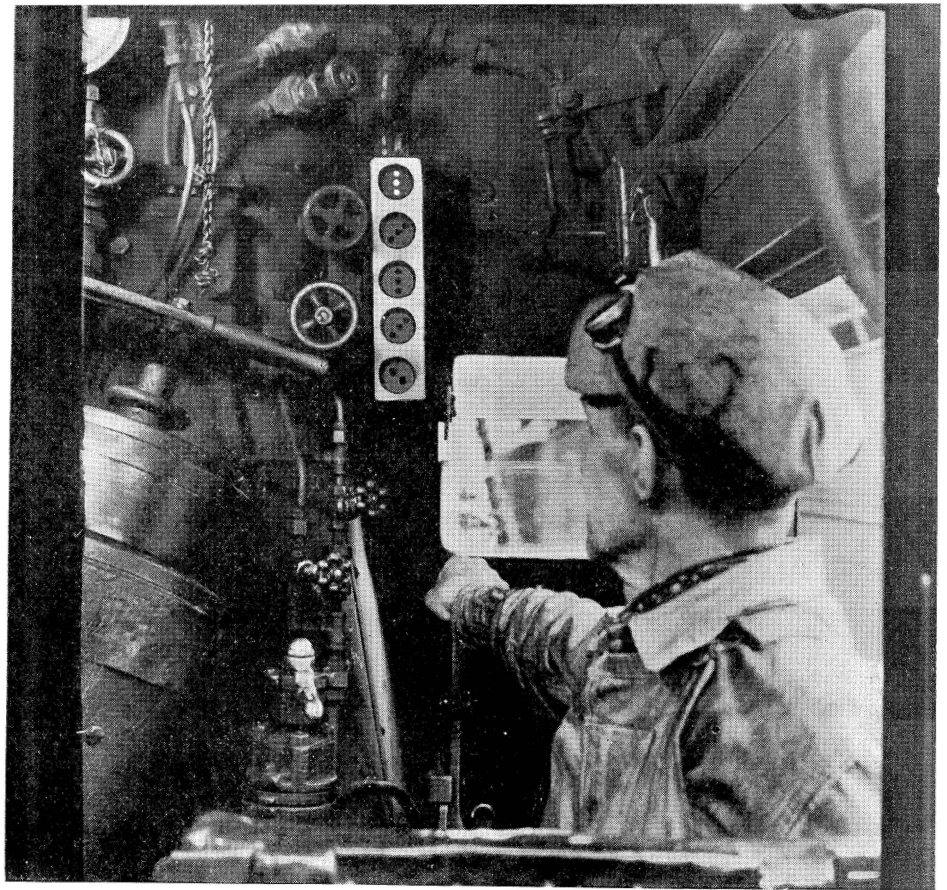


Cab Signaling*



An explanation of the inception, development, and extensive use of cab signals on the Pennsylvania

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IN 1922, the Interstate Commerce Commission issued a tentative order, requiring 49 railroads to equip one engine division each with automatic stop or speed control devices. Under this order, on February 8, 1922, the Pennsylvania presented a proposal for an installation of speed control on 48 miles of single-track line between Sunbury, Pa., and Lewistown.

The requirements laid down by the commission included among others:

1. Automatic train stop: Without manual control by the engineman, requiring the train to be stopped, after which the apparatus may be restored to normal condition manually and the train permitted to proceed.

2. Automatic train control or speed control, which permitted maximum-speed restriction, medium-speed restriction and low-speed restriction—a brake application in each case being avoided if the speed were below a prescribed rate, but, if the low-speed indication were not forestalled by a reduction in speed, an automatic stop would result.

The automatic stop was a simple device, but, as the brakes would be applied without any means of releasing them, whenever a train passed a signal indicating stop, it would be

necessary, in order to stop the train before it entered an occupied block, to provide two stop and one approach signals back of each train. This made it necessary to operate trains with at least one block additional to that in general use between trains, or, using the usual signal arrangement, where trains would receive an approach signal and then a stop signal if the block ahead were occupied, the automatic stop device would have to apply at each signal indicating approach, and a train, instead of reducing to one-half authorized speed at the distant signal and approaching the home prepared to stop, would have the brake applied every time it passed a distant signal indicating caution or approach. It was, therefore, quite clear that, under these requirements, the only device under which the Pennsylvania could operate its heavy-traffic main-line divisions was some type of speed control.

Cab Signal Came As an Accessory

The device installed on the Lewistown branch was known as the loop system, the control current passing through the rails and returning on the line wire known as the loop. As

the Pennsylvania signal system was based on three speeds, high, medium and low, the three-speed train-control system was particularly applicable and was chosen for this reason.

