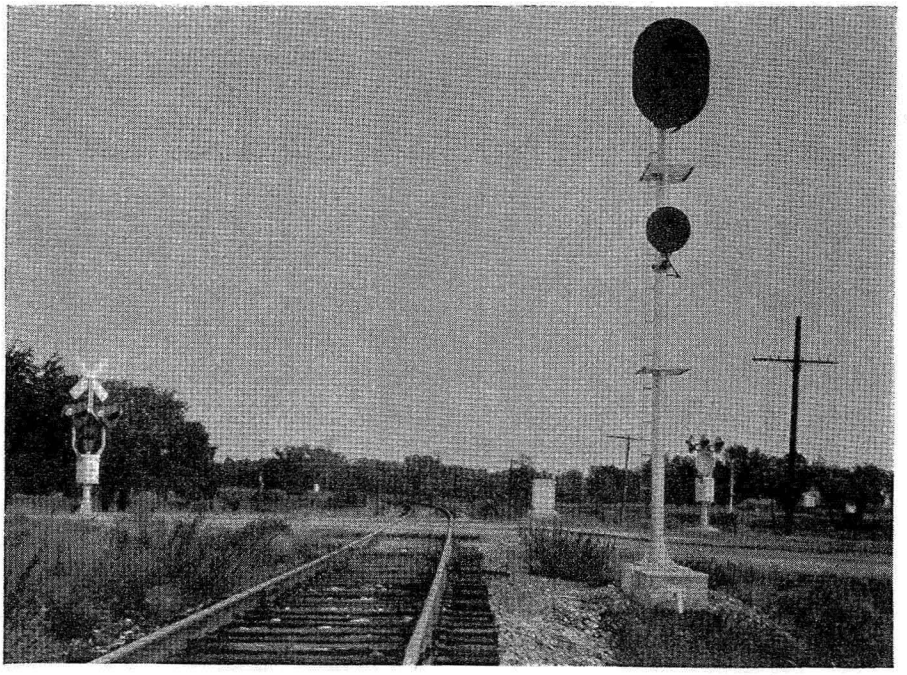


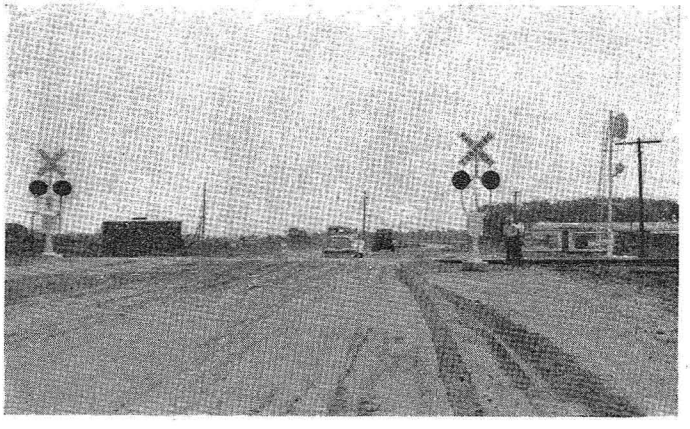
Movements of vehicles, as well as trains, facilitated by elimination of train stops at junction of two lines

Westward Signal 3 on the Mason City line, showing highway-crossing signals in background

Highway Crossing Protection and Spring Switch on Milwaukee

A SECONDARY main line of the Chicago, Milwaukee, St. Paul & Pacific extends from St. Paul, Minn., via Austin, Minn., to Calmar, Iowa, and on through to Chicago and Milwaukee, Wis. At a point about one mile south of Austin, a single-track line branches off and extends to Mason City, Iowa. The State of Minnesota constructed a new highway, Route 40, which crosses this Mason City line at a point about 1,000 ft. east of the junction switch, and, as a part of the highway project, highway-railroad crossing signals were installed at the crossing.

Under the previous arrangement, inbound trains from Mason City were required to stop to permit a trainman to throw the junction switch. A train making such a stop traveled at a slow speed when passing over the crossing, and, furthermore, when stopped at the switch, the train blocked the crossing, and continued to do so while being started again. The resulting delays to highway traffic were undesirable. Therefore, in order to eliminate train stops, an installation of a spring-switch mechanism for the junction switch, as well as signals for directing train movements was considered desirable.

