tion to its band on the roller operated by switch lever No. 9, causing the improper releasing of the lever, which resulted in the lever being set normal, while the switches No. 9 remained in position for the crossover movement from Track 3 to Track 2, thus releasing the mechanical locking and permitting the clearing of the signals for (straight) movements on Tracks 2 and 3." * * * The committee unanimously agree to the following:

"We believe that no changes should be made in the design of the interlocking machine or any additions thereto, excepting the strengthening of the fastenings of the contact springs on the combination board and the springs arranged so that there will never, when in the indicating position of the lever, be less than a one-eighth-inch opening between the 'I' and 'Y' springs and their respective bands on the roller. This will, with proper inspection, prevent the shifting of the springs, and this strengthening of the spring fastenings is recommended.

"Our inspection of the interlocking apparatus on November 10 developed that due care had been exercised in the maintenance of the plant. The tower and the machinery in the tower were found to be in the best condition.

"The committee found upon its inspection of the plant that the installation had been made in all its parts with proper care, good engineering and practice having been followed at the time of its installation. No changes affecting this inquiry have been made since that time.

"While the suggestion may be made that it is possible to make additions to the plant to bring the same up to a higher standard of the signaling art, and a number of suggestions for improvements were made by members of the committee, on no one of which the committee could agree, it is not, in the opinion of the committee, advisable or practicable to make additions and improvements generally until the same have been shown by long experience to give the reliability and safety in signal working which all roads are endeavoring to secure.

W. H. Elliott, Chairman."

THE SIGNAL SYSTEM IN THE DOWN TOWN TUNNELS OF THE HUDSON & MANHATTAN R. R. CO.

By JOHN LEISENRING
Asst. Engr., H. & M. R. R. Co.

Owing to the peculiar geographical conditions existing in the immediate vicinity of New York City, steam railroad traffic into the city itself has been very limited, entrance for passenger service being restricted to two railway systems and subsidiary lines. Other roads have been compelled to transfer their passengers wishing to enter the city to ferry boats, thereby offering very little choice as to the point of entrance. While this ferry trip, as the final leg of a long and tedious journey, might prove very pleasant during the summer months, it undoubtedly involves considerable time and danger when the river is fog and ice bound in winter, and is far removed from the present day idea of rapid transit.

The Hudson & Manhattan Railroad Co., have during the past few years, built and put in operation a system of tunnels under the Hudson river connecting the most important railroad terminals on the Jersey shore with the shopping and financial districts of Manhattan Island. The tunnels, which are now open to the public, consist of twin single track cylindrical cast iron tubes, built up of segmental rings, extending from the terminal of the Delaware, Lackawanna & Western R. R. at Hoboken under the river to Morton street, New York City, thence under various streets to Sixth avenue and 23rd street. Connections are made at two points under the Jersey shore to two other tunnels, which extend south under the Erie and Pennsylvania Railroad stations, then east under the river to the immense terminal under the office buildings on Church street between Cortland and Fulton streets, New York. See Fig. 1.

The tubes between Hoboken and 23rd street have been in operation since February, 1908, a description of the signal system installed being printed in The Signal Engineer of August of the same year.

