Track circuits can be applied with the M. D. M. electric interlocking for all the usual purposes, including switch locking, thus eliminating detector bars. For this purpose electric locks are fitted to the slide-bars in the machine. The usual practice is to feed the whole of the track-circuits and all other functions from the central source of energy at or near the tower. Semi-automatic replacement of signals is employed and an unusual feature is the station-master's switching control board. Switching and call-on signals are not found in France save in very rare cases—for what reason it is difficult to understand—and the rules do not allow a red and white checker-board signal at "stop" to be passed, even in switching operations. As a result, it is necessary to eliminate the track-circuit control in order to switch on to an occupied track—which is done under the station-master's authority, that officer actuating a "shunt switch" on a control-board in his office. The condition of each track-circuit is indicated in the tower. The use of track circuits has become very popular in France during the last few years. The M. D. M. system can be applied equally well to work with proper switching signals.

So far the M. D. M. system has always been installed as a 110-volt d.c. system, operated from storage battery sets in the usual manner, charged, as a rule, through a converter set from the local district supply, with gasolene engine and dynamo as stand-by. The electrical network is composed of armoured cables, one being led to each function, the general return being to earth. The lead-out in the base of the tower is neatly arranged (see Fig. 9), while the terminal plates and boards everywhere are designed so as to make it impossible to cause a false connection with tools, such as a screw-driver, when coupling up or testing. Any suitable method of running the cables may be employed. The fuses, etc., and in most cases track relays are also collected under the tower.

Other M. D. M. Installations

The first hydro-pneumatic plant was put in at Paris (Nord), Tower-A, in May, 1906, and up to January, 1923, there were in service 31 cabins, having in all 1,069 route-levers, 893 switches, 731 signals, nearly all on the Northern Railway. The electric system was first installed at St. Denis (Tower-A), in July, 1919, and by July, 1923, a total of 30 plants were in service, with 1,313 route-levers, 878 switches and 716 signals, practically all on the same road. Other installations are under construction, while since 1921 16 hump-yard plants, without route-levers, have also been erected. The writer has been able, through the courtesy of the railroad and the manufacturers, to examine the electric installation at Creil on the Paris-Boulogne main-line, where it has to handle a heavy and varied traffic and has given every satisfaction since it was put in service. The route-lever idea has, so far as he is aware, never yet been taken up in America and it would be interesting to know whether it has ever been proposed there. An application of the *principle* has already been made in England in an installation described in *Railway Signaling* for November, 1923, and other plants have now been authorized, also on the Great Western Railway.

Drafting Practice on Interborough

By Charles McGregor

THE basic conditions of any drafting room system are controlled by certain fundamentals, differing more or less with each railroad. While a diversity of methods is probably unavoidable, particularly between steam-operated trunk lines and electrically-operated interurban railways, it is possible that a more uniform practice might result from a better understanding of the methods used by various roads. It is with this idea in mind that the following description of the signal department drafting room practice of the Interborough Rapid Transit Company of New York is outlined.

Automatic Signal Requirements

The operation of high speed electrically-operated passenger trains on a headway of 1½ min. and the danger of congestion of traffic occurring when regular operation is interrupted, warrants the most careful consideration of the signal requirements. In order to show these requirements in a clear manner, and to provide a means of study and development of other plans, signal and signal apparatus plans are the first drawings prepared. These are drawn to a scale of 40 ft. to the inch, and show the tracks with curves, grades, station platforms, engineers stationing, the elevated structure columns and numbers, the locations of the automatic signals, automatic train stops and insulated joints, as determined from the operation curve chart of train movements computed from standard acceleration charts, breaking distance curves and other data of the rolling stock equipment in use. Speed control signals for entering stations, protecting interlocked switches, or for other special conditions and the track section controlling them are also shown.

Automatic signal circuits are made continuous. They are designed to show the controls for the automatic signals and train stops and are prepared from typical circuits modified as required for the individual signal control, as indicated on the operation curve charts or interlocking circuits.

Individual drawings called "Cable Keys" are made in detail for each location to show the entering cables, terminals, relays and interior case wiring. On the elevated system the track transformer, the track relay and the signal control relays are housed in one case for each signal location, so that a single cable key for each housing is all that is required for that type of construction, but in the subway system it is necessary to place the track relay and transformer in a separate case from the signal control relays because of limited space; the cable keys for this situation are, therefore, divided into two parts, namely, the a. c. case containing the track apparatus and the d. c. case containing the signal control relay. These cable keys are prepared from the typical circuit for automatic signaling, modified as required to provide for the signal controls as indicated on the operation curve charts, as is the case for the automatic control circuit plans explained above. If the cable keys are pasted together in proper order they will form a true and complete circuit drawing of the signal system as actually installed.

