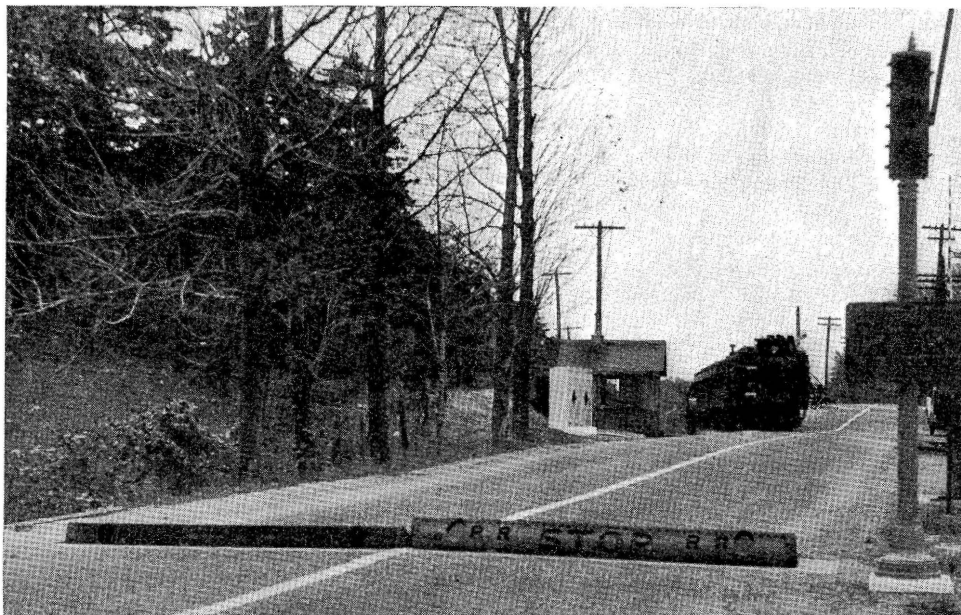


Highway Traffic Retarding-Barriers on the Boston & Maine

Three-indication advance warning traffic lights and switching cut-out are features of
Auto-Stop installation on Boston Post Road at Wayland, Mass.



View looking east—Barriers up to full height—Instrument case in background

ONE OF THE most recent installations of the retarding-barrier type of highway-railroad grade crossing protection is that at the intersection of the Boston & Maine and the Boston Post Road near Wayland, Mass., placed in service on September 30, 1936. A single-track line of the Central Massachusetts branch of the Boston & Maine crosses the Boston Post Road at this point at a flat angle of approximately 15 deg. View of the tracks is restricted due to trees, embankments, and other obstructions, particularly for east-bound highway traffic. Eight to 10 trains cross the intersection daily, operating under a maximum speed restriction of 50 m.p.h. Highway traffic is quite heavy, a check made on October 12, 1936, a state holiday, revealing the passage of 81 buses, 164 trucks, and 8,433 passenger cars, while a check on a normal week day showed 80 buses, 673 trucks, and 2,168 passenger cars. It is of inter-

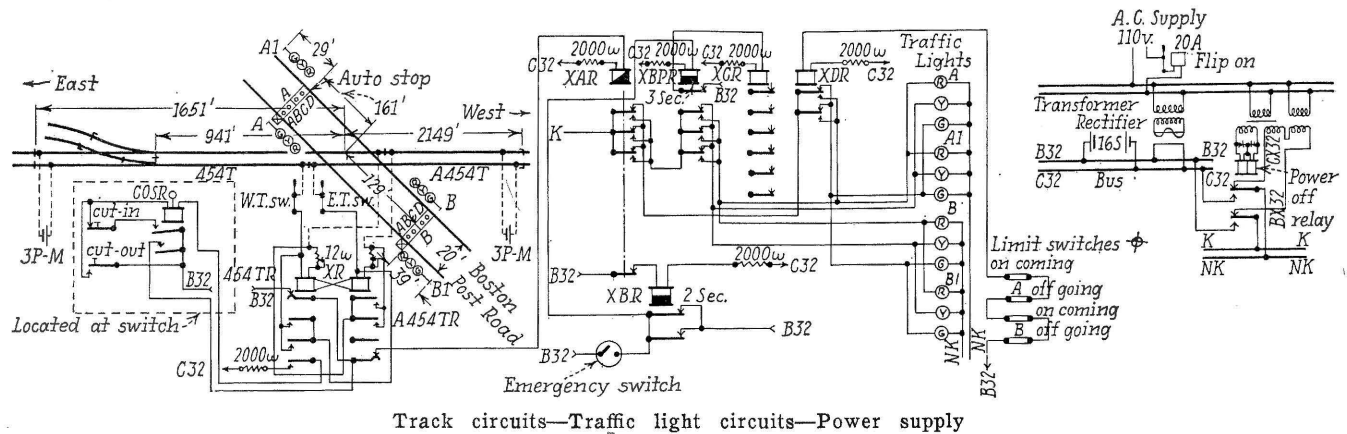
est to note that on a normal week day, there was one bus or truck on the road for every three passenger cars.

