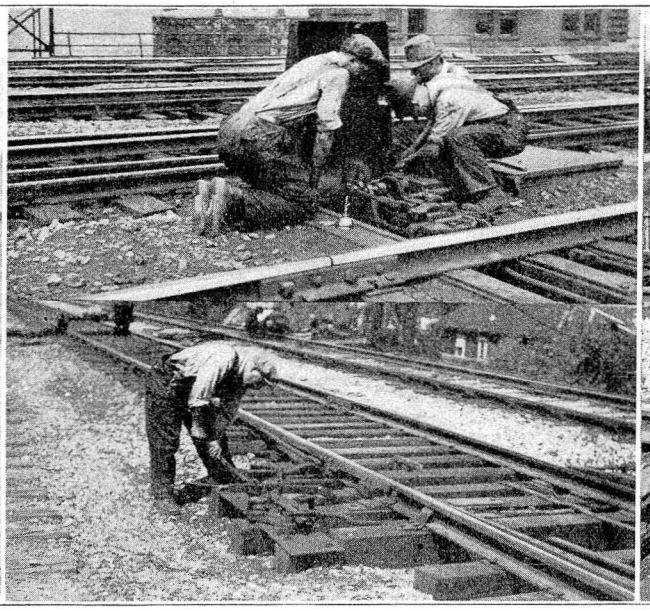
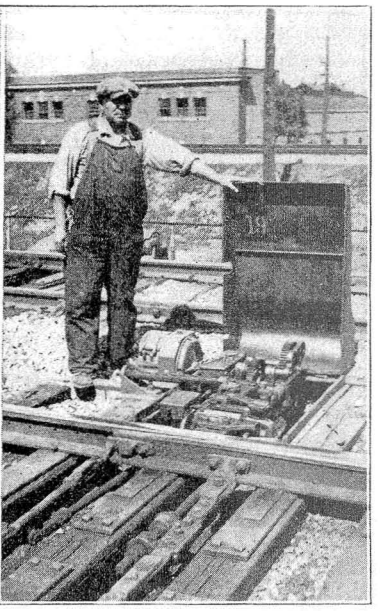
A. Johnson, Maintainer at Deering Inspecting a Dwarf Signal



Above—A Minor Maintenance Operation at Clinton St. Below—Adjusting a Mechanical S. & L. M. at Rosehill Plant



J. P. Winandy, Maintainer at Main St. Inspecting a Switch Machine

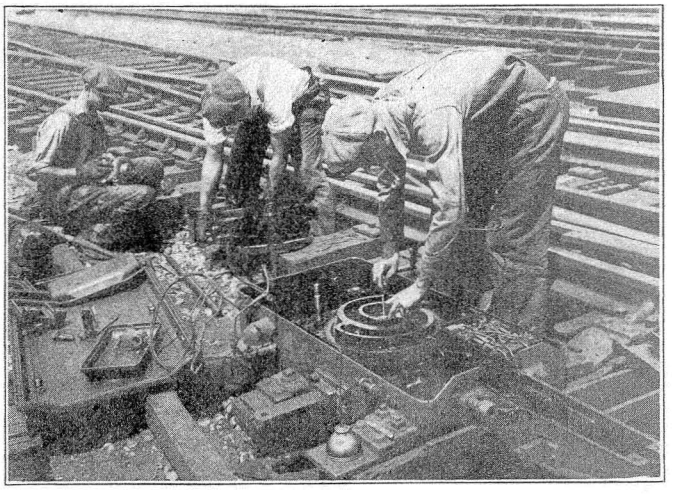
Maintenance on C. & N. W. Terminals

Heavy Passenger Traffic Requires Efficient Organization on Nineteen Interlockings and Intervening Automatic Signals

THE efficient maintenance of the automatic signaling, together with 19 interlocking plants, numerous wig-wags and all the crossing gates on the Chicago terminals of the Chicago & North Western involves many problems. The Lake street plant at the passenger terminal with 171 working levers is perhaps the most extensive layout, however an equal standard of maintenance is carried on all plants even though located in out-of-the-way coach yards. On account of the reduced net revenue of the railroad the signal maintenance forces have of necessity been reduced drastically, however excellent results are being shown. The present signal maintenance force includes two foremen, 20 maintainers, 11 assistant maintainers and 11 helpers. F. L. Wells is signal supervisor and P. O. Gladhill, assistant supervisor of this terminal territory. A unique feature of this organization is that Mr. Wells also has charge of all levermen on the terminals including 82 levermen and 5 relief men.

The Territory Covered, the Traffic and the Type of Plants

The track changes and elevation in connection with the building of the Madison street passenger terminal in 1910 included the construction of five General Railway Signal Company unit-type electric interlocking plants at Lake street, Clinton street, Carpenter street, Noble street and Division street. There are 300 scheduled train movements into and out of this terminal every 24 hours, and as this is a stub-end layout an approximately equal number of reverse moves are made to or from the coach yards. On an average 960 movements are made over the Lake street plant in 24 hours. The peak of suburban traffic is outbound between five and six o'clock in the evening, followed by the evening rush of main line trains. In the morning an equal number of trains are handled, but traffic is spread over a longer period, between seven and nine o'clock. A case of trouble on the interlocking plant, if for only a few minutes, is sure to cause numerous train



