

Power Problems: Is It Time to Say Goodbye To Your Generator?

Diagnostics & Adjustments May Save The Day... And Your Wallet.

By

Fred Lopez, Editor

Our 'disposable society' seems to have a central, underlying fixation with ridding ourselves of things that haven't nearly completed their life cycles. We opt to replace perfectly fine cars and SUVs with low mileage because the interior succumbed to a venti latte with an improperly affixed lid. We rid our living rooms of 2-year-old televisions in favor of High-Definition plasma sets-even though there's not much to watch in HD! Even contractors, who often pride themselves as being a thrifty and somewhat frugal lot, will often hastily toss a tool or piece of equipment without fully investigating all available remedies. So, before you toss your misfiring, under performing power source and dash off to Home Depot for a new one, take another look at what may be ailing your generator.

Generators are *indispensable*. Despite today's seemingly infinite number of advanced cordless tools available, the fact of the matter is work sites would be relegated right back to 19th Century status without them. Among the myriad of uses, we rely on them to illuminate dark basements, power pavement breakers and provide enough wattage for the hungriest air compressors. Perhaps, most importantly, they provide the needed recharge to our venerable arsenal of cordless batteries drained after a few hours labor.

The First Sign Of Trouble: An Odd Noise

Every machine has its own unique rhythm. Clinks, clatters, clunks in an engineered symphony that we become accustomed to. Our ears become attuned to the subtle nuances of each and every noise, which is how we know-or at least suspect-something is amiss. So more often than not, when you suspect that your generator's engine or generator head (or gen-head, in industry-speak) doesn't sound correct, this denotes a problem.

If you hear..

- *A continuous engine surge-* (anything longer than a few minutes while a high wattage equipment like a multi-phase compressor starts) The unit is being overtaxed and probably is exceeding its maximum surge-watt rating. Shut down immediately and reduce the load.
- *Bearing whine or squeal* -An overload condition exists. Restart with no load. If noise persists than an alternator bearing has likely failed.

- *An intermittent engine surge or pulsing*-The problem is most likely attributed to poor engine maintenance, i.e.; dirty fuel or a clogged fuel line. We'll discuss this scenario in more detail in the next few pages.

Diagnostics: Pinpointing What's Wrong

Diagnosing an engine and/or electrical problem is a bit of an art. You have to employ basic engine repair know-how, be methodical and *think sequentially* when trying to ascertain what has afflicted the unit. I'm assuming the reader has a basic understanding of engine repair and maintenance and a basic understanding of electrical theory as well. I'm also expecting readers to employ more than a modicum of common sense when working around gasoline and electricity. If after reading this article and your generator's documentation you don't feel confident about attempting your own repairs, **DO NOT ATTEMPT TO REPAIR IT.**

The 'Listening Diagnostic' is essential in beginning your diagnosis of your generator. You know what it sounded like when you first pulled it out of the box, filled it with gas and oil and started her up. If you purchased it used, you know what it sounded like when it was operating smoothly and powering your equipment. In short, *trust your hearing*. Now that you have noted any odd sounds emanating from the machine, visually inspect the unit when it is both running and switched off. You're looking for leakage of fluids, loose nuts and bolts, brackets and hangers, etc. Don't expect to immediately link a strange sound with a visual observation. For example, a bearing that has become fried because of an overload or lack of lubrication will not be visually apparent until the gen-head is separated from the engine, even then it may be hard to detect without some specialized tools.

For this article, we'll be utilizing a Porter-Cable H1000 10,000 watt generator and a Porter-Cable H650 CS 6500 watt as our test platforms. Both machines employ Honda engines to drive brush less alternators (many manufacturers switched to brush less designs in recent years to boost reliability and reduce maintenance). The engine that propels the H650's alternator is a Honda GX390, a 13hp, single cylinder, air-cooled engine. This particular engine is extremely popular and common in generator applications-as are its lower displacement siblings. The engine in the H1000 is a twin-cylinder Honda, 20 hp , forced-air-cooled type. While these engines are quite durable, the absence or lack of maintenance can cause some serious problems.

