Electro-Mechanical Interlocking at Trenton

Electric Power for Signals, Manual for Switches; No Plunger Locks, No Detector Bars; Novel Locking

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On account of a change in the arrangement of the tracks of the Pennsylvania at Trenton, N. J., during 1913, the wornout mechanical interlocking of 66 working levers was replaced by an electro-mechanical interlocking, U. S. & S., style P, of 22 working mechanical levers and 28 working electric levers. In considering the type of interlocking to be adopted, it was found that both the installation cost and the maintenance of an electro-mechanical plant would be somewhat less than for other types. The compactness of an electro-mechanical, as compared with a mechanical machine, as shown graphically in Fig. 2, was considered in connection with its operation, and the space saved in the interlocking station. The factor of safety of an electro-mechanical interlocking resulting from the actual mechanical connection between a switch and the lever operating it, and the electrical safeguards which are essential in a power interlocking, applied through the electric levers, was also considered.

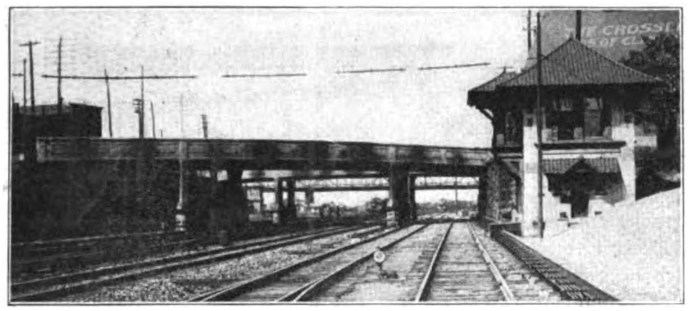

Fig. 1—Pennsylvania Interlocking at Trenton, N. J.—Looking East

The machine is shown in Fig. 3. Indication lights are located below the electric levers to show which track circuits are occupied. A diagram showing the track layout is mounted directly over the machine, and clockwork slow releases are placed at each end of the machine. Mercury slow releases are connected to levers controlling dwarf signals located close to switches.

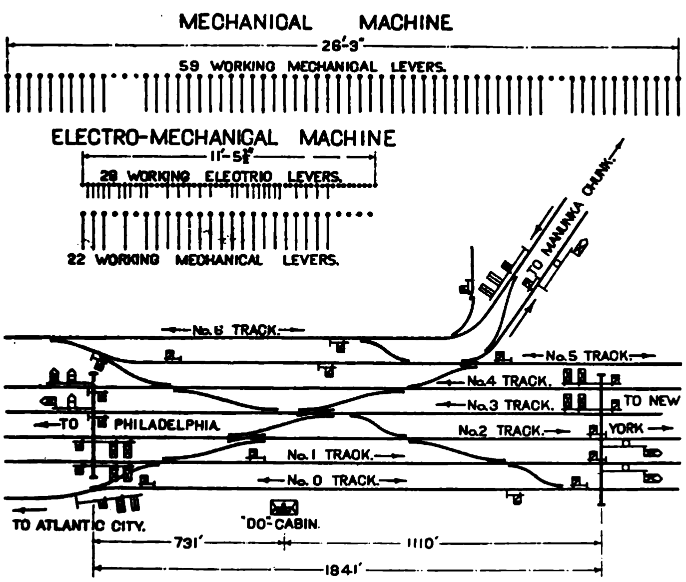

Fig. 2—Trenton Interlocking; Comparison of Old and New Machine

The switches are operated through switch and lock movements, eliminating the plunger facing point locks, detector bars, their pipe connections and levers. This somewhat radical departure from general practice for mechanically operated switches has been found safe and practicable on account of the use of the "indicating lock lever" in connection with the mechanical switch lever. As the function of the indicating lock lever may not be generally understood, its operation is described somewhat in detail with reference to Fig. 4.

The indicating lock lever, when normal, locks the mechanical lever normal at A; when the indicating lock lever is on center, the mechanical lever can be moved and the crossover operated; when the mechanical lever is reversed, the indicating lock lever can be moved from center to reverse position, locking the mechanical lever reversed at A, provided the crossover switches have responded to the movement of the mechanical lever, are locked, and the indication is received. If the indication is not received, the indication lock lever cannot be moved from its center position, and as this lever actuates the mechanical locking and unlocks signal levers only when its stroke is completed, all signal levers are mechanically locked normal and a proceed signal cannot be given. The detector lock prevents the indication lock lever from being moved from either the normal or reverse positions when the track circuits controlling the crossover are occupied, which, in turn, prevents the mechanical switch lever from being moved because it is locked at A.