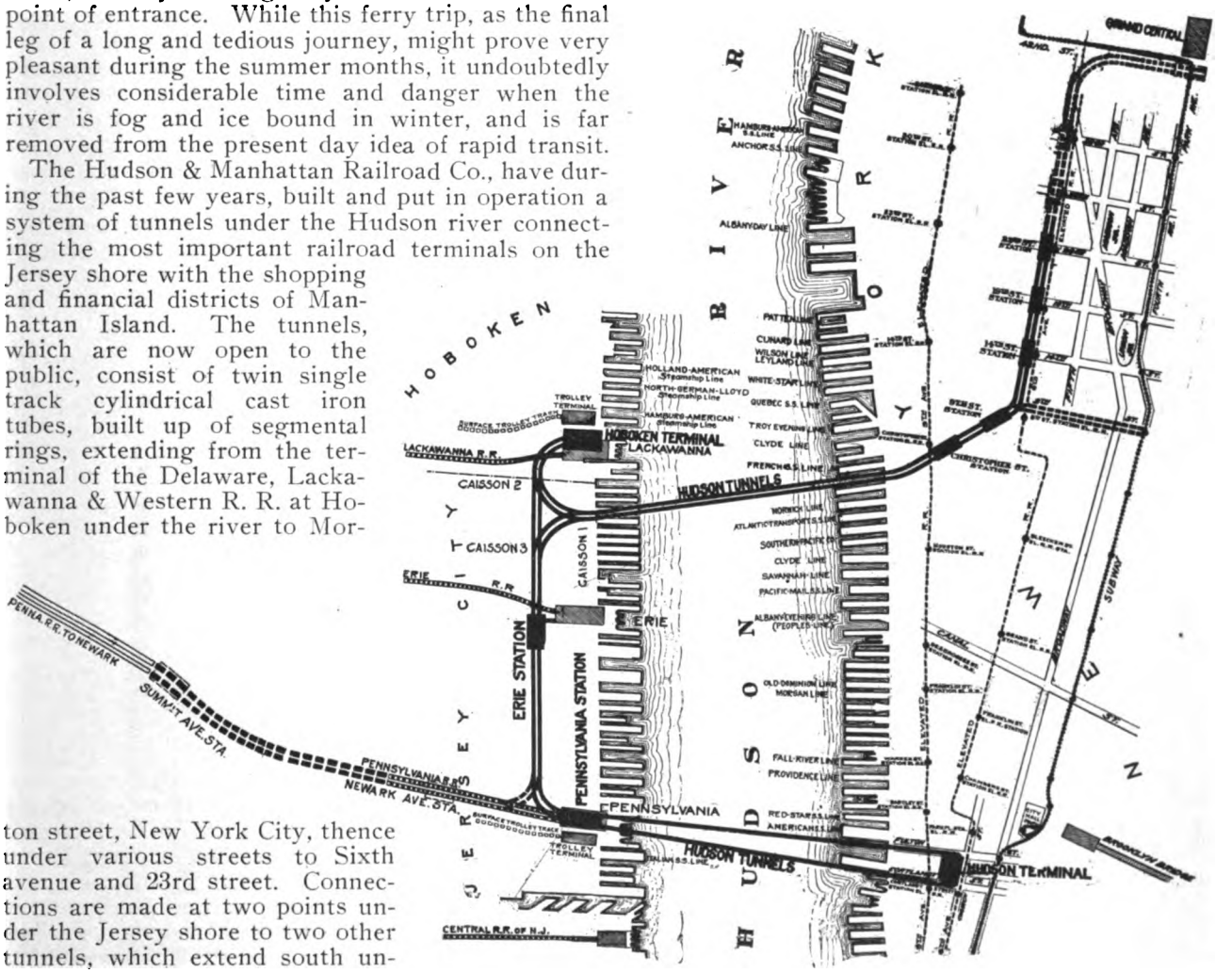

Fig. 1.

This line is now being extended to a terminal under the Grand Central station at 42nd street and Lexington avenue, affording additional stations at 28th, 33rd, 38th and 42nd streets and 5th avenue. The station at 33rd street will be a transfer point for passengers wishing to connect with the new Pennsylvania Railroad terminal at 33rd street and 7th avenue.

That part of the system which is described below is located between the junctions at Caissons Nos. 1 and 2 (see Fig. 1) and the down-town terminal. It must be understood that the term caisson is here applied to the reinforced concrete construction used to effect a junction of the iron tubes at points where tracks diverge. These caissons are built on the surface and sunk into place while under air pressure. They are built with two floors, one above the other, this arrangement allowing one train to pass directly beneath the other, eliminating grade crossings and the large element of danger involved. In Fig. 2

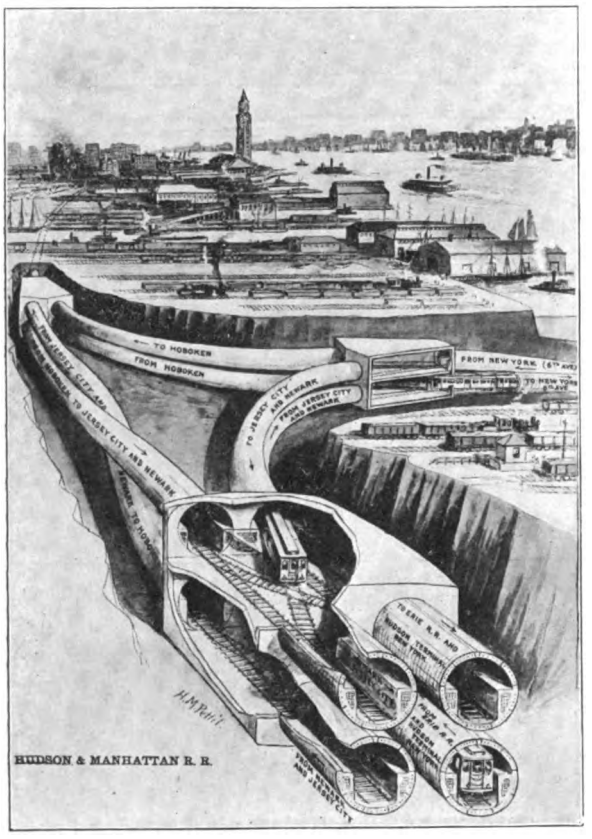

Fig. 2.

