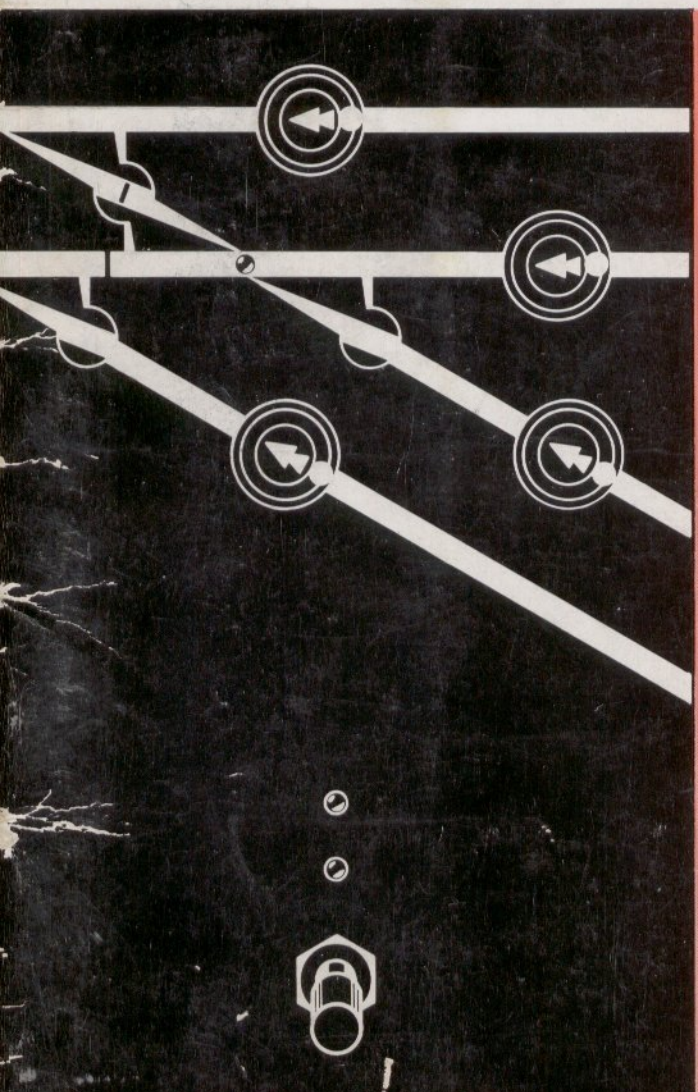
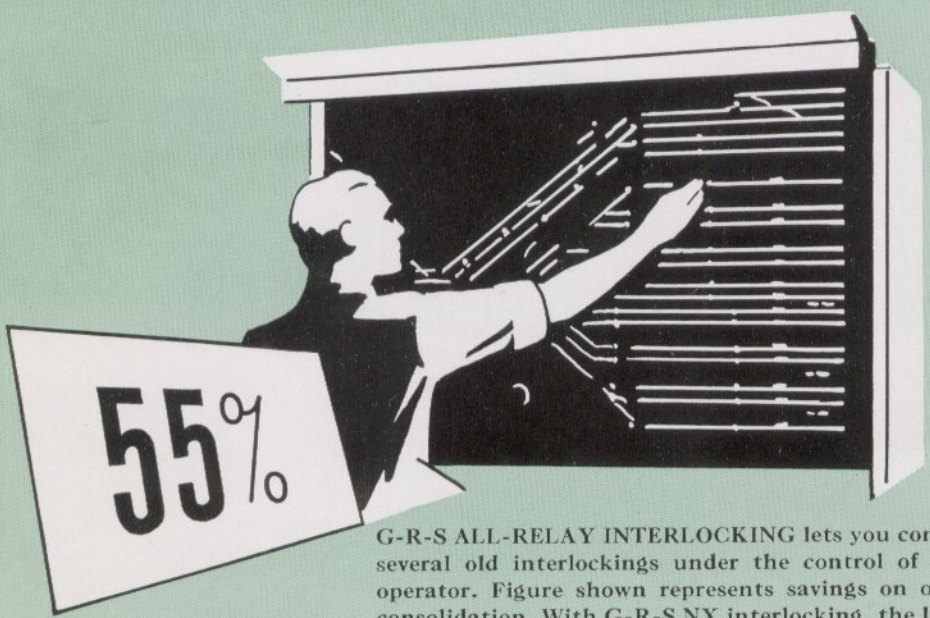
GRS

all-relay interlocking systems



BULLETIN 188

G-R-S
ALL-RELAY INTERLOCKING
SYSTEMS



G-R-S ALL-RELAY INTERLOCKING lets you consolidate several old interlockings under the control of a single operator. Figure shown represents savings on one such consolidation. With G-R-S NX interlocking, the last word in simplified train direction, the operator pushes an entrance knob and an exit button. Presto! the best available route lines up—automatically.

all-relay interlocking systems

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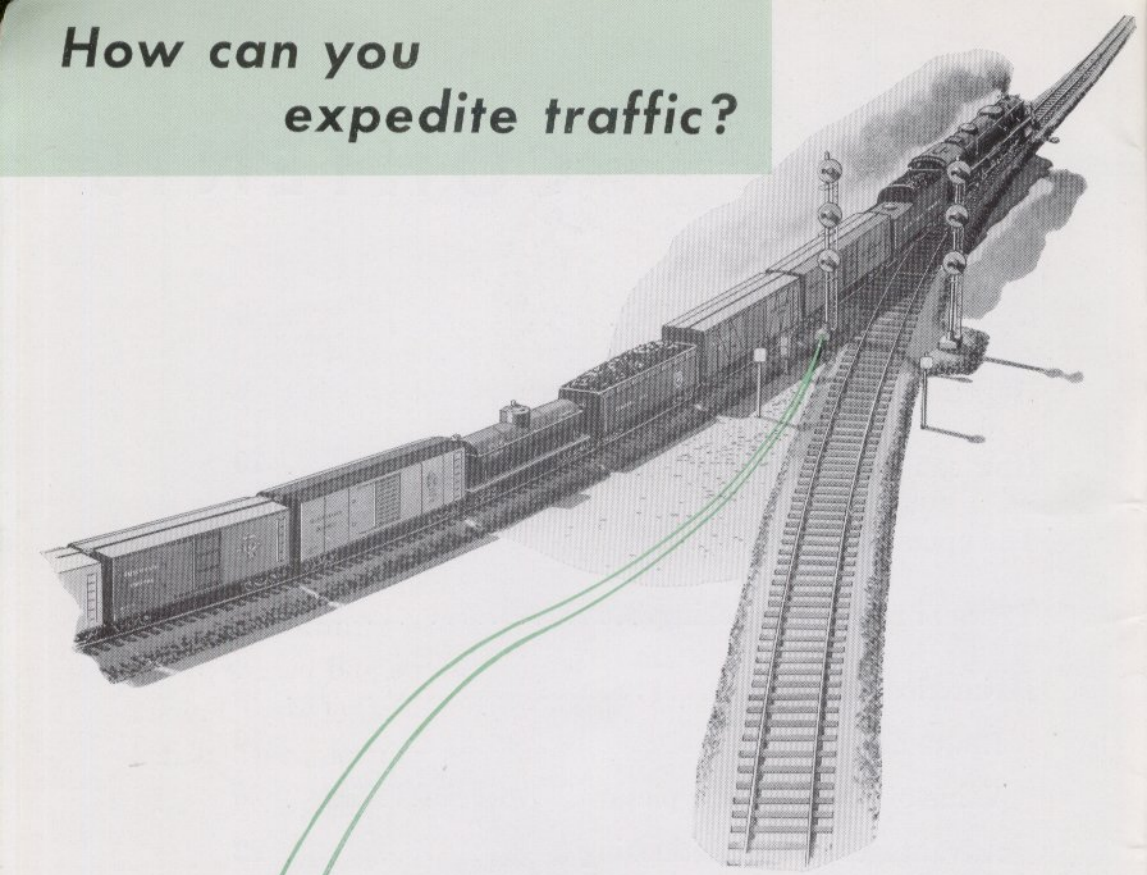
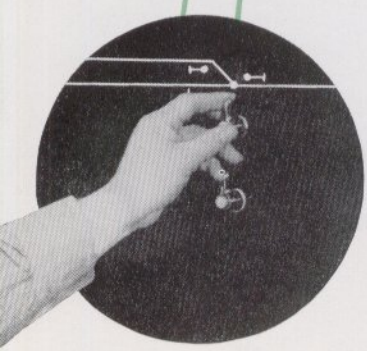
GENERAL RAILWAY SIGNAL COMPANY
ROCHESTER 2, NEW YORK

NX interlocking facilitates heavy traffic involving as many as 500 line-ups a day at Howell, Georgia, on the Nashville, Chattanooga and St. Louis Railway.

CONTENTS

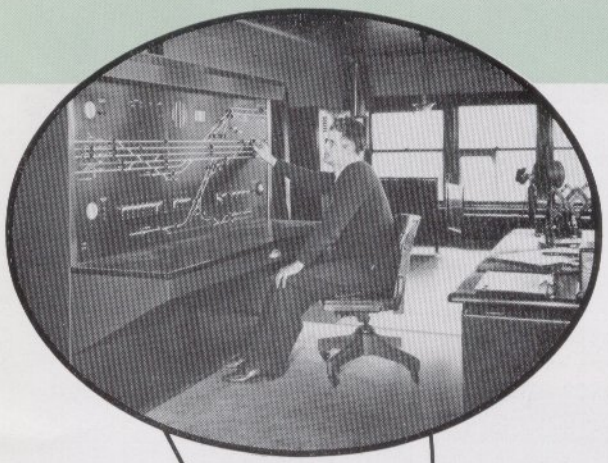
How can you expedite traffic?



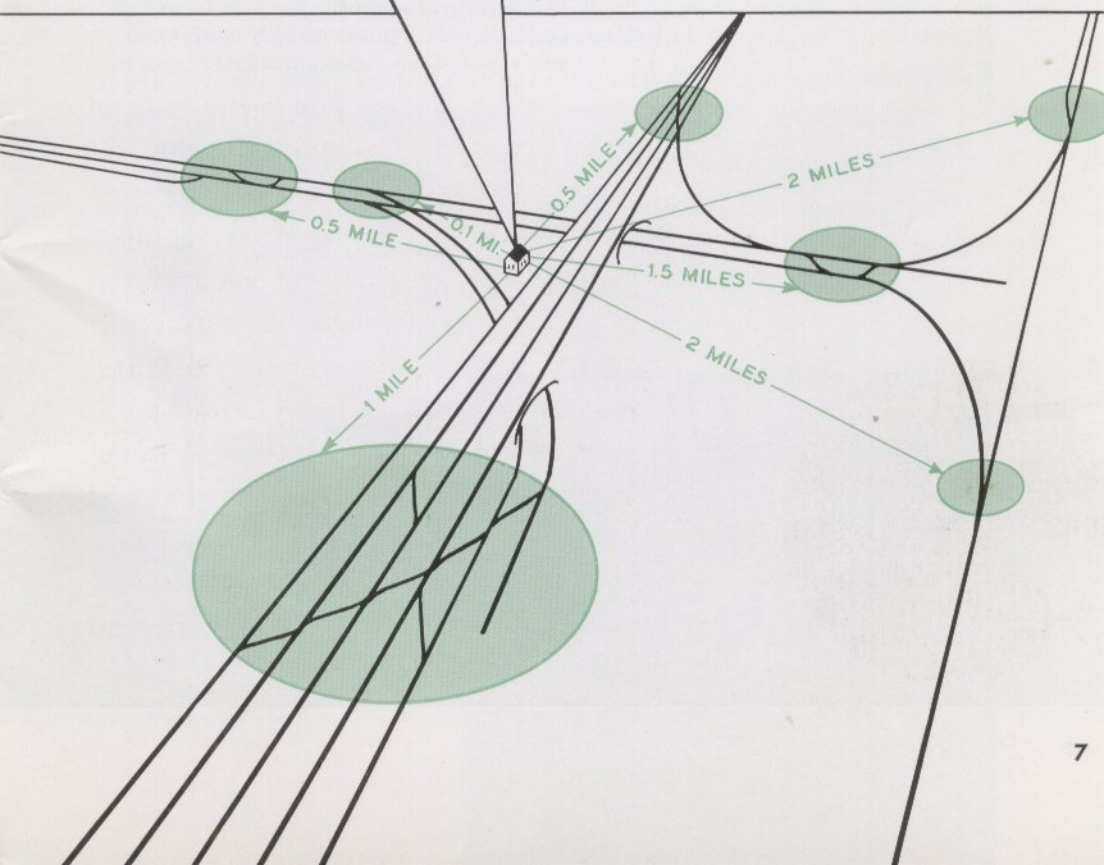


With G-R-S all-relay interlocking you can reach out and control any remote layout over as few as two line wires. For this reason, the system is well adapted for consolidating the control of scattered interlockings under the control of one operator.

