Where circuit controllers are directly connected to switch or derail connections, they may be thrown out of adjustment because of the condition of the switches and derails. This trouble may be located by taking a few readings on each side of the controller to determine if the local phase of the relay has a voltage lower than its normal working voltage which is stamped on the relay.

No matter what type of track circuit is used, the maintainer should not raise the secondary voltage across a track circuit where there is a defective joint, for in doing so he will have a larger drop across the defective joint and this in turn will mean a lower voltage aross the relay terminals in addition, and this will cause a greater drop across the cross-bonds marked P-1 and P-2 in. Fig. 3, which is more dangerous. This is dangerous because of the possibility of having sneak circuits energize a relay on an adjoining track circuit with a train in the block.

Again referring to Fig. 3, character Y, trouble may be caused by a frog jumper being broken underground. This can be ascertained if the maintainer will take a reading on each side of the solid rails adjoining the frog wings. Such a case of trouble will result in a drop of voltage similar to that of a wide open joint.

If for some reason a track reiay remains open after the maintainer has taken readings from the transformer end of the circuit to the relay end of the circuit and finds no appreciable drop at any place except at the relay terminals, which may show just the smallest amount of current, his trouble may be caused by water or ice in the impedance bond, depending on the season of the year. As has already been explained, this will cut out half of the bond. The bond will then become saturated with d. c. return current, lose its impeding effect, soak up practically all of the track circuit energy and not allow enough current flow to pick up the relay.

On rare occasions, when a track circuit is giving trouble due to the relay not being picked up strong enough because of low voltage across its terminals, it will be found that the transformer voltage may not be high enough. This is determined after it has been decided that the transformer has not been charged recently. Voltage readings taken across the transformer secondary terminals with the secondary circuit closed should check with the readings on the name-plate or tag attached to it. The writer has in mind one or two cases when the voltage readings on the secondary side of the transformer were one-third of that of the rated voltage. This was on a very long track circuit where the highest tap was used; instead of having 18 volts at the transformer, readings taken showed only 6 volts. Test as we would, beginning at the relay end and testing up through the switches and back to the relay, we could not discover where the loss in voltage was, so after doing this several times the writer took a reading across the rails at the *transformer, which he should have done first,* and found 6 volts instead of 18 volts. Investigation showed that lightning had burned out about two-thirds of the windings, yet one-third of the windings were intact and operating. Sometimes improper voltages are caused by transformers being tagged wrong, and again it may be found that they are designed for a frequency other than the one in use.

Shorts in track circuits may sometimes be caused by pipe connections running from the switch points to the derails or opposite ends of a cross-over having defective insulations, particularly where the connections are connected on one side of a switch adjustment which is not between the center line of the rails. This defective insulation will cause a considerable drop in the immediate location of the switch. It is a good idea then to disconnect the pipe line and ring out the insulation with a magneto similar to the way the switch rods were tested as mentioned elsewhere. Short circuits may also be caused by the fouling jumpers at a siding coming in contact with one another. This will also cause a large drop in voltage similar to that caused by an open joint.

On viaducts, where guard rails are used, any obstruction between the running rails and the guard rails will cause a short circuit. This obstruction may be only a washer or spike. When long screw spikes are used they may reach through the ties on rare occasions into the bridge or viaduct structure; this will result in a grounded track circuit and can be located by starting at the transformer end of the circuit and taking readings at every rail end or other suitable location. The maintainer will eventually come to an unusual drop between running rails and his trouble will not be far off.

It is not necessary for maintainers to take current readings on track circuits, particularly when polyphase relays are used, because, as a rule, the self-inductance of the meters is sometimes so great that when inserted in series with the track phase of a relay, the relay will fail to operate, consequently the maintainer cannot make such tests.

An a. c. voltmeter with readings of 1, 5, 25 and 125 volts will suffice for practically all track circuits in use today, irrespective of frequency. Maintainers should not tamper with these instruments, as they are very delicately made and should always be sent to the manufacturer to be repaired unless there is someone on the system who is capable of making repairs.

FIRE THREATENED TIE UP AT GRAND CENTRAL TERMINAL

THE burning out of a 660-volt positive third rail feeder at 6:30 a. m. Sunday, May 15, at Tower U interlocking Grand Central terminal, threatened to tie up all train movements into and out of the station and in addition caused damage to the interlocking estimated at $20,000. Trouble was first noticed when track fuses could not be kept from blowing out on one track circuit. When an inspection of the track circuit was made a thin line of smoke was noticed curling up from the ballast. Electrical department employees were notified, but before their arrival the feeder burned out and the heavy current discharge was carried through the ground, over pipes, and structural steel work in all directions.

