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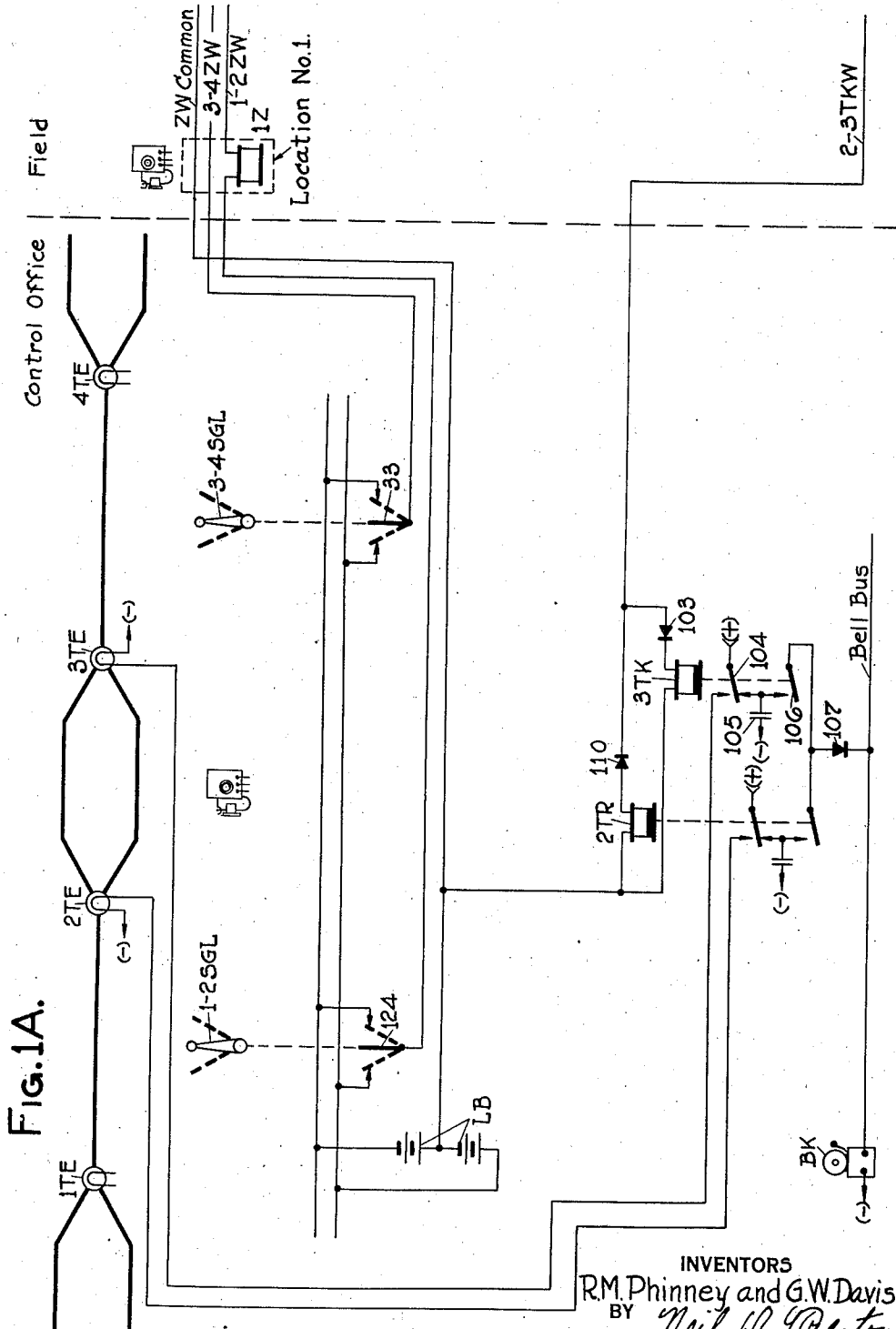
R. M. PHINNEY ET AL

2,355,327

CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

Filed March 1, 1943

6 Sheets-Sheet 1



INVENTORS
R.M. Phinney and G.W. Davison
BY *Neil H. Preston*
THEIR ATTORNEY

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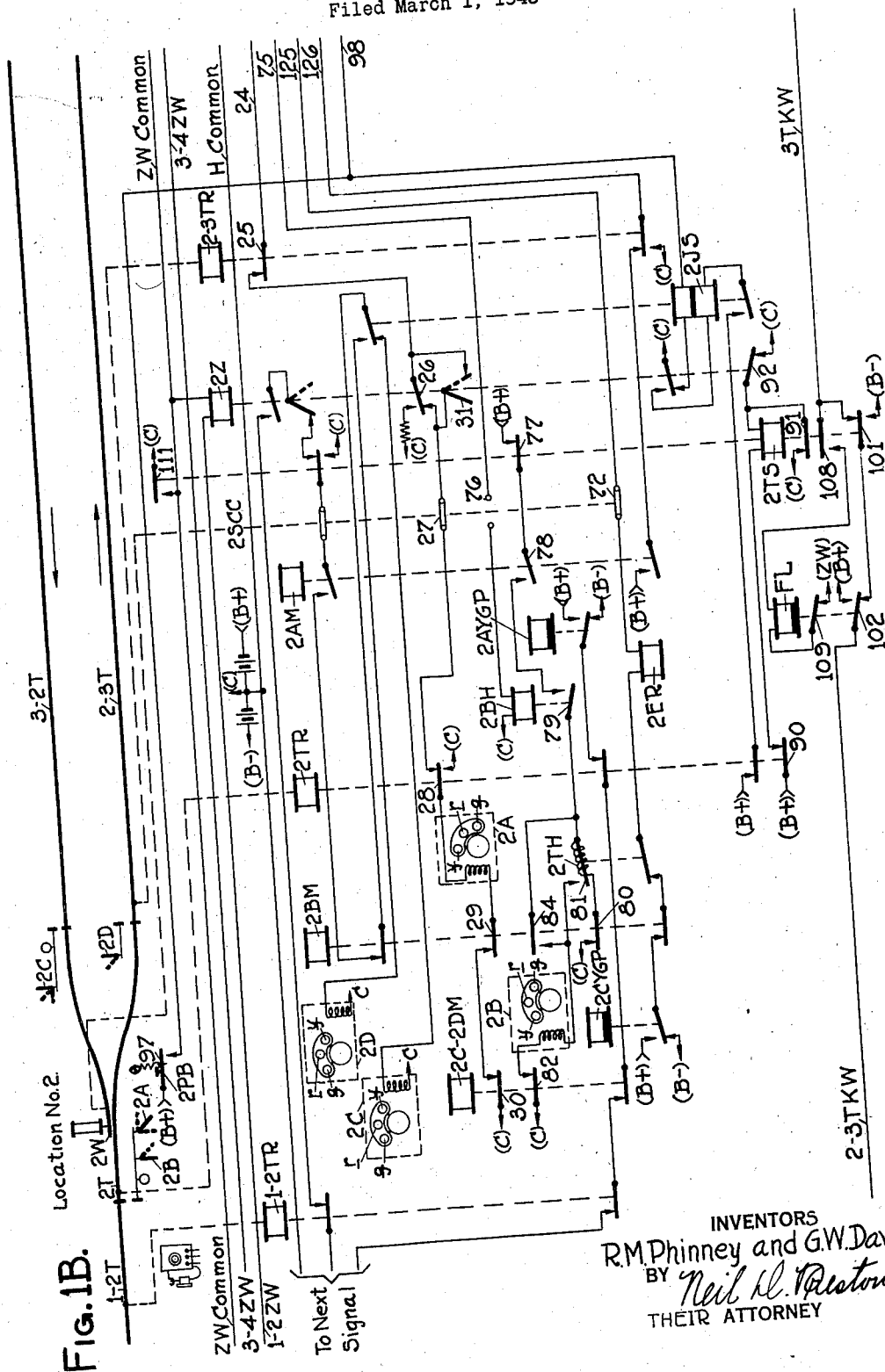
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6 Sheets-Sheet 2



