Electric Interlockings On the French Northern

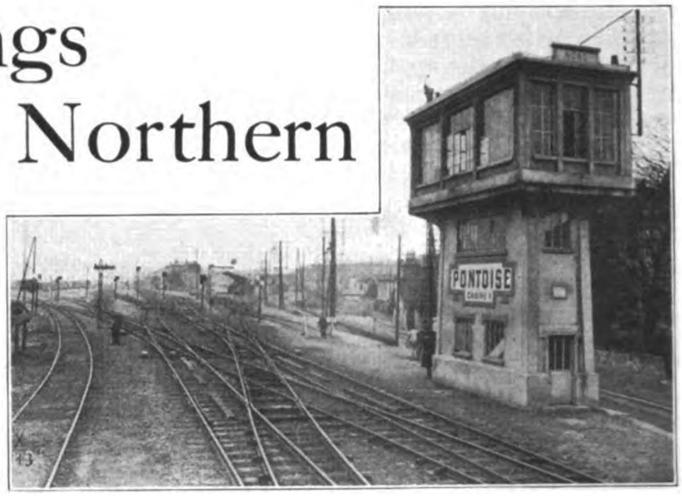

Fig. 1—Pontoise Interlocking, Northern Railway, France

The M. D. M. Electric System Includes Route Levers Which Facilitate Operation

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THE reconstruction of the railroads in France in the devastated areas has necessarily involved a great deal of signal and interlocking work. Numerous stations having been totally destroyed or rendered all but useless, opportunity has been taken in many instances to rearrange layouts to better advantage and to install power in place of mechanical interlocking in order to reduce the number of signal towers and realize in addition to economy an increased celerity of operation. The manual block has been supplanted by the automatic block in several cases* and there is no doubt that this will be carried out on a large scale. The Northern Railway suffered great damage and has been obliged to carry through a most extensive reconstruction scheme. Before the war this company had installed a number of power interlocking plants and some were under construction in August, 1914. The work has since been taken up again but during the war period technical developments led to the substitution of an all-electric for the original hydro-pneumatic principle, upon which the first plants were built, and all the new power interlockings are entirely electric. With the hydro-pneumatic system, though its actual operation was satisfactory enough, it was found that it was necessary to use electricity for such purposes as slotting and track-circuit control, which gave rise to considerable complication, so it was but a natural step to adopt electricity for everything.

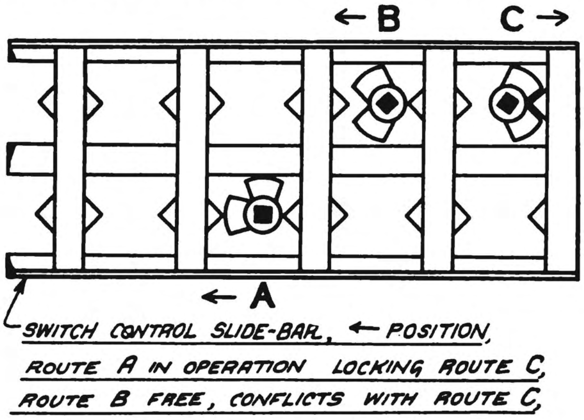

Fig. 3—Diagram of Locking

Practically the whole of the plants, both hydro-pneumatic and electric, on the Northern Railway have been built by the Aster Company, of Paris,[1] whose apparatus is familiarly known as the M. D. M.[2] system. It is in use on the principal French roads and has been specially selected by the Northern Company for the rebuilding of those parts of its line destroyed during the occupation. The first plant was installed in 1906 at Paris-Nord, Tower A, and since then improvements have been made continually, so that the present all-electric system represents the product of many years of study and experience.

Route-Lever Operation an Advantage

The idea of route-lever working has always been an attractive one to French engineers. The comparative absence of special switching signals in French signaling[3] made the adoption of it easier in the first instance than it would otherwise have been.