It appears that this current was carried into the interlocking tower on the steam heating pipes which, in running to the tower, are buried in ballast at this point. From these pipes the current spread to all metal parts of the tower and the insulation on the wires for all the interlocking and intercommunicating circuits was set on fire and burned fiercely, completely destroying all circuits. The city fire department on arrival completely flooded the tower, adding materially to the damage to the machine and instruments.

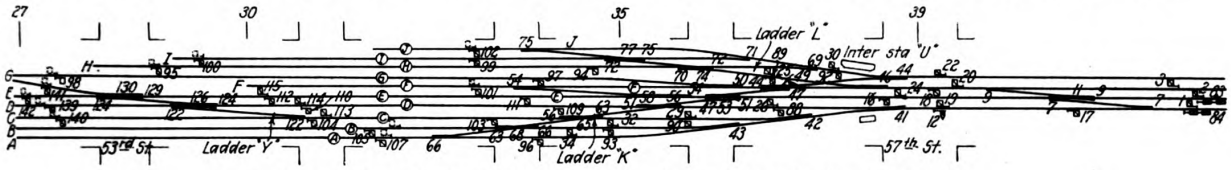
Tower U is an electric interlocking plant with a General Railway Signal Company unit-lever type machine having a 144-lever frame and 92 working levers. This interlocking has the following units:

17 electric locks for switches and signals.
19 lever lights.
45 signals.
40 switches and frogs.
29 track circuits.
55 lights.
152 miscellaneous electric units.
124 units on intercommunicating system.
138 actual operating units.

With the exception of the frame and the mechanical locking, the machine had to be stripped and entirely rebuilt and temporary circuits had to be run. This work was done by a force of 17 officers and men, who immediately

started to work to repair the damage under the direction of H. S. Balliet, assistant terminal manager.

Tower U is the neck of the bottle for the Grand Central terminal, as the 4 tracks approaching the station diverge into 10 tracks at this point, which in turn branch out into the tracks going to the upper and lower levels in the station. A study of the accompanying track layout and the



The Track Plan of Tower "U," Showing the Switch and Signal Locations

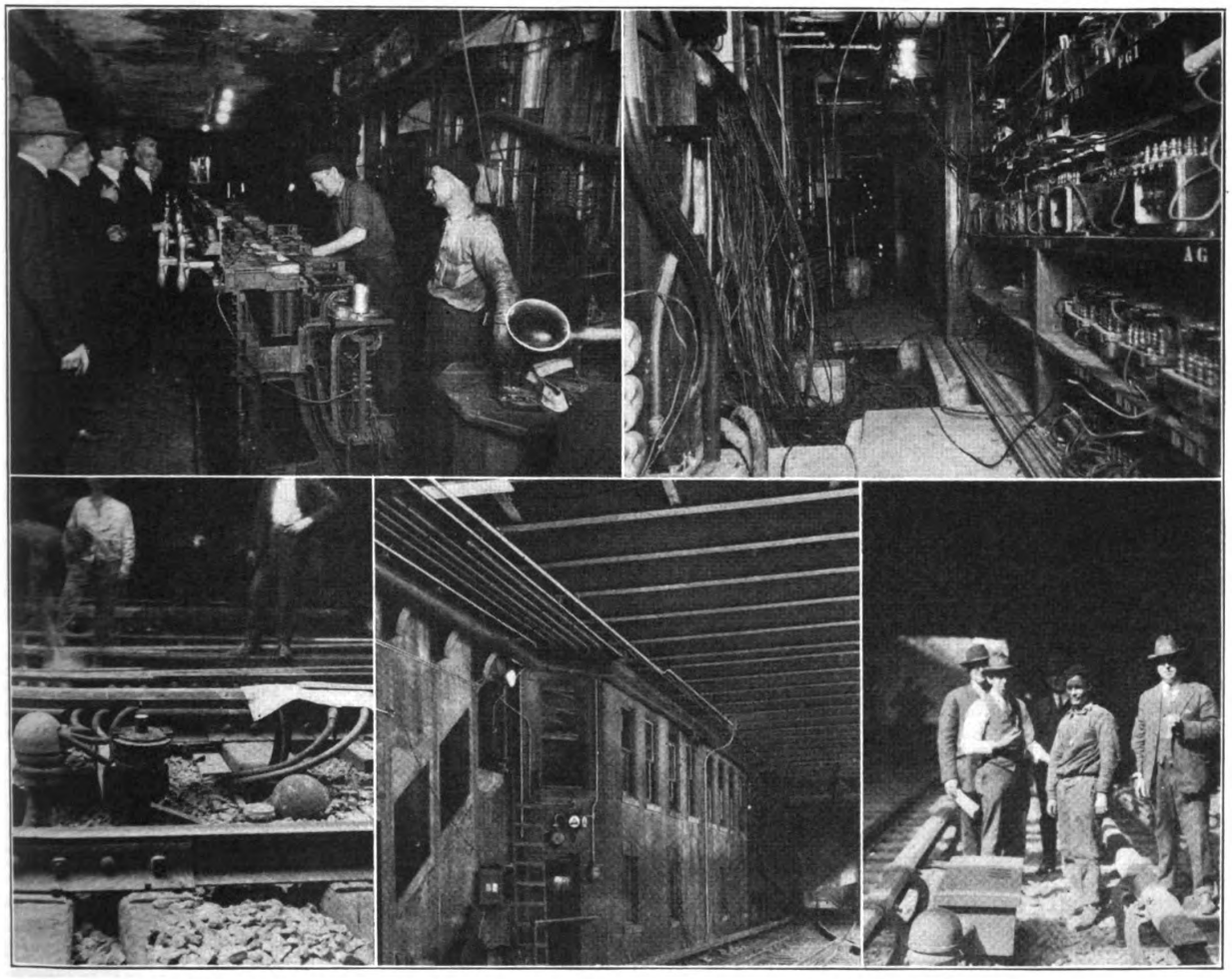
illustrations will show the conditions existing at this point and the necessity for repairs being completed in the shortest possible time, as there are about 400 train movements over this plant on Sundays, while on week days these movements average about 625.

