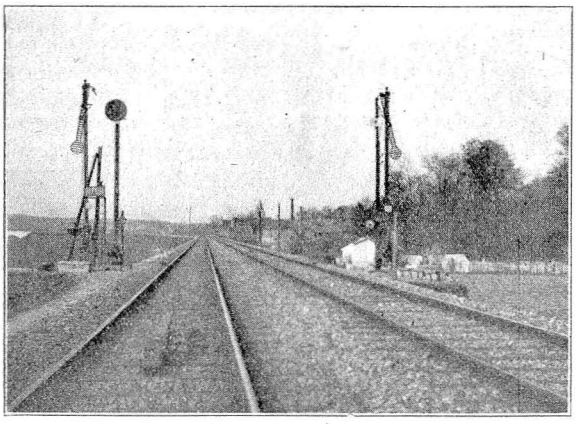

*Red Disc Signal With Contact Ramp Between Rails.*

# Automatics on Paris Grande Ceinture

## General Types of French Signals Compared with New Automatics

*By T. S. Lascelles, London, England*

ABOUT a year ago the Grande Ceinture Railway of Paris, which encircles the city outside the fortifications, introduced automatic signaling on a section of 44 miles double track, including 273 signals, and Monsieur Bernard, traffic superintendent, published an account of the installation in the "Revue Générale Des Chemins De Fer." He has been good enough to allow the writer to make use of it and certain other information for this article. Before proceeding to the subject, it may perhaps be best to make a few preliminary remarks upon French signaling generally.

### General Types of French Signals

The interlocking signals in France are, almost without exception, of the disc pattern, in which the signal is practically invisible when in the clear position, being turned on a vertical axis so as to present its edge to the engineman. Semaphores are used only as block signals or on the Paris-Lyon-Mediterranean road, as home interlocking signals at small stations. The disc signals are always placed either on the left-hand side of the track to which they refer, or are brought above that track a little to the left of the center line. The engineman's cab on locomotives built since 1900 is invariably on the left-hand side, a good practice which ought to be universally adopted in England too, whereas in France left-hand running is standard practice. All French signals, whether discs or semaphores, show white lights for clear and this must be regarded as a weak point.

A diagram of the principal signals is shown in Fig. 1 and may be explained as follows:

A.—Red and white checkerboard, showing two red lights side by side. This is an absolute stop signal and must not be passed at danger without written authority. It is frequently fitted with a torpedo-placer.

B.—Yellow square or disc showing one yellow light. Substitute for signal A on locomotive and industry tracks. Absolute stop signal like A.

C.—Red disc, showing one red light. This is a rather peculiar signal resembling nothing in English or American practice. When it is at danger the engineman must reduce speed to a walking pace and be prepared to stop within range of vision and, in any case, must come to a stand at the signal-tower working the signal, regardless of other signals being found at clear. He must stop clear of the first fouling-point and only proceed on the signalman's or conductor's instructions. It is followed at a suitable distance by a sign-post marked "Limite de protection du Disque," or "du Signal avancé," and a train, within this post may consider itself sufficiently protected by the red disc, which is nearly always placed to danger automatically by a mechanical device known as the "Aubine Treadle." This signal is not used on the Orleans Railway.

D.—Green and white checkerboard, showing two green lights side by side or placed vertically. This signal is merely a repeater of an A type signal further on or of a block semaphore. It is mounted cornerwise, with vertically arranged lights, if fixed at less than 3,280 ft. from the signal it repeats. On the Northern Railway and sometimes elsewhere it is a transparency illuminated from behind at night.

E.—Green disc, showing one green light. Employed at junctions to indicate reduction of speed. When the engineman can continue through the junction without reducing speed the disc is cleared and a white light given. It is placed at some distance in the rear of the junction, after the red disc, where that is used.

F.—Block signal, showing red light beside green light. The arm is made of open lattice work and falls into the post at clear. The small yellow arm has no meaning for the engineman and will be described later. On the P. L. M. line the arm is solid and resembles an American semaphore and there is then no small yellow arm.

