



# Highway Crossing Protection in Theory and Practice

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A NUMBER of investigations have recently been made to ascertain the care used by travelers in passing over railroad crossings. One made in St. Louis for a period of 48 hr. showed that of 1286 pedestrians, only one stopped and looked in both directions before proceeding over the crossing; two persons looked in both directions but did not stop; 9 per cent looked in one direction only, while 88 per cent did not stop or look to the right or to the left; also 91 per cent of the drivers of 2931 autos failed to stop or look in either direction. Tests made on crossings in other parts of the country have showed similar results. These conditions may account for the numerous highway crossing accidents and information from the National Safety Council shows that one person has been killed and three people injured for every two accidents. Because of the numerous accidents the problem of protecting highway grade crossings is one of first importance.

The ideal method of eliminating the danger of two objects coming in contact with each other is to provide paths which do not conflict. This means separation of grades. However, a recent estimate made for one state indicated that the average cost of separating grades would be \$50,000 and the cost thereafter for maintenance, depreciation, interest on investment, etc., \$4,000 a year. If applied to all crossings in the one state in question this would involve an expense of \$170,000,000 which would more than double the investment in those railroads.

In recommending other protection, people forget that they are building up a cost which in some cases may approximate that of grade separation in the way of operating expense. In comparing the costs of different types of protection we find that a crossing sign approximates \$20 expense and practically nothing for maintenance; a crossing bell, \$1,050 for installation and \$200 for maintenance and operation; an automatic flagman and bell, \$1,200 for installation and \$250 for maintenance and operation; an eight-hour flagman costs an average of \$1,070 per year, chargeable to operating expense, while 24 hr. flagman service costs \$3,170. At this point the cost of grade separation is being approached rapidly.

Crossing gates with flagmen, at an annual cost of \$3,315, may be compared with \$4,000 for the average cost

of grade separation. The public has no compunctions at all about requiring a railroad to put on flagman service, but it feels no obligation whatever towards paying a portion of that expense. It is becoming educated to a certain extent to the fact that grade separation is a joint benefit to the public and to the railroad and in some instances is willing to pay a portion of the expense. New York and some of the New England states for some years have had laws requiring the railroad to pay one-half the expense of grade separation, the municipality or township one-quarter and the state one-quarter. Under those circumstances, the cost to the railroad would be considerable less on an average for grade separation than it would be to put in a 24 hr. service flagman or gate protection.

