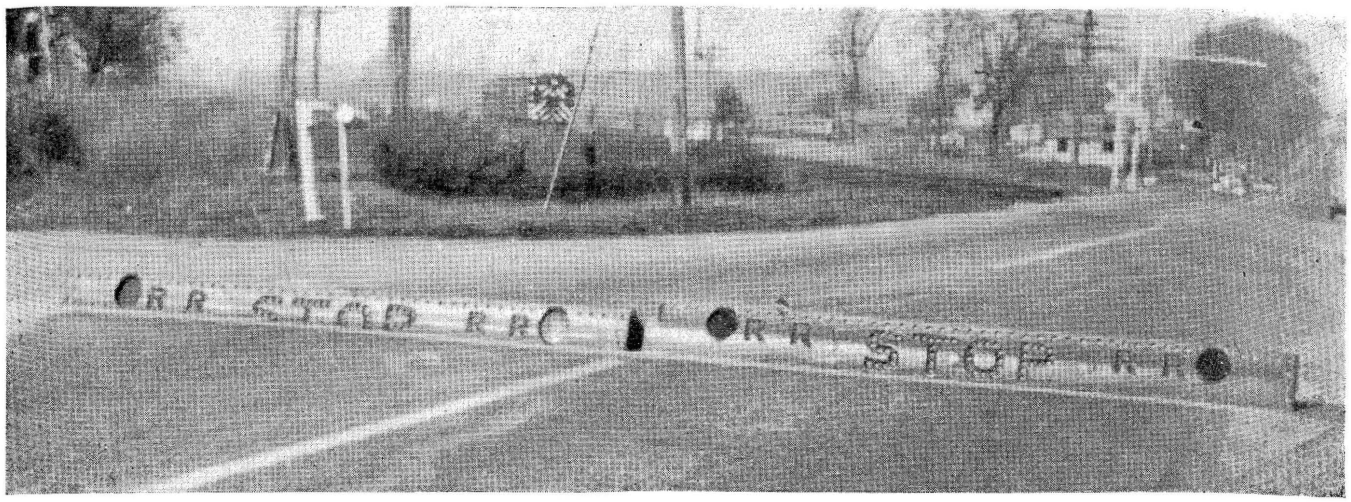


Right retarding-barrier unit at height of 10¼ in., locked—left unit at height of 6 in., unlocked

Barriers on the Michigan Central

Highway and railroad traffic is protected by two 20-ft. retarding-barrier units, traffic lights, and flashing-light signals

One of the most recent installations of the retarding-barrier type of highway crossing protective devices is that at the intersection of U. S. highway 127 with the double-track line of the Saginaw branch of the Michigan Central, near Jackson, Mich. U. S. highway 127 in this vicinity is a heavily traveled highway, approximately 3,000 automobiles crossing the intersection daily. The highway slopes down at a long slight grade for approximately ¼ mile either side of the intersection. The railroad traffic consists of 10 regularly scheduled passenger trains and 2 freight trains daily. The maximum permissible speed for passenger trains in this area is 60 m.p.h., and 40 m.p.h. for freight trains. Previously the crossing was protected by flashing-light signals controlled automatically by track circuits.

Protection Provided

During September, 1936, two 20-ft. retarding-barrier units were installed, each consisting of two 10-ft. sections and a motor drive unit, one on each side of the railroad, 100 ft. from the nearest rail. A two-indication traffic light, displaying red or green aspects, was suspended at a height of 15 ft. above the road surface, directly over each barrier-unit. Each traffic light is supported at the end of a 16-ft. arm extending from a pole mounted on a concrete foundation at the side of the road. The existing flashing-light signals at the crossing were continued in service. Two cross-buck railroad warning signs also remained in service. A reflectorized sign, 20 in. by 30 in., reading "Automatic RXR Barrier", with an arrow pointing to the left and down, was mounted on a pole on the right-hand side of the road, adjacent to each barrier unit. In addition, two approach warning signs, 24 in. by 36 in., reading "Slow-RXR Barrier-250 ft." and "Slow-RXR Barrier-500 ft.", respectively, were placed at the proper distances in approach to each barrier unit.