When the design of speed-control apparatus had been practically completed, the signal company representative asked us if we wanted a cab signal, which would indicate a few seconds before the apparatus on the engine started to apply the brakes, there being a certain time delay between the operation of the relay and that of the brake applier. We were advised that the cost would be only that of the cab signal itself and a little wiring, as the apparatus for operating it was already in place to work the control apparatus. We thought it would not do any harm and might be of some advantage to the engineman by giving him a slight advance warning of what was about to happen, and, as the purpose of the installation was to develop everything possible in connection with the problem, cab signals were installed. The indications given were "A", Authorized; "R", Restricted; and "S", Slow.

*Abstract of a paper presented before the New England Railroad Club, Boston, Mass., on April 14.

It was decided that, although not required for the operation on the Lewistown branch, we would arrange the installation for three-block control down-grade and two blocks up-grade on the same track, restriction on curves, enforcement of slow speeds through two towns, in conformity with local ordinances, and automatic cut-in and non-automatic cut-out, at the ends of the equipped section. In fact, every complication and condition to be met on our system that we could think of was reproduced, except only the effects of brake applications on heavy freight trains.

The installation was made without wayside signals except those located where it was necessary to stop and hold trains, and these signals indicated either stop or proceed. On the western half of the branch, what was known as the modified A.P.B. system was installed, by which the train itself, if the conditions were right, set up the combination by which it would receive clear signals, and an opposing train, stop signals; while on the eastern half we used what was known as the dispatchers' remote-control system, by which the operator at Sunbury set up the proper combination in the wayside apparatus. This was the forerunner of the centralized traffic control now in use on several railroads, including the Pennsylvania.

From the foregoing it will be seen that the cab signal was a by-product of the speed-control devices, being developed in connection with this speed control. The installation on the Lewistown branch was completed and placed in service on July 11, 1923.

Use of Foretaller Permitted

On July 18, 1924, the commission changed its order covering the automatic train stop, which read "Without manual control by the engineman requiring the train to be stopped, after which the apparatus may be restored to normal condition manually and the train permitted to proceed," by adding an alternative paragraph reading as follows: "Under control of the engineman who may, if alert, forestall the application of the brakes by the automatic train-stop device and control his train in the usual manner in accordance with hand signals or under limits fixed by train order or prescribed by the operating rules of the company."

This changed the entire picture as far as the automatic stop was concerned, in that, by forestalling, the "double red" or the non-release brake application at the distant signal was not required. It has been and is the feeling of our people that the control of the train should not be taken away

from the engineman, if he is alert, and that any device which did so remove his control and applied the brakes in the same way, regardless of the speed, size or weight of the train, was undesirable.

Under the revised ruling, the automatic stop was less objectionable in that the engineman, if he were alert, could prevent it from operating, and the experience on the Lewistown branch had convinced many of us that the cab signal was the real answer to the problem, because it would tell the engineman the conditions ahead, advising him of any change, and permitting him to control his train as his judgment dictated. The installation on the line between Baltimore, Md., and Harrisburg, Pa., authorized on January 14, 1925, was begun in April, 1925, and had to be completed by July, 1926. Therefore, the same system was installed as was used on the Lewistown branch, except that, instead of the speed control, stop and foretaller apparatus was placed on the engines, the wayside apparatus being identical, and except that we were permitted to equip one locomotive with two cab signals, one for the engineman and one for the fireman and substitute a whistle for the automatic stop. The whistle was a small one and only sounded for a short time whenever a more restrictive indication was displayed.

Coder System Developed

Meanwhile, the Union Switch & Signal Company had developed what is known as the coder system, which required very different engine and wayside apparatus, and provided four indications instead of three, in the cab. This was tried out for the first time on a specially equipped MU train on the Philadelphia division on July 15, 1926, the wayside apparatus being superimposed upon the existing signal installation. The results were so satisfactory that it was decided to use this scheme on the West Jersey & Seashore between Camden, N. J., and Atlantic City, and on the P. C. C. & St. L. between Columbus, Ohio, and Indianapolis, Ind.

On January 14, 1924, the Interstate Commerce Commission ordered additional installations, the Pennsylvania selecting the Middle division, Harrisburg, Pa., to Altoona, and another division on the P.C.C. & St. L. between Pittsburgh, Pa., and Newark, Ohio.

Early in 1927, a voluntary installation of cab signals, with whistle and acknowledger, was recommended on the New York division; it was finally

placed in service between Manhattan Transfer and Millham Junction on December 10, 1929, and between Millham Junction and Philadelphia on August 4, 1930.

Cab Signal Recognized by I.C.C.

Early in 1929, following an accident at Short Lane on the Maryland division, the Interstate Commerce Commission suggested that we consider automatic stops or cab signal installation in this foggy territory, this being the first time they recognized the cab signal as a proper device to suggest. Cab signals from Philadelphia to Washington, D. C., were authorized on February 27, 1929, and completed from Baltimore to Washington on January 15, 1930, and the installation from Philadelphia to Baltimore entirely completed on February 8, 1930.