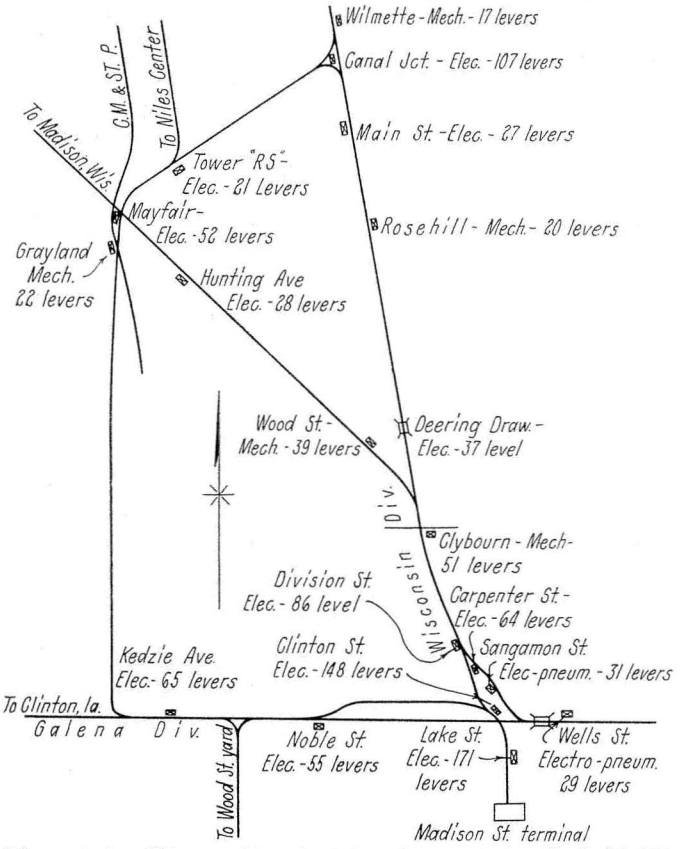
Performing a Major Operation on a Model-4 G. R. S. Switch Machine, This Is Done About Every Four Years

delays. That the maintenance is kept at a high standard is evidenced by the infrequency of such delays.

The Madison street terminal with 16 station tracks is the point of concentration of this traffic. The Lake street interlocking located near this station handles 23 sets of double slip crossovers between the six tracks of the throat as well as 29 switches for the tracks fanning out to other station tracks. As this is considered as a

switching area no derails are used, there being 29 levers for switches, 46 levers for double slips, 67 levers for signals, 23 for movable point frogs and 6 for traffic locks, totaling 171 working levers.

V. Ligman is the signal maintainer at Lake street on the first trick, having an assistant maintainer and one helper. His duties consist of the maintenance of all signals, switch machines, trunking and wire connections. The first two hours in the morning are devoted to a general inspection, the assistant maintainer taking certain tracks and the maintainer others, and checking over the entire plant. Unless trouble arises to interfere the remainder of the day is taken up by cleaning switch



Map of the Chicago Terminal Territory of the C. & N. W. Indicating Type of Plants and Number of Working Levers

machines, adjusting switch rods, repairing trunking, or any other regular maintenance work as may have been noted on inspections. On account of the large number of switch operations the pins and pin holes in the switch rods and lock rods wear quite rapidly, therefore the work of adjusting rods, taking up slack by forging and reaming holes, or renewing parts, requires considerable time. About every four years the Model-4 switch machines are taken all apart, cleaned and reassembled in the field as is shown in one of the views. In order to prevent injury to men working on switches on account of the lever being operated, a special tin sleeve has been provided that fits over the handle of the lever in such a way as to prevent the leverman from gripping the latch. Before working on any switch the maintainer places such a sleeve over the lever handle and no one but the maintainer has authority to remove it. The Model-2A signal mechanisms, used for both the high and dwarf signals, require but little time for inspection and oiling.

H. Anderson, the maintainer on the second trick at Lake street plant has one assistant maintainer. The second trick completes any special work which the first trick was unable to finish, inspects the lamps, and then attention is turned to the inside of the tower. The third trick maintainer, R. Rule, takes care of the interlocking machine, the illuminated track diagram, the relays, indicators, etc. The men on both the second and third tricks are, of course, called out for trouble occurring on any part of the plant and, if necessary, to other plants nearby.

The signal lamps are electrically lighted, using one carbon and one Mazda lamp, both of which are 110-volt, 10-watt, in each unit. If the Mazda lamp burns out, the carbon lamp will continue to give an indication, but the difference in brilliancy can at once be detected and a renewal made.

Importance of Ground Tests

A voltmeter ground test made from the power board at electric interlocking plants is made daily. This test should show a very low voltage to ground (not more than five volts) on either the positive or negative buses as neither side of the operating battery is grounded. A high voltmeter reading indicates a low resistance ground on the bus to which the ungrounded voltmeter terminal is not connected. In other words, with the voltmeter terminal on the positive bus, a high reading indicates a bad ground on the common side of the plant, and conversely a high reading with the voltmeter terminal on the plant common indicates a low resistance ground on the positive bus. A ground anywhere on an electric plant is always a potential source of trouble, and hence a daily check on ground insulation is important. Damp sand in the trays used to support open glass storage jars was responsible for one case of a 30-volt positive ground which was particularly difficult to locate.

All loose wire is renewed at any time that a megger test discloses faulty insulation. In this way, maintenance troubles caused by grounded wiring are reduced to a minimum. A further protection against possible grounds is obtained by clearing all ballast away from trunking runs. The efficiency of keeping the interlocking circuits free of grounds has increased decidedly during the last seven years. Previously a negative ground was present most of the time on many of the plants, strong enough to light a carbon filament lamp. With the increased efficiency of maintenance all grounds are kept clear so that no indications are shown, except in very damp weather, even on the more sensitive tungsten filament lamp now used.

