Canadian Pacific Installs *Absolute Permissive Block*

Installation in mountainous territory on 22 miles of single track, serving the Alberta coal fields in Canada, saves train time and provides increased protection for all train movements

FROM Dunmore, Alta., on the main Trans-Canadian route of the Canadian Pacific west to Vancouver, B. C., via Banff, Alta., this railroad has a secondary line which runs west to Lethbridge, Alta., Coalhurst, Crowsnest, Cranbrook, Nelson, Penticton and Vancouver. From Cranbrook, a branch line extends north along the Columbia river to Golden, B. C., where it connects with the main Trans-Canadian route, which passes through Lake Louise and Banff. This southern route was built about 1900, primarily to serve and provide an east-west outlet for the coal fields of Alberta. The portion of this line between Lethbridge and Crowsnest is known as the Crowsnest subdivision of the Lethbridge division, Alberta district, and it is in this territory that absolute permissive block signaling has been installed on 22 miles of single track between Burmis, Alta., and Crowsnest. Train operation was formerly governed by timetable, train orders and manual time block, the latter having been eliminated by the installation of the new automatic signaling.

Traffic Handled

Through traffic in this territory consists of 1 passenger; 1 mixed and 7 freight trains in each direction daily in addition to numerous freight switching moves. Approximately 50,000 to 75,000 gross tons of freight are handled daily over the line. Freight traffic consists primarily of bituminous coal going east and west to all points in Canada, but especially east to Winnipeg, where a large market for commercial coal is being developed. Also a considerable quantity of coke is shipped from Coleman to Tradanac Smelter located west of Nelson. Traffic also includes lumber going east to all points in Canada. Seasonal fruit traffic from British Columbia to the east further increases business at times. Other traffic consists of fertilizer being shipped from the Trail Smelter at Tradanac, to all points in Canada, and general merchandise in each direction.

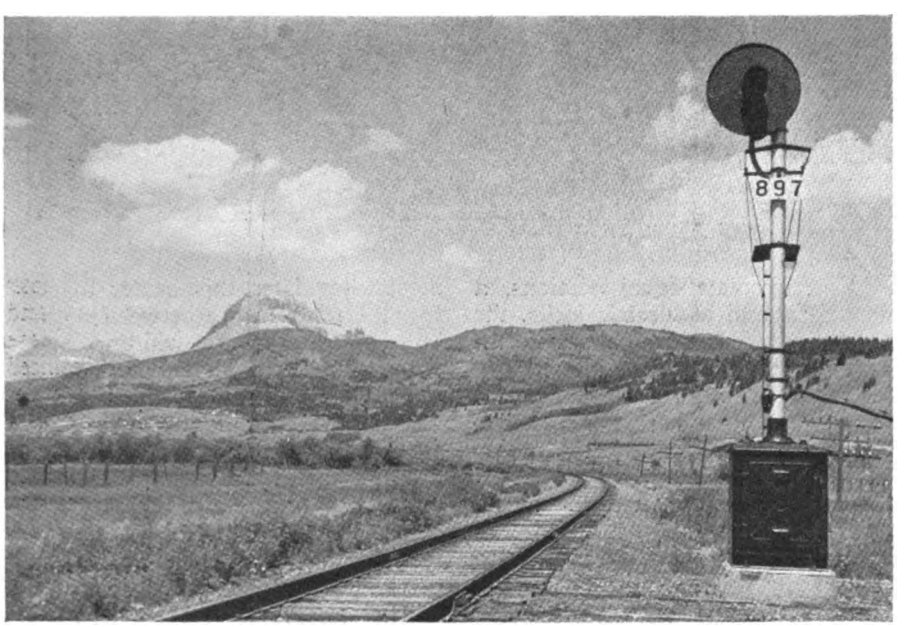
In addition to this through freight traffic, a considerable amount of switching is done in the territory in connection with coal mining activities. This consists of delivery of empty hopper and box cars to the mines for coal loading, and picking up loaded cars for making up through trains. Mine entrance sidings on the main line are located at Mohawk and Bellevue between Burmis and Hillcrest, at Greenhill, and West Canadian Colleries between Blairmore and Coleman, and at Coleman and McGillvary Creek Coal Co. west of Coleman.

