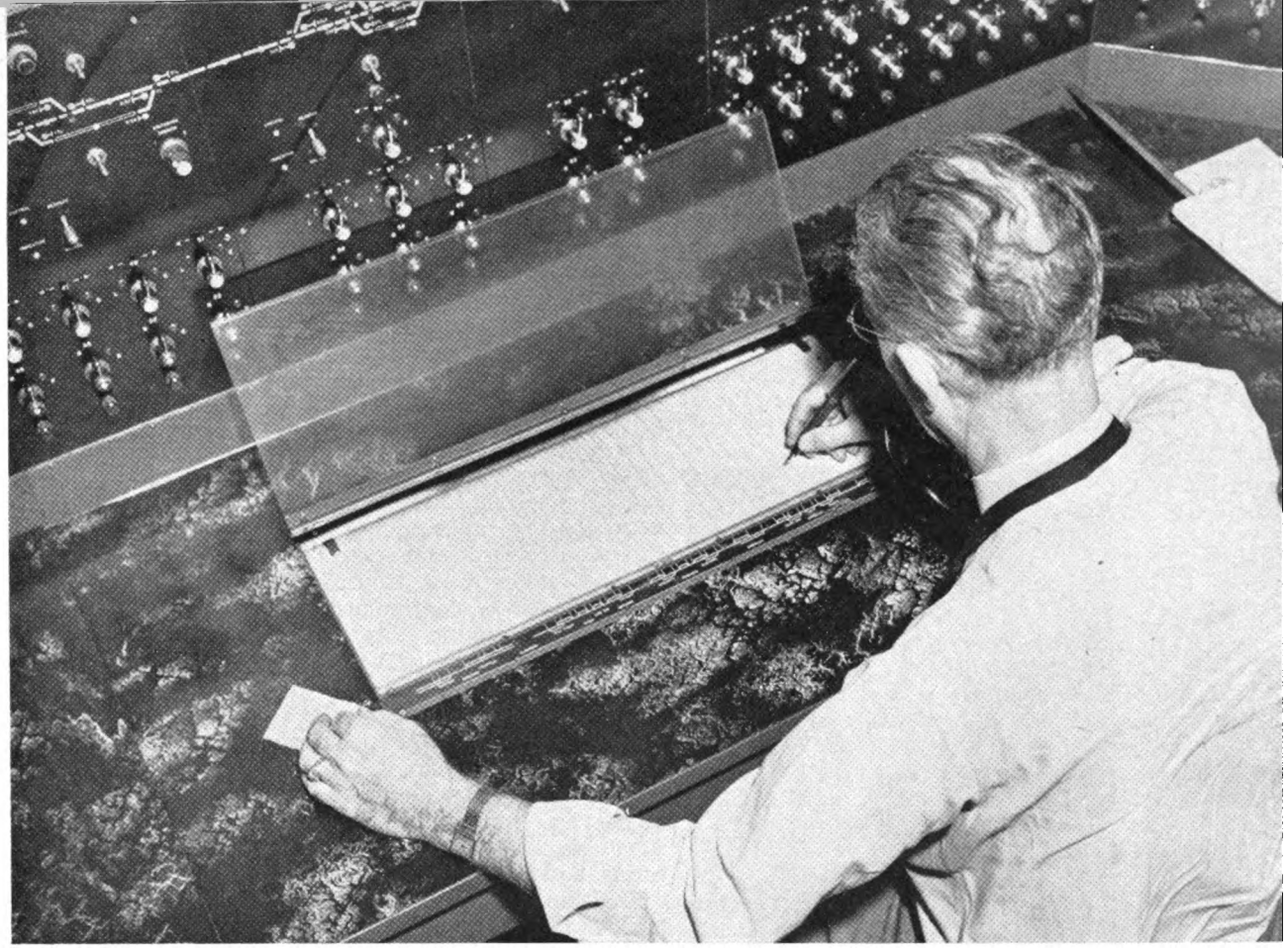


The dispatcher's control machine has an automatic train graph to make a record of train movements

