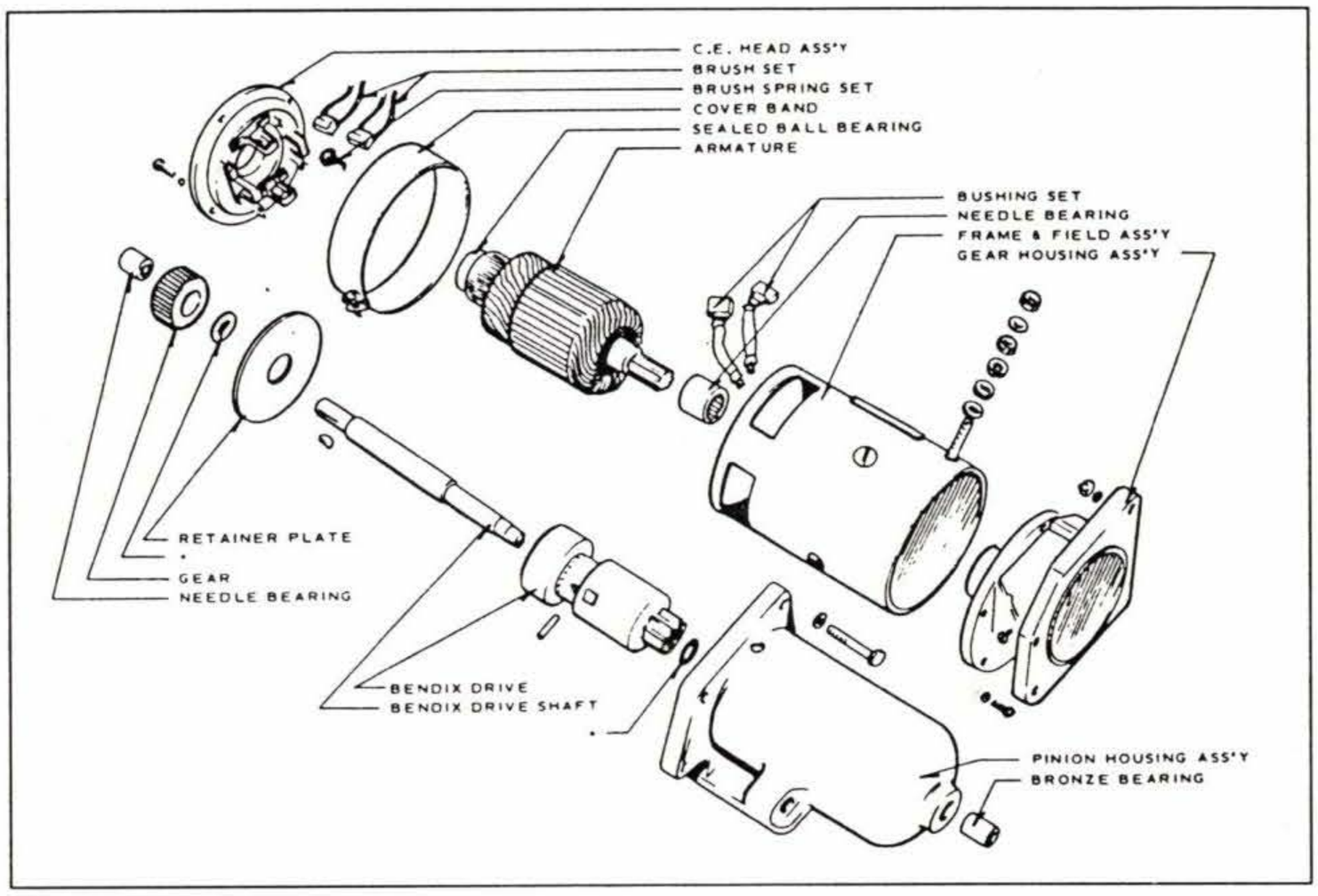

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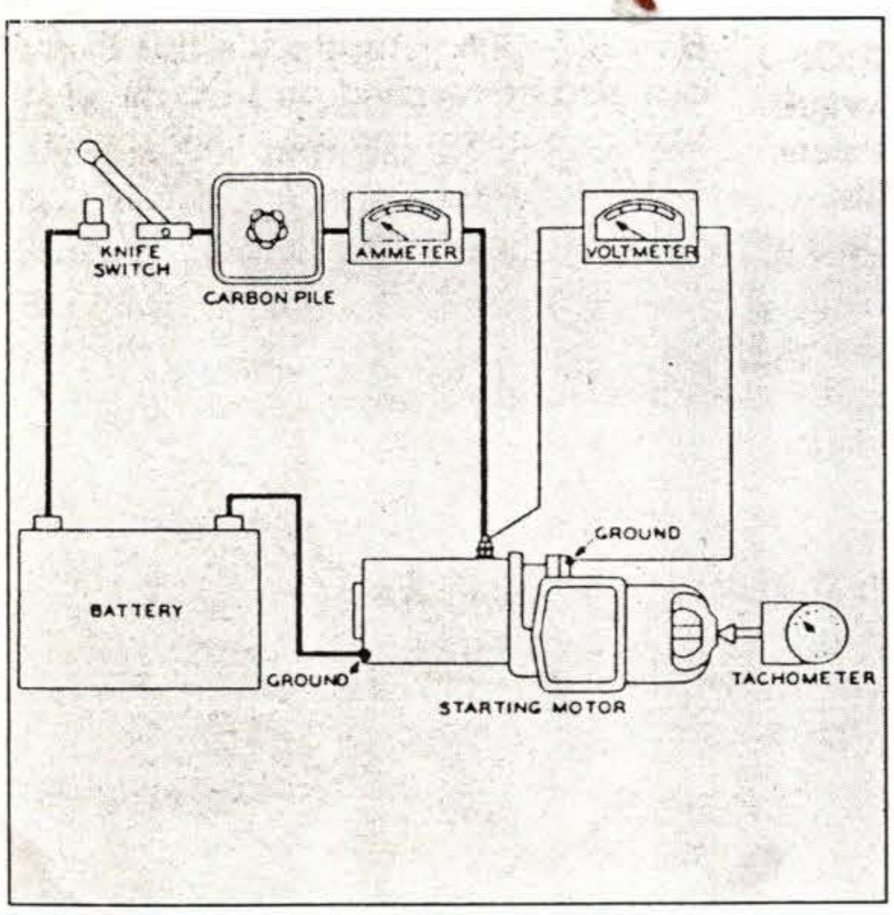