Since the alternator won't spin (or produce electricity) without the propulsion afforded it by the engine, we'll begin by making sure our engines are tuned properly before casting a 'suspicious eye' on the alternators or gen-heads. One note, our test machines are low-hour units without any major problems (outside of a neglected air filter or two), so the tuning procedures and tests you'll see are purely illustrative.



Digging Deeper: In Your Owner's Manual

Your first step in diagnosing and tuning your engine is to dig out the owner's manual out from under your truck's seat-its under there somewhere. When you locate it, first take note of the section detailing required periodic maintenance. Often this section will specify how often to change the oil, change a spark plug (s) and purge the carburetor of standing fuel, among other necessary details. If your generator is overdue for any of these-do it while you have your tools out and the time to allot to maintenance.

Hands-on Troubleshooting

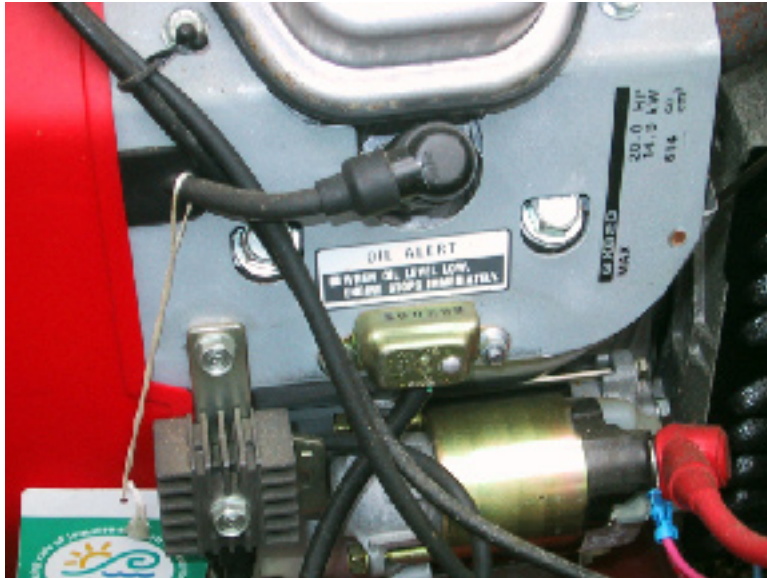
If you haven't located your owner's manual for the engine, try checking on-line at your engine manufacturer's website. Quite often, entire manuals are available in PDF format as well as any addendums that were created after your engine left the factory.

Despite all the technology that has poured into small gas engines since the days of Briggs & Stratton's domination of the marketplace, engines still depend on two simple things to run-fuel and spark.

First, establish that fuel is available to the carburetor. Fuel should be fresh and not have been allowed to mix with water or any other substance. If you suspect that it has-drain it in an approved container and legally dispose of it. Contaminated gas will have you pulling the starter cord or pressing the start button until the cows come home, and perhaps longer. The end result being-you'll never get it started. The Honda engines we've cited have sediment bowls on the bottom the carburetor that allow dirt and contaminants to settle into a trap where they cannot advance and clog passageways and ultimately cut off fuel delivery. Even if your engine doesn't have this feature, you can still remove the drain bolt on the underside of the carburetor and allow the fuel to drain. Remember to move the fuel valve on the tank to the 'off' position so 5 gallons of fuel don't spill on the pavement. Also, make sure the engine is completely cool before doing this.

Even after allowing dirty gas to drain from these key areas, contaminants may still remain, lodged perhaps inside the fuel line or fuel filter-or the carburetor itself. Carefully remove the fuel line from the tank and the carburetor. If its sectioned into multiple pieces, carefully disassemble these as well. Now run a few blasts of compressed air through the lines, this should dislodge any dirt particles that have accumulated. Do not try to clean the fuel filter with compressed air as this will damage the delicate filtering media, instead, replace it. While the air hose is handy, clean your air filter and re-oil if your owner's manual calls for it.

Finally, reinstall all hoses, filters and drain bolts/plugs. Install a new fuel filter, if needed, Check all your connections and take a final look at fuel lines for signs of wear. Now, fill the tank with fresh gasoline.



