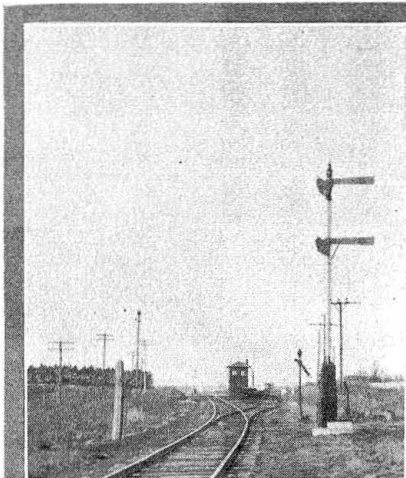


# Railway Signaling

Volume 21

February, 1928

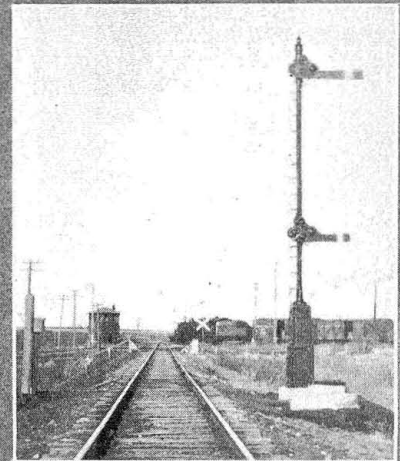
Number 2



*Single track crossing with Illinois Central at Waverly, Iowa, protected automatically—Part of old mechanical signaling retained*

*Home signal on the I. C.*

*Home signal on the C. G. W.*



## Automatic Interlocker on Chicago Great Western Effects Saving

**A**N automatic interlocking was recently placed in service at the crossing of the single-track lines of the Chicago Great Western and the Illinois Central near Waverly, Iowa. This new installation, which is controlled automatically by approaching trains, replaced a 16-lever mechanical interlocking plant that required a leverman for each of three tricks. The "out-of-pocket" cost for new materials and labor to make this change was about \$6,500, while the operating expenses of the old mechanical plant, including towermen's wages, fuel and other supplies not required with the automatic plant, totaled about \$5,000 a year. The new arrangement, therefore, shows an estimated saving at the rate of nearly \$5,000 a year or, in other words, the job will pay for itself in about 16 months' time.

### Traffic and Methods of Operation

The two lines involved in this crossing include the single-track main line of the Chicago Great Western from Oelwein, Iowa, to Omaha, Nebr., and a single-track line of the Illinois Central from Waterloo, Iowa, north to Albert Lea, Minn. On the Great Western the traffic includes two through passenger trains, a mixed train and about four freight trains each way daily, or a total of about 14 to 16 trains daily. The traffic on the I. C. approximates the same number of trains.

In the previous mechanical plant, annunciators warned the leverman of the approach of a train, giving him plenty of time to line up the derails for the route and clear the signals for the trains. With the new automatic plant no derails are used. Trains on

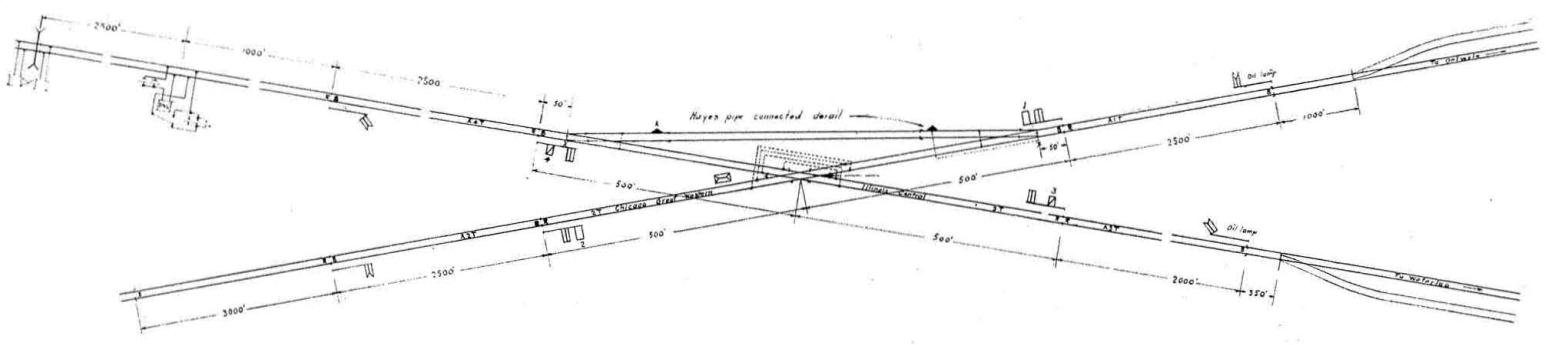
both roads are required by rule to approach the plant and pass over the crossing at a reduced speed of less than 15 m.p.h. In order to illustrate the operation of the plant the following description of the movement of an eastbound C. G. W. train is given as typical:

