Locating Automatic Block Signals for Heavy Traffic*

First of Two Installments, Explaining Acceleration and Braking of Trains with Reference to Signal Stops

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BLOCK signaling had its inception years ago, when the semaphore signal was called into use at stations for the purpose of conveying to trains information as to their further procedure. It is even doubtful if these "train order" signals could be called block signals if the term "block signals" is used in its strict sense of "train spacing signals." However, it was not long before these same signals were used as real block signals when their operation for a train to proceed was made to depend upon the receipt of information from the next station that the preceding train had cleared the space between the two stations.

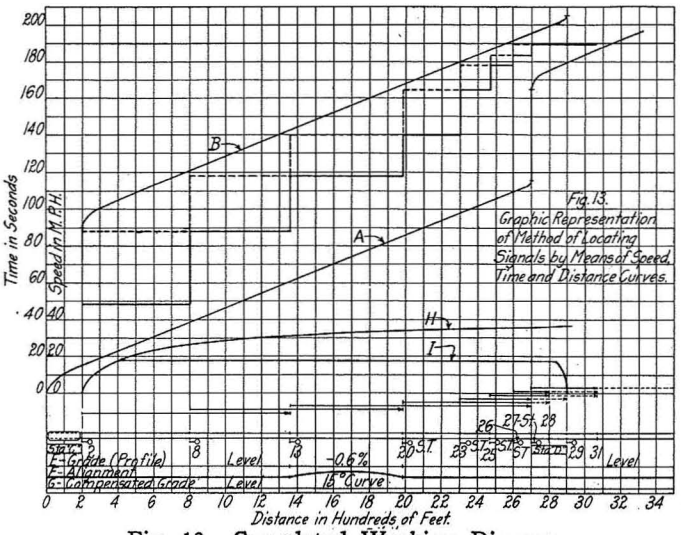

Fig. 13. Completed Working Diagram

If the towns were close together, the trains could be spaced close together and if far apart, the trains were necessarily spaced far apart, also. As these long blocks became prohibitive, block stations were located at intermediate points to permit more trains to use a given piece of track. Then as automatic block signals came into use they were located between the block stations and in many cases superseded the manual block signals and a still greater capacity for trains was thereby provided.

During this development, the signals at interlocking plants were used to indicate routes. These signals at first were in no sense block signals and were located solely with reference to the switches, crossings, etc., which they protected. In fact, the special track and operating conditions at interlocking plants are still the governing elements in the location of interlocking signals. But as block stations for the operation of manual block systems were frequently located at interlocking plants one set of signals was used for both the interlocking and block purposes. Later when automatic block signals came into use it was found desirable to have the interlocking signals serve also as automatic block signals, so that the block signals were located at more or less regular intervals between the interlocking signals, depending upon various physical conditions such as the location of stations, curves, tunnels, obstructions to the view of the engineman, and (not the least important) the location of signals on the other track. A great many block signals in use today were located in this manner and the fact that these signals are providing safe and expeditious movement of trains is clear indication that their locations are satisfactory, or at least, not very objectionable.

But an analysis of operating conditions and requirements soon discloses the fact that at least some of those practices in the location of block signals were economically unsound if track capacity was considered. Take for instance, the practice of locating signals for both directions opposite each other. The spacing of block signals depends in a very large measure upon the distance required for a train to stop after the application of the brakes—braking distance—the braking distance being less on an up-grade than it is on a down-grade. But if signals are located opposite (or on the same bridge) for both directions, the distance between signals will be the same on both tracks and on a grade, therefore, the block will either be too short for braking distance on the down-grade, or too long for maximum capacity on the up-grade.

There is a considerable saving in cost by locating the signals opposite, and where the traffic can be expeditiously handled by such an arrangement this opportunity to keep down the cost should be used. But where traffic is such that the track must be used to its maximum capacity, the saving in cost would be greatly overbalanced by the cost of delays to trains or even the necessity of running a few trains.

Location of Signal for Heavy Traffic

Similar arguments could be cited with respect to other methods of locating block signals. My analysis of the problem of locating signals for heavy traffic indicates that there are four main divisions into which all elements may be properly classified—namely—*Roadway*, *Car* and *Engine Equipment*, *Signal Equipment*, and *Train Operating Characteristics*—and I shall describe briefly the elements which in my opinion should be classified into each of these groups:

Roadway Elements

Curves in a track not only affect the view of signals but also the speed of trains—the speed affects the time a train will occupy a section of track and that in turn will affect the length of block, etc.

The profile also affects the speed of trains and there-

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