tenance than either a watchman or the automatic flagging device. But the gates overcome several difficulties. The gateman is usually in an elevated tower, from which position he commands a view of the track in each direction, and also he can protect the traffic in both directions on the highway. This is especially valuable when there are two or more tracks, as a second train may be approaching a crossing before a train that is passing has yet cleared the crossing. The gate will tend to prevent people on the highway from rushing on the track in the face of the approaching train. The gates extending, as they do, from one side of the highway to the other offer a very distinctive barrier to any approaching pedestrian or vehicle. At night a light is hung on each gate. The gateman is also provided with a gong or bell with which he can warn anyone near the crossing that a train is coming and he is about to lower the gates. Although the gates are sometimes connected direct by means of rods or wires to levers in the gate tower, the most common type is the pneumatic gate. Each gate post contains a set of cylinders, one for lowering the gate and one for raising the gate. These cylinders are connected by pipes to a bipass valve in the gate tower so that compressed air can be supplied to either cylinder as desired. Compressed air is supplied either by a pump in the hands of the gateman or at a very busy crossing by an air compressor operated generally by a small motor. A later type of gate is that operated direct by electricity. A small motor about one-half horsepower is placed in each gate and the circuit connected to a switch in the tower. A double-throw switch is used so as to reverse the current and thus provide for either lowering or raising the gates. In addition to the gates controlled by a gateman in the tower there is now in use at some crossings, where neither the railroad nor the highway has a heavy traffic, a style of automatic gate. This gate, instead of being a solid wooden barrier, as is the other style of gate, is a very flexible protecting device. It consists of a piece of pipe that is lowered to a horizontal position at a point sufficiently high to let the average vehicle pass beneath, but a number of ropes or chains are suspended from the pipe to attract attention to anyone attempting to cross the tracks while the gate is in the warning position. If the gate should fail to raise after the train, the vehicle can pass by brushing aside the ropes or chains.

From the foregoing it will be seen that every crossing of a highway with a railroad at grade requires some protection. The protection afforded the public on the highway depends upon the amount of traffic on the highway, the speed of the passing railroad trains and the local conditions surrounding the crossing.

INTERLOCKING IN INDIA.

In 1903 there were 14 interlocked stations with 60 towers upon the Great Indian Peninsula Railway, while at the close of 1913 there were 270 interlocked stations with 461 towers. Single line interlocking has not been by any means the Great Indian ePninsula Railway's only effort in this direction; 111 miles of double track from Khandwa to Itarsi, with 24 stations and 40 miles of double track from Lonavla to Poona with 10 stations, have also been equipped. Many complicated yards have been dealt with, notably Igatpuri, Bina, Itarsi, Bhopal, Delhi, Muttra and Jhansi. Jhansi is junction of four lines, and the freight working is of a complicated nature; however, the special design adopted, with classifying gridirons, etc., has been found to work well. The passenger yard is completely interlocked. There are three towers—the north with 65 levers; the station with 18 mechanical and 18 electrical levers, and the south, with 77 levers. The four tracking of the lines from Bombay to Kalyan involves interlocking of an interesting character. From Byculla, where the four tracking starts, to Kalyan, where it finishes, there are no less than 81 towers, of which 16 are for through lines, 25 for the local, 22 for freight lines and 18 for combined operation; the total leverage all through working out at 2,164 levers.

ELECTRO-PNEUMATIC TRAIN SIGNAL SYSTEM.

L. N. Armstrong, Pennsylvania Railroad, presented a paper on this subject, an abstract of which follows:

The present standard pneumatic train air signal used on steam trains has its limitations, and its operation on long trains is far from satisfactory. Where large volumes of are are used the signal valve has to be delicately adjusted; considerable time must elapse from the time the cord is pulled until the signal reaches the locomotive; several seconds must be allowed for the wave action of the air to subside and the line to recharge before another signal can be transmitted; false signals are given, caused by leaks in the signal line, even if the signal line is tight at the beginning of the run, as the long cars now in use when going over crossovers swing far enough to cause leaks at the signal hose couplings. These troubles have been overcome by using electricity as an agent to transmit the signal from the cars to the locomotive.

The signal switch, to which the ordinary bell cord is attached, has two wire connections, one for supplying the current to the switch,and the other for conveying the current to the magnetic valve in the cab.

The magnet valve consists of an electro-magnet, which, when energized, unseats a small air valve, allowing main reservoir pressure to flow directly to the whistle. A small spring closes the air valve when the current is off.

The whistle has an adjustable bowl, and is the same as that used with the pneumatically operated signal. When using high main reservoir pressure, it has been found advisable to insert a choke in the pipe connection leading to the whistle, having a 3/64 in. opening, to prevent the whistle from screeching.

A combined car discharge valve and train signal switch is designed to cover the transition period on steam trains. It is the ordinary car discharge valve, having a set of contacts added, and arranged so that when the cord is pulled the car discharge valve is opened and at the same time contact is made so that the signal will be transmitted electrically or pneumatically according to which system is used.

A test train, consisting of an engine and twelve steel cars, was operated for a period of four months, on the Pennsylvania Railroad, with such satisfactory results that the electro-pneumatic signal was recommended to be applied to all new equipment.

The electro-pneumatic signal, whether installed with low voltage battery current, or high voltage line current, is instantaneous in its action, reliable, and can be depended upon to transmit signals correctly and distinctly, eliminating entirely the elapsed time between the pulling of the cord and the signal reaching the engineer, no matter how fast the cord is pulled, or how short an interval is allowed between the blasts. With this signal system it would be possible to have a code in which long and short blasts were used, and thus increase the extent of communication between the train and the locomotive without using a large number of blasts. A test was made in which the signal cord was pulled seventeen times in a period of five seconds, and all of the signals were correctly transmitted.

It is free from false signals, and very economical to maintain, having no rubber diaphragms or hose connections to deteriorate, or any parts requiring expert repairmen for delicate adjustments. The operation of this signal on 90 cars during the past six years has shown its reliability and low cost of maintenance, requiring no periodical inspections.

DISCUSSION

It was explained further that by placing a whistle on each car it would be possible for the engineer to transmit signals to the train crew, which on long trains is of decided advantage, as it is often difficult for the steam whistle signals to be heard from the rear of the train. The air for the car whistles could be taken direct from the train line or auxiliary reservoir and in this way eliminate the signal pipe. If there are no wire jumpers between the cars the wires for this signal could be built in the train line air hose between the inner tube and the outer wrapper.