THE
HALL
SIGNAL
COMPANY

ALTERNATING CURRENT TRACK CIRCUIT INSTALLATION ON LONG ISLAND RAILROAD

CIRCULAR No. 12.

OFFICES:
NEW YORK CHICAGO
WORKS:
GARWOOD, NEW JERSEY

The Hall Signal Company

Circular No. 12.

A description of the alternating current track circuit installed on the LONG ISLAND RAILROAD, without insulated joints or reactance bonds.

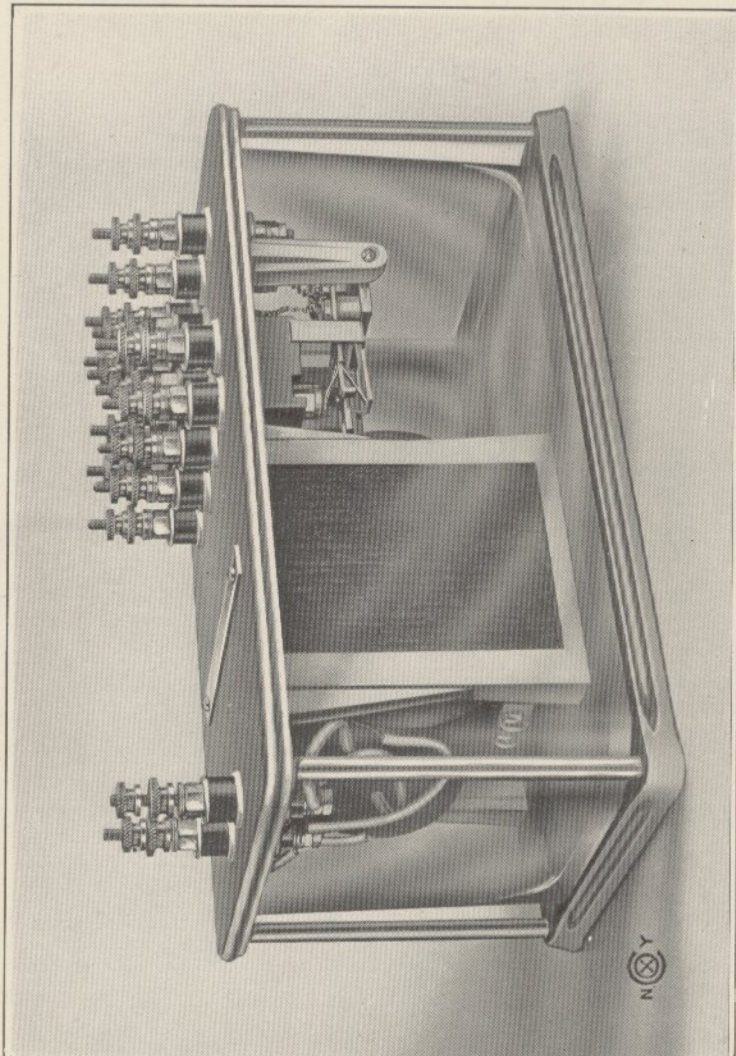
Offices:
New York - Chicago
Works:
Garwood, New Jersey.

PREFACE

ALTERNATING current track circuits form a comparatively new departure in signaling, but their use has already become established, particularly on railroads using electric propulsion. The system herein described was placed in service in June, 1908, and not a single failure has occurred since that time. Several smaller installations have been made since the one on the Long Island Railroad, and the perfect results obtained in every instance are convincing of the fact that the Hall Signal Company's alternating current track circuit system is the only system that completely solves the problem of track circuit signaling on electrified railroads.

The Hall Signal Company.

