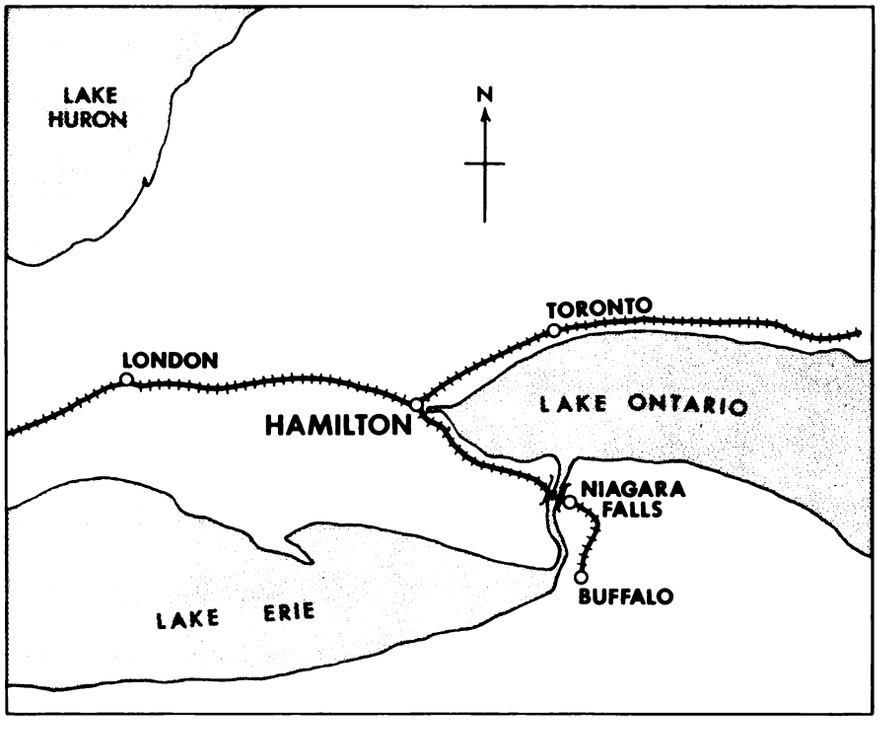
September, 1958

Railway Signaling and Communications

Bayview interlocking with Canadian National freight train moving towards Toronto. Old tower is in the background. Tracks in the foreground go to Hamilton West (London and Sarnia)