Protective Equipment

The retarding-barrier equipment for this installation was purchased from the Evans Products Company of Detroit, Mich., by the state of Massachusetts, and was installed by a contractor under supervision of the state and the Evans Products Company, while the control circuits were installed by the Boston & Maine under a force account provided by the state. One Auto-Stop unit, composed of two 10-ft. barrier sections and a motor drive section, was installed on each side of the tracks, one at a point 86 ft. from the nearest rail on the approach side of the road, and the other, on the other side of the tracks, 116 ft. from the

nearest rail on the approach side of the road. These units are of the latest design, being raised by spring pressure which is released by the operation of a motor, and being pulled down directly by the motor through a gear assembly and crank arms mounted on the main shaft. Two flashing warning lights are provided in the face of each section, so that four warning lights flash directly in the line of vision of the motorist when the units start to rise from the ground, and at all times that the barriers are more than one inch above the surface of the road.

Probably the most outstanding feature of this installation is the provision of two three-indication, normally-green, traffic signals on each side of the track in connection with each retarding-barrier, and the provision of ample pre-warning facilities. The signals are constructed according to the standards of the state for traffic signals as used at street



Track circuits—Traffic light circuits—Power supply

intersections, etc. At the right of the highway approaching the track, one traffic signal is located adjacent to the barrier. Also, a second traffic light signal is located at the left side of the highway, this signal being about 30 ft. in advance of the barrier. The purpose of this second signal at the left is that a vehicle standing short of the barrier may obstruct the signal at the right from the view of a driver of a second approaching vehicle, and he may turn out to pass, at which time he will be confronted with the second traffic signal at the left of the highway. A "Stop" line has been painted across the highway opposite this left-hand traffic signal, to hold traffic at this point when lights are red.

The normally-green traffic lights serve as markers to draw the attention of highway traffic to the fact

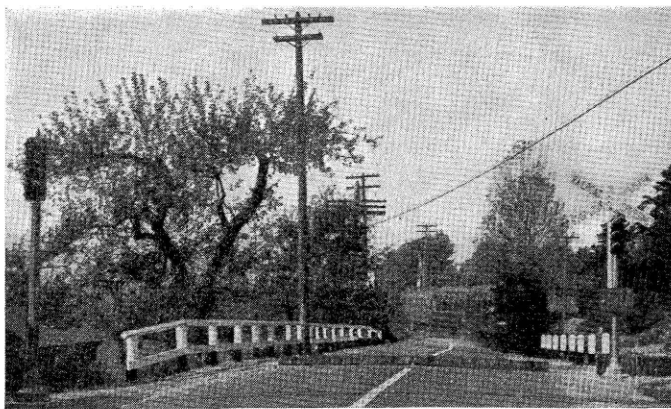
the right-hand side of the highway approaching the tracks, one sign, 24 in. by 18 in., placed 275 ft. from the Auto-Stop, reads "RR Slow"; a second sign, 24 in. by 36 in., placed 400 ft. from the barrier, reads "Slow-RXR Barrier—400 ft."; and a third, placed 500 ft. from the barrier, reads "Traffic Signal Ahead." In addition to these ample pre-warning features, the Auto-Stop control circuits are so designed that, when operation is initiated, all units hesitate at a four-inch height for seven seconds before rising to their locked position.

