Schematic Connection
Diagram

ALCO DIESEL-ELECTRIC LOCOMOTIVE SCHOOL
INSTRUCTION SERIES
No. 805
THE SCHEMATIC CONNECTION DIAGRAM

Each device and component part of a device has a particular function. It is necessary to represent these parts on a wiring diagram in a manner that aids in trouble shooting. Trouble in the electrical circuits is caused by the failure of a certain function, usually caused by the failure of a device or devices.

In the Schematic Connection Diagram, the devices are broken up into component parts. The diagram is sectionalized by function and each component part placed in that section to which it applies. For example: The connection diagram has sections named Propulsion Control, Motors 2 and 4, Motors 1 and 3, Generator and Excitation Circuits, Limit Circuits, and so on.

A power contactor has an operating coil, a main contact and several auxiliary control contacts called interlocks. The operating coil is placed in the propulsion control section, the main contact is on one of the motor sections, and the interlocks in a controlling circuit which would be located in a particular section by its function. For example: A power contactor interlock may control an alarm bell although the main function of the contactor may be to close the circuit to a motor. When the bell fails to ring, it is readily found that an interlock of this contactor controls the alarm bell, because this interlock appears in the alarm circuit section of the diagram. The wiring diagram now becomes an organized arrangement with a minimum number of lines or wires connecting devices.

When using the diagram, certain assumptions must be made and followed.

1. Everything on one diagram is for one locomotive unit only.

2. Everything on the diagram is shown de-energized. All switches, contactors, relays and other devices are shown in the shut down position.

3. All devices involving reverser action have no shut down position, so are shown set up for forward locomotive motion.

4. All dynamic braking devices are shown set up for motoring.

SYMBOLS

Two types of symbols are used, one system for pre-1950 and the other for 1950 locomotives. The one for pre-1950 is shown in Fig. 1. The symbols for the 1950 type are shown in Fig. 2.
READING THE DIAGRAM

Conditions must be set up in reading a wiring diagram. Consider the following circuit for an example.

```
TO CONTROL POWER POSITIVE
    13
    TH
    30A
    TH IDLE
    30C
    TH 1-8
    GEN. FIELD
    187
    DMR
    DMR
    TO CONTROL POWER NEGATIVE
```
To follow this section of the wiring diagram from wire 13 to wire 6, the following conditions exist:

Two paths are possible from wire 13 to wire 30A. Start from the top line through the throttle handle contact (TH Idle). It is apparent that the throttle handle must be in the idle position. But to proceed from wire 30A to 30C, it is necessary to have the throttle handle in some position other than idle (TH 1-8). As this is one and the same throttle handle and cannot be in two positions at the same time, this circuit cannot exist. Again start from wire 30A and follow the other path through operating coil of DMR to control power negative to energize DMR. When DMR relay picks up, its contacts (also marked DMR) close and complete a circuit from wire 13 to wire 30A. A path from wire 30A to wire 30C is now possible by operating the throttle in some position other than idle and from wire 30C to wire 6 by manually closing the generator field switch 187. In other words, to establish a circuit from wire 13 to wire 6, the DMR relay must be energized by first placing the throttle handle in the idle position. After this the circuit is completed by placing the throttle handle in some position from 1 through 8 and closing switch 187. Remember that whenever a circuit is traced through a device or part of a device, the condition or position of that device must be firmly established and adhered to.
<table>
<thead>
<tr>
<th>Operation</th>
<th>Motor Connection</th>
<th>Selector Switch</th>
<th>Parallel Switch</th>
<th>Notch Switch</th>
<th>Contactors</th>
<th>Relays</th>
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**Sequence Table**

**FIG. 3**
# SEQUENCE TABLE

This table indicates what happens when. The sequence table shown in Fig. 3 is for the pre-1950 model, and the dot signifies that for a particular condition of control handles the device is closed. If by observation it is found that the device does not close, that apparently is the trouble, and the circuit for that particular device can easily be traced.