a general layout of the tunnels in the vicinity of the above mentioned junctions is shown. The greater portion of the tunnels under consideration are of the iron tube construction, the remainder being built in the form of a reinforced concrete arch. In either arrangement after the tunnel itself has been built, a concrete invert or floor is laid, on this invert vitrified clay ducts are built up in the shape of side walls through which all cables are run. A view of the completed iron tunnel before any concrete is placed is shown in Fig. 3. The signals in the tunnels south of Caissons 1 and 2 were arranged in much the same manner as those described in the article referred to above, the same general scheme being followed; for instance, both installations are of the two block, overlapping, normally clear, double rail return system, automatic train stops being used at all signal locations. The principle differences are that in the tunnels between Hoboken and 23rd street, New York, an all-electric system, using alternating current on the automatic signals and direct current through the interlocking, was used with 600 volt D. C. motor control for the Kinsman automatic stops and signals of the shuttle type. In the more recent work alternating current is used throughout for interlocking as well as automatic signal control for the first time in the history of the art of signaling, the stops and track relays being operated by compressed air, and the signals being of the light type. A layout of the system to

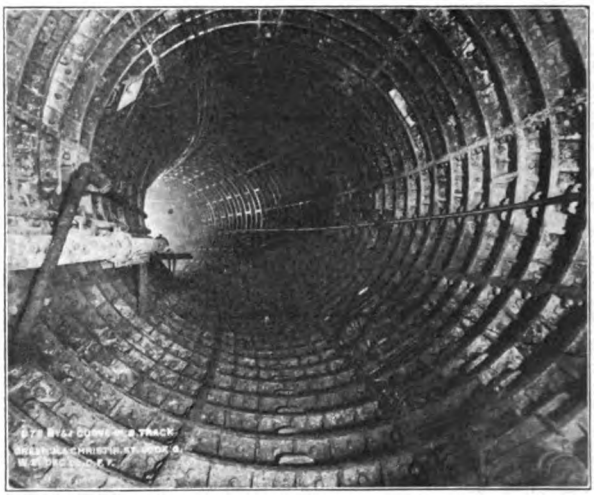

Fig. 3.

be described is shown in Fig. 5. The power house at Washington and Bay streets, Jersey City, is also shown. Before the completion of the power plant, which is recent, a substation, now supplied from the main plant, was used, foreign current being the source of supply. The present and final arrangement now in operation is as follows: The main plant consists of four General Electric steam turbine generators, two of 3,000 and two of 6,000 K. W. per hour capacity, one 3 and one 6, giving sufficient current for the present operation. The generators produce current at 11,000 volts, 25 cycles, the above mentioned substation at Christopher street and one

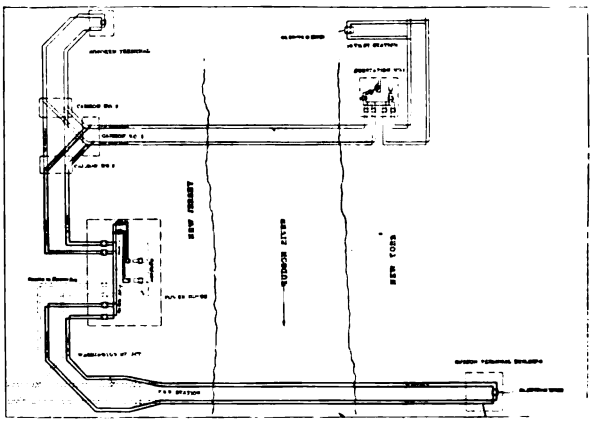

Fig. 4.

in the terminal building being distributing points.

Current is supplied to the signal mains of the down town system from the main power house at 1,100 volts, stepped down from the generated 11,000 volts by one of two transformers, either of which may be cut in through oil switches. From the signal bus bar connections are made through four switchboards to four sections of tunnel. The usual high tension signal mains consist of 2-conductor No. 5

