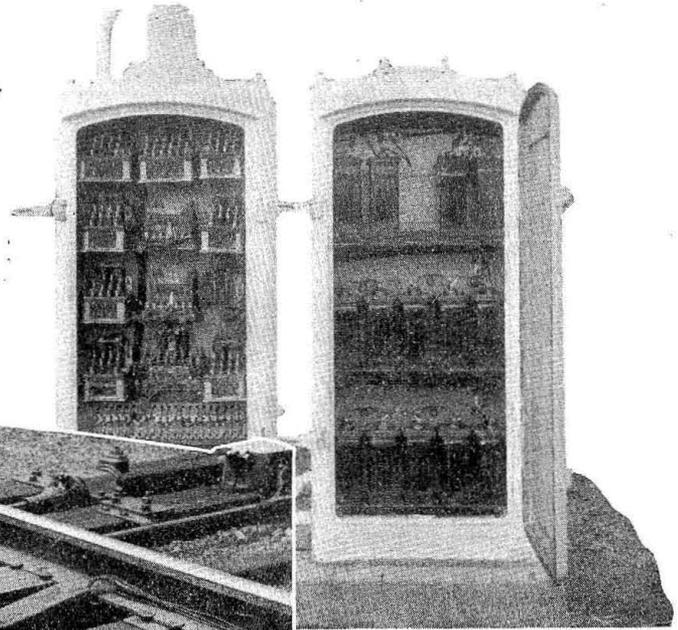
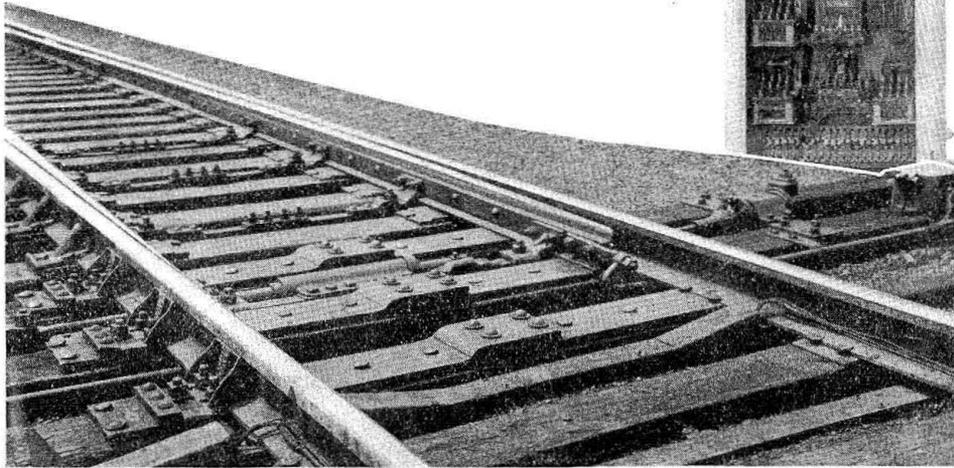


D. & R.G.W. Expedites Trains With Centralized Control

Remote switch machines, spring switches and direction of trains by signal indication assist in eliminating delays



