EMD MAINTENANCE INSTRUCTION

TRANSDUCTOR TYPE WHEEL SLIP CONTROL

The transductor type wheel slip protection system used on General Purpose (GP) locomotives utilizes two transductors to recognize the current differential between two traction motors, and the assistance of a sensitometer circuit to detect four motor high speed wheel slip while operating in parallel transition.

TRANSDUCTOR OPERATION

A transductor is, in effect, a DC current transformer. This device derives its power from the locomotive alternator. The changes in frequency and voltages which normally are encountered in the operation of the AC portion of the locomotive have no effect upon the operating levels of the transductors.

The transductor consists of two magnetic loops of steel through which two motor cables pass. The net flux from the difference in current in the two cables appears in the magnetic path of the device in the same manner as in the present through cable wheel slip relays. Each of the loops has a coil, one wound clockwise, and the other wound counterclockwise. If no current is flowing through the traction motor cables, or if exactly the same quantity of current is flowing through both cables, the impedance of the transductor is so high that very little AC current flows through the coils. However, if flux appears in the magnetic steel loops, the impedance is lowered and an amount of AC current proportional to the net flux will flow through the coils.

► In order to parallel the output of more than one transductor, it becomes necessary to provide a loading resistor to change the current to voltage, as shown in the circuit diagram, Fig. 3. The 35-ohm resistor acts as the loading resistor. Therefore, a voltage appears across each 35-ohm resistor which is proportional to the current difference between the two motors which that particular transductor checks. This AC voltage is converted to DC voltage with a rectifier bridge.

A DC voltage now appears across the coils of both the WCR and WS relays, which will pick up the relay when either transductor detects sufficient current difference in the traction motors to signal a wheel slip.

The WCR, or wheel creep relay, picks up at 125 amperes current differential. The WS, or wheel slip relay, is a relay which has three coils. These three coils are set into the circuitry in such a way as to give different pickup values under different conditions.

The main coil A-B which is connected to the transductor, is adjusted to give a basic pickup of 265 amperes differential. When the locomotive is in series, the E-F coil is permanently connected to the 74-volt system, recalibrating the pickup to 150 amperes differential. In parallel, the E-F coil is disconnected and the C-D coil is connected across the main generator. This results in a pickup characteristic which becomes lower as the main generator voltage becomes higher.

SENSITOMETER OPERATION

When the locomotive is running in parallel full field or parallel shunt, the wheel slip protection system incorporates the use of an additional circuit which results in a pickup characteristic which becomes lower as the main generator

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voltage becomes higher. This circuit uses the C-D coil of the WS relay as a bias coil to lower the pickup value of the A-B coil of WS. Results of this greater sensitivity require less motor current differential to initiate a wheel slip indication and correction.

► Operating in parallel full field, generator current will flow through the two series connected 1500-ohm resistors, see Fig. 1. Current will also flow through the 1500 and 6500-ohm resistors and the C-D coil of the WS relay. This current through the C-D coil causes it to bias the WS relay, to lower the pickup value and increase the sensitivity of the wheel slip system.

► When the locomotive is operating in parallel shunt, the L-M contacts of FS1 will be closed to connect another portion of the sensitometer to the circuit. As generator voltage builds up to a point when approximately 300 volts appears across the two diode tubes, they will start to conduct and allow a small current flow. Voltage drop across these diode tubes will now be constant regardless of generator voltage. When generator voltage reaches approximately 865 volts, the voltage at the slider FSK becomes positive with respect to the voltage at the positive side of the diodes. When this condition exists, current will flow through the rectifier, the regulating tubes, and the WS coil C-D. When the main generator voltage reaches approximately 935 volts, the WS relay will pick up and reduce power to the traction motors. This phase of the system protects against simultaneous four motor wheel slip in parallel shunt motor connection.

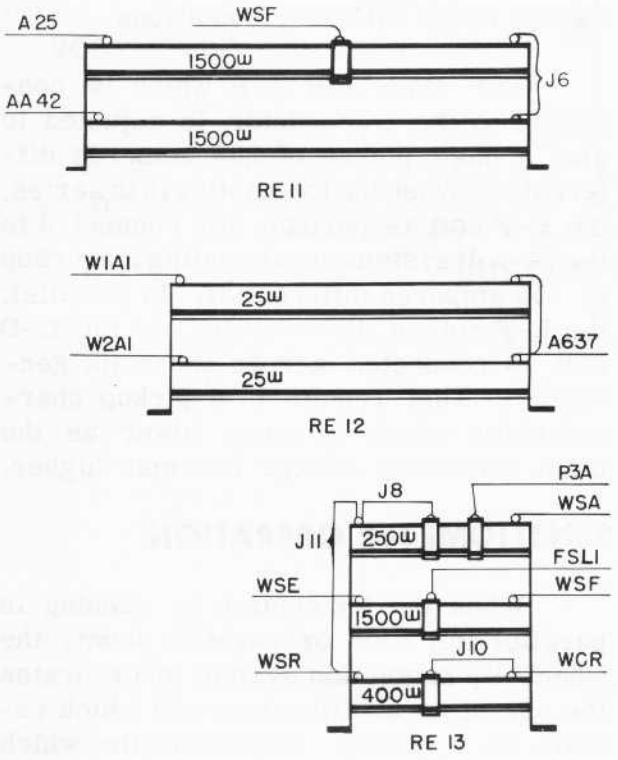

Fig. 1 - Wheel Slip Resistor Banks

►WHEEL SLIP RELAY ADJUSTMENTS

When it is necessary to check or set the wheel slip relay WS or the wheel creep relay WCR, refer to the specific locomotive wiring diagram and follow the general procedure given below.

