prevent moisture from entering the end of the cable. If the insulation between the conductor and the lead sheath absorbs moisture, there may be a tendency for the insulation to break down, particularly so if any inductive discharges either from lightning or other causes are carried by the cable.

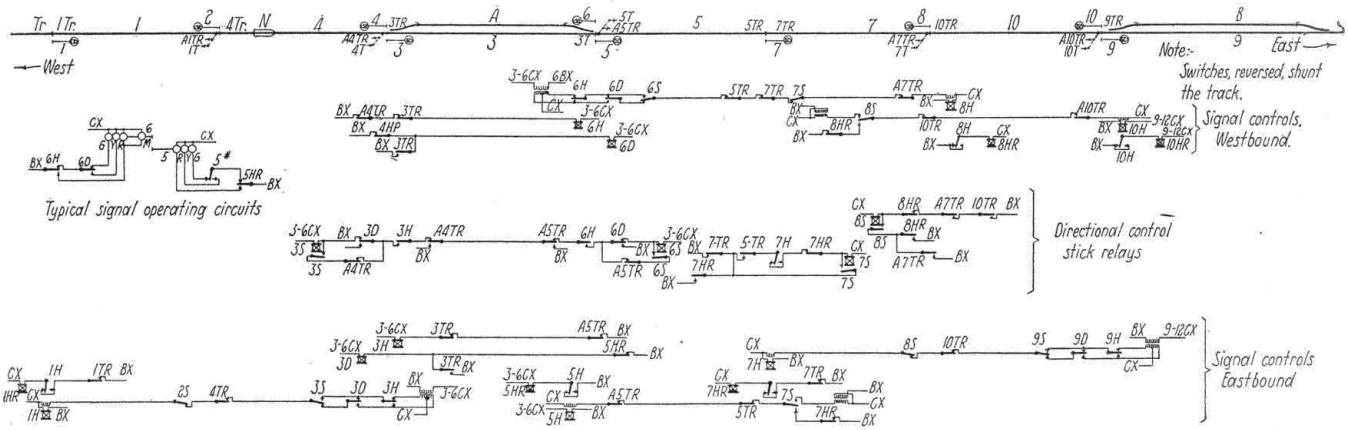
Chariton, Iowa. T. H. HOUSE,
Signal Maintainer, Chicago, Burlington & Quincy.

Various Circuits for Directional Control of Single Track Signals

"How are single track signals controlled so as to discriminate between opposing and following trains? ($5 will be paid for the most simple explanation of methods to provide directional control of single track signals.)"

Stick Relays Employed in Union Switch & Signal Directional Control Scheme—Slow Acting Home Relay Repeaters Used in Stick Circuits for Intermediate Signals

IN the accompanying drawing, an arrangement of circuits is shown for a typical layout of the well known system of A. P. B. single track automatic signaling. Incorporated in this design are directional control stick relays *3S, 6S, 7S* and *8S* which serve to differentiate the signal controls in respect to the direction of train movement and hence also as between following or opposing trains.



Single track, directional signal control scheme for color-light signals—Floating track relays control overlaps for

An understanding of the construction and functioning of the circuits may most readily be obtained by following the operation as a train proceeds over the stretch of track shown. For this purpose assume that an eastbound train *N* has entered section *4*. Opposing signal *4* will indicate "stop" and signals *6* and *8* will indicate "caution." If the track is clear ahead of train *N* all other signals shown to the right of section *4* will indicate "proceed."

When the train arrives at a point a certain distance from signal *3*, let us assume for example, 1,000 ft., floating track relay *A4TR* will become shunted and will therefore open the circuit of relay *6H* putting signal *6* to "stop." All other signals will continue to display the same indications as before. As train *N* starts into section *3*, signal *3* wil go to "stop" but none of the other signals will change. When the train clears section *4*, relay *4TR* will "pick up" thus closing the circuit of relay *1H* with its polarity reversed through back contact *3S*, front contact *3D* and back contact *3H*, thereby causing signal *1* to go to "caution." Signals *2* and *4* will go to "proceed" if the track is clear west of train *N*.

Upon starting into section *5*, train *N* will shunt track relays *A5TR* and *5TR* thereby opening the circuit of *5H* and putting signal *5* to "stop." At the same time, relay *5TR* will open control *8H* thereby putting signal *8* to "stop." Relay *5S* being down, control *10H* will also be opened at front contact *8HR* and signal *10* will go to "stop." With the front end of the train in section *5* and the rear end in section *3*, we now have signals *3, 5, 6, 8* and *10* at "stop," signal *1* at "caution" and signals *7* and *9* at "proceed."