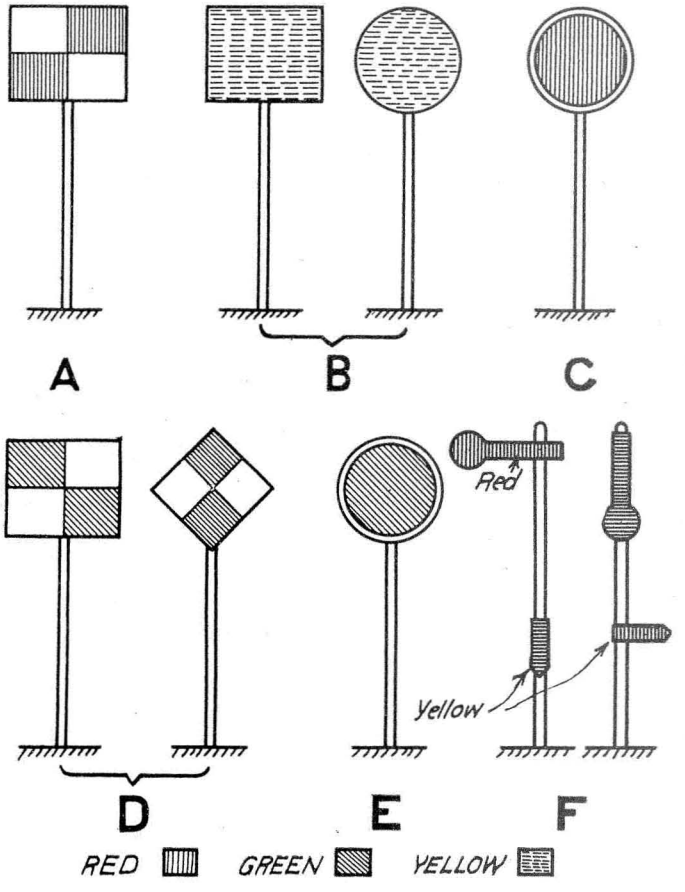


**Fig. 1—French Signal Types**

### Junction Signals

Only one A type interlocking signal is used at a facing junction, regardless of the number of routes. The direction is given by indicators, as shown in Fig. 2. The clear track is, in the two-way indicator, on the same side as the white light appears. For more than two routes, the arms read downwards and apply from left to right. The approach to the junction is shown by one of the illuminated signs illustrated in Fig. 3, where the State Rail-

ways speed signal is shown also; when the sign V. D. O. appears ("voie directe overte") it signifies that speed may be maintained, and thus resembles the green disc signal E. To English or American eyes this code seems unnecessarily complicated. It will be understood that certain slight variations occur, as between the different railways, in the rules governing the use of these signals.

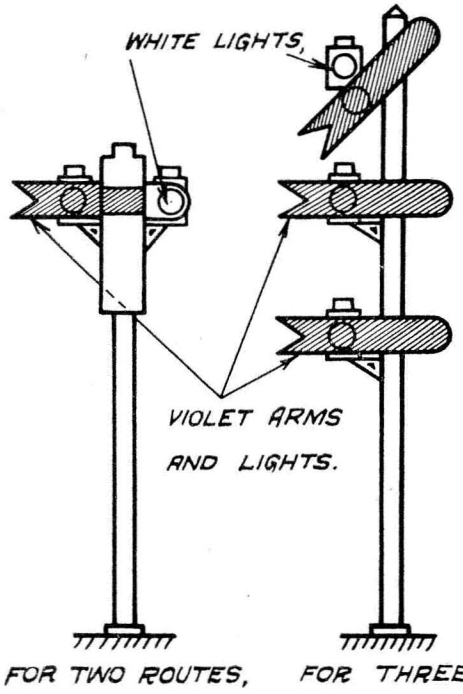


Fig. 2—Route Indicators

### Lartigue Block System

Block signaling is in general use in France on all the principal lines. On the Grande Ceinture the traffic on the busiest section, between the stations of Stains-Pierrefitte and Noisy-le-Sec, has been for the last 20 years worked by the Lartigue electro-semaphore block, which is also employed to a great extent by the Northern, Eastern and Orleans railways. It was introduced in 1875 or 1876, and appears to have been used for the first time on the Northern Railway main line from Paris to Creil.