The train upon approaching the plant enters an advance track section and causes the electric light in the fixed distant signal to be lighted. On passing the distant signal another track circuit is shunted and through a simple circuit arrangement employing ordinary signal relays, a check is made automatically to determine that no train is occupying the plant and that the approach sections of all other signals are unoccupied. If everything is safe the eastbound Chicago Great Western home signal moves to the clear position allowing the train to continue through the plant without stopping.

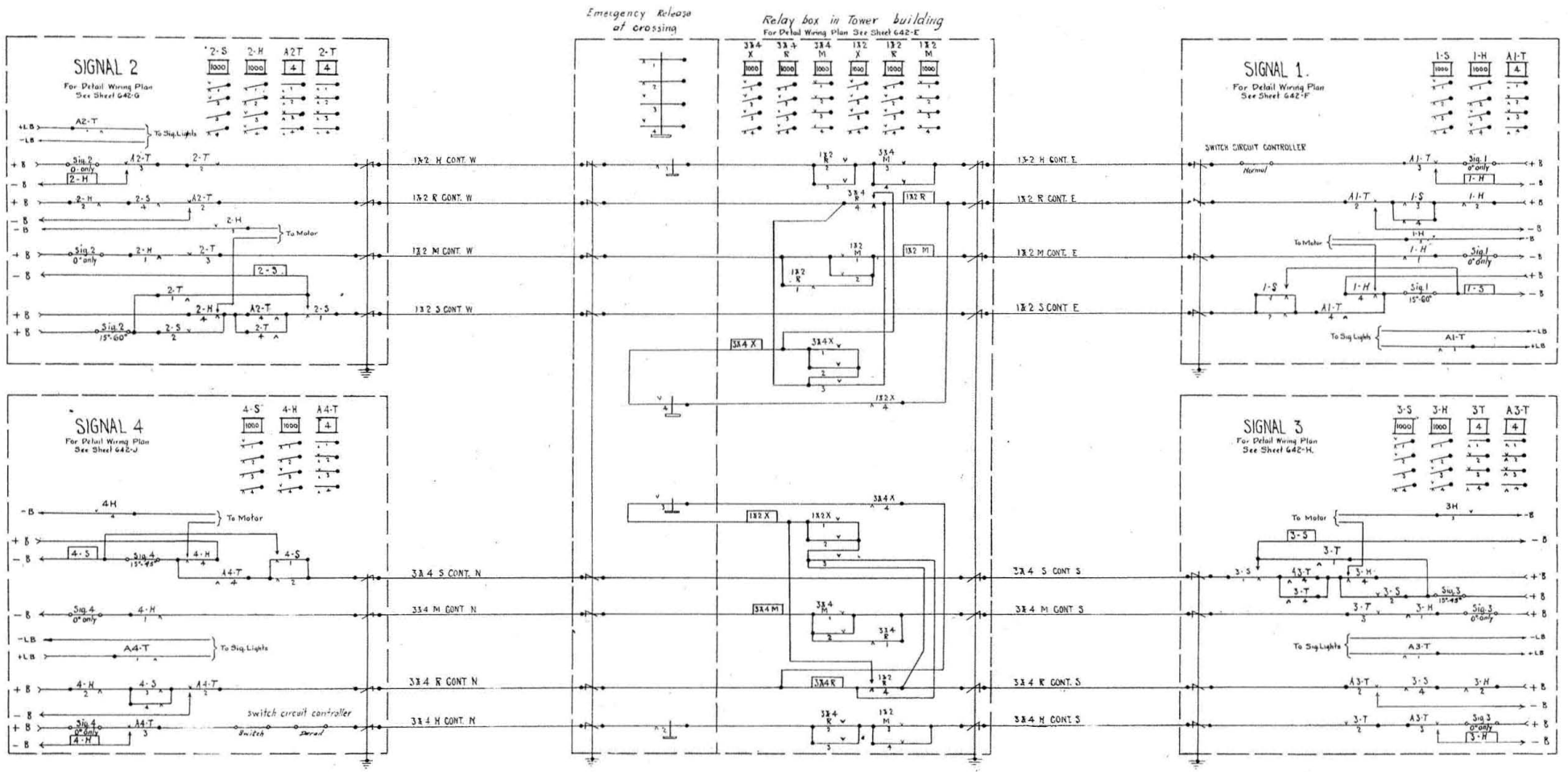
In case one train is following another the home signal will not clear for the second train until the first train has cleared the plant beyond the opposing home signal. If a train is occupying the plant and another train approaches on the other road, the home signal on the other line will not clear for the second train until the first train clears the plant. The automatic operation of the plant has been satisfactory in handling all trains without delay.