One man sees the entire operating picture. He can coordinate traffic far better than several men at different points without the time-wasting and sometimes confusing process of checking with several other persons before taking action. Thus, by using the facilities to best advantage, he can eliminate many train stops and delays.



The New York Central Railroad has eliminated many train stops and delays by the consolidation of seven layouts on one control panel at Depew, New York.



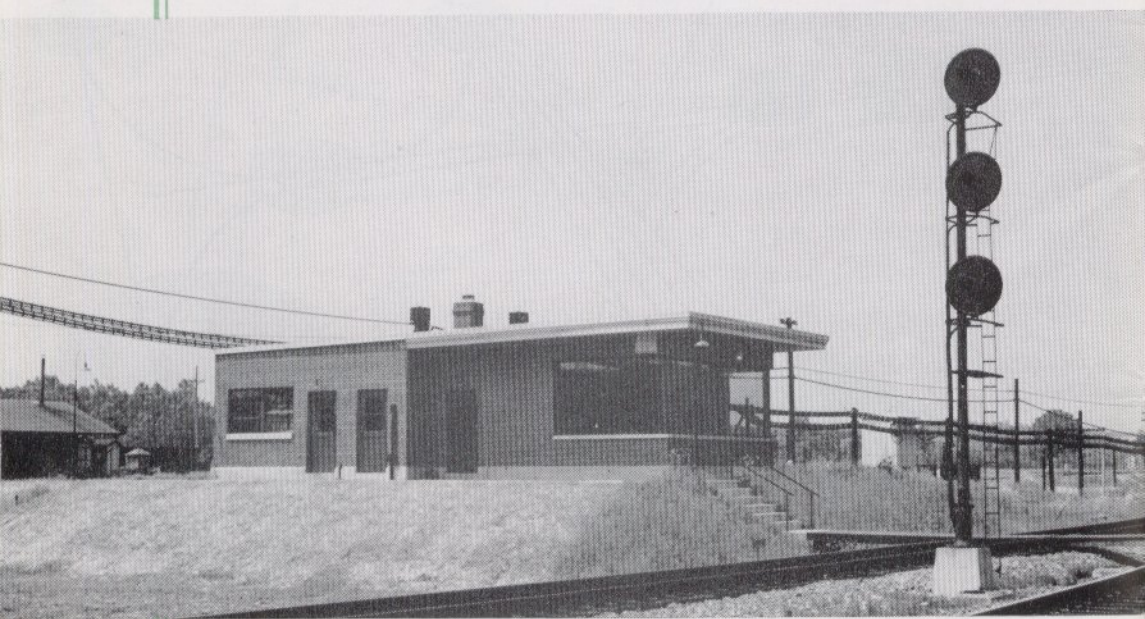
How can you reduce operating expenses?

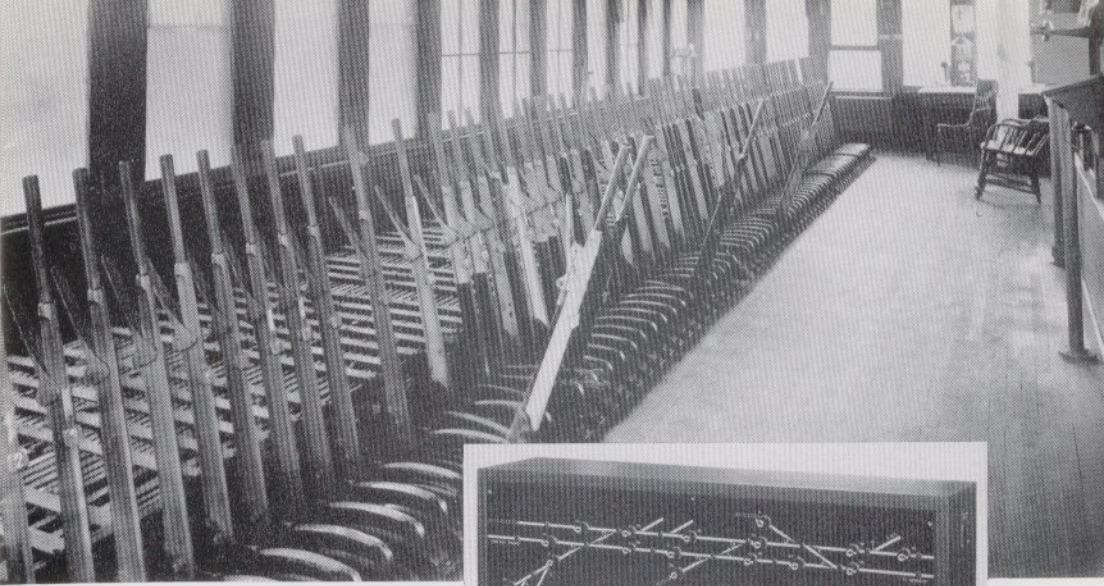
Consolidation of scattered layouts under the control of a single operator cuts labor and maintenance costs.

There are fewer towers to heat, light, paint, keep in repair, and pay taxes on. New towers can now be designed with a minimum of space and with a saving in initial cost, as a relay interlocking control machine requires but a fraction of the space required for older types of interlocking machines.

Page 9 shows the comparison between the size of an old mechanical interlocker and a relay interlocking control machine which replaces it. Existing electrical interlock-

This modern, air-conditioned building houses a control machine for four locations as well as relays, auxiliary power supply equipment, and repair shop, office, and locker space.

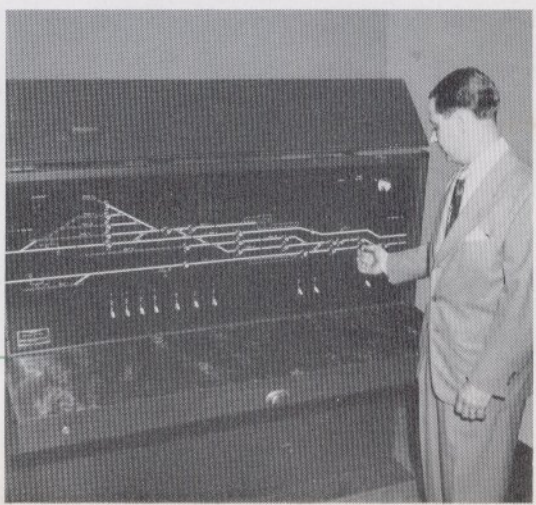




Modernization of this mechanical plant with all-relay interlocking improved train operation and reduced operating expenses.

ings can be kept in service while substituting new all-relay plants. All-relay interlocking can easily be expanded or revised without undue loss of time.

Relay interlocking, compact and simple to operate, permits more efficient use of existing space. Shown below is a control machine which was installed in a convenient space in a ticket office, thus saving expense of building a new control tower.



Compact all-relay interlocking control machines save valuable space in older towers, require a minimum of space allotment in new towers.

How can you increase operating efficiency?

Older forms of interlocking had a limited range. One man could control only a comparatively small number of switches and signals, and these functions had to be near the control tower.

All-relay interlocking rids you of these disadvantages. Compact control panels, free-operating miniature levers, and continuously displayed indications, increase the capabilities of the operator. Distance from the control tower to the field functions is no longer a barrier.

With modern and efficient relay interlocking, all locking is done in the field between the switches and signals, rather than in the tower between the levers. Interlocking protection at the functions increases safety and reliability.

Mechanical devices such as multi-gang switches, gears, clutches, etc., characteristic of a bygone era in signaling, are not used in relay interlocking. In their place, simple, reliable relays provide low-cost maintenance, ensure speed and absolute integrity of operation.

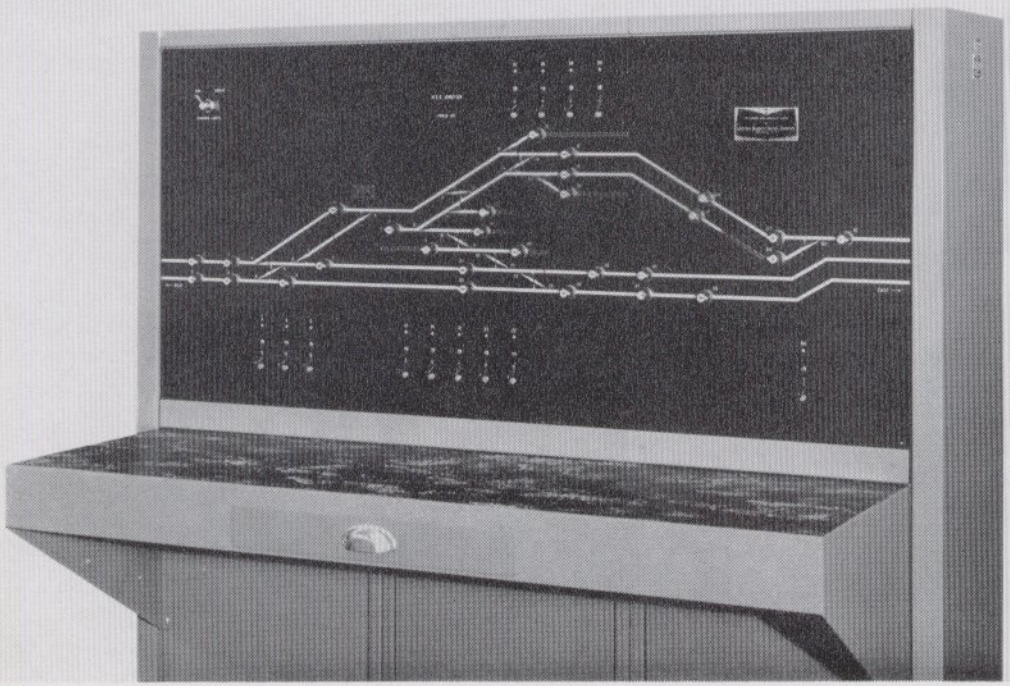
G-R-S Type B plug-in relays can be removed and replaced in a few seconds, without touching a wire.