Circuits

The control circuits provided for all automatic protective equipment operate for at least 20 sec. in advance of the arrival at the crossing of a train traveling at maximum permissible speed, in either direction on either track. No switches are involved in the approach circuits, which extend, on the eastbound track, 2,600 ft. westward and 2,650 ft. eastward, and, on the westbound track, 3,000 ft. eastward and 2,600 ft. westward. Direction selection, and cut-out when a train leaves the crossing, is provided by normally de-energized stick relays controlling a master crossing relay. The master crossing relay controls the operation of the flashing-light signals at the crossing as well as the relays controlling the traffic lights and the operation of the barrier units. Upon the entrance of a train, the flashing lights operate, and the traffic signals, which normally display green indications, display red indications. Three seconds later the barriers, which are of the Auto-Stop type, manufactured by the Evans Products Company, start rising.

The operating circuits for the Auto-Stop installation near Wayland, Mass., on the Boston & Maine were described in detail in the January, 1937, issue of *Railway Signaling*. The circuits of the Jackson installation are similar in principle, except that a Union DT-10 time-element relay, in-

stead of a G.R.S. thermal relay, is used to obtain the hesitation time at the warning point. However, the mechanical construction of the Auto-Stop has been subject to many changes and developments since the construction of this type of equipment was last described in *Railway Signaling*. Springs have been substituted for the weights previously used to raise the barrier, a new type of ice breaker has been developed, and numerous other modifications have been made. The remainder of this article, therefore, will feature the construction of the Auto-Stop.

Pit Construction

One of the Auto-Stop units is mounted in a reinforced concrete pit, approximately 26½ ft. long, 3 ft. 10 in. wide, and 5 ft. deep, with a manhole for entrance by maintainers. The other is mounted in a pit 29 ft. long, 3 ft. 10 in. wide, and 8 ft. 9 in. deep, to provide facilities for demonstration purposes. The latter pit is provided with a metal stairway and electric lighting. The concrete walls of each pit are approximately 10 in. thick, the base being a concrete slab approximately 6 in. thick. The cover over the entrance to the demonstration pit is a horizontal split steel door, hinged along both sides, and locking in the center with a signal department lock. When the doors are opened, the pit is made readily accessible by means of a steel stairway leading to the bottom of the pit. The cover over the inspection pit at the other barrier is a rectangular manhole cover, reinforced with 2½-in. angle bars, and equipped with a drop handle for lifting. Entrance to this pit is made by means of a ladder of grab irons set in the end of the concrete pit.

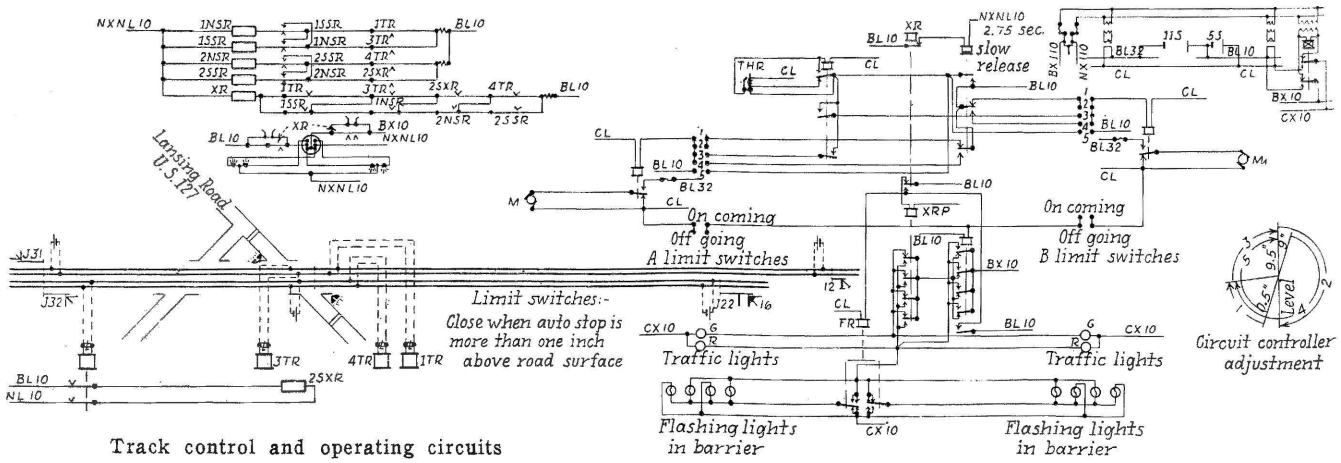
A section of the Auto-Stop consists of a hollow framework of cast steel within which is suspended a cast steel "protector" or lid, which is hinged along the back, and is flush with, and fastened to the top of the frame. Underneath this lid a crankshaft is mounted, with various springs and connecting rods for the raising and lowering of the lid. The sections are built in 10-ft. lengths, and are placed across the roadway on either side of the railroad, being mounted in the reinforced concrete pits with the top of the lid flush with the road surface. Each concrete pit is extended for five feet on one side of the highway and the driving mechanism is set in this extension, flush with the road shoulder and covered with the manhole cover previously described. The housing and drive mechanism consists of a box-like frame of 2½-in. steel angle bars within which are mounted the motor, brake, circuit controller and gear reducer necessary to operate the barrier.