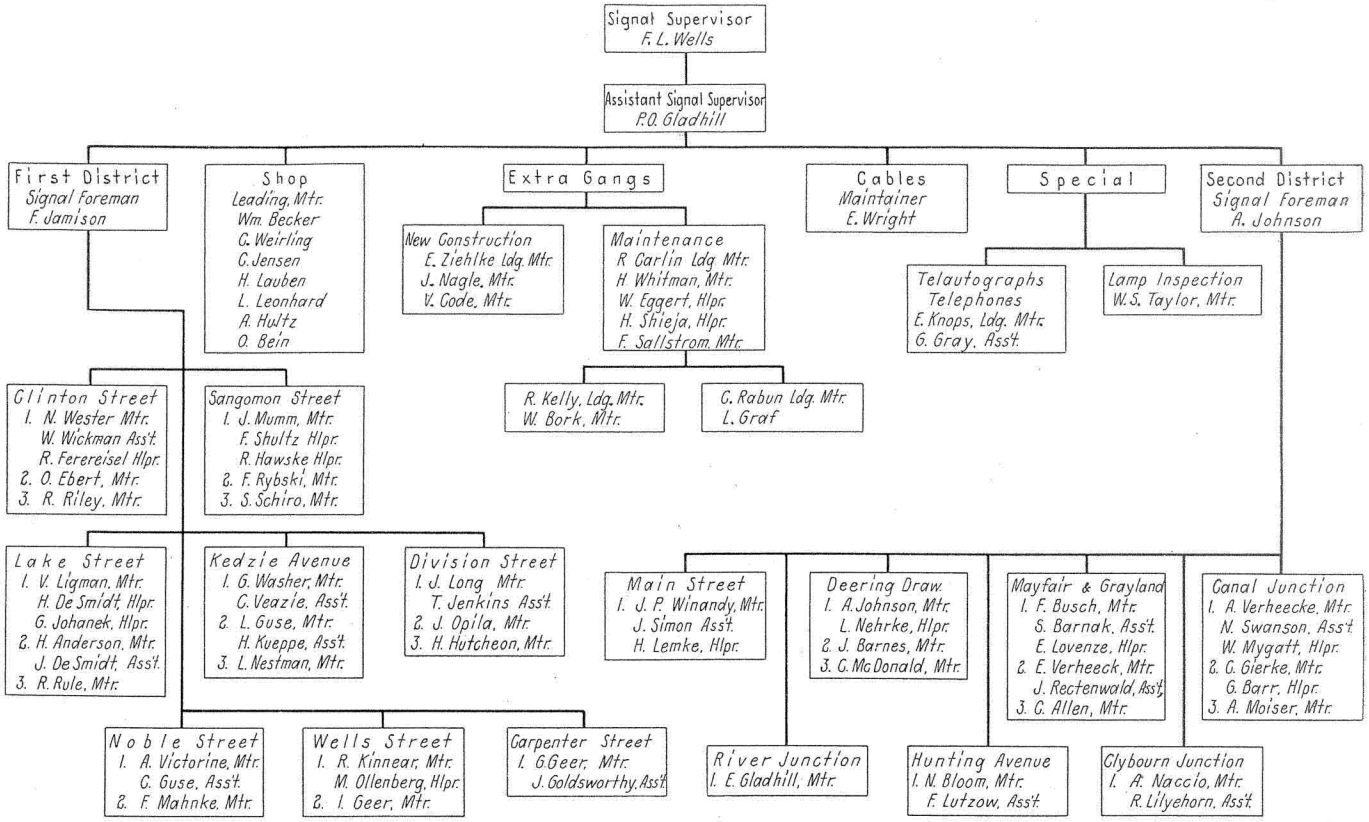
The care of the storage battery, charging equipment, switchboard, etc., is handled by the second trick force. The 110-volt, 400-amp. hour operating storage battery consists of 57 cells, Chloride-F11. The control battery consists of 12 cells of the same size and type of storage cell. The track circuits are all fed in groups from the control battery in the tower. The main battery is charged by a 110-volt, 50-amp. capacity generator, driven by a 220-volt a.c. motor, direct connected. A duplicate set is used alternately. Ordinarily the main battery is charged at 8 to 10 amp. floating charge. The low-voltage battery receives a charge of 30 to 35 amp. floating charge.

Wiring and Conduit Inspections

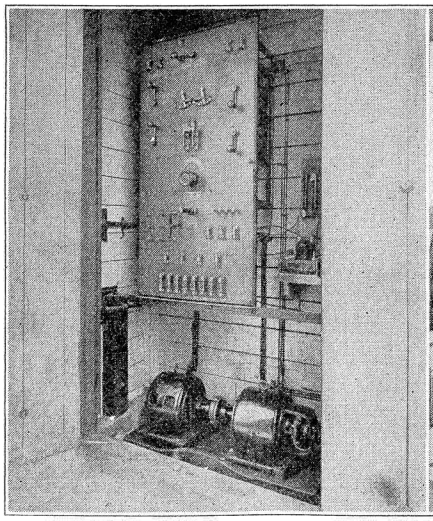
Circuits are distributed from the terminal board on the second floor of the tower through rubber insulated lead covered cables, run in fibre conduit set in concrete, to manholes located over the plant. In crossing under tracks or on bridge decks the fibre conduit is run in iron pipe. At the ends of these lead covered cables, in junction boxes, pieces of No. 14 wire are taped on to the cable wire, the joints being located in a 4-in. bell

which is poured full of paraffin. These wires are in turn taped to the wires leading out through trunking to the operating units. The joints, properly taped up in the junction box, are placed in a row on a rack similar to a terminal board, however no terminals are used in underground junction boxes, it being found by experience that corrosion caused too much trouble by introducing resistance at the point of contact. Between the junction boxes and the different units the No. 14 insulated wires are run in C. & N. W. standard cedar trunking. When these plants were installed in 1910 molten asphaltum was poured into the trunking to cover the wires. Experience showed that this asphalt would crack, allowing moisture to get to the wires decaying the insulation, causing grounds. In case any trouble developed it was necessary to tear up the trunking to get at the wires, thereby causing destruction that offset the benefits of the asphaltum. Therefore, the use of asphaltum was abandoned on replacements of trunking in the terminals.

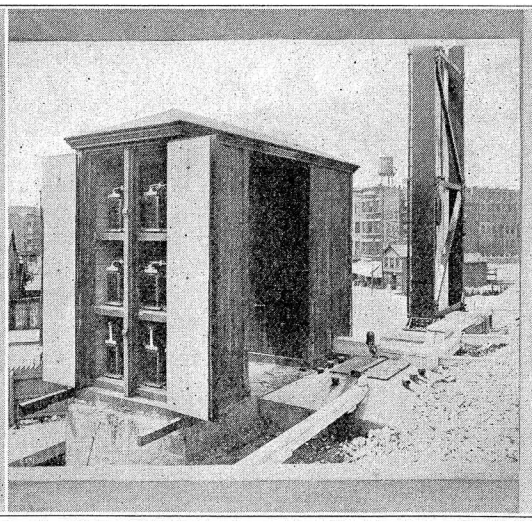
Experience has proved that when trunking is laid on the deck of a signal bridge that cinders and dirt get into the trunking to cause trouble. Therefore, on renewals the trunking is suspended on hooks underneath the deck of the bridge, the deck being on the lower girder. Where bridges are too low to allow proper clearance the trunking is placed on top of the upper bridge girders as is shown in one of the photographs. One unique feature on all trunking work is that no right angle turn is made as the wires are run through the piece of trunking running across the corner, thus making a corner of 135 deg. instead of 90 deg.



