

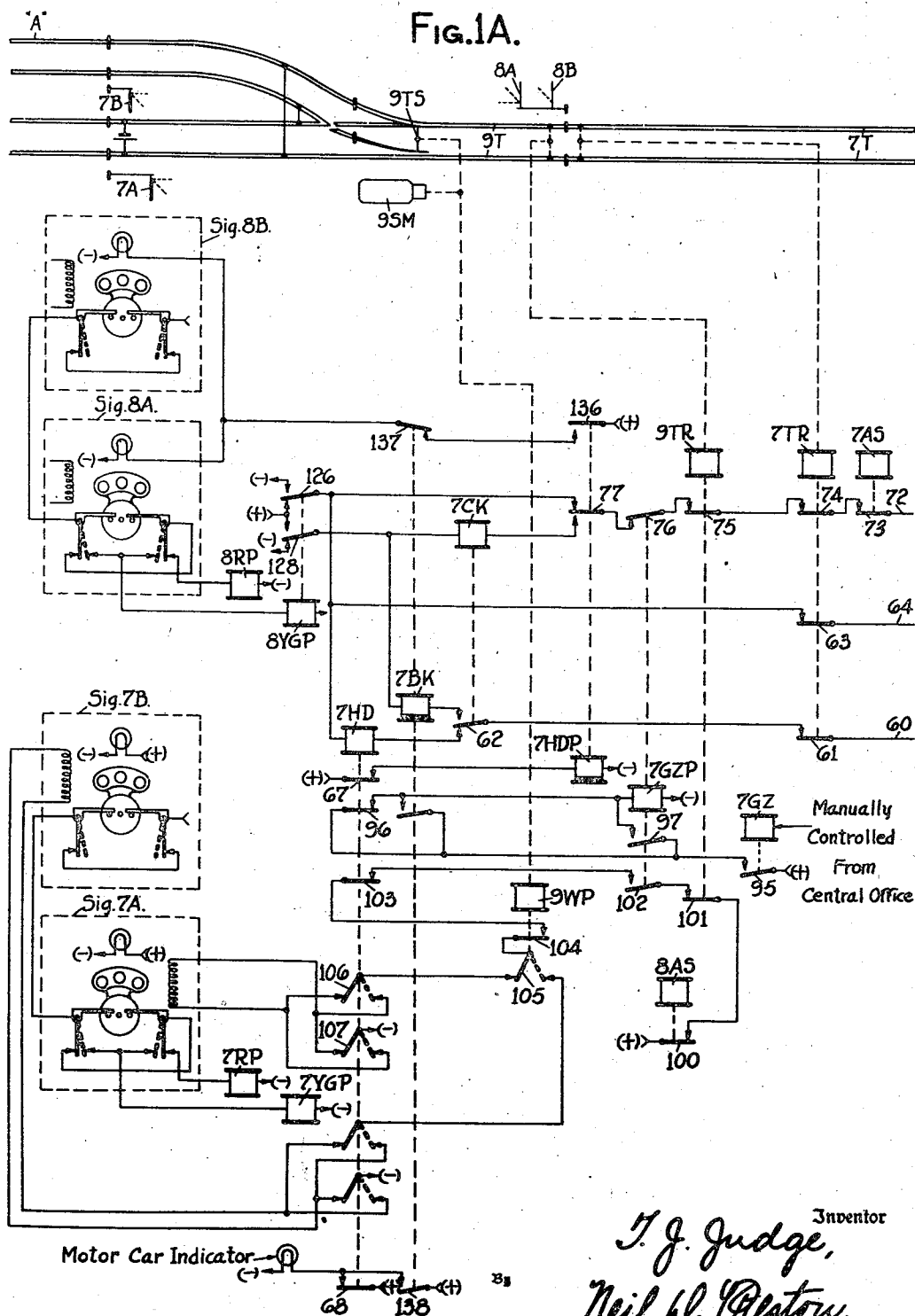
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SIGNALING SYSTEM FOR RAILROADS

Filed May 1, 1944

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FIG.1A.



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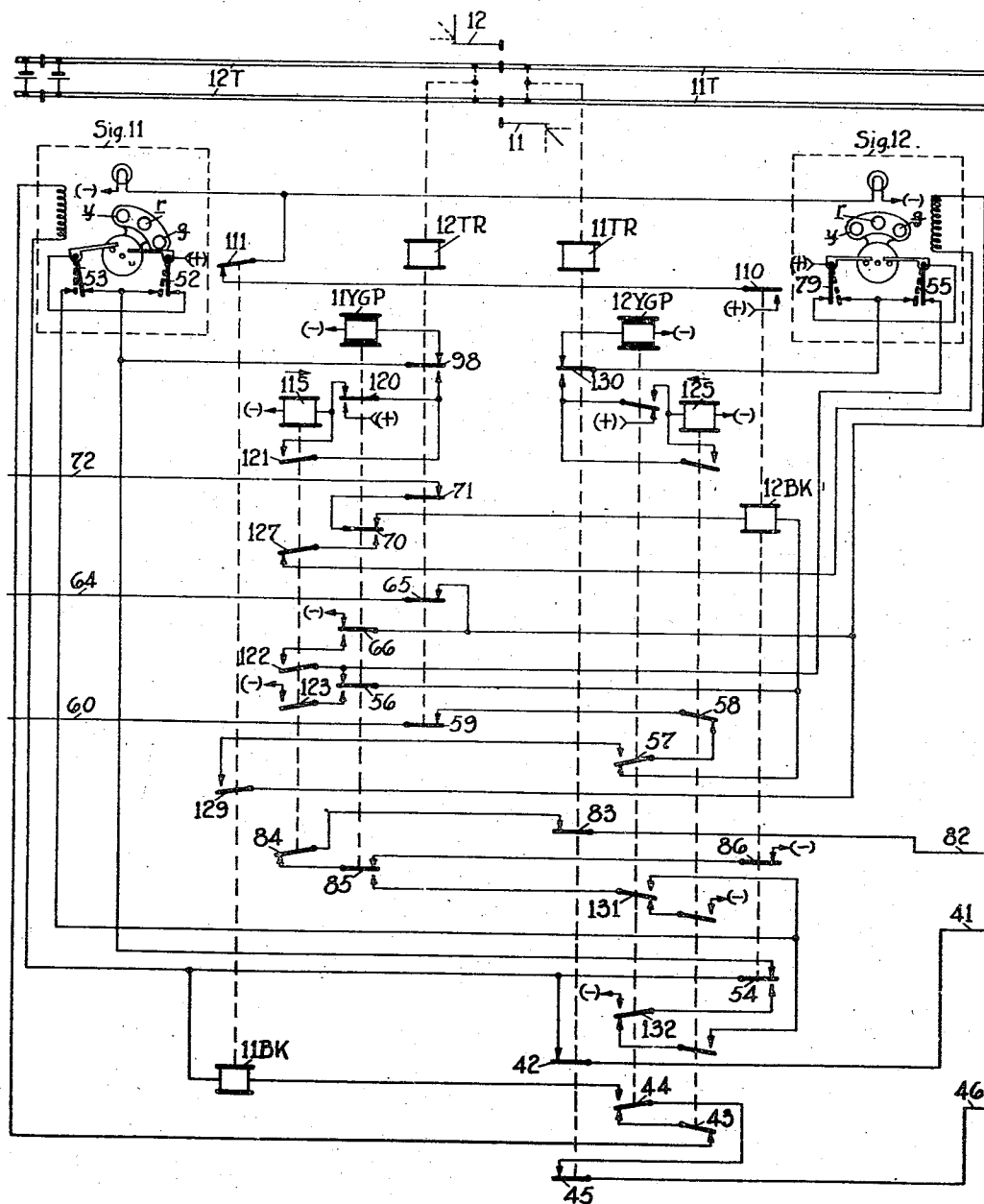
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SIGNALING SYSTEM FOR RAILROADS

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FIG. 1B.