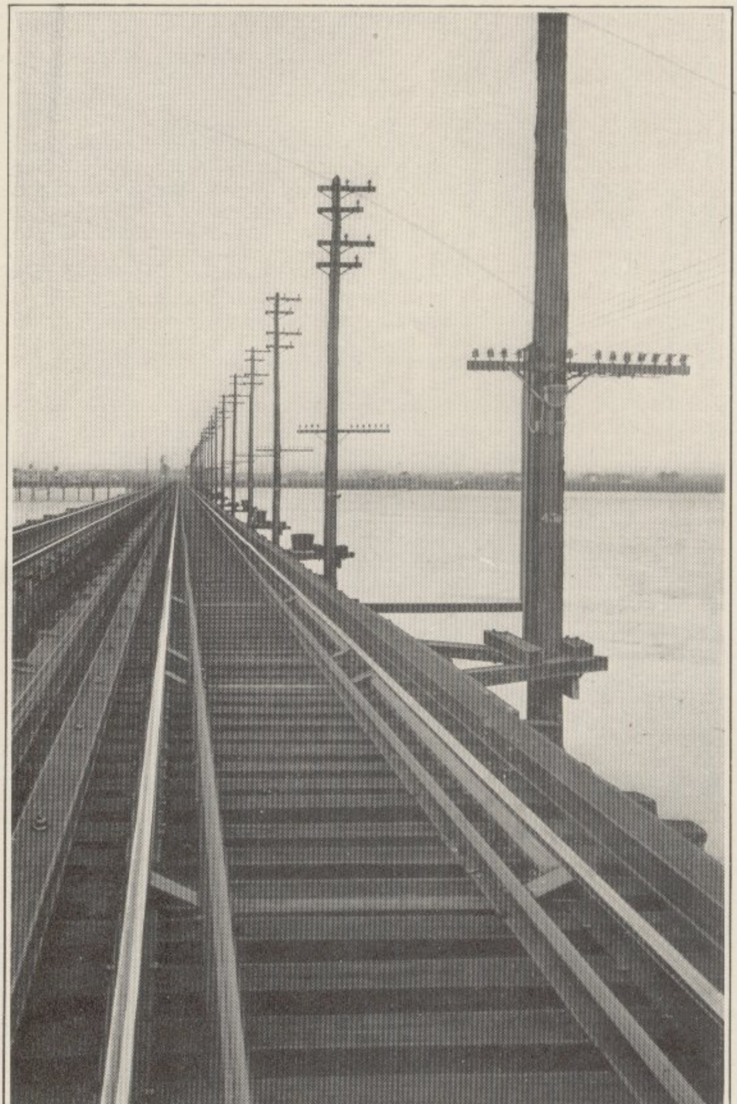
New York, Jan. 1st, 1909.



A. C. RELAY.

NOTWITHSTANDING the fact that the track circuit is the governing and most important factor in an automatic signal system, it is only within recent years that its principles and theory have been generally understood by signal engineers. There are five principal elements in a track circuit which govern its operation: 1st. The voltage and internal resistance of the track battery; 2nd, the resistance of the rails and joints; 3rd, the leakage between the rails; 4th, the resistance of the relay coils; and 5th, the leakage through the insulated joints. In addition to these, stray earth currents or foreign currents frequently cause interference to the operation of the track circuit. The resistance of the relay coils is the only constant in the above quantities.

With the experience gained by the long use of track circuits, the limits of variation of the track battery, rail resistance and track leakage are generally understood, and it is feasible, by proper attention to batteries, proper bonding, taking care of ballasting, regulating the length of track sections, etc., to control these factors and operate track circuits very reliably. The leakage through insulated joints, and protection against foreign current however, are still very troublous factors in the operation of track circuits, and until some reliable methods of control of these is accomplished, the safe and reliable operation of track circuits can hardly be assured.



A VIEW OF TRACK SECONDARY AT A SIGNAL LOCATION.
Note freedom from interference to traffic.

Insulated joints have always been considered an essential for the separation of blocks in automatic signal installations, and heretofore the efforts of signal engineers have been confined to improving the design and manufacture of the joints. But, notwithstanding the fact that substantial improvements have been made in joints for insulating between rails, it is a fact that the perfect joint has not yet been devised, and their continued use is a drawback to signal systems, and the maintenance of track.