The Auto-Stop rises to a height of approximately 3¾ in. and hesitates at this warning point for a period of 8 sec. It is held in this position by means of two operating springs which can be adjusted to be depressed by a force of 150 lb. A car whose driver refuses to regard the warning, and continues over the barrier will merely depress the lid flush with the road surface and continue on over it. At the expiration of the 8-sec. warning interval, both sections of each unit continue to rise. The section of each unit on the left-hand side of the road approaching the tracks rises only to 6 in., at which point it may be depressed easily by traffic leaving the intersection. The section of each unit on the right-hand side, however, rises until it reaches a height of 10¼ in. approximately 3 sec. after leaving the warning position. At the 10¼-in. height, it is locked mechanically and forms a retarding-barrier to highway traffic ignoring the warning indications. It remains at its full height until the train has passed the crossing, and then lowers itself into the roadway, presenting no obstruction to traffic. For all purposes the Auto-Stop in the lowered position is a section of the roadway.

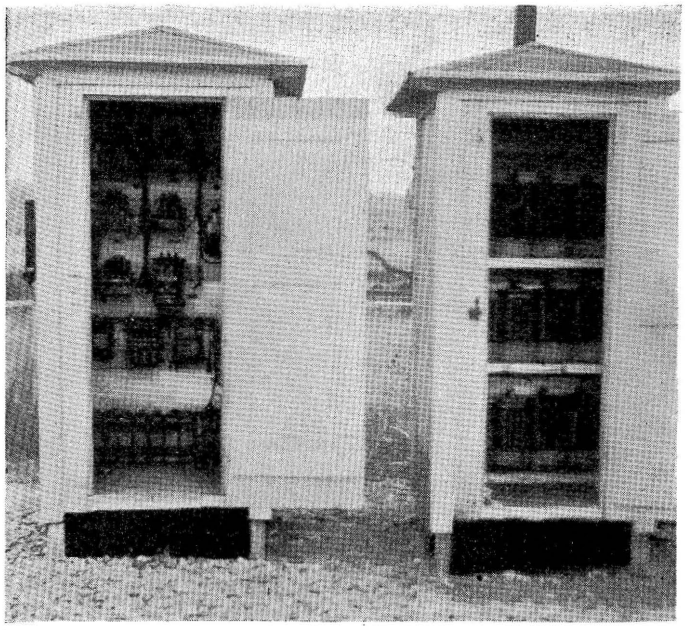
The frame, or housing of the protector unit, is made of annealed cast steel with walls having a minimum thickness of ½ in. It is a hollow box-like casting having a solid front and back, an open top, and heavy supporting cross members on the ends and bottom. The steel is the same as that used for draw bars and undercarriages of freight cars. The protector unit or lid is suspended within the housing and its lower edge rests upon seven buffer pads which are mounted, in turn, upon heavy springs. At the rear of the lid are four hinges, which are attached to the housing through vertical and horizontal spring mountings so that, when the lid is in the down position, it rests upon 11 springs (4 hinge springs in rear and 7 buffer pad springs in front). The springs cushion the weight of cars running over the lid. Horizontal hinge springs are installed to allow the lid to cushion the impact should the face be struck while in the protective position.