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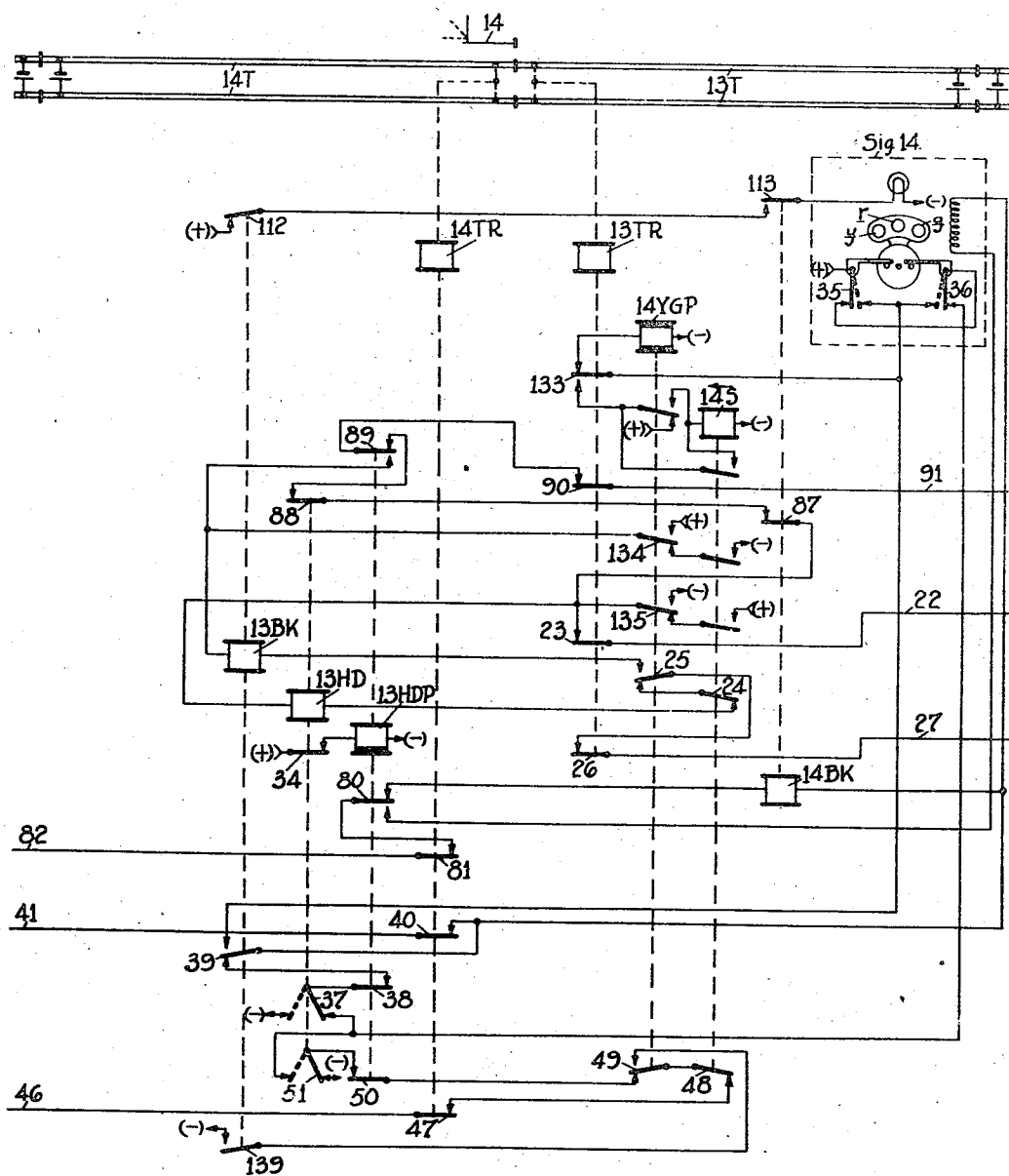
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SIGNALING SYSTEM FOR RAILROADS

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Fig. 1C.



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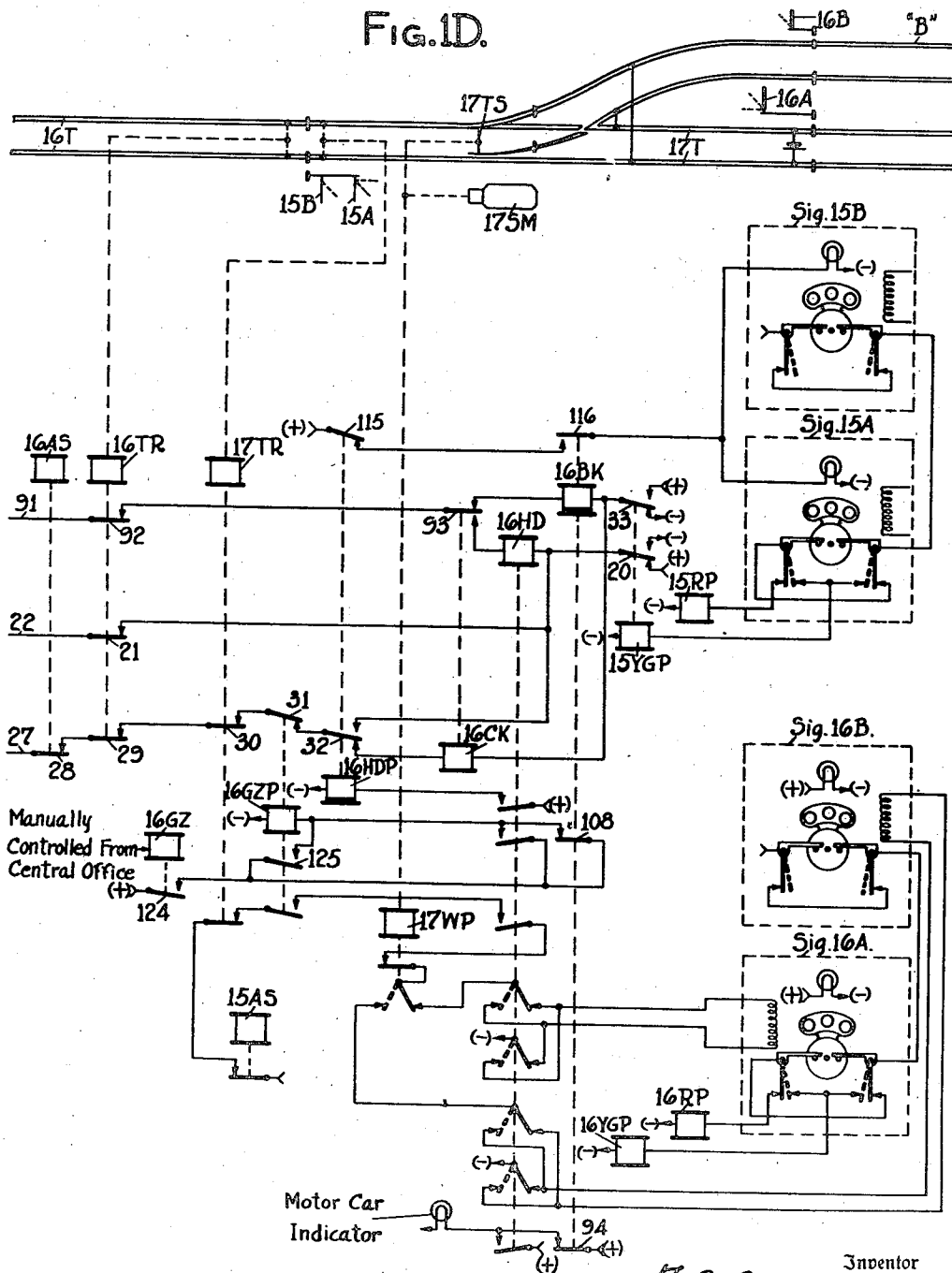
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SIGNALING SYSTEM FOR RAILROADS

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Fig. 1D.



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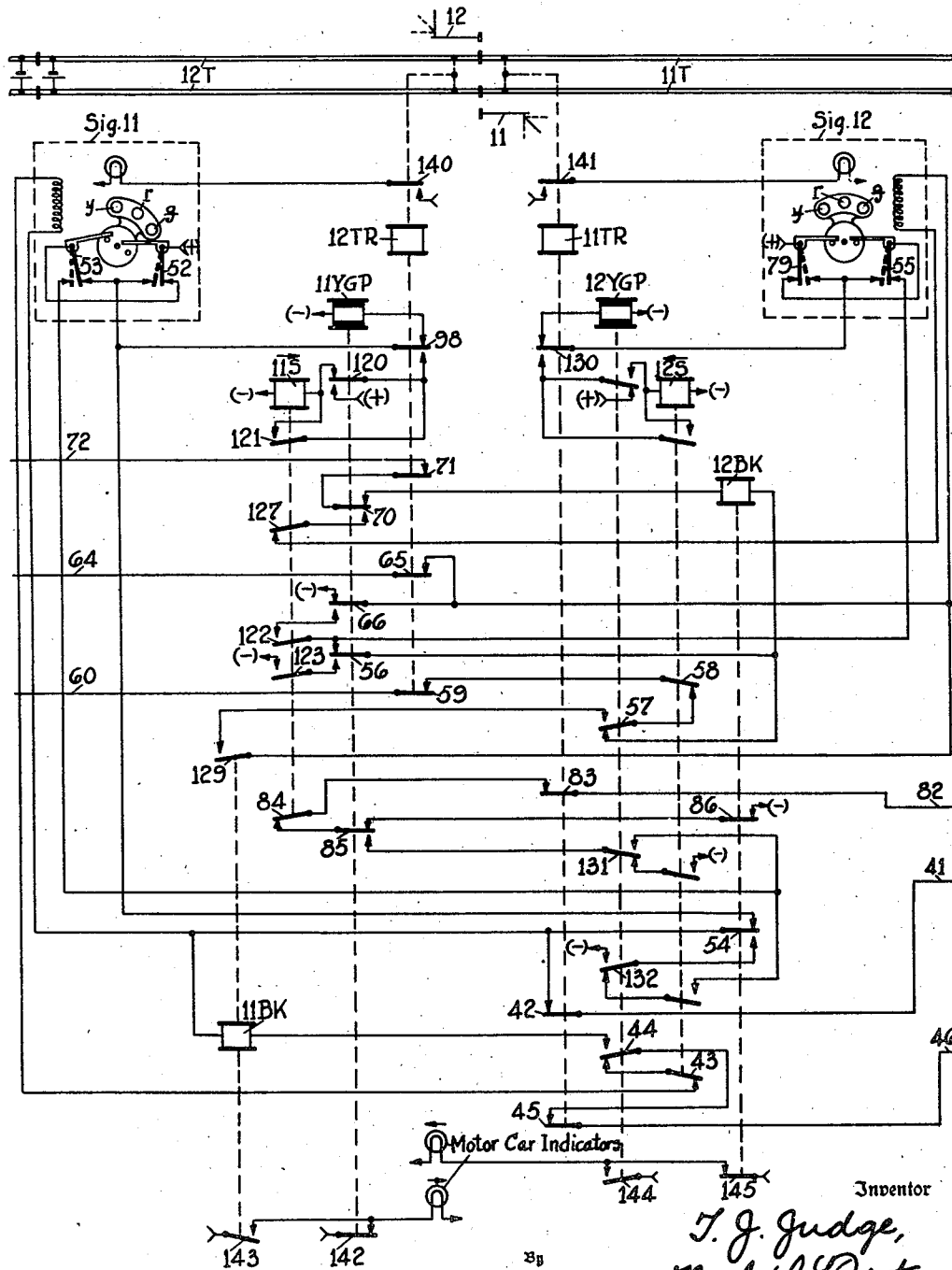
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SIGNALING SYSTEM FOR RAILROADS

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FIG. 2.