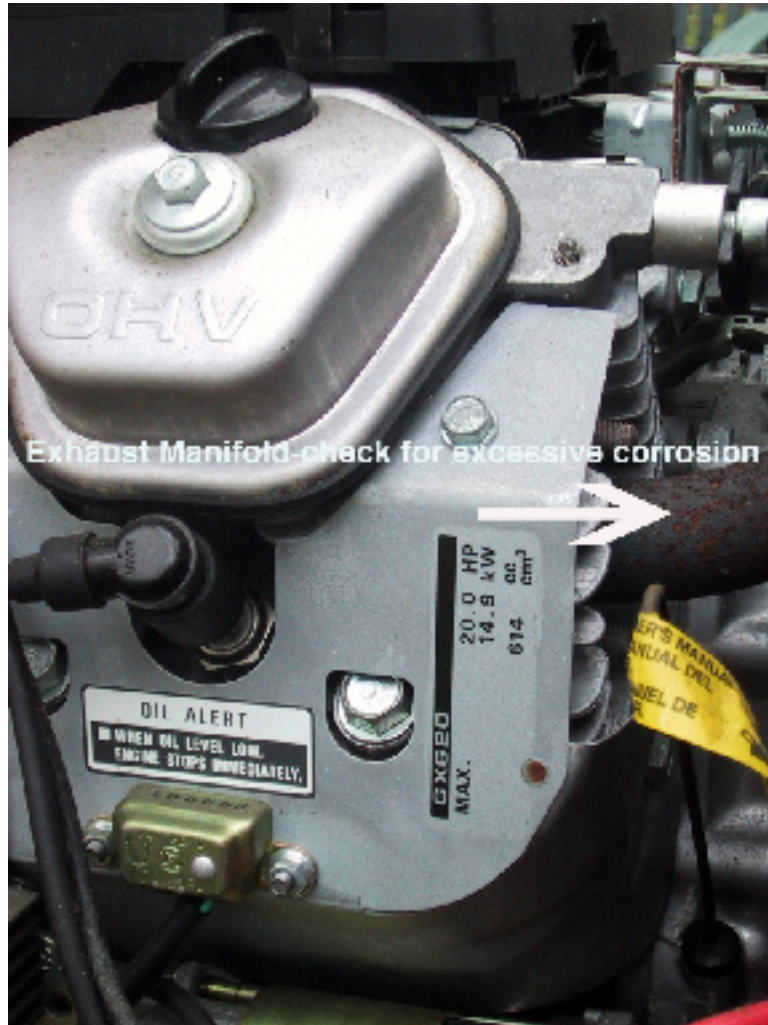
These steps should alleviate most fuel problems with the engine. However, the carburetor may still be in distress. If after the ignition system checks out alright, the engine still runs poorly, the carb may need to be repaired or replaced. The ignition system on most, if not

all, generator engines today is electronic, meaning that maintenance has all but been relegated to checking just a few parts. A key culprit with hard starting and rough-running engines is the spark plug. Even if it doesn't appear worn or dirty, a plug that is gapped incorrectly or is of the wrong 'heat range' will cause your engine to run poorly. Find the correct model plug in your owner's manual and purchase a new ones. Many plugs come pre-gapped so be sure to ask at the parts counter if yours is.



If your engine is equipped with a battery, check the connections. Make sure they are tight, *but not over torqued*. Use a multi meter to check for proper voltage.

As long as you are in the vicinity of the spark plug, take a close look at the exhaust manifold. Inevitably, a bit of rust or scale accumulates on the surface, especially in rust prone regions like the Northeast. Just make sure that something more sinister isn't