Above—Relay and storage battery housings

Left—Close-up of spring switch and oil buffer at Mitchell

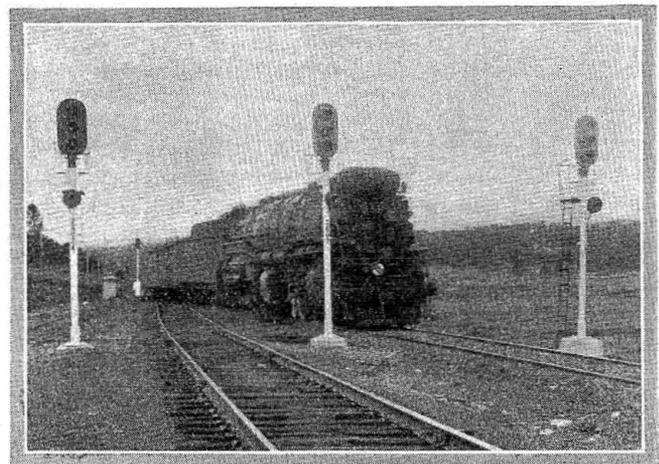
TRAIN movements through the Tennessee Pass tunnel on the Denver & Rio Grande Western have been expedited materially by an installation of centralized traffic control, including power-operated switches and signals, by means of which train movements are directed by signal indication without written orders. This district extends for one mile east and six miles west of the tower at Tennessee Pass. The centralized traffic control system, signals and switch machines were furnished and installed by the General Railway Signal Company.

The tunnel is 2,577 ft. long, with the summit of the grade at the middle, at an elevation of 10,250 ft. The single-track line approaching the tunnel from the east is on a 1.42 per cent grade. Two passing sidings at Tennessee Pass have capacities of 100 cars each. The switches at the east end of the passing sidings are provided with power-operated switch machines, controlled by the signalman, which eliminates the necessity of stopping the trains to throw the switches.

Approaching the tunnel from the west, a grade with a maximum of 3 per cent extends from Minturn, 20 miles, to the west portal and thence 1 per cent to the summit in the tunnel. Double track extends from Minturn to Deen, 15 miles; then a section of single track for 2 miles to West Mitchell; then a section of double track for 2.5 miles to East Mitchell. From the latter point, the single track extends through the tunnel to Tennessee Pass.

The traffic consists of from four to six passenger trains and from 3 to 10 freight trains each way daily. Between Minturn and Tennessee Pass one helper engine is used on most of the passenger trains, and

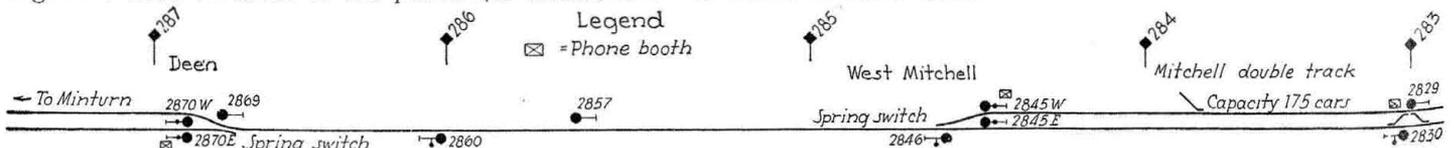
two helper engines on freight trains. Approximately 95 per cent of the helper engines on eastward trains return light from Tennessee Pass to Minturn, which greatly increases the number of movements in this territory. Westward freight trains are loaded to



A westbound train entering a passing track at the east end 3,000 tons, and eastward to 2,800 tons. In the month of October, 1928, the gross tons eastward were 481,000 and westward 313,000.

Method of Operation by Signal Indication

In the territory from the east switches at Tennessee Pass to the end of double track at Deen, all train movements are directed by the indication of the signals, without written train orders, and the superiority of trains is eliminated.

