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RAILWAY SIGNALING

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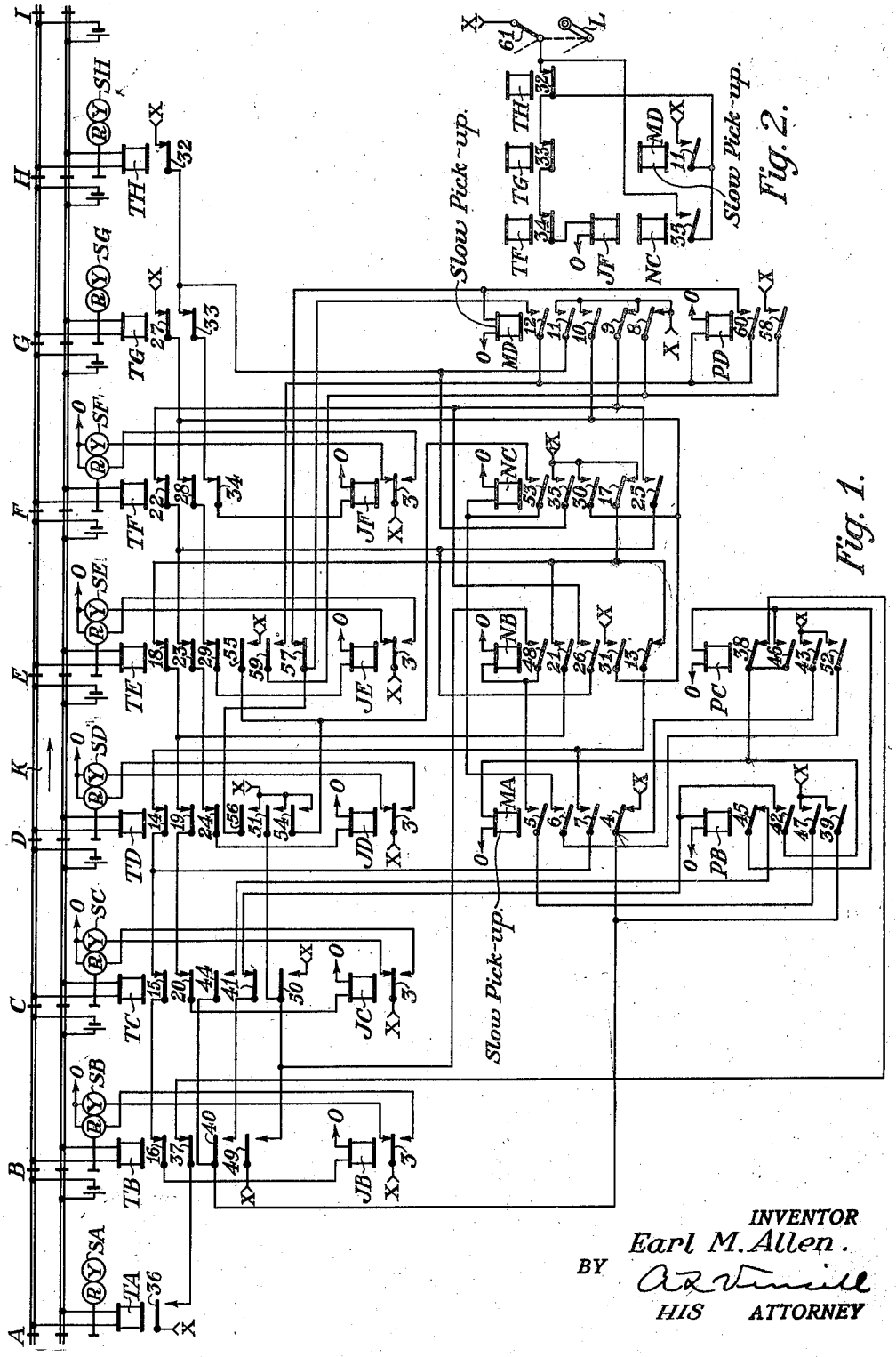

Fig. 2.

Fig. 1.

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RAILWAY SIGNALING

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My invention relates to railway signaling, and has for an object the provision of means for controlling signals in such a manner as to insure safe speed of trains over stretches of track where it is desired to have a number of trains follow each other closely, such for example, as at and near station platforms.

I will describe one form of signaling system embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawing, Fig. 1 is a diagrammatic view illustrating one form of signaling system embodying my invention, and Fig. 2 is a diagrammatic view showing a modification of a portion of Fig. 1, and also embodying my invention.

