AL

AEG

ELEKTRISKA AKTIEBOLAGET AEG

GENERALREPRESENTANT FÖR

GENERAL ELECTRIC U.S.A.

TELLUSBORGSVÄGEN 83-87
TELEFON: 45 27 50 45 28 80 (VÄXEL)
TELEGRAM: ELEKTROMOTOR

23/8. Kk. 1. AEG

TILL HANDL. FABRIKATIONEN

GODSADRESS: LILJEHOLMEN
BANKFÖRBINDELSE:
SKANDINAVISKA BANKEN AB

INKOM T. K. VÄG- OCH VATTENB.-STYRELSEN
JÄRNVÄGSBYRÅN
Dnr J V 482
23 AUG. 1952

Kungl. Väg- och Vattenbyggnadsstyrelsen
Rålambsvägen 3-5
Stockholm.

Eder beteckning	Edert brev	Vår beteckning	STOCKHOLM 32
		Rubin/MT	d. 21.8.1952

Ang. trycksaker för CTC-anläggningar. (utan prisuppg.)

Refererande till järnvägsinspektör E.Fredrikssons besök här den 6 dennes tillåter vi oss bifogat översända en sats trycksaker från Union Switch & Signal, U.S.A., ang. signalanläggningar av s.k. CTC-typ.

Högaktningsfullt

ELEKTRISKA AKTIEBOLAGET AEG
FABRIKATIONEN

Train Load Increased 32%

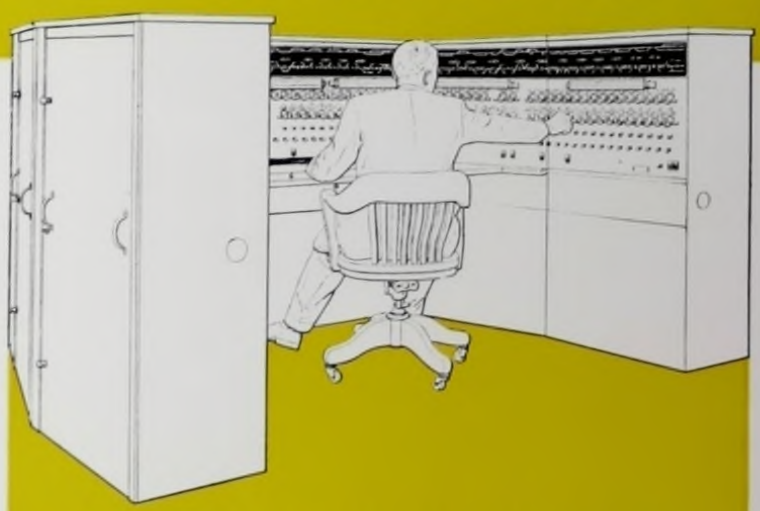
. . . in <u>one</u> year!

with "UNION" C.T.C. saving 17,498 freight train miles

HERE'S THE RECORD*

1. Reduced road time of through freight trains by 648 hours per year.
2. The tonnage of through freight trains was increased 32%.
3. Saved 17,498 freight train miles per year.
4. Saved 2,190 car days per year.
5. Eliminated two sidings and 5 main track switches.
6. Reduced cost of directing train movements.
7. Reduced annual operating expenses.
8. Increased capacity of line for future traffic.
9. Annual return over 3% interest:
   On Capital Investment—21.5%
   On Total Cost —19.9%

*Factual data will be supplied on request.



"UNION" Centralized Traffic Control can reduce terminal-to-terminal time with safety and pay its way through reductions in operating expenses. May we help you?

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

SWISSVALE, PENNSYLVANIA

NEW YORK • CHICAGO • ST. LOUIS • SAN FRANCISCO

T-1076

Advertisement Prepared by
KETCHUM, MACLEOD & GROVE, INC.
PITTSBURGH, PA.

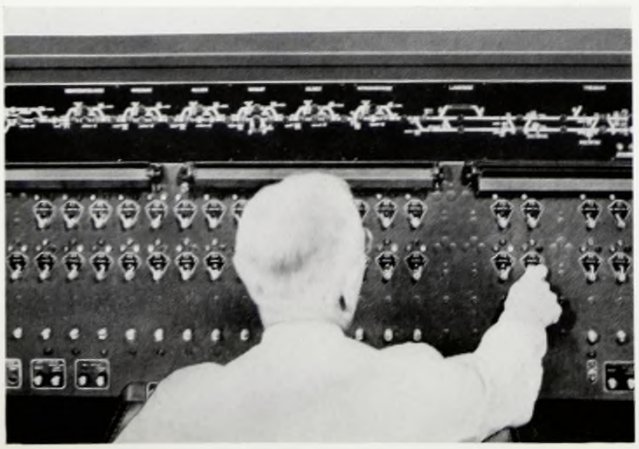
Railway Signaling and Communication, September 1951
Railway Age, September 10, 1951
Modern Railroads, October 1951

Here's a way to build profits ... by using LESS track!

This is the record

1. Centralized traffic control was installed on 137 road miles.

2. 27.81 miles of second main track were retired and 7.13 miles were converted to sidings.



3. Retired a substantial investment in grading for additional second main track where track had never been laid.

4. Retirements consisting principally of 28 miles of track and grading amounted to a gross credit to capital account of $1,085,389.00 or a net credit of $464,886.00 for the entire project.

**Factual data will be supplied on request.*

"Union" centralized traffic control can reduce terminal-to-terminal time with safety and pay its way through reductions in operating expenses. We'd like to help you use C.T.C. to reduce your operating costs.

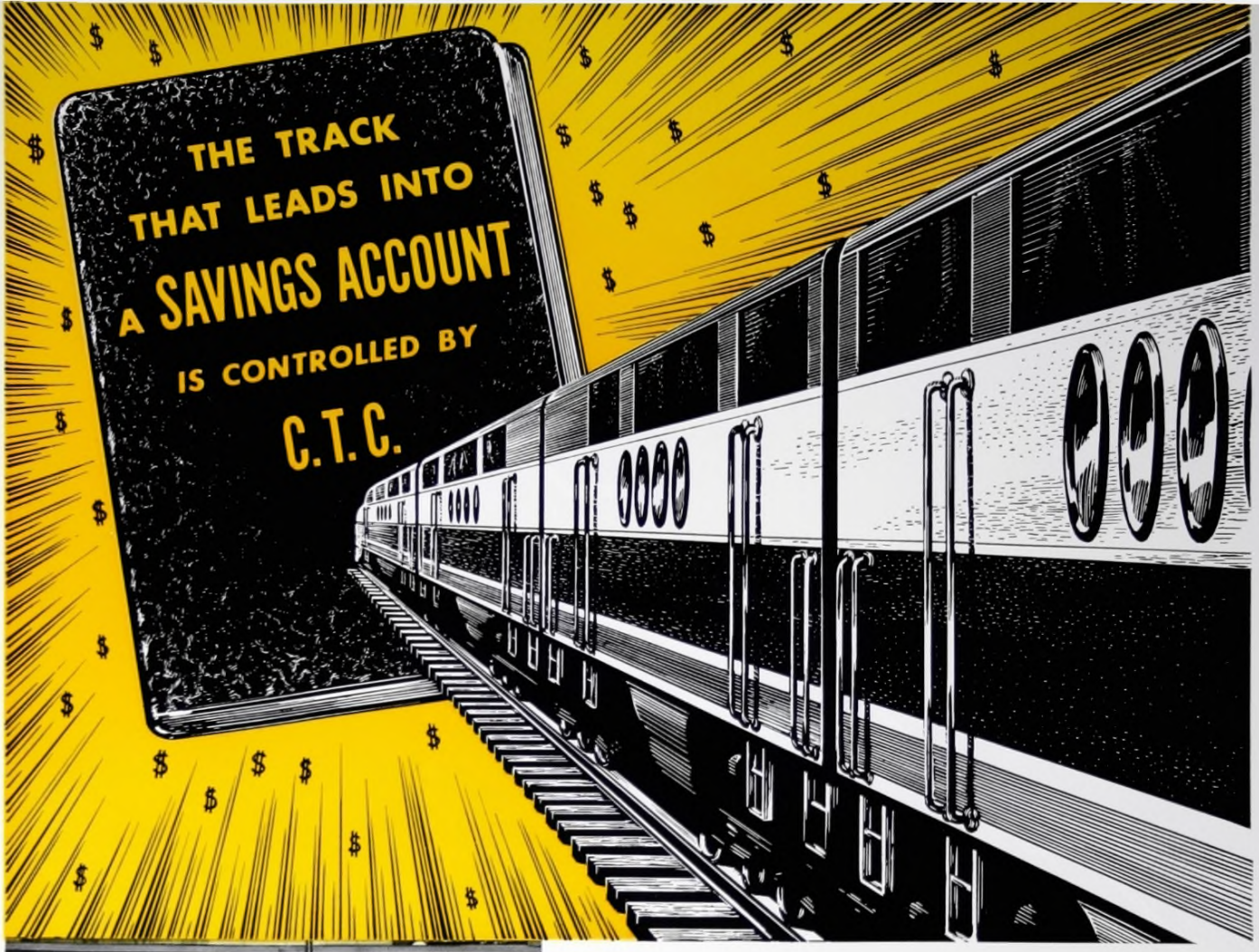
UNION SWITCH & SIGNAL

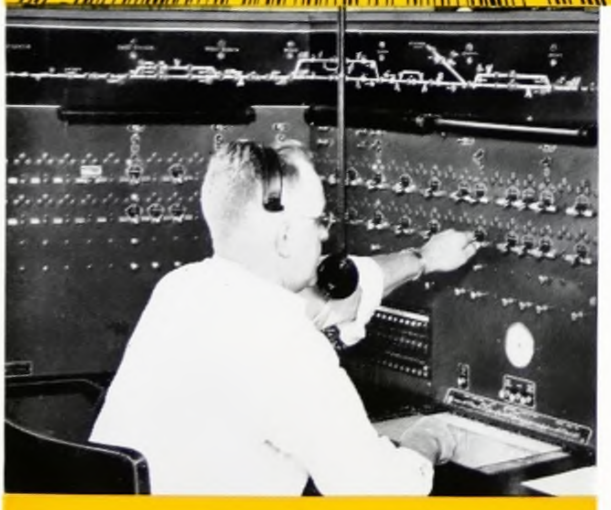
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

