Westbound train at the east end of the center siding at Robbins

Remote Control of Center Sidings

On Busy Double-Track Line

Chesapeake and Ohio controls six center-siding layouts and three crossovers on a 99-mi. double-track subdivision, with train movements authorized by signal indication

THE Chesapeake and Ohio has reduced train delays and operating expenses by installing remotely-controlled power switches and signals at six center sidings and three main-track crossovers, on the 99-mi. heavy-traffic, two-track main line, between the east end of Parsons Yard, Columbus, Ohio, and N. J. Cabin, Ky. These switches and signals are controlled from the dispatcher's office at Covington, Ky., 121 mi. west of N. J. Cabin, as shown on the accompanying map.

On the Northern Subdivision there is one passenger train each way daily, together with three manifest freight trains westward and two eastward. Every 24 hours there are also about 20 extra trains of loaded coal cars westward and an equal number with empty coal cars eastward, making a total of about 24 trains each way daily. At Russell, Ky., which is the eastern freight terminal of the Cincinnati Division and its Northern Subdivision, 19 mi. east of N. J. Cabin, westbound freight trains are made up in the yards. From Russell west to N. J. Cabin there are three main tracks, and from the junction at N. J. Cabin the two main tracks of the Cincinnati Division continue west along the south shore of the Ohio River to Covington, Ky., 121 mi. west of N. J. Cabin, then across a bridge to Cincinnati, Ohio.

From the junction at N. J. Cabin, the two main tracks of the Northern Subdivision, referred to in this article, extend over the Ohio River and on to Columbus, thence, on north, to coal docks on Lake Erie at Toledo, Ohio. On the Northern Subdivision, the ruling grade is in the 1.5 mi. section from N. J. Cabin, approaching the Ohio River bridge, in which section there is 2,500 ft. of 0.70 per cent and 4,000 ft. of 0.68 per cent ascending grade. Over this bridge, and continuing on for about a mile, thence over another bridge on the Little Scioto river, the grade is level. However, starting at MP 3.5 the grade ascends for about 7.5 mi.

to MP 11 at the east end of Wheeler.

For northbound trains of loaded coal cars, the most difficult section is the ascending grade from N. J. Cabin up to the Ohio River bridge and on up to the crest at Wheeler. Helpers are normally used out of N. J. Cabin for some trains as far as the south side of the Ohio River bridge, however, some tonnage coal trains when hauled by the heaviest of power and routed west on Track No. 1 at N. J. Cabin to Track No. 2 at the junction, will run the approach to the Ohio River bridge without stopping for a helper. The return of helper locomotives from Ohio River bridge to N. J. Cabin required extra moves and caused delays to other trains. Also; the slow train speeds on grades and time lost approaching and passing through the junction at N. J. Cabin, resulted in considerable congestion in this area. For these reasons, between N.J. Cabin and the west end of Wheeler, a distance of 12 mi., new signaling was installed for train movements by signal indication in either direction on both tracks. As additional means for routing trains from one main track to the other, a set of two power operated crossovers with signals was installed at MP 9, near Minford, and a single crossover with signals was installed at MP 3, just east of Little Scioto river.

From MP 12, at the west end of Wheeler, the railroad ascends the Valley of the Scioto River practically all the way to Columbus, the grade being slightly rolling in spots but, in general, ascending at 0.2 per cent or less all the way. On account of this comparatively light grade, single locomotives can handle trains of 160 loaded cars of coal at a speed of approximately 40 m.p.h. On this section of 87 mi., between the west end of Wheeler and Parsons Yard at Columbus, each track is signaled for one direction only, that is, right-hand running, and train movements are authorized by signal indications which supersede time-table superiority and train orders in accordance with Rule D-251, which reads as follows: "On portions of the road so specified in the time-table (or by special instructions) trains will run with the current of traffic by block signals whose indications will supersede time-table superiority."

