Introduction and Overview to Control Panels

Course 108

PARTICIPANT GUIDE

SIGNALS TRAINING CONSORTIUM

Introduction and Overview of Control Panels

Participant Guide

Signals Maintenance Training Consortium

COURSE 108

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How to Use the Participant Guide

Purpose of the Course

The purpose of the *Introduction and Overview of Control Panels* is to assist the participant in gaining an overview of the functions of control panels and their associated components.

Approach of the Book

Each course module begins with an outline, a statement of purpose and objectives, and a list of key terms. The *outline* will discuss the main topics to be addressed in the module. *Learning objectives* define the basic skills, knowledge, and abilities course participants should be able to demonstrate to show that they have learned the material presented in the module. A list of *key terms* identifies important terminology that will be introduced in each course module. *Review exercises* conclude each module to assist the participants in reviewing key information.

INTRODUCTION AND OVERVIEW OF CONTROL PANELS

Outline

Purpose and Objectives

The purpose of this module is to provide an overview of the different types of control panels, their purpose and function as well as typical control panel components. This overview will include a history of the development of control panels and their relationship to communication interface.

Following the completion of this module, the participant should be able to complete the exercises with an accuracy of 70% or greater:

- Describe the different functions and components of mechanical interlocking machines as compared to modern control panels
- Explain how control panels evolved since the early 20th Century by describing changes and technological advances made in the signaling system
- Explain purpose and key functions of control panels for signaling purposes
- Describe different types of control panels and their functions
- List and describe control panel components
- Identify each light, button or key on a control panel and describe its function
- Identify areas that have control panels and how their functions may differ at the mainline and interlockings/yards
- Identify control panels at your location and describe their key functions
- Demonstrate ability to read a lock diagram
- Describe different types of communication interfaces as they relate to control panels

Key Terms

- Alarm
- Analog modems
- Blocking device
- Centralized traffic control
- (CTC)
- Communication interface
- Emergency release clocks
- Ethernet modems
- Error codes
- Fiber optic cables
- Fiber optic modem
- Graphical user interface (GUI)
- Health indicator
- Human Machine Interface
- (HMI)
- Indicator lights
- Interlockings
- Lamp testers
- LEDs (light-emitting diode)
- Lever machine
- Local control panel
- Locking bed
- Locking dogs
- Locking sheet
- Mainline
- Maintainer test panel
- Master lever
- Master switch
- Mechanical interlocking machine
- Model board
- MTP Lamp
- Modem
- Programmable Logic Controller (PLC)
- Reset and transfer
- Rollers
- Remote/Local switch
- Signal lever
- Switch lever
- Stacking switches
- Status and control panel
- Supervisory Control and Data Acquisition (SCADA)
- Test strap
- Toggle switches
- Wafer switch
- Unit lever machine

1-1 OVERVIEW

The safe movement of trains is paramount in the rail industry. As noted in a prior course, signaling is a way of ensuring that trains are operating in an efficient and fail safe manner. Signal maintainers and other rail personnel are able to accomplish this is by using individual **local control panels.** The four (4) major functions of a local control panel are to:

1. Monitor the normal train movement and wayside activities
2. Provide status details for troubleshooting
3. Test **interlockings**
4. Provide an emergency take over

As defined in earlier courses, an interlocking is an arrangement of signals and signal appliances so interconnected that their movements must succeed each other in a proper sequence and for which interlocking rules are in effect.

In interlocking and yard areas these control panels also provide routing, signal and electric / pneumatic switch machine control. An interlocking control panel displays a line diagram of the tracks in and near a particular interlocking or group of interlockings, and is equipped with various push buttons, switches, computer screen controls and visual / audio alarms to allow control and monitoring of a section of track. Most individual local control panels are connected to a centralized operations center (see Figure 11) that monitors and controls all train movement and activity throughout the entire rail authority.