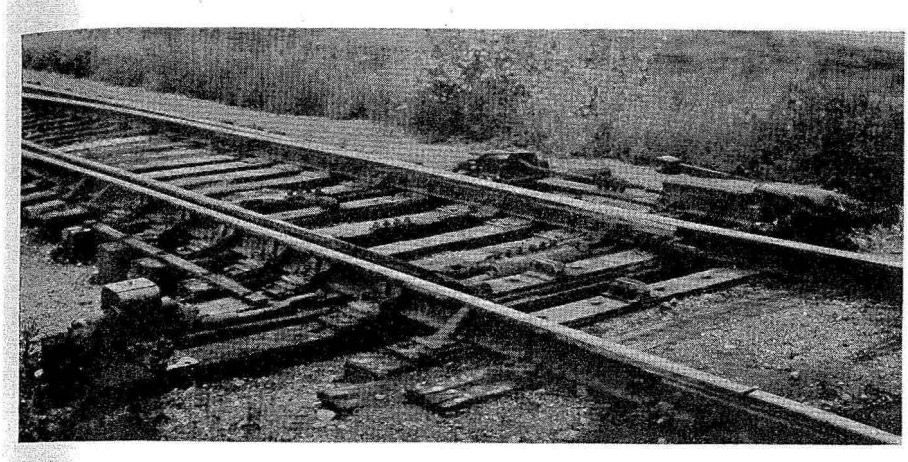


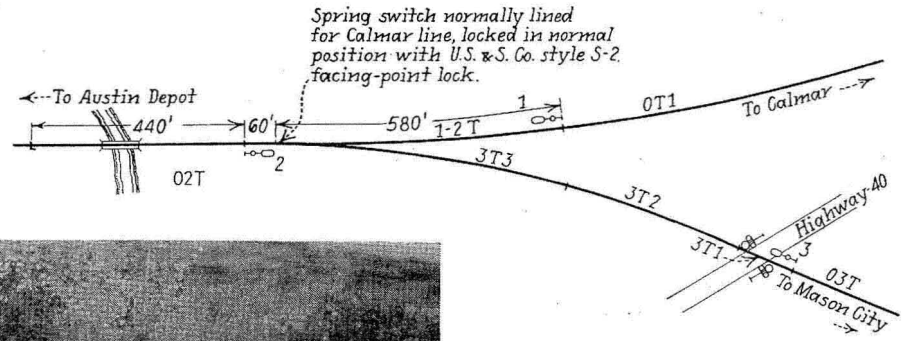
View looking east along highway showing crossing signal in clear position

The highway signals are the flashing-light type, with the rotating disk "Stop" sign, the word "Stop" being outlined with reflector buttons. This type of signal is standard for installations in Minnesota. The crossbuck sign is mounted above the rotating disk signal. Because the highway crossing is located only 1,000 ft. from the junction switch, train speeds approaching the crossing from either direction are comparatively slow. Therefore, the eastbound approach track circuit for controlling the crossing signals is only 400 ft. long, and the westbound is 440 ft. long. A separate track circuit 105 ft. long extends over the width of the crossing to insure that the signals continue to operate until the rear of a train

in either direction, clears the crossing.

The westward approach track circuit is designated 03T; the one over the crossing is 3T-1; and the eastward approach 3T-2. Track circuits 03T and 3T-1 each control a 4-ohm track relay, and a series circuit through contacts of these relays controls one side of an interlocking relay, rated at 2,000 ohms. The other side of the interlocking relay is wound to 4 ohms and is directly controlled by track circuit 3T-2. A 2,000-ohm relay, which has direct control of the crossing signals, is controlled by a circuit through a front contact of track relay 3T-1, so that the signals always operate when the crossing is occupied, and the circuit continues through contacts of the interlocking relay to effect control by approaching trains as well as to cut out the signals when a train clears the crossing circuit 3T-1.





Above—Track and signal plan of installation. Left—View of spring switch layout

Spring Switch and Signal Protection

A Union Type S-2 spring-switch mechanism, with mechanical facing-point lock and oil buffer, was installed at the junction switch. This switch is normally lined for the Austin-Calmar main line, so that trains in either direction on this route do not have to stop. Westbound trains on the Mason City-Austin line trail through the switch, thus eliminating a stop. However, eastbound trains on this route stop to permit a trainman to handle the switch.