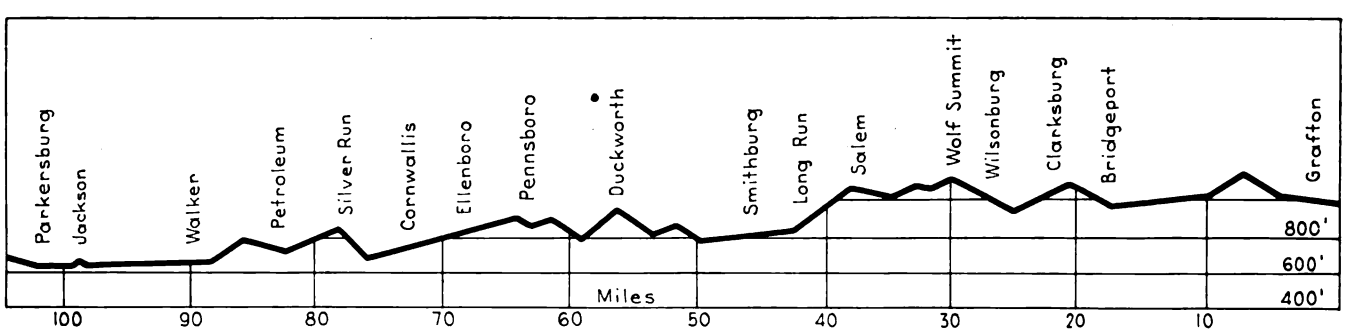
C.T.C. Pays Its Way on B. & O.

On busy single-track, handling 20 to 30 trains daily, train time is being saved and the operating expenses reduced by new control from dispatcher's office rather than by former local control at 14 points

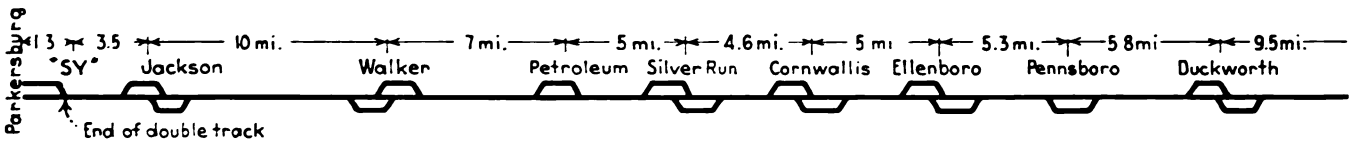
A COMPLETE system of centralized traffic control, including power switch machines and signals, for authorizing train movements, has been installed by the Baltimore & Ohio on the 103-mile subdivision, mostly single track, between Grafton W. Va., and Parkersburg. This subdivision is part of the route from New York-Baltimore and Washington west to Cincinnati and St. Louis. This new C.T.C. permits more efficient utilization of existing track facilities, saves train time, and reduces operating expenses sufficient to pay for itself in about five years, as is explained in more detail later.

Double track extends west 11 miles from Grafton to RS tower, and 4 miles from Lodgville through Clarksburg to J tower. Also double track extends from SY tower 1.5 miles to Parkersburg station. This leaves 8 miles of single track between RS and Lodgville and 78.9 miles between MO and SY, thus totaling 86.9 miles of single track, out of the total 103 miles.

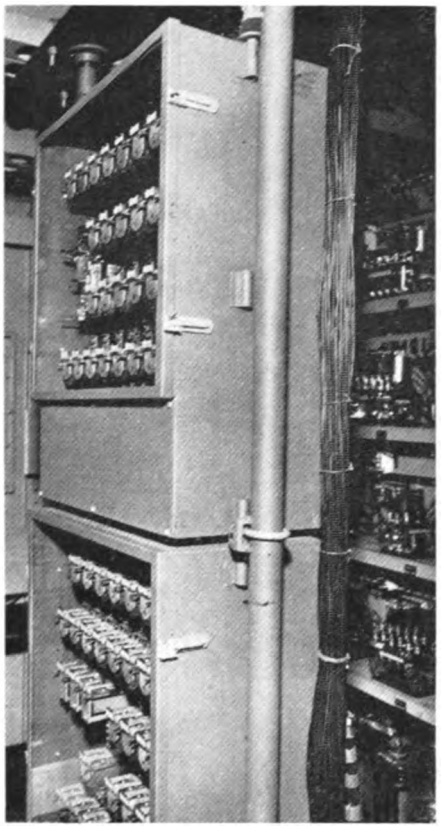
About 90 miles of this subdivision traverses rough terrain in the foot