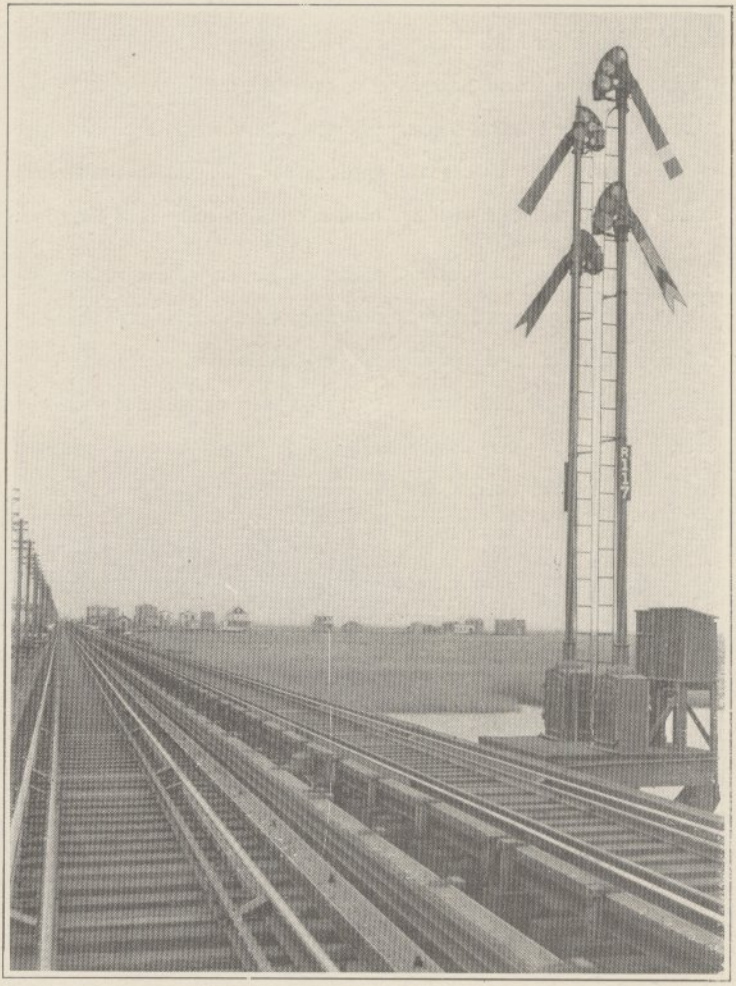
With the advent of the electric locomotive the insulated joint became a still greater problem; for reasons of economy in installations of third rail systems, the running rails are used as conductors for the return of the propulsion current. It was desirable that the signaling system should conform to this requirement, but where the standard track circuit with insulated joints was provided it became necessary, if the running rails were to be thus used for the return power current, to supply reactance bonds to bridge the insulated joints. Rather than do this, systems have been installed for electric roads in which only one rail was used for the return power current, the insulated joints for the separation of the block sections at the signals being provided in the other rail. Neither type, however, can be said to be satisfactory. The reactance bonds are still used in conjunction with insulation in the track, besides being

ANOTHER VIEW OF TRACK SECONDARY.

themselves an added source of trouble, to give up the use of one rail in each track for the return of the power current is obviously a serious disadvantage.

A system that does not require the use of insulating joints therefore, especially on electrified railroads, is peculiarly advantageous and should be of especial interest to all engineers interested in the subject of railroad signaling. Such a system of signals was placed in service on the Rockaway Beach Division of the Long Island Railroad in June, this year, between Ramblersville and The Raunt Station. On this division of the Long Island Railroad, the electric trains are operated by the third rail system, with 500 volt D. C. current as the operating power. At the sub-stations an A. C. current is transformed from 6,600 volts, 25 cycles, to 2,200 volts A. C., 25 cycles, at which voltage it is carried through the different sections of the road where automatic signals are used, on two No. 2 bare copper wires, for the signal supply current. As the territory through which the new signals were installed is on a trestle over Jamaica Bay, it was considered objectionable to use a high voltage on the trestle, accordingly a step-down transformer of 3 K. W. capacity was placed in the signal supply line at the west end of the trestle, to reduce the voltage to 220, which is the voltage used for the signal supply for the new system.

Figure No. 1 (see insert) shows the locations of the signals installed with this system of track circuit control. It will be noted



SIGNAL LOCATION ON TRESTLE.

that the signals for both directions are located on the south side of the tracks; this was found necessary in order to obtain a view of the signals, since the telegraph line obstructed the view on the north side of the tracks. The blocks are approximately 2,700 feet in length, and home and distant signals are used as on other sections of the road.

At each signal location, a storage battery of five cells in duplicate of the Standard Electric Accumulator Company's battery, charged from the third rail through resistances, is used for the operation of the motors and slots. At one of the signal locations, however, the storage battery is not used, but in its place is substituted a rectifier of special design, which is connected to the A. C. supply through the regular relay transformer, which provides direct current at 12 volts for the operation of the motors and slot magnets at this location.