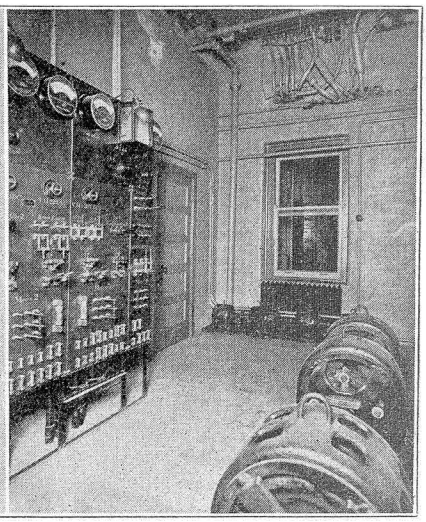
Organization Chart Showing Division of Work and Men Employed on Terminal Interlocking Plants



Charging Panels and Motor-Generator Set Used at Bridge Locations



Exterior View of Battery and Charging House Showing Storage Cells and Also Cable Manhole



Interior of Charging Room of Clinton St., Tower With Duplicate Motor-Generator Sets

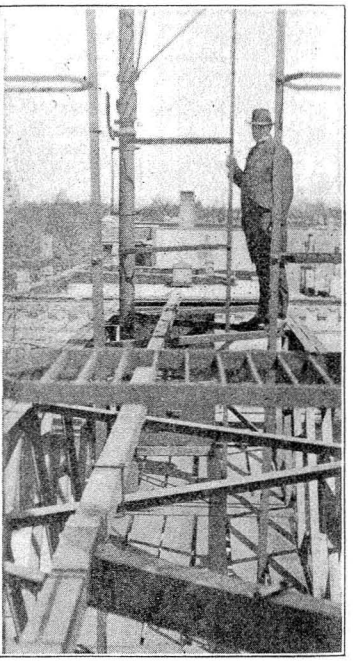
In some instances the lead covering of the cables in the conduit has become crystalized due to vibration, resulting in the covering cracking open to admit moisture which rotted the insulation, causing grounds on the circuits. The cables and all wiring are tested out for insulation resistance at least once a year by means of a megger set. Any circuit testing over 20 megohms is considered O. K. Circuits reading under 20 megohms are investigated in order of importance. If a cable tests under four megohms it must be pulled out and repaired or replaced. Underground cable repair work on the several interlockings is handled by E. Wright, maintainer, who has made a specialty of such work, and one of the pictures shows him at work splicing a cable in one of the main junction boxes in front of the Lake street tower.

able point frogs, 11 derails, 21 signals and 4 lock levers. This plant is maintained by one maintainer and one assistant on the first trick, a maintainer on the second trick, but no regular force on the third trick.

Following the Wisconsin division line north of Clinton street we find the Carpenter street plant. The two through tracks on the West are not involved in this plant. The Carpenter street plant handles the lead out of the old Wells street terminal to the north, including the roundhouse and suburban coach yards. This interlocking has 64 working levers for 11 switches, 8 double slips, 4 movable point frogs, 14 derails, 22 signals and 5 lock levers. One maintainer and one assistant on the first trick only care for this plant, the work on other tricks being cared for by doubling up from other plants.

Trunking Runs Are Painted White to Make Them Conspicuous For Safety

Above—Inspecting the Live End of an Electro-Pneumatic S. & L. M. at Wells St. Below—To Protect Wire Insulation All Trunking Junctions and Corners Are Made at 135 Degrees



F. L. Wells, Signal Supervisor on Bridge Showing Trunking on Top of Upper Girder

The discussion so far, although connected with the Lake street plant, applies in general to the organization and procedure used for the maintenance of the other large electric interlocking plants on the terminal. Therefore, only brief mention of the features of the other five plants and the maintenance organizations will be given.

Five Other Electric Plants Near Passenger Terminal

At Clinton street the four track line of the Galena division branches off to the west and the four track line of the Milwaukee and Wisconsin divisions continues northward. Another G. R. S. electric plant of 153 working levers handles this layout which includes 26 switches, 12 double slip switches, 6 movable point frogs, 33 derails, 62 signals and 14 lock levers. The maintenance force at this plant consists of one maintainer, one assistant maintainer and one helper on the first trick, one maintainer on the second trick, and one maintainer on the third trick.

Following the Galena division west we find a similar G. R. S. electric plant at Noble street where the lead to the old Wells street terminal goes down off the elevation to surface level. This machine has 55 working levers to handle 7 switches, 8 double slips, 4 mov-

At Division street, just north of the Carpenter street plant, is another electric plant with 86 working levers which handles the crossover moves from the six tracks approaching from the north onto the four track lead going on through south to the passenger terminal. One maintainer is employed at this plant on each of the three tricks, while the man on the first trick only has an assistant.

On the Galena division, 1½ miles west of Noble street, there is an old Model-3 G. R. S. electric plant located at Kedzie avenue with 68 working levers installed to handle the leads into the Crawford avenue roundhouse, coach yards at California avenue and also to the Rockwell street freight line. The maintenance force on this plant includes one maintainer on each trick, with an assistant on the first trick only.

Electro-Pneumatic Plants Well Maintained

An electro-pneumatic interlocking plant with 29 working levers was installed in 1893 at the throat of the old Wells street passenger terminal. This layout is now used exclusively for express and freight loading tracks. Considering the service of this yard and the lower standard of track maintenance it is surprising to note that this electro-pneumatic interlocking is being

maintained up to a standard of service equal to that of other equipment on the terminal district. Within the last few years the tower wiring has all been replaced in iron conduit and the machine has been rewired, giving a neat appearance. The storage battery is as yet being charged by a bi-polar 20-volt, 15 amp., d.c. generator belt connected to a motor which is driven by compressed air from the air line. This plant has 14 levers for 26 signals, 14 levers for 16 switches and 2 double slips and 1 lever for bridge lock, all electro-pneumatic, which is maintained by one maintainer and a helper on the first trick, one maintainer on the second trick, but the third trick is covered by men from other towers.

