TROUBLE SHOOTING

Good trouble shooting requires a plan of action. The type of malfunction must be considered to indicate the proper plan. It is good procedure to make a simple list of the steps to be followed. The more simple steps should be first on the list.

For example, the meter on the panel may indicate no voltage. This could be the result of a defective meter or a broken wiring connection. The first step would be to check this possibility step by step with another meter. During this check, keep a sharp lookout for broken or loose wire connections, including the crimped terminal ends. If it is definitely established that there is no voltage or very low voltage, investigate the possibilities that might have this result. Make sure that all brushes move freely in the holders and will snap back into contact with the slip rings when lifted and released. The field excitation circuit begins at the brushholders.

Measure the voltage at the brushholders. In some cases it will be found that there is a very low voltage measurement at this point. This low voltage would be the result of residual magnetism and indicate that there is a fault somewhere in the field circuit. This becomes a matter of tracing the field circuit step by step to find the fault. Wiring diagram E-8649 which applies to a three phase, center tap Delta generator will be used as an example. Follow the excitation circuit from Ring #1 basically to the choke to an AC terminal on the rectifier with the other AC terminal connected to Line #1 which results in an AC input of 120 volts. Note also that the current transformer secondary is connected to the AC terminals and that there is also a capacitor across these AC terminals. Under normal operation this provides the basic field current for no load voltage. As load is added the current in the voltage regulating transformer primary is reflected in the secondary to increase the field current and maintain voltage with varying load. The capacitor is connected as a safety valve to prevent damage to the rectifier during load change.

As a first step, the rectifier should be checked. The capacitor can be disconnected temporarily for a test. The capacitor can be checked with an Ohmmeter. Connection to its terminals should result in a deflection which gradually reduces to zero. Reversing the connections should achieve the same result. In the event that the choke is suspected it can be by-passed instantaneously by means of a jumper, however, this test must be instantaneous as it may result in a very drastic increase in voltage.

Occasionally voltage will be proper at no load but will droop excessively as load is added, assuming, of course, that the generator capacity has not been exceeded. The trouble shooting procedure in this case would depend on the excitation system of the generator. In some cases a single field circuit is used while other use both a shunt and series field. The diagram we have been following applies to a single field circuit. Since the voltage is proper at no load it is necessary to look for some factor which prevents increasing the excitation level to provide for the added load. This would indicate some fault in the voltage regulating transformer, possibly in the secondary. Once again a broken wiring connection from the secondary could have this result. It is also possible that the polarity of the transformer secondary is reversed in relation to the primary. This condition will be more evident when the load consists of electric motors rather than lamps, heaters, etc.

Wiring diagram E-8710 is an example of a generator which uses both shunt and series field. Since our problem is loss of voltage with addition of load, the procedure is to investigate the series field circuit. This involves the series field rectifier as the first step. In this case we use a Thyrector or a varistor as a safety valve protection for the diodes during load changes. Either of these items should measure infinite resistance in both directions when measured with an Ohmmeter. A measurable resistance in either direction can tend to act as a short circuit. The transformer can be suspected although this is a problem which is rather infrequent. Usually there is some evidence of overheating when the transformer is defective. If the above items check out properly, the series field coils should be investigated. It will necessary to disconnect field leads for this test. There should be a complete circuit. A lack of a circuit would indicate an open coil. With both leads disconnected from their normal connections, there should be no indication from one of the leads to the frame of the generator which indicate a grounded coil. A grounded coil would tend to jump out part of the field circuit as there is a ground on the neutral on normal connection. Polarity of both the shunt and the series field must be alike. When one field is reversed in relation to the other, one field will subtract from the other resulting in a drastic droop in excitation and output voltage.

Wiring diagrams for tractor-driven generators have been used for discussion. This was done intentionally as they are more simple as they do not involve engine controls. The excitation system is alike in both cases.

Wiring diagram E-9123-1 applies to Model GM-4B2-A/1 which is an air cooled engine driven set operating at 3600 RPM. This circuit would also apply to Model GM-4W2-A/1 as the only variation is in the driving engine. "B" indicates Briggs & Stratton and "W" indicates Wisconsin. This model is a revolving field type. The shunt and series fields are both included in the rotating element. In this case a transformer is not used for the series field as the actual load current is rectified for this purpose. Ring #1 (nearest to the bearing) is common for both fields. The same basic procedure is used for trouble shooting. If there is no voltage at proper speed, investigate the shunt field circuit which includes a the field, rectifier and wiring connections. A shunt field will have a resistance in the range of 35-60 Ohms depending upon generator capacity. The brushes must be lifted or insulated from the rings by heavy paper for resistance measurement. There should be no indication from the rings to the shaft which would indicate a grounded winding. The energy for the shunt field is provided by a single coil winding in the stator.

When voltage is correct at no load but droops on load it is again a matter of investigating the series field. The rectifier in this case consists of a positive and negative section. The energy for the series winding is the actual load current in the main stator windings.

Wiring diagram E-9381-1 applies to Model GM308W4-A which is a 4-pole, 1800 RPM, air cooled engine driven set. This model is a revolving armature type in which the field is stationary. This model uses a rectifier for the shunt field and also one for each load circuit, making a total of three. Again, the same basic trouble shooting procedure applies.

My intent has been to point out that a plan of action will save a great deal of time and achieve greater results.