

Block Signaling Practice on a British Railway

The Electrical Equipment Used in a Signal Tower on the Midland. First of a Series of Three Articles

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DURING the five years preceding 1914 the growth of the electrical equipment in Midland towers was continuous. This growth was brought about by the installation of track circuiting and the replacement of the ordinary block by the rotary interlocking block. Since 1914, war conditions have greatly retarded this growth. As the traffic working conditions and requirements which rendered track circuit and interlocking block necessary still exist, and as far as can be seen at the present time will exist after the war conditions are ended, it may be assumed that when this period arrives the installation of track circuiting and interlocking block will proceed as before. One very desirable and possibly the most important result of such installations is the abolition of the much discussed Rule 55* of the General Rules and Regulations.

The electrical equipment of a Midland tower may be divided as follows, the items being arranged in the order of relative importance:

- (1) The block system.
- (2) Track circuiting.
- (3) Signal repeaters. Signal light indicators. Train waiting apparatus. Tunnel alarms. Electrically controlled ground frames. Fouling bars.
- (4) Telephonic and telegraphic communication.
- (5) Semi-automatic signaling. Electrically operated switches and signals. Locomotive cab signaling. All installations under the headings in this item may, with the exception of electrically operated banner signals and distant signals operated by electric signal machines, be considered as experimental installations, and are not at present adopted as standard methods.

The tower apparatus in connection with Items 1, 2, 3 is fixed on a shelf immediately over the levers of the mechanical interlocking lever frame, convenient for manipulation by the signalman.

The general arrangement for a tower controlling one Up and one Down Line is shown in the illustration. At junctions, or in towers controlling more than two lines, the number of block instruments is increased in accordance with the number of lines. The maximum number of block instruments in use in one tower is 12.

The Block System

The object of the system of block telegraph signaling is to prevent more than one train being in the section between two block towers on the same line at the same time. The towers at which block telegraph working are in operation are furnished with instruments to signal for

*Rule 55—(a) In case of detention at a home, starting or advanced starting signal, the engine driver must immediately sound his whistle and, if still detained, the brakeman, switchman or fireman must—except where instructions are given to the contrary or where the lock-and-block system of train signaling is in operation—go into the tower and remind the signalman of the position of the train and remain there until the signalman can give permission for the train to go forward. In foggy weather or falling snow the brakeman, switchman or fireman must, immediately upon the train coming to a stand, proceed to the tower.

(b) When a train or cars has passed a home signal and are waiting to be crossed to another line or to be let into a siding, or have been switched on to the opposite running line or placed on either a main or branch line at a junction, or when a train or cars has been shunted from a siding on to a running line and are waiting to be crossed to another line, the brakeman, switchman or fireman must, when the train or cars come to a stand, proceed immediately to the tower and remind the signalman of the position of the train or cars and remain in the tower until the signalman can give permission for them to proceed or to be switched clear of the running lines.

each line of rails. Rather more than 75 per cent of the block sections on the Midland Railway are worked by ordinary block; that is, block apparatus which is not in any way interlocked with the semaphore signals.

The ordinary block instruments are as shown in the illustration (instrument D). Each section is provided with two needle instruments, one at each end of the section. The instruments are similar except that the instrument at the outgoing end of the section is provided with a trigger bolt in order that the commutator handle may be locked in either the "Line Clear" or the "Train on Line" position. In addition to the needle instrument, a single stroke bell is provided. This bell is used for signaling both Up and Down Lines; that is, one bell is common to two sets of needle instruments.

The working parts of the instruments are as simple and as efficient as possible. The experience of the 50 years during which this type of instrument has been in use has eliminated the weak portions and left an instrument which mechanically and electrically is very efficient for its own particular purpose. The lower portion of the needle instrument consists of a commutator which reverses the line current in accordance with the position

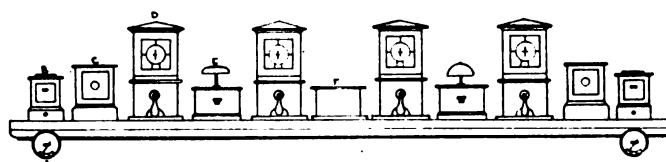


Fig. (1)
GENERAL ARRANGEMENT OF APPARATUS

A. SIGNAL REPEATER
B. SIGNAL LIGHT INDICATOR
C. TRACK CIRCUIT INDICATOR
D. BLOCK INSTRUMENT
E. BLOCK BELL
F. BLOCK SWITCH