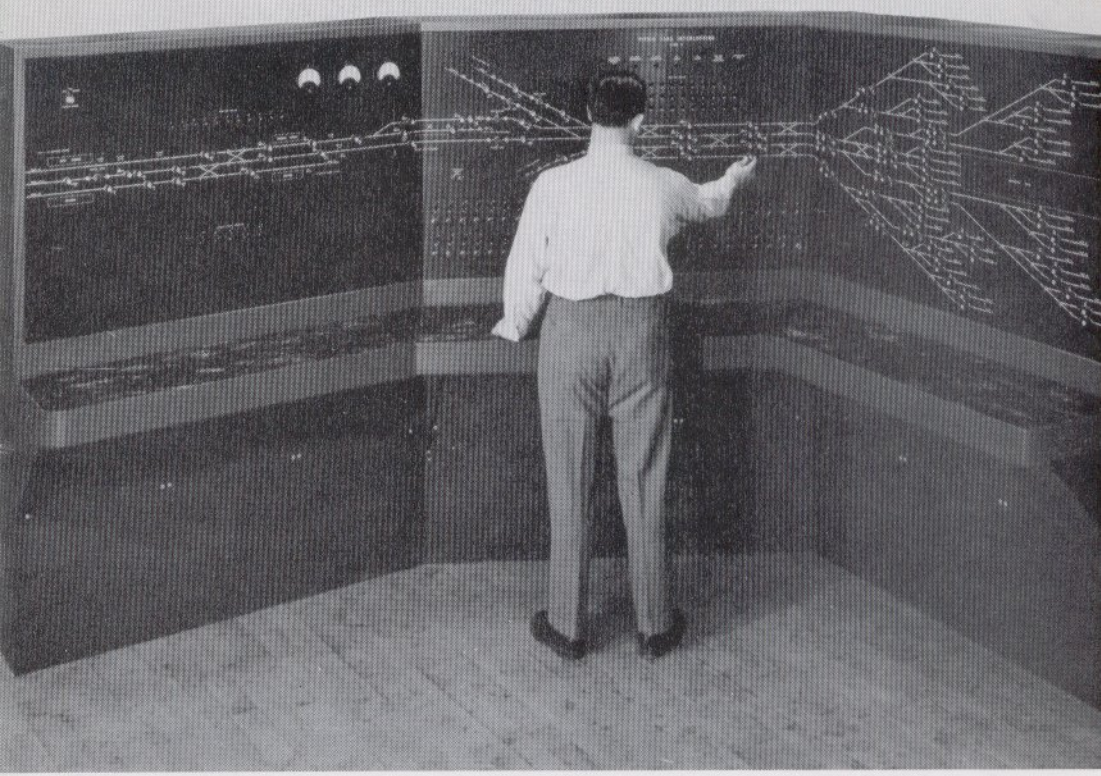
The operating picture

Let's consider relay interlocking further from the operating point of view. How quickly, how accurately can an operator line up routes? Part of the answer depends on the operator's skill, the rest depends on the facilities he has to work with.

Modern G-R-S all-relay interlocking tells him where each train is, the position of each switch and signal, what routes are lined up, and what routes are available. It gives him the facility to set up routes quickly and easily with free-operating miniature levers—or even by pressing a couple of buttons, thus decision is made easy, and execution can follow quickly after decision.

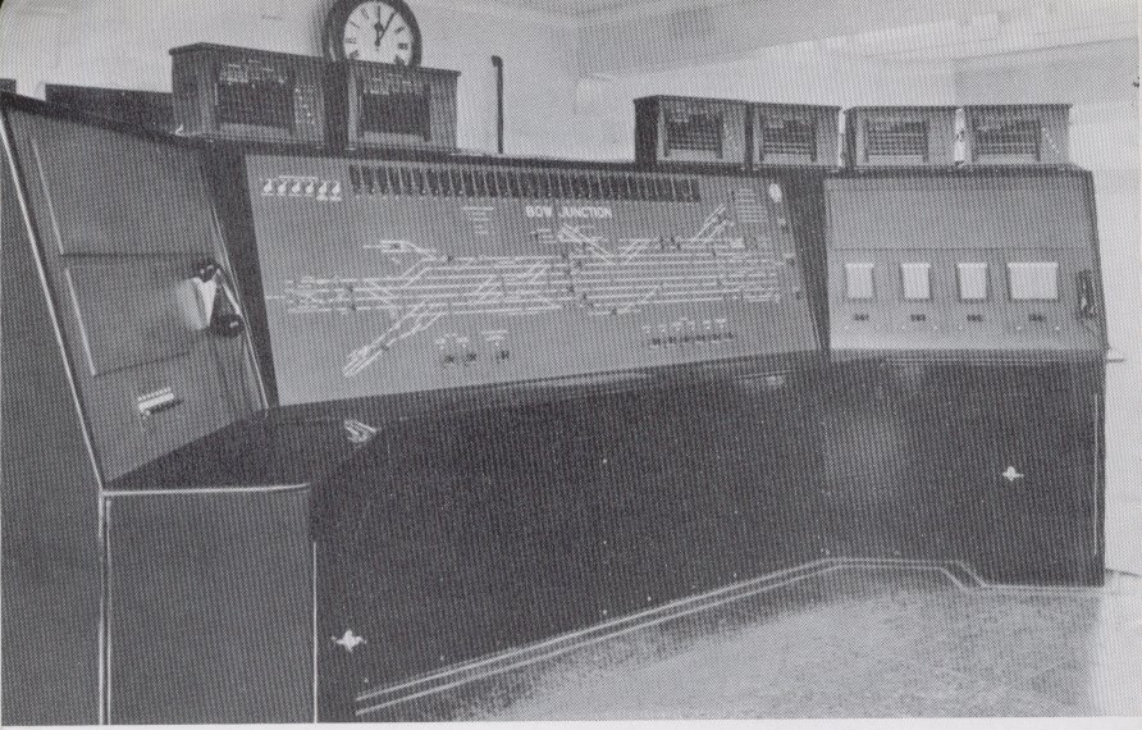
This all-relay interlocking machine at Rowlesburg, West Virginia, on the Baltimore and Ohio replaced a mechanical interlocking.





The operator sets up a route on this NX interlocking machine designed to handle trains on a 90-second headway per track.

How does modern G-R-S all-relay interlocking aid decision? Correct decision is based on facts. The facts, correct to the instant, are always in front of the operator. Engraved in white lines on a black panel, he sees a miniature geographic layout of the control area. Lights on the track lines tell him where each train is. At switch locations, the lines shape themselves automatically to show him switch positions. Lights at the same points, or with the switch levers, tell him which switches he may move. Lights in the signal levers tell him which signals are cleared. The moment he throws a switch, clears a signal, or a train moves, the picture changes to show the new condition.



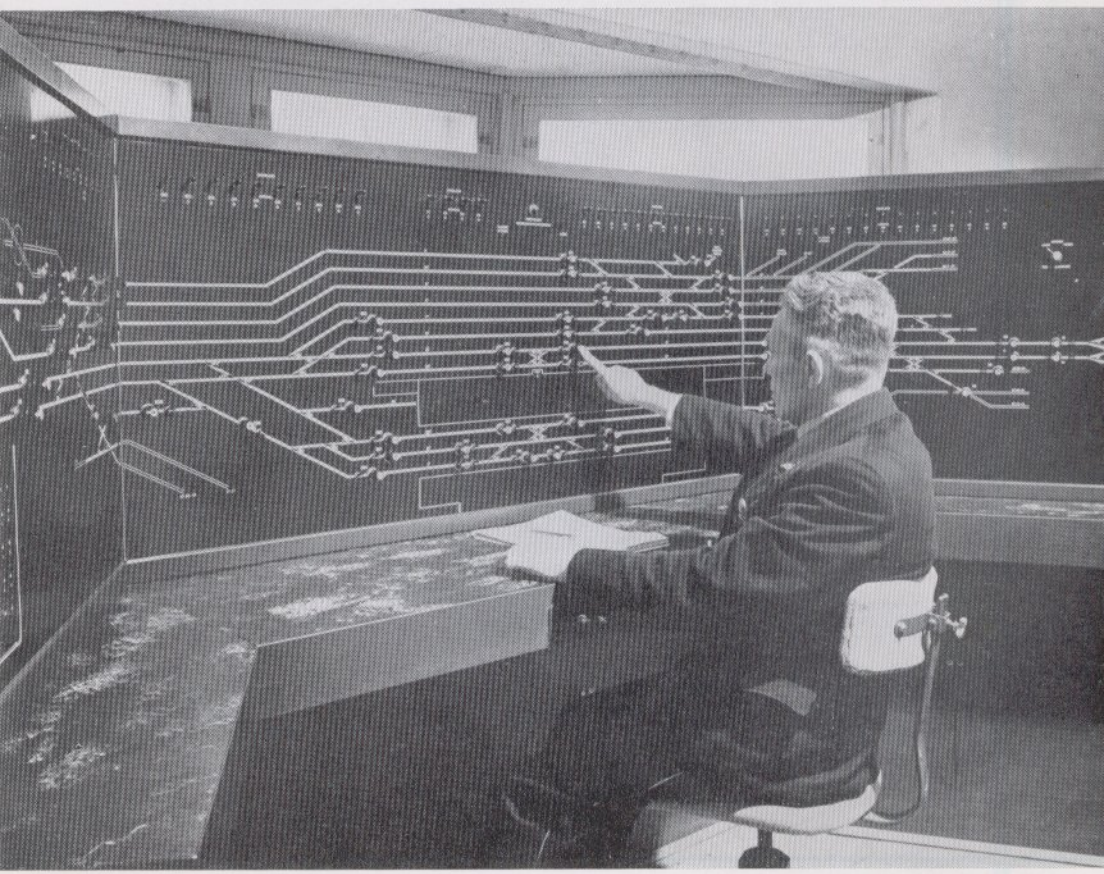
The Bow Junction NX installation in England replaces an outdated mechanical interlocking.

What prevents him from setting up a dangerous route?—from heading trains into each other?—or into open switches? Each time he lines up a route—or tries to line up a route—a network of electrical circuits goes to work. Faster and more accurately than a human brain, this network checks every factor connected with the route called for. Every switch is checked to determine if it is in proper position, every track circuit is checked to determine exactly where each train is, every signal is checked to make sure no other train can get a signal that would allow it to interfere with the route he wants. With all pertinent data instantly checked, collected and correlated, the system comes to a decision whether the route he wishes is safe or not. If the route is not safe, switches and signals will not

respond to his manipulations of the levers. Lights on his panel will tell him that what he wishes to do is unsafe, that it cannot be done.

If the route is safe, the switches concerned immediately start to position themselves as required. Then signals clear, and the train may proceed. Now he will see the train movement on the track diagram, indicating its position by successive lights as it passes through the route. The lights in the signal levers tell him that the signals are automatically protecting the rear of the

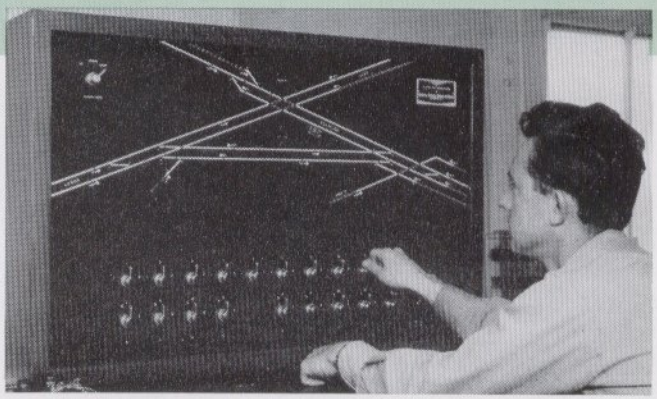
The NX operator at 's Hertogenbosch on the Netherlands Railway handles 1200 train movements a day.



train as it proceeds past them. As the train clears each switch in the route, indication lights will tell him that the switch is now free to be used in any other route he may wish to set up.

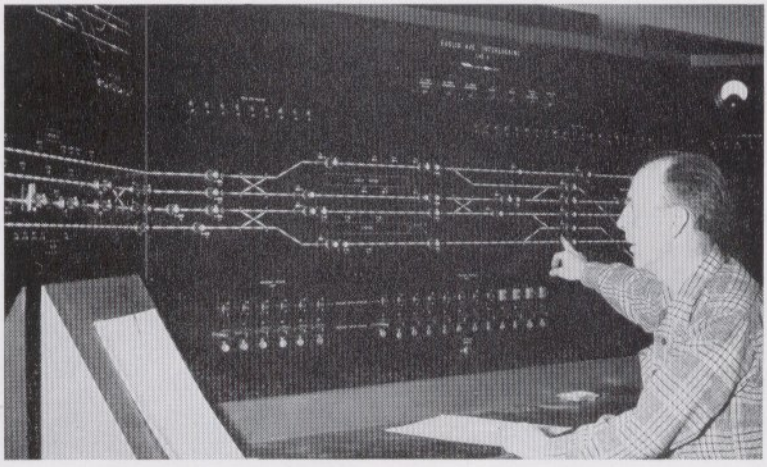
Thus he has complete, continuously accurate information always before him. He has complete control of every switch and signal that is safe to operate. He can plan and execute moves with speed, accuracy, flexibility, and entire safety.