Hand-Throw Switches Previously

In the previous operating arrangement, the switches at the six center sidings were operated by hand-throw stands, and, in addition, spring switch mechanisms, permitting departing trains to trail through without stopping, were in service at the main track leave-siding switches. A typical layout is shown in Fig. 2. With this arrangement, a westbound train, to take siding, would be stopped while the head brakeman reversed hand-throw switches No. 1 and No. 2. After the train was in the siding, the rear brakeman placed the switches normal. When the train was ready to depart, it trailed out through spring switch No. 5, without stopping. Stopping and starting a 160-car coal train to enter a siding resulted in delay of about 12 to 15 minutes, and even then, it had to be done carefully. With the new power switch machines and signaling, the dispatcher now operates the switches as required and controls the signals to direct trains to enter, as well as to depart from sidings.

Previously, train movements were authorized by time-table and train orders with automatic block signal protection for right-hand running. Offices, at one or the other end of nearly every siding, were manned by operators who were on duty part-time at some offices and full-time at others. Coal trains were required by rule to clear for superior trains prior to the arrival of such trains at the last open office in the rear, and, in no instances, less than 20 minutes. If the manifest freight trains or the passenger trains were running late, the coal trains lost a lot of time because the train order practice was not sufficiently flexible to permit the issuance of orders in time to advance the coal trains. As a consequence, the coal trains lost considerable time on sidings, when in reality, idle track and time were available for them to keep moving.

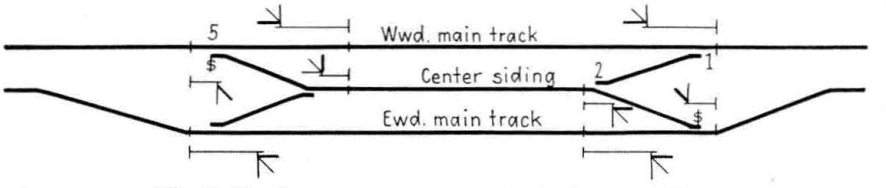


Fig. 2—Previous arrangement at a typical center siding

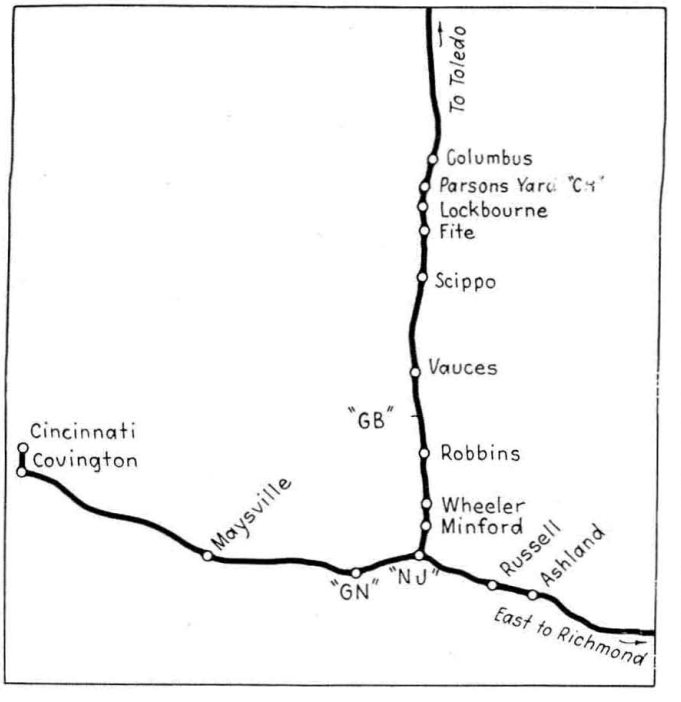


Fig. 1—Map showing locations of the sidings and control machine

Now, by means of the track-occupancy indications on the control machine, the dispatcher knows of the progress being made by all trains, and he can control the power switches and signals at the sidings to direct a coal train to hold the main track and keep going or to take siding closely ahead of a superior train. An important benefit is that the coal trains make many less moves into and out of sidings, which not only saves much time, but reduces the number of starts and stops.

A water and coaling station, located near the west end of the siding at G.B. Cabin, is arranged to service locomotives on both the main tracks and siding. Recently, when a westbound train stopped for coal and

water at G.B. Cabin, the dispatcher lined up for a following train to enter the siding and take coal and water, thereby saving at least 25 minutes as compared with previous practice, in which case the second train would have stopped on the main track and waited until the one ahead had gone.