SWISSVALE PENNSYLVANIA

New York • Chicago • St. Louis • San Francisco

T-1078





"Union" Centralized Traffic Control can reduce terminal-to-terminal time with safety and pay its way through reductions in operating expense. May we help you?

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

SWISSVALE PENNSYLVANIA

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

Here's an example of "UNION" C.T.C. saving $115,110.00 annually*

This is what happened

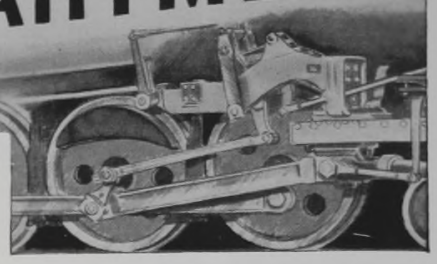
1. Train stops and slow downs were reduced.
2. Average road time per freight train was decreased 36 minutes eastward—59 minutes westward (52.7 miles of road—57.7 miles of track).
3. Average speed of freight train was increased 2.8 m.p.h. eastward and 4 m.p.h. westward.
4. Capacity of the line increased.
5. Net saving in operating expenses is $115,110.00.

**Factual data will be supplied on request.*

T-1077

Advertisement Prepared by
KETCHUM, MACLEOD & GROVE, INC.
PITTSBURGH, PA.

TECHNICAL DEPARTMENT



CTC for Modern Train Schedules

Increases Safety—Reduces Unnecessary Delays—Eliminates Congestion

WITH over 7500 track miles of Centralized Traffic Control in service today, hundreds of engineers and firemen have already learned the advantages of operating trains over territories equipped with this modern facility. And since CTC construction is continuing on an intensified scale, additional hundreds soon will be introduced to this up-to-date method of train dispatching in which train movements are authorized by signal indication and important switches are power operated. Centralized Traffic Control is firmly entrenched on the railroads because of its proved ability to dispatch trains effectively and efficiently with an unparalleled degree of safety. Therefore, this article should be of value to all engineers and firemen and not just to those who are already running on divisions which are equipped with CTC.

Although approximately 2700 track miles of CTC were in service when World War II started, it was the war itself, with the attendant traffic burdens heaped on the railroads, that dramatically demonstrated the full value of this modern facility. New car, locomotive and track construction was drastically curtailed by the government during the war even though traffic volume was soaring to new peaks. With such a situation it was inevitable that serious congestion and delays would result unless remedial action was taken on territories which were hardest pressed to keep trains moving with their vital cargo. CTC was turned to as the logical solution because prewar installations had already proved its ability to reduce safely unnecessary train delays, obtain maximum utilization of cars and locomotives and provide greatly increased track capacity. The government sanctioned the installation of CTC on lines where congestion existed or was imminent because immediate relief could be obtained with a justifiable expenditure of critical material. The benefits derived from the first installations fulfilled or exceeded all expectations and as a result CTC construction continued at an accelerated pace and succeeded in keeping traffic moving smoothly over many vital rail arteries which were threatened with serious breakdown.

Now that the war is over the railroads again can purchase cars and locomotives, not only to replace worn-out equipment, but to provide faster, more attractive service to the public. The experiences gained by the railroads in the last decade are serving as a guide to the planning and construction of this new equipment. The fast freights put in service before the war, which were given appealing names, operated on convenient schedules and made known to the public through intensive advertising, turned out to be very pop-

SOUTHERN PACIFIC Morning Daylight at the Chorro, California, siding on the San Luis Obispo—Santa Margarita Centralized Traffic Control Installation.

#98

ular with the shippers and profitable to the railroads. Likewise, the deluxe streamlined passenger trains proved that the railroads still had the power to attract and retain passenger business. Consequently, new freight locomotives are now being built and delivered which will sustain high speeds for long distances and afford a high rate of availability. In passenger train construction full advantage is being taken of new materials such as lightweight, bright metals, to improve further the appearance and performance of the type of trains which have proved so popular during the last ten or twelve years.

Improves the Railroad's Competitive Position

There are three important objectives which must be considered if the railroads are to maintain a favorable competitive position in relation to other forms of transportation, and these objectives cannot be attained by improved cars and locomotives alone. (1) Safety must always be given first consideration, (2) exacting schedules must be adhered to closely, (3) considerable, but safe reductions should be made in elapsed time between terminals. Centralized Traffic Control is an effective and efficient method of compassing these objectives. It is a safe and sure means of reducing unnecessary train stops and delays, thereby making it possible to effect faster schedules without exceeding safe and comfortable speed limits. For the same reason, it is a valuable aid in maintaining these fast schedules as well as recovering lost time so that far greater dependability of on-time arrivals at destinations is achieved. Furthermore, such accomplishments are made with an unexcelled degree of safety through the prevention of train accidents. These assertions are confirmed by the outstanding performance record of over three hundred installations already in service.

Thus, the Centralized Traffic Control which was installed before and during the war now stands ready to extract the utmost utilization out of new cars and locomotives as well as those already in service. And whereas construction of CTC during the war was restricted to congested lines only, the railroads are now free to construct this facility at all points where more effective train dispatching can improve the railroads' competitive position by reducing train delays, shortening schedules and aiding in the achievement of on-time performances.

Train Movements Authorized by Signal Indication

In Centralized Traffic Control territory the authorization for train movements is given by signal indication. A CTC territory includes complete automatic signaling with full interlocking protection at switches plus a communication system which enables an operator at the CTC machine to control the desired switches and signals. Fig. 1 illustrates a typical track and signal layout for a single track CTC territory with the usual passing track facilities and two-block, three-indication signaling. The signals at the ends of the passing tracks are semi-automatic, which means that they can be controlled by the CTC operator under safe circumstances, i.e., when by so doing a conflicting route would not be set up, a signal cleared with a train in the block or a route changed with a train in the approach section. This safety is assured by the automatic wayside control and locking of the signal system which supersedes the manual control initiated by the operator.

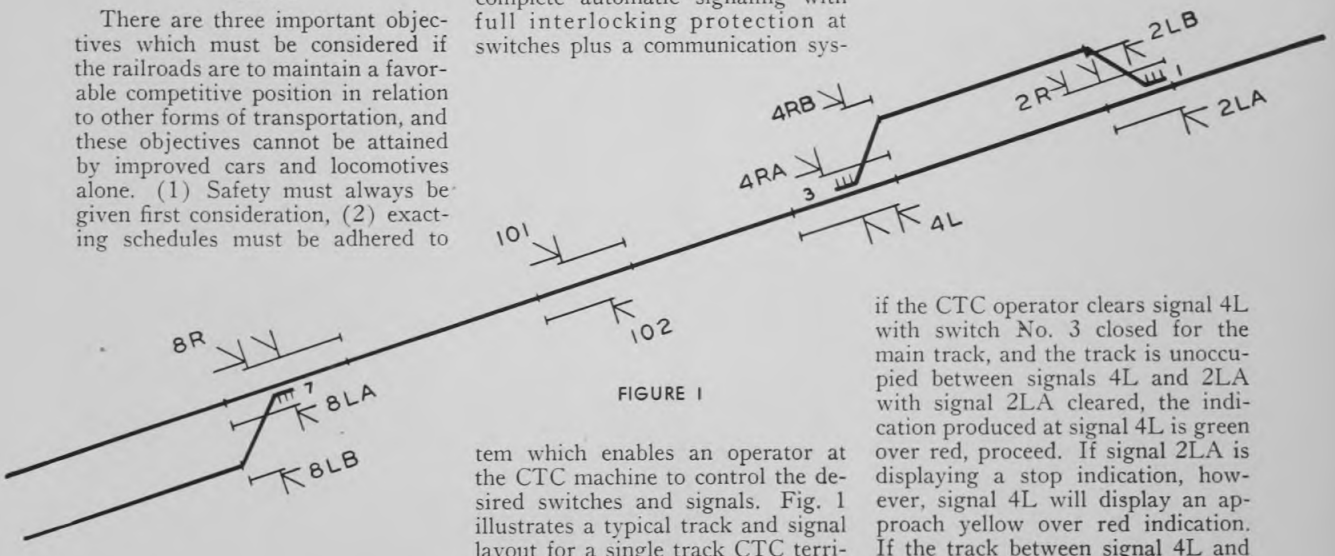


FIGURE 1

Signals 101 and 102 are intermediate automatic signals and are not directly controlled by the CTC operator except that each signal "repeats" the indication of the semi-automatic signal in advance to provide an approach indication to the latter signal. Although the illustration shows only two intermediate signals, the actual number required varies according to the distance between passing tracks, the density of traffic and the speed at which trains are operated. Where traffic is dense additional track capacity can be obtained by providing signaling for three or even more blocks for following movements, in which case additional signal indications are required. For example, three-block signaling requires four indications. Such an arrangement, however, permits closer spacing of trains and at the same time provides adequate braking distances.