Types of relay interlocking



IL relay interlocking has reduced operating expenses and improved train operation for the Nashville, Chattanooga and St. Louis Railway in Aulon, Tennessee.

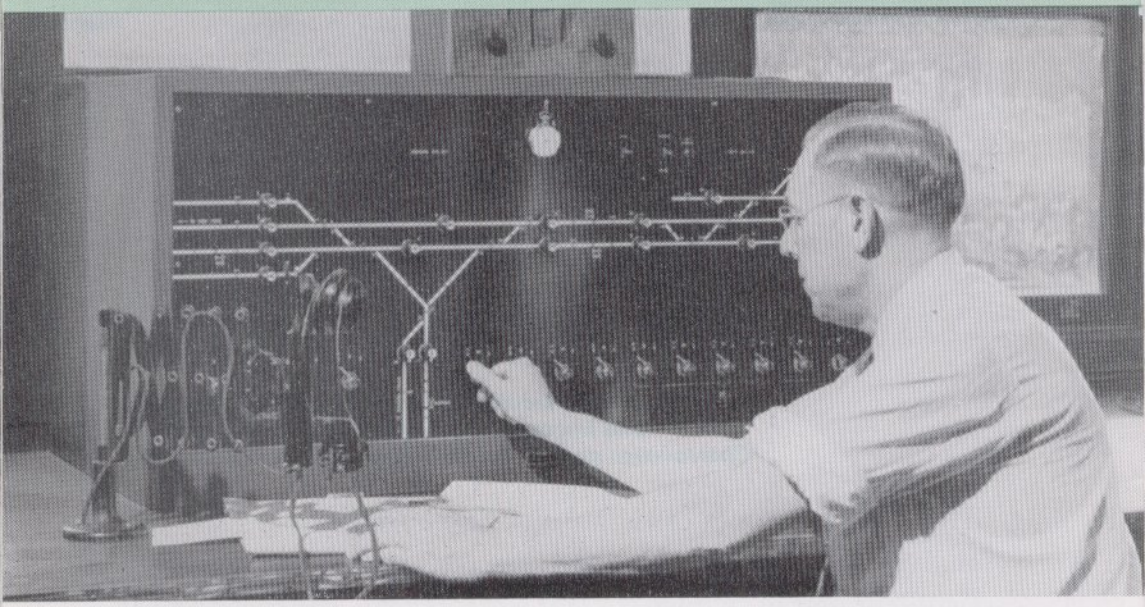
There are two types of G-R-S all-relay interlocking. One type, Individual Lever (IL), has a lever per signal and a lever per switch or pair of switches (as for a crossover). The second type, eNtrance-eXit* (NX), has an entrance knob for each route through an interlocking and an exit button at each exit.



The City of New York runs trains on a 90-second headway per track through this NX interlocking at Euclid Avenue, Brooklyn, New York.

*"NX" is the name coined by the General Railway Signal Company from the first syllable of each of the words "eNtrance-eXit."

IL interlocking



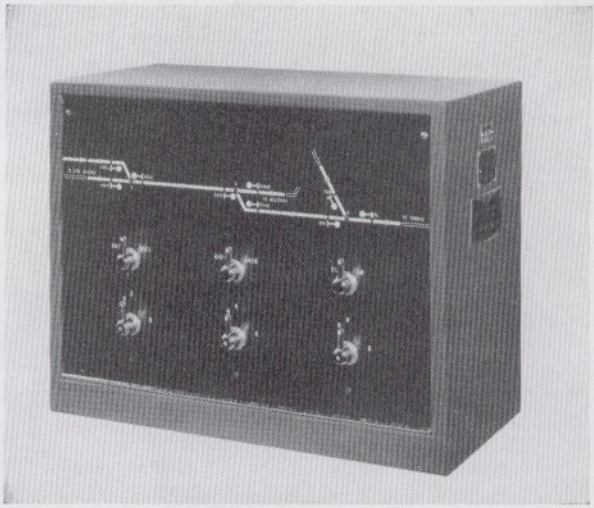
The Lehigh Valley control machine at Niagara Junction, New York, has signal levers on the track diagram. Consolidation with this machine eliminates congestion in peak periods and reduces stops and delays.

The individual lever, IL, type of relay interlocking has individual levers on the control machine for the switches and signals. The signal levers may be located below the track diagram or on the track diagram.

A route is set up by positioning the switch levers and operating the signal levers to clear the signals.

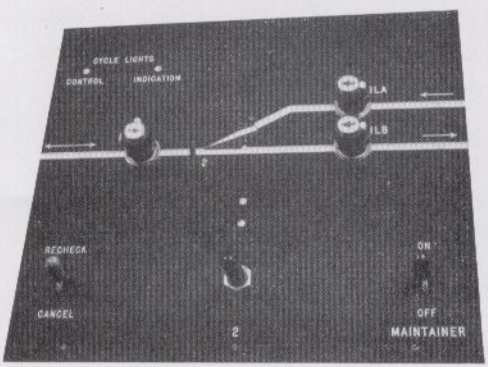
IL interlocking is in use in plants with as many as 152 levers and as few as 2 levers. The NX type, explained further on, is recommended if speed is a governing factor in small plants and also for simplicity as well as speed in handling larger and more complicated plants with heavy traffic.

The New Orleans, Texas and Mexico machine at Baton Rouge, Louisiana, has signal levers below the track diagram.

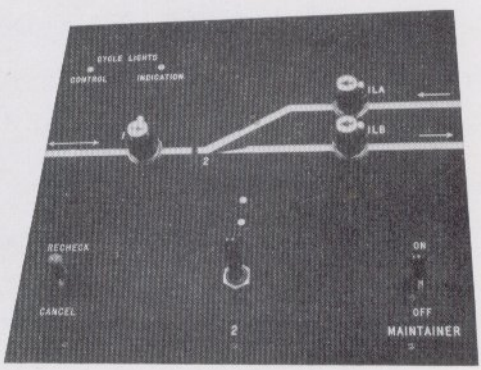


Route Indications

Indications showing routes lined up on the control panel can be displayed by the movable point indicator system. This system uses electrically operated point indicators mounted in the track diagram. The movable points pivot across the white track lines at the point of divergence so the route set up shows as a solid white line.

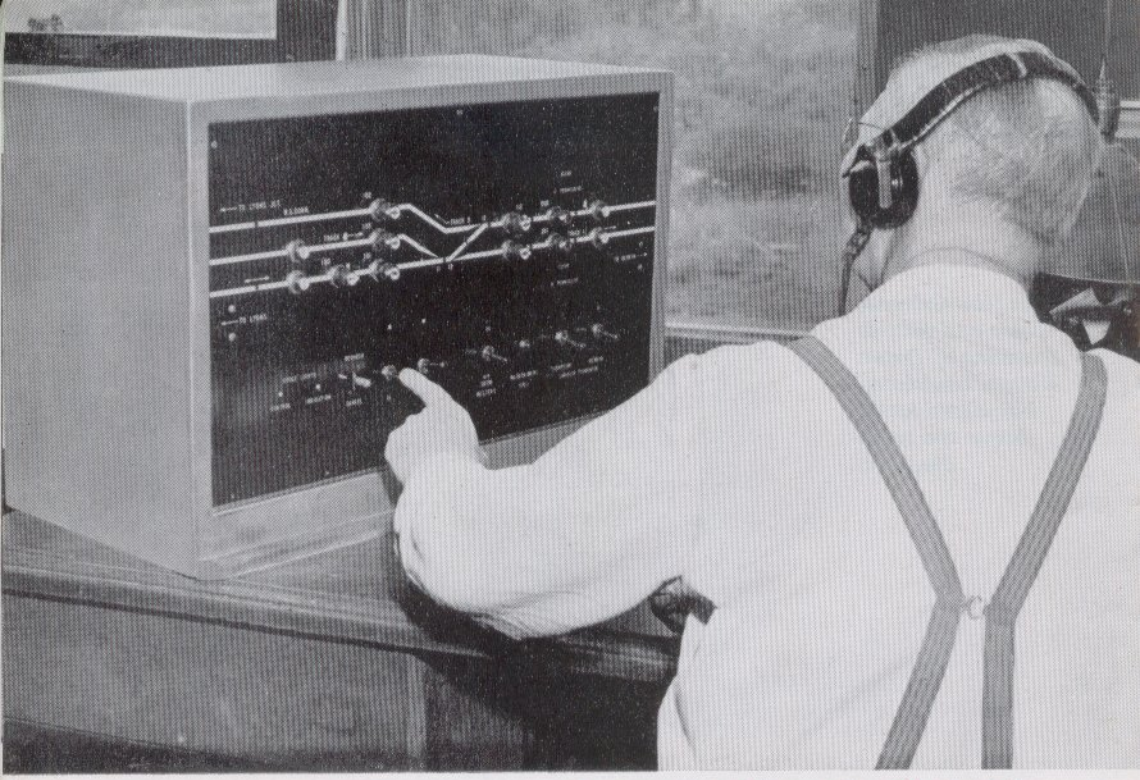


Through route



Diverging route

Movable point indicator panel.



The operator at Geneva, New York, on the New York Central Railroad, sends a Syncrostep control in one second to line up a route through an interlocking ten miles away.

Value of the Operating Picture

The control panel is not only a controlling medium, but it also projects a moving, operating picture. Here are the advantages:

A glance shows what route or routes are set up; lever positions need not be checked.

When one or more routes are set up, it is apparent what other routes are possible.

The panel shows clearly which switch levers must be moved to complete a route.

Switch levers are directly associated with their respective switches.

Signal levers are directly associated with the tracks over which they govern.

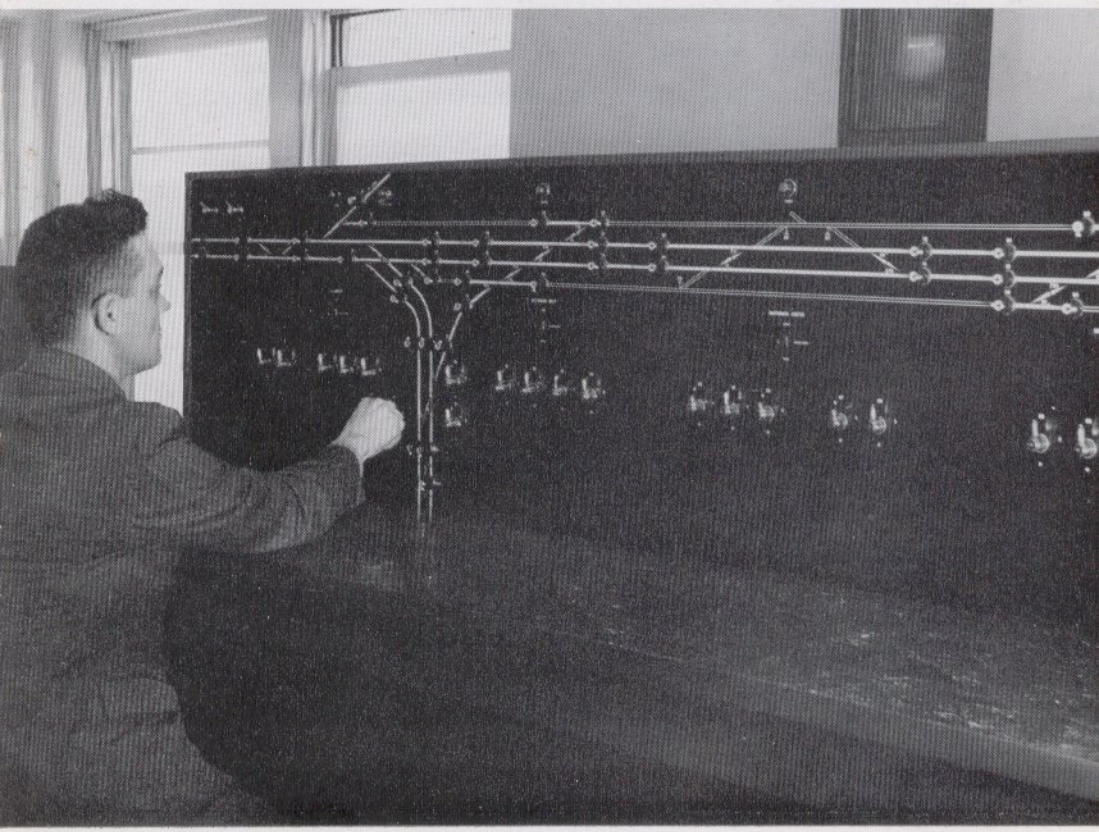
The operator can see at a glance which signals are clear and over what routes.

