Train Dispatching

On a Complete Operating Sub-division with UNION C.T.C.

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ON A COMPLETE OPERATING SUB-DIVISION

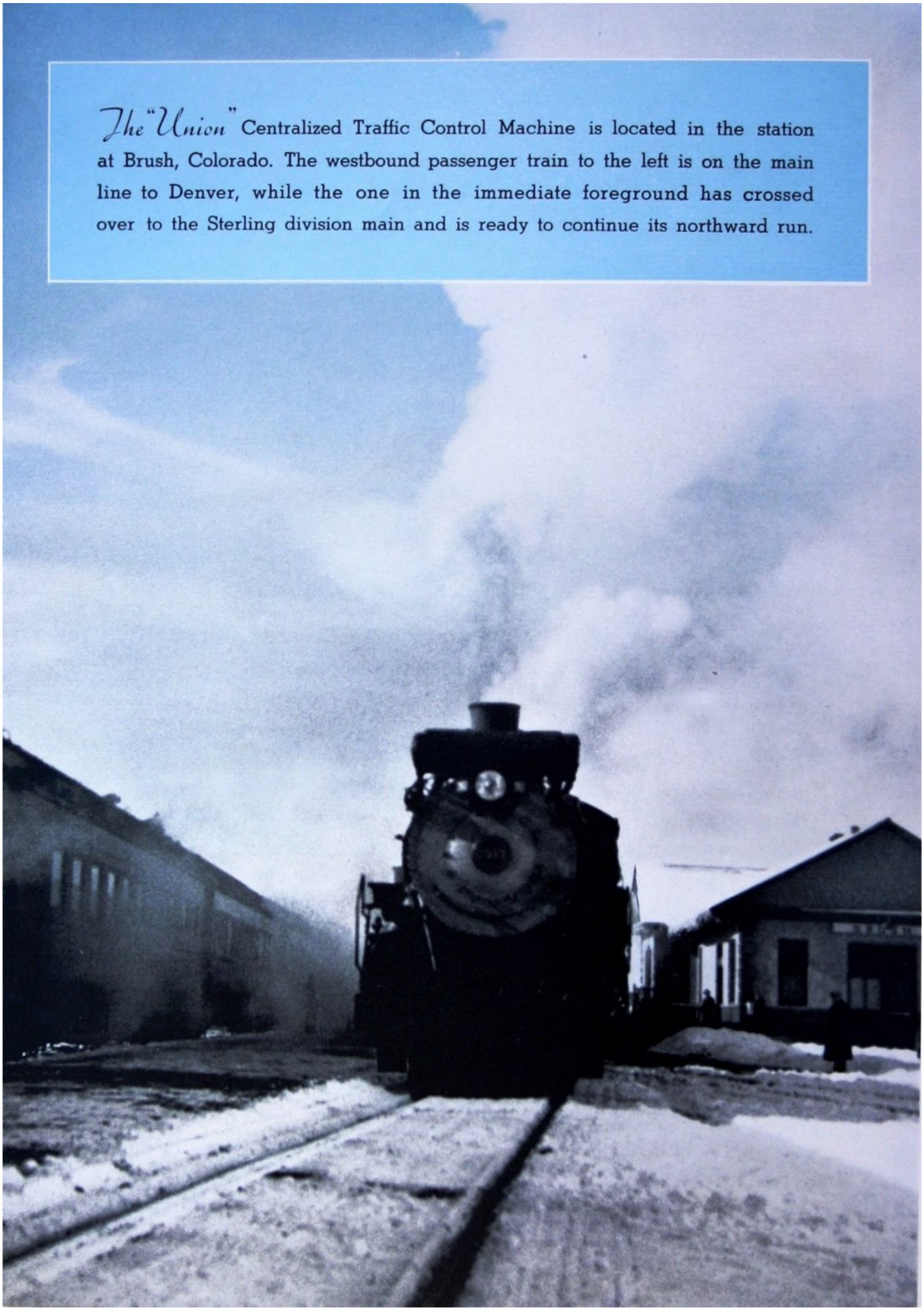
with

"UNION"

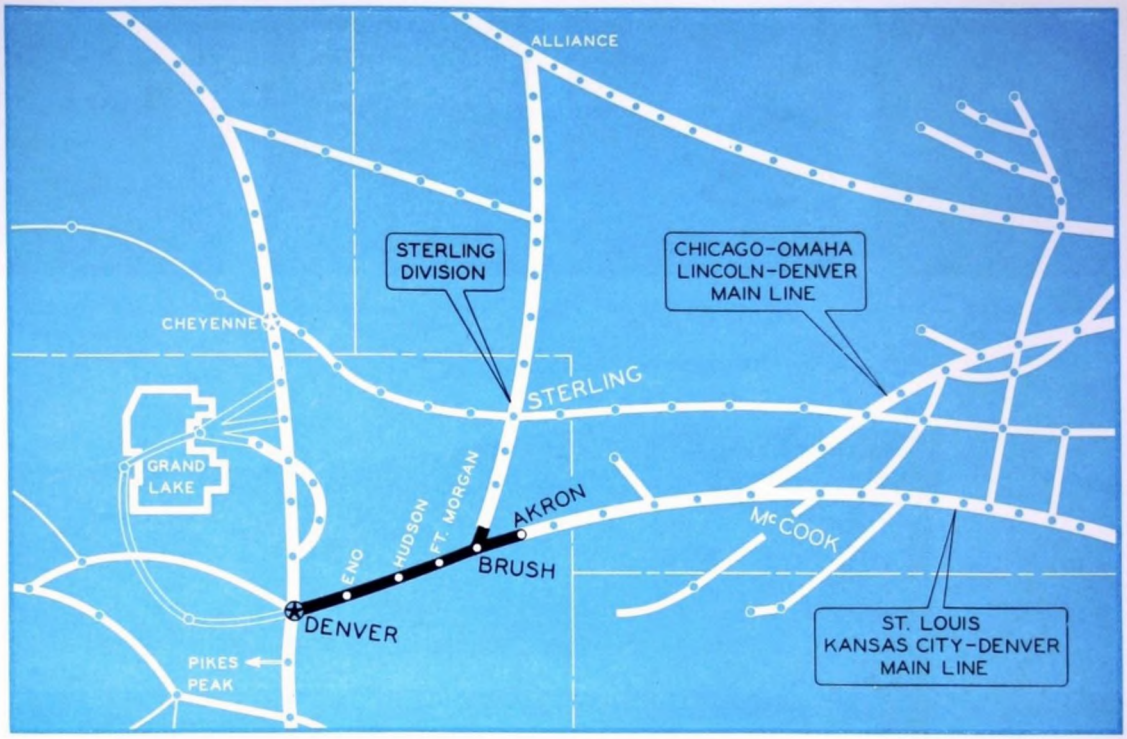
Centralized Traffic Control

Bulletin 154
MARCH 1939

UNION SWITCH & SIGNAL CO.
SWISSVALE . . . . . PENNSYLVANIA



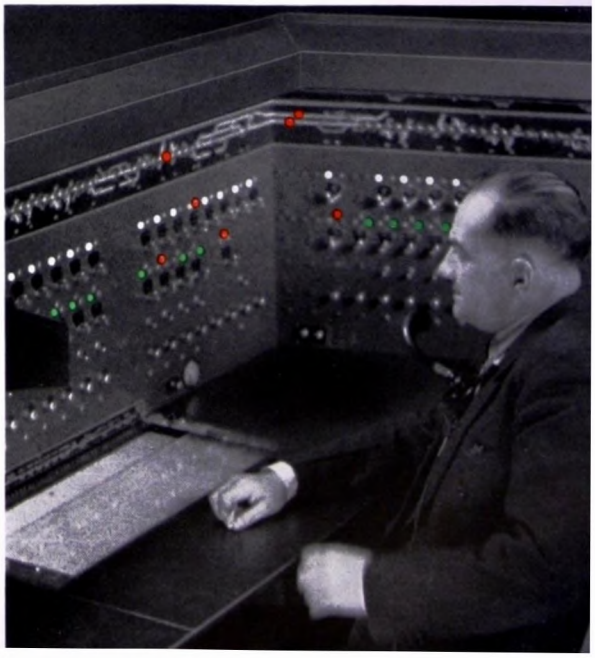
The "Union" Centralized Traffic Control Machine is located in the station at Brush, Colorado. The westbound passenger train to the left is on the main line to Denver, while the one in the immediate foreground has crossed over to the Sterling division main and is ready to continue its northward run.



All Trains Between Akron and Denver

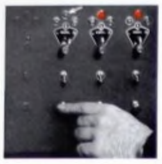
OPERATE ENTIRELY BY SIGNAL INDICATION

This 112-mile subdivision handles the combined Denver traffic from three Burlington routes. The Chicago-Omaha-Lincoln-Denver main line and the St. Louis-Kansas City-Denver line join at Oxford Junction, Nebraska just east of the division point, McCook, and run westward on single track to Denver. The Sterling division, north to Alliance, Nebraska and Billings, Montana, swings in from the north at Brush, Colorado and forms a "bottle neck" of 88 miles into Denver. Rather than double track, the Burlington installed the "Union" system of Centralized Traffic Control. With this system, all of the train orders are delivered to the enginemen by the signal indications at the points of action.