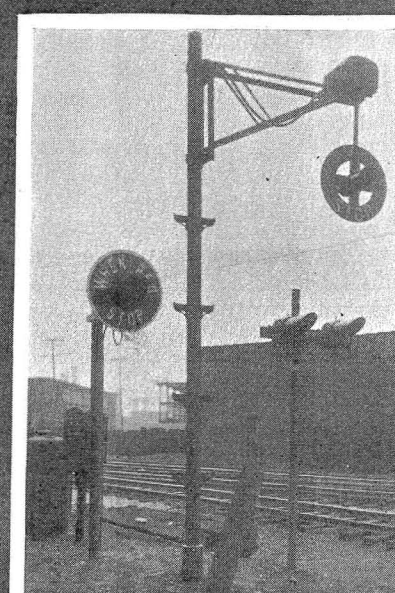
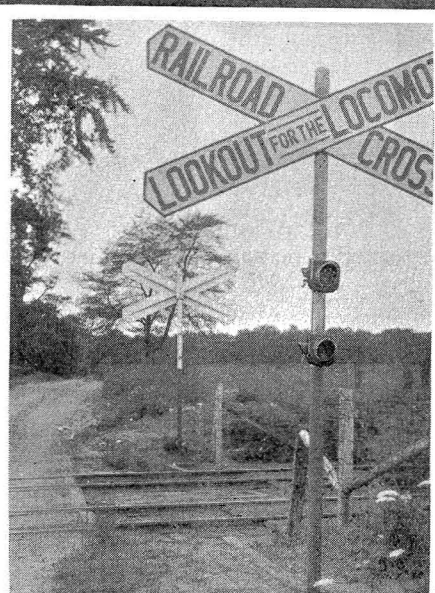
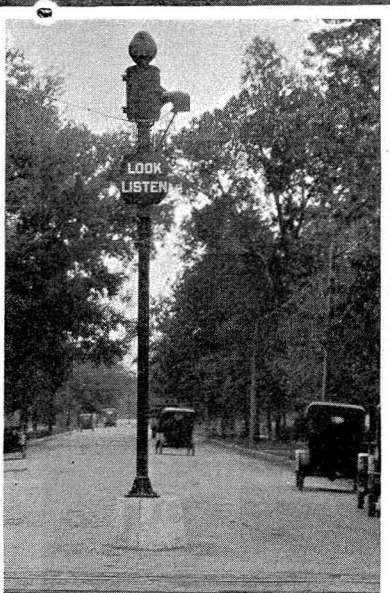
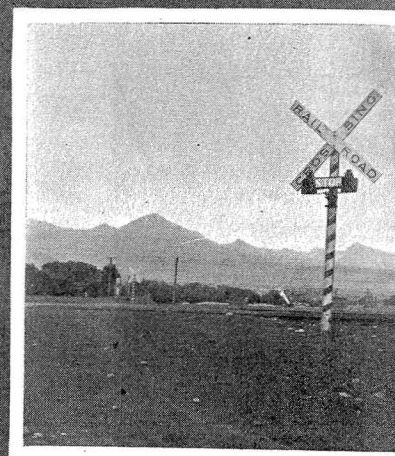
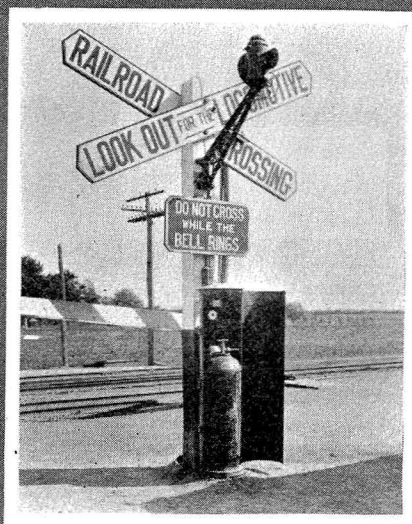
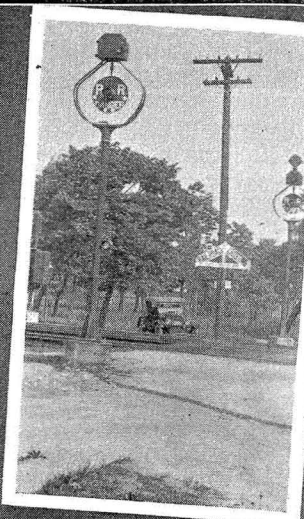
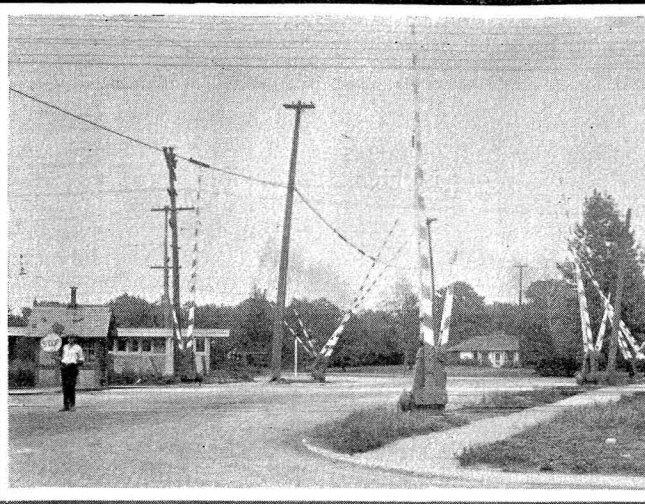
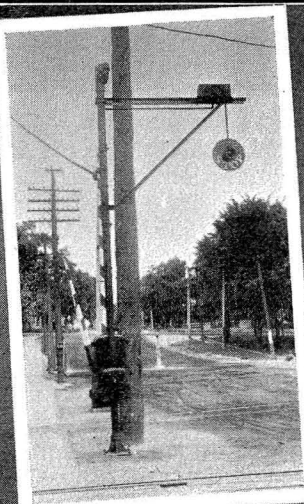
## A Preliminary Study of Each Crossing Necessary

The question of how best to protect a crossing is a problem. I was given charge of that line of work about 2 years ago and found no uniformity in making reports and as a result I had great difficulty in convincing my superior officers of the necessity for the protection recommended. Therefore some data was outlined which I insisted should be obtained.

The railroad data should show all of the tracks and indicate whether they are main, passing, house, yard or industrial. The alignment of the main tracks, right of way lines, width of crossings, planking, the nearby buildings and any obstructions to the view should also be shown.