INVENTORS
R.M. Phinney and G.W. Davison
BY *Neil H. Preston,*
THEIR ATTORNEY

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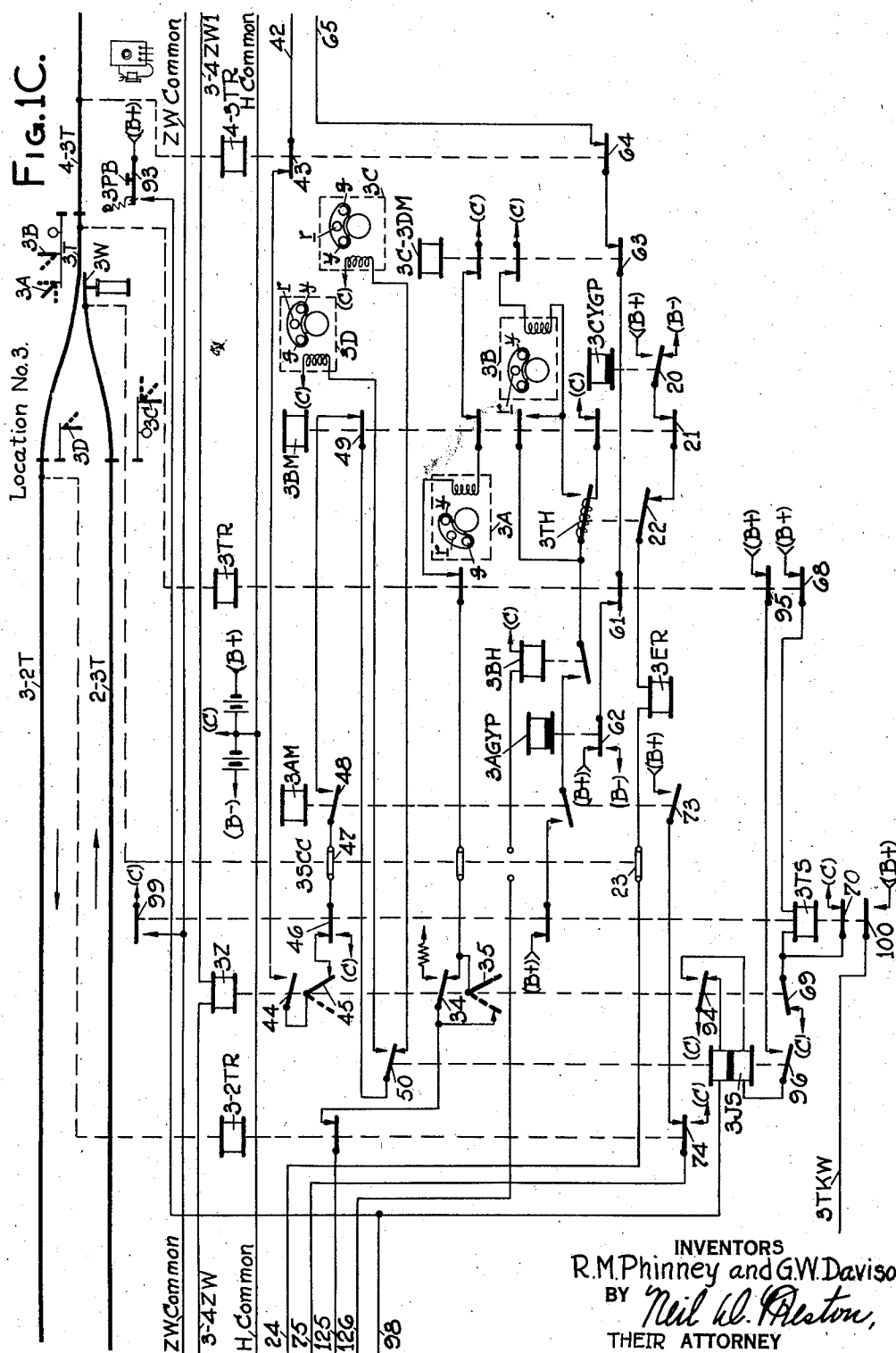
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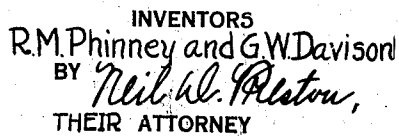
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R. M. PHINNEY ET AL

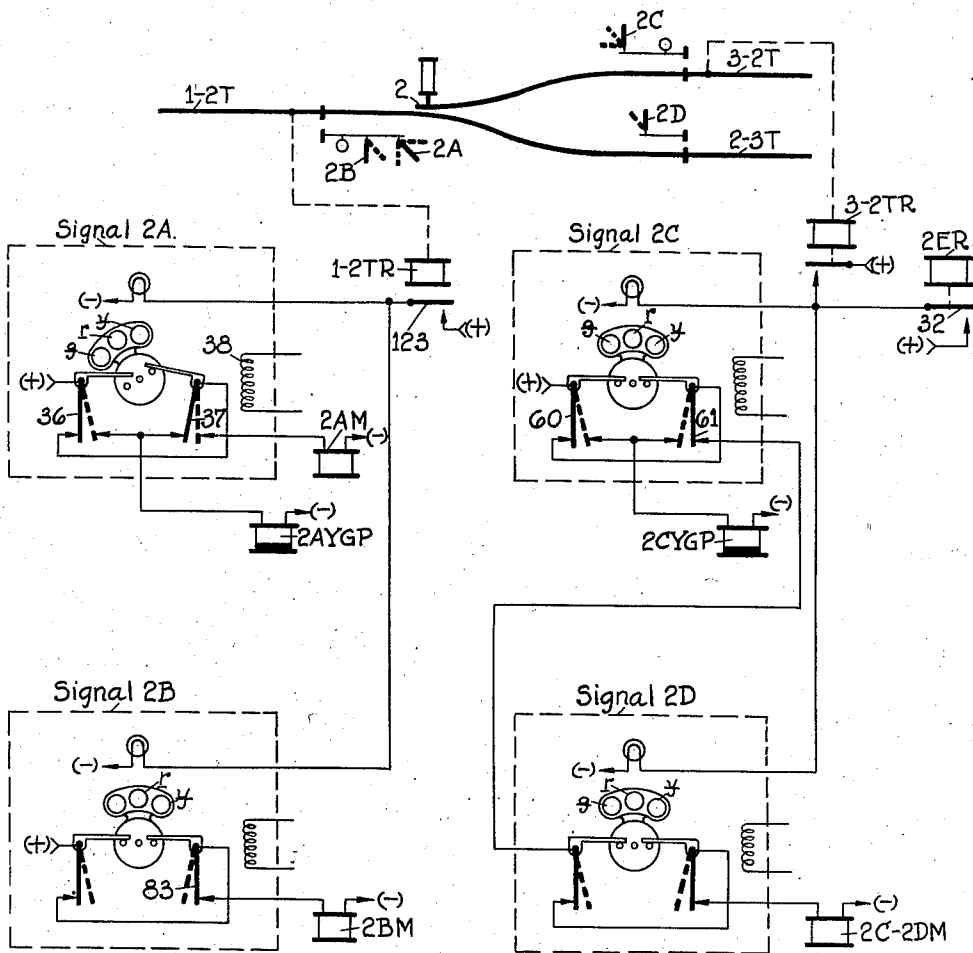
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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

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6 Sheets-Sheet 5

FIG. 2.



INVENTORS
R.M. Phinney and G.W. Davison
BY *Neil H. Preston*
THEIR ATTORNEY

Aug. 8, 1944.