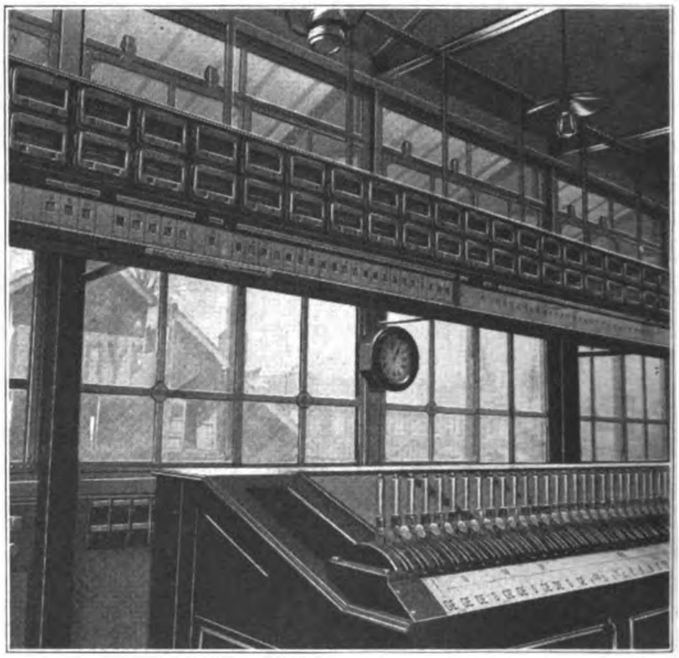

Fig. 2—"S S" Relays and Indicators Over Machine

In route-lever working the switches and signals are not operated one after the other by means of separate

*Including a section on the Northern Railway, which will be described in a future article.

[1]The Astor Company has installed the plants in France: the International M. D. M. Company holds the rights for other countries.

[2]M. D. M. signifies "maximum de manoeuvres" and "minimum de mouvements": it also represents the initials of the inventors' names.

levers in the machine but are operated in groups, according to the particular traffic movement concerned, by one lever only, as a rule, the levers in the machine being allocated to definite movements. Each lever can govern two conflicting movements, being thrown on one side or the other of a central position, like the signal-levers in the Union electro-pneumatic machine, and

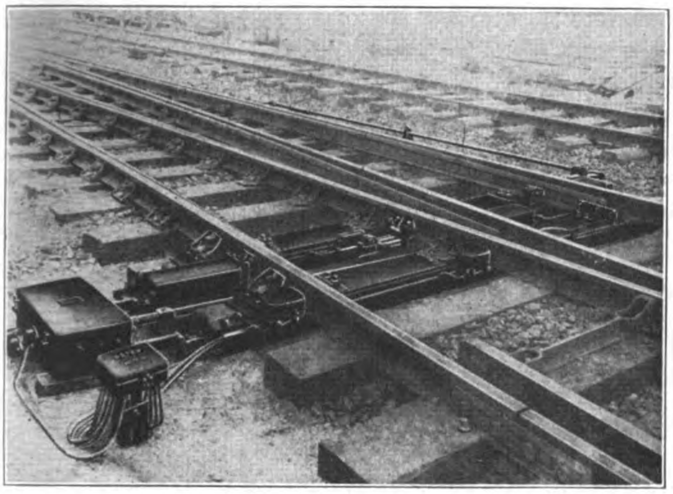

Fig. 4—Switch Motor for Slip Switch

causing the whole of the switches for a given movement to take up the required positions simultaneously. The operator is therefore primarily concerned with the train moves and has simply to consider those without having to follow out a series of operations as shown on the ordinary manipulation chart in the individual lever system. The result is that a smaller machine may be used and the setting up of routes is carried out very quickly —in most cases almost instantaneously.[4] The mechanical locking required is considerably reduced and is extremely simple. In some route-lever systems the selection of the switches in the machine is accomplished electrically, in others, as in the M. D. M. system, mechanically.

Operation of the M. D. M. Interlocking Machine

The M. D. M. machine is illustrated in Fig. 2. The levers are placed in one row with a track plan immediately behind on the sloping top of the machine, the levers standing normally in a vertical position. Pushing a lever authorizes one move and pulling it another; generally speaking opposing movements on one route are controlled by the one lever. The signals are not cleared until the lever reaches the last part of the stroke, the first part of the movement causing all the switches to take up the required positions in the particular route concerned.

Each lever by a rack-motion and bevel wheels actuates a horizontal shaft passing across the machine from back to front and this in turn operates vertical shafts at the back controlling the signal circuits. These horizontal shafts are in pairs, one above the other and their purpose is to select the switches for each route.

