British and American Railroad Signaling

Some Notes and Comparisons Pointing Out the Principal Differences in Practice Between the Two Countries

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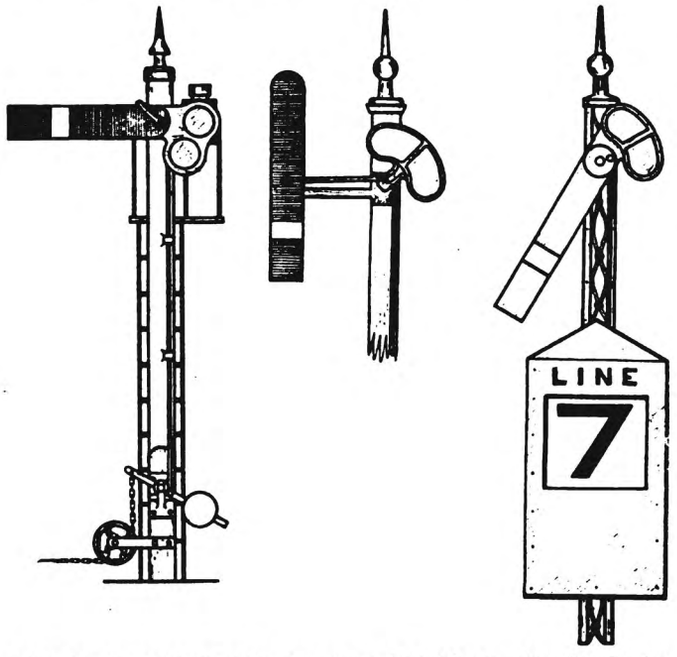
The operating conditions on the railways of Great Britain differ to a considerable extent from those on American lines, and these differences are reflected to some degree in the design and arrangement of signaling apparatus. Englishmen are justly proud of the remarkable immunity from accident enjoyed by their railways, due largely to the universal adoption of block signals and interlocking, and also to the excellent sense of duty and discipline prevailing throughout the railway service. England is the cradle of the signaling art and must ever be regarded with respect by all signal engineers of whatever nationality, for it is there that the blessings of the block and interlocking systems were first recognized and have had the most universal application.

SIGNALS.

The semaphore signal is universally used in England on main lines. It is displayed left-handed—the trains run left-

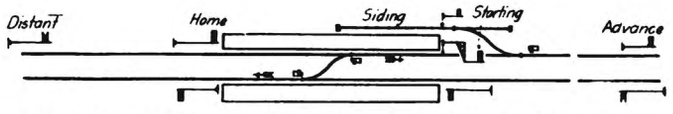


At Left, Typical English One-Arm Semaphore. In the Center, "Somersault" Semaphore in Clear Position. At the Right, a Route-Indicating Signal.

handed—and is normally placed to the left of the line to which it applies. Judging from pictures and from the appearance of the American signal at Paddington, on the Great Western, the writer would say that English semaphores are more substantial and conspicuous than American ones. American blades are smaller and seem to taper away so much as to detract from their visibility. The typical English semaphore, shown in the sketch, is always wire (never pipe) operated, and but one flexible wire is used. Tubular posts, or masts, are seldom seen, wood being the usual material for this purpose, but some lines make extensive use of lattice iron-work for their posts. Bracket and bridge signals are used for the same purposes as in America, but the dummy mast and marker light are never provided to assist in indicating for which line a signal applies.

One interesting form of signal is in use on the Great Northern and Taff Vale Railways (and in the colony of Victoria), called the somersault signal. The arm is balanced nearly in the center, as shown in the illustration, and comes to clear, parallel with the mast, making an exceedingly distinct signal, and one that is unaffected by snow accumulation on the blade. It was an accident caused by a snowbound signal sticking at clear that led to the adoption of this type of signal by the Great Northern. There is, unfortunately, a great amount of difference in the practice of the various lines with regard to the forms of signals for switching and subsidiary movements. Some roads put rings, letters and other symbols on the blades, or make the blades of peculiar shapes. It is to be hoped that some standardization will be attempted before long in this respect. For ground signals the dwarf semaphore is now becoming popular, but the disc (pot) signal is still in extensive use. Blades are universally painted red on the front and white on the back, with white and black sight-marks respectively, save on the electric lines in London, where yellow is now used for the front of the distant blade. The travel of the blade is almost always from 0 to 45 or 60 deg. in the lower quadrant, but the electric roads are now using upper-quadrant indications, while the signal at Paddington is three-position. Light signals are in use on the underground roads. A further type of signal is the Sykes' banner-signal, which is electrically operated, and which consists of a background of opal glass before which a banner moves made of red fabric, the whole being illuminated at night and presenting the same appearance as by day.

