A History of Flashing-Light Crossing

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WE have been living with a system of signaling for highway crossing protection that is fairly consistent throughout the country. Do you recall that the equipment standards were exactly 20 years old last September? And do you realize that in this time there have been continuous refinements in details of design that have made the equipment progressively better? A review as to why we have flashing-light signals, how they are made, and what they can give you when made and maintained properly, might be of interest.

In the horse-and-buggy days, simple crossing signs, such as "Stop-Look-and-Listen" or "Look out for Locomotive", were adequate. These signs were soon being supplemented and in many instances replaced by signs, more or less arranged in the form of a cross-buck, apparently to simulate the crossed bones of the "Grim Reaper's" label, but these told only of the presence of a "Railroad Crossing", leaving the rest to one's imagination. With the increasing speed of trains, and because many crossings were so located that the highway driver's view of approaching trains was restricted, better protection was needed. Warning bells with a loud distinctive tone were installed, operated automatically by the approach of a train. Later, a magnetically-operated swinging red banner was added to the usual bell warning, and the swinging banner carried a red light for night indication.

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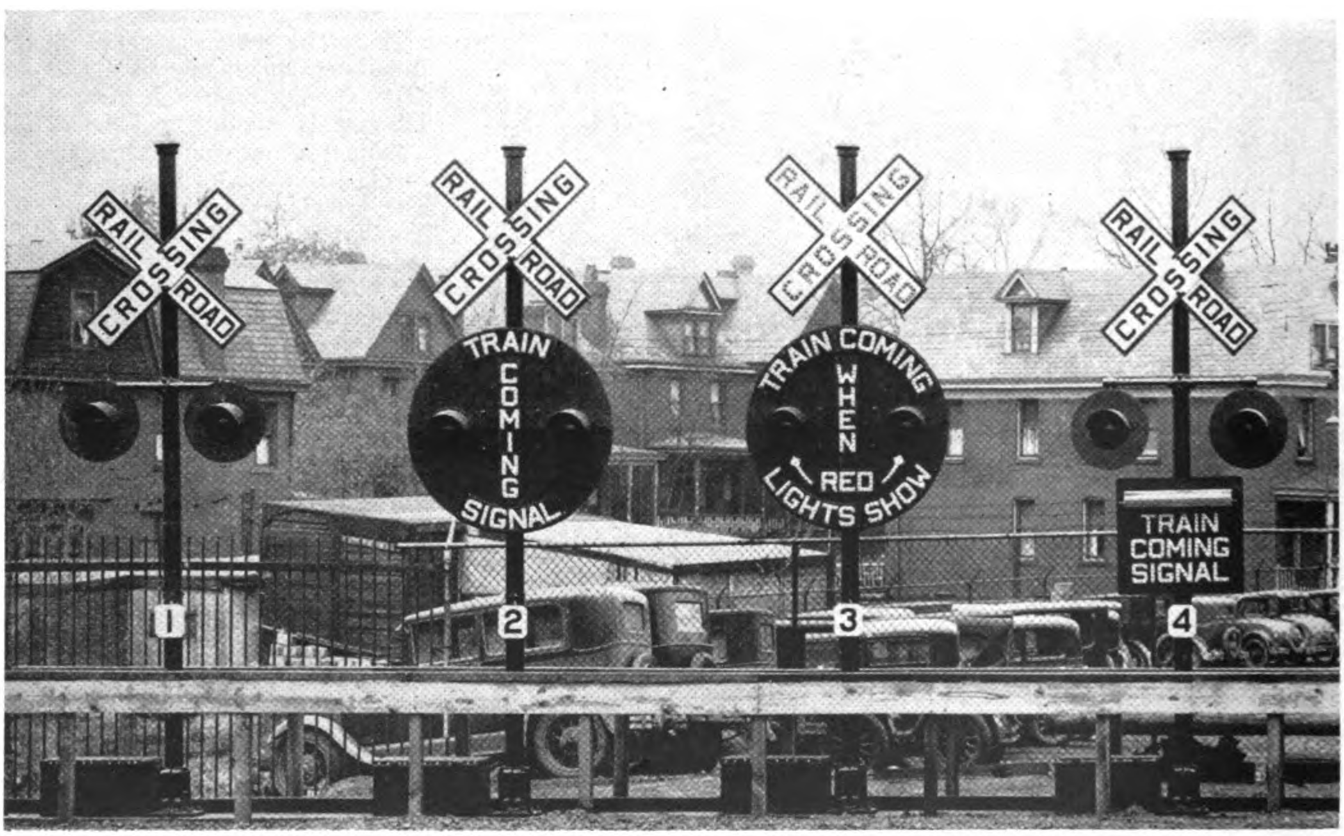
Improved Highways Bring Problems