Similar reference characters refer to similar parts in each of the views.

Referring first to Fig. 1, the reference character K designates a stretch of railway track along which traffic moves in the direction indicated by the arrow. This track is divided by the usual insulated joints to form eight track sections A—B, B—C, C—D, D—E, E—F, F—G, G—H and H—I. Each section is provided with the usual track circuit comprising a track battery 2 and a track relay designated by the reference character T with a suitable distinguishing suffix. Each section is provided with a signal designated by the reference character S with a suitable distinguishing suffix. As here shown, each of these signals comprises only a stop lamp R and a proceed lamp Y, but in actual practice the signals are usually provided with other lamps for giving additional indications.

Each signal is provided with a home relay designated by the reference character J with the same suffix as that applied to the corresponding signal. Each signal is controlled by contact 3 of the associated home relay in such manner that the proceed lamp Y is lighted when the relay is closed and the stop lamp R is lighted when the relay is open. The circuits for these lamps are obvious from the drawing without detailed explanation and in order to simplify the drawing I have omitted the home relays and circuits for signals SA, SG and SH.

Home relay JB is controlled in part by a slow-acting device MA having a first contact 4 which is closed when and only when the device is in its initial condition, and a second contact 5, a third contact 6 and a fourth contact 7, each of which is closed when and only when the device is in its operated condition. Associated with the slow-acting device MA is a normally open stick relay PB and a normally open stick relay PC. Also associated with the slow-acting device MA is a normally open stick relay NB and a normally open stick relay NC.

Home relays JE and JF are controlled in part by a slow-acting device MD having a first contact 8 which is closed when and only when the device is in its initial condition, a second contact 9 which is opened when and only when the device is in its operated condition, and a third contact 10, a fourth contact 11 and a fifth contact 12 each of which is closed when and only when the device is in its operated condition. Associated with the slow-acting device MD is a normally open stick relay PD.

Home relays JC, JD and JE are controlled in part by relay NB and home relays JD, JE and JF are controlled in part by relay NC.

Home relay JB is provided with a first circuit which passes from terminal X of a suitable source of current, through back contact 17 of relay NC, back contact 13 of relay NB, front contact 14 of track relay TD, front contact 15 of track relay TC, front contact 16 of track relay TB, and the winding of relay JB to terminal O of the same source of current; and with a second circuit which passes from terminal X through back contact 17 of relay NC, back contact 13 of relay NB, contact 7 of device MA, front contact 15 of track relay TC, and thence through the same path as the first circuit to terminal O.

Home relay JC is provided with a first circuit which passes from terminal X, through back contact 17 of relay NC, front contact 18 of track relay TE, front contact 19 of track relay TD, front contact 20 of track relay TC, and the winding of relay JC to terminal O; and with a second circuit which passes from terminal X, through back contact 17 of relay NC, front contact 21 of relay NB, front contact 19 of track relay TD, and then through the same path as the first circuit to terminal O.

Home relay JD is provided with three circuits. The first circuit passes from terminal X, through back contact 9 of device MD, front contact 22 of track relay TF, front contact 23 of track relay TE, front contact 24 of track relay TD, and the winding of relay JD to terminal O. The second circuit passes from terminal X, through back contact 9 of device MD, front contact 25 of relay NC, front contact 23 of track relay TE, and thence through the same path as the first circuit to terminal O. The third circuit passes from terminal X, through back contact 9 of device MD, front contact 26 of relay NB, front contact 23

of track relay TE, and thence through the same path as the first circuit to terminal O.

Home relay JE is provided with four circuits. The first circuit passes from terminal X, through front contact 27 of track relay TG, front contact 28 of track relay TF, front contact 29 of track relay TE, and the winding of relay JE to terminal O. The second circuit passes from terminal X, through contact 10 of device MD, front contact 28 of track relay TF, and thence through the same path as the first circuit to terminal O. The third circuit passes from terminal X, through front contact 30 of relay NC, front contact 28 of track relay TF, and thence through the same path as described for the first circuit. The fourth circuit passes from terminal X, through front contact 31 of relay NB, front contact 28 of track relay TF, and thence through the same path as the first circuit to terminal O.

Home relay JF is provided with three circuits. The first circuit passes from terminal X, through front contact 32 of track relay TH, front contact 33 of track relay TG, front contact 34 of track relay TF, and the winding of relay JF to terminal O. The second circuit passes from terminal X, through contact 11 of device MD, front contact 33 of track relay TG, and thence through the same path as the first circuit to terminal O. The third circuit passes from terminal X, through front contact 35 of relay NC, front contact 33 of track relay TG, and thence through the same path as the first circuit to terminal O.