Operating Difficulties

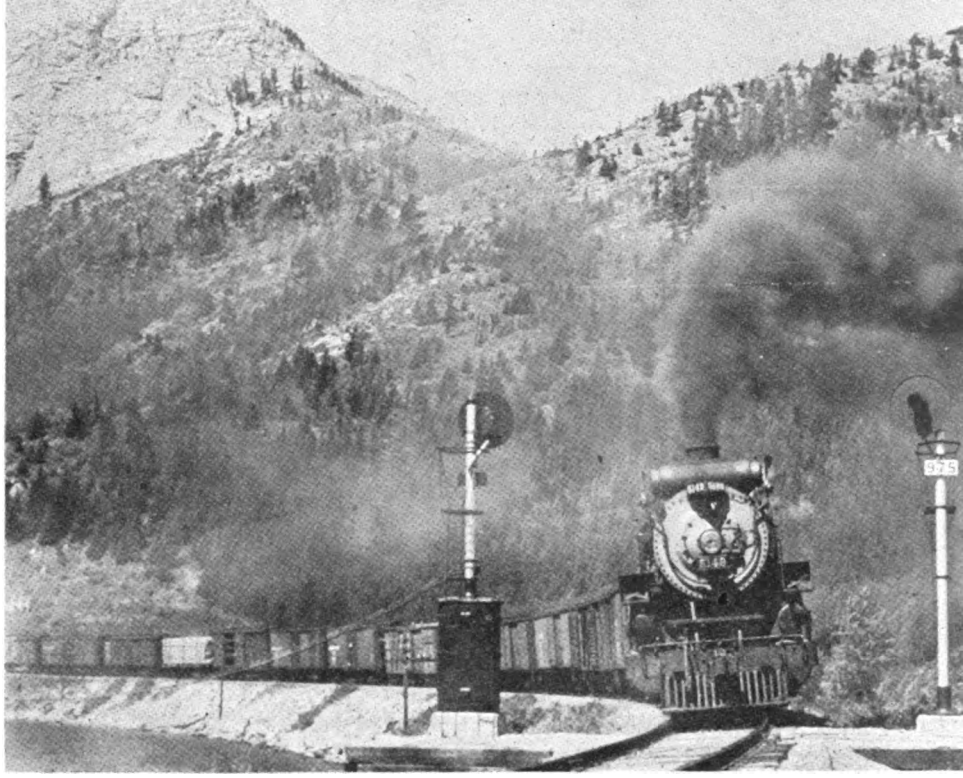
The entire territory is located in mountain country, and the principal operating difficulties are the heavy grades and sharp curvature, which produce poor visibility. The maximum grade, which ascends westbound from Burmis to Crowsnest, is 2.2 per cent, and curvature is as much as 16 deg. in places. Fog is heavy during the fall and spring between Burmis and Crowsnest, resulting in poorer visibility. Annual snowfall averages about 100 inches and exceeding high winds prevail in this area resulting in severe drifting and resulting blizzard conditions and poor visibility.

Because of these conditions, as well as the numerous main-line siding switches and switching movements, the decision was made to install the signaling in this particular territory. The main purpose of the new signaling is to expedite traffic, and at the same time provide increased protection for trains against conflicting movements, open switches and broken rails.

Train movements in this territory have been expedited an estimated 25 per cent as a result of the installation.



Typical single intermediate automatic location. Signals are the searchlight type



An eastbound freight train at a double intermediate location along Crowsnest Lake, near Crowsnest, B.C.

For example, a train running from Frank, 7.3 miles west of Burmis, to Crowsnest, formerly required 1 hour, 20 minutes, running time. The average running time is now about 50 minutes, a saving of 30 minutes. Heretofore, a train following a passenger train had to wait for the block before it could proceed, time blocking being in effect, i.e., a freight following a passenger train from Coleman to Crowsnest had to wait 20 minutes before proceeding. Offices being closed resulted in even longer delays. The new signaling has also facilitated the work of operators, who formerly blocked trains with train-order boards, which is no longer necessary under the new operation.