Construction of the Barrier

The top of the lid is ribbed to give a non-skid surface and the face is designed so as to give the greatest practicable surface of contact to the average tire. The bottom portion of the face presents a convex surface toward the motorist while the upper part is concave. The curvature of the face is designed so that a car striking the lid in the protective position has its front end thrown upward, dissipating a large proportion of the horizontal energy in the car. The remainder of this energy carries the front end on over the Auto-Stop, so that there is no sudden stopping to throw the driver and passengers through the windshield. When a car traveling at a high rate of speed strikes the barrier, the radius rods are bent, spring shackles are broken, or equivalent minor damage is done to the car which tends to



Track control and operating circuits



The electrical control apparatus and batteries are located in these two relay houses at the crossing

serve as an additional brake to stop the automobile.

Lifting and Depressing Bars

A set of two push bars are used to raise each section of the barrier and a set of two drive links are used to lower it, the upper ends of these rods being connected directly to the unit. The lower ends of the two push bars used for raising a barrier section are connected to helically wound cantilever operating springs which are under tension when the lid is down. The unit is held in the lowered position by means of the drive links, the lower ends of which are connected to the cam shaft. The shaft is connected through a coupling and through a drive sprocket to the motor which provides the energy for lowering the lid. A magnetic brake provides the means of holding the motor, with consequent holding of the lid at any position. The brake is in series with the motor windings, energization of the motor automatically releasing the brake and allowing the raising and lowering of the lid. As the crankshaft turns in one direction only, the unit is raised and lowered by means of connecting rods, or drive links, similarly to the action of the pistons in an automobile engine. On the "up" move, the drive links serve to restrain the unit as the torsion springs carry the lid up, allowing the barrier to rise only as fast as the cam shaft revolves, at the speed determined by the motor. This gives a uniform slow motion to the lid as it rises. On the "down" move, the drive links are actuated by the cam shaft and pull the lid down, at the same time winding up the operating springs for the next "up" move. The drive links, or connecting rods, are attached to their respective cranks through slotted couplings, allowing the lid to be depressed without affecting the position of the crankshaft or the springs.

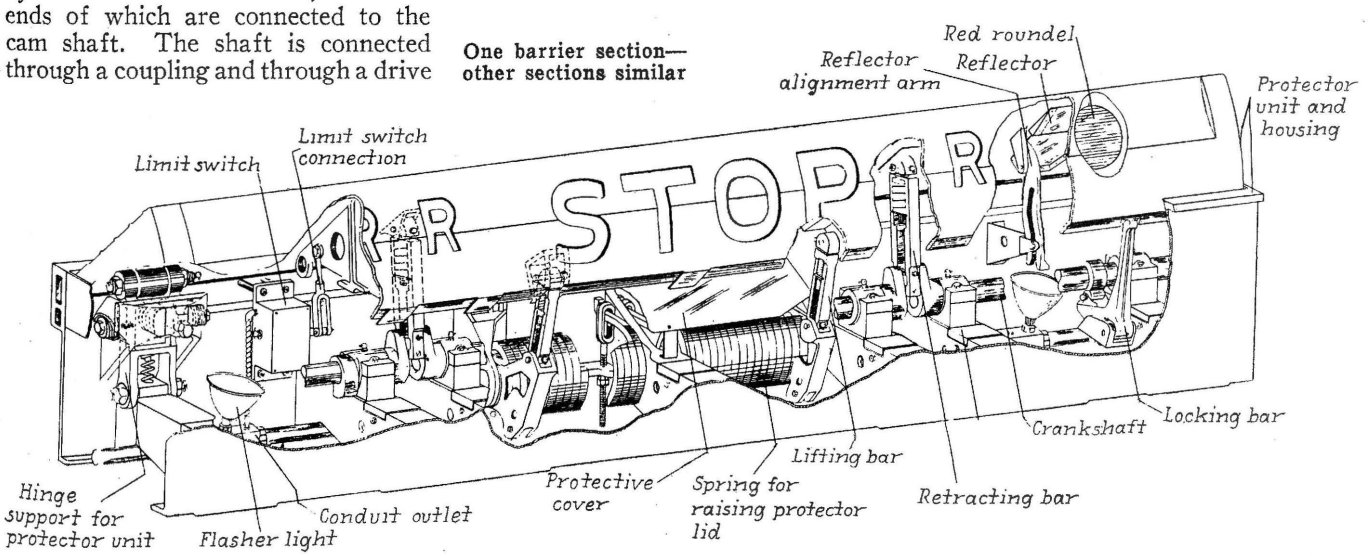
The crankshaft is of a capacity that will operate six sections and has a diameter of 2-3/16 in. Two cranks are provided for each section, each mounted between two bearings. The shaft for each 10-ft. section is mounted on 6 bearings approximately 3 in. long and fitted for pressure greasing.

