Dec. 22, 1925. **1,566,334**

R. A. McCANN

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Nov. 10, 1923 2 Sheets-Sheet 1

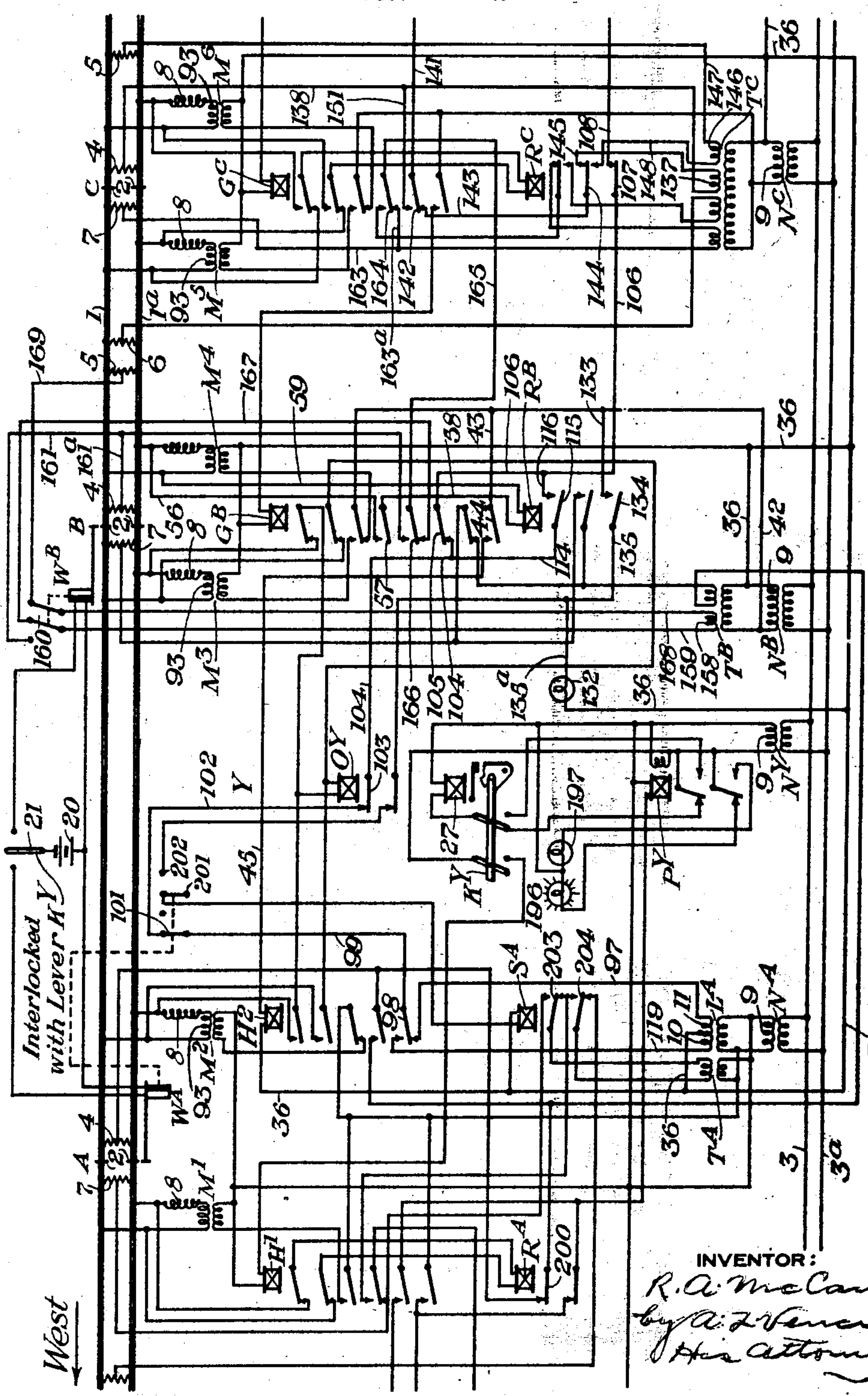

Fig. 1.

INVENTOR:
R. A. McCann,
by A. L. Vencill
His Attorney

Dec. 22 1925. 1,566,334

R. A. McCANN

RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Nov. 10, 1923 2 Sheets-Sheet 2