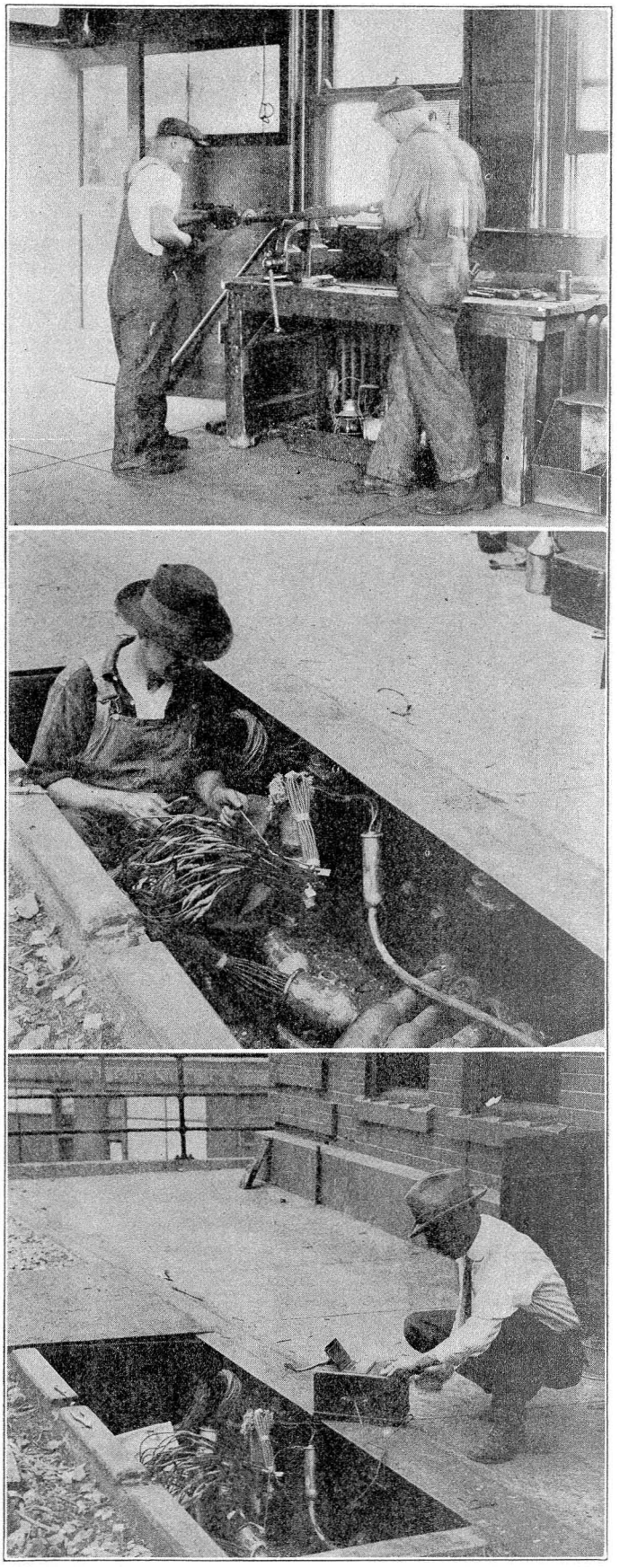
A second electro-pneumatic plant with 31 working levers is located at Sangamon street on the old line of the Wisconsin division between Wells street and the new elevation at Carpenter street. This plant handles the switches leading out of the suburban coach yard and roundhouse. This Sangamon street interlocking plant was completely overhauled and the machine placed in a brick tower about three years ago at which time the plant was out of service only four hours. A maintainer on each trick, with a helper on the first trick only, maintains this plant.

One Power Supply in Terminal Area

The power supply for the several plants already described is furnished from the power house of the C. & N. W. terminals. A motor-generator set in this plant delivers 6,600 volts, three-phase a.c. power to a signal transmission line which extends underground as far north as Division street and west to Noble street. At each tower and automatic signal location this 6,600 volts is transformed down to 220 volts for driving the motor-generators that charge the batteries. After this 6,600-volt a.c. underground line had been in service a few years failures commenced to occur almost daily caused by bad cables, fuses blowing, pot-heads or bus bars burning out, etc. In 1913 a vigorous campaign of maintenance was started on this underground line. All connections, fuse boxes and bus bars were cleaned and painted with P & B paint to seal up the surfaces from moisture, thereby preventing corrosion. The cables are given a regular megger test every six months, and each year, about September, the various contacts, fuse boxes, etc., are repainted with P & B, and all fuses replaced. As a result of the careful attention being given to this 6,600-volt underground circuit failures are being limited to an average of about one in eight months. The signal lights, illuminated diagrams and tower lights receive power from the transmission line, transformed down to the proper voltage.

At the automatic signal bridges motor-generator sets are provided to charge 160 a.h. capacity, 16-volt storage batteries that are used as a power source for the operation of signals in the immediate vicinity. The track battery is charged in the same circuit. Duplicate sets of both batteries are provided to permit cycle charging. One of the pictures shows the special housing for these motor-generators and batteries. As an emergency source of power for signal lamps a separate 220-volt circuit is carried as far north as Division street. In case power is cut off, the 110-volt lamps can be replaced by 10-volt bulbs and the lighting circuit switch connected to the local storage battery.

The air compressor which furnishes air for both the Wells street and the Sangamon street electro-pneumatic plants is located in the terminal power house. A 3-in. galvanized iron pipe runs from the power house



V. Ligman, Maintainer (Right) and His Assistant at Lake St., Making a Bench Adjustment on a Switch Rod

All Underground Cable Repair Work Is Handled by E. Wright, Maintainer Who Is Shown Here Splicing a Cable in a Main Junction Box at Lake St.

