



Burlington

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Control machine with the timbers, top and bottom, and bolted to form a solid unit for skidding and hoisting

SELDOM does a signal installation make history twice—but that's what happened on the Burlington. In 1937, the 105-mi. Akron-Derby centralized traffic control installation—the outstanding C.T.C. installation for a number of years—was placed in service with the control machine located at Brush, Colo., 24 mi. west of Akron. In 1947, this same machine was moved 167 mi. east to McCook, Neb., and placed beside the McCook-Akron machine, installed in 1946, to control another complete operating subdivision. Today, these two "Union" C.T.C. machines control a division-length C.T.C. installation over a single pair of wires by the use of coded carrier control. The most distant controlled location is at Derby, 248 mi. away, making this the longest C.T.C. line in service at present. A third machine, for the Hastings-McCook territory, located in the same room at McCook, completes C.T.C. over the entire main line of this division from Hastings, Neb., to Derby, Colo. And the Burlington, through the concentration of control at division headquarters, is obtaining the maximum advantages of this modern method of directing train movements by signal indication.

The many advantages of centralizing the control of traffic of an entire main-line division at division head-

quarters was apparent to the officers of the Burlington when they planned the McCook-Akron and Hastings-McCook installations, and placed the machines in the dispatchers' office at McCook. After the McCook-Akron territory was placed under C.T.C. control, the two adjoining subdivisions were controlled from two places by two machines. From an operating standpoint, McCook was the logical place for the control of the entire main-line territory which made it desirable to move the Brush machine to McCook as, through the extreme flexibility of coded carrier control, it is still possible to place additional stations in service in this territory and operate them from the same pair of line wires.

Making History

The machine at Brush, controlling the territory from Akron to Derby, was placed in service on December 7, 1937. This was before the introduction of coded carrier control, and, therefore, it was found advisable, at that time, to locate the control point inside the territory. This installation, controlling the 105-mi. territory from Akron to Derby, made history as the first complete main-line subdivision to be controlled from a centralized point.

It was the outstanding C.T.C. installation for a number of years, and established a pattern for the control of long territories. During the war, this territory handled a great increase in traffic with speed and safety.

In 1946, a 10-ft. "Union" C.T.C. machine was placed in service at McCook to control the adjacent territory between McCook and Akron, a distance of 143 mi. The use of "Union" coded carrier permitted the placing of the control machine at the east end of this territory instead of at some intermediate point. This installation consists of a Type 506A time code system using a multiple line circuit. Open type line wire construction, consisting of two No. 6 Copperweld conductors of 40 per cent conductivity, was used. The first section of the territory from McCook to Wray, 90 mi. is a d.c. physical line having 18 stations. The second section from Wray to Akron, 53 mi., has a d.c. physical line remotely controlled by coded carrier over the McCook to Wray section. The remote carrier station is located at Wray with a standby carrier repeater located at Benkelman, 52 mi. from McCook. There are 11 stations in the 53 mi. between Wray and Akron. Even though the Akron-Derby section uses the Type 504A time code system with a series line circuit, it was possible to

Concentrates C.T.C. Control At Division Headquarters

combine this section with the 506A system, because of their inherent flexibility, and operate the whole territory of 248 mi. from division headquarters by moving the Brush machine to McCook.

This ten-foot machine at Brush used one line circuit to control the territory west of Brush to Derby, the east limits of the Denver Terminal. The 81 mi. of line wire consists of No. 10 copper in a two-conductor aerial cable. Another line circuit, 24 mi. east to Akron also used the same type of aerial cable. Both of these circuits used the Type 504A time code system in a series line. The territory in the vicinity of Brush was direct-wire-controlled from the machine.

Planning the Move

Before a move of such magnitude could be made, much preliminary work was completed at the signal engineer's office in Chicago, at division headquarters, and out on the line. This work included the making of necessary

Coded carrier control made possible the removal of Akron-Derby C.T.C. machine from Brush, Colo., to McCook, Neb.

changes in circuit plans and having them available for the men in the field to follow in making the change-over. The field forces were responsible for having as much of the work completed, prior to the actual movement of the machine, as could be done without interfering with its operation up to the time of loading for shipment.