Restores switch lever to normal

Clears signal lever



Pushes code starting button

Switch operates— signal clears

Indications appear at all locations

Train enters "OS" track section

"OS" es on track model

"OS" records on train graph

"UNION" CENTRALIZED TRAFFIC CONTROL MACHINE

No. 62 Enters C.T.C. Territory

Burlington Time Freight No. 62 is entering C.T.C. territory ahead of No. 10, the Zephyr, as it awaits its starting time. "Union" Centralized Traffic Control permits handling of freight trains as soon as they are ready, without any lost time in the transmission of train orders, as the mechanics of transmittal are reduced to the simple movement of a small lever without requiring the intermediary action of another person.

No. 10 Prepares for Eastward Run

DENVER OPERATOR calls dispatcher at Brush saying, "Shall we fix up No. 10."

DISPATCHER answers the Denver operator, "Yes, clear him. No more for him."

OPERATOR writes out the clearance card. The conductor of No. 10 receives the original and one copy.

CONDUCTOR of No. 10 gives copy of clearance card to his engineman before the Zephyr's starting time.

CHICAGO-BOUND Zephyr at Denver station

ZEPHYR threads its way through interlocking

DISPATCHER CALLS 38th STREET

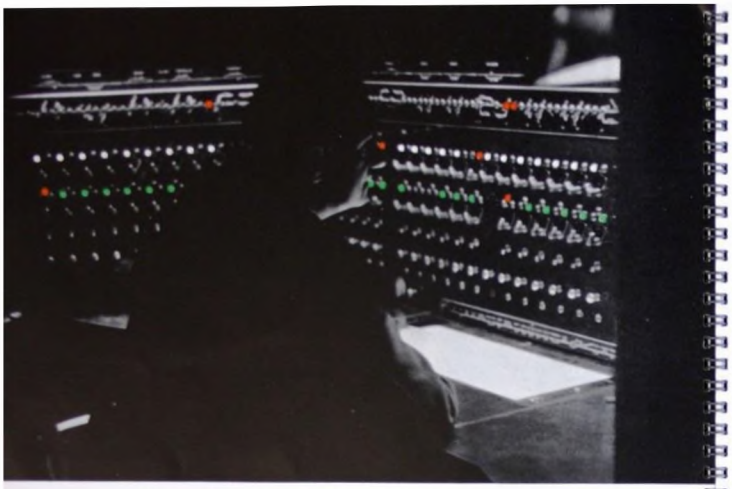
Before the departure time of the Zephyr, the dispatcher calls 38th Street operator and instructs him to "clear for No. 10." Shortly afterwards the Chicago-bound Zephyr pulls out of the Denver station on its eastward run.

DISPATCHER lines up route for No. 10 for its run over C.T.C. territory.

AHEAD of the Zephyr is No. 62

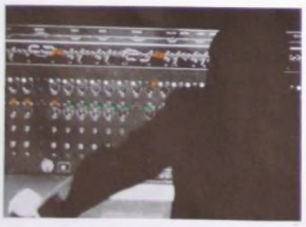
ZEPHYR in C.T.C. territory at Eno

While this modern streamline train threads its way through the interlocking at Denver and glides past the freight yards over the trackage controlled from 38th Street, the dispatcher lines up a portion of its route over the C.T.C. territory which he directly controls from Brush, Colorado. Outside of Denver, at Derby, the Zephyr reaches the yard limits and streaks eastward hot on the heels of No. 62. Neither of the two enginemen knows exactly where their passing meet will occur as they receive their train orders by signal indications at the passing point.



Watching A Sub-Division Operate

The dispatcher studies the movements of the trains as shown on his track model, carefully judges their respective speeds and skillfully plans their meets and passes, delivering his orders by signal indications at the points of action. C.T.C. permits him to use his intimate knowledge of the territory as well as of the engine crews, motive power and tonnage to obtain the utmost in operating efficiency. It gives the dispatcher the advantages equivalent to having an operator at each end of each passing siding, or at each controlled location.

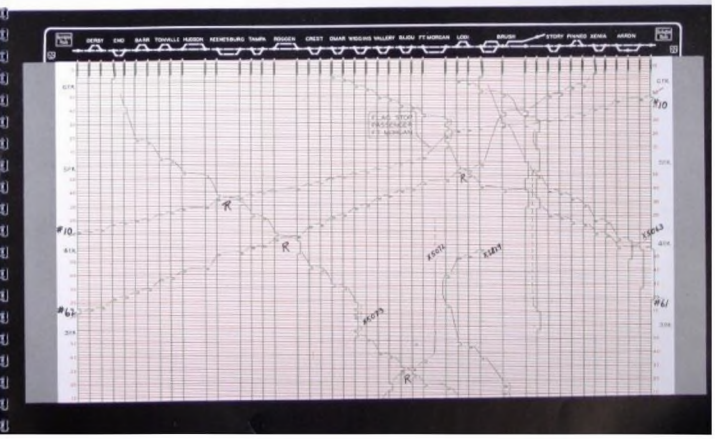


DISPATCHER connects "OS" marks on the train graph to make continuous record.

NO. 10, the Chicago-bound Zephyr, runs out of C.T.C. territory and on into the night.

AUTOMATIC TRAIN GRAPH *Makes a Complete Record*

As the Chicago-bound Zephyr rushes across the C.T.C. territory, it is automatically OS'ed on the Train Graph at each end of each passing siding and thus leaves an accurate record of its run. This permanent record is made on the graph sheet without any action on the part of the dispatcher, who merely connects the "OS" marks as each train progresses over the territory and makes such notations as train numbers and other information which he considers necessary. The Automatic Train Graph, which is illustrated below, shows the paths of Nos. 10 and 62, two eastbound trains, one the Zephyr and the other a fast freight. Certain other trains which were in the Centralized Traffic Control territory between the hours of 2:00 p. m. and 6:00 p. m. are also shown on the graph sheet.



"Mallard Hunting" in Colorado

EASTBOUND EXTRA 2829 receives order by signal indication for a meet with Westbound Extra 5073 at Bijou.

In Colorado, non-stop or running meets are known as "mallards." This term was first used by one of the dispatchers who loves duck hunting. The thought being that the name of the finest prize in his favorite sport should be applied to the finest of train movements on single track. With C.T.C., non-stop meets are possible through the perfect cooperation of the engine crews with the dispatcher. It is surprising how quickly this cooperation is acquired. Six non-stop meets were made on the fourth day of the installation's service. Four of these "mallards", which are designated by the letter "R", can be seen on Train Graph which is shown on the preceding page.

Another "Mallard" at Lodi After Sun Down

C.T.C. keeps train crews on their toes as the dispatcher is constantly aware of their movements and jealously guards against any delays which are common under train order operation.

Trains Are Handled As They Are Ready

No. 61 accepts signal at the east end of Brush and stops short of the station to take on water and coal.

Before No. 61 is ready to depart, another Denver-bound freight arrives on the Sterling main and changes crews.

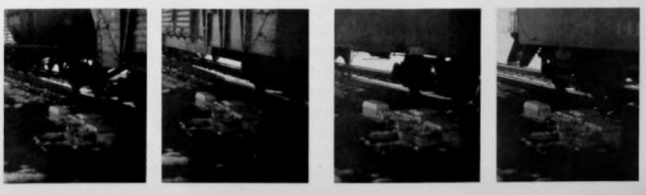
No. 61 completes its work before the Sterling freight is ready to leave and conductor informs the dispatcher who clears the signal for the main line move of No. 61.

After No. 61 clears Brush, the Sterling freight crosses over from the Sterling main to the Denver main and follows No. 61 under signal indication into Denver.

DUAL CONTROL electric switch and lock movement.

Power Operated Switches Save Stops

Since all of the switches at the ends of the passing sidings are equipped with "Union" Dual Control Switch and Lock Movements, trains are not required to stop when taking siding. These movements are ruggedly designed and have been thoroughly tested in heavy duty service. The dual control feature permits hand switching, when necessary. Of special importance in C.T.C. territory, these are the only movements available that indicate position of switch points during hand operation.



Much Traffic Originates in This Territory

Ft. Morgan is one of the principal stock and beet sugar centers along the Burlington and the locals usually find considerable work to be done. Westbound Extra 2848 handles this work swiftly so as to finish within the time allowed by dispatcher. This method of operation permits dispatcher to speed up local switching.

After completing the work the conductor calls dispatcher saying, "This is Westbound Extra 2848 at Ft. Morgan. All switches have been lined and locked for the main line and engineer notified." Dispatcher removes tags and clears signal and the engineman again proceeds by signal indication to his next destination.

C. T. C. REDUCES PENALTIES TO FREIGHT TRAINS AND CUTS TRANSPORTATION COSTS

WESTBOUND NO. 71 advanced Brush to Bijou siding saving 35 minutes

EASTBOUND EXTRA 6321 advanced Ft. Morgan to Brush saving 35 minutes

NO. 61 advanced Vallery to Omar —40 minutes saved

DUAL CONTROL MOVEMENTS FACILITATE SWITCHING

Conductor of Extra 5073 calls the dispatcher saying, "This is Extra 5073. We would like to use the controlled switch for the Sterling Main. How much time may we have?" Dispatcher glances at clock, examines machine

and replies, "You may have until 2:25 p.m." While the conductor likewise instructs the engineman, the dispatcher sets the protecting signals to stop and hangs a tag on lever controlling the Sterling switch at Brush.