Searchlight Signals

The signals are the General Railway Signal Company's Type-SA searchlight, equipped with 10-volt d.c., 250-ohm coils, units being mounted to the left of the mast. Compound lens assemblies and pre-cracked green roundels are used. In some instances 20-deg. deflecting prisms are used where signals are located on sharp curves. The signals are equipped with 10-volt, 5-watt single-filament lamps, except where deflecting lenses are used with 11-volt, 11-watt lamps. Enamelled number plates, with a white background and black numbers, are used on all signals to designate them as automatic signals. Signals are painted aluminum except for the background which is painted black.

Absolute head-block signals are designated by a lunar white marker lamp, located 5 ft. vertically below the main signal unit. These markers are equipped with 10-volt, ¼-amp. lamps. Permissive signals have no marker lamps.

Absolute signals display red-over-lunar white for Stop, yellow-over-lunar white for Approach, and green-over-lunar white for Clear. Permissive signals display red, yellow and green for Stop-and-Proceed, Approach and Clear, respectively. Dispatcher's telephones are located at all absolute signal locations, in a separate case mounted on the outside of the instrument case.

Spacing between intermediate signals is short as practicable to reduce spacing between following trains. The length of each block is train stopping distance, which is based on maximum train speed and tonnage combined with existing grades and curvature.

No Intermediates

As shown in Fig. 1 there are no intermediate signals between Hillcrest and Frank. Thus, in order to prevent two opposing trains from simultaneously accepting proceed aspects on head-block signals 860 and 849, the controls of eastward signal 860 are overlapped so that it will display red when a train passes the clearance point at Hillcrest, marked by a clearance sign. Similarly, the controls of station-entering signals 843 and 868 are overlapped to the cut section marked X in Fig. 1.

While a clearance sign is shown at Frank, it does not apply between Frank and Hillcrest. There are no intermediate signals between Frank and Blairmore, the next station west. Consequently the eastward head-block signal 880 at Blairmore (not shown) is overlapped to the clearance sign at Frank.

Where the distance between sidings is short, say about 4 miles, one set of intermediate signals is provided and where the distance between sidings is about 5 miles, there are two double locations. Figure 2 shows the layout between Coleman and Sentinel, as well as the controls of signals. Opposing controls are represented by solid lines and following controls by dotted lines.

A considerable amount of switching service is carried on in the vicinity of Burmis, and in order to make the sig-

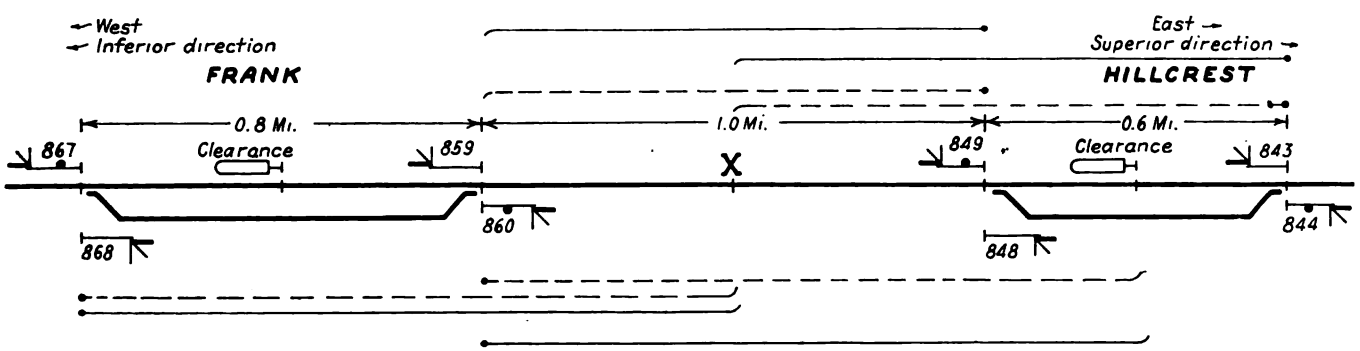


Fig. 1—Layout between Frank and Hillcrest, showing opposing and following controls by solid and dotted lines, respectively