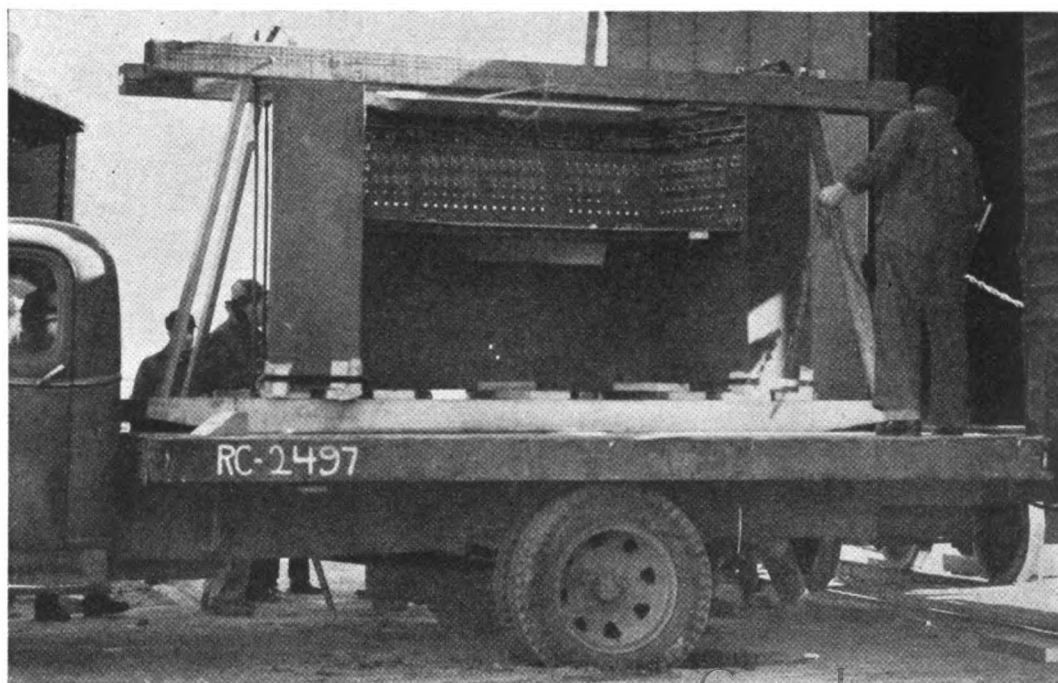
Planning the move of the C.T.C. machine from Brush to McCook brought out some interesting problems. It was desirable, from an operating standpoint to keep the territory in actual operation up to the time the machine was loaded in the baggage car for transport to McCook. Provisions also had to be made for the control of traffic in this territory during the hours the machine would be disconnected. As the time approached

for moving the machine, a working program was provided which coordinated the activities of all departments involved. The signal, the bridge and building, and the operating departments were affected. The tentative program was arranged so that the least possible delay would be experienced in train operation in the Akron-Derby territory. All men involved were informed that safety was to be the first consideration.

Operating Trains

While the machine was being moved by special train, the territory from Brush to Derby was to be operated by signal indication through the use of a test set at Brush, under the direction of train dispatchers left at Brush for

Control machine with the timbers, being skidded to motor truck from baggage car



that purpose. This test set was operated by a signal maintainer. The territory from Brush to Akron was to be operated under manual block rules, and to speed the procedure, no train meets were scheduled in this section; the switches being set for hand operation and spiked to take care of any eventuality. Maintainers were located at both ends of Pineo siding, about mid-way between Akron and Brush, where the dispatcher could reach them by telephone should he find it necessary to make emergency use of the siding. As anticipated, this was only a precaution.

The territory around Brush was handled by direct wires, and, during the time the machine was disconnected, the switches and signals in the vicinity of the station at Brush were inoperative and train movements were handled by a trainmaster working in cooperation with the dispatchers.

Prior to the day of the move, instructions had been issued by the operating department to have the yards at Denver, Akron, McCook and Hastings cleared so that time freights only would have to be run on the day of the move. In this way, all dead freight was moved the day prior to the transfer of the C.T.C. machine.

Moving Trains with the Test Set

Prior to the operation of the Brush to Derby section by the use of the test set, a large photostat of the diagram of the track layout, similar to that of the track model of the C.T.C. machine, was mounted above a desk. Station assignment numbers were clearly shown under each switch location. The switch and the signal levers were duplicated on this model by two rows of pegs on which tags could be hung. Tags, black on one side and red on the other, hung on the switch pegs, showed whether switches were normal or reverse. On the rows of signal pegs, the absence of a tag showed that the signal indicated "stop". When the signal was cleared for traffic to the right or to the left, a tag with a "R" or "L" was hung on that peg. Thus the operator had before him a chart showing the position of all switches and signals in the territory.