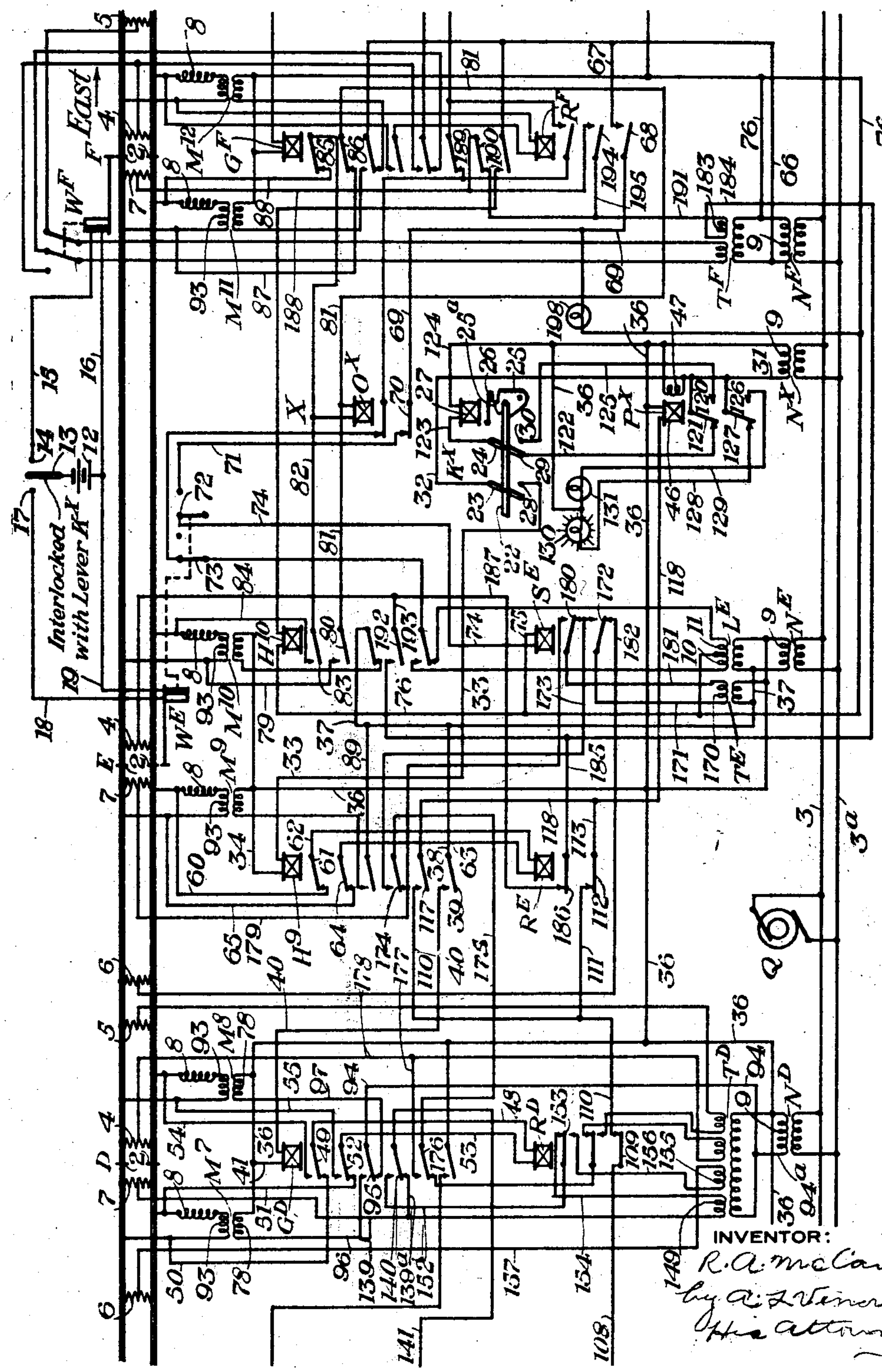

Fig. 2.

INVENTOR:
R. A. McCann,
by A. L. Vencill
His attorney

Patented Dec. 22, 1925. **1,566,334**

UNITED STATES PATENT OFFICE.

RONALD A. McCANN, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

Application filed November 10, 1923. Serial No. 674,058.

To all whom it may concern:

Be it known that I, RONALD A. McCANN, a citizen of the United States, residing at Swissvale, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Railway-Traffic-Controlling Apparatus, of which the following is a specification.

My invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type comprising train carried governing apparatus controlled by energy received from the trackway. More particularly my present application relates to the trackway portion of such apparatus.

I will describe one form and arrangement of railway traffic controlling apparatus embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawing, Figs. 1 and 2, when placed end to end with Fig. 1 on the left, constitute a diagrammatic view showing one form of trackway apparatus embodying my invention.

Referring to these drawings, the reference characters 1 and 1^a designate the track rails of a railway over which traffic normally moves in both directions. These rails are divided, by means of insulated joints 2, into a plurality of successive sections, A—B, B—C, C—D, D—E, E—F, etc. Located adjacent each end of each such track section is a track transformer here designated by the reference character M with a suitable distinguishing exponent. The secondary 93 of each such track transformer M is constantly connected across the rails of the associated section, an impedance 8 being interposed between the secondary and one track rail. The supply of alternating current to the primaries of the track transformers will be explained in detail hereinafter.

Traffic over the portion of track between points A and F is controlled from an interlocking station, designated in general by the reference character X and located adjacent the section E—F, and traffic over the portion of track to the left of point B is controlled by an interlocking station Y located adjacent section A—B.

Traffic from west to east over the stretch of track shown in the drawing is governed by track signals W^A and W^E, whereas traffic from east to west over this stretch of track is governed by signals W^F and W^B. These signals may be of any convenient form and as here shown are manually controlled semaphore signals, each comprising a semaphore blade capable of assuming two distinctive positions in which the signal displays a "proceed" or a "stop" indication.

Signals W^E and W^F are controlled from station X, this control being accomplished as shown in the drawing by means of a manually operated lever 13. When this lever is in its left-hand position an operating circuit for signal W^E is closed and current flows from a suitable source of energy, such as a battery 12, through lever 13, contact 17, wire 18, operating mechanism of signal W^E, wire 19 and back to battery 12, thus causing signal W^E to indicate proceed. If the operator wishes to clear signal W^F he moves lever 13 into its right-hand position, thus closing the operating circuit for signal W^F and current flows from battery 12 through lever 13, contact 14, wire 15, operating mechanism of signal W^F, and wire 16 back to battery 12. When this circuit is closed, signal W^F indicates proceed. If lever 13 is moved to an intermediate position as shown in the drawing the operating circuits for signals W^E and W^F are both opened and these signals both indicate stop. It will also be noticed that when either of the two opposing signals controlled by lever 13 indicates proceed, the other indicates stop. Signals W^B and W^A are supplied with current from battery 20 and controlled by lever 21 located at point Y in a manner similar to the control of signals W^E and W^F by lever 13.