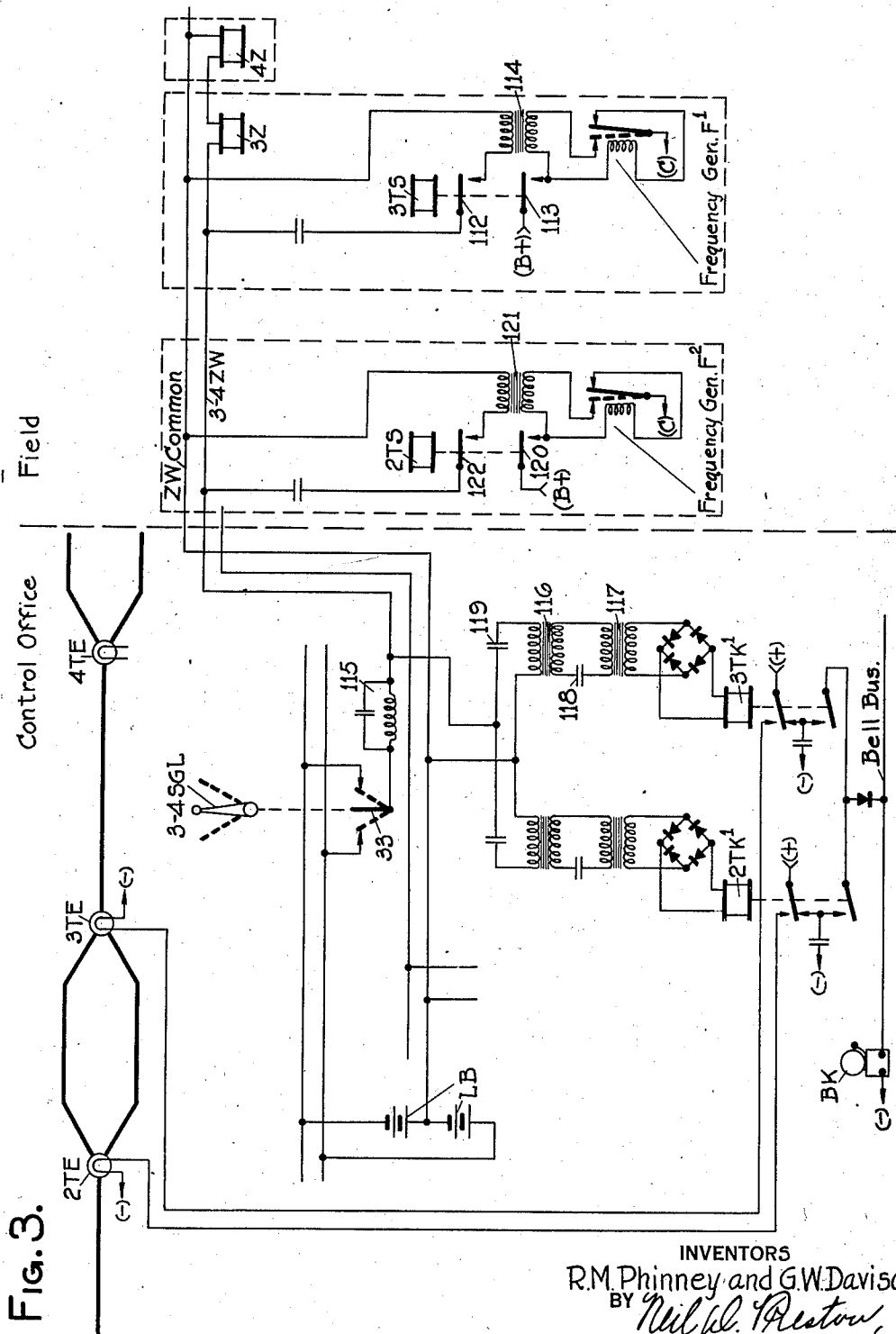
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CENTRALIZED TRAFFIC CONTROLLING SYSTEM FOR RAILROADS

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6 Sheets-Sheet 6



INVENTORS
R.M. Phinney and G.W. Davison
BY *Neil W. Preston,*
THEIR ATTORNEY

UNITED STATES PATENT OFFICE

2,355,327

CENTRALIZED TRAFFIC CONTROLLING
SYSTEM FOR RAILROADSRobert M. Phinney and Gordon W. Davison,
Rochester, N. Y., assignors to General Railway
Signal Company, Rochester, N. Y.

Application March 1, 1943, Serial No. 477,540

9 Claims. (Cl. 246—3)

This invention relates to centralized traffic controlling systems for railroads, and it more particularly pertains to systems in which signals are subject to direct line wire control from a remote control office.

In the conventional type of centralized traffic controlling systems, the signals and control apparatus at a track switch at the end of a stretch of double track, or at the end of a passing siding, constitute a field location or field station. The signals at each of the field locations are governed from a control office, either by one or more line circuits extending to that location, or by a coded line circuit extending to several locations. There are conditions encountered in practice where the number of field stations to be controlled is too small to warrant the expense of a coded line circuit system, but yet there are enough stations to render it impractical to provide a direct wire control line circuit for each of the stations. The present invention provides a centralized traffic controlling system at minimum cost that is particularly adapted to such conditions.

An object of the present invention is to minimize the cost of line wires and simplify the control machine at the control office in a centralized traffic controlling system by requiring only a single signal control lever and a single line circuit be provided for a pair of field locations, the field locations forming a pair being those at the opposite ends of a stretch of single track. The signals at the ends of the stretch of track are located according to standard centralized traffic control practice to form a short detector track section for the track switch, there being signals for governing traffic in both directions through that track section.

Another object of the present invention is to employ spring switches at the ends of the stretches of single track in such a manner as to facilitate the dispatching of trains in accordance with the grouping of the field locations without requiring the installation of power operated switch machines. By use of spring switches in the system, non-stop meeting of trains is made possible.

Another object of the present invention is to reduce to a minimum the manual controls required by making the entering signals automatic in their operation, there being manual means available, however, for putting such signals to stop. For the purpose of description of the present invention, the term "entering signal" is used in connection with a signal governing entrance to a stretch of double track, and the term "leaving signal" is used in connection with a signal

governing the leaving of a stretch of double track. The leaving signals are normally at stop, and they are subject to manual control for their clearing, while the entering signals are normally automatically controlled to display indications in accordance with the conditions of occupancy and of the signals for the blocks in advance thereof.

Other objects, purposes, and characteristic features of the present invention will be in part obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which parts having similar features and functions are designated throughout the several figures by like letter reference characters which are generally made distinctive by reason of preceding numerals characteristic of specific devices with which such parts are associated; and in which—

Figs. 1A, 1B, 1C and 1D when placed side by side respectively illustrate the general organization of this embodiment of the present invention comprising control office apparatus and circuits, and their association with apparatus and circuits in the field provided at the various field locations;

Fig. 2 illustrates in detail the circuits involved in the control of signals at a particular field location as typical of circuits provided for each of the field locations of the track layout illustrated in Figs. 1B, 1C and 1D; and

Fig. 3 illustrates a means for indicating track occupancy for the OS track sections at the opposite ends of a typical section of double track by means of tuned alternating current circuits superimposed upon signal control line wires extending from the control office to the field locations.

For the purpose of simplifying the description of the present invention, reference is made from time to time to functions common to all parts of a similar nature by use of the letter reference characters common to such parts without preceding numerals. It is to be understood that such reference applies to parts designated in the drawings by reference characters that are similar except for the numerals associated therewith.

The various parts and circuits constituting this embodiment of the present invention have been shown diagrammatically, and certain conventional illustrations have been employed for the purpose of simplifying the illustrations and facilitating in the explanation thereof, rather than for the purpose of illustrating the specific construction and arrangement of parts that would be em-

ployed in practice. The relays and their contacts are therefore illustrated in the conventional manner and symbols are used to illustrate the connection to terminals of batteries, or other sources of electric current, instead of showing all of the wiring connections to such terminals.

The symbols (+) and (−) are employed to indicate the respective positive and negative terminals of suitable batteries or other sources of direct current, and the circuits with which those symbols are used always have current flowing in the same direction. The symbols (B+) and (B−) indicate connections to the opposite terminals of a suitable battery or other direct current source which has a central or intermediate tap (C). The intermediate tap (C) of such source of energy is connected at each location to a common line wire designated as H common.

This embodiment of the present invention is applied to the governing of traffic from a control office through a track layout comprising stretches of single track spaced by stretches of double track which can be used for the meeting of trains. Although only a short and simple track layout has been chosen for this embodiment of the present invention, it is to be understood that the invention is applicable to practically any track layout of a similar general nature to be encountered in practice. It is believed that it will be readily apparent as the description of the invention progresses that the system as herein disclosed is of such a nature that by using this as a typical embodiment, those skilled in the art can readily adapt the system to most track layouts to be encountered in practice in connection with centralized traffic control.

The track switches employed at the ends of the sections of double track are spring switches in this embodiment of the present invention, arranged to be normally aligned for traffic to the right when a train enters a stretch of double track from a stretch of single track. It is desirable that the spring switches be provided with facing point locks. Spring switch control apparatus involving the provision of facing point locks can be provided, for example, as shown in the application of O. S. Field, Ser. No. 368,034, filed November 30, 1940. Each of the track switches has associated therewith a switch circuit controller SCC which has contacts used for circuit selection at the particular location of such track switch, and each of the track switches is provided with manually operable means for operating the track switch in order to make movements possible against the normal direction of traffic.