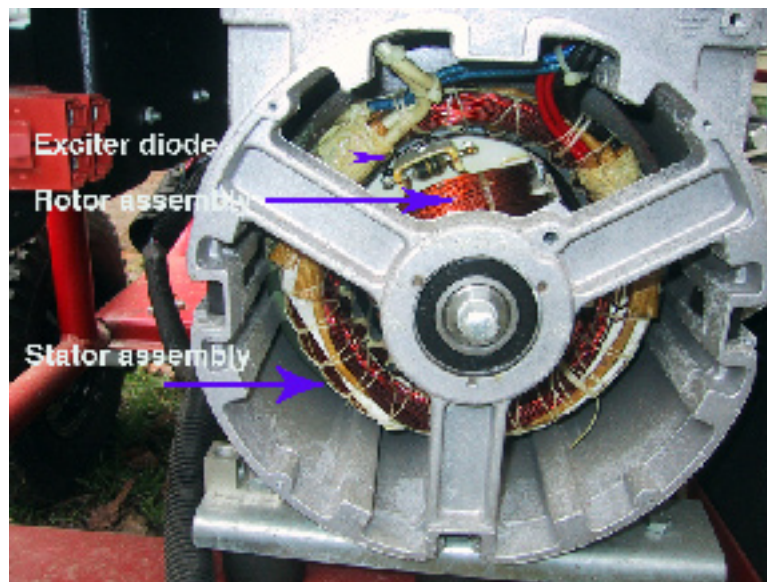
taking place, like deep pitting. These are essentially holes which will rob your engine of power as the engine loses compression-and the RPMs to keep the genhead producing enough wattage for your job site. If there is a hole, repair or replace the exhaust. Keep in mind though, as you perform these evaluations, you should be keeping an approximate 'running tab' of how much all these repairs will cost versus the cost of a new engine-or generator. If you've discovered, for example, that you need a new exhaust system and the cylinder head is cracked, the most cost effective approach would be to get a new engine. However, the engine is just one part of the equation-the gen-head is the other. A new, 13-hp Honda GX 390 engine costs around \$700 and up depending on configuration. Some gen-head assemblys cost \$600 and up. A new DeWalt DG7000E, 7000 watt generator with the same engine can be had for around \$2,200.

Evaluating The Gen-head

Hopefully you have isolated and corrected the problems that have befallen your generator's engine. The vast majority of problems with small gas engines are attributed to fuel problems exacerbated by poor maintenance. Most generators that live out their lives on job sites are abused. Left to run in the rain or snow when they aren't rated for such weather. Run in choking, dusty conditions and rarely seeing an air filter change or cleaning until its too late.

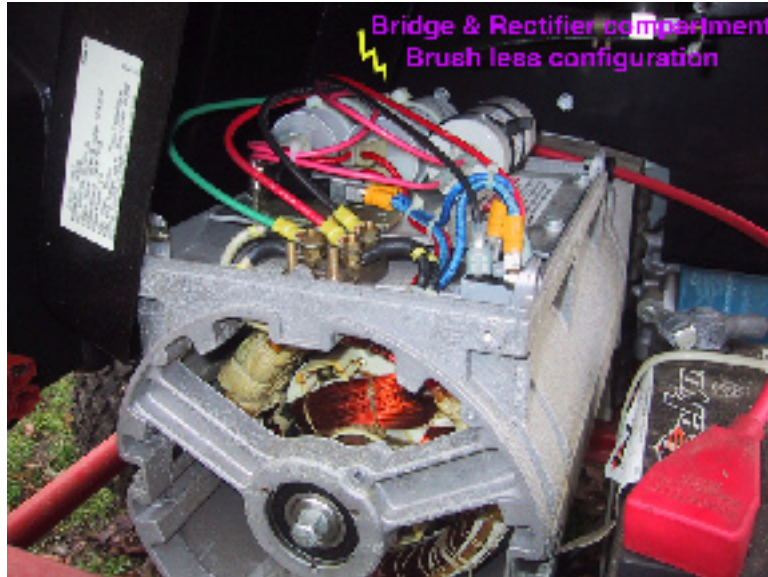
For the gen-head, the biggest problem by far is overloading or exceeding the generator's maximum wattage. A generator, if so rated, can run in a surge-watt phase for a short time to help a high-watt piece of equipment get up and running-but it cannot sustain this phase very long without incurring some form of damage.

