Railway Signaling

Economics of Modern Signaling

Last 25 years have seen development of centralized traffic control, car retarders, automatic interlocking, and highway-crossing signals, the installations of which are self-liquidating

VOLUMES could be written on the technical development of railway signaling facilities.* However, this article is to be devoted to a concise word picture of the application of modern signaling facilities as viewed from an economic standpoint, by the operating officers, as well as by the signal engineers and their associates.

Since the reader is familiar with the application of, and the operating benefits ordinarily derived from, automatic block signaling and interlocking, the discussion in this article will be confined to the four later and modern developments in the field: (1) Remote and centralized traffic control, for the operation of outlying switches and for the direction of train movements by signal indication; (2) Car retarder systems for the operation of switches and the control of cars in classification yards; (3) Automatic interlockings for the protection of railroad crossings and gauntlets without manual service, and (4) Modern highway-crossing protection as a means of improving protection for highway traffic and of reducing operating costs for the railroads.

During and immediately following the World war the railroads were required to handle an unprecedented volume of freight traffic. Delays approaching congestion were caused, not by a lack of locomotives and cars, but by inability to move the trains promptly over the line on account of a lack of track capacity, a contributing defect being the delays in classification yards. As soon as the roads were returned to private ownership in 1920, they proceeded to correct this lack of track capacity, as well as to improve yard operations.

Operating officers, as well as signal engineers, will be interested in this description of the economies being effected through the utilization of modern signaling facilities. Centralized traffic control is saving 1.4 to 1.8 minutes per freight train mile—Car retarders speed up classifications and save from 18 to 40 cents per car handled—Automatic interlockings pay for themselves in one to two years—Modern crossing signals replace watchmen and gates, thus giving 24-hour protection and saving from 25 to 100 per cent on the investment.

Increasing Track Capacity

CERTAIN ROADS entered into extensive programs of constructing additional tracks, which, of course, were very expensive in many cases. Other roads visualized what could be accomplished in the way of reducing train delays and increasing track capacity with signaling facilities, and then proceeded to install such apparatus extensively.

Especially with heavier trains, the elimination of unnecessary train stops is desirable. Therefore, the idea of interlocking was applied for the power operation of outlying junction switches which, together with the surrounding signals for directing train movements, were controlled remotely from an existing station or tower. These installations were so successful that the question soon arose, Why could not all the junction and passing track switches on a division be power-operated, and why not use the signals at each switch for directing train movements, thereby eliminating the need for train orders with their attendant source of delay and hazard? The first divisional installation of this character was placed in service in 1925 on a 50-mile single-track division of the Missouri Pacific between Kansas City, Mo., and Osawatomie, Kan. Several control stations were involved in this installation, which was, in fact, a series of interconnected remote-control layouts with controlled manual block for the direction of train movements. The next step was to concentrate in one machine the control of all the switches and signals for directing train movements. This entailed a vast amount of development in apparatus and circuits to simplify the arrangement so that it could be furnished at a reasonable cost. However, the "trick" was done, the first system of this character, now known as centralized traffic control, being placed in service in July, 1927, on the New York Central, to be followed soon after by an installation on the Pere Marquette. Since that time, centralized traffic control has been installed on more than 920 miles of road, involving 800 power switches and 2,000 controlled signals for directing train movements.

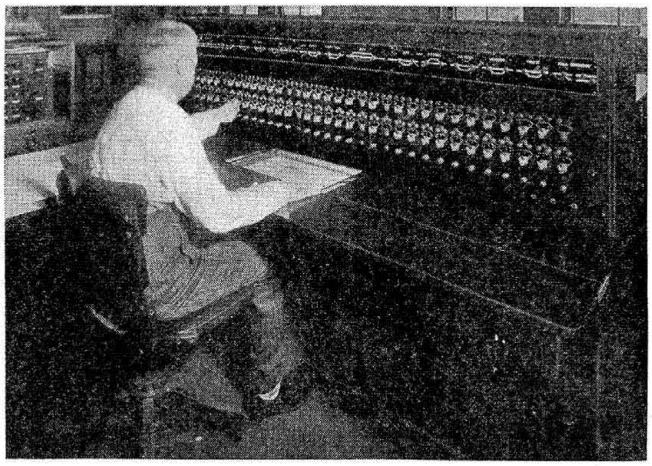
An installation of centralized traffic control, where adaptable to conditions on a busy division or a major section thereof, should effect annual savings in operating expenses equivalent to 18 to 24 per cent of the investment, by reason of the reduced number of operators required, the possibility of increasing train loads, and the reduction of overtime for train and engine crews. Furthermore, the additional savings realized annually by deferring expenditures for added track facilities, range from 10 to 20 per cent of the investment for centralized control. These savings, in addition to many advantages in

*Readers who are interested in a brief history of signaling developments are referred to an article on page 119 of this issue.

facilitating train operation and increasing safety, have been definitely proved on over 40 major installations which have been placed in service on both single- and multiple-track lines within the last six years. Centralized traffic control is, therefore, coming to be recognized as the most economical and modern method of directing train movements by signal indication without written train orders.