The highway data should include the alignment and width of the highway, width of traveled way, sidewalks, street car or interurban tracks, surface material, fences, and signs with their location and kind including crossing, approach warnings, advertising and other signs between the approach warning signs and crossing signs. There should also be an approximate profile of the roadway on each approach to the crossing for at least 300 ft. and the obstructions to view within 300 ft. of the crossing along the traveled way.

Where railroad cars are customarily left on the tracks so as to obscure the view from the highway, these should be indicated in their usual location. The lines of the maximum vision to the tracks from the street or highway



### Various Methods of Highway Crossing Protection Used on Different Roads

Autoflag With Bell

Crossing Gates

Autoflag, Center of Street  
Mounting

Enclosed Disc Type

Gas-Illuminated Sign

Oil-Lighted STOP Sign

Three-Position Autoflag

Light Signal

A Collection Studied by Com-  
mittee XX



at critical points within 300 ft. from the crossing should be shown. Information regarding the existing protection, giving data as to apparatus now in place, men employed, rates of pay, etc., should be supplied.

A count of traffic on the highway and on the railroad should be given by hours for a three-day period. The count for the first day should be for the full 24 hours unless there is known to be either no railway or no highway traffic during this period, in which case the reason should be given. The count of the remaining days should cover the number of hours necessary to corroborate the count of the heavy traffic periods on various days as, particularly in the country, there are differences because of market days, Sundays, etc.

It is often necessary to go back and make complete additional 24 hr. period checks in order to know that such variations are covered. For this reason days should be selected carefully and should not necessarily be consecutive. If there is a greater or less traffic on the railway or highways at any season of the year or during some particular period as when country fairs are being held or when adjacent highways are undergoing repairs, such information, if available, should be given.

### Points for Consideration in Making Recommendations

When making plans and recommendations the following points may well be kept in mind: The clearing away of shrubbery on the right of way, on the highway or on private property; the moving of poles, fences or buildings; the relocation of signs, the installation of additional signs and the removal of advertising signs; widening the approaches; reducing grades to avoid stalling of automobiles and cutting away knolls and widening cuts to improve the view. Some states have taken the stand that the property owners have a certain responsibility in clearing away shrubs, trees, etc. It is unfortunate that other states do not take that same view. In Wisconsin the railroad and adjacent property owners, if called on to do so, must clear away the shrubs and trees to leave a clear view for 325 ft., along the track from the same distance along the highway. In Illinois if there is not a clear view for 550 ft. along the railroad, for 200 ft. on the highway, the crossing is considered hazardous and this space must be cleared out or protection may be required. Either one of these requirements will allow an automobile running at 30 mi. an hr. to stop if the train is in sight, or to clear the track if the train is out of sight, even if the train is running 60 miles an hour.

The railroad companies have been very careless in the past in leasing their properties for industries with the result that buildings are often erected close to the highways, which require cars to be set near them. This is a point the railroads must consider in the future, not only when making new leases, but in re-leasing their property, because those industries, particularly coal sheds and even elevators can often be moved to other points where they do not create a dangerous condition. In some cases we are being penalized to the extent of being required to put on flagmen because industries which do not come anywhere near paying for the expense, are located so close to the crossings that standing cars create conditions which require protection.

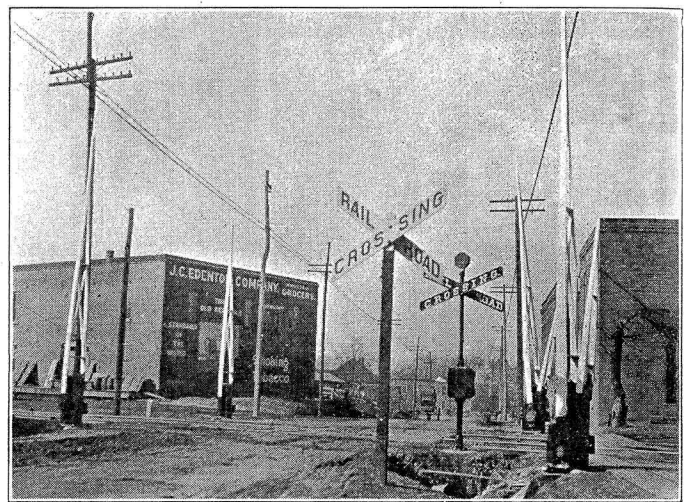
### Possible Methods of Protection

When it is decided that some protection is required, the question arises as to the advisability of installing (1) one or two automatic flagmen with a bell or without a bell, (if more than one automatic flagman is desirable the number needed and the reasons should be given). (2) Human flagmen with the number needed and between what working hours. (3) Crossing gates, num-

ber and between what hours they should be operated. In considering the possibility of installing gates it is often cheaper to give first class protection with gates than with a flagman, where protection for two or more streets close together is required or when two railroads are close together and one man can operate the gates for both.

