TROUBLE SHOOTING SECTION

The best form of trouble shooting is preventive maintenance of the equipment so that troubles will not develop. Careful attention to keeping all parts clean, especially where dirt may collect causing creepage and arc-overs, is very essential. Most electrical "troubles" are "mechanical" and apparatus in good mechanical condition is not liable to give trouble.

If, however, in spite of all preventive measures, a car does develop trouble, some general hints may prove helpful.

1. Be reasonably certain that there is actually trouble, because the only trouble which cannot be located is the one which does not exist.

2. Consider all outside reports, but draw your own conclusion.

3. Look for the simpler things first, for sometimes a blown fuse or tripped circuit breaker is found to be the trouble after much time has been spent taking apparatus apart.

4. Never jump to conclusions, even though the same conditions might have been encountered before.

5. Use eyes, ears and nose diligently to save time for often the trouble might be found immediately rather than ponder over a diagram for a long time.

6. Study the instruction book to become familiar with operation of equipment. It is not necessary to memorize the wiring diagram, but it is essential to know where to find important information quickly.

7. Follow up reported troubles, where no trouble could be found after thorough investigation.

8. Relay adjustments should not be changed except by authorized persons using the necessary instruments.

TROUBLE SHOOTING CHART

TROUBLE	CAUSE	RECOMMENDED PROCEDURE
1. Dead car (no power)	a. Control Troubles 1. Not turned on, or control fuse blown, or breaker tripped. 2. Center doors open or interlock not making. 3. Foot interlock not making. 4. Brake not completely releasing.	A quick check of the conditions may be made by operating controls and listening for closing of LB1 line breaker. If MG contactor is closed, items 1, 2, 3 and 4 have been checked, and LB1 still does not close, master controller and control group covers should be removed for a complete check of control operation.
	b. Main Power Circuit Troubles	If all contactors are operating properly and motor generator set is running, there is an open in the main power circuit, the following procedure is recommended: 1. Examine motor leads. 2. Examine main power wiring. 3. Examine main motor resistors. 4. Examine motors.
2. No brakes		Operators may report "No Brakes" but with proper operation of the braking system on a PCC car, the possibility of having available absolutely no brakes is so remote that the trouble should be analyzed as "poor" or "erratic" brakes.
3. Poor Brakes	Partial failure of brakes	Test each brake system in this recommended sequence.

TROUBLE	CAUSE	RECOMMENDED PROCEDURE
		1. Observe all four track brakes to see that they go down on the rail when tried. 2. Stop car with friction brake only and observe. 3. Check dynamic brake with millivoltmeter. Trouble with any individual braking system should be traced down and correction made in circuit or adjustment as required. If no trouble can be found, it may be caused by wheel slippage or wet or slippery rails.
4. Car will not coast	a. FS1 contactor not closing. b. ABR relay not controlling brush arm. Master controller finger not shorting out ballast resistors.	Check manual operation. If arm creeps when it should stop look for dirty contacts on ABR or in interlocks in series with it.
5. LB1 tripping.	a. Short in power circuit. b. Trouble in pilot motor control. c. Brush arm sticking.	Check manual operation, look for open circuit in ABR control circuit across pilot motor armature. If control is O.K. look for short in power circuit.
6. Car creeps and bucks in shutting off	a. C1 not closing. b. Brush arm stuck in A position.	This may be due to mechanical trouble which must be determined and remedied. Look for poor contacts first.
7. Slow in power and brake	a. Brush arm on commutator controller binding. b. ABR out of adjustment.	Probably due to mechanical misalignment. Make repairs. Check rates and adjust ABR relay.