Meantime, when relay *A5TR* "drops" it closes the circuit of *3S* through *A4TR* front contact, *3H* back contact and *3D* front contact, thus causing *3S* to "pick up." As the train leaves section *3*, relay *3D* will "drop" when *3TR* "picks up" and *3S* will then "stick up" through back contact *3D* in series with front contact *A4TR*. Immediately after the train leaves section *3*, signal *6* will go to "proceed" but signal *3* will remain at "stop" until the train has advanced far enough to permit relay *A5TR* to "pick up." Floating relay *A5TR* provides overlap for signal *6* as previously described.

When relay *A5TR* "picks up" it closes the control of *3H* thereby causing signal *3* to go to "caution." At the same time, relay *3H* by picking up, reverses the polarity of control *1H* because relay *3S* is energized. Signal *1* will now indicate "proceed" whereas if train *N* were at its present location but traveling in the opposite direction, relay *3S* would be "down" and signal *1* would indicate "caution" instead of "proceed." In this way, relay *3S* selects between the "caution" and "proceed" indications of signal *1* according to the direction of train movement.

As train *N* starts past signal *7*, relay *7TR* becomes shunted and hence closes the pick-up circuit of relay *7S* which will "pick up" before contact *7H* opens and will then "stick up" through back contact *7TR* and afterward through back contact of slow-acting relay *7HR*. When relay *7HR* "drops" signal *7* will indicate "stop."

Relay *7S* will continue energized as long as relay *7HR* remains "down." With relay *7S* energized, relay *5H* will "pick up" in its reverse direction as soon as the train clears section *5*, thus causing signal *5* to indicate "caution." In this way, relay *7S* selects between the "stop" and "caution" indications of signal *5* according to the direction of train movement, permitting signal *5* to indicate "caution" while the corresponding signal *10* at the other end of the block for governing in the

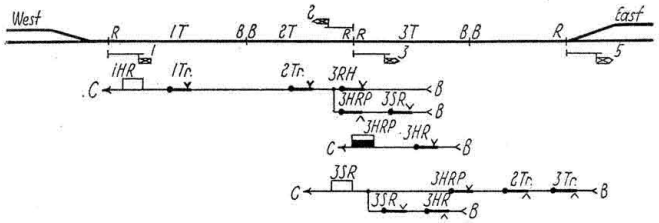
opposite direction, continues to indicate "stop." Relay *7S*, by opening its back contact in control *8H*, holds signal *8* at "stop" after train *N* clears section *7* and until it has cleared section *10*, thus preventing signal *8* from clearing and permitting a train to reverse its direction of movement while between passing sidings *A* and *B*.

Directional relays *6S* and *8S* "pick up" in connection with westbound train movements. Relay *6S* functions in the control of signal *8* similarly to the manner in which *3S* functions in the control of signal *1* and relay *8S* functions in the controls of signals *7* and *10* similarly to the manner in which *7S* functions in the controls of signals *8* and *5* respectively as just described.

Swissvale, Pa. L. E. SPRAY,
Circuit Engineer, Union Switch & Signal Co.

A Slow-Acting Relay, in Conjunction With a Stick Relay, Can Be Used to Secure Directional Control of Single-Track Signals

THE discrimination between opposing and following train movements can be effected by means of a stick relay such as *3SR* in the accompanying plan, this relay in turn being controlled by a slow-acting home repeating relay, *3HRP*, to pick it up. It will be noted from the sketch that this relay picks up for a train going east but does not pick up for a train going west. (Only the signals and control for the eastbound signals are shown). This circuit operates as follows: A train going east first drops track relay *1TR* which, in dropping, de-energizes home relay *1HR*, signal *1* displaying a red indication. Then track relay *2TR* drops, followed by track relay *3TR* and home relay *3HR*. There is sufficient time interval between the time that the home relay *3HR* drops and the repeating relay *3HRP* drops to pick up the special stick relay *3SR*. The latter relay will remain energized through its own front contact and the back contact of *3HR* as long as the latter relay, *3HR* is down, or in other words, until the train passes the signal next ahead. The directional feature is secured by the fact that relay *3SR* will not pick up for a westward train because the home repeating relay,



Directional control scheme for single-track signals which uses a slow-acting home repeater and a stick relay.