### Change-Over Was Accomplished for \$6,500

The mechanical interlocking plant at this crossing had been installed in 1906, and was in comparatively good condition when dismantled. The four electrically-operated semaphore signals for the old me-



Complete straight line circuit plan for Waverly automatic interlocker — Twenty relays are used in this plant.



chanical installation had been used previously as distant signals and were in good condition. They were moved in toward the crossing and now serve as the home signals for the new automatic plant. The old mechanical signals, in turn, were moved out about 2,500 ft. from the power home signals and now serve as the fixed distant signals. On the Great Western, two-arm home signals are used, the lower arm being inoperative, and the upper arm operating in two positions, 0 and 60 deg. in the lower quadrant. The Illinois Central also uses two-arm home signals but the upper arm is inoperative while the operative arm is 13 ft. lower and operates to 45 deg. in the upper quadrant. This low spacing and short blade is the I. C. standard aspect for a low-speed caution signal, which was considered desirable at this plant.

The derails, pipe lines, interlocking machine, etc., were removed and salvaged. The two switches for the connecting track were disconnected and equipped with ordinary hand-throw switch stands and switch circuit controllers, as is the practice in automatic block signal territory.

The tower, a brick structure, was not dismantled and is now used as a maintainer's shop and storeroom as well as for housing some of the control relays for the crossing signals.

#### Operating Rules Governing Plant

A few days before the Waverly plant went into service, the superintendent issued a bulletin to trainmen to acquaint them with the operation of the new crossing facilities. An abstract of this bulletin is given herewith:

"When a train approaches the crossing and it passes the distant signal, the home signal will go to the "Proceed" position providing there is no train within the limits of the home signal and there is no train approaching in either direction on the Illinois Central between the distant and home signals.

"Trains finding the home signal at "Stop" will stop in clear of signal to permit it to change to the "Proceed" position when train on the Illinois Central has passed out of home signal limits.

"If no cause for signal being at "Stop" is seen, or if there is a train on conflicting route standing outside of home signals, with no indications that they are to immediately proceed, trainman must be sent ahead to operate a release located in small iron box outside and on the East wall of tower building at railroad crossing. Box will be provided with standard switch locks and instructions for operating release will be posted inside box. These instructions follow:

"To operate release: Turn knob to the right to extreme position, about one quarter turn, then let go of knob and allow automatic release mechanism to run down, which will require about two minutes. Home signal should then clear for train to proceed.

"In case the operation of the release does not clear the signal the train may proceed slowly over the crossing under protection of flag of trainman at the crossing. This means that trainman must protect his train against any conflicting train and must be provided with complete flagging equipment when going ahead to operate release.

"All trains must be brought under control after passing a distant signal and the speed of trains shall not exceed 15 miles per hour while engine (or first car of train in case of back-up movement) passes the home signal.

"The transfer switches will be operated by standard hand throw switchstands and at the clearance

point on transfer track there will be a derail, pipe connected to the transfer switch and operating with the switch. Home signals will not govern movements to or from the transfer but trains in either direction must have clear-home signals on approaching the plant before using the transfer. Eastbound trains using the transfer will leave train west of eastbound home signal."

In the foregoing instructions it was believed necessary to call attention to the operation of the hand-throw switch on the transfer track, particularly because no lower-arm indication is provided for movements on to the transfer track. Once the C. G. W. switch is reversed, it is impossible to clear either home signal 1 or 2 but does not tie up the plant for the Illinois Central provided the switching engine and cars are entirely clear of the track-circuited section between home signals.