General Arrangement of Tower Apparatus

of the drop handle. The upper portion contains the block indicator, the only special feature being the induced polarized needle. The single stroke bell consists of a key to send the signals and an electro-magnet, the armature giving one stroke on the bell each time the key at the distant end is depressed. The electrical energy required for operating purposes is very small, the working current of the block instrument is 6 milliamperes. The bell requires 150 milliamperes, but as the normal rate is two beats per second, the total current consumption is even less than that of the block instrument.

On Sunday the amount of traffic falls to about one-third of the week-day traffic, and the length of the block section may then be extended without causing any delay to traffic. This extension is effected by means of the block switch shown in the center of the shelf Fig. (1). This is a multiple switch with all the block apparatus lines being carried through the respective contacts. When the switch is in the "Open" position, all connections are normal, and all apparatus is in circuit as though this switch was non-existent. On closing the tower the switch is moved to the "Closed" position, switching the block apparatus out of circuit, and connecting the respective lines straight through on either side of the tower. The tower should only be closed or opened when the sections

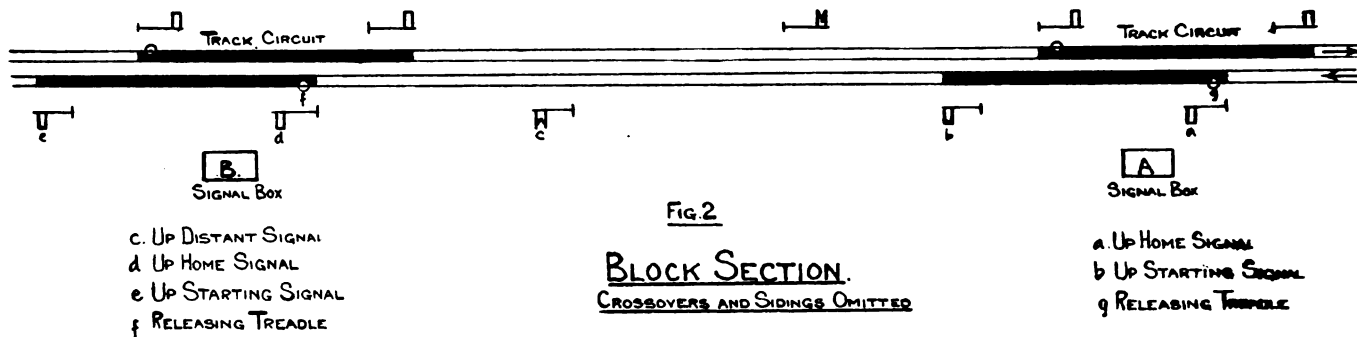
on either side are unoccupied. The switch is provided with an "Intermediate" position, in which the block apparatus is inserted in the lines, still leaving the two sections connected. This enables the signalman to ascertain the conditions in the long section before opening the tower.

INTERLOCKING BLOCK

The operation of the ordinary block has given good results, but the successful working depends entirely on the signalmen working strictly to the block telegraph

allowing the train to proceed. Thus a train can only enter the section with the permission of Signalman B.

Signalman A then gives the "Train Entering Section" signal and Signalman B moves the block handle to "Train on Line" and pulls clear home signal (d). A contact on the signal lever brings the releasing treadle contact (f) into circuit. This treadle is fixed to and under the running rail about 10 yards inside the home signal (d). The train passing over the treadle will close the circuit through the "Train on Line" lock, releasing this and



Block Section Showing Track Circuits, the Location of the Signals and the Releasing Treadle

regulations. Although the results reflect great credit on the signalmen, it was realized that the better course is to interlock the block apparatus with the outdoor semaphore signals.

The interlocking block in use on the Midland Railway is known as the rotary interlocking block. Its function is to attain all that is attained by the ordinary block, and in addition to compel the signalmen to carry out the operations in proper sequence and also to prevent the repetition of any operation until after the sequence is completed and another sequence commenced.