The slow-acting device MA is provided with three operating circuits. The first operating circuit passes from terminal X, through back contact 36 of track relay TA, front contact 37 of track relay TB, back contact 38 of relay PC, and winding of device MA to terminal O. The second operating circuit passes from terminal X, through front contact 39 of relay PB, back contact 40 of track relay TB, front contact 41 of track relay TC, front contact 42 of relay PB, and winding of device MA to terminal O. The third operating circuit passes from terminal X, through front contact 43 of relay PC, back contact 44 of track relay TC, back contact 45 of relay PB, front contact 46 of relay PC, and winding of device MA to terminal O.

The stick relay PB is provided with a pick-up circuit and a stick circuit. The pick-up circuit passes from terminal X, through contact 4 of device MA, back contact 40 of track relay TB, front contact 41 of track relay TC, and winding of relay PB to terminal O. The stick circuit passes from terminal X, through front contact 39 of relay PB, back contact 40 of track relay TB, front contact 41 of track relay TC, and winding of relay PB to terminal O.

The stick relay PC is provided with a pick-up circuit and a stick circuit. The pick-up circuit passes from terminal X, through contact 4 of device MA, back contact 44 of track relay TC, back contact 45 of relay PB, and winding of relay PC to terminal O. The stick circuit passes from terminal X, through front contact 43 of relay PC, back contact 44 of track relay TC, back contact 45 of relay PB, and winding of relay PC to terminal O.

The stick relay NB is provided with a pick-up circuit which passes from terminal X, through front contact 47 of relay PB, contact 5 of device MA, and winding of relay NB to terminal O; and with a stick circuit comprising its own front contact 48 and back contacts 49, 50 and 51 in multiple of track relays TB, TC, and TD, respectively.

The stick relay NC is provided with a pick-up circuit which passes from terminal X, through front contact 52 of relay PC, contact 6 of device MA, and winding of relay NC to terminal O; and with a stick circuit comprising its own front contact 53 and back contacts 54 and 55 in multiple of track relays TD and TE, respectively.

The slow-acting device MD is provided with a first operating circuit and a holding and second operating circuit combined. The first operating circuit passes from terminal X, through back contact 56 of track relay TD, front contact 57 of track relay TE, and winding of device MD to terminal O. The holding and second operating circuit passes from terminal X, through front contact 58 of relay PD, back contact 59 of track relay TE, front contact 60 of relay PD, and winding of device MD to terminal O.

The stick relay PD is provided with two pick-up circuits and one stick circuit. The first pick-up circuit passes from terminal X, through back contact 56 of track relay TD, contact 12 of device MD, and winding of relay PD to terminal O. The second pick-up circuit passes from terminal X, through contact 8 of device MD, back contact 59 of track relay TE, and winding of relay PD to terminal O. The stick circuit passes from terminal X, through front contact 58 of relay PD, back contact 59 of track relay TE, and winding of relay PD to terminal O.

From the foregoing description, it will be seen that the signals SB, SC, SD, SE and SF will each display the stop indication if any one of the three sections immediately in advance of each signal is occupied. When, however the two sections immediately in advance of each signal are both unoccupied, these signals may be caused, under certain conditions which will hereinafter be described, to indicate proceed by means of contacts on slow-acting devices MA and MD and on relays NB and NC, even though the third section in advance of each signal is occupied.

The slow-acting device MA has three cycles of operation. The first cycle is initiated by the closing of back contact 36 when track relay TA releases provided front contact 37 of track relay TB and back contact 38 of relay PC are both closed. The second cycle is initiated by the closing of front contact 42 of relay PB and the third cycle is initiated by the closing of front contact 46 of relay PC. The relay PB is picked up by the closing of back contact 40 when track relay TB is released, provided contact 4 of device MA and front contact 41 of track relay TC are both closed; and it is stuck up by the closing of its own front contact 39. The relay PC is picked up by the closing of back contact 44 when track relay TC is released, provided contact 4 of device MA and back contact 45 of relay PB are both closed; and it is stuck up by the closing of its own front contact 43.

The relay NB is picked up by the closing of contact 5 of the device MA provided front contact 47 of relay PB is closed; and it is stuck up by the closing of its own front contact 48 and the closing of any one of back contacts 49, 50 or 51 of track relays TB, TC, and TD, respectively. The relay NC is picked up by the closing of contact 6 of the device MA provided front contact 52 of relay PC is closed; and it is stuck up by the closing of its own front contact 53 and the closing of either back contact 54 or back contact 55 of track relay TD or TE.