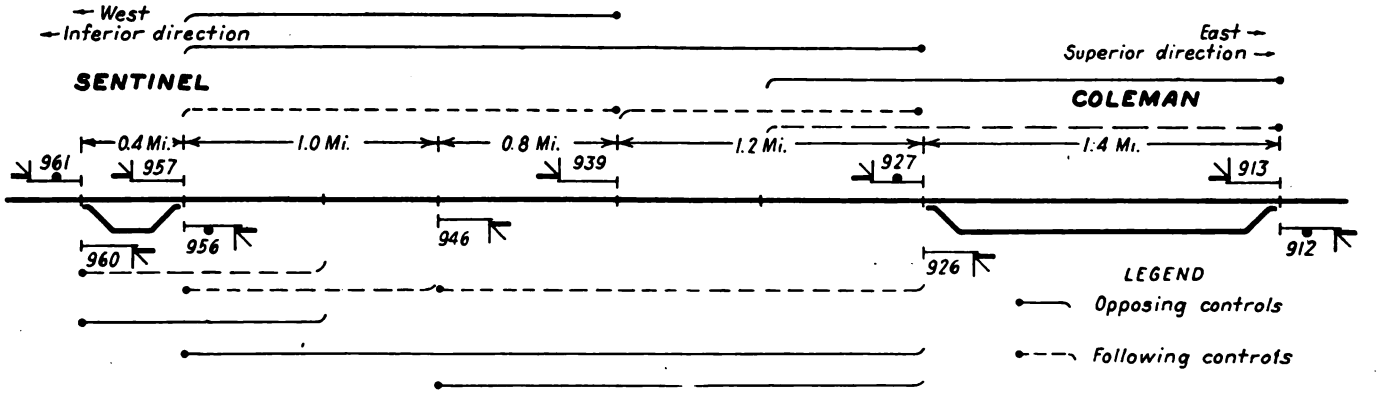
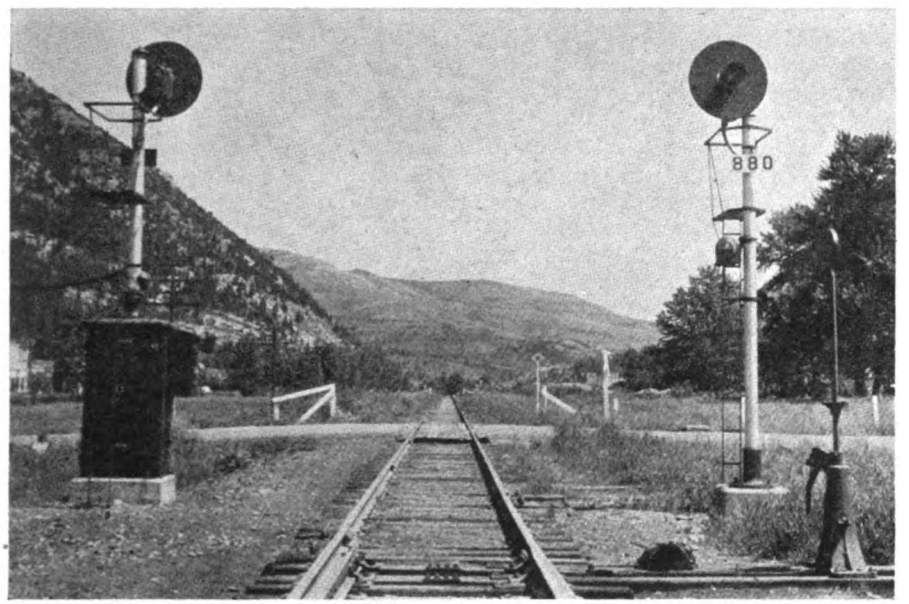


Fig. 2—Track and signal layout between Sentinel and Coleman, showing signal controls

nal system more flexible to cope with this situation and expedite train movements, a special westward switching signal 799, shown in Fig. 3, was installed 0.4 mile west of the westward head-block signal 795 at Burmis. Signal 799 is an absolute signal and is designated by a lunar white marker. This signal allows a westbound train to pass signal 795, when clear without knocking down the opposing head-block signal 844 at Hillcrest, and to switch in the Burmis area, at the same time permitting an opposing train to close up on Burmis without delay, which would not otherwise be possible.