This course will provide participants with an in depth look at the different types, purpose and functions of control panels, like the one depicted in Figure 1. Also, a variety of control panel components and their functions will be examined. A review of communication interfaces and lock diagrams will also be provided.

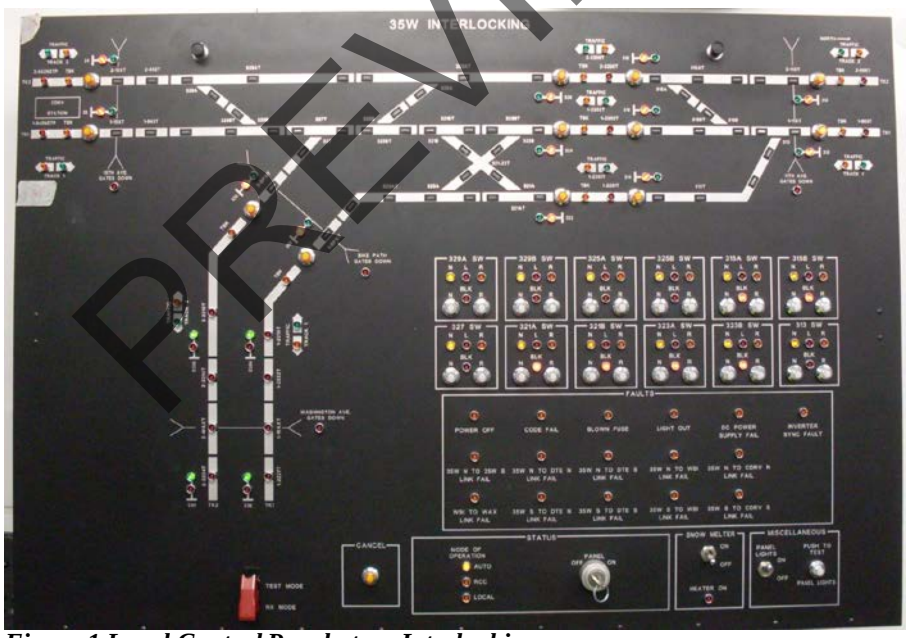

Figure 1 Local Control Panel at an Interlocking

1-2 HISTORY OF CONTROL PANELS

Early Control Panels

There were two main forerunners of today's train control panels were known as **mechanical interlocking machines**. There were two main types of these machines:

1. Lever Machine
2. Unit Lever Machine

Lever Machines

One type of **lever machine** is the US&S Model 14 (
Figure 2). Where these older, mechanical machines are used, signals, switches, and traffic were controlled by the use of levers. The upper portion of the machine contains a **locking bed** (Figure 3) consisting of steel bars that form a grid that is designed to prevent unsafe train routing through the use of mechanical and electro-mechanical logic.