The use of this rectifier is an interesting detail of the installation, since, by its use, a direct current supply is provided from the same A. C. source as used for the track circuit, which allows the use of standard signal apparatus with D. C. Motors and slot coils.

Figure 2 shows the circuit for the operation of the track circuit. At each signal location, two No. 4-0 copper cross bonds connect the rails, forming a short circuit between the rails at these points. A track transformer, the primary of which is connected to the signal supply wires and the secondary to the two rails, and which supplies A. C. current at 25 cycles, at approximately 4 volts,

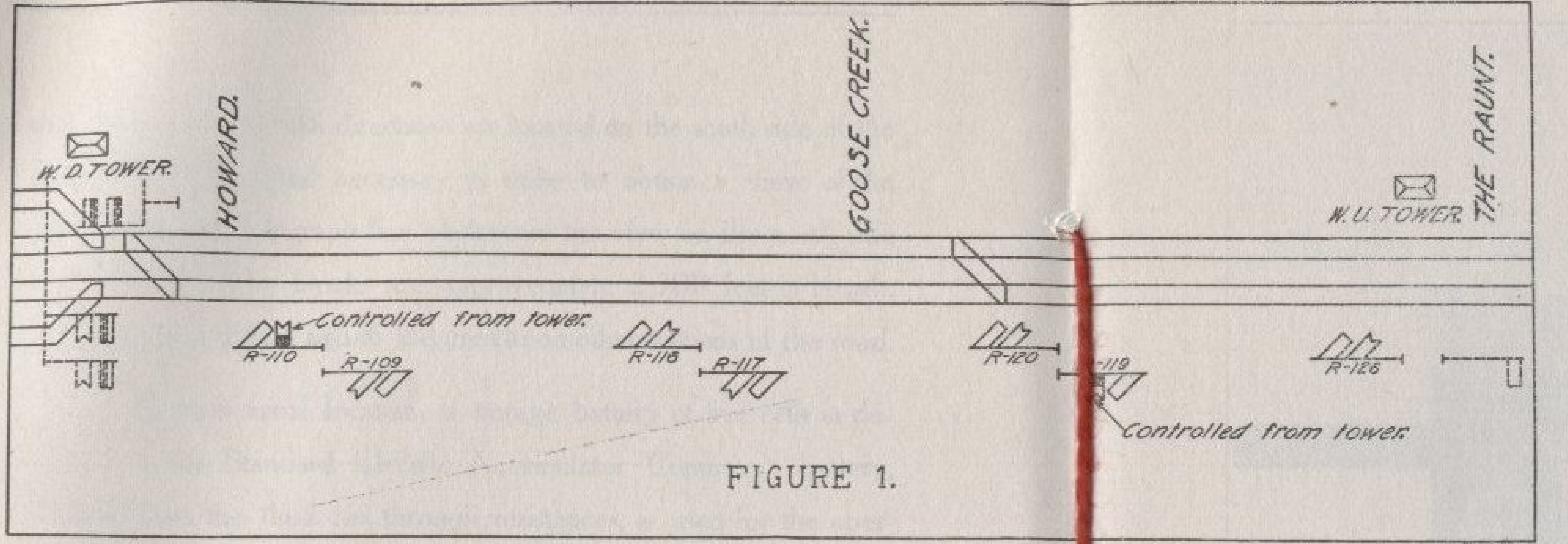


FIGURE 1.