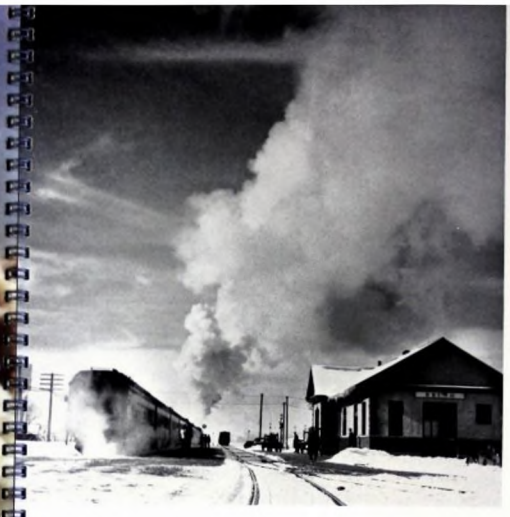
The conductor first throws the Selector lever and then operates the switch points with the Hand Throw lever. When the work is completed the conductor again calls the dispatcher and says, "This is Extra 5073 at Brush.

The Sterling Main switch has been lined to its original position and locked on power." Dispatcher removes tag and the conductor notifies the engineman as the train is ready to proceed toward its destination.

LOOKING EAST TOWARDS THE STATION AT BRUSH WITH CROSSOVER TO THE STERLING MAIN IN FOREGROUND

BURLINGTON CHICAGO TO DENVER ZEPHYR IN CENTRALIZED TRAFFIC CONTROL TERRITORY

THE "ARISTOCRAT" PROCEEDS BY SIGNAL INDICATION AFTER MAKING ITS SCHEDULED STOP AT AKRON



The "Aristocrat" Stops at Brush

No. 9, the Burlington "Aristocrat" makes a passenger stop at Brush station after its overnight run from Chicago and proceeds to Denver by signal indication. C.T.C. provides safety for all classes of trains as the system is "foolproof" in that it is impossible to set up conflicting routes so as to produce an unsafe condition for train movements. All signal functions are dependent *primarily* upon the occupied or unoccupied condition of the track and the check between opposing signals, and *secondarily* upon the will of the operator in charge.

THE "ARISTOCRAT" leaves C.T.C. territory at Derby.

LOOKING WEST from electric switch lock installation at Brush.

"Union" Electric Locks Guard Main Line Moves

All of the important house, industrial and side tracks, other than controlled passing sidings, are protected by electric locks which are equipped with indicators showing "locked" or "unlocked" in accordance with existing main track block conditions. These electric locks are controlled automatically, with the exception of those at Brush and the west end of the house track at Wiggins, which are controlled directly by the dispatcher from the machine at Brush.

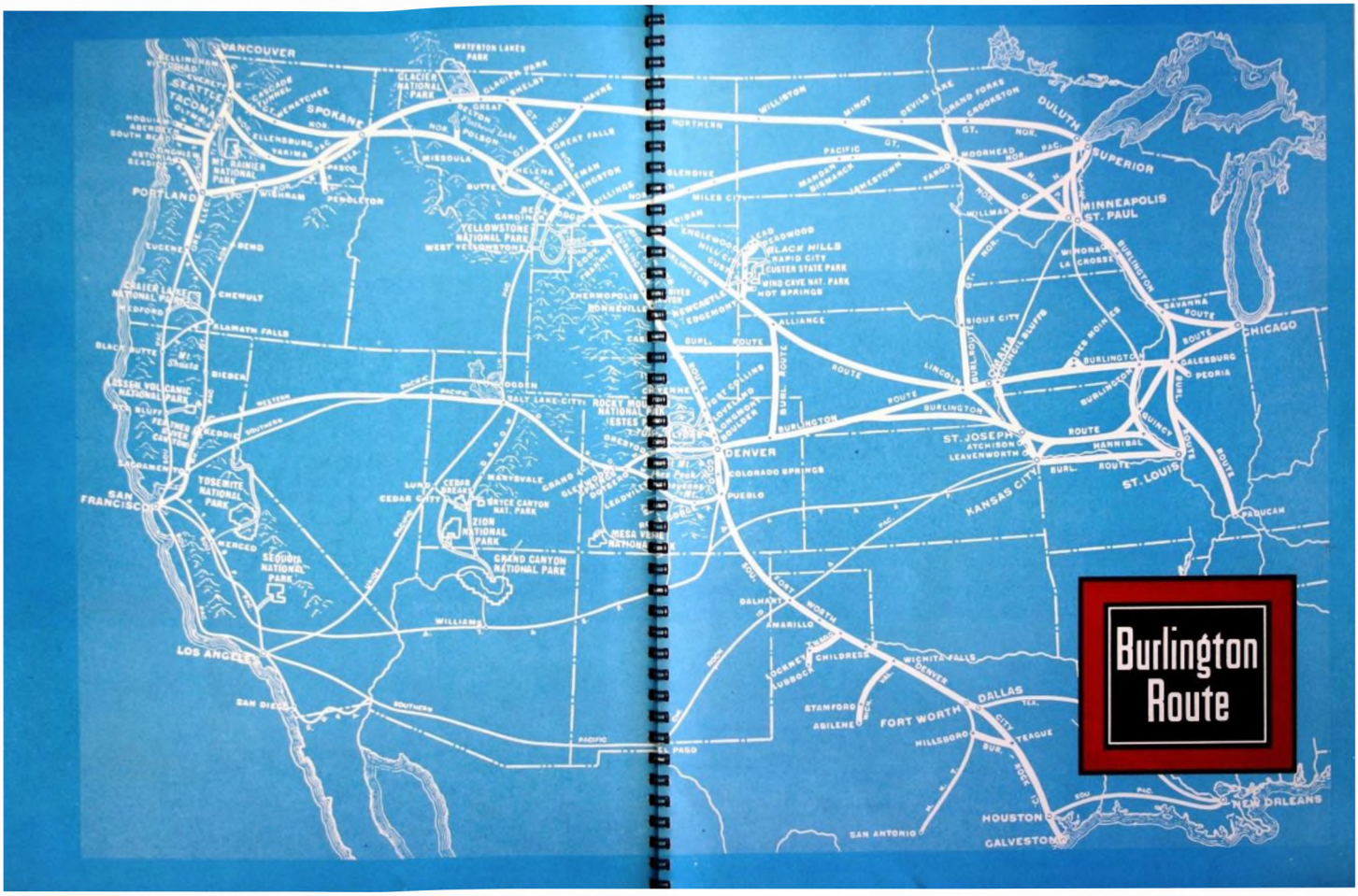
SPRING SWITCH NEAR WEST END OF BRUSH

A spring switch with a "Union" Mechanical Facing Point Lock is located at the west end of yard lead as the majority of train movements, other than main line moves, are westward from the yard. Standard automatic block signal control is provided for movements over this switch.

Westbound Extra 2848 Takes Siding at Ft. Morgan

Dispatcher advances Extra ahead of and without any delay to manifest freight, which shortly afterward speeds through Ft. Morgan. Dispatcher then allows Extra to back out on the main and pull down into Ft. Morgan.

Conductor of Extra 2848 calls the dispatcher and says, "This is Westbound Extra 2848 at Ft. Morgan. I want to work on the main." Dispatcher studies the movements of the other trains on the territory, estimates the time he can safely allow for the work to be done, and replies, "You may have until 2:15 p.m." He checks to see that the signals at each end of Ft. Morgan are at stop and places tags on corresponding switch levers. Conductor then opens the door of the electric switch lock and throws the lever which releases the locking from the switch.



DISPATCHER enters train on train sheet

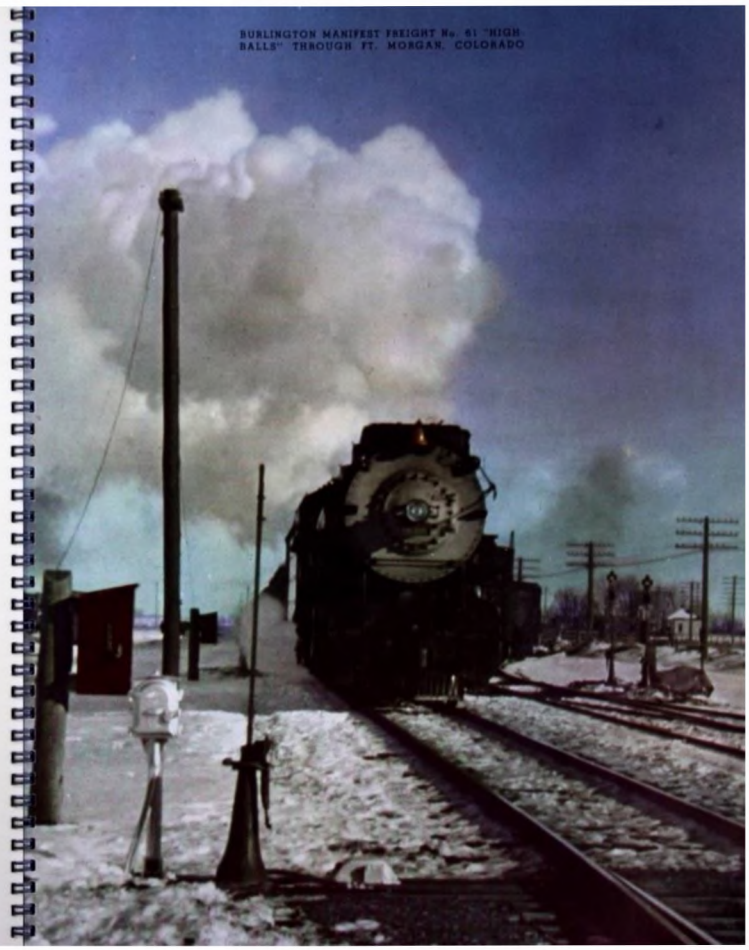
CALLS operator on phone to issue train order