The circuit controllers governing the switch-mechanism circuits, worked in the separate lever method by the switch levers, are, in this system, operated by horizontal slide-bars running lengthwise in the machine like the locking-bars in the S. & F. improved locking; they really consist of a kind of framework (see Fig. 3) with openings through which pass the horizontal shafts above mentioned. By sliding a bar back and forth the switch it governs will pass from normal to reverse and back. To set up all the switches in a given route it is only necessary to shift all the slide-bars involved at once and this is what occurs when a lever is moved by the leverman.

To effect this the horizontal shafts are fitted with cams fixed at suitable points so as to come into engagement with the slide-bars and either move them or hold them fast as the case may be. This is seen diagrammatically in Fig. 3.

Thus, in addition to selecting and operating the switches the cams and slide-bars effect the mechanical locking which reduces itself to a simple question of confliction or non-confliction of routes, special locking being eliminated. In some cases, as where two routes intersect without any actual connection existing, a dummy slide-bar, having no electrical function, is used to effect the mechanical locking. As a rule, in order to eliminate unnecessary expenditure of energy, the switches remain in the positions which they take up for a given movement, after that movement is finished, but when essential, as in the case of derails or safety switches, the replacement of the route-lever to its normal position returns these switches to a normal position. Owing to this, the expressions "normal" and "reverse" are not used, "left" and "right" being employed

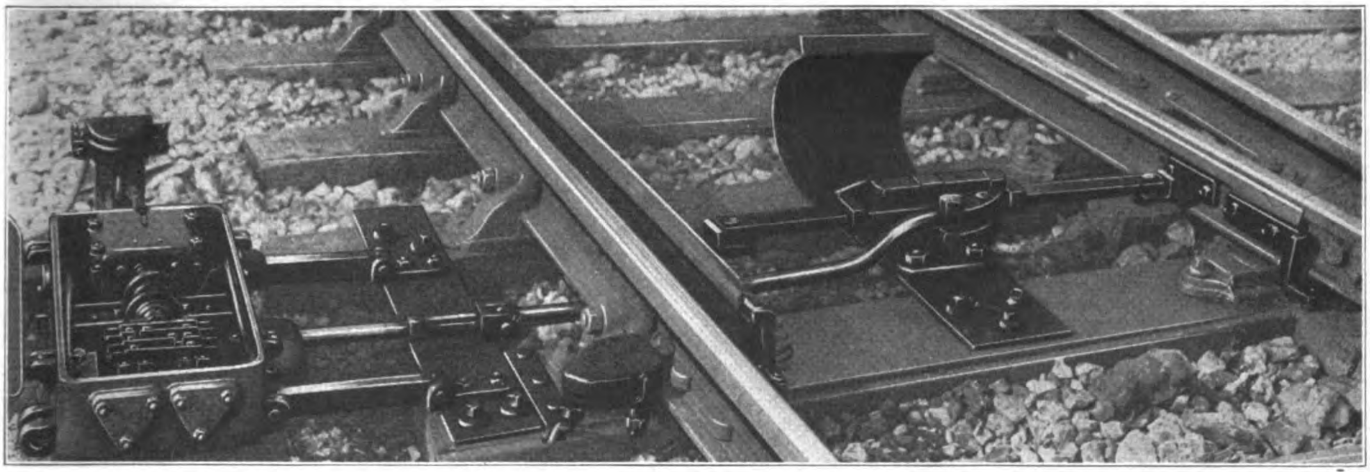

Fig. 5—Switch Machine and Switch and Lock Movement

[3]See "Railway Signaling," September, 1923, for an explanation of the French Signaling Code.

[4]At the No. 2 Tower, Aulnoye, (60 route-levers, 47 switches, 29 signals) an average of 5,500 switch and signal movements in 24 hours, is accomplished by 2,000 route-lever operations. There is only one operator per eight-hour trick.

instead, as more suitable to the practice just mentioned, when referring to the position of switches.