Profile showing grades on the centralized traffic control territory



Track plan of the 103-mile centralized traffic control territory showing the



Code equipment in house

hills of the Allegheny mountains. The line passes over eight major crests, with ascending grades averaging 1.0 per cent (and up to 1.25 per cent) for two miles or more in each direction toward each crest. In the first 90 miles west from Grafton, the line winds continuously along streams and around hills, with considerable curvature, ranging up to about 6 degrees, with a few up to 8 degrees and one 9 degree 30 minutes. There are 22 tunnels one of which is 2,800 ft. long. On the 77 miles between Bridgeport and Kanawha the maximum permissible speed is 45 m.p.h. for passenger trains, and further reductions are required on some curves. The timetable-authorized speed for frieght trains is 35 m.p.h. which is of course not attained on the longer ascending grades. Thus, on account of the comparatively low speeds, it is important to keep trains moving with minimum delay entering and leaving sidings. This is where the train operation by signal indication is a help.

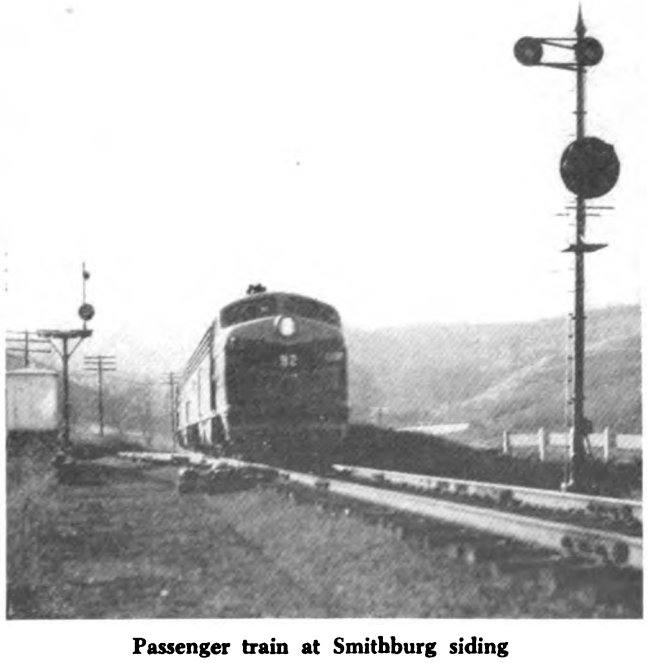
Peak Traffic at Night

Eight passenger trains and eight scheduled through freight trains are operated on this subdivision daily. A local freight runs east one day and west the next. An extra express and mail train is operated nearly every day during rush seasons, and extra freight trains are run when required. Thus about 18 to 20 trains are operated daily over the subdivision. In addition, 10 to 12 mine-run trains operate west out of Grafton to set out cars and pick up loaded cars at coal mines, and return to Grafton. Passenger trains and scheduled quick-dispatch freight trains are operated by diesel locomotives. Steam locomotives are used on local freight trains, extra mail trains, and extra freight trains. Passenger trains average 35.5 m.p.h. over the subdivision.