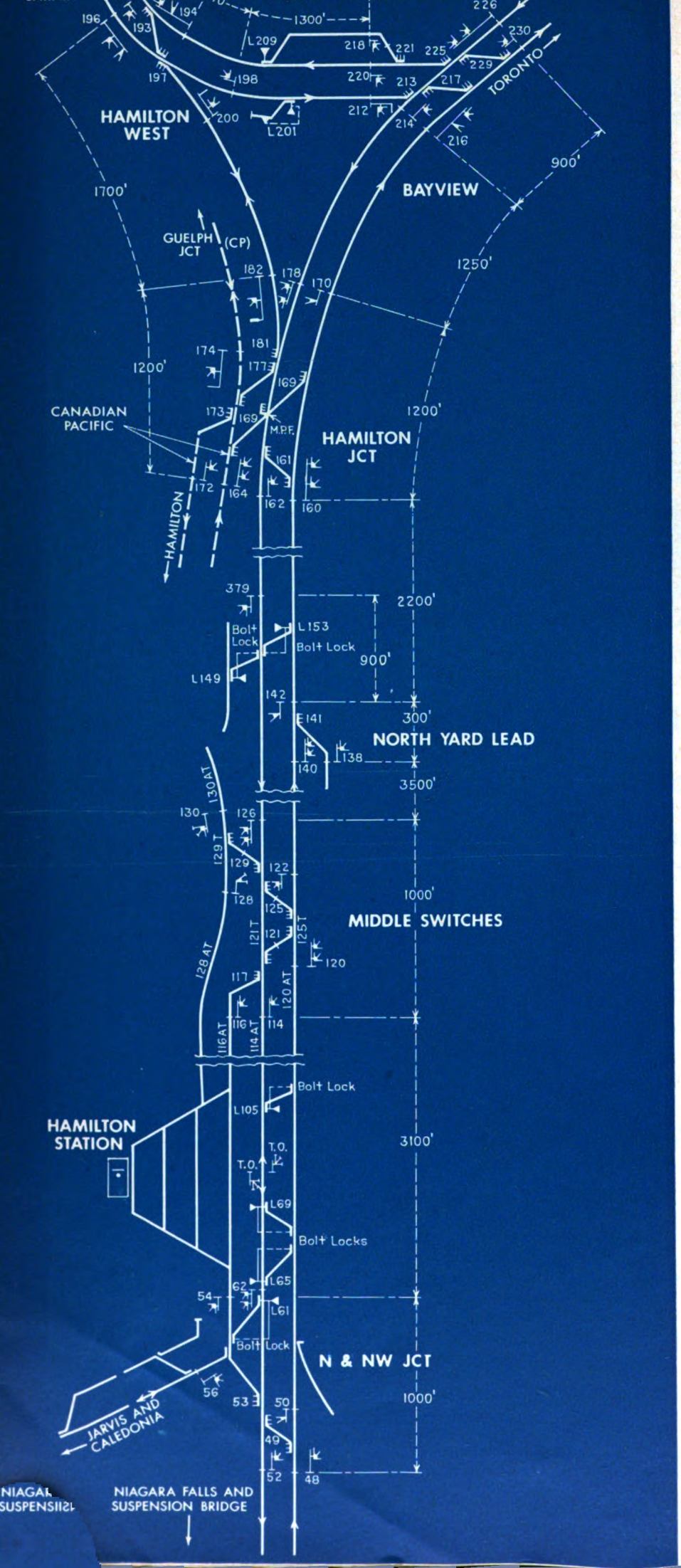
CN Consolidates Interlockings

A $580,000 installation at Hamilton, Ont., consolidates two mechanical and one remote interlocking and three new interlockings whose switches and signals were previously controlled by switch tenders.



SAVINGS OF OVER $44,000 in operating expenses annually are anticipated from a new Hamilton, Ont., interlocking on the Canadian National. Hamilton, an industrial city of 225,000 population, is at the west end of Lake Ontario. Several CN lines serve the city, including the Toronto-London-Sarnia, Toronto-Niagara Falls-Suspension Bridge and Hamilton-Jarvis (meets the Detroit-Buffalo line at Jarvis) lines.

This new terminal interlocking is concentrated in an area about 3 miles long. Double track extends west from Bayview through North Yard Lead interlocking to the Middle Switches. From here single track mainline runs through Hamilton passenger station to N&NW Jct. Here the mainline reverts to double track east toward Niagara Falls. The line between Middle Switches and N&NW Jct. was originally a double-track mainline, but as a result of the new signaling, one track was released for yard operation. From Bayview a double track line runs west to Hamilton West, and on to London and Sarnia. The third leg of the wye consists of a single track line from Hamilton West east to Ham-



ilton Junction, at which point i meets the Bayview double-trac line going toward Hamilton pas senger station. Hamilton Junctio is also the connection with th Canadian Pacific, this being double-track line to Hamilton.

Mechanical Plant Replaced

Originally, a movable point frog crossovers and three singl switches and associated inter locked home signals at Bayvie were controlled from a 24-leve mechanical interlocking machine This mechanical plant require extensive repair, hence was du for replacement. Also signalin had to be changed so that th aspects displayed would agre with the new Uniform Code o Operating Rules in Canada. Thes rules require the Canadian rai roads to change from previou route signaling to the speed sig naling.

A table interlocker in the Bay view tower controlled the singl switch, crossover and searchligh signals at Hamilton West.

The movable point frog, tw crossovers, four single switche and associated signals at Hamilto Jct., were controlled from a 4 lever mechanical interlocking ma chine owned by the Canadian Pa cific. The switch at North Yar Lead was formerly hand-throwr operated by switch tenders wh gave hand signals for directin train movements.

At the Middle Switches ar three crossovers and a singl power switch, formerly all hand thrown by switch tenders. Th crossover and new single switc with associated signals at N&NW Jct., east of the Hamilton passeng station, were formerly operated b switch tenders. A rearrangement c track was made at the N&NW Jc and Bayview to improve the lay out, the single switch at N&NW Jct. formerly being part of a sci sors crossover, and switches 21 and 217 at Bayview previousl forming part of a movable poi frog.

The switches and signals a N&NW Jct. and the Midd Switches are direct wire contro North Yard Lead, Hamilton Jct Hamilton West and Bayview inte lockings are remote controlled b the Syncroscan system.