The signals employed in this embodiment of the present invention are of the searchlight type such as disclosed, for example, in the patent to O. S. Field, No. 1,835,150, dated December 8, 1931. It is to be understood that other types of signals such as semaphore signals, position light signals, or color light signals having individual color lamp units can be employed in accordance with the requirements of practice. The symbols for the signals as shown along the trackway of the track layout in Figs. 1A, 1B, 1C and 1D are to be considered as indicative of the signal aspects the various signals can display rather than being indicative of the particular type of signals employed.

A neutral polar relay Z is provided at each of the field locations for controlling the signals in accordance with the manual actuation of the signal control lever at the control office for the

corresponding field location. Each of the relays Z is normally deenergized, and is energized with a particular polarity for the clearing of signals for governing traffic to the right, and with the opposite polarity for the clearing of signals governing traffic to the left.

At each of the field locations there is a stop repeater relay M for each of the entering signals, and there is a relay M for the leaving signals (see Fig. 2). There is also a yellow-green repeater relay at each of the field locations for each direction of traffic.

A neutral relay JS is provided at each end of each stretch of double track, together with a push-button PB for use in connection with the movement of trains against the normal direction of traffic.

A neutral relay TS is provided at each of the field locations, and it is used in the communication of track indications to the control office. It is also used in connection with the provision of stick signal control. A flashing relay FL is used in connection with the provision of what is commonly known in practice as a "galloping circuit" for the communication of OS indications to the control office, the use of such relay making it possible to transmit the OS indications for the opposite ends of a stretch of double track to the control office over a single line circuit. Slow acting neutral indication relays TK are provided at the control office for the various OS sections for causing the illumination of the various indication lamps TE, and associated with such relays is a bell BK which is momentarily sounded upon the picking up of any track indication relay TK.

The line circuits in the field comprise line wires ZW common, 1—2ZW, 3—4ZW and 2—3TKW extending from the control office to location No. 2; line wires ZW common, 3—4ZW, H common, 24, 75, 125, 126, 98 and 3TKW extending between location No. 2 and location No. 3; and line wires ZW common, 3—4ZW1, H common, 42 and 65 extending between location No. 3 and location No. 4.

Having thus considered the general organization of the system, consideration will now be given to its mode of operation.

Operation

The conditions of the system that exist when the trackway is unoccupied and the signal control levers at the control office are in their stop positions, are hereinafter referred to as the normal conditions of the system. Under such conditions the leaving signals at the various field locations are at stop in accordance with the position of their respective signal control levers at the control office. The entering signal at each of the field locations for governing the normal direction of traffic through the stretch of double track in advance thereof, however, is normally at caution because the next signal in advance, which is usually the leaving signal for the opposite end of the stretch of double track, is normally at stop. The lower arm of each of the entering signals is normally at stop because it is used only for governing movements against the normal direction of traffic in the stretch of double track. In accordance with the normal position of the signal control lever SGL as illustrated in Fig. 1A, the line controlled relays Z for the various field locations are normally deenergized.

The automatic intermediate signals such as signals 4—3 and 3—4 (see Fig. 1D) are normally clear because the next signal in advance thereof,

which is an entering signal in each case, is at caution. The intermediate searchlight signals employed are energized directly over polarized line circuits having their polarities selected by yellow-green repeater relays YGP in a manner well-known to those familiar with the art.

To consider the mode of operation upon passage of a train, it will be assumed that an eastbound train is in approach of the entering signal 2A (see Fig. 1B). Inasmuch as it is to be assumed that the trackway in advance of the train is unoccupied, the signal 2A is at caution for governing passage of the train over the lower track of the stretch of double track through the track section 2—3T to the leaving signal 3C at the right-hand end of such track section. The signal 2A has its winding energized under such conditions with a polarity to cause it to display a yellow indication by the closure of a circuit extending from (B—), including back contact 20 of relay 3CYGP (see Fig. 1C), front contact 21 of relay 3BM, normally closed contact 22 of the thermal relay 3TH, winding of the approach lighting relay 3ER, normally closed contact 23 of the switch circuit controller 3SCC, line wire 24, front contact 25 of relay 2—3TR, back contact 26 of relay 2Z, normally closed contact 27 of the switch circuit controller 2SCC, front contact 28 of relay 2TR, winding of signal 2A, front contact 29 of relay 2BM, and front contact 30 of relay 2C—2DM, to (C). If in the circuit just described, the relay 2Z is picked up with its polar contacts operated to right-hand positions, because of the actuation of the signal control lever 1—2SGL at the control office to its right-hand position, the circuit just described will include polar contact 31 of relay 2Z in its right-hand position rather than the back contact 26 as employed when the relay 2Z is deenergized.

If the route were established farther in advance of the train so as to cause the signal 3C to indicate proceed, the relay 3CYGP would have been picked up, and the shifting of contact 20 would have been effective to cause the signal 2A to indicate clear by the energization of its circuit with the opposite polarity from that which has been described for causing that signal to indicate caution. The circuit for the control of relay 3CYGP is not shown, but it corresponds to the circuit shown in Fig. 2 for the energization of relay 2CYGP. Relay 2CYGP is energized when signal 2C is cleared by an obvious circuit closed at contact 60 in its right-hand position, and it is energized when signal 2C is at caution by a circuit extending from (+), including contact 60 of signal 2C in its vertical position, contact 61 of signal 2C in its left-hand position, and winding of relay 2CYGP, to (—).

The passage of the train past the signal 2A causes the dropping away of the track relay 2TR for the OS track section 2T, and the dropping away of such relay causes the signal 2A to display a stop indication by placing a shunt on the winding of the signal in an obvious manner upon the closure of back contact 28. The opening of front contact 28 causes the dropping away of the approach lighting relay 3ER for the leaving signal 3C (see Fig. 1C) at the right-hand end of the stretch of double track. The closure of a back contact of the relay 3ER is effective to cause the display of a signal indication upon the illumination of the lamp in the signal 3C and also the lamp of the signal 3D, in a manner corresponding to that shown in Fig. 2 for the illumination of the lamps of the signals 2C and 2D in accord-

ance with the closure of back contact 32 of the relay 2ER, which has a circuit similar to that described for the relay 3ER. It will be noted that the inclusion of front contact 25 of relay 2—3TR in the circuit for signal 2A, and in the circuit for relay 3ER provides that the conditions of those devices will remain as they have been described after the detector track section 2T has become unoccupied in the rear of the train, as long as the train occupies the track section 2—3T. Inasmuch as signal 2A is an automatic signal it will be restored to caution when the track section 2—3T becomes unoccupied in the rear of the eastbound train by the energization of a circuit which has been described when considering the normal conditions of the system.

Should it be desirable for the operator at the control office to hold the train at the leaving signal 3C, he can do so by failing to actuate the signal control lever 3—4SGL for the clearing of that leaving signal. It will be noted at this point that the making of the entering signal 4A (see Fig. 1D) an automatic signal, provides a means by which the operator can have distinctive control over the leaving signal 3C at location No. 3 (see Fig. 1C) without affecting signal 4A. That is, if a first train were in approach of the entering signal 4A, and it were desirable to hold a following train at the leaving signal 3C, it would be possible to do that because the signal control lever 3—4SGL would not be required to be actuated to its right-hand position for the clearing of the entering signal 4A for the first train. In this manner distinctive control is provided for each of the leaving signals, without affecting the entering signal at the opposite end of the stretch of single track involved.

To consider further progress of a train along the trackway, it will be assumed that the operator desires to cause the leaving signal 3C to be cleared for passage of the eastbound train into the stretch of single track.

The actuation of the lever 3—4SGL (see Fig. 1A) to its right-hand position causes the picking up of the relays 3Z and 4Z at the respective field locations 3 and 4. The line circuit closed for the energization of such relays extends from the positive terminal of the control office line battery LB including contact 33 of the signal control lever 3—4SGL in its right-hand position, line wire 3—4ZW, winding of relay 3Z (see Fig. 1C), line wire 3—4ZW1, winding of relay 4Z (see Fig. 1D), and common line wire ZW, to the center tap of the line battery LB (see Fig. 1A).

The picking up of relay 3Z at the right-hand end of the stretch of double track, under such conditions of energization, causes the polar contacts of such relay to be actuated to their right-hand positions, and the signal 3A is put to stop because of the opening of a circuit for such relay at contacts 34 and 35 of relay 3Z. After the signal 3A has been put to stop, the stop repeater relay 3AM is picked up by the energization of a circuit not shown but corresponding to the typical circuit shown in Fig. 2 for the energization of the relay 2AM. The circuit for relay 2AM extends from (+), including contact 36 of signal 2A and contact 37 of that signal closed in the position assumed when the winding 38 of the signal is deenergized, and winding of the relay 2AM, to (—).