It will be noted that signals 2R, 4L and 8R are equipped with two-arms in order to provide indications for moves into the passing track as well as the main track. For example if the CTC operator clears signal 4L with switch No. 3 closed for the main track, and the track is unoccupied between signals 4L and 2LA with signal 2LA cleared, the indication produced at signal 4L is green over red, proceed. If signal 2LA is displaying a stop indication, however, signal 4L will display an approach yellow over red indication. If the track between signal 4L and 2LA is occupied, of course, signal 4L will remain red over red, stop.

If signal 4L is cleared with switch No. 3 reversed, a red over yellow aspect is displayed to authorize a movement into the passing track. On many CTC installations the passing track as well as the main track is track circuited, and where the passing track is of sufficient length intermediate signals are installed on the passing track itself. With such an arrangement signal protection is afforded on the passing track and the speed of trains entering this track is limited only by the size of the turnout and rules of the particular railroad involved.

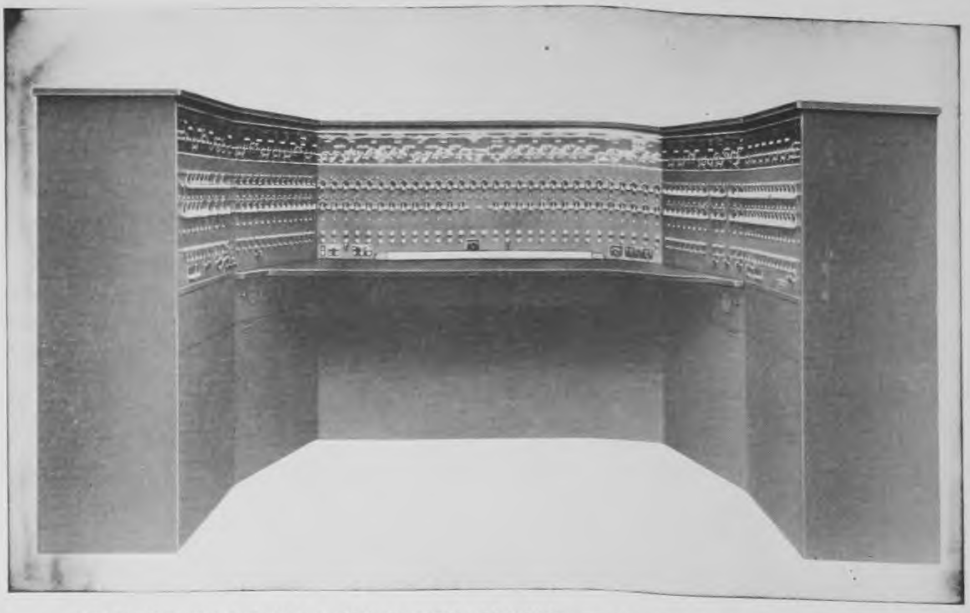
Signals 2LA, 4RA and 8LA are station leaving signals governing main track movements and signals 2LB, 4RB and 8LB are used to govern movements from the passing track. Selection between the "A" and "B" signal depends upon the position of the switch. If the operator desires to clear signal 4RB to

move a train from the passing track to the main track, switch No. 3 must be controlled to the reversed position. In order to clear signal 4RA for a train on the main track the switch must be in the normal position. Neither signal 4RA nor 4RB will clear if an opposing train is between signal 8LA and 4RA, but if a train moving in the same direction has passed signal 101, either signal 4RA or 4RB will display a yellow, approach indication, depending upon the position of switch No. 3. With the block clear, of course, a green proceed indication will be produced. A red indication requires a train to stop and a movement into a block cannot be made without authority of the CTC operator, unless flag protection is provided.

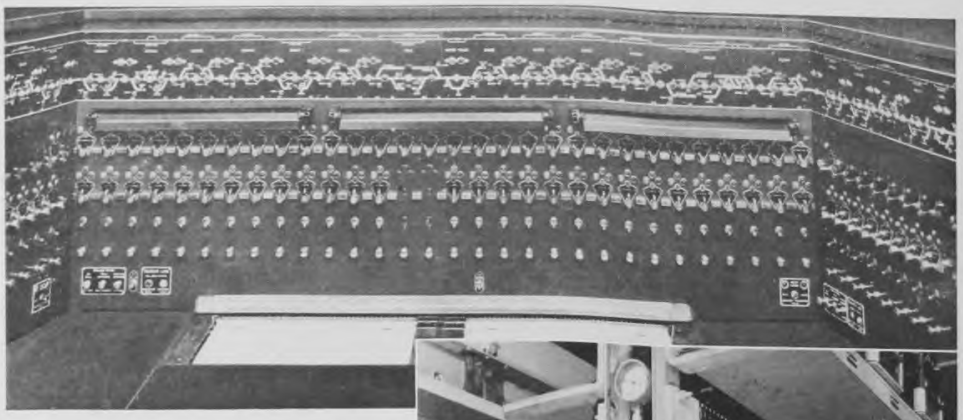
Normally, ground mast signals of regulation height are used for high-speed main track signals and dwarf signals are used to provide authorization for movements from the passing tracks. Signal bridges, especially the cantilever type, are constructed extensively where otherwise it would be necessary to throw out the track in order to obtain sufficient clearance. Any standard type signal can be employed with Centralized Traffic Control, although because of its unexcelled visibility, the searchlight signal is probably the most popular. Some roads make it a practice to install searchlight signals for the semi-automatic signals at the ends of passing tracks and color light signals for the intermediates.

Coded Track Circuits Save Material

Two new methods of automatic signal control for use in connection with CTC systems received widespread application during the war because these methods resulted in substantial savings of critical material. The first method substitutes two-wire line control for previous three- and four-wire schemes. The second utilizes coded track circuits and excludes the use of line wires completely for automatic signal control, except for special purposes. Two line wires, of course, are always required for the code control system which provides a medium for the remote control from the CTC machine of the wayside switches and signals. Where either the two-wire or coded track circuit systems are employed, traffic direction is established manually by the operator at the CTC machine under complete protection of the wayside safety circuits which make it impossible for the operator to line up conflicting routes.



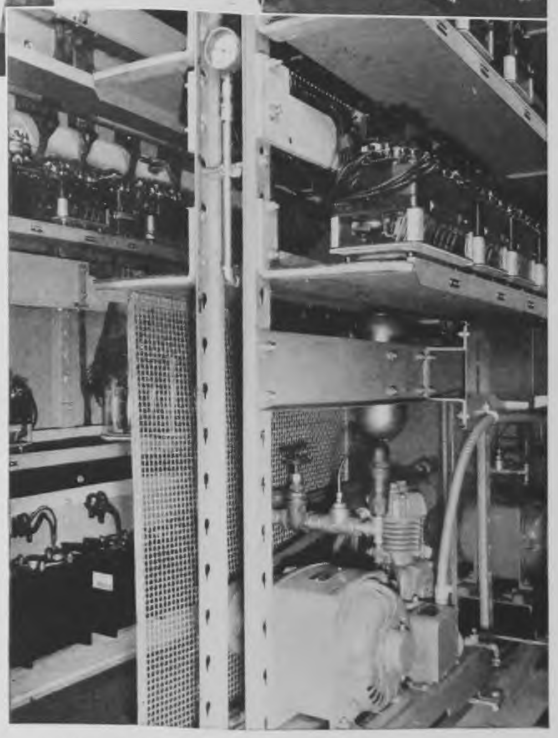
ALTHOUGH THIS CENTRALIZED TRAFFIC CONTROL machine controls a territory 171 miles long, all of the levers are within convenient reach of the operator.



THIS IS a closeup view of the control panel of a CTC Machine, showing the arrangement of levers and indication lights. Automatic train graph is installed in the desk area.

Two-wire line circuits and coded track circuits will continue to be used extensively because the savings of materials are obtained without sacrificing the safety and flexibility of former systems. As a matter of fact coded track circuits afford certain advantages other than line wire economies which are unobtainable in any other system. Among the advantages are increased shunting sensitivity, greater protection against foreign current and longer track circuits which reduce the number of cut sections required.

