

NEW INTERLOCKING PLANT, HOBOKEN TERMINAL YARD, DELAWARE, LACKAWANNA & WESTERN RY.

A new interlocking plant which exhibits some novel features tending toward greater safety and dispatch of operation has just been put into service by the Delaware, Lackawanna & Western Ry. at its terminal station at Hoboken, N. J. The plant controls all movements of trains in and out of the terminal train-shed, over a track system connecting 14 terminal tracks in the train-shed with the four line tracks.* Briefly, it

of 131 levers (99 active, 32 spare). All switches are guarded by detector track-circuits in place of detector bars. These circuits are supplemented by intermediate track-circuits between the switch-detector circuits, so that the entire terminal yard is covered. Four groups of route signals divide the yard outside of the terminal shed into four sections. Each signal is valid for its entire section, to the next signal. Correspondingly, the track-circuits in each signal section are so connected through their several relays and the interlocking machine that, when a route through the section has been set, and

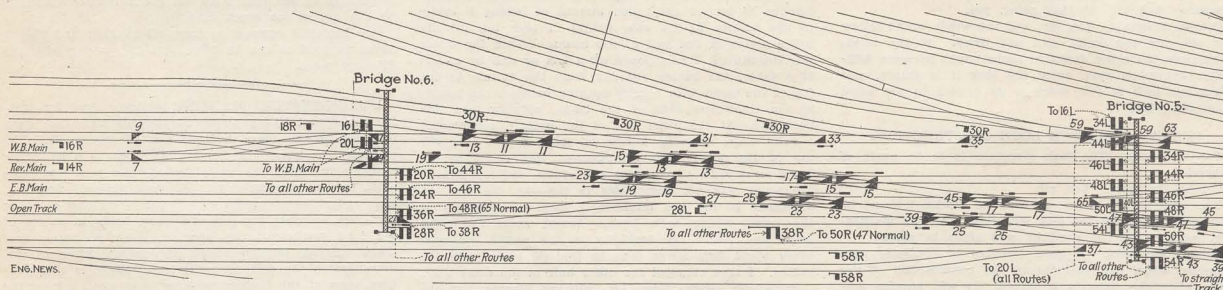
the train has entered upon it, all switches in the entire route ahead of the train are locked, and remain so until the train has passed completely into the next section. But at all times those parts of the route which the train has already passed become automatically *unlocked* and free to be set for another route. This latter is the distinctive feature of the present plant.

The purpose of this plan of unlocking an occupied route close behind the train traversing the route is to permit other trains on diverging, converging or intersecting routes to use tracks and switches as soon as the first



FIG. 1. VIEW OF EAST PART OF INTERLOCKED TERMINAL YARD AT HOBOKEN, N. J., DELAWARE, LACKAWANNA & WESTERN RY.

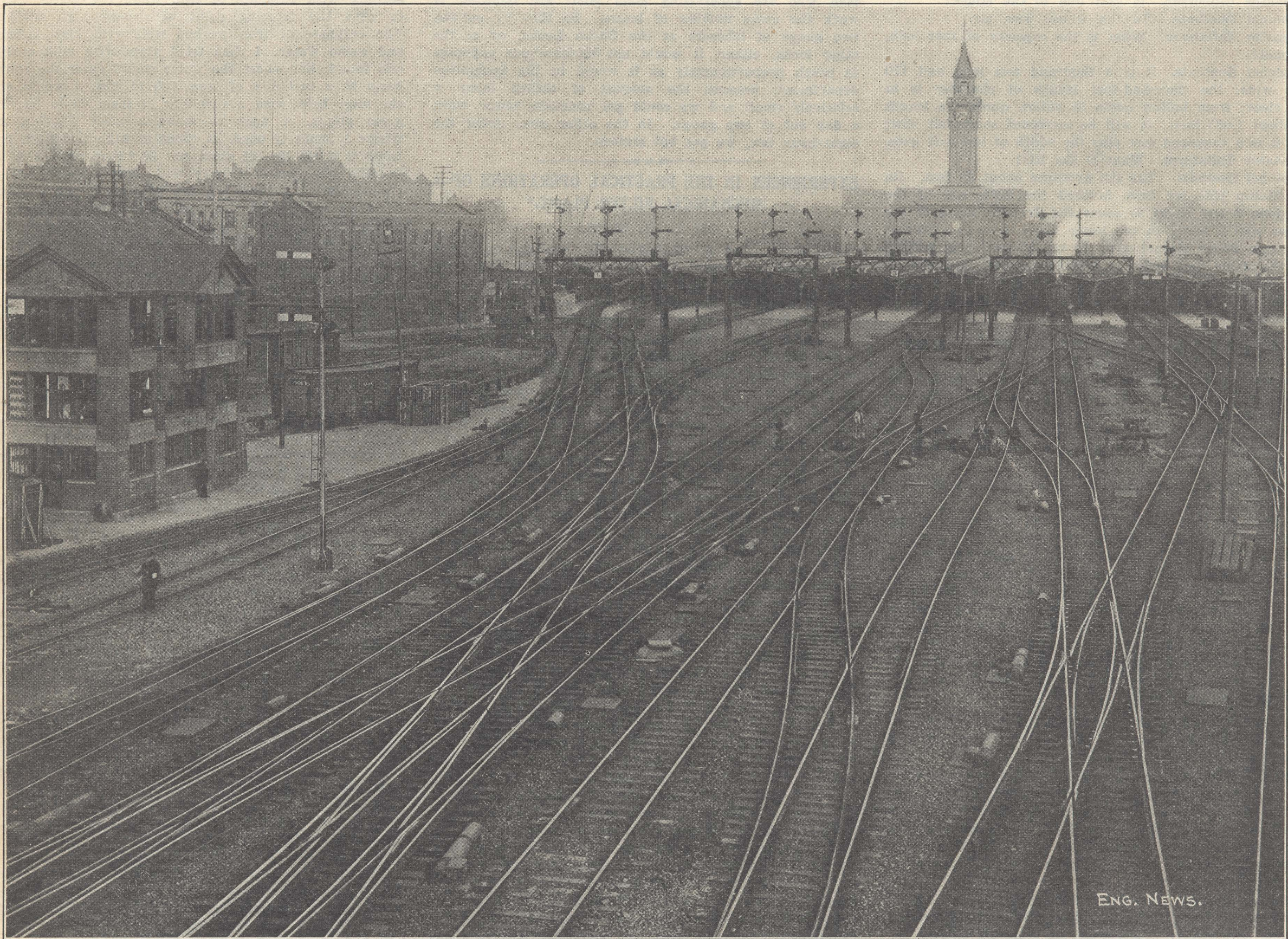
Looking east from Signal Bridge No. 5. The interlocking tower is seen at the left margin. Two double-slip crossings with movable-point frogs are in the immediate foreground. These frogs are operated by the machine operating one of the two sets of switch points.



comprises 36 switches or sets of switches and 110 signals, operated by compressed air and set from an electro-pneumatic interlocking machine

*Only two line tracks are in service now, as the tunnel through Bergen Hill, a mile west of the terminal, is double-track. A second tunnel has been under construction during the past year, and this when completed will give four tracks. Of these, two are main inbound and outbound tracks, and two are "reverse main tracks," being used exclusively inbound in the morning and exclusively outbound in the evening.

FIG. 2. PLAN OF TRACKS, SWITCHES AND



ENG. NEWS.

FIG. 1. VIEW OF EAST PART OF INTERLOCKED TERMINAL YARD AT HOBOKEN, N. J., DELAWARE, LACKAWANNA & WESTERN RY.

Looking east from Signal Bridge No. 5. The interlocking tower is seen at the left margin.

Two double-slip crossings with movable-point frogs are in the immediate foreground. These frogs are operated by the machine operating one of the two sets of switch points.

train has cleared them. The importance of the time-saving thereby secured is especially apparent in the case where it is not possible to set a route clear through the yard at once, and a train entering upon the first section is held at the end of the section until the following section can be set. In this case all tracks intersecting the route set would be blocked until the first train has proceeded entirely out of the section. On the other hand, the present arrangement enables the tower operators to utilize the cleared track behind the train. In fact, the exigencies of traffic operation in a large terminal yard having complicated track lay-out, frequently with step-by-step movement of trains and with many shunting or drilling movements, are such that the adoption of a route-locking system has been practically impossible hitherto, in the absence of an automatic clearing arrangement as here used.

The track arrangement of the yard is represented by the switch and signal plan Fig. 2. North and south of the western half of the yard is a series of coach tracks; north of the eastern half are express tracks and milk-train tracks, while to the south are a coach yard, immigrant, service, Pullman tracks, etc. Wherever these outer tracks enter the interlocked yard, they are of course cut off and protected by interlocked signals. A view of the easterly half of the yard is given in Fig. 1, reproduced from a photograph taken at signal bridge 5, looking eastward. The interlocking tower is seen at the left in this view.

The interlocking machine, located in the upper story of the tower, is shown by the photographic view, Fig. 5. Its general construction is the one typical for electro-pneumatic machines, but certain modifications were made to suit it to the more complex functions required in the present plant. Referring to Fig. 5, the upper levers are the switch-operating levers, standing normally to the left, and for reversed position to the right. (In the track plan, Fig. 2, where the switches are indicated by triangles, the direction of the long side of the triangle indicates the track for which the switch is normally set.) The lower levers operate the signals. These are normally in the vertical position, which sets both inbound and outbound signals at danger; pulling to the left clears the signal in one direction and locks the opposing signal, pulling to the right the contrary (if one position of the lever controls more than one signal, the setting of the switches "selects" the appropriate signal).