Upon the picking up of the relay 3AM, a circuit is closed for the winding of signal 3C, if the trackway in advance of such signal is unoccupied by a train, extending from (B+), including front

contact 39 of relay 3—4YGP (see Fig. 1D), back contact 40 of relay 4—3S, front contact 41 of relay 4—3TR¹, line wire 42, front contact 43 of relay 4—3TR, front contact 44 of relay 3Z, polar contact 45 of relay 3Z in its right-hand position, front contact 46 of relay 3TS, normally closed contact 47 of the switch circuit controller 3SCC, front contact 48 of relay 3AM, front contact 49 of relay 3BM, back contact 50 of relay 3JS, and winding of signal 3C, to (C). The energization of signal 3C under such conditions causes that signal to display a green indication because of the polarity applied to the circuit by the yellow-green repeater relay 3—4YGP at the intermediate automatic signal location in advance. If relay 3—4YGP were dropped away because of the presence of an eastbound train in its block, the polarity applied by contact 39 to the circuit for signal 3C would be such as to cause signal 3C to display a caution indication.

It will be noted that the energization of the circuit for causing the signal 3C to indicate caution is dependent upon the stick relay 3—4S at the intermediate signal location. Such stick relay is of the type normally employed in absolute-permissive-block signalling systems, and it is picked up only upon the passage of an eastbound train. Thus, the condition whereby signal 3C can be energized with a polarity to cause that signal to display a caution indication is dependent upon the occupancy of the block in advance of signal 3—4 by an eastbound train. Under such conditions, the signal 3C can be energized, if the operator in the control office operates his signal control lever 3—4SGL to its right-hand position, by a circuit extending from (B—), including front contact 59 of relay 3—4S (see Fig. 1D), back contact 39 of relay 3—4YGP, back contact 40 of relay 3—4S, front contact 41 of relay 3—4TR¹, wire 42, front contact 43 of relay 4—3TR (see Fig. 1C), front contact 44 of relay 3Z, polar contact 45 of relay 3Z in its right-hand position, front contact 46 of relay 3TS, contact 47 of switch circuit controller 3SCC, front contact 48 of relay 3AM, front contact 49 of relay 3BM, back contact 50 of relay 3JS, and winding of signal 3C, to (C).

Upon the acceptance of signal 3C by an eastbound train, the dropping away of relay 3TR for the detector track section 3T causes a tumble-down through the stretch of single track between locations 3 and 4 according to usual practice in APB systems. That is, the dropping away of relay 3TR opens the circuit by which the signal 4—3 is normally energized to cause such signal to be conditioned for the display of a danger indication. The dropping away of the relay 3TR opens the circuit for signal 4—3 at front contact 61, the circuit being normally energized from (B+), including front contact 62 of relay 3AYGP (see Fig. 1C), front contact 61 of relay 3TR, front contact 63 of relay 3C—3DM, front contact 64 of relay 4—3TR, wire 65, front contact 66 of relay 4—3TR¹, and winding of signal 4—3, to (C). The deenergization of signal 4—3 is effective to cause the dropping away of its yellow-green repeater relay 4—3YGP in the usual manner, and the dropping away of that relay is effective, by the opening of front contact 67, to remove energy from the circuit for the control of signals 4C and 4D to prevent the clearing of either of such signals if an operator at the control office should inadvertently actuate the signal control lever 3—4SGL to its left-hand position at a time when an eastbound train is occupying the stretch of

single track between locations 3 and 4. Although the circuits have not been shown in detail for the control of signals 4C and 4D, it is to be understood that such signals are controlled in a manner comparable to that which has been described for the control of the opposing signal 3C at location No. 3.

The dropping away of relay 3TR upon the passage of the eastbound train into the detector track section 3T is effective to cause the dropping away of the relay 3TS by opening an obvious stick circuit by which the relay 3TS is normally energized at front contact 63. The dropping away of relay 3TS by the shifting of contact 46 deenergizes and applies a shunt to the winding of signal 3C to cause that signal to be put to stop. Signal 3C will be maintained at stop until the relay 3TS is again picked up; and, as a means for providing stick signal control, the relay 3TS cannot be picked up after the track section 3T has become unoccupied by the train until the operator at the control office has restored his signal control lever 3—4SGL to its center position to allow the dropping away of the relay 3Z. The dropping away of relay 3Z opens the circuit for signal 3C at front contact 44 to cause that signal to be maintained at stop after the relay 3TS is restored to its normally energized position.

Assuming the operator at the control office to have restored the lever 3—4SGL to its center position after receiving an indication that the eastbound train has entered the OS track section 3T, the dropping away of the relay 3Z is effective to close a circuit by which the relay 3TS can be picked up when the detector track section 3T becomes unoccupied. Such circuit extends from (B+), including front contact 68 of relay 3TR, winding of relay 3TS, and back contact 69 of relay 3Z, to (C). The picking up of that relay closes a stick circuit at front contact 70 to shunt back contact 69 out of the circuit just described, thereby providing that the relay 3TS will be maintained picked up subsequent to the picking up of the relay 3Z when the operator at the control office next actuates the signal control lever 3—4SGL to a signal clearing position. Upon consideration of the circuit that has been described for the signal 3C, it will be noted that such signal can be caused to indicate caution for the passage of a following train, only after the first train has vacated the respective track sections included in the block in advance of that signal.

Inasmuch as the track switch 3W is a spring switch, it is not necessary for the eastbound train to stop at the switch. If the switch has a facing point lock such as is disclosed in the above mentioned application of O. S. Field, Ser. No. 368,034, filed November 30, 1940, the switch is mechanically unlocked by the springing of the rails as the train proceeds through the trailing switch.

The entrance of the eastbound train into the track section 4—3T¹ is effective to cause the approach lighting of signal 3—4 by the closure of an obvious circuit at back contact 71 for the lamp of such signal. Although the complete circuit for the signal 3—4 is not shown, inasmuch as the present system is symmetrical for both directions of train operation, it is to be understood that such circuit is comparable to the circuit which has been described for the energization of the intermediate signal 4—3 which is used in governing the opposite direction of traffic. The approach of the eastbound train to signals 4A and 4B completes the consideration

of the passage of a train through a typical portion of the trackway for which the system is provided. That is, the control of signals 4A and 4B is comparable to the control of signals 2A and 2B which are specifically considered as typical of entering signals provided at various other locations in the track layout.

Movements against the normal direction of traffic.—There are certain conditions encountered in practice requiring movements against the normal direction of traffic in a section of double track. Such conditions can be, for example, when one train is to pass another train proceeding in the same direction, or when a worktrain is to get into the clear to allow the passage of a train in one direction or another.

The passing of trains proceeding in the same direction can be accomplished in either of two ways. The first train to approach the double track stretch can enter in the normal direction of traffic, and the following train can pass against the normal direction of traffic; or, the first train can enter against the normal direction of traffic and the second train can pass in the normal direction of traffic. The system provides means by which an operator at the control office can have control over train movements to govern the passing of trains in either of these two ways.

Assuming that a first eastbound train has proceeded in the normal direction of traffic so as to occupy the track section 2—3T in a manner which has been described, the signal 2A is at stop because of the opening of its circuit at front contact 25 of the track relay 2—3TR, and the second train in approaching signal 2A will be required to stop at such signal. Under such conditions the procedure is for a trainman to call the operator by use of a telephone at location No. 2 and receive instructions as to whether the second train should proceed against the normal direction of traffic in the double track section or it should wait and follow the first train. If the trainman is instructed to reverse the track switch 2W, and proceed against the normal direction of traffic, he proceeds to operate the track switch by hand to its reverse position, and such operation is effective by the opening of contact 72 of switch circuit controller 2SCC in the circuit for relay 2ER and signal 3A at location No. 3 to cause that signal to be put to stop, and to cause the relay 2ER to be dropped away to provide for the illumination of the lamps of signals 2C and 2D at location No. 2.