Reduction in Number of Employees

One of the most tangible benefits derived from an installation of centralized traffic control is the elimination of operators at intermediate block offices, outlying junctions and railroad crossings. In view of the fact that the expenditure for wages for these positions is usually constant, regardless of the volume of traffic, it is evident that the greatest proportionate savings can be made by eliminating such positions in periods of minimum traffic, such as that now prevailing.



Centralized traffic control machine on the Southern Pacific

To be specific, centralized traffic control has made possible an annual saving in operators' wages alone of $26,950 on a 40-mile section of the New York Central. Likewise, when the Missouri Pacific installed centralized control on 43 miles of single track between Kansas City, Kan., and Atchison, the removal of 3 interlockings, and the elimination of 14 operators resulting therefrom, enabled an annual wage saving to be effected which was equivalent to 20 per cent on the investment for the centralized control. Again, on a 37-mile section of single track on the Wabash, the release of 8 operators is creating an annual saving in wages of $14,000 annually. Likewise, when the Peoria & Pekin Union installed centralized traffic control on 7.8 miles of line, involving 16 track miles, several interlockings and block offices were abandoned, eliminating 14 levermen and operators, with an annual wage saving of $19,347, equivalent to 20 per cent on the investment involved. Again, a 40-mile installation on the Southern Pacific saves about $10,500 annually in wages for operators and station personnel.

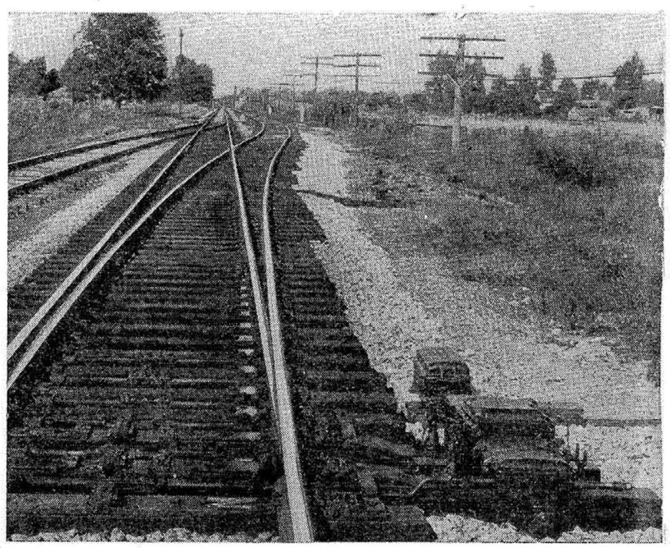
Postponement of Expenditure for Additional Tracks

Another very definite saving made possible through centralized traffic control is the deferment of large expenditures for additional track facilities. On lines where the volume of traffic exceeds the economic capacity, that is, where the business is being moved over the road but delays are excessive, overtime becomes a large item of expense, many block offices are required, and delivery schedules are not met with sufficient regularity to satisfy shippers. In some cases, peak traffic movements cause congestion just at the time when prompt delivery is of most importance. On many such divisions, the physical conditions are such that the addition of another track would necessitate heavy expenditures, and such a program is, therefore, postponed from year to year. Now centralized traffic control offers a solution for such a problem at a moderate outlay.

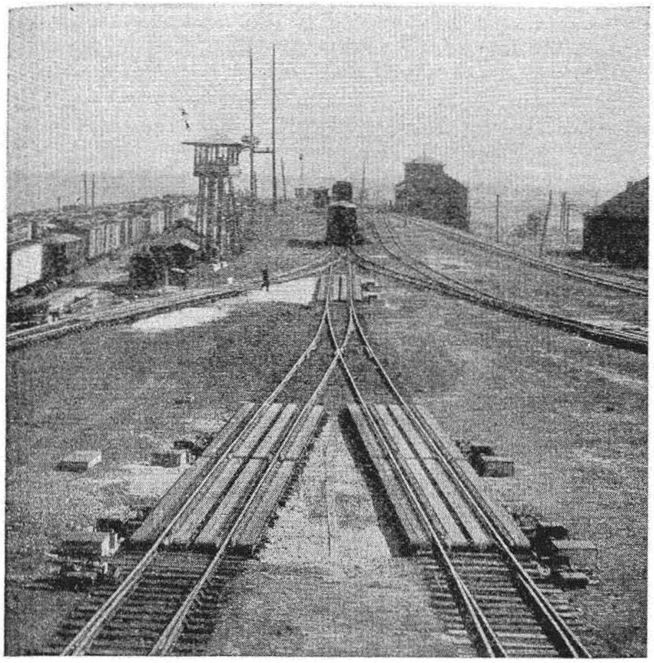
For example, the Southern Pacific handles a peak movement of fruit and vegetables over a 40-mile section of line in California where the installation of centralized control affords so much relief, in the way of improved operation and increased track capacity, that a $2,500,000 second-tracking program has been indefinitely deferred. As another example, the estimated cost of constructing a second track, which was postponed by the installation of centralized control, on 40 miles of the Toledo & Ohio Central, was $2,000,000. Likewise, in 1925, the Missouri Pacific estimated that the revision of the alinement and second tracking of the line between Kansas City, Mo., and Osawatomie, Kan., would cost $60,000 per mile, whereas by installing a system of power switches and signaling for directing train movements by signal indication, the heavy traffic has been handled satisfactorily since that time without the second track.