The lever shafts in the machine run horizontally from front to back. In the front half they engage the interlocking bars, while in the rear half they carry the electro-magnetic locks (one for normal, the other for reverse setting) and the contact springs for the operating and indicating circuits. The electric lock circuits are not connected when the lever is at rest, being held open by a mechanical detent latch on the

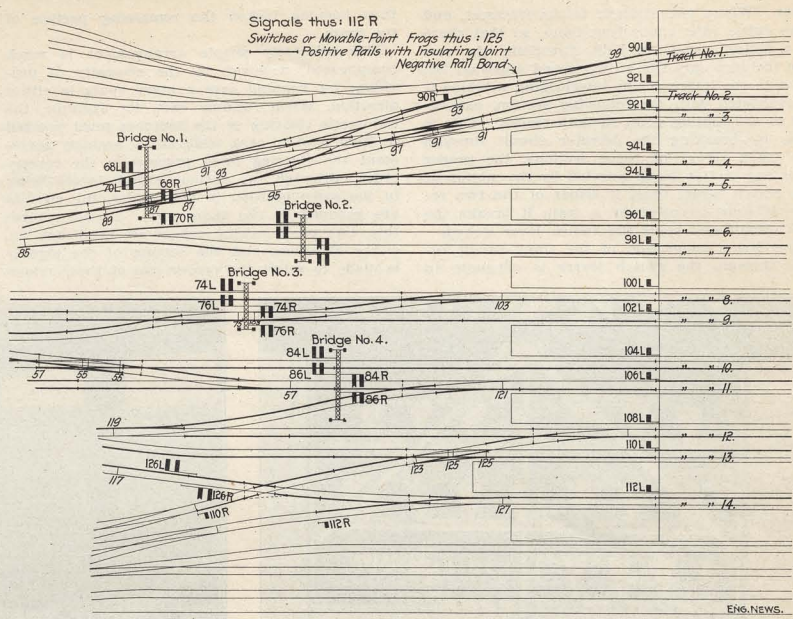


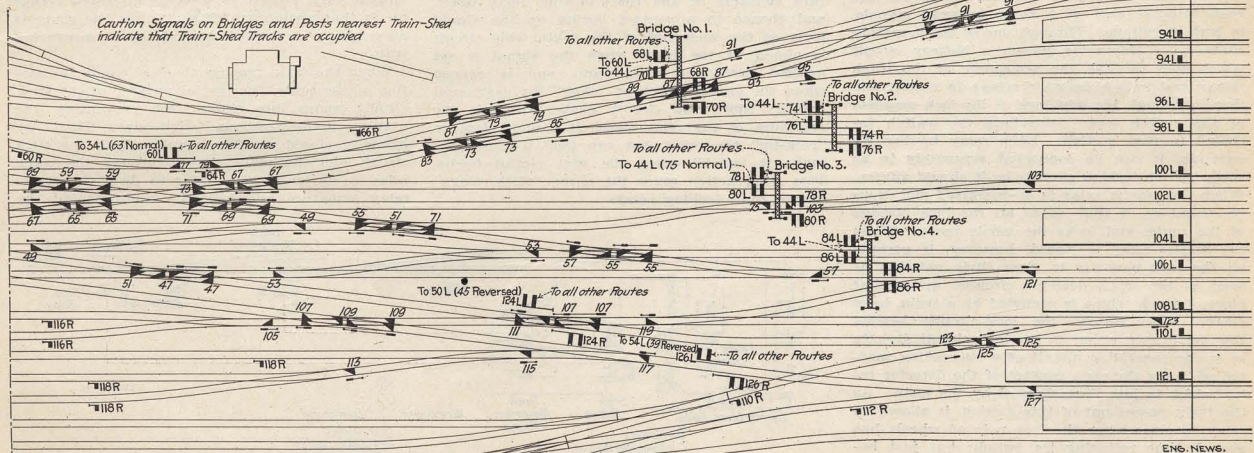
FIG. 3. DIAGRAM OF TRACK CIRCUIT SECTIONS IN A PART OF THE TERMINAL YARD.

lever handle; when the detent is pressed, preliminary to moving the lever, the lock circuits are closed at the latch, and if both the detector and the route-locking relays are closed, the lock magnet is energized and withdraws the lock, thereby releasing the lever for the desired movement. The horizontal shafts of the machine were not long enough to take the numerous additional contact springs required for the route-locking circuits, as the machine was designed before the use of route-locking had been decided upon. A set of vertical shafts was, therefore, added at the rear of the machine, geared to the horizontal shafts and rotating with them. The route-locking contacts are mounted on these vertical shafts; they are accessible through removable panels at the rear of the machine. The other contacts, the locks and the interlocking bars are accessible through the removable glass panels which cover the machine.

A further addition made to the machine is a set of small monitor lamps, one for each switch, mounted under a glass ledge board at the bottom edge of the front of the machine, each lamp directly below the corresponding switch lever. Each lamp is in circuit with the electric lock circuit (but shunted around the latch cut-out),

so that the lamp is lighted up whenever the corresponding switch is unlocked, but becomes dark as soon as the lock goes into action, whether because of the presence of a train on the switch detector circuit or because of the automatic locking of an entire route through the switch. The auxiliary equipment of the interlocking tower will be mentioned farther on.

Turning now to the track and its protective circuits: In order to show how the detector circuits and the supplementary track circuits are arranged, Fig. 3 is given, representing the rail sections in the eastern portion of the yard, and typical for the entire yard. The heavy lines indicate the insulated sections, to which the positive side of the track battery is connected. In general, the detector circuit of a switch extends from just ahead of the point of the switch to the fouling point, located a sufficient distance beyond the frog, in both main track and turnout, so that cars on the two tracks will clear each



SIGNALS IN HOBOKEN TERMINAL YARD, D. L. & W. RY.