Because of the large number of cable keys required

for a particular installation, it is found desirable to make standards for the usual layouts only. These standards, which include all types of signals and signaling, such as single overlap, double overlap, light signals and electro-pneumatic signals, show only the relays, terminal strips, cable and other work that is common to that particular type of signaling. White prints of these standards are then marked to show all special details and the data necessary for the individual signal location. A draftsman then transfers these markings and special details to printed tracing cloth forms which are duplicates of the white prints before being marked. This procedure reduces to a minimum the labor of laying out the cable keys and in tracing them.

Interlocking Requirements

Where interlocking plants are to be provided, plans are drawn to a scale of 40 ft. to the inch, similar to the signal and signal apparatus plan. These drawings show the signal functions that are part of the interlocking, and are used for authorization and approval only. All information contained in these drawings is eventually added to the signal and signal apparatus plans.

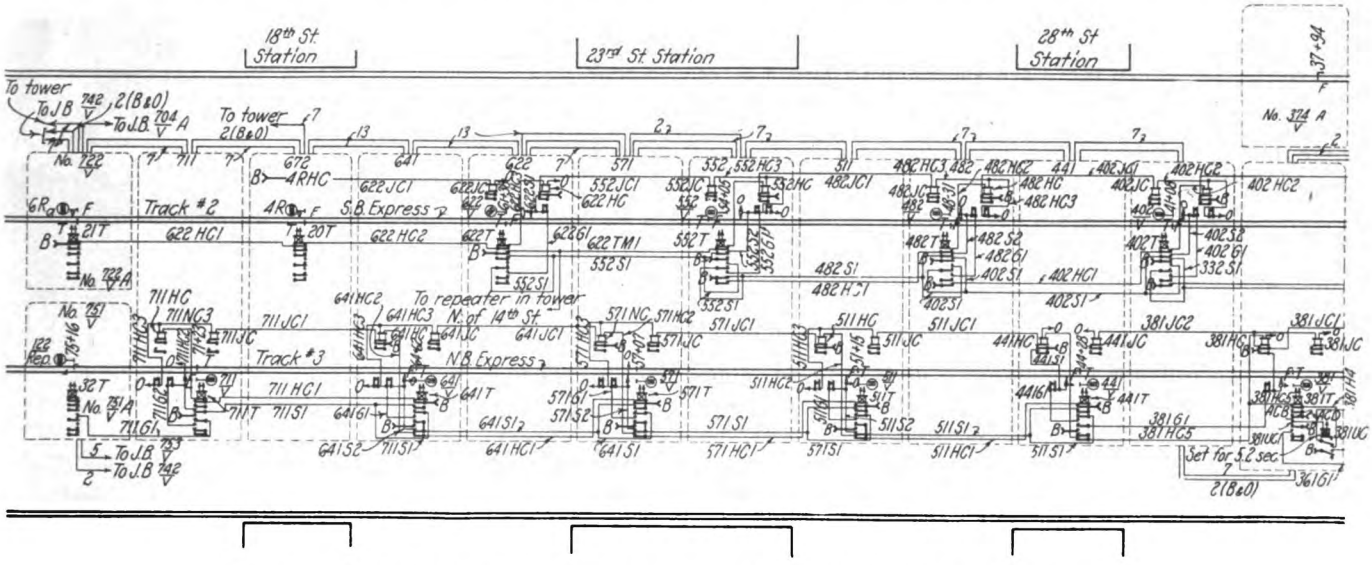
Spring combination dog and locking plans of the electro-pneumatic interlocking machines are prepared. These show locking details, the terminals for the control wires leading from the interlocking machine and the different circuit combinations accomplished by the interlocking machine levers.

Track circuit plans of the interlocking limits and approaches are the next plans prepared. These are not drawn to scale, but show in their relative location all switches, interlocking signals, and all automatic signals and train stops, the controls of which are modified by the interlocking, also the different track circuits through and approaching the interlocking. Besides these drawings, other plans are provided to show in detail all circuits in the interlocking, including the circuits for the automatic signals and train stops affected by the interlocking, except the switch controls. The switch controls being standard, they are covered by typical circuits applicable in all cases.