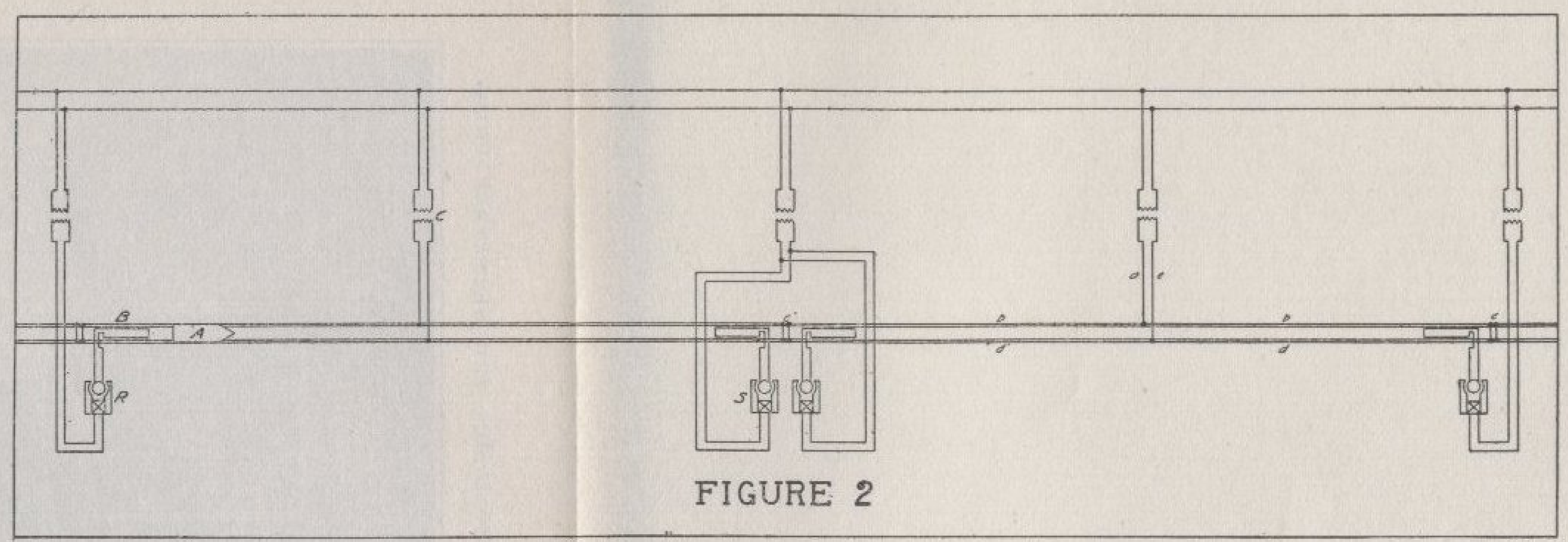
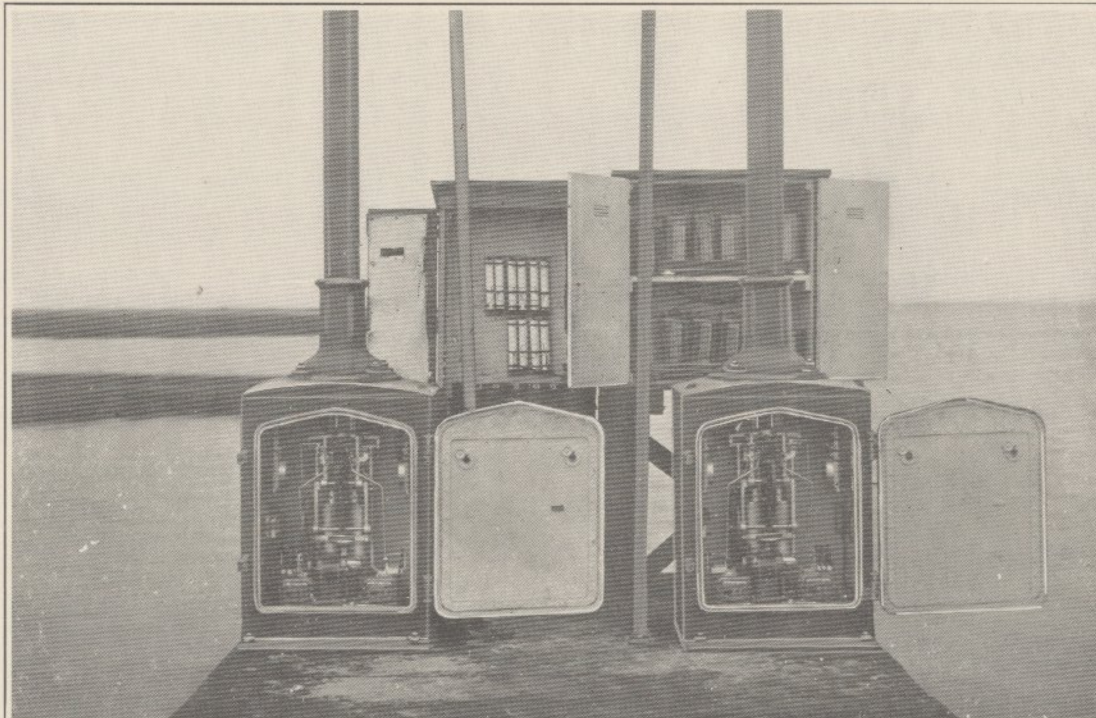