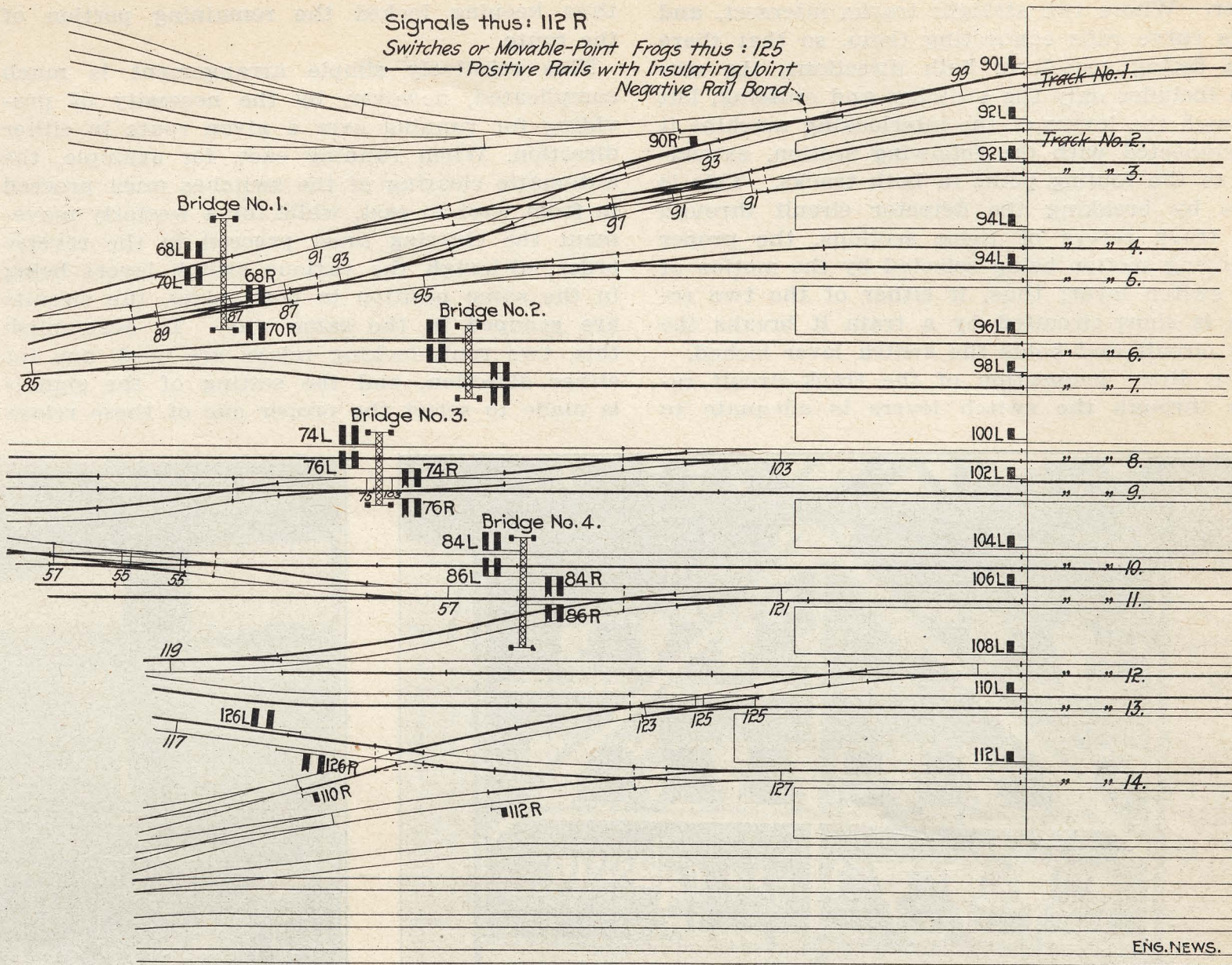
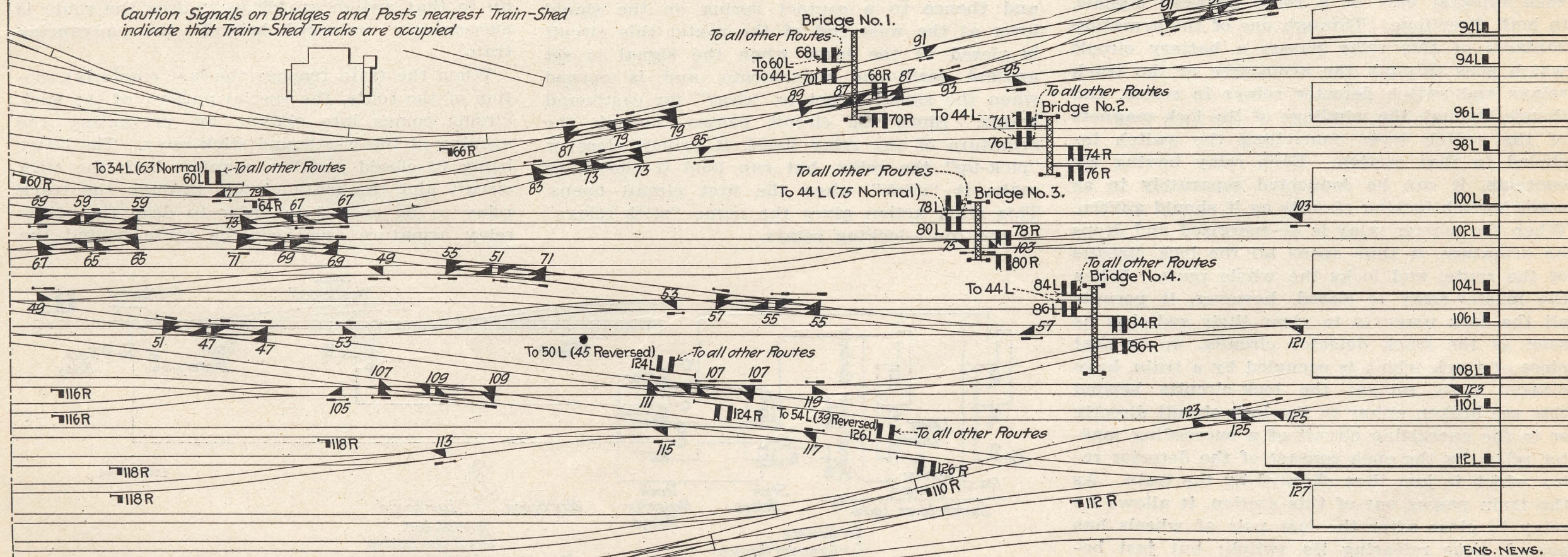


FIG. 3. DIAGRAM OF TRACK CIRCUIT SECTIONS IN A PART OF THE TERMINAL YARD.

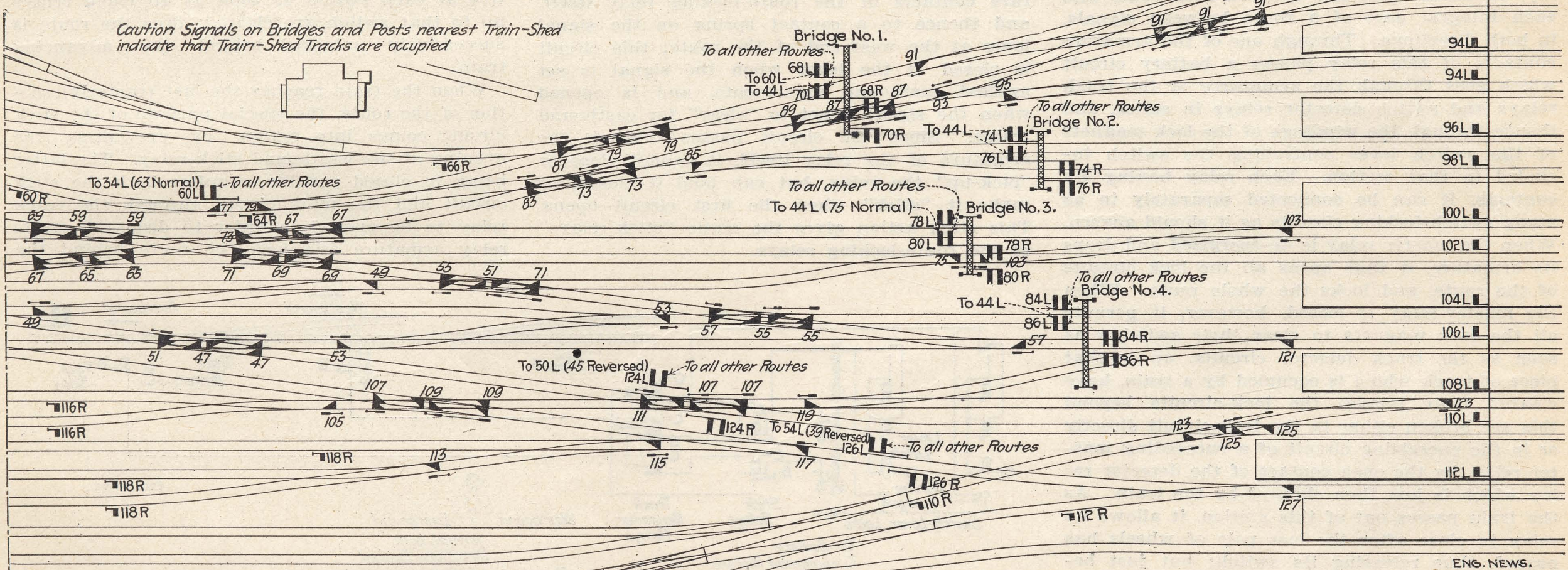
A further addition made to the machine is a set of small monitor lamps, one for each switch, mounted under a glass ledge board at the bottom edge of the front of the machine, each lamp directly below the corresponding switch lever. Each lamp is in circuit with the electric lock circuit (but shunted around the latch cut-out),



ENG. NEWS.

SIGNALS IN HOBOKEN TERMINAL YARD, D., L. & W. RY.

set of small monitor lamps, one for each switch, mounted under a glass ledge board at the bottom edge of the front of the machine, each lamp directly below the corresponding switch lever. Each lamp is in circuit with the electric lock circuit (but shunted around the latch cut-out),



SIGNALS IN HOBOKEN TERMINAL YARD, D., L. & W. RY.

*Only two line tracks are in service now, as the tunnel through Bergen Hill, a mile west of the terminal, is double-track. A second tunnel has been under construction during the past year, and this when completed will give four tracks. Of these, two are main inbound and outbound tracks, and two are "reverse main tracks," being used exclusively inbound in the morning and exclusively outbound in the evening.

other. Where two straight tracks intersect, and have curve rails connecting them, so that there is a facing switch in both directions, the section includes only the switches and crossing, but through the levers of the interlocking machine it is connected with the following section, extending to the fouling point in both tracks. This is done by breaking the detector circuit through the track relays of these sections, the proper following section being selected by the motion of the switch lever; thus, if either of the two relays is short-circuited by a train it breaks the lock circuit and holds the switch lever locked.

The direct connection of the track-circuit relays through the switch levers is adequate to

thus keeping locked the remaining portion of the route.

This relatively simple arrangement is much complicated, however, by the necessity of providing for running over a given route in either direction. When running east, for example, the automatic clearing of the switches must proceed in from west to east, while for a westerly movement the clearing must proceed in the reverse order, although the various switch levers being in the same position in both cases, the circuits are grouped in the same way. To accomplish this, two route-locking relays are used, one for either direction, and the setting of the signals is made to select the proper one of these relays

When the route is set by the switch levers at the tower, the stick-relays being permanently connected to the detector relays of the westerly and easterly track sections, respectively, are in the lock system. Upon setting the signal lever for eastbound movement, the stick circuit of the eastbound relay is broken. This in itself accomplishes nothing toward locking the route, as the relay is still held closed by the track relay at the west end of the route. But when a train enters this westerly section, it opens the track relay, which opens the other circuit through the winding of the stick-relay and thereby drops the armature of the latter. This action, directly or by breaking the circuits of

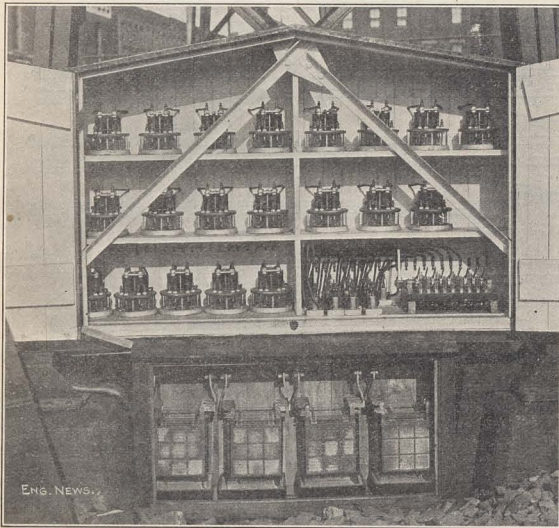


FIG. 4. TRACK BATTERIES AND TRACK RELAYS IN BOX AT BASE OF SIGNAL BRIDGE.

