Light Signals on C., M. & St. P.

Details of New A. C. Installation on 440 Miles of Single-Track Main Line in Connection with Greatest Steam Road Electrification Ever Undertaken

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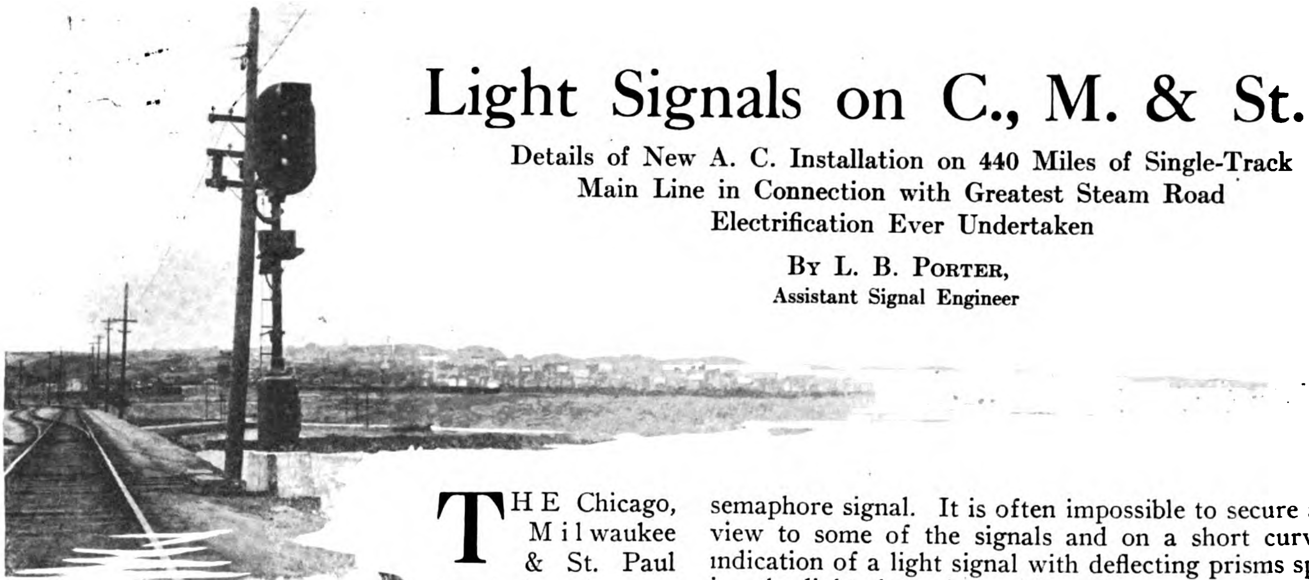
Assistant Signal Engineer



Model 14 Intermediate Signal

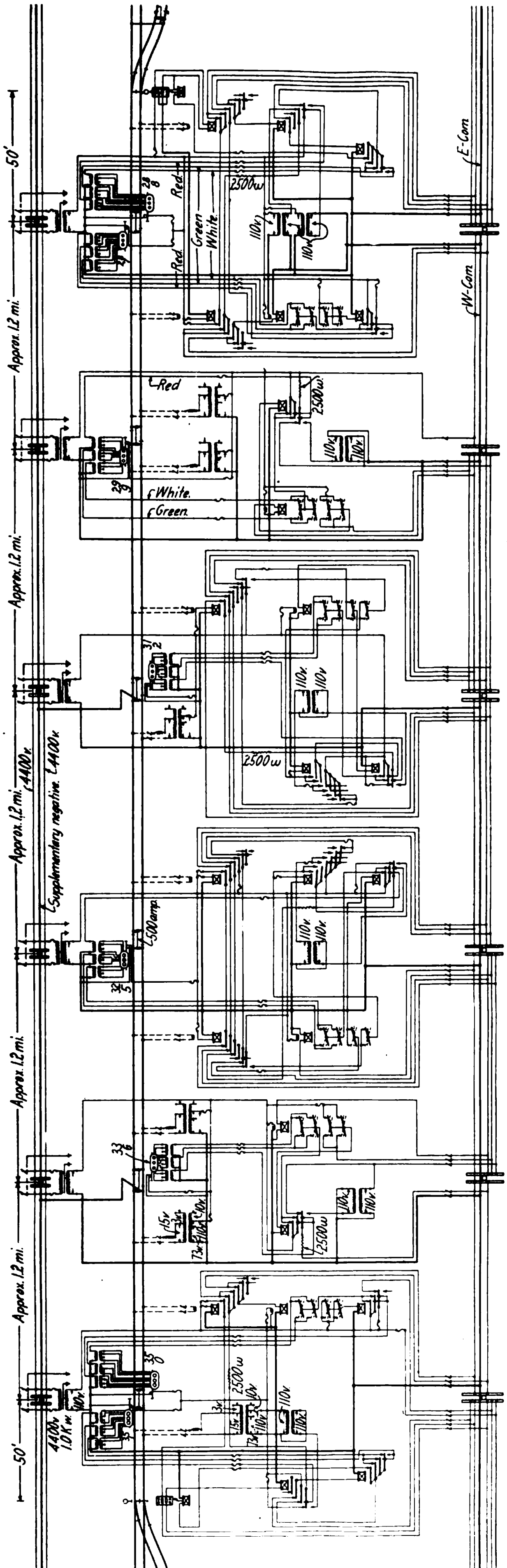
THE Chicago, Milwaukee & St. Paul has had under way since 1914 the most extensive steam railway electrification project in the world on its single-track main line through the mountain district from Harlowton, Mont., to Avery, Idaho, a distance of 440 miles. The line crosses three rugged mountain ranges: the Belt mountains, through a part of which the line follows the Sixteen-Mile canyon; the Rocky mountains, where the line crosses the main continental divide, and the wooded Bitter Root mountains between Montana and Idaho. In crossing these ranges, there are a number of heavy grades, the most difficult being the 21-mile two percent grade on the east slope of the Rocky mountains, and the longest, the 49-mile average one percent grade on the west slope of the Belt range. The curvature is also necessarily heavy, the maximum being ten degrees. Regular electric train operation was commenced between Three Forks and Deer Lodge in December, 1915, and the entire project was completed early in 1917. The results obtained have been so satisfactory that another section of 211 continuous miles through the Cascade mountains from Othello, Wash., to Seattle and Tacoma is now being electrified.