Operation

Operation of the auxiliary traffic lights used in connection with the Auto-Stops and operation of the retarding-barrier equipment at the expiration of a traffic light warning in-

trains, make a station stop shortly before entering the operating circuit; hence, the westward circuit is shorter than the eastward one.

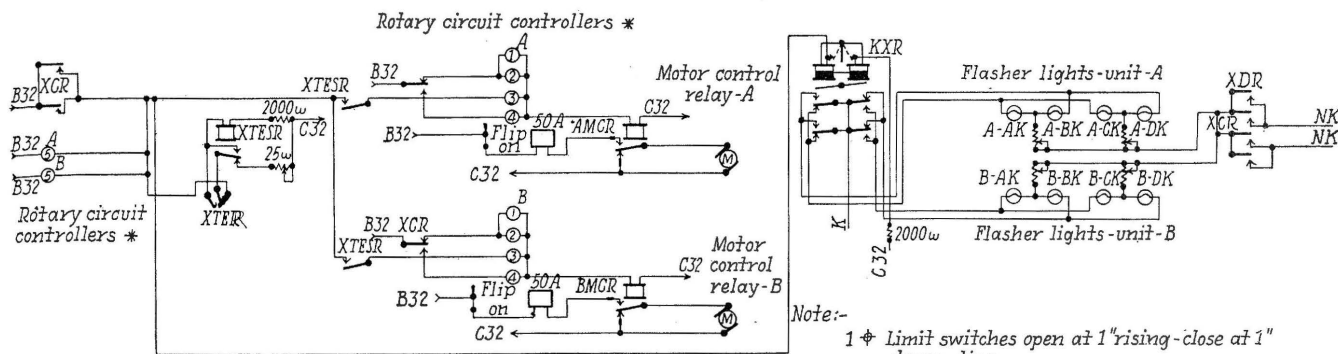
Entrance of a train into an approach section causes all green traffic light indications to be extinguished and yellow indications to be displayed for five seconds. After the warning indication has been given on the traffic lights, the indications change to red and operation of the retarding-barrier equipment is initiated. At the same time, the flashing red warning lights in the face of the barrier begin to operate. The Auto-Stop units rise, in approximately 2 sec., to a warning height of 4 in., where they remain for approximately 7 sec.; at the end of this hesitation period the sections on the right-hand side of the road approaching the tracks continue to a height of about 9½ in., consuming approximately 2 sec. in this operation, at which point they are locked mechanically until the train has cleared the crossing, or until a switching cut-out push-button located at a switch 941 ft. east of the crossing is operated; the sections on the left-hand side of the road approaching the crossing (on the right-hand side leaving the crossing) rise only to a height of approximately 7 in. and are never locked against depression by highway traffic striking them. The latter feature prevents trapping of highway traffic within the area controlled by the barriers. When the train leaves the crossing, or when the switching cut-out push-button is operated, the control relay picks up, the barrier castings are drawn back into a position flush with the road, in approximately four seconds, and after the retarding-barriers are down the traffic light changes from red to green. One light in the face of each Auto-Stop section remains lighted as the barriers descend until the barrier is to within one inch of the roadway. An essential feature of operation of the Auto-



The left traffic light is 30 ft. in advance of the barrier

that a point of danger exists. The traffic lights change from green to yellow for five seconds, then to red before the barrier starts to rise out of the ground. Reflectorized signs on the adjacent traffic light posts warn of a railroad crossing barrier at that point. Standard cross-buck signs are provided on each side of the track, and additional warning is given by three advance warning signs on each side of the tracks; on

terval is initiated by the entrance of a train into standard railroad track circuits extending either side of the crossing, 1,651 ft. to the east and 2,149 ft. to the west. These distances give a minimum warning time of approximately 22 sec. for west-bound trains and 29 sec. for east-bound trains approaching the crossing at 50 m.p.h., the maximum permissible speed. All scheduled, as well as regular "extra" westward



Retarding barrier motor and flashing light circuits

Stop is the fact that any section may be depressed by anything overcoming the 150 to 200-lb. spring pressure at any time that the retarding-barriers are not locked at their full height. In other words, the units do not form an effective retarding-barrier unless they are locked, and locking occurs only at approximately their full height.