The deenergization of signal 3A is effective to cause the picking up of its stop repeater relay 3AM, and the picking up of that relay is effective to cause the energization of the relay 2BH at location No. 2. The relay 2BH is energized by a circuit extending from (B+), including front contact 73 of relay 3AM (see Fig. 1C), front contact 74 of relay 3—2TR, wire 75, contact 76 of switch circuit controller 2SCC (see Fig. 1B) closed in its reverse position, and winding of relay 2BH, to (C). Upon the picking up of the relay 2BH, a circuit is closed for the winding of the thermal relay 2TH extending from (B+), including front contact 77 of relay 2TS, front contact 78 of relay 2AM, front contact 79 of relay 2BH, winding of thermal relay 2TH, and front contact 80 of relay 2BM, to (C). It will be readily apparent that the heating of the thermal relay 2TH can become effective only if the track section 3—2T is unoccupied by a train and only if the opposing signal 3A is at stop; and not only must these conditions be fulfilled before the signal 2B can in-

dicade proceed, but the signal 2B can indicate proceed only after the thermal relay 2TH has had time to operate. Such time is provided in order that an opposing train which may have been approaching the signal 3A at the time it was put to stop would have had time to be brought to a stop in the rear of signal 3A, or have had time to overrun such signal and cause the dropping away of the relay 3—2TR to open the circuit for relay 2BH at front contact 74. Thus, the winding of signal 2B becomes energized so as to cause the display of a yellow indication after the thermal relay 2TH has had time to operate, if the line control relay 2BH is continued to be energized. The circuit by which the winding of signal 2B is energized under such conditions extends from (B+), including front contact 77 of relay 2TS, front contact 78 of relay 2AM, front contact 79 of relay 2BH, contact 81 of thermal relay 2TH, winding of signal 2B, and front contact 82 of relay 2C—2DM, to (C). The energization of signal 2B causes the dropping away of the stop repeater relay 2BM for such signal by the opening of its circuit at contact 83 (see Fig. 2), and the dropping away of such relay, by the closure of back contact 84, shunts contact 81 of thermal relay 2TH out of the circuit just described for the energization of the winding of signal 2B. It will be noted that the dropping away of relay 2BM causes the cooling of the thermal relay 2TH by opening the circuit for the winding of that relay at front contact 80.

When the eastbound train accepts the signal 2B, the dropping away of the track relay 2TR causes the dropping away of relay 2TS by opening its circuit at front contact 90. The stick circuit by which the relay 2TS is normally energized extends from (B+), including front contact 90 of relay 2TR, winding of relay 2TS, and front contact 91 of relay 2TS, to (C). The relay 2TS, by the inclusion of back contact 92 of relay 2Z in its pickup circuit, is effective to provide stick signal control for signal 2C in a manner similar to that which has been described in connection with the control of signal 3C.

After the train has passed the track switch 2W, such track switch is restored to its normal position by a trainman, and the conditions are again established whereby the signal 2A can be automatically cleared, dependent upon the block in advance of the signal, in a manner which has been described.

To consider further progress of the train against the normal direction of traffic, it will be assumed that it is desired to have such train proceed in the stretch of single track between location No. 3 and location No. 4. Before signal 3D can be controlled to display a proceed indication for the passage of the train against the normal direction of traffic, the trainman must communicate by telephone with the operator at the control office and receive instructions with respect to the train movement. If the operator desires to allow the passage of the train into the stretch of single track between location No. 3 and location No. 4, he instructs the trainman to depress the push-button 3PB which is located along with the telephone at location No. 3; and the operator at the control office must actuate the signal control lever 3—4SGL from its center to its right-hand position at a time when the trainman is holding the push-button 3PB at location No. 3 in its depressed position. By this arrangement, the movement against the normal direction of traffic into the stretch of

single track between the location No. 3 and the location No. 4 can be made only upon the cooperation of the trainman and the operator at the control office, thus eliminating the possibility of any misunderstanding.

The depression of the button 3PB, when the relay 3Z is dropped away, causes the picking up of the relay 3JS for selecting between signals 3C and 3D. The relay 3JS is picked up under such conditions by the energization of a circuit extending from (B+), including contact 93 of button 3PB in its depressed position, upper winding of relay 3JS, and back contact 94 of relay 3Z, to (C). When the operator at the control office actuates the signal control lever 3-4SGL to its right-hand position, while the relay 3JS is maintained picked up because of the closure of contact 93 of push-button 3PB, the picking up of relay 3Z opens the pick-up circuit that has just been described for the relay 3JS at back contact 94, and closes a stick circuit to maintain that relay picked up until passage of the train. Relay 3JS is sufficiently slow acting to be maintained picked up during the shifting of contact 94 of relay 3Z to establish its stick circuit. Such stick circuit extends from (B+), including front contact 95 of relay 3TR, front contact 96 of relay 3JS, lower winding of relay 3JS, and front contact 94 of relay 3Z, to (C). It will be noted that the inclusion of front contact 95 of relay 3TR in that circuit provides that the relay 3JS can be dropped away upon entrance of a train into the track section 3T, and the inclusion of front contact 94 of relay 3Z in that circuit provides that the operator at the control office can cause the dropping away of relay 3JS by restoring the signal control lever 3-4SGL to its center position.

With the relay 3JS picked up, and assuming the stretch of track between location No. 3 and location No. 4 to be unoccupied, a circuit is closed to cause the signal 3D to indicate caution. Such circuit extends from (B+), including front contact 39 of relay 3-4YGP, back contact 40 of relay 4-3S, front contact 41 of relay 4-3TR¹, wire 42, front contact 43 of relay 4-3TR, front contact 44 of relay 3Z, polar contact 45 of relay 3Z in its right-hand position, front contact 46 of relay 3TS, contact 47 of switch circuit controller 3SCC, front contact 48 of relay 3AM, front contact 49 of relay 3BM, front contact 50 of relay 3JS, and winding of signal 3D, to (C). Upon the acceptance of signal 3D by the train, the dropping away of relay 3TR is effective to cause the dropping away of relay 3JS in a manner which has been described. The dropping away of relay 3TS, because of the opening of its circuit at front contact 68 of relay 3TR, applies a shunt to the winding of signal 3C to cause such signal to indicate stop. The signal 3D is caused to indicate stop by the opening of its circuit at front contact 50 of relay 3JS.

In order to facilitate the movement of trains, it is provided that the leaving signal governing a movement against the normal direction of traffic, such as the signal 3D, can be caused to clear by the actuation of the push-button PB at the opposite end of the stretch of double track when a trainman receives instructions at that point to enter such stretch against the normal direction of traffic. That is, for example, to consider the specific condition that has been described, at the time the trainman called the operator at location No. 2 to receive permission to reverse the track switch 2W and proceed against the normal di-

rection of traffic, he could have depressed the push-button 2PB (see Fig. 1B), and, by the operator's cooperation in the actuation of the signal control lever 3-4SGL from its center to its right-hand position when the button 2PB was depressed, cause the picking up of the relay 3JS (see Fig. 1C), and the subsequent control of the signal 3D to indicate caution. By this procedure, the train would not be required to stop at location No. 3 because the signal 3D would be conditioned for passage of the train, without requiring the actuation of the push-button 3PB. The relay 3JS could be picked up under such conditions by the energization of a pick-up circuit extending from (B+), including contact 97 of push-button 2PB (see Fig. 1B) in its depressed position, line wire 98, upper winding of relay 3JS (see Fig. 1C), and back contact 94 of relay 3Z, to (C). It will be readily apparent that the picking up of relay 3JS in this manner would be effective to cause the energization of circuits which have been described by which the signal 3D can be energized so as to indicate caution.

It will be noted that although each of the entering signals is automatic and thus is normally at caution, such signal can be put to stop at the will of an operator if he wishes to stop a train at that signal. He can do this by operating the control lever belonging to that signal to a position for clearing the opposing signal. For example, signal 2A can be put to stop by the actuation of the lever 1-2SGL to its left-hand position. By such operation the relays 1Z and 2Z are energized with a polarity to operate their polar contacts to their left-hand positions thus opening the circuit for signal 2A at back contact 26 and polar contact 31 (see Fig. 1B) to cause signal 2A to indicate danger. The lamp in signal 2A is illuminated upon the approach of a train by the closure of back contact 123 of relay 1-2TR (see Fig. 2). The circuit by which the relays 1Z and 2Z are energized under such conditions extends from the negative terminal of line battery LB (see Fig. 1A) including contact 124 of lever 1-2SGL in its left-hand position, winding of relay 1Z, line wire 1-2ZW, winding of relay 2Z, and common wire ZW to the center terminal of line battery LB.