HE ENTERS order in train order book

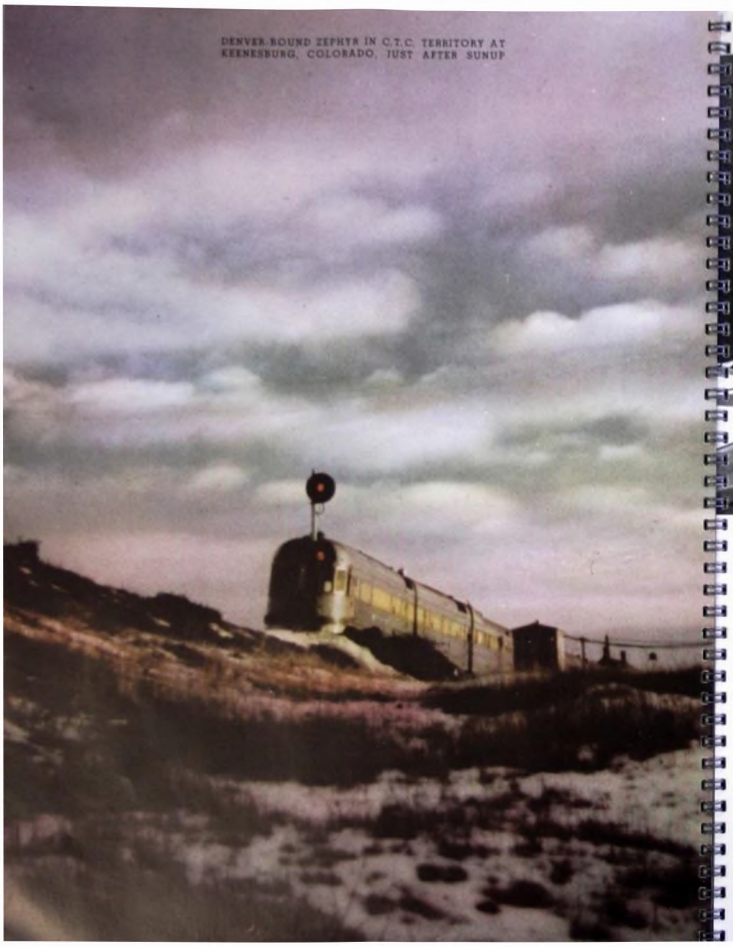
Train Order Operation Formerly Used

The dispatchers for the McCook to Denver division were formerly located at McCook where they dispatched trains over the complete division by train orders. They were moved to Brush, Colorado where, in addition to operating the Centralized Traffic Control Machine which controls the Akron to Denver sub-division, they continue to dispatch by train orders the remainder of the division from Akron to McCook, a distance of 143 miles. C.T.C. has eliminated the issuing of approximately 130 train orders daily for the territory between Akron and Denver as formerly handled; thus the daily routine work of the dispatchers is considerably lightened.

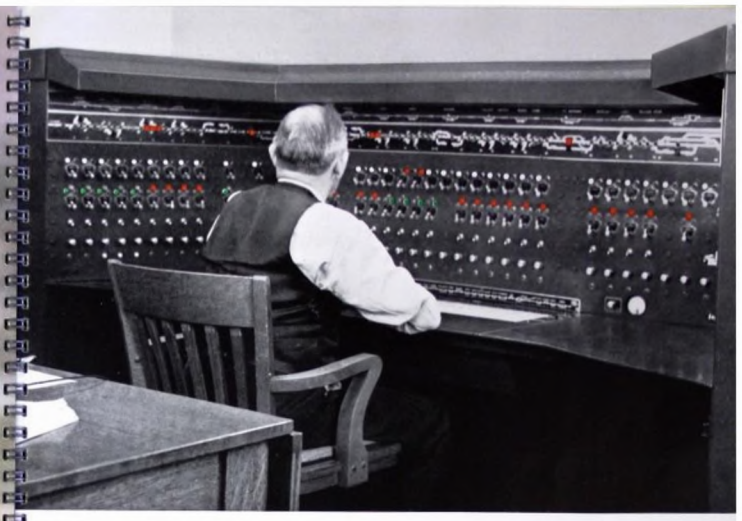
Dispatcher transmits the train order to the operator over the telephone. The operator then repeats train order back to the dispatcher. The dispatcher then designates the order complete.



BURLINGTON MANIFEST FREIGHT No. 61 "HIGH BALLS" THROUGH FT. MORGAN, COLORADO



DENVER-BOUND ZEPHYR IN C.T.C. TERRITORY AT KEENESBURG, COLORADO, JUST AFTER SUNUP



The Denver-bound Zephyr Meets the Dawn

C.T.C. does *not* provide a substitute for the good judgment of an experienced train dispatcher in the planning of train movements. It *does* provide an operating tool which makes it possible for the dispatcher to secure prompt action on his planned movements. This is particularly important where high speed train operation is involved. The dispatcher may delay his final decisions on points of meeting or passing with opposing or slower traffic until he is reasonably sure that any delays occurring will be reduced to the minimum. As the Denver-bound Zephyr rapidly approaches Akron, the dispatcher lines up the route for it to enter C.T.C. territory.

DISPATCHER lines up switches for main line and clears westward signals.

SIGNALS clear at Akron and Xenia. Switch goes normal at East Pinnec and signal clears.

SWITCH and signal indications quickly appear on the C.T.C. machine.

THE DENVER-BOUND Zephyr automatically "OS"es as it receives its signal indication and glides into C.T.C. territory at Akron.

Burlington Installs

FIRST COMPLETE OPERATING SUB-DIVISION

THE Akron-Denver territory on the Chicago, Burlington & Quincy Railroad over which trains are operated entirely by signal indication, comprises 111.54 miles of single track road. The Centralized Traffic Control machine is operated by dispatchers, and is located at Brush, Colorado which is 24 miles west of Akron. In addition to operating the C. T. C. machine, the dispatchers also continue to dispatch the remainder of their division, Akron to McCook, 143 miles, by train orders.

This installation lightens the work of the dispatchers as formerly the entire 255 miles between McCook and Denver was handled by written train orders, while at present only 143 miles between Akron and McCook are operated in this manner. Before Centralized Traffic Control was installed, an average of 130 train orders per day were issued between Akron and Denver. None are used now on the sub-division. One dispatcher's telephone circuit serves all of the stations on the McCook to Akron territory, and is extended to the office at Brush for exclusive use in handling train orders on that section. Another circuit starts at Akron and extends to Denver, being connected to telephones at the switches in the C. T. C. territory as well as in the offices. Each circuit is equipped with a separate loud speaker.

There is in service at 38th street yard office, Denver, Colorado a controlled manual block machine handled by operators to control main line train movements within the Denver area only, known as Derby-Denver section, a distance of 6.27 miles.

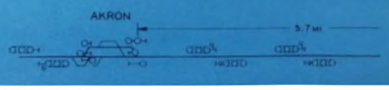
This territory includes connections with the freight yard at 38th street and switches leading to other yards and numerous industries, as well

THROUGH AKRON

THROUGH AKRON

RECEIVING TRAIN ORDERS BY SIGNAL INDICATIONS

WEST END OF AKRON



as interlockings at crossings with the Union Pacific and the Colorado & Southern. The westbound yard limit board is located at the west switch at Derby and Rule 93 is in effect from there to Denver because of many local moves.

Passing Sidings

There are 20 passing sidings in the territory from Akron, Colorado to Derby connected for power operation from C. T. C. machine. Of the 40 switches controlled by the dispatcher, 38 of these are on 19 passing tracks, one at the junction switch with the Sterling division at Brush and the other at the west end of the yard at Akron. The switch at the west end of Derby is 80 miles from the control machine at Brush. Excellent use has been made of all of them, particularly in connection with effecting non-stop meets, as shown by the table on page 33. Number 15 turnouts with 24-ft. switch points are used at each controlled switch. Where 90-lb. rail was not in service on sidings, the sidings were relaid with 90-lb. rail and the ties and ballast were replaced as necessary. A maximum speed of 25 m.p.h. is permitted through all of the passing sidings.

Before installing C. T. C., a study was made of the capacities of the sidings as compared with the average maximum lengths of trains, consideration being given to the desirability of having the sidings longer than the average train in order to provide for non-stop meets. Such meets which are made through the cooperation of the dispatcher and the train crews are very desirable as they result in the least loss of time for train delays.

At Brush a 125-car siding was constructed on the south side of the main line, leaving the old siding on the north as an additional yard track. At Akron, the west end of the siding was extended, increasing the capacity to 143 cars. Also, the sidings at 18 other locations were extended, the general idea being to have every second siding with 125-car capacity and the alternate sidings with 85-car capacity.

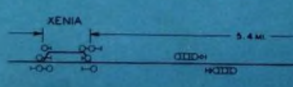
In considering the operation of the track facilities, it was decided that all passing siding switches were to be equipped with power machines and signals for directing train movements, for past experience had shown that the policy of equipping certain sidings only to fit existing train operation would not be satisfactory. A change in schedules, an increase in traffic, trains running late, and extra sections of trains, create conditions that may make it desirable to provide for meets or passes at any

IN AUTOMATIC TERRITORY

THROUGH CUT WEST OF AKRON

EAST END OF XENIA

WEST END OF XENIA



siding on short notice in order to derive the maximum benefit in advancing trains. For these reasons all passing track switches and the junction crossover at Brush were equipped with power machines operating in 7½ sec. and a spring switch with facing point lock was installed at the departure end of the yard lead at the west end of Brush.

In order to determine to what extent all sidings were used in C. T. C. territory, a survey of the graph sheets, covering a 40-day period, was made with the results as shown in the accompanying table.