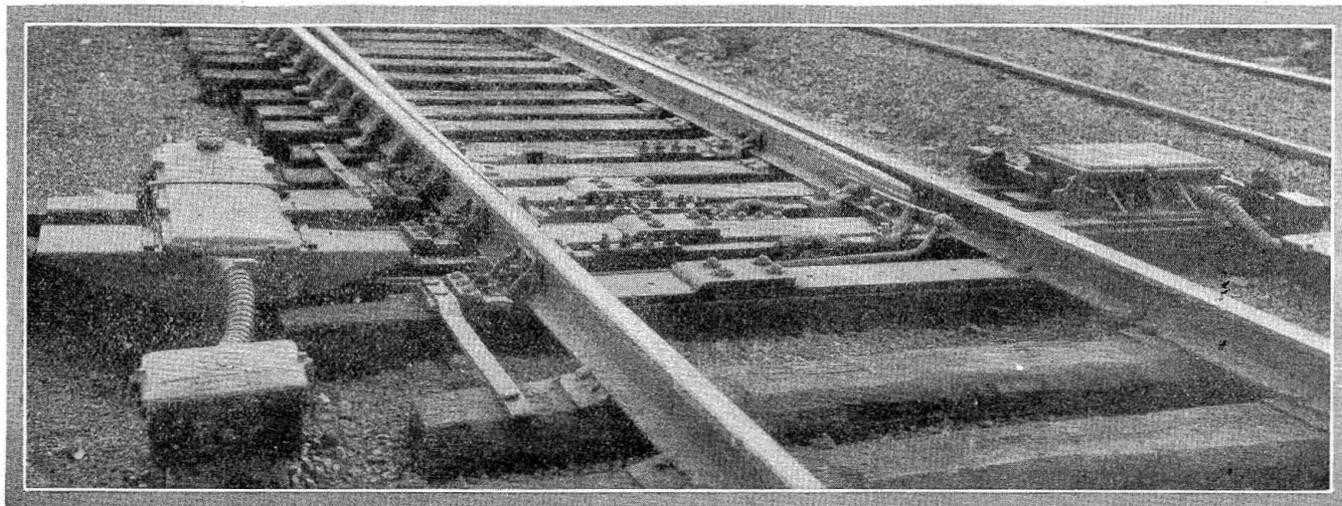


Track and signal plan of the territory

The operation of trains is, briefly, as follows: Trains approaching from the east are governed by the indication of signals 2801 and 2801-A at the east switches at Tennessee Pass, and proceed on the main track or into either passing siding without stopping, until they arrive at signal bridge 2811 at the west end of Tennessee Pass. All passenger and freight trains are stopped at Tennessee Pass for inspection, and to turn up the retainers on the air brakes for the movement down the descending grade west of the tunnel.

On signal bridge 2811, just west of Tennessee Pass tower, three signals govern westward train movements from the main track or the respective passing sidings. Switches No. 4 and 5 at the west end of these passing sidings are hand operated by trainmen,

reading "Audible Annunciator" 3,000 ft. west of Deen, the engineman sounds a code signal with the engine whistle, which informs the signalman at Tennessee Pass what kind of a train is approaching, and affords him ample time to arrange for its movement, and operate the machine control levers accordingly. If it is desired to move the train to East Mitchell only, signal 2870-E is cleared, while if it is desired to move the train through to Tennessee Pass, signal 2822-E at East Mitchell, as well as signal 2812 or 2812-A, is cleared. While an eastbound train is moving from Deen to East Mitchell, a westbound movement can be made from Tennessee Pass into the double track at East Mitchell; to protect this movement, eastbound signal 2822-E at East Mitchell is held to indicate stop, by the signalman's control lever, and also by the westbound train on the track circuits.



Adjustable rail braces and heavy gage plates eight inches wide and one inch thick are used in all switches

or car inspectors, under the direction of the signalman. When the signalman desires one of these switches operated, he sounds a code signal on a siren located on the signal bridge. He can see the switches from the tower, and he also gets an indication on the control machine when the signal changes. The signals governing movements over these switches are controlled by levers in the centralized traffic control machine, but they will not give a proceed indication until the switch is in the proper position.

After passing through the tunnel, a westward train is governed by automatic signals 2821 and 2829 and can be stopped on the double track at West Mitchell by signal 2845-W, which likewise can be used to authorize the train to proceed to Deen, the indication being under the joint control of the track ahead and the signalman's control machine. Upon passing Deen, a westward train leaves the territory controlled by the signalman, and enters the double track, operated by time table, train orders and automatic block signals.