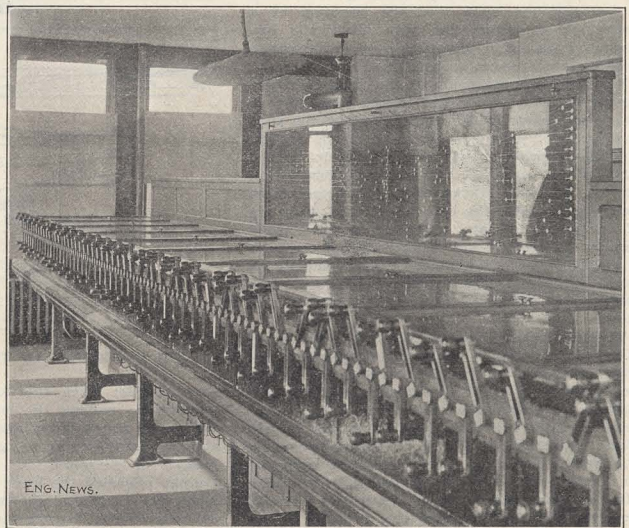


FIG. 5. THE ELECTROPNEUMATIC INTERLOCKING MACHINE OF 131 LEVERS AT THE HOBOKEN TERMINAL, D., L. & W. RY.

protect a train both against throwing a switch under the train and against the possibility of any other train being permitted to come within the fouling limits and thus colliding with the first train. The mechanical interlocking within the machine, on the other hand, prevents setting switches for intersecting or opposing movements, or setting signals in opposition to a movement for which switches have been set. Neither of these devices provides for the route-locking and clearing, which is accomplished by another series of electric locking circuits, as will be explained.

The essential device of the route-locking and clearing circuits is a route-locking or master relay, of which there are two for each route and each integral part of a route between signals, in both directions. Through one of the armature contacts of this relay passes a battery circuit which goes through the armatures of the track relays and switch detector relays in series, and thence through the windings of the lock magnets of the switch lever controlling the switch included in that section. Each relay having six contacts, it can be connected separately in as many switch-locking circuits as it should govern. When the master relay is de-energized and drops its armature, it thus opens all the lock circuits of the route, and locks the whole route. When the master-relay is closed, however, it permits all the lock magnets to clear their switches as soon as the track detector circuits, up to that piece of track which is occupied by a train, have cleared their relays; the lock-circuits beyond this are broken either in the lock circuit directly or in the energizing circuit of a succeeding master relay, by the open contact of the detector relay which is just then shunted by the train. As the train passes out of this section, it allows its relay to close after the last pair of wheels has passed, thus releasing its switch; but just before this the train has already entered the section just ahead, and has shunted its track relay,

by a peculiar arrangement of the circuits, in the following manner:

Taking the eastbound route-locking relay as an example, we find that its windings are supplied by two distinct battery circuits connected in parallel. The first of these goes through the armature of the relay connected to the (one or more) track-sections at the west end of the route; when a train enters the westerly section, therefore, it opens this circuit, and provided the other circuit is also open (as will be shown, this can occur only when the signal is set for eastbound trains), it drops the lever of the route-locking relay and locks the entire route. The second circuit goes through one of the armature contacts of the route-locking relay itself, and thence to a contact spring on the signal lever at the west end of the route; this circuit is closed at the lever when the signal is set against eastbound movements, and is opened when the signal is set to "clear" for eastbound trains. Since the circuit passes through the armature of the relay itself, it cannot close or "pick-up" the relay, but can hold it closed, or make it "stick" when the first circuit opens. This stick action gives the name "stick-relays" to the route-locking relays.

succeeding stick-relays, breaks the series lock-circuits through all the switches on the route, and locks the route.

After the train has entered upon the route, the leverman in the tower throws the signal back to danger, to close the route against a following train. This motion of the signal lever restores the stick circuit, which, however, is unable to cause the stick-relay to pick up. Picking up occurs only after the train has passed the first part of the route (usually the first switch), when the clearing of the track relay restores the main circuit through the stick-relay. The latter, attracting its armature, thereby completes the unlocking circuit, and this circuit becomes active at each switch as soon as all track relays up to that switch are cleared; thus the route is successively unlocked behind the advancing train.

When the train reaches the last (easterly) section of the route, the special purpose of the stick circuit comes into action, by preventing the opening of the westbound stick-relay. The latter being in closed position, requires both the stick circuit and the main circuit through the track relay to be opened in order to drop the stick-relay armature and lock the route behind the

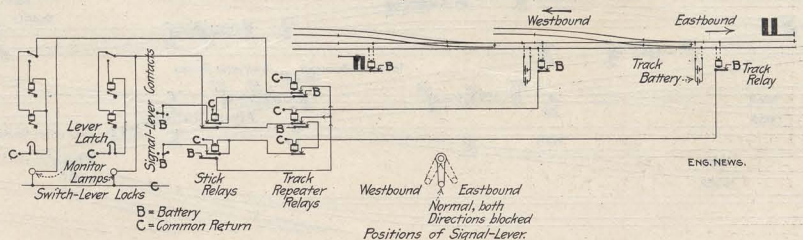


FIG. 6. DIAGRAM OF DETECTOR AND ROUTE-LOCKING CIRCUITS ON A SIMPLE ROUTE.

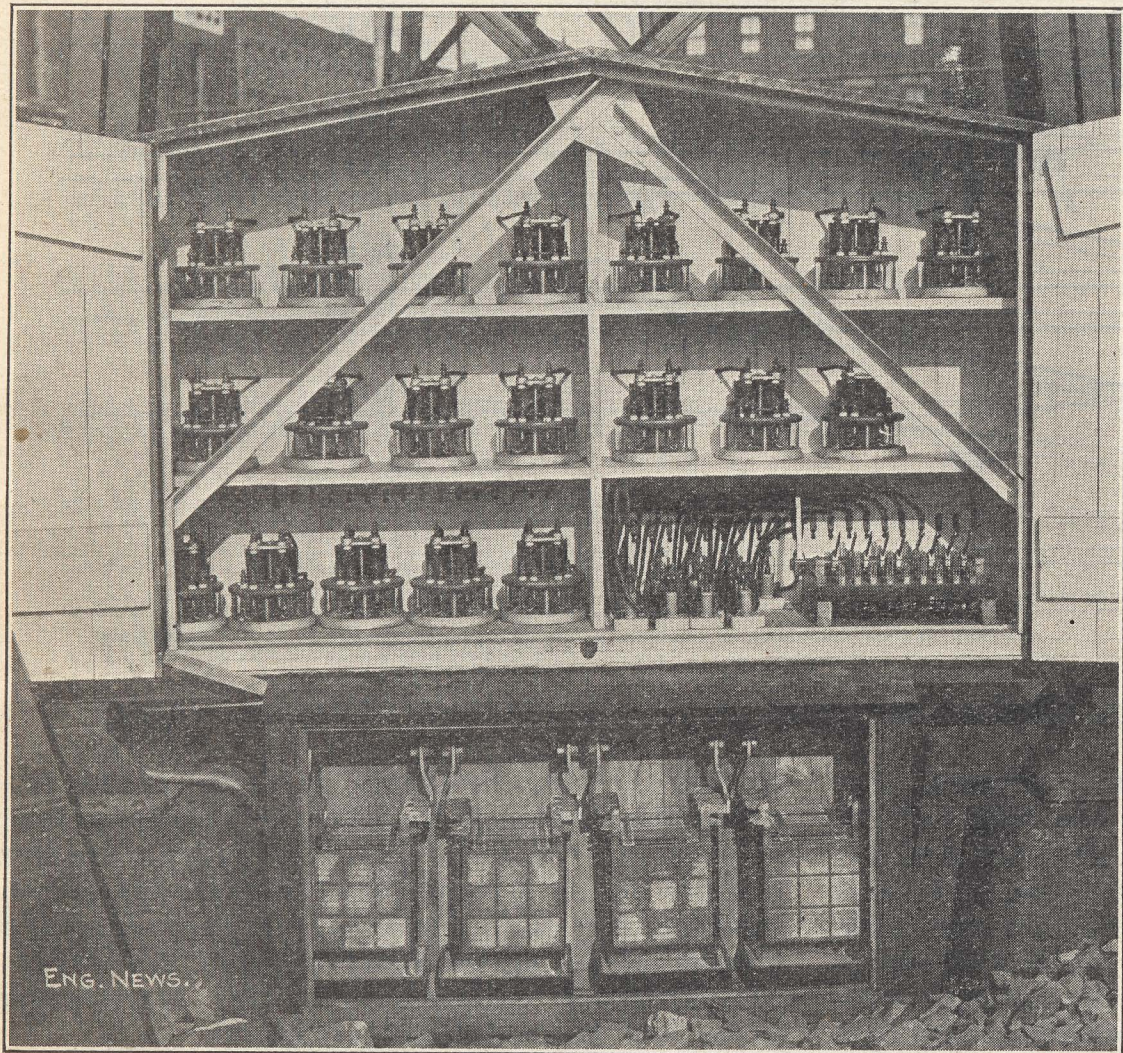


FIG. 4. TRACK BATTERIES AND TRACK RELAYS IN BOX AT BASE OF SIGNAL BRIDGE.