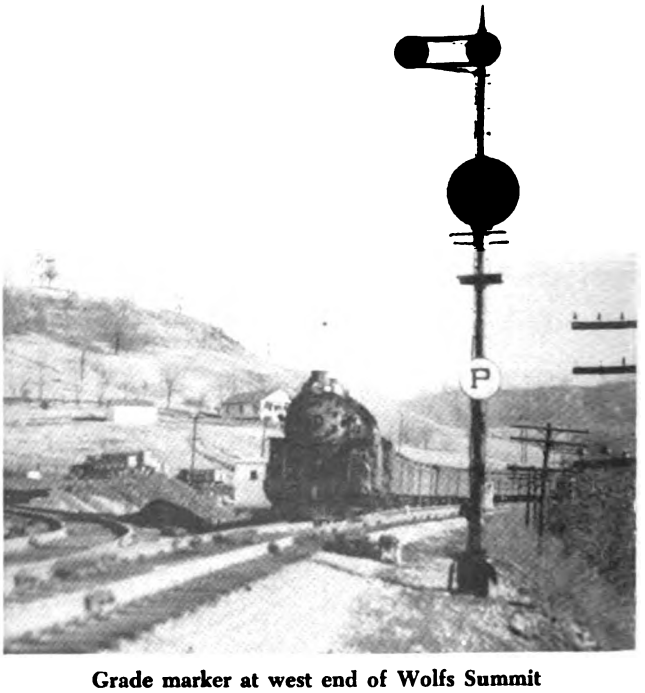
As measured by time, this subdivision is about half way between New York and St. Louis, and it happens that the four most important through passenger trains meet on this section during the night. Likewise most of the fast through freights are operated at night on this subdivision. Thus the operating problems involve not only grades, curves and slow maximum speeds but also the fact that more than 75 per cent of the through trains are bunched on this subdivision in a peak period between 8 p.m. and 6 a.m.

Prior Control Arrangement

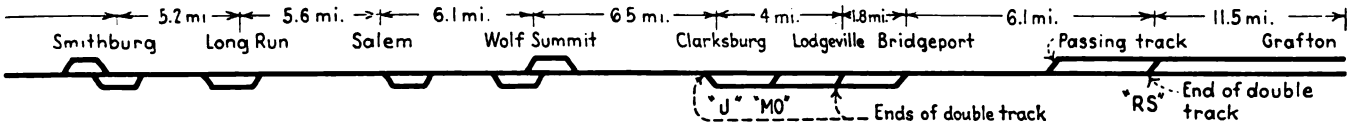
As one of the pioneers in the practice of authorizing train movements



Passenger train at Smithburg siding



Grade marker at west end of Wolfs Summit



power switches at sidings and ends of double track

by signal indication on entire subdivisions, the Baltimore & Ohio installed such a system on Grafton-Parkersburg territory in 1929. A set of interlocked desk levers were installed in each of 14 intermediate block offices. Each desk lever machine controlled not only the electric switch machines at both ends of the siding or sidings at that location but also signals to authorize train movements. Thus at each block office the switches and signals for authorizing train movements were controlled locally by the operator. The operators at the block offices worked under the direction of the train dispatcher by telephone communication.

As the years passed, the Baltimore & Ohio made several installations of complete centralized traffic control elsewhere on extensive single track sections, so that experience was gained in the advantages of this system. Therefore, in 1951, decision was made to so modernize the signaling system on the Grafton-Parkersburg subdivision.

Now Controlled From One Machine

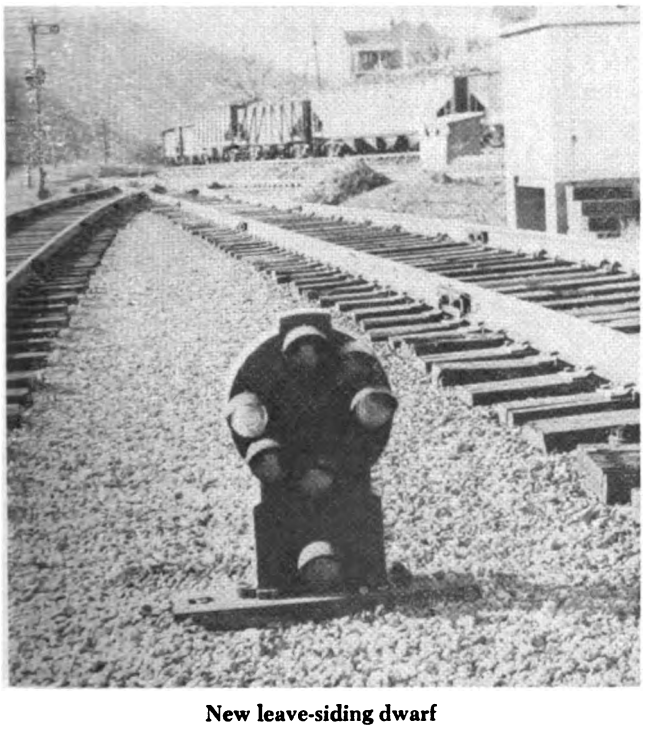
In general, the 1951 project consisted of the installation of a C.T.C. control machine in the dispatcher's office with a line circuit and coding equipment so that the dispatcher now has direct control of the power switches and signals at 14 of the prior outlying interlockings and block offices, plus the end of double track at Lodgville. A track change at Clarksburg included the extension of second track east through new tunnel No. 1 to Bridgeport, with end of double track at Lodgville. This reduces the interlocking at Bridgeport to a single switch. The terminal interlockings at Grafton, Clarksburg and Parkersburg were left undisturbed, and not included in the C.T.C. Thus, local movements are handled with less delay and the dispatcher is free to expedite the through traffic.