Typical station-entering and head-block signals. Note marker on head-block signal

The signaling and controls between Burmis and Hillcrest are shown in Fig. 3. Solid lines represent opposing controls and dotted lines represent following controls. Assume that a westbound train moves by signal 795 at Burmis for the purpose of switching. This causes signal 808 to display red, and signal 826 to display yellow. Signal 844 remains Clear while switching is taking place in switching area, and thus authorizes a movement up to signal 808. However, should the westbound train pass signal 799, eastward signals 826 and 844 are controlled to red. An eastward train movement passing signal 844 results in westward signals 827, 809, 799 and 795 displaying red. A train switching in area between signals 795 and 799 will, when signal 799 goes to red, immediately push into clear to avoid stopping an opposing train at signal 808.

Station Protection Signals

Automatic signals, governing train movements through stations may be designated as station protection signals, in which case they are designated by the letters SPS on a separate plate from the regular number plate. Such signals are in service approaching Crowsnest from the east and approaching Burmis from the west. Signal 808, shown in Fig. 3, is a station protection signal.

The signaling is controlled by conventional A.P.B. circuits. Intermediate signals are controlled by 670-ohm

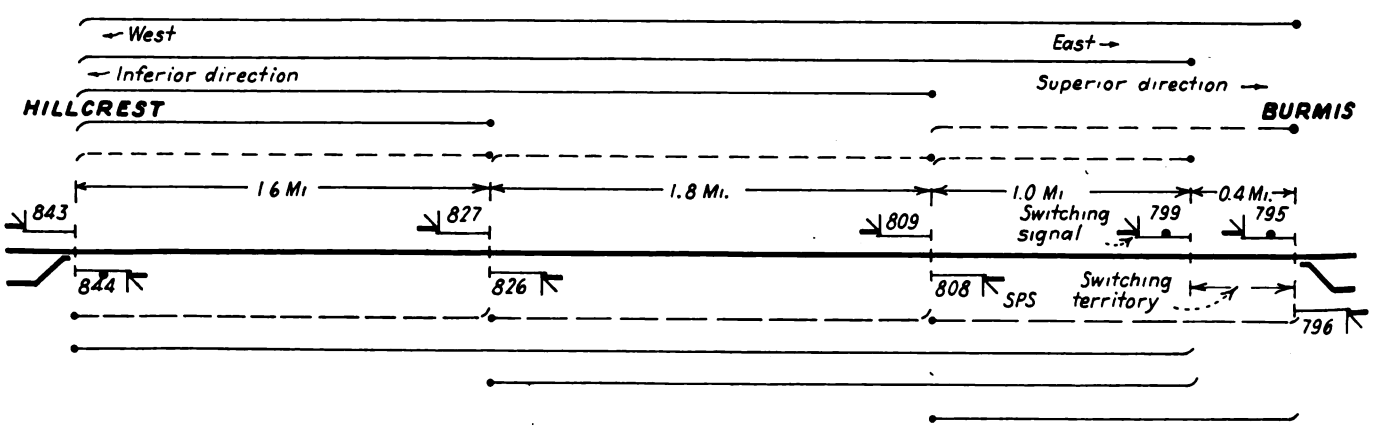
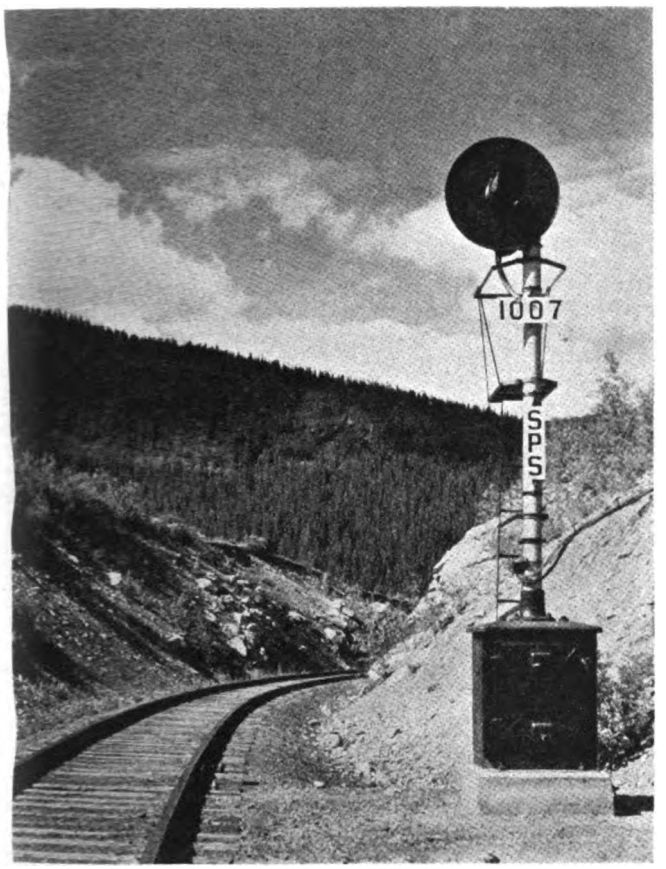