Lights in the track diagram show the position of each train.

All controls and indications are directly associated with the track diagram on the control panel.

Indications are clearly given as to whether the switches are in correspondence with their levers.

Including either-direction control of both tracks over Victoria Bridge, this Canadian National machine handles up to 135 trains daily in the busy Montreal area.



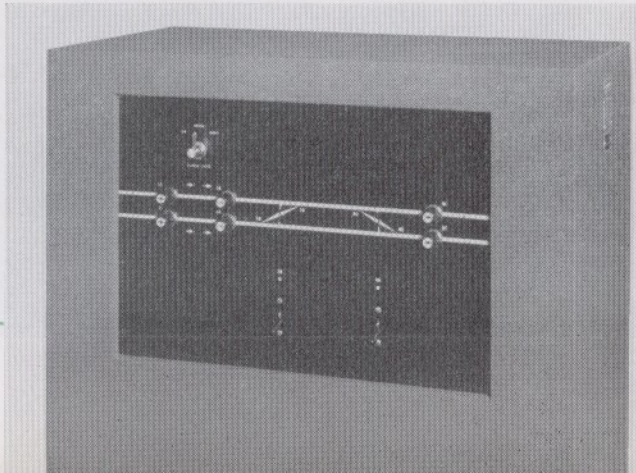
This operator at Lyons, New York, controls three remote layouts as well as movements near the tower, handles up to 106 New York Central trains daily.

Advantages of IL Interlocking

IL interlocking is an economical means of handling interlockings. It requires a minimum of apparatus. The circuits are relatively simple.

Compared with NX interlocking, IL does require more time and mental effort, as the route must be analyzed in terms of individual switches and signals.

IL interlocking can handle large as well as small layouts. Some handle 180 trains a day; one handles as high as 265 trains a day.



Two crossovers are remotely controlled by this machine at Austell, Georgia, on the Southern.

NX interlocking

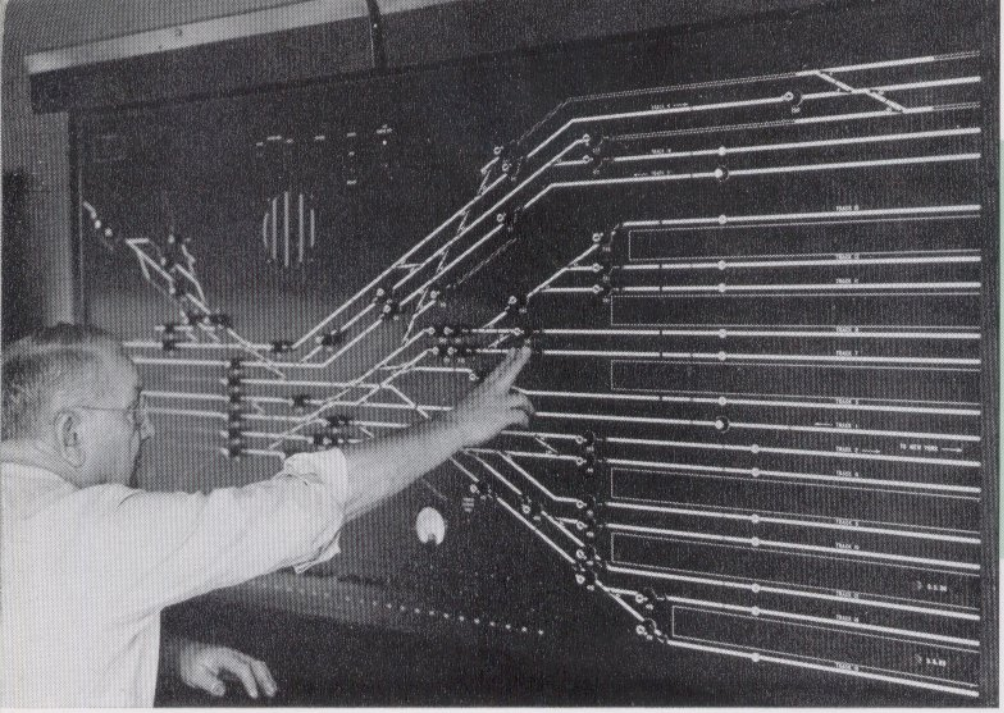
The NX type of relay interlocking is based on the idea that every route has an entrance and exit. On a miniature track diagram there is placed an entrance knob at every possible entrance and an exit button at every exit. The entrance knobs are physically represented on the ground by interlocking signals.

The operator makes two simple movements to line up a route. Hence he takes less time than when he has to operate several levers.

The operator wastes no time in breaking the route down into "this switch reverse," "that switch normal," "this signal clear." Route "entrance" and "exit" is all that he need concern himself with. These two facts are subconsciously associated with the entrance knob and the exit button.

The NX control machine is in effect the "brain" of the system. It automatically selects the best optional route if the preferred route is occupied. It will allow no conflicting routes to be set up. It eliminates individual lever control of each switch and signal.

End-to-end route lineup is easy with NX. Any route can, by a simple choice of entrance knob position, be made to (1) return to normal automatically after passage of a train, or (2) clear again for a following train when the first train has cleared the route, or (3) clear a restricted speed route onto an occupied track, for example, for coupling up. Where traffic is heavy, the resultant speed and simplicity of route lineup with NX are an economic benefit to operation.

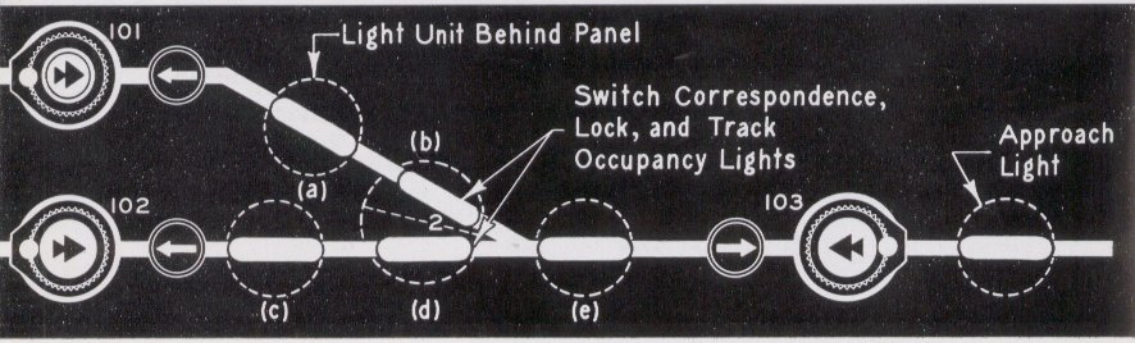


The operator easily handles 400 train movements daily in

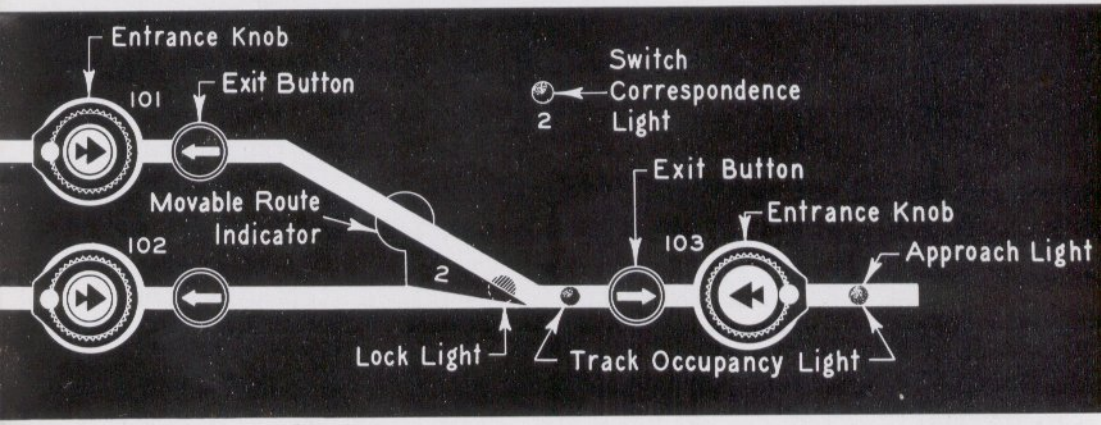
Route Indications

Routes lined up on the panel are shown either by the line-o-lite system or the movable point indicator system.

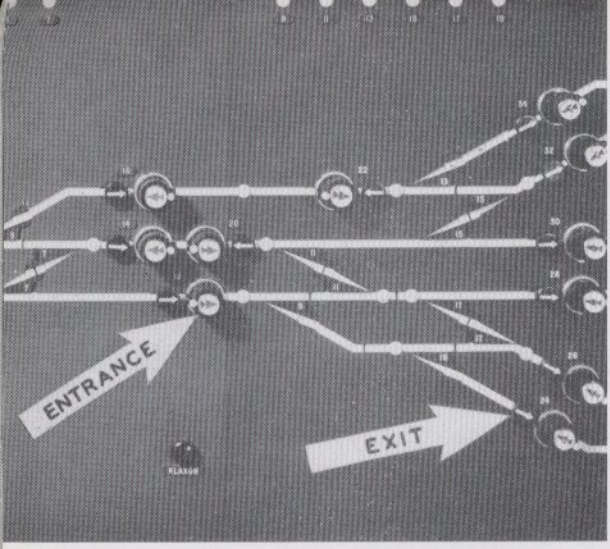
Below is a small portion of a line-o-lite control panel. Routes are shown by illumination of lights in the track diagram. Steady white lights indicate that a route is set up. Flashing white lights indicate that a switch is not yet lined for the route called for. Red lights indicate that a track is occupied.



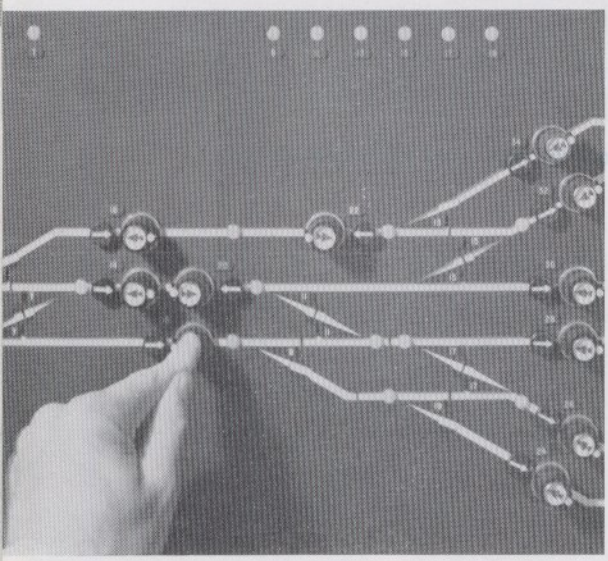
this large NX interlocking at Utica, New York, on the New York Central Railroad.