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2,410,504

SIGNALING SYSTEM FOR RAILROADS

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Application May 1, 1944, Serial No. 533,493

14 Claims. (Cl. 246—3)

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This invention relates to railway signaling systems, and more particularly to a signaling system for governing the movement of traffic over stretches of single track over which traffic may move in both directions.

Single track railroads are ordinarily provided with signaling systems of the absolute-permissive-block type in which trains may move in only one direction in a single track stretch at any one time, but where following trains are permitted to move under the usual three indication signaling where clear, caution and stop indications are provided. In other words, an absolute-permissive-block (APB) signaling system prevents the entrance of all opposing trains into the single track stretch when it is occupied but permits following train movements with the usual block spacing. In a single track railroad provided with centralized traffic control, the APB signaling is organized so that the head-block signals, that is, the signals governing the movement of traffic into the single track stretches, and the entering signals, that is, the signals governing the entrance of traffic into the siding sections from a single track stretch, are normally held at stop, but may be cleared in response to manual control subject to the automatic signaling circuits.

In such a system where centralized traffic control is employed with APB signaling, it is considered desirable to check all opposing signals at stop before the signals for the desired direction are permitted to clear. Thus, one object of the present invention is to provide a system of signaling wherein the opposing signals are checked at stop before the signals of the desired direction can be cleared together with the provision of means which prevents the interruption of an established route by the manual control at the leaving end of the route. It is also proposed that this shall be accomplished over a minimum number of line wires, such as the three line wires disclosed in the present application as including two control lines and a common return line, such line wires being individual to each block of the single track stretch.

A further object of the invention is to provide means for lighting the signals only when a route is established so as to conserve both the equipment and energy that would otherwise be used if the signals were continuously illuminated. It is further desired to effect this lighting of the signals to forewarn workmen of the contemplated passage of a train in a given direction.

A further object of the invention is to provide so-called motor car indicators at the head-block

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signal locations which are caused to indicate when opposing traffic is established to warn workmen against proceeding into the single track stretch against the established direction of traffic.

5 A still further object of the present invention is to provide motor car indicators associated with each of the intermediate signal locations as well as the head-block signal locations when the usual track circuit controlled approach lighting is employed.

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

15 In describing the invention in detail, reference will be made to the accompanying drawings, in which like reference characters provided with distinctive preceding numerals designate corresponding parts throughout the several views, and in which—

20 Figs. 1A, 1B, 1C and 1D when placed side by side represent one form of signaling system provided by the present invention; and

25 Fig. 2 illustrates a modified form of the circuit organization shown in Fig. 1B to illustrate a modified form of the present invention where motor car indicators are employed at intermediate signal locations when conventional track circuit controlled approach lighting is employed.

30 For the purpose of simplifying the illustrations and facilitating in the explanation, the various parts and circuits constituting the embodiment of the invention have been shown diagrammatically and certain conventional illustrations have been employed, the drawings having been made more with the idea to make it easier to understand the principles and mode of operation, than with the idea of illustrating the specific construction and arrangement of parts that would be employed in practice. Thus, the various relays and their contacts are illustrated in a conventional manner, and symbols are used to indicate connections to the terminals of batteries, or other source of electric current, instead of showing all of the wiring connections to these terminals.

35 The symbols (+) and (—) are employed to indicate the positive and negative terminals respectively of suitable batteries or other source of direct current, and the circuit with which these symbols are used always provide for current flow from such source in the same direction. In this connection, it is to be understood that these symbols represent different and separate sources for the different signal locations shown in the several

figures of the drawings, that is, each of the Figs. 1A, 1B, 1C and 1D are provided with separate batteries or other sources of direct current. This is pointed out so as to make clear that the same line wire may be connected to more than one source at the same time without causing a short circuit.

On the other hand, it is to be understood, that alternating current sources may be employed if desired, and if such alternating current sources are employed, then the symbols (+) and (—) are to be considered as merely indicating the relative instantaneous polarities.

General organization

With reference to Figs. 1A, 1B, 1C and 1D placed side by side, it will be seen that a stretch of single track has been shown extending between two passing sidings A and B. These passing sidings are connected to the main track by the usual power operated track switches. In Fig. 1A, the track switch 9TS is shown as connecting the passing siding A to the main track when in a reverse position, and this track switch 9TS is operated to its normal main line position and to its reverse position by a power operated switch machine 9SM. Associated with this switch is the usual detector track section 9T normally energized by a suitable track battery for maintaining energized the track relay 9TR except when a train is present in such track section.

Similarly, the track switch 17TS of Fig. 1D provides for main line or passing siding traffic in accordance with its normal and reverse positions respectively as provided by the power operation of switch machine 17SM. An associated detector track section 17T with the usual track battery is provided for energizing its associated track relay 17TR.

The head-block signals 7A and 7B of Fig. 1A are provided for governing eastbound traffic over the single track stretch, while the head-block signals 16A and 16B of Fig. 1D are provided for governing westbound traffic over the single track stretch. Entering signals 8A and 8B are provided for governing westbound traffic over the main track or on to the passing siding A; while the entering signals 15A and 15B are provided to govern eastbound traffic over the main track or on to siding B as the case may be.

In Fig. 1B, a double intermediate signal location is illustrated as including signals 11 and 12 for eastbound and westbound traffic respectively; while in Fig. 1C a single intermediate signal location is shown having the signal 14 for governing westbound traffic.

The single track stretch is of course divided into track sections or track circuits of the usual or conventional type where a so-called cut-section is provided at some intermediate point supplied with energy at such cut-section for energizing the track relays at the opposite ends of the section adjacent the signal locations. These cut-sections have been given reference characters bearing the same preceding numeral as the signal with which they are immediately associated. These track sections or blocks between pairs of signals may have coded track circuits applied thereto, in which case cut-sections are not usually required. In other words, it should be understood that any suitable type track circuits may be employed in which there is train detecting means adjacent each end of the block to effect the principles of operation of the present invention.

For convenience in the illustration, the signals have been shown as being of the multiple aspect searchlight type signal, such as shown, for example, in the Patent No. 1,835,150, granted to O. S. Field, December 8, 1931, but it is to be understood that any other suitable signal might be employed and still practice the principles of the present invention. Each of these light signals has a movable spectacle which is normally biased to its center position in which the signal displays a stop or red indication when illuminated; but the signal displays a green or yellow indication when such spectacle is moved to one or the other extreme position respectively. This movement of the spectacle is also used to operate contacts which normally assume the positions shown, but when the spectacle is operated to the right, the left-hand contact assumes its dotted line position, but when the spectacle is operated to the left the right-hand contact assumes its dotted line position. These contacts are employed to provide for the energization of the usual red repeating relays RP and the yellow-green repeating relays YGP. These relays are of course supplied with suitable distinctive preceding numerals to indicate the particular signal with which they are associated.

The red repeating relays, such as relay 1RP, are normally energized with the associated signals at stop, but are deenergized whenever an associated signal is caused to give a proceed indication, either yellow or green. The yellow-green repeating relays, such as 1YGP, are controlled so as to be energized whenever the associated signal is caused to indicate yellow or green. However, it should be noted that this is with respect to the main signal only, since the automatic block signaling is provided for the main track. For example, the clearing of the signal 1B does not provide for the energization of the relay 1YGP, since there is usually no automatic signaling associated with the side track. Similarly, the clearing of the turn out signal 8B does not cause the energization of the relay 8YGP because a high speed indication under such circumstances should not be given by the signal 12 since the route is a low speed route over the track switch 9TS in its reverse position.

In the specific form shown, searchlight type signals are employed where the operating windings actuate both signal aspects and relay contacts, but it should be understood that color light signals may be employed if desired. In such a case, only a suitable relay structure is necessary to be controlled the same as each signal shown, and the contacts of such relay structure can be used to control the color lights of the signal. This is pointed out since it is convenient in the claims to consider the signals as relays, which they are, so as to generically recite the essential elements of the present invention without specifying the type of signals to be used.

Although power operated switch machines SM have been indicated as associated with the track switches TS, no manual control has been shown for such switch machines, since this control may be of any desired type, such as disclosed for example in my prior application, Ser. No. 455,922, filed August 24, 1942, now Patent No. 2,350,620, dated June 6, 1944. Such control would of course include suitable detector and approach locking means, such as shown in said prior filed application. However, it is believed that all such switch machine control is unnecessary for an under-

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standing of the present invention, although approach locking stick relays AS have been shown in block form in Figs. 1A and 1D to indicate their relationship to the circuits of the present invention. For example, it is only necessary to understand that the relay 7AS is deenergized whenever the signal 7A or 7B is caused to indicate clear and this relay 7AS remains deenergized for a predetermined measured time subsequent to the restoration of such signals to their stop displaying positions.