Figure 4 is a diagram explaining the principles of double-track working of the Lartigue System, with three block-stations, A, B, and C. An electro-semaphore is placed at each block, generally preceded by a red disc-signal R. When the train enters the block AB, the towerman at A places his semaphore to danger, which act causes the minature arm x to appear at B, a bell ringing there also at the same moment. Towerman A cannot now alter the arm of his own semaphore. The train on passing the red disc of block-station B places it to danger by means of the Aubine treadle "t." When the train clears B, the towerman at B first places his semaphore S2 to danger, causing the miniature arm y to appear at C, and then conceals his own miniature arm x, which unlocks the semaphore S1 at A, allowing it to fall to the clear position, and so on. A red disc cannot be cleared until its relative semaphore is clear. It will be seen that while an operator places his own signal to danger, the next operator clears it. In consequence of this a semaphore must not be used to stop a train from any other cause than an occupied block. If necessary to stop a train before a clear block the red risc must be kept at danger; this, as explained,

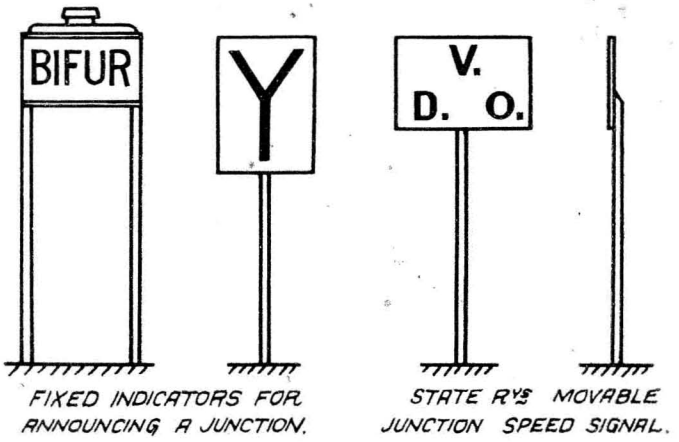


Fig. 3—Junction Approach Indicators

obliges the driver to stop at the block station, regardless of the semaphore. Where no red disc exists, as on the Orleans Railway, hand-signals must be used or, if there be one, a red and white checkerboard signal must be placed at danger. As a rule the semaphores for each direction are mounted like train-order signals, but this practice has been given up now.

### Ceinture Railway Automatic Block

In adopting the automatic block system the Ceinture Railway decided to adhere to the same general arrangement of signals used with the Lartigue system, and to employ a semaphore of the same appearance; Fig. 5 illustrates the scheme adopted.

Each block is governed by a semaphore which is preceded by a red disc; this is followed at the regulation distance by the protection post "pl" before mentioned. The signals are normally in the clear position. Thus semaphore S1 is clear as block x is clear, but S2 is held by the train in block Y and therefore disc R2 is also held. The discs go to danger when passed by a train exactly as the semaphores. With short blocks, the average length is 1.25 miles; the red disc of one block is placed just after the semaphore of the preceding block, as seen in Fig. 6. About 32.7 ft. in the rear of the semaphore a loud-sounding bell is provided which rings all the time the red disc in the rear is at danger. By this means the conductor is able to know if his train is properly protected while waiting at the semaphore. If the bell does not ring a flagman must be sent back at once. In Fig. 7, this bell can be seen on the left and the semaphore ahead of it in the clear position.