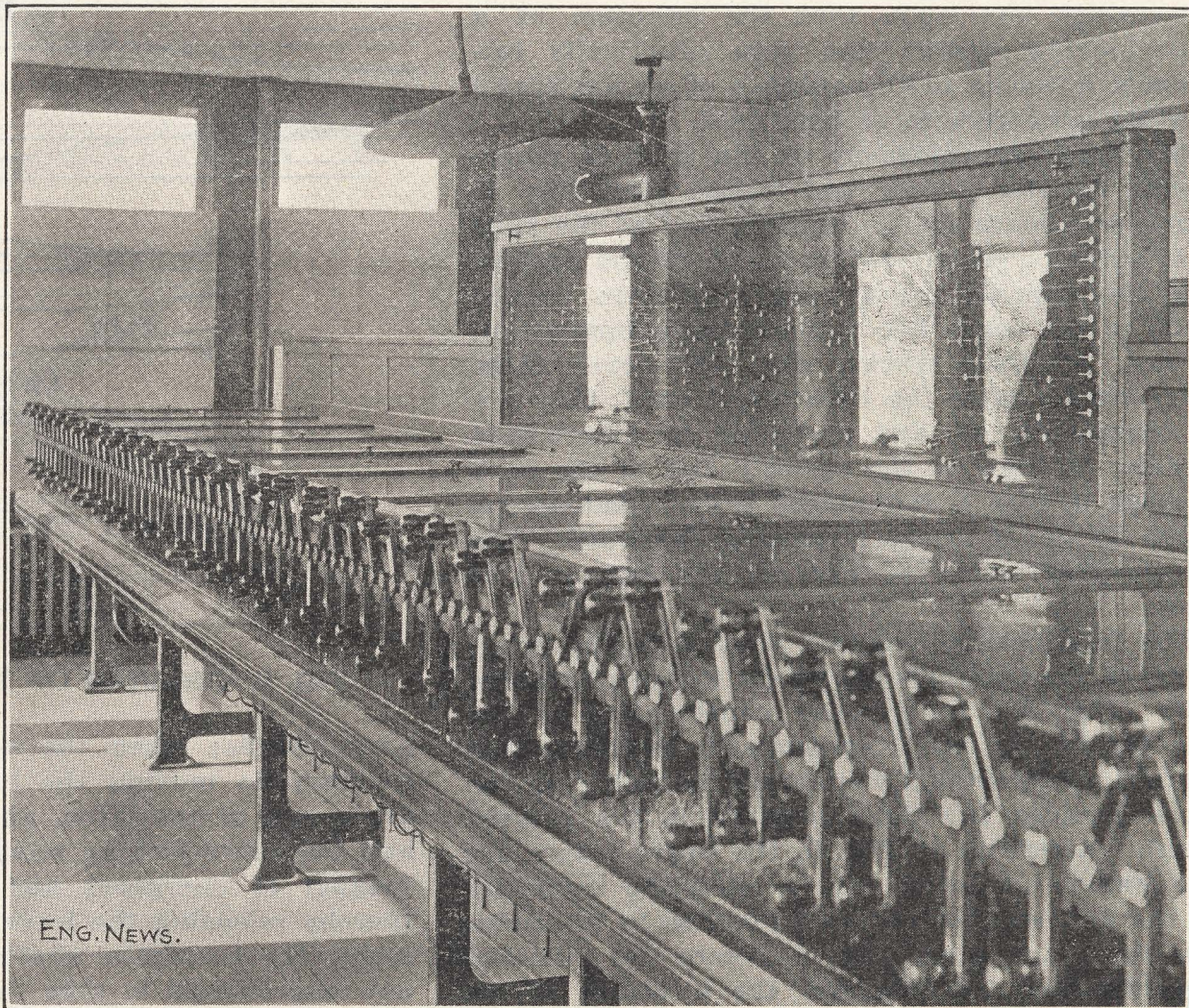


FIG. 5. THE ELECTROPNEUMATIC INTERLOCKING MACHINE OF 131 LEVERS AT THE HOBOKEN TERMINAL, D., L. & W. RY.

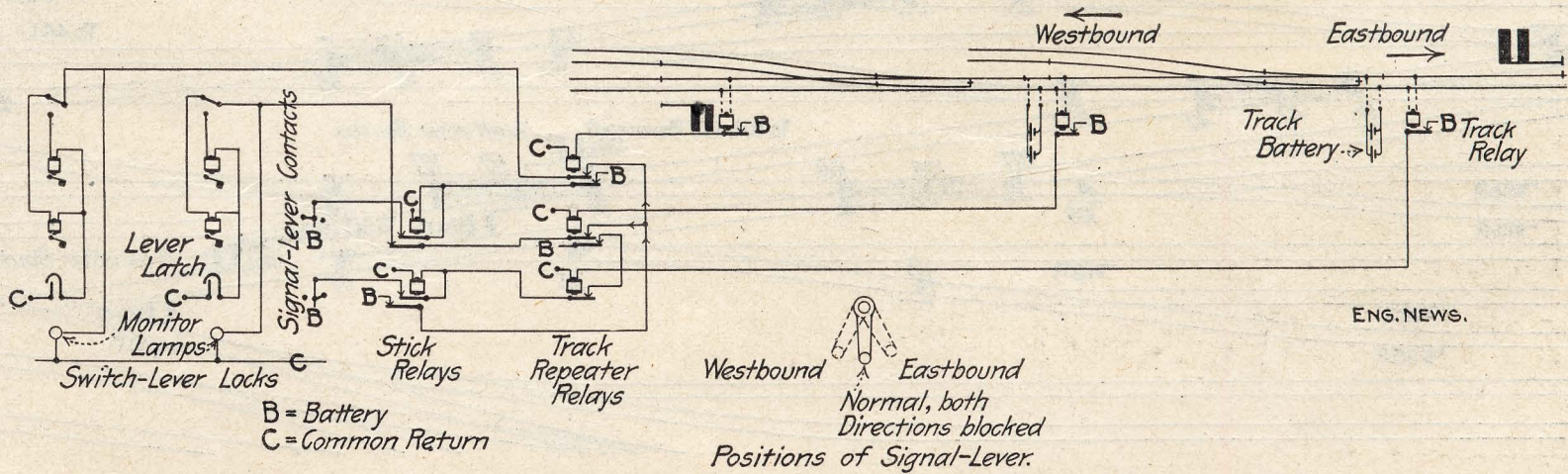


FIG. 6. DIAGRAM OF DETECTOR AND ROUTE-LOCKING CIRCUITS ON A SIMPLE ROUTE.

train. But the signal lever, set for eastbound movement, keeps closed the stick circuit of the westbound relay; consequently, the opening of the main circuit through the latter by the track relay does not open the stick relay, and the eastbound progression of the unlocking is left undisturbed. As soon as the train has passed completely out of the route, the last track relay is restored and thus the last switch is unlocked. The route is, therefore, free to be set either in part or as a whole for any movement in either direction, consistent with the setting of the switches on intersecting routes (which act by way of the mechanical interlocking).

To make the arrangement and operation of this mechanism clear by a graphical example, the circuits for a simple route of three sections, with two switches, are shown in the diagram, Fig. 6. In this case, eastbound and westbound signals are operated by a single lever, the corresponding positions being indicated by an auxiliary sketch in Fig. 6. The signal lever has two sets of contacts for the stick-circuits, one for each of the two route-locking relays; the two sets of contacts are of necessity shown separately.

As a further illustration, an actual part of the circuits used in the Hoboken yard is represented by the diagram Fig. 7, which circuits control train movements in either direction between Tracks 1 and 2 of the train-shed and signal-bridge No. 1. The track is shown in the upper part of the diagram, with the numbers of the track-circuit sections, the switches and the signals noted in their proper places. Only one of the track relays is sketched, namely that for detector section 10, with its repeater relay (the repeater relays being grouped in the tower, so as to give short wire connections); the other track sections are represented in the circuit diagram only by their numbers, and by the dash-and-dot reference lines which indicate where they are connected in the lock circuits.

This piece of track comprises one single switch (99) and two crossovers (91 and 93), the latter being each operated as one switch. There is a further switch, 97, which deflects an incoming train into either track 2 or track 3. This switch, being not involved in most of the movements, has been omitted in the lock-circuits. It is locked by stick-relay 97 E and by its proper detector relays.

The lock circuits of the other three switches are shown by the three horizontal lines at the bottom of the diagram. Where a cross is marked on any one of these lines, the lock circuit passes through an armature contact of the relay whose number is noted directly above, so that when this relay is de-energized and drops its armature, it breaks the lock circuit and thus locks the switch. For example, switch 99 is locked when either track relay 10, track relay 11, or stick-relay 93 E is open.