3HRP, will then open before the track relays *2TR* and *3TR* are de-energized during the passage of the train.

The home control for signal *1* is carried over a front contact on *3HR* or a back contact on *3HRP* and a front contact on the directional stick relay *3SR*. This control scheme enables signal *1* to clear to the 45-deg. position as soon as the train clears signal *3*.

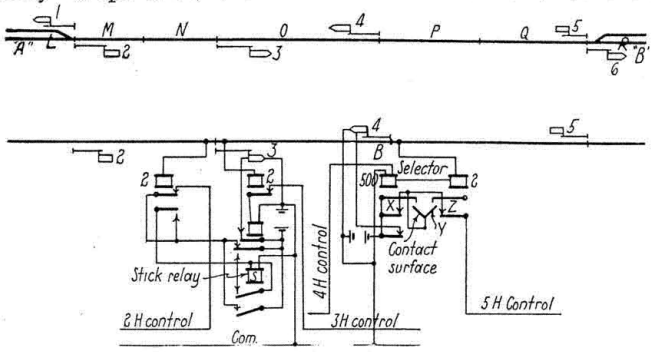
A westward train first drops relay *5HR* which in turn drops *3HR*, the latter in turn dropping home relay *1HR*, placing all opposing signals at danger. In the accompanying sketch the distant control is not shown for the signals. This may be obtained by using polarized home relays or by separate relays.

Richmond, Va. A. G. WALKER,
Circuit Designer, Chesapeake & Ohio.

Single-Track Signal Control Circuits Explained for Both Stick and Selector Relay Types

IN the accompanying circuit plan I have endeavored to show the Hall-Kendall selector relay scheme for directional signal control on single track as used on the Illinois Central and also the common stick relay scheme. Referring to the sketch in Fig. 1, it will be seen that head-block signal *2* with the overlap control scheme, would block to track section *E* controlling intermediate signal *4*, while westward head-block signal *5* would control to one track section west of intermediate signal *3*. In order to provide an absolute block between head-block locations *A* and *B* for opposing train movements, it would be necessary to arrange the control so that signals *2* and *5* would control to each other. This can be accomplished and yet a short block length maintained for following train movements by using a selector relay or a stick relay to provide a parallel battery connection for the H relay control wire for the signal in the rear. At the same time, all opposing signals are held at block.

The Hall-Kendall selector as used on the Illinois Central comprises a track relay element and a line relay element coupled with the selector feature which is so designed that when the track side is dropped first, the line side, in dropping, will cause the selector contact to fall on a metallic surface, establishing an electrical circuit to clear up the *H* relay for the signal one block in the rear of a train. If the line side of the selector relay drops first, the selector will not make contact



Two different schemes for obtaining directional control of single track signals, one involving the use of a Hall-Kendall selector relay and the other the use of a stick relay.

because the finger will fall upon an insulated segment. When the line side drops first the finger in the accompanying sketch pulls the insulated block *Y* to the left and falls upon insulation, opening the H relay control for head block signal *5*. If, however, the track relay side drops first, finger *Z* pulls the block *Y* to the right so that when the line relay side of the selector drops, the finger will fall on a contact surface. When the contact finger on the line relay side of the selector falls as just mentioned, the *H* relay control for signal *5* is closed through contact finger *X* and the metallic surface on block *Y*. It will be noted that this is a parallel feed connection for the head-block relay control circuit.

Owing to the fact that the *H* relay controls of all signals are carried through the front contacts of the *H* relays controlling the signal ahead all opposing signals are blocked when a train leaves either head-block location. Were it not, however, for the selector relay, it would not be possible to pick up the *H* relay of any signal until the train had passed out of the single-track section.

