

Before entering the tunnel the rear switchman on every freight train, who is compelled under the rules to ride on the rear end of the last car, is given a numbered leather disk by the yardmaster. This number is communicated to the dispatcher or operator at the west end of the tunnel. As the train passes "MS" office at the east end the rear switchman delivers this disk to the operator, who reports its number to the dispatcher at "X" office. Unless the number reported by the yardmaster and operator agree, no train is permitted to enter the tunnel until it has been found clear by a light engine feeling its way through.

Another form of block signal is the automatic, which is defined as follows in the Signal Dictionary:

"A block signal, worked by electric or pneumatic agency, which is controlled by the passage of a train into, through and out of the block section to which the signal is connected. The entrance of a train sets the home signal at stop, and the clearing of the block section by the passage of the train out of it sets that signal clear. The apparatus is so arranged that the misplacement of a switch or the accidental entrance of a car from a side track will set the signal at stop."

This result is accomplished by the use of the track circuit defined as follows in the same volume:

"An electric current flowing through the rails of a railroad track. In a typical track circuit, the current flows from the battery to the nearest rail of the track, thence to the other end of the track circuit section; thence by wire to the track relay (controlling a signal) back by a wire to the farther rail, and by that rail back to the battery. Each rail is made electrically continuous from one end of the track-circuit section to the other by metallic bonds at the joints, and at the ends of the section insulated joints are used."

Automatic signals have been in use in this country since 1871 with "track instruments" and since 1879 with "track circuits."

The first form of automatic signal was the enclosed disk or banjo type which is still used on some of the largest railroads. The day indications are given by the color or position of circular disks, and the night indications by the usual colored lenses.

Of late years the disk signal has been almost entirely superseded by the semaphore; defined as follows:

"A type of signal introduced on railroads in England about 1841 and now in almost universal use for both block and interlocking signals. It consists of an arm about 4 ft. long and 10 in. wide, mounted on a post usually 24 to 30 ft. high at one side of the tracks; or on a shorter post supported by a bridge or other structure above the track. Day indications are given by the position of the arm horizontal, inclined or vertical, and night indications by a light. The pivot of the arm is combined with a spectacle casting holding colored glass disks, which, as the position of the arm is changed, move in front of a lamp mounted on the post."

By far the largest portion of all automatic semaphore block signals are electric, although there are some electro-pneumatic and electro-gas signals.

In some of the earlier automatic installations, the signal indicated the condition of the track for one block section only. It was found particularly in mountainous regions, where the view of the track ahead is obscured, that this was not sufficient, if a reasonable speed was to be maintained. Three general methods have been used to supply the engineman with additional information.

(1) By the overlap, which is an extension of the track circuit one or two thousand feet beyond the advance signal. The effect of this is to encourage an engineman to pass a signal at danger, by giving him the assurance that the track for a considerable distance beyond it is clear. As there is a large element of danger in this, the use of the overlap as outlined is not considered good practice.

(2) By the use of the distant signal which, when clear, indicates that the home or main signal is clear, and when blocked tells the engineman that he must be prepared to stop at the home signal. The distant signal is frequently placed on the same mast with the preceding home signal, and by this means the condition of the track for the two blocks ahead is indicated.

(3) By the use of the three-position signal, which indicates the condition of the track for two blocks ahead as follows:

Blade horizontal, first block occupied.

Blade inclined at an angle of forty-five degrees, first block clear, second block occupied.

Blade vertical, both blocks clear.

Automatic block signals are usually operated on the permissive system as follows: If a signal is in the stop position, the train must come to a full stop for one minute, after which it may enter the block under control prepared to stop in case of danger without any additional signal or warning.

The number and location of automatic block signals varies with the nature of the service. On lines of heavy traffic they must be placed as close together as possible, so as to get the maximum operating capacity out of the line. In no event should they be placed any closer than the distance required by the fastest and heaviest train to come to a full stop.

The automatic block signal is superior as a safety device to any of the manual block systems, because in addition to making known the presence of a train in the block, it also gives an indication of track obstructions, such as cars on sidings fouling the main line, broken rails or other defects destroying the continuity of the track.

The automatic block, like the manual, does not and cannot guard against the failure of the engineman to obey signals. The only manner in which the engineman can be controlled is by some system of automatic speed control or train stop, which would shut off the steam supply and set the brakes on the locomotive. There has been considerable talk about these devices but so far nothing practical for general use has been developed, and we must therefore depend on the care and watchfulness of the man at the throttle. After all, in spite of the multiplicity of automatic devices, we must always in the last analysis depend on a man or men for our safety.

One of the latest developments in automatic block signals is the use of alternating current signals. An installation of this kind was recently completed on the Southern Railroad between Denim, N.C., and Charlotte, N.C., a stretch of 100 miles. The line had been previously operated under the manual block system with 19 stations. When the new system was installed 15 of the 19 operators were no longer needed and were sent to other parts of the line. The power-house was installed at about the middle of the system and the current, which was also used for lighting stations and other buildings along the right-of-way, was transmitted at 4,400 volts. There are 118 signals in the system and the total energy required for the signals, track circuits and lights in the signals, is less than 10 kw.