Numerous methods of providing electrical power for the apparatus are available. Normally, commercial sources of supply alone are not considered sufficiently reliable for CTC or other signal operations, but this source in conjunction with primary



INTERIOR VIEW of an instrument house on the Bessemer and Lake Erie

or storage battery standby is the most frequently used power supply system. Usually the ac supply is distributed throughout the territory on the railroad pole line at 440 or 550 volts and is stepped down to the proper voltage at each signal location. It is common practice to use the ac power itself for certain circuits, such as lighting circuits, with the battery serving as standby. Other circuits derive energy directly from the battery, which, in the case of storage cells, are charged from the transmission line. The charging rate is adjusted to be approximately equal to the discharge rate, thus giving this system the name ac-floating storage battery system. Primary cells have given dependable service for many years and have a high standby capacity, therefore many installations use this battery for standby to the ac supply.

Recently a number of CTC installations have been put in service which use normally de-energized coded track circuits, meaning that the code transmitters, relays and signal lamps are energized only at the approach and passage of a train. In addition, highly efficient searchlight signals are installed which permit using low-voltage, low-wattage lamps without sacrificing good visibility. With such a saving in power consumption and with certain traffic conditions, it is entirely practicable to use primary battery only between passing track locations, thus eliminating the necessity of installing a power transmission line between towns. At the ends of passing tracks, storage cells are usually employed to operate the switches, because there is a heavy current drain during the time the switches are in transit. Commercial power is usually readily available at such locations and this source is used to charge the storage cells.

The switch machines at power-operated switches can be either the electric or electro-pneumatic type. Both high and low voltage electric switch machines are used, the high voltage machine requiring more battery, of course, but having the advantage of faster operation. Where utmost speed of operation is important, electro-pneumatic switch machines give the most satisfactory service. This type has sufficient power to move even 152-lb., 33-ft. switch points almost instantaneously. Also, this abundance of power is exceptionally effective in breaking down obstructions between the switch point and stock rail such as ice and snow, rocks, brush, etc. Small electric-motor-driven compressor units are installed at electro-pneumatic switch locations to supply compressed air for powering the mechanism. Regardless of whether electric or electro-pneumatic switch machines are installed the mechanism is usually the dual-control type so that the switch can be manually operated if desired.

Control Machine Is the Nerve Center

The nerve center of the Centralized Traffic Control system is the control machine itself. By means of this control machine the operator has at his finger tips control over signals, switches and special functions comprising the entire CTC territory. In addition, by means of indication lights, the machine conveys to the operator information concerning the progress of all trains in the territory and the position of signals and switches. Special indications such as traffic direction, power off, low air pressure, etc., can also be provided. The control machines described and illustrated in this article, as well as the Time Code Control System which is also described. are manufactured by the Union Switch and Signal Company.

Inasmuch as the length of territory and the number of switches and signals controlled varies greatly from one CTC installation to the next, the control cabinets are designed and constructed to permit considerable flexibility in choosing an arrange-

WESTERN PACIFIC First 54, engine 252 at wye location Keddie, California, Oroville—Portola installation.

EXTRA 252 WEST pulling out of the west end of the Spring Garden, California, siding on the same Western Pacific Railroad installation.

ment for each particular installation. The standard cabinets are comprised of one or more basic units of two sizes, the larger size having twice the capacity of the smaller. With territories of lesser extent, only one unit of either of the two sizes often has sufficient capacity to control the entire territory. On more extensive territories, the cabinet is assembled from a combination of the basic units, usually bolted together to form a configuration. The photograph reproduced on page 167, for example, illustrates a cabinet which is assembled with a large unit forming the center section and two smaller units on each end of the center section forming the wings. This is a large capacity cabinet, containing sufficient apparatus to control a 171-mile territory, yet the semi-octangular arrangement places the control levers within convenient reach of the operator.

There can be some variation in the arrangement of the control levers and pushbuttons on the control machine, although the arrangement shown on page 167 is the most widely used. The track model at the top of the control panel is a miniature representation of the actual CTC territory. The small lamps inserted in the track lines become illuminated to indicate track occupancy and serve to give the operator a comprehensive picture of the progress of trains throughout the territory. The pairs of lamps inserted in the arrows which are located on the track model outside the track lines are employed to indicate the direction in which the operator has established traffic.

The first row of levers under the track model are switch control levers. It will be noted that a pair of lamps are associated with each switch lever, these lamps serving to indicate the position of the switch. Signal control levers are arranged in the row beneath the switch levers, with a group of three indication lamps mounted above each lever. The center lamp is illuminated when the signals are controlled to stop. The left lamp, when lighted, indicates that the left signal has been cleared and the right lamp, when lighted, indicates that the right signal has been cleared. The row of toggle switches which are located under the signal levers are for calling the signal maintainer. On some installations this space on the panel is used for toggle switch or pushbutton call-on signal control. In such cases the maintainer's call toggle switches are located elsewhere. The pushbuttons located beneath the toggle switches are code-starting buttons. Each group of control levers has an associated code-starting button which is used to initiate a code for each particular station. The miscellaneous toggle switches and pushbuttons in the bottom row are for such purposes as electric switch lock control, OS bell cut-out, field station disconnect, etc.

An automatic train graph is installed in the center of the desk part of the machine. This is a graphic recorder which advances a continuous chart at the rate of three inches per hour. The paper is printed with parallel lines and is arranged for direct reading of time. An individual pen is provided to record the passage of a train at each desired point in the territory. By connecting the markings on the graph paper the operator obtains a comprehensive, permanent record of the progress of all trains through the territory.

The office coding equipment is contained in the control cabinet. Similar coding equipment is also required at each field station and is installed in instrument houses or cases along with other apparatus, near the switches and signals. The office coding equipment provides a means for sending out control codes to the field and for receiving and registering indication codes from the field. Similarly, the field equipment provides a means for receiving and registering the control codes sent out from the office and for transmitting indication codes back to the office.

It is interesting to note at this point that although the code control system is used only as a communication system between the office and field, and does not perform a safety function, it is this facility which made Centralized Traffic Control practicable. The basic principles of CTC were recognized long before a satisfactory system was worked out to control the many remote functions involved in a territory extending out very far from

SWITCH AND SIGNAL LOCATION at the east end of the siding at Tumia, Oregon, on the Union Pacific La Grande—Rieth Installation.

NORFOLK AND WESTERN First 88 leaving north end of siding at Rileyville, Virginia, on Shenandoah Division CTC.

UNION PACIFIC Extra West on siding to meet eastward freight at Perry, Oregon, on the La Grande to Rieth Installation.

the control point. Former methods of control required separate direct-wire circuits to control and indicate each function so that unreasonably large quantities of line wire were required for even a comparatively short installation.

Complete Sub-divisions Controlled from One Machine

With the introduction of the Time Code Control system by the Union Switch and Signal Company in 1929, the barrier to extensive CTC construction was removed, as this system reduced to only two the number of line wires required to control up to twelve stations. In 1931 the capacity of the system was increased to 35 stations, thus paving the way for the installation of CTC on complete operating sub-divisions, with all the functions controlled from one machine over only two line wires. In 1941 Coded Carrier Control for use with the Time Code Control system was announced by the same company. The introduction of carrier frequencies into the code control scheme has extended indefinitely the length of CTC that can be controlled over only two line wires. Coded Carrier Control will be discussed more fully later.

The Time Code Control system is designed for multiple line application, which means that the line relays are connected into the line circuit in multiple. There are no relay coils or contacts in series with the line circuit, thus the same pair of line wires can be used readily for telegraph and telephone circuits as well as for controlling the CTC system. In general, if an existing pair of line wires are mechanically strong it is unnecessary to string an additional pair. On the other hand, if a new pair of wires are installed for the CTC system they can also be used for telegraph and telephone circuits, including selectors. Through cooperation of the telegraph and signal departments, line circuits can be so arranged that the CTC line can be used as a standby in emergencies for other important circuits without interrupting the operation of the CTC system. Likewise, other communication lines can be used for operation of the CTC system in case the CTC line should break, without interference with the communication circuits.

The coding action in the Time Code Control system is produced by alternately energizing and de-energizing a group of associated relays in proper sequence. Most CTC installations now in service using this control system employ the 16-step code, which means that sixteen impulses are used for the control code and sixteen are used for the indication code. The code is made up of long and short impulses, and the sequence of these long and short impulses determines the character of the code.

Functions Are Controlled by Code

The control code is initiated by the operator at the CTC machine. For example, suppose it is desired to direct a train to enter a passing track at a station assigned the number 257, and the switch has been lined previously in the normal position for main track movements. The operator places the switch control lever in the reverse position and places the lever controlling the signal governing movements into the passing track in the position which will clear this signal. (It will be assumed that this is the L signal.) He then presses the code-starting button associated with these levers and thus initiates the control code.

The first step of the control code is always long and serves to check that the line is not already in use. It also locks out the line so that a field station cannot start to transmit a code while the office is coding. The next seven impulses, three of which are long and four are short, are used for station selection. The sequence in which the long and short impulses are transmitted selects the desired station. In this case, it is assumed that station 257 is selected. Therefore the second, fifth and seventh steps of the code would be long impulses. Following the station selection portion of the code, the next seven impulses are used for the control of switches, signals, maintainer's call, or other special functions. Any of these impulses can be long or short depending upon the information to be transmitted. In this case the operator reversed the switch and cleared the L signal, so that the eleventh impulse (reverse switch step) and the thirteenth impulse (clear left signal step) would be long. The other five impulses of the function control portion of the code would be short, as it is not desired to change the position of any of these functions. The sixteenth and final step of the code is always long and is used to reset the apparatus to the normal condition.