The signaling of the first project of 440 miles was started shortly after the electrification was commenced. At that time d. c. right-hand semaphore signals were in service between Lennep and Three Forks, 79 miles; between Piedmont and Butte Yard, 37 miles, and between St. Regis and Haugan, 19 miles. On account of interference of the 3,000-volt d. c. propulsion current with the d. c. track circuits, it was necessary to install a. c. track circuits that would be immune to the effects of the d. c. propulsion; and on account of the view of the existing signals being obstructed by the trolley poles and arms it was necessary to use either a left-hand semaphore signal or a light signal. After considerable investigation of the systems in use on other electrified roads, and after installing some of each type for comparison, it was decided to adopt the color light signal as standard in the electric zone, both for automatic signaling and at interlocking plants. The existing semaphore train order signals are retained, special provision being made to improve the view by the use of side brackets or other means where it is obstructed. The light type signal is especially well adapted to this territory and to this class of service. It requires less clearance than a semaphore signal and can be located inside the trolley poles where the view is less obstructed. The mountains generally make a good natural background for a light signal, but a poor one for a semaphore signal. It is often impossible to secure a long view to some of the signals and on a short curve the indication of a light signal with deflecting prisms spreading the light through a wide angle can be more readily picked up by an engineman than could the indication of a semaphore signal.

Authority was accordingly issued for a complete, uniform light-signal installation over the 440 miles of electrified road except between Haugan and Avery, a distance of 38 miles through the Bitter Root mountains, where the controlled manual staff system is now in use and is to be retained. It is estimated that the entire installation will involve an expenditure of approximately $683,000. The d. c. semaphore signals on 135 miles of line have now been replaced with light signals; an additional section of light signals between Butte Yard and Finlen, about 20 miles, has been placed in service and work is well under way on the balance of the 402 miles. When this installation is completed, the automatic block will then be continuous from Harlowton, Mont., to Seattle and Tacoma, a distance of approximately 886 miles, with the exception of two short sections of line on which the staff system is in use. It is the intention to reinstall the d. c. semaphore signals removed from this section as well as from the other line now being electrified, on the line east of Harlowton, and it is expected that, within a few years, practically the entire line from Chicago to the Pacific Coast will be protected by automatic block signals.

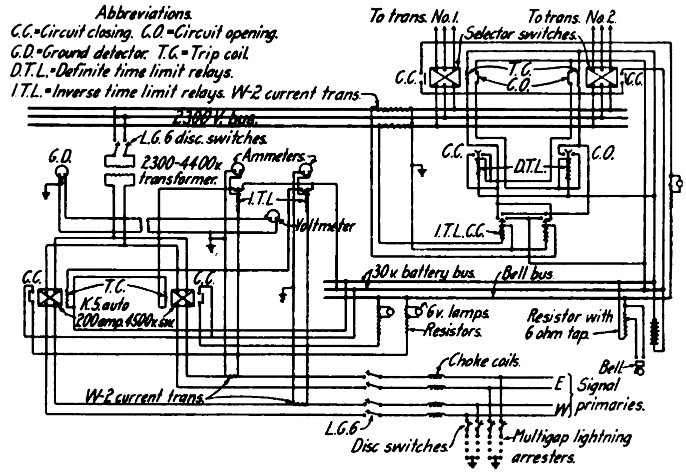
The signal equipment for the electric zone was purchased from the Union Switch & Signal Co. under contract. The construction work is being done by the railroad company's forces. The engineering, drawing up of plans and ordering of material is being handled by the signal engineer's office at Milwaukee. The locating of signals and field construction is under the general supervision of L. W. Smith, assistant signal engineer, at Tacoma. A complete organization under the charge of R. F. Tyler, general construction foreman, has been built up to handle the construction work. The high-tension primary signal circuit and power equipment in substations was installed by the electrification department. The low-tension secondary signal wires were placed on the railroad company's telegraph pole line by the telegraph department.

