Speed-Signaling in England*

Searchlight signals installed on the London-Midland Scottish
Three- four- and five-aspect signals are used

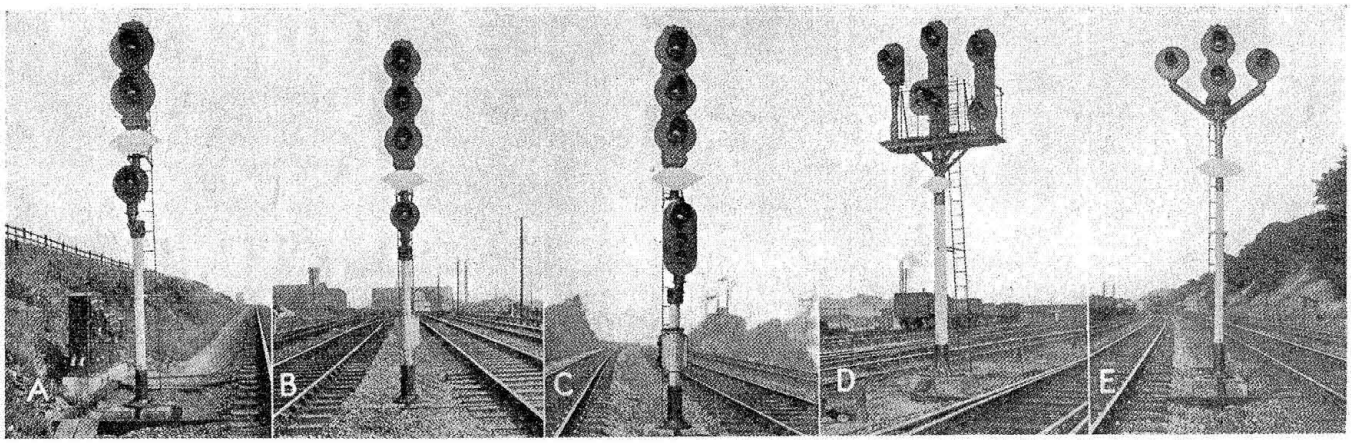


Fig. 3—Typical signals in the new installation

AN INSTALLATION of color-light signaling which constitutes one of the most important developments in British railway signaling was brought into service last summer. This searchlight color-light system is now in operation at Mirfield, between Heaton Lodge Junction and Thornhill L. and N. W. Junction—a distance of 2¾ miles—on the London-Midland-Scottish main line northeast of Huddersfield.

The new signaling installation was not intended primarily as a means of economizing in the number of cabins, although this feature was carefully considered, having regard to the work to be performed. On the other hand, with its complicated junction operation and increased traffic movement following the laying of additional tracks, it was regarded as a favorable location for the application of the principles of speed signaling.

From Heaton Lodge Junction to Thornhill and N. W. Junction, i. e., throughout the color-light area, all the tracks have been track circuited. In view of the multiplicity of junctions, block signaling has been retained between cabins, the standard L. M. S. "Class-C" type being employed. This interlocks with the relative signal levers, but in this instance is free of track circuit control, as the latter is continuous and itself exercises a direct control on the various signals. The signals are controlled from the respective signal cabins.

The opportunity has been taken to introduce "speed" signals in the numerous instances where trains can be diverted on to alternative tracks following the same alinement as the main track. This is in contradistinction to "route signaling," the aim being not so much to indicate to the driver the route he is to take, as to show the relative speed at which he is to travel over it, and this latter indication is given by the relative position of the "proceed" aspect on the signal mast.

Multi-Aspect Signaling

Three-, four- and five-aspect signals are employed in this installation, their use depending upon the spacing of the signal ahead and the braking distance required. Each signal, other than those at junctions, normally displays two red lights—one 12 ft. and the other 8 ft. above rail level. The upper light is a multiple-aspect color-light signal of the searchlight type, capable of displaying a red, yellow or green light; the lower light is the marker (See Fig. 1 and 3A). The lower light indicates to an engineman that he is in a multiple-aspect signaling area; this light can also be used as a low-speed signal. These marker lights are placed vertically below the top light, except in the case of automatic signals, where they are placed 10 in. to the left of the vertical, giving a staggered effect. Except when used in connection with junction "speed" signals, the marker light is extinguished when the color-light signal above it is changed to green, but, when the latter is changed to yellow, the marker light remains lighted.