SOUTHERN PACIFIC No. 51, the San Joaquin Daylight, doubleheading over the heavy grades on the Bena—Tehachapi, California, installation. CTC is especially helpful in preventing congestion where helper movements are frequent.

After the control code is finished and the functions in the field have responded in accordance with the information transmitted from the office, the field coding apparatus automatically transmits an indication code back to the office to indicate to the operator the response of the field functions. This is also a 16-step code and is very similar to the control code. The first step is always short, serving to check that the line is not already in use and to prevent the initiation of a code from the office or another field station. The next seven steps are used for selection of the office station relay, in the same manner as this was accomplished with the control code. The next seven impulses, which can be long or short, are used for function indication. The last step, which is always long, is used to operate the indication stick relays in accordance with information transmitted on the preceding seven steps. In addition this last step also resets the apparatus to the normal condition.

Whereas the improved Time Code Control system made it practicable

to control an entire operating subdivision over two line wires, the Coded Carrier Control system extended indefinitely the length of territory that can be controlled over a single pair of wires. At present there is an installation in service where the most remote station is 210 miles from the control point. Actually this distance could just as well be several hundred or even several thousands of miles.

On CTC installations employing Coded Carrier Control the territory is divided into two or more sections, depending upon its length and the number of functions which are controlled and indicated. If the control machine is situated adjacent to the end of the territory the first section extending out from the machine can be controlled by the conventional Time Code Control system and direct current impulses in the usual manner. The second, or any additional sections are controlled by high-frequency alternating current impulses, known as carrier currents. A separate set of frequencies (one frequency for control codes, and one for indication codes) is assigned to each section. These carrier circuits, together with the conventional dc circuits are superimposed on the same pair of line wires. For example a CTC territory is divided into three sections. The two wires between the control machine and the point dividing the first and second sections would include the dc circuit for controlling the first section, and also two sets of carrier frequencies for controlling the second and third sections. The same two wires would handle the one set of carrier frequencies and a dc circuit from the point dividing the first and second sections to the point dividing the second and third sections. From the latter point to the end of the territory, of course, only the dc circuit would be used to control and indicate the third section.

Each carrier section has a capacity of 35 stations, the same as conventional dc sections. Regardless of the extent of a territory, all sections can be controlled and indicated simultaneously without increasing coding time because electrical filters are used on each section in such a manner that the apparatus of each section can respond only to current of the frequency assigned to that particular section.

SOUTHERN PACIFIC Westbound First 639 passing signal at west end of Sims, California, siding on the Black Butte—Redding, California, installation.

In addition to the Coded Carrier Control, communication circuits (including voice) can be carried over the same pair of line wires, and the circuits can be used simultaneously without interfering with each other.

CTC Simplifies Train Operation

This description of Centralized Traffic Control is not intended to give the impression that CTC introduces many new complications into train operation. Actually the reverse is true. In the case of passenger trains, timetables must be observed, of course, in so far as conforming to schedules advertised to the public are concerned. Otherwise all train movements, freight and passenger alike, are authorized entirely by signal indication, in lieu of both timetables and train orders. Any engineer or fireman who is familiar with automatic block signals has very little difficulty becoming acquainted with signal indications in CTC territory. For instance here is the only difference, in so far as indications are concerned, between two-block, three-indication automatic APB signaling and two-block, three-indication CTC signaling: At the end of a passing track, the signal for the CTC installation governing movements into the passing track is a two-arm signal rather than a one-arm signal, in order to provide indications for movements into the passing track as well as on the main track. In addition, a dwarf signal, displaying the usual aspects is provided for authorizing movements out of the passing track.

Centralized Traffic Control is a tremendous aid to engineers and firemen in getting their trains over the road because the authorization of train movements by signal indication and the power operation of important switches gives them much more time for the fundamental business of running an engine. It is the most effective dispatching system ever developed and helps make it possible to maintain the rigid schedules which are necessary if the railroads are to retain their prominent position as mass movers of passengers and freight.

Reprinted from the August, 1947, issue of the Brotherhood of Locomotive Firemen and Enginemen's Magazine

EXPANDING EVIDENCE THAT *"UNION"* *C.T.C.* SAVES MORE THAN IT COSTS!

"UNION" C.T.C. INSTALLATIONS IN THE UNITED STATES

UP TO 25 MILES | 26 TO 50 MILES | 51 TO 100 MILES | 101 TO 150 MILES | 151 TO 200 MILES | OVER 200 MILES

BEGIN C.T.C.

"Begin C.T.C." is a welcome sign on every modern railroad because "Union" Centralized Traffic Control has proved its ability to get trains to destinations faster—to increase track capacity—and to cut fuel, man-hour, and equipment waste!

That's why each year railroads install *more* "Union" C.T.C. on *more* miles of track across the nation. Ideally suited to long range planning . . . "Union" C.T.C. can be put in service section-by-section . . . and control can be concentrated at division headquarters. Why not let "Union" engineers show you how C.T.C. can fit *your* railroad's present and future needs?

UNION SWITCH & SIGNAL COMPANY

SWISSVALE PENNSYLVANIA

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

EACH YEAR "UNION" C.T.C. *SERVES* MORE RAILROADS . . . *SAVES* AT MORE LOCATIONS

On modern railroads, "Begin C.T.C." is a sign of progress. For each installation of Centralized Traffic Control brings immediate operating advantages . . . far-reaching results.

Because train movements are governed by signal indication, "Union" C.T.C. saves unnecessary stops and delays . . . eliminates the "red tape" of written train orders . . . surrounds all train movements with safety. It increases track capacity, shortens road-time, assures dependable and efficient operations, builds smoothly-functioning territories.

And the ever-increasing number of "Union" C.T.C. installations indicates that *"Union" C.T.C. saves more than it costs!* Consider these proved advantages in relation to your present or future plans—then let our representatives show you how "Union" C.T.C. can best serve your railroad.

UNION SWITCH & SIGNAL COMPANY

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NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

64% of The N. C. & St. L. Atlanta-Memphis main line will soon have "UNION" Centralized Traffic Control

In 1943, The Nashville, Chattanooga & St. Louis Railway installed "Union" C.T.C. on 41 miles of single track and 2 miles of double track between Atlanta and Cartersville, Ga.

In 1944, this Railway installed "Union" C.T.C. on 109 miles of single and 4 miles of double track between Nashville, Tenn., and Stevenson, Ala. At Cowan, Tenn., one 15-foot C.T.C. machine controls the 87-mile territory northward to Nashville. A 5-foot machine at this location controls the 26-mile territory southward to Stevenson. With 12 passenger and 50 freight trains daily, time for through freights was reduced one hour and 45 minutes, time for local freights reduced two hours and 30 minutes, for passenger trains 19 minutes.

Small wonder then that The N.C. & St.L. extended its Centralized Traffic Control!

In 1945, another 95 miles—from Nashville west to Bruceton—was C.T.C. equipped. A single machine at Bruceton controls this territory. Maximum time savings have not been realized because a dam project on the Tennessee River has necessitated relocation of about ten miles of track and delayed completion of this portion of the C.T.C. installation. However, through freights are even now saving an hour.

And now additional C.T.C. is being installed on the 87-mile territory between Cartersville, Ga., and Chattanooga, Tenn. A 10-foot machine, located at Dalton, Ga., will control this territory. When this construction is completed, 64% of the 526.6 miles of main line from Atlanta, Ga., to Memphis, Tenn., will be controlled by "Union" C.T.C. Every mile from Atlanta to Bruceton will be C.T.C. except four miles in the Nashville Terminal area and 38 miles of double track between Chattanooga and Stevenson.

This is how just one railroad is extending and consolidating its "Union" C.T.C. trackage for efficient and economical train movement. "Union" engineers will gladly work with you in applying Centralized Traffic Control to your specific operating conditions.

N.C.&St.L.