Call-On Aspects Are Provided

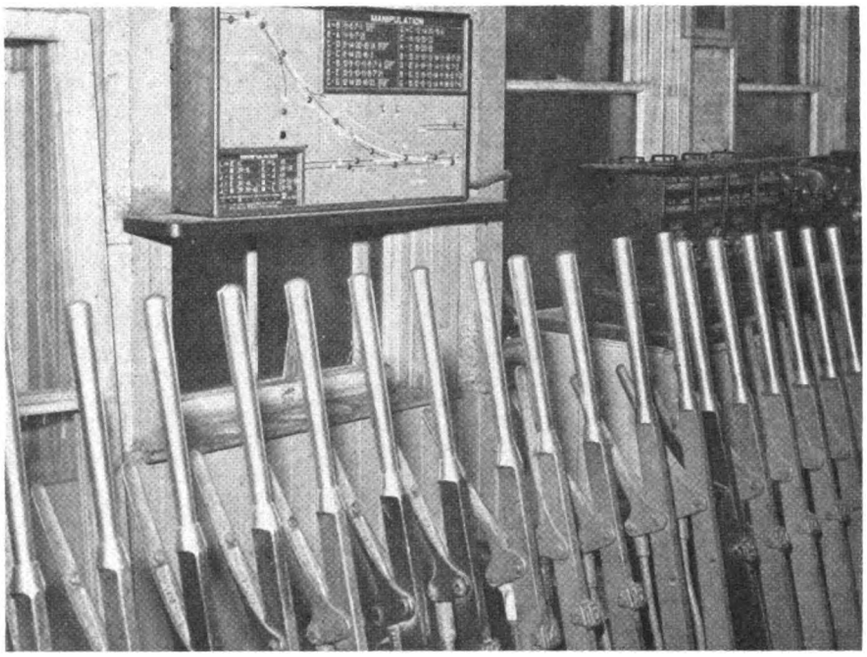
Single track is signaled f double-direction running and circuited to give the equivalent

traffic locking, in that opposing call-ons are not allowed to clear, nor traffic direction be changed with a train in the block. Call-on aspects are used only for following moves. This is accomplished by the use of normally de-energized APB-type directional stick relays for intermediate signals on the single-track leg of the wye (Hamilton West to Hamilton Jct.). Normally energized route stick relays are used for the call-on aspect on the single track in the vicinity of the Hamilton passenger station. When a route stick relay is de-energized by clearing a signal in a given direction, the opposing call-on signal is locked out.

Double track is signaled for single-direction normal right-hand running. Trains can be routed against this normal direction of traffic by signal indication; however, only call-on aspects are provided in this direction. Call-on aspects cleared against the normal direction of traffic in double track territory are non-interlocked, in that a call-on can also be cleared with the current of traffic into the one previously cleared. Circuits provide, however, that when a call-on is initiated against the normal direction, the "H" circuit to the adjacent plant is de-energized and a time interval runs before the call-on will clear. These call-on aspects against the direction of traffic provide for coupling-on movements. For example, helper engines at Bayview back on to westward freights to assist them up a one per cent grade toward Hamilton West and on to London. Other moves where call-on aspects are used, are for car transfer movements at Hamilton Jct., between the CN and the CP; and also for switching movements at North Yard Lead and the Middle Switches.

All mainline turnouts are No. 12, which are good for 28 mph. Speed restrictions due to curves and grades hold speeds to 20 mph Hamilton West to Bayview (descending a one per cent average grade), and 35 mph Bayview to Middle Switches. The approach to N&NW Jct. from Niagara Falls is also restricted to 35 mph, and the approach from Caledonia to 10 mph because of several street crossings at grade.

Two-arm signals are provided in this area because of the slow-speed signaling being all that is required. The only flashing aspects used are Red-over-Flashing-Yellow on a high signal or a straight Flashing-Yellow on a dwarf signal, which is displayed when the route is lined through a turnout with the signal in advance at Stop. All interlocking signals at N&NW Jct., Middle Switches and North Yard Lead are dwarf type, while high signals are used at the other plants when governing routes in the normal direction of traffic.



Bayview interlocking was controlled by a 24-lever mechanical interlocking machine. The table interlocker (at right) controlled the Hamilton West plant

