

CENTRALIZED
TRAFFIC CONTROL

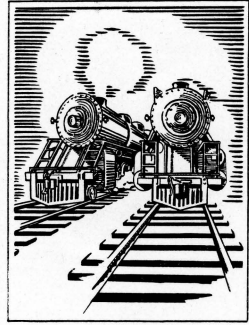


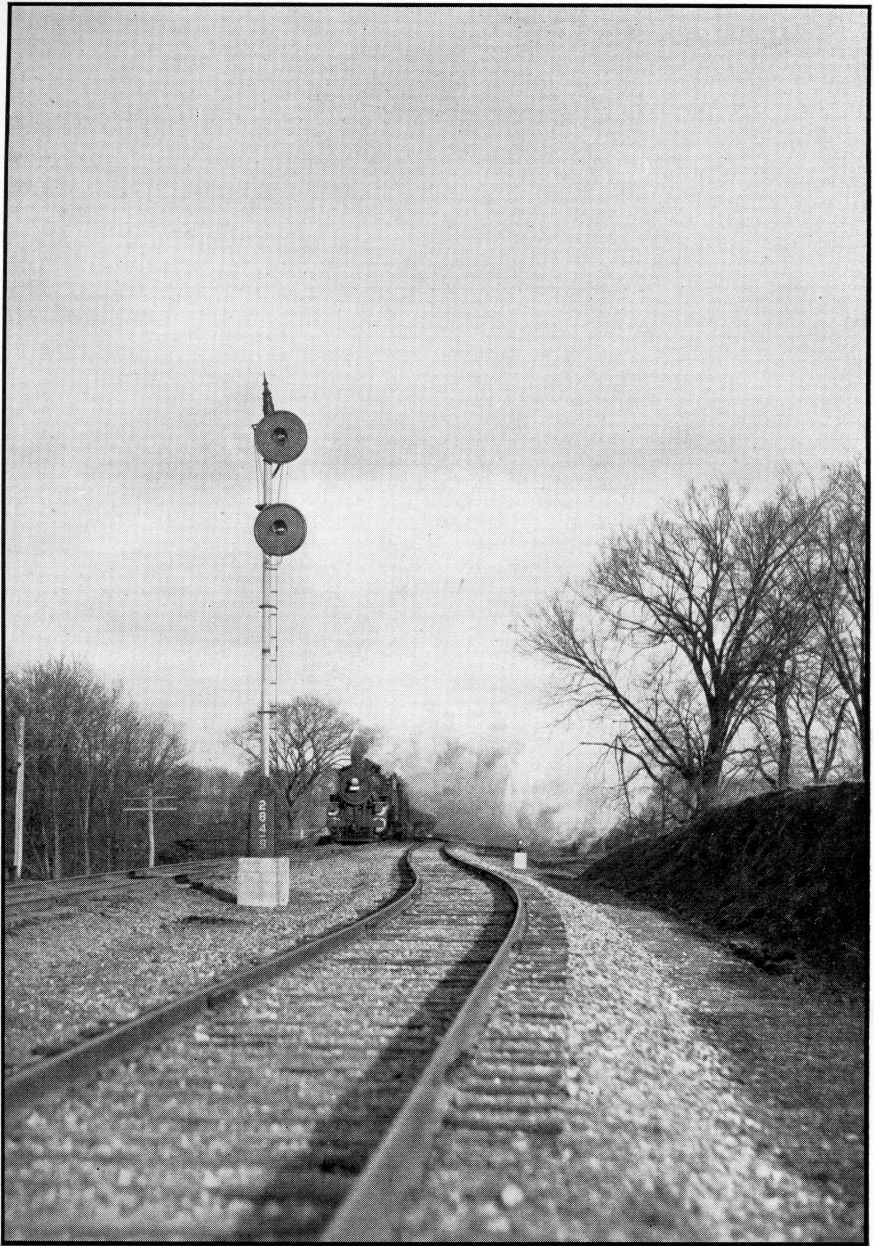
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BULLETIN 148

Union Switch & Signal Co.

SWISSVALE, PENNSYLVANIA





CENTRALIZED TRAFFIC CONTROL



Bulletin No. 148

UNION SWITCH & SIGNAL CO.
SWISSVALE, PA.

Preface

WHEN the first telegraphic train order was sent by Superintendent Charles Minot of the Erie on September 22, 1851, a new era in railroad operation was inaugurated. For prior to that date the time card was the sole reliance of the railroad man for getting trains over the road.

The telegraphic train order greatly reduced the former delays to trains which were required to wait one hour for opposing trains, then proceed under flag until they met. In spite of the great advantages resulting from the written train order, it has its limitations as well. And it has been only through the development of modern signaling systems that many of its shortcomings have been mitigated.

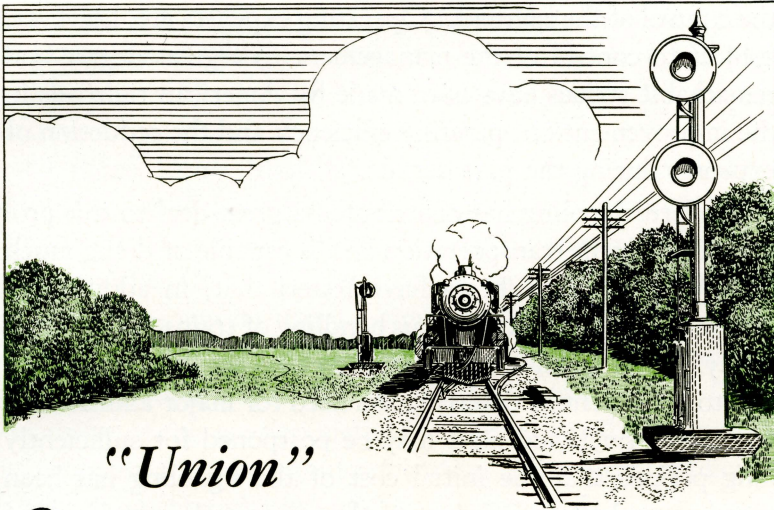
Through the development of the "Union" Centralized Traffic Control System the written train order now may be discarded, for orders can be delivered to the train by *signal indication* at the point where action must be taken.

The "Union" C. T. C. System, as described in the following pages, is flexible enough to meet the numerous operating problems arising on the railroads. Its application enables railroads to operate entire divisions by signal indication from a centralized point or to correct certain troublesome operating conditions on short sections of track with a minimum of materials and labor. This bulletin describes how the railroads are using the "Union" C. T. C. System for making further substantial reductions in operating costs.

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"Union"

CENTRALIZED TRAFFIC CONTROL

RAILROADS ARE LIMITED in the charges they may make for their services. Stockholders and managements are looking to the operating officers for a lower cost per traffic unit so that they may earn a satisfactory return upon the money invested in the system. The operating officers are charged, not only with the task of keeping operating expenses at a minimum, but also with the utilization of physical property to its fullest extent. It is important that the fixed as well as the direct charges applicable to each ton-mile or passenger-mile be kept within reasonable bounds.

The revenue of a railroad is dependent directly upon the production of ton-miles; its expenses are largely dependent upon the train miles and train hours required in that production. Tonnage offered the carrier for transportation fluctuates with business conditions and is, therefore, ordinarily beyond

the control of the railroad. Operating expenses are, however, subject to control of the management to a great degree and remarkable strides have been made by American railroads in the improvement of operating efficiency and the reduction of expenses during the past decade.

Modern signaling has contributed a great deal to this program of efficient transportation and is capable of doing much more. Operating officers have found that, in addition to providing for more expeditious handling of trains with greater safety, signal installations have increased the capacity of the line to the extent of deferring the need for major additions to trackage. Such additions may be postponed for sufficiently long periods that the initial cost of the signaling has been saved several times over out of the conserved capital cost of the more expensive trackage improvement.

The "Union" Centralized Traffic Control System, which is among the latest developments in railway signaling, provides a means for the more efficient handling of trains and the more economical utilization of existing trackage. It is in accord with the trend to more efficient transportation by greater utilization of existing operating units and facilities. In addition to cutting the direct costs of operating trains by reducing their time on the road, the system, where it defers the addition of trackage, cuts the indirect or fixed charges of producing transportation.

This system goes a step beyond any previous development in the railway signaling field in that it combines all the functions of control over traffic into one centralized unit, permitting train operation by signal indication without the use of written train orders. Protection, direction and the actual manipulation of switches and signals for the passing of trains are brought about by this system. It is adaptable to any existing signal installation and can be applied in combination with

any type of automatic signaling, train control, cab signaling or power interlocking installation. It may also be applied in connection with manual block signaling to handle special situations.

“Union” Centralized Traffic Control may be applied to double and multiple track lines as well as to single track lines. The centralized control features may be employed for the economical control of an interlocking or of a single outlying switch. The system may be applied to a short section with a particular operating problem or to a full division where the entire operation can be handled by signal indication. Consideration of this modern method of signaling will often reveal its economical application to operating situations of all kinds where more intensive use of tracks is required.

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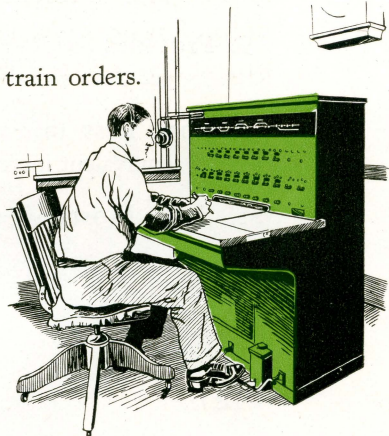
Advantages of the “Union” Centralized Traffic Control System

1. Increases

- (a) Net earnings.
- (b) Productive use of equipment.
- (c) Safety of train operation.
- (d) Track capacity.
- (e) Switch point protection.
- (f) Car miles per car day.
- (g) G. T. M. per train hour.

2. Reduces

- (a) Train delay.
- (b) Number of train stops.
- (c) Number of operators required.
- (d) Danger of misunderstanding of train orders.
- (e) Number of train orders.
- (f) Possibility of collisions.
- (g) Fuel consumption.
- (h) Train miles.



3. Provides

- (a) Prompt and correct automatic "OS"es.
- (b) Greater protection to work and extra trains.
- (c) Approach and section locking at each power-operated switch.
- (d) A model board which shows the operator the train movements over the entire controlled section.
- (e) The operator with instant information relative to trains holding to schedule or losing time.
- (f) The advantages of either-direction signaling.
- (g) Additional "OS"ing points.

4. Facilitates

- (a) Switching movements.
- (b) Meets on close schedule.
- (c) Handling of additional traffic.
- (d) Stopping trains in case of emergency.

5. Saves

- (a) Running time by transmitting orders by signal indications.
- (b) Stops or reduction in speed for delivery of train orders.
- (c) Necessity for additional trackage.
- (d) Locomotive hours.

6. **Is Universal in Application.** May control all signals and switches or a portion of them in a given territory, or simply the signals. Can be used on one or more tracks to speed up operation under a variety of conditions.

7. **Centralizes** control of train movements in charge of one instead of a group of operators.

8. **Transmits Orders Instantly** and directly by signal indication without requiring co-operation of second party.

9. **Provides Safety** by making it impossible for opposing trains to get clear signal for the same block.

10. **Costs Less** than any alternative capital improvement providing equivalent increase in capacity.

11. **Saves Most** train time per dollar of investment.

Extent of Application

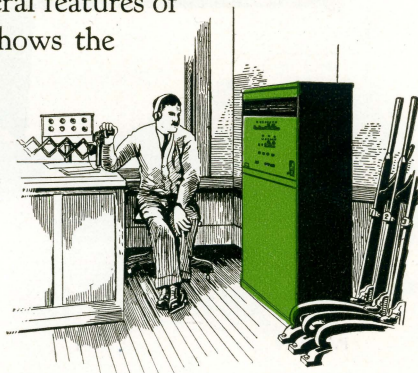
THAT THE "UNION" C. T. C. SYSTEM, because of its flexibility and adaptability to all operating conditions, has met with the favor of the railroads is evidenced by the number of installations now in service or under contract. The first extensive application of this system was only made on the Pere Marquette in 1928. Those installations in service, including the remote control applications, range in length from approximately 1 track mile to 100 or more track miles, and include from 1 to 55 controlled switches.

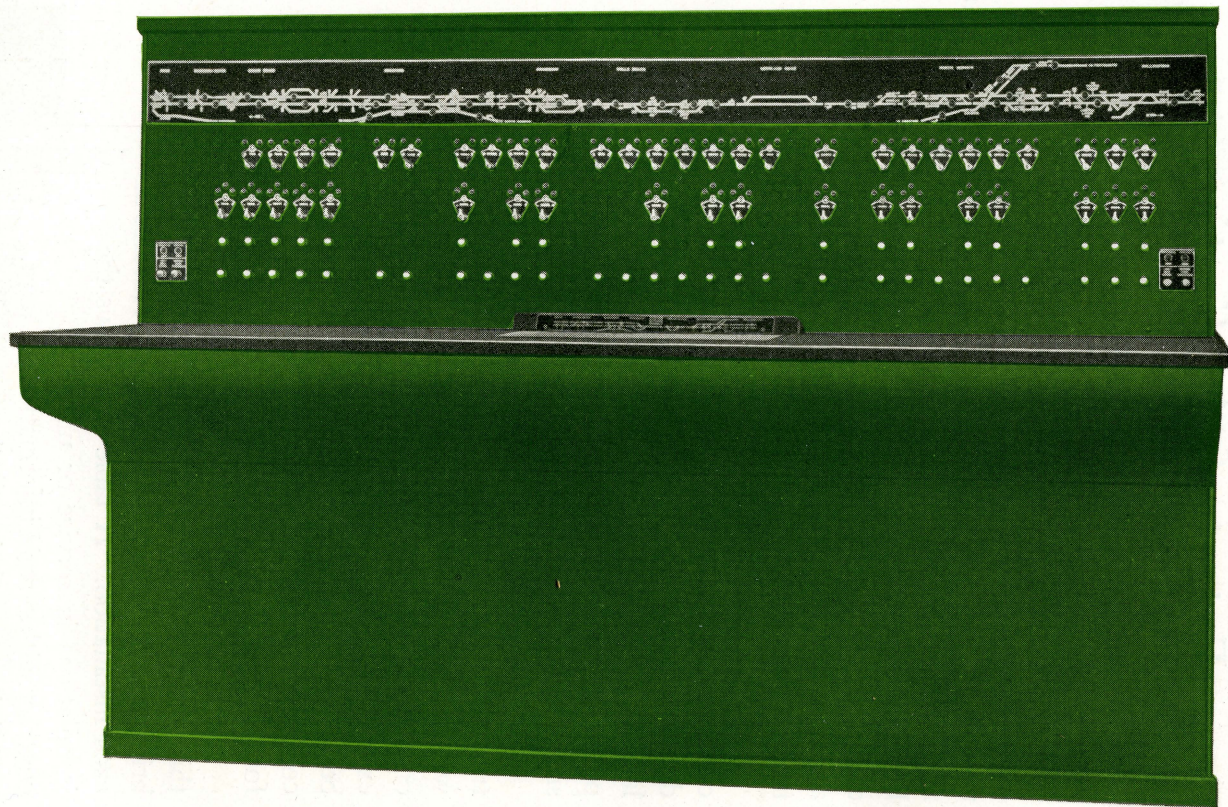
The remote control installations utilize the C. T. C. principle, in that but two or three line wires are required, thus dispensing with expensive pole-line construction. The installations permit additional controlled switches and signals to be placed in service at any time in the future without the necessity of stringing other line wires for their control.

The "Union" C. T. C. System is not only adapted to single track operation, but is proving its worth also in connection with multiple track operation where it is desired to run trains on either track in either direction by signal indication. An example of this type of installation is that under construction between Dover and Rigby on the Boston and Maine for the control of 35 miles of single track and 34 miles of double track for "either direction" operation.

Elsewhere in this bulletin are shown actual applications of this system for solving operating problems together with a brief description covering the general features of each installation. A table also shows the installations in service or under contract with certain information pertaining to each installation.

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The control machine may be located at any convenient place on the division.

Component Parts of the System

THE "UNION" C. T. C. SYSTEM combines the safety features of modern automatic signaling, either-direction signaling and power interlocking. Each end of each passing siding is, in fact, a small interlocking plant, remotely controlled from a designated point on the division. The signals between passing sidings operate automatically on the well-known A. P. B. principle whereby the block for opposing trains extends from passing siding to passing siding while permissive moves in the same traffic direction may be made.

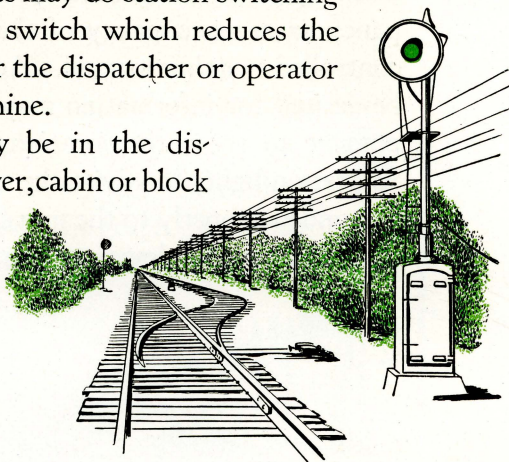
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The units making up the C. T. C. System are the control machine, the automatic train-graph, the controlled wayside signals, power-operated switch machines, and other signal apparatus.

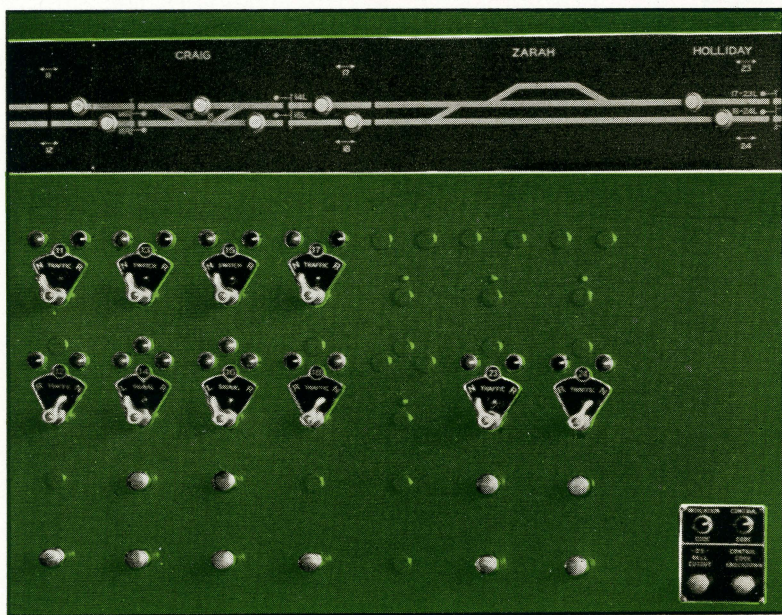
The power-operated wayside signals may be of any standard type in use on American railroads or the indications may be carried directly into the cab of the locomotive by use of the "Union" Continuously Controlled Cab Signal System.

The power-operated switch machines more often used are of the dual-control type which permit hand operation, as occasion requires. Switch machines may be electric (d. c. or a. c.) or electro-pneumatic, dual control being available for each type. Thus local freights may do station switching by manual operation of the switch which reduces the amount of work necessary for the dispatcher or operator in handling the control machine.

The control machine may be in the dispatcher's office or at some tower, cabin or block office on the division and it may be handled by the



dispatcher, an operator, leverman or designated employee working under instructions from the dispatcher. As the control machine provides for the housing of all code-sending



On the control machine is a miniature track layout of the district.

and receiving equipment at the control point, the space required is determined only by the size of the machine.

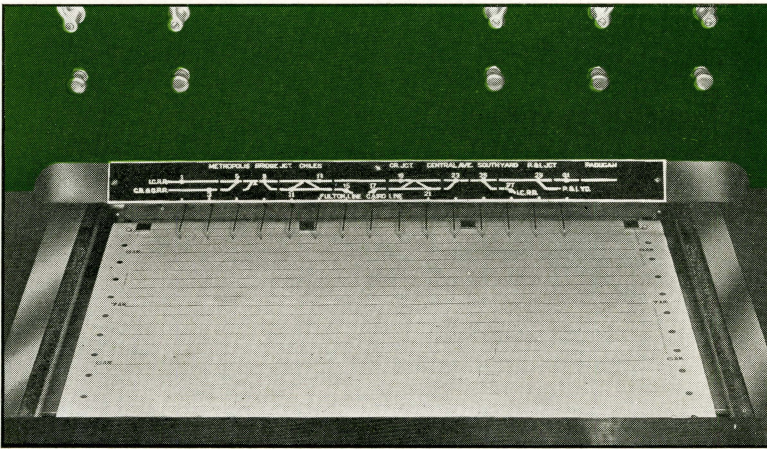
On the control machine before the operator, is a miniature track layout of the district. Colored lights indicate the occupancy or non-occupancy of the track circuit in which each controlled switch is located. Additional track circuits as may be desired for information may be indicated, thus making it possible to show the locations of trains between stations. Indication lights to advise the operator if the functions have responded properly to the movement of the levers are located directly above the levers on the control panel. These indica-

tion lights show at all times the locked position of the switches and whether the signals at the ends of passing sidings are in the clear or stop position.

The Automatic Train-Graph

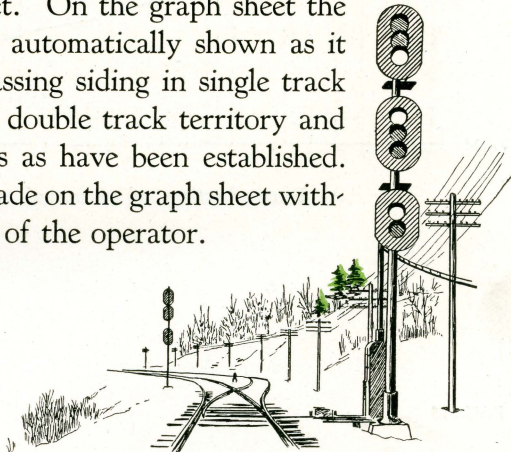
One of the important units entering into this system is the automatic train-graph which is part of the control machine,

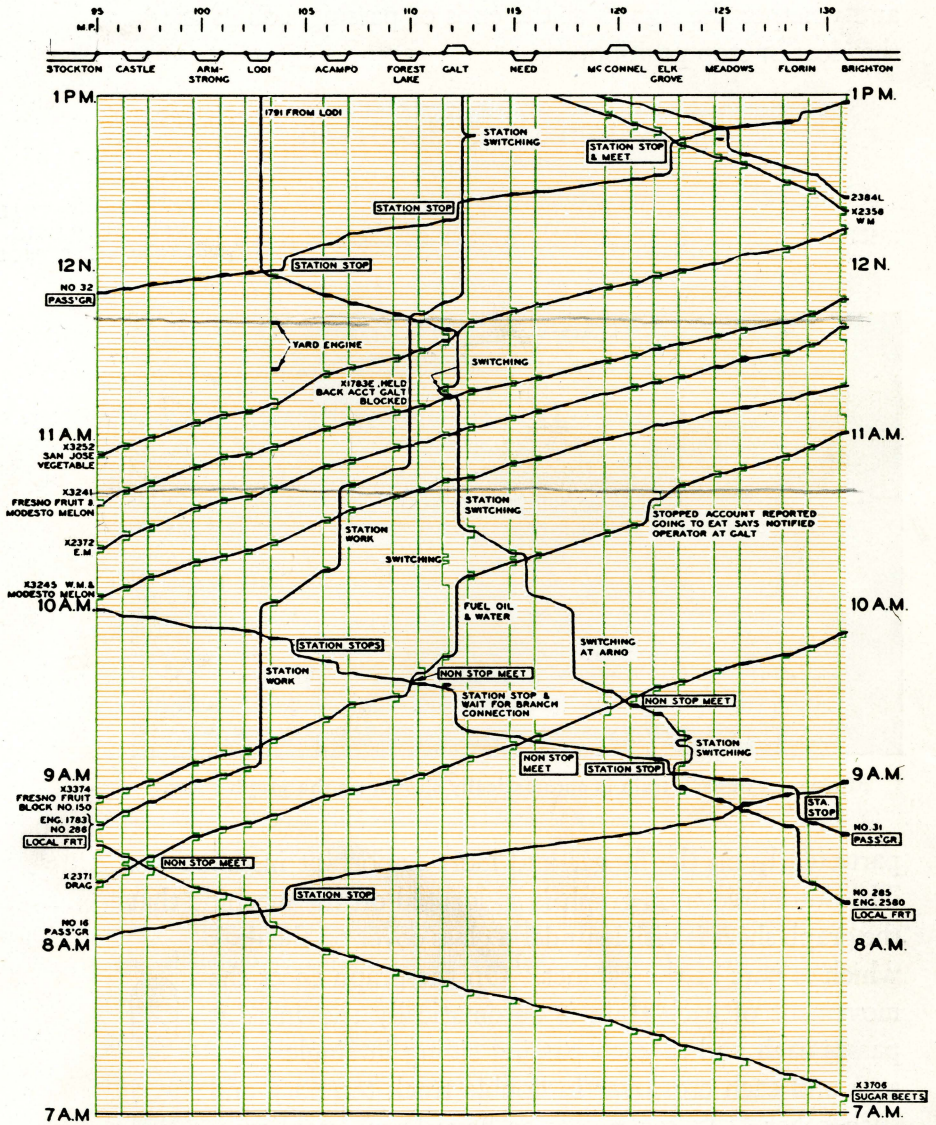
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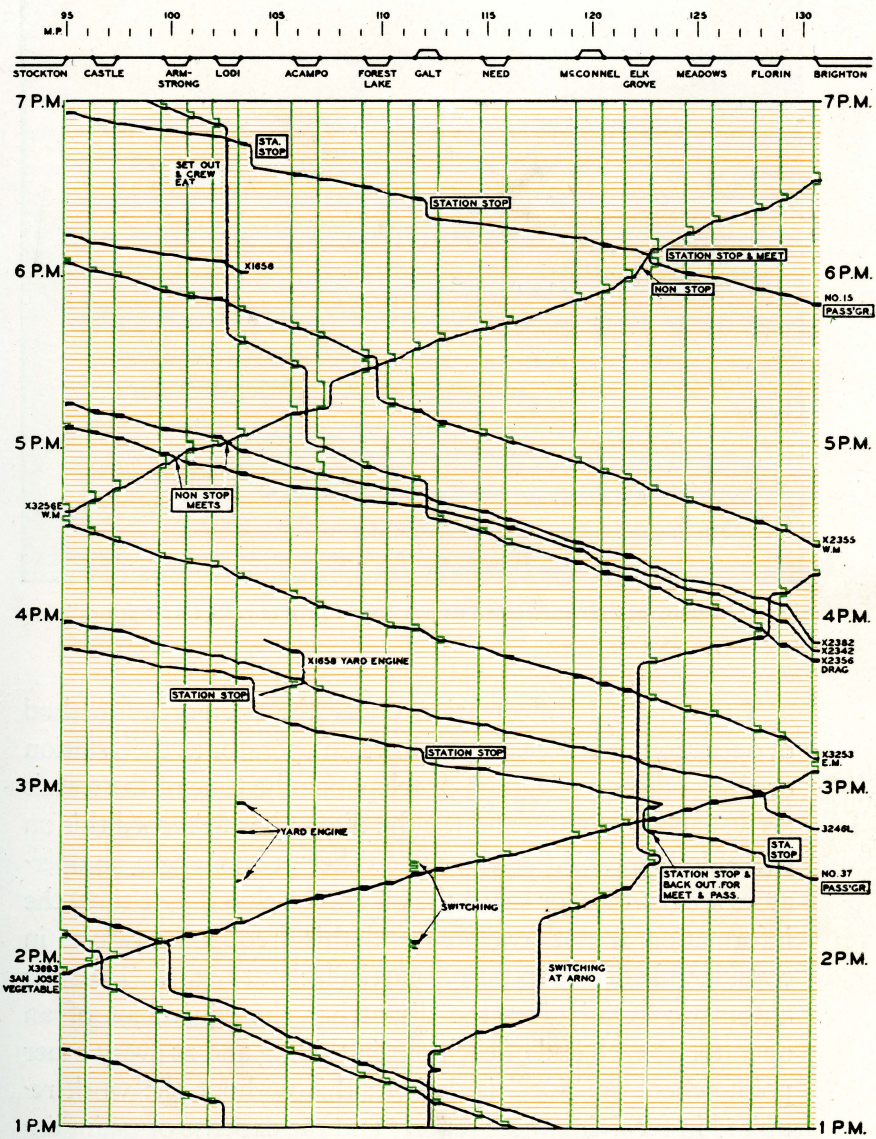
Movement of each train is automatically shown on the graph sheet.

particularly on the longer and more important installations. The automatic train-graph is so located on the machine that the graph sheet is visible under a glass cover on the desk which is part of the cabinet. On the graph sheet the movement of each train is automatically shown as it passes each end of each passing siding in single track area and each crossover in double track territory and such other "OS"ing points as have been established. This permanent record is made on the graph sheet without any action on the part of the operator.

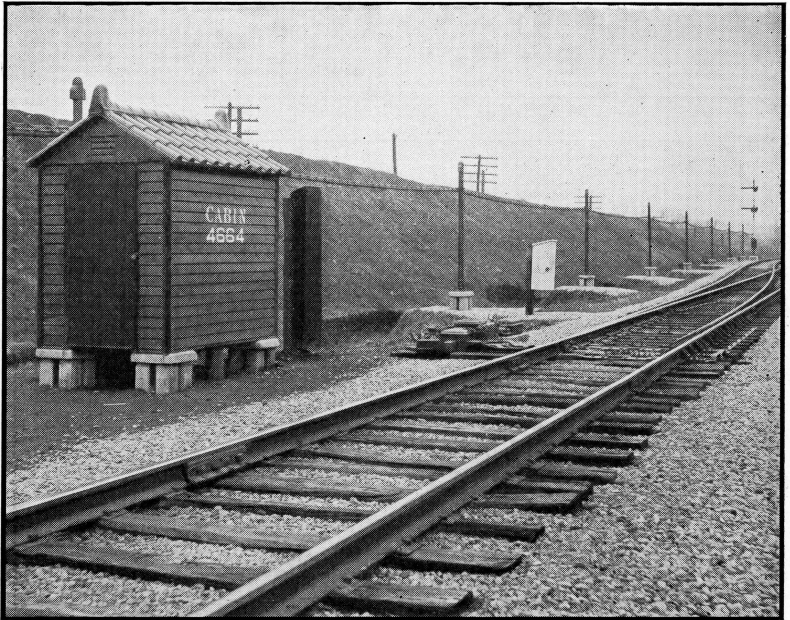




Reproduction of an actual train graph for a typical 12-hour



period on the Southern Pacific Stockton to Brighton installation.



The field equipment at end of passing siding is called a "station."

To secure this information under the train-order method of operation, it is necessary to have an operator at each station or block office to telegraph or telephone the time of the train's arrival and departure and for the dispatcher to record this on the train sheet. At stations and other points where no operators are on duty, or when the offices are closed part time, the information is not available and this frequently results in considerable delays to trains, particularly at night. Thus the automatic "OS" gives the dispatcher the equivalent of an operator at each end of each passing siding and at every other point where an "OS" is desired; this without the work required in receiving these reports and the expense of maintaining additional operators over the territory.

As the "OS"es are graphically recorded on the train-graph

sheet, the passage of trains over the territory is not only brought to the attention of the operator, but a permanent record is produced which may be attached to the daily train sheet. This record is made even though the operator momentarily may be otherwise engaged and it is only necessary for him to glance at the graph sheet which shows the location of all trains.

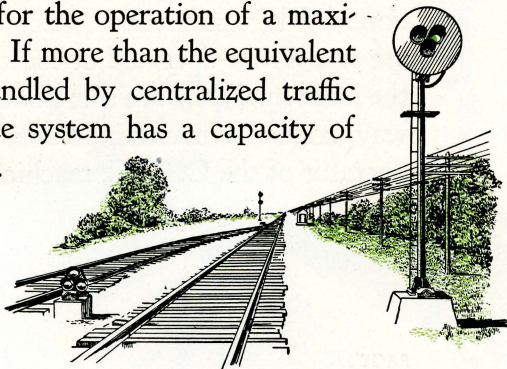
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The train-graph, together with the other indications, makes the system one which gives the dispatcher or operator an audible, visual and permanent record indication of the location and movement of trains. The visual indication is given by the lights on the control panel; the audible indication by a single stroke bell which may be used at the will of the man in charge of the control machine to call his attention to a particular train's arrival at a certain point.