The direction of traffic over the portion of track shown in the drawing is controlled by manually operable switches K^X and Y^Y, located at stations X and Y, respectively. Referring particularly to station X, switch K^X comprises a bar 22 operatively connected with two pivoted levers 23 and 24 and a locking segment 25. When switch K^X is in its left-hand position as shown in the drawing lever 24 engages contact 29. When the bar 22 is moved to its reverse or right-hand position, lever 24 engages contact 30 and lever 23 engages contact 28. An electric lock 27 is provided with an armature 26 arranged to engage a dog 25^a on segment 25 when the lock is de-energized but to disengage this dog when the lock is energized. The locking segment 25 and the armature 26 are so proportioned and so disposed that switch K^X can be moved from either extreme position only when lock 27 is energized.

The switch K^X is also interlocked with lever 13, by means forming no part of my present invention and omitted from the drawing for the sake of simplicity, in such a manner that switch K^X may be operated to change the direction of traffic over the stretch which it governs only when lever 13 is in its intermediate position, thus insuring that both signals W^E and W^F are at stop.

Switch K^Y located at point Y is controlled in the same manner as just described for switch K^X, and is interlocked with lever 21 so that switch K^Y may be operated to change the direction of traffic through the stretch of track which it governs only when signals W^A and W^B are both at stop.

Located adjacent the junction of each two adjacent track sections is a line transformer designated by the reference character N with an exponent corresponding to the location. The primary of each such line transformer is constantly supplied with alternating current from a suitable source of energy, such as an alternator Q, over line wires 3 and 3^a.

Located at each of the points B, C, D and F is a directional relay designated by the reference character G with an exponent corresponding to the location. Two similar directional relays H′ and H^2 are located at point A, and two other similar directional relays H^9 and H^{10} are located at point E. Relays H^9, G^D, G^C, G^B and H^2 are controlled in cascade by switch K^X in the following manner:

When switch K^X is moved into its right hand or reverse position a circuit is closed for relay H^9 over which current flows from secondary 9 of line transformer N^X, through wires 31 and 32, lever 23 and contact 28 of switch K^X, wire 33, winding of directional relay H^9, wires 34 and 36 back to secondary 9 of transformer N^X. This circuit is closed only when switch K^X is in its reverse position under which condition relay H^9 is energized. The energization of relay H^9 closes a circuit for relay G^D and current flows from secondary 9 of transformer N^E through wires 37 and 38, front contact 39 of directional relay H^9, wire 40, winding of relay G^D, and wires 41 and 36 back to secondary 9 of transformer N^E. Relay G^C is controlled by relay G^D, and relay G^B in turn by relay G^C, in the same manner as just described for the control of relay G^D by relay H^9. When relay G^B becomes energized a circuit is closed which passes from secondary 9 of transformer N^B, through wires 42 and 43, front contact 44 of relay G^B, wire 45, winding of relay H^2, and wire 36 back to transformer N^B. It will thus be plain that when switch K^X is reversed, relays H^9, G^D, G^C, G^B and H^2 are successively energized, and that if switch K^X is then returned to its normal or left-hand position, these relays will be successively de-energized. Relay H′ and other directional relays associated with the track to the left of point A and not shown in the drawing are controlled by switch K^Y, and relays H^{10}, G^F, and other directional relays associated with the track to the right of point F are controlled by a switch similar to K^Y, in a similar manner.

A track relay designated by the reference character R with an exponent corresponding to the location is located adjacent the junction of each two track sections. Referring for example to relay R^D, this relay is at times connected across the right-hand end of section C—D through a circuit which passes from rail 1 of section C—D through wire 50, back contact 49 of directional relay G^D, wire 48, winding of track relay R^D, wire 53, back contact 52 of relay G^D and wire 51 back to rail 1^a of section C—D. This circuit is, of course, closed only when relay G^D is de-energized. When relay G^D is energized, track relay R^D is disconnected from section C—D and is connected across the left-hand end of section D—E, and the circuit then passes from rail 1 of section D—E through wire 55, front contact 52 of relay G^D, wire 53, winding of relay G^D, wire 48, front contact 49 of relay G^D, and wire 54 back to rail 1^a of section D—E. The control of relay R^C by relay G^C is similar to that just explained in connection with the control of relay R^D by relay G^D. Relay R^B is provided with a circuit which passes from rail 1 of section B—C through wire 59, winding of relay R^B, wire 58, front contact 57, of relay G^B, and wire 56 back to rail 1^a of section B—C. It follows that when relay G^B is energized relay R^B is connected across the rails adjacent the left-hand end of section B—C, but that when relay G^B is de-energized relay R^B is disconnected from section B—C and is therefore de-energized. The control of relay R^F is similar to the control of relay R^B and will be understood from the drawing. Relay R^A is at times connected with the right-hand end of the section to the left of point A by relay H′. Similarly relay R^E is at times connected with the right-hand end of section D—E by relay H^9.

In addition to the track relays already described, a track relay O^X located at point X is at times connected with section E—F in the following manner:

When directional relay H^{10} is energized, track relay O^X is connected across the rails adjacent the left-hand end of section E—F by means of a circuit which may be traced from rail 1 of section E—F through wire 79, front contact 80 of relay H^{10}, wire 81, winding of relay O^X, wire 82, front contact 83 of relay H^{10} and wire 84 back to rail 1^a. When relay G^F is de-energized relay O^X is connected across the rails adjacent the right-hand end of section E—F, the circuit then passing from rail 1 through wire 87, back contact 86 of relay G^F, wire 81, winding of relay O^X, wire 82, back contact of relay G^F and wire 88 back to rail 1^a. Track relay O^Y located at Y is similarly controlled by directional relays H^2 and G^B.

