control which would be effective for opposing but not for following moves, although where only one or two signal location layouts are used between sidings, the overlaps would extend within station limits which might introduce certain complications and possible train delays.

Another expedient might be to devise a control arrangement by means of which certain signals would display the Approach aspect normally, and change to the Clear aspect on an approach control scheme, thus eliminating the necessity for extended overlaps. Another solution, which has been proposed for an installation on one road, is to introduce an additional fourth aspect, yellow over yellow as Advance Approach, with overlaps which are effective for opposing moves but not for following moves. With this arrangement, the intermediate signals can be placed opposite rather than staggered, and following train movements can be made on a time-distance basis.

The situation under discussion has been brought about not only by the sections of the rules quoted above, but also by the fact that where train speeds have been increased, the required braking distances also have increased decidedly. Nevertheless, a question arises as to whether this situation justifies any considerable expense for changes and, if so, what changes can be made that will not interfere with train operation. The subject should be discussed thoroughly before further action is taken. Those interested are invited to consider the question on page 615, and send their comments to the editor for publication in *Railway Signaling*.

Interconnection of Train Signals and Crossing Protection

THE inclusion in highway-railroad crossing protection projects of an arrangement of wayside signals which do not display aspects for trains to proceed unless the crossing protection is in operation, represents a practice which is adaptable in solving some serious problems on slow-speed switching tracks, but is highly impracticable as well as undesirable on tracks handling high-speed trains.

The idea of using wayside signals to control switching movements at slow speeds is not only adaptable but also serves to solve certain complexing problems where approach track circuits long enough to secure proper timing control for the crossing protection cannot be used. Such an arrangement, including wayside signals, were installed in 1928 on the Manufacturer's Railway, a switching line in St. Louis, Mo., as described in an article in the February, 1929, issue of *Railway Signaling*. Here, a special push-button control, operating in conjunction with wayside signals, was used on one of the track sections where cars were sometimes spotted.

During 1935, the Michigan Central made a similar installation on a double-track industrial switching line in Detroit, Mich., involving 17 street crossings, as described in the February, 1936, issue of *Railway Signaling*. At some of these crossings involving street car lines, automatically-controlled flashing-light signals direct motor vehicle traffic, color-light type signals direct street car movements as well as vehicle traffic, and color-light wayside signals direct train movements. Time cut-outs and key controllers, operated by standard switch padlock keys, are used to effect special controls. In 1938, the Chicago, Milwaukee, St. Paul & Pacific made an installation at Narragansett avenue in Chicago, involving a crossing with two passenger main tracks, four freight main tracks and six yard tracks. Here the flashing-light signals and crossing gates are controlled automatically by track circuits on the passenger main tracks and on two of the freight main tracks, while manual control is effective for movements on these tracks as well as on the two remaining freight tracks and the yard tracks. Color-light dwarf signals, controlled in conjunction with the crossing protection, direct train movements on the four freight tracks. This installation was described in the July, 1938, issue of *Railway Signaling*.

A further development of this idea of using wayside signals to direct switching movements in connection with crossing protection has been made on the Pullman Railroad, a switching line in Chicago. Eleven tracks are involved in this project and the types of control vary. Where approach control sections of the proper time distance cannot be arranged, very short sections are used. When a movement is to be made, the locomotive or first car is stopped on this clearing section, which causes the crossing protection to be set in operation, but the wayside signal does not clear until after a 20-sec. time interval has elapsed. On one track, cars are spotted up to the street line, thus occupying the clearing section, and the control is set in operation when a derail is reversed.

In some of the European countries, where gates are in service at highway-railroad crossings, wayside railroad signals are so controlled that these signals display Stop aspects normally, and display the Proceed aspect only when the crossing gates are in position to obstruct highway traffic. At least one railroad in the United States, handling slow-speed freight traffic only, made a considerable number of flashing-light crossing protection installations including wayside signals so arranged that Clear aspects would not be displayed to authorize trains to proceed unless the crossing signals were in operation.

Such an arrangement is, of course, impracticable on tracks where trains are operated at high speeds, because train stopping distances are too long. For train speeds of 90 m.p.h. for passenger trains and 50 m.p.h. for freight trains, with a train stopping distance of 7,500 ft., the wayside signal would have to be placed this distance in approach to the crossing. A track section located in approach to the wayside signal would have to be long enough to set the crossing protection in operation, and to afford time for the aspect of the wayside signal to change, as well as to permit time for the engineman to view the signal; thus this section would have to be 2,000 ft. or more in length. The crossing protection, therefore, would be set in operation 93 sec. before a passenger train would arrive at the crossing, and 129 sec. before a freight train arrived. If crossing gates are used and are to be checked in the down position, requiring at least 16 sec. more time-distance in the preliminary section, the time of operation before the arrival of trains would be extended still further. Thus the crossing protection would have to be in operation for a very long period in excess of the standard 20 sec. The conclusion is that, with reference to tracks on which trains are operated at speeds above 40 m.ph., no such provision of wayside signals to check the operation of crossing protection is feasible, because the crossing protection would operate for too long a period.