With the coming of paved roads and the general use of the automobile, man's zone of highway travel was vastly increased. Many new and novel devices were developed and installed with the intent to provide greater protection against the increasing hazards at railroad crossings. The Signal Section of the Association of American Railroads attempted to provide standardization for this equipment by recommending in 1923: "That an electrically or mechanically operated signal used for the protection of highway traffic at railroad crossings shall present toward the highway, when indicating the approach of a train, the appearance of a horizontally swinging red light and/or disc".

Survey In 1930

In the period from 1923 to 1930, most of the new devices included some form of flashing red light. Some were definitely startling and attempted to scare the driver into obeying the warning of a train approach, or even to wreck his car if he failed to stop. The Signal Section of the A.A.R. made a survey in 1930, and found more than 60 different devices being used on the different railroads. As a result of this study, and the growing need for standardization, a joint committee was formed in 1930 of representatives from the Operating, the Safety, the Engineering, and the Signal Sections of the Association of American Railroads. They found that



Picture of exhibits at the 1930 Union Switch & Signal Company develop-

Signals — What They Are and Why*

two signals were more widely favored than any others—the wig-wag and the flashing-light. They recommended that those signals be adopted as standard.

Since 1930, the wig-wag type has rapidly dropped out of the picture for new work, and now we see practically 100 per cent use of the horizontal two lights, alternately flashing. The rotating "STOP" sign is used in some states, and short-arm automatic gates in all states, but these are classified as adjuncts—for use supplementary to the standard flashing two lights. The automatic short-arm gates first appeared in July, 1936, and in 10 years reached a record of being installed at 1200 crossings on 71 railroads. In 1948, there were 775 new gate installations, in 1949 there were 945, and in 1950 there were 1,109.

Naturally, during all the development years the question has been frequently raised, and still is, as to which is the best kind of crossing protection. It would seem that to be the best it would have to be the one that would more often prevent accidents at the crossing. All will agree that it must be a signal that is easily seen and recognized. It will not be of any value if nobody knows what it means. It must be reliable and easy to maintain in