FIGURE 2

FIGURE 6



VIEW SHOWING MECHANISMS IN CASES, ALSO STORAGE BATTERIES AND RESISTANCE UNITS.

to the track, is provided at the center of each block. The path for this current is from secondary connection a to rail b, cross bonds c, rail d, connection e, to other side of transformer secondary. At the same time a current of equal value passes from secondary connection a, rail b-1, cross-bonds c-1, rail d-1, to the transformer; so that the A. C. current passes continuously through both rails throughout the block. At each end of the block, a coil of wire is placed along the rails with its terminals connected to the armature of an A. C. Relay of the two circuit type. This coil is composed of 40 turns of No. 10 insulated copper wire, wound continuously, as in a transformer or magnet coil, along and between the rails. The wire is protected from mechanical injury by angle irons along the rails and clamped to them; and by wood trunking between the rails. Angle irons are also clamped to the outside of the rails. These angle irons, in addition to forming protection to the coils, increase their electrical efficiency by providing a core. A sectional view of the rail, coil and angles is shown in Figure 3. The coil is thirteen feet six

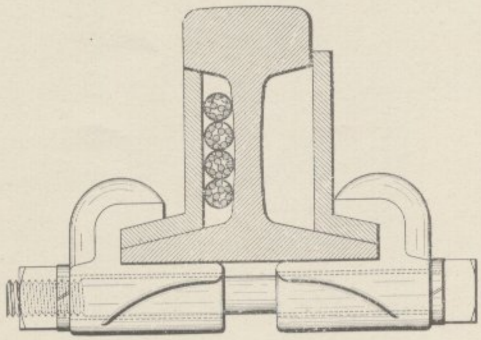


FIGURE 3

inches in length, and is made of well insulated flexible wire, impregnated with a weatherproof compound. The size and construction of this coil is such that it can be placed between track joints when the ordinary thirty feet rails are used. Where the coil passes between the rails, it is placed below the base of the rail, and so that the top of trunking which protects it is no higher than the top of tie, which construction provides ample protection from mechanical injury from parts dragging from cars. Figure 4 is a photograph of two of the coils in place, which gives an idea of the freedom from interference to traffic and road bed which the use of these coils provides.

The A. C. current which passes along rail b, cross bonds c and rail d, induces a current of the same frequency in the coil, and this induced current is carried through the armature winding of the two-circuit relay, R. This action on the coil is the same as the action of a transformer; the rails through which the initial current passes form the primary of the transformer, the angles and clamps form the core, and the coil forms the secondary of the transformer. The fields of the relay are connected directly to the main signal supply wires through a field transformer, which reduces the supply from 220 volts to 55 volts, and in addition to supplying A. C. current at 25 cycles, 55 volts, to the fields of the relays at this location, also provides current at the same voltage, for the rectifier. A cut of