Train movements over the junction including the spring switch are directed and protected by three signals which are controlled automatically. Signal 2, located 60 ft. from the switch, directs eastbound movements to both diverging routes and includes facing-point protection for the switch. Signal 1, located on the Austin-Calmar line 580 ft. from the switch, directs westbound moves on this route. Signal 3, located on the Mason City-Austin line, 1,052 ft. from the switch, directs westward moves on this line through the switch and to the main line.

In view of the fact that train movements in either direction on two conflicting routes are involved, interlocking of circuits was required to prevent the clearing of signals for conflicting routes. The interlocking between routes is accomplished by stick relays which also prevent the clearing of a signal when a train is receding in an approach control section such as 0T1 and 03T. Track circuit 02T is used as an overlap in the controls of signals 1 and 3. A westbound train, when occupying 02T, will cause signal 2 to clear, but this is no serious handicap because the circuit is only 440 ft. long.

The circuits are so arranged that the control relay 2H for signal 2 is energized under normal conditions, i.e., with the track circuits within the home signal limits unoccupied, and the WP relay energized. The WP relay checks the switch normal and also the normal position of the lock plunger as to overthrow or underthrow. Therefore, if an eastbound train for the Austin-Calmar route enters approach circuit 02T, signal 2 will display the proceed aspect, authorizing the movement. When the train releases track relay 1-2T, stick relay 1S is picked up and it holds up until the train clears the receding track circuit 0T1. As long as stick relay 1S is energized, signal 2 cannot clear, thus preventing a receding train from clearing the signal.

If an approaching eastward train is to take the diverging route to the Mason City line, the engineman accepts the proceed aspect of signal 2 and passes it, but stops the locomotive short of the switch; then a trainman goes to the switch and reverses it. This operation of the circuit controller in the point detector and plunger detector completes circuits which cause stick relay 1-3S to pick up, and it is held up as long as any one of the track circuits, 3T3, 3T2, 3T1, are occupied, regardless of the fact that the switch was placed normal behind the train. As long as stick relay 1-3S is thus energized, battery is fed to the control of 1-2H so that either signal 2 or signal 1 can be cleared for an approaching train, regardless of the fact that the departing Mason City train has not as yet cleared the track circuits.

Home Relay Control

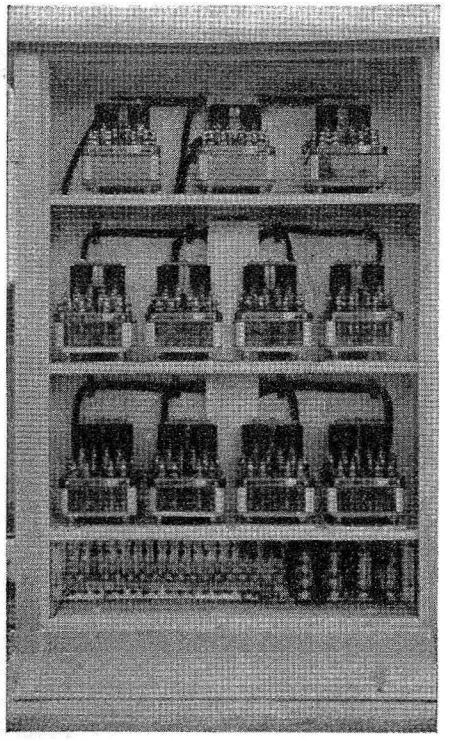
The home relay for the westward signal 1 on the Calmar line, relay 1H, is normally de-energized, and the circuit is completed by a back contact of track relay 0T1 when released by an approaching westbound train, providing stick relay 3MS is picked up and relay 1S is released and the track relays for circuits inside the signal limits, as well as 02T, are energized, and the switch is normal.

Stick relay 1MS is normally energized, the stick circuit through its own front contact being fed through a back contact of home relay 1H. When the approaching westbound train caused relay 1H to be picked up, stick relay 1MS dropped. As long as this relay is de-energized, signal control 3H is open and signal 3 cannot clear. When the westbound train passes signal 1, the 1H relay drops, and when the rear of the train clears track circuit 0T1 the stick relay 1MS is picked up and it sticks up through a back contact of 1H. Thus, when a train enters an approach circuit and gets a signal, the conflicting signals are locked out. The circuits for control

of signal 3 and relays 3MS are similar to those previously explained. The signals are of the color-light type and are designated as absolute stop signals.