Also, a switch position repeating relay WP of the usual polarized type is shown associated with each of the switches. For example, the relay 9WP is indicated as a polar neutral relay controlled to a normal energized position with the track switch 9TS and switch machine 9SM in normal locked positions, and is controlled to a reverse energized position with the track switch 9TS and switch machine 9SM in reverse locked positions, but is deenergized whenever the track switch 9TS or switch machine 9SM becomes unlocked. Suitable correspondence repeating relays would probably be employed with such switch position indicating relay, but these have not been shown for the sake of simplicity in the illustration of the present disclosure.

Extending between each of the signal locations of the single track stretch are three line wires, two of which are used as control lines and the third wire being used as a common return. These line wires are individual to each of the sections of track or blocks between two signal locations and serve for controlling the home-distance relays HD or signal operating windings at each end of the section as well as the traffic locking relays BK and CK. Certain of the home-distant relays HD are provided with direct repeating relays of the slow acting type given the reference characters HDP.

At each head-block signal location the entering and head-block signals are shown as being held at stop by suitable manual control which takes the form of a manually controlled relay GZ that may be controlled in any suitable manner from a central office by either direct line wire control or a suitable code type communication system. This manually controlled relay GZ has associated with it a repeater relay GZP which can repeat its energization subject to certain traffic conditions indicating that it is proper for the newly desired route to be established.

Associated with each head-block signal as shown in Figs. 1A and 1D, are suitable motor car indicators so designated by their respective legends, which indicators are illuminated only when it is safe for a motor car or workmen to proceed over the track into the single track stretch from their respective head-block signal locations.

This form of control is provided so as to give an indication on the side of safety, since a burned-out lamp corresponds to the most restrictive indication which the indicator can give. In the form of the invention shown in Figs. 1A, 1B, 1C and 1D, it is contemplated that the motor car operators will be advised as to traffic conditions by the illumination of the signals themselves when a route is set up by the central operator through his manual control of the GZ relays, which conditions are set up in advance of the actual approach of the train. On the other hand, conventional approach lighting may be employed as disclosed in Fig. 2, and in such cases two motor car indicators, one for each direction,

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are provided at each signal location which will be illuminated when a route is established even though the signals themselves are not illuminated until a train approaches. This form of motor car indicator for an intermediate signal is particularly useful on railroads where the signal itself cannot be seen around a curve sufficiently far to give proper warning to a motor car, and in such a case the indicator would be located at a proper point in approach to the curve and its control extended from the intermediate signal.

Operation

The system is organized to have a signal clearing tumble-down circuit for each direction of traffic with these tumble-down circuits interlocked in such a way that the signals can be cleared for either selected direction only providing the signals for the opposite direction are at stop. In addition to these signal clearing tumble-down circuits, a traffic locking tumble-down circuit is also provided for each direction of traffic, and these traffic locking tumble-down circuits are superimposed upon the signal clearing tumble-down circuits in a manner to avoid the use of additional line wires.

Under normal conditions when no route is established, both the signal clearing tumble-down circuit for the last direction of traffic and the traffic locking tumble-down circuits for the opposite direction are energized. Since both signal clearing and traffic locking tumble-down circuits are subject to manual control exercised at the ends of the single track stretch, the energization of the GZ relay at either selected end of the stretch in response to manual control causes the deenergization of the particular tumble-down circuit then energized from that end and relating to the opposing direction of traffic.

With more specific reference to the Figs. 1A, 1B, 1C and 1D, the last direction of traffic movement was from left to right so that the signal clearing tumble-down circuits for the signals 7A and 11 are energized, while the traffic locking tumble-down circuits for signals 16, 14 and 12 are also energized. Thus, if the relay 7GZ is picked up, then its repeater relay 7GZP is energized and opens a back contact for causing the deenergization of the traffic locking tumble-down circuits including relays 12BK, 14BK and 16BK. On the other hand, if the relay 16GZ is energized, instead of relay 7GZ, then the relay 16GZP is energized causing the deenergization of the signal clearing tumble-down circuits for signals 7 and 11 so as to cause a reversal of the established direction and the energization of the signal clearing tumble-down circuits for the signals 12, 14 and 16, it being understood that so long as the relay 16GZP is maintained picked up that the traffic locking tumble-down circuits for the signals 11 and 7 would remain deenergized.

It can thus be seen that the signals are so controlled that the opposing signals must be at stop before the signals for particular direction can be cleared and that the deenergization of the traffic locking tumble-down circuit, which is of course deenergized for the opposing direction of traffic at the same time that the signal clearing control is set up, prevents the manual control of a GZ relay at the opposite end of the single track stretch from being effective to pick up its repeating relay and thus interrupt the established direction of traffic. The traffic locking tumble-down circuits are thus used to lock

the established route and at the same time provide approach lighting control for the intermediate signals as well as control for the motor car indicators.

With this general discussion of the operation of the system, it is believed that further discussion should be given with respect to the specific circuits and operations involved in the system.

Normal conditions.—As above mentioned, the track circuits are normally energized so that their respective track relays TR are picked up. Also, the approach locking stick relays, such as relays 7AS, 8AS, 15AS and 16AS, shown in block form, are also normally energized, as explained in detail in my prior application Ser. No. 455,922, filed August 24, 1942.

All of the signals are unilluminated except the head-block signals 7A, 7B, 16A and 16B, and these signals are continuously illuminated so that a train standing on the siding where no track circuits are provided, will be advised as to the traffic controlling conditions. As above mentioned, the last movement of traffic was from left to right, and this leaves the signal clearing tumble-down circuit for the signals 7A and 11 energized. Since the signal location of Fig. 1C is shown as a single intermediate signal location, the signal circuit for signal 11 is controlled to a caution condition, but it is to be understood that if a double intermediate signal location were provided in Fig. 1C, that such signal governing traffic toward the siding B, would indicate caution in the rear of the signals 15A and 15B, and that the signal 11 would then be controlled to its clear or green indicating position. It of course should be understood that this control is present although the signals are not illuminated.

With this general understanding of the signal clearing tumble-down circuits for the eastbound signals, a specific description of each circuit involved will now be given.

The relay 13HD (which has no associated intermediate signal) is energized by a circuit closed from (+), and including back contact 20 of relay 15YGP, front contact 21 of track relay 16TR, common line wire 22 to the signal location of Fig. 1C, front contact 23 of track relay 13TR, windings of relay 13HD, back contact 24 of relay 14S, back contact 25 of relay 14YGP, front contact 26 of relay 13TR, line wire 27 to the signal location of Fig. 1D, front contact 28 of approach locking stick relay 16AS, front contact 29 of relay 16TR, front contact 30 of relay 17TR, back contact 31 of relay 16GZP, back contact 32 of relay 16HDP, windings of relay 16CK, back contact 33 of relay 15YGP, to (—). The energization of relay 13HD closes front contact 34 to energize its repeater relay 13HDP through an obvious circuit.

Referring to Fig. 1B, the operating winding of signal 11 is energized so as to actuate its movable spectacle to a caution or yellow indicating position, and this energizing circuit may be traced from (+), through a circuit including the contacts 35 and 36 of signal 14 at stop positions (see Fig. 1C), polar contact 37 of relay 13HD in a right-hand position, front contact 38 of relay 13HDP, back contact 39 of relay 13BK, front contact 40 of relay 14TR, line wire 41 to the signal location of Fig. 1B, front contact 42 of track relay 11TR, through the operating winding of signal 11, back contact 43 of relay 12S, back contact 44 of relay 12YGP, front contact 45 of relay 11TR, line wire 46 to the signal location of Fig. 1C, front contact 47 of track relay 14TR,

back contact 48 of relay 14S, back contact 49 of relay 14YGP, front contact 50 of relay 13HDP, polar contact 51 of relay 13HD in a right-hand position, to (—). The current which flows in this circuit actuates the signal 11 to its caution indicating position, which closes an energizing circuit for the relay 11YGP from (+), and including contact 52 of signal 11 in its normal position, contact 53 of signal 11 in an operated position, front contact 98 of relay 12TR, windings of relay 11YGP, to (—).

The energization of this relay 11YGP with the signal 12 at stop completes a circuit for the relay 7HD (+), and including signal contacts 79 and 55 of signal 12 in normal stop positions, front contact 56 of relay 11YGP, back contact 57 of relay 12YGP, back contact 58 of relay 12S, front contact 59 of relay 12TR, line wire 60 to the signal location of Fig. 1A, front contact 61 of relay 7TR, back contact 62 of relay 1CK, windings of relay 7HD, front contact 63 of relay 7TR, line wire 64 to the signal location of Fig. 1B, front contact 65 of track relay 12TR, front contact 66 of relay 11YGP, to (—). The current which flows in this circuit is of such a direction as to operate the polar contacts of relay 7HD to their left-hand positions and to close the neutral contacts of this relay. The closure of front contact 67 of relay 7HD energizes the repeater relay 7HDP through an obvious circuit.

The closure of front contact 68 of this relay 7HD completes an obvious energizing circuit for the motor car indicators, thus giving an indication to a motor car operator or to other workmen that there is no opposing traffic and that it is safe to proceed in an eastbound direction over the single track stretch.