TROUBLE	CAUSE	RECOMMENDED PROCEDURE
8. Will not coast and bucks above 15 mph.	a. B3 not closing. b. Short in main resistor circuit.	Look for mechanical trouble. Look for electrical trouble in operating coil circuit. Examine resistors for damaged or warped sections.
9. Too much braking, causing skids - acceleration O.K.	ABR shunt coil circuit open, possibly at ballast resistors, ABR out of adjustment.	Test braking current with millivoltmeter. If very high test ABR shunt coil circuit. If only slightly high reset ABR.
10. Erratic brakes LB tripping.	Brush arm stuck near B position.	Look for trouble caused by bad contact in control of pilot motor circuit or mechanical trouble.
11. Erratic operation. a. No power at times. b. No dynamic brakes at times.	Poor contact.	Look for bad contacts in main power and control circuits similar to No. 1. 1. Examine interlocks in B+ feed for B1 and B2. 2. Look for bad contact at reverser or B1 and B2 contact tips. 3. Check ABR control during braking. 4. Examine main braking power circuit. Erratic troubles are the most difficult to trace. Obtain all information possible from operator, in determining where to make a thorough visual inspection. Connect a low-reading ohmmeter across the suspected circuit and try moving wires, coils, interlocks, etc. in an effort to detect an intermittent open circuit.

TROUBLE	CAUSE	RECOMMENDED PROCEDURE
		In locating troubles on PCC car, it is often advisable to check sequence of operation of various apparatus or control sequence. Sequence charts are found on the main wiring diagram. Refer to INSPECTION SECTION.
	Loose connections.	Tighten.
	Dirt or grease on contact.	Clean contacts by wiping them with dry, lintless wiping cloth.
	Burned or pitted tips.	Smooth tips with a fine file or replace them.
	Broken copper shunt.	Replace shunt with new one.
	Improper contact tip pressure.	Adjust pressure in accordance with recommendations.
12. Armature Heating.	Brushes stuck or too short.	Free or replace brushes.
	Overloading.	Locate cause and correct.
	Short-circuited armature coils.	Rewind armature coil or repair insulation.
	Poor commutation.	See "Commutator Trouble" on this chart.
	Short-circuited field coils or field current.	Rewind field coil or repair insulation.
	Bucking or reversed field coils.	Readjust so that adjacent poles are of opposite polarity. This can be checked by separately exciting the field circuit and testing with a compass.
13. Sparking at brushes.	Excessive overload.	Determine cause and correct.
	Poor brush fit.	Sand brushes to fit.
	Brushes may not have proper pressure, or the pressure may not be the same on all brushes.	Adjust brush pressure according to table given.

TROUBLE	CAUSE	RECOMMENDED PROCEDURE
	Brushes stuck in holders.	Clean out brush holders.
	Brushes worn too short.	Replace brushes with new ones.
	Brush surface burned.	Sand off burned surfaces.
	Worn carbonway.	Replace carbonway with new ones.
	Dirty or oily commutator.	Clean off commutator with sandpaper.
	Rough or eccentric commutator surface.	Stone or turn in a lathe, depending on degree of roughness.
	High or low commutator bar.	Turn in a lathe until all bars are even.
	Loose commutator bars.	Tighten commutator bars and stone lightly.
	High mica on commutator.	Undercut the mica.
	Grounded or short-circuited armature.	Rewind armature.
	Loose connections of armature lead to commutator ear.	Repair lead and solder to commutator ear.
14. Commutator trouble.	Roughness caused by overspeed or excessive wear.	Resurface by stoning and observe maximum speed limit.
	Beaded commutator caused by sparking.	Resurface by stoning; clean out slots.
	Short brushes, or brush rivet wearing into commutator, thus dragging copper across slots.	Replace brushes when worn to within 3/8 inch rivet. Inspect brushes regularly.
15. Broken brushes.	Rough commutator; burned spots; flat spots; high bars.	Resurface commutator by stoning; replace brushes.
	Low brush-spring tension.	Adjust to correct value.
	Motor vibration (caused by wheel slipping or rough track).	Replace brushes as necessary.
	Eccentric commutator surface.	Turn commutator in lathe.

TROUBLE	CAUSE	RECOMMENDED PROCEDURE
16. Grounded armature or field coil.	Dirty, oily, water-soaked, charred or broken insulation.	Remove motor or MG set and repair. Reinsulate defective coils.
17. Bearing failure.	Overlubrication or underlubrication.	Follow instructions in LUBRICATION SECTION.
	Dirt.	Keep grease and oil clean. Wipe off fitting before adding lubricant.
	Pitting of bearing or grounded armature.	Replace bearing.