The track-occupancy indication lights on the dispatcher's control machine show minute-to-minute progress of trains, and based on this information, obtained from the dispatcher by telephone, the yardmaster at Parsons Yard can continue switching operations up to the time that a westbound train arrives. This has been a big help in Parsons Yard.

The above applies primarily on the Wheeler - Columbus section where trains are operated right-hand running. Additional benefits as follows apply on the 12-mi. section Wheeler and N.J. Cabin where both tracks are signaled for either-direction operation. With both tracks available for westward trains up the grade, the leverman at N.J. Cabin has a much better chance to accept a westbound coal train and keep it moving through N.J. Cabin and up the grade without stopping, thereby avoiding the necessity for calling a helper locomotive. (See Fig. 3.) Straight track with no turnout extends from main track No. 1 at N.J. Cabin through the junction to Northern Subdivision Track No. 2. Therefore, by routing a coal train on this track there is no speed reduction for a turnout which is a help in making a run for the ascending grade to the bridge. Thus whenever possible, coal trains are routed on Track No. 2 from N.J. Cabin to the crossovers at Minford, where they are diverted to Track No. 1. While a westbound coal train is ascending the grade on either Track No. 1 or No. 2, a westbound passenger or manifest freight train can use the other track to run around. This move is made frequently. For example, recently a manifest train and a coal train passed N.J. Cabin going to Columbus, with their locomotives abreast. The manifest train outran the coal train so far that even though the manifest had to cross over from Track No. 2 to Track No. 1 at Minford, the coal train never received anything less than clear signals after leaving N.J. Cabin. In such instances, prior to the new signaling, the coal train would have been held at Russell Yard or at N.J. Cabin until the manifest freight had gone. As it was, the coal train saved at least an hour.

Signal in approach to siding

The signals on this subdivision are of the three and four-indication color light type, and they display standard A.A.R. Signal Section aspects. In addition, the Chesapeake and Ohio has a special position-light type aspect used on approach signals as advance information that an approaching train is to take siding. One of the pictures shows intermediate signal No. 317, which has a standard color-light signal head at the top of the mast, and also on the same mast is a square background with five lamp units. These lamps are normally dark, but can be lighted to form an "X", in combination with a yellow in the main signal head. The sidings are track-circuited for the control of signals, as well as the control of track-occupancy indication lights on the dispatcher's machine.

Special Aspect Saves Time and Stops

Referring to Fig. 4, showing the layout at Robbins, when crossover 141 is reversed for a westbound train to enter the siding, with siding unoccupied, signal 142L can be controlled to display red-over-yellow, and approach signal 209 then displays yellow over five lighted lamps forming a figure "X". Thus, with these aspects, which check siding occupancy and give advance information at the approach signal, an engineman can bring his train up to and through the turnout into the siding at restricted speed without being prepared to stop at the entering signal which would be the case if only the conventional approach aspect were displayed on the approach signal.

Circuits are interconnected so that two opposing signals such as 142L and 130R cannot be cleared at the same time to direct opposing trains to enter the siding. Also, for example, if an eastbound train is occupying the siding, then westward signal 142L cannot be cleared for a westbound train to enter. The turnouts from the main track to the sidings are No. 16 with 30-ft. switch points. The turnouts from a siding to the two main tracks include a split No. 11 frog and 22-ft. points.

The dwarf signals to direct a train to depart from sidings are of the

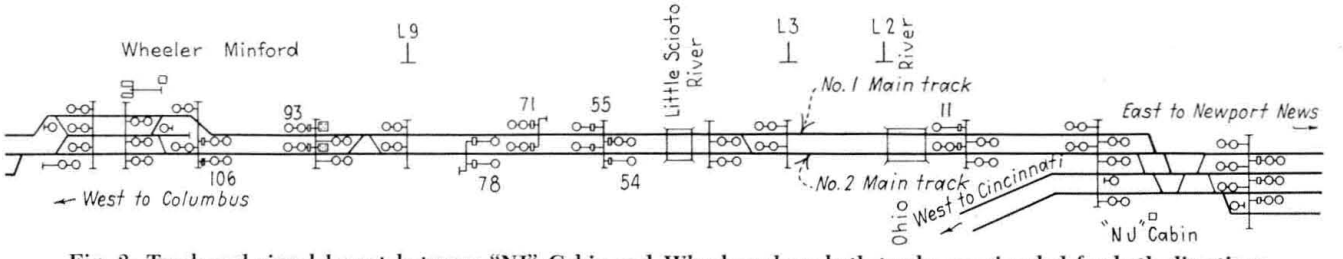


Fig. 3—Track and signal layout between "NJ" Cabin and Wheeler where both tracks are signaled for both directions