The combination of the slow-acting device MA and its associated relays PB and PC provides

therefore, in conjunction with the track relays TA, TB, and TC, a means for initiating three operating periods of the device MA depending upon which of the three sections A—B, B—C or C—D is occupied; and, also, the device MA with the associated relays NB and NC provides a means which is responsive to the completed operation of the device in each period.

The slow-acting device MD is set into operation by the closing of back contact 56 of track relay TD, provided front contact 57 of track relay TE is closed. If this device completes its operation so as to close contact 12 before front contact 57 of track relay TE opens, the first pick-up circuit for relay PD will be established. The energization of relay PD will close its own front contacts 58 and 60, which will establish the holding circuit for device MD as soon as back contact 59 of track relay TE becomes closed. If, however, the device MD fails to complete its operation before the opening of front contact 57 of track relay TE, the device returns to its initial condition thereby reclosing contact 8. The reclosing of contact 8 establishes the second pick-up circuit for relay PD when back contact 59 of track relay TE becomes closed. The energization of relay PD establishes its own stick circuit through the closing of front contact 58 of relay PD which also initiates the second operation of the device MD by the closing of front contact 60 of relay PD.

The combination of the slow-acting device MD and the relay PD provides, therefore, in conjunction with the associated track relays, a means for initiating the operation of the device in section D—E, a means for holding this device in the operated condition while section E—F is occupied if it completes its operation during the occupancy of section D—E, and a means for again initiating the operation of this device when section E—F is occupied if it fails to complete its operation while section D—E is occupied.

The home relay JB will be energized by the closing of contact 7 of the device MA, provided back contact 17 of relay NC, back contact 13 of relay NB, front contact 15 of track relay TC, and front contact 16 of track relay TB is each closed, even though front contact 14 of track relay TD is open.

The home relay JC will be energized by the closing of front contact 21 of relay NB, provided back contact 17 of relay NC, front contact 19 of track relay TD, and front contact 20 of track relay is each closed, even though front contact 18 of track relay TE is open.

The home relay JD will be energized by the closing of either front contact 25 of relay NC or front contact 26 of relay NB, provided back contact 9 of the device MD, front contact 23 of track relay TE, and front contact 24 of track relay TD is each closed, even though front contact 22 of track relay TF is open.

The home relay JE will be energized by the closing of either contact 10 of the device MD, or front contact 30 of relay NC or front contact 31 of relay NB, provided front contact 28 of track relay TF and front contact 29 of track relay TE is each closed, even though front contact 27 of track relay TG is open.

The home relay JF will be energized by the closing of either contact 11 of the device MD or front contact 35 of relay NC, provided front contact 33 of track relay TG and front contact 34 of track relay TF is each closed, even though front contact 32 of track relay TH is open.

Home relay JB will not be energized by the closing of contact 7 on the device MA at the completion of the second and third operating periods of this device, since the first control circuit of relay JB will be opened by either back contact 13 of relay NB or back contact 17 of relay NC. These back contacts also have another function in that they prohibit a train from passing signal SB or SC and thereby establishing the pick-up circuit for relay NB or NC while these relays are being held energized by a preceding train.

The first control circuit for home relay JD includes back contact 9 of the device MD to insure a stop indication at signal SD while the device MD is in the operated condition.

The operation of the system is as follows: Assuming that all of the apparatus is in the condition as shown in the drawing, signals SB, SC, SD, SE, and SF indicate proceed because home relays JB, JC, JE, JD, and JF are energized.

I will now assume that a first train enters section A—B and proceeds through sections B—C and C—D, to section D—E, thus causing signals SB, SC, and SD to display the stop indication. For convenience, it will be assumed that the first train does not cause operation of either slow-acting device MA or slow-acting device MD and, therefore, back contact 13 of relay NB, back contact 17 of relay NC, and back contact 9 of the device MD will remain closed. I will now assume that a second train enters section A—B thereby closing back contact 36 of track relay TA to initiate the first operation of slow-acting device MA. The second train is prohibited from entering section B—C before the device has completed its operation; since the first control circuit for relay JB is opened by front contact 14 of track relay TD; and the second control circuit for relay JB is not closed until device MA completes its operation and contact 7 of the device becomes closed. Thus the second train is forced to consume a given time interval in section A—B in order to provide itself with a proceed indication at signal SB.