The Code System is Rapid and Flexible

The control of wayside equipment throughout the territory is obtained by means of a coded relay scheme which is very rapid in operation. These codes are sent out from the control machine by pushing the starting button after the switch and signal levers have been moved to the desired position.

Through the employment of the code system, up to 35 stations can be controlled and indicated over 2 line wires; over 3 wires, as many as 81 stations can be so controlled. The term "station," as used herewith, represents the field equipment at one end of a passing siding; therefore, for one passing siding there are two field stations. Consequently, the two-wire code system provides for the operation of a maximum of 17 passing sidings. If more than the equivalent of 17 sidings are to be handled by centralized traffic control, the three-wire code system has a capacity of more than 40 passing sidings.





Main line switches, not power-operated, are sometimes electrically locked.

By using the "Union" two or three-wire code system it is possible to locate the control machine at one end of the controlled territory, near the center, or miles away. It is thus apparent that the code system is very flexible.

The code equipment for a controlled switch location will operate all functions normally operated by one switch lever, including both ends of a crossover or a switch and derail.

It is not always advisable or necessary, from an operating standpoint, to equip all main line switches for power operation. When main line switches in the controlled territory are not power-operated at locations where trains may clear the main line, they are sometimes electrically locked. In this way, control is maintained over the use of the switch by the operator of the C. T. C. machine.

Reliability of Operation

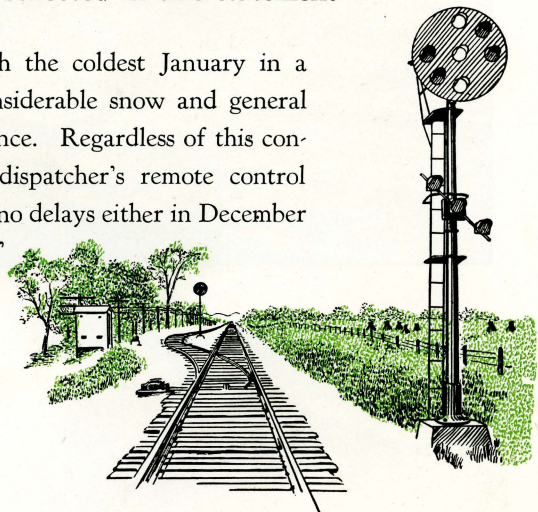
THE QUESTION is frequently asked as to the effects of snow, sleet and other adverse weather conditions upon the operation of the power-operated switches and signals at isolated locations many miles from the point of control.

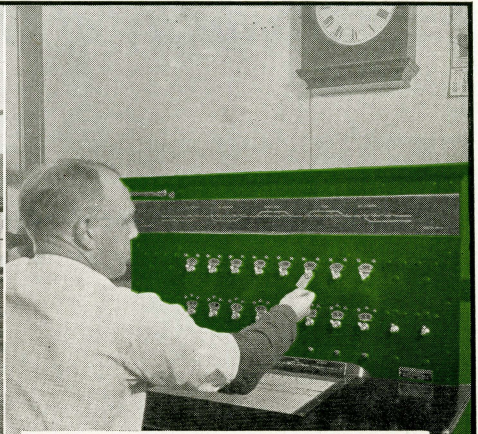
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During snow or sleet storms or at times when rain freezes as it falls, the dispatcher or operator will manipulate his switch levers frequently enough to prevent the switch points freezing up or becoming clogged with snow. In the event of a switch being obstructed by snow, sleet or ice the dispatcher can, by stopping the train, instruct the train crew to enter siding and to sweep out the switch if necessary, after which it may be power-operated. Through the use of the dual-control power-operated switch machine it is a simple matter for the train crew to hand-operate the switch, as it is easily moved by means of the lever for hand operation. The weather conditions mentioned would not interfere with the operation of the signals, the only possibility of delay being in the obstruction of the switch. It might sometimes be desirable to have extra attention given to cleaning out certain switches by track maintenance forces.

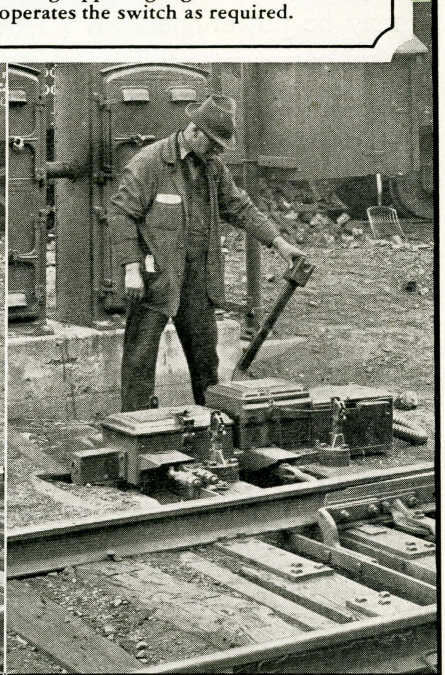
An evidence of the excellent performance of power-operated switch machines is reflected in this statement of a railroad officer:

"We have just passed through the coldest January in a number of years, along with considerable snow and general bad weather for proper maintenance. Regardless of this condition the performance of the dispatcher's remote control equipment was perfect. We had no delays either in December or January due to the equipment."





To hand-operate switch, trainman calls operator for authority. When granted, operator places tag on switch lever. Trainman then throws selector lever setting opposing signals red and hand-operates the switch as required.



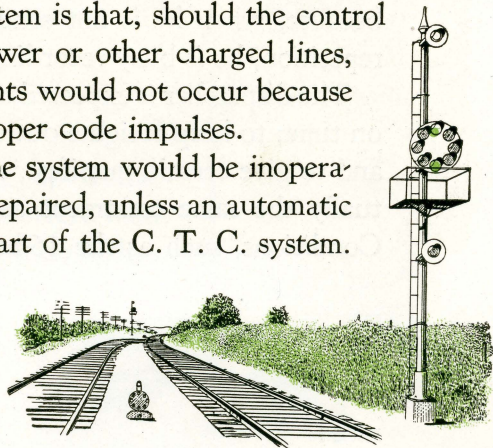


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Adverse weather conditions do not interfere with proper operation.

Another question which frequently arises is, "What happens should a cross occur between the two or three wires used throughout the territory for the control of the equipment?" A cross on the control wires would make inoperative the stations located beyond the cross, but the operator would have control and could operate the stations from his machine up to the station nearest the cross. An additional safety feature of the "Union" C. T. C. System is that, should the control lines become crossed with power or other charged lines, false signal or switch movements would not occur because they respond only to their proper code impulses.

Should a line wire break, the system would be inoperative until after the break was repaired, unless an automatic feature was incorporated as part of the C. T. C. system.



C. T. C. Helps Solve Superintendent's Problems

ONE OF THE PROBLEMS confronting the superintendent is to get trains over the division in the shortest time without undue and unnecessary delay. He is striving constantly to lower his division operating costs because, in so doing, he is providing better service for his patrons, the shippers, and he is also helping to lower the operating ratio for the railroad.

Many costly delays arise through the use of the written train-order system because of the time consumed in calling operators, repeating, checking and completing orders. Their delivery to trains necessarily slows down or stops the trains to obtain information for them to proceed. Before these orders may be issued, it is necessary that meets be arranged considerably in advance of the time the meets are actually made and conditions may change whereby the superior train may fail to make its schedule, thus necessitating a complete realignment of orders or costly delay to the other train.

Delays to trains are more frequent in territory where telegraph offices are far apart and additional delays occur through errors and tardiness in the "OS"ing of trains. When many trains are on the road, the dispatcher has no idle moments because, when he is not sending orders and checking their repetition, he is busy recording "OS" reports on train sheet.

The dispatcher is expected to keep passenger trains running on time; to keep freights out of the way of passenger trains; and to give certain manifest, symbol or "red ball" trains virtually the same treatment as is accorded passenger trains. Conditions, such as the 16-hour law, the livestock confine-

ment law, and many other requirements of state and national regulatory bodies must engage his attention.

Train dispatching has developed from the time, after the telegraph was invented, when conductors on trains would arrange their own meets, until the time when train orders were handled from division points—the orders being sent by the superintendent or his chief clerk, acting in his absence, to the time when train dispatchers were appointed to issue all orders for the operation of trains. As traffic continued to increase and it was necessary to promote greater economies, more and heavier burdens were placed upon the dispatcher until, to meet these conditions and simplify the work, the “Union” C. T. C. System was developed.

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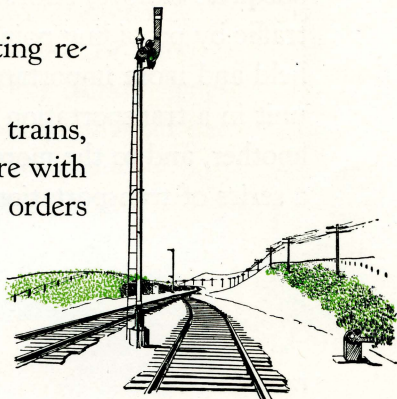
Centralized Traffic Control eliminates much of the “red tape” from train dispatching and makes it possible for the dispatcher to confine his attentions to the actual arrangement of meeting or passing points. Automatic “OS” reports, as produced by the “Union” C. T. C. System, are always accurate and are not subject to the time interval in their reception.

Eliminating Delays at Yards

Substantial delays to trains getting out of the yards are due to train-order requirements and could be eliminated by the movement of trains by signal indication. Delay at yards may generally be classified under two heads:

1. Those incident to yard operation and the classification and making-up of trains.
2. Those incident to road operating requirements.

Yard delays due to making up trains, inspection, etc., are bound to interfere with dispatching trains by means of train orders



which must be placed for trains in advance of the action required of them. The "Union" C. T. C. System makes it possible to move opposing trains without dependence upon the estimates of yard forces which cannot, by the very nature of yard operation, always be accurate.

Under a system of operation using "Union" C. T. C., the dispatcher could always operate his district without delay, with respect to those trains within the territory and ready to enter it, rather than being hampered by consideration of trains called out of a terminal which may or may not be ready. The flexibility of Centralized Traffic Control makes it possible to keep the *maximum number of trains in motion at all times* and permits the dispatcher to transmit orders by signal indication *at the time they are to be executed* rather than in anticipation of a series of events which are problematical.

With the "Union" C. T. C. System to aid the dispatcher he is able to take immediate action, in the event of unforeseen contingencies, to keep traffic in motion and to secure the maximum utilization of his trackage with minimum delay and the least confusion.

The capacity of the line is dependent not only upon the line itself but also upon the yards through which the traffic must pass. The capacity of existing yard facilities and sidings along the line should be such as to permit a greater use of "fleet dispatching" and reduce the number of meets to a minimum. The use of a "Union" C. T. C. System, with adequate sidings, affords a means of regulating the flow of traffic by providing points where less important trains can be held and more important ones run around them. Thus one unit in a transportation machine may work to the benefit of another, and to the more efficient handling of traffic through a series of transportation facilities.

Expediting Traffic

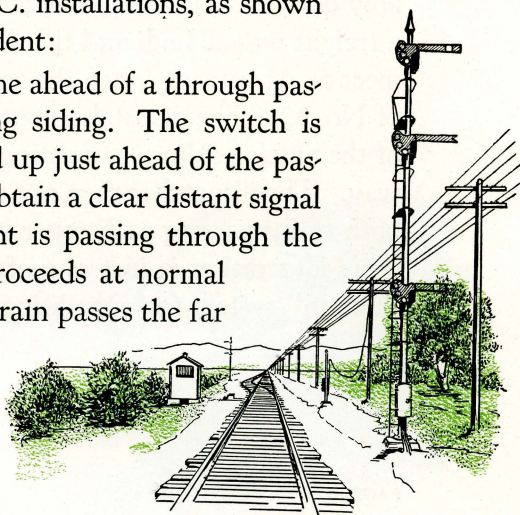
TRAFFIC IS EXPEDITED by the "Union" C. T. C. System because all trains are moved by signal indication, regardless of time-table superiority. No delays occur awaiting the transmission and delivery of train orders at stations along the line. The movement of through trains is expedited by the elimination of train orders and local trains can spend a larger portion of their time in productive work.

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The dispatcher is not concerned with trains which are to leave terminals until they are actually ready to depart. Under normal train-order operation, where there are only a few operators on the territory, the effect of trains in yards has to be considered if the dispatcher does not desire to slow up opposing moves.

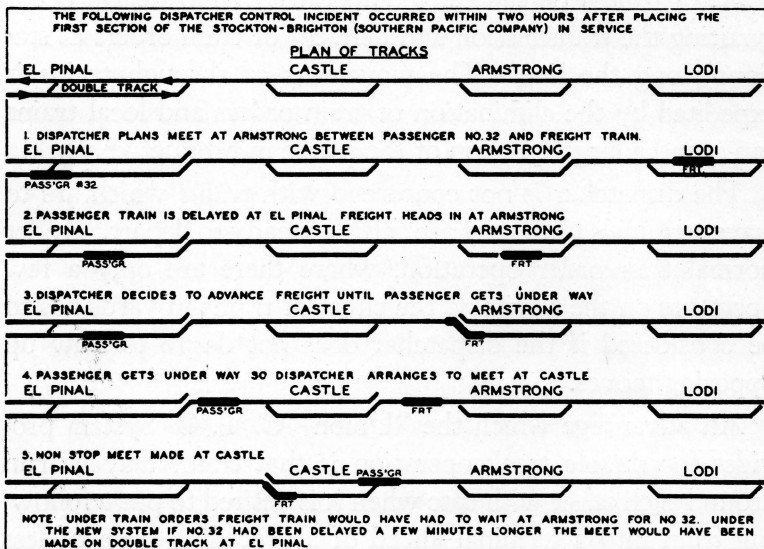
An advantage which the "Union" C. T. C. System provides for double track operation is that trains may be run around each other with ease when it is desired to put a following train into a terminal ahead of a preceding train of less importance. These orders can be given and the switches operated without relying upon any other means of communication than the switch and signal levers on the control machine. The ease with which this can be done is frequently evidenced on existing C. T. C. installations, as shown by the following typical incident:

A freight train on short time ahead of a through passenger train, enters a passing siding. The switch is placed normal, signals cleared up just ahead of the passenger train in time for it to obtain a clear distant signal indication. While the freight is passing through the siding the passenger train proceeds at normal speed. After the passenger train passes the far



end of the siding, the switch is reversed for the freight to continue on its way. Neither train has been stopped.

A very striking feature of how a "line-up" may be shifted to prevent delays to trains is illustrated in the accompanying diagram. Just two hours after four stations on the Southern



Ability to change "line-up" instantly prevents train delays.

Pacific, Stockton to Brighton installation were placed in service, passenger train No. 32, having left El Pinal, was unavoidably delayed near the end of double track. In the meantime, a freight was at Lodi and the dispatcher planned to make the meet at Armstrong when the report reached him of the delay of No. 32. The dispatcher immediately lined up the exit end of the passing siding, permitting the freight to continue on its way. The dispatcher then put the freight in on Castle siding, both trains passing each other without either having to stop. This illustration is just one of the many advantages of the "Union" system for expediting traffic.

Economic Advantages

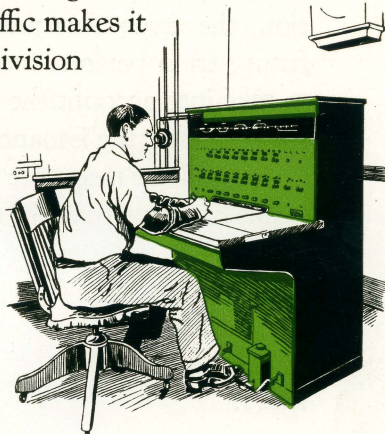
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CONTROL

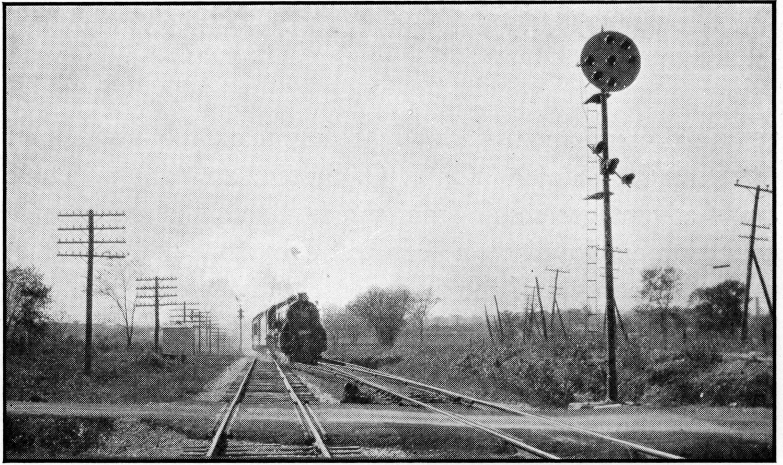
ECONOMIC ADVANTAGES resulting from the installation of the "Union" C. T. C. System are many. These advantages result from the fact that the methods of operation employed have been tested by time and have met with the approval of the most conservative railroad officers. The advantages may be classified under two general heads:

1. The conservation of capital by providing increased capacity of existing facilities at a much lower cost than by any other improvement.
2. The reduction of operating expenses by providing for greater efficiency in the movement of trains; by reducing the number of train hours and by the elimination of train stops to take sidings or receive train orders.

Among operating expenses, the savings will be greatest in the individual items which go to make up the direct cost of running trains, such as overtime wages, fuel, the wages of telegraph operators and the expense of maintaining the telegraph and block stations; but there will also be a great many other operating accounts in which savings will be brought about by greater operating efficiency.

The saving in equipment costs as reflected by reduction of per diem charges and the release of equipment for a new tour of productivity is important although, in absolute amount, ordinarily it does not compare with the wage and fuel savings. The speeding up of traffic makes it possible to move the tonnage of the division with fewer locomotives and brings about a saving in locomotive costs, because the released power ordinarily can be used at other points on the





Train stops for throwing switches are eliminated.

railroad. The purchase of new cars also can be deferred because of the increased availability of existing locomotives for service. On some installations it has been found possible to increase train loads because of the fact that trains can be run into sidings without stopping.

Among the specific economic advantages of the "Union" C. T. C. System may be mentioned:

1. Delays Are Reduced.

Under the C. T. C. System the dispatcher can operate from minute to minute instead of from hour to hour because no time is required to change the line-up when it becomes necessary to do so. Under the train-order method of operation, the dispatcher must base his estimates of meets upon future train performance. This makes it necessary for him to take into account the train movements to be made an hour or more after the issuance of an order. Should these superior trains fail to meet the expected performance, the inferior trains frequently will be tied up because the train-order system

requires so much time in the transmission of orders that it is not always possible to afford relief to them by new orders.

Railroad officers in all departments are giving greater attention to the cost of train delay and are realizing more and more that the elimination of unproductive train hours and train stops means dollars in the treasury of the carrier. The money value of a saved train hour will vary with conditions on each road, but in a number of cases has ranged from \$15.00 to \$20.00. Where competitive conditions are severe a train hour saved may be worth much more. Where a road is near its margin of capacity, the saving of a number of train hours each day will be of even greater importance.

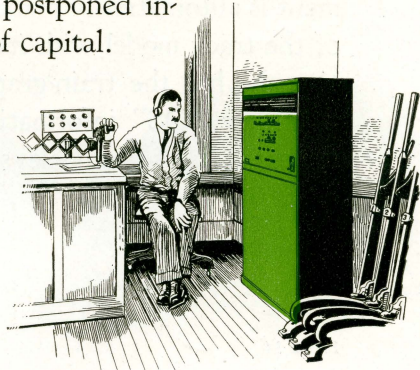
CENTRALIZED
TRAFFIC
CONTROL

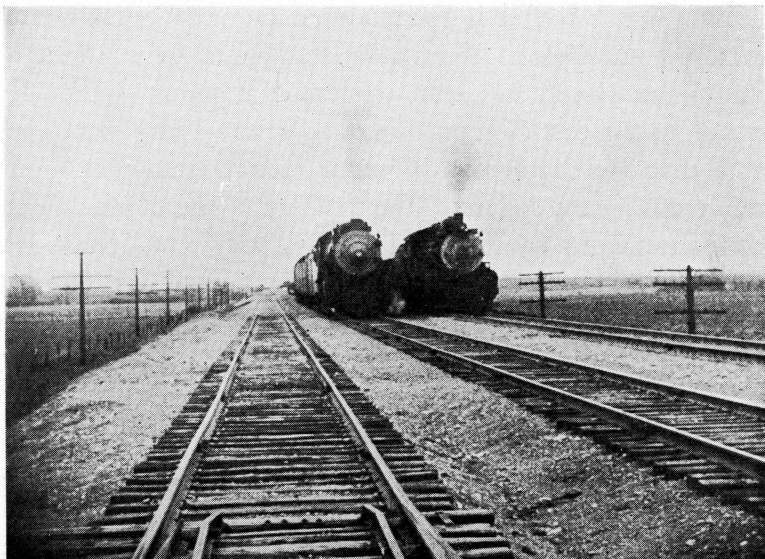
Slow-downs and stops are eliminated and trains are kept moving when they are directed by signal indication instead of by train orders. Train stops for throwing switches are also eliminated because the power-operated switches keep the trains moving. The train stop saved has a wide range of values depending on the length and tonnage of the typical train involved and the characteristics of profile on the road. This value for a typical freight train stop may range from \$1.00 to \$3.00 or more.

2. Track Capacity Is Increased.

Train operation over a division is much smoother when trains can be kept moving. Trains are kept moving by the "Union" C. T. C. System because delays are reduced and track capacity is increased. Because the track capacity is increased on single track lines, double tracking, which is often prohibitive in cost, is frequently postponed indefinitely with a resultant saving of capital.

By the application of this system for either-direction operation on multiple tracks, the track capacity





“Union” C. T. C. provides either-direction operation on multiple tracks.

is increased materially or to such an extent that the construction of additional main tracks often can be postponed.

3. Increase in Safety.

The facilities provided by the “Union” C. T. C. System greatly reduce operating hazards. The operating facilities include dispatcher or operator control of the signals in use at points where it is necessary to direct train movements such as at passing sidings, switches, ends of double track, cross-overs, junctions, etc. The same man also has control of the power-operated switches in the territory. The train movement is automatically made visible for the operator by means of the track model with its colored indications, and, in addition, he has the train-graph which automatically gives the necessary “OS” information for each train. Because this system reduces train delays and trains are kept moving, safety

is increased. It has well been said that "a standing train is a liability."

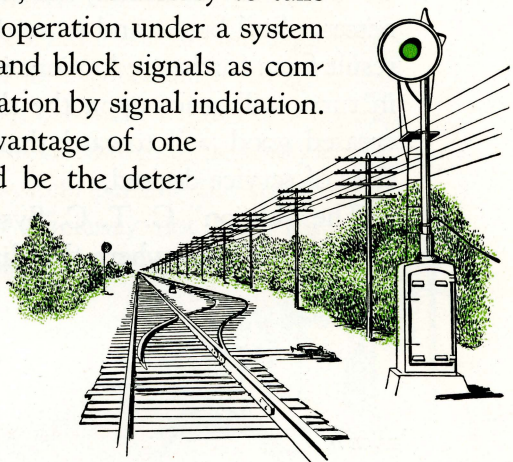
4. Freight Train Operating Costs Are Reduced.

Whenever the operating costs are unduly high on a portion of railroad, even though no serious consideration of additional tracks is involved, it will pay to investigate the running of trains by signal indication and operating siding switches by the "Union" C. T. C. System. The savings in direct operating costs alone will ordinarily make the installation financially desirable. By reducing freight train delays through the elimination of unnecessary stops, the average speed of trains between terminals is increased without increasing the speed while in motion. This increase in average speed decreases train hours, crew overtime and fuel and also increases track capacity.

A decrease in the train hours increases the efficiency of a transportation system because less labor and fewer cars and locomotives will be required to produce a given output of ton-miles. Through the increased track capacity afforded, the need for additional main track may be postponed indefinitely as is shown by records of many C. T. C. installations at present in service; thus heavy expenditures for additional main tracks are postponed, effecting large savings in operating, maintenance and interest charges.

In order to determine what particular system of operation is best adapted to a road's use, it is necessary to take into account the cost of train operation under a system of time-table, written orders and block signals as compared to the cost of train operation by signal indication. Therefore, the economic advantage of one system over the other should be the determining factor as to the system to be used and the cost

**CENTRALIZED
TRAFFIC
CONTROL**





Modern signaling makes possible large improvement in freight service.

of the installation must be balanced against the estimated saving.

Modern signaling has been largely instrumental in bringing about large improvement in freight service. The shipping public has quickly noted this improved operating condition and accordingly has taken advantage of it to reduce the amount of stock formerly maintained for their restrictive businesses. Still better and more dependable freight service will result from further reductions in avoidable train delays. This, in turn, will react upon the shipping public in building increased good will toward that railroad which supplies the class of service desired.

The "Union" C. T. C. System is not only applicable to single track lines where the elimination of the written train

order is a great factor in the promotion of operating efficiency, but is applicable as well to double or multiple track layouts where greater capacity of line can be secured by operating trains against the normal current of traffic by signal indication. The advantages of the system, particularly as it is applicable to double track situations in the immediate vicinity of terminals, has attracted some consideration. Some of the reasons for installing C. T. C. on double track lines are:

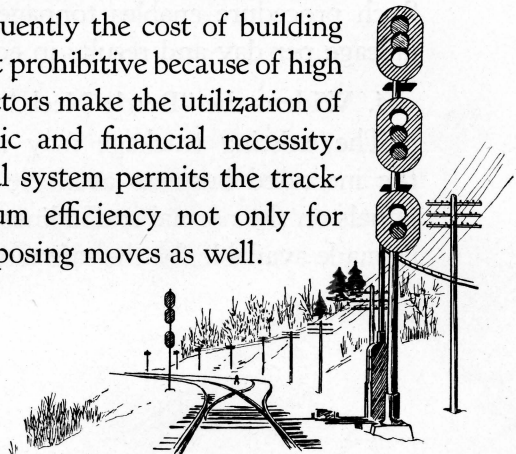
**CENTRALIZED
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1. Directional Peak Traffic—Double Track.

Because of the fleeting of trains from terminal territory after business hours, there is a heavy volume of traffic in one direction during a portion of the day which can be expeditiously handled on existing tracks, provided they are made available for safe train operation. The cost of providing the new signaling and necessary crossover facilities is nominal compared to the cost of building additional tracks and other facilities. This method of operation permits the handling of freight trains at a time when the passenger movement in the same direction is heavy and the movement on the opposite track light.

2. Heavy Traffic in Terminal Zones.

The growth of industries and suburban passenger business in some localities has greatly increased the number of trains required for the movement of passengers and freight. The existing trackage cannot handle this increase without serious delays and frequently the cost of building additional trackage is almost prohibitive because of high property values. These factors make the utilization of existing tracks an economic and financial necessity. An extremely flexible signal system permits the trackage to be used at maximum efficiency not only for following moves but for opposing moves as well.





Heavy traffic in terminal zones requires flexible and safe operation.

3. Keeps Tonnage Freight Moving.

With the advent of longer and heavier freight trains with heavier power, it becomes all the more essential to keep these trains in motion whenever possible. Lighter freight trains and even passenger trains can be routed around the slow tonnage train on other tracks which are not in use for the normal direction of traffic, in that particular territory. Such procedure enables tonnage freight to make increased mileage per day and results in economy of train operation.

4. Widens the "Bottle Neck."

The existing trackage may not be sufficient to handle the increased business available from certain yards or terminals on the normal traffic lines. The present trackage can be made available for the safe movement of this new business

in a much shorter period of time without as large a capital expenditure as would be required to build new track facilities.

5. Emergency Detours.

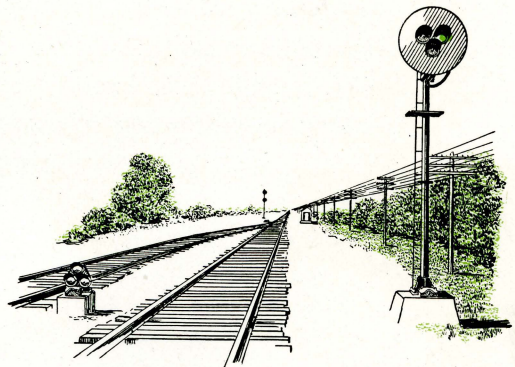
During emergency conditions, such as wrecks, etc., the ability to use one or more tracks at will, by simply giving the proper signal indications, is an important factor in reducing traffic delays.

6. Speed Factor in Competition.

Competition among the railroads has resulted in improved passenger and freight service which has overtaxed the older track facilities with train order operation and made it necessary to utilize the existing trackage to its capacity in the most economical manner. Modern signaling plays a big part not only in reducing operating costs but in expediting fast competitive traffic.

Economic studies of the performance of C. T. C. installations on various railroads show estimated annual returns upon the investment, above interest and maintenance charges, which in some cases exceed 50 per cent, with traffic varying from 15 to 46 trains a day. The time saved per freight train on some installations is averaging about one minute per mile of signaled territory.

CENTRALIZED
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Installations that Promote Economies

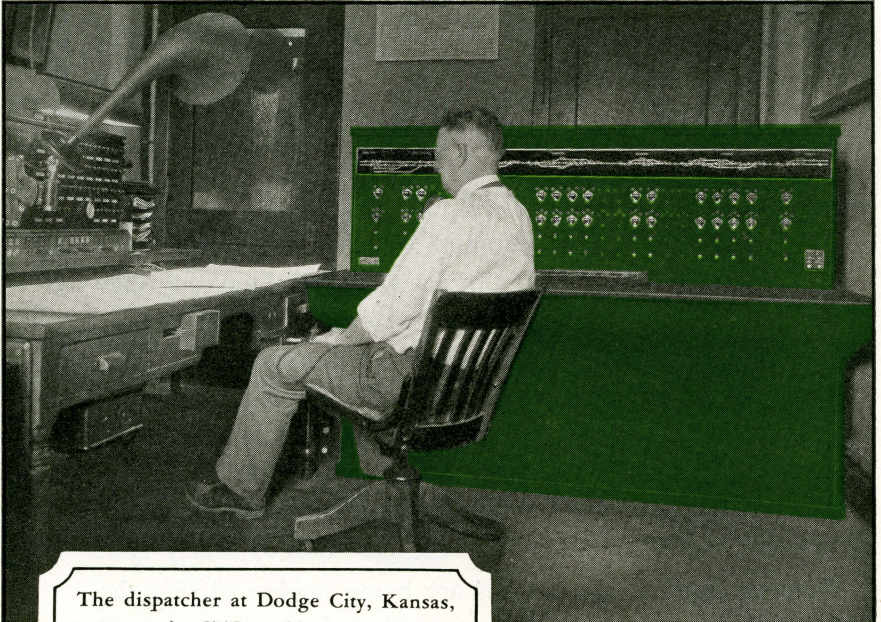
THAT the "Union" C. T. C. System, because of its flexibility and adaptability to all sorts of operating conditions, has met with the favor of American railroads is evidenced by the number of installations in service or under contract. The first extensive application of this system was made on the Pere Marquette Railway in 1928. The fact that a number of railroads have made several installations to handle a variety of operating problems is a testimonial to the effectiveness of this type of operation. Installations in service range from a few miles to nearly 100.

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Remote control installations are being made utilizing the C. T. C. principle in that but two or three line wires are used for the operation of functions requiring a much larger number under previous remote control practice. These eliminate expensive pole line construction and maintenance and permit the placing in service of intermediate units without the necessity of stringing additional line wires for their operation.

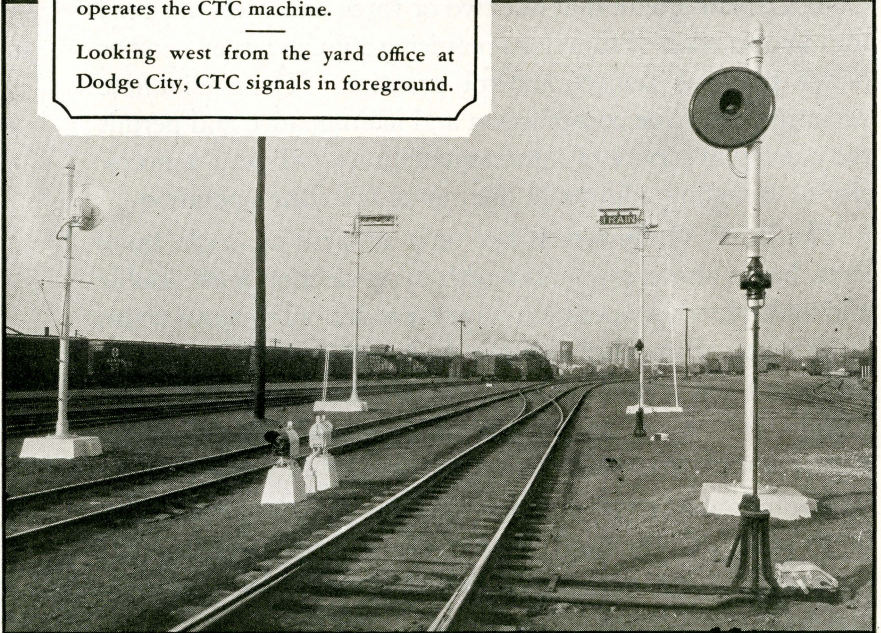
The C. T. C. System is not only adapted to single track lines, but is also proving its worth in connection with double and multiple track operation where it is desired to move trains on either track in either direction by signal indication. Applications of the system have been made to relieve traffic congestion and to promote operating economies under many varied conditions and with many varieties of track layouts.