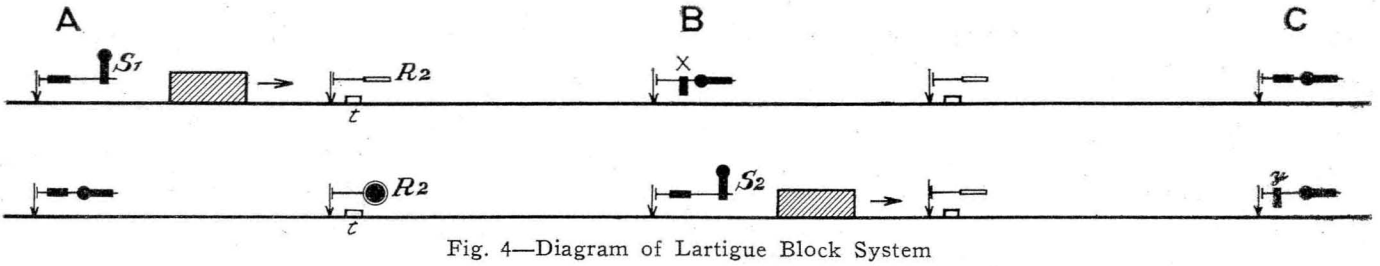


Fig. 4—Diagram of Lartigue Block System

Track circuit is carried through all interlockings in the automatic area with control on all the signals. A simple case is given in Fig. 8. The entrance to the station or interlocking is controlled by the red and white signal C, followed by a green and white repeater D

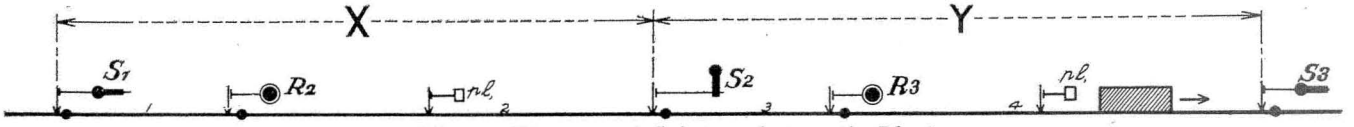


Fig. 5—Diagram of Ceinture Automatic Block

relating to the semaphore S2. A red disc R2 exists as usual and cannot be placed at clear unless the track up to S2 is clear and both S2 and C are in the clear position. When signal C operates semi-automatically two effective blocks exist, X and Y, and S1 can clear when X is clear. When, however, C is worked manually only, X and Y form one block while the tower E is closed or if C is not

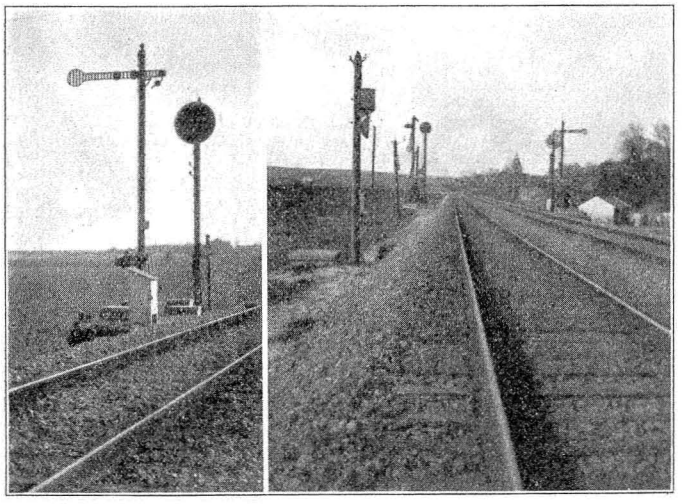

Fig. 6—Semaphore and Disc Signals. Fig. 7—Semaphore and Disc and Bell

replaced to danger. The act of replacing C to danger sub-divides the block, and its lever remains locked while Y is occupied. The track circuits are, of course, indicated in the tower. These principles are carried out at all interlockings. Where necessary, mechanical signals are fitted with electric slots.