Operation of Route-Lever

A route-lever can be operated in one stroke, as far as the operator is concerned, or be divided into moves as he may require, indication locking not being employed, as ordinarily understood in electric plants. The sequence of movements is as follows:

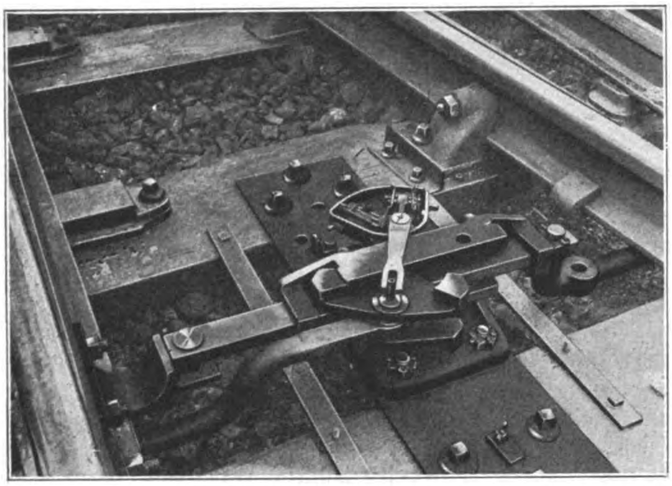

Fig. 6—Switch and Lock Movement, Non-Trailable Type

1. Operation of mechanical locking. Simultaneous setting of all switches in the route or those necessary for its protection. Electrical verification that this has taken place properly.
2. Clearing of the home signal or switching signal, as the case may be, and, if necessary, of the direction indicators.
3. Clearing, if required, of the distant signal.

As explained the route-lever can be pulled over far enough to make a part only of these movements or all of them as the operator wishes. In replacing the lever the movements occur in the reverse order except that here a kind of indication lock is employed which prevents the complete return of the route-lever to its normal position unless the signals concerned return fully to the "stop" position. This lock is utilized also for electric route locking. As absolute stop signals (red and white checker boards) in France are fitted with torpedo-placers as far as possible, it is necessary to remove the torpedoes from the rail when a movement is authorized past a signal in the reverse direction, such as running into a terminal track past the out-going starting signal. This action takes place in the M. D. M. system during the first part of the stroke of the route-lever.

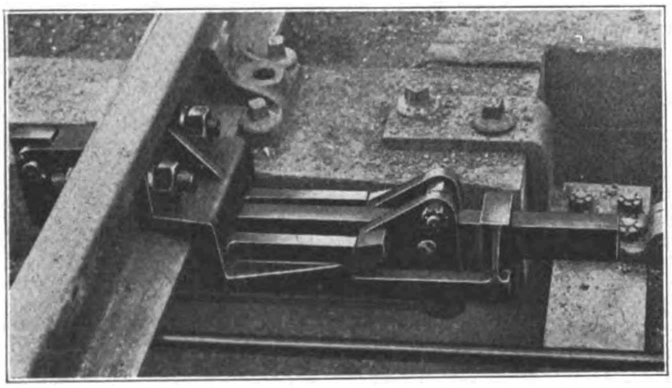

Fig. 7—Switch Lock, Trailable Type

Independent Switch and Signal Operation

In addition to the route-levers the machine may be provided with special levers or handles for certain purposes such as the control of the outer home (Red Disc) signals which are not interlocked in France, as a rule, but slotted; also for the operation of isolated switches which do not come into the route scheme. Block semaphores, which are independent of the ordinary interlocking signals on most French roads, may also be controlled in this way. To operate those switches controlled by the route-levers independently in an emergency, it is only necessary to open the end panels of the machine and push the slide-bars to and fro, which can only be done under the full control of the mechanical locking. Therefore a wrong combination cannot be set up in this way.