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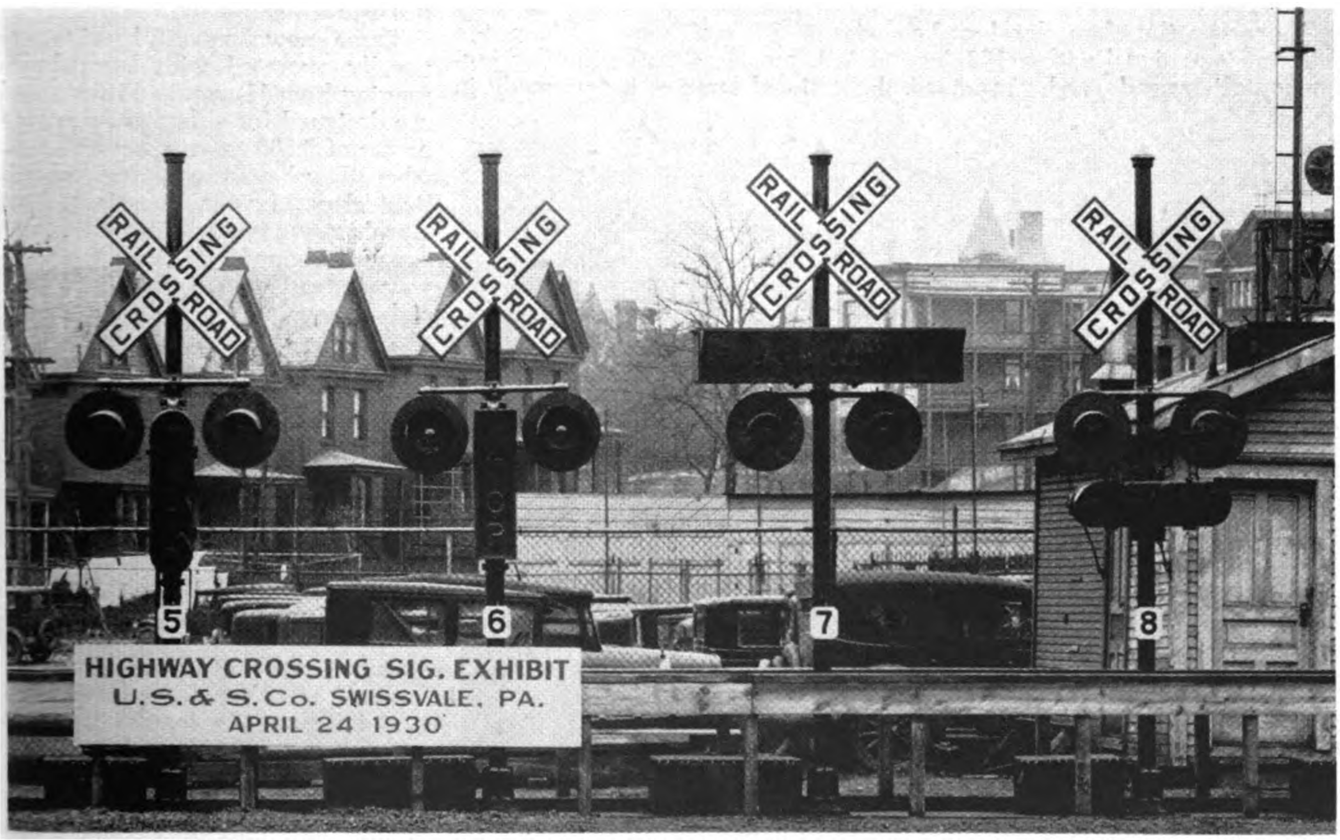
proper working condition. This all adds up to require a uniform standard signal for use throughout the country. The flashing-light signal as now made and covered by A.A.R. Signal Section requisites, drawings and specifications fulfills all these requirements for a basic signal used alone or in conjunction with gates.

History of the Signal

Actually the first flashing-light signal for highway crossing protection was installed by the Central Railroad of New Jersey in 1913 at Woodbridge Ave., Sewaren, N. J. The Union Switch & Signal Company has been a pioneer in the design and manufacture of railroad signal equipment and systems since 1881, and, since we naturally take an active part in the development of signals for highway crossing protection, we are pleased to be able to tell you something about the developments during the more recent years.

The light units that were used from 1913 to 1923 were very simple devices with small lenses 5-⅜-in. in diameter, not very efficient optically, but still adequate for the slow speed and smaller volume of traffic that existed at that time. The use of this signal was extended rapidly by many railroads to all parts of the country. The extended service ex-



ment study, prior to the highway crossing signal standardization

perience soon revealed a need for much stronger lights, and this brought forth an 8-⅜-in. diameter optical doublet lens assembly in 1923, the same efficient type that was developed for railroad color-light signals. The beam pattern was spread only 8 deg. horizontally at first, and then was changed to 30 deg., and with this a range in daylight of 300 ft. was considered satisfactory. The red color was made a little paler than for railroad signals so as to get more light through a wide angle.

This design was popular from 1923 to 1928 and was recognized as being practically free from phantom. However, it soon became obvious that with the rapid increase in the volume of automobile traffic, and the high speeds on highways, that more light (a stronger indication) was necessary, and also that some definite improvement to the close-up indication was mandatory. The only way to obtain stronger light was to use a different optical system, namely, a reflector instead of a lens optical system, and the only way to improve the close-up indication was to design a special cover glass. This was practicable with a reflector optical system, but not for a doublet lens system, unless an exorbitant amount of power was used in the lamp bulb for the lens system.

Reflector Type

There was, therefore, developed a reflector type signal with a 160-deg. horizontal spread and improved close-up indication, known as the HC-5, in 1928, and in 1930 there was made available the HC-7 which was similar to the HC-5, except that it had a 5-⅜-in. diameter backlight attachment, to enable the automobile driver to obtain his close-up indication by viewing the back of the signal located on the opposite side of the railroad crossing. Even with the improved close-up indication available on the main cover glass for the HC-5 and HC-7, automobile traffic required the additional signal indication from the other side of the crossing.

It was considered by all parties consulted at this time that the improved indications obtainable through the use of the reflector optical system were so necessary and desirable that the greater vulnerability to "phantom" might not be too serious so long as suppression devices such as the phankill could be developed for application to vulnerable locations without too much loss in range.