## Control Circuits

The track-circuits are of the battery type, energized by gravity cells, while Leclanche batteries are employed for the line-circuits. Figure 9 is a view of the signal mechanism, which is of the slot type, while in Fig. 10 a relay box is shown. The signal controls are interesting as they involve the principle of proving the return to danger of each block signal. In Fig. 11 this is illustrated.

alternatively, d and e are energized. Thus before S1 can clear behind a train, not only must block x be clear but S2 must go to danger and close contact t, as a rule; but should S2 stick clear S1 can clear when relay e picks up, proving S3 has gone to danger and block Y clear. Thus a signal failing to go to danger simply results in extending the block to the next signal working properly. This is a safety feature of great value. Line relays are used to control the motor circuits of the signal mechanisms, but the slot coils are connected directly to the line in parallel with these relays, a somewhat unusual feature. All block signals and home interlocking signals are equipped with torpedo apparatus designed to cause an explosion if a stop signal be passed when at danger.

Instead of torpedoes, shot-gun cartridges are used, exploded by the fall of a hammer released by the de-

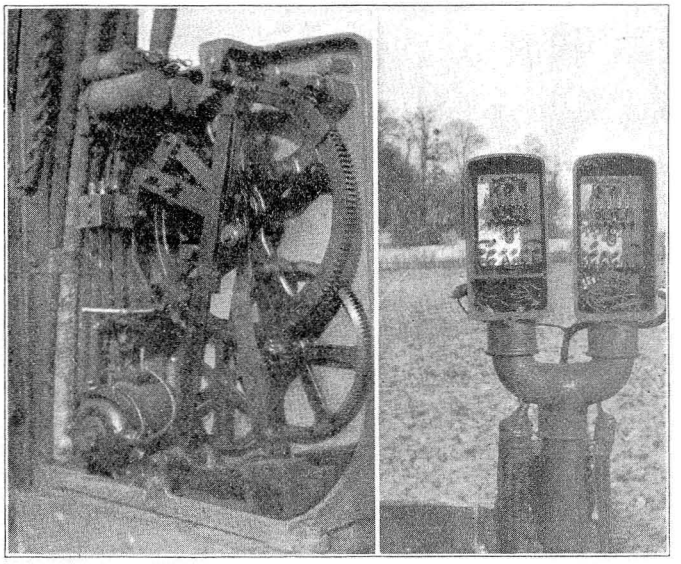

Fig. 9—Signal Mechanism, and Fig. 10—Relay Case.

energization of an electro-magnet. Two cartridges and hammers are provided at each signal: only one cartridge is exploded at one time.

## Working of Audible Alarm Signal

As explained, great numbers of signals in France are fitted with mechanical torpedo placers which maintain torpedoes on the rail when stop is indicated, principally in connection with the red and white checkerboards. Such a simple arrangement is not suited to automatic

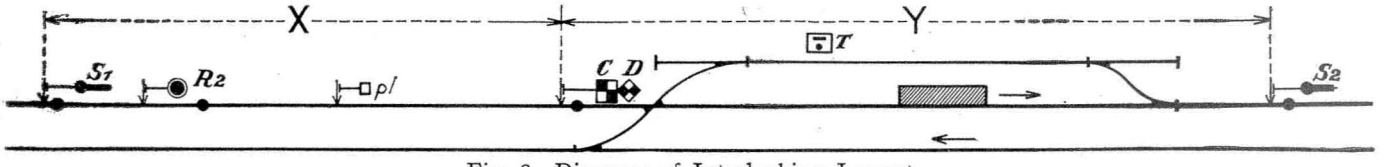


Fig. 8—Diagram of Interlocking Layout

A short track-circuit, 97.4 ft. long, is provided (see A and D) immediately after the signal, the purpose of which will be seen later. Track relay b governing control circuit x of signal S1 cannot be energized unless c is energized and this cannot occur unless d is energized and contact t on semaphore S2 at danger is made or, block working because if a train has to proceed past an automatic signal at danger, under the "Stop, then Proceed" rule either the torpedoes are exploded or the conductor must remove them before the train enters the block. In each case the signal is left without torpedoes against a following train, which is unsatisfactory. Ac-

cordingly in the Ceinture installation an audible signal device has been designed which is controlled by the circuits given in Fig. 12.