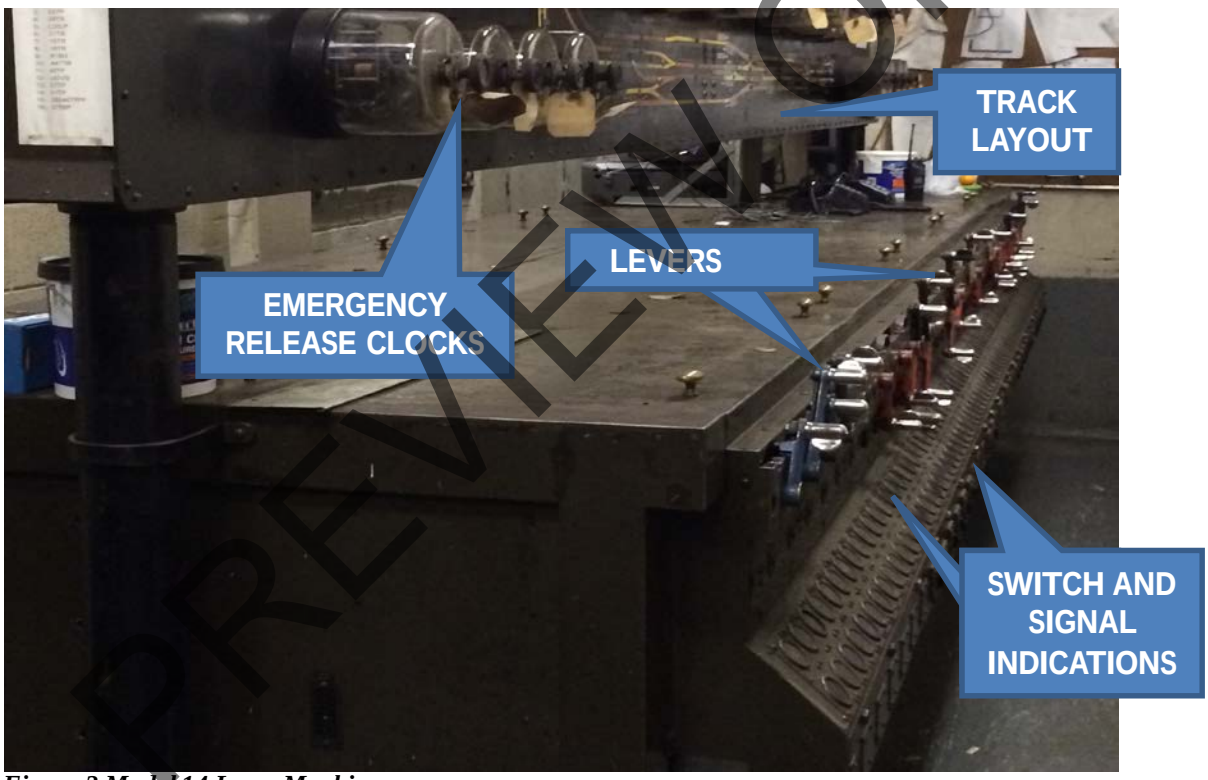

Figure 2 Model 14 Lever Machine

This mechanical logic is equivalent to logic performed by relays and/or microprocessors in later generations of interlocking control. Here are a few examples:

- A **signal lever** cannot be moved into a position to display a permissive signal unless the corresponding traffic lever is in the proper position for said train movement.
- A signal lever placed into position to display a permissive signal will mechanically lock all of the switch levers within the route.
- A signal lever cannot be moved into position to display a permissive signal unless all switch levers within the route are in a proper corresponding position.
- A **switch lever** cannot be moved into a fully corresponding position unless the position of the switch lever and the switch circuit controller are in correspondence.

In the Model 14 machine to mechanically unlock a signal lever, the associated levers would all have to be in their correct positions in the locking bed (Figure 3). There are machined notches in the steel bars of the locking bed that coincide with projections called **"locking dogs"** in precise locations to allow or prevent levers to be moved into positions that would allow for invalid routing of trains.