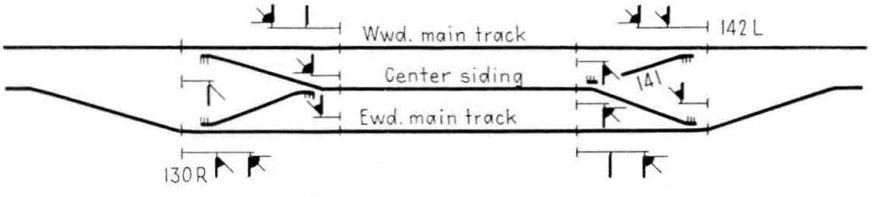


Fig. 4—Remote control power switches and signals at typical siding

three-indication color-light type and display Stop, Slow-Approach, and Slow-Clear aspects. The Slow-Clear aspect indicates that the next signal is displaying either the Approach or the Clear aspect and, therefore, as soon as train has passed through the turnout to the main track, authorized speed may be resumed.

The crossovers between main tracks at Minford and at MP-3 are No. 16 with 30-ft. points. (See Fig. 3). When one of these crossovers is reversed, the home signal governing through the crossover is cleared to display the clear medium aspect

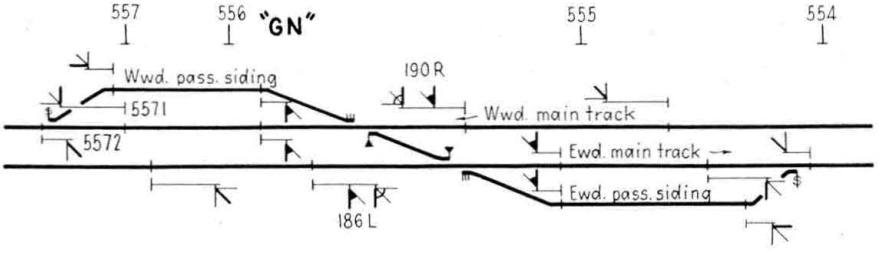


Fig. 5—New remotely-controlled arrangement at "GN"

red-over-green, and the signal in approach displays the approach-medium aspect, yellow-over-green.

Light-Out Protection

The signals are lighted with differential filament lamps rated at 18 plus 3.5 watts and 10 volts, except that where signals are on curves requiring spreadlite lenses, the lamps are rated at 30 plus 6 watts and 10 volts. The controlled signals are continuously lighted and other signals are approach lighted.

At each signal which has two color-light heads on the same mast, there is a light-out relay connected in series with the lamp filaments of certain lamps in the upper head, and the control circuits for the lamps in the lower head are through front contacts of this relay. If a lamp filament in the upper head is burned out, a Stop aspect is displayed by the lower head rather than a less restrictive aspect that would have resulted if the light-out relay had not been used.

In the Wheeler-Columbus territory, there are a few hand-throw crossovers between main tracks that are used only for local switching or for emergencies. Each switch has a facing-point lock, both of which are pipe connected to and operated by a hand-throw lever between the rails at the center of the crossover.