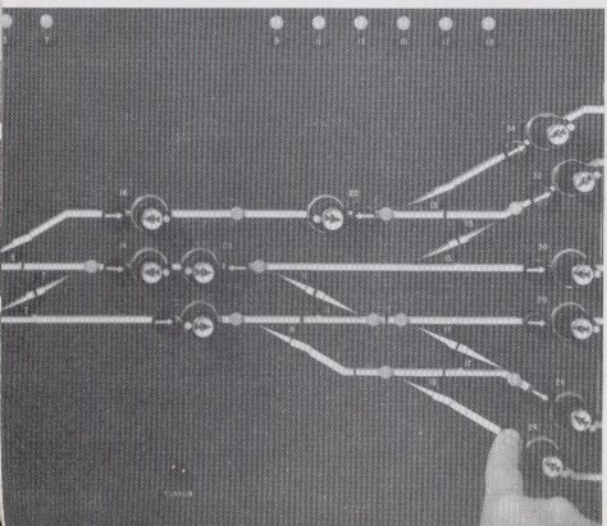
The movable point indicator system, in more common use, uses electrically operated point indicators mounted in the track diagram. The movable points pivot across the white track lines at the point of divergence so the route set up shows as a solid white line. Operation with this system is shown on the following pages.



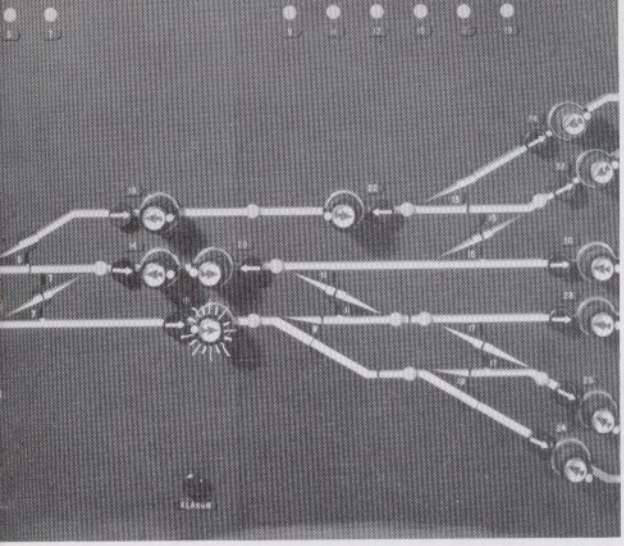
The sequence of illustrations shows how the operator lines up a simple route between two opposing signals on an NX panel equipped with route indicators.



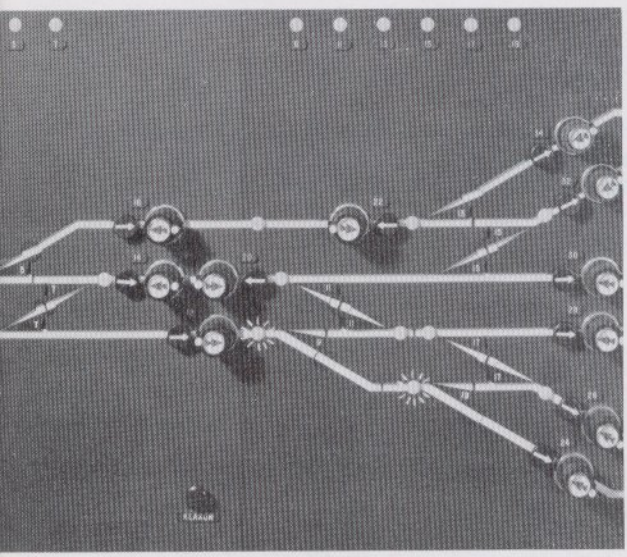
The operator presses the entrance knob corresponding with the point where the train will enter the route. The light behind the arrow begins to flash, indicating that a route has been initiated at that point.



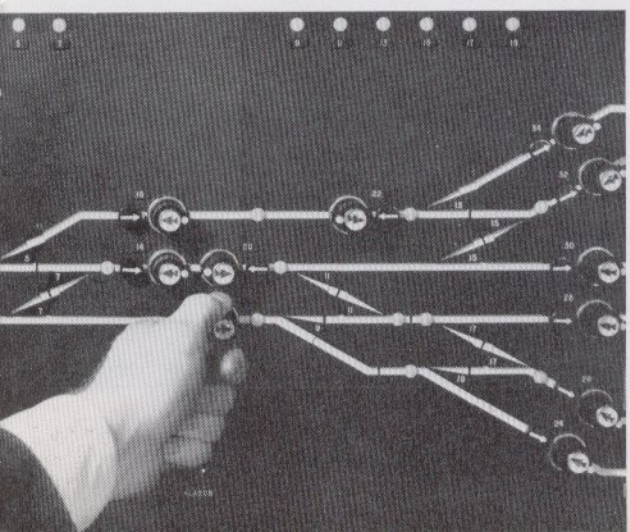
He next presses the exit button corresponding with the point where the train will leave the route. The rest is automatic. The entrance and exit points having once been established, the system throws the switches and clears the signals.



The route indicators snap into position to outline the route; red "lock-lights," behind the pointed ends of the route indicators, show that the switches are locked; a steady white light in the entrance knob indicates that the signal has cleared.



As the train travels over the route, the white track lights are illuminated. The light in the entrance knob is extinguished as the signal goes to stop behind the train. The red lock lights are extinguished as the switches in the route are released.



If the operator wishes to change the route before the train accepts it, he first cancels by pulling the entrance knob. He lines up the new route as described before.

Advantages of NX Interlocking

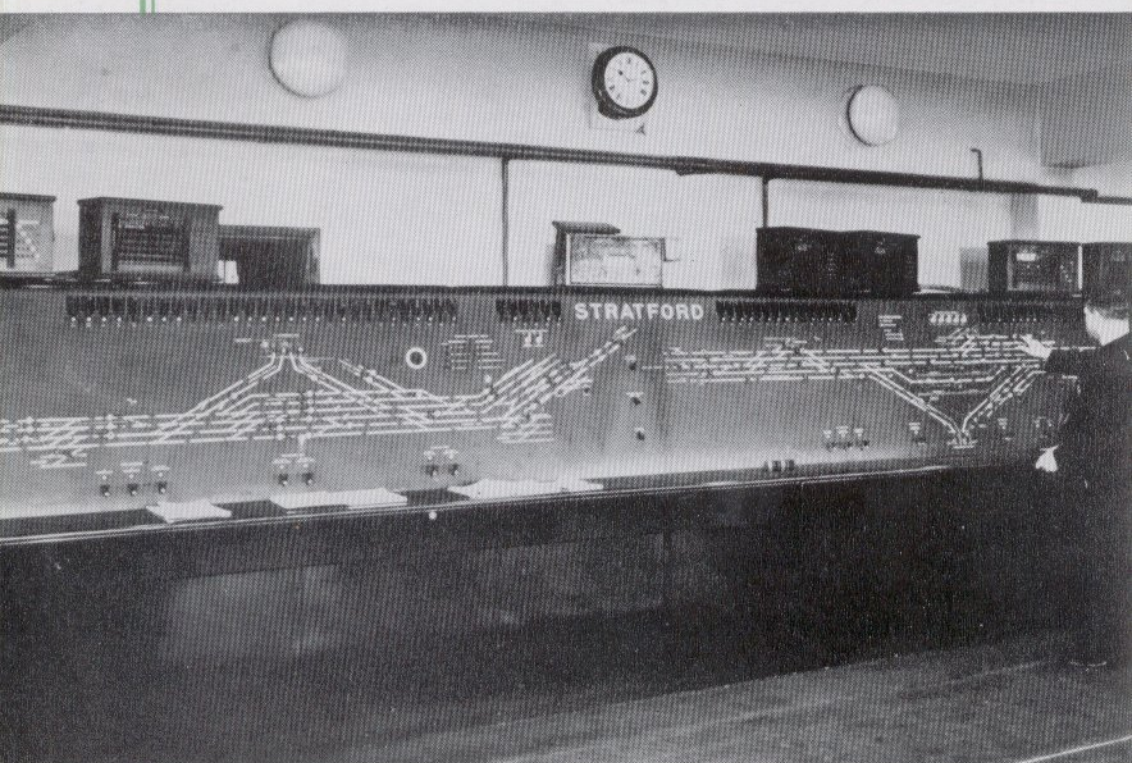
NX is based upon the simple principle of identifying the route entrance and exit. The route need not be broken down into its separate switches and signals, as with older types of interlocking.

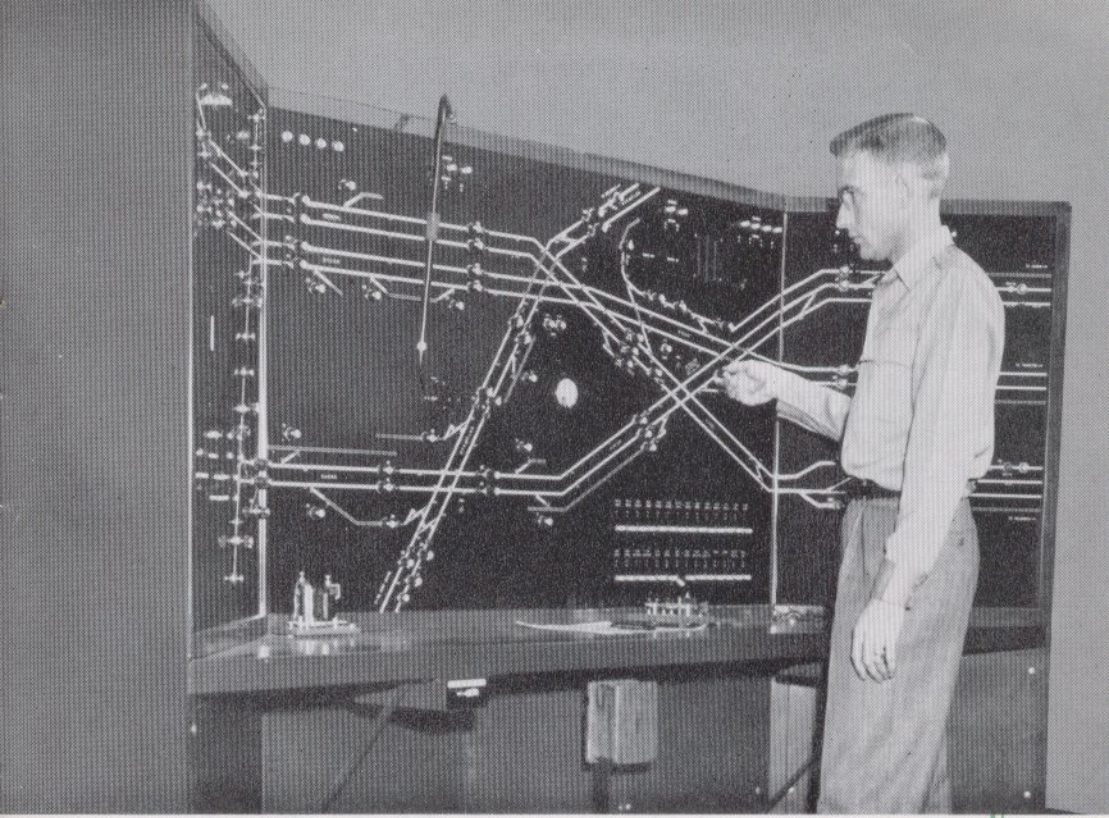
The operator need not take his eyes off the route he is setting up.

Because NX operation is simple, new operators can be trained quickly, easily.

Chances of error are reduced to a minimum.

One of several NX systems in service on the British Railways, this machine handles heavy steam and electric traffic at Stratford, England, with 968 train movements per day.





Four railroads have realized an annual return of 42.3% on their capital investment with the installation of an NX interlocking at Fostoria, Ohio.

NX routes can be set up faster than with any other type of interlocking.