Associated with track relay R^F is a repeater relay S^E, this latter relay being provided with a circuit which passes from the secondary 9 of transformer N^F, through wires 66 and 67, front contact 68 of relay R^F, wire 69, contact 70 of track relay O^X, wire 76, contact 72 operated by signal W^E, wire 74, winding of relay S^E, and wires 75 and 76 back to transformer N^F. It follows that relay S^E is energized only when signal W^E indicates proceed and relay R^F is energized. A second repeater relay S^A is controlled by track relay R^B and by signal W^A in the same manner just described in connection with relay S^E.

The supply of energy to the primary 78 of each track transformer M is controlled by an adjacent directional relay G or H in the following manner:

Referring for example to the apparatus located at point D, transformer M^7 is provided with a circuit which passes from secondary 9 of transformer N^D, through wires 94^a and 94, front contact 95 of relay G^D, wire 96, primary winding 78 of transformer M^7, and wire 36 back to transformer N^D. Transformer M^8 is provided with a circuit which passes from a secondary 9 of transformer N^D through wires 94^a and 94, back contact 95 of relay G^D, wire 97, primary 78 of transformer N^8 and wire 36 back to transformer N^D. It will thus be plain that track circuit current is supplied to the left-hand end of section D—E by track transformer M^8 or to the right-hand end of section C—D by track transformer M^7 depending upon whether relay G^D is de-energized or energized respectively. The control of track transformers M^3, M^4, M^5 and M^6 and of transformers M^{11} and M^{12} will be readily understood from the foregoing. In a similar manner transformers M^9 and M' are energized only when relays H^9 and H' respectively are energized. Transformers M^{10} and M^2 are so arranged that energy is supplied to the primary of these transformers only when directional relays H^{10} and H^2, respectively, are de-energized.

As shown in the drawing switch K^X is in the normal or left-hand position and the directional relays H^2, G^B, G^C, G^D, and H^9 are de-energized. Similarly, switch K^Y is in its normal position and relay H' is de-energized. Directional relays H^{10} and G^F are also de-energized. Under these conditions each section is supplied with track circuit current from the track transformer located adjacent its left-hand end and connected with a track relay at its right-hand end. If switches K are operated to energize directional relays H and G, each track section will be supplied with track circuit current over the track transformer located adjacent its right hand end and will be connected with a track relay at its left hand end.

The electric lock 27 which controls the movements of switch K^X is controlled by a polarized relay P^X. This relay comprises two windings 46 and 47 and two armature contacts 121 and 127. Winding 47 is constantly supplied with alternating current from secondary 9 of transformer N^X as will be apparent from the drawing. When winding 46 is supplied with alternating current of one relative polarity, which I will term "normal" relative polarity, armatures 121 and 127 are swung to their left or normal position. When winding 46 is supplied with current of the other relative polarity, which I will term "reverse" relative polarity, armatures 121 and 127 are swung to their right or reverse position. When the route is set up for traffic from east to west, that is, when switch K^X is normal, and the portion of track between points A and E is unoccupied, current of normal relative polarity is supplied to winding 46 of relay P^X over the following circuit: from the right-hand terminal of winding 11 of transformer L^A, through wire 97, back contact 98 of relay H^2, wire 99, contact 101, operated by signal W^A, wire 102, front contact 103 of track relay O^Y, wire 104, back contact 105 of relay G^B, wire 106, front contact 107 of relay R^C, wire 108, front contact 109 of track relay R^D, wires 110 and 111, front contact 112 of track relay R^E, wires 113 and 118, winding 46 of relay P^X and wire 36 back to the left-hand terminal of winding 11 of transformer L^A. When this circuit is closed relay P^X is energized in the normal direction.

When the route is set up from west to east and the stretch of track between points A and E is unoccupied a second circuit is closed for relay P^X and current then flows from the left-hand terminal of winding 10 of transformer L^A through wire 119, front contact 98 of relay H^2, wire 99, contact 101 operated by signal W^A, wire 102, front contact 103 of relay O^Y, wire 104, front contact 115 of relay R^B, wires 116 and 106, front contact 107 of relay R^C, wire 108, front contact 109 of relay R^D, wire 110, front contact 117 of relay H^9, wire 118, winding 46 of relay P^X, and wire 36 back to the right-hand terminal of winding 10 of transformer

L^A. When this circuit is closed relay P^X is energized in the reverse direction.

Locking magnet 27 of switch K^X is provided with a circuit which passes from secondary 9 of transformer N^X through wires 31 and 120, normal point of contact 121 of relay P^X, wire 122, contact 29, lever 24 of switch K^X, wire 123, lock magnet 27 associated with switch K^X and wire 124 back to transformer N^X. Another circuit is provided for magnet 27 over which current flows from secondary 9 of transformer N^X, through wires 31 and 120, reverse point of armature 121 of relay P^X, wire 125, contact 30 and lever 24 of switch K^X, wire 123, lock magnet 27, and wire 124, back to transformer N^X. It follows that magnet 27 is energized, and hence switch K^X is unlocked, when relay P^X is energized in the normal direction and switch K^X is in its normal position, or when relay P^X is energized in the reverse direction and switch K^X is in its reverse position.

Means are also provided for supplying to the rails of each track section in parallel a current which I shall term a "local" current. For this purpose an impedance 4 is connected across the rails adjacent the left-hand end of each section, a similar impedance 7 is connected across the rails adjacent the right-hand end of each section, and two other similar impedances 5 and 6 are connected across the rails at intermediate points in each section except section A—B and section E—F.