In order to understand how it fails, we need to explore first how it works. A generator turns mechanical energy into electrical energy via electromagnetic induction. You may recall from your physics classes of yesteryear that when a coil of wire is facilitated through a magnetic field, voltage is induced in the coil. Inside the gen-head, this magnetic field, or *rotor*, is rotated. This rotation creates voltage in the stationary coils, or *stator*, which envelopes the rotor.



The rotor is the mechanism that is hitching a ride on the propulsion provided by the engine. Seen here above, the rotor is a shaft-mounted iron-core enveloped by a tightly-wound wire coil. The diode serves as sort of a check valve whereby accumulated voltage in the stator is forced to stay in it and not seek a path back towards the rotor. These items can and do fail, but most often it is a relay, relay filter or other component *within* the control panel, or on top of the alternator in its own compartment.

This compartment, which usually sits above or to the side of the alternator assembly, houses the bridge and rectifiers. A typical arrangement for a brush less alternator is seen below.



As you can probably surmise from these photos, the wiring arrangements within these panels and compartments is somewhat complex and difficult to navigate without a wiring schematic. Make sure you have one specific to your generator *before* proceeding with any repair. Additionally, when considering when to repair/replace a component yourself, be honest with yourself. Do you have the patience, tools and time to effectively repair the machine yourself?

Again, the purpose of this article is not to lead you into buying an arbor press to remove a bearing or bench testing a stator for an open circuit (an alternator repair shop can tackle that with specialized tools and equipment). We are looking for the more *common* causes ..

- Loose connections within panels and bridge compartments.
- Burned out connections, blocks and components such as relays, relay filters, idle-control panels and the like.
- Bad ground connections.

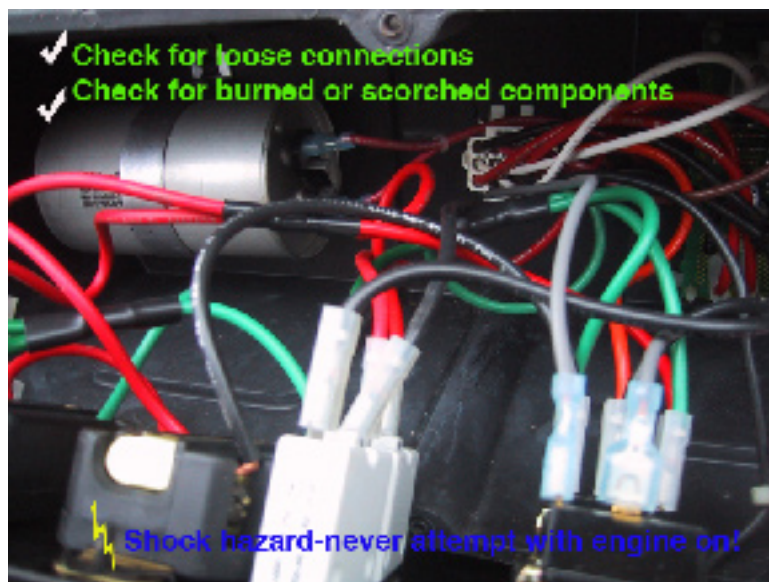
We'll take a look at some the main culprits of alternator/gen-head trouble on the next page.



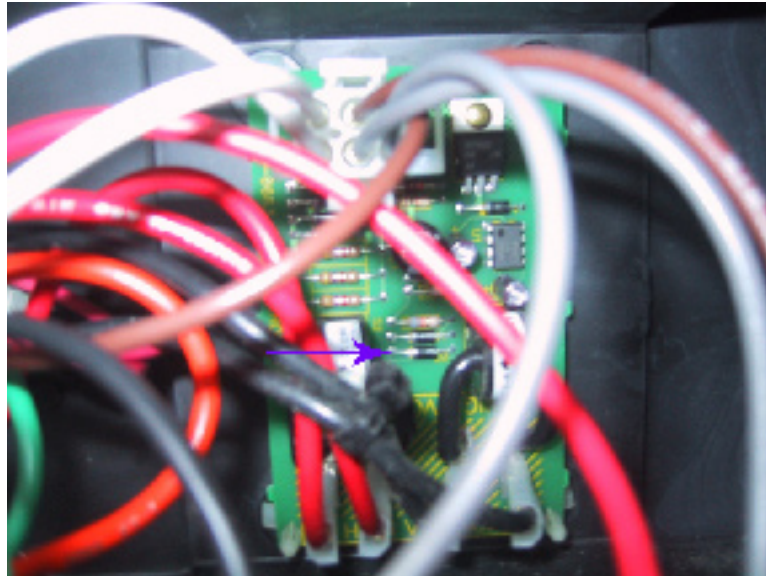
Some culprits are more obvious than others. On this Porter-Cable unit, each receptacle has its own reset switch should one of the circuits exceed capacity or experience an over current. Reactivating the receptacle is as easy as pressing the reset button, but chronic resets indicate something else is amiss. An extension cord gauge may be too small for the amount of current passing through