A manual recall was added to all series line LCS units between Brush and Derby, and to the series line test set. This feature made it possible to locate a train in the territory by asking the field station for a recall, without changing conditions at a field location.

A practice session was held on the operation of the test set before the move. The C.T.C. machine was disconnected from the line west and the test set placed in operation. Signals were cleared over the complete terri-

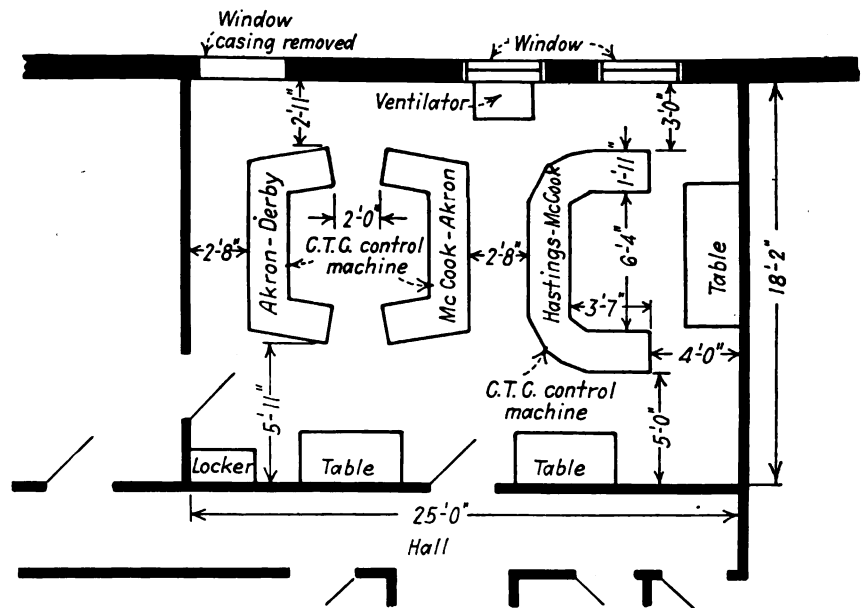
tory, Brush to Derby, for No. 10, the Chicago-bound Zephyr. Handling this train over the territory by means of the test set proved very satisfactory, and left no doubt that the test set could handle this section of the territory while the C.T.C. machine was being moved. The dispatchers kept their record of all train moves on the train sheet during the time the C.T.C. machine was out of service.

Wiring Changes

Many wiring changes had to be made in the field, as well as in the machine. To save time during the actual move, as well as to be able to

be cut in at the time of the change-over so that this could be accomplished as quickly as possible and yet keep the original installation in operation until that time. Three new stations were created to take care of the former direct-wire area around Brush. These were also arranged so that a minimum of work was required to add them to the McCook-Akron multiple line at the time of the move.

The 81-mi. series line from Brush to Derby was kept intact as a series line, but was arranged to be carrier-controlled from McCook to Brush. This section, using the 504A series LCS units installed ten years ago, is the first series line installation to be



Floor plan showing the new locations of the three control machines in the office at McCook

check the new circuits in advance, these changes had to be carried as far as it was possible, and then temporarily restored. A system of color tags was used on the wires to be changed; wires to be connected had red tags attached, and wires to be removed were marked with yellow tags.

It was decided, after careful study, that the eight stations on the series line east from Brush to Akron, and the direct-wire area at Brush, would be added to the carrier-controlled multiple line from the Akron-McCook machine. To do this, the 504A series LCS units were rewired and retimed as 504B multiple units. The code assignment in each was changed to work with the 506A multiple units already on the line, and then operated as 504A series units until the actual time of the cut-over. Style KP multiple line relays were provided to replace the Style P-4 series relays. Station disconnect and code filters were made ready to be added to these eight stations. All of these changes were wired and ready to

carrier-controlled. The problem involved in applying carrier control to this section was in its transmission over 167 mi. between McCook and Brush, in which the first part of the circuit was over open line wires, while the last 24 mi. was in two-conductor aerial cable. To hold attenuation within practical limits, it was necessary to use carrier frequencies lower than those generally employed. Accordingly, a 4 KC carrier is used from McCook to Brush for the control codes, while a 5 KC carrier from Brush to McCook handles the indication codes. A normal repeater was located at Wray, the remote location of the 14-17 KC carrier already in use controlling the multiple line between Wray and Akron. The stations between Akron and Brush were added to the 14-17 KC carrier control. A standby repeater for the 4-5 KC carrier was placed at Benkelman alongside the already existing 14-17 KC standby repeater. A normal and a standby repeater for the 4-5 KC carriers was also placed at