Eastbound Train Movements

Eastbound trains moving from Minturn to Tennessee Pass ascend the 3 per cent grade; when passing a sign

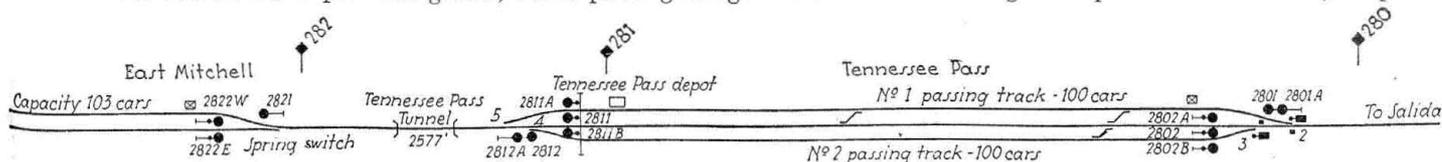
Oil-buffer spring switches are used at the ends of double track, which eliminate the stopping of trains to throw these switches for movements in either direction. Under the old system of train operation in this territory, trains on the ascending grade were required to stop to throw these switches.

Eastbound trains stop at Tennessee Pass to cut out helper engines, and for inspection, and then proceed on the main track or either passing track, as the case may be, and are governed by the indication of signals 2802, 2802-A or 2802-B, no stop being made to throw the switches at the east end of Tennessee Pass because these switches are power operated and controlled by the signalman.

Details of Construction

The power for the signals, track circuits and switch machines is furnished by storage batteries charged by the a-c. floating system. The tower battery consists of 20 cells and the switch battery of 12 cells. The batteries are Exide charged by Balkite rectifiers.

The signal lamps are rated at 10-volt, 10-watt and are burned normally at 8.5 volts. The marker lamps are lighted only when the red signal lamp is lighted. The construction of the signaling is in accordance with the D. & R. G. W. signal department standards, a special

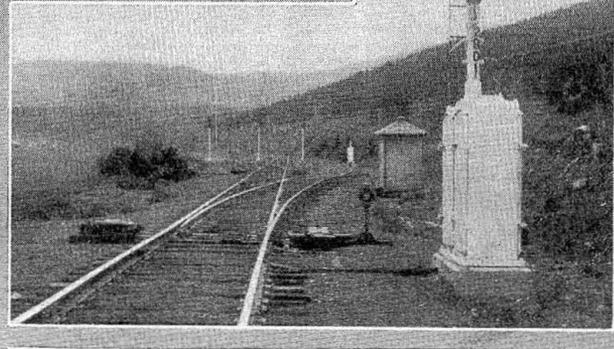
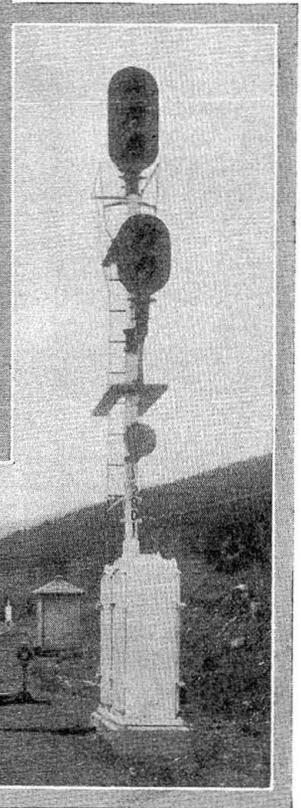
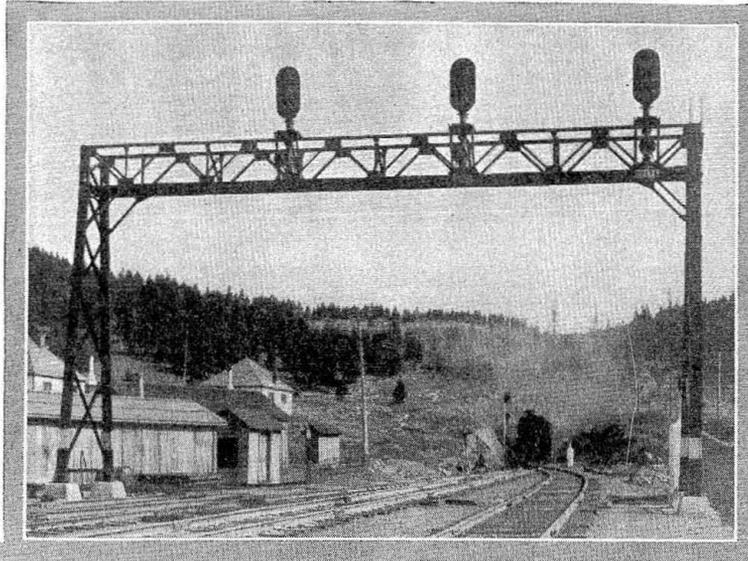