Demands for stronger indications for main light units as well as backlight units resulted in the appearance in 1935 of the HC-81 with a 30-deg. spreadlight cover glass, and its use for both the main indication and the backlight indication. A.A.R. requisites were changed about this time to call for a 1,500-ft. minimum range instead of 300 ft., and to require that this range be obtainable with a 10-watt lamp. When the A.A.R. specification for the flashing-light signal lamp unit was made in 1940, it was based upon this type of unit, and included a requirement that it should be made so that a suitable device could be added in the field to minimize the effect of phantom.

This HC-81 unit without phankill, and with an 11-volt 11-watt lamp, produces a range of 3,200 ft. on the axis, 2,500 ft. at 10 deg. off the axis, and 1,100 ft. at 15 deg. off the axis, and the addition of a phankill merely reduces the range of the unit only 10 per cent to 2,900 ft., 2,300 ft., and 1,000 ft., respectively. The range even with the phankill is more than adequate to meet A.A.R. present requisites.

Back-to-Back Mounting

When the more powerful units became available, there also was established the practice of having four of these units face approaching traffic, two on the near side of the crossing to the right of the highway and two on the far side of the crossing and the highway. With this arrangement, where every signal has a back-light, there can be no excuse for a driver to miss the light. If stopped so close to the near signal that he cannot distinguish its flashing, while waiting for a train to pass, he can still see the lights from the other side of the crossing flashing if, after the train passed by, there would be another train approaching on the second track.

These new, powerful units are usually operated with lamp bulbs ranging from 11-watt to 18-watt, and are designed for a daylight range in excess of 3,200 ft. with these lamps, when they have the 30-deg. spreadlight glass. In some locations these signals are mounted on cantilever supports about 20 ft. above the highway, instead of the usual 8 ft. Special glassware is usually used with these so as to spread the light more effectively for the changed conditions.

Minimum Range

The minimum range of the signal beam throughout all angles of spread sideways and downward is given now in careful detail for the various types of roundels used for standard and special purposes. It appears in A.A.R. Signal Section Specification 190, Manual Part 166, for the reflector type unit. It is also detailed in the doublet lens unit specification 232, Manual Part 244. These range figures are based on 10-watt lamps for the reflector type and 18-watt lamps for the doublet lens type (10-watts not practical). The

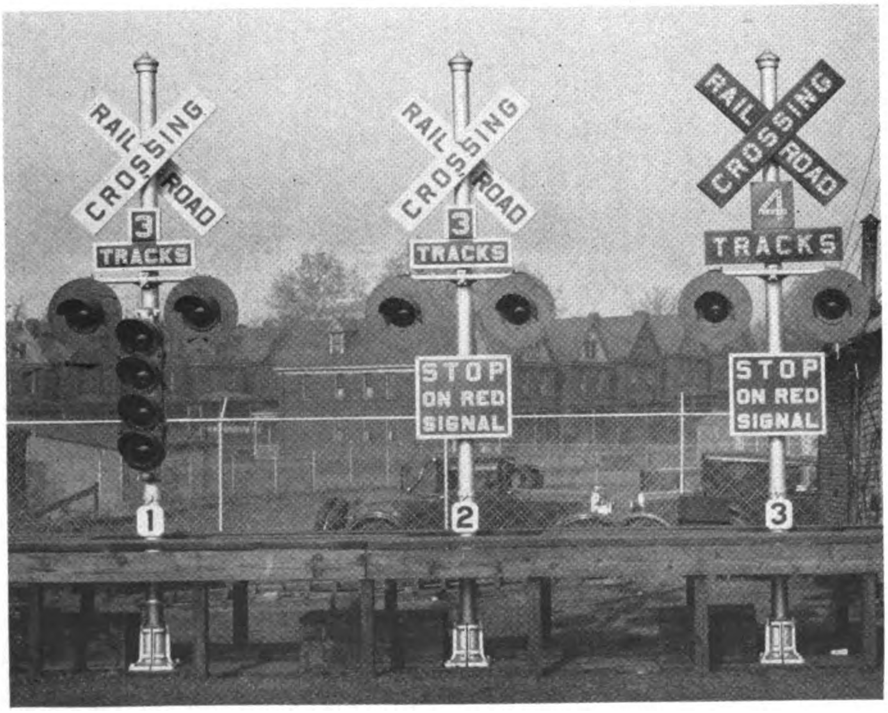


Exhibit in 1932 preliminary to final establishment of Signal Section Standards

reflector units in service are mostly with 18-watt lamps. All of these light units have clear side light windows to direct a light down the track so that the railroad engineer can observe that they are working for his train. It is a practice on many railroads to require the engineer to report the failure of any of these flashers as he observes them while approaching or passing the highway.