The hammers (of which there are two in this case) which explode the cartridges are normally held up by electro-magnet E, constantly energized by the battery. The short track circuit A really governs the working of the device. Should a train pass onto track A while semaphore S is clear, current can still pass by contact y, which is closed with the signal at clear, and arm 12 of

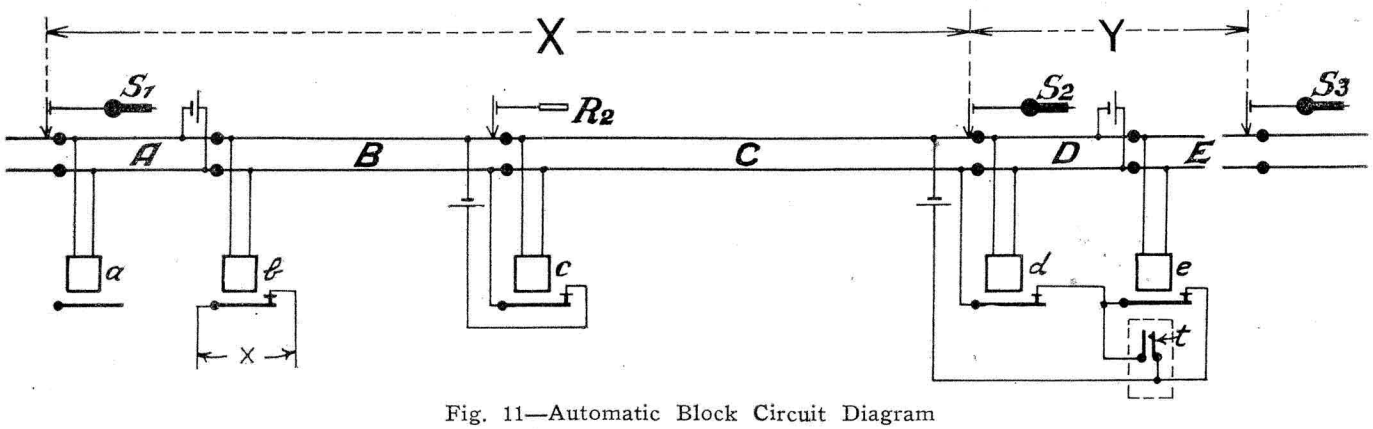


Fig. 11—Automatic Block Circuit Diagram

relay b. Back contact of arm 13, relay a, picks up stick-relay r, held on its own contact 15, and this maintains the energization of E, after track circuit B is entered and signal S going to Stop, contact y is broken. When the train is clear of the short section A, relay a picks up, de-energizes stick-relay r but by closing of contact 14 holds E energized again as before and thus no explosion is produced. Should a train over-run the stop signal and enter track A with the semaphore at danger the electro-magnet E is de-energized, because contact y being open the stick-relay does not pick up.