The night indications are red for stop and green for clear, while red also means caution in the distant signal.



Typical Arrangement of Signals for Small Station on an English Line.

Some attempts have been made to get a distinguishing sign for the distant signal at night by using flashing lights and also by an additional V-shaped white light next to the red and green, while yellow is used on the London electric roads. Our back lights show a small white light when the blade is at danger and no light at clear. In general our fittings are similar to those used in America. Long burning lamps are now much in use, while gas and electric lighting are used also when convenient. It is to be regretted that on some roads insufficient attention is paid to lighting. A good deal of improvement in this respect could be made, as also in the direction of keeping the signals cleaner and the blades more often painted. There is a good deal of slotting, i. e., control of a signal from more than one tower and a few good mechanical devices are in use for this purpose. As a rule more signals are used in any given installation than would be the case for the same track layout in America. Advance signals are more extensively used, and more attempt is made to indicate routes than in American practice. Even at an ordinary station a fair number of signals is provided, as may be seen in the typical arrangement of signals for a small station reproduced herewith. Wherever a connection from a siding to the main line is located beyond the station, an advance signal is provided to hold the train in case the block ahead is not clear. This is also done at junctions to allow a train to proceed down (say) the branch line and wait while the junction is cleared for the use of a main-line train. For all through running move-

ments route signaling is adopted; that is, the enginemen are told where they are going, though for movements governed by dwarf signals this is not always done. The practice of placing blades one over the other for this purpose is not now followed, it being the custom to place the blades on separate doll-masts and distinguish between inferior and superior routes by the varying heights of the dolls. Naturally at certain points this is difficult to carry out without an excessive number of blades and dolls, which would lead to confusion, and in those cases what are called route indicating signals are adopted. A representation of this idea is shown in the figure, which, it will be seen, consists of a semaphore combined with a symbol of some sort. Speed signaling, as recommended by the R. S. A., is not in use, and does not seem to appeal to British operating officers.

OPERATION OF SWITCHES.

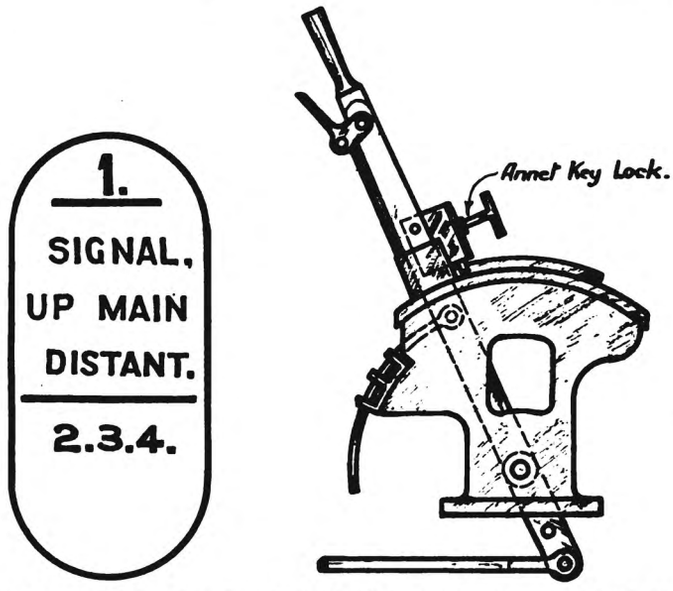
Switches or points, as they are termed in Great Britain, are operated by pipe lines on carriers in a manner similar to American practice, but some roads use solid rodding and others use channel rodding. The adjustment with jamb nuts at the tie rod found in America is replaced by a special adjusting crank at the switch. Compensation is as a rule effected by "lazy-jacks," but the straight arm compensator is also in use, notably on the Midland Railway. Facing point lock plungers are always located in the four-foot way* and not in the six-foot† as is the American practice. Switch-and-lock movements are also in use to some extent, the Midland Railway adopting them universally. Detector bars, or lock bars as the English call them, are generally fitted on the inside of the rail, the reverse of American practice. Some British roads make the levermen throw a lever to lock the switch, but others let the switch stand locked with the lever normal, and the leverman throws the lever to unlock. The writer believes this is never done in America. Electric track locking is coming into use for the purpose of holding switches instead of using detector bars, but some engineers who do not like to rely entirely on this retain the bar as well. Pipe carriers are mounted on wooden or cast-iron supports and seldom, if ever, on concrete. Deflecting bars are not used, nor is it the custom to run pipe and wire lines in oil-filled pipes when crossing under highways or tracks.