I will now assume that the first train has advanced to section E—F, thus causing signals SC, SD, and SE to display the stop indication. The second train now enters section B—C thereby releasing track relay TB to open the first operating circuit for the device MA, and to initiate the second operating circuit. The second train is prohibited from entering section C—D before the device has completed its operation; since the first control circuit for relay JC is opened by front contact 18 of track relay TE; and the second control circuit is not closed until device MA completes its second operation to energize relay NB, and front contact 21 of relay NB becomes closed. Thus the second train is forced to consume a given time interval in section B—C in order to provide itself with a proceed indication at signal SC.

I will now assume that the first train has advanced to section F—G, thus causing signals SF, SE, and SD to display the stop indication. The second train now enters section C—D thereby releasing track relay TC to open the second operating circuit for the device MA and to initiate the third operating circuit. If the second train consumed the required time in section B—C, it will find signal SD displaying the proceed indication; since the third control circuit for home relay JD has already been closed by the closing of front contact 26 of relay NB. If, however, the second train failed to consume the required time

in section B—C, the train will be prohibited from entering section D—E before the device MA has completed its operation; since the first and third control circuits for the home relay JD are opened by front contacts 22 and 26 of track relay TF and relay NB, respectively; and the second control circuit is not closed until the device MA completes its third operation to energize relay NC, and front contact 25 of relay NC becomes closed. Thus the second train is forced to consume a given time interval in section C—D in order to provide a proceed indication at signal SD only if the train failed to consume the required time in section B—C.

I will now assume that the first train has advanced to section G—H, thus causing signals SG, SF, and SE to display the stop indication. The second train now enters section D—E thereby releasing track relay TD to initiate the operation of slow-acting device MD. If the second train consumed the required time in either section B—C or section C—D, it will find the signal SE displaying the proceed indication; since either the third or the fourth control circuit for home relay JE has already been established by the closing of front contact 30 of relay NC or by the closing of front contact 31 of relay NB. If, however, the second train failed to consume the required time in either section B—C or section C—D, the train will be prohibited from entering section E—F before the device MD has completed its operation; since the first control circuit for the relay JE is opened by front contact 27 of track relay TG; and the third and fourth control circuits are opened by front contacts 30 and 31 of relays NC and NB respectively; and the second control circuit is not closed until the device MD completes its operation, and contact 10 of this device becomes closed. Thus the second train is forced to consume a given time interval in section D—E to provide a proceed indication at signal SE only if the train failed to consume the required time in either section B—C or section C—D.

I will now assume that the first train has advanced to section H—I, thus causing signals SH, SG, and SF to display the stop indication. The second train now enters section E—F, thereby releasing track relay TE to establish the stick circuit for the device MD if the train consumed the required time in section D—E, or to initiate the second operation of the device MD if the train failed to consume the required time in section D—E. If the second train consumed the required time in either section C—D or section D—E, it will find the signal SF displaying the proceed indication; since either the second or the third control circuit for the home relay JF has already been closed, either by the closing of contact 11 of the device MD or by the closing of front contact 35 of relay NC, respectively. If, however, the second train failed to consume the required time in either section C—D or D—E, the train will be prohibited from entering section E—F before the device MD has completed its operation; since the first control circuit for the relay JF is opened by front contact 32 of the track relay TH; and the second and third control circuits are opened by contact 11 and front contact 35 of the device MD and relay NC, respectively; and the second control circuit is not again established until the device MD completes its second operation, and contact 11 of this device becomes closed. Thus the second train is forced to consume a given time interval in section E—F to provide a proceed indication at signal SF only if the train failed to consume the required time in either section C—D or section D—E.

The home relay for signal SA is not shown; but I wish to point out that in actual practice a back contact of the slow acting device MA will usually be introduced into the control circuit for signal SA to insure that a restrictive indication is displayed in the event of the device MA being improperly held in the operated condition.

While, as here shown, the first control circuits for the home relays extend over three sections of track in advance of the associated signals, and the second, third and fourth control circuits include only two sections, it is understood that these circuits need not necessarily be limited to the number of track sections shown.

Referring now to Fig. 2, I have shown a modification of the control circuits for home relay JF in which I have introduced apparatus not responsive to traffic conditions for opening the first control circuit. This apparatus, as here shown, is a contact 61, actuated by a manually operable lever L, either one or both of which may be placed adjacent the track or at some remote point. It is obvious without detailed description that, provided track relays TF and TG are closed, if contact 11 of device MD is closed, home relay JF will be energized and signal SF will display a proceed indication, although either contact 32 of track relay TH or contact 61 actuated by lever L might be open.

A contact similar to 61, actuated by a lever or other means, might also be included in the control circuits for the home relays JB, JC, JD, and JE.