With the locomotive shut down, make the following preliminary setting on wheel slip resistors.

1. Move the P3A slide band, Fig. 1, on the 250-ohm resistor of RE13 to a point three-fourths of the tube length up from wire connection for J11. Move the J8 slide band on this same resistor to the approximate center of the resistor tube.
2. Move the J10 slide band on the 400-ohm resistor of RE13 to a point one-third up from the WSR wire connection.
3. Move the WSF slide band on the 1500-ohm resistor of RE11 to a point two-thirds up from the A25 wire connection.

FINAL SETTING WITH ENGINE RUNNING

1. Set up the unit to operate at standstill and work against the brakes.
2. Hold open contactor S13 by placing a piece of fiber insulation between the main contacts.

3. Connect a calibrated meter with a 75 millivolt scale to the indicating meter shunt. The shunt is located at the engine side of the electrical cabinet.

4. Remove the P34 wire from contactor P3 at "A" terminal connection, see Fig. 2.

5. Place the throttle in #1 position, WS should pick up when there is an indication of 265 $\pm$ 10 amperes on the meter connected to the indicating meter shunt. If the relay does not pick up at this amperage, adjust slider band for J8 jumper wire on the 250-ohm resistor RE13 for proper pickup. Return the throttle to idle position.

6. Reconnect P3A to the "A" terminal on P3 contactor.

7. With the throttle once again in #1 position, WS relay should pick up at 150 $\pm$ 10 amperes. If not, adjust slider band P3A on the 250-ohm resistor on RE13 for proper pickup. Return throttle to idle position.

8. Remove the wire W1A from CR10, see Fig. 2. Place throttle in #1 position. WCR relay should pick up when 120 $\pm$ 10 amperes are registered on the meter. If the relay does not pick up at this amperage, adjust J10 slide band on the 400-ohm resistor of RE13.

9. Reconnect the W1A wire on CR10.

10. Remove the W2A wire on CR11 for continuity and pick up check. With throttle in #1 position, WCR relay should again pick up at 120 $\pm$ 10 amperes. Return throttle to idle position.

►SENSITOMETER RESISTOR ADJUSTMENT

1. Remove the AA41 wire from WS sensitometer (+) side, see Fig. 3.

2. Remove the A26 wire from WS relay coil "D" terminal.

3. Connect a motor-generator set and voltmeter across the sensitometer as shown in Fig. 1. Connect the positive leads of the M-G set and meter to the (+) side of the sensitometer and the negative leads to the "D" terminal of the WS coil.

4. Remove P3A wire at "A" terminal of contactor P3.

5. With 900 volts on the motor-generator set and the throttle in #1 position, adjust the WSF slider band on the 1500 ohm resistor RE11 to give 80 amperes pickup on WS relay.