The connections through the track repeater relays, in the left half of the diagram, form the detector or the "absolute" locking of the corresponding switches, while the connections through the five stick-relays at the right form the route-locking. In the route-locking circuits, the numbers denoting the several detector relay contacts, switch-lever contacts and signal-lever contacts are inserted in the circuits in place of sketching in the contacts themselves; inclined numbers denote track relays; light vertical numbers denote signals, and heavy vertical numbers denote switches, while the stick-relays are numbered in shaded lettering.

The path of the current will be readily understood, thus: Stick-relay, 91 W, is energized from the battery over two circuits in parallel: (1) The stick-circuit through contacts on signal lever 92 when this is in normal position or to the right [i. e., referring to the track plan, when train-shed tracks 2 and 3 are blocked against westbound movement; when either track is cleared for a departing train, the stick-circuit is broken]. (2) The main circuit, which passes in series through armature contacts on the detector-relays, of track sections 230, 31 and 32. Thus, when a train departing from Tracks 2 or 3 in response to the signal (which opened the stick-circuit) enters on track section 230, the main circuit also opens, therefore stick-relay 91 W

opens and breaks the lock-circuits of switches 93 and 91, locking their levers in whichever position they occupy at the time, and extinguishing their monitor lamps.

On examination of the route-locking circuits in Fig. 9 it will be found that the five stick-relays have the following functions:

91 W: For westbound from signal 92 L [track 2 or 3] to signal-bridge No. 1 [to either signal 68 L or 70 L]. Locks switches 91 and 93 until the train clears track-section 32; thereupon, the stick-relay closes, but the detector circuits still hold; if the train is bound for signal 70 L, detector 52 holds switch 93 locked, but releases 91, while, if the train is bound for signal 68 L via the crossover, detector 12 holds both 91 and 93 locked, and the final section 13 holds only 91 locked.

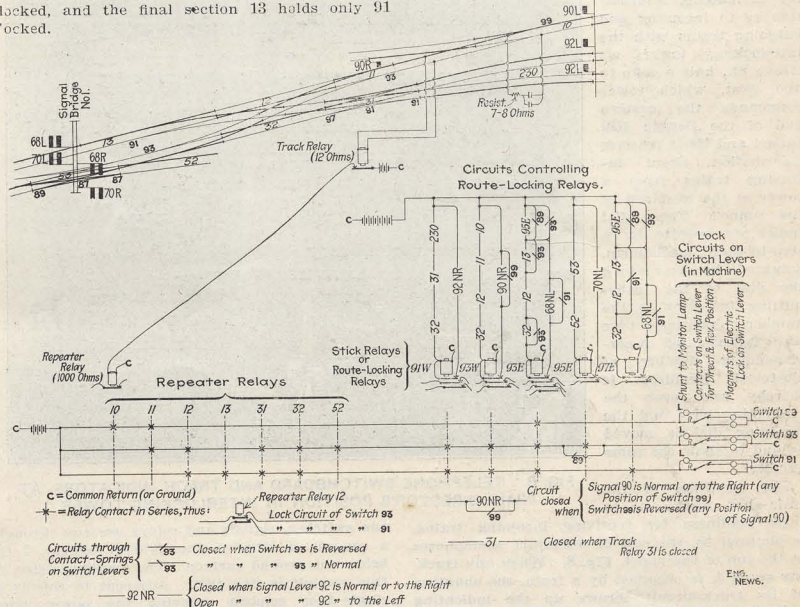


FIG. 7. RELAY AND LOCKING CIRCUITS FOR TRACKAGE BETWEEN TRAIN-SHED TRACKS 1, 2 AND 3 AND SIGNAL-BRIDGE NO. 1, GOVERNING BOTH EAST BOUND AND WEST BOUND TRAIN MOVEMENTS; D., L. & W. TERMINAL AT HOBOKEN, N. J.

93 W: For westbound from signal 90 L [track 1] to signal-bridge No. 1 [to either signal 68 L or 70 L]. Locks the route only when switch 99 is set for the straight track [normal]. Locks switches 91 and 93 until train clears track-section 12 on the route to signal 68 L, or track-section 32 on the route to signal 70 L. Over the rest of the route, the stick-relay is out of action, but in the absolute locking section 13 locks switch 91 if the train is bound for 68 L, and section 52 locks switch 93 if the train is bound for 70 L.

95 E: For eastbound from signal 70 R to the easterly end of track-section 52, and thence [by 95 E being connected in the battery-circuit of succeeding stick relays] to train-shed tracks 1, 2, 3, 4 and 5. Locks switch 93 only when switch 89 is set normal, i. e., for the straight track, and locks other switches on these routes under certain conditions, as will be seen from the following:

93 E: For eastbound from either signal 68 R or 70 R to train-shed track 1. Locks switches 91, 93 and 99 from the moment the train passes signal-bridge 1 until it clears section 12. On the rest of the route, switch 93 is locked in the absolute locking by section 11, and switch 99 by both 11 and 10. Note that signal-lever 68 R acts on this relay only when switch 91 is set for the straight track, so as not to lock switch 99 on a movement from signal 68 R to track 2; that signal-lever 70 R is effective only when switch 89 is normal and 93 reversed, i. e., for movement from 70 R to track 1 only; section 13 acts on the stick-relay only when switch 93 is set for the straight track, so that, for example, a westbound train on section 13 will not hold locked a route set from 70 R via the crossover to track 1; and that section 32 is ineffective when switch

93 is set for the straight track, so that when signal 68 R is cleared for an eastbound movement to track 1, the relay will not be affected by a train either eastbound or westbound between track 2 and signal 70.

97 E: For eastbound from either signal 68 R or 70 R to track 2. Locks switch 91 from the moment the train passes signal bridge 1 until train passes section 32. On rest of route, switch 91 is locked in the absolute locking by detector circuit 31. When train is entirely in section 230, the route is cleared. Note that stick-relay 95 E is shunted and therefore without effect on 97 E, unless switches 89 and 93 are both normal, i. e., unless switches are set for a train from signal

70 R straight to track 2; that the contacts to detectors 12 and 13 are shunted when switch 91 is set for the straight track, so that when a train passes from signal 70 R to track 2, this stick-relay will not interfere with a westbound movement from track 1 to signal 68 L; and that signal-lever 68 is effective in this stick-circuit only when switch 91 is set for the crossover (i. e., for movement 68 R to track 2), but not when switch 91 is set for the straight track (i. e., from 68 R to track 1). In the latter case the relay acts only through signal-lever 70 R through stick-relay 95 E, switches 89 and 93 being set for the straight track; while a simultaneous movement from 68 R to track 1 is taken care of by stick-relay 93 E.

The circuits illustrated by Fig. 9 are for the most part permanent connections of the several relays. The absolute locking, by the track repeater relays, is necessarily connected permanently in the lock-circuits of the respective switches. The stick-relays, having specific localized duties, are also connected permanently in the lock circuits, and have the track repeater relays connected permanently in their winding circuits. The only connections in the route-locking which are made by the interlocking machine are those of the switch shunt circuits and the signal-lever stick circuits.

The operation of the interlocking plant is conducted by a train director, assisted by several levermen. The former receives information about outgoing and incoming trains by indicators, and communicates with the station, the yardmaster's office, the roundhouse and the coach yard by telephone. The levermen set routes in accordance with his directions. They are able to follow the progress of trains over the various switches

the crossover, detector 12 holds both 91 and 93 locked, and the final section 13 holds only 91 locked.