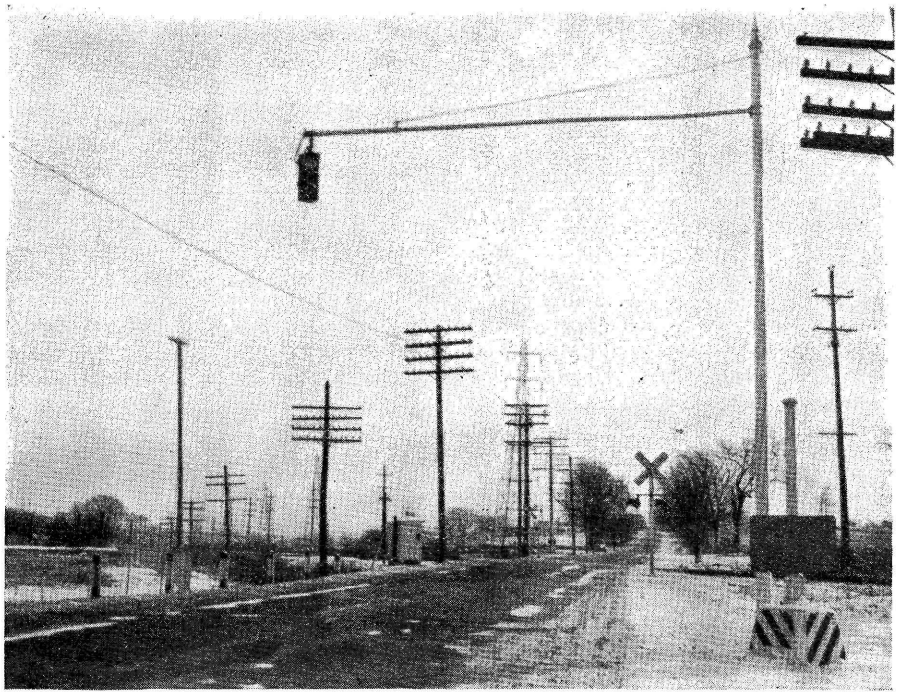
Locking bars are provided to lock the lid in its full-up position. These locking bars are located at each end of each section and are operated by cams on the crankshaft. When a section reaches its maximum height of 10¼ in., the cams move the lock bar forward under the edge of the lid face, which keeps the barrier from being depressed. When the railroad is clear and the lid can be safely lowered, the cams turn with the crankshaft and force the locking bars back out of the way, permitting the lid to be pulled down by the motor. As locking bars are not provided for the sections on the left or departure side of the road, these sections are always free to be depressed to allow a car to travel over them and not be "trapped" on the crossing. The left section is allowed to come to a height of 6 in. only, instead of 10¼ in. as the right hand section does. The lower height for the off-going section precludes the danger of the lid catching on the undercarriage of a car passing over it.

Flasher Lights in the Barrier

As mentioned above, two holes 5⅜ in. in diameter are cast in the face of the barrier unit and fitted with red roundels through which lights flash whenever the lid is more than 1 in. above the surface. Behind each of these roundels is a movable flat reflector with an eccentrically slotted arm designed so as to keep the reflector properly alined with the roundel regardless of the position of the lid. Under this reflector is an electric lamp using a railroad signal

One barrier section—other sections similar





Each traffic-light signal is mounted on a 16-ft. arm extending over the roadway

bulb with a standard single contact base. The lamp is mounted in a parabolic reflector which throws a beam upward to the plate reflector where it is deflected through the roundel. These lamps are connected electrically so that one is lighted when the other is out and vice versa. The timing of the lamps is accomplished by the use of a flasher relay, the lamps flashing from 30 to 40 times per minute. The face is outlined with reflector buttons as are also the letters RR-STOP-RR. A total of 148 reflector buttons are used in each 10-ft. section.