It is believed to be apparent from the mode of operation as it has been described for certain typical train movements for a particular direction of traffic that a similar mode of operation is effected under similar traffic conditions for the opposite direction of traffic, as the system is symmetrical in the provision of apparatus and in its circuit organization for both directions of traffic. It will therefore be readily understood that the meeting of trains can be accomplished with the trains proceeding in the normal directions of traffic through the double track portions of the track layout with a minimum amount of delay, it being entirely possible to provide train meets in some cases without either train being required to stop.

Indications.—In order that an operator may be informed of the passage of a train through each of the detector track sections, the occupancy of each of such sections is indicated by the illumination of a corresponding indicator lamp TE on the track diagram at the control office. Although various means for transmitting the indications from the respective field locations to the control office can be employed, in the embodiment of the present invention shown in Figs. 1A through 1D, the indications are grouped

in pairs and transmitted over a single line circuit for each group, one indication line wire being used in combination with the control common wire ZW for each group.

As a typical example of how indications are communicated from a pair of field locations to the control office, the circuits have been shown in detail for indicating the occupancy of the detector track sections at field location No. 2 and at field location No. 3, such indications being transmitted over line wire 2—3TKW extending from the control office to field location No. 2.

To consider specifically the manner in which the indications are transmitted, it will be assumed that the track section 3T has become occupied by a train so as to cause the dropping away of the track relay 3TR (see Fig. 1C). The dropping away of that relay causes the dropping away of the relay 3TS by opening the circuit for such relay at front contact 63. The dropping away of relay 3TS connects the center terminal C of the battery at location No. 3 to the common wire ZW upon the closure of back contact 99 and the indication relay 3TK at the control office becomes energized by a circuit extending from (B+), including back contact 100 of relay 3TS, line wire 3TKW, front contact 101 of relay 2TS, (see Fig. 1B), back contact 102 of the flashing relay FL, line wire 2—3TKW, asymmetric device 103 (see Fig. 1A), winding of relay 3TK, common wire ZW, and back contact 99 of relay 3TS, to (C).

The picking up of relay 3TK at the control office applies energy to an obvious circuit for lamp 3TE at front contact 104. The picking up of relay 3TK opens an obvious circuit which has been closed at back contact 104 for charging the condenser 105, and the closure of front contact 106 is effective to close a shunt circuit across the condenser 105, including the winding of the bell BK, so as to cause a single stroke of such bell. The shunt circuit involved in energizing the bell extends from (—), including condenser 105, front contact 106 of relay 3TK, asymmetric device 107, and winding of bell BK, to (—). The inclusion of the asymmetric device 107 in the circuit prevents an oscillation to insure the sounding of only a single stroke of the bell.

If the track sections 2T and 3T become occupied contemporaneously, the flashing relay FL becomes active. The flashing relay FL is energized under such conditions by a circuit extending from (B+), including back contact 100 of relay 3TS (see Fig. 1C), line wire 3TKW, back contact 103 of relay 2TS (see Fig. 1B), winding of relay FL, back contact 109 of relay FL, common line wire ZW, and back contact 99 of relay 3TS, to (C). When the back contact 102 of relay FL is closed, and the relay 2TS is dropped away, the line circuit including line wire 2—3TKW is energized with a negative polarity to cause the picking up of the relay 2TK. The circuit by which the relay 2TK is energized under such conditions extends from (B—), including back contact 101 of relay 2TS (see Fig. 1B), back contact 102 of the flashing relay FL, line wire 2—3TKW, asymmetric device 110 (see Fig. 1A), winding of relay 2TK, common line wire ZW, and back contact 111 of relay 2TS, to (C). It will be noted that such circuit is closed steadily if the relay 2TS is dropped away and the relay 3TS at location No. 3 is picked up; but when the relay 3TS is also dropped away, the flashing relay FL is energized by a circuit which has been described,

and the circuit for relay 2TK is only intermittently energized, such relay having sufficiently slow drop-away characteristics to cause it to be maintained steadily picked up. It will be readily apparent that the relay 2TK causes the energization of the lamp 2TE and the sounding of the bell BX in a manner similar to that which has been described for the control of the lamp 3TE and the bell BK by relay 3TK.

During the times when the flashing relay FL is picked up, the relay 3TK is energized by a circuit extending from (B+), including front contact 102 of the flashing relay FL, line wire 2—3TKW, asymmetric device 103, winding of relay 3TK, common line wire ZW, and back contact 111 of relay 2TS, to (C), the relay 3TK having slow drop-away characteristics to cause it to be maintained steadily picked up as long as the flashing relay FL at field location No. 2 is active. It will be noted from the circuits which have just been considered that the indicator lamps are maintained energized until the respective relays TS that have caused their energization are restored. Inasmuch as such relays can be restored only after the operator has restored the signal control levers SGL associated with those locations to their center positions, the indicator lamps for the respective track sections will be maintained illuminated until the necessary action is taken on the part of the operator to cause the relays TS responsible for their illumination to be restored to their normally energized positions.

Another means for transmitting the indications to the control office is illustrated in Fig. 3. The circuits shown in this figure illustrate as a typical example how the indications can be transmitted by superimposing alternating current upon the line wires used in the control of the relays 3Z and 4Z. By this arrangement, no extra line wires are required for the transmission of the indications to the control office.

The indicating system shown in Fig. 3 provides that the dropping away of the relay 3TS is effective by the closure of back contacts 112 and 113 to energize the line circuit for the control of relays 3Z and 4Z with a frequency produced by a frequency generator or inverter F¹ of a suitable nature. The closure of back contact 113 of relay 3TS is effective to cause energization of the winding of the frequency generator F¹ in an obvious manner to cause the energization of the line circuit through the transformer 114 with an alternating current of the particular frequency generated. The frequency generated is sufficiently high as not to affect the operation of the relays 3Z and 4Z, and the alternating current is blocked from flowing through the line battery at the control office by a suitable filter 115.

At the control office the relay 3TK¹ is responsive to the energization of the line circuit including line wire 3—4ZW by an alternating current only if such current is of the frequency generated by the frequency generator F¹ because of its energization through the medium of a tuned circuit including transformers 116 and 117 and the condenser 118. The condenser 119 serves as a blocking condenser to prevent the flow of current from the direct current source through the primary winding of the transformer 116 when the line circuit is energized for the control of the relays 3Z and 4Z.

The dropping away of the relay 2TS in response to the occupancy of the track section 2T at field location No. 2 is effective to cause the energization of the line circuit including line wire 3—4ZW

with alternating current of a frequency distinctive from the frequency generated in response to the dropping away of the relay 3TS. Such frequency is produced by the frequency generator F² upon the closure of back contact 120, and is supplied to the line circuit through the transformer 121 in accordance with the closure of back contact 122 of relay 2TS. The reception at the control office of the alternating current at such frequency is effective to cause the picking up of the relay 2TK¹ through a circuit tuned to that frequency in a manner similar to that which has been described for the energization of the relay 3TK¹ upon the reception of the alternating current at the frequency generated by the frequency generator F¹ at field location No. 3.

The circuits by which the lamps 2TE and 3TE are energized, and the manner in which the bell is sounded upon the reception of the respective indications corresponds to that which has been described with respect to the operation of the relays 2TK and 3TK shown in Fig. 1A.

Having described a centralized traffic controlling system for a particular stretch of trackway as one specific embodiment of the present invention, it is desired to be understood that this form is selected to facilitate in the disclosure of the invention rather than to limit the number of forms which the invention may assume; and it is to be further understood that various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention except as limited by the appending claims.

What we claim is:

1. In a centralized traffic controlling system for railroads for a stretch of single track having signals at each end thereof for governing traffic in both directions, a signal control lever at a control office having respective first and second and neutral positions, a line circuit extending from the control office to the signals at the respective ends of said stretch of track, signal control means including said line circuit for causing the signal at one end of said stretch for governing traffic out of said stretch to indicate proceed when and only when said signal control lever is in either said neutral or said first position, signal control means including said line circuit for causing the signal at the opposite end of said stretch for governing traffic out of said stretch to indicate proceed when and only when said signal control lever is in either said neutral or said second position, signal control means including said line circuit for causing the signal at said one end of said stretch for governing traffic into said stretch to indicate proceed only when said signal control lever is in said second position, signal control means including said line circuit for causing the signal at said opposite end of said stretch for governing traffic into said stretch to indicate proceed only when said signal control lever is in said first position, and means acting to prevent each signal control means from causing its associated signal to indicate proceed if the trackway immediately in advance of such signal is occupied by a train.