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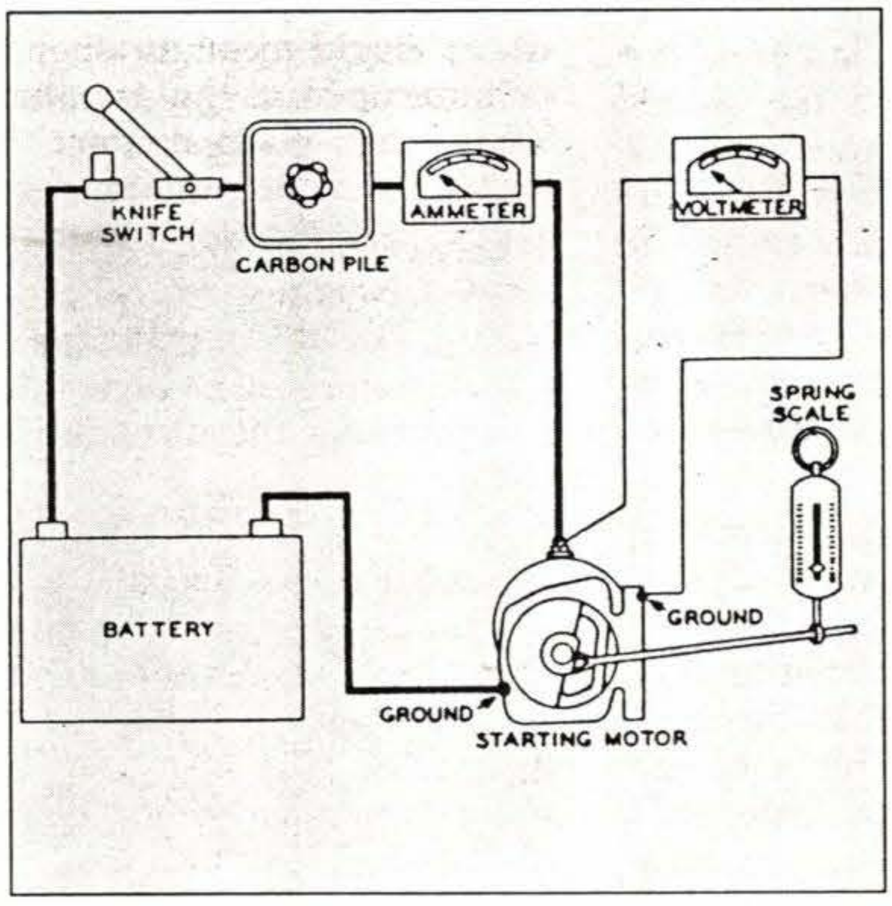