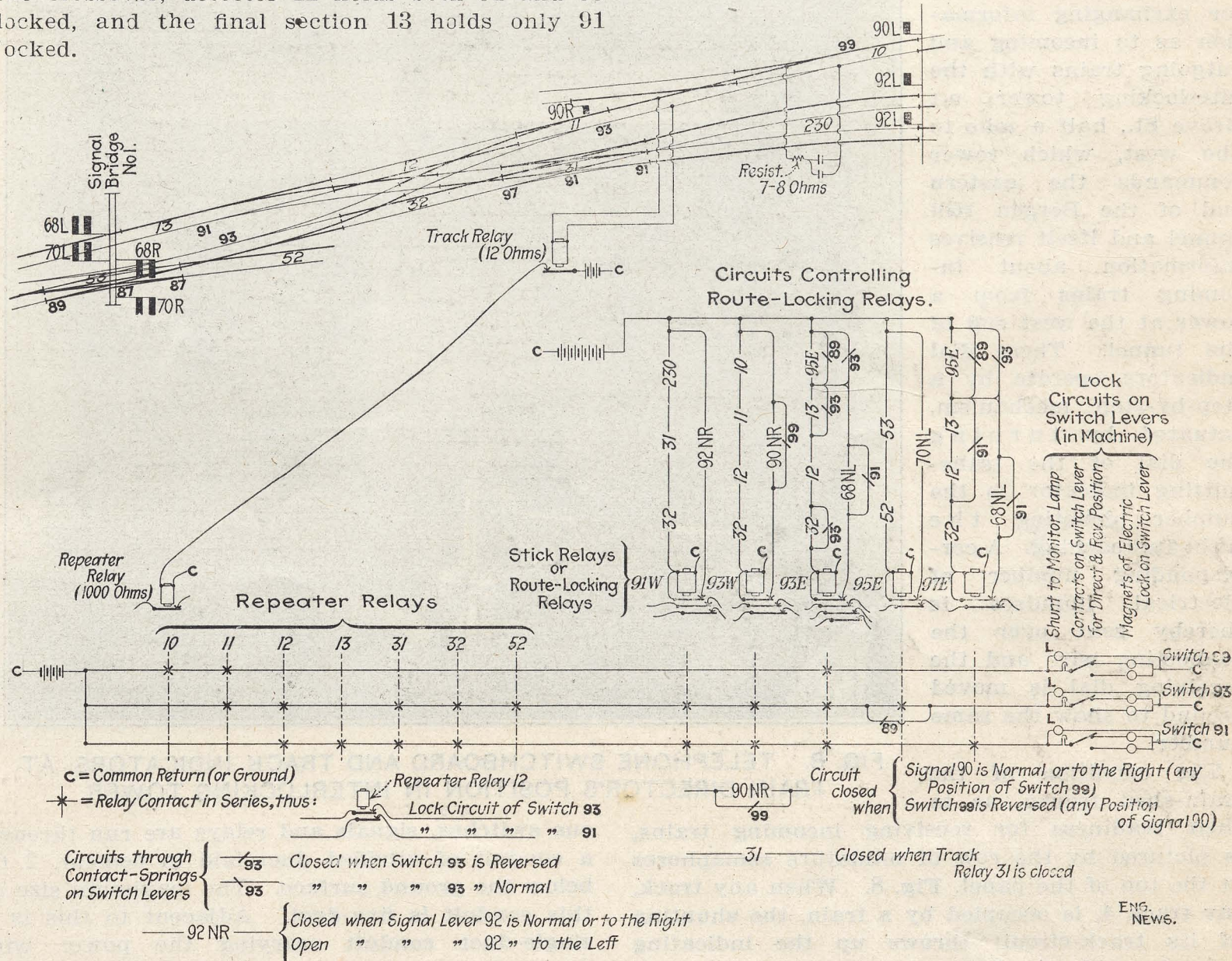


FIG. 7. RELAY AND LOCKING CIRCUITS FOR TRACKAGE BETWEEN TRAIN-SHED TRACKS 1, 2 AND 3 AND SIGNAL-BRIDGE NO. 1, GOVERNING BOTH EAST BOUND AND WEST BOUND TRAIN MOVEMENTS; D., L. & W. TERMINAL AT HOBOKEN, N. J.

by means of the monitor lamps already mentioned. When they have set a route and a train enters upon it, they are required to restore the starting signal to danger as soon as the train has cleared the first switch. The route thereupon automatically unlocks itself behind the train, as explained.

The train director's position is shown by the view Fig. 8. The telephone switchboard has connection to the various points already mentioned. The dial indicators on either side are for exchanging information as to incoming and outgoing trains with the interlocking tower at Grove St., half a mile to the west, which tower commands the eastern end of the Bergen Hill tunnel and itself receives information about incoming trains from a tower at the west end of the tunnel. These dial indicators operate by a step-by-step mechanism, actuated by turning the dial of the transmitting indicator to the number denoting the train approaching. A corresponding number of electrical impulses is thereby sent over the connecting wire and the receiving dial is moved around to show the same number.

The condition of the train-shed tracks, as to their readiness for receiving incoming trains, is pictured by the row of miniature semaphores at the top of the panel, Fig. 8. When any track, say track 4, is occupied by a train, the shunting of its track-circuit throws up the indicating semaphore No. 4. When the semaphore is down, therefore, the track is clear to receive an incoming train. But in order to accommodate single cars which may lie in the terminal, waiting sleepers, for example, the track-circuit is made to extend only to a point two car-lengths from the bumping-posts. A single car or two cars may, therefore, stand at the inner end of each track without throwing the indicator.

The series of small circles below the semaphores in Fig. 8 contains numbered drops, one for each track of the train-shed, which communicate with push-buttons placed at the inner and outer ends of the track. When a train is ready to go out, the conductor pushes one of these buttons; this drops the correspondingly numbered indicating shutter in the tower.

As an assistance in the operation of the interlocking machine, an accurate model of the interlocked yard is mounted over the machine, as shown in Fig. 5 and more clearly in Fig. 9. The switches of this model are thrown by the movement of the actual switches in the yard. The electric "indication" circuit, which returns from the switch to the interlocking machine, must be energized by the actual moving of the switch in response to the movement of the lever before the lever-movement can be completed. But the last part of the stroke of the lever shifts the switch of the model, by a direct mechanical connection. The condition of the model therefore shows the actual state of the switches at all times.

The arrangement of the accessories of the signal plant can be summarized briefly. The track relays and the track batteries are grouped in boxes built in the foot of the posts supporting the signal-bridges. These relays are not used directly for the locking circuits, but are each "repeated" by another relay in the interlocking tower (see Fig. 6, "Track repeating relays").

The repeating relays and the stick-relays are mounted in racks on the mezzanine floor of the tower, directly below the machine, thus giving the shortest possible length of wiring.

The wire circuits from the tower to the vari-

the signal maintainer to interchange the two sets at one moment. This is done every two or three days, so that the cells are always well charged.

The wire conduit leads into a manhole, containing a sump or drip-box, at each signal-bridge and at intermediate points. Short runs of duct distribute the wires from these manholes.

The relays and the operating and lock circuits belonging to the interlocking machine are served by a battery of 16 cells of 440 ampere-hours capacity each, used in two groups of 8 each, of which one is being charged while the other is in use. A motor-generator set of 3-KW. capacity, changing the 60-cycle current of the yard power-plant into 60-volt direct current for charging, supplies these batteries. In addition there is a $\frac{1}{2}$ -KW. motor-generator set producing 20-volt direct current, for use on the operative circuits direct, in case there is trouble with the batteries.

The switches and signals are operated by pneumatic cylinders controlled by electro-magnetic valves. Air is supplied to them at 90 lbs. per sq. in. by an air line of 2-in. pipe, extending from the power-house through the yard. This pipe is buried 12 ins. below the ground surface, and is fitted with drip boxes at the sags to trap condensation. This pipe line is supplied from compressors supplemented by two large reservoirs at the power-house.

The plant thus briefly sketched was designed in its general outlines and installed by the Signal Engineer's Department of the Delaware, Lackawanna & Western Ry., Mr. Lincoln Bush, Chief Engineer, and Mr. M. E. Smith, Signal Engineer. The work of installation was in charge of Mr. W. B. Weatherbee, Chief Signal Inspector. The Union Switch & Signal Co., of Swissvale, Pa., designed and built the interlocking machine and furnished all signals and switch mechanism.

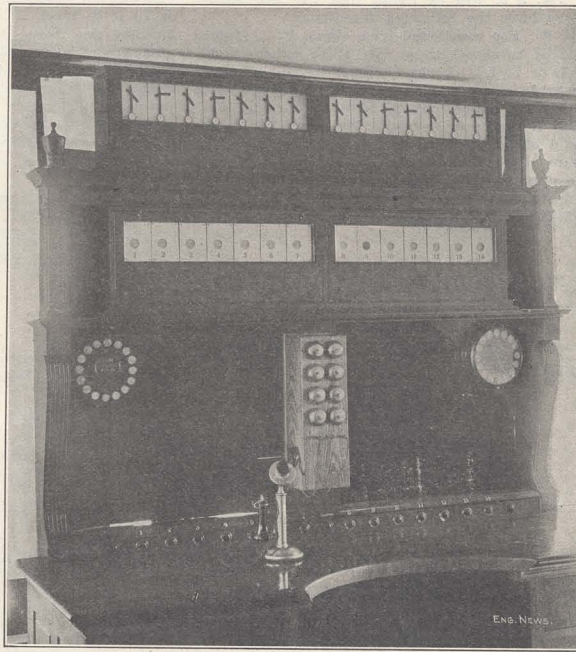


FIG. 8. TELEPHONE SWITCHBOARD AND TRACK INDICATORS, AT TRAIN DIRECTOR'S POSITION IN INTERLOCKING TOWER.

ous switches, signals and relays are run through a conduit of vitrified duct laid in cement, 2 ft. below the ground surface. The maximum size of this conduit is five-duct. Adjacent to this is a single-duct conduit carrying the power wire from which are fed the signal lamps, and also a wire for charging the track batteries. This wire leads from a motor-generator set in the lower story of the tower to the various battery boxes. Each track-battery group consists of two sets, one of which has its cells connected in parallel and lies across the track, while the other has its cells in series and is connected to the charging wire. A switch in the box enables

THE RAILWAYS OF JAPAN are being taken over by the Government. The terms of purchase are substantially, 20 times the average of the net profits for the years 1902, 1903 and 1904, divided by the cost of original construction and multiplied by the same at date of purchase.

EXPORTS OF IRON AND STEEL MANUFACTURES from the United States in 1907 amounted to nearly \$200,000,000, breaking all records. The extent to which the foreign trade of American manufacturers has grown by leaps and bounds in the past two decades is indicated by comparison with 1887, when this class of exports totalled only 16½ million dollars, and with 1897, when it reached 63 million dollars.