The track circuits controlling this installation are normally double-rail, d-c. track circuits, fed by three Waterbury 500 a.h. type ARA2 cells connected in multiple. Control at the crossing is effected by the use of two interlocked track relays in the form of a G.R.S. Type K interlocked relay with one set of flagman contacts on each side. A single-pole, single-throw switch is provided in one of the relay track leads of each of the two circuits at the crossing to provide for the daily test required of the signal maintainer. These two switches, together with an emergency switch for direct control of the barriers and lights without track circuit control, are housed in a separate cast-iron test box located on the east side of the apparatus case. Daily tests do not, therefore, require opening of the larger case. The emergency switch is a key switch which can only be operated after breaking a seal and inserting the key. Its purpose is to provide emergency means to lower the barrier and clear the traffic lights from red to yellow in the event of a track circuit failure, which otherwise might seriously delay highway traffic until the signal maintainer reached the location. The section foreman and the agent and operator at Wayland station have instructions how to operate this switch if necessary, and also to see that the crossing is protected by a man at the crossing until repairs are made.

Upon the entrance of a train into the approach block, the corresponding track relay is de-energized. A back contact on this relay shunts

around the insulated joint at the crossing which is on the same side of the highway as the train. This action extends the track section across the highway, so that the track relay remains de-energized until the rear of the train has cleared the crossing.

Power Supply

The power supply for this installation is obtained from a local 110-volt, 60-cycle line. The power is transformed by means of a G.R.S. Type K1-13C-239R transformer and transmitted to a 32-volt, a-c. bus which normally feeds all light circuits. A G.R.S. Type BP, Size 248 transformer-rectifier is used to charge 16 cells of Exide EMGS-9 battery connected across a 32-volt, d-c. bus used to feed all of the Auto-Stop d-c. control circuits. During power-outage, a power-off relay of the G.R.S. K2 type, is de-energized to transfer the lighting bus from the normal 32-volt transformer feed to the 32-volt battery bus. The motor circuits of the Auto-Stop are usually designed for 32-volt, d-c. operation, and, since 32-volt traffic light lamps were satisfactory to the state traffic authorities, it was decided to use 32-volt wiring throughout. Rather than go to special relays, ordinary 10-volt, d-c. relays, with 2,000-ohm resistors in series at their terminals, were used.

Traffic Light Control

Proper operation of the traffic lights is accomplished by the use of four relays, XAR, XBR, XBPR, and XDR. Front contacts of the flagman type on the interlocked track relays are connected in series to control normally energized relay XAR. An emergency switch, described above, is provided for manual control of XBPR at the crossing. XBR is a normally energized repeater of XAR but has a slow drop-away time of approximately two seconds, while relay XBPR repeats XBR, consum-

ing three seconds additional before releasing. XDR is a normally energized relay controlled over normally closed contacts, connected in series, on limit switches mounted on each section of the Auto-Stop; these limit switches are directly connected to the lid of each section and the contacts in the XDR controls are open when the sections are more than one inch above the surface of the road. Entrance of a train into a track circuit breaks the control of XAR which drops, breaking at its front contacts the control of the green traffic lights, and energizing the yellow traffic lights over its back contacts and front contacts on XBPR. At the expiration of five seconds, XBPR, which was de-energized by XAR and XBR cascaded, drops and breaks the control of the yellow lights, and energizes the red traffic lights over its back contacts and over back contacts on XAR. When XBPR drops, it also de-energizes XCR which drops immediately and initiates operation of the Auto-Stop, causing the two units to rise. XDR is de-energized by the operation of the limit switches, and remains de-energized as long as any section of the retarding-barrier is more than one inch above the surface of the road. The de-energization of XDR breaks the green traffic light control so that a green light cannot be displayed as long as any section is higher than one inch above the road, regardless of the positions of the other relays. When the rear end of the train clears the crossing and the track relay picks up, XAR is re-energized, XBR and XBPR are re-energized, and XCR is re-energized. When XCR picks up, which is almost immediately, circuits are set up for retracting the retarding-barriers, which start down. However, when

Note:-
1 Φ Limit switches open at 1" rising-close at 1" descending.