Akron, the beginning of the 24-mi. section of cable that carries the d.c. line and 4-5 KC carriers on to Brush. Matching transformers were located at each end of this section of cable between West Akron and Brush, in order to match the impedance of the carrier repeaters and oscillator-amplifier units to the impedance of the cable section.

The 4-5 KC carrier operates normally with either the Benkelman or the Wray repeaters out of service. However, should some abnormal line condition arise, both the Benkelman and Wray standby repeaters can be placed in service to boost the carrier voltage.

Some of the wiring in the control machine at Brush was re-arranged before the move. A change was required in the wiring of that section of the machine controlling the 24-mi. territory from Brush to Akron. As this section was to be added to the 14-17 KC carrier from the machine already at McCook, the office coding unit for this section would be eliminated. The change required the wiring of all control and indication circuits in this section.

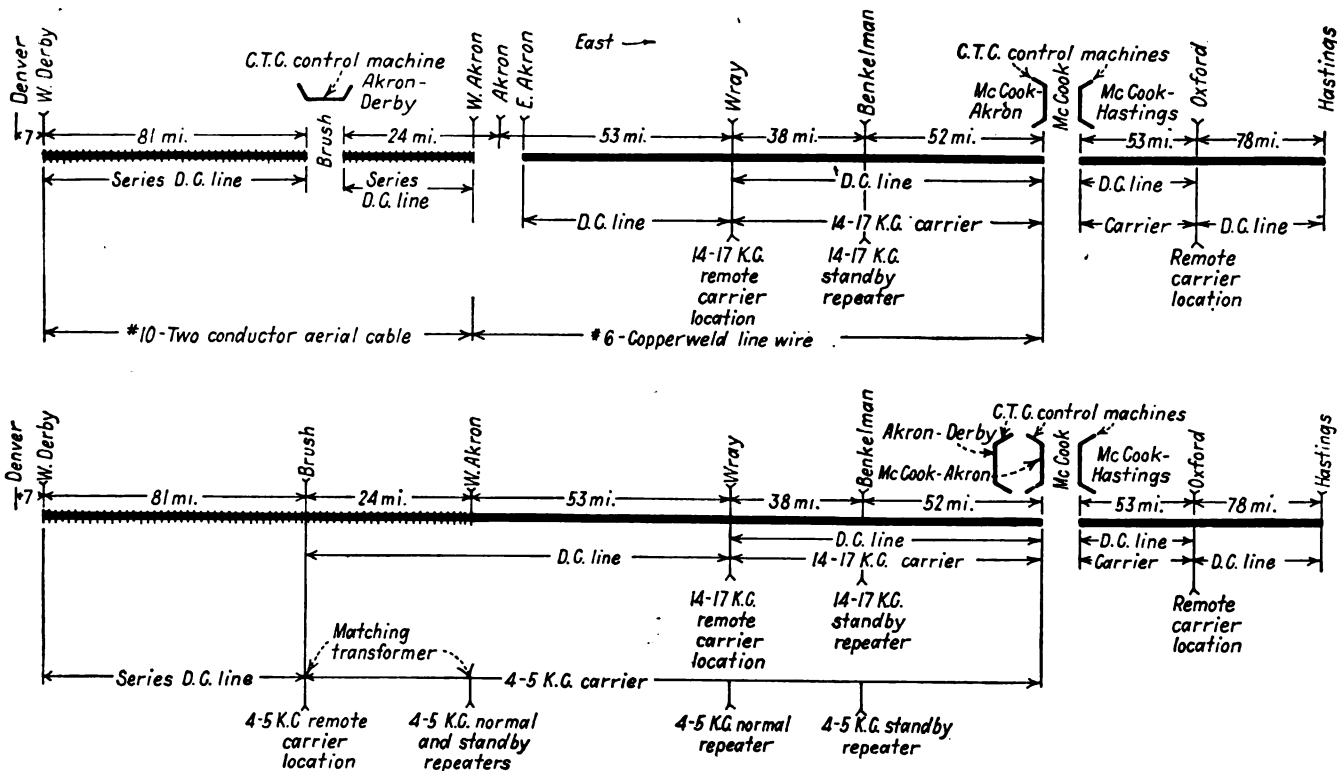
The territory around Brush had been direct-wire-controlled from the C.T.C. machine. Under the new program, this section was to be code-controlled from the multiple line out of the 14-17 carrier location at Wray. This required the addition of the necessary code relays in the machine and the creation of a new field location including one LCS unit and two storage units to handle the field location at Brush.