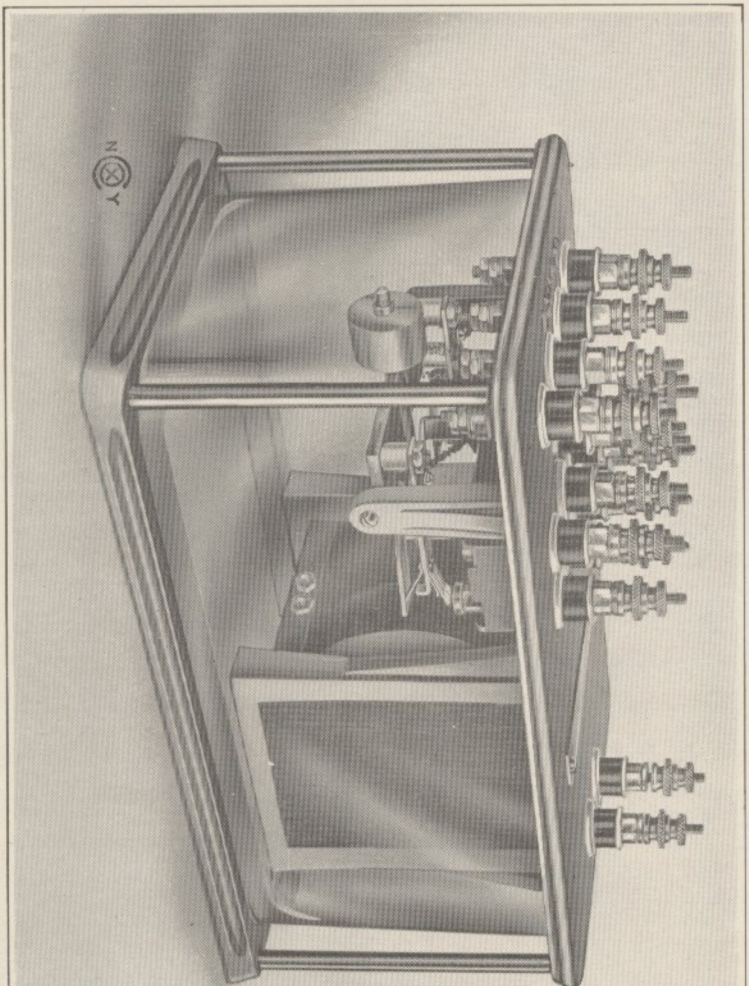
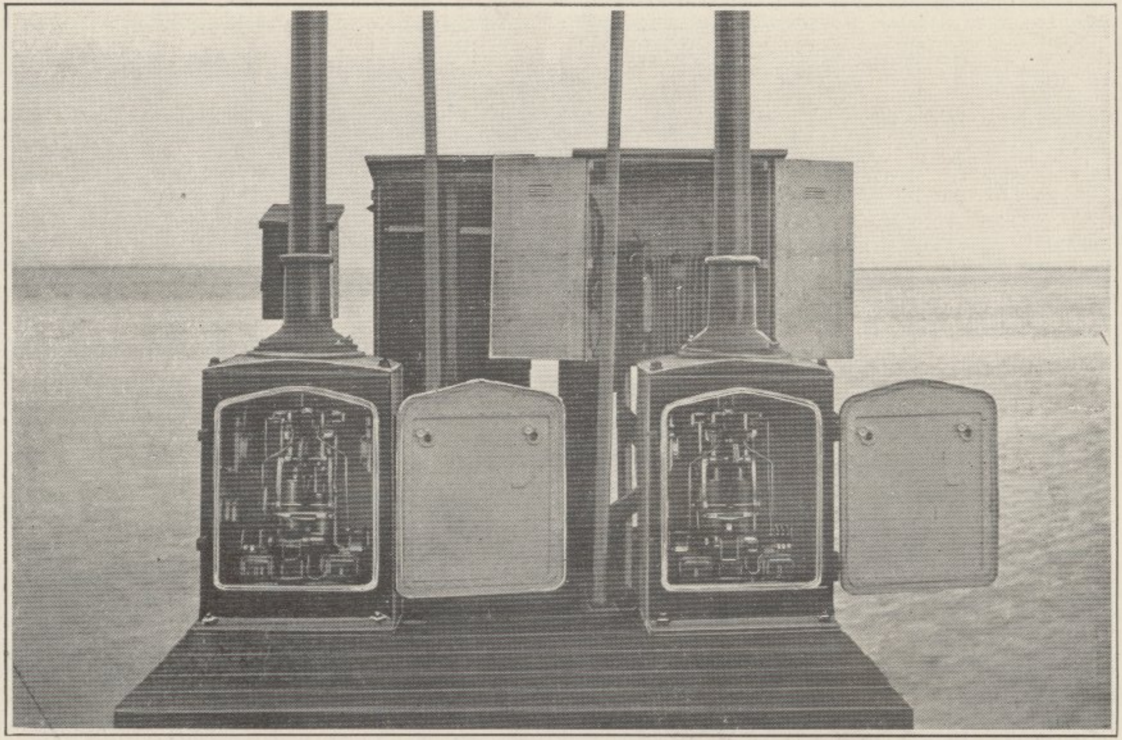


FIGURE 5.