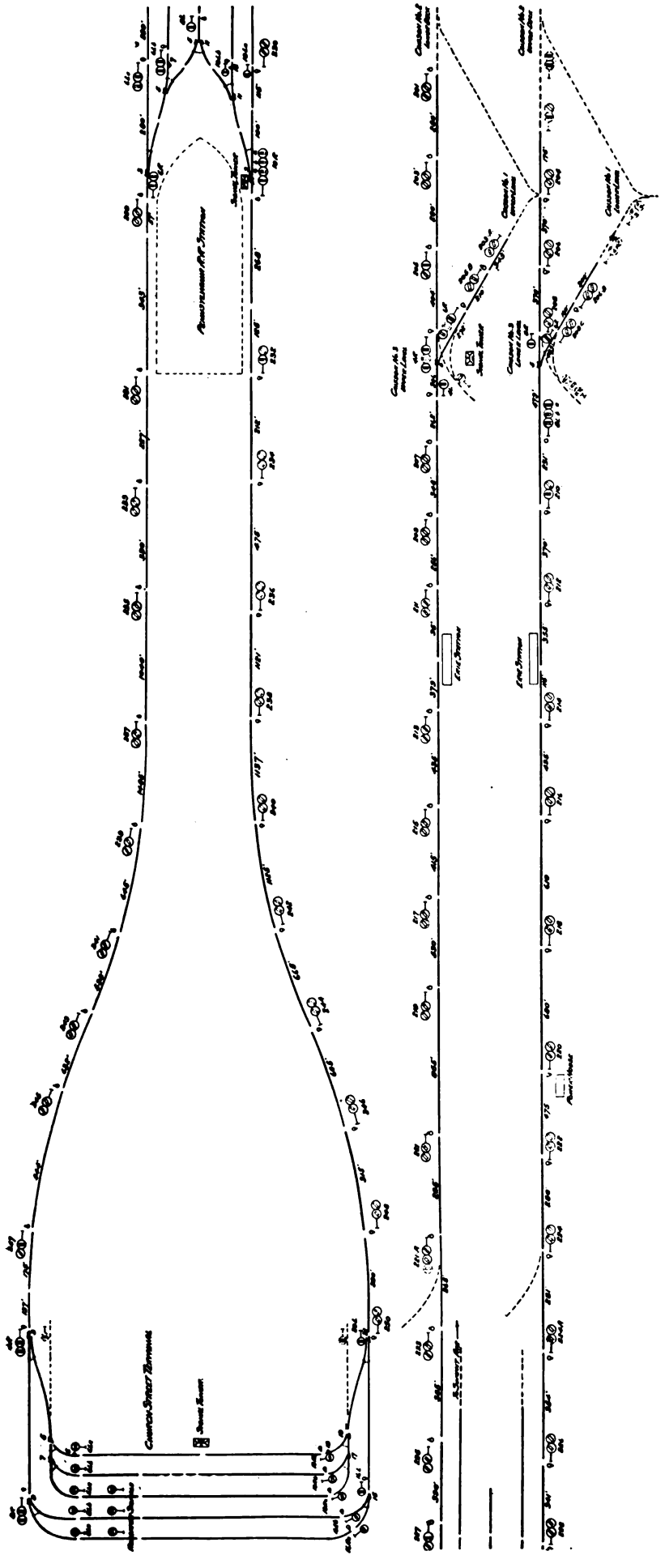

Fig. 5.

stranded lead covered cables, which deliver current at the above voltage to each signal location, where it is again transformed to the low voltage desired for the operation of the local apparatus and the feeding of the track circuits. From the power house south to the Pennsylvania Railway station and east to the Terminal building one cable is run in each tunnel to be connected when desired through a normally open oil switch in the signal tower at Church street, the function of which will be better understood by referring to Fig. 4. It is here shown that current is normally fed from the power plant through both the east and west bound tunnels to Church street terminal, the circuit being completed back through the same tunnel over one wire in the two-conductor cables which is marked so that the functions of the two wires can be readily determined. In case trouble develops in either tunnel, such as the burning out of a cable or anything necessitating the pulling out of a length of the high tension feeder, current is cut off the section in question in the high tension fuse box, which will be described later, and the oil switch, in the tower at Church street, thrown in, thereby connecting the end of the feeder in which conditions are normal to the easterly end of the feeder in which the length of cable is cut out, energizing the system through the oil switch up to the dead section. The signals west of this point are fed in the usual manner. Through the use of this expedient energy is kept on all the signals while the work is being done.

The feeders running north are arranged in the same way, connecting with the up-town set at Caissons Nos. 1 and 2, the oil switch for this section being placed in the tower at 19th street. Between the power house and the junctions the feeders are made up of two No. 2 wires instead of No. 5, the increase being due to the possibility of these cables having, in case of trouble at the substation, to feed all the way to 23rd street, and when the extension is finished, to 42nd street. The size of all the feeder cables is figured to give sufficient capacity to handle the normal voltage with not more than a 5 per cent drop at the end of the line.

After the feeder cables were all run and connected through the fuse boxes at each signal location a final test was made for crosses and grounds by increasing the current supply in the power house to 3,000 volts, nearly three times the usual load, and leaving this voltage on the line for three minutes in each test.

(To be continued.)