The immediate source of this supply of local current to each section is a local transformer designated in general by the reference character T with an appropriate exponent. Referring first to section C—D, traffic from east to west through this section is supplied with local current over a circuit which passes from winding 137 of transformer T^C, through wire 138, impedance 4 in section C—D, through both rails of the section in parallel to impedance 7, wires 139 and 139ª, back contact 140 of relay G^D, wire 141, back contact 142 of relay G^C, wire 143, front contact 144 of relay R^C, and wire 145 back to winding 137 of transformer T^C. When this circuit is closed local current of normal relative polarity is supplied to the rails of section C—D throughout their length. If, however, relay R^C is de-energized, local current of reverse relative polarity is supplied to section C—D between impedances 5 and 7 from a circuit which starts with winding 146 of transformer T^C and passes through wire 147, impedance 5 in section C—D, through both rails of the section in parallel to impedance 7, wires 139 and 139ª, back contact 140 of relay G^D, wire 141, back contact 142 of relay G^C, wire 143, back contact 144 of relay R^C and wire 148 back to winding 146 of transformer T^C. When this circuit is closed section C—D is supplied with local current of reverse relative polarity between impedances 5 and 7 but with no local current between impedances 4 and 5. Westbound traffic through section D—E is supplied with local current by means of circuits similar to those just traced for section C—D.

When the route is set up for traffic from west to east through section C—D, the local circuits for this section are as follows: from winding 149 of transformer T^D, through wire 139, impedance 7 in section C—D, through the rails of the section in parallel to impedance 4, wires 138 and 151, front contact 142 of relay G^C, wire 141, front contact 140 of relay G^D, wire 152, front contact 153 of relay R^D and wire 154 back to winding 149 of transformer T^D. When this circuit is closed section C—D is supplied with local current of normal relative polarity throughout its length. Another circuit passes from winding 155 of transformer T^D, through wire 156, back contact 153 of relay R^D, wire 152, front contact 140 of relay G^D, wire 141, front contact 142 of relay G^C, wires 151 and 138, impedance 4 in section C—D, through both rails of the section in parallel to impedance 6 and wire 157 back to winding 155 of transformer T^D. When this circuit is closed local current of reverse relative polarity is supplied to the rails of section C—D between the impedances 4 and 6. The eastbound local circuits for section B—C are similar to those just explained in connection with section C—D.

The relative polarity of the local current supplied to section B—C for traffic from right to left is controlled by a pole-changer 160 operated by signal W^B. When signal W^B is at proceed, local current of normal relative polarity is supplied to the rails of section B—C throughout their length over a circuit passing from winding 158 of transformer T^B through wire 159, pole-changer 160, wires 161 and 161ª, impedance 4 in section B—C, through both rails of the section in parallel to impedance 7, wires 163 and 163ª, back contact 164 of relay G^C, wire 165, back contact 166 of relay G^B, wire 167, pole-changer 160, and wire 168 back to winding 158 of transformer T^B. When this circuit is closed section B—C is supplied with local current of normal relative polarity throughout its length. Another local circuit is provided for section B—C which may be traced from winding 158 of transformer T^B through wire 159, pole-changer 160, wire 167, back contact 166 of relay G^B, wire 165, back contact 164 of relay G^C, wires 163ª and 163, impedance 7 of section B—C, through both rails of the section in parallel to impedance 5, wire 169, pole-changer 160, and wire 168 back to winding 158 of transformer T^B. When this circuit is closed, section B—C is supplied with local current of reverse relative polarity between impedances 5 and 7. The partial section immediately to the right of point F is provided with local circuits similar to those associated with section B—C.

When the route is set up for traffic from west to east through section D—E the relative polarity of the local current supplied to this section is controlled by a pole-changer comprising two armatures 180 and 172 on relay S^E. One local circuit passes from winding 170 of transformer T^E, through wire 171, front contact 172 of relay S^E, wire 173, front contact 174 of relay H^9, wire 175, front contact 176 of relay G^D, wires 177 and 178, impedance 4 in section D—E, through both rails of the section in parallel to impedance 7, wire 179, front contact 180 of relay S^E, and wire 181 back to winding 170 of transformer T^E. Another circuit passes from winding 170 of transformer T^E, wire 171, back contact 172 of relay S^E, wire 182, impedance 6 in section D—E through both rails of the section in parallel to impedance 4, wires 178 and 177, front contact 176 of relay G^D, wire 175, front contact 174 of relay H^9, wire 173, back contact 180 of relay S^E and wire 181 back to winding 170 of transformer N^E. It will therefore appear that section D—E is supplied with local current of normal relative polarity throughout its length or with local current of reverse relative polarity between impedances 4 and 6, depending upon whether relay S^E is energized or de-energized, respectively.

The partial section immediately to the left of point A is provided with local circuits similar to those just described for section D—E.

Section E—F is provided with a local circuit for westbound traffic which circuit commences at winding 183 of local transformer T^F and passes through wires 184 and 185, front contact 186 of relay R^E, wire 187, impedance 4 in section E^F through both rails of the section in parallel to impedance 7, wires 188 and 189, back contact 190 of relay G^F, and wire 191 back to secondary winding 183 of transformer T^F. When section E—F is prepared for westbound traffic the rails of the section are therefore provided with local current of normal relative polarity throughout their length or with no local current according as relay R^E is energized or de-energized, respectively. Similarly section E—F is provided with an eastbound local circuit from which current flows from winding 183 of transformer T^F, through wire 184, front contact 192 of relay H^{10}, wires 193 and 187, impedance 4 in section E—F, through both rails of the section in parallel to impedance 7, wire 188, front contact 194 of track relay R^F, and wires 195 and 191 back to winding 183 of transformer T^F. It follows that when section E—F is prepared for traffic moving from east to west the rails of the section are supplied with local current of normal relative polarity throughout their length or with no local current according as track relay R^F is energized or de-energized respectively. The local circuits for section A—B are exactly similar to the local circuits just described in connection with section E—F.