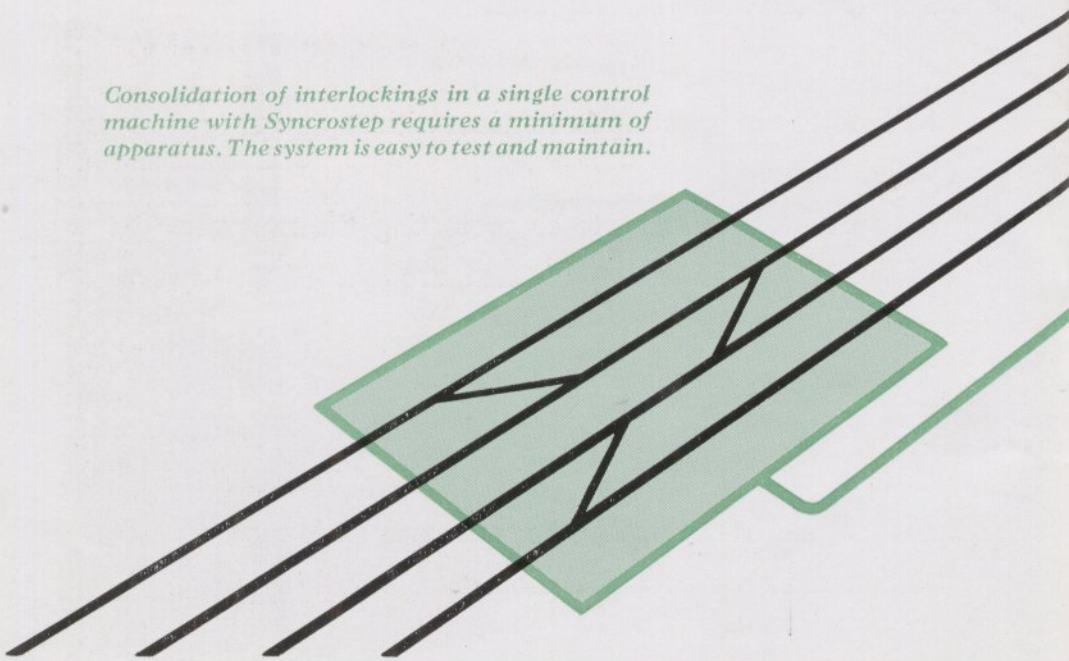
All switches in the route or protecting the route are automatically positioned and locked, are released for new routes the moment safety permits.

We have shown sequence of operation for a simple route, without intermediate signals. Any other route, regardless of the number of intervening intermediate signals, would be set up by the same two basic motions: push (or turn) *one* entrance knob, push *one* exit button.

As the tendency is towards the consolidation of interlockings in order to obtain operating flexibility and economy, control of remote groups is becoming increasingly important.

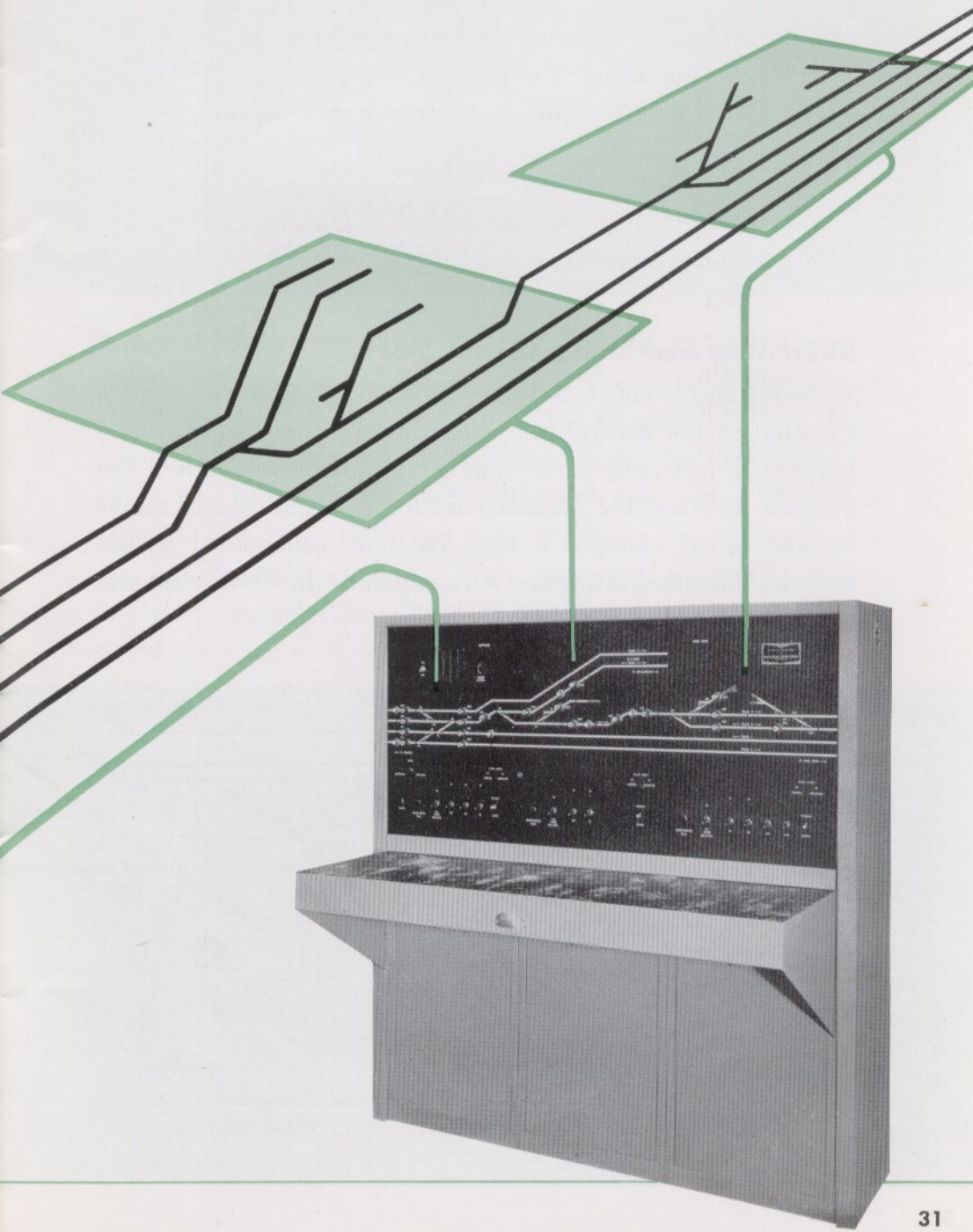
Controls and Indications

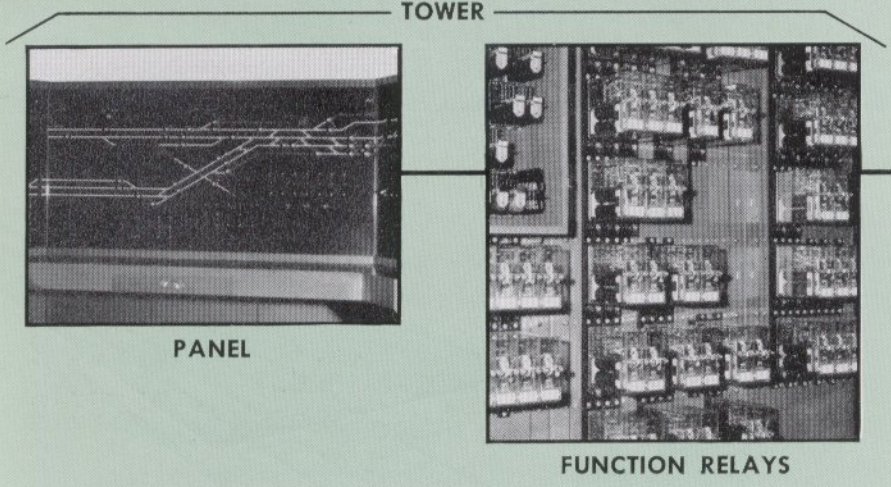
When a control machine operator sets up a route in an interlocking, he turns a knob or manipulates levers to send out controls to operate a switch machine, signal, or other device in the plant. When the device has operated to the position called for, an indication is transmitted back to the control machine to tell the operator that the device has responded properly to his control.



Consolidation of interlockings in a single control machine with Syncrostep requires a minimum of apparatus. The system is easy to test and maintain.

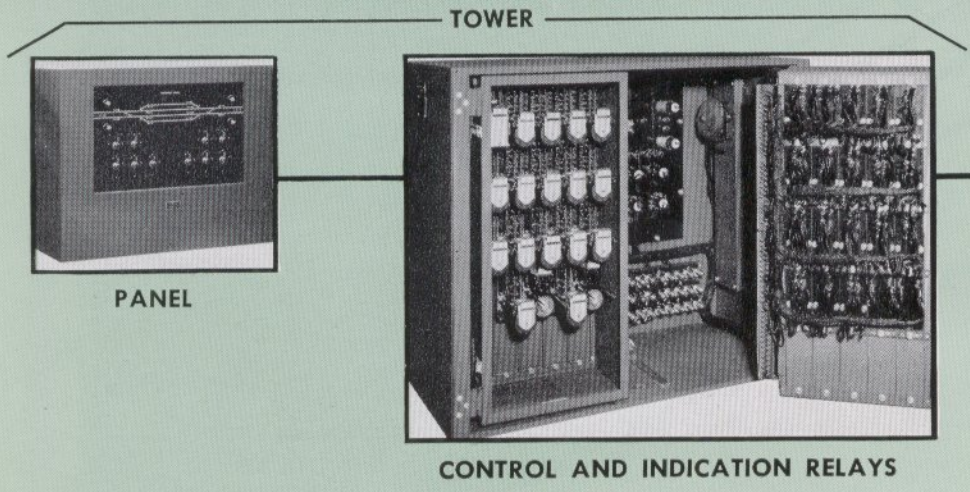
and consolidating interlockings





Direct-Wire Near Group Control (above)

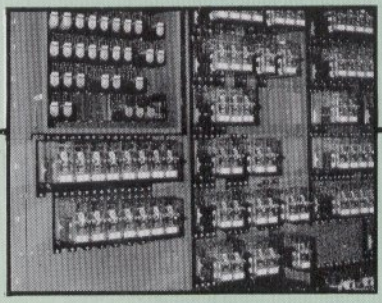
A near group is controlled over direct-wires from the control machine to the control relays as shown above. This system requires a relatively large number of line wires. When the distance between the control machine and the control relays becomes great enough, it may be more economical to use systems that need fewer line wires, such as direct-wire remote control or a coded system.



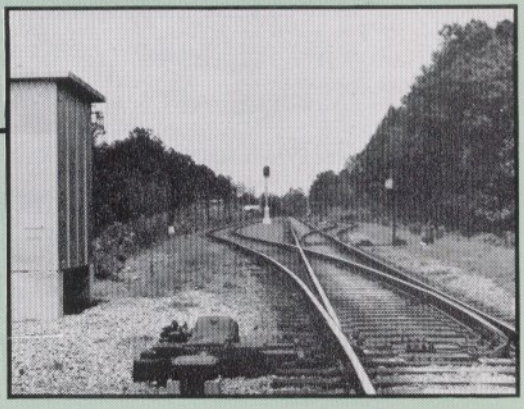
NEAR GROUP

Direct-Wire Remote Group Control (below)

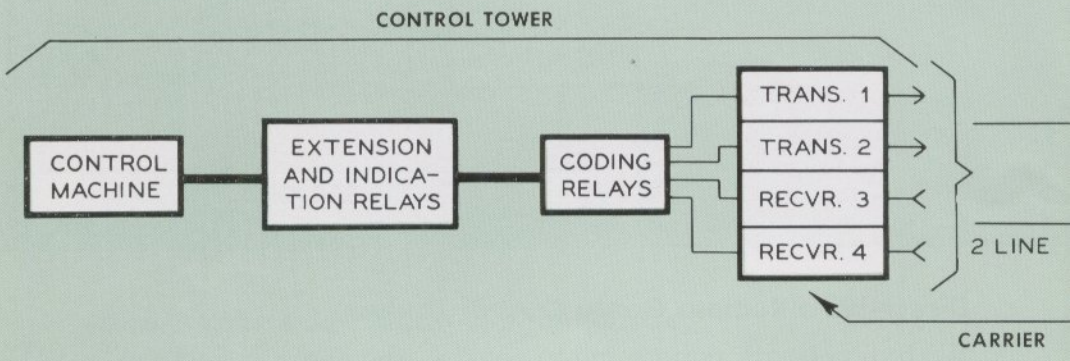
With direct-wire remote group control, the controls and indications are carried through relays in the tower to relays in the wayside case, as shown below. These relays in turn control relays which operate the switches and signals. Many of these controls and indications run over the same line wires, thus saving wire. As the distance from the control machine to the location increases, it may be more economical to use one of the coded systems, as they reduce the line wires to a minimum.