It will be noted in the table that there are no figures available for Akron because it is the terminus of the sub-division. This table is interesting in that it shows that each siding has been used to advantage in connection with train operation—not only for regular meets but for non-stop meets, of which there was a total of 168. Passes have also been made at each siding, with the exception of Barr, during the 40-day period studied. The local moves naturally are greater at Brush, the junction with the Sterling division line and at Ft. Morgan, where considerable traffic originates. This table clearly shows that greater flexibility exists in connection with train operation through the equipment of all siding switches with power operated switch machines than would have been possible had certain sidings only been so equipped. Thus, the Burlington is in a posi-

Use of Sidings in C.T.C. Territory

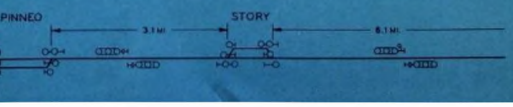
Stations	Siding Capacity Cars	Meets	Non-Stop Meets	Passes	Local Moves
Akron	143	..	..	..	..
Xenia	85	21	3	9	..
Pinneo	125	17	5	3	..
Story	85	26	8	3	..
Brush	125	43	9	12	256
Lodi	85	24	9	5	..
Ft. Morgan	137	41	13	3	92
Bijou	85	23	12	2	9
Vallery	85	26	11	1	..
Wiggins	125	28	5	6	1
Omar	85	17	5	2	2
Crest	85	26	8	2	..
Roggen	125	24	11	4	..
Tampa	85	23	9	3	9
Keenesburg	125	33	9	1	1
Hudson	125	31	11	6	1
Tonville	85	27	14	3	..
Barr	125	27	9	..	..
Eno	85	20	9	3	..
Derby	117	28	10	1	..
Totals		505	168	71	371

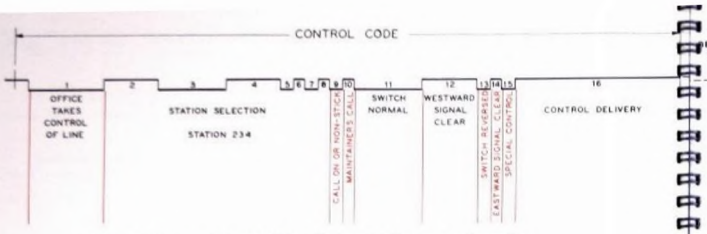
EAST END OF PINNEO

WEST END OF PINNEO

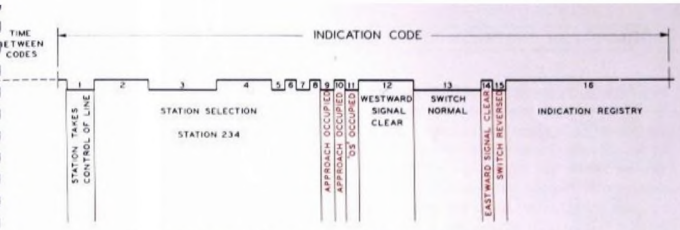
EAST END OF STORY

WEST END OF STORY





Schematic Diagram of Control Code—The long impulses in a code are the working impulses. The short impulses act merely as spacers and do not affect the functions, indicated in red, which are not desired in this particular code setup.



Schematic Diagram of Indication Code—After the control code, shown on the opposite page, is received and the functions have responded, station 234 reports back that switch is normal and westward signal clear, as shown by long impulses.

tion to meet emergency operating conditions which constantly arise on any railroad, in arranging meets or passes at any siding on short notice. The maximum benefit consequently is being derived through the ability to advance all of the trains rapidly, with safety.

Results in Improved Train Operation

After the installation had been in service but a short time, the benefits being derived in improved train operation were decidedly evident. The preponderance of traffic is westbound from midnight to noon and eastbound from 2:30 p.m. to midnight. C. T. C. has so facilitated freight movement that freights can be kept moving a comparatively short time ahead of passenger trains. Departure delays have been reduced and passing moves are not as numerous as might be expected.

One example, will illustrate how train operation is facilitated. Usually, manifest freight train No. 62 can now arrive in Akron ahead of the eastbound Zephyr; formerly No. 62 did well to reach Brush ahead of the eastbound Zephyr at 5:11 p.m. By arriving in Akron ahead of the Zephyr, the waiting time is used to advantage for changing crews or engines, which would have been required later if the train could not have been advanced to Akron.

Flexibility of train operation under C. T. C. is well illustrated in connection with train operation on February 8th, 1938. The eastbound Zephyr No. 10 is scheduled to leave Denver at 4:00 p.m. At 4:20 it was not on C. T. C. territory and when the dispatcher was asked as to where it was he answered that he did not know but would ask Denver. He found that No. 10 would be about 25 minutes late out of Denver, awaiting a connection from Cheyenne, Wyoming. It is interesting to note that it was of no consequence to the dispatcher as to when No. 10 would leave Denver inasmuch as he was in a position to handle trains at any time they were ready to enter C. T. C. territory—a condition which is not always possible under the train order and timetable method of operation.

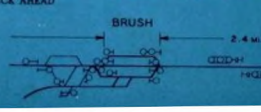
At this same time, there were two freight trains switching in Brush yard. No. 62, an eastbound fast freight, was picking up stock and No. 71, a Sterling division train, was enroute to Denver. At 5:00 p.m. the conductor of No. 62 in the Brush passing track, called the dispatcher on the 'phone saying he was ready to leave (No. 10, the eastbound Zephyr was due at Brush at 5:11 p.m.). The dispatcher immediately lined up the east switch of the passing track at Brush, cleared all eastward signals to Akron, setting west switch at Akron to enter the yard and No. 62 pulled out arriving at Akron at 5:38 p.m., 10 minutes ahead of No. 10, No. 10 passing the Denver yard office 25 minutes late. At about 5:10 p.m., No. 71 reported that it was ready to leave Brush. The dispatcher immediately cleared the leaving signal at the west end of Brush yard. In the

EAST END OF BRUSH

"BEGIN C.T.C." ON THE STERLING MAIN

ENGINEMAN WATCHES TRACK AHEAD

PASSING BRUSH STATION

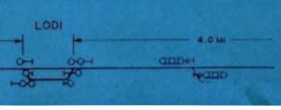


NEAR WEST END OF BRUSH

WEST END OF BRUSH

EAST END OF LODI

WEST END OF LODI



meantime, No. 10 had not arrived at Ft. Morgan. No. 71 did not leave immediately but ran to the next station, Lodi, where it went into the "hole" for No. 10. No. 71 got into the siding only 4 minutes before No. 10 passed. No. 10 was stopped at Ft. Morgan, which is a flag stop for the Zephyrs, and after making this stop passed Brush at 5:31 p.m., 20 minutes late. The Zephyr arrived at Akron 13 minutes late and went into McCook on time. During the run of the Zephyr, it made up 25 minutes from Denver to McCook, making one stop, slowing down to 60 miles an hour at Akron to pick up terminal clearance, and observed all Zephyr slow signs throughout the territory. The average running time of the Zephyr over the Denver to McCook division was 84.8 m.p.h.

On this same day, No. 303, passenger train from the Sterling division, was due to leave Brush at 5:30 p.m. It arrived on time but baggage and station work delayed it 20 minutes. No. 71 ran ahead of No. 303 to Barr where it was put into the passing track for No. 303 to pass. Ordinarily, No. 71 would have cleared No. 303 at Wiggins or Omar but on this date would have run into Denver ahead of No. 303 if it had not been necessary to stop at Hudson for water. Under train order and timetable operation, No. 62 or No. 71 could not have left Brush before No. 10 as the dispatcher would not have been able to give No. 10 a "run late" order at Denver without the risk of delaying that train. The flexibility of operation by Centralized Traffic Control was ably demonstrated by No. 10 and No. 303 being late on this day in comparison of this method of operation with the handling of trains by means of written train orders.

The benefits of C.T.C. are especially noticeable in clearing up congestion of trains caused by a disruption of the track for a few hours. About 2 a.m. on December 9, 1937, an arch bar on a truck of a freight car failed, blocking the main line for several hours. That afternoon, between 4 p.m. and 5 p.m., four eastbound freights, one westbound freight, and the eastbound Zephyr, were on the line between Wiggins and Brush, 24 miles, and the meets and passes were arranged so closely that none of the trains were delayed seriously in their passage over this sub-division.

Soon after the entire territory was placed in service, the time saved by trains, especially freight trains, became pronounced, as indicated in the accompanying table for 11 days of January, 1938. Non-stop table is on page 38.