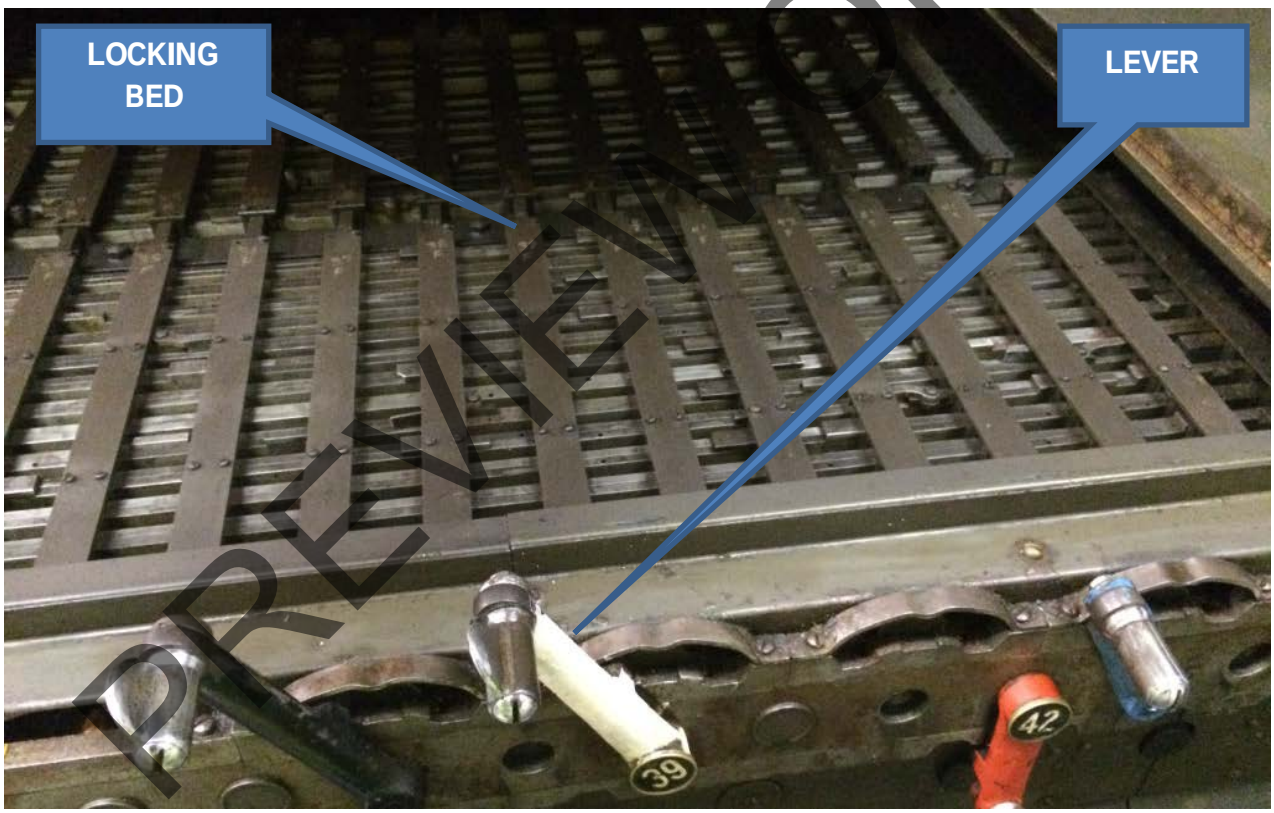

Figure 3 Locking Bed on US&S Model 14 Mechanical Interlocking Machine

The properly energized signal circuits would electrically unlock the signal lever via a magnet in the back of the machine, and the same would apply for the switch and traffic levers (Figure 4).

Figure 4 Magnets located in the rear of the lever machine

As the lever(s) become mechanically and electrically unlocked, they can be thrown to the position(s) necessary to move trains. While the lever is moving from one position to the next, corresponding **rollers** (Figure 5) which are found in the back of the Model 14 machine rotate and allow circuits to be opened or closed.