Fig. 3—Track and signal layout between Hillcrest and Burmis, showing special switching signal 799 west of Burmis

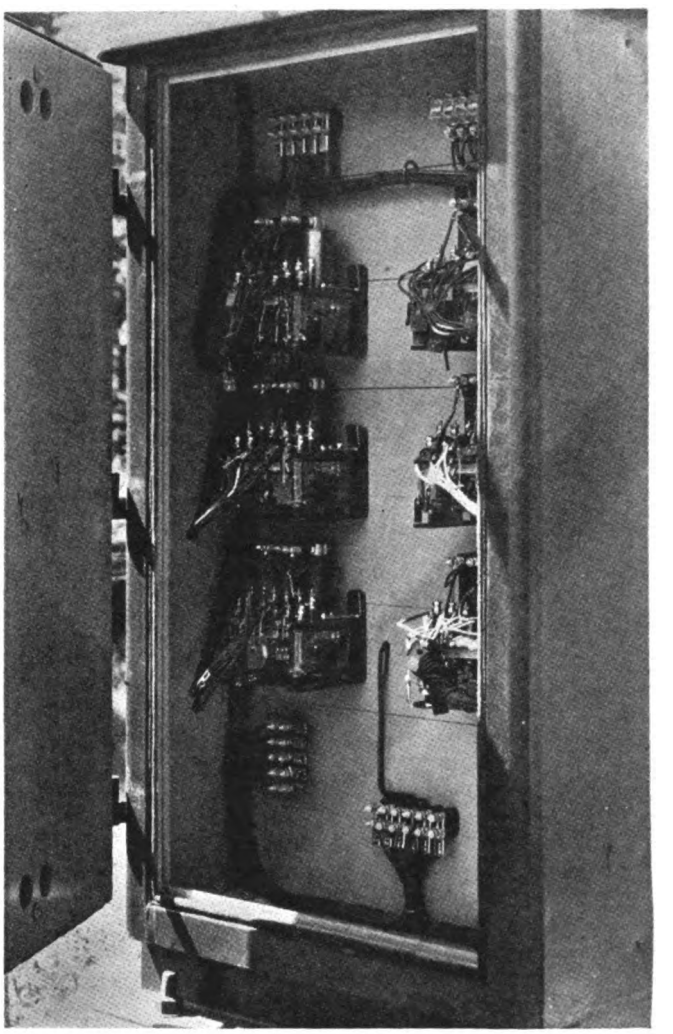
d.c., neutral type directional stick relays to clear for following trains in a station-to-station block.

Searchlight coils are connected directly to polarized line control circuits, thus eliminating line relays. Each line circuit consists of two wires, extending double-make, double-break through contacts of the track relays. Connections are made to shunt the line circuit back towards the signal when a track relay is de-energized.

Each signal is repeated by a 350-ohm, d.c., slow-pickup slow-release neutral relay, which is energized when the signal is either yellow or green, except at head-block entering signals where the green position only is repeated. The feed to the line circuit to the rear is polarized through contacts of this signal repeater relay, thus avoiding flashing of aspects.