Written circuits are prepared to show the signal control, signal lock, automatic stops, switch detector and other circuits. These are made separate and in regular order. Wiring plans of relay racks and tower cable keys are prepared to show all cables entering the tower, and the wiring of all tower relays. All cables are shown in correct relation to the tower, according to the direction from which they enter. The cables for the interlocking signals and track relays are similar to those described for the automatic territory. Each signal and track relay case is provided with a print of the cable key, of that location, pasted on the inside of the door.

Plans drawn to a scale of 20 ft. to the inch are prepared to show the location of insulated joints and jumpers around the switches of the interlocking plants. These show the work to be accomplished more clearly than could be shown on the signal and signal apparatus plans, which are drawn to a smaller scale.

Plans drawn to a scale of 4 ft. to the inch are prepared to show the location of the tower, interlocking machine, relay cabinet, terminal strip cases, storage batteries, switchboards and motor generators. Plans are prepared to the same scale, to show, in a similar manner, the location of the air compressors, cooling coils and any electrical apparatus housed with the air compressors.



Typical Circuit Plan for Express Tracks Through Three Stations

A diagram showing the tracks and functions within and approaching the interlocking, supplemented by a manipulation chart of all possible train moves completes the drawings made for the interlocking layouts.

Filing and Indexing

The Interborough Rapid Transit system consists of two divisions: the subway and the elevated. These are again subdivided into lines such as the Third avenue line, the Lexington avenue line, etc. To each line is given a distinctive letter, for identification purposes, such as "T" for the Third avenue line and "L" for the Lexington avenue line. The old subways, the new Manhattan subways, the new Brooklyn subways and the elevated each have their drawings in a separate section of the file. Each section has a separate drawer for each class of drawing such as circuits, cable keys and signal and signal apparatus plans and each drawer is subdivided into lines by folders, so that it is a comparatively simple matter to locate any drawing referring to a particular installation. Drawings applicable to all lines or that are inconvenient to file under the lines for any reason, are filed according to their sizes, and are indexed.

Drawings are made of a number of standard sizes. Of these C, D and H are used the most, C being used for

locking sheets, spring combinations, cable keys and floor location plans; D for signal and signal apparatus plans, track and control circuits, interlocking plants, etc., and H for insulated joint plans. These letters are used as the first part of the number for any drawing and denote the size of the drawing. For circuit plans this letter is followed by W and for cable keys by K in order to show the kind of drawing; then follows the number, which is derived from one of the following methods. If the drawing is applicable to all lines it is numbered according to the sequence of numbers assigned to that size of drawing. If, however, the drawing has reference to any particular location it is given the engineers' stationing, nearest to the location, and also if referring to one particular track, as is usual with the cable keys, the figure designating the track is added. To complete the identification the number is terminated by the letter designating the line to which the drawing has reference. As an example, D-W-133-L is a D size drawing of a wiring circuit plan (W) for the interlocking nearest to or at the engineers' station 133 on a Lexington avenue line (L). Similarly C-K-1322-L is a C size drawing of the cable key (K) for the location nearest to the engineers' stationing 132 concerning the track designated by the figure 2 on the Lexington avenue line (L). Where there are several instrument cases for the same location, the additional cable keys required have the same number, to which A, B, etc., is added as required. For instance, C-K-1322-A-L is the track relay cable key for the above location.

All drawings are recorded under the class letter denoting the size and card indexed in the file in a manner similar to that described above for filing the tracings. In addition, a book is kept which is divided into sections, and subdivided into pages. Each section pertains to one line, and each page to one interlocking. On each page is shown a list of all the drawings pertaining to that interlocking. The pages for all interlockings on one line are in their proper order, supplemented by the sheets, giving the cable key numbers for automatic signals, and other information pertaining to that line complete in sections, which section index letter is that designating the line.