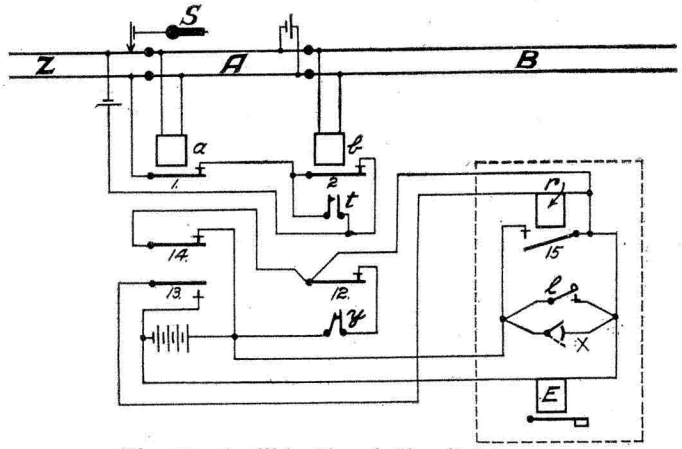


Fig. 12—Audible Signal Circuit Diagram

This first hammer is thereby released and explodes a cartridge but in so doing it closes momentarily contact x, which picks up relay r and so re-energizes E in time to stop the second hammer from falling. The clearing of track A will restore r and leave this hammer ready in case another train over-runs the signal. It is evident that the same principle could be used to control several hammers arranged to fall consecutively, but it has been considered sufficient to use two. Visual indicators enable the state of the hammers to be seen from outside the case.

When the train has to enter a block under the "Stop, then Proceed" rule the conductor must depress a push-button and so hold contact "l" closed until the locomotive has entered the 100 ft. track-circuit. This establishes the stick circuit for relay r and therefore energizes E, preventing the release of a hammer exactly as if the signal were at clear.

### Audible Cab Caution Signals

The red disc signals are equipped with a contact ramp or "crocodile" shown in heading illustration, which is energized when the signal is at stop and by means of a brush-contact on the engine releases a Hughes electro-magnet and opens a steam whistle. The whistle blows until silenced by the engineman. Although working on the open circuit principle this device, adopted in the seventies on the Northern Railway, is extensively used all over France and its operation seems to be fairly satisfactory in spite of its fundamental defect. Usually applied to the red discs it can be employed also for the green and white checkerboard repeaters and is much used in this way on the Orleans road, where red discs are not seen.

### Train Operating Rules

Generally speaking, the signification of the various signals, semaphores, red discs, checkerboards, etc., in the automatic area is similar to that on other parts of the road, but special regulations had to be issued directing trainmen how to act in the presence of an automatic block signal found at stop. The engineman is required to come to a stop as close up to the signal as possible and must wait there for 10 min. unless the signal clears before that, in which case ordinary running may be resumed. If the signal remains at stop, however, the conductor must, unless he has received information of some obstruction existing or that a train is still in the block and in no need of assistance, deliver to the engineman a written authority to proceed at slow speed, prepared to stop short of any obstruction, to the next block signal. This order must be delivered up to the operator at the next open signal-tower. In the case of a light engine, the engineman must pass the stop signal on his own responsibility, but he must make a note of the time and the number of the signal concerned, stopping to deliver this information to the next operator, as in the previous case. If information is received that there is a train in the block requiring assistance in the rear, the occupied block may be entered in this manner without waiting the 10 min. interval.

In cases where a semaphore or square stop signal is located at a signal-tower where an operator is on duty, then in no circumstances may it be passed at danger unless he issues the authority to do so, but at stations this authority is delivered to the conductor by the station-master, in accordance with the usual continental practice. Permission to proceed must not be given till 10 min.

after the previous train has passed in cases where no reason can be ascertained why the signal remains at stop. The 10 min. interval will seem a long one to Americans who are accustomed to the simple "Stop, then Proceed" rule, but on a road like the Ceinture, with numerous junctions and a varied class of traffic, a signal may quite likely be held at stop legitimately for some minutes and it would not do to assume too hastily a breakdown in the apparatus. The practice of entering an occupied block after waiting a certain time interval, as short sometimes as two minutes, is generally practiced in France with the Lartigue Block-System and, owing to the non-existence of track-circuit, gives use to peculiarly dangerous and inconsistent working of that system in the writer's opinion.

The installation of the automatic signals has given great satisfaction, since it was brought into use and in addition to accelerating the traffic and increasing the security it has also proved an economical proposition.

The cost of installation came to about $800 more per block (single-track) than would have been required for the Lartigue Manual Block, but the elimination of operators and block-stations reduced the annual cost of maintenance and wages by some $3,000 per block, single track, which throws the balance heavily in favor of the automatic system. The working is safer and more regular, there having been only about half as many failures, to the block, in the automatic signaling area compared with adjacent sections operated under the Lartigue system. Track circuiting has already met with a very good reception in France and the Grande Ceinture signals will no doubt result in further developments.