Under these normal conditions the traffic locking tumble-down circuits for the opposing direction are energized. More specifically, the relay 12BK of Fig. 1B is energized by a circuit closed from (+), and including contacts 79 and 55 of signal 12 in their stop positions, front contact 56 of relay 11YGP, windings of relay 12BK, front contact 10 of relay 11YGP, front contact 71 of track relay 12TR, line wire 72 to the signal location of Fig. 1A, front contact 73 of relay 7AS, front contact 74 of relay 7TR, front contact 75 of relay 9TR, back contact 76 of relay 7GZP, front contact 77 of relay 7HDP, front contact 63 of relay 7TR, line wire 64 to the signal location of Fig. 1B, front contact 65 of relay 12TR, front contact 66 of relay 11YGP, to (—).

It will be noted that this energization of the relay 12BK is from a source of energy located at the signal location of Fig. 1B instead of the signal location of Fig. 1A as might be expected for tumble-down circuits. This relationship of the relay 12BK with respect to its source is provided so as to prevent any erroneous energization of relays at the head-block signal location of Fig. 1A upon a reversal of the direction of the signal control, as will be mentioned more in detail later. However, it will be mentioned here, that the traffic locking tumble-down circuits with respect to the plurality of intermediate signals are arranged to have the source at one signal location and the indicating relay such as 14BK at the other signal location, as shown between the signal locations of Fig. 1B and 1C.

The energization of the relay 12BK provides that the relay 14BK of Fig. 1C is energized over a circuit closed from (+), and including contact 52 of signal 11 in a normal position and contact 53 of signal 11 in an operated position, front con-

tact 54 of relay 12BK, front contact 42 of relay 11TR, line wire 41 to the signal location of Fig. 1C, front contact 40 of relay 14TR, windings of relay 14BK, front contact 80 of relay 13HDP, front contact 81 of track relay 14TR, line wire 82 to the signal location of Fig. 1B, front contact 83 of track relay 11TR, back contact 84 of relay 11S, front contact 85 of relay 11YGP, front contact 86 of relay 12BK, to (—).

This energization of the relay 14BK permits the energization of the relay 16BK of Fig. 1D by reason of a circuit closed from (+), and including back contact 20 of relay 15YGP, front contact 21 of relay 16TR, line wire 22 to the signal location of Fig. 1C, front contact 23 of track relay 13TR, front contact 87 of relay 14BK, front contact 88 of relay 13HD, front contact 89 of relay 13HDP, front contact 90 of track relay 13TR, line wire 91 to the signal location of Fig. 1D, front contact 92 of track relay 16TR, front contact 93 of relay 16CK, windings of relay 16BK, back contact 33 of relay 15YGP, to (—).

The energization of this relay 16BK closes front contact 94 to energize the motor car indicator by an obvious circuit which gives an indication to a motor car operator or other workmen that conditions are not set up for eastbound traffic, thus making it safe for westbound movement into the single track stretch.

With a tumble-down circuit normally energized for each direction, it will be presently explained how the exercise of manual control at either selected end of the single track stretch will result in the establishment of a route for traffic movement away from that end and at the same time approach lighting the signals of the stretch and acting to prevent accidental manual control at the other end from interrupting the established route.

Manual signal clearing for eastbound traffic.—Let us assume that the operator desires to clear signal 7A and by suitable communication means effects the energization of the relay 7GZ. This picking up of relay 7GZ closes a pick-up circuit for the relay 7GZP from (+), and including front contact 95 of relay 7GZ, front contact 96 of relay 7HD, windings of relay 7GZP, to (—). As soon as the relay 7GZP picks up, it closes front contact 97 to complete a stick relay wholly dependent upon the continued closure of front contact 95 of relay 7GZ.

Since the previously established route was for eastbound traffic, the relay 7HD is already energized, and a circuit for immediately clearing the signal 7A is closed from (+), and including front contact 100 of relay 8AS, front contact 101 of relay 9TR, front contact 102 of relay 7GZP, front contact 103 of relay 7HD, front contact 104 of relay 9WP, polar contact 105 of relay 9WP in a left-hand normal position, polar contact 106 of relay 7HD in a left-hand position, operating winding of signal 7A, polar contact 107 of relay 7HD in a left-hand position, to (—). The energy which flows in this circuit is of such a direction by reason of pole changing contacts 106 and 107 of relay 7HD, that the signal 7A is operated to its clear or green indicating position and such an indication is immediately displayed because its lamp is continuously lighted.

At the same time that relay 7GZP effects this signal clearing control, the traffic locking tumble-down circuit for the opposing direction of traffic is deenergized by reason of the opening of back contact 76 of relay 7GZP which deenergizes the circuit for the relay 12BK of Fig. 1B; the

opening of contacts 54 and 86 of this relay 12BK also deenergizes the circuit for the relay 14BK of Fig. 1C; and this relay 14BK in turn opens front contact 87 to deenergize the relay 16BK of Fig. 1D.

Referring to Fig. 1D, the opening of front contact 108 of relay 16BK entirely opens the pick-up circuit for the relay 16GZP. Thus, it will be apparent that any unintentional or accidental control of the relay 16GZ, cannot result in the picking up of the relay 16GZP and thus break the energized signal clearing tumble-down circuit governing eastbound traffic by the opening of back contact 31.

The opening of front contact 94 of relay 16BK also extinguishes the illumination of the associated motor car indicator and advises workmen that opposing traffic has been established.

The deenergization of the traffic locking tumble-down circuit including relays 13BK, 14BK and 16BK also effects the lighting of their respective signals. More specifically, in Figs. 1B, the closed condition of back contacts 110 and 111 of relay 12BK and 11BK respectively, completes obvious energizing circuits for the lamps of signals 11 and 12 in multiple. Similarly, the closed condition of back contacts 112 and 113 (see Fig. 1C) of relays 13BK and 14BK respectively, completes an obvious energizing circuit for the lamp of signal 14. Also, the closed condition of back contacts 115 and 116 of relays 16HDP and 16BK respectively, completes the energizing circuits for the lamps of signals 15A and 15B in multiple. Although these signals are assumed to be at stop in the prior description of the signaling circuits, it is to be understood that they can be manually cleared subject to suitable automatic signaling circuits (not shown) for the main track through the siding section.

Before considering how manual control can be exercised at the signal location of Fig. 1D by the picking up of relay 16GZ and thus establish westbound traffic, it appears to be expedient to first consider the operation of the system upon the passage of an eastbound train through the single track stretch.

Passage of an eastbound train.—Let us assume that a train accepts the clear signal 7A and proceeds into the detector track section 9T, this opens front contact 101 of the track relay 9TR included in the circuit for signal 7A and thus causes it to go to stop. At the same time, front contact 75 of relay 9TR is opened, so that the traffic locking tumble-down circuit for the opposing direction of traffic cannot be reenergized even though the operator might restore the relay 7GZ to its deenergized position which would result in the deenergization of the relay 7GZP and closure of the back contact 76. In other words, the presence of the train in the detector track section 9T continues the locking condition for opposing traffic that has been established by the picking up of the relay 7GZP.

Assuming that the train proceeds into the track section including track circuits 7T and 12T between the head-block signals and the signal 12, the track relay 7TR is first deenergized opening front contacts 61, 63 and 74 and is then followed by the deenergization of track relay 12TR opening the front contacts 98, 59, 65 and 71, thus continuing the open condition of the line circuit for the traffic locking tumble-down circuit. It will be noted that the opening of front contact 61 of track relay 7TR, and also the continued opening of such line circuit by opening front

contact 59 of relay 12TR causes the deenergization of the relay 7HD so that the signals 7A and 7B are maintained at stop by open front contact 103 although the track relay 9TR is reenergized closing front contact 101 when the train leaves the detector track section 9T.

When the train deenergizes the track relay 12TR, a pick-up circuit for the directional stick relay 11S is closed from (+), and including contact 52 of signal 11 in a normal position, contact 53 of signal 11 in an operated position, back contact 98 of track relay 12TR, front contact 120 of relay 11GYP, windings of relay 11S, to (-). The deenergization of the track relay 12TR opens front contact 98 so that the relay 11GYP is deenergized after a period of time measured by its slow releasing characteristics opening front contact 120 included in the pick-up circuit for 11S, but this does not affect the continued energization of relay 11S since front contact 121 of relay 11S completes a stick circuit which receives energy directly from the contacts 52 and 53 of the signal 11. Upon the closure of back contact 120 of relay 11GYP, energy (+) is applied directly to the stick circuit of the relay 11S so that the restoration of the signal 11 to stop when the train passes into the track circuit 11T does not in any way cause the release of the stick relay 11S.

When the train has proceeded past the signal 11 and caused it to be placed at stop by reason of the open condition of front contacts 42 and 45 of the track relay 11TR, the directional stick relay 11S closes an energizing circuit for the relay 7HD from (+), and including contacts 79 and 55 of signal 12 in their normal stop positions, front contact 122 of relay 11S, back contact 66 of relay 11GYP, front contact 65 of relay 12TR, line wire 64 to the signal location of Fig. 1A, front contact 63 of track relay 7TR, windings of relay 7HD, back contact 62 of relay 7CK, front contact 61 of relay 7TR, line wire 60 to the signal location of Fig. 1B, front contact 59 of track relay 12TR, back contact 58 of relay 12S, back contact 57 of relay 12YGP, back contact 56 of relay 11GYP, front contact 123 of relay 11S, to (-). The energy which flows in this circuit for the relay 7HD has such a direction as to operate the polar contacts of the relay 7HD to their right-hand positions, in which the signal 7A or the signal 7B may be actuated to a caution or yellow indicating position in response to manual control. In other words, a following train movement is permitted in the rear of the train which has now passed the signal 11.