The following pages describe a number of these installations of "Union" Centralized Traffic Control and indicate the versatility of the system as a means of promoting efficiency and economy in railway operation.



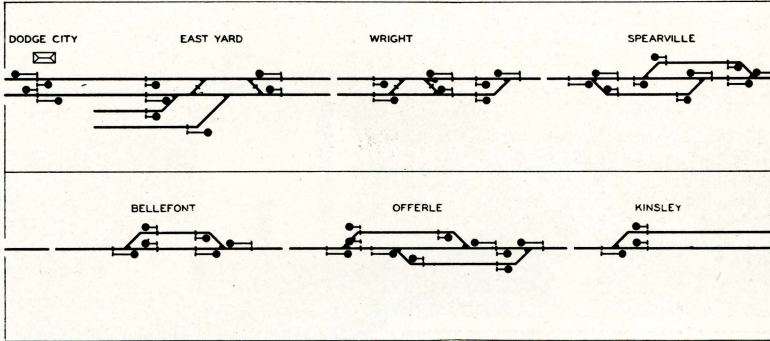
The dispatcher at Dodge City, Kansas,
operates the CTC machine.

Looking west from the yard office at
Dodge City, CTC signals in foreground.



Dodge City to Kinsley

A. T. & S. F.

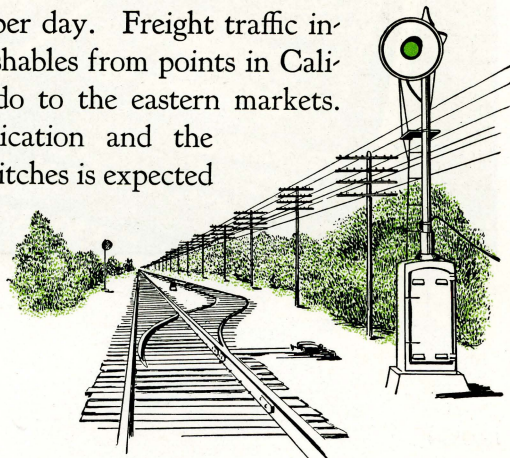


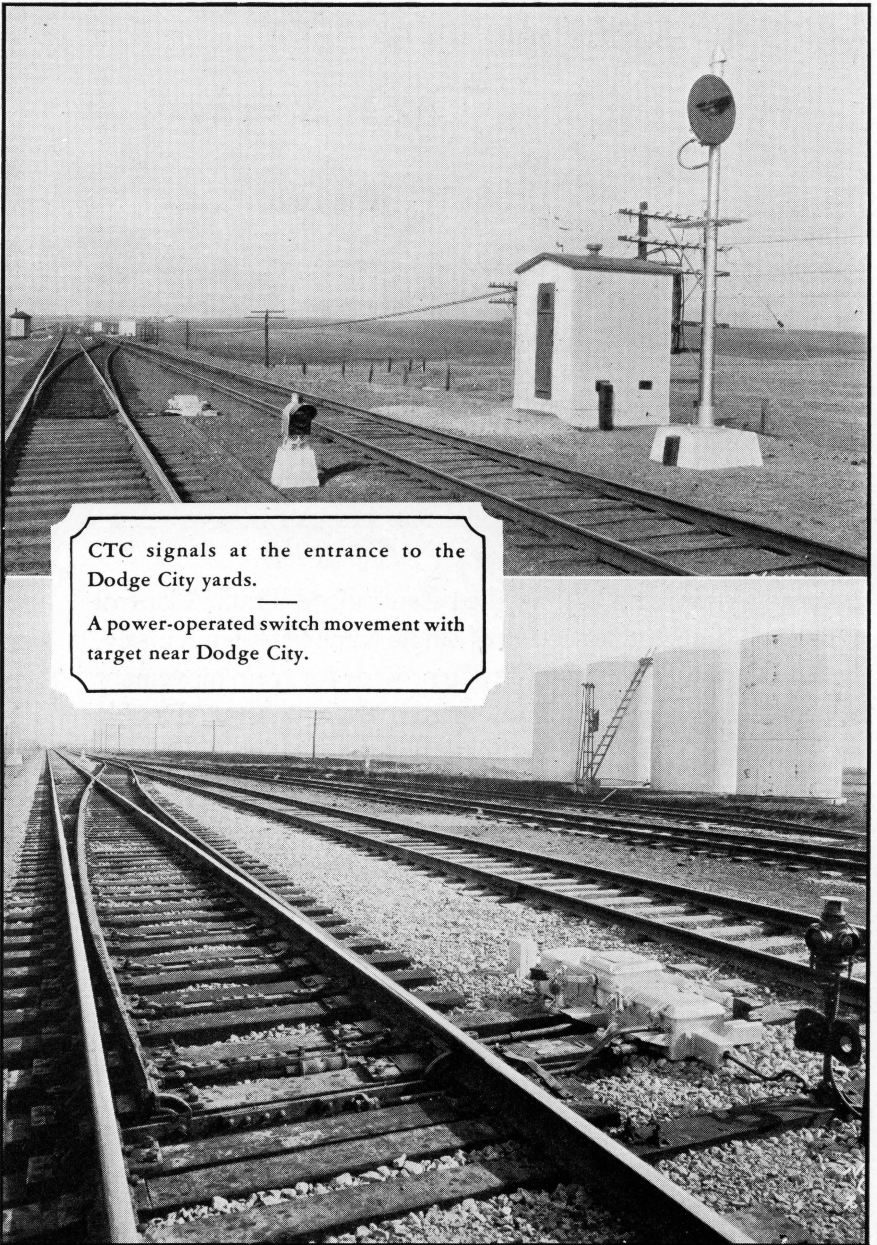
CENTRALIZED
TRAFFIC
CONTROL

THE SANTA FE has installed Centralized Traffic Control on the 22-mile section of single track between Kinsley, Kansas and Dodge City to provide for train movement by signal indication without written train orders. Double track portions of the territory on the Dodge City end have been equipped for either-direction operation by signal indication.

This section handles all the high class California and Colorado passenger trains, as well as a heavy freight movement from both points which becomes extremely heavy during certain seasons of the year. There are from 14 to 20 regular passenger schedules per day. Freight traffic includes the movement of perishables from points in California, Arizona and Colorado to the eastern markets.

Operation by signal indication and the power operation of siding switches is expected to afford a greater flexibility of train movement.



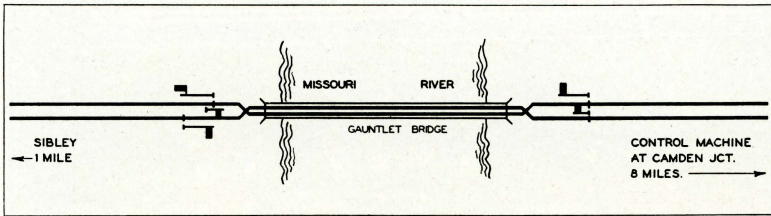


CTC signals at the entrance to the Dodge City yards.

A power-operated switch movement with target near Dodge City.

Sibley to Camden Junction

A. T. & S. F.

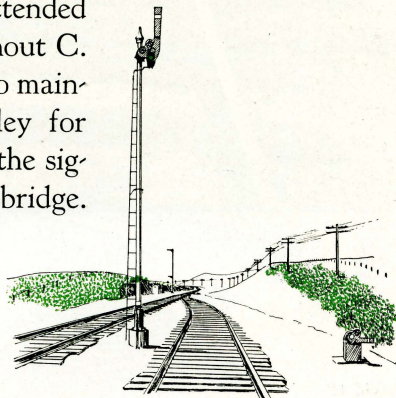


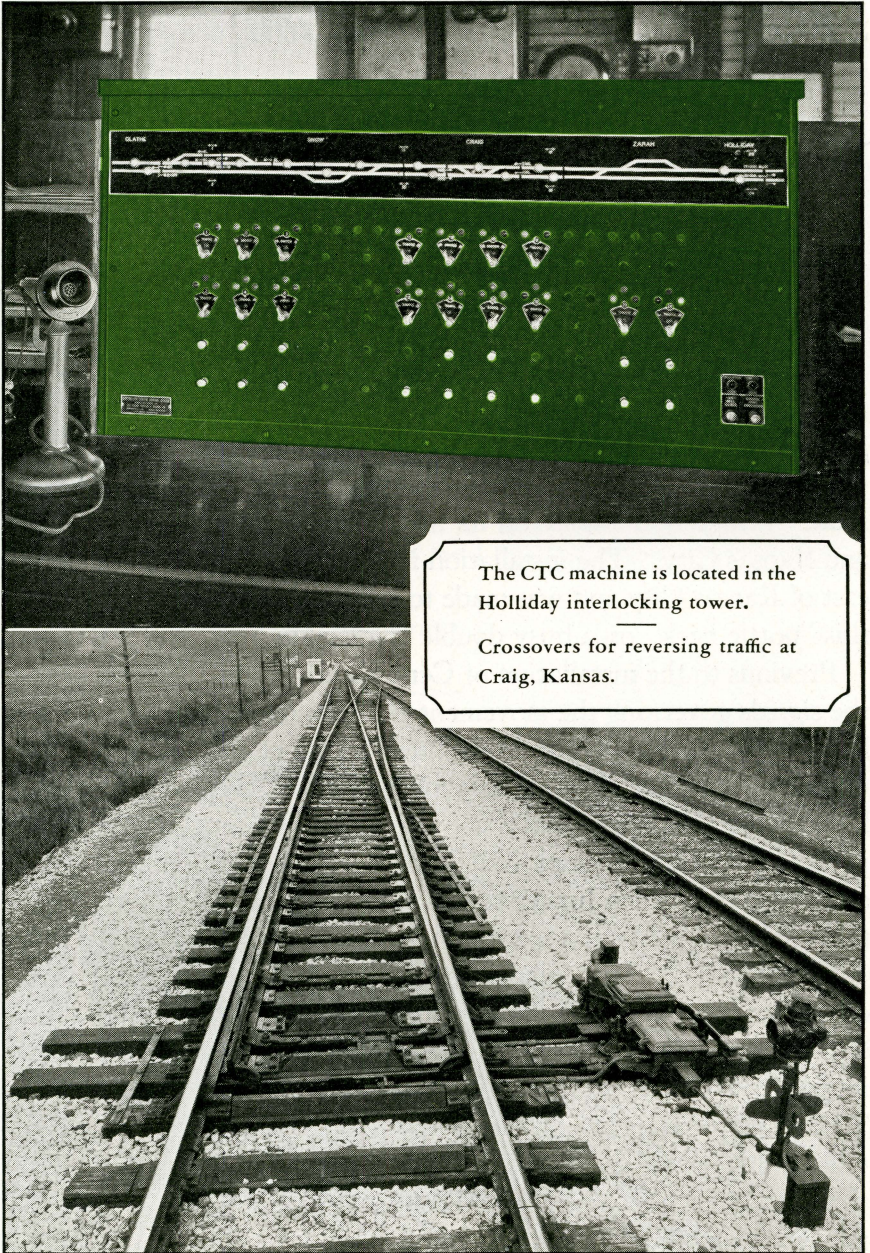
CENTRALIZED
TRAFFIC
CONTROL

THE SANTA FE has installed "Union" Centralized Traffic Control on the gauntlet track over the Missouri River bridge near Sibley on its main line between Chicago and Kansas City. The installation is approximately 25 miles east of Kansas City and was made to facilitate operation over this "bottle neck" on a busy double track main line.

Previous to the installation of Centralized Traffic Control, the signals governing the movement of trains over this gauntlet track were controlled from the interlocking plant at Sibley. Owing to the fact that the other functions of Sibley interlocking did not warrant the continued maintenance of the plant, C. T. C. was employed for the control of the bridge signals from Camden Junction, which is a busy junction with the Wabash Railroad, approximately 8 miles east of Sibley.

In this case, C. T. C. made possible the economical remote control of interlocking functions and the performance of the work, previously requiring two attended interlockings, from one plant. Without C. T. C. it would have been necessary to maintain and operate the plant at Sibley for three tricks each day for control of the signals governing movements over the bridge.

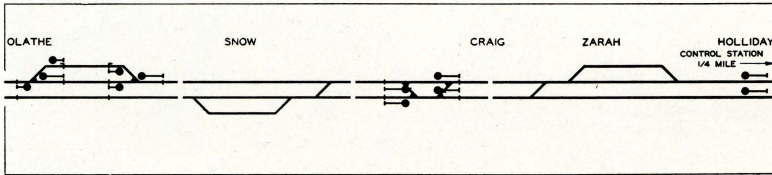




The CTC machine is located in the Holliday interlocking tower.
Crossovers for reversing traffic at Craig, Kansas.

Holliday to Olathe

A. T. & S. F.



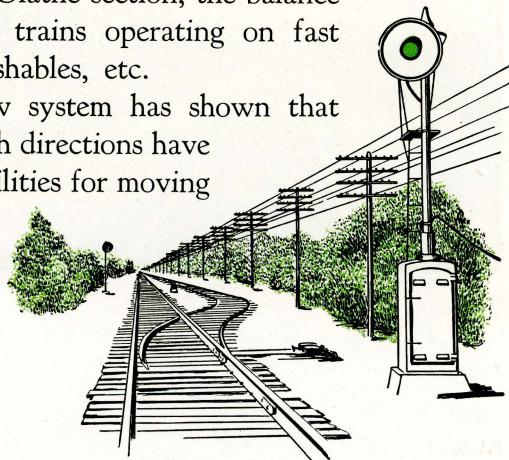
CENTRALIZED
TRAFFIC
CONTROL

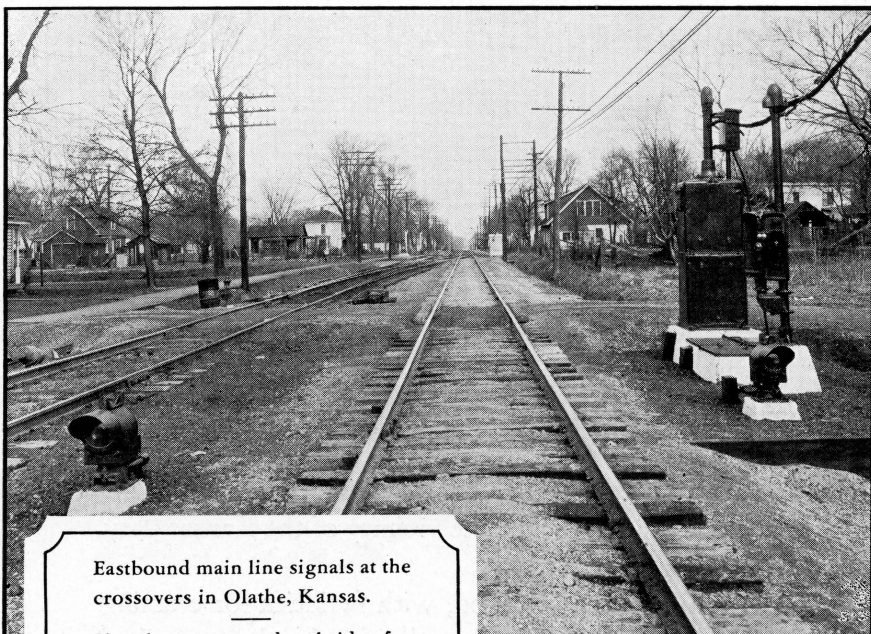
THE SANTA FE has installed Centralized Traffic Control on the double track main line between Holliday, Kansas and Olathe to increase the capacity of the double track line in the immediate vicinity of the Kansas City Terminal.

Operation by signal indication, with facilities for crossing trains from one main track to the other, under the control of the operator at Holliday has improved the utilization of existing track facilities at a point where it is natural to expect the greatest congestion, i. e. in the sections of track near a terminal.

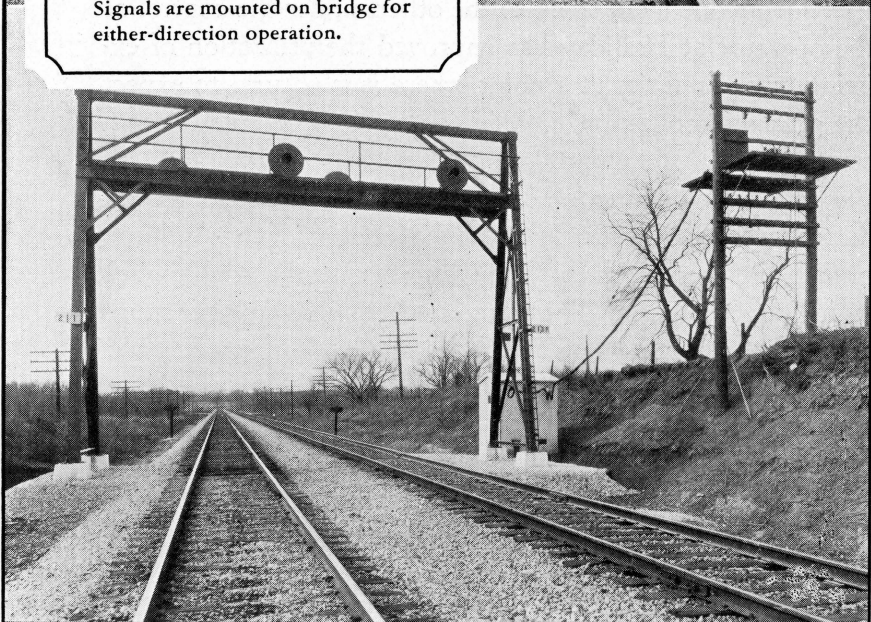
Holliday is the junction of double track with the four-track line eastward to Kansas City, also the junction of the Atchison branch and the Topeka branch which rejoins the double track main line at Emporia. There are 12 scheduled passenger trains operating over the Holliday-Olathe section, the balance of the traffic being freight trains operating on fast schedules and carrying perishables, etc.

Operation under the new system has shown that delays to freight trains in both directions have been reduced by utilizing facilities for moving trains by signal indication without train orders.





Eastbound main line signals at the crossovers in Olathe, Kansas.
Signals are mounted on bridge for either-direction operation.



North Lima to Roachton

BALTIMORE & OHIO

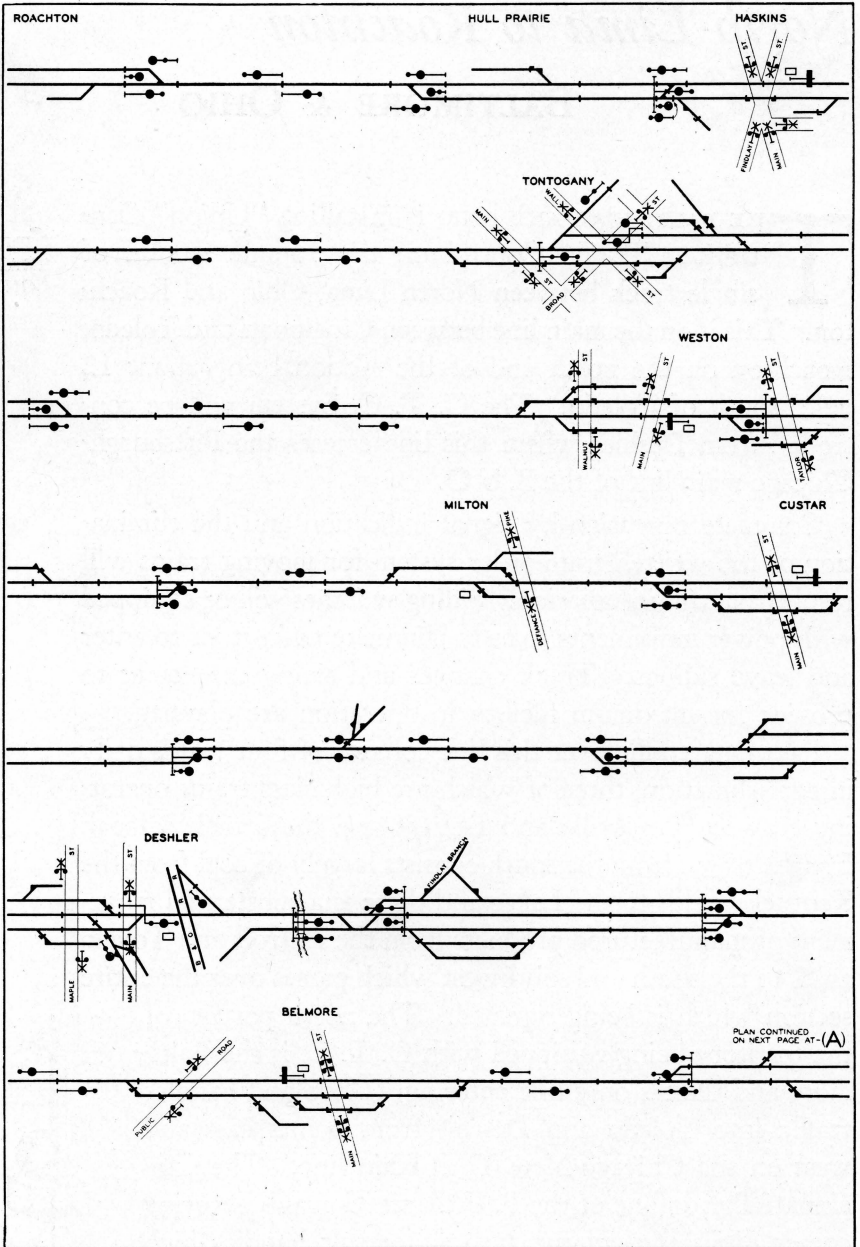
THE BALTIMORE AND OHIO is installing "Union" Centralized Traffic Control on the 56-mile section of single track between North Lima, Ohio and Roachton. This is on the main line between Cincinnati and Toledo, Roachton on the north end of the section being about 12 miles south of Toledo. The C. T. C. System will be controlled from Deshler where this line crosses the Pittsburgh-Chicago main line of the B. & O.

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TRAFFIC
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Complete operation by signal indication and the elimination of the written train-order system for moving trains will result from this installation. Siding switches will be equipped with power movements so as to eliminate train stops to enter and leave sidings. Track changes and siding extensions to provide for maximum facility in operation are planned.

Passenger traffic over this line consists of four trains daily in each direction, three of which are high class trains operating between Louisville and Detroit and the fourth a local. Freight traffic from the south consists largely of coal from the Kentucky fields to the Lakes and there is a substantial movement of manufactured products from the Detroit and Toledo areas to the south and southwest which passes over the entire section which is being signaled. The north portion of the territory being equipped with C. T. C. is the Baltimore and Ohio's only line entering Toledo and handles traffic into Toledo and Detroit from points east and west on the Chicago-New York main line. The Cincinnati-Toledo line of the B. & O. serves manufacturing communities throughout and as a result handles high



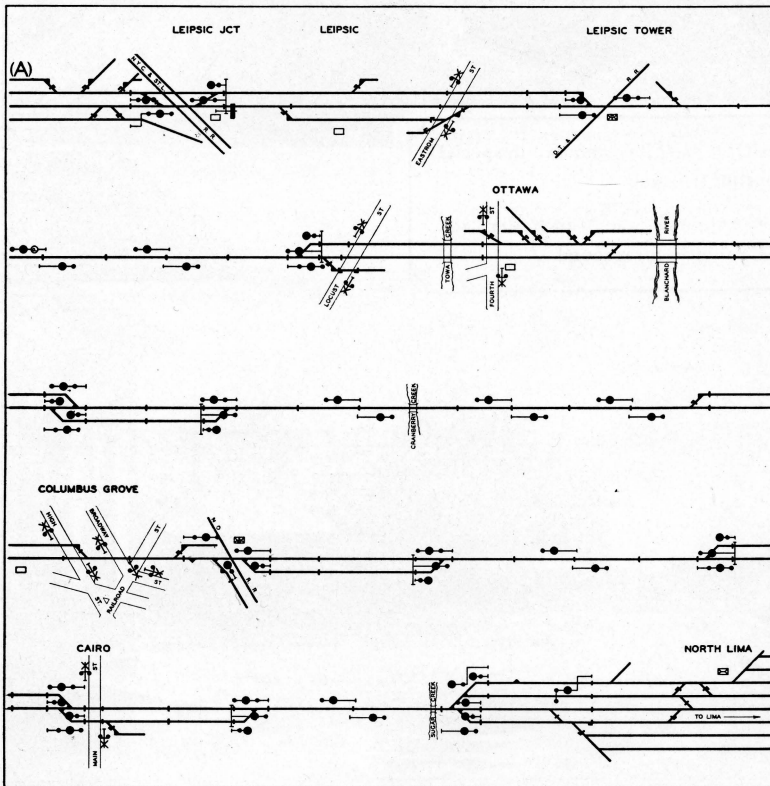


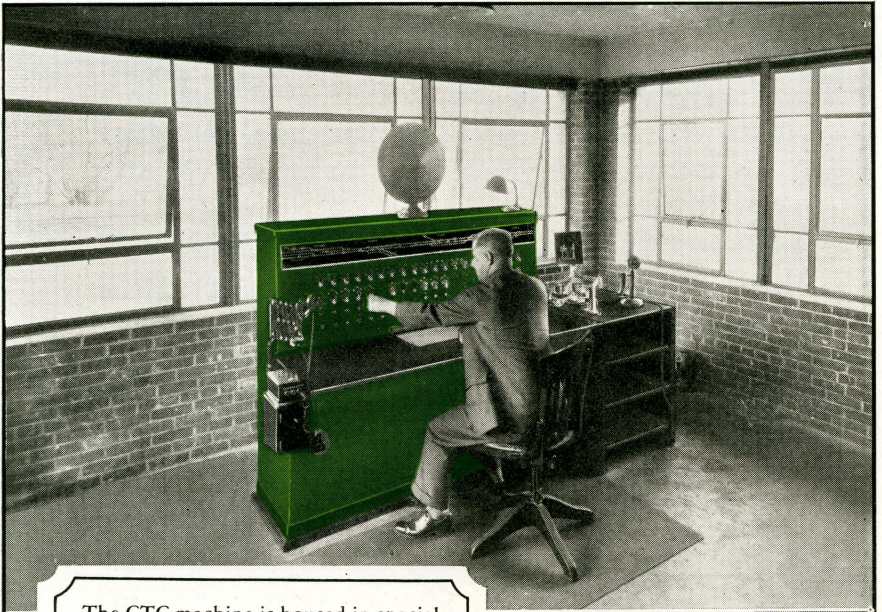
class competitive freight which must move with a minimum of delay.

This is a typical example of a C. T. C. installation on a busy section of single track where operation by signal indication is used to increase the capacity of the line and improve operating performance.

Centralized Traffic Control is being installed, at the same time that the line is being equipped with automatic block signals, with the expectation that traffic over this section will be materially expedited through the reduction of train delay and the elimination of train stops to enter and leave sidings.

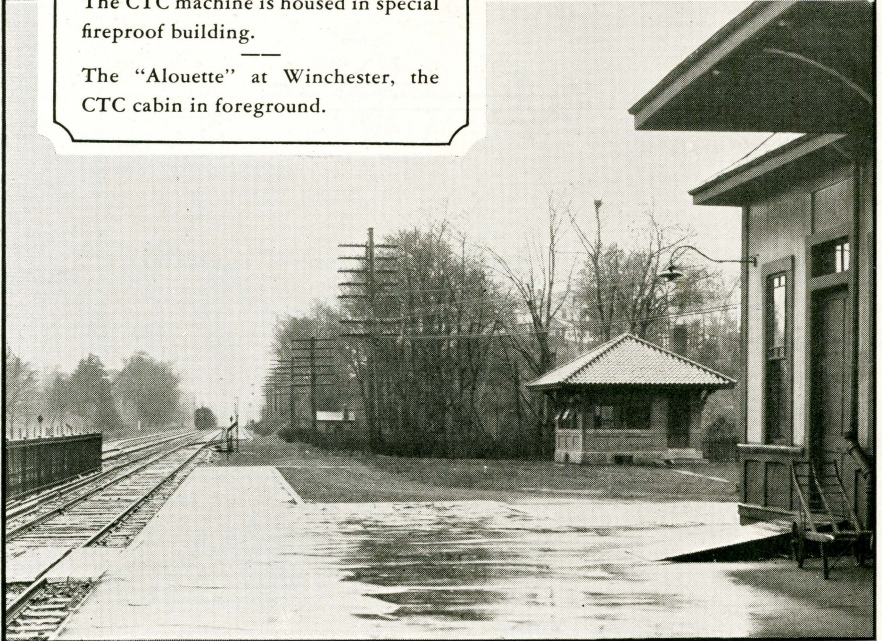
CENTRALIZED
TRAFFIC
CONTROL





The CTC machine is housed in special fireproof building.

The "Alouette" at Winchester, the CTC cabin in foreground.



Winchester to Wilmington

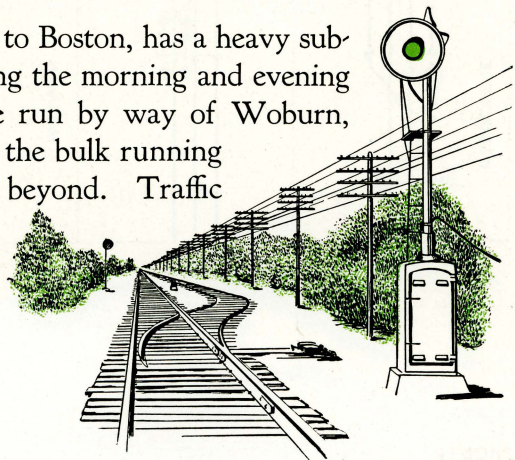
BOSTON & MAINE

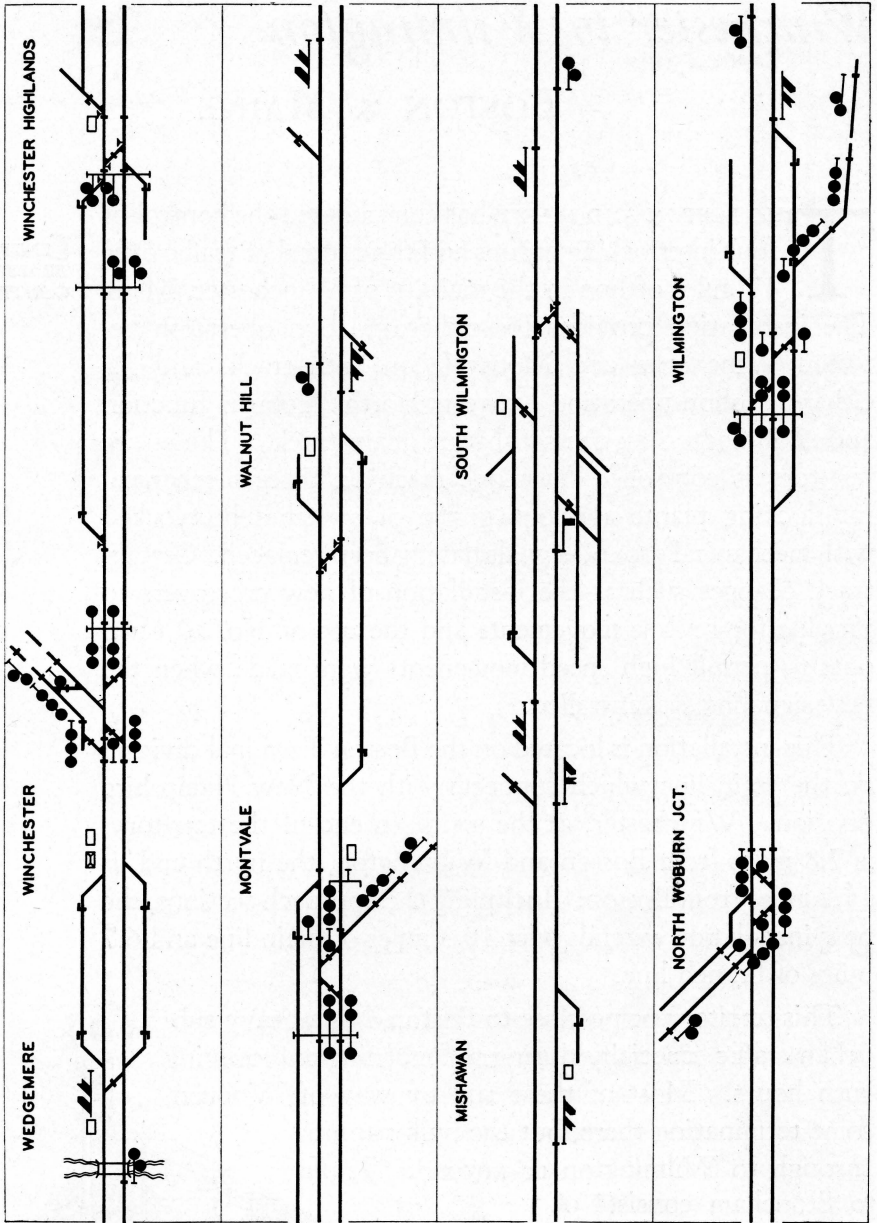
THE BOSTON AND MAINE has consolidated the control of four interlocking groups and the control of traffic over 17 miles of line in the vicinity of Winchester, Mass. The installation provides for either-direction operation between Winchester and Montvale on both tracks and for either-direction operation between North Woburn Junction and Wilmington on the southward main track. The entire territory is controlled from one machine, three mechanical interlocking plants and one group of switches bolt-locked with mechanical ground signals having been replaced. Certain track changes such as the installation of new crossovers to provide for reverse movements and the use of No. 20 turnouts to permit high speed movements were made when the new signaling was installed.

