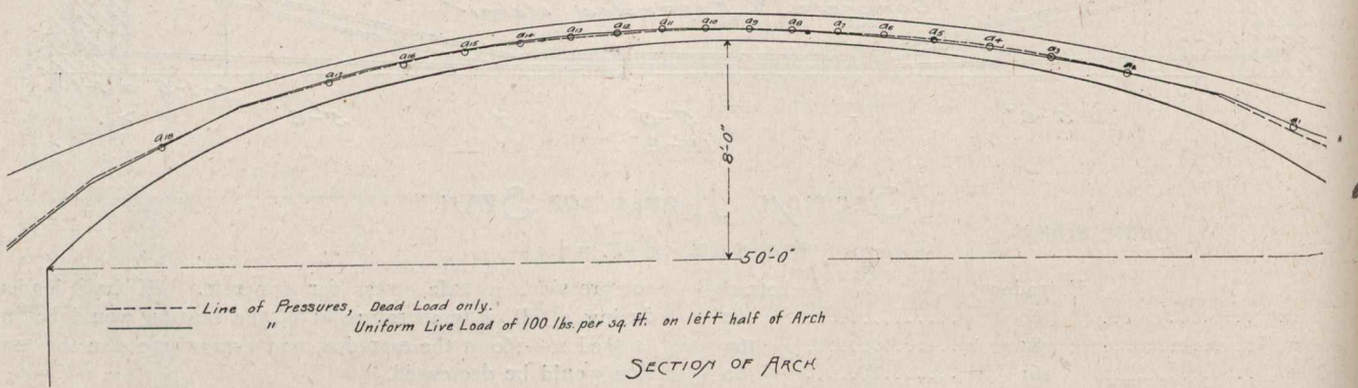
became more important each year, until to-day there is hardly another subject of so great importance to the railway manager. Fundamentally, railway signalling may be divided into two distinct groups. Under the first group come all the devices and means which aim at a general control of train movements over a division of railway, a control such as a despatcher exercises over trains on his entire division. The second group includes all devices and means which aim at a local control of train movements, such as flagmen in the rear of a standing train warning a following train of danger, switch targets, telling of open switches, torpedoes, manual block systems, interlocking plants, automatic block systems, and automatic stops.

Since the invention of the Morse telegraph, practically only one method for the general control of train movements has been in use. which is known as the telegraph train order system. A train despatcher, located at some central office, has charge of train movements on from 100 to 200 miles of road. Telegraph operators located in the stations along the road, ordinarily averaging one to every five miles, inform him of the progress of the trains. When trains have to pass each other along the road, the despatcher telegraphs the operator an order to be delivered to the engineer and conductor of the train, directing them where to meet and pass another train. This system requires a large number of men for its operation, and when any one of these men makes an error an accident will likely result. Precautions were taken against these errors by requiring flagmen to go some distance to the rear of their trains as soon as it stopped. This added another human element, which at times failed. As traffic increased additional precautions were necessary for the local control of train movements, which resulted in the development of the manual block system. In this system the road is divided into blocks of from two to five miles in length, depending on traffic conditions. At each end of a block a signalman is placed. A signalman is not permitted to let a train enter a new block until he first finds out from the signalman at the next station that the previous train has left the block. This method adds considerably to the safety of trains, in that each man's action is checked by another man before a train can proceed. The expense of this system, however, is very heavy, the signalman's wages alone often exceeding over $400 per mile per year, an expense permissible only for the busiest of trunk lines.

Partly to reduce this yearly maintenance expense and partly to eliminate the human element, the failure of which still resulted in accidents, the automatic block system was developed. The aim of the automatic block system is the same as the manual block system; that is, to prevent the entry of a train into a block which is occupied, or otherwise in a dangerous condition. The difference is mainly in that the signalman is replaced by a signal, which is operated by a machine, and this machine is automatically controlled by what is known as the track circuit. The track circuit was invented by Wm. Robinson in 1872, and forms the basis of the modern automatic block system. All the methods mentioned so far for the local control of train movements aim to give the engineer a signal if there is danger ahead of him. It frequently happens, however, that the engineer will not obey such a danger signal for various reasons, and shortly after the introduction of the air-brake numerous inventions were made for automatically applying the air-brakes if an engineer neglected to respond to a stop signal. Nearly five hundred automatic stop patents have been issued in the United States, but only in recent years has any progress been made in this direction. Developments of the last two years, however, indicate that automatic stops will come into use, at least on the more important trunk lines. This question has become of such importance that the Congress of the United States has ordered an investigation of block signals and automatic stops. Congress instructed the Interstate Commerce Commission to investigate and report on the use of and necessity for block signal systems and appliances for an automatic control of railway trains in the United States.

The Commission appointed a special board, known as the Block Signal and Train Control Board, composed of M. E. Cooley, Dean of the Department of Engineering of the University of Michigan; Capt. Hazel Ames, Jr., signal engineer, New York Central and Hudson River Railroad; F. G. Ewald, consulting engineer of the Illinois Railroad and Warehouse Commission; B. B. Adams, associate editor of "Railway Age Gazette." This board has been engaged on this investigation since July, 1907, and I quote the following from the 1907 report made to Congress:—

By the terms of the law two subjects are to be considered: (1) Block signals, and (2) appliances for the automatic control of trains. As the block system proper is now in general use, and information concerning it can be obtained with comparative ease, the board has devoted its attention primarily to the question of automatic stops. In considering the desirability of such devices on railroads generally one of the first problems to be solved is the reliability of the apparatus when its operation is interfered with by snow, ice, or accidental disturbances or obstructions.



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Another problem is the arrangement and regulation of the apparatus so as to provide against failure or inconvenience and delay caused by such irregularities as unusually long or short trains, varying rates of speed, train movements in the reverse direction, and the unexpected stoppage of trains.

The questions to be determined by test are. first, the merit when used in general service of those devices which are already in use in exceptional situations; and second, what merit there may be in the large number of inventions and alleged inventions which have not yet been developed and installed. Concerning the first class a number of concerns are now proposing to make experimental installations, and these, if ready, will be inspected by the board during the coming winter. As to the second class, all but a few of the devices that have been presented for consideration are from inventors who have little knowledge of the present state of the art of signalling, and who appear to have taken little pains to secure the counsel of men experienced in railroad operation.

The use of automatic stops necessitates special equipment on each engine traversing the line where the stops are installed. This is a radical innovation, and involves questions which must be considered with great care. There are two principal methods of communication with the engine, namely, by mechanical trips and by electrical contacts. The relative desirability and reliability of these methods is one of the first questions to be settled. Under this head it will be desirable to investigate certain cab-signal installations in Europe, some of which are of ten years' standing. Cab signals are not automatic train stops, but they use either the mechanical trip or electrical contact in the same way that