The only changes in the section of the machine controlling the 81-mi. series line west were the addition of the circuits required to operate the series office coding unit through the oscillator-amplifier carrier unit. This section was to be controlled by the 4-5 KC carrier after the machine was moved to McCook. The series line with the 504A units was left intact.

Further preparation of the Brush C.T.C. machine included crating. While still in operation, the machine was raised from the floor and two 8-in. by 8-in. timbers were placed under it, the long way of the machine. Two similar timbers were placed on top and joined to the bottom with tie-

section. Here he could carry out instructions while the series line relays were disconnected and the KP multiple relays were tested on the line. A field station in this section was wired to the same code-setting as the east Akron station which was already controlled by the McCook C.T.C. machine, and the East Akron station was temporarily disconnected. With the selected station wired to the East Akron code-setting, it was possible to make a complete check of all control steps and all indication steps by means of the East Akron panel on the McCook control machine over the 14-17 KC carrier. At the completion of the tests, all components were restored to their original functions, awaiting the move of the machine.

While the series line from Brush to West Akron was disconnected from the Brush machine and changed to a multiple line out of McCook, the 4-5 KC carrier frequencies, which were to be used to control the Brush to Derby section, were checked. The carrier levels were adjusted to check the attenuation through the 24-mi. cable section between Akron and Brush.



The upper diagram shows the C.T.C. code line circuits when the machine was at Brush
The lower diagram shows the C.T.C. code line circuits after the machine was moved to Akron

tion to a connector block so that a cable could be run between the two machines after they were properly placed at McCook. A similar connector block was added to the McCook machine. The station selection wiring in the machine for the eight stations, Brush to Akron, also had to be changed.

bolts. Cable eyes and cables were also added, forming a solid unit for hoisting.

A thorough operating test of the 4-5 KC code line and the units added to the 14-17 KC code line was advisable before the actual move. To check the latter, a maintainer was located at each field station in the Akron-Brush

After adjusting these levels, the 506A test set was connected at McCook to control the 4 KC oscillator-amplifier unit, and to record the indications from the 5 KC oscillator-amplifier. This was necessary in order to make a preliminary check on the remote carrier location at Brush since, at this time, there was no control machine

available at McCook for operation of this series line section. The series line west of Brush was then disconnected from the Brush machine and connected to the 4-5 KC carrier units located in the new remote location at Brush.

With this arrangement the west end of Brush was checked, using the test set at McCook to furnish controls and receive indications. This test also gave an operating check on the remote carrier location at Brush. By adjusting the test set to the West Derby code assignment, the switch was operated and the signal cleared from McCook. The test proved that everything would operate as intended when the final cut-over was made.

The Actual Move

So complete were the tests and so thorough the preparation by all men involved, the actual move was almost an anti-climax. On the change-over morning, when No. 39, the westbound Exposition Flyer, had passed Brush, and No. 1, the westbound Denver Zephyr, was approaching Brush, the west code line was changed from the C.T.C. machine to the test panel. This was at 6:47 a.m. Fifty-five minutes later, after the Denver Zephyr had passed Brush and entered the western section, the east code line was disconnected and, according to plan, all

switches in this 24-mi. section were placed on hand operation and spiked. Field changes were begun. All units were placed in multiple operation, station disconnect and C.T.C. code filters were added. After making the change at each location, the men were instructed to check that the line relay was in its energized position, and to watch that it followed at least one control code when some other station on the original line was being coded. This insured that all line relays were properly connected.

Into A Baggage Car

After the machine was completely disconnected from external wiring, it was moved through a door, turned and pushed up a ramp into a waiting baggage car. Two business cars completed the special train that carried the machine to McCook. A portable telephone had been installed between the baggage car and the first business car so that the two men riding in the car with the machine could keep in touch with those in charge.