Derails are not allowed in passenger tracks, their use being confined to freight and engine tracks. The English name for them is trap-points. At junctions the required protection is obtained by the absolute block system, the rules of which forbid the acceptance of conflicting trains at the same moment, unless there are outer home signals situated 440 yards back from the fouling point. If these are not provided, one train must wait back at the next block station. An exception to this rule is allowed for freight trains (and in very special cases for passenger trains, too) at certain points and when a train is being allowed to approach a junction in these circumstances the operator at the block station preceding the junction must verbally caution the engine runner and exhibit a caution hand-signal. This is known as "section clear, junction blocked" working, or the "warning arrangement." As a consequence of the non-use of derails, there is hardly the same need for time or electric locking.

MACHINES AND INTERLOCKING.

A variety of machines are found on English roads. Some of the earliest were, of course, of the Saxby type, but the improved S. & F. machine so common in America is not in use, though some power machines have locking of the same pattern. The various signal firms have designs and so have the railway companies. Preliminary and direct locking are about evenly matched, some roads using one, and others the other. There is no compulsion to use preliminary locking as in some of the states. Tappet locking is now universally adopted for the work. Leadouts are of the vertical and crank type.

The levers in the machine are painted in distinguishing colors and the number plates contain not only the number of the lever but also the numbers (if any) of those that must be reversed first. This is illustrated in one of the accompanying sketches and it makes a manipulation chart less necessary. The towers are not supplied with these charts as a rule, except in large plants, but have a diagram of the tracks and signals and sometimes a locking sheet. On some machines the function of the lever is shown on a board at the back, and the label contains the numbers only.



At Left, Typical Number Plate for Interlocking Lever. At Right, Application of Annett's Key Lock to an Interlocking Lever.

The practice of working more than one signal from one lever through a selector is in use to a limited extent, as are also "push-and-pull" levers.

For outlying siding switches ground lever machines with horizontal leadout are used, controlled, when near to a block tower, by a mid-way lock operated from two levers in the machines. Electrical control is also used and is far better than the mid-way lock. For outlying sidings between block stations a very common method of control is by the use of Annett's key lock, on the lever in the machine as shown in one of the sketches. The key is either taken from a similar lock on the lever in the tower, or from an instrument containing a supply of keys, only one of which can be extracted at a time. This instrument controls the block signals. The key must be taken through the block and put in a companion instrument at the other end, or it must be replaced in the one it was taken from else the signal giving admission to the block will be held. Further the key can only be withdrawn from the lock on the lever when the latter is locked in some pre-determined position. This secures the switch against operation by malicious persons. The ground machine is sometimes placed in a shelter with door locking so that no unauthorized person can get at the levers.

SIGNAL TOWERS.