under the control of the operator at Tennessee Pass

feature being that the circuits from the relay cases up to the signals on the bridges are run in parkway cable clamped to the bridge. Series fouling circuits are used to insure broken-rail protection.

The audible annunciator mentioned previously consists of a telephone transmitter mounted in an open box on a cable post, the circuit being cut in by means of a special track relay at a center feed of the regular track circuits. When a train enters the track circuit, the transmitter is cut in so that when the engineman blows the whistle the sound is

clearance cards issued decreased 16 per cent as compared with a similar period prior to the centralized control operation, during which periods approximately the



Top—Eastbound train leaving tunnel
Left—The control machine in the station
Right—Power switch machines at east end

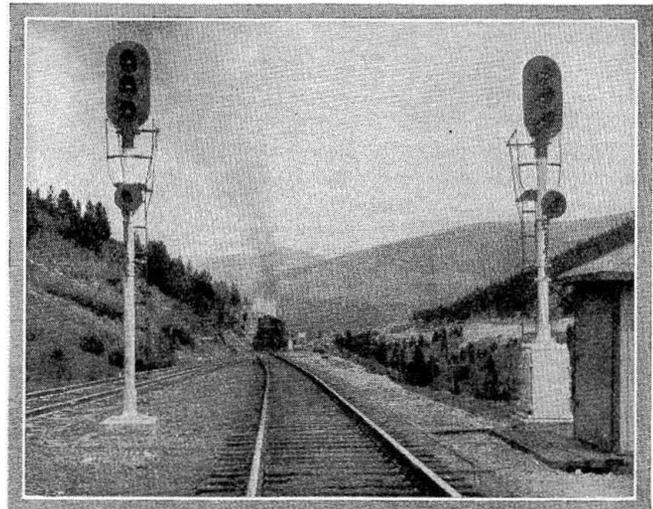
transmitted over a line circuit to the operator.

The results obtained by this installation include the limitation of train stops formerly required to get orders and to operate switches. In view of the fact that these stops were made on heavy grades, it may be readily seen that delays have been reduced, and train movements decidedly expedited as compared with previous operations, which statement is borne out by the fact that during the nine months following the installation of the centralized control system, November 1, 1928, the average freight train speed over this subdivision was 13.8 m.p.h., and the gross ton miles per train hour 25,402, compared with an average freight train speed of 12.8 m.p.h. and gross ton miles per train hour of 23,748 during the nine months immediately preceding the installation of the centralized control system. This method of handling trains has also greatly reduced the time previously used by helper engines to run from Minturn to Tennessee Pass and return to Minturn, of which movements there are from 9 to 23 per day.

Satisfactory Results Obtained

A noticeable reduction has been made in the number of train orders and clearance cards issued on the subdivision of which this territory is a part. A check indicates that during a given period, the number of train orders issued decreased 18 per cent, and the number of

same number of movements were involved. In addition, the safety of train operation in this territory and through the tunnel has been increased. A telegraph



An eastbound train near West Mitchell

office previously maintained at Deen was discontinued coincident with the inauguration of centralized train control.