Heavy Traffic Area

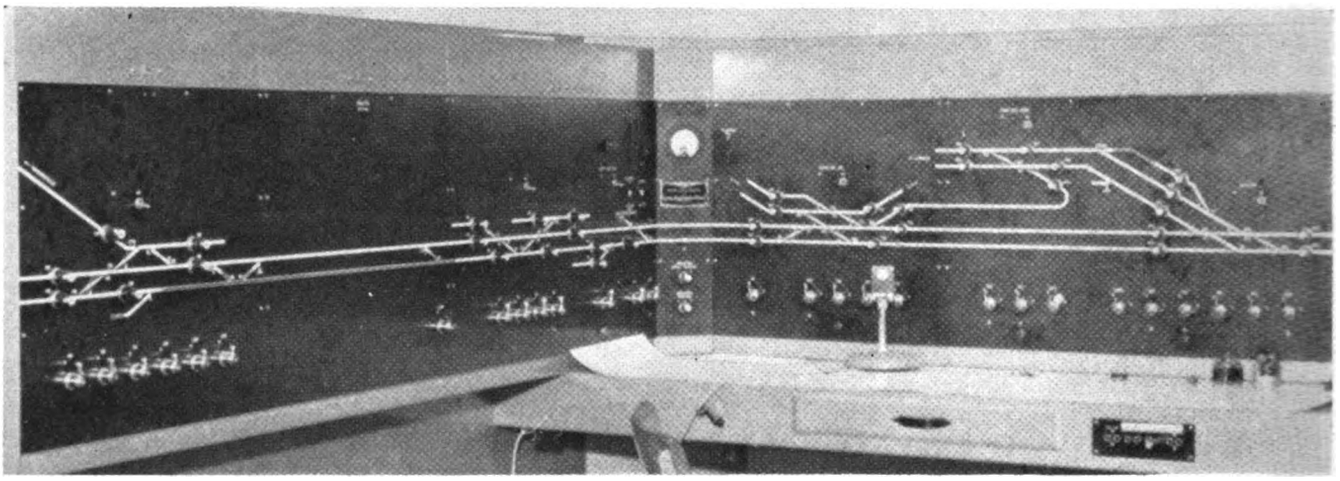
This interlocking area handles the heaviest mainline traffic in Canada, with an average of 52 passenger and 37 through freight trains (both CN and CP) by Bayview daily. This includes an average of ten freight and eight passenger trains of the CP operated over Canadian National tracks between Toronto and Hamilton Jct., at which point they go on to their own tracks. Two CP freight trains operate through Hamilton Jct. between Hamilton and Guelph Jct. Through manifest freights of the CN pick up and set off cars at Hamilton. In addition to the scheduled daily trains, the interlocking also handles switchers serving industrial tracks, helper engines, way freights, work trains, etc.

A breakdown of train movements through each interlocking is as follows: Bayview 120; Hamilton West 50; Hamilton Jct. 90; North Yard Lead 84; Middle Switches 200 (this includes moves by yard and road engines to and from the shop, and crossover moves between the North and South Yards); N&NW Jct. 70. a total of 614 moves every 24 hours.

To add to the traffic problem is the fact that Hamilton terminal is off the main Toronto-London-Chicago and Toronto-London-Detroit routes. This requires Toronto passenger trains bound for London to head in and back out to Bayview before proceeding to Hamilton West. London passenger trains bound for Toronto-Montreal proceed from Hamilton West to Bayview, and back in to Hamilton passenger station before heading out and proceeding to Toronto. All these passenger trains follow this procedure with the exception of two eastward and one westward daily trains which bypass Hamilton and make their station stops in the suburbs. Four passenger trains in addition to freight traffic operate daily in both directions between Hamilton, Niagara Falls and Suspension Bridge. On the Hagersville subdivision between Hamilton and Jarvis, only extra trains are operated at the present time.

"L-Shaped" Panel for Future Signaling

The interlocking control machine, in the Hamilton passenger station, is "L-shaped" with a left wing accommodating three interlockings: N&NW Jct., Middle Switches and North Yard Lead. The center section controls three interlockings: Hamilton Jct., Hamilton West and Bayview. A blank panel section has been left in the



Control machine has space for controls of switches and signals at the passenger station tracks (center of left panel). A proposed right wing would include controls for double-track CTC between Hamilton and Toronto.

depot area between N&NW Jct. and the Middle Switches to provide space for switch and signal levers for future power operations of the passenger station tracks.

The proposed right wing would house the relays and electronic equipment for the Toronto-Hamilton extension, as well as provide the track diagram and control levers. This proposed signaling would be on the 30 miles of double track between Toronto and Hamilton, and would be a double-direction traffic control system extending to and tying in with the Mimico interlocking at Toronto. Construction of three new high-speed interlockings at Oakville, located midway between Toronto and Hamilton, and controlled from this panel, is now under way.

The signal circuits of the Hamilton-Bayview interlocking consist of two systems: direct wire and remote control. For direct wire locations, wires are brought up from the relay room, located on the ground floor of the station, to AAR terminals on the top of the machine. The remaining interlockings have control office equipment housed in the machine. Sliding cabinets with plug-in relays and electronic units allow easy maintenance. The master sections of the machine at each end of the center section house the control stepper unit and indication counter unit as well as the carrier transmitters, receivers, timers, filters and power supply equipment in duplicate. A test panel is mounted in a compartment at the rear of the control machine for the purpose of checking the incoming carrier pattern with an oscilloscope, and synchronizing the "scope" on individual stations as desired. The carrier equipment and the machine circuit wires are brought out to terminal boards with push-on connectors, these being prewired at the factory.

Controls Initiated by Signal Levers

On the control panel, the signal levers (one for each signal) are located in the track diagram with switch and lock levers in a horizontal row beneath. The signal lever barrel contains the "signal clear" light, which displays a flashing-green arrow when the lever has been pushed. The arrow changes to a steady green when the signal clears in the field. Signal levers can also be rotated 90 deg. and must be so operated when clearing a call-on for a following movement or clearing a signal against the normal direction of traffic. When a signal lever is rotated 90 deg., the flashing-green arrow is not required as the position of a marker, a white dot, will be down. A steady green arrow is displayed when the signal clears. These arrows are extinguished by the passage of a train or the cancelling of a signal.