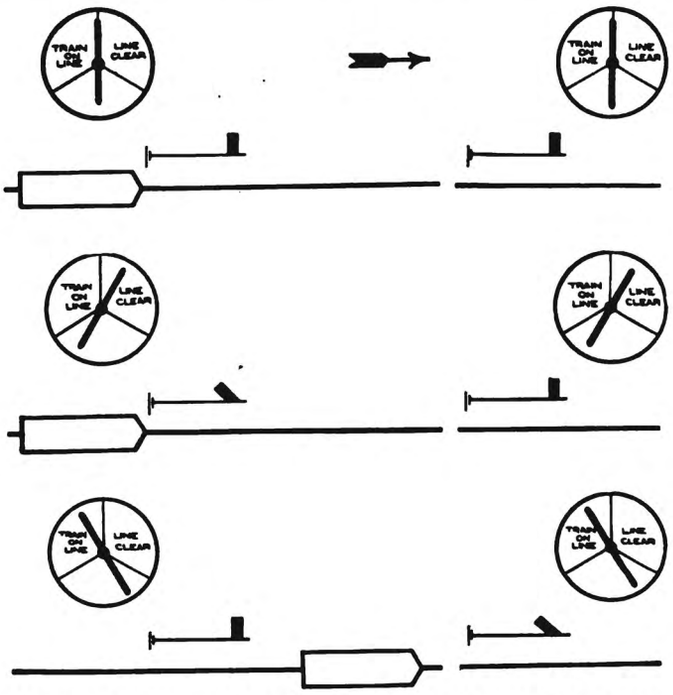
The towers on British roads generally consist of two stories, the one-story type only being used for very simple and unimportant block stations. It would be an improvement if bay-windows were adopted as is done in some cases in America. Some lines use all-wood towers, others half wood and brick, while a few use all-brick structures. It is now becoming the practice with some roads to place the machine so that the leverman has his back to the tracks when throwing the levers. This gives unrestricted access

*The space between the rails of a track.
†The space between adjacent tracks.

to the windows and throws a good light on the block signaling instruments. Our towers are distinguished by names, the American plan of using symbols being only used by the electric roads.

BOLT LOCKS.

The use of bolt locks, or detectors, as they are called in England, is, of course, much the same in both countries. Electrical detection is used to a great extent in complicated plants, where mechanical apparatus becomes too cum-



Standard Indications for Needle Telegraph Manual Block Operation.

bersome. It is now a common practice to detect dwarf signals for switching movements with their respective switches. The plunger of the facing point lock is also detected in some cases, as where this is done the Board of Trade will grant an extension of the limit of operation for such switches. In connection with electrical detection it is now becoming a practice to use detector relays in the tower operated by the circuit-changer at the switch, and to do all the circuiting for the control locks locally in the tower. The electric locks used on machines for this and other purposes are almost invariably on the lever direct and seldom on the latch. When a signal lever is "back-locked," it can be thrown back about five-sixths of its stroke, and this, with wire operation, is enough to put the blade to danger, although, of course, the locking is still held.

GRADE CROSSING PROTECTION.

Grade crossings of one railway with another are practically non-existent in Great Britain, there being only two or three instances of this kind, and it is a practice that would never be followed or allowed now. Where they do exist, they are properly protected by interlockings, only the block system takes the place of the derail. Grade crossings of highways and railways are more to be found, but these are not sanctioned now on new roads. In such cases properly constructed gates worked from a tower (or by a gateman controlled by a tower) are always provided and are interlocked with the signals. The American arrangement of relying on crossing alarms and "wig-wag" flagmen would never be permitted for main roads. In the case of private roads that cross the railway, crossing alarms are used, but even here gates are almost always provided, so that persons using the road are compelled to open them, and so are practically forced to take proper heed for their safety. The number of accidents on American highway crossings forms a very unpleasant record, but perhaps the craze to take a sporting chance may have a deal to do with it.

DOUBLE-TRACK BLOCK SIGNALING.

The block system is compulsory on all lines used by passenger trains, and has been so for 25 years. The most generally used method is the manual, employing needle telegraph instruments operated by constant currents, any failure of the current giving the "line blocked" indication. As it is necessary to use independent instruments for each track and so to give a constant indication of the condition of each block, the practice of using a telephone only for block working is not found. Communication between operators for block signaling purposes is by a bell-code. Some roads use instruments operated by intermittent currents, but these are not quite so general as the constant current type. The standard indications are shown diagrammatically in one of the illustrations. The upper figure is the normal state of the indicator, the next the condition when a train has been authorized to enter a block, and the lower that when a train is actually traveling through the block. It must be borne in mind that the operator towards whom the train is going is the only one who is able to change the indications of the instruments. The block regulations are framed so as to cover every possible contingency of working and are altered in minor details for any particular block station if circumstances render this desirable.