From the foregoing, it is readily apparent that I have provided two slow-acting devices MA and MD, with their associated relays, for the five sections A—B, B—C, C—D, D—E, and E—F, and that these devices are so controlled, that in order to provide clear indications at signals SB, SC, SD, SE, and SF when these signals are caused to indicate stop by the occupancy of the third section in advance of each signal, a train must consume a given time interval in section A—B for signal JB, in section B—C for signal JC, in section B—C or C—D for signal JD, in section B—C, C—D or D—E for signal JE, or in section C—D, D—E or E—F for signal JF. In other words, a train must consume a measured amount of time in at least three of the five sections in order to provide proceed indications at the signals involved under the conditions outlined above; that is, when these signals are caused to indicate stop by the occupancy of the third section in advance of each signal, assuming that track K is at or near a station platform where it is desirable to permit a number of trains to follow each other under close headway, it will be seen that I have provided an effective means for governing the speed of such trains over this portion of track.

Although I have herein shown and described only two forms of apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, eight sections of railway track, a signal for each of five of said sections, means for causing each signal to indicate stop when any one of the three sections in advance

of such signal is occupied, a first slow-acting device, means for initiating the operation of said device when a train enters the first section, means for again initiating the operation of said first device when the train enters the second section, means for initiating a third operation of said first device when the train enters the third section, a first means responsive only if the second operation of said first device is completed during passage of the train through the second section, a second means responsive only if the third operation of said first device is completed during passage of the train through the third section, a second slow-acting device, means for initiating the operation of said second device when the train enters the fourth section, means for holding said second device in its operated condition only if the operation of the second device is completed during passage of the train through the fourth section, means for again initiating the operation of said second device when the train enters the fifth section if the operation of the second device is not completed during passage of the train through the fourth section; means operating when the third section in advance of each signal is occupied, for clearing the first signal provided said second means and said first means is each in its initial condition if the operation of said first device is completed during passage of the train through the first section, for clearing the second and third and fourth signals provided said second means is in its initial condition if the operation of said first device is completed during passage of the train through the second section, for clearing the third and fourth and fifth signals provided said second device is in its initial condition if the operation of said first device is completed during passage of the train through the third section, for clearing the fourth signal if the operation of said second device is completed during passage of the train through the fourth section, and for clearing the fifth signal if the operation of said second device is completed during passage of the train through either the fourth section or the fifth section.

2. In combination, a stretch of railway track divided into five sections, a first slow-acting device, means for initiating the operation of said first device when a train enters the first section, means for again initiating the operation of said first device when the train enters the second section, means for initiating a third operation of said first device when the train enters the third section, a second slow-acting device, means for initiating the operation of said second device when the train enters the fourth section, means for holding said second device in its operated condition while the train traverses the fourth section only if the operation of said second device is completed during passage of the train through the fourth section, means for again initiating the operation of said second device when the train enters the fifth section if the operation of said second device is not completed when the train enters the fifth section, a first means responsive to the second completed operation of said first device, a second means responsive to the third completed operation of said first device; and signals for said stretch of track controlled in part by said first device, said second device, said first means and said second means.

3. In combination, eight sections of railway track, a signal for each of five of said sections, means for causing each signal to indicate stop if any one of the three sections in advance of such signal is occupied, two timing devices controlled by traffic conditions in certain of said eight sections, and means controlled by said two timing devices for clearing each of said five signals if a measured time interval is consumed by a train in traversing the section immediately in the rear of such signal when the third section in advance of the signal is occupied.

4. In combination, four sections of railway track, a slow-acting device having a first contact closed when and only when the device is in its initial condition and a second and a third and a fourth contact each closed when and only when the device is in its operated condition, means for initiating the operation of said device when a train enters the first section, means for again initiating the operation of said device when the train enters the second section if and only if said first contact is closed, means for a third time initiating the operation of said device when the train enters the third section if and only if said first contact is closed, a first normally open relay closed only if said second contact becomes closed during passage of the train through the second section, a second normally open relay closed only if said third contact becomes closed during passage of the train through the third section, a signal for the second section, means for causing said signal to indicate stop if the fourth section is occupied, means for clearing said signal when the fourth section is occupied if and only if said fourth contact becomes closed during passage of the train through the first section, means including a back contact on said first relay and a back contact on said second relay to prevent the clearing of said signal by either the second or the third completed operation of said device, and signals for the second and third sections controlled in part by said first relay and said second relay.