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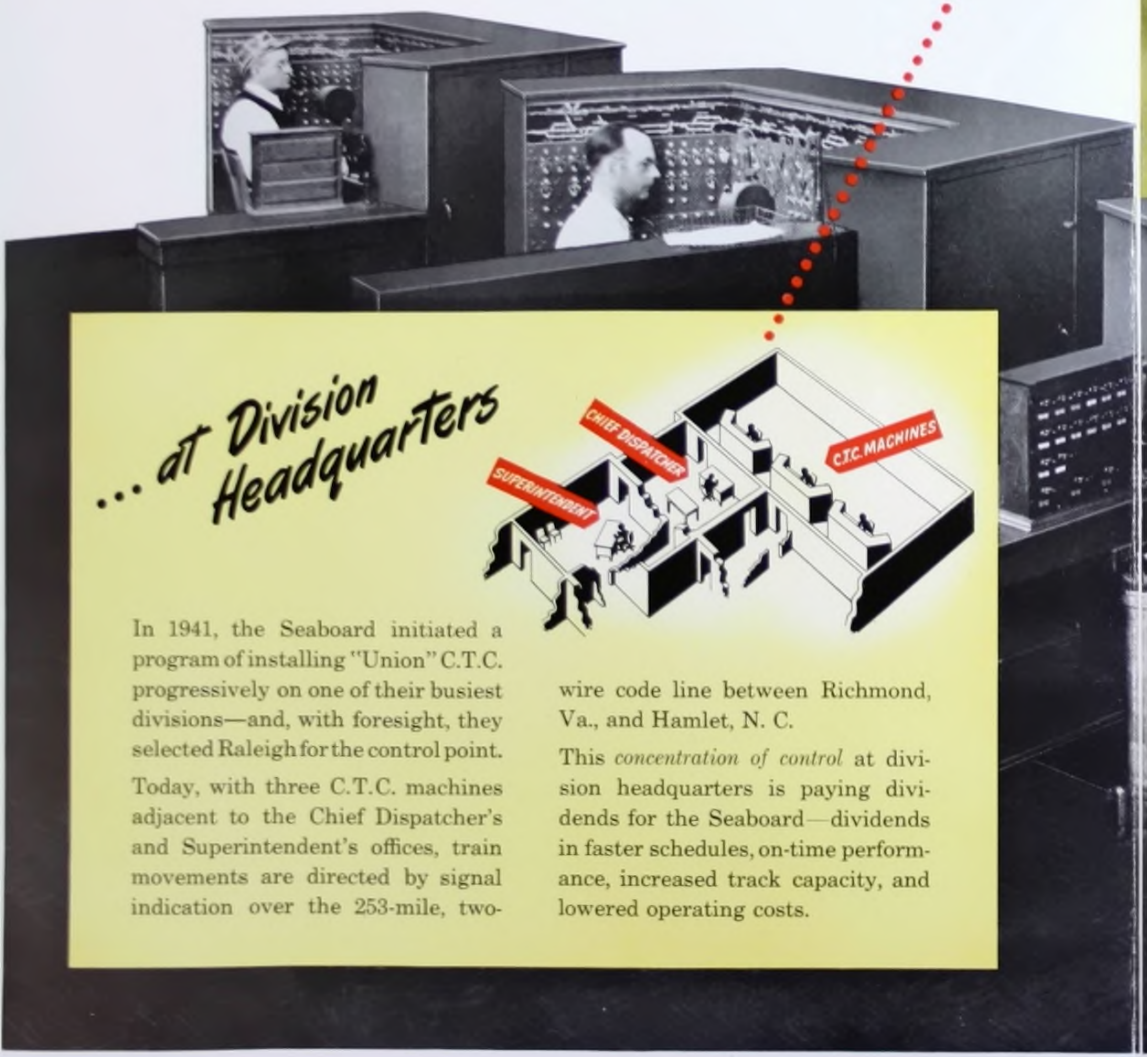
"UNION" C SAVES YOU MORE THAN IT COSTS

"UNION" C.T.C. ON THE SEABOARD

concentrates control.....



... at Division Headquarters

In 1941, the Seaboard initiated a program of installing "Union" C.T.C. progressively on one of their busiest divisions—and, with foresight, they selected Raleigh for the control point.

Today, with three C.T.C. machines adjacent to the Chief Dispatcher's and Superintendent's offices, train movements are directed by signal indication over the 253-mile, two-wire code line between Richmond, Va., and Hamlet, N. C.

This *concentration of control* at division headquarters is paying dividends for the Seaboard—dividends in faster schedules, on-time performance, increased track capacity, and lowered operating costs.

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PITTSBURGH, PA.

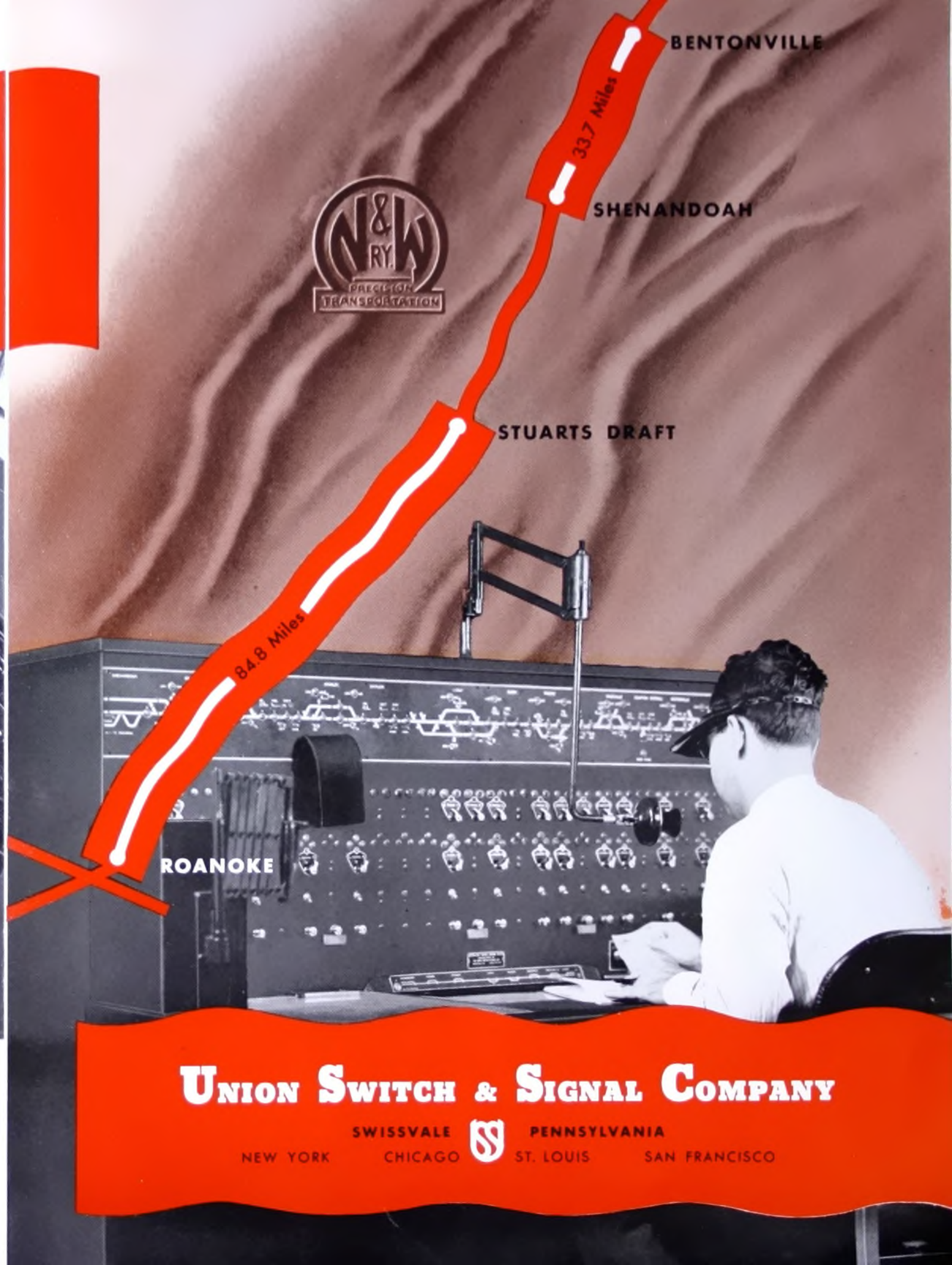
"UNION" C.T.C.
on the Norfolk & Western
concentrates control.....

...at Division Headquarters

Heavy trains kept moving on ascending grades in helper territories . . . operating delays eliminated . . . track capacity increased . . . schedules greatly improved with through freights saving more than a minute per C.T.C. mile . . . and operating costs slashed! . . . That's how the Norfolk & Western benefits from "Union" C.T.C. on its Shenandoah Valley Line.

Train operations in the two C.T.C. territories are directed by signal indications over a two-wire line from the machines located in adjacent rooms at division headquarters in Roanoke—with chief dispatcher's, trainmaster's, and superintendent's offices in the same building.

Thus, modern railroads are concentrating control of division-length operations at the logical place for *maximum* efficiency. Have you considered the possibilities of such centralization for your railroad? Our representatives will gladly help you determine them.



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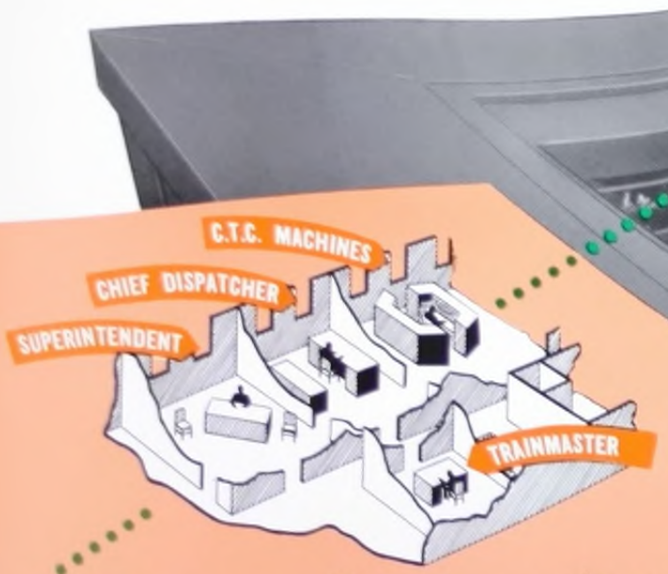
"UNION" C.T.C. ON THE BURLINGTON

concentrates control.....