Since there is no intermediate signal at the location of Fig. 1C, there is no directional stick relay provided. Thus, the opening of the front contacts 26, 23 and 90 of the track relay 13TR deenergizes the relay 13HD which continues the signal 11 at stop and which in turn merely permits the signals 7A or 7B to be operated to their caution indicating positions. However, when the train has passed beyond the detector track section 17T into the passing siding or into the main track section, the relay 13HD is reenergized and thus restores the signal 11 to its caution indicating position which in turn will permit the signals 7A or 7B to be caused to indicate clear or green in response to manual control.

It will be noted that the directional stick relay 11S is maintained stuck up until the signal 11 is restored to its caution indicating condition resulting in the picking up of the relay 11GYP and the opening of the stick circuit for the relay 11S at back contact 120. This occurs when the east-

bound train passes out of the single track stretch. Inasmuch as the relay 16GZP cannot be picked up in response to manual control until the traffic locking relay 16BK has been reenergized, which in turn is dependent upon the signal clearing tumble-down circuit for eastbound traffic, the release of the directional stick relays (such as relay 11S) associated with the signals for eastbound traffic is assured. In other words, the directional stick relays for either direction are assured of release because of the sequence in which the tumble-down circuits must be restored to their conditions established prior to the entrance of a train before the direction of traffic can be reversed.

Approach locking control.—It should be noted that once a route has been established by the clearing of a head-block signal, the reversal of traffic direction in the single track stretch is prevented for a predetermined time after such head-block signal is restored to stop, if a train is approaching such signal. This feature is provided so as to give a train approaching the signal 7A, for example, sufficient time to come to stop upon the restoration of such signal to stop in the face of that train, or to allow the train sufficient time to enter the detector track section and by its presence prevent the reversal of traffic in the single track stretch. If the reversal of traffic were permitted immediately upon the placing to stop of signal 7A for example, it might happen that the signal would be placed at stop in the face of an on-coming train and the traffic in the single track stretch reversed even though the train could not stop in advance of the signal 7A. This might result in two trains entering the single track stretch at the same time, which is obviously undesirable.

Thus, the present invention provides that the approach locking stick relay 7AS has a front contact 73 included in the traffic locking tumble-down circuit so that such traffic locking tumble-down circuit will not be energized upon the closure of the back contact 76 until a predetermined time after the signal 7A or 7B has been restored to stop. Thus, the traffic locking relay 16BK at the opposite end of the stretch remains deenergized preventing the manual control of the relay 16GZP for the time measured by the approach locking time measuring relay, as disclosed in my prior application Ser. No. 455,922, filed August 24, 1942.

Similar control is of course provided at the opposite end of the stretch indicated in Fig. 1D by the provision of the approach locking stick relay 16AS.

The signals 7A and 7B are similarly held at stop for a predetermined time after the signals 8A or 8B have been cleared and restored to stop. This is accomplished by the inclusion of front contact 100 of the relay 8AS in the signal controlling circuit, since this approach locking stick relay 8AS is deenergized for a predetermined time subsequent to the restoration to the stop of the manually controlled signals 8A and 8B.

Manual control for westbound traffic.—Let us assume that the system is in the condition illustrated, and that the central operator desires to allow a train to pass from the siding B into the single track stretch toward the siding A. To do this he first controls the track switch 17TS to a reverse position by the proper control of switch machine 1SM, which causes the switch position indicating relay 7WP to be energized with the opposite polarity when the track switch

17TS is in its reverse locked position. Manual control is then exercised to energize the relay 16GZ thus completing a pick-up circuit for the relay 16GZP from (+), through a circuit including front contact 124 of relay 16GZ, front contact 108 of relay 16BK, winding of relay 16GZP, to (-). As soon as this relay 16GZP picks up and closes front contact 125, an obvious stick circuit is closed rendering the relay 16GZP wholly dependent upon the energized condition of relay 16GZ.

The opening of back contact 31 of relay 16GZP causes the deenergization of the relay 13HD followed by the restoration of the signal 11 to its stop condition. The restoration of signal 11 to its stop condition moves contact 53 of signal 11 to its normal position to deenergize the yellow-green repeater relay 11YGP which in turn opens the circuit for relay 7HD at front contact 56. The release of relay 7HD of course opens the energizing circuit for its repeater relay 7HDP.

The dropping away of the relay 11YGP opens its front contacts 56 and 66 removing energy from the circuit for the relay 12BK at the same time that the relay 7HD is deenergized. Then after a period of time measured by the release of the slow acting relay 7HDP energy is applied to a circuit for energizing the operating magnet of the signal 12 by a circuit closed from (+), and including back contact 126 of relay 8YGP, front contact 63 of relay 7TR, line wire 64 to the signal location of Fig. 1B, back contact 65 of relay 12TR, operating winding of signal 12, back contact 127 of relay 11S, back contact 70 of relay 11YGP, front contact 71 of relay 7TR, line wire 72 to the signal location of Fig. 1A, front contact 73 of relay 1AS, front contact 74 of relay 7TR, front contact 75 of relay 9TR, back contact 76 of relay 7GZP, back contact 77 of relay 7HDP, windings of relay CK, back contact 128 of relay 8YGP, to (-). The energy which flows in this circuit is of such a direction as to cause the signal 12 to be operated to its caution indicating position. The energy which flows in this circuit also energizes the relay 7CK included in series thus picking up front contact 62 to prepare the circuit for the relay 7BK which of course cannot be energized so long as the relay 16GZP is picked up. However, it might be desirable to note that the circuit for the relay 7BK has no energy applied to it at this time and cannot receive energy until the relay 11BK picks up and closes front contact 129 in Fig. 1B.

The operation of the signal 12 to a caution or yellow indicating position completes an energizing circuit for the relay 12YGP from (+), and including contact 54 in an operated position and front contact 130 of relay 11TR. The picking up of the relay 12YGP completes an energizing circuit for the operating winding of signal 14 from (+), and including contacts 52 and 53 of signal 11 in normal positions, front contact 131 of relay 12YGP, back contact 85 of relay 11YGP, back contact 84 of relay 11S, front contact 83 of relay 11TR, line wire 82 to the signal location of Fig. 1C, front contact 81 of relay 14TR, back contact 80 of relay 13HDP, operating winding of signal 14, front contact 40 of relay 14TR, line wire 41 to the signal location of Fig. 1B, front contact 42 of track relay 11TR, back contact 54 of relay 12BK, front contact 132 of relay 12YGP, to (-). The current which flows in this circuit is of such a direction as to cause the signal 14 to be operated to its clear or green indicating position. This in turn causes the energization of the relay

14YGP by a circuit including contact 35 of signal 14 in a normal position, contact 36 of signal 14 in an operated position and front contact 133 of track relay 13TR.

The energization of the relay 14YGP completes the energizing circuit for the relay 16HD from (+), and including front contact 134 of relay 14YGP, back contact 89 of relay 13HDP, front contact 90 of relay 13TR, line wire 91 to the signal location of Fig. 1D, front contact 92 of relay 16TR, back contact 93 of relay 16CK, windings of relay 16HD, front contact 21 of relay 16TR, line wire 22 to the signal location of Fig. 14, front contact 23 of track relay 13TR, front contact 135 of relay 14YGP, to (-). The current which flows in this circuit energizes the relay 16HD in such a direction as to permit the operation of the signal 16B to a clear or green indicating position by reason of an energizing circuit similar to that pointed out in connection with the signal 7A.

From the above description, it will be observed that each signal is cleared dependent upon its opposing signal being at stop. For example, the signal 12 has an energizing circuit which is closed only providing the relay 7GZP is deenergized closing back contact 76, which of course insures that the front contact 102 will be open holding the signals 7A and 7B at stop. Similarly, the energizing circuit for the signal 14 includes contacts closed only providing the signal 11 is at stop and providing the signal 12 is indicating caution. It can thus be seen that the signal clearing tumble-down circuits build up from the remote or leaving end of the route to be established and thus permits the clearing of the head-block signal only after all of the opposing signals have been checked at stop during this reversal in direction of the signal clearing tumble-down circuits. It will be noted that the traffic locking relays, such as relays 11BK and 12BK, are all deenergized thus causing the intermediate signals to be illuminated to give the proper indications in accordance with the established control. Both of the signals 8A and 8B are illuminated by reason of the closure of back contacts 136 and 137 of relays 7HDP and 7BK respectively. These signals 8A and 8B are of course shown as indicating stop, but it is to be understood that they may be manually controlled to indicate caution or clear as the case may be in accordance with the manual control dependent upon suitable automatic circuits not shown. If the signal 8A is caused to indicate caution or clear, prior to the passage of a train past the signal 12, the contacts 126 and 128 are moved to their front contacting positions thus reversing the polarity on the control circuit for signal 12 causing it to indicate clear. This does not effect the signal 14 since it would be already indicating clear (assuming of course that the train has not passed the signal 14).

Detailed operations involved during the passage of a westbound train will not be pointed out in detail, since such operations will be understood by analogy to the operations involved with regard to the passage of an eastbound train. It will of course be recognized that each time the westbound train proceeds past a signal location that the associated directional stick relay is picked up and energy is applied to the signal control circuit in the rear to allow for following train movements. When the train has entirely passed through the single track stretch, the signal clearing tumble-down circuits will be reenergized for

actuating the signals 12 and 14 to their caution and clear positions respectively, assuming that the signal 8 is at stop.

