

Here Is a Review of Maintenance Practices In Step With Growing Use of Dc in Industry

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FINISHING STANDS in Pittsburgh Steel Co strip mill use 4000-hp 600-v dc motor

Shooting Trouble on Dc Machines

SYMPTOM POSSIBLE CAUSE OF TROUBLE: CURE

General Overheating of Frame, Field Coils

- 1 Machine overloaded. Proper protective gear; fuses, relays, temperature detectors generally keep this symptom in check
- 2 High ambient temperatures. May be simple matter to improve ventilation with ducts, fans
- 3 Restricted ventilation through machine because of dirt in vent ducts or screens
- 4 If shunt field coils appear as heat source, check for shorted turns, too-high voltage, part of winding shorted-out
- 5 Where series field is overheating look for short-circuited turns; current density too high indicating wire size is inadequate; machine overloaded

Overheating of Armature Coils, Commutator

- 1 First make sure machine is not overloaded
- 2 Megohmmeter insulation test spots grounds; try for minimum of one megohm for units to 600 v
- 3 Individual coils may be shorted, open, incorrectly connected to commutator segments (adjacent leads to segments may be accidentally swapped in rewinding)
- 4 Commutator overheating may indicate too great brush friction, contact drop. Here are some points to check: tarnishing of commutator (may stem from presence of gases from production equipment), rough surface, excessive brush pressure, wrong brush grade

Excessive Sparking at Brushes

- 1 Once again, make a close check on machine loading to rule out possibility of overloading

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- 2 If brushes appear to vibrate when machine is running, check for eccentric commutator, low bars or flots, rough or grooved commutator. In each case the cure lies in turning, polishing commutator, preferably in its own bearings
- 3 If commutator appears distorted with some bars high, the answer is to "re-season." This means heating commutator uniformly to about 100 C, running full speed, then shutting down and tightening commutator bolts. Finish off with a fine stoning to take off any high spots
- 4 Commutator may be out of dynamic balance or vibrating at frequency of some external unit: namely, transmission gears
- 5 Do brushes slide easily in their holders?
- 6 Brushes may be off neutral; shift brush boxes to improve commutation
- 7 Brushes may not be equally spaced around commutator. Check this by actually measuring distances between all adjacent brushes; unequal spacing leads to circulating currents being set up
- 8 Incorrect brush pressure, brush type, unequal air gaps can cause sparking. Unequal gaps can stem from worn bearings
- 9 Open, short or loose connection in armature circuit. Open or shorted armature coils can usually be spotted at the commutator bar or bars connecting to the faulty coil; copper or mica will be burned. There may be signs of solder throwing out of the commutator joints where a loose connection is the fault
- 10 Brush arms and interconnections may have unequal

TIPS TO CUT DOWN THE NUMBER OF TROUBLE CALLS

GENERATOR OPERATION. Where a compound generator feeds a motor load, disconnect both electrically before bringing the units to rest. If both are left connected when prime mover is shut down, generator may come to rest before the motor, leaving the latter to act as a generator. The motor would then pass current through generator series field reversing its polarity. You'd then run into trouble on start-up if fields were not flashed first.

Where a shunt generator is one of several connected to the same bus, the field can be energized from bus by closing main machine switch after raising the armature brushes. But hang a resistor across field terminals to prevent voltage build-up when field is opened. Series field of compound generator will be energized in correct direction if equalizer and main switch are closed with armature brushes raised.

GENERATOR LOADING. If you run into trouble balancing load between generators where field rheostat is hand operated, try slight shifting of brush arms; forward movement increases, backward decreases. But you're limited by the effect brush-shifting will have on commutation.

Remember, for stable operation of compound generators in parallel an equalizer connection is necessary between inner terminals of the series field. For a true indication of load being carried, make sure

the machine ammeter is in the generator lead that's not connected to the series winding. Otherwise, with current flowing in the equalizer, the ammeter would give a false reading of load distribution between machines.

MACHINE MAINTENANCE. Don't overlook the importance of staggering brushes on commutator to prevent grooving. By staggering brush arms in pairs you'll also reduce the tendency toward "copper picking" at brush faces.

I've found the following brush pressures work out best: carbon and graphite brushes, generally between 1.5 and 2 psi. Where motors must face up to heavy overloads it may be necessary to go to 2.5 or 3 psi. Still higher pressures are required for metal-graphite brushes; minimum about 3 psi.

INSULATION. There are three practical methods of measuring resistance of electrical insulation with a megohmmeter: (1) short-time or spot reading (2) time-resistance or dielectric absorption (3) 2-voltage (POWER, June 1950, pp 116, 117). The short-time test is the most popular. But in the past some confusion has existed about when to stop the test since the value of insulation resistance would ordinarily keep climbing with time. So for purposes of standardization, 500-v dc applied for 60 sec is recommended where short-time single readings are to be made.

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resistances, resulting in unequal current distribution in the arms. Thorough maintenance on all joints and terminals generally rules out this as a factor in brush sparking

- 11 Remember, a partially shorted or grounded main or interpole field winding upsets the magnetic balance much as would uneven air gaps
- 12 Are interpoles reversed? Check this with compass. Commutating pole for motor should have same polarity as the main pole following, traveling in direction of rotation. For a generator it should be same polarity as main pole preceding it, still considering the normal direction of rotation. At same time, check equalizer connections to assure that circulating currents are not at root of sparking

Motor Running at Other Than Normal Speed

- 1 Overspeeding of series motor generally indicates load was accidentally removed. Where a compound motor speed is unstable, check that the series winding is not reversed
- 2 A shunt motor overspeeds when field is too weak or a portion of the winding is shorted, grounded. Supply voltage may be too high. If it's running too slow, check for overloading, low supply voltage, short in field rheostat
- 3 Sudden speed and current spurts may mean a change in load, defective transmission, such as slipping belts or clutches. Where a shunt motor "bunks" it may point to commutator brushes that have shifted too far backward

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- 4 Where a motor is to be reversed: Reverse either the field or armature leads for a series motor, reverse field leads only in a shunt motor, reverse both fields in a compound motor

Generator Fails to Build Up Voltage

- 1 No excitation may mean an open in field circuit, high resistance at joints or terminals—or the residual field may be lost. In the latter case, disconnect the field leads and separately excite from a dc source
- 2 Individual field coils may be reversed
- 3 Dirty commutator, low brush pressure, can build up contact resistance at commutator preventing voltage build-up
- 4 Is generator turning in proper direction?

Generator Voltage Too High or Low

- 1 Check speed and excitation amperes
- 2 Where voltage is low and field current OK, check for shorted portions of field coils. Also look into brush setting
- 3 If voltage is too low after the machine has been repaired, suspect wrong reconnection of fields, too large an air gap
- 4 If generators fail to share load evenly, machines may have different voltage characteristic curves. Also check through the excitation circuit
- 5 Where compound generators are unstable when paralleled, check equalizer connections