Left—Westward station protection signal 1007 east of Crowsnest. Note special plate



Right— Interior of instrument side of base-of-mast case at double intermediate automatic signal location, showing relays

Train-Order Signals Tied in With Block Signals

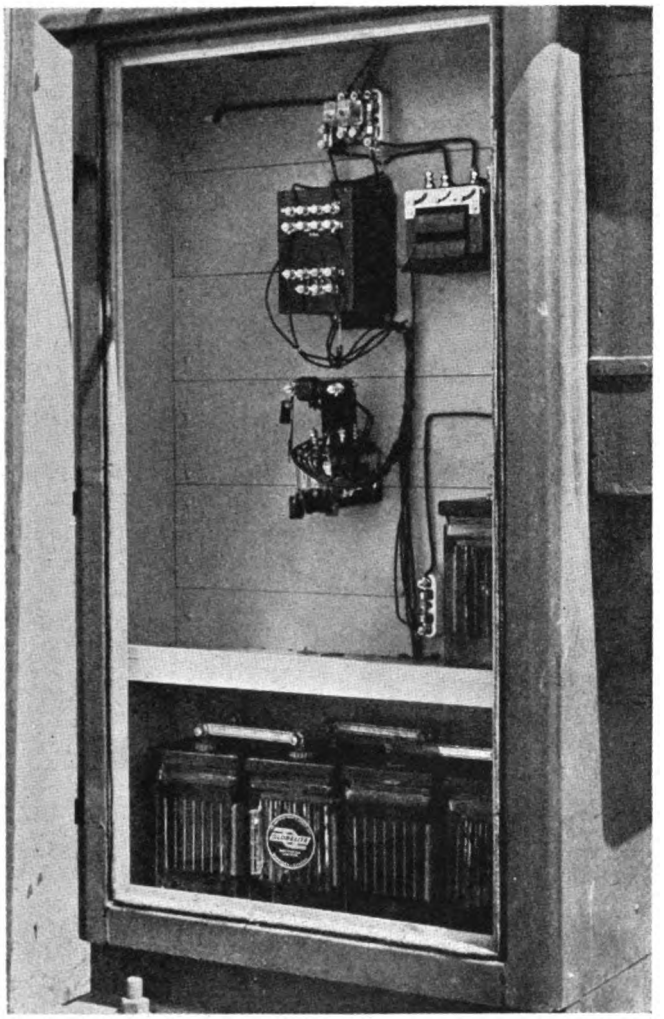
The semaphore train-order signal for each direction at the open offices has a circuit controller which controls a D relay at the next automatic signal in approach to the train-order signal. When the train-order board is red, the D relay referred to is de-energized to control the first automatic signal to yellow. Simultaneously, when the D relay is de-energized at the first automatic signal, the GPR is de-energized and the polarity of the line circuit to the second automatic signal is reversed to cause that signal to display yellow also. Thus, when a train-order signal is red, two automatic signals in approach to it display yellow.

All signals are approach lighted through approach lighting or track relays. Head-block absolute signals are also lighted when they display a red indication, this circuit being through back contacts of the YGP relay. Thus, a train on a passing track, or a maintenance-of-way man on a motor-car gets information when an opposing train leaves the next siding.

At each intermediate automatic signal location, there is a push-button switch for lighting the signals. This enables maintainers to determine the location of trains on the line, thus providing increased safety in the operation of motor-cars. This push-button is located near the top and on the track side of the instrument case at each intermediate signal location.

As part of the project, light-type indicators were installed in each open office, namely, Burmis, Hillcrest, Frank, Blairmore, Coleman and Crowsnest. These indicators contain two white lights, one representing each direction, and inform the operators of the approach of trains to the station. The lights are normally extinguished. In addition to each indicator there is a buzzer. These indicators are operated on a station-to-station basis. In other words, when a train leaves a station and passes a head-block signal into the station-to-station section, the indicator and buzzer at the next station in the direction the train is moving is operated. The indicators are normally energized and are controlled over front contacts of the YGP relay of the head-block signals.