it, allowing its ampacity to be exceeded, thus heating up the cord dangerously and tripping the breaker on the panel. Always use a heavier-than-needed extension cord, especially with high Amp/watt tools.

Use a *good quality* plug in circuit/receptacle tester on the panel's receptacles to determine if voltage is present. Follow the tester manufacturer's directions and make sure every access panel, door, etc is sealed shut before starting the generator. Give the fuel lines and spark plug cables a once over as well. If the tester indicates no voltage, the receptacle may be bad. Shut down the engine and allow to cool. When cool, remove the panel attaching bolts or screws to reveal the receptacles and wiring. Examine the connectors on the receptacle, if they are scorched, burned, melted or otherwise look as if they've been to hell and back-replace the receptacle. If possible, clean the connectors with fine sandpaper and some electrical connector cleaner. DON'T use spray on lubricant like WD-40 inside the panel-its flammable. The connectors shown here are widely available, so you can splice on a new one if the old one cannot be effectively salvaged.

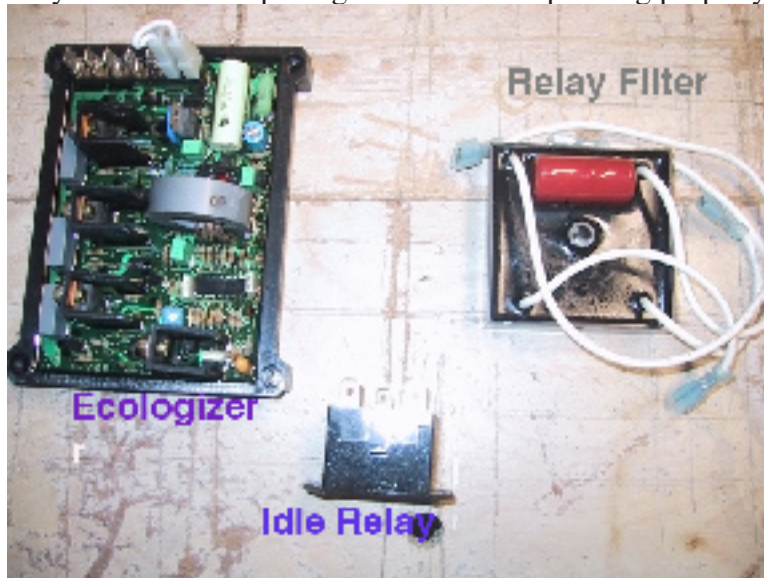


The wiring and components inside the panel and various compartments should look pristine-for the life of the machine. These environments are purposely designed to limit intrusion by dust, soot or other contaminants, so locating burned out components or connections should be obvious after scanning the panel box. Today's generators employ some of the same silicon chips and diodes found in other modern



electronics that grace our homes and offices. These parts are minute, and are often difficult to see so enlist the aid of a magnifying glass for closer inspections. Your examination is NOT about replacing diodes and capacitors-merely noting a burn-out or scorcher for possible replacement-of the *entire board*. For circuit boards, there is nothing the lay person can do to remedy it. However, you can replace a circuit board as you would with a computer in your home or office. Again, having the wiring schematic for your generator available cannot be stressed enough. The image above details the idle control assembly for the H650 generator. If it were to fail, your generator will race unrestricted as if it were powering your entire street. Replacement of this panel is a reasonable repair to attempt. Note the wiring position and disconnect and reconnect connectors sequentially after the new panel is installed. Before replacing a suspected panel, be sure to inspect the electro-mechanical actuator located on the engine that this panel connects to. While the engine is running (and generator is sealed completely) activate the idle control with no load. The switch should activate the actuator to move the throttle linkage on the engine. Its unlikely that the actuator is bad as this is usually quite a durable component, so replace the panel and switch as a unit.