A flat-bed truck was waiting at McCook. The machine in its crate, was pushed directly onto this truck, brought around to the side of the station where a sturdy scaffold had been erected, level with a third floor window. A crane was hooked to the prepared sling, the machine lifted, and

the truck was driven away. A load check was made and the machine was raised to the top of the scaffold. It was now pulled through an open window onto cribbing in the dispatchers'

Log of Move Made in Connection With the Moving of the Brush C.T.C. Machine From Brush to McCook

Mountain Time

- 6:57 a.m. Cut west code line.
- 7:03 a.m. Test set placed in operation.
- 7:10 a.m. Door taken off at Brush.
- 7:51 a.m. Cut east code line.
- 8:19 a.m. First roll on machine.
- 8:24 a.m. Machine out of door and turned.
- 8:29 a.m. Machine hooked to winch in truck.
- 8:34 a.m. Machine in car.
- 8:39 a.m. Special train started from Brush.
- 9:23 a.m. Arrived Akron } Changed
- 9:25 a.m. Left Akron } engine crews.
- 11:51 a.m. Arrived McCook.
- 11:53 a.m. Truck up to car door.
- 11:54 a.m. End machine shows in door.
- 11:56 a.m. Machine on truck.
- 12:01 p.m. Wiring in field, Akron to Brush, completed.
- 12:03 p.m. Truck at scaffold and crane hooked on.
- 12:12 p.m. Start hoisting machine.
- 12:25 p.m. Machine in office on shoring.
- 12:55 p.m. Machine crate on floor on block at each end, and wire rope sling being removed.
- 1:02 p.m. Top fir beams off.
- 1:03 p.m. Tie bolts removed.
- 1:10 p.m. On floor on bottom sills.
- 1:32 p.m. Last bottom sill removed.
- 1:37 p.m. On base plate.
- 6:14 p.m. Lights on board. Hookup check started.
- 6:15 p.m. Through wiring—connect up wire at time.
- 6:23 p.m. Graph hooked up and started working.
- 9:15 p.m. Cutting in C line at Brush.
- 9:16 p.m. No. 72 going out of Hudson.
- 9:18 p.m. "C" line cut in.
- 9:19 p.m. No. 12 by east switch at Derby.
- 9:20 p.m. No. 62 approaching W. switch at Keensburg.
- 9:28 p.m. Checked in from Derby to Brush.
- 9:35 p.m. All tests completed.
- 9:39 p.m. Brush told to take down Test Board.
- 9:45 p.m. Orders No. 251 and 253 annulled.
- 9:47 p.m. Complete.

room. By removing this cribbing, a layer at a time, it was not necessary to rig a hoist to lower the machine to the floor.

Returning the Machine to Service

By the time the wiring changes were made between the two machines, the field work between Brush and Akron

The machine being lifted by a crane onto the deck of a scaffold outside the window of the office at McCook



had been completed. An operating check was made of the sections affected by the change with the action being observed and reported by men at each field location. Next the series line from Brush to Derby was disconnected from the test set and connected to the remote carrier at Brush. Tests of the connection were quickly made, and the move was officially completed. The entire 248-mi. territory, McCook to Derby, was now handled from McCook.

The movement of the machine from Brush to McCook showed that the control of signals over a section of railroad by C.T.C. operation is very flexible. During the time that the machine was out of service 77 per cent of the territory normally operated by the machine being moved was still controlled by means of the test set. The other 24-mi. section could also have been similarly handled, but, due to the complications in rewiring the field locations, it was felt that this section could be better handled by train orders.

New Records Established By This Move

The entire McCook division, Hastings to Derby, is controlled by two dispatchers on each trick under the supervision of the chief dispatcher. One dispatcher controls a section from Hastings to McCook, operating a General Railway Signal Company machine. The second dispatcher controls the section from McCook to Derby by operating the two adjacent 10-ft. "Union" C.T.C. machines.