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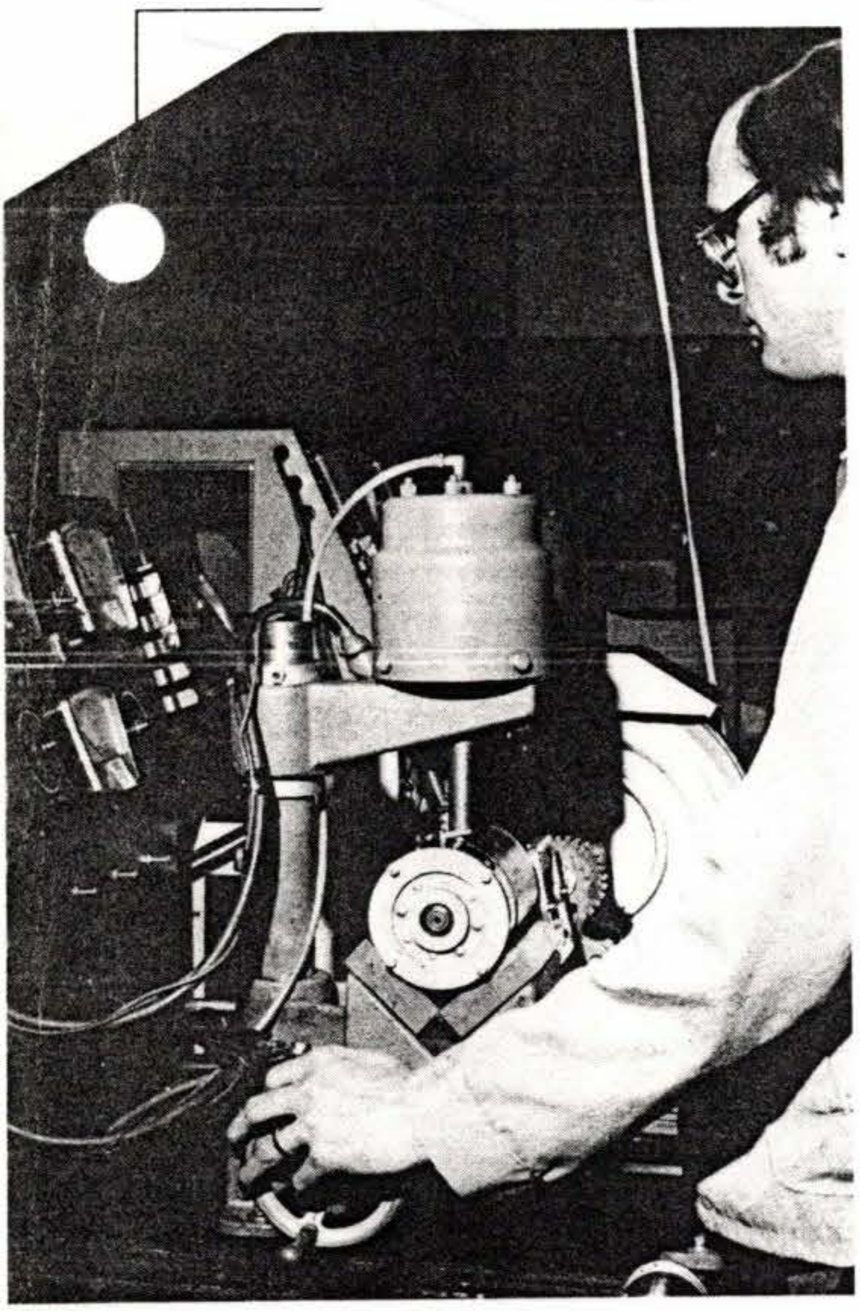

Proper testing of a starter motor includes a bench check of stall torque, stall amperage, and no-load rpm.

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episode was due to a bad contactor or poor connection.) Prestolite recommends checking the voltage loss from the battery to the starter motor during cranking (observing due caution with respect to whirling propellers); the drop should be no more than 0.2 volts per 100 amperes of current draw. (The voltage loss from the battery ground post to the starter frame should be no more than 0.1 volt per 100 amps.) Better yet, connect a jumper around any switch or solenoid (contactor) suspected of being defective, and see if the engine cranks faster with the jumper in place. If it does, you know where the problem is.

Note that a properly working starter motor (motivated by a properly charged and functioning battery) will draw substantial current in normal operation—a couple hundred amperes isn't unusual for a 12-volt system. (The exact amount depends on many things, including the viscosity of the oil in the crankcase.) In addition, voltage may fall well below 12 volts (or 24, on a 24-volt aircraft). In a total "lockup" condition—where the starter won't turn at all—a typical 12-volt Prestolite motor will draw 500 amps or more, producing 40 ft-lbs of torque.