2. In a centralized traffic controlling system of the character described for a stretch of track having a signal at each end for governing entrance thereto, a signal control lever at a control office having a neutral position and respective first and second signal clearing positions, a line

circuit extending from the control office to the ends of said stretch, a self-restoring manually operable contactor at each end of said stretch having a contact closed only while such contactor is manually actuated, circuit means including said line circuit for causing said signal at one end of said stretch to clear when and only when said control lever at the control office is actuated from said neutral position to said first signal clearing position at a time when said contactor at that signal is manually maintained in its actuated position, circuit means including said line circuit for causing said signal at the opposite end of said stretch to clear when and only when said control lever at the control office is actuated from said neutral position to said second signal clearing position at a time when said contactor at that end of the stretch is manually maintained in its actuated position, and means acting on the circuit means for each signal to prevent the clearing of that signal if the trackway immediately in advance of such signal is occupied by a train.

3. In a centralized traffic controlling system for railroads for a stretch of double track having a signal at each end thereof for governing traffic out of such stretch against the normal direction of traffic, a manually operable signal control lever at a control office for each of said signals having distinctive neutral and signal clearing positions, a self-restoring manually operable contactor at each end of said stretch having a contact closed only while such contactor is manually actuated, a line circuit extending from the control office to each end of said stretch, circuit means including said line circuit for causing said signal at each end of said stretch to clear when and only when said signal control lever at the control office for that end is actuated from its neutral to its signal clearing position at a time when said contactor at either end of said stretch is manually maintained in its actuated position, and means for preventing each signal from being controlled to a clear indication by its associated circuit means if the trackway immediately in advance of such signal is occupied by a train.

4. In a centralized traffic controlling system for railroads for a stretch of double track having a track switch at each end connecting the double track to single track portions, a signal at each end of said double track stretch governing train movements over the track switch at that end to the adjoining single track portion, a signal control lever at a control office for each of said signals having distinctive signal stop and signal clearing positions, a self-restoring manually actuated contactor at each end of said double track stretch, a line circuit extending from the control office to each end of said double track stretch, circuit means for each signal including its associated line circuit for allowing that signal to indicate proceed only in response to the actuation of said control lever at the control office for that signal from said stop to said signal clearing position at a time when said manually actuated contactor at either end of said double track is manually maintained in its actuated position, means acting on said circuit means for each of said signals to prevent that signal from indicating proceed if the trackway immediately in advance of such signal is occupied, and means effective upon the acceptance of either of said signals by a train to allow such signal to indicate proceed again only after said lever at the control office for that signal has first been actuated to its stop position.

5. In a centralized traffic controlling system of the character described for a stretch of double track connected at each end to a portion of single track by a hand-throw switch normally aligned for traffic to the right through such double track stretch, a signal at each end of said stretch for governing entrance to that stretch in the normal direction of traffic, a signal at each end of said stretch for governing entrance to that stretch against the normal direction of traffic, a signal control lever at a distant control office for each end of said stretch having distinctive stop and signal clearing positions, signal control means for causing the signal at each end of said stretch for governing traffic in the normal direction through said double track stretch to clear in accordance with the unoccupied condition of the trackway in advance thereof, and signal control means for causing said signal at each end of said stretch for governing entrance to that stretch against the normal direction of traffic to clear only when said signal control contactor at the control office for that end of said stretch is actuated to its signal clearing position, such means being effective to clear that signal only after the track switch at that end has been in its reverse position for a predetermined length of time.

6. In a centralized traffic controlling system for railroads for a stretch of track having a signal at each end for governing entrance thereto, a signal control lever at a control office having a neutral position and respective first and second signal clearing positions, a line circuit extending from the control office to both ends of said stretch, a self-restoring manually operable contactor at each end of said stretch having a contact closed only while such contactor is manually actuated, circuit means including said line circuit for causing said signal at one end of said stretch to clear when and only when said control lever at the control office is actuated from its neutral position to its first signal clearing position at a time when said contactor at that signal is manually maintained in its actuated position, circuit means including said line circuit for causing said signal at the opposite end of said stretch to clear when and only when said control lever at the control office is actuated from its neutral position to its second signal clearing position at a time when said contactor at that end of the stretch is manually maintained in its actuated position, means acting on each of said circuit means to prevent either signal from indicating proceed if the trackway immediately in advance of such signal is occupied, and means effective upon the acceptance of either of said signals by a train to allow such signal to clear only after said lever at the control office for that signal has first been actuated to its stop position.

7. In a centralized traffic controlling system for railroads for a stretch of single track having signals at each end thereof for governing traffic into said stretch, a signal control lever at a control office having a neutral position and respective first and second signal clearing positions, a neutral polar relay at each end of said stretch, a single line circuit connecting the control office and the respective ends of said stretch for controlling the neutral polar relay at both ends of the stretch, means for energizing said line circuit at the control office with one polarity when said signal control lever is actuated to said first position, means for energizing said line circuit with the opposite polarity when said signal control lever is actuated to said second position,

means for deenergizing said line circuit when said signal control lever is actuated to said neutral position, signal control means at one end of said stretch for causing the signals governing the entrance of traffic at that end to indicate proceed only when said neutral polar relay at that end is energized with the said one polarity, signal control means at the other end of said stretch for causing the signals governing the entrance of traffic at that end in the opposite direction to indicate proceed only when said neutral polar relay at that end is energized with said opposite polarity, means governing both of said signal control means to prevent the clearing of their respective signals if the trackway immediately in advance of such signal is occupied, and means associated with said signals at opposite ends of said stretch effective upon the acceptance of a signal at either end of said stretch by a train to allow such signal to indicate proceed for a following train only after said neutral polar relay for that end has first been deenergized and then reenergized with the appropriate polarity.

8. In a centralized traffic controlling system for a single track railroad having successive stretches of double track connected by a stretch of single track with signals governing the entrance of traffic into each single track stretch for each direction of traffic, a single signal control lever of the three-position type for each stretch of single track, a neutral polar relay at both ends of each single track stretch, a single line circuit connecting in series said relays for each single track stretch to the corresponding signal control lever in the control office, means for energizing each line circuit with one polarity or the other when its associated signal lever is operated to one or the other of two operated positions and for deenergizing that line circuit when such lever is in a non-operated position, and signal control means associated with each of said single track stretches and governed by the respective neutral polar relay for the opposite ends of that stretch to effect the clearing of the signal for one direction of traffic when the corresponding line circuit is energized with one polarity and to effect the clearing of the signal for the opposite direction of traffic when such line circuit is energized with the opposite polarity but holding such signals at stop when such line circuit is deenergized, said signal control means associated with each stretch of single track acting to prevent the clearing of a signal governing the entrance of traffic into the stretch if a train occupies that stretch immediately in advance of such signal.

9. In a centralized traffic controlling system for a single track railroad having successive stretches of double track connected by stretches of single track with suitable track switches normally positioned for the movement of traffic out of the stretches of single track into the opposite ends of a stretch of double track in such a manner as to permit the passing of opposing trains to the right of each other, entering and leaving signals at each end of each double track stretch for governing traffic into and out of said double track stretch respectively, a single signal control lever for each stretch of single track, a polarized signal control relay for each end of each stretch of single track, a single line circuit associated with each single track stretch for connecting in series said relays for the opposite ends of that single track stretch to the corresponding signal control lever in the control office, means for energizing each line circuit with one polarity or the

other when its associated signal control lever is operated to one or the other of two operated positions and for deenergizing that line circuit when such lever is in a non-operated position, signal control means associated with each single track stretch for clearing a leaving signal governing the entrance of traffic into such single track stretch at one end or the other when the associated signal control relays are energized with said one or said other polarities respectively 10 providing said stretch is not occupied by a train immediately in advance of the selected signal,

and other signal control means associated with each double track stretch for normally clearing each entering signal to allow traffic to proceed through the double track stretch to the next leaving signal, said other signal control means acting on said first signal control means to restore an entering signal to stop when the associated signal control relay is energized with the polarity required for clearing the opposing leaving signal.

ROBERT M. PHINNEY.
GORDON W. DAVISON.