BURLINGTON INSTALLS FIRST COMPLETE OPERATING SUB-DIVISION

Time Savings in Train Operation Effected by Centralized Traffic Control

Date—Jan.	Trains	Train Advanced	Time Saved
1	61 and 10	61 Brush to Ft. Morgan	30 min. to 61
1	71 and 303	71 Brush to Bijou	35 min. to 71
2	72 and 2	72 Brush to Story	35 min. to 72
2	67 and 68	67 Crest to Tampa	35 min. to 67
2	68 and 1	68 Pinneo to Story	20 min. to 68
2	67 and 3	67 Keenesburg to Tonville	25 min. to 67
2	61 and 10	61 Vallery to Omar	40 min. to 61
3	X-6321 and 67	67 Keenesburg to Tampa	30 min. to 67
3	X-6321 and 3	X-6321 Ft. Morgan to Brush	35 min. to X-6321
3	61 and 10	61 Keenesburg to Hudson	30 min. to 61
3	71 and 10	71 Brush to Ft. Morgan	30 min. to 71
5	62 and 10	62 Story to Akron	35 min. to 62
5	71 and 303	71 Brush to Wiggins	40 min. to 71
5	71 and 6	71 Barr to Eno	25 min. to 71
6	X-6314 and 3	X-6314 Wiggins to Vallery	25 min. to X-6314
6	62 and 10	62 Brush to Xenia	35 min. to 62
7	67 and 72	67 Ft. Morgan to Bijou	20 min. to 67
8	68 and 301	68 Wiggins to Bijou	20 min. to 68
8	67 and 68	67 Hudson to Tonville	25 min. to 67
9	68 and 301	68 Vallery to Bijou	20 min. to 68
9	62 and 10	62 Brush to Story	25 min. to 62
9	61 and 10	61 Xenia to Pinneo	35 min. to 61
9	71 and 6	71 Derby to 38th St. Yard	25 min. to 71
9	61 and 6	61 Barr to Eno	20 min. to 61
10	68 and 3	68 Vallery to Ft. Morgan	25 min. to 68
11	67 and 68	68 Roggen to Keenesburg	35 min. to 68
11	68 and 301	68 Crest to Omar	20 min. to 68
11	62 and 10	62 Omar to Brush	40 min. to 62


EAST END OF FT. MORGAN


FT. MORGAN STATION

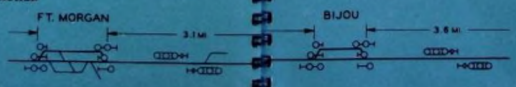

RECEIVING TRAIN ORDERS AT POINTS OF ACTION


WEST END OF FT. MORGAN


EAST END OF BIJOU


"MALLARD" WITH NO. 68 AT BIJOU


WEST END OF BIJOU



BURLINGTON INSTALLS FIRST COMPLETE OPERATING SUB-DIVISION

Non-Stop Meets Resulting from Train Operation under C.T.C.

Date Jan.	Trains	Non-Stop Meets	Date Jan.	Trains	Non-Stop Meets
2	67 and 68	Tampa	7	3 and 68	Omar
3	61 and 10	Hudson	7	301 and 68	Wiggins
4	9 and X-2841	Crest	8	61 and 62	Keenesburg
5	61 and 10	Barr	9	68 and 3	Wiggins
6	X-6314 and 301	Bijou	11	61 and 62	Omar
6	61 and 62	Roggen	11	61 and 10	Crest
6	61 and 10	Barr	11	71 and 6	Roggen
6	303 and 6	Derby	11	71 and 72	Keenesburg
			11	71 and 302	Tonville

The daily saving in time up to January 11th had ranged from about 25 minutes on a day, when six non-stop meets were made and traffic conditions were light, up to 4 hrs. 45 min. for all of the freight train movements on another day.

Signaling

The previous signal installation consisted of A.P.B. single track automatics, with semaphore type signals. The new C. T. C. installation consists of three-indication Style H-2 Searchlight type signals, except the intermediate signals which are color-light, three-indication signals. A minimum braking distance of 8,000 ft. and a maximum braking distance of approximately 14,000 ft. is provided. "Union" Style M-22 low voltage dual-control switch movements, which operate in 7½ sec., are used for the power-operated switches. Each controlled switch is protected by detector and approach locking to eliminate the possibility of a dispatcher reversing his switch in the face of a train which has accepted the indication to proceed.

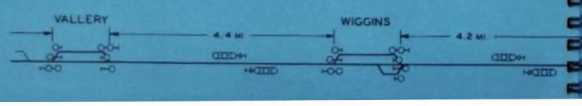
The important industry, house and side tracks, other than the controlled passing sidings, are protected by electric switch locks equipped with an indicator showing "Locked" or "Unlocked." All electric locks are automatic with the exception of those at Brush and the west end of the house track at Wiggins which are controlled directly by the dispatcher. The west end of the yard lead at Brush is located


EAST END OF VALLERY


WEST END OF VALLERY


EAST END OF WIGGINS


WEST END OF WIGGINS



BURLINGTON INSTALLS FIRST COMPLETE OPERATING SUB-DIVISION


Maintainer's Call Signal on relay house at W. Omar


Dispatcher operates West Omar Toggle Switch


Dispatcher presses code starting button


Maintainer's Call Signal illuminated at W. Omar

inside of controlled signals and is equipped with a spring switch having a "Union" Mechanical Facing Point Lock. Standard signal control is provided for trailing movements. The C. T. C. machine is provided with the necessary levers for the control of switches, signals and electric switch locks and toggle switches for the control of the maintainer's call signal. The track model is divided into two parts, the lower part represents the signal layout with the necessary indication lamps while the upper part of the track model shows the track layout with the car capacity of the sidings and the distances between sidings. The Union Time Code System of Centralized Traffic Control, using only two wires throughout the territory, transmits the controls and indications for the switches and signals except in the immediate vicinity of the station at Brush where they are controlled by direct wire from the C. T. C. machine.

Ruling Grades and Curves

In this C.T.C. territory there are two westbound ruling grades and two eastbound ruling grades. These grades are as follows:

Westbound

Mile post 489.5 to 507.0; maximum gradient .65
Mile post 484.3 to 487.5; maximum gradient .6

Eastbound

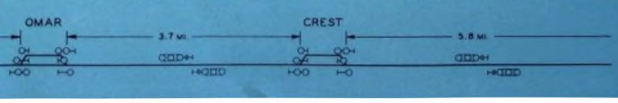
Mile post 494.2 to 491.7; maximum gradient .7
Mile post 443.0 to 441.4; maximum gradient .7


EAST END OF OMAR


WEST END OF OMAR


EAST END OF CREST


WEST END OF CREST



BURLINGTON INSTALLS FIRST COMPLETE OPERATING SUB-DIVISION

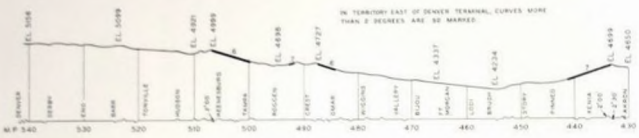


Chart of profile and curves on entire sub-division

Origin of Traffic

Traffic is fed over the Brush to Denver line from three different sources: the Sterling division from Alliance, Casper, Billings and the northwest, at Brush; the St. Louis-Kansas City line at Oxford, Nebraska; and Chicago-Omaha-Lincoln line at Oxford. Traffic from the St. Louis-Kansas City line joins with traffic from the Chicago-Omaha line at Oxford, moving between Oxford and Brush, Colorado. Traffic from the Sterling division joins the main line at Brush so that all of the traffic from the three sources is handled between Brush and Denver.

Kind of Traffic

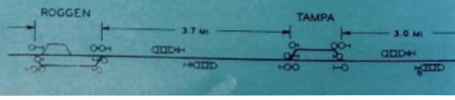
Ordinarily, the dullest season of traffic extends from the middle of December to March 1st, the peak season being the spring and fall. During the grain season, much grain is moved from Benkelman, Nebraska near the Colorado line, west. Through business between Denver and McCook consists of fruits, etc. and some coal from Colorado mines. A heavy stock movement also passes over this territory, the sheep movement starting around December 1st. This, in addition to many other commodities move between Chicago, Omaha, St. Louis, Kansas City and Denver. In the irrigated sections, the principal industry is the raising of sugar beets, which during the season, provides considerable local traffic for the sugar beet factories from a number of the beet dumps located along the railroad. During the summer months there is a heavy tourist travel to and from the Rocky Mountain section and other Western points.

EAST END OF ROGGEN

WEST END OF ROGGEN

EAST END OF TAMPA

WEST END OF TAMPA



What is

CENTRALIZED TRAFFIC CONTROL

The foregoing description of the longest Centralized Traffic Control installation in service shows how this modern signal system helps speed up traffic on the Burlington. However, C.T.C. is economically desirable for facilitating train operation on short sections of track and "bottle necks" as well as for the longer installations. Therefore, a brief description of this modern signal system may be of assistance in visualizing its many advantages and places where this modern method of directing trains may be installed to promote additional economies in operation.

Centralized Traffic Control Defined

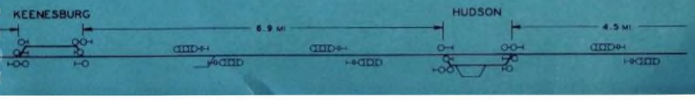
Centralized Traffic Control is defined as "a term applied to a system of railroad operation by means of which the movement of trains over routes and through blocks on a designated section of track or tracks is directed by signals controlled from a designated point without requiring the use of train orders and without superiority of trains." The limits of an installation are defined as "the points between which a Centralized Traffic Control installation is effective are the home signal limits within which the time-table superiority does not apply and the use of train orders to govern or direct the normal operation of trains is not required."

EAST END OF KEENESBURG

WEST END OF KEENESBURG

EAST END OF HUDSON

WEST END OF HUDSON



WHAT IS CENTRALIZED TRAFFIC CONTROL

Adaptable to any Signal Installation

Centralized Traffic Control 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 any manual block signaling system to handle special situations.

Operating Advantages

The advantages of this method of operation—which supplements the timetable and train-order methods—are many. The time element in the transmission of orders is practically eliminated and more efficient dispatching is the result. Direct control over the movement of each train is made possible without depending upon a system of control involving intermediate steps for the delivery of train orders. The most flexible type of train operation results.

Centralized Traffic Control Cuts Transportation Costs

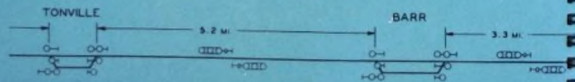
Centralized Traffic Control occupies an important position in the picture of cutting transportation costs. It provides a means for the more efficient handling of trains and the more economical utilization of existing trackage. It is in accord with the trend to more efficient transportation by reason of 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 the fixed charges of producing modern transportation.