5. In combination, five sections of railway track, a slow-acting device, means for initiating the operation of said device when a train enters the first section, means for again initiating the operation of said device when the train enters the second section, a normally open relay closed only if the second operation of said device is completed during passage of the train through the second section, a signal for the second section, a signal for the third section, means for causing said signal for the second section and said signal for the third section each to indicate stop when any one of the three sections in advance of such signal is occupied, means for clearing said signal for the second section if the fourth section is occupied if and only if the operation of said device is completed during passage of the train through the first section, and means including a front contact on said relay for clearing said signal for the third section if the fifth section is occupied.

6. In combination, six sections of railway track, a slow-acting device, means for initiating the operation of said device when a train enters the first section, means for again initiating the operation of said device when the train enters the second section, means for initiating the third operation of said device when the train enters the third section, a first normally open relay closed only if the second operation of said device is completed during the passage of the train through the second section, a second normally open relay closed only if the third operation of said device is completed during the passage of the train through the third section, a second signal

for the second section, a third signal for the third section, a fourth signal for the fourth section, means for causing said second and said third and said fourth signal each to indicate stop when any one of the three sections in advance of such signal is occupied, means for clearing said second signal if the fourth section is occupied if and only if the operation of said device is completed during the passage of said train through the first section, means including a front contact of said first relay for clearing said third signal if the fifth section is occupied, and means including a front contact of said second relay for clearing said fourth signal if the sixth section is occupied.

7. In combination, six sections of railway track, a first slow-acting device, means for initiating the operation of said first device when a train enters the first section, a relay closed only if the operation of said device is completed during the passage of the train through the first section, a second slow-acting device, means for initiating the operation of said second device when the train enters the second section, means for holding said second device in its operated condition while the train traverses the third section if and only if the operation of the second device is completed during the passage of the train through the second section, means for again initiating the operation of said second device when the train enters the third section if the operation of said second device is not completed during the passage of the train through the second section, a signal for the fourth section, means responsive to traffic conditions in the three sections in advance of said signal for causing the signal to indicate stop, apparatus not responsive to traffic conditions for also causing said signal to indicate stop, means including a front contact of said relay for clearing said signal if the signal is caused to indicate stop by traffic conditions in the third section in advance, and means operating only if said second device is in its operated condition for also clearing said signal if the signal is caused to indicate stop either by traffic conditions in the third section in advance or by said apparatus or by both.

8. In combination, six sections of railway track, a first slow-acting device, means for initiating the operation of said first device when a train enters the first section, a relay closed only if the operation of said device is completed during the passage of the train through the first section, a second slow-acting device, means for initiating the operation of said second device when the train enters the second section, means for holding said second device in its operated condition while the train traverses the third section if and only if the operation of the second device is completed during the passage of the train through the second section, means for again initiating the operation of said second device when the train enters the third section if the operation of said second device is not completed during the passage of the train through the second section, a signal for the fourth section, means responsive to traffic conditions in the three sections in advance of said signal for causing the signal to indicate stop, manually operable apparatus for also causing said signal to indicate stop, means including said relay for clearing said signal if the signal is caused to indicate stop by traffic conditions in the third section in advance, and means operating only if said second device is in its operated condition for also clearing said signal if the signal is caused to indicate stop either by traffic conditions in the third section in advance or by said manually operable apparatus or by both.

9. In combination, four sections of railway track, a track circuit including a track relay for each section, a slow-acting device, an operating circuit for said device including a back contact of the track relay for the first section and a front contact of the track relay for the second section, a signal for the second section, a first controlling circuit for said signal including a front contact of the track relay for the fourth section and a second controlling circuit for said signal including a contact closed only when said slow-acting device is in its operated condition.

10. In combination, five sections of railway track, a track circuit including a track relay for each section, a slow-acting device, a normally open stick relay, a pick-up circuit for said stick relay including a contact closed only when said device is in its initial condition and a back contact of the track relay for the second section, a stick circuit for said stick relay including a back contact of the track relay for the second section, a first operating circuit for said device including a back contact of the track relay for the first section and a front contact of the track relay for the second section, a second operating circuit for said device including a front contact of said stick relay, a second normally open relay, a circuit for said second relay including a front contact on said stick relay and a contact closed only when said device is in its operated condition, a signal for the second section, a signal for the third section, a first controlling circuit for the signal for the second section including a front contact of the track relay for the fourth section, a first controlling circuit for the signal for the third section including a front contact of the track relay for the fifth section, a second controlling circuit for the signal for the second section including a back contact of said second relay and a contact closed only when the device is in its operated condition, and a second controlling circuit for the signal for the third section including a front contact of said second relay.