Elimination of Stops and Waiting Time

Two important characteristics of a centralized control installation make it possible to save time and fuel. In the first place, the use of power-operated switches reduces the number of train stops at junctions, crossovers and passing-track switches. A series of accurate time-distance checks made on the Big Four showed that the use of a power switch to eliminate the stopping of a tonnage train to enter a siding saved an average of 5 min. 36 sec. for each move, while 7 min. 53 sec. were saved when leaving a siding. With power-operated switches, two train-stops are eliminated, and if a non-stop meet is made, the entire meet can be completed in from 4 to 6 min. as is being done, from 4 to 15 times every day, on the Wabash, the Burlington and other roads having centralized control installations. Thus, a saving of at least 8 to 10 min. is made on each such movement. On one 40-mile installation of centralized control, 90 per cent of the meets are non-stop. Of course, the train which runs through on the main track makes about the same time as before, so that the average time saved on typical installations, such as on



Power switch in c.t.c. territory on the Baltimore & Ohio the M. P., the T. & O. C. and the D. & R. G. W., is from 1.4 min. to 1.8 min. per freight-train mile. On the Southern Pacific, the running time of freight trains has been reduced 1 hr. 10 min. westbound and 1 hr. 7 min. eastbound, over a 120-mile sub-division, by the installation of



Car retarders in Potomac yard on R. F. & P.

centralized control on a 40-mile section of this territory.

On one installation an average increase of 217 tons was made per train while the speed was increased 6.5 m.p.h., resulting in a reduction of 59 min. for each freight train on the 42-mile installation. On the New York Central, the saving made possible by a reduction in train delays was computed to be worth $138,850 for one month as compared with a similar month prior to the use of centralized control. On this same territory, the tonnage was increased 2 per cent, using the same locomotives, and this increase, together with the 36 per cent increase in average speed, made possible by the centralized control, led to a 39 per cent increase in gross ton-miles per train-hour.

Another important advantage of centralized control operation, which cannot be seen by comparing train times between terminals, is brought about by the ability to start trains out of a terminal or junction when they are ready to go, the system being so flexible that line-ups can be changed on a moment's notice, whereas, with train-order operation, if a train is not ready to pull out when the dispatcher figured it would, the entire line-up is changed, and it may become necessary to delay the departure an appreciable length of time. With centralized control, which permits close meets and eliminates the necessity for trains clearing the main line several minutes before the arrival of other trains, it is possible to change a line-up quickly and keep trains moving to meet the immediate conditions.

The fuel saving made possible by centralized control is an important item, fuel being saved by the elimination of train stops, by a reduction in the time previously wasted when waiting for meets or for orders, and by getting the trains over the road more quickly, thus reducing the total time that fuel is being consumed. To determine the magnitude of this saving, a study was made of a month's operation on a 24-mile centralized control installation on the Burlington where the traffic included eight passenger trains and six freight trains each way daily. The fuel saved by the elimination of stops for a freight train entering and leaving a siding was calculated to be 500 lb. and for a passenger train, 200 lb., while a locomotive waiting on a siding consumed 200 lb. of coal an hour. For a month after the centralized control was in service, a check showed that 481 freight-train and 35 passenger-train stops were eliminated, which, together with the time spent waiting on sidings, effected a total fuel saving of 230 tons for the month.

Results of Proposed Installation Can Be Calculated

The results to be accomplished by a proposed installation of centralized traffic control can be calculated quite definitely because the factors involved are known quantities. The number of operators to be relieved is definite. Time-distance charts can be drawn from data on the dispatchers' sheets and the same trains can then be redispatched to show the operation under the centralized control system.

Classification-Yard Operations Expedited

REFERRING back to one of the causes of traffic congestion during certain periods, i. e., the delays in classification yards, it will be found that one of the principal sources of delay was the handling of yard switches by hand and the use of hand brakes operated by car riders to control the speed when the cars were running down the hump on to the classification tracks. The car-retarder system, including equipment for the operation and control of the switches, as well as devices for controlling the speed of the cars, was invented about 1921 and was developed as a part of the signaling field. To date, 35 yards have been equipped with retarders and power switches, involving 915 retarders, 57,828 track feet of retardation, 1,099 power switches and 694 skate machines.

The installation of power switches and car retarders in a classification yard of suitable traffic characteristics will make possible a saving in operating expenses of from 18 to 40 cents per car classified, an amount which will ordinarily pay a return of 25 to 40 per cent annually on the cost of the improvement. The tangible savings include the wages of car riders, of switchmen and of engine crews that were eliminated, while the intangible but nevertheless real benefits include reductions in personal-injury claims and in damage to equipment and lading, and the advantage of being able to provide quicker service.

Facilitate Yard Operation

The fact that car retarders facilitate the operation of a yard, results not only in expediting the traffic normally tributary to this yard, but also makes possible the reduction of operating expenses by the transfer