EAST END OF TONVILLE

WEST END OF TONVILLE

EAST END OF BARR

WEST END OF BARR



WHAT IS CENTRALIZED TRAFFIC CONTROL

The First Installation

Signaling, which provided for the movement of trains in either direction on single track without train orders, was used as early as 1882 by the Pennsylvania Railroad at Louisville Bridge, Ky.

Description of the System

Briefly, the Centralized Traffic Control system consists of the following basic groups of apparatus:

1. A control machine with levers for the operation of switches and signals; indication lights showing the position of switches and signals and also the occupied or unoccupied condition of sections of track; and an automatic train graph which records the passage of all trains.

2. Equipment at the controlled location consisting of power switches, signals, relays, etc. Track circuits approaching and within the limits of the controlled signals are used to actuate indications of the passage of all trains which appear on the control panel of the machine.

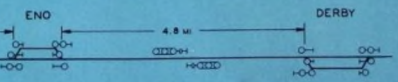
3. A set of control wires extending from the control machine to all controlled locations, over which the circuits actuating the switches and signals are carried and indications of conditions at the outside location are returned to the operating panel of the control machine housed at a convenient point.

EAST END OF ENO

WEST END OF ENO

EAST END OF DERBY

WEST END OF DERBY



Standard Signal Practices Employed

Centralized Traffic Control is based upon the coordination of established practices long used in automatic block signaling and interlocking systems. All signal functions are dependent primarily upon the occupied or unoccupied condition of the track and the check between opposing signals, and secondarily upon the will of the operator. The same electrical safeguards are employed as are used in connection with an interlocking. The system is completely "fool-proof", through use of safety circuits, in that it is impossible for improper manipulation of control levers to set up an unsafe condition for train movements.

Train Movements Expedited

Centralized Traffic Control provides for expedited movement of trains by greatly increasing the efficiency of the train dispatcher because it provides a direct means of conveying his orders to each train without intermediary steps in transmission and without relying upon other methods of communication. Each order is given by signal indication at the point where it is to be delivered to the train which is to execute it, thus the dispatcher's control is direct and constant over all train movements, and at all times.

Simple and Flexible Operation

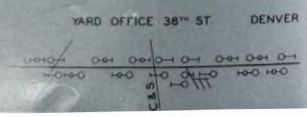
The telephone simplified the mechanics of issuing train orders and gave the dispatcher a fast means of communication. C. T. C., however, provides even more outstanding aid to efficient dispatching, reducing the mechanics to the simple movement of a small lever without the intermediary action of another person. It gives the dispatcher the advantages equivalent to having an operator at each end of each siding or at each controlled location

U. P. CROSSING

UNDERGRADE CROSSING

38TH STREET

NEARING DENVER



without the delays which would be involved in communicating with trains by means of the train order system. In most cases there are some three or four times as many "OS" locations as under operation by timetable and train orders because each end of the siding and sidings which were formerly "blind" are controlled with the C. T. C. system.

Under this method of operation the dispatcher can devote practically all of his time to the planning of meets and passing moves and to the many other duties which have gradually fallen to his lot. C. T. C. does not provide a substitute for the good judgment of an experienced train dispatcher in the planning of train movements. It does provide an operating tool which enables dispatchers to secure action quickly on their planned movements.

Economic Advantages and Increased Safety

The economic advantages of C. T. C. result principally from the following basic sources:

1. The conservation of capital, by providing increased capacity of existing facilities at a much lower cost than can be obtained by other methods.

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 siding or receive train orders.

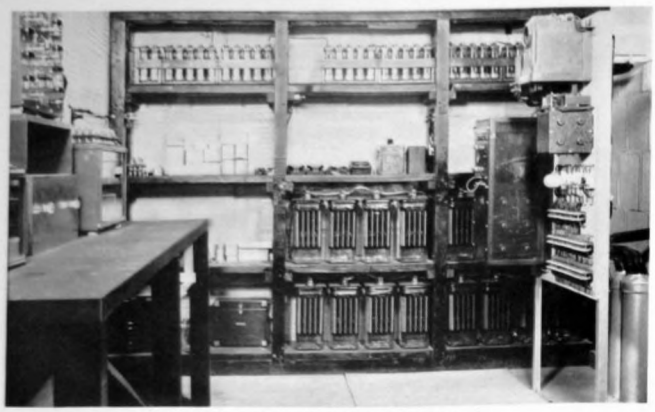
Safety of operation is increased and there are many desirable advantages through the use of the "UNION" C. T. C. System.

DENVER

DENVER STATION

ALONG THE PLATFORM

"ON TIME"



Interior of battery room in Brush station showing the rectifier and power panel on the right and the testing set to the left.

A concrete relay house, with maintainer's call signal and telephone, is located at each control point.

Interior of a concrete relay house showing part of the control equipment and apparatus housed in it.

REPRESENTATIVE "UNION" CENTRALIZED TRAFFIC CONTROL

Installations

RAILROAD	LOCATION	MILES ROAD	MILES TRACK	REMARKS
A.T. & S.F.	Dodge City, Kan.—Kinsley	34.0	41.6	Trains expedited on busy single track line. Train delays are eliminated and overtime reduced.
	Holliday, Kan.—Olathe	12.6	25.2	Tonnage trains expedited with a saving of 9 minutes per train. Increased track capacity postponed need for third track at this point.
	Rowe, N.M.—Fox	5.1	5.1	
	St. L. & S.W. Jct., Tex.—Saginaw	5.2	5.2	
	Oak Cliff, Tex.—Hale Jct.	3.6	3.6	
	Santa Fe Jct., Tex.—Oak Cliff	2.2	2.3	
	Birds, Tex.—Polk	1.6	1.6	
	Las Animas Jct., Col.—Las Animas	1.5	1.5	
B. & O.	N. Lima, Ohio—Roachton	54.7	54.7	Eliminated 46,355 train stops per year, increased traffic capacity, increased the safety of train operation and reduced operating expenses by reducing overtime and closing of manual block stations.
B. & M.	Rigby, Maine—Rollinsford, N.H.	70.2	100.9	Increased flexibility of operation by providing for either direction running on double track line, reduced operating expenses, and increased the capacity of the double track sufficiently to permit virtual abandonment of parallel single track line except in emergencies.
	Rollinsford, N.H.—Dover	3.0	6.0	
	Rigby, Maine	1.4	2.2	
	Winchester, Mass.—Wilmington	17.0	34.0	Either direction signaling on double track suburban territory facilitates train operation. Three interlockings installed in 1885 were consolidated and C.T.C. controlled.
	Hoosick Jct., N.Y.—Eagle Bridge	3.3	6.6	

REPRESENTATIVE "UNION" CENTRALIZED TRAFFIC CONTROL INSTALLATIONS

RAILROAD	LOCATION	MILES ROAD	MILES TRACK	REMARKS
C. of Ga.	Ames, Ga.—Ocmulgee	4.8	4.8	Eliminated congested section and postponed second track. Estimated capacity of the line 80 trains daily.
	Macon Jct., Ga.—Payne	4.1	4.1	
	Terra Cotta, Ga.—Echeconnee	8.6	8.6	
	Echeconnee, Ga.—Carman	15.0	15.0	
C.R.R. of N.J.	North Branch, N.J.—White House	4.4	17.6	Greater flexibility of movements in territory of congested traffic provided by installation permitting reverse moves to be made by signal indication. This installation relieved pressure on adjoining double track enough to postpone four-tracking.
C. & O.	"AR" Cabin—Highland Park, Va.	2.4	2.4	
	"HY" Cabin—M.P. 282, Va.	2.0	2.0	
	Limeville, Ky.—M.P. 541	2.0	2.0	
	Brighton, Ohio—Cheviot	5.0	5.0	Eliminated absolute block of 4.5 miles on heavy grade, reducing delays and greatly expediting traffic.
C.B. & Q.	**Akron, Col.—Derby**	**105.3**	**105.3**	**The longest continuous section of C.T.C. yet placed in service, to the description of which this bulletin has been devoted and is dedicated.**
	Derby, Col.—Denver	5.6	5.6	
	Red Oak, Iowa—Balfour	**25.3**	**27.8**	**Power operation of siding switches on grades permits heavier tonnage trains to save more than 19 minutes per train. Return on investment approximately 20% per year.**
	Greenwood, Neb.—Waverly	5.4	5.4	Eliminated hand operation of switches at ends of double track, postponed need for additional double track and brought about a return of 20% on the investment.
	Block 104—Arenzville, Ill.	3.4	3.4	
	Graham, Ill.—Galesburg	3.1	6.2	
	Shannon, Iowa—Chariton	7.5	15.0	
	Block 36—Armour, Mo.	6.5	6.5	
C.G.W.	Winston, Ill.—Rice	1.5	1.5	C.T.C. replaces staff system for handling trains in single track tunnel. Saving 38.9% per year on the investment in new signaling.