Before explaining the operation of the apparatus as a whole it should be pointed out that the trackway apparatus herein shown and described is suitable for, though by no means limited to, co-operation with train carried governing means in the following manner: When the train occupies a stretch of track which is provided with track circuit current and also with local current of normal relative polarity a "proceed" indication is received on the train; when the portion of track occupied by the train is supplied with track circuit current and also with local current, the relative polarity of either of which currents is reversed, the train receives a "caution" indication; and when the train occupies a stretch of track from which the supply of either track circuit current or local current is discontinued the train receives a "stop" indication.

Located at station X are two indicators 130 and 131. These indicators may be of any suitable form and as shown in the drawing are electric lamps. The circuit for indicator 130 passes through secondary 9 of transformer N^X through wires 31 and 126, normal contact 127 of relay P^X, wire 128, indicator 130 and wire 36 back to secondary 9 of transformer N^X. This circuit is closed only when relay P^X is energized in the normal direction and it follows that when K^X is in the normal position and indicator 130 is lighted the operator is informed that switch K^X is unlocked and may be manipulated to reverse the direction of traffic from the portion of track governed by this switch. The circuit for indicator 131 passes from secondary 9 of transformer N^X, wires 31 and 126, reverse contact 127 of relay P^X, wire 129, indicator 131, and wire 36 back to transformer N^X. When switch K^X is in the reverse position and indicator 131 is lighted the operator is informed that switch K^X is unlocked and that by proper manipulation of this switch he may set up the route for traffic from east to west from the stretch of track governed by switch K^X. Two indicators 196 and 197 are located at point Y and are provided with circuits similar to those provided for indicators 130 and 131 and serve to inform the operator at station Y concerning the condition of the track governed by switch K^Y. A third indicator 132 similar in all respects to indicators 196 and 197 is also located at point Y. The circuit for this indicator may be traced from secondary 9 of transformer N^B, through wires 42 and 133, front contact 134 of relay R^B, wires 135 and 135^a, indicator 132, and wire 36 back to transformer N^B. Indicator 132 is energized only when track relay R^B is energized, but track relay R^B is energized only when relay G^B is energized and section B—C is unoccupied. The condition of relay G^B is in turn controlled in accordance with the direction of traffic for which the stretch A^F has been prepared by switch K^X. When indicator 132 is lighted therefore the operator at point Y is informed that the route is set up for eastbound traffic from point A to point E, and he may therefore take the proper steps to move signal W^A to proceed. Indicator 198 is located at point X and informs the operator at that station as to the condition of the track to the right of point E as explained in connection with indicator 132.

I will now describe the operation of the apparatus as a whole: As shown in the drawing levers 13 and 21 are both in their intermediate positions and signals W^E and W^F and signals W^A and W^B all indicate stop. Switches K^X and K^Y are both in their normal or left-hand position and directional relays H and G are therefore all de-energized. As a result each track circuit is supplied with track circuit current from the track transformer connected across its left-hand end and is provided with a track relay connected across its right-hand end. Assuming the stretch of track to be unoccupied track relays R^A, O^Y, R^E, R^D, R^C, and O^X are energized. Track relays R^F, and R^B are de-energized and repeater relays S^E and S^A are therefore also de-energized. Relay P^X is energized in the normal direction and indicator 130 and lock 27 of switch K^X are therefore energized. Similarly relay P^Y is energized and lock 27 of switch K^Y and indicator 196 are energized. The remaining indicators 197, 132, 131 and 198 all are de-energized.

Since it is understood that each switch K controls its associated portion of track in the same way, I will confine my explanation to the portion of track controlled by switch K^X. I will first assume that the operator at station X desires to permit a westbound train to proceed past signal W^F. He first clears signal W^F by moving lever 13 into its right-hand position. The train now proceeds past signal W^F and receives a proceed indication since the track is supplied with track circuit current from transformer M^{10} and with local current from transformer T^F over front contact 186 of relay R^E. As the train proceeds successively through sections D—E and C—D the proceed indication received on the train is continued. Assuming that signal W^B still indicates stop section B—C is supplied with track circuit current from transformer M^4 and with local current of reverse relative polarity between impedances 7 and 5 through transformer T^B but with no local current between point B and impedance 5. As the train passes point C therefore a caution indication will be received on the train which indication will persist till the train passes impedance 5 at which point the indication of the train will change to stop. If, now the operator at station Y clears signal W^B the train is permitted to proceed as explained, in connection with signal W^B.

I will now assume that the train passes into section D—E and stops, and that a second train passes signal W^F. The presence of the train in section D—E does not affect the supply of the track circuit current to section E—F but the de-energization of relay R^E by this train opens the local circuit for section E—F and the following train therefore receives a stop indication as soon as it enters section E—F.

I will next assume that a train enters section C—D and stops. A second train moving from east to west will receive a proceed indication throughout section E—F, but relay R^D, now connected with section C—D, is de-energized by the train occupying that section and hence local current of reverse relative polarity is being supplied to section D—E between impedances 5 and 7. As soon as the second train enters section D—E, the reversal of the local current causes the train to receive a caution indication, which changes to a stop indication as the train passes impedance 5.

In explaining the operation of the apparatus when trains moving through the stretch in a direction contrary to the direction in which the route is set up, I will assume the apparatus to be in the condition illustrated in the drawing. If now a train moving from west to east attempts to pass signal W^A at stop and enters section A^B, the local circuit for section A—B will be broken at contact 200 of track relay R^A and the supply of track circuit current to the train carried governing apparatns will be interrupted as soon as the train passes the point of connection of transformer M^2. The train therefore receives a stop indication. In a similar manner as the train passes successively through sections C—D, D—E, etc. the supply of track circuit current to the governing apparatus of track trasnformer is interrupted as soon as the train passes the point of connection of such transformer. The train therefore receives a stop indication throughout the stretch of track shown in the drawing.