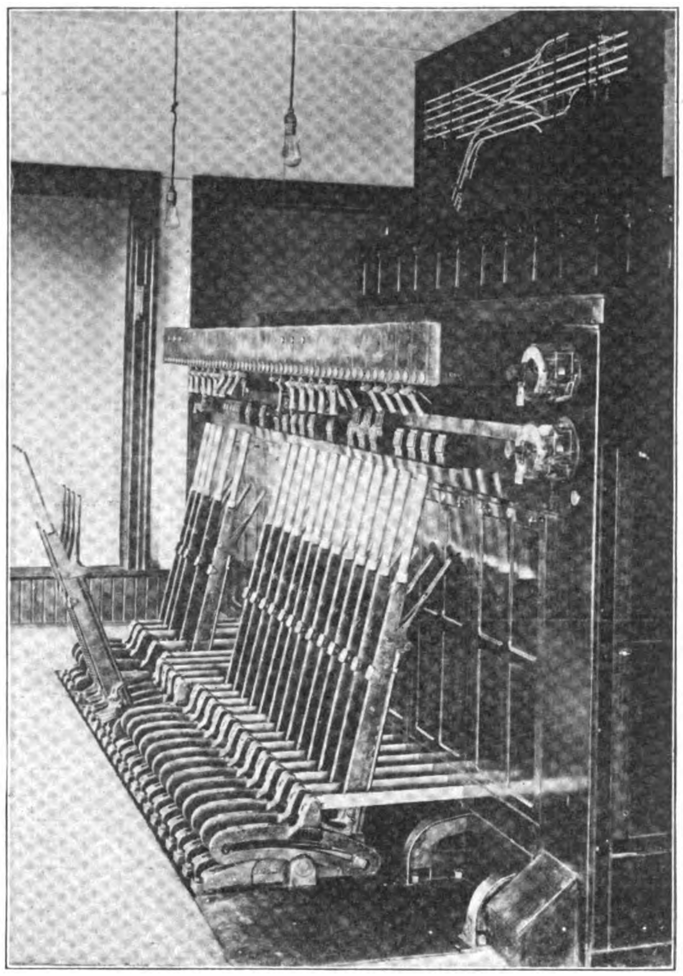

Fig. 3—Electro-Mechanical Interlocking Machine

It will be noted that all vital parts of the machine, namely, mechanical locking, spring combination, indication and detector locks, are actuated by the small levers, resulting in a minimum amount of wear and strain on these parts. The mechanical lever and the pipe connections are merely to transmit the power applied by the leverman to the switch. A counterweight, W, is applied to the tail levers of the mechanical levers to assist in moving the lever to the normal position. As a leverman can apply more power to move a lever to the reverse position than to the normal, it was found that the addition of the weight evened up the effort on the part of the leverman. It was also found that a switch moves easier during the first part of the lever stroke, and the momentum gathered by the weight while moving the lever about half-way helps to carry the switch to

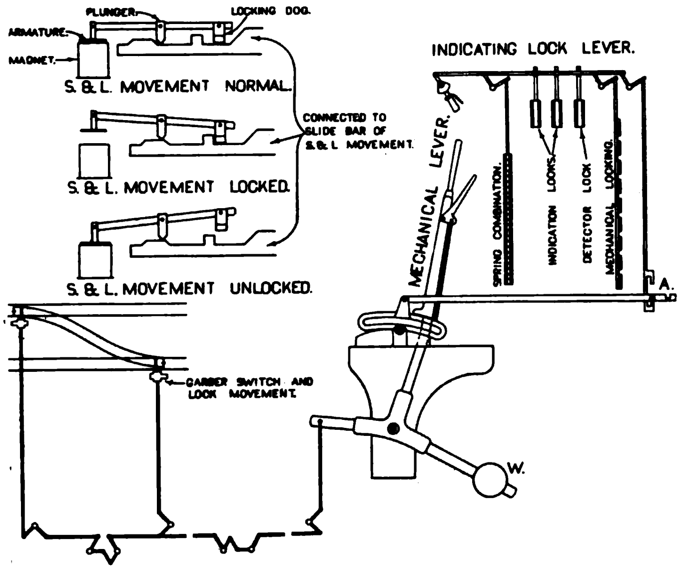

Fig. 4.—Connections of Levers and Switch Movement

the completion of the movement and lock it. In other words, the addition of the weight smoothes out the lever movement in both directions. The furthest crossover at the east end of the plant, between Nos. 1 and 0 tracks, is 1,040 ft. from the machine. It is operated with one mechanical lever and is easily thrown.