The installation was divided into the usual number of short sections for convenience in handling the construction work, material and reports. In general, the work was divided into two parts, as there were really two installations to be considered, one being authorized several months after the other. In the first installation the d. c. semaphore signals were to be replaced, and in the other,



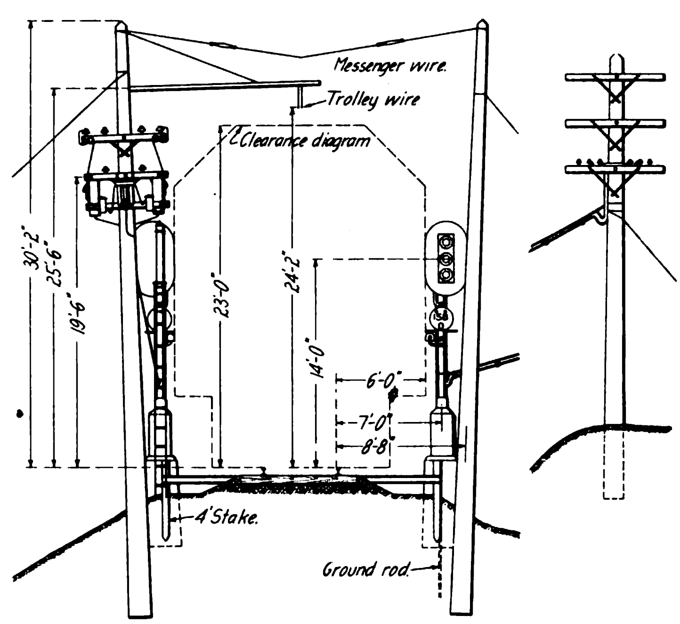
Typical Circuit for Automatic Signals with Eight Signals Between Stations

an entirely new installation was to be made. While the installation is practically standard throughout, there are a few differences between these two sections. With a few exceptions, the signal foundations of the original installations were used, whereas on the new work, the signals were spaced farther apart, as it was possible to use longer track circuits. A slightly different signaling scheme was followed on the new work, having addi-



Signal Sub-Station Equipment in Electrified Territory

tional intermediate signals between stations instead of providing approach signals, although this was done at division points and at important stations. The model 14 light signal was used on the first work installed, and the type L light signal on the new work. There were also improvements made in some details of the equipment as the work progressed and in details of construction, such as locating impedance bonds outside the track instead of between the rails, and changing location of apparatus, wiring of the instrument cases, and circuits. This article



Arrangement of Apparatus at Double Signal Location

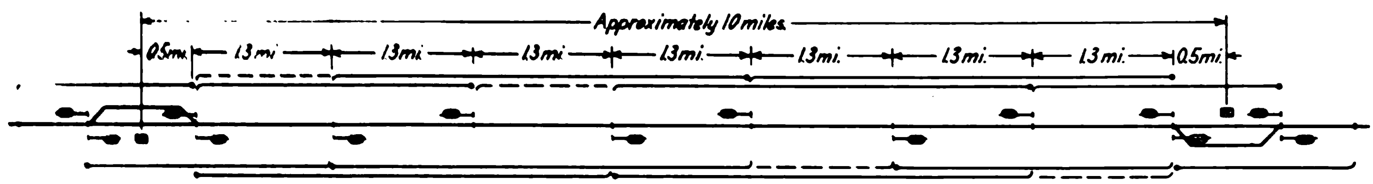
will describe particularly the signaling of the new installation rather than that on which the signals were replaced, although, as before stated, the work is practically standard throughout.

Type and Location of Signals

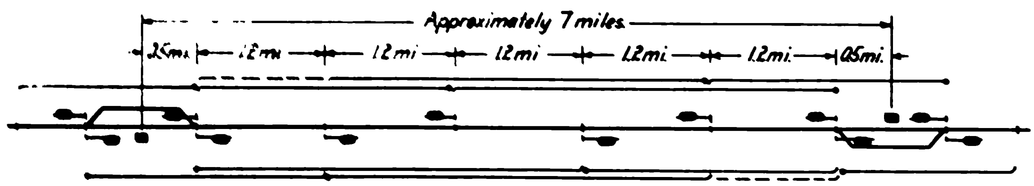
The model 14 light signal with 10-in. lens, having one hood over all, has been installed on 136 miles, and the type L signal with 8½-in. lens and individual hoods over each lens is being installed on the balance of the work. Three indications are given by most of the signals; the red unit giving the stop indication, being located at the bottom; the green unit, giving the caution indication, in the middle, and the white unit, giving the clear indication, at the top. Where only two indications are required, the unit not in use is covered with a blinder. A red marker lamp is provided on the left-hand side of the poles of automatic signals and on the right-hand side of home signals at interlocking plants. Short poles are used in order to bring the middle unit about 14 ft. above the rail which is in the plane of the engineer's vision.

The main lamps illuminating these signals are 6-volt, 28-watt, G-18½ bulb, bayonet candelabra base, with concentrated filament. The main lamps behind the colors are burned at normal voltage, while those behind the clear lens are burned at 4 volts. A similar lamp is used for a pilot lamp, but it is burned at reduced voltage to prolong its life. It is so located as to give a short range indication in case the main lamp is burned out. A small transformer is provided at the back of each signal unit for operating the lamps of that unit. The use of the individual transformer for each light unit insures a more even voltage at the lamp and reduces the possibility of lamps being burned out by lightning, as no other external circuits are connected to them. The primary of this transformer is wound for 110-volt operation, which means that the relay contacts controlling the light circuits will have to carry only a small amount of current. The same voltages are used for both day and night indication.

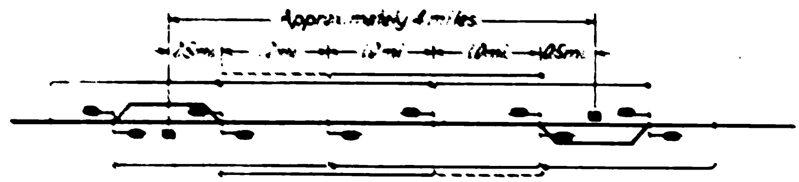
The lenses ordinarily used give a spread of 3 deg., which is sufficient for tangent track, but on curves, deflecting prisms of 10 and 20 deg. are used, the angle of spread depending on the curvature of track and length of view. From observations of the signals in service it has been found possible to read the indications at a distance of from 4,000 to 5,000 ft. under favorable conditions, although the average range is about 2,000 to 3,000 ft. in the daytime. The range of vision, of course, decreases under adverse conditions, such as occur when the sun is low with its rays shining directly against the signal. During twilight or during foggy or stormy weather, the indication of the light signal is superior to that of the semaphore signal.