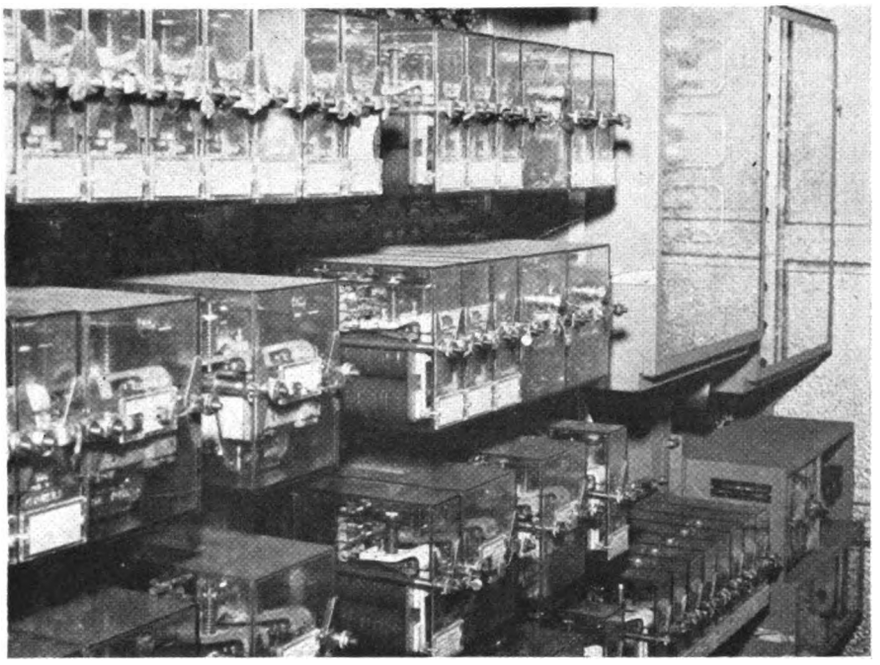
A signal cleared by a "push" manipulation requires a "pull" manipulation of the lever to cancel. A rotate manipulation is cancelled by rotating the signal lever back to normal.

A correspondence light indicating when a switch is over and locked is located in the barrel of each switch lever. These are also provided in the electric lock barrels to indicate when the lock release has been accepted by the switch tender or a member of a train crew. The lamp is lit when the release is given, and is extinguished when the switch or cross-over has been fully reversed in the field. Red lock lights are located in a horizontal row below the switch and electric lock levers. They are the conventional type except that those for electric lock levers for locks outside interlocking limits have not been provided in the past.

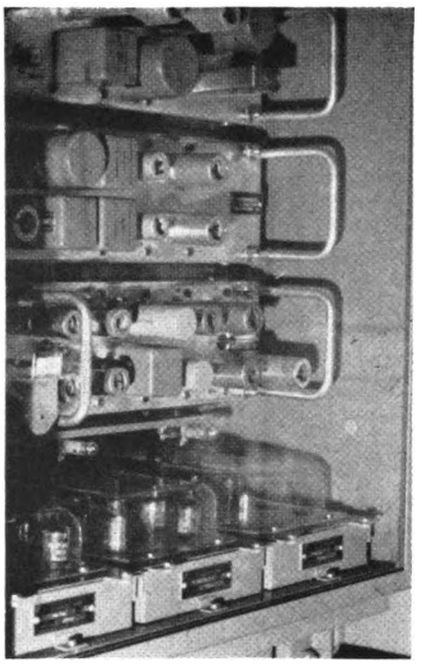
While code "start" buttons are provided, one located beneath the center signal lever for each coded interlocking, they are not required to be pushed when lining a route and clearing a signal. This is so because the manipulation of the signal lever automatically sends out a control code to position switches as called for, or release an electric lock, and clear the signal, all functions being sent out in the one control cycle (double cycle of 3 sec.). The "start" button is used only when desiring to reline the switches to normal after a move has been completed (without clearing a signal), or operating the maintainer-call horn and light (single cycle of 1.5 sec.). All controls are based on the progressive delivery principle. Indications are brought in at the rate of 100 per second, a speed which is achieved by the scanning principle.

