

ARMATURES AND STATORS

Armatures and Stators, that's where the action is! They are the heart and guts of their respective type of machine.

Rotating electrical machines can be divided into two categories-- revolving armature and revolving field.

An armature is defined as that part of an electrical rotating machine where the working voltage and the working current exist.

We are all quite familiar with the armature of a rotating armature type machine. Now what we call the stator of a revolving field type machine is actually an armature, as that is where the working voltage and the working current exist. However, the common practice is to call a stationary armature a stator, and we will continue that practice.

A short as a fault in an electric machine may be defined as an accidental, or unintentional connection, between two parts of the same winding or circuit, or between two adjacent windings or two adjacent circuits in the same machine. A short as a fault in an armature or stator is due to a breakdown in the insulation. Such a short can occur within a single coil or between two coils of the same phase or a different phase. A shorted turn is catastrophic in nature in an armature or stator. In a field coil it is of little consequence. Why is that? A shorted turn in a field coil does not have any voltage generated in it. A shorted turn in an armature or stator will have voltage induced in it. The field coil sees a nearly steady magnet flux in one direction. The armature and stator coils see an alternating magnet flux. Now when we have a voltage generated in a turn, and it is closed upon itself (as it would be in a short) the generated voltage in that coil sees a short circuit as far as its load is concerned, and a high current will flow in that coil. See figure 1.

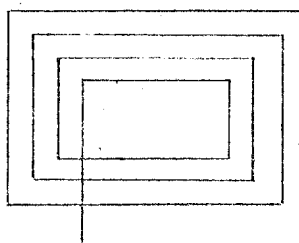
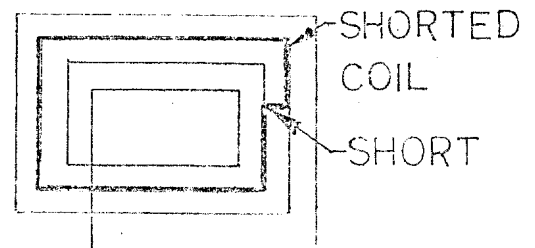


FIGURE 1



This current in the shorted coil will be much higher in value than rated current and will eventually damage the insulation in the adjacent coils and thus cause them to short, and cause catastrophic failure.

A short in a self-excited generator will seldom show up as a catastrophic failure for the simple reason that a short will usually prevent a machine from building up, or will cause it to lose its excitation while running. When everything else in a machine has been checked and found O.K. one would generally suspect a shorted armature or stator. How would you test for a shorted armature or stator with a volt-ohmmeter as your only instrument in order to verify your assumption. The most direct way is to disconnect the field leads from the diode bridge or from the voltage regulator, and connect them to a 12 volt battery. The unit should then be run at no load. If the unit generates, it of course will show only partial voltage. This is because of the reduced excitation. There are several things that can happen as follows:

1. If the short involves an appreciable part of the winding the machine will run rough and vibrate.
2. If the machine does not show any symptoms given in #1, run the machine for about 10 minutes, shut the machine down and feel the armature or stator winding. If part or all of the winding is hot, there is a short.
3. If the machine is a three phase generator or a three wire single phase, a voltage check can be made on the different circuits. A circuit with a short will have a lower voltage than a corresponding counter part.

So much for shorts. How about ground? A ground as a fault is an accidental or unintentional connection between any winding and a metal part of the machine. One ground by itself does not cause any malfunction, however, when you have two grounds you have a short because you have accidental connection between two points on the same winding, or between points of different windings that are connected together. See figure 2.



FIGURE 2

Therefore, two grounds make a short, and a short causes a machine to malfunction or not function at all.

We are all familiar with the fact that we ground the winding at a neutral point on the generator. We connect the neutral to the frame of the generator. The customer is told to ground the generator frame to earth or building ground. On a 120/240 volt system it means that the maximum possible voltage to ground is 120 volts. Without the neutral connected to ground, the maximum possible voltage to ground is 240 volts. See figure 3.