This appears to be an eminently logical and satisfactory arrangement, because the extinguishing of the marker when the main signal shows green obviates the possibility of an engineman interpreting green/red for "home off, distant on" as in mechanical practice. Also, observation shows that the use of the red in conjunction with yellow is very valuable in helping an engineman correctly to distinguish the latter, while the two in combination are most arresting as a cautionary signal. Moreover, wherever a signal may be situated and whatever its type, so long as it is showing green alone the driver knows he has a clear road, without any qualifications.

Junction Speed Signals

At a junction the arrangement of signal aspects is as follows: Where permissible speeds over alternative routes vary by 20 or more miles per hour, the aspects are given by vertical instead of horizontal displacement, as in Fig. 1, 3B and 3C. Normally three red lights are displayed vertically on each junction signal mast. The top light is for the high-speed route; the center light is for the medium-speed route; and the bottom light is for the lowspeed route. High speed is the highest per-

*Abstracted from Modern Transport, London, England.

missible speed at any given location. Medium speed is the restricted speed suitable to the diverging route. Low speed is for switching.

The high- and medium-speed signals operate on the multiple-aspect principle, being capable of displaying a red, yellow or green light. The low-speed signal does

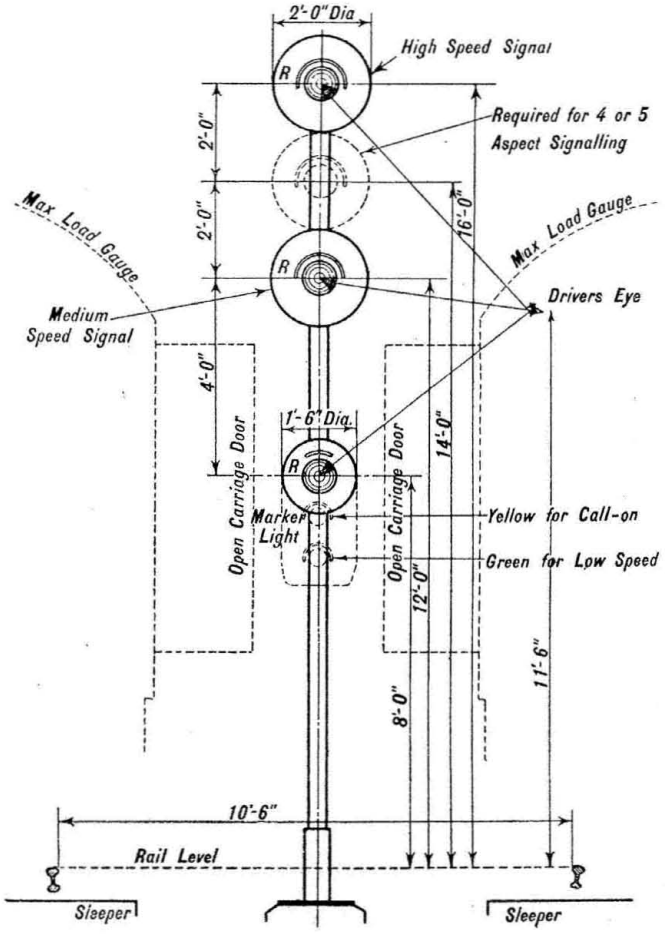


Fig. 1—Front elevation of typical speed signal for junction

not operate on the multiple-aspect principle, but it can be changed to yellow or green, depending upon the condition of the line ahead. The yellow and green lights of the low-speed aspects are of short range and are half the size of the normal lights (Fig. 3C).

At junctions where the permissible speeds over alternative routes vary by less than 20 m. p. h., the junction signal aspect is given by horizontal displacement, as in semaphore signaling (Fig. 3D). Distant-signal aspects with horizontal displacement are provided for junction home signals where necessary. The application of these principles is shown in Fig. 2 and 3E.

Meeting Varied Requirements

Where the braking distance between consecutive signals ahead demands a double yellow, the additional yellow unit is located between the high and medium speed aspects on a junction speed signal, as in Fig. 1, and above the "searchlight" signal on other signals (See Fig. 3A and 3B).

In certain cases the braking distance on high-speed routes demands a fifth aspect, given by displaying a green aspect below the yellow, this being of considerable value in keeping heavy mineral trains moving at their highest speed, because, where these signals are used, the enginemen know they will have ample warning when the need to stop arises.