Also, assuming that the manual control of relay 16GZ has been restored to its deenergized position, the relay 16GZP is released so that the traffic locking tumble-down circuits including relays 13BK, 11BK and 7BK are successively energized to restore the intermediate signals to their normal dark conditions, and thus cause the motor car indicator of Fig. 1A to be energized through front contact 138 of relay 7BK. This energization of the motor car indicator of course advises workmen that they may proceed into the single track stretch because there is no opposing direction of traffic established.

More specifically, the relay 13BK is energized by a circuit closed from (+), and including front contact 134 of relay 4YGP, windings of relay 13BK, front contact 25 of relay 14YGP, front contact 26 of relay 13TR, line wire 27 to the signal location of Fig. 1D, front contact 28 of relay 16AS, front contact 29 of relay 16TR, front contact 30 of relay 17TR, back contact 31 of relay 16GZP, front contact 32 of relay 16HDP, front contact 21 of relay 16TR, line wire 22 to the signal location of Fig. 1C, front contact 23 of track relay 13TR, front contact 135 of relay 14YGP, to (-).

The picking up of the relay 13BK in turn causes the energization of the relay 11BK by reason of a circuit closed from (+), and including contact 35 of signal 14 in a normal position and contact 36 in an operated position, front contact 39 of relay 13BK, front contact 40 of track relay 14TR, line wire 41 to the signal location of Fig. 1B, front contact 42 of track relay 14TR, windings of relay 11BK, front contact 44 of relay 12YGP, front contact 45 of relay 11TR, line wire 46 to the signal location of Fig. 1C, front contact 47 of track relay 14TR, back contact 48 of relay 14S, front contact 49 of relay 14YGP, front contact 139 of relay 13BK, to (-).

Relay 7BK is energized by reason of a circuit closed from (+), and including back contact 126 of relay 8YGP, front contact 63 of relay 7TR, line wire 64 to the signal location of Fig. 1B, front contact 65 of relay 12TR, front contact 129 of relay 11BK, front contact 57 of relay 12YGP, back contact 58 of relay 12S, front contact 59 of relay 12TR, line wire 60 to the signal location of Fig. 1A, front contact 61 of relay 7TR, front contact 62 of relay 7CK, windings of relay 7BK, back contact 128 of relay 8YGP, to (-).

Summary of tumble-down circuits.—With reference to the drawings, it will be seen that the signal clearing tumble-down circuits for opposite directions are interlocked with respect to each other. For example, the signal 11 is controlled through a back contact 44 of relay 12YGP, while the signal 12 is controlled through a back contact 70 of relay 11YGP. By reason of these contacts the signal clearing tumble-down circuits with respect to this signal can be cleared for only one direction at a time. A similar interlock is provided at each of the intermediate signal locations.

The signal clearing tumble-down circuits are of the regular tumble-down type in that the relay of the circuit for each block is adjacent its associated entering signal for that block while energy is applied to such circuit from the other end of the block. The line wires which provide control for these signal controlling circuits have superimposed upon them the control for the traffic lock-

ing tumble-down circuits for the corresponding directions. For example, the signal 12 is controlled through back contact 70 of relay 11YGP, while the traffic locking relay 12BK is controlled through a front contact 70 so that the line wire 72 is used for both the signal clearing circuit and the traffic locking circuit for the same direction.

With respect to the traffic locking circuits as between pairs of intermediate signal locations, each relay is controlled by energy applied to its circuit at the other end of the block. However, this is not true with respect to the end track sections between the head-block signals and the first intermediate signal location. For example, the traffic locking relay 12BK is controlled from the signal location of Fig. 1A, but its energy is supplied from its own signal location, as will readily be seen by a study of its detailed circuit previously described. Likewise, the traffic locking relay 7BK receives energy from its own signal location although its circuit is controlled from the signal location of Fig. 1B in accordance with the energization of the relay 11BK under the proper conditions, as previously described. Thus, the traffic locking tumble-down circuits for the end sections or blocks of the single track stretch are not symmetrical with respect to the intermediate track sections. However, it should be understood that there may be more than the one intermediate track section when conditions require it. For this reason, it should be understood that other intermediate signal locations might be provided by arranging the controls for such signals as disclosed for the opposing signals 11 and 14. If the signal location of Fig. 1C is desired to be of the double intermediate type, then an additional signal 13 can be provided for governing traffic towards the siding B with its operating winding replacing the relay 13HD and its associated relay 13YGP (not shown) taking the place of the relay 13HDP. In other words, such a signal would have the same relationship to its siding as the signal 12 has with respect to the siding A.

Modification of Fig. 2.—This Fig. 2 illustrates a modification of the invention as shown in Fig. 1B by changing the approach lighting control of the signals 11 and 12 to track circuit controlled contacts 140 and 141 of relays 12TR and 11TR respectively. In other words, the signal 11 is illuminated only when a train approaches such signal and deenergizes the track relay 12TR. This same principle of approach lighting may be applied to each of the other approach lighted signals in the same manner as shown for these signals 11 and 12, but which has not been shown applied to the other figures for the same of simplicity. The signal clearing tumble-down circuits and the traffic locking circuits for this form of the invention are exactly the same as shown in Fig. 1B. However, two motor car indicators for opposite directions of traffic, as indicated by arrows with the respective indicators, are provided so that it is safe for a motor car to proceed over the trackway only when both such indicators are illuminated. The eastbound indicator is controlled by front contacts 142 and 143 of the relays 11YGP and 11BK respectively; while the westbound indicator is controlled by front contacts 144 and 145 of the relays 12YGP and 12BK respectively.

With reference to the preceding description for an understanding of the operation of the various tumble-down circuits, it will be understood that when a route is established for eastbound traffic, the relay 11YGP will be picked up closing front

contact 142 but the relay 12BK will be deener-

gized so that only the motor car indicator with the arrow pointed to the right is illuminated. This informs the motor car operator, or other workmen, that a route has been established and that it is unsafe for motor car operation, but the indicator which still remains illuminated advises the direction in which traffic is established, so that the direction from which a train should be expected will be known. It will be obvious that when the train has actually passed the signal location both indicator lamps will be extinguished until such train has passed beyond the next intermediate signal location or has left the single track stretch entirely, as the case may be, at which time the lamps will be illuminated in accordance with the traffic conditions just discussed. It is believed that the indication displayed by these indicators for traffic in the opposite direction will be readily understood.

As previously mentioned, these indicators need not necessarily be located at the signal location itself but may be located at a suitable point in accordance with the particular curvature of the track, or the like, requiring a different location. For example, such indicators might be located in the building adjacent a highway crossing, so as to advise the crossing flagman as to when to expect a train.

Having thus described a signaling system 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 it may assume. 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 as limited by the appended claims.

What I claim is:

1. In a manually controlled block signal system for single track railroads, a stretch of single track having a head-block signal at each end and intermediate signals at intervals governing train movement in opposite directions into and through said stretch of single track, a series of line circuits for each direction of traffic, a traffic direction locking relay for each direction associated with each signal and energized alternately by an associated line circuit dependent upon the direction of traffic established, approach lighting means for each intermediate signal responsive to the deenergization of both of the associated traffic direction locking relays for opposite directions of traffic, and manually controlled means governed by said series of line circuits and said traffic direction locking relays for governing the clearing of signals for train movement into and through said single track stretch for either selected direction of traffic.

2. In a system of centralized traffic control for single track railroads, a stretch of single track between the ends of passing sidings and having signals at intervals governing train movement into and through said stretch in opposite directions, a signal control relay for governing the indications of each signal, a traffic direction locking relay associated with each signal, two series of interlocked line circuits one for each direction of traffic for governing the energization of the signal control relays of the signals for only one direction of traffic at a time and also the energization of said traffic direction locking relays associated with the signals for the opposite direction of traffic, and manually controlled means

governed by said traffic direction locking relays for the opposing signals at the ends of said single track stretch for governing the clearing of said signals for either selected direction of traffic.

3. In a system of centralized traffic control for single track railroads, a stretch of single track having signals at intervals governing train movement into and through said stretch in opposite directions, a signal control relay for governing the indications of each signal, a series of line circuits for each direction of traffic for energizing the signal control relays of the signals governing train movement in a corresponding direction, means for interlocking said series of line circuits for opposite directions of traffic to permit the clearing of signals for only one direction of traffic at a time, auxiliary traffic direction locking relay means governed by the continuity of each series of line circuits when not effective to energize signal control relays, and means manually controlled from a distant control office and dependent upon the condition of said traffic direction locking means for governing said series of line circuits to clear signals for the movement of trains into and through said stretch in either selected direction.

4. In a system of centralized traffic control for a single track railroad, a stretch of single track between the ends of passing sidings having a head-block signal at each end and intermediate signals at intervals governing train movement into and through said stretch in opposite directions, a signal control relay associated with each of said signals for governing its indications, two series of interlocked line circuits one for each direction for energizing the signal control relays of the signals for only one direction of traffic at a time, traffic direction locking means for each end of the stretch responsive to the continuity of the series of line circuits relating to the direction of traffic away from that end even though that series of line circuits is not then effective to control the energization of the signal control relays for that direction of traffic, and means for each end of said stretch manually controlled from a distant control office and governed by the associated traffic direction locking means for controlling the clearing of the associated head-block signal and the continuity of the series of line circuits for the opposite direction of traffic.