No-Load Test

Some idea of how healthy a starter motor is can be gotten by removing it from the plane and running it with no load. (Note: If you can, hook a tachometer up to the shaft.) Ideally, you should also put a carbon pile or other variable-resistance "voltage controller" in the circuit in series with the motor, so that you can control the voltage seen by the starter. When you do this, your Delco-Remy starter should spin 3,000 rpm at 10.6 volts, and it should draw 60 amps in the process. (That's for a 12-volter. A 24-volt unit should make 2,800 rpm at 23.5 volts, with 55 amps' draw.) A Prestolite 12-volter should achieve at least 2,000 rpm at 10 volts, drawing 75 amps. A 24-volt Prestolite motor should run 1,800 rpm (minimum) and draw 35 amps at 28 volts or so.

What if you don't get these numbers? Low speed and high current draw means tight bearings, a dragging (possibly bent) armature, etc.—i.e., high friction in the motor somewhere. It could also mean a shorted armature. Low speed and *low* current draw would indicate a high internal resistance due to poor connections, dirty commutator, or possibly worn brushes.

Failure to operate, with *no* current draw, would mean an open field circuit, an open in the armature somewhere, or poor contact between brushes and commutator segments.

Failure to operate with *high* current draw means a direct ground in the terminal or fields, or frozen bearings (which you could have determined by hand-turning the armature to begin with).

Miscellaneous Checks

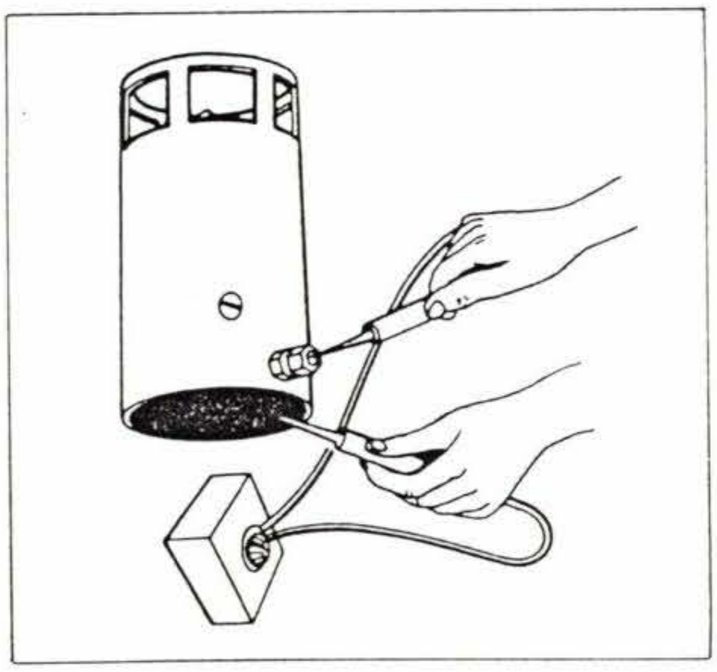
The no-load test isn't the only test of a starter motor's condition. A repair shop will also check the unit's torque in a static lock test (by hooking a brake arm and spring-type fish scale to the shaft, for example). As indicated above, the stall torque (and amperage draw) can be quite high. The applicable specs vary from motor to motor; a complete listing of specs is not possible here. For further information, write directly to Prestolite, P.O. Box 931, Toledo, OH 43694 or Delco-Remy, 2401 Columbus Ave., Anderson, IN 46018.

Still, there are other checks an owner can perform. One is simply to check brush condition. Brushes that have worn down beyond half their original length (compare with new parts) should be replaced. Brushes should also be making firm contact with the commutator. Brush tension should be somewhere between 1.5 and 2.5 lbs.

Field coils should also be checked for grounds. With coil ground connections disconnected, you should be able to touch one probe of a hot light to the motor's frame and the other to the starter terminal without getting continuity (be sure brushes aren't touching the frame). If the hot light lights, the fields are grounded and should be repaired or replaced as necessary.

If the motor checks out good (and is getting juice) but the engine doesn't want to crank, or there is noise coming from the Bendix drive, check the Bendix per the article in *LPM* in April '87 (p. 8).

Should your starter need rebuilding, try Aerotech (FAA Certified Repair Station 713-13), 815 Huntington Rd., Louisville, KY 40207 (502/895-5262) or Electrosystems, Inc., P.O. Box 273, Ft. Deposit, AL 36032 (phone 205/227-8306. (Aerotech's Bill Evans can also be reached on LIX, the electronic bulletin board. Dial online: 203/967-8260.)



Testing fields for grounds.