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TRAFFIC
CONTROL**

This installation is located on the Boston Terminal division on the main line which connects with the New Hampshire division. Winchester, at the southern end of the territory, is 7.8 miles from Boston and Wilmington, the north end, is 15.2 miles from Boston. Including the approach sections, the new installation extends over 10.3 miles of main line and 6.7 miles of branch line.

This territory being close to Boston, has a heavy suburban traffic especially during the morning and evening rush hours. Most of these run by way of Woburn, some terminating there, but the bulk running through to Wilmington or beyond. Traffic to Stoneham consists of commuter trains in the





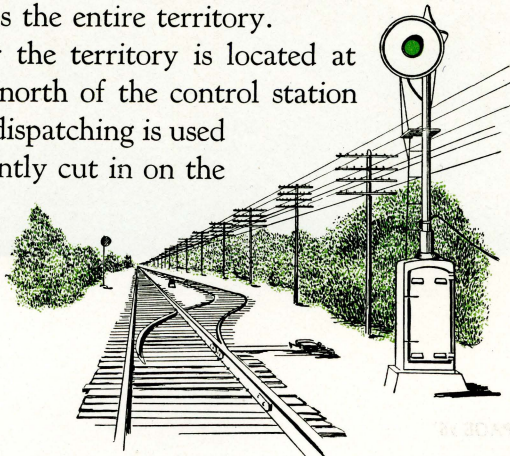
morning and evening and a local freight during the day. The double track main line handles the through passenger and freight traffic between Boston and major part of the state of New Hampshire, most of northern Vermont and a considerable portion of the Province of Quebec. It forms a part of the route of the "crack" trains operating between Boston and Montreal. In addition to this traffic all the through freight traffic of the Portland division is carried over this line so as to reach the Boston classification yards at Mystic Junction.

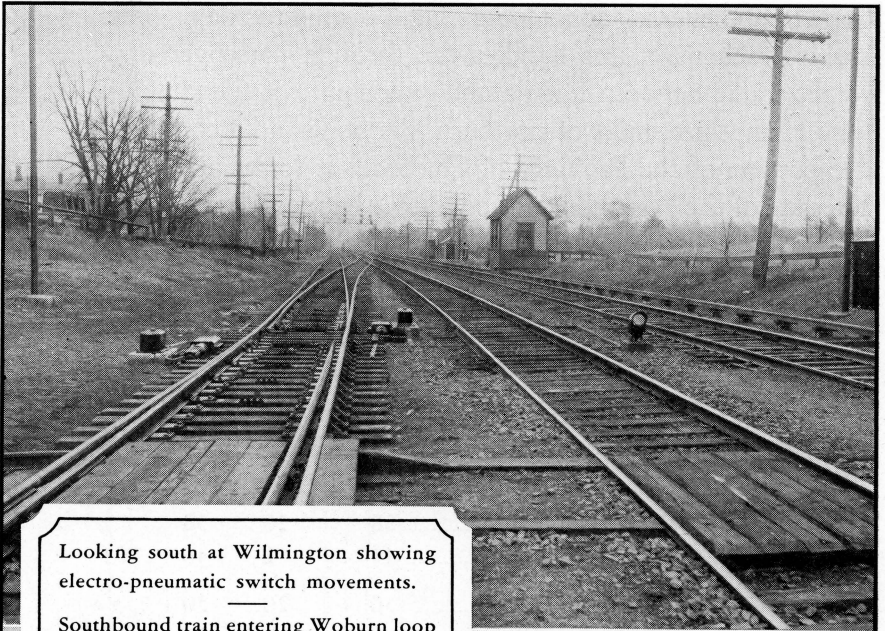
During an ordinary week day, traffic at the four interlocking locations, not including switching movements, is about as follows:

	<i>Passenger Trains</i>	<i>Frts.</i>	<i>Total</i>	
	Main Line.....	38	20	58
Winchester.....	Woburn Loop.....	44	2	46
				104
	Main Line.....	30	20	50
Montvale.....	Stoneham Branch.....	8	2	10
				60
	Main Line.....	30	20	50
No. Woburn Jct....	Woburn Loop.....	30	0	30
				80
	Main Line.....	42	16	58
Wilmington....	Lawrence Br. & Eng. House	18	4	22
				80

In the controlled territory there are three main line crossovers which are used ordinarily only once or twice a day for movements by local freight trains. These are equipped with electric switch locks under the control of the towerman at Winchester who controls the entire territory.

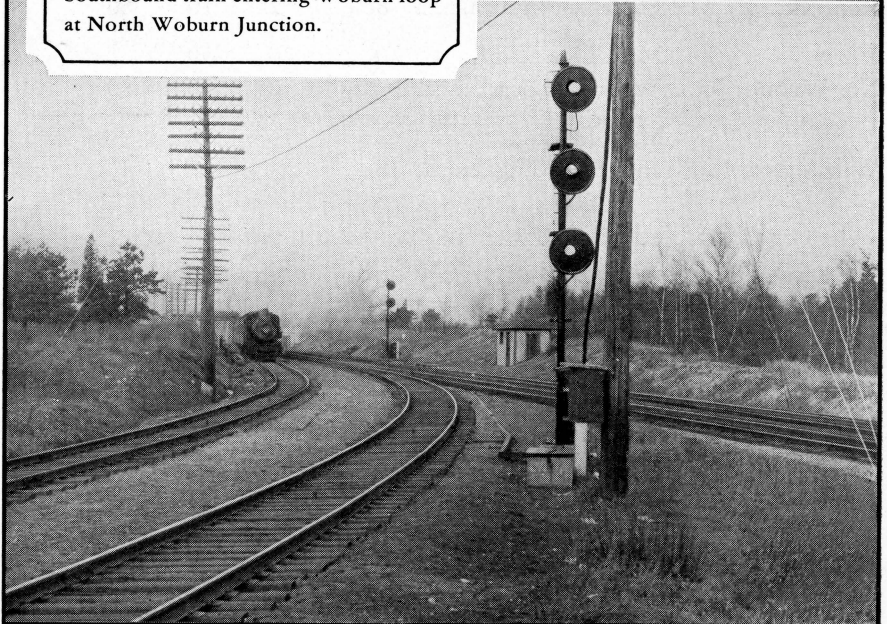
The train dispatcher for the territory is located at Concord, N. H., 66 miles north of the control station at Winchester. Telephone dispatching is used and the towerman is constantly cut in on the dispatcher's phone line by means of a loud speaker.





Looking south at Wilmington showing
electro-pneumatic switch movements.

Southbound train entering Woburn loop
at North Woburn Junction.



By following the business over the phone line, the towerman is kept posted as to any irregularities of train movements on the division.

Switch layouts are operated with "Union" electro-pneumatic switch movements for which air is supplied by small compressor units at each group of switches. These movements provide for very high-speed switch operation and were selected because the exceptionally heavy traffic during a few hours of the day made it desirable that switches be operated as quickly as possible.

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TRAFFIC
CONTROL**

This system has increased the capacity of the trackage in this territory at the same time that it has reduced operating expenses. The control point was selected so as to provide for the inclusion of the territory south to Mystic Junction later.





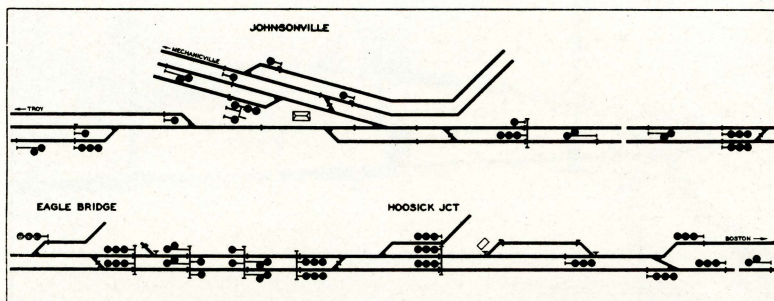
Left—Machine in corner of tower.
Right—Looking west at Hoosick Junction

The interlocking at Johnsonville is now operated from CTC machine.



Johnsonville to Hoosick Junction

BOSTON & MAINE

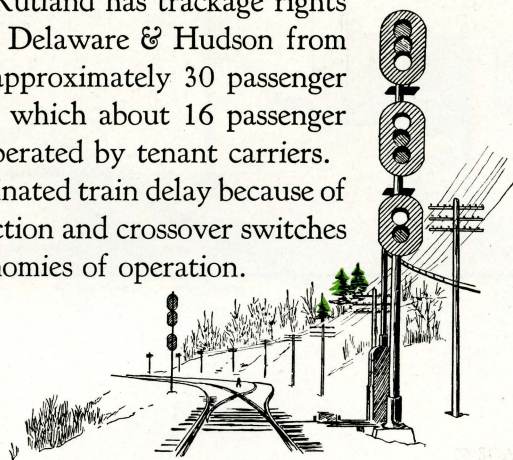


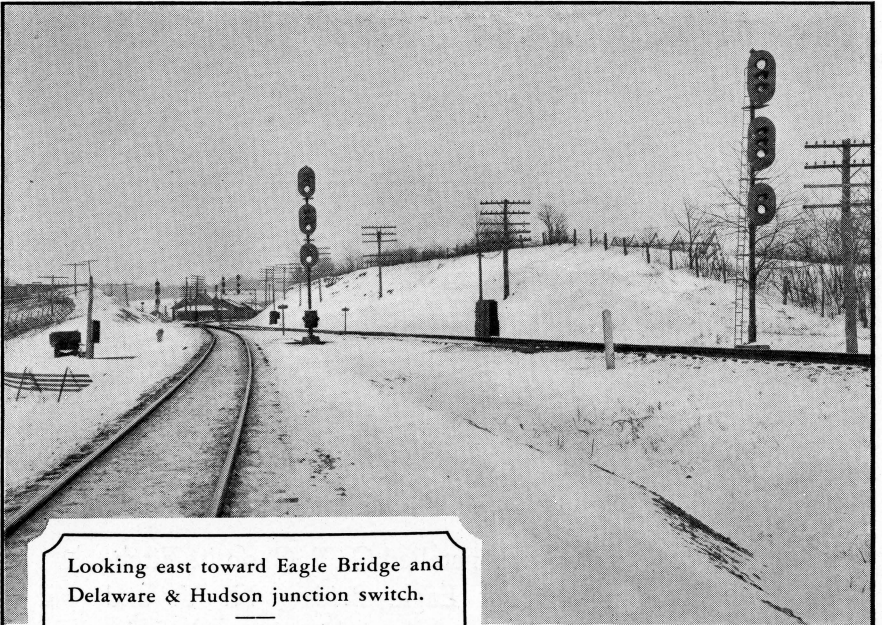
CENTRALIZED
TRAFFIC
CONTROL

THE BOSTON AND MAINE installed C. T. C. on its Fitchburg division between Eagle Bridge, N. Y. and Hoosick Jct. with the control machine located in the interlocking tower at Johnsonville, N. Y. This installation is on the main line between Boston, Mass. and Troy, N. Y., the route of the famous "Minute Man" and covers approximately 10 miles of double track signaled for either-direction operation. The original installation has been extended to include the interlocking facilities at Johnsonville; electro-pneumatic switch movements were substituted for mechanical functions and are now controlled from the C. T. C. machine.

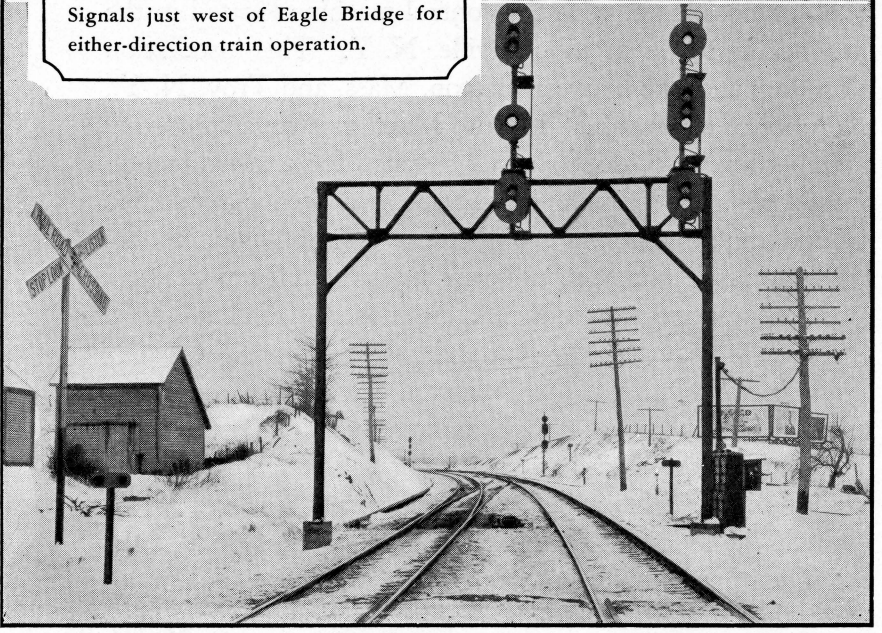
Traffic is heavy, as the Rutland has trackage rights from Hoosick Jct. and the Delaware & Hudson from Eagle Bridge. There are approximately 30 passenger and 38 freights per day of which about 16 passenger trains and 4 freights are operated by tenant carriers.

This installation has eliminated train delay because of the power operation of junction and crossover switches and has effected other economies of operation.



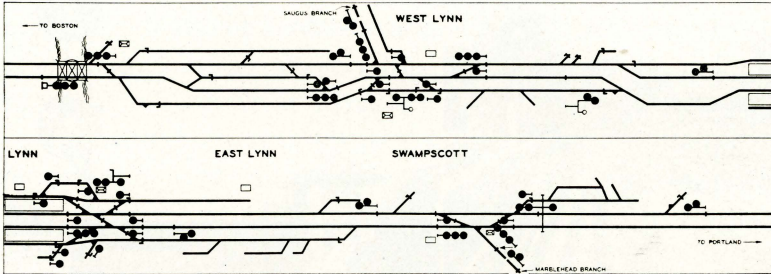


Looking east toward Eagle Bridge and Delaware & Hudson junction switch.
—
Signals just west of Eagle Bridge for either-direction train operation.



Lynn to Swampscott

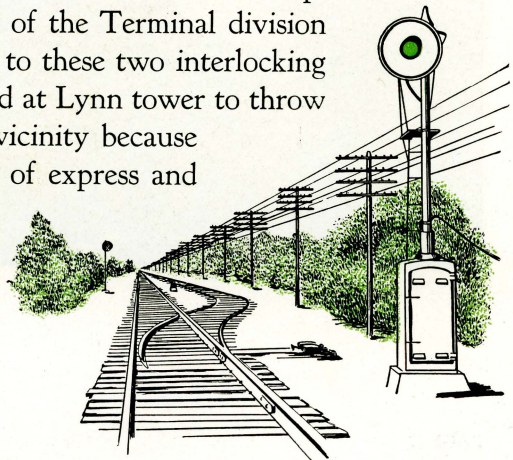
BOSTON & MAINE

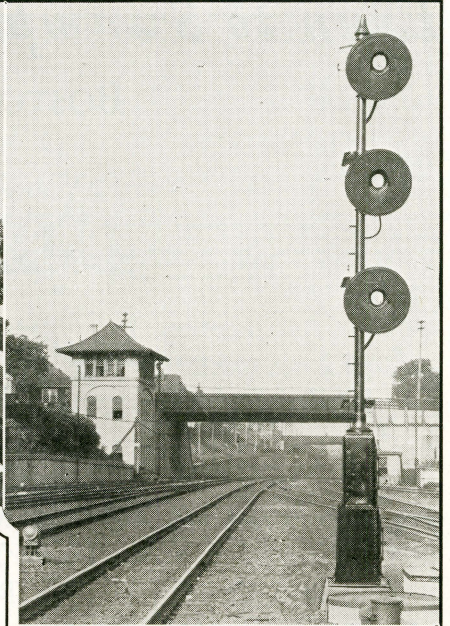
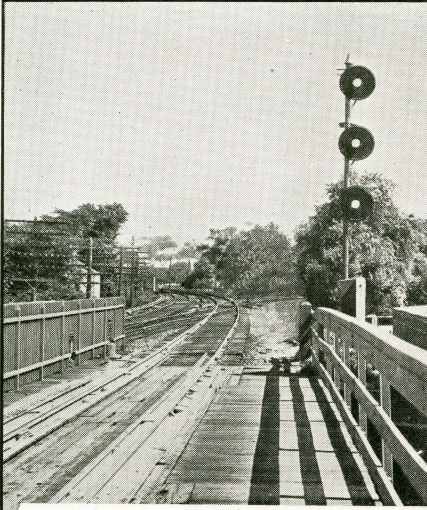


CENTRALIZED
TRAFFIC
CONTROL

THERE ARE TWO ROUTES between Boston and Portland on the Boston and Maine Railroad; one via the Terminal division through Revere Beach to Beverly, Mass., and thence the Portland division to Portland, Me., the other, a route from Boston to West Lynn by way of the Saugus branch and passing through West Everett and Saugus. Each of these routes is double-tracked and thus there is the equivalent of four tracks between Boston and West Lynn.

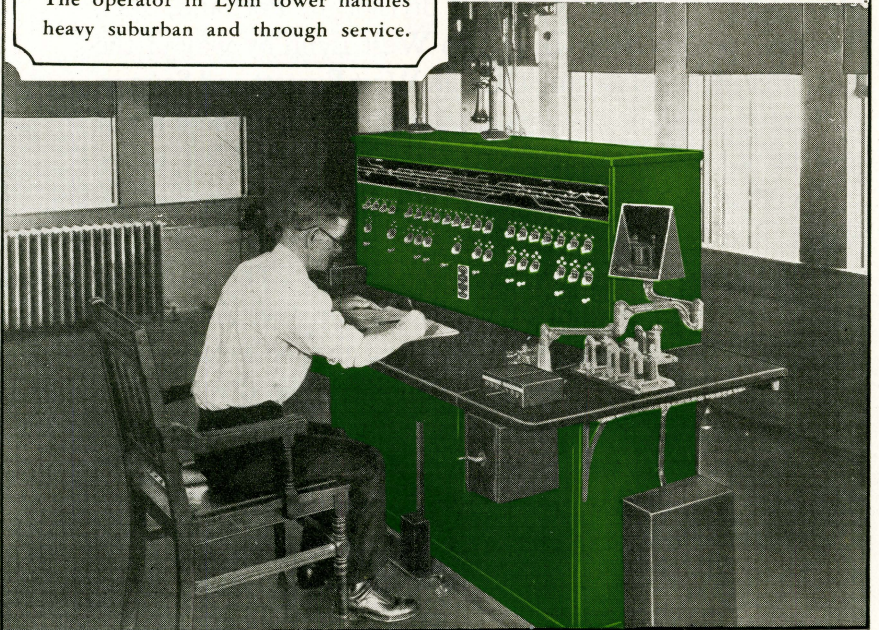
At West Lynn and at Swampscott there were interlocking plants, that at West Lynn was an electro-mechanical plant and that at Swampscott a mechanical plant. The interlocking at West Lynn controlled the junction of the Saugus branch with the Revere Beach line, and that at Swampscott controlled the operation of the Terminal division for Marblehead. In addition to these two interlocking plants, switchmen were located at Lynn tower to throw by hand the switches in the vicinity because of the many switching moves of express and milk trains at Lynn and the fact that some trains





Left—E. B. home signal at Swampscott.
Right—E. B. home signal at Lynn tower.

The operator in Lynn tower handles heavy suburban and through service.



terminated runs there and required special switch handling.

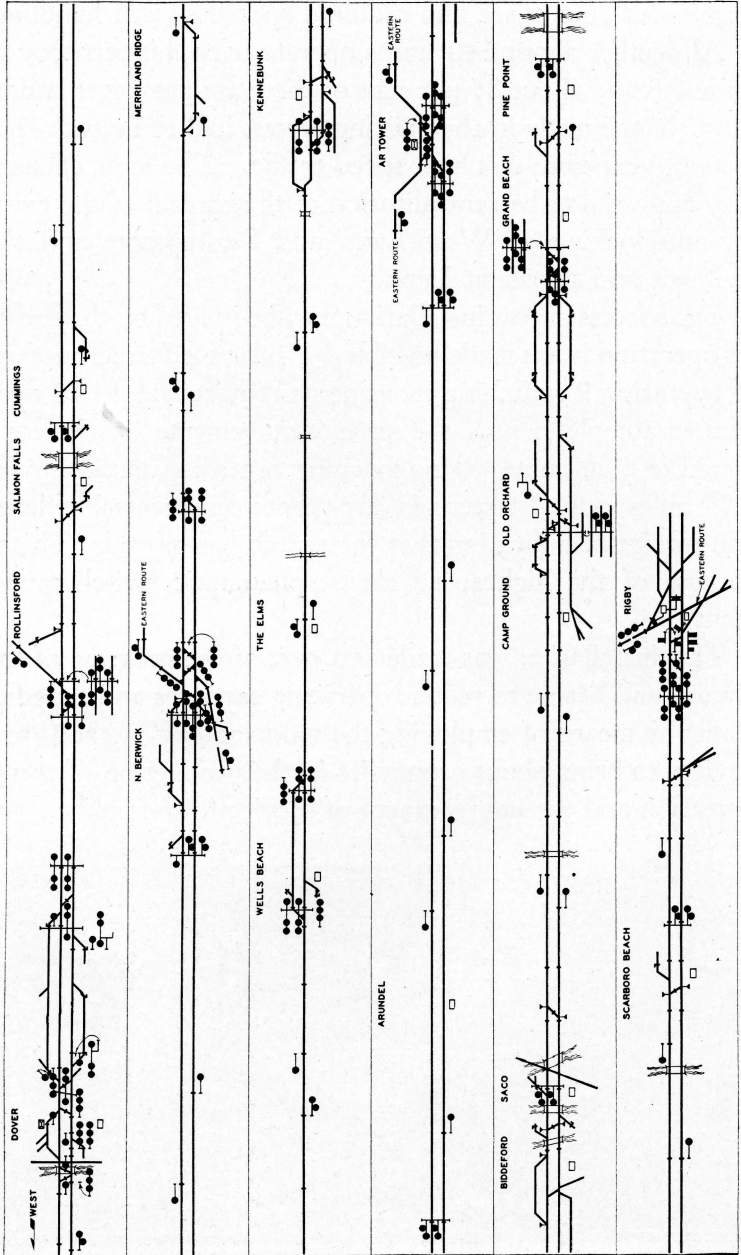
Altogether about 140 trains operate over this territory in 24 hours and about 85 per cent of these are passenger trains. Any change made in the existing layout had to be such that it would expedite this high speed traffic. The most efficient way appeared to be centralization of the control of the existing interlocking at West Lynn and Swampscott and the switches and signals at Lynn.

CENTRALIZED
TRAFFIC
CONTROL

The success of this installation may be judged by the speedier operation it has made possible. Under the former method of operation 9 switching movements required 15 to 20 minutes to complete; now the same 9 movements can be completed in 5 minutes. This machine controls functions over 4.75 miles; only 2.5 seconds elapse between reversal of lever and receipt of indication that the switch has moved. This is because of the high speed electro-pneumatic switch movements.

This installation was made as a part of the program of the Boston and Maine to reduce operating expenses and expedite traffic by means of employing the most modern methods and devices to bring about economies in the production of transportation and the improvement of service to the public.





Dover to Rigby

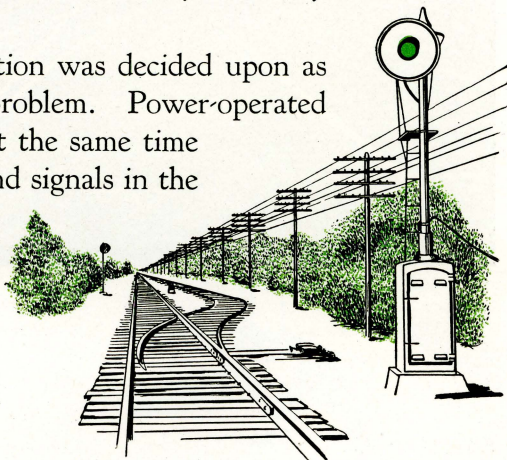
BOSTON & MAINE

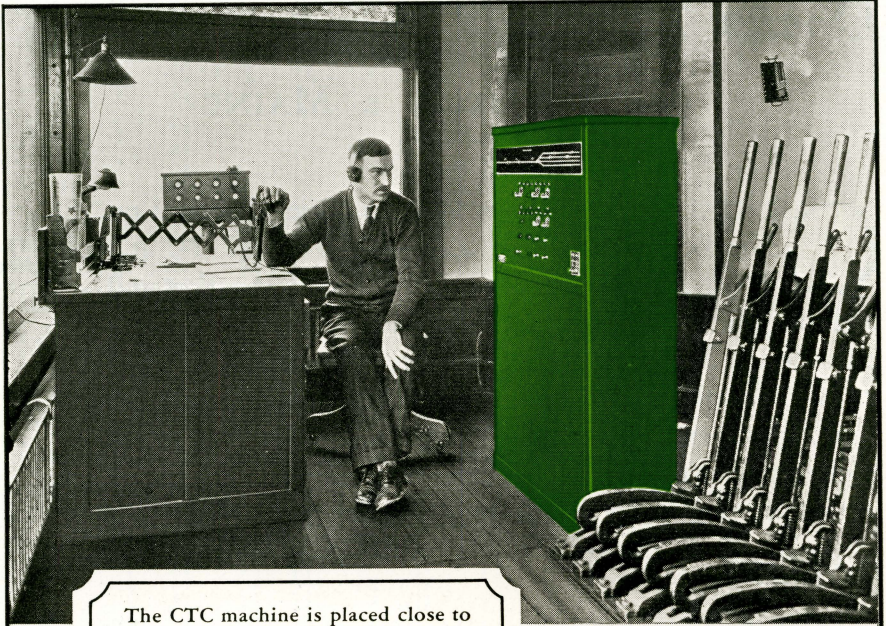
CENTRALIZED TRAFFIC CONTROL is being installed on the Boston & Maine between Dover, N. H. and Rigby, Me. on the western route of the Portland division which parallels the eastern route between North Berwick and Rigby. The eastern route is double track except for some single track between North Berwick and Kennebunk, thus there is practically a three-track railroad between Rigby and North Berwick. The Centralized Traffic Control installation will make it possible to utilize more effectively existing track facilities by routing trains over the most advantageous track.

CENTRALIZED
TRAFFIC
CONTROL

There is a heavy passenger and freight movement over the Portland division, the bulk of the passenger movement being via the western route. Approximately 26 regularly scheduled passenger trains operate over the western route and 8 over the eastern route. There is also a heavy freight traffic consisting mostly of merchandise and coal with trains sometimes in excess of 100 cars in length. This heavy traffic so congested the single track between North Berwick and Kennebunk that it was necessary to route trains over the eastern line against the normal direction of traffic by authority of written train orders.

Operation by signal indication was decided upon as the solution to this traffic problem. Power-operated switches are being installed at the same time and the control of switches and signals in the territory is to be centralized under one operator.





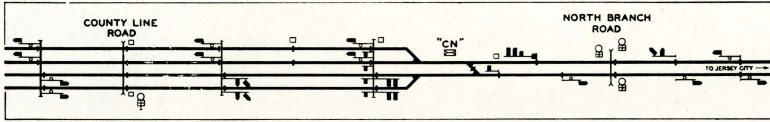
The CTC machine is placed close to operator near mechanical machine.

White House interlocking tower is at one end of the 4-track territory.



North Branch to White House

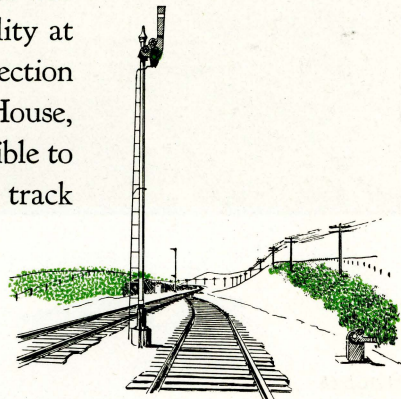
C. R. R. OF N. J.

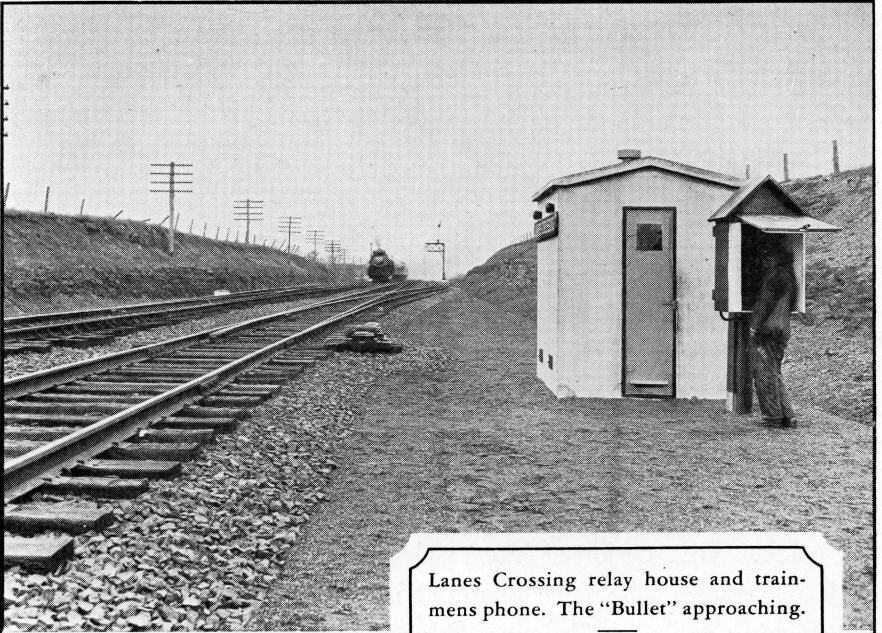


CENTRALIZED
TRAFFIC
CONTROL

THE CENTRAL RAILROAD OF NEW JERSEY has applied Centralized Traffic Control to an interlocking layout at North Branch, New Jersey. The installation affords operation by signal indication on a 4.86 mile section of four track railroad and provides for reverse traffic moves on one track. This section of four track line is between sections of double track. The new signaling has replaced a mechanical interlocking at Lanes Crossing (North Branch) at one end of this four track section and the control machine is in the interlocking tower at White House at the other end of the section.