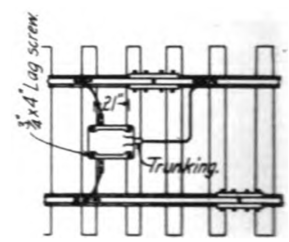
Stations over 7 but not more than 10 miles apart-10 Signals.



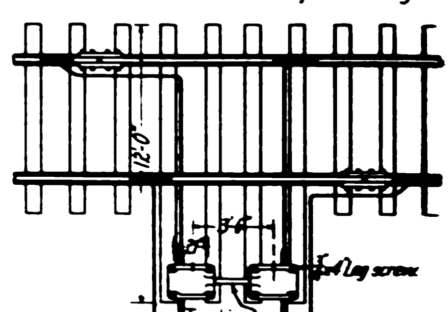
Stations over 4 but not more than 7 miles apart-8 Signals



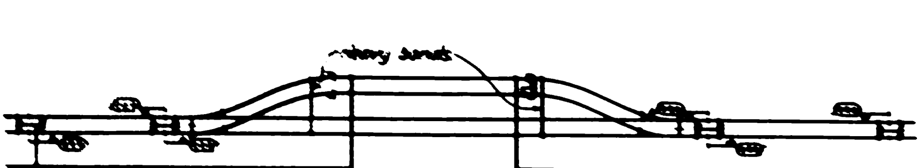
Stations not more than 4 miles apart-6 Signals



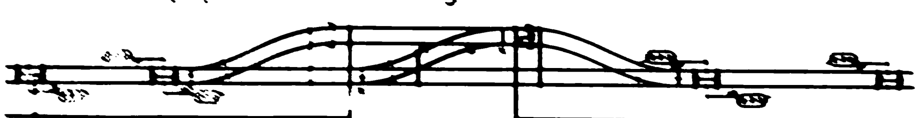
500 Amp. Bond Single



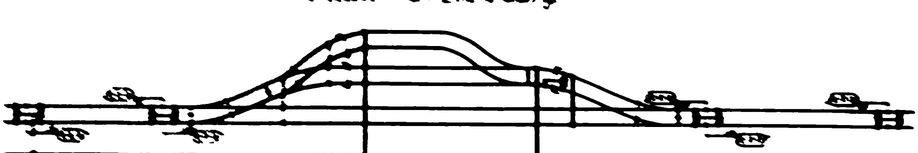
500 Amp. Bond Double



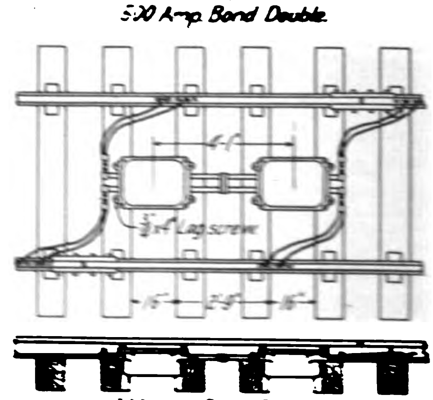
Supplementary negative Siding



Crossover Main Line to Siding



Siding with Switch inside of Siding



500 Amp. Bond Double

The Three Typical Signaling Schemes in the Electrification Territory

Arrangement and Connection of Bonds and Supplementary Negative

Detailed Layout of Impedance Bonds

A uniform scheme of spacing and locating signals was followed, as shown on the accompanying diagrams, although it was of course necessary to depart from the standard scheme in some cases on account of grade, view, sidings, yards and other local conditions. The general scheme requires a double signal location at each end of passing sidings and the number of intermediate signals between stations depends upon the distance between stations. Views of several locations are shown.