Control and Drive Equipment

A so-called "limit switch" is installed on each section and is connected to the top of the lid through a lever arm and connecting rod. This switch is constructed so that its contacts are closed when the lid is in any position one inch or more above the road surface. The traffic lights and flasher lights are connected through these limit switches in multiple so that the traffic light and flasher lights are lighted at any time that the contacts are closed.

Since two or more sections are placed end to end across the highway, a means must be provided to connect the crankshaft together at the junction between sections. The sections are placed at vertical angles with each other to fit the crown of the road, hence this coupling must be flexible to allow for the turn of the crankshaft. The flexibility is obtained by means of a "link belt" type of coupling, consisting of two sprockets, placed side by side, one on the end of each crankshaft, with a roller chain connecting the two sprockets. This construction gives a rigid coupling and at the same time sufficient flexibility to meet the maximum crown used in road construction.

The drive mechanisms for the barriers were shipped as two complete units and were installed at the end of the Auto-Stop sections, on the east side of the road. Each mechanism consists of a motor, circuit controller, brake, and gear reducer. The motor drive shaft is alined with the crankshaft of the Auto-Stop sections and connected to it by means of a slow speed coupling made of two flanges, each having fingers projecting forward between the fingers of the other half. The fingers are separated from each other by heavy rubber pads which serve to absorb vibration of the barrier sections.

The motor, rated at not less than ¼ hp., is a specially designed compound wound, 32-volt, d-c., 40-deg. rise, continuous duty, totally enclosed motor, with windings impregnated to be impervious to water. It is mounted in the same frame with the brake and a 100 to 1 speed reducer. The motor is designed to give a high starting torque without dangerous inrush of current.

The brake is incorporated in the motor housing, and is of the frictional disk type. When the motor is de-energized, spring action pushes the disks together, holding the motor securely in position. When the motor is energized, the brake coils, which are in series with the motor winding, pull the brake disks apart against the spring action, and the motor is free to revolve.

The circuit controller is of rotating drum type with six relay type contacts which are made and broken by means of cams located on the shaft. The controller shaft is connected by means of a roller chain to the motor shaft so that its relative position is definitely determined by the crankshaft. One complete revolution of the drive shaft raises and lowers the Auto-Stop; a proportionate turn of the drive shaft raises the Auto-Stop to its hesitation position; a further proportionate turn of the drive shaft carries it to the full "up" position. The contacts on the circuit controller are made and broken at these various positions, thereby energizing or de-energizing the motor and brake as required. The circuit controller is equipped with six contacts, five of which are in use, and the function of which has been described in articles covering other installations.

Ice Breaker

The ice breaker consists of a counter-weighted eccentric cam on the drive shaft, placed under a foot cast into the face of the barrier unit. The cam is designed to rotate freely on the shaft when not needed to break ice, so that it clears itself and does not interfere with the normal action of the protector. The cam becomes effective to break ice when lugs, on a collar keyed to the shaft and extending into the cam, encounter lugs on the side of the cam. The friction surfaces are tempered so hard that a file cannot touch them, thereby reducing to a minimum the friction of contact during the ice breaking action.

The entire Auto-Stop unit is painted with one coat of filler and two coats of tangerine colored paint with a rubber base. The top of the protector unit, and the letters in its face are painted with a black rubber base paint. In the event that the maintainer should desire to operate the Auto-Stop manually, means are provided to readily disconnect the motor from the drive shaft, and a spanner wrench is supplied for turning a ratchet gear installed on the drive shaft.

The Auto-Stop equipment for this installation was purchased by the state, the installation being made by a contractor under the supervision of the Evans Products Company. Control equipment manufactured by the General Railway Signal Company and the Union Switch & Signal Company was used in the control circuits. The signal wiring was done by the signal department of the Michigan Central.