The Garber switch-and-lock movement, which was designed for electro-mechanical interlocking, was used for each switch and movable-point frog. The pipe connection to this switch-and-lock movement is in the direction of the movement of the switch, and is operated by a direct thrust or pull on the operating rod of the switch, instead of through an escapement crank or a motion plate. This reduces to a minimum the power re-

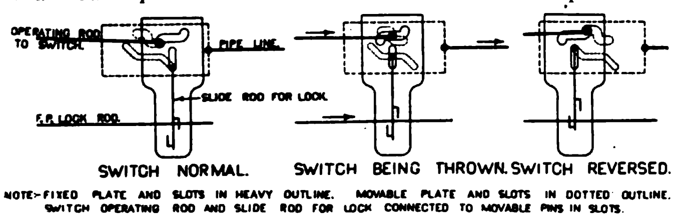

Fig. 5.—Garber Switch and Lock Movement

quired to operate the switch. A diagram showing the mechanical movements for unlocking, throwing and locking the switch, is shown in Fig. 5. A view of this switch-and-lock movement is shown in Fig. 6.

In mechanical and electro-mechanical interlockings, it is possible, although the probability is very remote, that something dragging from a passing train may catch the cross pipe lines and pull a switch open. On account of pipe lines crossing so many tracks at this point, it was thought best to lock electrically the facing point switches which might be pulled open when in the normal position. An electric lock for switch-and-lock movements has been designed to accomplish this. The magnet is de-energized when the indicating lock lever is normal or reversed, and should the pipe line be pulled by something dragging, the first movement of the slide rod would lift the armature and the locking dog would engage the projection on the slide rod, thereby locking the switch movement against further movement. If the indicating lock lever is on center, as is the case when the switch is to be thrown, the magnet is energized, and the first movement of the slide rod would lift the locking dog, allowing the switch to be moved in the usual way.

This electric lock is very rugged. Several tests proved that the pipe line would break should it be caught, and the electric lock still hold and prevent the switch from being pulled open. The same tests were applied on a switch equipped with the usual mechanical connections to see if the plunger lock and lock rod would hold the switch closed if the operating pipe line was

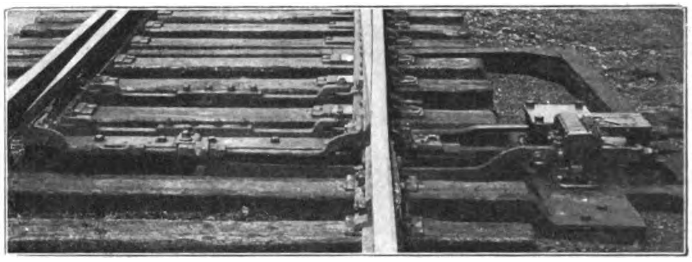

Fig. 6.—Garber Switch and Lock Movement

caught and pulled. The results showed that the front and lock rods bend and the switch can then be pulled open. These locks are only placed on switches where a track intervenes between the switch and the pipe line, and which face the normal direction of traffic. Fig. 4 shows the mechanical movements of this lock.

The electric current is obtained from the 3,300-volt, 60-cycle, underground signal feeders which supply the signal system between Trenton and Holmesburg Junction, about 20 miles. The generators for this system are situated in the pumping station at Bristol, 10 miles from Trenton. Suitable transformers are placed through the interlockings to furnish current for the track circuits and lights. A 14-volt storage battery of 150 ampere hours capacity, charged through a mercury-arc rectifier, furnishes direct current for the signals and indicators.

There are, on an average, 1,350 signal and 1,900 switch movements at this plant each day. The results of two years of service show this type of interlocking to be entirely practicable at a busy point. There are now 44 such plants in service on the Pennsylvania Railroad.

LEHIGH VALLEY'S NEW YORK ORE DOCK

The Lehigh Valley is building at Constable Hook, Bayonne, on New York bay, 5 miles south of the Battery, a long pier which will be the northern terminus of a line of ore-carrying steamships, to be used by the Bethlehem Steel Company to bring iron ore from Chile by way of the Panama Canal. Ore will be brought also from Cuba.

The new pier will be 1,060 ft. long and 67 ft. wide, and there will be a basin 200 ft. wide. A channel which will insure 35 ft. of water at low tide will be dredged. The pier will have four railroad tracks running its whole length, and will be equipped with modern unloading machines, two of them, which can work on one vessel at the same time, each with a maximum capacity of 500 tons an hour, or both together, 300 cars of ore a day.

The site of the new pier adjoins the plant of the Standard Oil Company. Plans of the Bethlehem Steel Company contemplate an annual importation of 750,000 tons of ore from its beds in Chile (Coquimbo). The Chilean deposits of iron ore, grading very high, are said to be the largest known in the world.

The foundation of the pier includes a section of cribbing work 710 ft. long and 46 ft. wide.