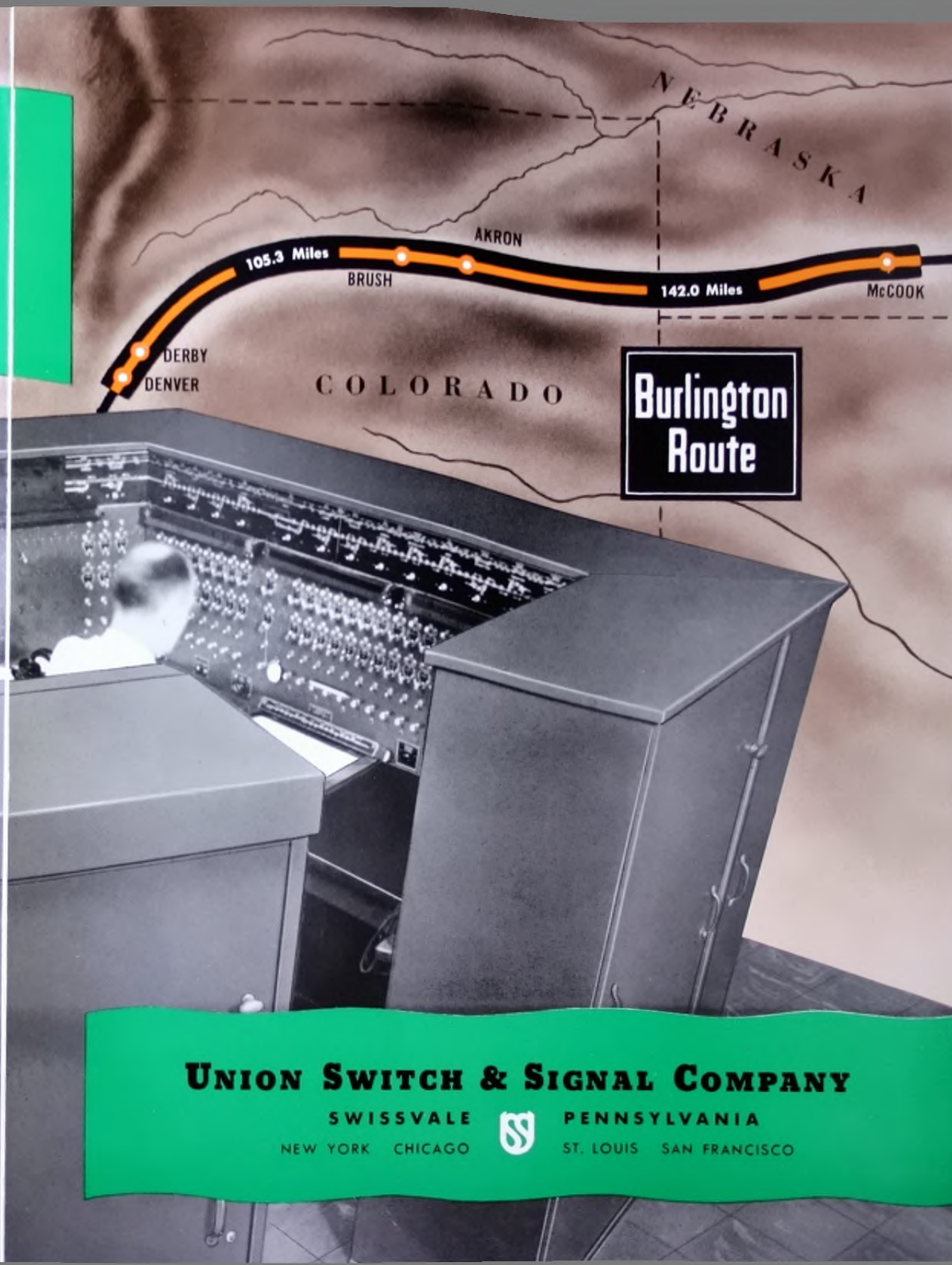
at Division Headquarters

SELDOM does a signal installation make history twice—but that's what happened on the Burlington!

• In 1937, the Akron-Derby Centralized Traffic Control installation—*the outstanding* C.T.C. installation for a number of years—was placed in service with the control machine at Brush, Colorado.

• In 1947, this same machine was moved 167 miles east to McCook, Nebraska and placed beside the McCook-Akron C.T.C. machine which was installed in 1946 to control the other complete operating sub-division. Today, these two "Union" C.T.C. machines control a division-length C.T.C. installation over a single pair of wires with *the farthest controlled location at Derby, 248 miles away.*

• And the Burlington, through the *concentration of control* at division headquarters, is obtaining the *maximum* advantages of this modern method of directing train movements by signal indication.



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"UNION" C.T.C. on the Union Pacific

concentrates control.....

at Division Headquarters

The 325-mile installation on the Union Pacific, between Salt Lake City, Utah and Caliente, Nevada, is an *outstanding* example of how "Union" C. T. C. with Coded Carrier Control eliminates distance as a major engineering problem.

The entire territory is controlled by two machines located at Salt Lake City in the fire-proof, air-conditioned dispatchers' building . . . convenient to other division offices. One machine controls the section between Salt Lake City and Lynndyl, 118 miles; the other, the section between Lynndyl and Caliente, 207 miles. Both machines can be operated simultaneously, and only two code line wires are used to handle the controls and indications for the entire installation.

And, with *control concentrated at division headquarters,* the Union Pacific receives *maximum* advantages from this outstanding C. T. C. installation. Faster, more efficient handling of traffic is assured at greatly reduced operating costs.

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Traffic Control

can be *REALLY* centralized

Centralized Traffic Control has been speeding up train movements for more than 15 years, but the greatest economy and flexibility of application was not realized until 1942, when The Union Switch & Signal Company introduced *Coded Carrier Control.*

"Union" Coded Carrier Control greatly extends the length of territory which can be efficiently and practically controlled from a single point. It makes possible the location of control machines in offices many miles from the controlled territory; it permits the maximum utilization of line wires, whether signal, C.T.C., telegraph or telephone.

In less than three years, 27 C.T.C. sections using "Union" Coded Carrier Control have been installed, and the percentage of such installations is still growing. Only "Union" C.T.C. installations have this feature.

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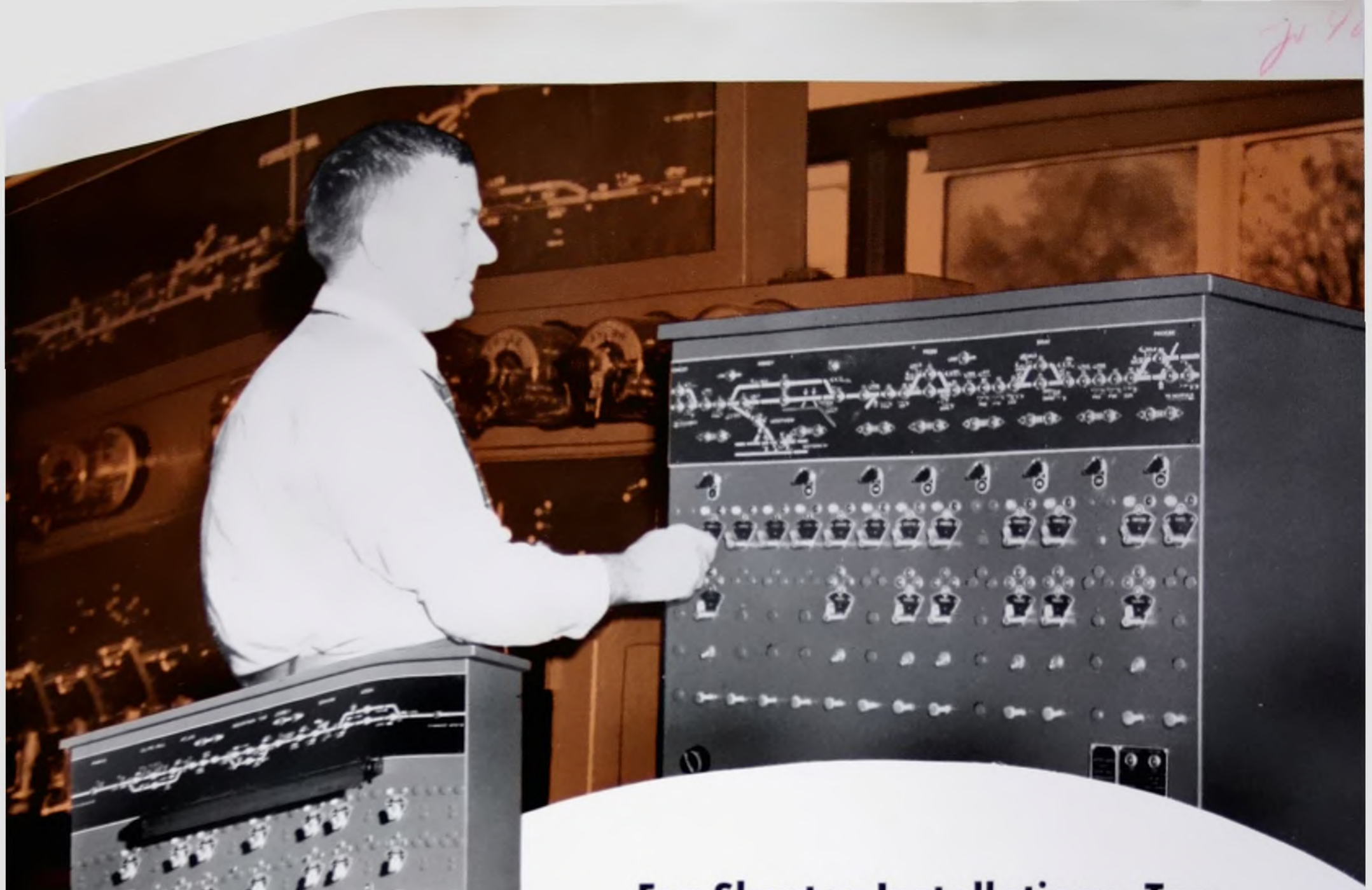

For Shorter Installations, Too ... "UNION" C.T.C.