5. In a signaling system for single track railroads, a stretch of single track between the ends of two passing sidings, head-block signals at each end of the stretch for governing traffic into the stretch at that end, intermediate signals located at intervals through the stretch for governing traffic in both directions, manually controlled line circuit means for causing the head-block signal to be cleared at either selected end of the stretch and also causing the clearing of the intermediate signals for the corresponding direction, and motor car indicators associated with each end of the stretch and each being governed by said line circuit means to indicate at its end of the stretch the establishment of an opposing direction of traffic upon the manual clearing of the head-block signal at the opposite end of the stretch.

6. In a signaling system for single track railroads, a stretch of single track divided into sections between the ends of two passing sidings, head-block signals at each end of the stretch for governing traffic into the stretch at that end, intermediate signals located at the ends of the sections through the stretch for governing traffic in both directions, line circuit means for said

stretch including three line wires individual to each track section, manually controlled means at the ends of the stretch for acting over said line wires to cause said signals to be cleared for either selected direction only after the signals for the opposing direction have been checked at stop, said means also clearing the head-block signal for the corresponding direction, motor car indicators associated with each end of the stretch, and means at each end of the stretch controlled by said line circuit means for causing the motor car indicator at that end of the stretch to indicate the establishment of an opposing direction of traffic.

7. In a single track railroad signaling system, a stretch of track between two passing sidings provided with light signals at the head-blocks and at spaced intervals through the stretch for governing traffic in both directions, said intermediate signals being normally unilluminated, line circuit means associated with said signals and manually governable for causing the clear control of the head-block signal at either selected end of the stretch and the intermediate signals for the corresponding direction, approach lighting control means associated with each intermediate signal for illuminating that signal when a train is in approach thereto, a motor car indicator associated with each head-block and intermediate signal, and control means for said motor car indicators governed by said line circuit means to cause said indicators for the intermediate signals to indicate the established direction of traffic upon the manual control of said line circuit means and to cause the motor car indicator at the leaving end of the stretch to indicate the establishment of an opposing direction of traffic in response to the manual control of said line circuit means for clearing the head-block signal at the opposite end of the stretch, whereby the establishment of the traffic direction in a stretch of single track is indicated for the benefit of workmen prior to the entrance of a train into the stretch.

8. In a signaling system for a single track railroad having a stretch of single track between two passing sidings, head-block signals at each end of the stretch for governing the entrance of traffic into the stretch, intermediate signals located at intervals through the stretch for governing traffic in both directions and dividing said stretch into sections, line circuit means associated with said stretch of single track and manually governable for clearing the head-block signal at either end of the stretch and the intermediate signals for the corresponding direction, said line circuit means being so organized as to require all opposing signals to be placed at stop before the signals for the selected direction can be cleared, said line circuit means being effective to prevent manual control of either end of the stretch to interrupt an established direction of traffic when the manual control at the opposite end of the stretch is effective to establish traffic, said line circuit means comprising two line wires and a common line wire for each track section of the stretch, and circuit means controlled by said line wires for each track section for indicating adjacent each signal location whether or not said line circuit means is being manually governed.

9. In a signaling system for a stretch of single track between two passing sidings, head-block signals at each end of the stretch for governing traffic into the stretch at that end, intermediate signals normally unilluminated and located at

intermediate points through the stretch for governing opposite directions of traffic, line circuit means associated with said stretch and normally conditioned for governing said intermediate signals for one direction or the other to clear conditions, manually controlled means at the ends of said stretch effective to control said line circuit means for governing said intermediate signals to clear conditions for either selected direction of traffic followed by the clearing of the head-block signal for the corresponding direction, said control of said line circuit means being distinctive while said manually controlled means is active, means associated with each intermediate signal for causing that signal to be illuminated during the distinctive control of said line circuit means, and motor car indicator means associated with each end of the stretch and distinctively controlled by the distinctive condition of said line circuit means whenever the head-block signal at the opposite end of the stretch is cleared to thereby indicate the establishment of traffic toward its end.

10. In a railroad signaling system for stretches of single track over which traffic can move in either direction between two passing sidings, light signals located at intervals through said stretch for governing both directions of traffic, line circuit means associated with said stretch and manually controlled for causing the signals to be conditioned to indicate clear for only one direction of traffic at a time and acting to maintain the controlled condition of the signals for the last established direction of traffic although the manual control is removed, and means responsive to the manual control of said line circuit means at either selected end of the stretch for lighting all of the signals in the stretch and preventing manual control of said line circuit means at the other end of the stretch.

11. In a signaling system for single track railroads, a stretch of single track extending between the ends of two passing sidings and divided into track sections, head-block signals at each end of the stretch for governing traffic into the stretch, intermediate signals located at intervals through the stretch corresponding to the ends of the track sections for governing traffic in opposite directions, said head-block and intermediate signals being of the light signal type, line circuit means for said stretch of single track comprising a signal clearing tumble-down circuit and a traffic locking tumble-down circuit for each direction of traffic imposed upon three line wires individual to each track section, said tumble-down circuits receiving energy at the ends of the stretch and being interlocked to normally provide for the energization of the signal clearing tumble-down circuit for the last direction of traffic and for the energization of the traffic locking tumble-down circuit for the opposite direction, manually controlled means at each end of the stretch for causing the deenergization of the particular signal clearing or traffic locking tumble-down circuit then receiving energy from that end of the stretch to thereby cause the signal clearing tumble-down circuits for the signals governing traffic away from that end of the stretch to be energized to clear such signals while the deenergization of the traffic locking tumble-down circuit for the opposite direction prevents said manually controlled means at the opposite end of the stretch from being controlled, means associated with each intermediate signal from illuminating that signal upon the deenergization

of both traffic locking tumble-down circuits, and motor car indicators at the head-block signals controlled by said traffic locking circuits to indicate when it is safe for a motor car to leave a head-block signal to travel through said stretch of single track.

12. In a railroad signaling system for stretches of single track over which traffic can move in either direction between two passing sidings, signals located at intervals through said stretch for both directions of traffic, signal control relay means associated with each signal, signal clearing tumble-down circuits for each direction of traffic comprising successive link circuits, one for each of said signal control relays, said link circuits for opposite directions of traffic being interlocked at each signal location to permit the energization of the tumble-down circuits for only one direction or the other at the same time, a traffic condition relay associated with each signal, traffic condition tumble-down circuits for each direction of traffic including a link circuit for each traffic condition relay and each of the link circuits being controlled through a front contact of the signal control relay means for the opposite direction, whereby the signal clearing tumble-down circuits are energized for only one direction at a time and whereby the traffic condition tumble-down circuits can be energized for only the opposite direction, manually controlled means at each end of the stretch effective when rendered active to deenergize the signal clearing tumble-down circuit and the traffic condition tumble-down circuit governing the signals which govern traffic towards its end of the stretch, said manually controlled means being capable of being rendered active only if either the signal clearing tumble-down circuit or the traffic condition tumble-down circuit for traffic away from that end is energized, and means for illuminating each of said signals when both of the traffic condition relays for that signal location are deenergized.

13. In a railroad signaling system for stretches of single track over which traffic can move in either direction between two passing sidings, signals located at intervals through said stretch for governing traffic in both directions, control relay means associated with each signal and controlled in accordance with the control relay means associated with the signal next in advance for the same direction and in accordance with the traffic conditions in the intervening section to thereby provide a so-called tumble-down circuit, means associated with each signal for causing that signal to indicate clear only when the associated control relay means is energized, means at each signal location including contacts of the control relay means at that signal for interlocking said tumble-down circuits for opposite direc-

tions to permit energization of the relay means for only one direction at a time, manually controlled means at each end of the stretch effective when rendered active to deenergize the tumble-down circuit for the signals governing traffic towards its end to thereby permit energization of the tumble-down circuit for the opposite direction for clearing the signals away from that siding end, and circuit means associated with said stretch and rendered effective when the manually controlled means at one end of the stretch is active to prevent the manually controlled means at the other end of the stretch from also being rendered active, whereby said signals associated with said stretch of track can be cleared for only one direction at a time and whereby a direction of traffic established at one end of the stretch by manual control cannot be interrupted by independent manual control at the opposite end of the stretch.

14. In a signaling system for railroads, a stretch of single track between two passing sidings divided into a plurality of track sections, signals located at the section ends for governing traffic in both directions through the corresponding sections, signal control relay means associated with each signal and capable of clearing its signal only when such relay means is energized, line circuit means for rendering each signal control relay means energizable in accordance with the traffic conditions and the condition of the signal control relay for the signal next in advance for the same direction of traffic to thereby provide a so-called tumble-down circuit organization for each direction of traffic, said tumble-down circuits for each direction of traffic including at each signal location a contact opened when the signal control relay means for the opposite direction of traffic is energized whereby the tumble-down circuits for only one direction of traffic can be energized at a time, traffic controlling circuits extending through said stretch, manually controlled means at each end of the stretch, each being energizable independently in response to manual control from a central office, traffic controlling relay means at each end of the stretch rendered effective in response to the associated manually controlled means to deenergize the tumble-down circuits for the signals governing traffic toward that end to thereby permit the clearing of the signals governing traffic away from that end of the stretch, said traffic controlling relay means being effective to act through said traffic controlling circuits to prevent the response of the traffic controlling relay means at the opposite end of the stretch in response to its associated manually controlled means.

THOMAS J. JUDGE.