6. Shut engine down and back off M-G set to drop WS relay.

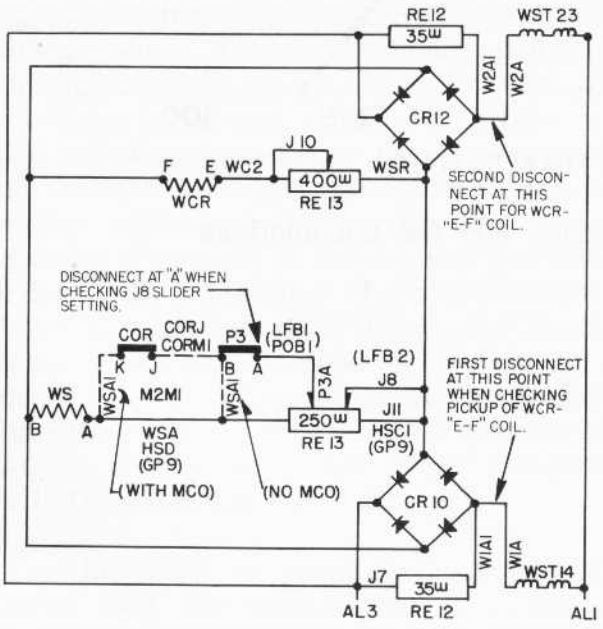

Fig. 2 - W.S. -"A-B" And WCR "E-F" Coil Pick Up Calibration Circuits

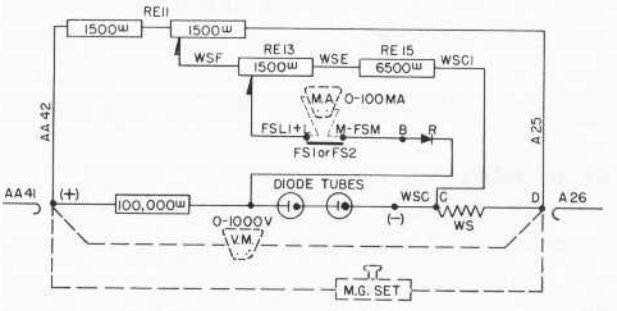

Fig. 3 - W.S. -"C-D" Coil Pick Up Calibrating Circuits

7. Place a milliammeter (0-100 MA range) at the "L-M" interlocks of FS relay, see Fig. 2. Place the positive lead of the meter on the "L" terminal and negative on the "M" terminal.

8. Adjust slide band WSF on 1500-ohm of RE13 so that the milliammeter moves off zero at 865 ± 10 volts on the motor-generator set.

9. As a check, the WS relay should pick up when the motor-generator voltage is raised to 920-960 volts.

10. After settings are completed, return unit to normal operating condition, reconnect all leads, and remove all test equipment.

    Refer to Fig. 4 for actual wheel slip operating values.

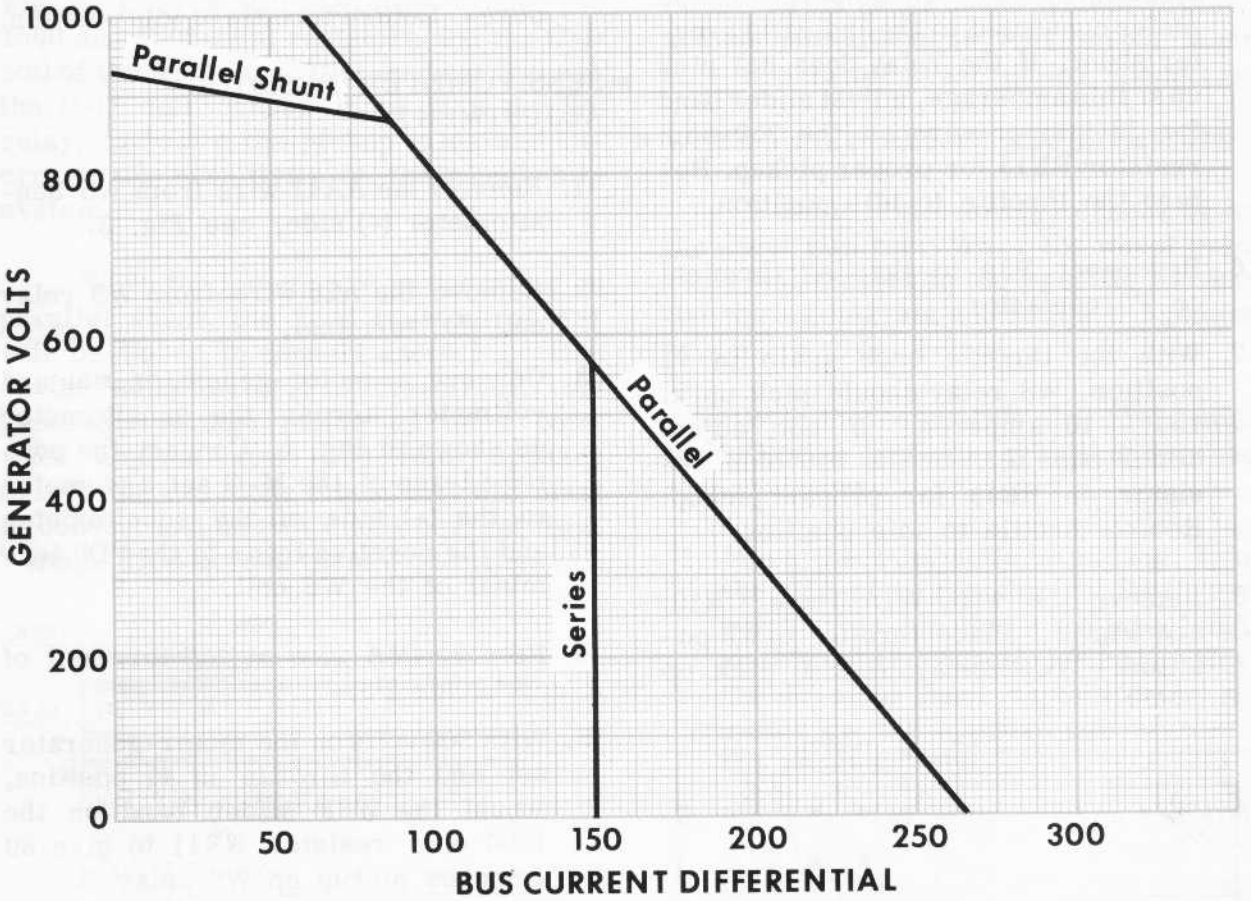

Fig. 4 - Wheel Slip Operating Values For GP Locomotives