The call-on signal is given by a small yellow aspect below a red, and this is brought about by the marker light being extinguished and the small yellow appearing in a position immediately below that previously occupied by the marker light. Although the lever operating the marker light from red to the call-on yellow, is free to be pulled at any time, the light does not change until the approaching train reaches a point approximately 100 yards from the signal, when by the action of the track circuit, the light changes automatically, thus relieving the signalman for his other duties.

As the exhibition of the small yellow signifies that the road ahead is occupied, whereas the small green indicates clear for a movement at low speed, where there is no track circuit for use as a selecting medium, a plunger is provided in the cabin and only after the signalman has pressed this is it possible for the small green to be displayed, the use of the plunger cutting out the control by the approach track already referred to, so obviating a heavy coal train being brought practically to a standstill with possible difficulties in restarting.

The signals are carried on a tubular post secured to a concrete block, the high- medium- and low-speed aspects being 16 ft., 12 ft. and 8 ft., respectively, above rail level.

Searchlight Signals

The searchlight signal embodies the use of a miniature spectacle carrying the three colors (green, red and yellow) inside the body of the signal, operated on the principle of a polarized relay, the hue being given by the interposition of the required color screen near the focal point of the lens combination. This prevents any possibility of a false phantom indication by extraneous light, and permits the use of a reflector system, whereby an intensity as high as 50,000-beam candle power can be obtained. In consequence, it is anticipated that the services of fog-signalmen will not be required.

The optical construction of the searchlight signal is of special interest. A concentrated filament lamp is so arranged that its filament is at the focal point of an ellip-

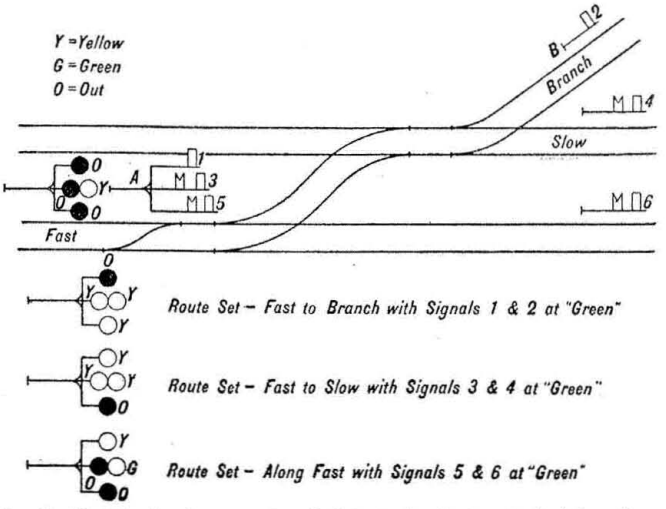
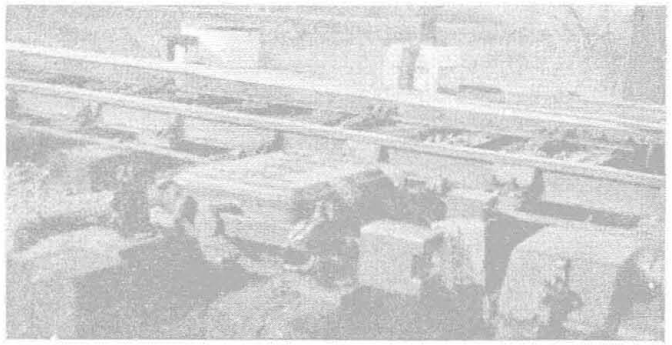


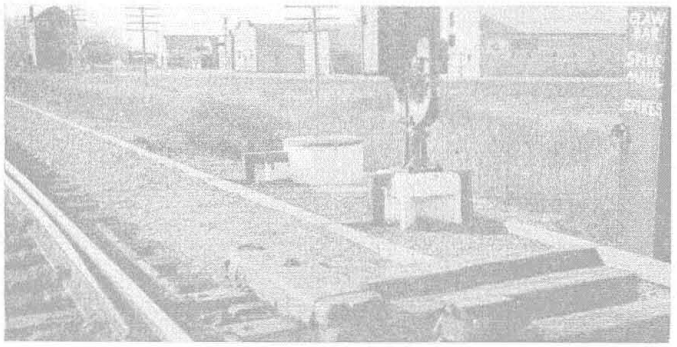
Fig. 2—Sketch showing aspects of distant signal at a typical junction

tical reflector, which, collecting a large percentage of the light rays emitted from the lamp, concentrates and projects them at the second focal point of the reflector. At this point, which is coincident with the focal point of a clear lens system, the light rays pass through a