2 * On rotary circuit controllers A and B -

Contact	Closes	Opens
1	1/2"	4"
2	9 1/2"	Level
3	4"	9 1/2"
4	Level	4"
5	9 1/2"	Level

XAR picked up, it switched the light battery feed from the back contacts of XBPR to back contacts on XDR, which remains de-energized. Thus while the barriers are descending, a red light is maintained in the traffic units and neither green nor yellow is displayed at any time. When the barrier sections are all less than one inch above the surface of the road on their way down, XDR is picked up by the limit switch contacts reclosing. This action switches battery from the red light circuit to the green light circuit so that a green light is again displayed, indicating that all conditions are normal.

Retarding-Barrier Control

As stated above, during normal operation, the dropping of XCR initiates operation of the Auto-Stop. With an Auto-Stop unit flush with the road, rotary circuit controller contacts 4 are closed so that XCR, dropping, energizes AMCR and BMCR. When these relays pick up, 32 volts d-c. is applied to motor A and motor B. Each motor is equipped with a spring-applied, electrically-retractable motor-brake. The control coil of each motor-brake is in series with the motor to which it is applied. Thus, when energy is applied to the motor, the motor-brake is released, the motor is put into operation, the drive shaft is freed, and the operating springs and motor, acting together, raise the Auto-Stop retarding-barriers. At a height of four inches, rotary circuit controller contacts 4 are broken, de-energizing the motor control relays, these de-energizing in turn the motor and motor-brake circuits and applying a direct shunt to the coils of each motor. The combined effect of the spring actuated motor-brakes and the shunted motor circuits is to bring the motors to a stop quickly and stop the retarding-barriers at a height of approximately four inches.

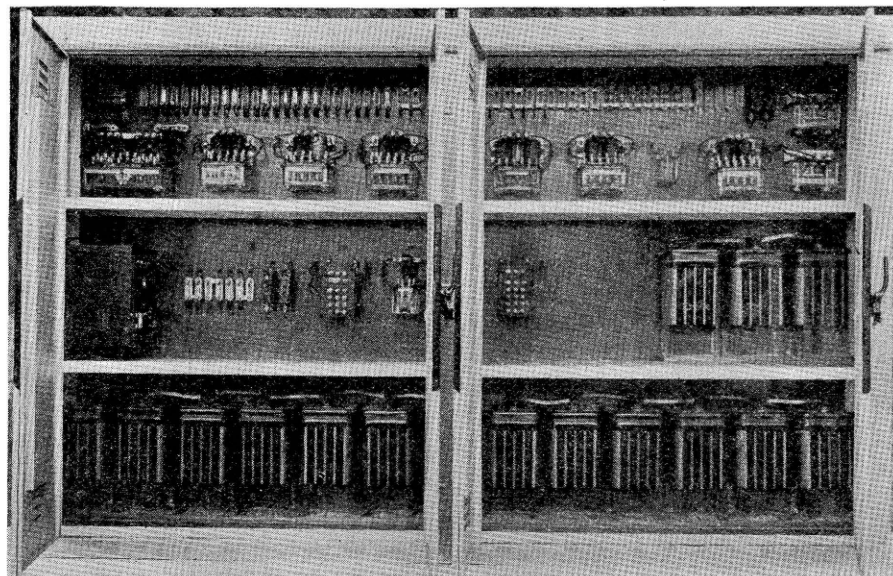
When XCR drops, G.R.S. Type K flasher relay KXR is energized and starts into operation, continuing in operation until XCR is picked up or until rotary circuit controller contacts 5 are broken at the $9\frac{1}{2}$ -in. point. Simultaneously, the circuits through the flashing lights mounted in the face of the auto-stop are closed by the back contacts of XCR. These circuits are also closed, a little later, by back contacts of the XDR relay, which is de-energized by the opening of the normally closed limit switch contacts connected in series, which are opened at any time the respective sections to which they are applied are more than one inch above the surface of the road. Thus, flashing of these lights begins practically simul-

taneously with the initiation of action of the auto-stop and is maintained until the retarding-barriers start to descend. Also, although the flasher relay is de-energized on the downward movement of the barriers, whichever set of lights is connected through the flasher relay when it stops operating will remain continuously lighted through the action of limit switch contacts until the sections are less than one inch below the road surface.