Along with the pronounced trend toward division-length C.T.C., don't overlook the operating and economic benefits resulting from the installation of shorter C.T.C. sections at strategic locations on your railroad. For example, "Union" C.T.C. effectively breaks up those bottlenecks which occur:

- ... in sections of single track, into which the heavy traffic of adjacent multiple-track territories is operated.
- ... on portions of the railroad where traffic is unusually heavy due to joint operations with a "foreign" road.
- ... in territories where numerous switching or helper movements cause congestion.

Under such circumstances, it is not unusual for a short installation—perhaps only 20 miles long—to save 30 minutes or more for every freight train passing through it. Look over your railroad—pick out those costly bottlenecks—then let our representatives help you plan a "Union" C.T.C. system that will *save you more than it costs.*

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This is EASY with "UNION" C.T.C.

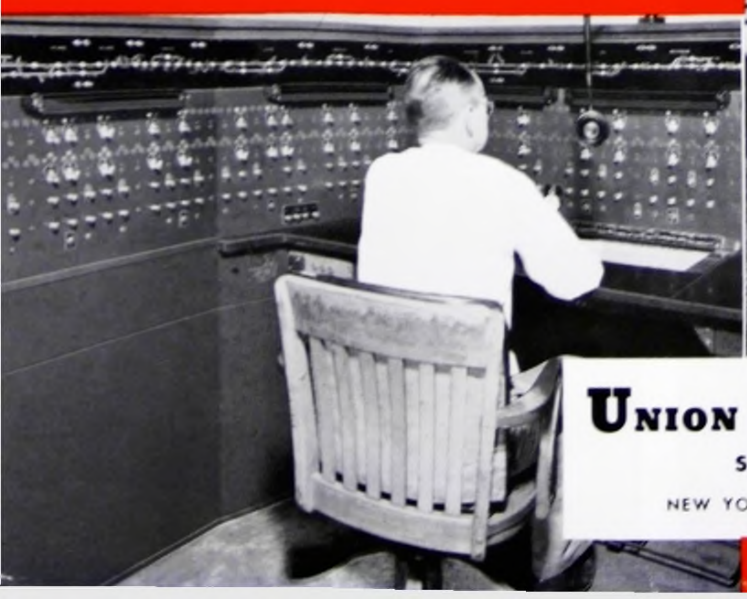
These action pictures clearly illustrate how closely meets and passes can be coordinated when train movements are directed by signal indication and switches are power operated. Results? Fewer stops . . . time saved . . . efficiency increased . . . less wear and tear on equipment . . . lowered operating costs.

1. Extra 2722 west with solid train of loaded hoppers advances ahead of passenger No. 37 into double track territory.

2. No. 37 runs around Extra 2722 on eastbound track without stopping...returns to westbound track through power-operated crossover.

3. Switches returned to normal...signals cleared... manifest freight No. 92 east highballs through without stopping.

4. After taking water, and with No. 37 and No. 92 out of the way, Extra 2722 proceeds with minimum delay.



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The Pennsylvania Railroad

Expedites Branch Line Operations . . .

LOWERS COSTS

with "UNION" C.T.C.

The Pennsylvania Railroad's line between Tyrone, Pa. and Lock Haven, 53 miles, is an important branch . . . and with the help of "Union" C.T.C., operations are carried on with efficiency comparable to that of a first class mainline.

Before C.T.C. was installed, the P.R.R. was handicapped in handling traffic consisting of heavy coal trains eastbound —returning trains with empties westbound—interspersed with arranged service freights. Immediately after "Union" C.T.C. was installed the average road time per freight train was reduced 59 minutes westbound and 36 minutes eastbound. Average speed of freight trains was increased 4.0 m.p.h. westbound and 2.8 m.p.h. eastbound.

These savings in train time were attained by the more effective and efficient train handling made possible by "Union" C.T.C. . . . not by increasing top train speeds. As a result, operating costs were reduced substantially.

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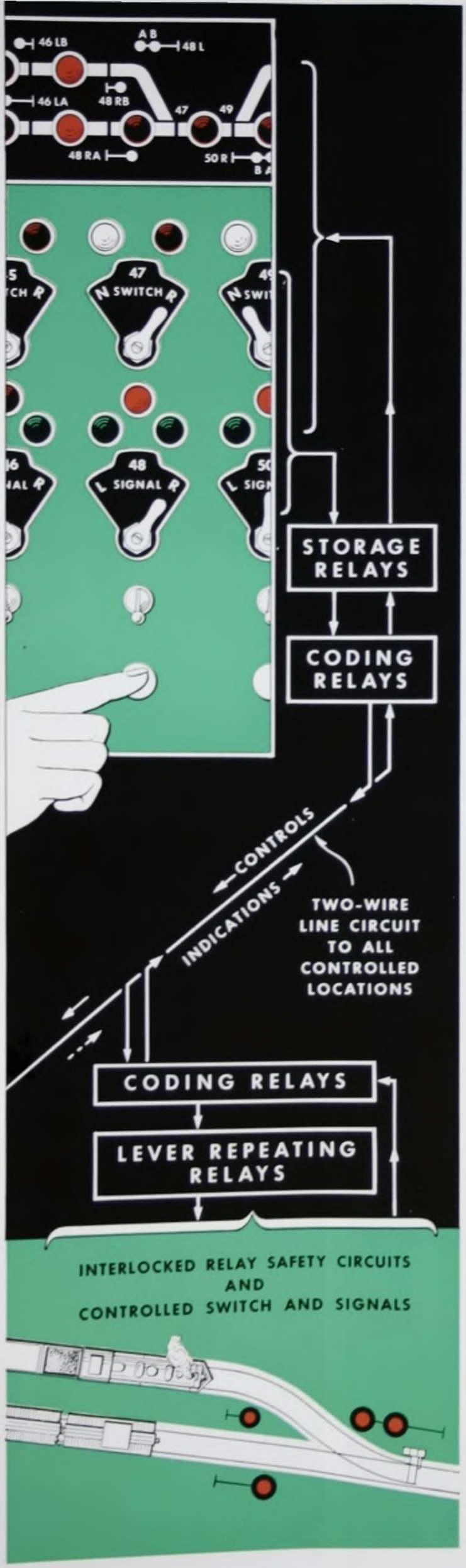

Here's what Time Code Control does in modern C.T.C. systems

In its familiar application to Centralized Traffic Control, the "Union" Time Code Control performs a complex job in modern signaling with simplicity and efficiency.

Let's take the typical situation shown at the left—to authorize the train on siding to advance requires only simple manipulation of levers on the C.T.C. machine. Switch lever 47 is reversed, lever 48 is turned to the right, and the code starting button is pushed.

This causes a group of office coding relays to transmit a control code, consisting of a predetermined arrangement of pulses, over the two line wires to all C.T.C. stations. The first portion of the code causes the selection of the station controlling switch 47 and signals 48, while the last portion actuates certain lever-repeating relays at this station to accomplish the desired functional controls.

The response of vital functions to the desired controls depends finally on the "safety circuits" that are localized and interlocked in the field. Switches cannot be operated while route locking, approach locking, and certain occupied track circuit controls are in effect. Furthermore, the signal control circuits are designed to establish traffic direction, hold opposing signals at stop, check switch position, and assure that the track in advance is not occupied before permitting the display of a non-restrictive signal aspect.

Any significant change in condition at a field location automatically initiates an indication code. This code includes a complete report of switch position, signal indication track occupancy, etc., prevailing at the time. At the office the code is "translated" for the resultant display of indication lights above the levers and on the track diagram.

A popular form of time code control for C.T.C. is the "Union" 506 System which has a maximum capacity of 35 stations. When used in combination with "Union" Coded Carrier Control, two or more C.T.C. sections may be operated simultaneously over the same pair of line wires.

Our nearest district office will be glad to give you full information about "Union" Code Control Systems and their applications.

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S-3723

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KETCHUM, MACLEOD & GROVE, INC.
PITTSBURGH, PA.

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