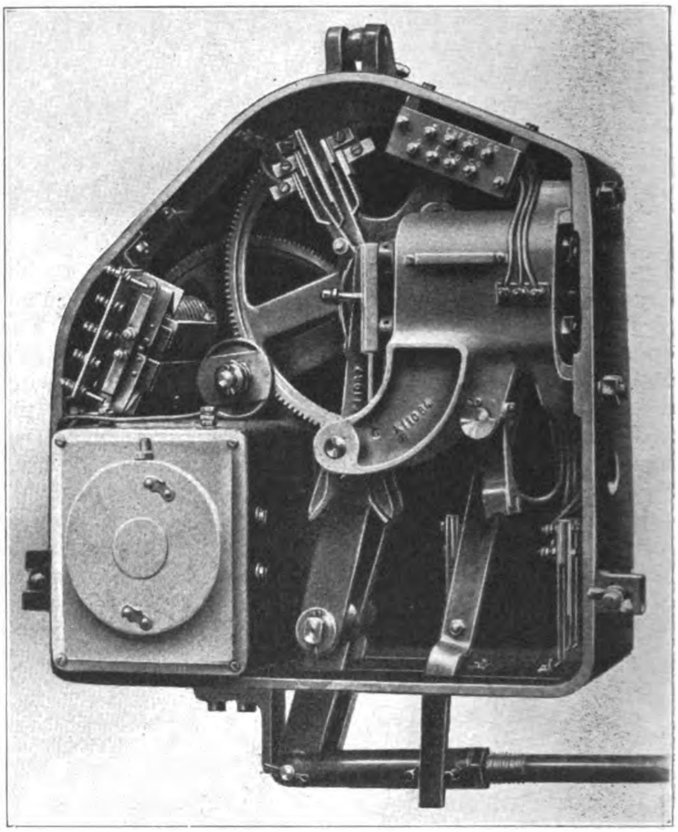

Fig. 8—Signal Motor and Mechanism

Control over Switch-Movements and Signals

Indication locking is used only to check the return of signals to the stop position. The switches are all repeated in the tower by detector relays, substantially on the SS principle, registering continually the correspondence between the position of the switches and their control in the machine. Continuous detection is thus given resulting in the automatic replacement of signals to "stop" in case of disturbance of the switches after a route has been given and preventing the clearing of signals unless a route is correctly lined up. While switches are in motion or not, in accordance with the position they are intended to be in—that is with the controlling route-lever or levers—an audible alarm sounds, consisting of a bell or hooter. The operator's attention is thus drawn at once to any irregularity and as each relay carries an indicating card showing its condition the switch at fault can be localized immediately. These detector relays can be seen in Fig. 2.

The exact position of every signal is repeated in the tower by indicators (also seen in Fig. 2) having three signs, "Signal On," "Signal Off" and "Wrong"—that is, signal in a doubtful position or not in accordance with the machine combination set up at the moment. The control circuit also checks the correct operation of the torpedo-placers. Similar indicators are used to govern the check-lock movements between towers, stationmaster's control working, etc.; as required.

Switch Operation

The switch motor, seen in Fig. 4, throws the switches in about one second, on a 110-volt circuit. It can be

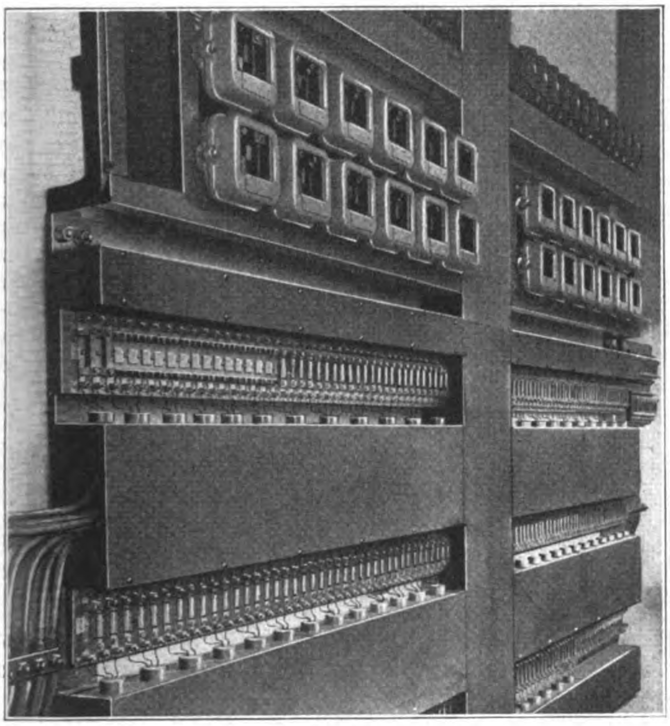

Fig. 9—Wire Terminals and Lead-out in Base of Tower

made trailable or not, and when trailable it allows the switches to remain where they are put by a car coming from the wrong direction and does not merely take up the movement on a spring, a method which, although used in some systems, does not constitute a truly trailable switch, but may actually be a source of danger.