A detail which may be somewhat aside from the point is the location of gates for the protection of streets in the vicinity of depots or team yards to give the proper protection and at the same time not unduly delay vehicles. There should also be included a statement of the accidents that have occurred at the particular crossing being investigated and the manner in which they happened. Other conditions should also be recorded which occur to the observer and which may influence the decision.

The above outline will not be found to be such a burden as it appears when it is considered that an improper installation may cost the company unnecessary money. When a report is made complete but little difficulty is ex-



A Crossing Protected by the Standard Crossing Sign, Automatic Bell and Manually Operated Gates

perienced in securing approval of the recommendations.

All of the possible methods of protecting a crossing have not been mentioned above and additional ways will unquestionably be developed in the future. The use of signs is the least expensive protection. The joint committee of the American Railway Association and the state railroad commissioners has decided on certain signs which are coming into quite general use. Unfortunately, however, some authorities oppose them.

It seems very desirable that the forms and the use of certain signs and signals should be uniform throughout the country so that the driver of an automobile may know just what each means as he approaches it. On a railroad it is feasible to have two or more types of signals controlling the engineman on his run and to use them with perfect safety, but the engineman is thoroughly acquainted with the physical characteristics of the line over which he operates and knows and recognizes these differences at once. This is not true with people driving over highway crossings which are strange to many of them.

A short time since I noticed a book describing the "International Road Signs." These signs are so clear in their meaning that they can be understood on first observation. It is unfortunate, inasmuch as such signs have been adopted, that they are not in use in the United States as there are signs, not only for approach and warning, but also for sharp turns, grades, etc., for which there are now none in general use in this country.

With the proper location of signs, some crossings may be given sufficient protection at a very small expenditure; however, more attention should be paid to their uniform location to the right of the driver for whose information they are installed. The barber pole effect on gates came from an accident that happened on the Long Island railroad. There is a shale road parallel with the track (which is electrified) running six miles out of Long Beach. It was the general practice of automobile drivers to start from Long Beach and race electric trains to that particular crossing. One night seven of them tried it. The fourth one was hit but, even with the proof of the drivers before and behind this car, the railroad was blamed by the jury because the crossing was not properly protected. The railroad then protected the crossing by placing across it telegraph poles 8 in. in diameter at the top and about 12 in. at the butt, counterweighed and painted barber pole effect. The railroad advertised what it had done and there were no more accidents.

It is necessary to put the fear of God in the automobile driver's heart. I know of no other way to cure some of them. The hump has that idea in view. It can be built so that a man running at moderate speed will hardly feel it, but if he is speeding it will throw him through the top of his auto—as did actually occur in one place. I believe it was in Nashville, where a man filed such a case against the city but the court decided against him.

#### Other Forms of Protection

In one state we were asked to install illuminated signs before the wig-wag was developed and there are a good many in service yet as they have proved to be fairly effective devices. A number of reflecting signs have been used in Ohio and elsewhere; it seems that they have their place, particularly in giving approach information for a crossing. The crossing sign itself should not be moved out for it belongs where it is. It is similar to the stop signal used in railroad signaling. However, automobile drivers in many instances have not been furnished with signs serving the same function as a distant signal on the railroad. Various railroads are developing signs, for example one railroad uses a two-light signal which it claims is distinguishable.

The automatic flagman, the waving light and the flashing light are designed to attract attention by motion, but varying uses are made of them on railroads and on highways in different parts of the country; for instance, flashing lights not connected to track circuits are in service on some railroads at certain places to indicate dangerous points without reference to the approaching of a train. Flashing lights are also being placed at dangerous highway road crossings, or at curves where there are no railroads. Therefore, their effect is lost in indicating a railroad crossing specifically.

Two types of automatic flagmen are installed. (1) The two position flagman with the banner hanging down when no train is near and waving when a train is approaching, and (2) the three position flagman with the banner hid from view when no train is close, waving when a train is approaching and hanging straight down when the mechanism is out of order.