Call-On Used for Closing Up

For closing up trains entering the yard or passenger station, signals can be controlled to display the call-on aspect. This aspect is yellow for a dwarf signal and red-over-yellow for a high signal. To do this, the traffic supervisor turns the signal knob so that the white dot is below the arrow in the barrel of the knob. This call-on aspect is also used for directing train moves against the normal current



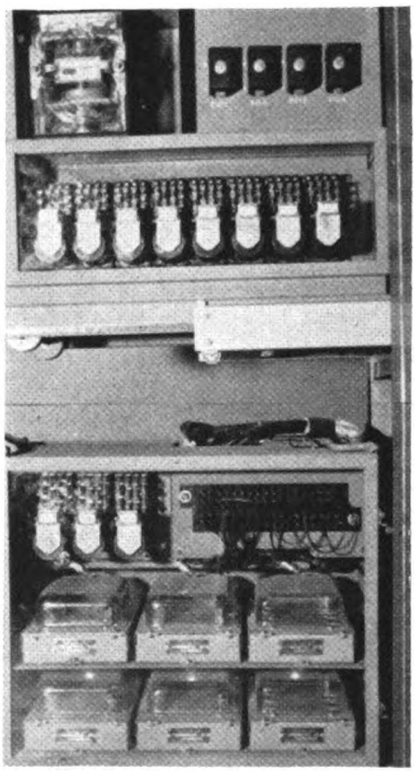
Typical bungalow in the field with Syncroscan equipment at right of relays (indication carrier equipment above; stopper unit is below)



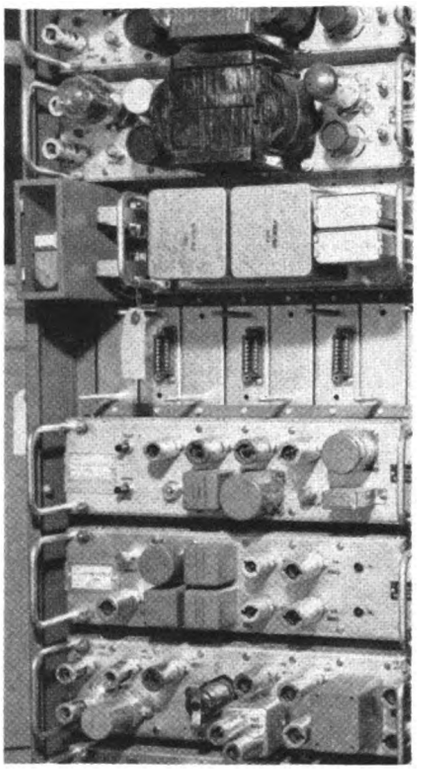
Syncroscan indication carrier equipment is rack mounted in a typical bungalow

of traffic in those portions of the interlocking having two main tracks.

Call-on signals cleared in the normal direction of traffic are progressive and cannot be cleared indiscriminately: the block and approach track must be occupied before the signal will clear. If the block becomes unoccupied before the call-on is accepted, the signal will progress or climb to a less-restrictive aspect. When clearing call-ons against the current of traffic, the block is not required and the signal aspect remains Red-over-Yellow or Yellow. To cancel a signal which has been cleared to the call-on aspect, the signal knob is rotated so that the white dot is at the base of the arrow. In the case of any signal which is cancelled by the traffic supervisor, time locking is from 35 sec. to 4.5 min., depending upon the braking distance involved.



Control stopper unit (top) in control machine. Indication counter unit (below)



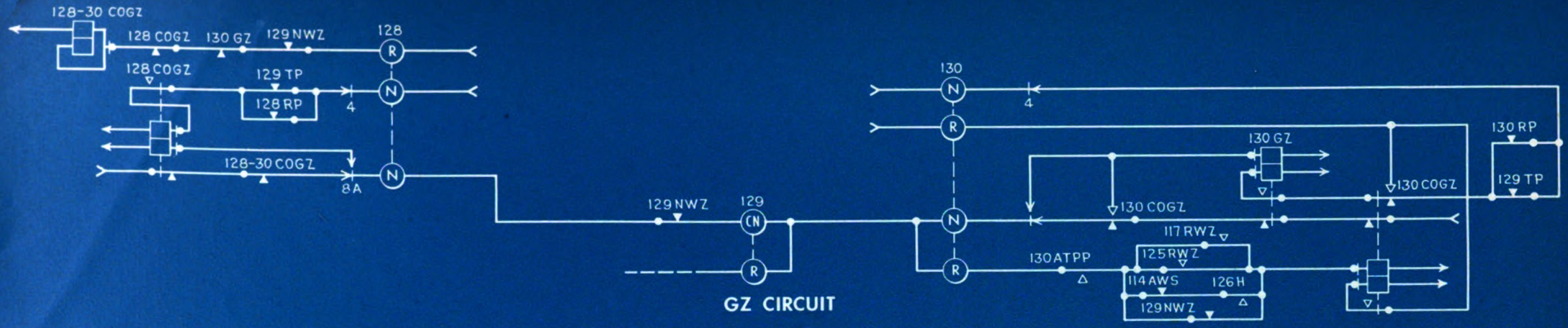
Carrier section of Syncroscan equipment in the new interlocking control machine