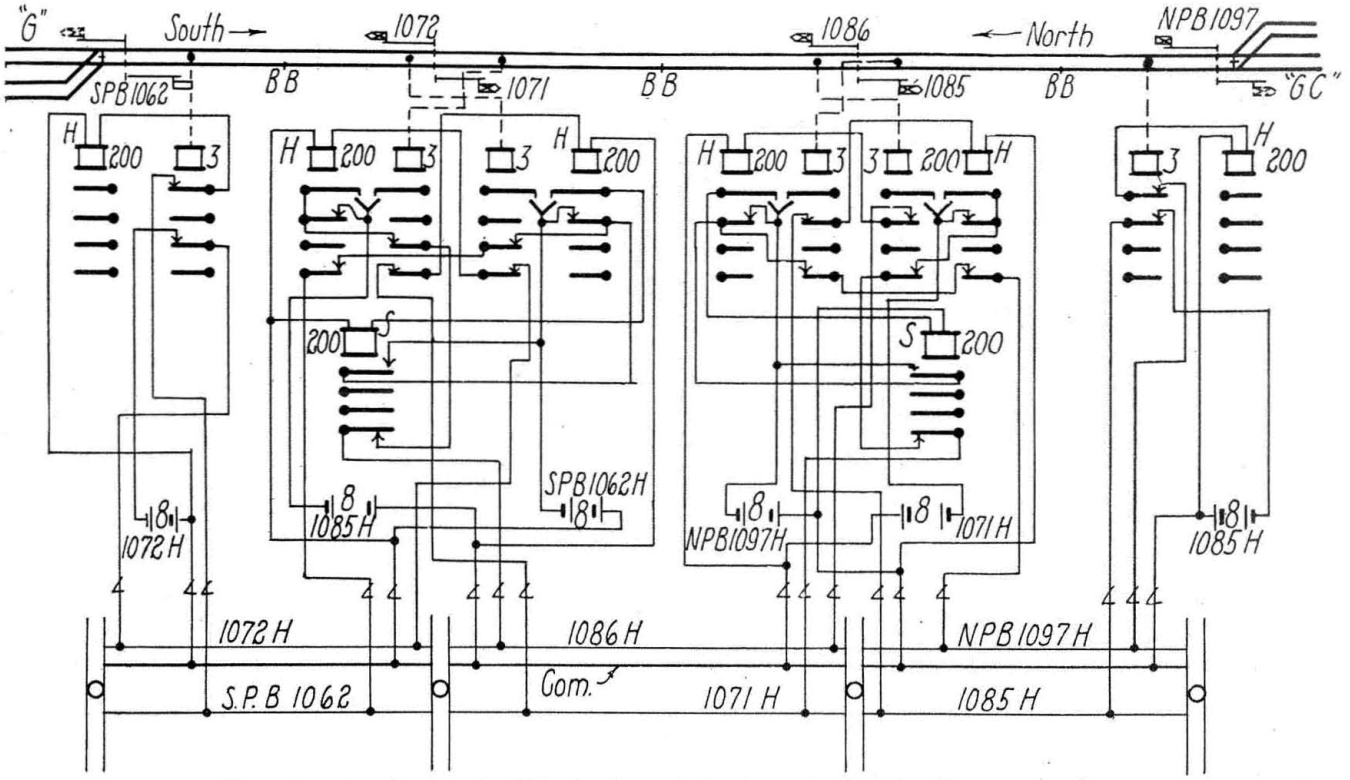
In the stick relay control scheme, the stick relay is picked up when the train reaches the signal, which in turn allows the *H* relay for the signal one block in the rear to pick up when the rear end of the train clears

the last pair of joints as at signal *3* in the accompanying plan. As in the previous schemes, the *H* relay control wire is relayed through a front contact of the *H* relay of the signal ahead but is provided with a parallel connection whereby battery is obtained through a front contact on the stick relay. The stick relay is held up as long as the *H* relay at signal *3* (in this case) is de-energized. When relay *3H* picks up as it will after the train clears the signal one block in advance the stick relay circuit at signal *3* is broken and the relay drops. The *H* control circuit for signal *2* then receives its battery energy through the normal control circuit, namely through the front contact of relay *3H*.

Chicago A. R. WHITEHORN,
Office Engineer, Signal Dept., Illinois Central.

Selector-Relay Circuit for Single Track Semaphore or Color-light Signaling

THE method used to discriminate between following and opposing trains on the single track district where my present territory is located, makes use of a selector relay and a special relay. The selector relay is a Hall-Kendall type comprised of a 3-ohm track relay and a 200-ohm line relay, each of which has three ordinary relay fingers with front and back contacts, and the necessary selector feature. This feature is so designed that when the track side is dropped first the line side when dropped will cause the selector to



Complete circuit plan for Illinois Central single track signaling between stations

make contact. If the line side drops first the selector will not make contact.