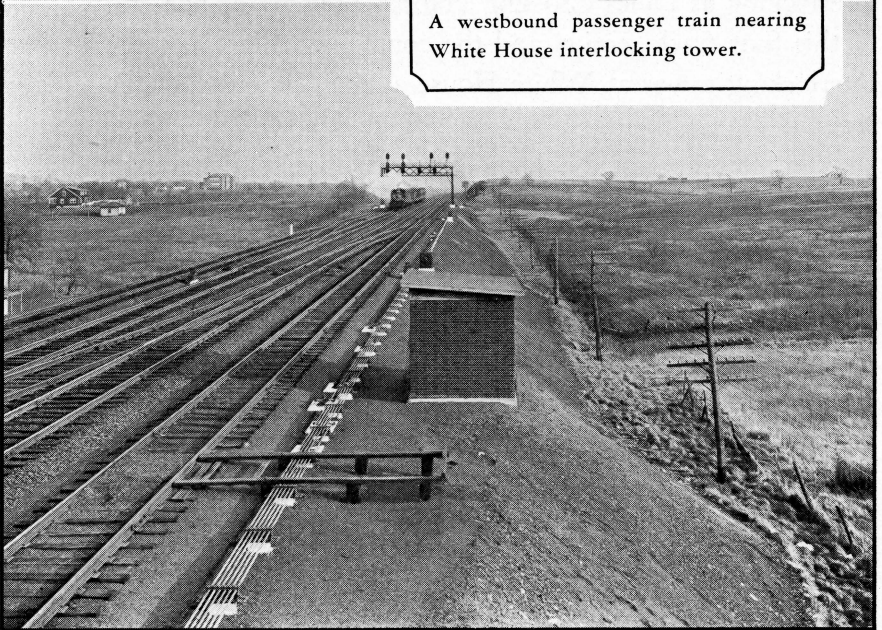
From Jersey City, N. J. to White House, a distance of approximately 45 miles, the Central division of the C. R. R. of N. J. consists of four or more main tracks, with the exception of 4 miles of double track between Raritan and Lanes Crossing. Because of the high cost involved, it was decided that the expenditure for four-tracking this section was inadvisable. Centralized Traffic Control was selected to provide for greater flexibility at Lanes Crossing and on the four track section between that point and White House, which increased facility makes it possible to utilize the short section of double track





Lanes Crossing relay house and trainmen's phone. The "Bullet" approaching.

A westbound passenger train nearing White House interlocking tower.



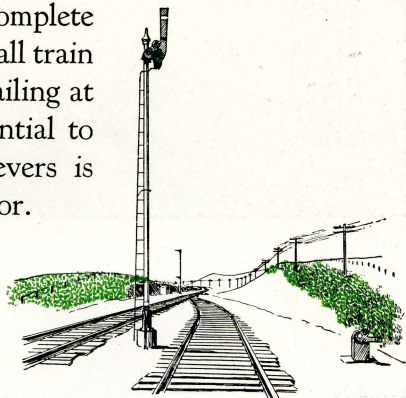
to the east more effectively and to indefinitely postpone the need for additional tracks there. The four-track line between North Branch and White House functions as a passing and inspection point for freight trains in the eastward direction prior to entering the busy suburban area east of Raritan. Westward freight trains frequently take on helpers at White House to assist up the 12-mile grade to Hampton at the summit of Cushatunk mountain.

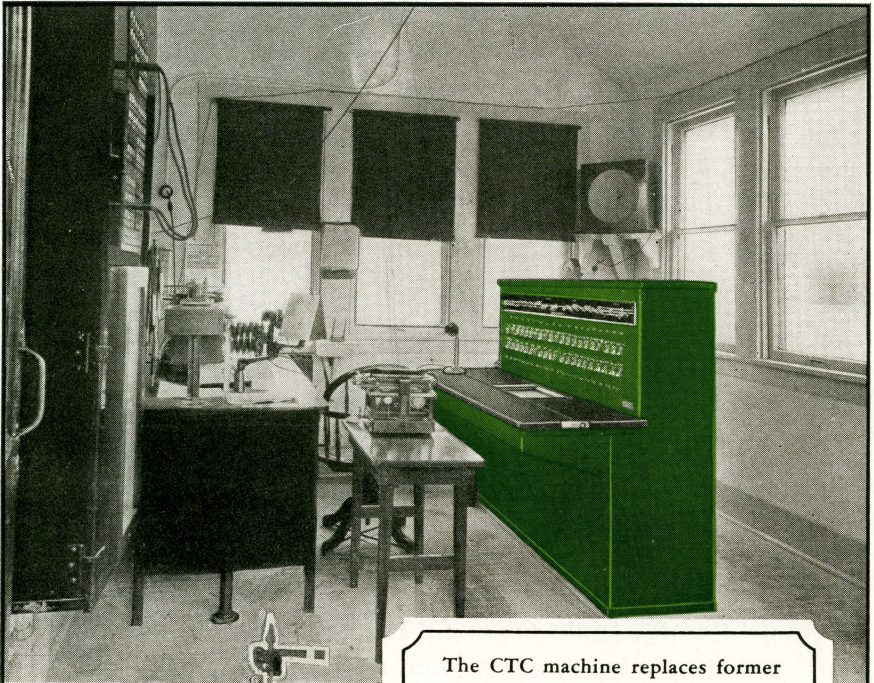
CENTRALIZED
TRAFFIC
CONTROL

The east end of the double track section between Lanes Crossing and Raritan continues to be operated by an electro-pneumatic interlocking. This double track section is a "bottle neck" because of an ascending grade for eastbound trains at Vandeviers cut, just east of Lanes Crossing. A "light" indicator is provided on the control panel for the information of the operator at White House to show the progress of eastward trains over the double track. This enables him to keep additional tonnage trains moving if the track is clear, and to avoid admitting a tonnage train into the territory when it is likely to be stopped on a difficult grade because of a preceding train in the block.

This installation has provided operating savings in addition to the advantages of expedited traffic because of the elimination of the attended interlocking at Lanes Crossing, and is typical of what can be done in the way of centralizing the control of functions of two or more interlockings, using the C. T. C. system of control.

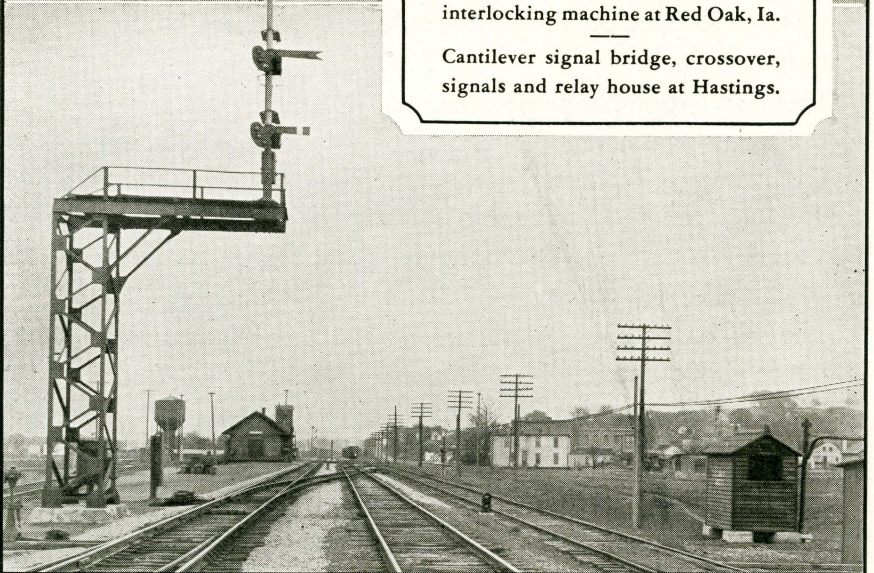
The control machine in White House tower is extremely compact and carries on its panel complete and accurate information regarding all train movements and the conditions prevailing at all locations. All information essential to the proper manipulation of the levers is plainly displayed before the operator.





The CTC machine replaces former interlocking machine at Red Oak, Ia.

Cantilever signal bridge, crossover, signals and relay house at Hastings.



Red Oak to Balfour

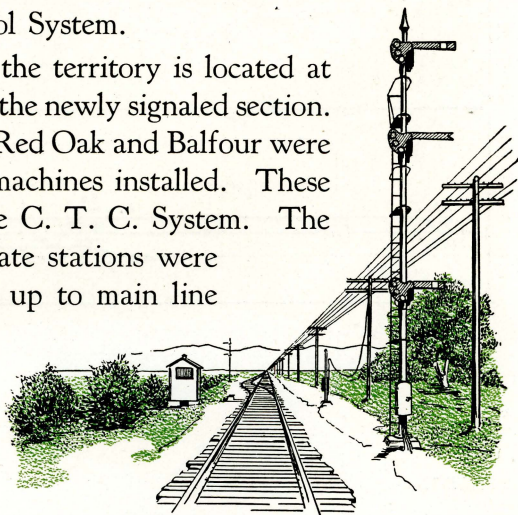
C. B. & Q.

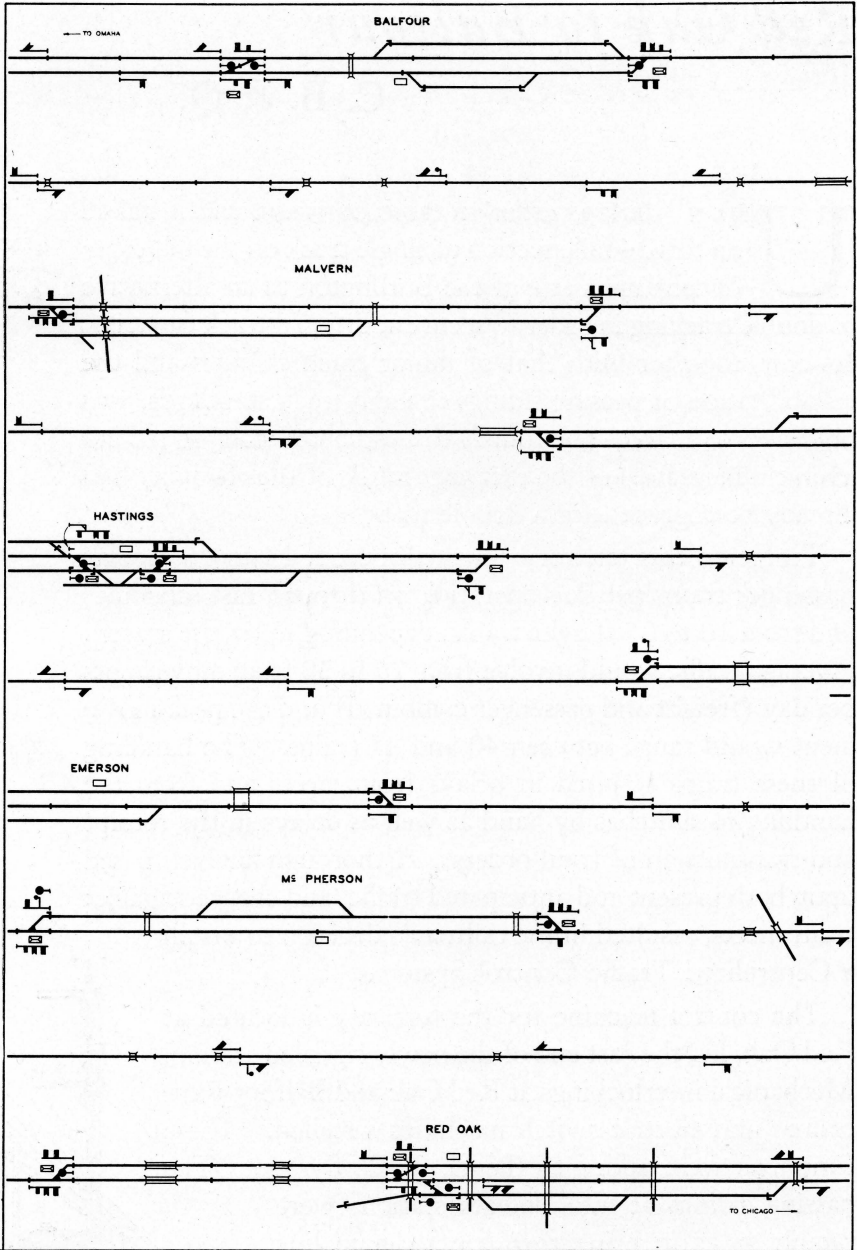
“UNION” CENTRALIZED TRAFFIC CONTROL was installed on this 24-mile section of single track on the Chicago-Omaha main line of the Burlington as an alternative to double tracking in order to secure additional track capacity. Its cost, together with that of minor track changes and the rehabilitation of passing sidings to main track standards, was only approximately one-fourth the estimated cost of second main track in spite of the fact that much of the roadway had already been graded for a double track line.

CENTRALIZED
TRAFFIC
CONTROL

Traffic on this territory consists of from 14 to 16 regular passenger trains per day operating on through fast schedules and from 10 to 25 freight trains, depending upon the season. Average traffic would involve from 25 to 30 train movements per day (freight and passenger combined) and the peak movement would range between 40 and 45 trains. The handling of these trains resulted in delays from meets and from the handling of switches by hand as well as delays in the receipt and transmission of train orders. A thorough analysis based upon both present and anticipated traffic, and checked against train sheets, resulted in the railroad's decision to install a Centralized Traffic Control System.

The control machine for the territory is located at Red Oak, Ia., the east end of the newly signaled section. Mechanical interlockings at Red Oak and Balfour were retired and electric switch machines installed. These functions were added to the C. T. C. System. The passing sidings at intermediate stations were rebuilt so as to bring them up to main line



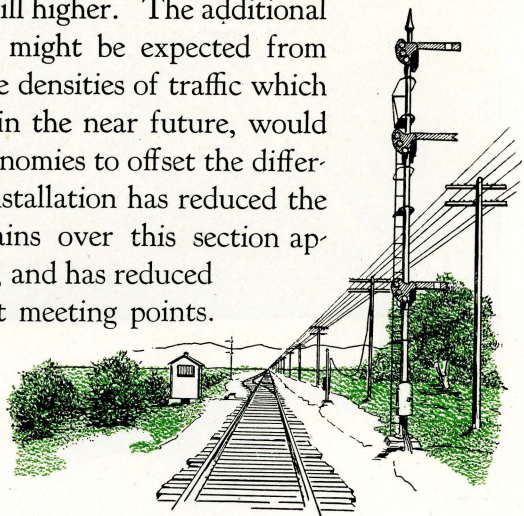


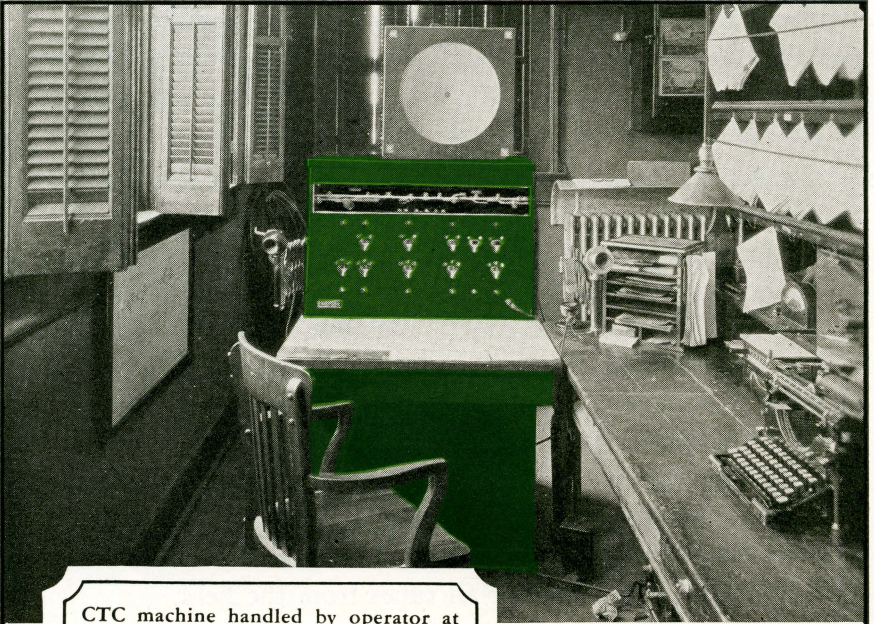
standards and No. 15 turnouts were installed to replace the No. 11 turnouts at all controlled switches. The old interlocking tower at Red Oak was used to house the control machine and associated apparatus.

In order to provide for the most efficient operation of trains with the new installation, a complete system of indications was included as a part of the control machine. A record of all train movements is made automatically by the train-graph which is part of the control machine, an "OS" point having been established at each controlled location. The occupied or unoccupied condition of the track is indicated by lights on the track diagram which is part of the control machine. The position of switches and signals is also indicated by means of lights on the control panel. This system of indications furnishes the man operating the machine with complete information obtained at all times from the field.

A study of the installation undertaken after it had been in service about six months showed a net saving in operating expenses amounting to approximately 19 per cent on the investment. The study was predicated upon an analysis of relatively light traffic conditions and it is not unreasonable to expect that a study of a peak-traffic period would show a greater rate of return on the investment. If the study considers the savings accruing from the conservation of capital, the rate of return would be still higher. The additional expedited movement which might be expected from double track operation, at the densities of traffic which can reasonably be expected in the near future, would not bring about sufficient economies to offset the difference in investments. This installation has reduced the running time of freight trains over this section approximately 10 minutes each, and has reduced the number of train stops at meeting points.

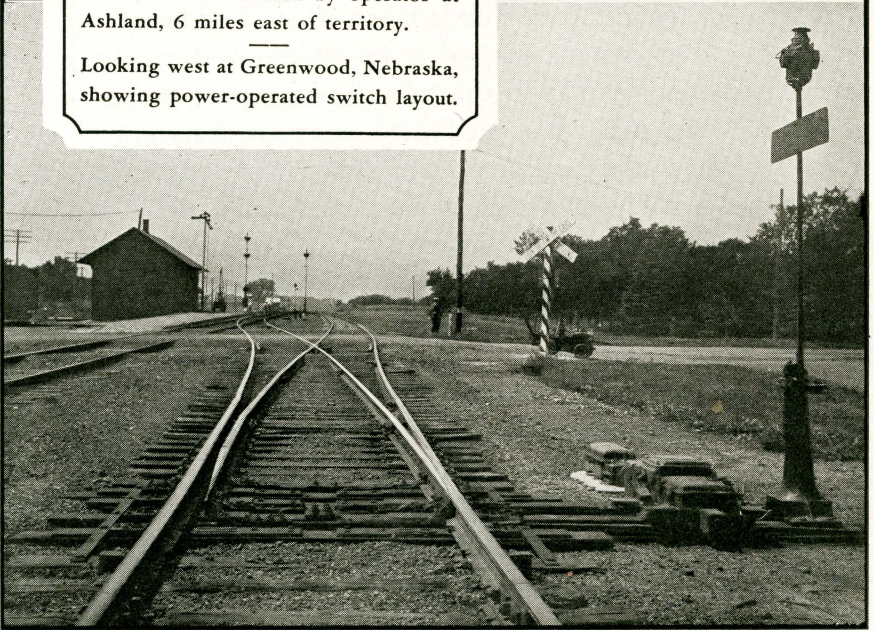
CENTRALIZED
TRAFFIC
CONTROL





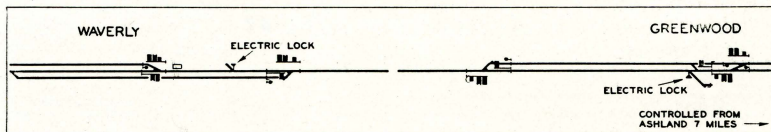
CTC machine handled by operator at Ashland, 6 miles east of territory.

Looking west at Greenwood, Nebraska, showing power-operated switch layout.



Waverly to Greenwood

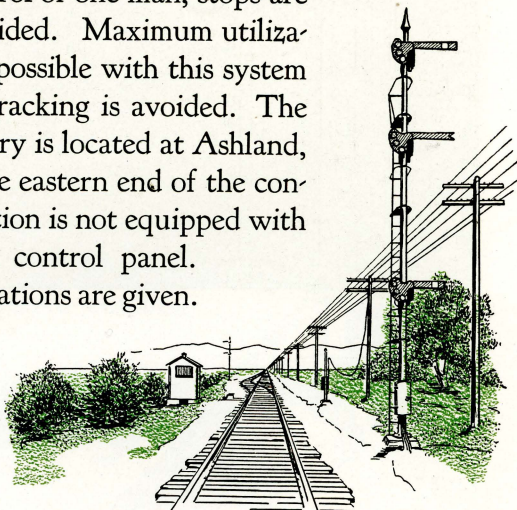
C. B. & Q.



CENTRALIZED
TRAFFIC
CONTROL

THIS INSTALLATION on the Burlington is another example of the application of "Union" Centralized Traffic Control to the widening of a "bottle neck." Waverly, Neb. is at the western end and Greenwood at the eastern end of a five-mile section of single track on the main line between Omaha and Lincoln. This line handles all the Chicago-Colorado passenger traffic, there being approximately 14 passenger train schedules over the district. Freight traffic from Colorado and Nebraska points as well as from Wyoming and Montana to Chicago passes over this line. The total number of trains handled per day is about 40. A large portion of these during certain seasons are grain and stock trains.

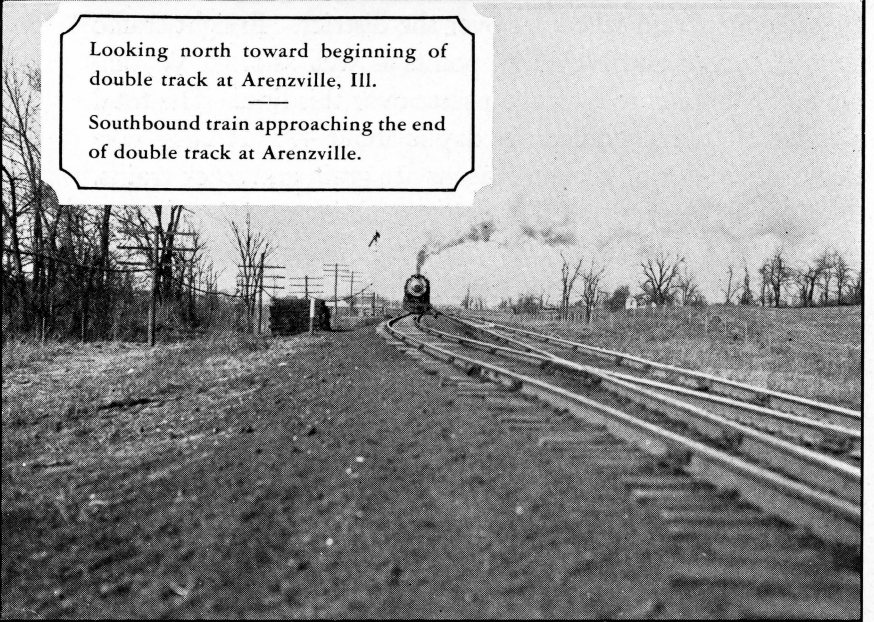
"Union" Centralized Traffic Control is providing for expedited train movement over this single track portion of the line. With the operation of all switches and signals in the territory under the direct control of one man, stops are eliminated and train delay avoided. Maximum utilization of the single track line is possible with this system and the necessity for double-tracking is avoided. The control machine for the territory is located at Ashland, approximately 7 miles from the eastern end of the controlled territory. This installation is not equipped with an automatic train-graph on control panel. Visual and audible "OS" indications are given.





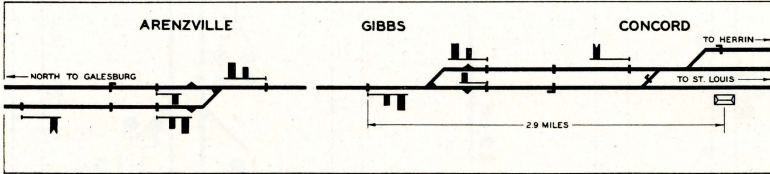
Looking north toward beginning of
double track at Arenzville, Ill.

Southbound train approaching the end
of double track at Arenzville.



Concord to Arenzville

C. B. & Q.

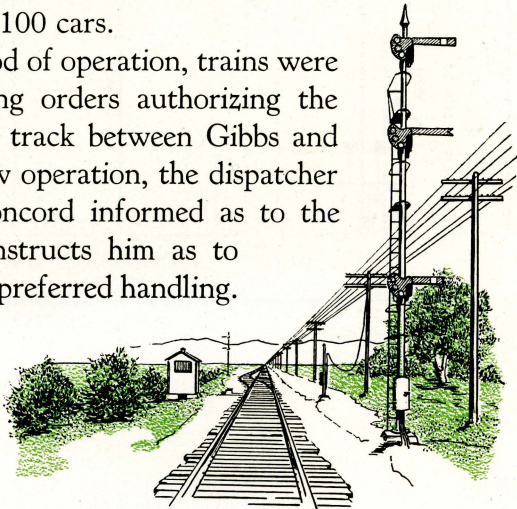


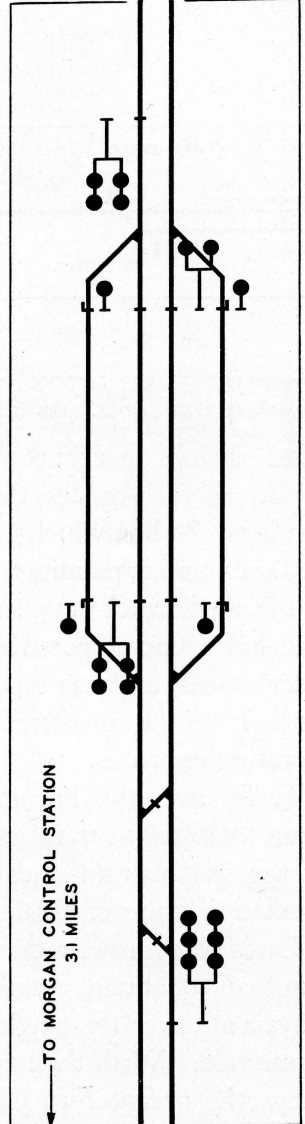
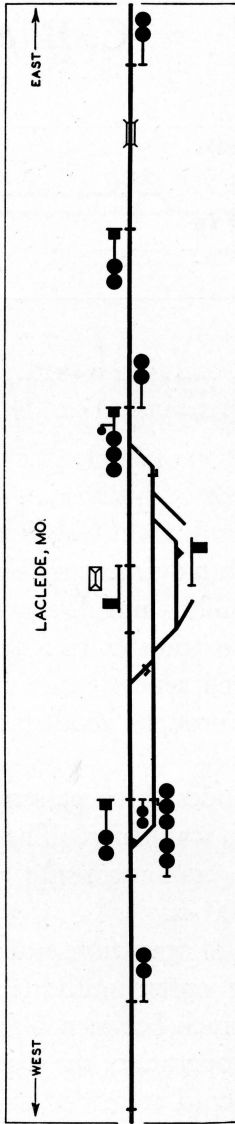
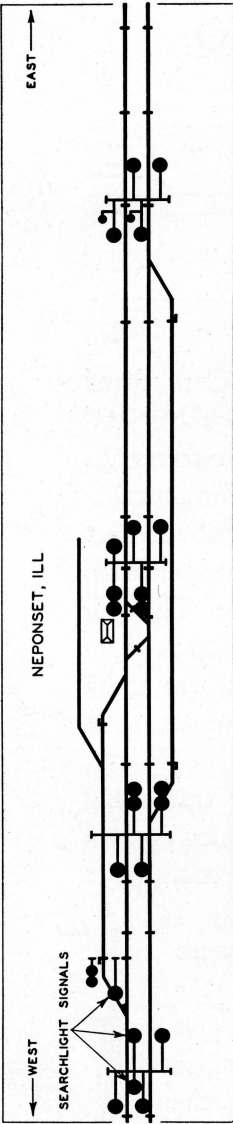
CENTRALIZED
TRAFFIC
CONTROL

THE BURLINGTON has installed "Union" Centralized Traffic Control for the operation of switches and signals on a short section of single track between ends of double track on the Beardstown division. This installation is on the line which extends from Galesburg, Ill. to East St. Louis, and it permits train movement by signal indication on the single track between Gibbs and Arenzville. The railroad has found it possible to transfer two three-trick train order offices, and has received a net return in excess of 27 per cent on the investment, brought about by the saving in operating expenses.

Traffic over this line includes three passenger trains and about four freight trains each way daily. The major portion of the northbound freight traffic consists of coal, handled in trains of about 100 cars.

Under the former method of operation, trains were required to obtain running orders authorizing the movement over the single track between Gibbs and Arenzville. With the new operation, the dispatcher keeps the operator at Concord informed as to the approach of trains and instructs him as to which train he should give preferred handling.





Neponset and Laclede

C. B. & Q. R. R.

THE BURLINGTON has installed Centralized Traffic Control at the two points indicated above. Neponset, Ill. is on the double track main line between Chicago and Omaha; Laclede, Mo. is on the single track line extending to Kansas City from Galesburg, Ill.

CENTRALIZED
TRAFFIC
CONTROL

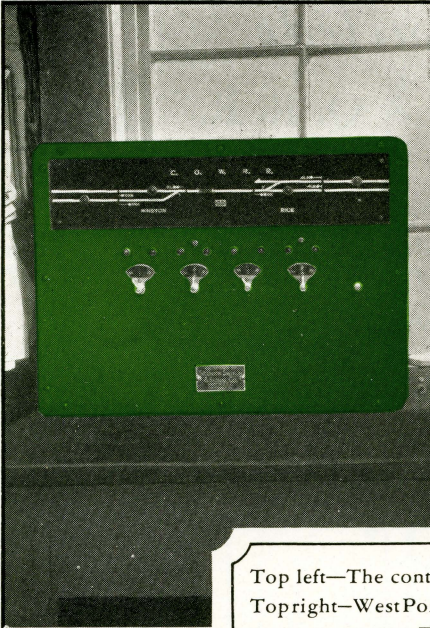
Traffic on both of these routes is relatively heavy and the power-operated switches eliminate train stops. There are 14 regularly scheduled passenger trains on the Neponset section and 12 on the Laclede section.

DeGraff to Morgan

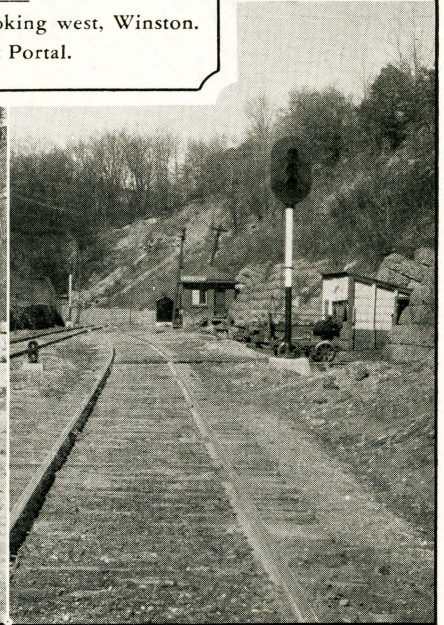
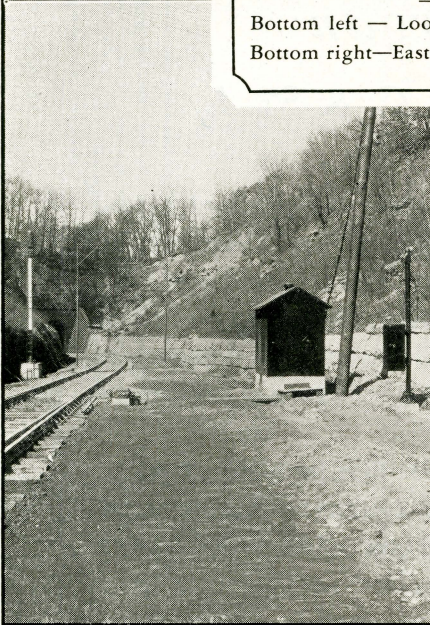
C. C. C. & ST. L.

THE BIG FOUR is installing "Union" Centralized Traffic Control on a short section of double track line between De Graff, Ohio and Morgan. This section is just west of Bellefontaine, Ohio on the Cleveland-Indianapolis line of the Big Four. There are 16 regularly scheduled passenger trains including the fast New York-St. Louis trains of the N. Y. C.—Big Four.

The "Union" C. T. C. System is finding favor at places where outlying switches are located a sufficient distance from the control point so that the reduced cost of line wires becomes a factor in the economies of the installation. This system promotes economy of line wire and affords simplicity of operation.

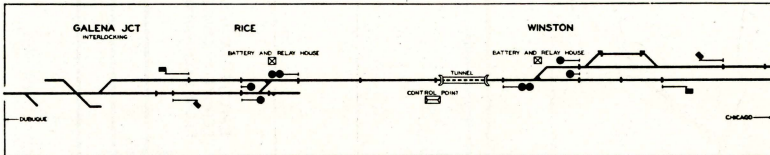


Top left—The control machine.
Top right—West Portal and controlhouse.
Bottom left — Looking west, Winston.
Bottom right—East Portal.