The inbound traffic would occupy the rush period in the morning, while that in the evening would be outbound, but the schedule for the Grand Central terminal is so constructed as to cover peak loads, both inbound and outbound, both mornings and evenings at almost the same periods. Consequently, in order to handle the Monday morning business, May 16, the following units controlled directly from the interlocking machine had been placed back in service:

Signals 12, 19, 20, 3, 22, 17, 20, 30, 25, 26, 14, 15, 93, 105, 109, 88, 140, 107, 139, 142, 141, 112, 110, 103, 115, 101, 114, 111, 96, 113, 32, 34, 90, 104, 95, 29, 98.

Switches 41, 46, 69, 71, 42, 43, 70, 50, 54, 129, 55.

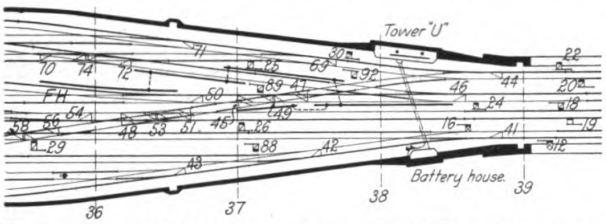
This gives some idea of the efficient and rapid manner in which repairs were made. The terminal manager had asked that switches 41, 46 and 71 and signals 88, 20, 22 and 30 be working by 5:30 a. m., Monday, May 16. At 5:00 a. m. Monday morning 11 switches and 37 signals were in operation. On Tuesday a. m. all signals on the plant (except two backup signals seldom used), 17 switches and all track circuits were back in service and repairs had been made on the intercommunicating system. As the switches were connected up, they were tested out and then spiked until the electric selector locking was



Reconstructing and Rewiring the Machine **Repairing the Faulty Feeder** **Tower "U" in the Retaining Wall** **Wire Chase in Relay Room Center—E. H. Sartain, Maintainer**

placed in service. In spite of the damage done, the train dispatcher's report for Sunday showed but 653½ minutes of accumulated delay, a large portion of which was caused by the city fire department requiring all power to be cut off at this point for about 40 minutes. On Monday, the 16th, the dispatcher's report showed that no delays were chargeable to the interlocking.

When the fire broke out, E. H. Sartain, first trick maintainer, was trapped in the rear part of the tower on the



Heavy Line and Jumpers Indicate Third Rail and Faulty Feeder Location

first floor, but by the use of chemical fire extinguishers he did much in confining the flames and preventing further damage. The main d.c. battery fuses were then pulled and all switches were spiked. The tower director and leverman, within 15 minutes after the fire, knew the conditions on the plant and began to move trains. In changing routes for train movements, only one man was allowed to crank over the switches and this work was done under the direction of the signal supervisor.