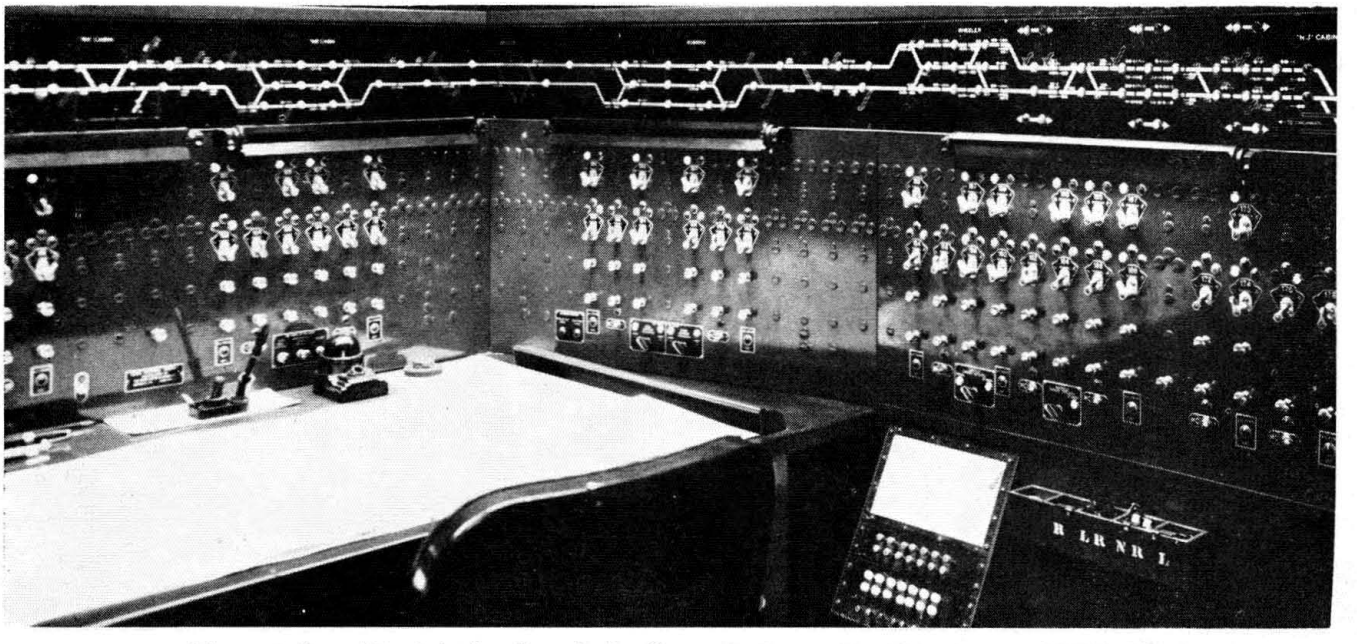
Railroad Crossing Protection

The single track of the Scioto Valley Railroad, an electric interurban line, crosses the C. & O. at MP-85, near Lockbourne. At this crossing standard high interlocking home signals are in service on the C. & O. for right-hand running. Dwarf signals are in service on the Scioto Valley and for reverse running, on the C.&O. On the Scioto Valley, there are two lift-type derails pipe connected to a one-lever stand which has an electric lock, locked when a train is approaching within approach locking limits on the C. & O. The C. & O. signals are held at Stop if the derails, the operating lever, and the lock are not in their respective normal positions.