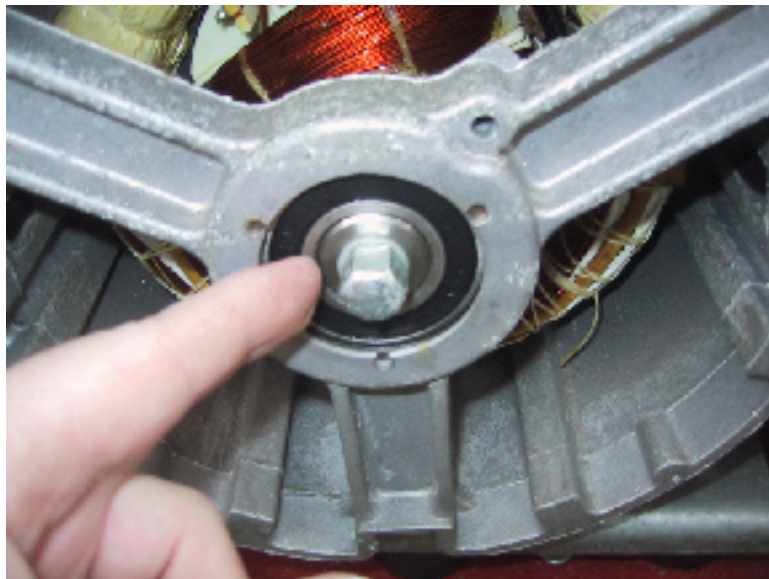
Beyond idle control, there are a few more common components that can lead to generator failure. As seen in the image below, the ecologizer, idle relay and relay filter may individually-or as a set-keep the generator from operating properly. If there is me-



chanically nothing wrong with the linkage or actuator on the engine and the connections are solid among the trio of parts (or quartet or more, which may be the case with your generator) , these devices will undoubtedly have to be replaced.

Stator and Rotor

As mentioned previously, the thrust of this article is about finding some common causes to generator failure outside of the typically solid-state alternator components: the stator and rotor. Its more common to find failure *outside* of these items than with them, as manu-



facturers move to source switches, relays, circuit boards and other components from the lowest bidder. By its very design, the stator and rotor have to be of a specific quality to perform their tasks, and the quality is quite often very high. This is not to say that the stator and rotor will never fail, eventually they will. Quite often that tell-tale sign that the rotor is on its way out is that awful bearing squeal. The image above details a rotor end shaft bearing. Replacement of the rotor and stator is often costly, so be prepared for some sticker shock.

Calculating Cost: Repair Vs. Replacement

What exactly the final tally will add up to is a variable that cannot be assessed here. That's determined upon your machine type, age and availability of parts from the manufacturer-and who performs the work. Check your warranty statement from the manufacturer. If the part or parts that failed are part of an emission controls family of parts, you may be covered by the factory warranty. Read the fine print though, as there is often a list of exclusions as long as your arm.

As a general rule of thumb, if the cost of repair and parts replacement for your generator exceeds 60% of the cost of a new one- retire your old generator and buy a new one to serve as your frontline unit. You can still keep and rehabilitate your generator over a longer period of time, spreading the cost out over a greater period of time with spare change you'd otherwise be spending at Starbucks.

Just remember to always work safely and competently when engaging in any repair of electrical equipment. Don't rush or allow yourself to be rushed through a repair. Its all to easy for a costly and injurious mistake to occur, and for the sake of repairing a generator- it just isn't worth it. Your health and saftey, and that of others, is always paramount. Best of luck!

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