Trailable switches are used a great deal on the Continent and are very useful in busy yards: a "run-through" does not cause a block, perhaps at a critical moment, nor does it damage anything. It does, however set or hold any conflicting signals at "stop" and sound the tower alarm, which can be silenced only by re-establishing the agreement between the switch and the levers in the machine. Four wires, not including common, connect each switch with the tower and provide complete control and constant detection. All wires not in use are held connected to common at one and sometimes both ends. The detection of the position of each switch point is made directly at the end of the blades by individual circuit closers as may be seen in Fig. 5. Facing switch locks are of two types. That shown in Fig. 6 is a switch-and-lock mechanism operating in three moves, as is usual in American practice. This pattern is not trailable. The second type shown in Fig. 7 (and in Fig. 4) applied directly at the point of the blades is trailable and its action is somewhat like the Büssing hook-lock used in Belgium and Germany. It can also be arranged as a non-trailable lock. In either type an irregularity cannot occur unless there are two breakages in the connections at once. The employment of the special type of detector (also seen in Fig. 4) is interesting, for besides being very compact it eliminates rod connections across the tracks.

Signal Operation

Signals are operated by the motor shown in Fig 8. As is often the case in Continental practice, the signal mechanism is equipped with slot coils and with a return to danger winding. The signal can thus be forced to the "stop" position from the tower or slot-released by track-circuit or switches being run through, etc., as desired. When a torpedo-placer is fitted a slot is provided for this purpose, acting on another circuit so that the automatic return of the signal to "stop" by a passing train entering the track-circuit ahead will not replace the torpedoes under the wheels but hold them clear till the last vehicle is past. A track replaced signal must be cleared again by the operator himself on the stick-circuit principle. This second slot is utilized by itself in clearing the torpedoes for a setting back movement. In the case of several signals on one mast, such as direction indicators, one motor only, equipped with a number of slots, is employed, the slots selecting the required blade. These "selector" slots are fixed outside on the mast.

The motor is applicable to a semaphore or to the disc

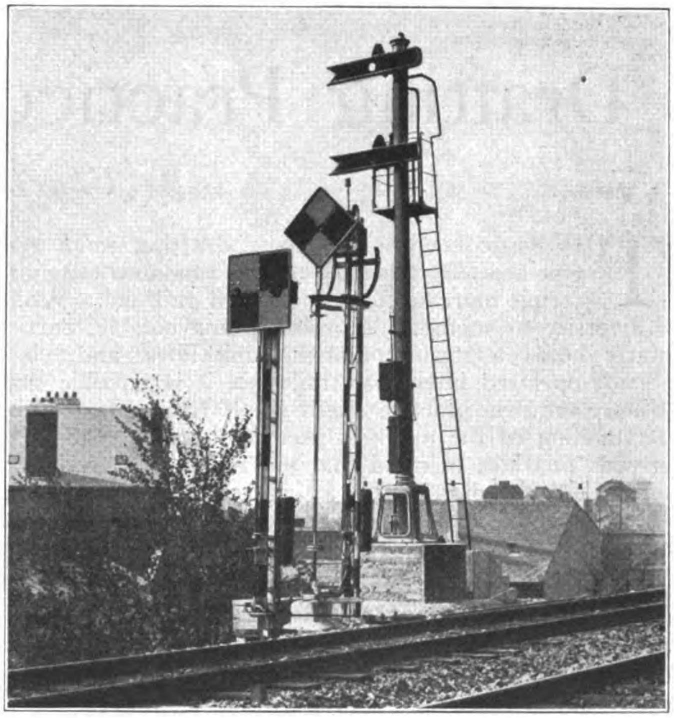

Fig. 10—Stop Signal, Distant Signal and Direction Indicator

type signal with vertical axis used for interlockings in France, and is used as a low-voltage mechanism for primary battery as well as with power-interlocking. The signal circuits which have to be controlled, according to the route called for, over the switch detection relays, are governed by the vertical barrel controllers in the view of the machine. In French practice, where one interlocking signal reads for any number of routes, this selection is comparatively simple. There is, however, no difficulty in adapting the system to the practice of other countries.

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