Automatic flagmen installed on the C. & N. W. have a small box locked with a switch lock and containing a test switch attached to the relay case. Section foremen at outlying points are required to use the test switch daily to test the bell or wig-wag. The maintainer tests the apparatus in automatic signal territory.

Sometimes it is necessary to install more than one automatic flagman. At heavy traffic crossings automobiles often follow so closely that the attention of a driver is taken up in watching the man ahead and he may over-

look warning signs. When a road angles at or close to the railroad it may not be possible to locate one automatic flagman so that it can be seen readily at all times from both directions. The red light on the device should never be placed so that it can confuse enginemen; to avoid this on sharp angle crossings it may be necessary to use long hoods or to locate the automatic flagman a considerable distance from the track.

A peculiar condition exists on double track where only one flagman is used as it may be located across the track from an approaching automobile driver. Should a train pass on the track nearest to him, he is likely to start across immediately behind it when there may be another train approaching from the opposite direction. Therefore on angle crossings particularly it is advisable to use two wig-wags so that one will be waving directly in front of the driver and at least give him food for thought before he starts across.

#### The Human Flagman

The human flagman is placed on many crossings during hours when traffic is heaviest. A great improvement was made in this protection when the "stop" sign, in place of the flag, was put into the hands of the watchman. Under the old conditions with the flag, it was hard to determine just what the watchman meant by his signal, whereas now it is almost impossible for it to be misjudged.

When the "stop" sign was first adopted I felt that it should be used with a very short handle but we have now adopted the long handle because of the careless manner in which some flagmen held up the "stop" sign and because it was practically impossible to compel a man to hold up his sign for any great length of time even though he was not careless.

#### Automatic Gates

Automatic gates have been advocated and two different types have been designed, viz.: (1) the high type, with an arm so high above the level of the road that it will not be struck by a passing vehicle even when in the horizontal position, this type having whips attached to it to indicate that it is down, and (2) the low type, which is practically the ordinary gate but operated with track circuit control on the approach of trains. Neither of these types has apparently proved successful, and I believe the reasons may be briefly stated as follows: The high type does not attract sufficient attention nor does it prevent the driver from going across the tracks even though it is in the "stop" position; with the low type, there is nothing to prevent it from coming down on top of a vehicle or in such a way as to hold the vehicle on the track between the gates.

Manually operated gates perhaps give the best protection at crossings where there is sufficient traffic to warrant their use. Sometimes it is economical to install gates where the traffic is comparatively light when two or three sets can be operated by one man rather than to put in a flagman at each crossing.

When called as a witness once in a crossing prosecution case I was asked the relative efficiency of a manual flagman (human flagman) as compared with an automatic flagman and after due consideration, stated that perhaps the human flagman was the better at that particular place. After the case was settled I happened to meet the judge and he took me to task for my testimony on the basis that a human being was never as reliable as a piece of machinery and that in view of the conditions at the crossing which was under consideration, the automatic flagman would be much more reliable because there was nobody except perhaps an officer on an occasional train to see whether the flagman was performing his duty.



No one type of crossing protection is best adapted for all crossings nor is any one type the most efficient for all; machinery is often more reliable than a man and is on duty 24 hr. a day, whereas the man may be on duty but a few hours. Therefore, from a signalman's viewpoint, each crossing must be studied separately and only after

considering fully all of the conditions surrounding it can a decision be reached as to proper protection needed.

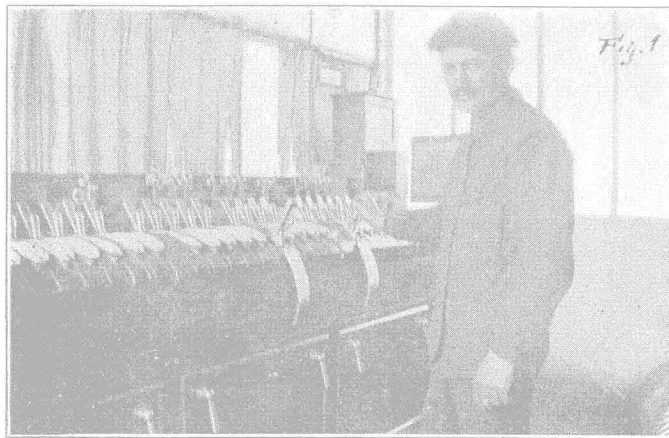
The uniforming of flagmen is a point that should be considered, particularly in protecting crossings in cities, because the average automobile driver will recognize a man who wears a policeman's uniform.