In the new project, the dispatcher's C.T.C. system includes the control of power switches and signals at RS, Bridgeport, Lodgville, Wolf Summit, Salem, Long Run, Smithburg, Duckworth, Pennsboro, Ellenboro, Cornwallis, Silver Run, Petroleum, Walker and Jackson. The track layouts at these locations are shown in the accompanying plan.

The dispatcher's control machine has five panel sections arranged in a "U" shape so that he can easily reach all the levers. The panel has the customary arrangement of levers, indication lamps and illuminated track plan to indicate the location of trains. An automatic train graph in the desk portion of the machine makes a record of the time that trains pass each power switch layout. The C.T.C. line code system includes carrier apparatus so that codes to or from the east and west sections can be handled simultaneously. The switches in the 47-mile east section between Grafton and Smithburg are controlled by D.C. code with carrier superimposed for handling the 52-mile west section from Smithburg to Jackson, using d.c. code west of Smithburg.

C.T.C. Pays For Itself

The new system of centralized traffic control from the dispatcher's office has: (1) made possible a more efficient utilization of existing track facilities; (2) brought about smoother train operation and thus improved on-time train performance; and (3) made a decided reduction in operating expenses, sufficient to pay for the capitol cost of the signaling improvement in about five years. The 1951 project involved a complete signal reconstruction program at the interlocked switch locations. Everything is new except the electric switch machines, the high signals, the track relays, the local line circuits, and the 440-volt a.c. power line wires. New



New leave-siding dwarf

High signal with two top side markers

leave-siding dwarf signals were installed, and additional aspects were provided on many high signals. The annual direct saving is approximately $180,000, and the General Railway Signal Company, which furnished all the new signaling equipment for the 1951 project, entered into a conditional sales agreement which enables the railroad to pay for the signaling in monthly installments, based on the savings in operating expenses.

Under the previous system, with 15 separate locally controlled layouts, when an approaching train "hit" an annunciator, the operator would call the dispatcher, and, as soon as he could, the dispatcher would tell the operator what to do with the train, i.e.: (1) run it through on the main track; (2) head train into the siding; or (3) hold it on the main. If the telephone circuit was being used or if the dispatcher was busy, time was lost, because the operator had to wait. In the meantime, the train reduced speed in accordance with Approach aspects, and in some instances came to a stop, needlessly. With the new C.T.C. control, the dispatcher watches the progress of trains as indicated on his illuminated diagram, and he controls the power switches and signals directly to keep trains moving at maximum permissible speed and to make meets with minimum loss of time. In numerous instances meets are made without either train being required to stop. A few minutes, here and there, makes a saving of 20 to 25 minutes for a freight train on the 103-mile run. In general the trains are now handled more evenly, so that track and time are available to keep trains moving. Therefore trains running late can make up time easier than previously, and on-time performance, which previously was good, has now been further improved. Another advantage is that extra trains can now be handled efficiently without disrupting other operations. In brief the centralized control has made it possible to utilize existing track facilities more efficiently.