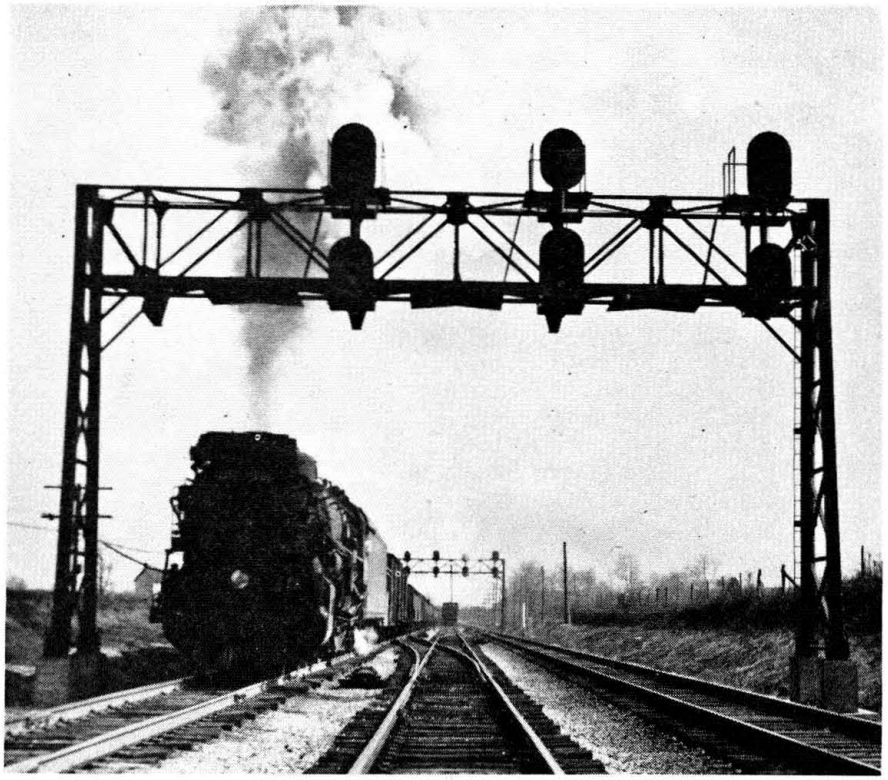
Two Sidings And Crossover at GN Cabin

After the new signaling on the Northern Subdivision was completed a decision was made to also include an installation of power switches, electric locked crossover, and signals to place a mechanical interlocking at GN Cabin, 12.8 mi. west of N.J. Cabin, on the main line of the Cincinnati Division. The previous mechanical interlocking included entrance switches for two sidings, one connected to the eastward main track and the other to the westward main track, and also a main track crossover. Spring switches were, and are still in service at the leaving ends of both sidings. The new power switches, electric lock on center lever crossover locking device and signals at G.N. Cabin are now controlled by the same dispatcher at Covington who controls the locks, switches, and signals on the Northern Subdivision.

Referring to Fig. 5 showing track layout of G. N. Cabin, the two high signals 186L and 190R, when cleared for straight movement, are non-stick. Thus the dispatcher normally positions these levers for through movements, thereby requiring no further attention on his part until he is ready



The control machine is in the dispatcher's office at Covington, Ky., 121 mi. west of "NJ" Cabin



Westbound train at the east end of the center siding at Wheeler

to line up for a train to enter one of the sidings.

The signaling at the leaving end of these sidings is shown on the plan. The leave-siding dwarf normally displays a green aspect, and main line high signal No. 5571 is normally dark. The aspect of the dwarf changes to red, and the green aspect is displayed on high signal No. 5571 when a westbound approaching train enters a track circuit 7,200 ft. long in approach to the westward distant signal to 190R.

Coded C.T.C. Carrier

As shown on the map, the control machine at Covington is 121 mi. from N. J. Cabin which is the nearest end of the new controlled signaling on the Northern Subdivision, extending from N. J. Cabin west to Columbus. The outgoing controls and incoming indications are handled by a time coding system on two line wires which are No. 8, 40 per cent conductivity copper covered steel with double braid weatherproof covering. These wires are located in the third gain on pins 23 and 24 and are transposed for 30 k.c. frequency to avoid interference with communication circuits on the same pole line.

On the Cincinnati Division from Covington east to G.N. Cabin there are three carrier circuits, namely, "A", "B", and "C", with a carrier repeater station located at Maysville, Ky., 63 mi. east of Covington. (See Fig. 6).

Line "A" carrier circuit is converted to d.c. code at G.N. Cabin on the main line and extends to G.B. Cabin on the Northern Subdivision, a distance of 45 mi., with 26 control stations in this territory. Carrier circuits "B" and "C" are superimposed on the d.c. code line. The control code from Covington to G. N. Cabin is 29.7 k.c. and the indication code is 16.5 k.c.

Line "B" carrier is converted to d.c. code line at G. B. Cabin and extends west to Scippo with Line "C" carrier control superimposed on the d.c. code line, a distance of 36 mi., with 15 control stations. As Line "B" extends east from Covington to N. J. Cabin, then west to G. B. Cabin, it was necessary to transpose the carrier control and indication frequencies of this section at N.J. Cabin to keep the direction of transmission in accordance with A. A. R. requisites. This was accomplished by installing carrier block filters at N.J. Cabin. A standard oscillator-amplifier unit was also installed for each carrier at this point. A plug-in adaptor was added by means of which the 25 k.c. control code from Covington is fed into the amplifier to operate the receiving relay, and the receiving relay in turn "keys" the oscillator which is connected through the adaptor to the line west to G.B. Cabin, and feeds 12.8 k.c. carrier control to G.B. Cabin. The "B" line indication from G.B. Cabin to N.J. Cabin is 25 k.c. carrier, which by means of another oscillator-amplifier is transposed to 12.8 k.c. carrier to transmit indications west to Covington. These oscillator-amplifiers serve both as a means of properly transposing the carrier frequencies and also as carrier repeaters.