The special relay is a 200-ohm, Hall neutral type, having four relay fingers with front and back contacts. This relay is of the wall type. It is normally de-energized, the only time it is energized being when the selector controlling it has made contact. It is used as a means of clearing the signals in the rear for following trains. In the plan shown there are only two of these relays, one at each intermediate location, if there had been another location in this block between the two intermediates it would have required two more special relays. What follows is a description of the action of the home, selector and special relays.

To illustrate the operation of these relays we will assume that a train enters the block at *G*. As the train enters the block at *S. P. B. 1062* it de-energizes *S. P. B. 1062H* and *1072H*, which is the line side of the selector, causing the same to select on insulation, thereby relaying the de-energized condition to *1086H*, which in turn relays it to the home relay *N. P. B. 1097*. As the train proceeds towards signal *1071* it has all the northward blocks at danger as far out as *N. P. B. 1097* at *GC*, and is protected in the rear by *S. P. B. 1062*. As the train passes signal *1071* it drops *1071H* and the selector makes contact, picking up the special relay there. Through the front contacts of this relay current is fed back through the front contacts on the track relays, picking up *S. P. B. 1062H* for a follow-up move southward. At the same time relay *1072H* picks up restoring signal *1072* to the proceed position. The train now passes *1085*, dropping *1085H* and that selector drops on the contact, which picks up *1071H*, which in picking up drops the special relay at signal *1071* and takes over the special's job of holding *S. P. B. 1062H* up and clears *1071*. Through the special's back contact current is fed back to *1086H* and that signal is cleared. Now *S. P. B. 1062* and *1071* are ready for a following train, *1072* and *1086* also being clear. The train is protected by *N. P. B.1097* at *GC*, and at the rear by *1085*. When the train passes out of the block at *GC*, *N. P. B. 1097H* picks up and also *1085H* and these signals are cleared. The block is now ready for use in either direction. A northward move through this block would give the same action except that it would result in a non-contact on selectors controlling the southward signals, and contact on all northward selectors, as the train operated them.

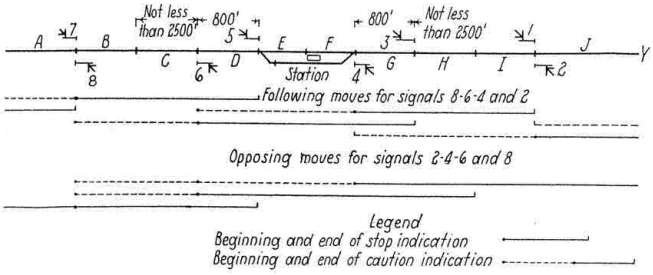
When the selectors were first installed there was some difficulty with wrong selections, due mostly to

vibration caused by the train. After a small tray was made and installed under each selector and mounted on four small coiled springs, this trouble disappeared.

Gibson City, Ill. C. ROBISON,
Signal Maintainer, Illinois Central.

Absolute Permissive Block Signaling for Single Track on the Chicago & North Western Employs Stick Relays—Entrance Signals at Stations are Located Approximately 800 Ft. From Switches