Winston to Rice

CHICAGO GREAT WESTERN



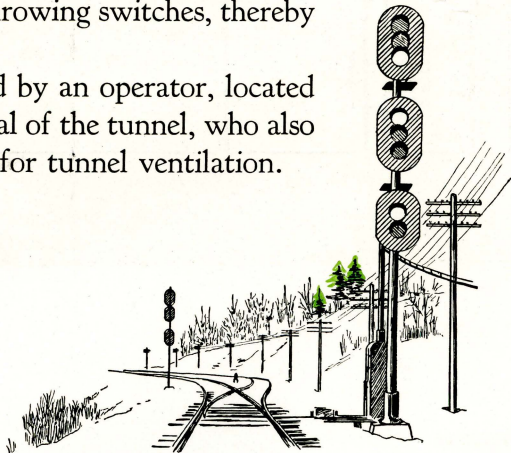
CENTRALIZED
TRAFFIC
CONTROL

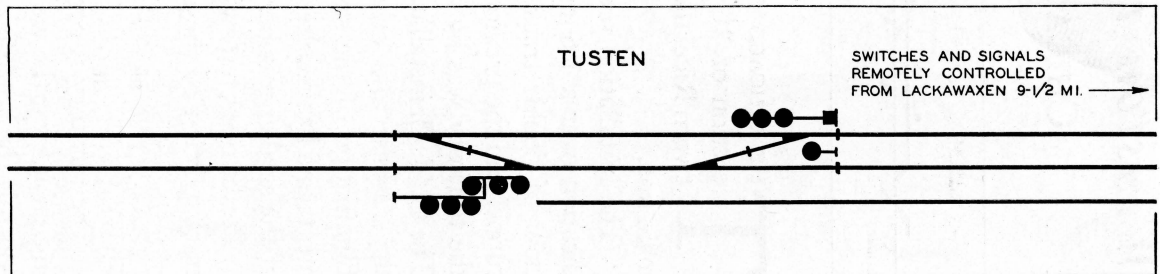
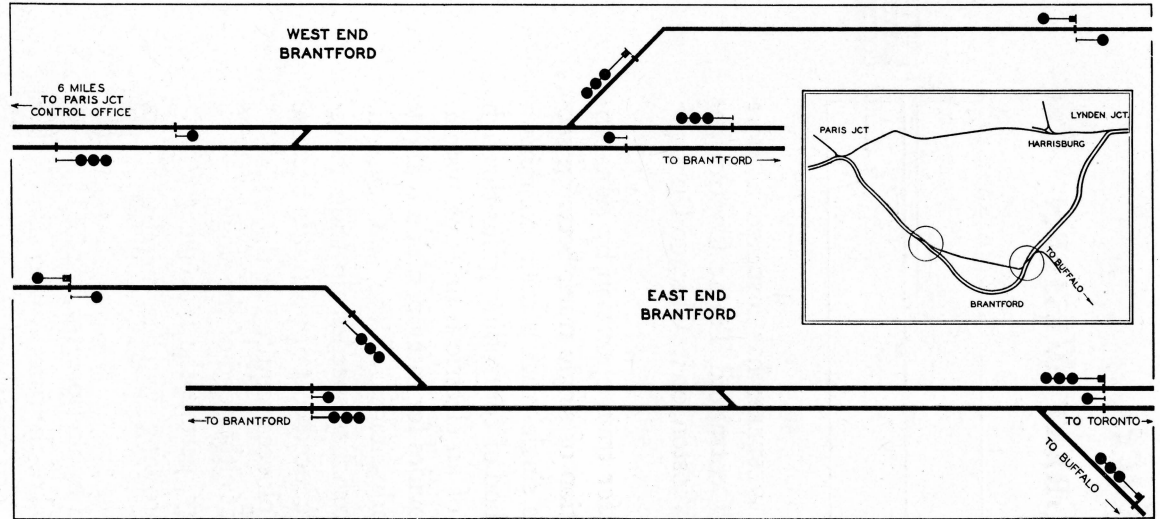
THE CHICAGO GREAT WESTERN has installed a short section of "Union" Centralized Traffic Control between Rice, Ill. and Winston, on its Chicago-Dubuque main line.

The installation provides for train operation by signal indication over a 1.6-mile section of single track between sections of double track. This single track section contains a tunnel and the previous method of controlling trains through the territory was by means of an electric train staff system. The C. T. C. installation provides for safe operation without the expense and other disadvantages of the staff system. Elimination of the staff system has speeded up train movements and has resulted in a reduced cost of operation because of the smaller number of employees required at this point.

Power operated switches at either end of the single track portion of the territory, permit the movement of trains without stops for throwing switches, thereby saving delay.

The territory is controlled by an operator, located in a cabin near the west portal of the tunnel, who also controls the apparatus used for tunnel ventilation.





Paris Junction to Brantford

CANADIAN NATIONAL

“UNION” CENTRALIZED TRAFFIC CONTROL is being installed on the new single track cut-off at Brantford, Ont. Each end of this cut-off, which is approximately 3½ miles in length, will be operated from the C. T. C. machine located in the interlocking tower at Paris Junction about 6 miles from the nearest controlled point on the territory. Freight and passenger trains will operate over this line to and from Buffalo and Toronto. The east end of the cut-off joins the main line through Brantford at the junction of the line to Buffalo. The installation includes two power-operated crossovers and three switches with necessary signals.

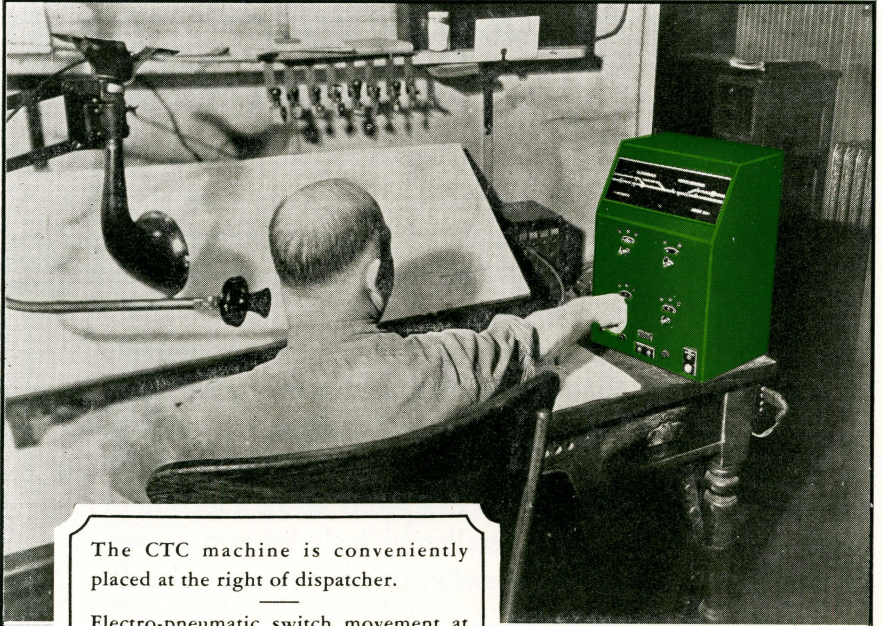
CENTRALIZED
TRAFFIC
CONTROL

Tusten to Lackawaxen

ERIE RAILROAD

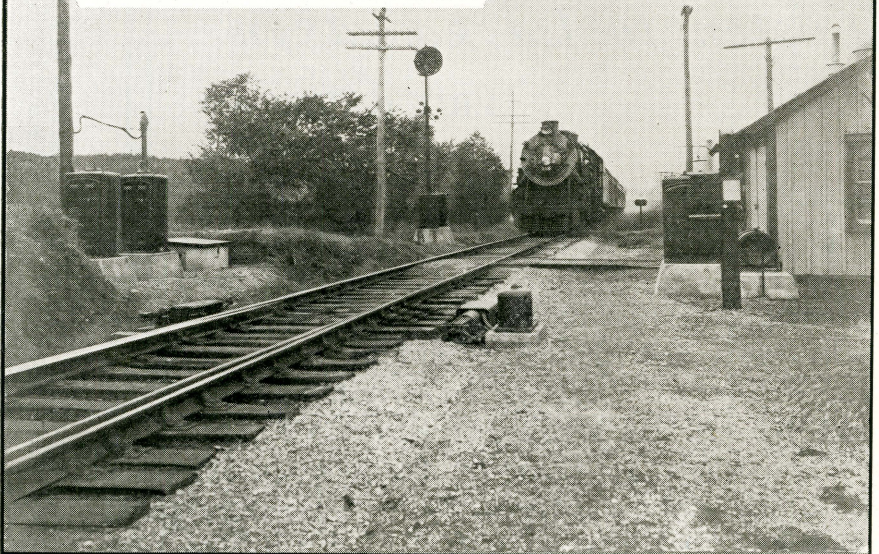
THE ERIE has installed “Union” Centralized Traffic Control on this short section of the double track between Tusten, N. Y. and Lackawaxen to provide for reverse traffic movements at a point where operating conditions make it desirable to make such movements regularly. This installation is on the main line over which all the through traffic between New York and the west passes.

Tusten is about 9½ miles west of Lackawaxen, the control point. The control machine has been designed to provide for the inclusion of a substantially similar layout at Rosas later.



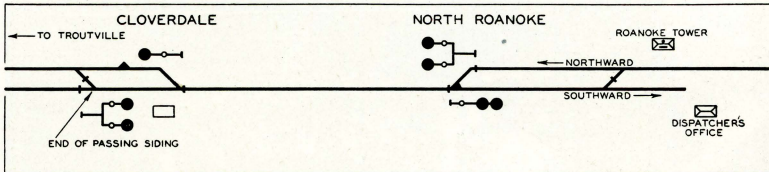
The CTC machine is conveniently placed at the right of dispatcher.

Electro-pneumatic switch movement at end of double track, North Roanoke.



North Roanoke to Cloverdale

NORFOLK & WESTERN



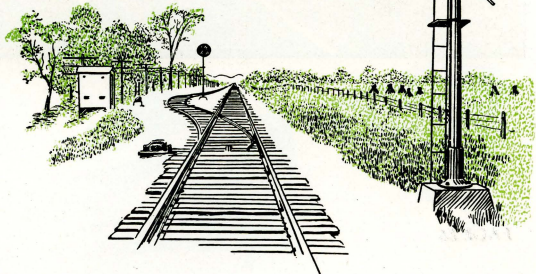
CENTRALIZED
TRAFFIC
CONTROL

THE NORFOLK AND WESTERN has installed a short section of "Union" Centralized Traffic Control on the single track between Roanoke and Cloverdale, about 8.5 miles. This installation has speeded up traffic and brought about operating savings which amount to a net return of more than 29 per cent on the investment. The installation involves the control of switches and signals at the end of double tracks at North Roanoke and the switches and signals at the near end of the first siding on the single track and affords additional capacity immediately adjacent to a terminal where it is most urgently needed.

Four passenger trains and 12 freight trains are operated daily in this territory, the average number of cars per freight train being 70. There has been a saving in wages owing to the closing of the telegraph office at North Roanoke and the changing of hours at Cloverdale and Troutville.

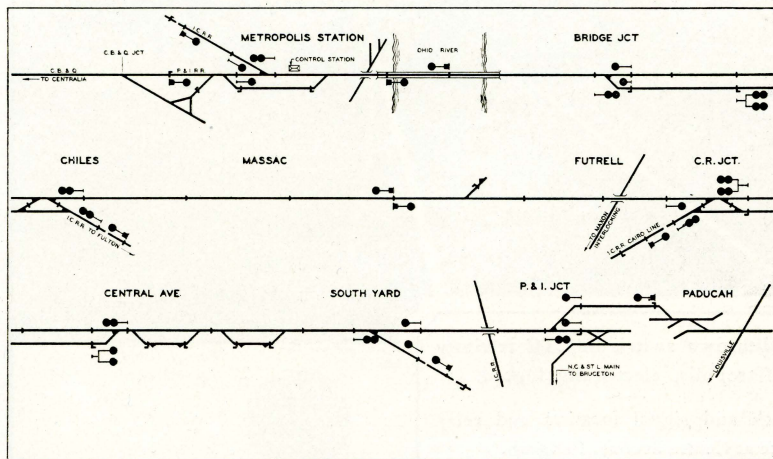
Under this system, trains are run by signal indication throughout the controlled territory, the machine being operated from the dispatcher's office at Roanoke.

This installation is equipped with an electro-pneumatic switch movement which is supplied by a small motor-driven compressor housed in signal instrument case.



Metropolis to Paducah

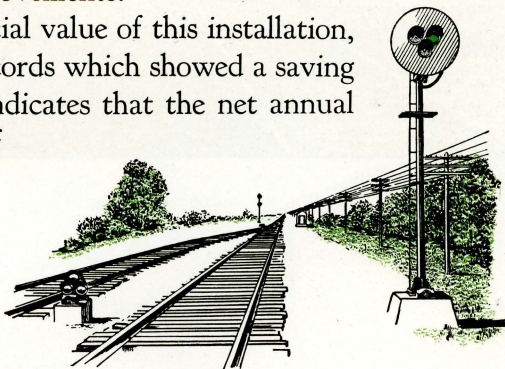
PADUCAH & ILLINOIS

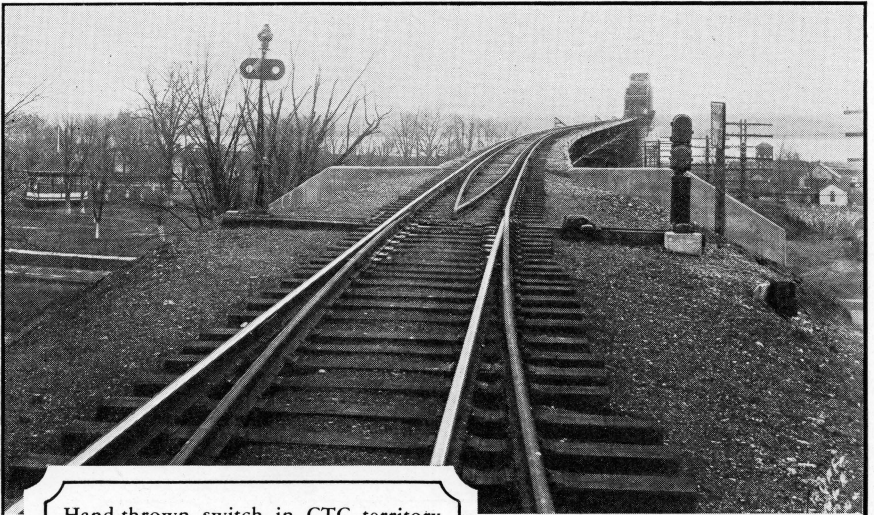


CENTRALIZED
TRAFFIC
CONTROL

“UNION” CENTRALIZED TRAFFIC CONTROL has made it possible to direct train movements by signal indication over this entire railroad. The Paducah & Illinois is a short connecting line over which trains of the Burlington and the Illinois Central are operated as well as occasional movements of the managing and operating carrier, the N. C. & St. L. For the most part, train movements were directed by a train order and manual block system; there was also a staff system in use over the Ohio river bridge. Centralized Traffic Control has replaced these two systems and materially expedited train movements.

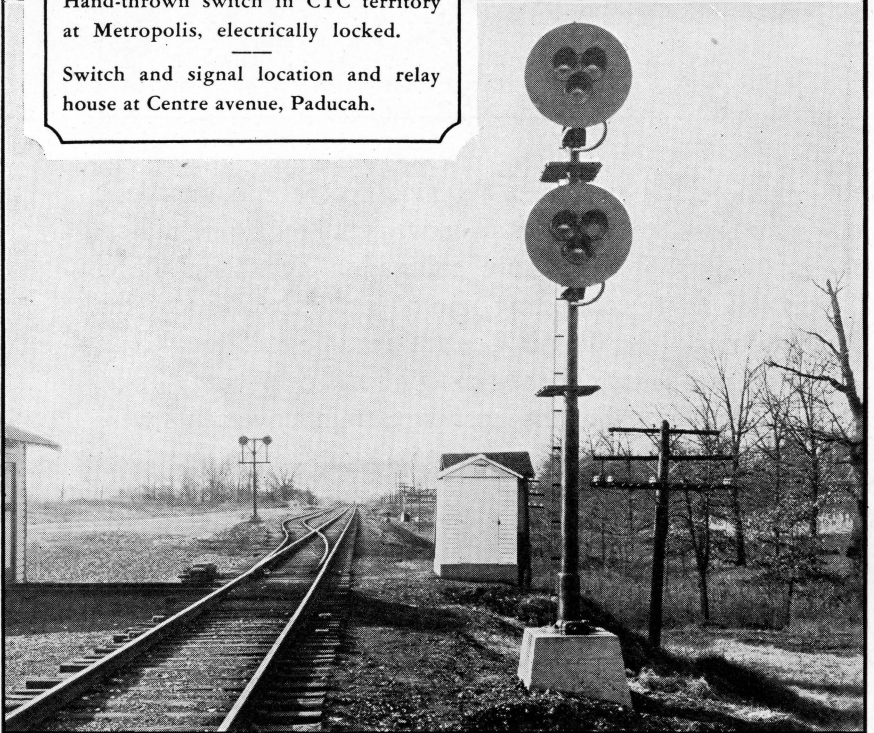
An estimate of the financial value of this installation, based upon performance records which showed a saving of 9.1 minutes per train, indicates that the net annual savings would be in excess of





Hand-thrown switch in CTC territory
at Metropolis, electrically locked.

Switch and signal location and relay
house at Centre avenue, Paducah.



24 per cent. The annual saving in number of train hours was calculated to be 1,592. There have been a large number of non-stop meets at sidings and junction points.

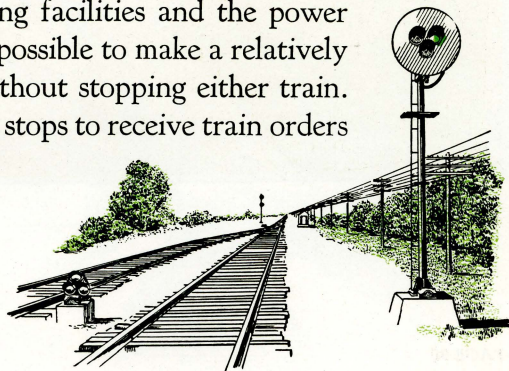
The P. & I. property extends from the junction switches of the Illinois Central and the Burlington, just north of Metropolis station, to Paducah, about 15 miles. In tonnage the most important single commodity handled over the P. & I. is coal from the Western Kentucky fields, while diversified manufactured and agricultural products also form an important part of the traffic. Four passenger trains, and from 40 to 60 freight trains are operated daily and this number is to be increased following a rearrangement of schedules and a re-routing of through traffic of the Illinois Central.

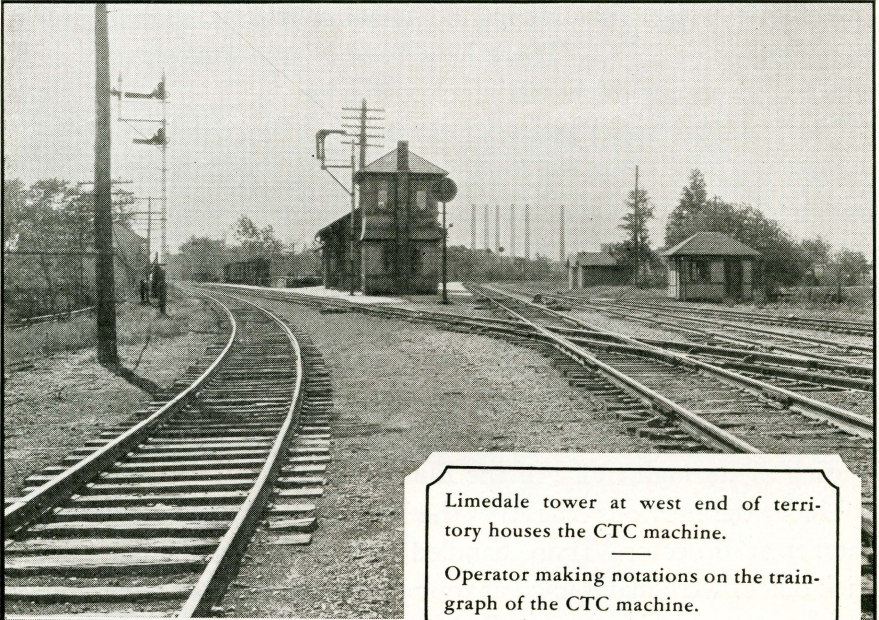
**CENTRALIZED
TRAFFIC
CONTROL**

Under the previous operation the N. C. & St. L. train dispatcher at Bruceton, Tenn. handled the territory and three trick offices were maintained at four points on the line. The present system which is controlled from the station at Metropolis requires no other block or telegraph stations on the line.

Centralized Traffic Control with power-operated switches and movement by signal indication is exceptionally well adapted to the type of operation encountered on this road where the number of train movements is relatively high and the average length of run and time on the territory is short. The large number of points from which traffic originates complicated operation by train orders but with track changes to permit the maximum number of simultaneous moves and the power operation of all switches, the present method of operation by signals has greatly facilitated the handling of trains.

Because of improved siding facilities and the power operated switches, it is now possible to make a relatively high percentage of meets without stopping either train. There are now, of course, no stops to receive train orders with this new operation.



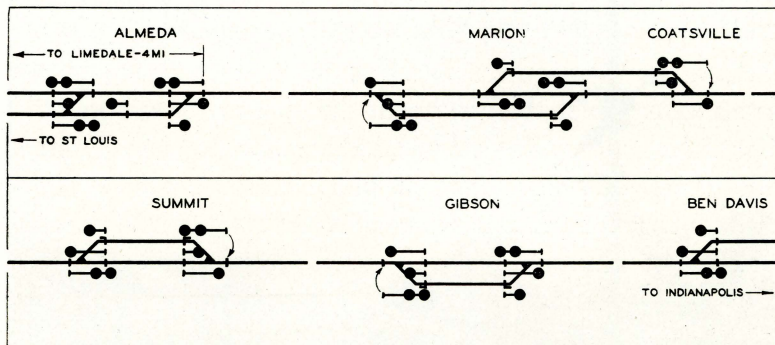


Limedale tower at west end of territory houses the CTC machine.
—
Operator making notations on the train-graph of the CTC machine.



Limedale to Ben Davis

PENNSYLVANIA R. R.

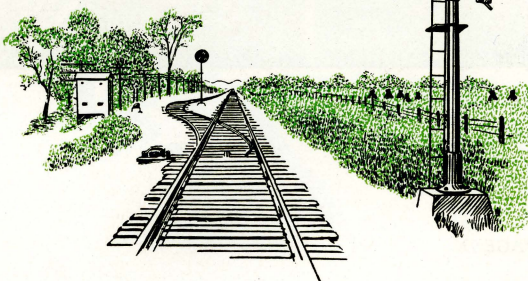


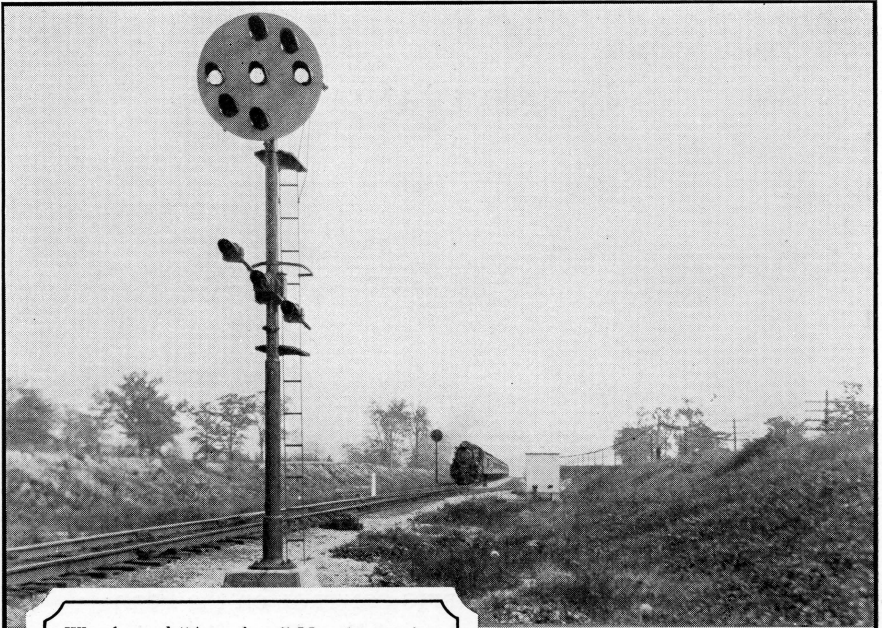
CENTRALIZED
TRAFFIC
CONTROL

“UNION” CENTRALIZED TRAFFIC CONTROL on the Pennsylvania between Almeda and Ben Davis is saving 12 minutes for each freight train stop avoided as a result of the power operation of siding switches.

This section comprises 30.3 miles of single track on the main line between Indianapolis, Ind. and St. Louis, Mo. As a result of the installation of this Centralized Traffic Control System for the operation of switches and signals the movement of trains, especially freights, has been greatly facilitated. This result is accomplished chiefly through the elimination of train stops when entering and leaving the sidings.

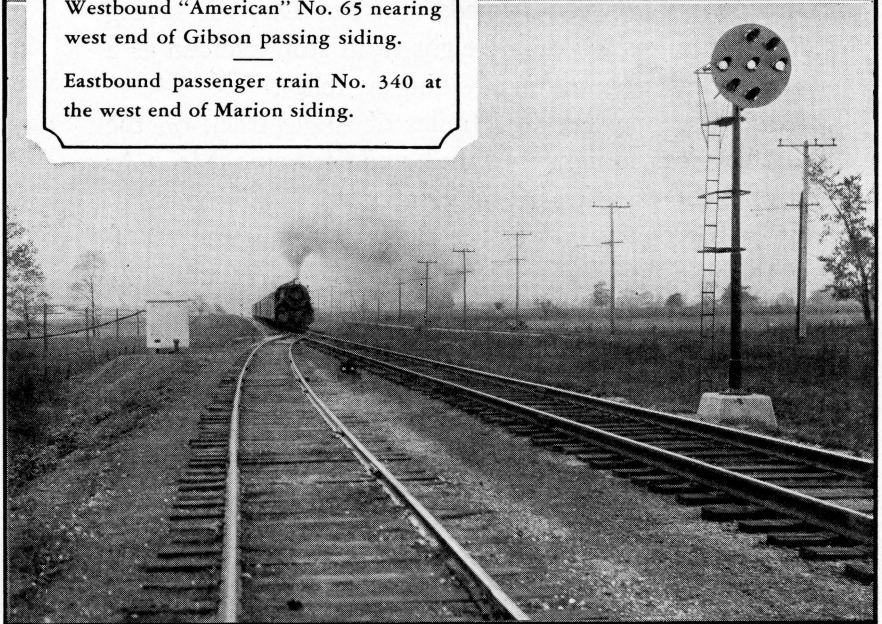
Double track extends from Indianapolis to Ben Davis, 6.9 miles, and also from Almeda to Limedale, 3.1 miles, the second tracking of the intermediate section between Ben Davis and Almeda, 30.3 miles, having been postponed on account of proposed line changes and extensive grade revisions. This section traverses a rough,





Westbound "American" No. 65 nearing
west end of Gibson passing siding.

Eastbound passenger train No. 340 at
the west end of Marion siding.



rolling country and has short grades up to 0.83 per cent.

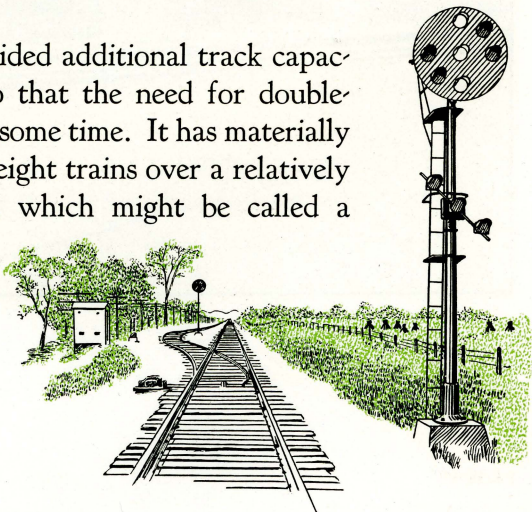
The traffic on this division consists of 19 regular passenger trains and an average of 16 freight trains daily. All but two of the passenger schedules are fast through trains covering the 30.3 miles in about 30 minutes eastward and 32 minutes westward. Freights are for the most part fast through trains which operate up to 50 m. p. h.

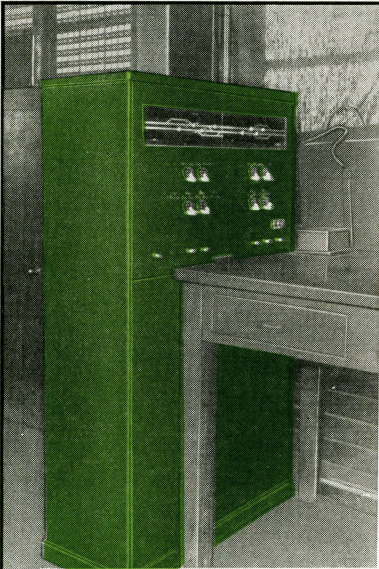
The passing tracks in the territory include advance tracks at Ben Davis and Almeda, a set of lap sidings at Marion and single sidings at Gibson and Summit. On account of the grade conditions, serious delays were caused when trains were stopped to enter sidings at Summit and Gibson, so much difficulty being experienced at Gibson that the siding was only used when absolutely necessary.

The control machine for the territory is located in an existing interlocking tower at Limedale. Establishing the control at this point made it possible to discontinue train order offices at Almeda and Summit. A feature of the track diagram on the control machine is the continuous indication of the location of all trains on the entire territory. One lamp is provided in the track diagram for each track circuit or group of circuits in the field, this lamp being extinguished only during the time that the corresponding track circuits are occupied. The lamps at the levers give continuous indication of the position of each switch and the indication displayed by each controlled signal.

This installation has provided additional track capacity to a single track line so that the need for double-tracking will be deferred for some time. It has materially expedited the handling of freight trains over a relatively busy piece of single track, which might be called a "bottle neck" on this portion of the railroad.

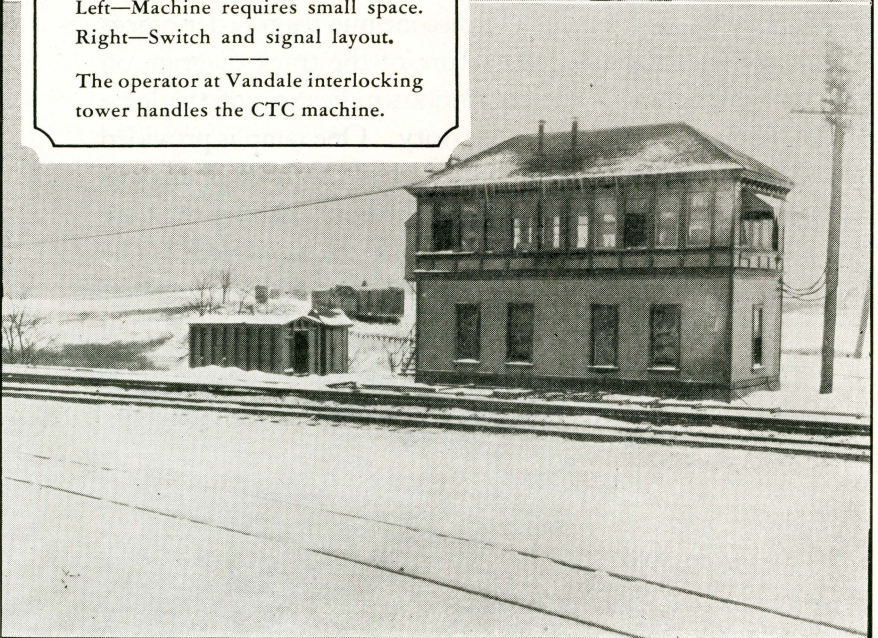
**CENTRALIZED
TRAFFIC
CONTROL**





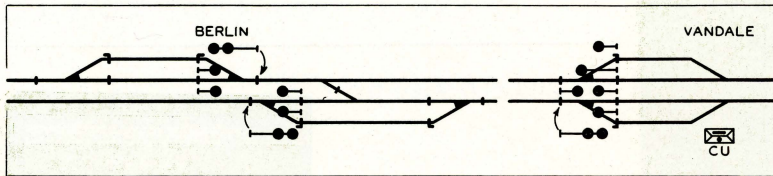
Left—Machine requires small space.
Right—Switch and signal layout.

The operator at Vandale interlocking tower handles the CTC machine.