If the route is set up for westbound traffic and signal W^F is at proceed and the operator at X wishes to permit an eastbound train to move through the stretch of track between points A and E, he first moves signal W^E to stop thus rendering ineffective the interlocking between lever 13 and switch K^X. Switch K^X being in its normal position, the portion of track between points A and E being unoccupied, and the signal W^A being at stop, lamp 130 is lighted and the operator may move switch K to its reverse position, lock 27 being energized. The opening of contact 24—29 of switch K^X immediately opens the circuit for magnet 27 and switch K^X is thus locked in its reverse position. At the same time the closing of contact 23—28 of switch K^X completes the circuit for relay H^9 which thereupon becomes energized. The closing of front contact 39 of relay H^9 picks up relay G^D which in turn successively picks up relays G^C, G^B, and H^2. Under these conditions track circuit current is supplied to each of sections A—B, B—C, C—D and D—E by the track transformer located at the right-hand end of such section and each section is provided with a track relay connected with the left-hand end of the section. Assuming that the stretch of track between point A and point E is unoccupied, track relays O^Y, R^B, R^C and R^D are energized. The indicator 131 and lock 27 of switch K^X are now energized and switch K^X is unlocked. The energization of relay R^B closes the circuit for indicator 132 which becomes lighted to inform the operator at station Y that he may clear signal W^A. The operator therefore moves lever 21 into its left-hand position thus clearing signal W^A. The movement of signal W^A to proceed position interrupts the circuit for P^X and again de-energizes lock 27 of switch K^X. At the same time the closing of contact 201—202 operated by signal W^A completes the pick up circuit for repeater relay S^A. The pole changing contacts 203 and 204 now supply local current of normal relative polarity to the section at the left of A. If now a train moving from west to east enters the stretch of track shown in the drawing it receives a proceed indication in the section to the left of A. As this train enters section A—B it is supplied with track circuit current from transformer M^B and with local current of normal relative polarity from transformer T^B. The proceed indication hence continues to be received by the train as it passes through section A—B. In a similar manner the train receives a proceed indication as it passes successively through sections B—C and C—D. Assuming that signal W^E is still at stop, relay S^E is de-energized, the circuit for this relay being opened at contact 73—72 operated by signal W^E, and local current of reverse relative polarity is supplied to section D—E between impedances 4 and 6, but no local current is supplied to this section between impedance 6 and point E. As the train enters section D—E it receives a caution indication which changes to a stop indication as the train passes impedance 6. If now signal W^E is moved to the proceed position the train is permitted to proceed past this signal as explained in connection with signal W^A.

The operation of the apparatus for following trains and for movements of traffic in opposition to the direction in which the route is set up will be understood from the description of eastbound traffic moves without further explanation.

If the track is unoccupied and it is desired to return the apparatus to the normal condition, it may be accomplished by moving signal W^A to stop thereby completing at contact 100—101 thereof a circuit for relay P^X over which current of reverse relative polarity is supplied to winding 46 from transformer L^A. Relay P^X is therefore energized in the reverse direction and the circuit is closed for lock 27 through lever 24 and contact 30 of switch K^X and reverse point of contact 121 of relay P^X. The apparatus may then be returned to normal by the return of switch K^X to its normal position.

It should be particularly pointed out that with the arrangement of circuits here shown, each switch K is locked in position except when the polarized relay P associated therewith is energized in the proper direction.

Although I have herein shown and described only one form and arrangement of railway traffic controlling 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, a stretch of railway track, a relay responsive to the relative polarity of the current supplied thereto, a switch, means controlled by said switch for governing the direction of traffic over said stretch and for supplying current of one relative polarity or the other to said relay in accordance with the condition of the switch, and locking means for said switch controlled by said relay.

2. In combination, two successive sections of railway track, a track relay, a directional relay for at times connecting said track relay across the rails of one said section, and for at times connecting the track relay across the rails of the other section, means for supplying said sections with track circuit current, a switch for controlling said directional relay, a polarized relay, means controlled by said track relay for supplying said polarized relay with current of one relative polarity or the other, and locking means for said switch controlled by said polarized relay.

3. In combination, a section of railway

track, a track relay, a directional relay for at times connecting said track relay with the rails of said section, a polarized relay, means controlled by said polarized relay for operating said directional relay, and means controlled by said directional relay and said track relay for supplying current of one relative polarity or the other to said polarized relay.

4. In combination, a section of railway track, a track relay, a directional relay for at times connecting said track relay with the rails of said section, a polarized relay, means controlled by said polarized relay for operating said directional relay, a second directional relay controlled by the first said directional relay, and means controlled by said two directional relays and by said track relay for supplying current of one relative polarity or the other to said polarized relay.

5. In combination, two successive sections of railway track, a first and a second directional relay, a track relay arranged to be connected with the rails adjacent one end or the other of one said section in accordance with the condition of said directional relays, a second track relay arranged to be at times connected with the rails of the second said section, a switch for controlling said directional relays, a polarized relay controlled by said two directional relays and said track relays, and locking means for said switch controlled by said polarized relay.

6. In combination, a stretch of railway track, a series of directional relays for governing traffic over said stretch, a switch for energizing the first said relay, means for energizing each of the remaining relays when the preceding relay becomes energized, a polarized relay, means controlled by the last relay in said series for supplying said polarized relay with current of one direction or the other, and locking means for said switch controlled by said polarized relay.

7. In combination, a stretch of railway track, a series of directional relays for governing traffic over said stretch, a switch for energizing the first said relay, means for energizing each of the remaining relays when the preceding relay becomes energized, track relays for said stretch, a polarized relay, means controlled by the last relay in said series and by said track relays for supplying said polarized relay with current of one polarity or the other, and locking means for said switch controlled by said polarized relay.