Construction, Maintenance and Inspection

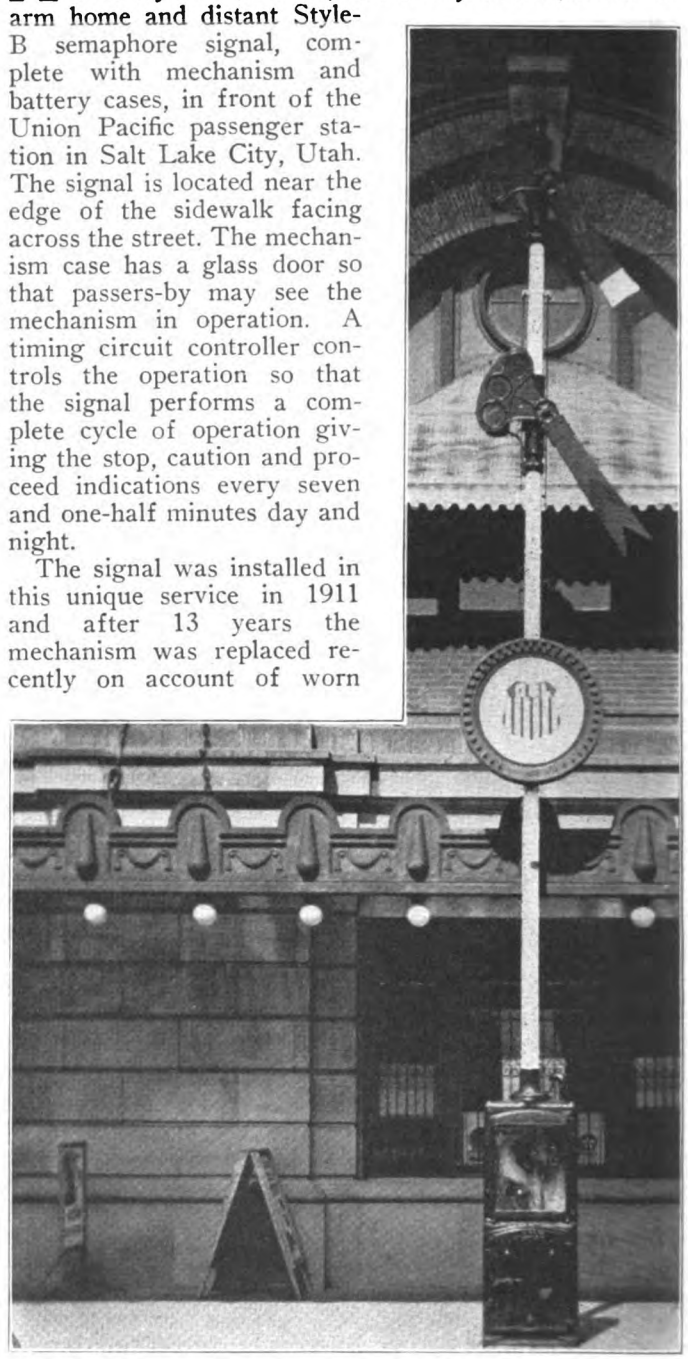
The construction and maintenance forces must be furnished with correct blueprints of the work under construction or undergoing change. To add to or withdraw from these prints without confusion or delay is a matter of considerable importance and many times becomes a very hrad task to handle. It is essential and desirable that co-operation between the office and the construction forces be maintained in order that any changes in detail, found necessary as the work proceeds, may be reported to the office. The drawings may then be revised and a new blueprint promptly issued. Any changes originating in the office while the construction work is in progress require the revision of the drawings, the issue of new blueprints and the withdrawal of the old prints affected.

When starting new construction work on the Interborough Rapid Transit, the foreman on the job is supplied with a complete set of blueprints, in duplicate, for all work to be done. When the installation is completed one set is retained by the foreman and the other returned to the office, with any minor changes that may have come up marked upon them. The returned blueprints are compared with those in the office construction file. These are withdrawn from that file, and both sets of plans are then permanently filed away. The remaining blueprints in the office construction file show what prints the foreman has for the job, as office copies are always placed in the construction file when any prints are sent out to the foreman and withdrawn when the foreman's copies are returned. The drafting room practice and co-operation between the drafting room and the construction forces on the Interborough Rapid Transit has been gradually developing with the result as indicated herein.

A Century of Signal Service

ABOUT thirteen years ago the Union Pacific Railroad System installed, as a safety exhibit, a double-arm home and distant Style-B semaphore signal, complete with mechanism and battery cases, in front of the Union Pacific passenger station in Salt Lake City, Utah. The signal is located near the edge of the sidewalk facing across the street. The mechanism case has a glass door so that passers-by may see the mechanism in operation. A timing circuit controller controls the operation so that the signal performs a complete cycle of operation giving the stop, caution and proceed indications every seven and one-half minutes day and night.

The signal was installed in this unique service in 1911 and after 13 years the mechanism was replaced recently on account of worn parts. During this time several timing mechanisms have been worn out but the signal mechanism has been maintained in its regular operation. With a cycle of operation for every seven and one-half minutes, 24 hours a day, there would be a total of 926,040 operations in the 13 years of service. If the signal had been in regular service on the railroad, on the basis of one train an hour, the 926,040 operations would have extended over a period of 104 years.



Automatic Signal That Served the Union Pacific for Thirteen Years as an Advertisement