The movement of the machine from Brush to McCook resulted in several new records being established for the Burlington. This is the longest C.T.C. line now in service, there being approximately 250 mi. from McCook to Derby with continuous C.T.C. over the entire line. The two "Union" 10-ft. machines, electrically interconnected, control this territory. A General Railway Signal Company machine, located in the same room at McCook, controls the territory between McCook and Hastings. Thus, the entire main line of the McCook division is controlled from division headquarters at McCook. This continuous stretch of C.T.C., from Hastings, Neb. to Derby, Colo., is a distance of 380 mi. In addition, a second General Railway Signal Company installation, between Lincoln and Hastings of approximately 97 mi., adjoins the 380-mi. stretch. This makes approximately 477 mi. of continuous C.T.C. between Lincoln and Derby, the longest continuous stretch of C.T.C. territory in existence at this time.

I.C.C. Signal Hearings

The Interstate Commerce Commission, W. J. Patterson, commissioner, presiding, held hearings in Chicago, November 17 to 21, inclusive, to hear the petitions of certain additional railroads for relief from the requirements of the Commission's signaling order issued June 17, 1947. The roads heard at those sessions were the Chicago & North Western, the Chicago, St. Paul, Minneapolis & Omaha, the Chicago, Rock Island & Pacific, and the Minneapolis, St. Paul & Sault Ste. Marie. In brief, this order of June 17 requires the railroads to install block signaling on all lines, not now so equipped, on which freight trains are operated at 50 m.p.h. or more, or passenger trains at 60 m.p.h. or more, and protection in the form of train stop, train control or cab signaling on all tracks where any train is operated at 80 m.p.h. or more.

The North Western, including the Omaha, sought relief from the requirement to install train stop, train control or cab signaling on certain lines between Chicago and St. Paul where streamlined trains are operated at speeds higher than 80 m.p.h. Also, as applying to territories between Milwaukee, Wis., and Escanaba, Mich., via Green Bay, Wis., and between Mankato, Minn., and LaMar, Iowa, the request was to operate trains at speeds up to 65 m.p.h. without being required to install a block signal system.

Rock Island Petition

The Rock Island requested permission to run certain streamlined Rocket trains over some territories at speeds up to 90 m.p.h. without being required to install cab signaling, train stop or train control. Some of these territories are on 117 mi. between Farnam, Iowa, and Grinnell; 265 mi. between Herington, Kan., and Chickasha, Okla.; and 336 mi. between Pratt, Kan., and Tucumcari, N. M. This railroad also requested permission to operate one train each way daily at speeds higher than 60 m.p.h., without installing block signaling, on 235 mi. between Booneville, Ark., and Oklahoma City, Okla.

The Soo Line is the operating agent for the Wisconsin Central, now in bankruptcy. In opening its case, the Soo Line stated that negotiations were under way, subject to approval of the federal court, to install automatic block on 268 mi. between Spencer,

Wis., and Wheeling, Ill., which is 31 miles from Chicago. Also, this carrier requested permission to operate trains at 60 m.p.h. without installing signaling on certain territories totaling 266 mi. on the route between Minneapolis, Minn., and Winnipeg, Man., as well as at 65 m.p.h. on 142 mi. between Spencer and a junction near St. Paul, Minn.

Similar to Those of Other Roads

For the most part, the information brought forth at these sessions was similar to that given at the hearings held in October when the cases of the Union Pacific, the Great Northern, the Southern Pacific and the Santa Fe were heard. (See page 549 of *Railway Signaling* for October.) One new thought brought out during the November hearings was contained in a statement by Commissioner Patterson, to the effect that the Commission's order does not necessarily require wayside automatic block signals in an installation of cab signaling.

Fourth Aspect

As a part of these sessions, a brief time on Friday morning, November 21, was given to applications which had been made by the Union Pacific to install a fourth aspect, Advance Approach, Rule 282A, on three signals, and by the Illinois Central to install such a fourth aspect on one signal. Both these railroads proposed to use a flashing yellow as this fourth aspect. However, the discussion and decision had to do with the meaning of the indication to an engineman rather than dealing with the character of the aspect, i.e., whether it was yellow-over-yellow or flashing-yellow. In the Standard Code, the indication for the fourth aspect, Advance Approach, Rule 282A, is "Proceed preparing to stop as second signal." As applying to the fourth aspect on the proposed signals on the Union Pacific and the Illinois Central, as mentioned above, Commissioner Patterson, at the session on November 21, disclosed a decision that the indication should be "Proceed, train speed must be reduced immediately, sufficiently to pass next signal at a speed not to exceed 30 m.p.h."

The Union Pacific accepted this stipulation, but the Illinois Central withdrew its application as involving the proposed signal in question.