(Continued on page 365)

curidge, Minn., in 1924, that the necessity arose for providing, at a point where no attendant was on duty, some means of holding an unlocked switch securely in the position it occupied when the current was cut off the operating motor. It was found that an unlocked switch machine might "drift" when power was cut off, thus opening the switch under, and causing the derailment of a train which was proceeding over the plant on a hand signal. The application of a magnetic brake was suggested to the manufacturers and insisted upon by the Great Northern, and is now in use on all low-voltage switch machines installed on that road.





Two views of the power switch layout. Dual-control selector above

Comparatively little work was necessary in changing the Lohman plant over to automatic operation. The table-lever machine was removed, the two push-buttons and knife-switch were installed, and the circuits were, of course, considerably revised. In all other respects, however, the plant is unchanged. The signals are the General Railway Signal Company's Lebby-mirror color-light type. This company also supplied the Model-5 switch machine, dual-control selector and all control apparatus. Primary battery, supplied by the Waterbury Battery Company, is used on the track circuits. The control circuits are fed by Exide storage battery on a-c. floating charge, and are carried in trunking and on an open line, Copperweld wire being used. The investment required in the change to automatic operation was $1,280 and the annual saving is $2,888. The plant was designed and installed by the forces of the railroad company.

Speed Signaling in England

(Continued from page 358)

miniature color disk, fill the lens and emerge in a colored beam. Under this arrangement approximately 80 per cent of the light emitted from the lamp is collected and produces a beam of exceptionally uniform intensity.

It is found that this development, in combination with the optical construction employed, has made this type of color-light signal economical for use with primary batteries, since a 3-watt 4-volt lamp produces an indication of 11,000-beam-candle-power. Further, by using a lamp which consumes only 12 watts of energy, an indication of 37,500-beam candle power may be produced, and thus a very brilliant and powerful unit in color-light signaling becomes economically possible.

Signal and Point Repeaters

All switches and color-light signals fitted with electrical detectors are repeated in the cabin from which they are controlled. The indications are given by small 12-14-volt 3-watt lamps fixed behind colored lenses. These repeaters are fitted behind the levers to which they apply. The point indicator is a red light which appears only when the switch points are out of the normal or reverse positions, are not properly bolted, or are in opposition to the lever, due to a broken switch rod.

Marker lights, and those lamps which are normally out and only display one aspect, such as the second yellow light in a four-aspect signal, are not repeated, but are fitted with double-filament lamps. The yellow and green aspects of low-speed signals are indicated in the cabin.

There are 74 track circuits, varying in length from 30 to 900 yards. These are all of the alternating current (phase-controlled constant-current) type, and the feed apparatus and the relays are in the majority of cases housed in buildings adjacent to, or forming part of, the signal boxes.

There are two pairs of power-operated points controlled from Mirfield No. 1 signal cabin. The machines are of the British Power Railway Signal Company's 110-volt alternating-current type. Provision is made for operating these machines by hand in the event of a failure. The locking is so arranged that when any signal leading over these points is cleared, the crank handle cannot be obtained, and also the removal of this handle locks all such signal levers in the normal position.

No detector bars are provided at facing points, protection being given by track circuits extending wherever possible about 50 ft. in the rear of the points. The switch levers are locked in the normal and reverse positions by these track circuits.

Power Supply

Power for operating this installation is obtained from two separate substations, at a pressure of 400 volts a-c. A hand-operated switch is fixed in Mirfield No. 2 cabin for changing over from one supply to the other, if necessary. From the signal box, current is carried by twin-armored cable, at 400 volts, to each cabin between Heaton Lodge Junction and Thornhill and N. W. Junction.

The current is transformed to 110 volts at each cabin, the transformers and switchgear for each box being supplied by the British Power Railway Signal Company. From each cabin, current at a pressure of 110 volts is carried over rubber-insulated twin cables to cast-iron distribution boxes. This current is used for switch-indication relays and for feeding the local coils of the search-light signals.

Each signal box is equipped with an indicator, which shows a green light when the plant insulation is normal, but if there is any leakage through faulty insulation the green disappears and is replaced by an upper or a lower red light, corresponding respectively to a positive or negative ground.