The outward appearance of the rotary interlocking block instrument is similar to the ordinary block, but at the outgoing end of the section the drop handle operating a commutator is replaced by a handle which can only be turned in a clockwise direction. Two electric locks are fitted on the commutator, one to lock the handle in the "Train on Line" position, and one in connection

allowing Signalman B to move the block handle to the vertical or "Line Blocked" position ready to accept a following train.

The arrangements for compelling the signalman to carry out the operations in proper sequence, and also to restore signals to the danger position are as follows:

The mechanical lever locking frame is fitted with rotation locking which provides that the home signal (a) pulled and replaced becomes locked until the starting signal (b) has been pulled over and replaced. The electric lock on the starting signal (b) is provided with a mechanical catch which comes into operation when the lever is put back, and locks the lever even when the "Line Clear" increment current is holding out the electric lock, thereby preventing two lever pulls during one "Line Clear" permission. When "Train on Line" is given on the block the current falls to a value which is sufficient to operate the block indicator, but is 20 per

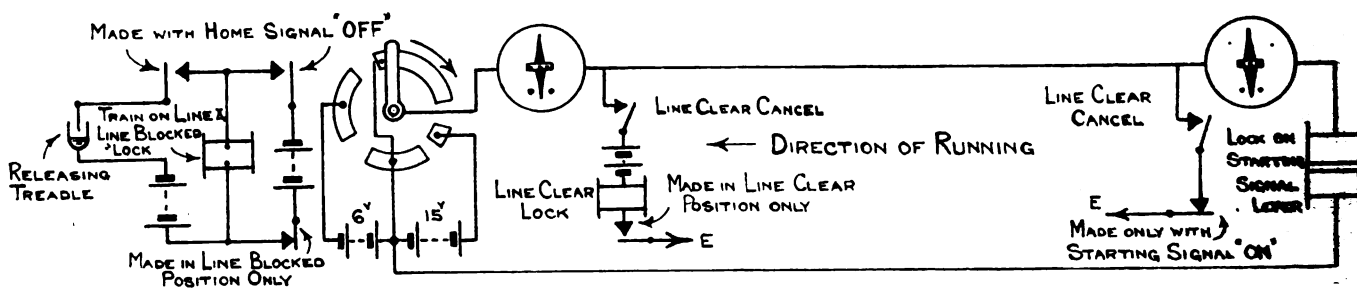


FIG. 3.

The Circuit Diagram for the Operation of the Block Instruments

with the "Line Clear Cancel." The bell is similar to the bell in connection with the ordinary block.

The functions of the various pieces of apparatus will be seen by following the operations in connection with a train proceeding from tower A to tower B (Fig. 2).

Signalman A will ask "Is Line Clear" by means of the bell. If Signalman B is ready to accept the train, he repeats this signal and moves the block handle to "Line Clear." This puts both block indicators to "Line Clear" and also brings the increment battery into circuit. The current is now sufficient to lift the lock on the starting signal (b) and Signalman A pulls this signal clear, thus

cent under the value required to hold up the lock bolt. This bolt then falls, and the mechanical catch moves to the normal or inoperative position. In the block instrument at tower B, the "Train on Line" lock is fitted with an additional catch which locks the block instrument handle in the vertical or "Line Blocked" position until home signal lever (d) is put back to normal position.

CANCELLING

Cancelling keys are provided, one at each end of the section for cancelling "Line Clear," and one at the outgoing end of the section for cancelling "Train on Line." Although this is the weak spot in connection with the

interlocking block, it does not under present working conditions appear possible to abolish these keys.

Assuming that Signalman B has accepted a train and has placed his block instrument to "Line Clear." When the train arrives at A it may be found that the train has to stop to detach cars, or for some other purpose. In this case, provided that Signalman A has restored his starting signal to the normal position, Signalman B can, with the co-operation of Signalman A, cancel the "Line Clear." This is carried out by each signalman simultaneously pressing the "Line Clear" cancel button. This action electrically lifts the ratchet pawl in the block instrument, and Signalman B can turn the block handle back to the normal position.