Each of the track circuits is energized by a set of three cells of Edison 500-a.h. primary battery. A set of six cells of Exide DMGO-9 storage battery, located at the crossing, feeds the line circuits, operates the crossing signal sign mechanisms, and serves as a standby supply for the signal lamps in case of an a-c. power outage. Another set of five cells of the same type is used in connection with signals 1 and 2.

The signal control circuits are normally energized, but the signal lamps are extinguished, being lighted by approach control circuits. The signal lamps are rated at 10 volts, 18 watts. An electrically-operated time clock is used to control the lamp-feed circuits so that the voltage at the lamps is increased during daylight hours and reduced during darkness. The purpose of this special feature is to reduce the brilliancy of the lamps at night so as not to be blinding to enginemen, preventing them from observing hand signals when switching in the immediate vicinity.



Interior of instrument case at crossing

The signals, relays, rectifiers, transformers and spring switch equipment were furnished by the Union Switch & Signal Company, and the crossing signals by the Griswold Safety Signal Company.

Iowa Grade Crossing Accidents

A SUMMARY of highway-railroad grade crossing accidents in the State of Iowa during 1937, prepared by H. A. Franklin, engineer of the Iowa Railroad Commission, contains the following tables and comments:

As of January 1, 1937, signals were in service at about 18,000 crossings in the United States and some 1,300 were added during the past year. In view of the fact that thousands of these standard signals have been in service for years, and in consideration of the general instructions issued to motorists by various states, and the common availability of knowledge as to the meaning of these signals, any argument is unreasonable and beside the point to the effect that the average motorist does not understand the meaning of the signals when displaying the danger aspect. In a vast majority of cases in which drivers have survived accidents, they have admitted that they understood that the flashing of lights indicated the approach of a train. Their failure to obey crossing signals must, under such circumstances, be largely ascribed to gross negligence. The vast majority of drivers do observe and obey such signals, and it is a relatively small percentage that either ignore them or deem it their right, when the lights are flashing, to exercise their own judgment about crossing the track before the train arrives.

There was allocated to the State of Iowa out of federal funds, for the period July 1, 1937, to July 1, 1938, $1,400,000 for the separation of grades at crossings and/or the protection of such crossings with signal devices. These funds were largely used for the separation of grades, there having been only about 21 crossings authorized for protection. There has also been allocated about the same sum for the period July, 1938, to July, 1939, and, in accordance with indications contained in conferences recently held between state authorities and the railroads, it is strongly indicated that a portion of these funds up to possibly $1,000,000 will be used for the protection of crossings.

At protected crossings, the use of part-time protection should be discouraged. If such protection is to be continued, then in fairness to those traveling on the highways, some form of sign should advise the traveler that there is no protection at a specific interval of time. Automatic flashing-light signals should not be installed at locations where, because of switching movements, etc., there is too much false indication of the signals; that is, operation of the signals when no train is about to cross.

A few situations, particularly those involving multiple track, are worthy of the protection of automatic gates or an arrangement representing a combination of automatic gate with automatic flashing-light signals. This form of protection has its particular merit in compelling regard of the signal, since the right-hand side of the highway is blocked and the driver can run by the lowered arm only by making an S curve; the lessened probability that the signal will be overlooked due to its being so well lighted, flashing lights being installed on gate arms, as well as at the side of the street; and its ability to keep drivers from going on to the tracks behind one train and being struck by a train on another track.

Highway-Railroad Grade Crossing Accidents in the State of Iowa

	1937	1936	1935	193
Total number of accidents	141	140	134	14
Total number killed	63	61	51	4
Total number injured	165	149	158	18
Number of accidents which occurred:				
During daylight hours	73	84	74	7
During hours of darkness	68	56	60	7
During reported clear weather	97	109	88	10
During reported inclement weather	44	31	46	4
Where passenger trains were involved	51	56	53	5
Where freight trains were involved	69	67	71	6
Where switching movements were involved	21	17	10	2
At unprotected crossings	103	113	103	11
At protected crossings	34	26	31	2
Where protection is under part-time operation	4	1	2	
Crossings reported as having obstructed views	15	13	18	1
Where automobile trucks were involved	27	36	24	2
Where vehicle ran into side of train	63	54	55	5
Which involved railway motor passenger cars	11	12	16	2