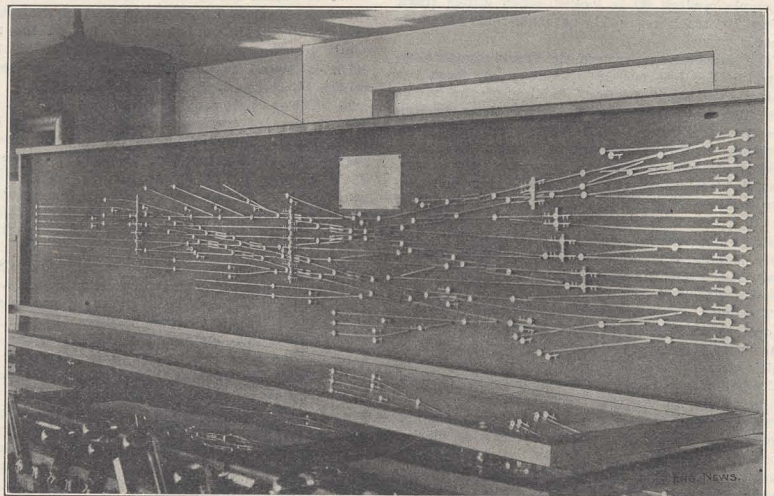


FIG. 9. TRACK MODEL OF INTERLOCKED YARD, OVER INTERLOCKING MACHINE.

The switches are operated by lever connections from the switch levers during the final half of their movement (after receiving the electric "indication" showing that the switch has responded to the movement of the lever.)

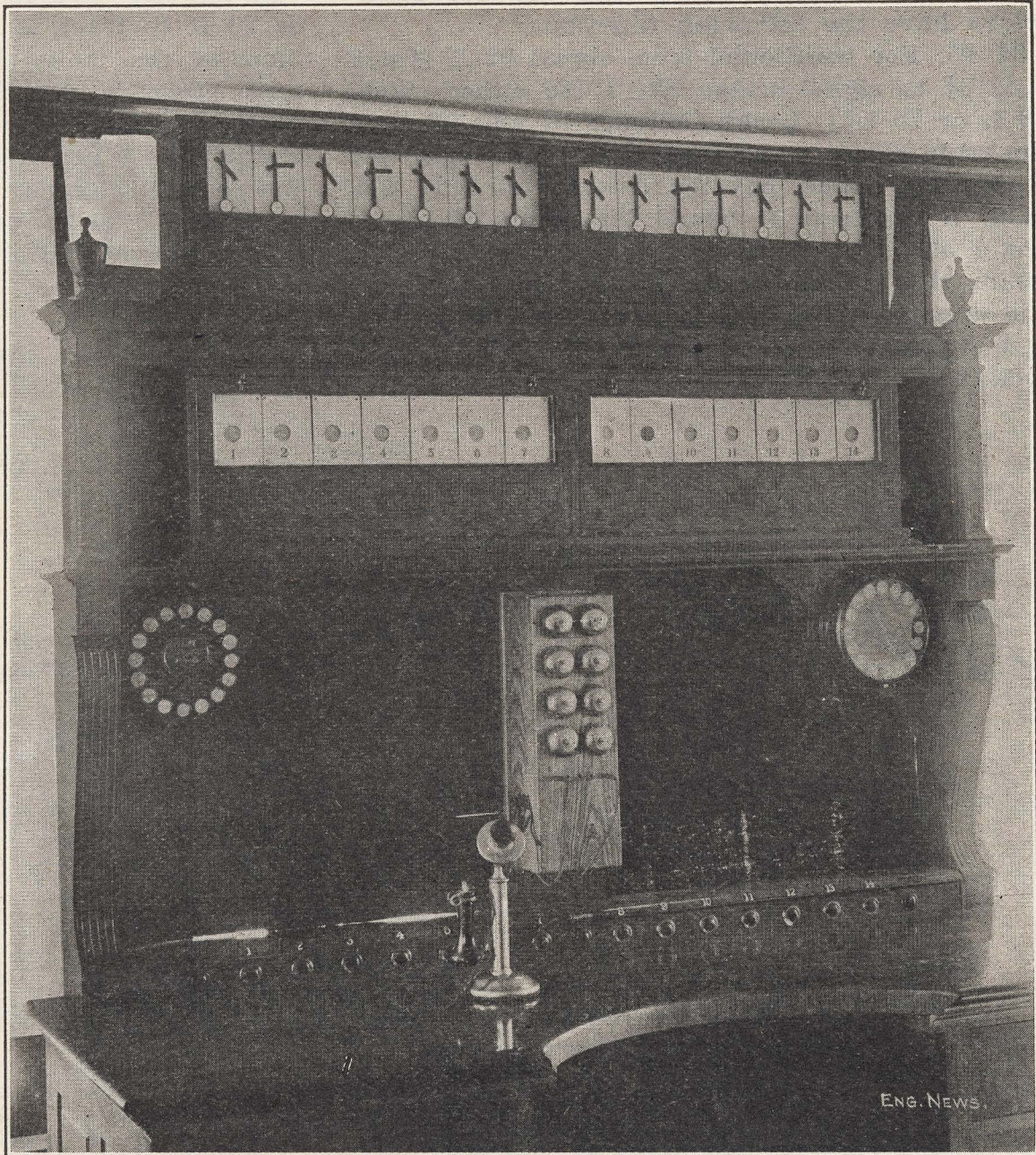


FIG. 8. TELEPHONE SWITCHBOARD AND TRACK INDICATORS, AT TRAIN DIRECTOR'S POSITION IN INTERLOCKING TOWER.

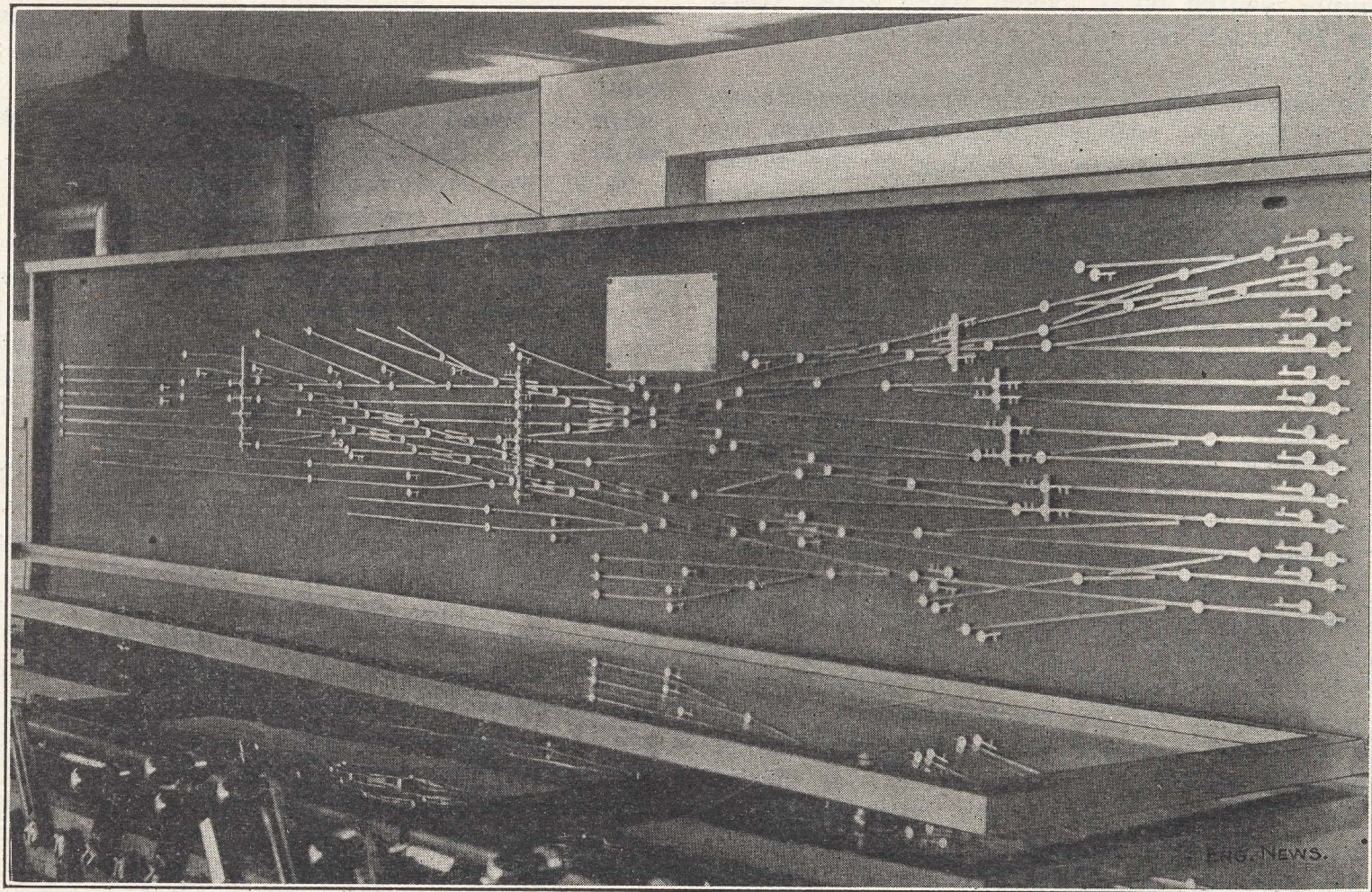


FIG. 9. TRACK MODEL OF INTERLOCKED YARD, OVER INTERLOCKING MACHINE.

The switches are operated by lever connections from the switch levers during the final half of their movement (after receiving the electric "indication" showing that the switch has responded to the movement of the lever.)