#### Principles of Circuit Scheme

A total of 14 line relays and 6 track relays, or 20 relays in all, is used in the automatic interlocking circuits for the Waverly installation. As will be noticed from reference to the circuit plan, each signal case houses the *H* relay for controlling the semaphore, the *S* or stick relay for directional control of the home signal and either one or two track relays. Where two track relays are housed in one signal case, one is controlled by the approach section and the other by the track circuit between home signals. There are only two of the latter type, relay 2*T* being located at signal 2 and relay 3*T* being located at signal 3. In a relay box in the tower building, six more relays are found, these, as reference to the plan will show, are designated as the *R*, a checking or repeating relay for the directional control of the *H* relays; the *M*, a special stick relay to repeat the condition of the track circuit between home signals as well as the position of the home signals, and in addition the *X*, or emergency release stick relay for obtaining a clear home signal in case of an approach track circuit failure on either line. That is, to clear home signal 2 on the C. G. W. with, let us say, track circuit 4*T* out because of trouble, it is necessary to pick up stick relay 3&4*X* in order to energize relay 2*H* and clear signal 2.

#### Detail Operation of Circuit

It will be seen that signals 1 and 2 are the westbound and eastbound home signals of the Chicago Great Western and that signals 3 and 4 are the northbound and southbound home signals, respectively, of the Illinois Central. Most of the control wires between signals are used as joint wires for the two home signals. The functioning of the stick relay *S* at the signal, the special stick relay *M*, which is in effect the route locking relay, the repeating relay *R* and the emergency release stick relay *X* can best be described by taking a particular train movement and following it through. Let us assume that an eastbound C. G. W. train approaches signal 2.

When within 3,000 ft. of the fixed distant signal the electric light, which is approach controlled, becomes illuminated. As the train proceeds past the distant signal it drops relay 4*T* and this completes the circuit for relay 2*H* to battery through a back point of relay 4*T*, a front point of relay 2*T*, controlled by the track section at the crossing, through a normal contact on the emergency screw release at the tower, through a normal contact on relay 1&2*R*, through a normal contact on relay 3&4*M*, through a normal contact on the switch circuit controller connected to the switch at the C. G. W. end of the interchange track, then through a

front point of relay  $A1T$  and circuit controller of signal  $1$  in the stop position to battery.

### Repeating Relays Simplify Wiring

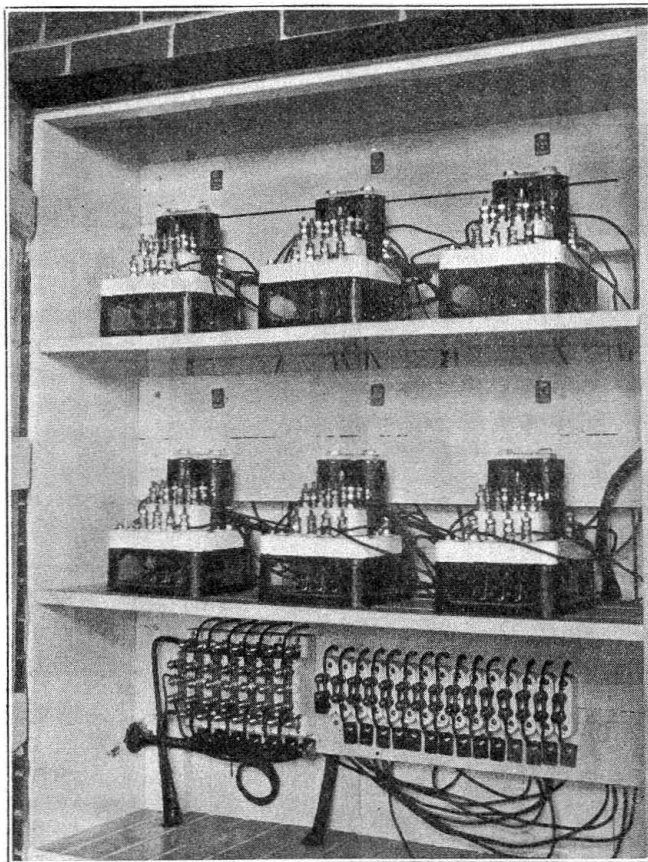
To continue the explanation of the circuit control it is necessary to consider the control of the checking relay  $1\&2R$  as well as the control of the special stick relay  $3\&4M$ . Reference to the circuit plan will show that relay  $1\&2R$  repeats the position of the approach track relays on its own line. That is, it will become energized if either relay  $A2T$  or relay  $A1T$  drops. Relay  $1\&2R$  also checks the position of the  $H$  relay for the

route-locking relay and supplements the protection provided by the interlocked control of checking relays  $1\&2R$  and  $3\&4R$ . As indicated in the circuit the  $H$  control for home signals  $1$  and  $2$  is carried through two front contacts in multiple of the stick relay  $3\&4M$  which in turn is controlled by the position of the home signals,  $H$  relays and the track relay  $3T$  (governed by the circuit between home signals  $3$  and  $4$ ) on the Illinois Central. By carrying the  $1\&2H$  circuit through relay  $3\&4M$  assurance is obtained that both home signals on the I. C. are at stop and that the crossing circuit on that road is unoccupied.