# I. C. C. Report on Sprague Train-Control Tests on N. Y. C.

JOINT observations and tests by the Bureau of Safety of the Interstate Commerce Commission and the American Railway Association have been conducted on the Sprague Safety Control and Signal Corporation's automatic train control device in the laboratory and shop of that company at New York and as installed in the electrified zone of the New York Central lines between Ossining, N. Y., and Tarrytown, N. Y. An abstract of the joint report of the inspectors of the Bureau of Safety and the A. R. A. is given as follows:

On May 12, 1921, at a joint meeting of representatives of the Interstate Commerce Commission, the American Railway Association, the New York Central, and the Sprague Safety Control and Signal Corporation, arrangements were agreed upon for conducting a test of the Sprague device upon the New York Central. The official road test began on May 1, 1922, and ended January 31, 1923. During the official test the locomotive apparatus was sealed by the Bureau of Safety. May 1 to November 20, 1922, was considered as a development period, and November 21, 1922, to January 31, 1923, was considered as a service period. This report is based upon test made during the latter period. A description of this apparatus and installation was published in the *Railway Signal Engineer* for June, 1922, page 226.

## Analysis of Tests

In recording the performance of this device the movement of the locomotive over each track magnet was counted as an operation when the device was in service. The operations were classified as first applications, second applications, and resets. The movement of the locomotive through a block was recorded as a test, each block being equipped with three magnets; there were normally three operations to each test (block).

When an application magnet in a stop condition (active) was passed and a brake application was initiated, the operation was recorded as a first application or second application, as the case may have been. If a brake application was not initiated, the operation was recorded as a false clear failure (operation).

When an application magnet in proceed condition (canceled) was passed and a brake application was not received, the performance was recorded as a clear operation. If a brake application was initiated, the operation was recorded as a safe failure (operation).

When a locomotive in the clear or proceed condition passed over a reset magnet in the proceed condition (energized) and there was no change in the locomotive condition, the performance was recorded as a clear operation.

For the purpose of this report all performance was tabulated so as to segregate the operations that occurred as track magnets from those occurring between track magnets, and also in unequipped territory. The performance of this device during official tests from November 20, 1922, to January 31, 1923, is indicated as follows:

### Equipped Territory

| | |
|---|---|
| Trips | 145 |
| Mileage | 638 |
| Tests | 725 |
| Proper operations at track magnets | 2174 |
| Safe failure at track magnets | 1 |
| False clear operation at track magnets | 1 |
| Unsatisfactory operations at track magnets | 1 |
| Proper high-speed operations between track magnets | 23 |
| Unsatisfactory high-speed operations between track magnets | 1 |
| Proper speed-control operations between track magnets | 141 |
| Unsatisfactory speed-control operations between track magnets | 1 |
| Reset at points tabulated by Sprague Co. | 1 |
| Reset at point not tabulated by Sprague Co. | 1 |

### Unequipped Territory

| | |
|---|---|
| Mileage | 1554.6 |
| Application or impulse received at points tabulated | 51 |
| Reset impulse received at point tabulated | 0 |
| Reset (locomotive) impulse received at points not tabulated | 7 |
| Reset (detector) impulse received at points not tabulated | 4 |
| High-speed operation | 8 |
| Speed-control operation | 13 |

In addition to the foregoing, a series of standing tests were made to determine whether or not this device had any bad effect upon the standard air-brake system, and also to demonstrate the effect of leaks at gaskets and pipe connections. A number of special tests were made in equipped territory in which conditions were created for test purposes. The locomotive apparatus was also inspected and tested to determine whether or not the apparatus had changed or deteriorated materially during the two-month period covered by the tests.

A safe failure in test 1073 occurred January 26; it was a failure to obtain a reset in block 5 at a speed of 40