Special Clearing for Switching Moves

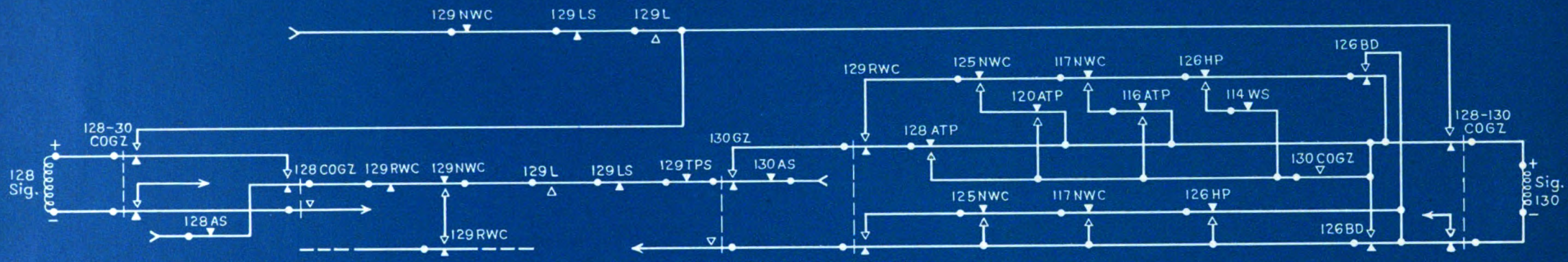
To facilitate switching moves over the South yard lead near the yardmaster's office at Middle Switches, a special control is provided on signals 128 and 130, in addition to their usual control. Normally signal 128 will clear to Yellow when the signal knob is pushed, and will cancel when the train passes the signal. By rotating the 128 knob, both 128 and 130 will clear to Yellow, the aspects remaining displayed till cancelled from the control machine. This unique control allows switching moves on the switching lead in both directions with the switch normal without attention by the traffic supervisor. These signals are sometimes left cleared for long periods of time while switching is taking place, and this feature allows the traffic supervisor to ignore these signals unless the trainman calls in for the switch to be thrown reverse.

Timing Circuits for Release of Electric Locks

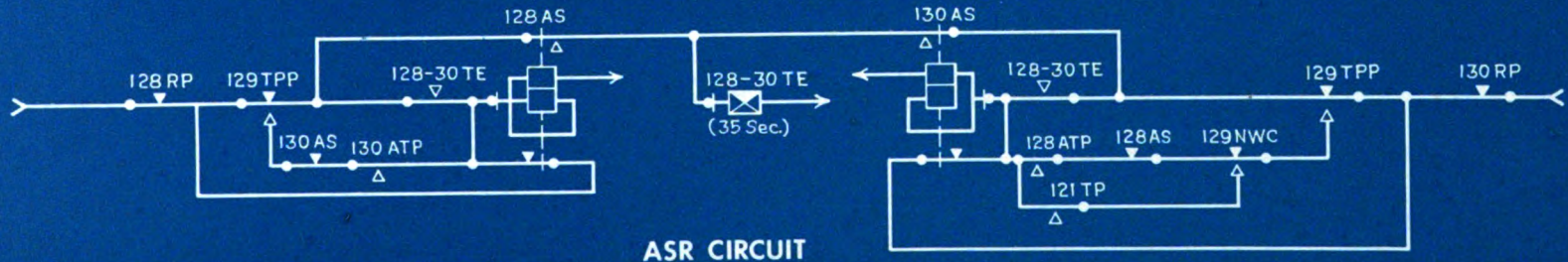
All main-track hand-throw switches are equipped with electric locks, with the exception of the



GZ CIRCUIT



SIGNAL CONTROL CIRCUIT



ASR CIRCUIT

CONTACT SYMBOLS

- Independent Front on Normally Energized Relay
- Independent Front on Normally De-energized Relay
- Independent Back on Normally Energized Relay
- Dependent Front-Back on Normally Energized Relay

short spur track at Hamilton West into which trains do not normally clear. Where a crossover is the entrance to the mainline, the mainline switch is electrically locked with the opposite switch being bolt-locked by a pipe connection. All locks are lever controlled for supervisory control by the traffic supervisor.