The signals installed in 1929 on this subdivision were the Baltimore & Ohio standard color-position-light type. As part of the 1951 project the Approach-Medium aspect was added on many of the high signals, and the Approach-Slow aspect was added on a few high signals. These aspects are an aid to enginemen in controlling their train speeds smoothly without reductions of speed other than where actually required for safety, as well as avoiding unnecessary train stops.

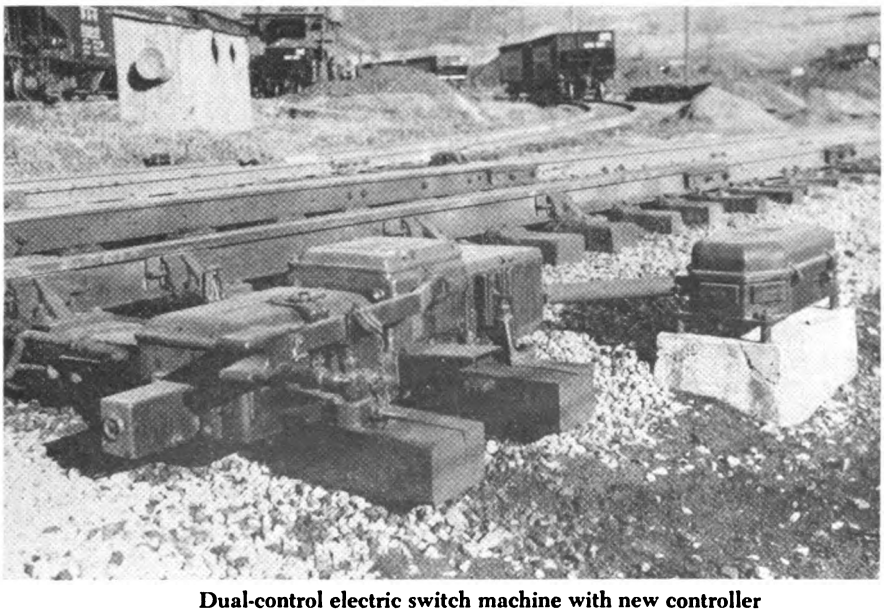
The dwarf signals at interlocked locations were replaced with new color-position-light dwarfs which have a white bottom marker. These signals are capable of being controlled to display four aspects via No. 10 turnouts: (1) Stop; (2) Stop and Proceed; (3) Slow Approach; and (4) Slow Clear. This range of aspects permits a train to leave a siding sooner behind a train of the same direction which has just passed, thus saving several minutes in many instances. Main track signals that govern in the ascending direction on heavy grades are equipped with a "Tonnage" marker consisting of a white letter "P" painted on a black background, which authorizes trains with 80 per cent or more of tonnage rating to pass, at restricted speed, and continue without stopping at the signal. Trains are not permitted to accept letter "P" on signals except when displaying red with the top marker lighted, indicating stop and proceed for a following move.

Electric lock of hand-throw stand

The electric switch machines, installed in 1929 are the Union Switch & Signal low-voltage dual-control type. These machines were continued in service, a new biased-neutral controller was added at each switch machine. As part of the 1951 project, electric locks were installed on all the main-line hand-throw switches leading to house tracks, mine spurs and industrial sidings, and also separate electric locks were installed on the hand-throw derails located at the clearance point on these turnouts.

At each power switch layout at the end of a siding or end of double track a sheet-metal house was installed for the relays, batteries and line coding equipment. At the intermediate signals, new sheet-metal cases are being installed under the maintenance program. At interlocking case wiring, wires to track connection, cables to switch machines and other underground runs between signals, line-drop cables and some of the aerial cables were all installed new in the 1951 project. The insulated wire and cable used was made by the Kerite Company. Style K relays were used. A bias-neutral relay, in combination with rectifier, was used in lieu of a polarized relay for the line control of signals, switch-repeating relay circuits, etc.

This 1951 centralized traffic control project was planned and constructed by signal forces of the Baltimore & Ohio, under the jurisdiction of A. S. Hunt, chief engineer communications and signals, and under the direction of W. W. Welsh, signal engineer.



Dual-control electric switch machine with new controller