Line "C" carrier circuit is converted to d.c. code line at Scippo and extends from Scippo to C. H. Cabin, Parsons Yard, a distance of 24 mi. with 11 control stations. The control is 21 k.c. from Covington to N.J. Cabin where it is transposed to 11 k.c. in a manner similar to Line "B" for transmission to Scippo. The indi-

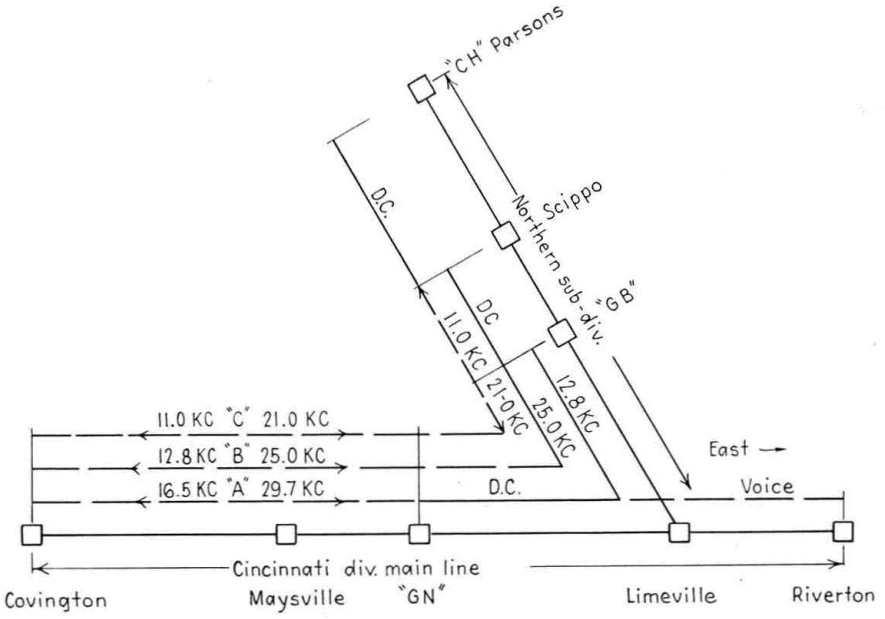


Fig. 6—Schematic diagram of carrier circuit arrangement

cation code is 21 k.c. carrier from Scippo to N.J. Cabin where it is transposed to 11 k.c. for transmission to Covington.

Each instrument house and maintainer's tool house is equipped with a telephone which can be connected to either the block line or code line. These telephones are equipped with 1,000-cycle buzzers which will operate a call detector on the C.T.C. machine to enable the maintainers to contact the dispatcher. At the supervisor's office, in an adjoining room at Covington, there is a talk-back speaker connected to the code line which places the supervisor in direct contact with the maintainers. This talk-back speaker also is valuable in detecting changes in line conditions, as the amplifier is so adjusted that any unusual condition such as a short or partial short on the line will be audible.

Each instrument house is equipped with a horn and a maintainer call light. Double - pole sectionalizing switches are installed at the east end of each siding by means of which grounds or other line trouble can more readily be located by sectionalizing the code line.

At N.J. Cabin a series line time code control machine is in service for controlling the functions from Limeville east to Riverton. This d.c. line is equipped with maintainer telephones, and through a voice pass filter is connected to the multiple Covington-Parsons line. This enables the supervisor at Covington to talk directly to the maintainers on the Limeville-Riverton territory.