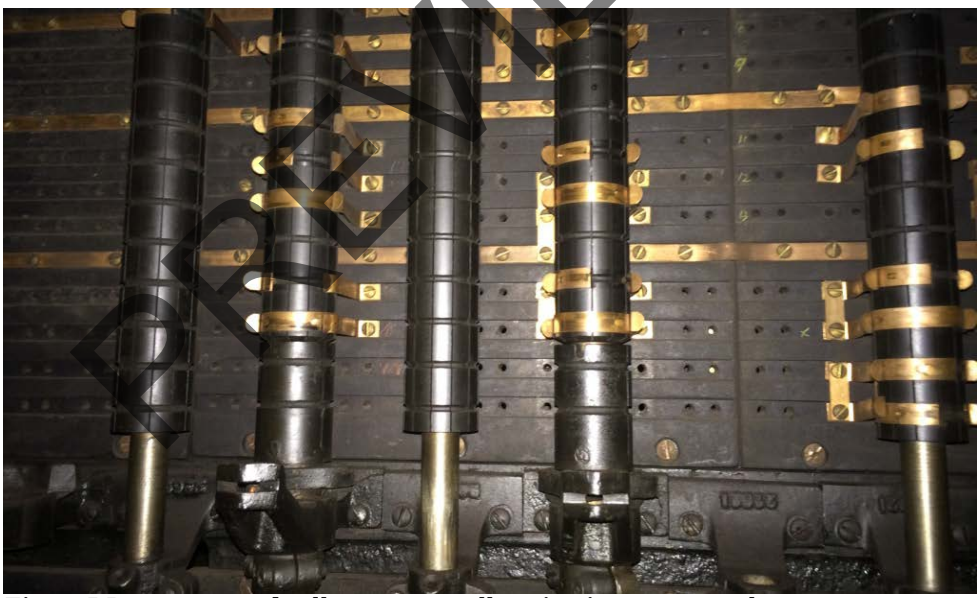

Figure 5 Inter-connected rollers rotate to allow circuits to open or close

Classroom Activity

Using the control panel components listed in chart below, complete the following:

- Select one typical local control panel at your location.
- Locate the similar components on your local control panel.
- Describe the function of the component in detail.
- Add any other component not listed here but available on your authority's local control panel.

Table 1 Control Panel Components Summary Chart

Components	Participant Notes
Indicator Lights	
Switches	
Push Buttons	
Audible / Visual Alarms	
Keyboard and Mouse	
Health Indicators	

Warning: Safety Precautions!

If your agency uses fiber optic cables, do not look into the end of the fiber optic cable with the light beam.

1-6 LOCK DIAGRAM READING

The interlocking referenced in the 'Elementary Principles of Mechanical & Electrical Locking' diagram (Figure 42) utilizes a 4 Lever Model 14 Mechanical Interlocking machine. This interlocking consists of four signals ***(2R and 2L / 4R and 4L)*** which are controlled by 2 levers which can be moved either left or right.

- There is a single crossover switch **(3)** whose normal or reverse movement is controlled by **3** levers. Lastly, there is a traffic control lever **(5)** to allow for proper movement of trains.
- Below the track plan illustration are drawings of the respective levers, shown in their normal positions as well as the locking segments and electro-magnetic locks.
- The illustration at the bottom of the page represents the mechanical locking bed with the respective lock dogs and lock bars which provide the mechanical logic necessary for the safe movement of trains.

To better understand the mechanical logic incorporated into the machine, refer to the **Locking Sheet** chart on the bottom left of the diagram. A locking sheet is a description in tabular form of the locking operation in an interlocking machine. An example of how to read the chart is as follows:

- The **left** column indicates the lever and its position, either left, right or in the case of the Traffic lever, normal N or reverse R.
- The **center** column indicates "when" and in this example the number 3 with a circle around it represents **3 Switch** in the reverse position.
- The **right** column shows the results or what becomes mechanically locked as a result of the positions of the machine levers.

Referring to the **1st row**, it translates as follows:

- With **2 Signal** lever fully in the **"R"** position, mechanical locking will be in effect on **3 Switch** in either normal or reverse position and **5 Traffic** lever will be locked in the **"R"** position.

Referring to the **2nd row**,

- With **2 Signal** lever fully in the **"R"** position, with **3 Switch** reverse, **4 Signal** lever will be locked.

1-7 SUMMARY

This module provided an overview of control panels. It provided details about different types of control panels, their functions and purpose. It also examined several control panel components and the specific function of each one. In addition, the module traced the history of how local control panels developed, changed and improved since the 20th century. It reviewed communication interface as it relates to control panels and concluded with how to read a lock diagram.

This module provides the foundation for the subsequent course on the inspection, testing, maintenance of control panels.