REPRESENTATIVE "UNION" CENTRALIZED TRAFFIC CONTROL INSTALLATIONS

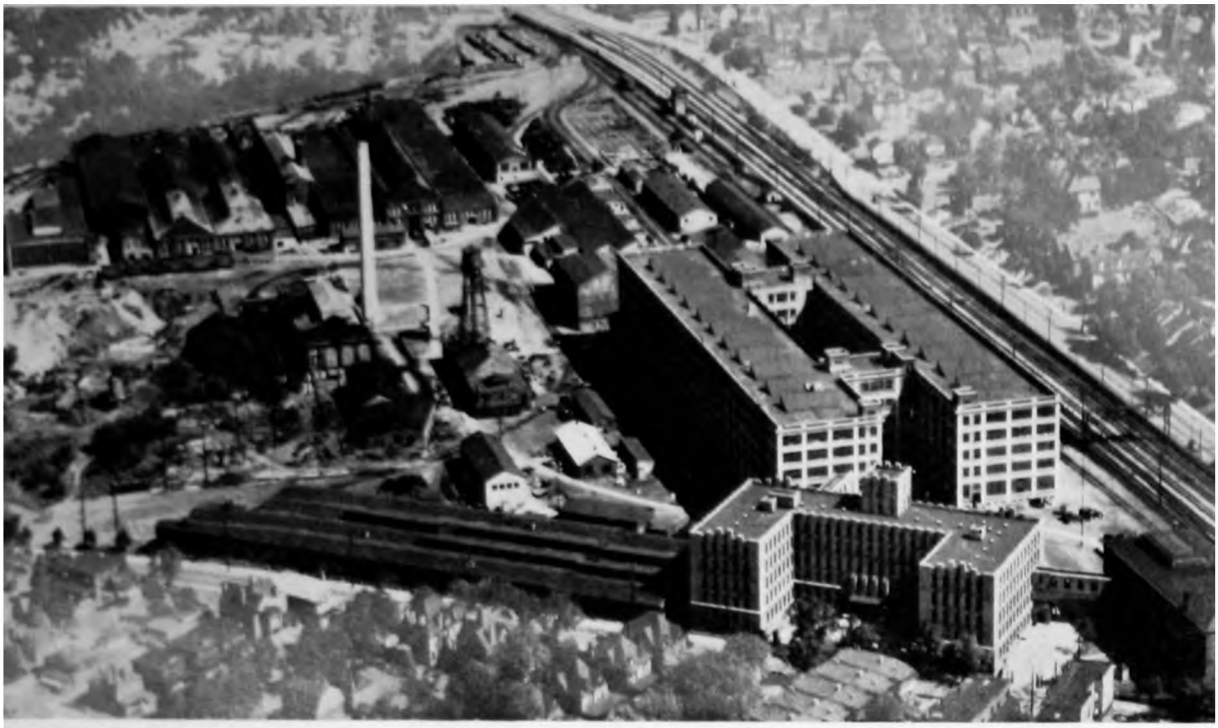
RAILROAD	LOCATION	MILES ROAD	MILES TRACK	REMARKS
C.M. St. P. & P.	**Lawson Jct., Mo.—Moseby Jct.**	**11.6**	**11.6**	
	Gary Jct., Ill.—Tallmadge	3.8	3.8	
	West Yard—Sioux City, Iowa	2.2	2.2	
	Beloit Jct., Wis.—Beloit	1.4	1.4	Replaced staff system, eliminates delays incidental to handling of staff and facilitates train operation by permitting following moves. Annual return of 50% on investment.
	Beloit Yard, Wis.—Rockton	1.7	1.7	
	Sturtevant, Wis.—A68	6.3	12.6	
	Tunnel City, Wis.—Raymore	2.7	2.7	
	Austin, Minn.—Ramsey	2.2	2.2	
	Ottumwa, Iowa—Rutledge	2.8	2.8	
C.R.I. & P.	**Polo, Mo.—Birmingham**	**37.7**	**75.4**	**Operation of a low grade single track freight line with a single track freight and passenger line, jointly with the C.M. St. P. & P.**
	Trenton, Mo.—Lock Springs	20.7	31.1	
	Albert Lea, Minn.—Glenville	10.4	10.4	
	Hot Springs Jct., Ark.—Biddle	1.2	1.2	
Erie	**Lackawaxen, Pa.—Tusten**	**9.4**	**18.8**	**Reduced delays, expedited preference freight trains and increased capacity of a busy double track.**
	Olean, N.Y.—College Crossing	2.0	2.0	
	Hubbard, Ohio—Coles, Pa.	3.6	3.6	
	Kennedy, N.Y.—Randolph	5.2	5.2	
	Lackawaxen, Pa.—Wyo. Div.	1.6	1.6	
	Elmira, N.Y.—Southport	.2	.4	
	Red House, N.Y.	1.3	2.6	
	Seneca, N.Y.—Lehigh Jct.	.4	.4	
I.C.	Illinois Jct.—Ballard Jct., Ky.	1.6	1.6	
P. & I.	**Paducah, Ky.—Metropolis, Ill.**	**14.8**	**14.8**	**Short connecting freight line speeds traffic by reducing delays at five junction points. Saving 24.2% annually on the investment.**
M.K.T.	Wybark, Okla.—Muskogee	4.2	4.2	Facilitates train movements between junction point and terminal.
	Ray, Tex.—Redtex	3.9	3.9	
	Ray, Tex.—Pottsboro	3.5	3.5	
	Eureka, Tex.—Houston	3.4	3.4	

REPRESENTATIVE "UNION" CENTRALIZED TRAFFIC CONTROL INSTALLATIONS

RAILROAD	LOCATION	MILES ROAD	MILES TRACK	REMARKS
N. de Mex.	**Colonia—Lecheria**	**22.0**	**27.0**	
	Buena Vista—Lecheria			
N.C. & St. L.	Cowan, Tenn.—Sherwood	7.6	8.4	Relieved traffic congestion and increased track capacity of the line.
N.Y.C. & St. L.	"KG"—"NP", Ashtabula, Ohio	1.0	1.0	
	Kishmans, Ohio—Vermillion	4.6	4.6	
	Maumee, Ohio—Toledo	**5.2**	**10.2**	**Signal indication operation on new layout used jointly by four roads.**
N.Y.O. & W.	N.Y.C. Jct., N.Y.—Fulton	2.1	2.1	
N. & W.	N. Roanoke, Va.—Cloverdale	5.0	5.0	Installation of this short section of C.T.C. near a terminal saves 30% per year in operating expenses.
	Bonsack, Va.—Alberta	3.5	8.5	
	Dorney, Ohio—Circleville	4.4	4.4	
	Devon, W. Va.	2.0	4.2	
P. R. R.	**Ben Davis, Ind.—Almeda**	**30.2**	**30.2**	**Freight train hours reduced 49%, train tonnage increased 1%, freight train speed increased 87% and G.T.M. per train hour increased 89%. The C.T.C. installation is on the single track "bottle-neck" of a division otherwise double track.**
	Huntley, Pa.—Sterling Run	4.6	4.6	
	Clare, Ohio—Rendcomb Jct.	2.6	5.2	
	Richmond Br. Jct.—Valley	1.0	1.0	
	Red Bank—E. Norwood	4.0	4.0	
	Sw. 1, Oakley—Sw. 2, Oakley	.6	.6	
	Sw. 3, Oakley—Heights	1.6	1.6	
	Shocks Mills—Creswell, Pa.	12.0	25.5	
	Caln-Glen Loch, Pa.	14.6	58.4	
P.M.	**Mt. Morris, Mich.—Bridgeport**	**19.8**	**19.8**	**Freight train speed increased 26%, time per freight train reduced 21%, train loading increased and track capacity increased. Annual rate of return on investment about 22%.**
P. & L.E.	Wampum, Pa.—West Pittsburgh	3.1	6.3	

REPRESENTATIVE "UNION" CENTRALIZED TRAFFIC CONTROL INSTALLATIONS

RAILROAD	LOCATION	MILES ROAD	MILES TRACK	REMARKS
Phila. Subway *(P.R.T. operated)*	Broad St.—Darby	10.0	20.0	These installations for handling the traffic of the Ridge Avenue Subway and the connection with the Delaware River Bridge are the busiest C.T.C. controlled facilities for the operation of a double track line. Rush hour traffic involves long trains on 2 minute headway.
Del. Riv. Joint Comm. *(P.R.T. operated)*	Ridge Ave. Subway Ext.	5.5	5.5	
St. L.—S. F.	Springfield—Nichols, Mo.	3.5	3.5	
	Turrell, Ark.—Clarkdale	4.5	4.5	
	Critco, Ark.—Memphis, Tenn.	6.4	6.4	
	Birmingham, Ala.	1.1	1.1	
S. P. CO. *(Pacific System)*	**El Pinal, Cal.—Polk**	**39.7**	**42.2**	**Eastbound freight train speed increased 26%, time per freight train reduced 21% and train loading increased. Track capacity increased, second tracking postponed, with reduction in operating expenses.**
	San Jose, Cal.—Lick	4.9	5.4	
S. P. Co. *(T. & N.O.)*	**Alpine, Tex.—Paisano**	**12.7**	**12.7**	**Train movements expedited on track used jointly with Santa Fe.**
	Virginia Point, Tex.—Island	2.3	4.6	
	Beeville, Tex.—Skidmore	**10.3**	**10.3**	**Busy single track line handling traffic from two routes. Delays reduced and traffic expedited, particularly during heavy peak periods.**
	Ennis, Tex.—Garrett	1.2	1.2	
	Harrisburg, Tex.—Tower 86	3.8	3.8	
	Miller Yard, Tex.—T. & P. Jct.	3.9	3.9	
	Nacodoches, Tex.—Bonita Jct.	2.9	2.9	
Wabash	Walbridge Jct., O.—Wanick Jct.	5.3	10.6	
	Lafayette Jct., Ind.—State Line	**37.0**	**37.0**	**Train stops and train hours reduced, freight train speed increased, block stations eliminated and second track postponed. Control point is 93 miles from farthest controlled switch.**



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