Berlin to Vandale

PENNSYLVANIA R. R.



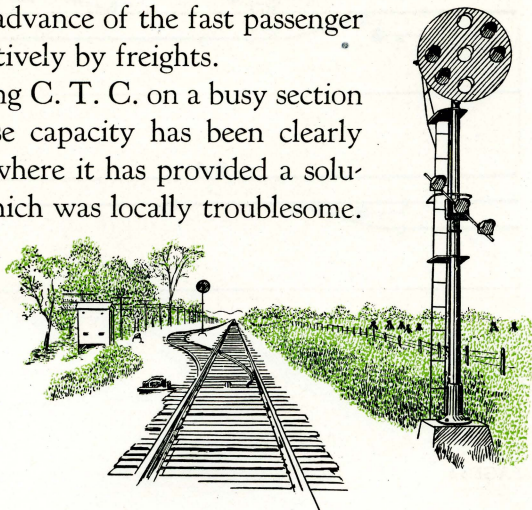
CENTRALIZED
TRAFFIC
CONTROL

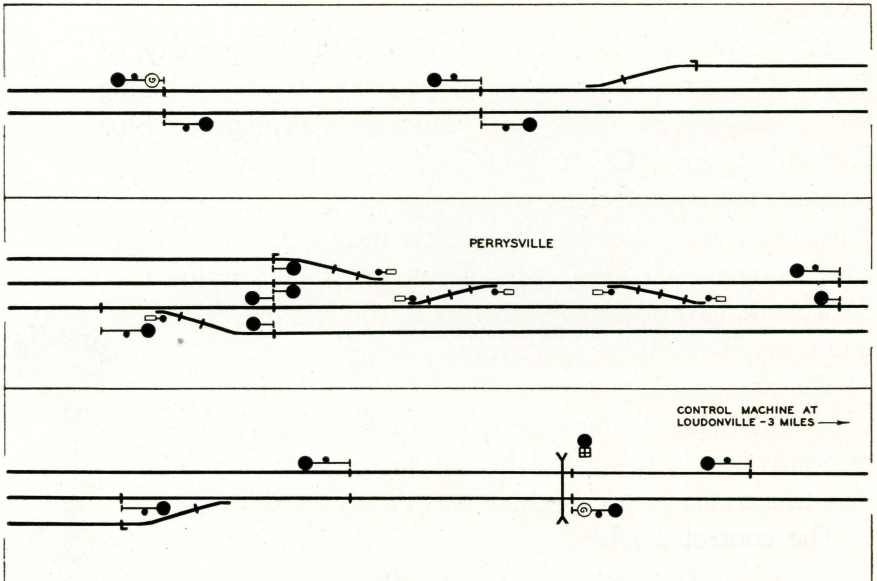
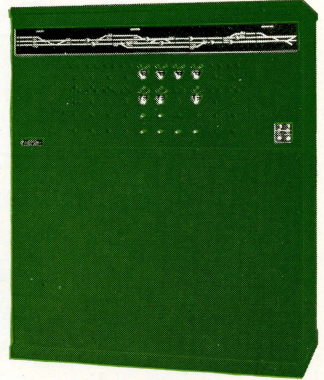
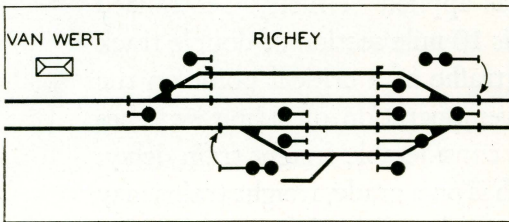
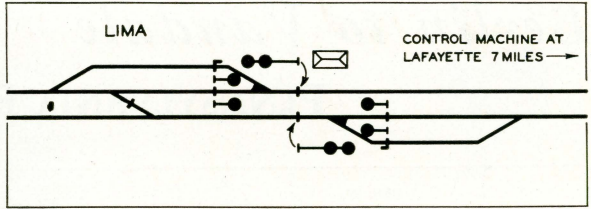
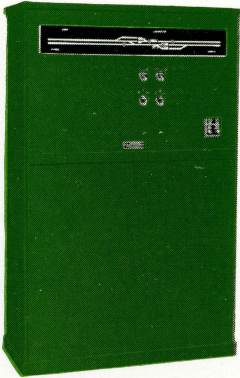
THE PENNSYLVANIA has applied "Union" Centralized Traffic Control to this 10-mile section of double track in order to expedite traffic at a critical point on the Fort Wayne division. Power operation of siding switches has made it possible to avoid considerable freight train delay; for, where the entering switch is on a grade, freight trains may be moved into sidings quickly and without delay to following passenger trains.

Traffic over this line averages 65 to 70 trains per day, of which 32 are regularly scheduled passenger trains, including the Chicago-New York and Chicago-Washington "Blue Ribbon" trains. Centralized Traffic Control has made it possible to move freight trains greater distances ahead of these passenger trains and frequently means that 45 minutes to 1 hour is saved on each of several freight trains. Shorter periods of time in advance of the fast passenger trains may be utilized effectively by freights.

The practicability of using C. T. C. on a busy section of double track to increase capacity has been clearly demonstrated in this case where it has provided a solution to a traffic problem which was locally troublesome.

The control machine is in the Vandale tower.





Perrysville to Loudonville *Lima to Lafayette* *Richey to Van Wert*

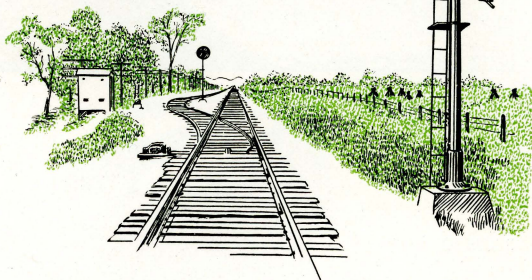
PENNSYLVANIA R. R.

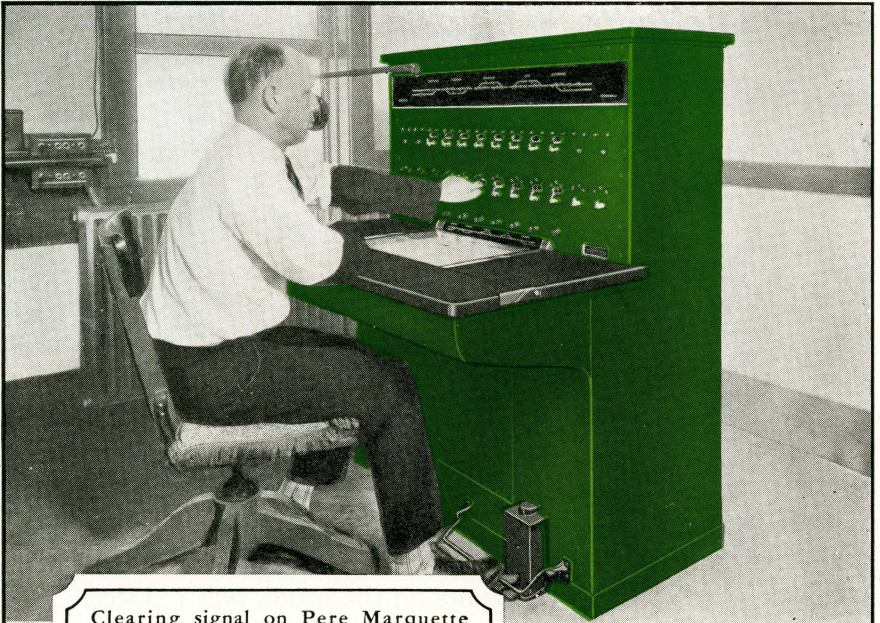
CENTRALIZED
TRAFFIC
CONTROL

THE PENNSYLVANIA RAILROAD has installed Centralized Traffic Control at four points on the double track line between Pittsburgh and Chicago. All these installations are on the route of the Broadway Limited and other fast Pennsylvania trains, both passenger and freight. The traffic over this route averages 65 to 70 trains per 24-hour period. About half are passenger trains. These installations, which have been placed at critical points on the route, will reduce the amount of train delay.

The Perrysville-Loudonville installation replaced a mechanical interlocking at Perrysville which had been destroyed by fire. There are two crossovers and two ends of siding controlled. The machine, which is located at Loudonville, about three miles from the controlled territory, has space provided on it to handle additional functions at another place west of Perrysville when it becomes desirable to make the expansion.

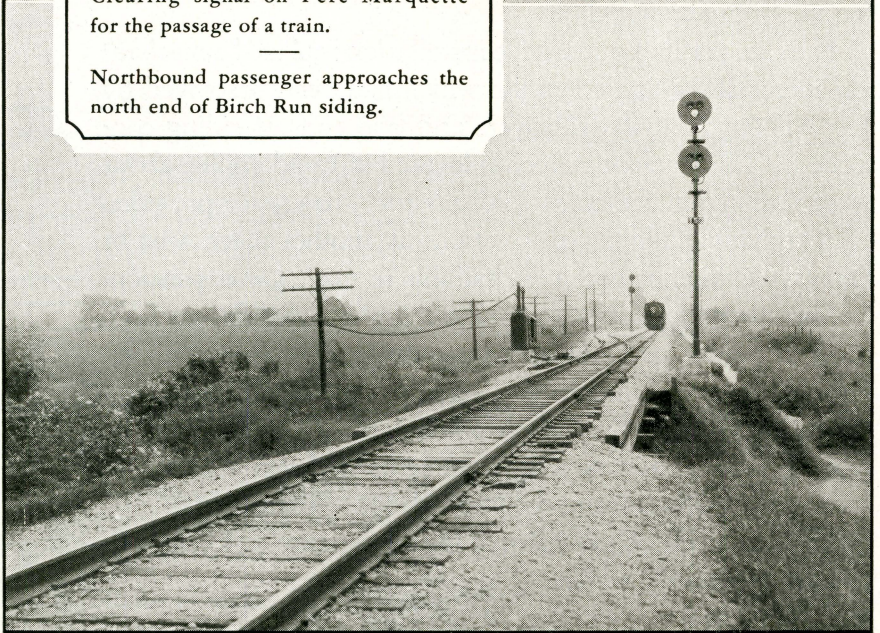
The other installations, Lima to Lafayette and Richey to Van Wert, are not so extensive as that between Perrysville and Loudonville. There are four switch movements at Richey which control the ends of two passing sidings, and switch movements at Lima which control the adjacent ends of two sidings. These installations are excellent examples of the application of C. T. C. to short double track sections of heavy traffic.





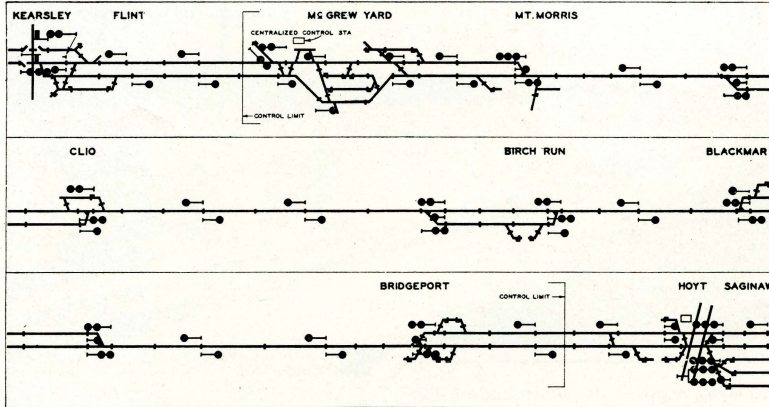
Clearing signal on Pere Marquette
for the passage of a train.

—
Northbound passenger approaches the
north end of Birch Run siding.



Bridgeport to Mt. Morris

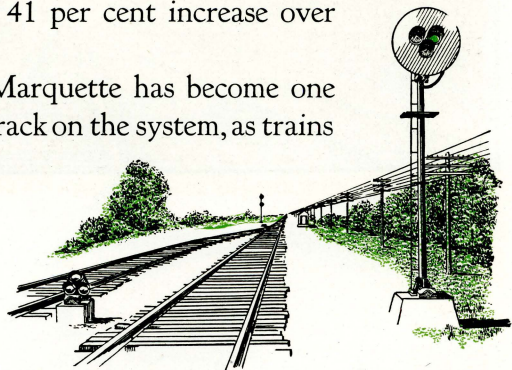
PERE MARQUETTE



CENTRALIZED
TRAFFIC
CONTROL

FOR NEARLY THREE YEARS, the Pere Marquette has had in service an installation of "Union" Centralized Traffic Control on a 20-mile section of single track between two sections of double track where trains are operated by signal indication without written train orders. Coincident with the installation of C. T. C., the three intermediate sidings were lengthened and the complete change has resulted in a decided improvement in train operation, increased speed, increased train loading, reduction in number of train hours and a more dependable operation. No. 20 turnouts were installed to permit movements at higher speeds into sidings. In the first year of operation under the new system, gross ton miles per train hour showed 41 per cent increase over the two preceding years.

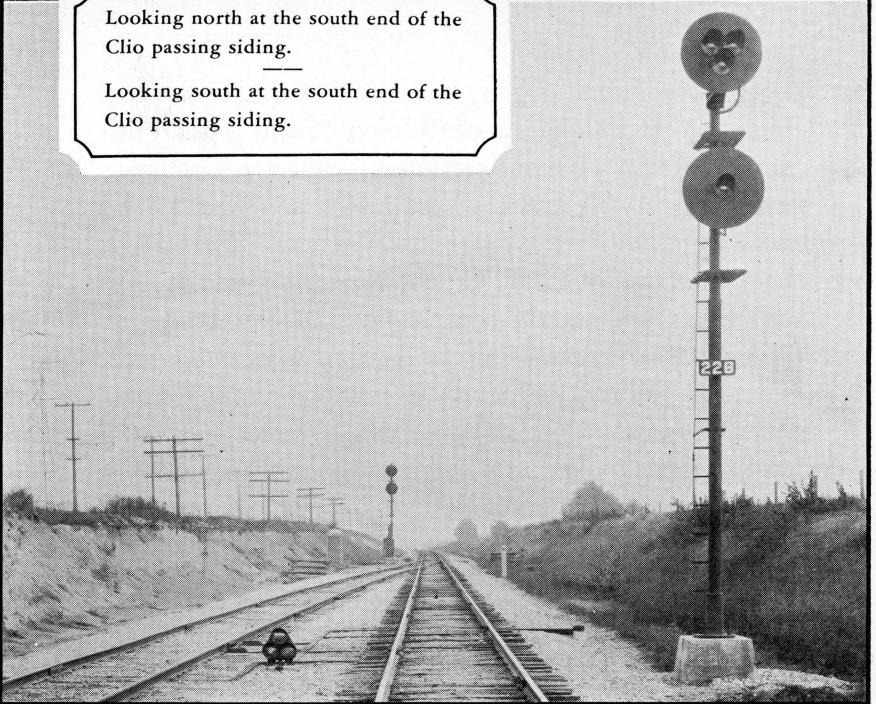
This section of the Pere Marquette has become one of the busiest pieces of single track on the system, as trains from 5 different directions





Looking north at the south end of the
Clio passing siding.

Looking south at the south end of the
Clio passing siding.



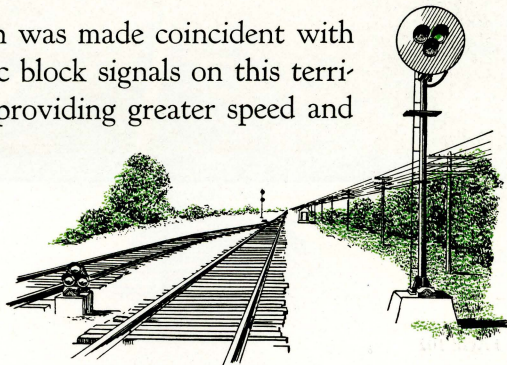
must use it. Traffic over the line averages about 14 trains each way daily, of which 3 are passenger and 9 freight trains. The operating difficulties were not occasioned by the number of trains in the 24 hours, but rather by the fact that the majority of the traffic must be handled over the territory at night, especially between 6:00 p. m. and 1:00 a. m. Loaded cars are pulled from the automobile plants after 5:00 p. m. and must be moved out promptly to make connections. Deliveries of merchandise are so arranged that this traffic must move over this section of the line during the early hours of the night. Coal and other traffic must be kept moving with a minimum of delay.

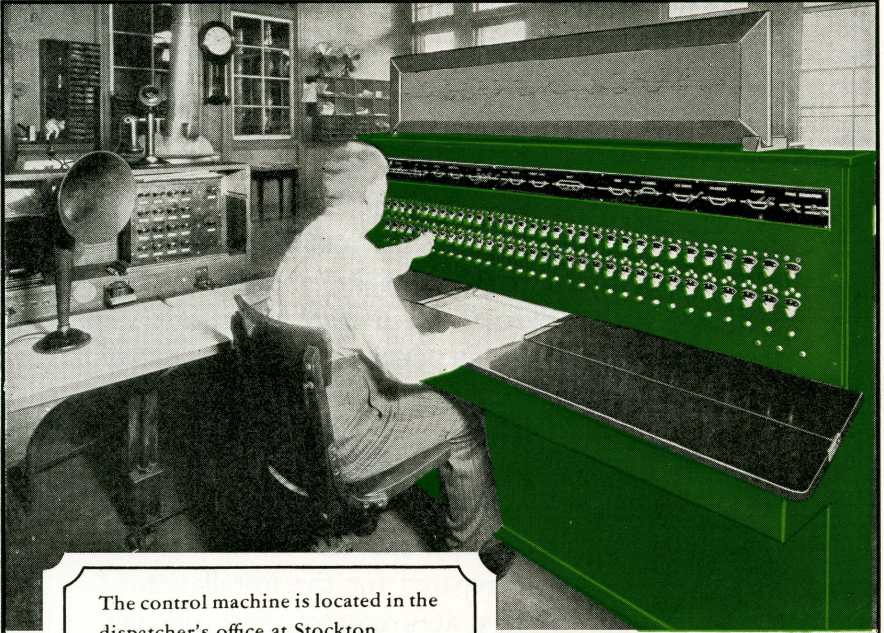
**CENTRALIZED
TRAFFIC
CONTROL**

Prior to the installation of Centralized Traffic Control, trains were directed by time table, train orders and a manual block system. At about the time that C. T. C. was first developed, plans had been prepared for the installation of second track on this territory at a cost of approximately \$750,000. It was decided, however, to install C. T. C. with some track changes at about one-fifth the total cost.

A study of the performance of the new system during the first year of its operation on this section has indicated that the net saving in train operating expense per year is sufficient to bring about a return of more than 22 per cent on the investment after all costs and normal interest charges. In addition to this the new signaling has increased the capacity of the line and has postponed the need for building second track at a much higher capital cost until the growth of traffic justifies the additional expense, thereby reducing interest and maintenance expense.

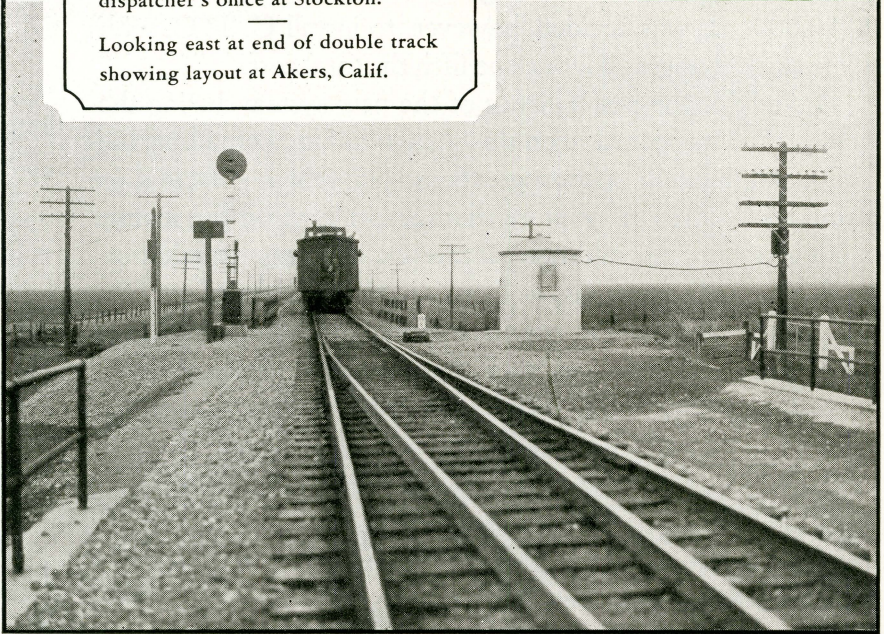
The C. T. C. installation was made coincident with the installation of automatic block signals on this territory, the combined system providing greater speed and safety for train operation.





The control machine is located in the dispatcher's office at Stockton.

Looking east at end of double track showing layout at Akers, Calif.



Stockton to Brighton

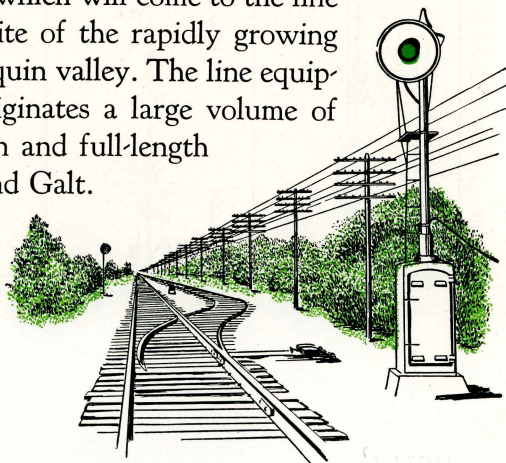
SOUTHERN PACIFIC

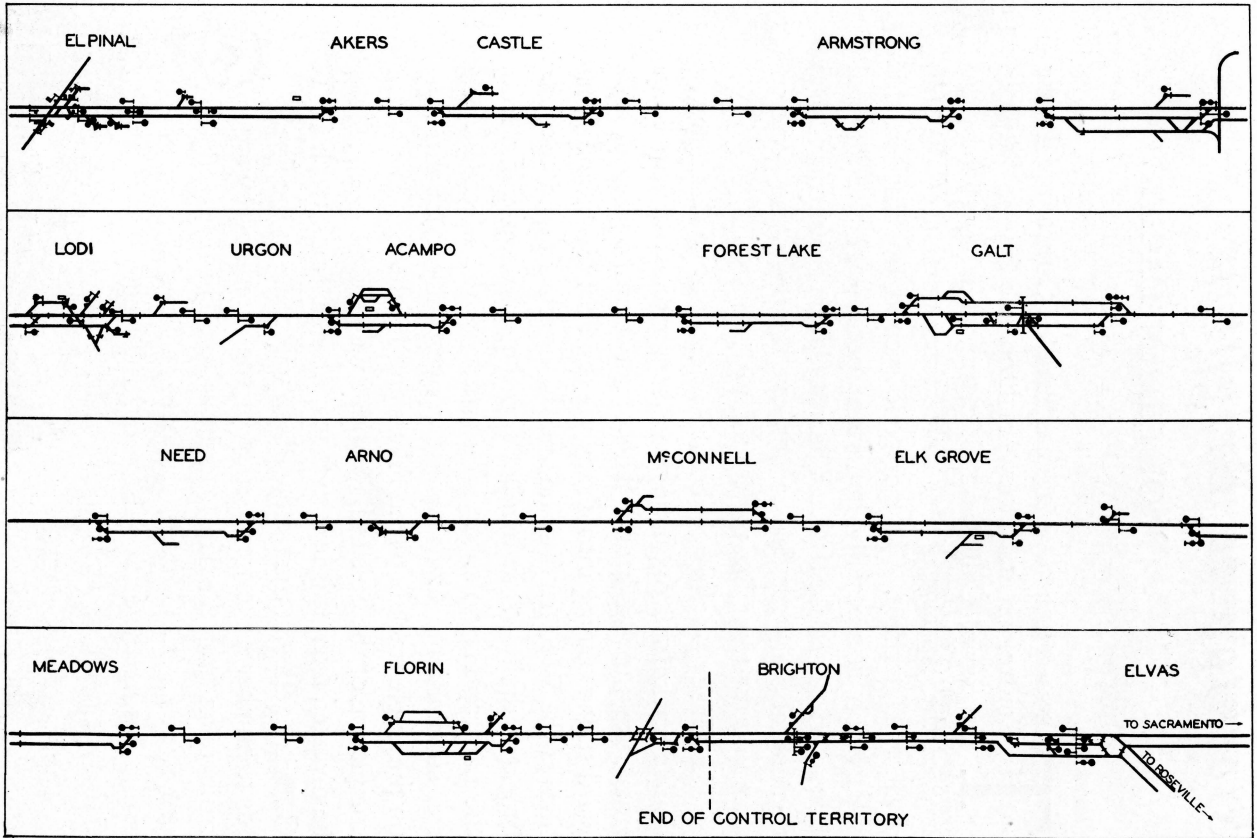
THE SOUTHERN PACIFIC has installed Centralized Traffic Control on its Tracy-Brighton subdivision between Stockton, Calif. and Brighton, and has thereby increased the capacity of this single track portion of the subdivision materially. To postpone second tracking on this subdivision is especially important because of the seasonal characteristics of the traffic. The installation has accomplished this and also a great deal to improve the operating performance in gross ton miles per train hour.

The Tracy-Brighton subdivision consists of 21 miles of double track line from Tracy to Akers and a single track line from Akers to Brighton. This subdivision handles all eastward traffic coming into Tracy via the Port Costa and Niles lines of the Western division and the Fresno-Tracy line of the Stockton division. It handles also the eastward traffic from the Lathrop-Fresno subdivision and from the Merced-Stockton subdivision. Considerable congestion occurs therefore on the single track between Akers and Brighton. The recent completion of the Suisun Bay bridge will cause some traffic to be diverted from this line so that the single track, with C. T. C., will handle all the traffic which will come to the line for a number of years in spite of the rapidly growing fruit traffic from the San Joaquin valley. The line equipped with C. T. C. itself originates a large volume of traffic during the fruit season and full-length trains are made up at Lodi and Galt.

The seasonal characteristics of the traffic are

CENTRALIZED
TRAFFIC
CONTROL





very marked. The peak traffic is in October with almost as many trains in the month of September and the first part of November. There is a spring peak about the first of May which is considerably less than the October peak and is not therefore a controlling factor. The number of freight trains per day over a period of one year varied from 9 to 37, the distribution being as follows:

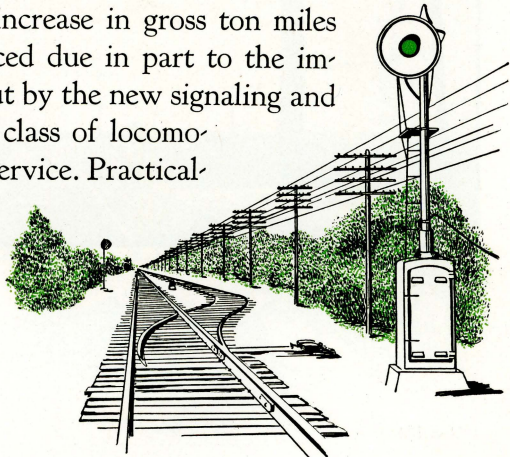
**CENTRALIZED
TRAFFIC
CONTROL**

<i>Freight Trains per Day</i>	<i>Number of Days</i>
9 to 15	145
16 to 20	96
21 to 25	68
Over 25	55

In addition, there are 9 scheduled passenger trains per day.

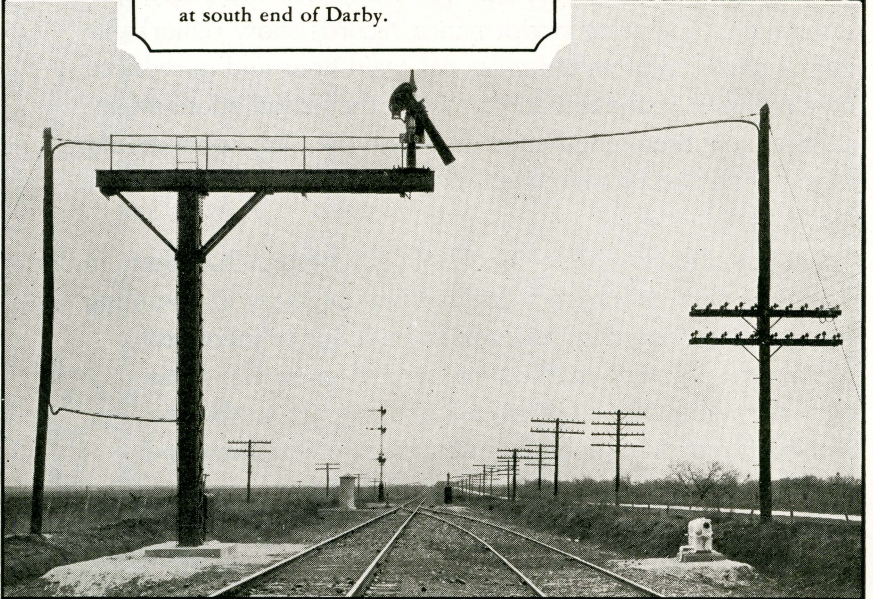
The installation was made as a result of an intensive study of the relative advantages of C. T. C. and second tracking and subsequent indications are that the study was extremely conservative. Operating performance records show remarkable improvement in gross ton miles per train hour and in reduced time of trains on the territory. As in other installations where sidings have been lengthened or where they are considerably longer than the average train, non-stop meets are frequently made.

During the time that the C. T. C. System has been in operation there has been a decided improvement in operating performance records on this subdivision due to increased efficiency. A very marked increase in gross ton miles per train hour was experienced due in part to the improved facilities brought about by the new signaling and in part to the change in the class of locomotives used in through freight service. Practically all delays due to meets have now been eliminated.



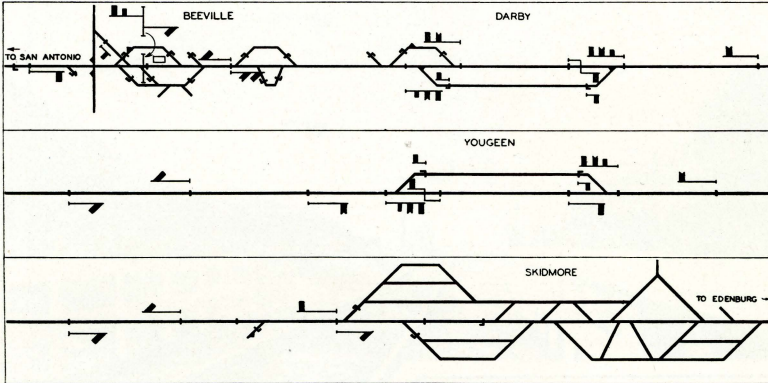


Left—Machine at Beeville.
Right—Switch and signal location.
Main line and leave siding signal
at south end of Darby.



Beeville to Skidmore

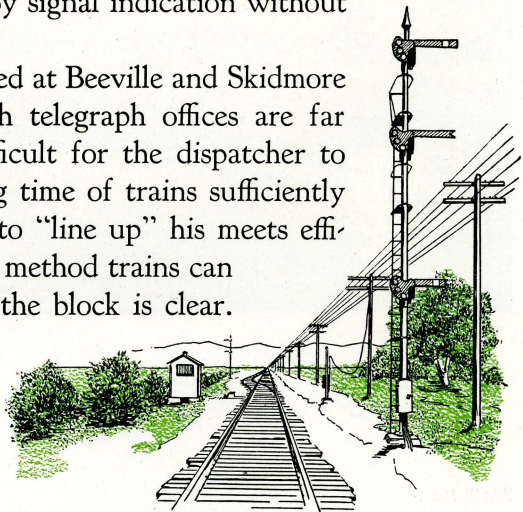
SOUTHERN PACIFIC (T&NO)



CENTRALIZED
TRAFFIC
CONTROL

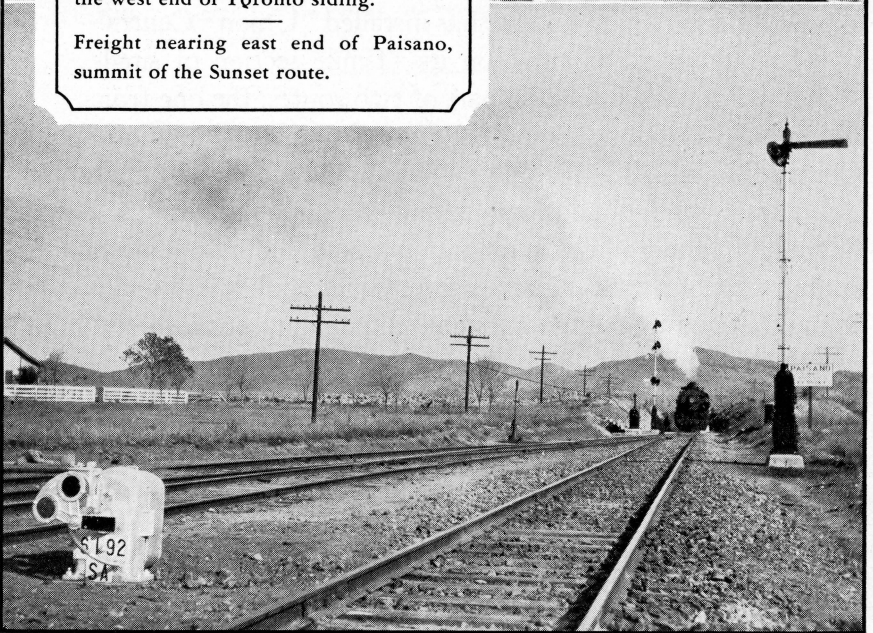
THE SOUTHERN PACIFIC has installed "Union" Centralized Traffic Control on its 11-mile section of single track, which forms a part of two routes, the one from Houston to Brownsville and the other from San Antonio to Corpus Christi. The installation was made because the combined traffic caused considerable congestion in the handling of trains. A more flexible operation which eliminates delays is the result of the new installation by means of which trains are authorized to operate by signal indication without written train orders.