The controlled manual system (principally of Sykes' pattern) is in extended use, especially on the crowded suburban roads in the south and east of London. Track instruments and track circuits are used to control the apparatus, the latter superseding the former. Track circuits are now being extensively used in conjunction with the manual block. Automatic block signals are also in use on the London electric roads, in this case in conjunction with automatic stops, and they are also in use on the North Eastern (normal danger) and on the South Western and Great Central (normal clear). Other roads have isolated instances of such signals, principally where it has been found necessary to split up a block between two towers that have proved too far apart for modern needs.

SINGLE-TRACK BLOCK SIGNALING.

Single-track lines in Great Britain are never controlled by despatchers' orders alone as in America, such a method not being permitted. Any road of importance now has the electric staff (or tablet) system operated under strict rules. On roads with little traffic, the old staff and ticket system is still in operation, and in some cases the staff alone is used. The controlled manual system ("non-token" block) has been developed on a few roads, and it is probable that this method of operation will find increased favor. English single-track roads can, of course, hardly be compared directly with American, for the conditions are so vastly different. To an Englishman the American method of relying on a despatcher's orders, with all the complications and risk of mistake associated with that system, is far too dangerous for single tracks. No single track automatic block signals are in service in England.

SUBSIDIARY APPARATUS.

The use of electric signal repeaters, annunciators and platform indicators is widespread, as also is telephone communication between towers and stations, etc., while traffic control, after the manner of a despatching system plus the block system, has come into operation in some districts. Isolated sections of track circuit are spreading everywhere. Cab signals in a variety of forms have been tried and are in use to some extent, notably on the Great Western and North Eastern roads. The Prentice system of wireless control and cab signal has also been installed on the Hampton Court branch of the South Western. A committee of railway officers is at present sitting on the vexed questions of cab sig-

nals and automatic train control, and its report will be received with great interest.

POWER SIGNALING.

There are many interesting and important installations of power signaling, including all the well-known systems—electric, electro-pneumatic, pneumatic and electro-mechanical. It is difficult to say towards which system favor most inclines at present. Probably the choice will lie between the electric and the electro-pneumatic. England is the home of the electro-mechanical system, and the large installations at St. Enoch (Glasgow) and Victoria L. B. & S. C. R. (London) are on this plan. The same system has also been adopted at many interlockings on the London electric lines in connection with the installation of automatic block signals. Power operation is not so readily adopted as in America, as the lines are already completely signaled and mechanical installations are not usually superseded unless there is a radical change in the arrangement of a station or yard. There are of necessity some places where power working has to be adopted, but in general it is not so readily put forward as in America. It may be that this will be changed when there is a greater recognition paid to the signaling profession and a freer hand is given to it in its work. There is perhaps not quite the same scope for power operation here, as the immense layouts that are found in America are not met with here, nor are moderately large layouts very numerous, and power operation is not much adopted for small installations. Mention must be made of a. c. track circuiting, which is in extensive use on the electric lines and is being substituted for d. c. circuits at some points at present. American signaling practice is now attracting considerable attention among English signal engineers, and the near future may see some three-position signaling, and even speed signaling, on these roads.

Speaking generally, British roads are more completely signaled than American, and with more rigid regard for safety, but the actual apparatus does not exhibit to such an extent the stamp of engineering and technical skill. But, as time passes, changes are bound to come, and these will probably be in the direction of higher class work all around and the application of scientific principles to the subject on a more extended scale. The conservatism of the English is reflected in their signaling practice, but in operation there are seen two other qualities of the British railwayman, discipline and care, to which the extraordinary safety which is enjoyed is, in no small measure, due.