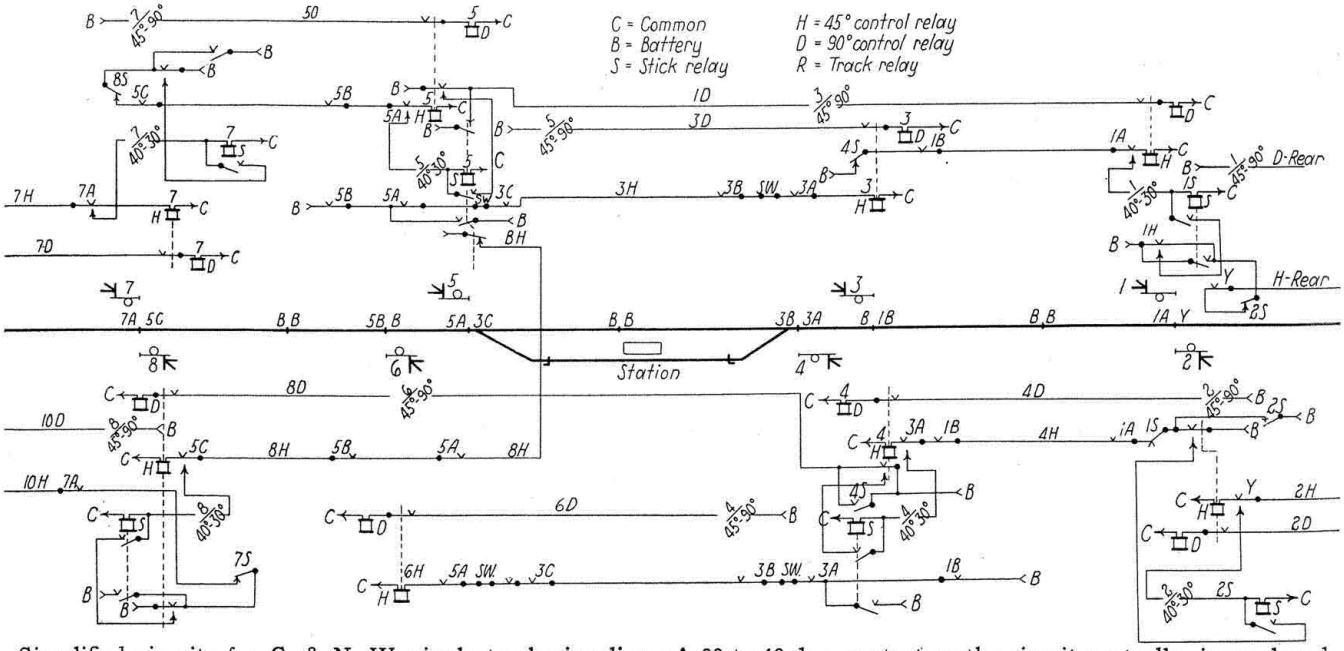
THE accompanying track and circuit plan is in reply to question No. 4 in the June issue of *Railway Signaling*. In order to make the control scheme as clear as possible I will describe first the operation of the signals for following train movements:



or clear position. The train in continuing into track section *J* will cause signal *2* to assume the stop position, signal *4* to go to the 45 deg. position and signal *6* to the 90 deg. position. Upon leaving track section *J* the train when entering the next block will cause signal *2* to go to the 45 deg. position and signal *4* and signal *6* to the 90 deg. position.

For opposing train movements a westward train leaving station *Y* will cause signals *2* and *4* to assume the stop position and signals *6* and *8* the caution positions. Upon entering track section *H* signal *6* will go to the stop position owing to the fact that this signal is overlapped through this track circuit for opposing train movements. At the same time signal *8* remains at the 45 deg. or caution position. After passing through the station and upon entering track section *D* signal *8* as well as all opposing signals to the next station will assume the stop position.

It will be noticed that the stick relays at the intermediate signal and also at the head-block signals are picked up through a 30 deg. to 40 deg. contact on the circuit controller (which is closed only while the signal arm is moving from the proceed to the stop position) in series with the back point of the track relay at the signal location. Therefore, it will be seen that this stick relay will only pick up when the track relay is de-energized at the time the signal arm is moving from 90 deg. to the stop position. The



Simplified circuits for C. & N. W. single track signaling—A 30 to 40-deg. contact on the circuit controller is employed to pick up the stick relay

An eastward train entering track section *B* will cause signal *8* to assume the stop position. When the train continues into track section *D* signal *6* will assume the stop position. As the train leaves track section *D* signal *8* will pick up to the 45 deg. position owing to the fact that signal *8* is overlapped to the opposing head-block signal. After the train passes through the station and enters track section *G*, signal *4* assumes the stop position. It will be noticed that station signals *6* and *3* are located approximately 800 ft. from the entrance switches, and that for following movements these signals overlap approximately 800 ft. beyond the head-block signal. Therefore, as soon as the train leaves track section *G* station signal *6* will pick up to the 45 deg. position and this in turn will cause signal *8* to go to the 90 deg. latter condition will only obtain for following train movements. When the stick relay is once picked up it will stick up through its own front contact and the back contact of the *H* relay at the signal. The battery energy for the pick-up circuit is obtained at the signal and is fed as just described through the back contacts of the *H* relay at the signal, thus minimizing the possibilities of locking up signals between stations. By using the 30 deg. to 40 deg. contact on the signal controller assurance is obtained that the stick relay will not pick up if the signal sticks clear.

The accompanying circuits which are shown in simplified straight line form are standard for single track signal control on the C. & N. W.

Chicago. HERMAN HENN,
Signal Draftsman, Chicago & North Western.