As part of this installation G.R.S. 10-volt, d.c., 500-ohm, switch indicators were installed at each main-line switch. These indicators are operated on a station-to-station basis. For example, referring back to Fig. 2, an eastbound train leaves Sentinel. When



Interior of battery - side of base-of-mast instrument case at a head-block signal location, showing transformers, power-off relay and storage battery

the train passes the eastward head-block signal 956, all switch indicators at Coleman display Stop, and remain in that position until the train passes the first eastward intermediate signal 902 (not shown) east of head-block signal 912 at Coleman. The indicators at Sentinel function similarly when a westbound train leaves Coleman. Indicators at other switches in the territory function in a similar manner. Thus, a person about to throw a switch gets full station notice, and a train must clear one block beyond the switch before the indicator will clear again. These indicators are controlled through the track relays and the YGP relays of the signals.

Power Supply

The power supply at each absolute head-block and intermediate signal location consists of a set of 5 cells of Type-GD-15, 140-a.h., lead-acid storage battery, furnished by the Globelite Battery Company, Winnipeg, Man. These batteries are on a floating charge of about 50 m.a. from a G.R.S. Type BT-132 rectifier.

Absolute head-block signals are normally lighted from the a.c. power, but at all such locations there is a power-off relay which cuts over the lighting to the storage battery if commercial power fails. This arrangement at head-block signals is followed because of the heavy drain on the storage battery which would be incurred if the signals were normally lighted directly from the storage battery. Power-off relays, however, are not used at intermediate signal locations, the signals being lighted on the approach of a train directly from the battery.

Each track circuit, which averages 3,500 ft., is fed by 1 cell of storage battery, on a floating charge of about 50 mills from a G.R.S. Type BT-3 rectifier. The track relays are G.R.S. Type K, rated at 2 ohms. Variable 5-ohm resistances are used in track battery feeds.

Power for the entire territory is picked up at Blairmore from a 2,200-volt, 60-cycle, a.c. commercial source, through a 5 kva. oil-cooled transformer, which transforms the voltage down to 550 volts, 60 cycles, a.c. The power circuit, which is transposed about three times per mile, is on two No. 8, weatherproof braided hard-drawn copper wires, on a new 10-pin crossarm with other new signal circuits installed on the existing telephone and telegraph line. This line has a pole spacing of about 40 per mile. At each signal location the power-line tap is taken through fused cut-outs and a G.R.S. 0.5 kva. air-cooled transformer on the crossarm, which reduces the voltage to 110 volts.

Cables and Wiring

Underground cable between signals and instrument cases is 4-conductor No. 14, with lead sheath, steel tape and jute. Track connections employ single-conductor No. 9 parkway. Signal line control circuits are on hard-drawn Copperweld weatherproof insulated wire tied to glazed white porcelain insulators on wood pins.

Line-drop cables for signal circuits are made up of No. 14 soft-drawn, rubber-covered, wire, suspended on galvanized-iron messenger wire. The power distribution circuit is in 2-conductor No. 14 cable. Wiring in instrument cases is No. 14 flexible. Ground wire is No. 6 bare copper wire. The wire and cable on this installation was furnished by Canada Wire & Cable Co.

The rail in this territory is 100-lb. Single-cable bonds, with $\frac{3}{8}$-in. plugs, were used throughout this territory. Single-cable bonds, with $\frac{3}{8}$-in. plugs are also used for bootleg connections. Bootleg risers are cast-iron, and were furnished by Mumford Medland, Winnipeg, Man.

Each main-track switch is equipped with a Model 7, 2-position, 4-way switch circuit controller. A series connected track circuit is used at each siding turnout, the advantage being that if any wire or bond breaks, the circuit fails on the safe side. The circuit is quick shunt which is an advantage.

Incoming circuits in instrument cases are protected by Raco No. 481-5 Clearview lightning arresters. A network grounding system is used at all signal locations, the signals, instrument cases and pole transformers being tied together to the same ground. Grounds were located and installed with a maximum resistance of 15 ohms or less. Ground rods are 10 ft. by $\frac{3}{4}$ in., Copperweld, equipped with key type ground rod clamps. Switch lamps on switches located within 200 ft. of the protecting signal were removed from service. Otherwise they were retained in service.

This project was installed under the direction of A. Davies, signal engineer, Western lines, and under the supervision of W. Abell, signal supervisor. Construction work was carried out under the jurisdiction of C. Mark and E. T. Simper, signal construction foremen. The major items of signaling equipment were furnished by the General Railway Signal Company.