The light beam is produced by a small lamp with a concentrated filament positioned accurately at the focal center of a special shallow parabolic reflector. The reflector is made of polished glass, silvered on the back. This silver coating is covered by a heavy copper coating for protection, then treated with a high quality baked enamel. The light projector converts the light from a 15-c.p. lamp bulb into a concentrated beam of light with over 50.000 beam candlepower before it passes through the red glass. The colored glass roundels are uniform and reliable as to color, being made and checked to Highway Crossing Red standards as set up bv the joint action of the A.A.R. and the National Bureau of Standards in Washington.

Standard Spacing

The units are always spaced 30 in. apart, and each one carries a 20-in. diameter background. These two features assist materially in providing a distinct signal at a distance. The alternate flashing is standardized at 30 minimum to 45 maximum flashes per minute. It is accomplished bv a flasher relay designed for reliability and long life and operated bv 10 or 12 volts d.c. Each of these relays includes, as standard equipment, a small rectifier suppressor for radio interference due to the coil operating circuit. There is seldom any interference from contact operation, but if it does appear there is a capacitor suppressor available. If for some reason the flasher relay should fail to start operating when intended, one of the signal light units in each pair will be lighted steadily in accordance with modern circuiting. In some of the earlier circuits all the light units would burn steadily under this condition. This explains the reason for the reflector button sign which says "Stop on Red Signal". If the red lights are displayed either flashing or steady one can expect to find a train approaching the crossing.

If the power for the flashing-light lamps is normally 60-cycle a.c. with the transformer voltage stepped down to 10 or 12 as required for the lamps, these same transformer taps that operate the lamps should also energize a "power-off" relay, so that the auxiliary power source will be connected to the de-energized contacts of this relay in such a manner that it will serve to operate the lamps just as soon as the commercial power gets too low in voltage for good lights or is off for any reason. The reserve power for this service is usually a battery of such capacity that it can operate the lights as required for 24 hours, and means are usually provided for keeping the battery fully-charged so long as the commercial power is on.

"No Left Turn" Signal

Many locations, where a street or road parallels the railroad, are being equipped with the relatively new "no-left-turn" and "no-right-turn" signals which do not add much complication but do simplify the signaling problems.

When adapting crossing protection to the various kinds of traffic operated on most railroads, serious consideration must be given to the problem of unnecessarily delaying highway traffic. At crossings where local switching work is performed or trains regularly stop at stations or to take on fuel, this matter becomes quite acute. Various ways of cutting out the operation of crossing warning devices are available ranging from automatic time cut-outs to elaborate schemes of manual or auto-manual supervisory control. In highly congested areas (with respect to both highway and railway traffic) some roads have seen fit to furnish an indicator for the benefit of engine crews to serve as a warning that the protective devices have been "timed off". Automatic means are always provided to restore the cut-out features to normal after they have served their purpose.

A variation of the time cut-out may be used where there is a large variance in speed between the fastest and slowest trains operated over a crossing. This variance in speed usually results in extraordinarily long warning device operating times for the slower trains in order to meet the requirements for the faster trains. To meet this situation a measuring track circuit or a series of such circuits can be provided to select the proper warning time within certain predetermined speed ranges for all trains operating over the crossing. Many roads have found some form of this scheme, arranged to select between two or three speed ranges, very effective and have received the hearty approval of the public.

Obedience to Signals

In closing, may I submit the suggestion that one important factor regarding this subject might be to continue with the fostering of a better understanding, on the part of the public, of the purpose and problems of the railroads in providing adequate crossing protection.

All railroad employees and particularly signal department personnel should explain to their fellow townsmen such things as the advantages of closing certain crossings in order to provide better over-all protection, and the hazards to the public and to freight and passengers in careless disregard of warning signals. You should continue to support safety education programs in local public schools. Local service and business groups might well sponsor such programs in their communities.