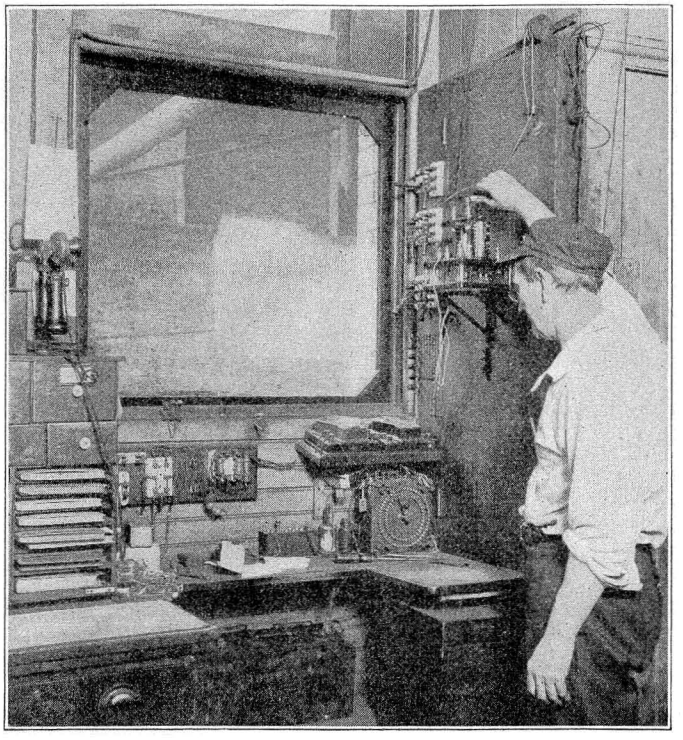
F. Jamison, District Maintenance Foreman Is Engaged Making a Megger Test of Cable Insulation

to each of the plants, being carried on oak blocks on the surface of the ground.

The six electric interlockings and the two electro-pneumatic plants, together with a few intermediate automatic locations which have been discussed in this article up to this point, are maintained under the direction of F. Jamison, district maintenance foreman.

Second District Includes 11 Plants and 12 Miles of Signals

The territory on the Wisconsin division north of Division street interlocking plant, and extending to Wilmette on the Milwaukee line and to Mayfair on the Madison line, is under the supervision of A. Johnson, district maintenance foreman. His territory includes 6 electric plants and 5 mechanical plants, as well as 12



Testing a Track Relay at the Lake St. Repair Shop, Simultaneous Readings of Current and Voltage Can be Obtained

miles of three-track automatics on the Milwaukee line, 2 miles of double track and 4 miles of three-track automatics on the Madison line, and 7 miles of double track signals on the Evans cut-off from Mayfair to Canal Jct. A maintenance organization of 13 maintainers, 5 assistant maintainers and 5 helpers on all three tricks is required to handle the work in this territory.

The signal department maintains all the electrical equipment at the Deering bridge. This is a three-track single leaf Straus bascule bridge with a 185-ft. span across the north branch of the Chicago river and is locked both electrically and mechanically from the interlocking machine located in the bridge operating room. Two 150 h.p., 440-volt a.c. Westinghouse motors operate the bridge, with a 50 h.p. gasoline engine as a reserve source of power.

At Main street, Evanston, Ill., there is a plant with three cross-overs in a three-track layout to handle suburban traffic. Construction work now being done will eliminate the necessity of levermen during the second and third tricks, through a rearrangement of signaling which will permit full automatic operation during these periods of the day. This change will be effected at an estimated cost of $4,000.

The maintenance forces at most of the interlocking plants in the territory under Mr. Johnson's supervision, are also responsible for the maintenance of automatic signals in the vicinity of such plants. In each section of automatic territory the men work out a maintenance schedule of their own, but the following illustrates in a general way the weekly program:

Monday is "lamp day"—oil lamps with gallon founts are trimmed every 10 days and filled every 21 days.
Tuesday is not reserved for any particular class of work.
Wednesday is the day that material is obtained from the division storekeeper.
Thursday is also "lamp day"—eight-day lamps are filled.
Friday is reserved for cleaning signals.
Saturday is spent finishing any work that could not be completed on the day scheduled.

In addition, after every storm all relays and arresters are checked and any damaged apparatus replaced as quickly as possible.

Some of the Peculiar Troubles That Have Been Encountered

Mr. Jamison foreman of the first district has grown up with the signal department of the North Western, starting in 1905, serving in the capacities of lampman, battery man, helper, maintainer and foreman. He can tell of many interesting cases of trouble that required quick work and steady nerve to prevent serious delays.

At one time when the Lake street machine was being rewired to change the route lock lever feeds an improper battery connection was made in the temporary wiring of the 20-volt control circuits going through selection on the combination board. In setting up a certain route the 30-amp. fuse in the feed from the control battery would be blown. After the line-up was changed and the fuse replaced there was no means of locating which lever the troublesome contact was located on. After several such cases of trouble Mr. Jamison connected a 2-ohm relay coil in series with the 20-amp. coil of an ammeter across the empty fuse clip. The various combinations were set in the machine while one man watched this ammeter. When the needle jumped up to about 12 amp. he called to the leverman to hold the last lever moved. The contacts on this lever were then opened one at a time until the trouble was located.

A serious case of trouble occurred at one time which tied up the terminal for several minutes caused by some of the fuses in the track circuit feeds blowing out as fast as new fuses could be slipped in the clips. After numerous tests to localize the source of energy it was found that a 64-volt head-end train lighting generator in a baggage car in the terminal had become grounded and was pumping about 30 amp. in through the track circuits.