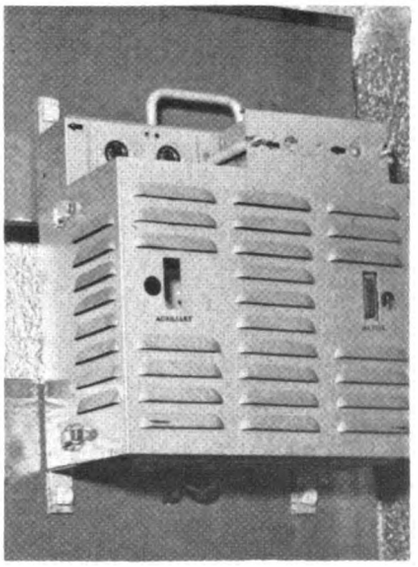
For a movement from the main track to a siding or yard track, the lock release cannot be sent out while a signal is cleared into the block, because with a release given a call-on signal only is allowed. Therefore, a lock release going out after the signal was cleared would have to de-energize the "H" circuit, thus cancelling the signal. A lock release can be sent out, however, after the block becomes occupied. With the release given and the block occupied for time, the electric lock in the field may be released. This time is sufficient for the train to have reached the switch, thus obviating the short release track.

If the release is sent out before the signal is cleared, the "H" circuit is de-energized and a call-on signal only is allowed.

When entering the mainline from a siding or yard track through an electrically locked switch, no special time is involved other than the usual time equivalent to that for approach locking. Signals governing into the route must have been at Stop for a predetermined time interval. Of course, the mainline track circuit timed-up would also allow the lock to be released. Lock L61 is the exception to this rule because it is within interlocking limits. Time locking is used throughout with two-track release of the AS relay.

GRS model 5D dual-control switch machines were installed on all power-operated switches, with straight gage plates extending through to the machine for rigid mounting. The head blocks were drilled and gage plates attached at the Hamilton signal shop. The assemblies were installed at the switches ready for the machines to be bolted down. Motor circuits are 24-volt d.c. operation with 10-volt d.c. control circuits. No snow melters have been installed at the switch points, although the control machine is wired for future installation, if found necessary.

Model 9B electric switch locks with high stands were used throughout. Door contacts were used, by passed by a stick circuit so that opening the door of the lock with an approaching train will not cancel the signal. The release must have first been given by the traffic supervisor.



Cornell-Dubilier converters supply a.c. for control if commercial power fails

Standby Power If Commercial Fails

The control office is supplied with an auxiliary source of commercial power from an independent substation feeder. This is fed into the station at 230-volts a.c. and stepped down to 115-volts. It is taken through a power-off relay so that the changeover to standby power is automatic. A power-off light on the control panel draws attention to failure of normal power. For field locations Cornell-Dubilier converters are used to develop 120-volts a.c. from a 32-volt battery bank in case of failure of commercial power. A minimum of 105 volts a.c. is required for the Syncroscan equipment.

The code line is No. 10, 30 per cent Copperweld line wire with neoprene cover. It is energized with 101 volts d.c. drawing .045 amp. with the system at rest (no controls being sent out; indication scanning occurs continuously). The Syncroscan system is duplex in operation in that controls can be transmitted without interfering with the continuously incoming flow of indications.

Line drops and buried cable for the code pair are in a separate two-conductor No. 14 twisted pair. The code line can be manually sectionalized by opening a knife switch in the bungalows where the incoming and outgoing code pairs are not both in the line drop. Pellet-type power line lightning arresters are installed on the crossarms of the junction pole at each bungalow for lightning protection of the code line. Raco clearview lightning arresters are used in the bungalows for the code line as well as all other line circuits.

Phone Circuits Into Control Machine

Telephone circuits are brought to the control machine jack panel on the front edge of the desk portion, within easy reach of the traffic supervisor. In addition to the circuits to Toronto, Hamilton & Buffalo interlocking, CN Hamilton and London dispatchers; one jack is for phones around this Hamilton terminal interlocking. These phones are in boxes around the plant for use by trainmen.

Terminals for portable phones are also located in the relay bungalows and switch machines for use by maintainers. This maintainers' phone circuit is superimposed on the code line pair. When the maintainer speaks into his phone, a voice-actuated relay at the interlocking control machine will actuate a buzzer and light a lamp to attract the attention of the traffic supervisor. Calls on the trainman phone circuits will also cause the buzzer to sound and an indication lamp to be lighted.

Construction work was handled by railway forces, directed by H. J. McKenna, General Foreman under the supervision of H. H. Moore, Signal Supervisor, Hamilton, and A. P. Young, District Supervisor of Signals, Toronto. The engineering was under the jurisdiction of D. H. Green, Signal Engineer, Canadian National Central Region at Toronto. Engineering and equipment was furnished by the General Railway Signal Company.

Circuit plans show release of electric locks as well as operation of switching signals 128-129.

When level 128 is rotated the 128-130 COGZ is energized after checking the 129 switch normal, the 128 signal not cleared by a push, and the 130 signal not cleared by a push or rotate.

When 128-130 COGZ is energized, its front contacts bypass all the 128-130 signal network and feed battery directly to the signal heads after checking 129 switch normal, 129 lock stick relay down, and 129 lock relay down.