SIGNAL VALUATION UNITS

By E. T. Ambach

IN order that the valuation of railways can be continued, certain instructions have been issued from time to time by the valuation board. A question often arises which brings forth discussion, viz.: "What Is a Unit of Property." Briefly, it would appear that "A Unit of Property is one where the removal of one or more primary elements would cause unit to cease to function."

A transportation company would represent a certain intangible value based upon the number, kind and size of units used in the manufacture of its product. On account of the complexity of the transportation plant, it appears the property would be composed of certain major units, which are made up of composite units, which in turn consist of primary units. It is not at all difficult to classify major units, such as station buildings, bridges and locomotives, but when it comes to classifying signal apparatus, spread over a wide territory, an intricate problem is introduced.

Valuation order No. 3, second revised issue, states:

Page 8 (12) "The unit designations, the quantities and descriptions recorded in the completion reports and in the record of property changes shall be stated so far as possible in the terms of the inventory taken by this Commission.

Page 13 (21)

"(2) a list of property, etc. The property listed shall be stated in the terms of the inventory and shall be so arranged and classified as to correspond with the inventory. Provision shall be made under each account for inserting descriptions of any new types of property or units that may have been introduced since the inventory."

To state property changes in terms of the inventory may be capable of more than one interpretation. Some may say that it includes the primary units only; others that composite units may be used; while others state the major units may be used.

The Bureau of Valuation seems to have had in mind major units, which, of course, in turn are composed of composite and primary units. A major unit may not be replaced in its entirety, but a number of composite units may be retired or replaced. It is thought that in the matter of retirement of the major unit that when more than 50 per cent of the unit is to be rehabilitated, the entire unit should be retired and replacement made accordingly.

A study of the subject from various angles warrants the belief that the issuance of order No. 3 makes it obligatory for the carriers to keep a perfect system of records in its own files and to formulate a system of reports to be filed with the Commission. The records of property change should be clear and concise, so as to avoid any complications or misinterpretations. The following is recommended for the major units:

Account 27

Item	Unit
A—Tower Building—Kind, size, and spec. reference. (For details of appropriate units see Acct. 16)	Each
B—Other Buildings—Kind, size, plan and spec. reference. (For details of appropriate units see Acct. 16)	Each
C—Interlocking Plant—With power plant serving one plant. Kind, size, plan, ref.	Each
D—Power Plant (excluding building)—Including pole and station equipment	Each
E—Signal Bridges—(For details of appropriate units see Account 6)	Each
F—Outlying Switch Protection—Kind and plan, reference	Each
G—Station, Train Order and other Misc. Signals. Kind and plan, reference	Installation
H—Automatic Signals—Kind, plan and specifications, reference, including line wire and fixtures	Valuation Section / Installation
I—Staff Block System—Kind and plan reference	Valuation Section / Installation
J—Protection of non-interlocked crossing or junctions	Valuation Section / Installation
K—Pole lines, including poles, crossarcs, hardware, pins, glass, messenger wire, cable, line wire, etc.	Installation
L—Train control, train starting and other systems	Installation

Account 15

Item	Unit
A—Crossing signal bells or other warning signals	Installation
B—Crossing gates (excluding buildings).	Installation
C—Watch houses and apparatus	Each

ROCK ISLAND AMPERE CLUB

THE employees of the telegraph department of the Rock Island have organized an educational association known as the Ampere Club, the purpose of which is a mutual study of telephone and telegraph apparatus.

The employees realize that the efficiency of the telegraph system could be increased if they had more general knowledge of the apparatus. In an effort to overcome this difficulty each office was furnished with a complete set of specifications, drawings and instructions covering the theory and operation of the equipment. A series of examination questions was instituted and the idea was enthusiastically received by the employees.

From this start the Ampere Club was organized, consisting of a number of local clubs managed by a general committee selected by ballot by the members. Local clubs are formed at various points and regular meetings are held at which time recognized electrical courses will be carried out. Local equipment failures will be noted and the causes discussed at these meetings.

This organization seems to be a step ahead of any previous undertaking of the railroad in the education of telegraph employees. G. D. Hood, superintendent of telegraph, and his assistant, A. W. Douglas, with representatives of the department at Cedar Rapids, Chicago, Davenport, Des Moines, El Reno, Fairbury, Fort Worth, Kansas City, Topeka and Trenton, are responsible for this new educational club.