Perhaps a more serious case of trouble occurred when a 110-volt common wire was open intermittently. Such a defect is difficult to find and will tie up a plant until located. In order to locate the function nearest to the break in the common return wire, the different switches were operated in turn, starting with the one nearest the tower. The first switch that refused to move or was sluggish was marked. The heaviest loaded switch, such as a double slip, that was close to the far end of the circuit away from the tower, was then operated. As there was no common return for the indication of this function it would attempt to indicate through the indication coils of the function between it and the break in the wire. By watching the indication magnets affected by multiple indication the

break in the wire was located between two switches. Further investigation showed that there was a high resistance joint in this common return wire which had been made with a sleeve when splicing the cable. This case of trouble which tied up a portion of the plant was reported about 3:00 o'clock one Saturday afternoon and by 3:20 the trouble was located and temporary repairs made to get the plant in operation.

At one time intermittent trouble was caused by a grounded track circuit on the Chicago river bridge at the Wells street plant. Numerous tests and physical inspections failed to locate any cause for the trouble. As a final resort a buzzer set was connected in the track circuit feed in place of the track resistance and the bootlegs were cut off at the relay end of the track circuit. By means of an exploring coil trouble was indicated at a certain point, but on retracing the test the trouble was clear. After several tests, about half of which showed trouble at a particular point, Mr. Jamison went down under the bridge and found a brake shoe key wedged between the base of the rail and the deck of the bridge. The removal of this key, that looked just like a sliver of wood, cleared the trouble.

Ordinarily an underground cable shows trouble from grounds, however in one special case a certain interlocking cable indicated that the wires were crossed. Tests by means of a Wheatstone bridge located the cross in conduit near the ceiling in the power house. When the cable sheath was opened admitting air the cross caused a burst of flame. Investigation showed that the insulation in this cable had evidently been baked and deteriorated by excessive heat from the boiler room.

In the 14 years since the electric plants were placed in service there have been many derailments. Perhaps the worst was caused by excessive speed of a train resulting in the engine being turned over on its side at right angles to the tracks on one end of a double slip switch. This accident tied up five of the six tracks at the throat of the terminal, damaged seven switch machines and four or five signals beyond immediate repair. By systematic quick work on the part of the maintenance forces the damaged interlocking equipment was replaced and ready for service when the tracks were cleared, an accomplishment which received the favorable comment of operating officers.

Record Books for All Delays or Failures

A record book of daily maintenance is kept at each plant and all failures occurring during any trick are recorded in this book. A typical entry taken from the book at Deering interlocking is as follows:

July 22, 1925, Pos. 6—Neg. 85, No failures, no delays.

A. Johnson,
J. Barnes.

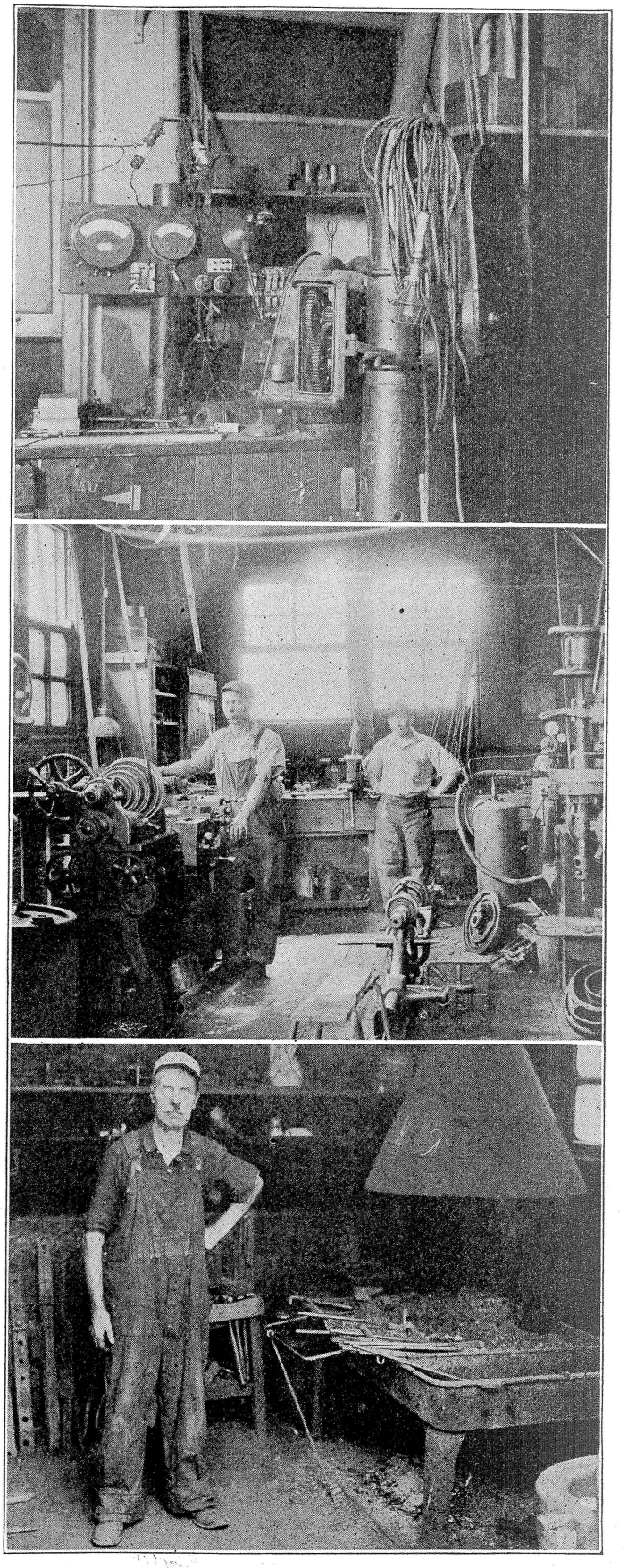
Pos. 6—Neg. 90, Automatic signal C297 northbound and C304 southbound out at 6:08 p.m. (Diversey Yard) due to center track switch box G contacts open. Found bolt lock lever unlocked and bolt lock open. "O. K." at 6:42 p.m. Trains 101 and 405 stopped for same.

J. Barnes,
McDonald.

Pos. 5—Neg. 87, No failures.

McDonald,
A. Johnson.