A complete duplicate of all carrier apparatus was installed for standby operation in case of failure of any component. A 52-volt battery located at Covington controls a polar relay at Maysville and a neutral relay at G. N. Cabin and serves to select the normal or standby apparatus at these locations. Through a changeover lever on the control panel, this d.c. line normally holds these relays energized. One position of the changeover lever pole-changes the d.c. line to reverse the polar relay at Maysville, thus selecting the desired carrier equipment. Another position of the changeover lever adds sufficient resistance to the circuit to de-energize the neutral relay at G.N. Cabin for carrier equipment selection. This latter operation does not affect the relay at Maysville. A short on the line would de-energize both relays, thereby changing over to the standby apparatus which is set to operate on a lower received signal, as well as to transmit a higher voltage. The carrier equipment at N.J. Cabin, G.B. Cabin, and Scippo may be changed to standby operation by means of control codes. A line break or short circuit would also cause an automatic transfer to the standby equipment at these locations.

Each carrier location is equipped with a tuned alternator which operates from the local battery to supply 110 volts a.c. to the carrier equipment in case of an a.c. power interruption.

In this project, track circuits are the conventional d.c. neutral type with 4-ohm relays on circuits less than 1,000 ft. long, and 2-ohm relays on those more than 1,000 ft. long. Each local line control circuit is double-wire double-break with a 400-ohm d.c. retained-neutral polar relay. Between each approach signal and each home signal, there are two line wires for approach locking. These local signal control and locking circuits are No. 10, 40 per cent conductivity copper covered steel weatherproof wires. A line circuit of two No. 6, hard-drawn copper wires, with weatherproof covering, is used to distribute 440 volts a.c. power. Power is purchased at various locations to feed this 440-volt circuit in both directions from each feed point with a sectionalizing switch at the end of each circuit. Stored at a central location on this division is a portable, skid-mounted gasoline engine driven alternator rated at 115 volts, 3,000 watts. If a sleet storm or other disaster should damage the line circuits of public utilities which supply any of the railroad service, this portable gas-engine and transformer would be transported to that location and placed in operation.

At each controlled location, the switch machines are operated by a set of 13 cells of 110-a.h. lead storage battery. Eight of these cells also operate the code equipment. Five cells of 240-a.h. lead storage battery operate local circuits and serve as standby for signal lamps. At each intermediate signal location, a set of five cells of 150-a.h. lead storage battery is in use. Where a.c. power is available, each track circuit is fed by one cell of 80-a.h. nickel-iron storage battery. Where no a.c. is available, each track circuit is fed by five cells of primary battery in multiple, using high-voltage cells on circuits 5,000 ft. or longer, and standard voltage cells on shorter circuits.

The 440-110 volt transformers at the end of the siding layouts are rated at 500 watts, and at intermediate signals 150 watts. At each field station where carrier equipment is located, there is a stabilizing transformer rated at 0.6 amp., 500 watts to maintain a uniform output with a varying input.

This signaling system was planned and installed by railroad forces. A power-operated trench digging machine mounted on a tractor crawler was used to dig trenches for buried cables. An air compressor mounted on a four-wheel drive Jeep was used to operate pneumatic digging tools, grinders, etc. This vehicle was also used to pull in line wires.

In addition to the usual assignment of track motor cars, each construction crew had a motor truck. The instrument houses were shipped on flat cars and unloaded on their foundations by power derricks. No other work train service was required, the remainder of the materials being transported to final locations on push cars or motor trucks.

NEW BOOK

Primary Batteries. By G. W. Vinal, physicist, National Bureau of Standards. 336 pages, 101 illustrations, 5¾ in. by 8½ in. Bound in cloth. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $5.

THIS book thoroughly covers the subject of primary batteries, with a wide range of information on history, theory, materials, chemical reactions, manufacture and operating characteristics. Much recent data are included which have been derived from the use of new research tools such as the electron microscope, x-ray spectrograph, mass spectrograph, and the petrographic microscope. "These have been applied," says Mr. Vinal, "to study the crystal structures of the solid phases resulting from discharge and the gases liberated during periods of storage." Several new types of special-purpose batteries are covered. Included are batteries for operating at low temperatures, for giving large currents, for producing more energy per unit of weight, and those which remain inactive until required for use. Practical, detailed material is presented on silver-oxide and chloride batteries, mercury-oxide batteries, and perchloric and fluoboric-acid batteries. For those dealing with precise electrical measurements is a thorough chapter on standard cells (standard of emf.). Among other aspects it gives history, a general discussion, preparation, assembly, intercomparing emf.'s and temperature control.