The dropping of XCR also energizes G.R.S. Type T, Class A thermal relay XTE in series with an 85-ohm

moments, when danger is imminent for any traffic on the crossing, the Auto-Stop forms a definite retarding-barrier to the continued advance of highway traffic.

Upon the departure of the rear end of the train from the crossing, XCR picks up as described previously. When it does so, its front contacts close circuits to pick up AMCR and BMCR through rotary circuit controller contacts 2, which are closed from the $9\frac{1}{2}$ -in. height, and with the barriers descending, until they are again flush with the road. At this point, rotary circuit controller con-



The relays are mounted on ply-wood panels

resistor. Upon the timing of this relay depends the hesitation time of the retarding-barrier at the four-inch height. At the expiration of the time interval for which it is set, it closes its contact, energizing stick relay XTESR, which in turn connects its own coils with 2,000 ohms resistance, in series with XTE, allowing the latter to cool. Front contacts on XTESR close control circuits for AMCR and BMCR through rotary circuit controller contacts 3, which are closed when the barriers are between 4 in. and $9\frac{1}{2}$ in. above the road and are rising. AMCR and BMCR remain picked up and energize the motors and motor-brakes until the barriers reach the $9\frac{1}{2}$ -in. height, at which point rotary circuit controller contacts 3 open. Slightly before the $9\frac{1}{2}$ -in. height is reached, the retarding-barriers are locked by cam-operated locking arms which prevent the depression of the barriers against the spring pressure by highway traffic ignoring the warning indications. By this time a train traveling at maximum permissible speed would be quite close to the crossing. Thus during the last few

tacts 2 open, AMCR and BMCR drop, the motors are stopped, and the barriers remain flush with the road until the next train approaches. When XCR is picked up and rotary circuit controller contacts 5 were broken, XTESR was de-energized. Thus all equipment is normal and ready for the next cycle of operation.

Switching Cut-Out

A switching cut-out feature was provided in connection with the switch located 941 ft. east of the crossing. Operation of a "cut-out" push-button at this point provides for the energization of a special stick relay, a front contact of which feeds battery around the open flagman contact on the track relay of the occupied approach section to the control circuit of crossing relay XAR. A "cut-in" push-button is provided to release the stick relay when switching is completed. The stick relay at the switch location is of the Union Switch & Signal Company tower-indicating type with an indicator to inform the trainmen as to whether the crossing protection is cut out or cut in. If

the train crew fail to push the "cut-in" button after once cutting out the apparatus, the stick relay will be de-energized as soon as the train clears the occupied track circuit and the apparatus will be automatically restored to normal operation.

Circuit Emergency Features

Various emergency features are also provided by the Auto-Stop control circuits. Chief among these is the feature provided for those cases where a following train enters the approach circuit almost immediately after the first train has cleared the same approach circuit. In such a situation the possibility arises that the retarding-barriers will have already started down. To assure that they will continue down and then immediately come to the warning position again, rotary circuit controller contacts 4 close just as the units leave their full height, at nine inches on the descending movement, and remain closed until the units are again at the four-inch height on the ascending movement. From the level position, normal operation, as described above, ensues.

Another feature of distinct interest is the provision made for chattering or intermittent de-energization of the control relay XCR from any causes whatsoever. Such action might

and 5 were provided. Contacts 1 provide for energization of the motor control relays, AMCR and BMCR, and thus allow the barriers to be driven uniformly to their four-inch height if, for any reason, they should rise above the road surface when XCR is not de-energized due to the passage of trains. Rotary circuit controller contacts 5 provide the proper hesitation time at the 4-in. height by feeding battery to the thermal timing relay, and also provide for the operation of the barriers to the 9½-in. height through rotary circuit controller contacts 3. The retraction of the Auto-Stop units is then accomplished through rotary circuit controller contacts 2.

Housings and Cable

The major portion of the relays and other instruments used at this project, as well as the main 16-cell battery, were housed in a Union Switch & Signal Company sheet steel instrument case. This case is 6 ft. 1½ in. high, 23 in. wide, and 9 ft. 8 in. long. It has a front section with floor and two shelves 13¾ in. in width. The rear section of the case is for cable distribution. The case has two double doors on both front and rear, and is mounted on a concrete foundation which extends about one foot above the ground level. All cables are brought into the bottom of the case through a chase in the foundation. An interesting feature of the instrument case construction is the use of ½-in. (5-ply) plywood for the terminal boards.