The table shown in Fig. 4 is for the 1950 model and is similar except that the devices dependent upon throttle handle position are tabulated separately.
APPARATUS TABLE

The Apparatus Table lists other necessary information concerning the devices and equipment. Each device is listed alphabetically and the following information can be found for each item.

1. Symbol
2. Type
3. Cat. No. and resistance of operating coil, if any.

*SYMBOL IN THIS COLUMN REFER TO LOCATION OF APPARATUS IN LOCOMOTIVE IN ACCORDANCE WITH THE FOLLOWING:
CP CONTROL COMPARTMENT
CR CONTROL RELAY EQUIP. (IN CONTROL COMPARTMENT)
CS CONTROL STAND IN ENGINEER'S CAB
E ON ENGINE
EP IFM 482 I ENGINE CONTROL PANEL
EX IFM 483 PANEL (IN CONTROL COMPARTMENT)

FIG. 6
4. Type of interlock, if any.

5. Where the device is located on the locomotive.

6. In what section of the wiring diagram can be found all the component parts of the device.

7. Recommended adjustments or settings, if any.


Fig. 5 is the Apparatus Table or Index and Fig. 6 the Location Symbol Key for pre-1950 models. Fig. 7 is the Key and Fig. 8 the Table for 1950 models.
RELAY AND INTERLOCK SKETCHES

It is also necessary to know the physical location of an interlock on any contactor or relay having a number of interlocks. This is obtained from the section on the diagram titled Relay and Interlock Sketches (Pre-1950) or Device Sketches (1950). For example: In Figure 9, it is seen that the fourth contact from the left on AVF causes a circuit from wires B1 to 32M when AVF is energized and from 32A to 32M when AVF is de-energized.

DEVELOPMENT

The Development shows when throttle, reverser and selector handle control contacts open and close in various positions of these handles. Development sketches such as Figure 10 are used to locate the physical positions of these contacts and possibly to check the wiring on the diagram.

The contacts are shown in the shut down position. This is "off" for the reverser handles, "idle" for the throttle handles and "off" for the selector handle.

DEVICE SKETCHES

FIG. 9
Assume that the following is shown on the diagram:

How can this contact be found on the locomotive? When referring to Fig. 10 it is seen that contact 15-7A is open in the idle position. The rectangular portion opposite this contact shows an unshaded area in the idle position, while at positions 2, 4, 6 and 8, the shaded or black portions show that this contact closes at these throttle positions. Furthermore, the physical location of this contact can be determined by counting down the contactor drum. The contact in question, is the seventh from the top.
TROUBLE SHOOTING

To better understand trouble shooting, set up a case of trouble and follow through the various steps in its analysis. Assume the diesel engine does not crank over, and the fault is due to an interlock on P21.

FIG. 11

The first step is to determine what is supposed to happen when the start switch is turned. "What happens when", is seen from the Sequence Chart. Refer to Figure 4 and note that GS1 and GS2 contactors should be closed. To find
the location of GS1 and GS2 on the locomotive, see Fig. 8, which places them in CP. Fig. 7 explains that CP is the control compartment. The location of GS1 is now known. Observation will show that GS1 and GS2 have not closed. The next step is to find the coil of GS1 and GS2 on the wiring diagram and attempt to determine why these coils are not energized from control power. From the Apparatus Table, Fig. 8, note that GS1 parts are found in Sections B, F, K and T. The coil is found in Section K, Fig. 11, and the problem now consists of an examination of all equipment in this circuit. It is seen that a normally closed interlock on P21 is in this circuit. Again refer to the Apparatus Table to locate this interlock on the locomotive.

The diagram indicates that the interlock that has 43 and 43A wires, is normally closed. If the wire numbers cannot be identified, the Device Sketch, Fig. 12, will show that this interlock is the third from the right. By cleaning or repairing this contact, the trouble is corrected.

By following this method any type of trouble can be traced to its source and corrected.

This type of diagram, with a little practice and experience, provides a very efficient means of trouble shooting.

DEVICE SKETCHES

FIG. 12