### Emergency Release Circuit

The foregoing description applies to the normal operation of the plant. If a track circuit failure occurs it is necessary to resort to some emergency control to clear the desired signal. For instance, a failure of track circuit  $A4T$  on the I. C. would automatically clear home signal  $4$  and tie-up the plant. Under these conditions it is possible to clear signal  $2$  for an eastbound C. G. W. train by operating the emergency screw release located at the crossing. Operation of the release picks up the emergency release relay  $3\&4X$ , in this case, because the track circuit failure is on the I. C. This release relay is picked up over the  $1\&2R$  control wire through a reverse point on the screw release which operation allows enough time for the  $X$  and  $R$  relays to pick up. Then the circuit continues through a back point of the other emergency release relay  $1\&2X$  to make sure that both emergency release relays cannot be picked up at the same time. By picking up relay  $1\&2R$ , relay  $3\&4R$  is dropped allowing  $1\&2R$  to remain energized after the screw release returns to normal position and allowing relay  $2H$  to pick up and clear signal  $2$ .

No provision is made to provide for clearing a signal in case of a track circuit failure in advance of the opposing home signal. That is, if relay  $A1T$  is down it is impossible under any conditions to clear signal  $2$  for an eastbound train. The emergency screw release circuit provides only for clearing a home signal in case of approach track circuit trouble on the other line.

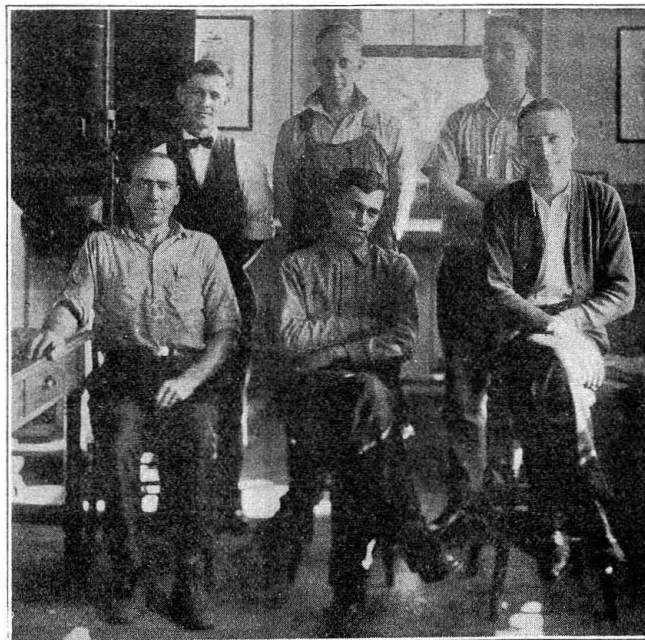


Control relays at tower—These are the  $M$ ,  $R$  and  $X$  relays shown in the circuit

opposing signal. In addition it checks the position of the directional control stick relay for the opposing home signal.

The eastbound train, by dropping relay  $A2T$  will pick up relay  $1\&2R$  provided relay  $1S$  is down. The stick relay  $1S$  is normally de-energized but picks up when a westbound train passes the home signal, in this case signal  $1$ , and is held up until the rear end of the train clears the extreme limits of the interlocker. Its purpose is to prevent the clearing of home signal  $2$  when a westbound C. G. W. train is in track section  $A2T$ . It will be seen that under these conditions stick relay  $1S$  would be energized. However, under the conditions first mentioned, stick relay  $1S$  is down and relay  $1H$  is also down so that the connection to the positive side of the control battery is made and the checking relay  $1\&2R$  is picked up. To make certain that the approach sections on the Illinois Central are unoccupied, the  $1\&2R$  circuit is carried through a back point of relay  $3\&4R$ , which is the corresponding checking relay for the Illinois Central.

There remains the explanation of the control for the special stick relay  $3\&4M$ . This relay is in effect a



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