The circuits between the instrument case and each Auto-Stop were run in 23-conductor, 3 No. 8 and 20 No. 12, Simplex rubber-jacketed underground cable. The wiring through the Auto-Stop units was single-conductor No. 12 run in conduit. Traffic light controls were run from each barrier unit in 7-conductor, No. 12 underground cable.

Most of the electrical operating equipment for this installation was provided by the General Railway Signal Company, the wire and cable being furnished by the Simplex Wire & Cable Company. The Eagle Signal Company installed the traffic lights for the state, while the railroad signal work was done by the railroad signal department forces. Baker & Co., contractors, built the pits housing the barriers and installed the units under the direction of the state highway department and a field representative of the Evans Products Company. Descriptions of other Auto-Stop installations will be found in the October, 1934, June, 1935, and August, 1936, issues of *Railway Signaling*.

Electric Signal Lights in Austria

THE Railway Gazette, London, reports that the Austrian Federal Railways have been seeking to improve the efficiency of the signal lights during the last few years, and to reduce the maintenance charges, which were very heavy with the old system of oil lighting and one-day burners. Herr Ortner has described in the press the steps taken to introduce electric lighting. Where an efficient electric supply is available, there is, of course, no great difficulty in doing this, but it is possible only at certain places. Accordingly, two systems of low-voltage lighting have been developed, and applied to the mechanical signals with good results since 1929. Approach lighting has not been adopted; instead, time switches have been used to switch on the signal lights during certain hours only, according to the period of darkness and the train service. On lines where there is an interval at night without trains, the lights are extinguished during the interval, effecting a considerable saving in energy. A certain number of signals have been fitted with flashlight equipment and storage cells, recharging being necessary on the average every 90 days, while others have been provided with steady lights and primary batteries, as a comparison. As a rule, the batteries are found to last about six months. The electric lights give a very clear indication and the new arrangements are stated to pay for themselves in about 2½ years.

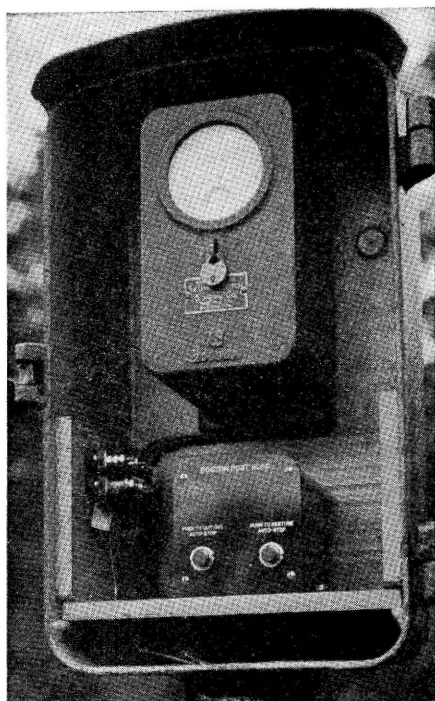
Rule for Crossing Protection

TO THE EDITOR:

I note in the December issue of *Railway Signaling* on page 629, instructions for crossing protection in New York, quoting rules adopted by four railroads which apply in the state of New York only. The Pennsylvania has system rules applicable everywhere, and the rule corresponding with those quoted on page 629 is as follows:

"When shifting movements are made in the vicinity of a highway crossing protected by automatic highway crossing signals, or when a train is stopped, thereby operating the signals unnecessarily, every effort must be made by trainmen to avoid delay to highway traffic. When it is safe for vehicles or pedestrians to cross the track, the trainman will say 'all right' and beckon to cross."

A. H. RUDD,
Chief Signal Engineer, Pennsylvania



Cut-out pushbuttons and indicator

cause the barriers, through rotary circuit controller contacts 4 and 3, to rise to some position between level and their 9½-in. height and remain there. In order to overcome this, rotary circuit controller contacts 1