It will be noted that each trick maintainer records first the ground reading at the time he reports and then lists any failures that occur while on duty and also operating delays resulting therefrom. In order to insure that each man acquaint himself with the trouble encountered during the preceding trick, it is required



The Equipment Used for Shop Testing of G. R. S. Model 2A Signal Mechanisms

At Lake St., a Separate Building Houses a Machine Shop for Mechanical Repairs, W. Becker, Leading Maintainer in Charge of Shop Work Is Shown at the Right

A Blacksmith Forge Forms Part of the Shop Equipment

that each trick maintainer coming on duty sign his name below the signature of the man just leaving as well as at the end of his own trick.

Repair Shop Facilities for Chicago Terminals Are Conveniently Located

A shop completely equipped to handle signal and interlocking repairs within the terminal territory is located on the first floor of the Lake street tower and also in a separate building adjacent to the tower. The latter building houses the machine shop and blacksmith forge, the machine shop equipment including a lathe, drill press and welding torch. Any part of a switch machine or signal requiring mechanical repairs can be rebuilt. W. Becker, leading signalman, is in charge of all shop work on the Chicago terminal.

Light repair work, testing and overhauling of relays, signals and interlocking machine parts is done in the shop in the tower. The equipment for testing relays is in one corner of the room alongside of the shop foreman's desk and comprises a Weston voltmeter with a 0-1.5-volt scale, and external multiplier for 3, 6, 15 and 30 volts, a Weston milliammeter with a 0-500 m.a. scale and a 2,000-ohm Bryant Zinc potentiometer. As shown in the illustration the relay to be tested is mounted on the shelf projecting from the wall and the test leads are carried over pulleys at the top and are counterweighted in a manner similar to telephone switchboard cords to keep them out of the way when not in use. Relays are tested ordinarily for pick-up, release and contact resistance. The plug and jack arrangement on the wall permits the proper number of cells to be connected into circuit, which varies according to the relay being tested. A 14-volt storage battery mounted in a box outside the shop furnishes the energy for testing purposes. It is also possible to check small portable meters such as used by maintainers, against the standard instruments in the shop which are more accurate. When checking meters a fine adjustment of current is obtained by the use of a carbon compression rheostat.

Operating tests of relays to determine the service life of contacts can be arranged with the use of a thermostat equipped with a Hall indicator and counter. This thermostat is designed to hold the contacts open longer than closed and operates about 12 times a minute.

Operating and indicating tests of Model-2A mechanisms are made with the switchboard and test signal shown herewith. By throwing the knife switch to the right the current required to operate the signal to 45 deg. and also to 90 deg. can be determined. The operation of the mechanism to either of these positions is controlled by the two snap switches below the knife switch. With the latter switch thrown to the left the indication current of Model-2A signals can be measured. The voltmeter has a 0-150-volt scale and the ammeter has three scales, 0-6-15, the desired one being obtained by the plug and jack arrangement shown to the right of and below the ammeter. Rewound signal armatures and rebuilt circuit breakers can be tested in the test signal.

A lever test frame forms part of the shop equipment and allows the testing of dogs and lever latches. The levers in most of the interlocking machines in the terminal territory have been overhauled in the shop, a spare lever being placed in the machine for every lever removed. At the time of overhauling, the signal lever handles were enameled white, the switch lever handles black and movable point frog lever handles black. The latter, however, were painted yellow between the handle and frame.

Coil winding is done on a small bench lathe driven by a Taylor signal motor. Brass and phosphor bronze parts are cleaned with a solution of lye and alcohol. If a polish is desired brass parts can be placed in a tumbler box mounted on one of the benches. This tumbler is filled with sawdust and is rotated slowly by an old Taylor signal motor through a suitable belt driven speed reducer.

Cabinets and stock bins at the north end of the room contain new and rebuilt material, including relays, indicators, hold clear coils, pole changers and miscellaneous signal parts.

Northern Pacific Builds Fences to Detect Rock Slides

By C. A. CHRISTOFFERSON
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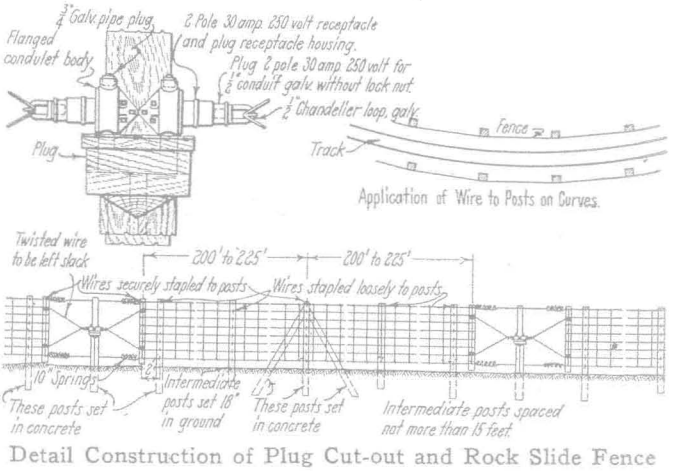
AUTOMATIC block signals, because of their closed circuit control features, lend themselves readily to providing additional safety protection, aside from that which is commonly considered as their function. In 1921, one of our supervisors of bridges and buildings, J. Flemming, conceived the idea of putting a heavy mesh wire fence along the right-of-way on rock slopes, where we occasionally had slides and where it was necessary to maintain a watchman and to connect these fences up with our automatic block signals. In March, 1923, we installed the first fence on a branch line near St. Regis, Mont., This consisted of two sections, each 150 ft. long. After installing this fence we were able to dispense with one watchman.

As shown in the sketch, one end of a 200-ft. section of fencing is stapled solid to the end post and stapled loosely to the intermediate posts, while the end near the plug is stapled securely to a loose stick. The coil springs, top and bottom, which are attached between this stick and the center post, take up the



Detail Construction of Plug Cut-out and Rock Slide Fence

slack in the fence, yet allow movement of the wire mesh when large stones roll against it. Any movement of the fence caused by a large stone rolling against it pulls the wires through the loose staples and jerks the loose stick, thus stretching the springs and jerking the plug out of the connector. The opening of this contact through which the track circuit is connected at once sets the automatic signal at the danger indication.

Our records show that this first installation at St.