HOUSING
CONTROL, INDICATION
AND FUNCTION RELAYS



REMOTE GROUP



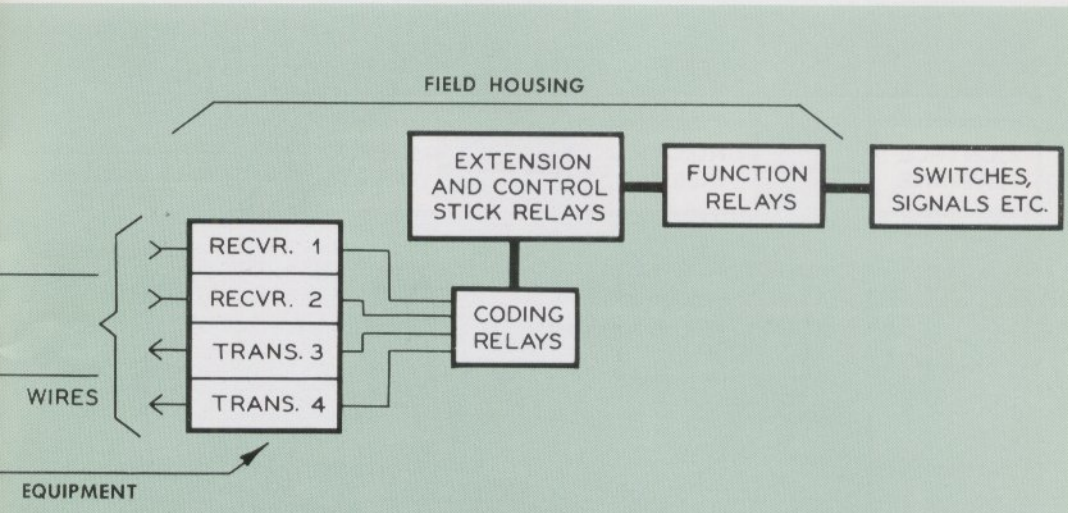
QUIKODE

Coded Control Systems

Coded control systems are used when it is desirable to keep the number of line wires to a minimum.

G-R-S Quikode is a high-speed system, transmitting controls and indications with a speed practically equivalent to unit wire. Quikode uses carrier impulses on two line wires for the control of large, complex, remote interlockings. Quikode control units and indication units are entirely independent of each other, but both use the same pair of line wires. Thus the capacity of the control unit and the capacity of the indication unit can each be separately fitted to the requirements of any installation.

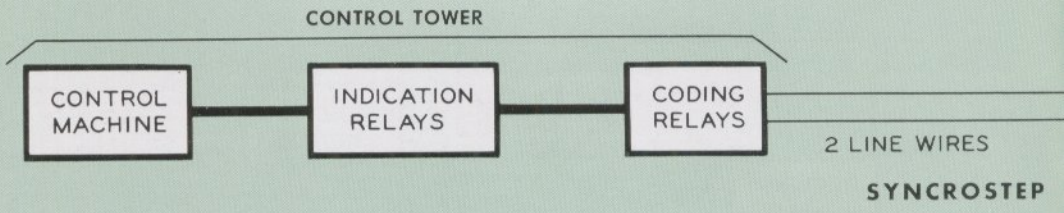
Stepping speed of either unit, control or indication, is at the rate of 30 steps per second. Utilized to full capacity,



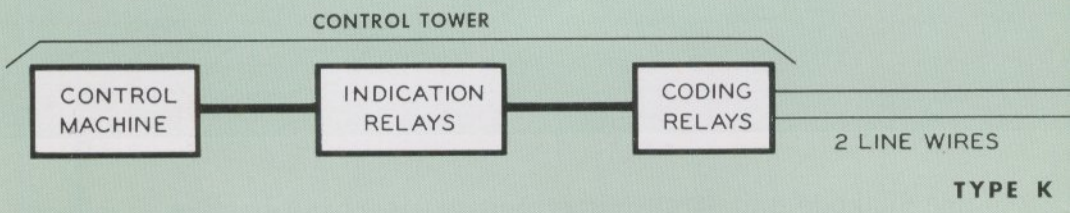
REMOTE CONTROL

one Quikode unit (transmitter plus receiver) can handle, if used as a control unit with 6 carrier channels, 90 controls in approximately one second. If used as an indication unit, with 4 carrier channels, it can handle 90 indications in approximately one second. For example, in approximately one second, a Quikode system can transmit controls to position 90 switches, normal or reverse, and can transmit occupied or unoccupied indications for 90 track circuits.

If later changes in the interlocking layout require it, Quikode systems can be expanded in increments of 8 steps, each 8-step increment adding approximately one quarter of a second to the cycle time. Consolidation of the control of remote interlockings is obtained by use of additional Quikode units.

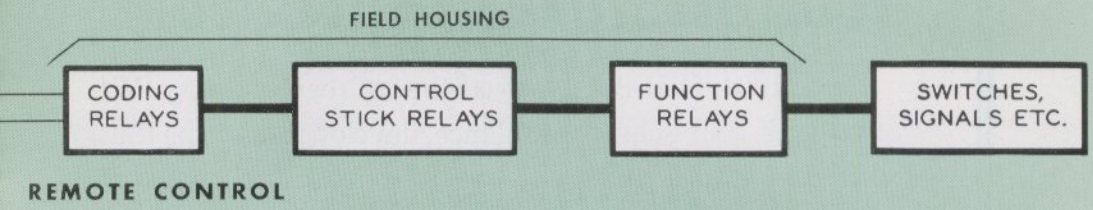


SYNCROSTEP

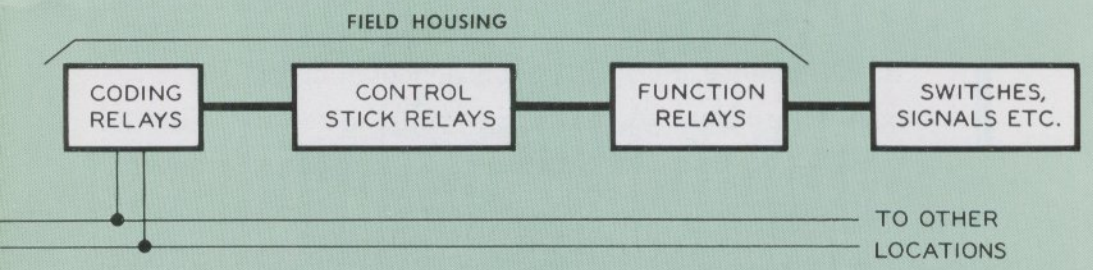


TYPE K

G-R-S Syncrostep is a simple and economical means of controlling a remote field location over two line wires. The 7-step simplex system has a capacity of 16 two-position controls; the 11-step simplex system, a capacity of 256 two-position controls. Each system has a capacity for indications that is wholly adequate for the largest number of controls that might be required. Transmission speed of the 7-step system, for example, is one second for a control cycle, during which one control is transmitted, and two seconds for an indication cycle, during which an entire group of indications is transmitted. Consolidation of remote locations may be obtained by the use of additional



REMOTE CONTROL



CODED CONTROL

Syncrostep systems, each with its own direct-current line circuits, or by superimposing carrier frequencies on existing line circuits.

The G-R-S Type K2 coded control system is used to consolidate the control of multiple field locations, all on a single two-wire line circuit. This system can be used for consolidation without the use of carrier equipment, as the line time is shared among the several field locations. The basic capacity of the Size 9 system, with 64 separate field locations, is 9 controls and 11 indications. The time required to transmit a typical control or indication cycle is 4 to 5 seconds.

Your assurance of service

Since 1904, G-R-S has served the railroad industry. We have, with your help and guidance, developed systems that have been put to profitable use by railroads everywhere: APB, cTc, NX, electric retarders, automatic switching, and a host of other systems and appliances. During that time we have maintained a policy of strict adherence to three ideals: quality, reliability, and dependability.

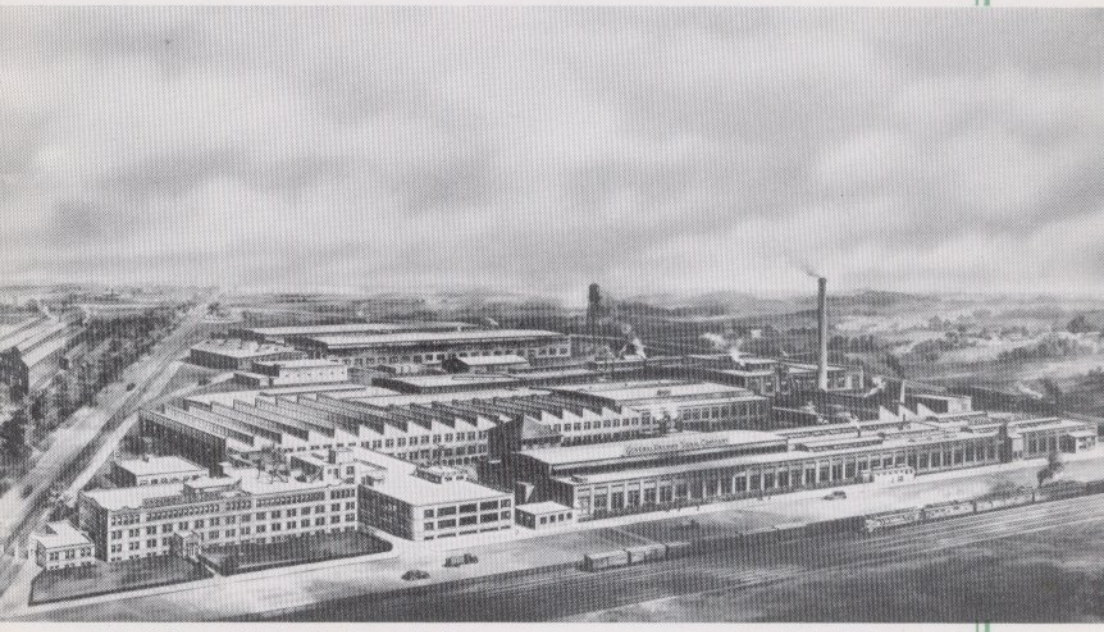
We are proud to share with you the responsibility of serving railroads with our best, of being ever ready to bring you any improvement that can measure up to the exacting standards formed during our half century of signaling experience.

Our interest in G-R-S equipment continues far beyond the day it is sold. Since 1904, we have backed our products with engineering information, parts lists, service data—with a complete and continuing program designed to help you get the most out of every G-R-S appliance and system.

When you install G-R-S relay interlocking, you install a proven system, fitted precisely to your requirements by professional signal engineers, men who realize, and who share with you, the vital personal responsibility that the signaling profession places upon its members. You are getting *signal* equipment, designed and built for the utmost reliability of operation. You are getting not only the highest quality of physical equipment, but also time-proven assurance of our continued service and interest.

Studies and estimates

Ask your G-R-S district office for studies and estimates of your interlocking improvement possibilities. They can arrange to have well qualified specialists work with you to prepare conservative forecasts of possible benefits.



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