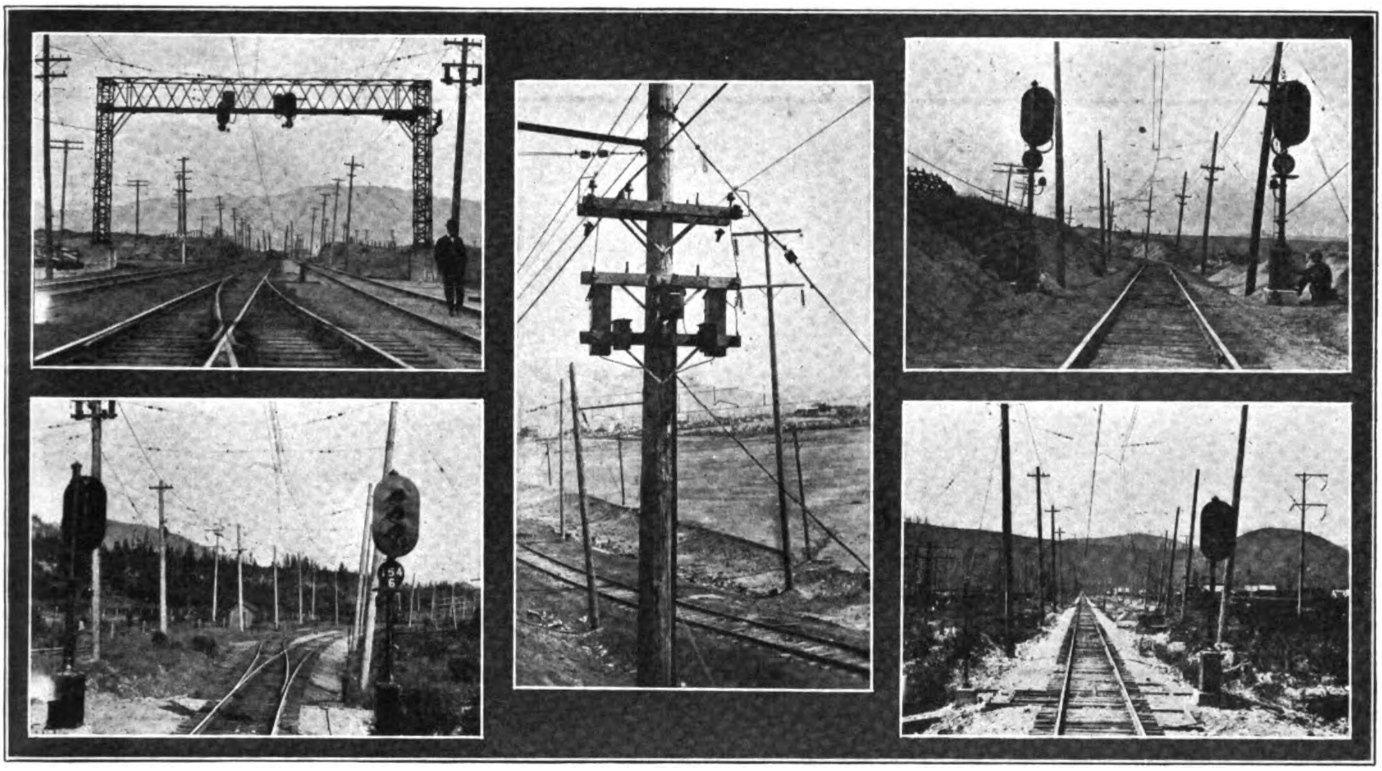
Control of Signals.

The overlaps and controls for the automatic signals are indicated on the diagrams, the circuits being arranged as shown on the typical circuit plan, which is for an eight-signal layout. All signals are controlled by 110-volt, 60-cycle, single-phase circuits, carried over the line on No. 9 B. W. G. weatherproof, galvanized iron line wires. Cable drops and cross-track connections are No. 14 B. & S. copper with 4-64-in. wall Kerite insulation.

The inbound signals at ends of passing sidings are controlled by two single-element, two-position, 60-cycle, single-phase vane type relays; one of these, the home relay, repeats for the track circuit through the station and the first track circuit outside the station, and the other, or the distant relay, repeats the position of the line relay controlling the stop indication of the next automatic signal; and it is also controlled through a circuit controller on the train order signal at the station, so that a stop indication of this signal is preceded by a caution indication of the automatic signal governing the approach to the station.

The outbound signals reading away from the stations and the intermediate signals between stations are controlled by two-element, three-position, 60-cycle, single-phase, model 15 vane type line relays and a slow-acting, single-element, two-position vane type relay which is controlled locally through the three-position line relay. This slow-acting relay controls the local light circuits and prevents flashing of the lamps when the phase of the three-position relay is reversed, and it also serves as a phase changer for the next signal in the rear. The reversal of phase for the three-position line relay circuit is obtained by the use of a small 1-to-1, 110-volt transformer at the point of control—one polarity of this transformer being connected to the back contact of the relay serving as a phase changer and a circuit of opposite polarity from the main line transformer being taken to the front contact of this relay.

The red light giving the stop indication is always controlled by the de-energized position of the relay; the white, or clear, and the green, or caution indications, are controlled by the energized normal or energized reverse positions of the line relay. The circuits are arranged so it is impossible to give more than one indication at the same time. Wherever additional contacts are available they are usually connected in multiple to reduce contact resistance and the chances of failure.



Type L Suspended Light Signals
Double Signal Location, Type L Signals
Near View of Pole Line Construction, Showing Transformer
Double Signal Location, Model 14 Signals
Type L Intermediate Signal

An absolute overlap of at least one track circuit beyond the next signal governing in the same direction is provided for all following movements except through station limits and an overlap beyond the next opposing signal is provided for all opposing movements. The overlap of the outbound signal at stations and the intermediate signals is in some cases shorter for following movements than for opposing movements. This shortening of the overlap was not done primarily because the traffic was heavy enough to require a permissive indication for following movements, but in a number of cases it permitted the use of fewer track circuits; it simplified the line control and made the blocks of more equal length. This feature is obtained by the use of a single-element, two-position, 60-cycle, single-phase, quick-releasing model 15 vane type relay. The usual precautions have been taken in arranging the circuits to guard against permissive indications being given when work train or other irregular train movements are being made and still to have the circuits so arranged that opposing signals will clear up when passed, provided no train is following.

All signal line control circuits are broken through the switch instruments in the immediate block. No switch instruments shunt the track circuits on account of the possibility of the contacts being burnt off by propulsion current in case of an unbalancing of the circuit. Where approach signals are used, they are usually controlled by single-element, vane type relays, the same as the inbound signals at stations.