# An Old Electric Interlocking in France

*By S. D. Ashford*

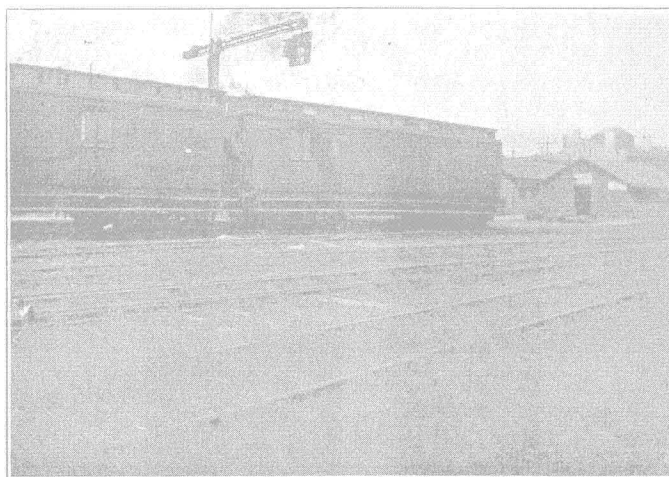
Captain, Signal Corps, United States Army

**W**HILE in Bordeaux, France, on my return home with the A. E. F., I had the opportunity of visiting an old electric interlocking plant at the "Gare du Midi." The accompanying photograph shows a towerman operating an electric interlocking machine, which



The Electric Machine Has Peculiar Locking Arrangement

was built similar to some of the early machines in the United States; however, the outward appearance is rather novel. This French machine was equipped with vertical type mechanical locking, together with electric locks and

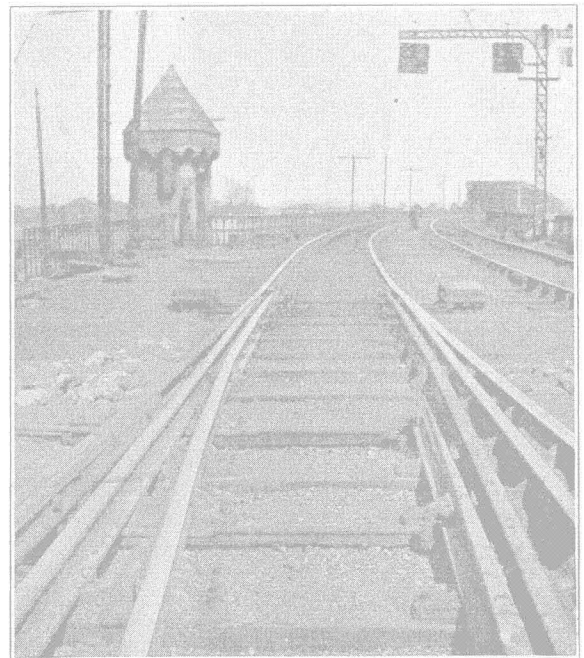


Checkerboard Signal in Stop Position

electric indication. Miniature electric semaphore and disc signals were used in conjunction with various toned bells and an electro-magnetic track model, to give the indication of the approach of trains and the position of switches and signals. The towerman on duty at the time stated

that this same interlocking machine had been exhibited at the Brussels exposition.

A "checkerboard" signal in the "Stop" position is shown in the second photograph directly over the German cars. The rear of the signal is shown, including the oil lamp, which is a part of the signal and moves with it. The "Clear" position is indicated by turning the whole signal through 45 deg. by means of an electric motor situated on the signal mast. The edge of the "checkerboard" is then towards an oncoming train and by night a white light is shown, the lamp having two lenses. The motor operated mechanism might be compared with the



Special Three-Point Switch and Home Signals

type of signal once in use on the Cumberland-Connells-ville section of the Baltimore & Ohio.

The throat or exit from the yard to the double track main line is shown in one of the illustrations. In the foreground the tracks converge in a three point triple switch operated by two electric switch machines. This is possible as the traffic here passes very slowly as it enters the train shed. Two "checkerboard" signals are shown in the background at the entrance to the yards and control traffic from the main line. For the convenience of yard engines and switching movements another signal is located a short distance beyond the two signals shown, and is suspended from the railway bridge spanning the Gironde river, over which the line passes immediately after leaving the yard tracks.