WHISTLING BILL'S CONVERSION

BY "MAINTAINER"

The signal department on the Mountain division was in a hurry. It had orders to finish a new installation and do it quick. At least, that was the meaning of a terse message from the signal engineer, and it was hinted by our foreman that the general superintendent had handed it down to the signal engineer pretty warm.

The reason for all this haste arose from the fact that a few days previous, the eastbound Limited, the crack train of the road, had gone into a westbound extra, resulting in the sudden ending of several lives and considerable expenditure on the part of the claim agent. One of the first things that struck the eye of the "old man" as he rushed to the scene of the wreck was one of the unfinished signals standing alongside the track. Therefore his order and therefore our haste.

Every signal man knows that a new set of automatics usually has a few bad spots scattered along, and that it pays to test them out carefully before putting on the blades and lighting the lamps. These signals were no exception and had their share of "bugs," some of which could have been traced back to the man who made the first design.

I had been detailed as the maintainer on the fifteen-mile section to be completed first, and my troubles began early on the day the hurry-up order arrived, and lasted many more days and far into the nights. In fact, my recollection is that they lasted all of most of the nights, and the boarding-house knew me no more. The coyotes used to pause in their nightly concerts to watch me go pumping by on the old "Armstrong," for that was before the day of the luxurious motor conveyance. Each time I came in sight of a telegraph office the operator would begin to pull messages off his hook. If I sat down to rest and meditate in some quiet place by the track, the eastbound train crews would point westward and the westbound crews would make signs in the opposite direction. Generally the head brakeman did more than point. He screamed horrid curses regarding block signals and all those who had to do with them.

It was very depressing. I often wonder why I stuck, but I did, and finally there came a day—as the story writers say—when my cares began to lighten and I dared to show up around the terminal. So it happened one morning that I chanced to meet the engineer of the mail train as he was oiling 'round. He seemed to have something on his mind. He began to recall occasions when he had been held up by "my" signals and wanted to know why things were thus. He said he never had discovered the reason for a board being horizontal. He had been pulling trains over the Mountain division for thirty years, "by gum," and he had never been in an accident. He was beginning to grow eloquent in his discourse when the conductor requested him to "pull out," favoring me, as he did so, with a haughty stare.

Old "Whistling Bill," for that was his name on the division, climbed stiffly up to his cab. Being struck with a new idea about that time he stuck his head out of the cab window and said: "Come on, sonny, climb up and ride till we come to one of your ding-blasted signals stickin' out across the country, and after you can't find out what's the matter with it, you can beat it through the block. The head man has rheumatiz in his feet and he can't walk a mile in an hour." So up I got and we left town.

Things went fine until we got away down in a twisty canyon, and there, sure enough, across a sweeping curve, stood a distant signal indicating that about two thousand feet beyond it we must stop. Old Bill seemed delighted and grinned across the boiler head at me as he gently lapped his brake lever. We slid around the foot of a mountain and came to a stop about a hundred feet from a facing-point switch. There a Greek or a dago or some other breed of a "wop" was sweeping snow and the points were on a dead center.

Bill had been busy whistling out the flagman and had the echoes screeching up and down the canyon before he took a look at those switch points. When he did look, the last screech died out in a kind of a wail. It was my time to assume a dignified demeanor, and I assumed all I could, but it was lost on Bill. He was watching the rheumatic brakeman amble up to the switch-stand, for the section boss's assistant and custodian of the switch key had taken one look at that advancing pilot and gone away. He tarried not to manipulate the switch-stand lever nor did he retain his broom. No son of sunny southern Europe had ever shown such speed before in those mountains. His departure and the dying out of the echoes left nothing but dense silence. As the brakeman replaced the switch and the signal came to proceed, Bill seemed in a daze. That signal was talking to him in a strange language and Bill's brain was busy.

That was the "silentest" train I ever saw face a stop signal. Far below us on one side wound a river and on the other towered a mountain wall. How near those passengers in the Pullmans behind us had been to death they will never know. Train men don't talk of those things. But there before us stood the signal, saying, "Proceed; all is safe," and so we did. But *old* Whistling Bill never proceeded. He of the profane and jeering tongue stayed back on the other side and a new Bill finished that run. And they say that ever afterward when he passed that signal he whistled a salute.