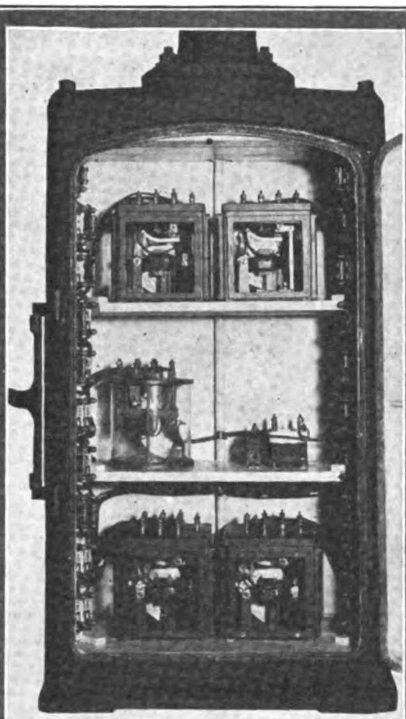
Track Circuits.

Track circuits are double rail and if not in excess of 7,500 ft. long, are end fed. If they are more than 7,500 ft. long, they are center fed. They are fed from 0.5-kv.a 110-volt primary, 1-18-volt secondary, air-cooled transformers. A large reactor is used in series with the track circuit feeds.

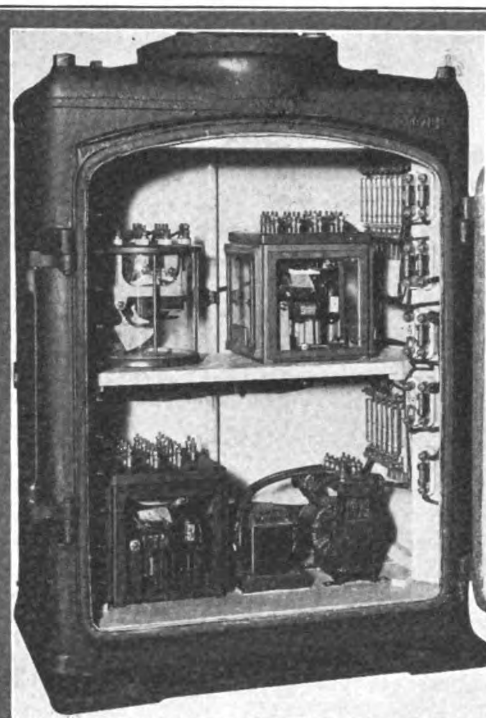
The track relays are two-element, two-position, 60-cycle, single-phase. model 15 vane type, the normal voltage required for the track element being about 1 volt. The local element of the track relay is wound for 110-volt operation. The connections from rail to track transformer are reversed at each location so that adjacent track circuits are of different polarity, which reduces the possibility of a track relay holding up through leakage current that might come from an adjacent section. Wires carrying track circuit current are No. 8 B. & S. copper with 5-64-in. wall Kerite insulation. The rail in use is 85 and 90 lb. and was bonded to capacity by the electrification department for the propulsion current.

Impedance Bonds

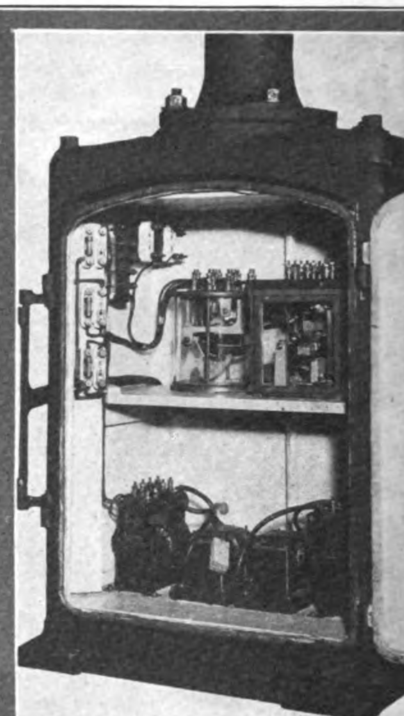
Two sizes of impedance bonds for carrying the propulsion current around the insulated rail joints are used. In territory where the maximum grade does not exceed 1.6 per cent, a 500-ampere capacity bond having a d.c. resistance of .0014 ohms is used, the resistance per rail around the insulated joint being .0025 ohms at 20 deg. C. Where the grade exceeds 1.6 per cent, a 1,500-ampere capacity bond having a resistance of .0003 ohms is used, the resistance per rail around the joint being .00056 ohms at 20 deg. C. Standard double bonds are used in front of the substations for connecting in the d.c. propulsion current. A single 500-ampere bond is used on sidings, being placed in the end nearest to the substation that is normally used for feeding that section. All yard tracks are crossbonded and tied together. The bonds for the first work were placed on ties between the rails, a sheet metal cover being placed over them, but on account of frequent damage caused by dragging equipment it was decided on the later work to place them on long ties outside the track.



Instrument Case Wiring at Intermediate Signal Location



Instrument Case Wiring at Head Block Signal



Instrument Case Wiring at Intermediate Signal Location

The annealed cable for connecting bonds to the track is sent out on reels and the proper lengths are cut and rail terminals applied on the ground. Rail terminals are the expanded type with 7/8-in. pin, the lugs and pins being the same type as those used by the electrification department. Bonds are filled with petroleum. The different types of bonds and layouts are shown on the accompanying plans.

A 4-0 copper conductor, called a supplementary negative feeder, for the return propulsion current around broken rails or rails that are to be removed, extends through the entire electric zone, except through station limits, where it is bonded into the sidings and the rails are utilized instead of the copper conductor. This supplementary negative is connected to the track at intervals averaging 8,000 ft., connection being made through the neutrals of alternate impedance bonds. Care was taken to see that the connections to the supplementary negative were so arranged that broken rail protection would be provided in the track circuits. The accompanying plan shows the arrangement of connections to the supplementary negative feeder.