the relay is shown in Figure 5 and in the frontispiece. It is designed on the principle of the D'Arsonval type of electrical instrument, with a moving coil enclosed in a stationary field. The contact fingers of the relay are attached to the moving coil or armature, and in order to have a closed contact, it is necessary to have a current of the same frequency pass through both field and armature coils in synchronism. As the A. C. current from the supply at 25 cycles passes through the field coils continuously, the operation of the relay is dependent upon the current from the same source, through the track coils. A train entering a block, as at A, Figure 2, cuts off the supply of track coil "B" which is supplied from track transformer "C", and in consequence the armature of track relay R is de-energized and the contact opens. As the train proceeds in the block and approaches the center where the connections are made to the track transformer, this transformer is short-circuited to such an extent that the relay S at the opposite end of the block, as well as relay R, is de-energized, and its front contacts open.

The signal circuit, diagram of which is shown in Figure 6, is a normally clear wire circuit with home and distant control. The wire for each home signal is carried through the home block in order that the home signal may be controlled through a contact on the relay at each end of the block, in series circuit.



SIGNAL MECHANISMS IN CASES, AND RECTIFIER IN BOX BACK OF SIGNAL CASE.

The breaking of a cross bond causes the signal to go to danger because the circuits from the transformers on each side of the bond are broken. When, however, a train is between two adjacent track transformers it completes a circuit from each. The connections of the transformers and relays are made in such a manner that the train approaching the broken bond clears the signal in advance, but the current to the train from a source to the rear will not give a clear indication. Broken rail protection is also afforded on both rails, since a broken rail will cut off the supply to the track coil at one end of the block and de-energize the relay at that end. It is also feasible with this system to cross-bond between tracks on a two or more track road at each signal location without interference with the operation of the system or the protection afforded by it.

The amount of energy consumed for each track circuit will vary in accordance with the length of section, condition of ballast, etc. On this installation the track transformer delivers 30 amperes at 3.3 volts or 99 volt amperes, and the field transformers deliver 2 amperes at 55 volts or 110 volt amperes. The power factor of the transformers, however, is low, and the actual consumption of energy for each section is only approximately 90 watts.

This system is equally practicable to steam roads. The only effective remedy for foreign current interferences to the operation of track circuits is the use of alternating currents for track circuits, with relays which respond to the alternating current supply only Not only does the system provide these safeguards, but, by dispensing with the insulated joints, it provides a track circuit free from the serious defects of direct current track circuits as ordinarily used.

This track circuit was originated by Mr. C. J. Coleman, known among signal engineers as the designer of the electro-gas signal sold by The Hall Signal Company. It was perfected by the engineers of The Hall Signal Company, by whom the installation on the Long Island Railroad was made, under the direction of Mr. E. M. Weaver, Signal Engineer.

WM. HOUSTON KENYON.
ALAN D. KENYON.
ROBERT N. KENYON.
RICHARD EYRE.
WILLIAM C. WITTER

KENYON & KENYON,

COUNSELORS AT LAW.

49 Wall Street, NEW YORK

TELEPHONES { 7627 / 7628 } HANOVER
CABLE ADDRESS "AMAXIA, NEW YORK."
A. B. C. CODE USED

PATENTS, TRADE-MARKS
COPYRIGHTS.

December 26th, 1908.

The Hall Signal Co.,

Gentlemen:

We have examined the Coleman system of signaling for electric roads which was recently installed by you on the Long Island Railroad, and made careful and exhaustive search of the prior art in order to determine its novelty and patentability, and we are pleased to be able to report to you that the said Coleman system is absolutely novel, and broadly novel and pioneer in character, marking a fundamental departure in the art of signaling from what was old, and striking out along an entirely new line. Both method and apparatus are clearly patentable, and we are pleased to inform you that already broad and fundamental and all-controlling claims have been allowed by the U. S. Patent Office, and practically without reference in the prior art, over even approximations, and Letters Patent of the United States for the basic invention, and for the improvements that have been added to it in practice, will, in our opinion, issue to you in due course upon applications owned by you and already long pending in the Patent Office.

The importance of this Coleman invention to the practical art, is known to you, and has been demonstrated in experimental and practical applications, and is evident to all engineers who study its principle, or observe its operation, and, in our opinion, the Letters Patent of the United States that will issue to you in the matter will completely cover and protect the invention in all its possible forms.

Very truly yours,

Kenyon & Kenyon

COX ENGRAVING PRINTING CO·N.Y.