11. In combination, six sections of railway track, a track circuit including a track relay for each section, a slow-acting device, a first normally open stick relay, a second normally open stick relay, a pick-up circuit for said first relay including a contact closed only when said device is in its initial condition and a back contact of the track relay for the second section and a front contact of the track relay for the third section, a pick-up circuit for said second relay including a contact closed only when said device is in its initial conditon and a back contact of the track relay for the third section and a back contact of said first relay, a stick circuit for said first relay including a back contact of the track relay for the second section and a front contact of the track relay for the third section, a stick circuit for said second relay including a back contact of the track relay for the third section and a back contact of said first relay, a first operating circuit for said device including a back contact of the track relay for the first section and a front contact of the track relay for the second section and a back contact of said second relay, a second operating circuit for said device including a front contact of said first relay, a third operating circuit for said device including a front contact of said second relay, a third normally open relay, a fourth normally open relay, a circuit for said

thrd relay including a front contact of said first relay and a contact closed only when said device is in its operated condition, a circuit for said fourth relay including a front contact of said second relay and a contact closed only when said device is in its operated condition, a signal for the second section, a signal for the third section, a signal for the fourth section, a first controlling circuit for the signal for the second section including a front contact of the track relay for the fourth section, a first controlling circuit for the signal for the third section including a front contact of the track relay for the fifth section, a first controlling circuit for the signal for the fourth section including a front contact of the track relay for the sixth section, a second controlling circuit for the signal for the second section including a back contact of said third relay and a back contact of said fourth relay as well as a contact closed only when said device is in its operated condition, a second controlling circuit for the signal for the third section including a front contact of said third relay, and a second controlling circuit for the signal for the fourth section including a front contact of said fourth relay.

12. In combination, a plurality of sections of railway track, a signal for each of five of said sections, means for causing each signal to display the stop indication if a certain section in advance of such signal is occupied, two slow-acting relays controlled by traffic conditions in certain of said plurality of track sections, and means controlled by said two slow-acting relays for causing each of said five signals to display the proceed indication if a measured time interval is consumed by a train in traversing the section immediately in the rear of such signal when said certain section in advance of the signal is occupied.

13. In combination, a plurality of sections of railway track, a slow-acting device, means for initiating the operation of said device when a train enters the first section, means for again initiating the operation of said device when the train enters the second section, a normally open relay closed only if the second operation of said device is completed during passage of the train through the second section, a signal for the second section, a signal for the third section, means for causing said signal for the second section and said signal for the third section each to indicate stop when a certain section in advance of such signal is occupied, means for clearing said signal for the second section if said certain section in advance of such signal is occupied if and only if the operation of said device is completed during passage of the train through the first section, and means including a front contact on said relay for clearing said signal for the third section if said certain section in advance of such signal is occupied.

14. In combination, a stretch of railway track divided into a plurality of track sections each having a track circuit including a track relay, two timing devices controlled by said track relays, a plurality of signals one for each section of a portion of said stretch governed by one of said timing devices, and another plurality of signals one for each section of another portion of said stretch controlled by both said timing devices.

15. In combination, a stretch of railway track divided into a plurality of track sections, a first timing mechanism controlled by traffic conditions in three successive sections of said track sections, a second timing mechanism controlled by traffic conditions in two successive sections of said track sections, and a plurality of traffic governing devices for said stretch all of which are controlled by said first timing mechanism and certain of which are also controlled by said second timing mechanism.

16. In combination, a stretch of railway track divided into a plurality of track sections, a signal for each of five of said sections, a first timing device controlled by traffic conditions in the first three successive track sections, a second timing device controlled by traffic conditions in the next two successive track sections, two relays controlled by said first timing device, and means including contacts of said first timing device and said second timing device as well as contacts of said two relays for at times controlling said plurality of signals.

17. In combination, a stretch of railway track divided into a plurality of track sections, a single timing mechanism controlled by traffic conditions in certain of said plurality of track sections, means controlled by said timing mechanism and by traffic conditions in other of said sections, and five signals one for each of five sections of said stretch controlled by said single timing mechanism and by said means.

18. In combination, a stretch of railway track divided into a plurality of track sections, a plurality of signals one for each of certain of said sections, means for causing each signal to indicate stop if any one of the three sections in advance of such signal is occupied, two timing devices controlled by traffic conditions in certain of said plurality of sections, and means for each section controlled jointly by said two timing devices for causing each of said signals to display a proceed indication if the speed of a train moving over said stretch is properly controlled even though the third section in advance of each such signal is occupied by another train.

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