The a.c. automatic signaling is to be carried through seven interlocking plants, six of which are at crossings with the Northern Pacific at Sappington, Piedmont, Silver Bow, Sinclair, Huson and Drummond, Mont., and the seventh is at Rocker, Mont., where the Butte, Anaconda and Pacific is crossed. The interlocking plant at Piedmont has been built since the electrification, and construction of the plant at Drummond is to be commenced in the near future.

Standard light signals are used on the C. M. & St. P. for the home and distant signals at these plants except that oil-burning markers instead of electric are used on the home signals and these are located on the right hand side instead of the left hand side of the pole and in some cases the home signals are equipped with a second two-indication light unit for low-speed routes. The control and overlaps of the semi-automatic home and distant signals are very similar to those used for the automatic signals with the addition of the lever control. The circuits are arranged for non-stick operation of the home signals. Approach disc type indicators with annunciators and a semaphore type indicator for the track section between the home signals are provided in the towers. Approach, route, and section locking are afforded by means of an a.c. electric lock placed on one of the facing point lock or derail levers and this lever is made to lock all the other units of the route. This electric lock is controlled through the home track section indicator and through a single-element vane type stick relay which is de-energized by the clearing of a route provided a train is actually approaching, which drops the approach indicator. The stick relay is picked up again by the signal lever being put normal while the track section indicator is de-energized or it picks up automatically after the approach indicator has picked up. Clock-work time releases are provided in case it is necessary to change a route which has once been set up and not accepted, and emergency releases in smash boxes are provided to release the locks in case of failure of the stick relay or home section indicator.

As the Northern Pacific has no automatic signaling on its line through these interlockings, no track circuits are used for the electric locking on that road. Instead, a clock-work time release operated by a key lever is used to afford route locking. A d.c. electric lock is placed on this key lever, and its control circuit is broken through contacts on the clock-work time release. These contacts require a time interval before closing when the lever is put normal and during this interval the lock circuit is open.

Power Supply and Equipment

The utmost precautions were taken in making plans for the electrification to insure a reliable source of power. The Montana Power Company, which supplies the power, operates a number of transmission lines throughout the state, which are fed from a main plant at Great Falls, and a number of other water power plants at widely separated points, most of which are tied together by high-tension lines. These transmission lines tap into the railway system at seven different points. The railway company transmits this power at 100,000 volts on a pole line of its own which follows the right of way for most of the entire distance of 440 miles, although at several points there are cut-offs which make a saving in the length of the line.

Fourteen sub-stations at an average distance of 35 miles apart are distributed along the line for receiving and converting the 100,000-volt power. Each station contains step-down transformers, motor-generator sets, switchboard and the necessary controlling and switching equipment. The transformers receive the line current at 100,000 volts and reduce it to 2,300 volts for the synchronous motors for the d.c. propulsion system. A separate 25-kv.a. 2,300-volt primary, 4,400-volt secondary, 60-cycle, single-phase transformer is provided for supplying current for the signal system. This power is transmitted on a line consisting of two No. 4 B. & S. solid copper wires supported on cross-arms on the trolley poles.

The substations are so arranged that a 2,300-volt, three-phase bus is provided at the main switchboard. This bus is fed from the secondary of the main power transformers and in order that the circuit may not, under normal conditions, be interfered with because of a damaged transformer or switching equipment, provision was made whereby the connections could be quickly transferred to either one of the two transformers. This is accomplished by means of so-called selector switches. (See diagram.) The tap for each power transformer is connected through so that when it is desired to transfer the 2,300-volt bus feed from one transformer to the other, the open switch is thrown in and the switch originally closed, tripped out. In this way the signal circuit is not interrupted at the time of transfer.

The sections of automatic signaling are normally end fed, one substation feeding through to the next adjacent substation, but as the a.c. power at adjacent substations is synchronous, the stations can be tied together; and the system has been so designed that this can be done without any adjustment of equipment, or, if desired, a dead station can be cut out entirely and the two adjacent sections tied together through the dead station. Independent circuits and automatic oil switches have been provided so that where one substation feeds in both directions, trouble occurring on one signal line will not affect the other.

The switchboards match up with the electrification department switchboards. The meter equipment consists of a recording voltmeter, ammeter and ground detector with the necessary current and potential transformers for each primary circuit. The voltmeter is a Bristol type instrument with 24-hour chart. The ground detector is of the electrostatic, vane type and will indicate the presence and extent of a ground on either circuit. Inverse time limit relays to open the automatic oil switches in case of overload are provided. The automatic oil switches are equipped with contacts for controlling a bell alarm and pilot lamp circuit to notify the operator when a switch has tripped. The diagram shows the wiring and complete substation equipment for primary signal circuits. Type F, form P, G. E. oil break sectionalizing switches are placed in the line at practically every passing siding or approximately five miles apart.

Transformers

Line transformers at signal locations and track circuit feeds are G. E. type H 1.0 kv.a. oil-cooled. They are protected by two G. E. graded shunt resistance multigap, lightning arresters. Expulsion fuse cut outs, No. 155757, with one ampere fuse fastened to the inside of the hinged door of the cutout so that they are automatically removed when the door is opened, are used between the high-tension line and the primary of the line transformer. G. E. porcelain plug cut outs with solid copper wires in place of fuses are provided so that all apparatus on the pole including the transformer and arresters can be disconnected from the line in case it is necessary to do work on the pole. A detailed view of the pole line construction showing typical transformer location is shown.