In order that our engines equipped with cab signals, stop and foretaller, operating between Pittsburgh and Columbus, might have this protection throughout the run, wayside apparatus was placed in service early in 1930 between Newark, Ohio, and Columbus on the C. & N. division of the Baltimore & Ohio. The installation on the Pittsburgh division was completed on November 16, 1930. Meanwhile, the New York & Long Branch equipped its line from Woodbridge Junction to Bay Head Junction with four-indication cab signals, stop and foretaller, placed in service on May 31, 1928.

On March 26, 1935, wayside apparatus was placed in service on the Perth Amboy and Woodbridge branch, filling in the gap between New York and Bay Head, and on May 3, 1935, work was finished on the freight line from Landover, Md., to the north portals of the Virginia Avenue tunnel, Washington, D. C.

We now have cab signals on our main line from New York to Washington, from Atlantic City to Camden, and from New York, Atlantic City, Philadelphia, Baltimore and Washington to Indianapolis, except between Philadelphia and Harrisburg, and our alternative line through Dayton (between Pittsburgh and Columbus); also from New York to Bay Head via our line and the New York & Long Branch, and on the Long Island from New York to Port Washington, N. Y. and Jamaica to Babylon.

Cab Signal and Whistle Replaced Automatic Stop

On February 6, 1931, the Interstate Commerce Commission granted
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The control and operating circuits are fed from primary battery

enced since the automatic plant was placed in service than when the mechanical plant was in operation. The changeover was made by the signal forces of the T. & N. O., the out-of-pocket expense being \$1,567, as compared with an annual saving in operating expense of about \$5,000, which is being effected. The plant is maintained by the T. & N. O. The

maintainer, who is located at Nacogdoches, 90 miles away, arranges his schedule to inspect the plant at least once a week.

The signaling equipment required for the changeover, including signals, relays, etc., is of Union manufacture. Edison primary battery is used, and the new wire and cable is of Kerite manufacture.

Cab Signaling

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us permission to operate cab-signal (whistle and acknowledger) equipped locomotives, if used in inter-divisional runs, over territory where the automatic stop had been ordered in, and on December 12, 1932, permission to remove the stop and forestaller from all locomotives, substituting therefor the whistle and acknowledger. This work was started at once, with the result that on February 15, 1933, all active equipment was in operation with the Union Switch & Signal Company's coded continuous automatic four-indication cab signals, with whistle and acknowledger.

The acknowledging device was the same as that required for the forestalling of the automatic stop, but, instead of the latter, a deep-toned whistle was provided and the circuits so arranged that, whenever the cab signal changed to a more restrictive indication, the whistle would, sound

and continue to sound until acknowledged by the engineman or fireman. The same action was required to acknowledge the signal as to forestall the stop.

Only one cab signal per engine was used on the Lewistown branch and but one signal was also used in the loop system between Baltimore and Harrisburg. When the coder system was adopted on the W. J. & S., giving indications: "Proceed," "Approach Restricting," "Approach," and "Caution Slow Speed," it was decided to put in two cab signals, one for the engineman and one for the fireman, and this has been the standard since.

Code Developed for Control of Wayside Signals

There usually are two types of current in the rails, a-c. 60-cycle or 100-cycle constant, or d-c. for operating

the signals, and the 100-cycle interrupted current for operating the cab signals; and, in such cases, two sources of supply are used, except where all is 100-cycle. The original coder system had been designed for operating wayside signals, but this was lost sight of largely on account of the necessity of developing the cab signal apparatus for electrified territory. However, after this development was finished and there was time to go further, the Union Switch & Signal Company engineers attacked the problem of operating the wayside signals and the cab signals from the same interrupted code current in the rails, and, on March 12, 1933, the first installation of this system was made on the Philadelphia terminal through the Pennsylvania station at Thirtieth street, using d-c. apparatus, except in the track circuits and the a-c. code-following relay.

As a result of this test, the coder system, operated with d-c. track circuits and storage battery standby service, with a-c. code imposed on it, was installed between "Lewis" and "Jacks," 24.3 miles, on the Middle division, and placed in service in December, 1933. The coder system, using a-c. track circuits, for operating both wayside and cab signals, is now in service between Wilmington and Washington*, except through interlockings where 100-cycle coded circuits are superimposed on the 100-cycle a-c. track circuits—the cam shaft, however, making 15 instead of 20 revolutions per minute and producing a 75 instead of an 80 code. A great advantage of this system is the almost total elimination of line wires except at interlockings.

Double-Heading Feature Developed

Our motive power people developed another important improvement, by arranging the apparatus so that cab signals are now operative in the second electric engine of a double header or even on a third or fourth engine coupled. The cab signal, supplementing and co-ordinated with the fixed signals along the road, is a great help to the engine crew, especially in fog or storm when the wayside signals may be partially obscured some distance away; by changing its indication if conditions change, it expedites traffic if an occupied block ahead is cleared. It also provides an added safeguard if track ahead is obstructed after a train has passed a wayside signal indicating proceed.

*For explanation of this installation see page 205 of *Railway Signaling* for May, 1935.