The operation of the "Train on Line" cancel is a more serious matter, and may be rendered necessary as above, or on account of the treadle having failed to release the block instrument by the passage of the train out of the section. In this case the "Cancel" is entirely in the hands of Signalman B. The "Train on Line" cancel button is covered by a glass fitted in the sealed front, and it is necessary for the signalman to break the glass before he can operate the cancel and turn the block instrument forward to the normal position. This forms a record of the use of the cancel, and after such use the glass is replaced, and re-sealed by the lineman. The action of the "Train on Line" cancel is purely mechanical.

The use of the cancel key is very rare, and as a percentage of the total number of operations through the section is very small, but these rare cases are considered sufficient to justify the retention of the keys.

REVERSIBLE WORKING

In order to assist in clearing a terminal station it is advantageous to be able to use both main lines for out-going traffic. The one main line approaching St. Pancras station is so fitted. The block section is fitted with two complete sets of block instruments for this line. The switching arrangements are such as to enable the signalmen concerned to switch out the instruments for handling traffic in the normal direction and to switch in the additional block instruments for handling trains against traffic. This can only be carried out when the section is clear. After the change is made, trains moving against traffic may run on this line, and it is only possible to revert to normal working when the section is again clear.

Single Line Block

Single lines are worked on the electric tablet block system. The line is divided into block sections, and the object of the system is to prevent more than one train being in one section at the same time; also to admit of a train being started from either end of the section, and in addition to admit of a train passing through the section or returning and passing out at the end from which the train entered the section.

This is accomplished by means of tablet instruments. Two similar instruments are provided for each section, fixed one at each end of the section. Thirty tablets are supplied for each section, and the possession of a tablet is the only authority enabling an engine driver to take his train into a section. Any engine driver entering a section without the proper tablet is liable to dismissal from the Company's service. The exception is the case of a train worked by two engines. In this case the tablet must be shown to the driver of the leading engine and delivered to and carried by the rear engine.

The tablets are circular in shape, and in addition three configurations are in use. This prevents a tablet of any particular section being used in the instruments of an adjoining section. The instruments are so arranged that

a tablet may be withdrawn at either end of the section with the permission and electrical co-operation of the signalman at the other end of the section. The act of withdrawing a tablet locks both instruments, and the return of the tablet to either instrument allows both instruments to be restored to the normal position ready for the next train.

In some sections there will be a siding connection for a colliery or some other purpose. The switches admitting to such sidings are controlled by the tablet. The tablet must be placed in the switch lever frame. This unlocks the switch and the tablet can only be removed from the frame when the switch has been restored to the normal position; that is, sidings closed.

REST IN PEACE (?)

I
If we had no Manual for our needs
Or Digests with their lengthy screeds,
No standard circuits, cranks or studs,
We'd all be unexploded "duds."
If it wasn't for the R. S. A.
We'd clutter up the right o' way
With experiments and hobbies punk
And spend a million bucks for junk.

II

For this signal game's no easy graft
And grief would now engulf the craft
If every mother's son had tried
To all his skill and knowledge hide,
But R. S. A. (our worthy dad)
Collected "kinks" both good and bad,
Culled out the worst and kept the best,
Adopting those that stood the test.

III

Since way back there in ninety-five,
He gathered *hombres* who were *live*.
A flock of green and vernal rubes,
Strong and husky untrained boobs,
Some brains mixed in; yes, quite a lot
And poured all in the melting pot.
The alloy of this motley clan
Produced the present signal man.

IV

In spite of all the good he's done
It looks as if his race was run,
It seems at times there's no escape,
We must go out and order crepe.
We're told, a "step-dad" (A. R. A.)
Has moved right in, prepared to stay.
In line "us orphans" then must stand
And jump sidewise at each command.

V

If our *real Pater* is laid out,
Let us romp in and stand about
And shed a salty, briny tear,
As we gang around his somber bier.
Go tell the bunch; let each one make
An effort to attend the wake,
For in the future, life will be
Dry (two ways) for you and me.

VI

Our step-dad will feed us hash galore
On handling scrap down at the store,
He'll teach us how to ballast track,
And high explosives—how to pack.
We'll read of weights, airbrakes and claims
'Till our mind gets like a pair of hames,
And warped and bent we'll lose our grip,
Our interest and our membership.