Standard sheet iron instrument cases are furnished at all signal locations for housing the relays, track transformers, reactors and other auxiliary equipment, except at some of the intermediate signal locations where specially high cases were required to house the equipment.

All line circuits entering or leaving a location are terminaled on G. E. vacuum tube type T single-pole lightning arresters placed on terminal boards set at an angle on each side of the door of the cases. The terminals and fuses are also placed on these boards as shown in the illustrations. Economy refillable cartridge, ferrule type fuses of 5 and 10-ampere capacity held in clips on standard R. S. A. porcelain terminal blocks are used on all circuits except in the track connections. No fuses are used in track leads except at the center fed track circuit locations where a 60-ampere fuse in a Manville fuse block is used. Standard R. S. A. porcelain terminal blocks with connector to hold the tag are used. Round aluminum tags are used on the cross-arms for line circuits.

The instrument cases were all wired up by the U. S. & S. Company at its factory, a uniform scheme being followed throughout. All apparatus was placed in the instrument cases at the factory except the relays which were shipped separately. The jumpers, properly tagged and terminaled ready for connecting to the relays, were furnished so that all that was necessary to do in the field was to connect up the relays. Combination relay boxes and cable posts of various sizes were used for track circuit feeds and at other points where there were no signals.

Switch indicators are U. S. & S. Z.-armature, two-position, 0 to 90-deg., upper quadrant, right-hand, semaphore type, arranged for 110-volt, 60-cycle, single-phase operation. They are provided at all main line switches except on short spurs or sidings. The indicators at passing track switches where there are double signal locations repeat the stop and caution indications of the inbound signal only, as the indications of this signal are not visible from the switch, but as the outbound signal can be plainly seen it is not necessary to have its indications repeated by the switch indicator. Universal switch circuit controllers with four contacts are used on all switches and the rotary type controller is used on siding derails.

Four B. Z. automatic, movable, visual, audible crossing signals and one ordinary crossing bell are in service in this territory. These signals are controlled by a.c. interlocking relays and are arranged for 110-volt, 60-cycle, single-phase operation. All automatic signals are ground post except in the vicinity of Butte, where it was necessary to place four signals on signal bridges on account of there being insufficient clearance between the C. M. & St. P. and the Butte, Anaconda & Pacific tracks. The light signals were suspended from these bridges as shown in the views.

OPERATING MEN DISCUSS THE USE OF THE OVERLAP

THE majority of operating men with experience on roads having block signals are apparently opposed to the overlapping of stop signals for following movements as indicated by a series of discussions published in the "Railway Age Gazette" of August 10. The provision of two caution signals behind a stop signal was favored by many where there is insufficient breaking distance, the division of opinion on this point being practically along the lines of former arguments in favor of and against the simplified system of signaling.

The following are abstracted from the remarks of four railroad vice-presidents and one government officer taking part in this published discussion:

V. P. 4.—Our rules make it plain that the train must be stopped before reaching the stop signal. We believe that maintaining strict discipline is better than providing overlaps. We believe further that overlaps are a trap for the engineman, for by their use we say to him when the signal indicates stop: "You must stop before reaching it, but if you do not, nothing will happen, because we hav provided protection for you in case you run by the signal." With distant signals and no overlaps, we tell the engineman that having the advance information he must stop before reaching the home signal or pay the penalty. Consequently, he stops and there is no penalty to pay.

V. P. 5.—What is needed is absolute observance of the stop signal. It is not material for what cause the signal appears at stop. It may be due to defective apparatus, and the track may be in perfect condition for the following train to proceed, nevertheless, the stop must absolutely be made. The moment you permit trains to ignore the stop indication for any cause or at any speed, you introduce a dangerous condition, because it is only a question of time when this bad practice will result in a train passing a signal with a track obstruction close ahead. The theory of overlapping blocks is predicated on trains running by signals in the stop position and in practice the overlap begets that careless condition.

V. P. 9.—The most satisfactory method we have ever found of educating our men in the aspects and indications of the signals, is the use of an instructor. This man, traveling in a signal instruction car, is on the road constantly, informing our men as to how they can and must control their trains to secure the greatest good as well as the greatest protection from the information given by the signals. This education has not only given the men a better understanding of the signals and their meanings than can be obtained either from the book of rules or from the explanations ordinarily given by the officers, but also has given the men absolute confidence in the signals.

V. P. 28.—It is our opinion that the bad wrecks which have occurred on account of overrunning home signals at stop are not so much the result of improper signaling, as of the improper observance of the caution indication. The elimination of the "proceed with caution" indication in the recently adopted A. R. A. code rules is a decided step away from safe practice. The retention of this indication and the strict observance of it by enginemen will effect a cure, and a revision of the code rules to recognize this most important indication in the same simple everyday language that we all have known for many years and that all can understand, is earnestly waited for.

I. C. C.—In the consideration of numerous train accidents brought before the Interstate Commerce Commission, I have given the subject of overlapping automatic signals considerable study. The overlap has been largely done away with in general practice and is now used principally for special conditions. The roads, as a whole, however, have not entirely eradicated the idea of giving enginemen a second chance. We are all doubtless agreed on the principle that we should stand firmly on the ground of absolute obedience to signal indications properly given. Any deviation from this course means disaster. I confess, however, that it is somewhat difficult to be inflexible in this position in the face of repeated collisions on roads with good signal installations and with discipline which is apparently as near perfect as it can be made. It should be pointed out, further, that the use of the overlap to meet this condition is only a half-way measure. There