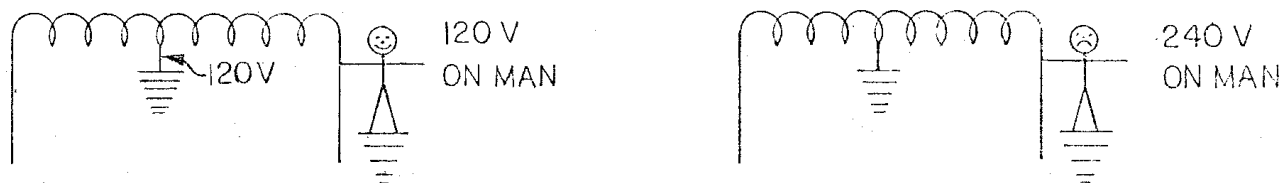


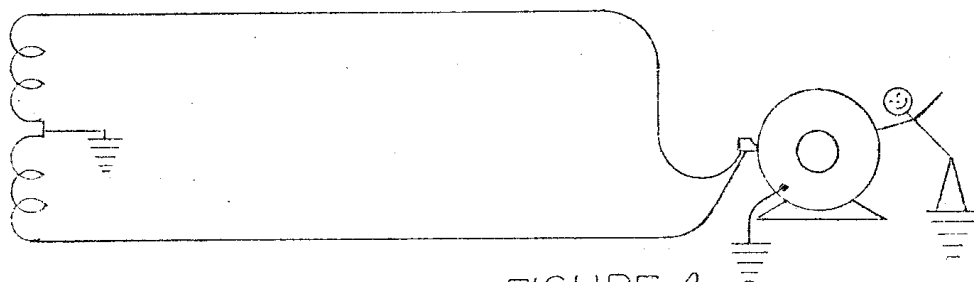
FIGURE 3

In this deliberate grounding practice, there are two kinds of grounds--the wiring ground and the equipment ground. The wiring ground is made only at the transformer in the case of a normal power supply, and at the generator in the case of an emergency generator.

Any electrical equipment with metal parts should be grounded. A motor should have its frame grounded. Conduit and switch boxes are also grounded in equipment grounding. A portable drill has a third wire coming to it which is the ground wire and it is connected to the metal case of the tools. Therefore, this deliberate grounding practice accomplishes two things.

1. It reduces the maximum possible voltage to ground.
2. It prevents shock hazard to anyone touching the metal part of a generator, motor, or other electrical equipment when there is an accidental wiring ground.

See figure 4.



NO VOLTAGE DIFFERENCE
BETWEEN MOTOR AND
GROUND EVEN IF
WINDING GROUNDS
IN MOTOR

FIGURE 4

It does, however, create a new hazard if anyone touches a current carrying part. He is subjected to a shock hazard especially if standing on wet ground. It also creates a hazard if there is a break in the ground wire going to a portable tool. However, these hazards are considered less than those occurring in an ungrounded system.

Now getting back to the accidental ground in a generator, we can see that with an intentional wiring ground we already have one ground and therefore it takes only one accidental, or one unintentional ground, to cause a short and in turn a malfunction.

Testing for grounds is very simple, especially compared to testing for shorts. the wiring ground must be disconnected first. A dead ground will show up on an ohmmeter by placing one terminal on the winding, and the other on a metal part of the generator. However, an ohmmeter will not show up all grounds because of the low voltage of the ohmmeter.

If a hi pot is not available, a 110 volt light bulb should be used as shown in figure 5.

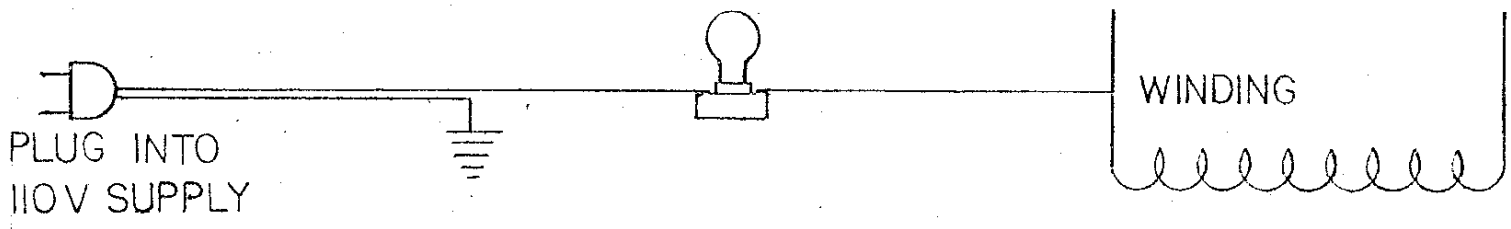


FIGURE 5

This will place 110 volts a.c. across any ground. The lamp will light in case of a ground.

A ground in an armature or a stator will require a replacement in most cases. There are very few grounds that can be repaired.