Because trains are received at Beeville and Skidmore from two routes on which telegraph offices are far apart, it was formerly difficult for the dispatcher to know the probable arriving time of trains sufficiently in advance to permit him to "line up" his meets efficiently. Under the present method trains can be moved promptly when the block is clear.



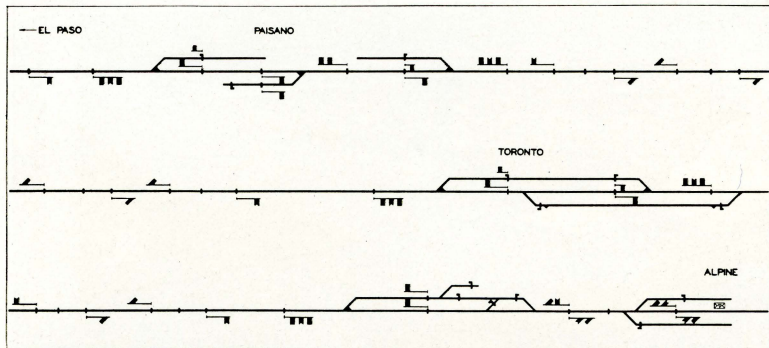


Westbound Sunset Limited approaching
the west end of Toronto siding.
Freight nearing east end of Paisano,
summit of the Sunset route.



Alpine to Paisano

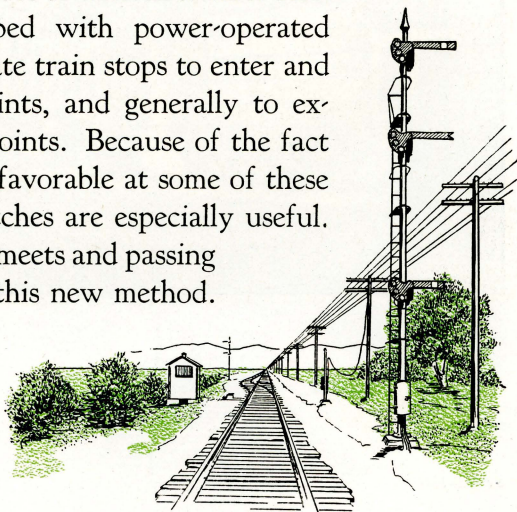
SOUTHERN PACIFIC (T&NO)

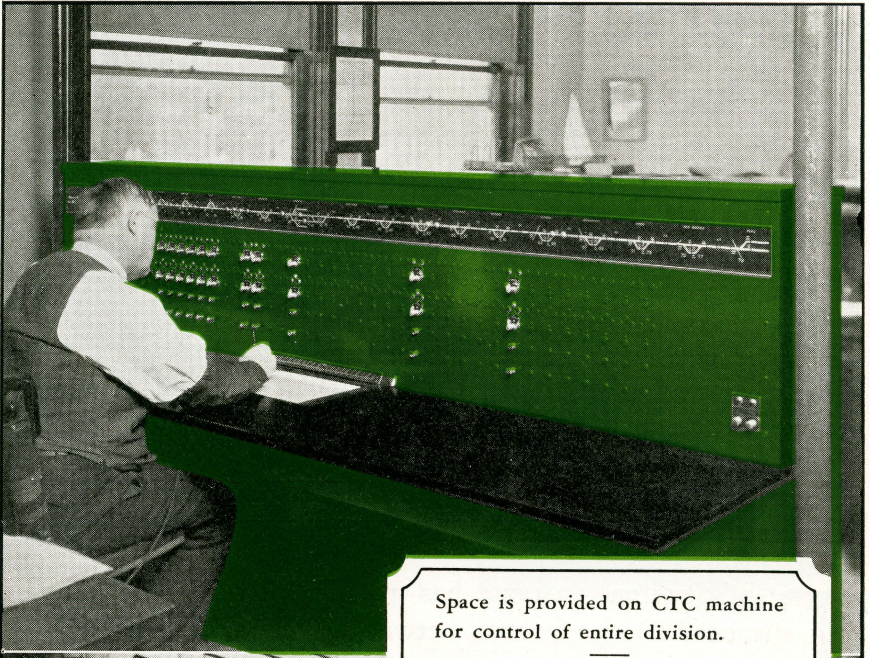


CENTRALIZED
TRAFFIC
CONTROL

THE SOUTHERN PACIFIC has installed "Union" Centralized Traffic Control between Alpine, Texas and Paisano on the main line between San Antonio, Texas and El Paso. Paisano is the summit of the Sunset Route, the elevation being 5,074 ft. This section of single track, about 12 miles in length, is 200 miles east of El Paso and handles the highly competitive business from the west to Mississippi river gateways as well as the Sunset Route traffic to New Orleans.

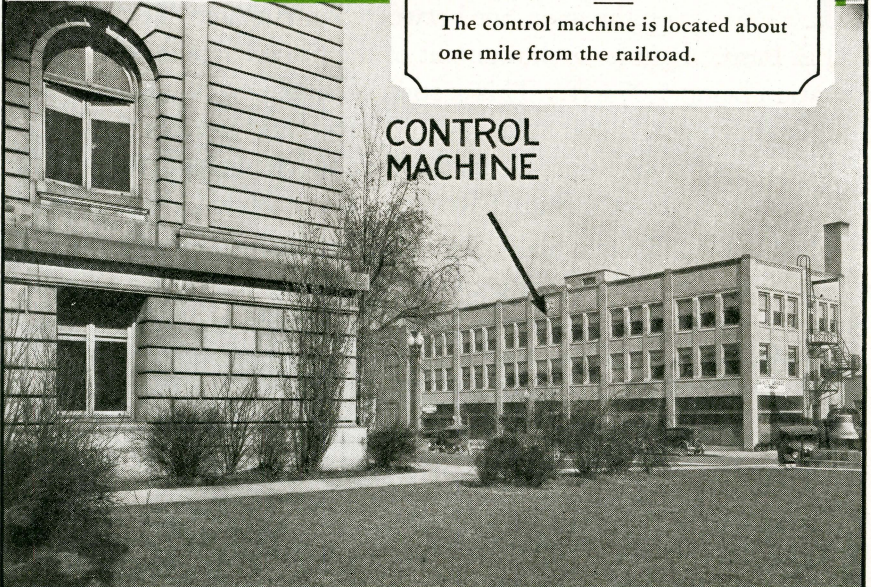
The C. T. C. System makes it possible to operate trains by signal indication without the use of written train orders. Siding switches are equipped with power-operated switch movements to eliminate train stops to enter and leave sidings at meeting points, and generally to expedite movements at these points. Because of the fact that grade conditions are unfavorable at some of these sidings, power-operated switches are especially useful. Greater flexibility in making meets and passing movements is possible with this new method.





Space is provided on CTC machine
for control of entire division.

The control machine is located about
one mile from the railroad.



**CONTROL
MACHINE**

Peru to State Line

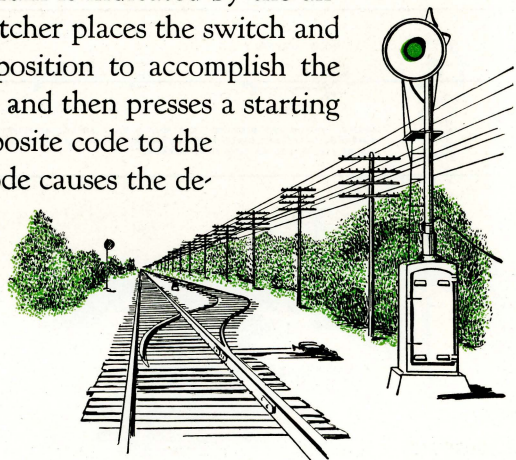
WABASH R. R.

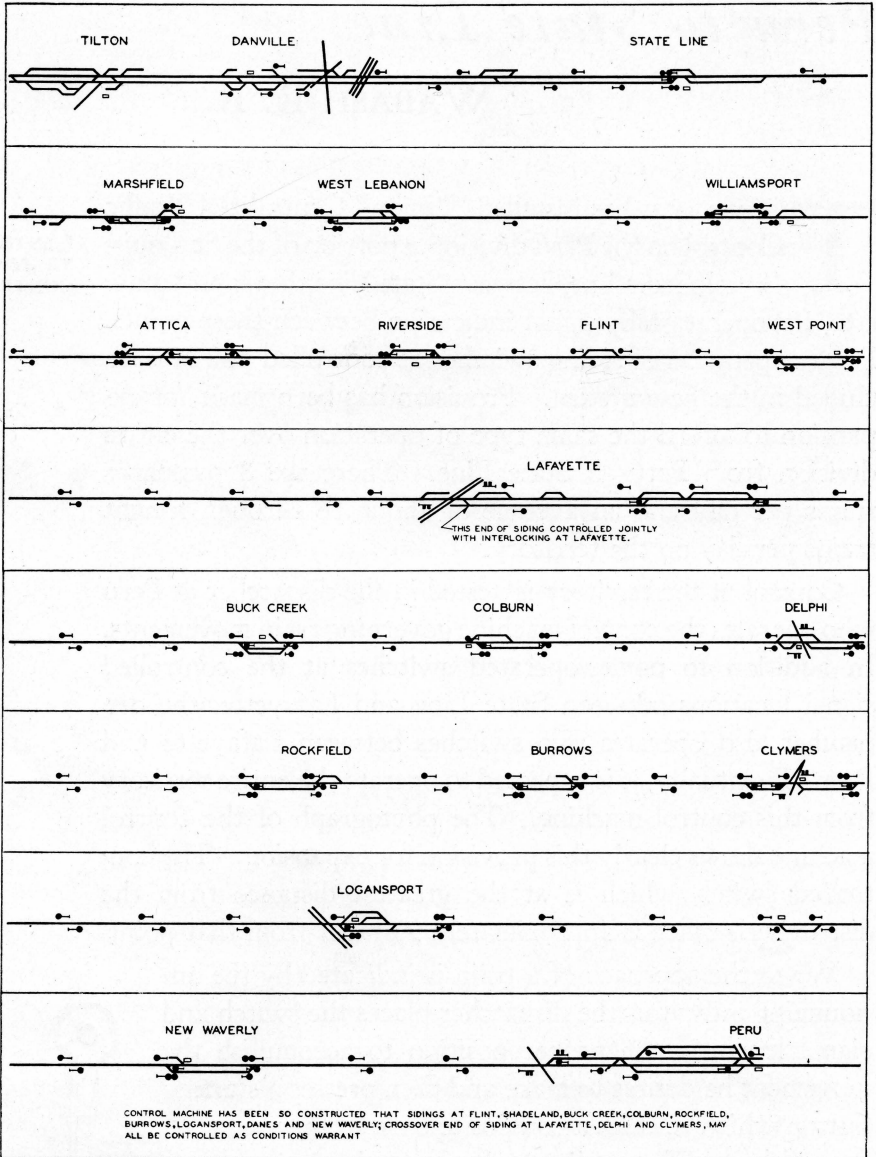
THE WABASH has installed "Union" Centralized Traffic Control on the Peru division, a portion of the St. Louis-Buffalo main line, between State Line, Ind. and Lafayette, for operation by signal indication between these points. Power operation of siding switches at controlled points is included in the new system. Provision has been made for expansion to afford the same type of operation over the entire division from Peru to State Line. There are 8 passenger trains per day and an average of about 16 through freight trains per day on the territory.

CENTRALIZED
TRAFFIC
CONTROL

Control of the territory is vested in the dispatcher at Peru who operates the control machine governing train movements. In addition to power-operated switches at the controlled signal locations between State Line and Lafayette, the dispatcher also operates two switches between Lafayette and Peru. Eventually, it is expected to operate the entire territory from this control machine. The photograph of the control machine shows clearly this provision for expansion. The controlled switch which is at the greatest distance from the dispatcher's office is approximately 93 miles from that point.

When the approach of a train is indicated by the announcing indicator, the dispatcher places the switch and signal levers in the proper position to accomplish the movement he desires to make and then presses a starting button which releases a composite code to the control line. The sending code causes the desired functions to operate in the field, after which





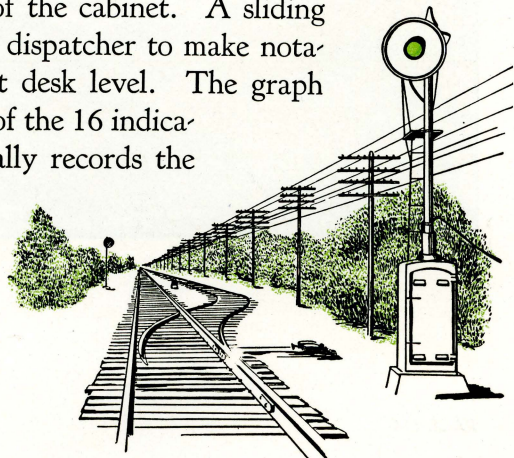
an indication code is returned to the control machine for the information of the dispatcher. About 1½ seconds are required for the transmission or reception of a code, thus with field functions (switch and signal) which will operate in 8 seconds the total time cycle, from the starting of the code by the dispatcher to the reception of information that the desired switch and signal changes have been made, is only 11 seconds. Where the changes involve only the signals, this cycle is only 4 seconds.

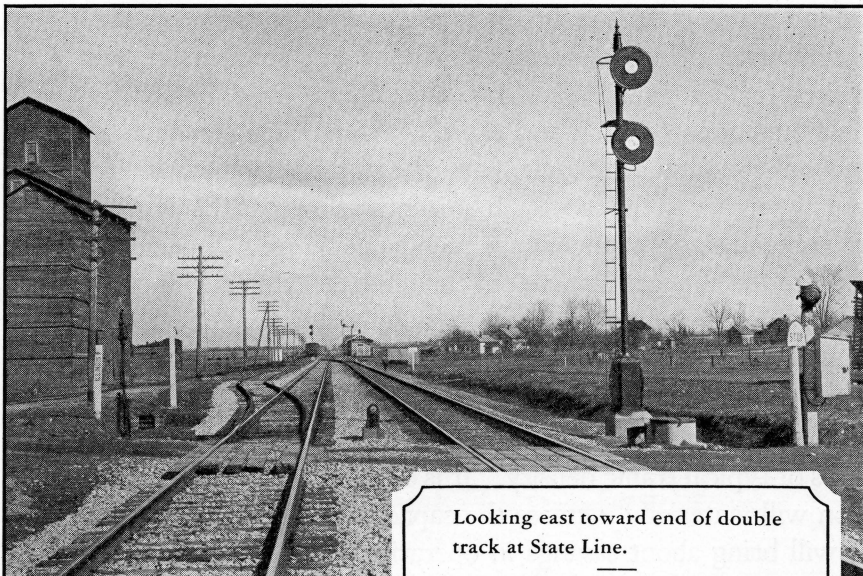
**CENTRALIZED
TRAFFIC
CONTROL**

The installation was made after a study of its probable economies was determined from an analysis of train charts prepared from dispatcher's records of train movements on days of typical traffic density. It is expected that the installation will materially increase the capacity of the line and that it will bring about savings in operating expenses because of the reduction in the number of train hours required to handle the business of the division as well as the reduction in the number of train stops at meeting and passing points.

Savings of approximately 15 minutes per train have been realized in the first few months of operation.

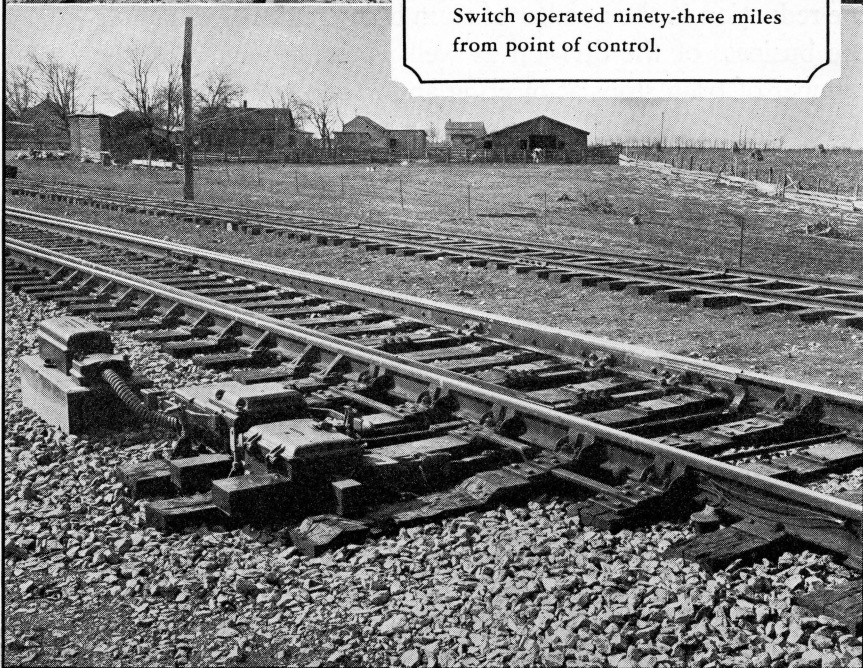
The control machine was placed in the dispatcher's office located in an office building in the business district of Peru, Ind. about one-half mile from the railroad. The location and progress of trains is indicated on the illuminated track model which is a part of the control machine, and an automatically recorded permanent "OS" is made on the train-graph which is built into the desk of the cabinet. A sliding glass cover which permits the dispatcher to make notations on this train-graph is at desk level. The graph instrument has a pen for each of the 16 indication points, which automatically records the arrival and departure of trains from the corre-





Looking east toward end of double track at State Line.

Switch operated ninety-three miles from point of control.

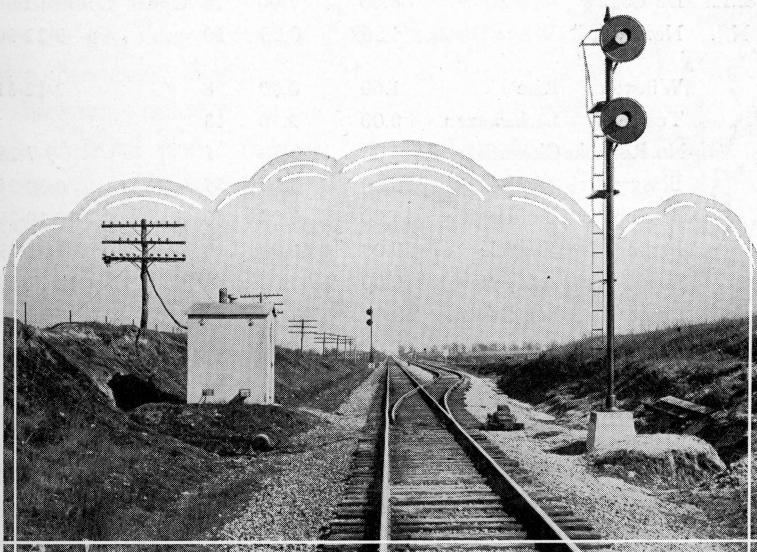


sponding locations on the territory. The graph paper is about 20 inches wide and advances at the rate of 3 inches per hour. Indication lamps on the control board repeat the indication of each signal and the position of each switch.

With the use of the C. T. C. System, all trains are operated by signal indication instead of by written train orders. This method offers a much more flexible system to the dispatcher in that he need not consider meet requirements until the trains involved are relatively close together and he can better predict their performance. He is then better able to take advantage of the fact that one train or the other may make better time than could possibly have been predicted longer in advance.

Facility is increased by the ability to operate more trains over the same trackage. Congestion is relieved and the necessity for installing additional tracks is avoided, consequently there is a large saving in capital cost and maintenance.

**CENTRALIZED
TRAFFIC
CONTROL**



"Union" C. T. C. Installations

Operation by Signal Indication

Railroad	Location		Mileage		Total Functions	In Service
	From	To	Single	Double		
A.T. & S.F.	Sibley	Camden Jct.	0.00	8.50	4	7-7-30
A.T. & S.F.	Holliday	Olathe	0.00	12.00	19	12-15-30
A.T. & S.F.	Dodge City	Kinsley	25.00	9.50	67	12-23-30
B. & M.	Johnsonville	Hoosick Jct.	0.00	10.50	53	12-15-29
						Add. 1-27-31
B. & M.	Lynn	Swampscott	0.00	4.75	69	8-15-30
B. & M.	Winchester	Wilmington	0.00	17.00	66	9-21-30
B. & M.	Dover	Rigby	33.00	34.00	102	Under Construction
B. & O.	North Lima	Roachton	56.00	0.00	164	Under Construction
Can. Natl.	Paris Jct.	Brantford	3.75	5.70	27	Under Construction
C.B. & Q.	Concord	Arenzville	2.00	3.00	7	2-15-28
C.B. & Q.	Waverly	Greenwood	5.00	7.00	19	9-17-29
C.B. & Q.	Red Oak	Balfour	23.00	2.50	76	1-8-30
C.B. & Q.	Neponset		0.00	1.50	5	Under Construction
C.B. & Q.	Laclede		0.75	0.00	5	Under Construction
C.C.C. & St.L.	De Graff	Morgan	0.00	5.00	26	Under Construction
C.R.R. of N.J.	No. Branch	White House	4.86*	0.00	10	9-22-30
C.G.W.	Winston	Rice	1.60	0.00	8	2-12-31
Erie	Tusten	Lackawaxen	0.00	9.50	13	
N. & W.	No. Roanoke	Cloverdale	0.00	8.50	5	9-7-28
P.M.	Bridgeport	Mt. Morris	20.00	3.00	55	6-30-28
P. & I.	Metropolis	Paducah	15.00	0.00	46	10-10-29
P.R.R.	Berlin	Vandale	0.00	10.00	18	12-2-29
P.R.R.	Lima	Lafayette	0.00	7.00	8	12-21-29
P.R.R.	Limedale	Ben Davis	30.00	3.00	44	7-11-30
P.R.R.	Perrysville	Loudonville	0.00	5.00	15	11-25-30
P.R.R.	Richey	Vanwert	0.00	8.00	16	
S.P.	Stockton	Brighton	37.00	6.00	180	12-9-29
S.P.(T.&N.O.)	Beeville	Skidmore	11.00	0.00	28	1-18-30
S.P.(T.&N.O.)	Alpine	Paisano	12.00	0.00	42	11-5-30
Wabash	Peru	State Line	93.00	0.00	72	2-4-31

*4 tracks

Other Applications

CENTRALIZED
TRAFFIC
CONTROL

THE PRINCIPLES of centralized traffic control have been used by a number of railroads in the remote control of outlying switches and signals. The illustrations which follow show a few of these applications of the principles of wire utilization found in "Union" Centralized Traffic Control and improved remote control circuits which require a minimum of control wires. Through the use of these circuits the economic range for the control of outlying signals and switches is increased. The train order signal applications on the Big Four are especially interesting.

These installations are not the most extensive co-ordinated applications of remote control and do not compare in size or operating significance with such notable recent installations of "Union" Remote Control as were made on the Baltimore & Ohio, between Grafton, W. Va. and Parkersburg; on the Southern Pacific, between Bena, Calif. and Tehachapi; and on the Big Four between Terre Haute, Ind. and Pana. They are, however, examples of the installation of remote control which was made more economical at a greater distance from the control point because of the use of C. T. C. circuit principles which require a minimum number of wires and thus cut down the pole line expense.

C. C. C. & St. L. Control of Manual Block Signals

The Big Four has applied the principles of Centralized Traffic Control to the remote control of manual block signals at five points on its lines in Indiana in order to secure "middle order" protection at sidings located where there are not three-trick manual block offices. These installations have made it possible to establish the "middle order" by signal indication,

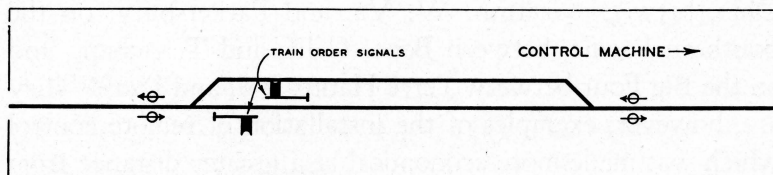
and thereby utilize additional sidings as meeting points without the expense of maintaining continuous block offices.

Installations of this type of control are in service at the following points on the Big Four.

<i>Location</i>	<i>Control Point</i>	<i>Miles from Point of Control</i>
Horace	Greensburg	7.50
Duncanville	Owen	3.00
Trimble	Owen	5.00
Ernst	Marshall	5.50
Gossett	Norris	4.00

The sixth application of C. T. C. to manual block signals on the Big Four is being installed at Brewersville, Ind. and is to be controlled from Westport, 5.5 miles distant.

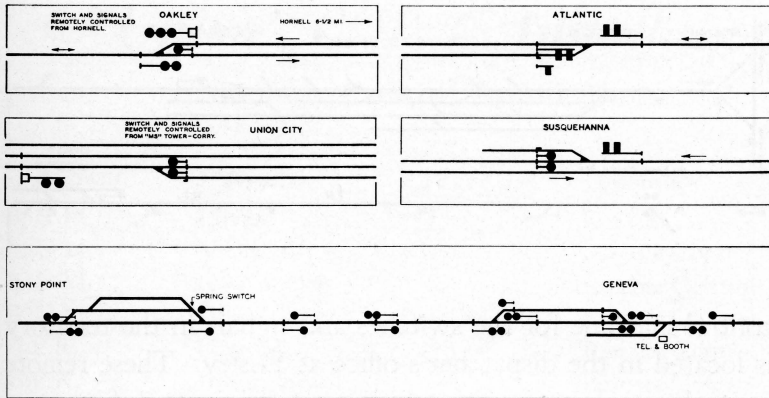
The saving and increased operating facilities brought about by the use of the C. T. C. principle to give attended block



office protection by means of the remote control of manual block signals has been sufficient to make this type of installation economically justifiable. The number of installations of this type on the Big Four is a testimony to the operating practicability of the scheme.

Erie Railroad

The Erie has installed remote control at a number of points on its Chicago-New York main line, using the "Union" minimum control wire remote control circuits. These are



**CENTRALIZED
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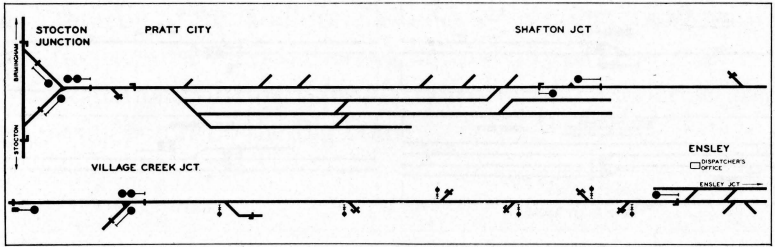
junction points and ends of important sidings where delay from the hand operation of switches had proven costly and where attended interlockings would be uneconomical because of the higher operating costs they would bring about.

These installations have contributed to the speeding up of traffic by eliminating train stops and train delays at points where switches are used a great deal.

The track plans show typical remote control layouts at various points on the Erie. The control points for the different locations range from a little more than 1 mile to 10 miles distant. The installations are typical of those made on a number of other roads under substantially similar operating conditions.

Tennessee Coal, Iron & Railroad Co. Pratt-Ensley

This company, which operates industrial railways in the Birmingham, Alabama mineral district, has made several installations of remotely controlled switches. The installation involving the control of switches between Stocton Junction (Pratt City) and Ensley is the most extensive of these. The

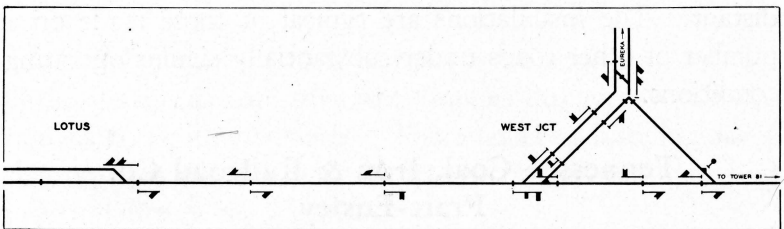


control machine for the switches and signals in the territory is located in the dispatcher's office at Ensley. These remote controls employ circuits requiring a minimum of control wires.

Southern Pacific Company (T. & N. O.) West Junction

The Southern Pacific has installed remote control at West Junction, Texas, near Houston. The switch at West Junction is controlled from Eureka approximately 10 miles distant.

This remote control installation is typical of installations using a small number of line wires for control being installed

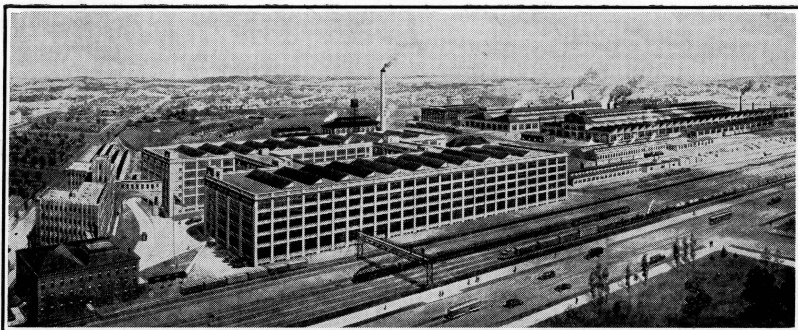


extensively throughout the country. This type of installation makes it economically feasible to increase the distance of a remote controlled switch or signals from the control point because of the saving in line wires.

"Union" C. T. C. Installations

Remote Control Applications

<i>Railroad</i>	<i>Location</i>		<i>Application</i>	<i>Total Functions</i>
	<i>From</i>	<i>To</i>		
B. & M.	Dover		Remote Control	11
B. & M.	Newfield Jct.		Remote Control	
B. & M.	Newton Jct.		Remote Control	12
B. & M.	White River		Remote Control	4
C.P.R.	Grenfell		Remote Control	6
C.P.R.	Indian Head		Remote Control	6
C.M.St.P. & P.	Franklin Park		Remote Control	13
C.C.C. & St.L.	Brewersville	Westport	T. O. Signal	2
C.C.C. & St.L.	Duncanville		T. O. Signal	2
C.C.C. & St.L.	Ernst		T. O. Signal	2
C.C.C. & St.L.	Gossett		T. O. Signal	2
C.C.C. & St.L.	Horace		T. O. Signal	2
C.C.C. & St.L.	Trimble		T. O. Signal	2
Erie	Atlantic		Remote Control	4
Erie	CB Cabin		Remote Control	4
Erie	CM Tower		Remote Control	4
Erie	Coles	Hubbard	Remote Control	4
Erie	JA Tower		Remote Control	7
Erie	JO Tower		Remote Control	4
Erie	NE Tower		Remote Control	4
Erie	Oakley		Remote Control	7
Erie	RH Tower		Remote Control	5
Erie	Stoney Point		Remote Control	4
Erie	Waugam		Remote Control	4
Erie	West Hawley		Remote Control	4
N. & W.	Vickers		Remote Control	4
N.Y.C. & St.L.	Broughton		Remote Control	4
N.Y.C. & St.L.	Continental East		Remote Control	5
N.Y.C. & St.L.	Continental West		Remote Control	5
N.Y.C. & St.L.	Townwood		Remote Control	4
S.P.(T. & N.O.)	West Junction		Remote Control	5
T.C.I. & R.R.	Pratt	Ensley	Remote Control	12
T.C.I. & R.R.	Wyco Tower	Edgewater Jct.	Remote Control	5



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