8. In combination, a stretch of railway track divided into a plurality of successive sections, a series of directional relays, means for controlling each relay except the first by the next adjacent relay of the series, a switch for controlling the first relay of said series, a polarized relay, means controlled by the last relay of said series for supplying such polarized relay with current of one relative polarity or the other, and locking means for said switch controlled by said polarized relay.

9. In combination, a stretch of railway track divided into a plurality of successive sections, a plurality of track relays, a series of directional relays for supplying track circuit current to the right hand end of each section and for connecting a track relay with the left-hand end of each section when said directional relays are energized and for supplying track circuit current to the left-hand end of each section and for connecting a track relay with the right-hand end of each section when said directional relays are de-energized, means for controlling each directional relay except the first in said series by the adjacent relay of the series, a switch for controlling the first relay of the series, traffic governing means for each section controlled by the associated track relay, and locking means for said switch controlled by said track relays.

10. In combination, a stretch of railway track divided into a plurality of successive sections, a plurality of track relays, a series of directional relays for supplying track circuit current to the right-hand end of each section and for connecting a track relay with the left-hand end of each section when said directional relays are energized and for supplying track circuit current to the left-hand end of each section and for connecting a track relay with the right-hand end of each section when said directional relays are de-energized, means for controlling each directional relay except the first in said series by the adjacent relay of the series, a switch for controlling the first relay of the series, traffic governing means for each section controlled by the associated track relays, and locking means for said switch controlled by said track relays and by certain of said directional relays.

11. In combination, a stretch of railway track divided into a plurality of successive sections, a plurality of track relays, a series of directional relays for supplying track circuit current to the right-hand end of each section and for connecting a track relay with the left-hand end of each section when said directional relays are energized and for supplying track circuit current to the left-hand end of each section and for connecting a track relay with the right-hand end of each section when said directional relays are de-energized, means for controlling each directional relay except the first in said series by the adjacent relay of the series, a switch for controlling the first relay of the series, traffic governing means for each section controlled by the associated track relays, and

locking means for said switch controlled by said track relays and by the last directional relay of said series.

12. In combination, a stretch of railway track divided into a plurality of successive sections, a plurality of track relays, a series of directional relays for supplying track circuit current to the right hand end of each section and for connecting a track relay with the left-hand end of each section when said directional relays are energized and for supplying track circuit current to the left-hand end of each section and for connecting a track relay with the right-hand end of each section when said directional relays are de-energized, means for controlling each directional relay except the first in said series by the adjacent relay of the series, a switch for controlling the first relay of the series, traffic governing means for each section controlled by the associated track relays, a polarized relay controlled by said track relay and by the last relay in said series, and locking means for said switch controlled by said polarized relay.

13. In combination, a stretch of railway track divided into a plurality of successive sections, a plurality of track relays, a series of directional relays for supplying track circuit current to the right-hand end of each section and for connecting a track relay with the left-hand end of each section when said directional relays are energized and for supplying track circuit current to the left-hand end of each section and for connecting a track relay with the right-hand end of each section when said directional relays are de-energized, means for controlling each directional relay except the first in said series by the adjacent relay of the series, a switch for controlling the first relay of the series, traffic governing means for each section controlled by the associated track relays, an indicator responsive to the condition of said directional relays, and locking means for said switch controlled in accordance with the condition of said indicator.

14. In combination, a stretch of railway track divided into a plurality of successive sections, signals for controlling traffic in both directions over said stretch, a plurality of track relays, a series of directional relays for supplying track circuit current to the right-hand end of each section and for connecting a track relay with the left-hand end of each section when said directional relays are energized and for supplying track circuit current to the left-hand end of each section and for connecting a track relay with the right-hand end of each section when said directional relays are de-energized, means for controlling each directional relay, except the first in said series by the adjacent relay of the series, a switch for controlling the first relay of the series, traffic governing means for each section controlled by the associated track relays, and locking means for said switch controlled by said track relays and by said signals.

15. In combination, a stretch of railway track divided into a plurality of successive sections, signals for controlling traffic in both directions over said stretch, a plurality of track relays, a series of directional relays for supplying track circuit current to the right-hand end of each section and for connecting a track relay with the left-hand end of each section when said directional relays are energized and for supplying track circuit current to the left-hand end of each section and for connecting a track relay with the right-hand end of each section when said directional relays are de-energized, means for controlling each directional relay except the first in said series by the adjacent relay of the series, a switch for controlling the first relay of the series, traffic governing means for each section controlled by the associated track relays, locking means for said switch controlled by said track relays, and means for further locking said switch when any of said signals are not in the stop position.

16. In combination, a section of railway track, a directional relay for each end of said section, selector means for controlling said relays, a track relay connected with the rails in advance of said section, and means controlled by said directional relays and by said track relay for at times supplying local current of one relative polarity to the rails of the entire section and for at other times supplying local current of the other relative polarity to the rails of a portion only of said section.

17. In combination, a section of railway track, a directional relay for each end of said section, selector means for controlling said relays, a track relay connected with the rails in advance of said section, means controlled by said directional relays and by said track relay for supplying local current to said section, a polarized relay controlled by said directional relay and said track relay, and locking means for said selector means controlled by said polarized relay.

18. In combination, two sections of railway track, a track relay, a directional relay for connecting said relay with one end or the other of said sections according as the directional relay is energized or de-energized, selector means for controlling said directional relay, and a local circuit for each said section controlled by said directional relay and by said track relay.

19. In combination, an east, a middle, and a west section of railway track, two track relays, a directional relay arranged when energized to connect one said track relay with said east section, and when de-energized to con-

nect the one said track relay with one end of the middle section, a second directional relay arranged when energized to connect the second said track relay with the other end of said middle section and when de-energized to connect the second track relay with said west section, a switch for controlling said directional relays, and means controlled by said directional relays and said track relays for supplying local current to said middle section.

20. In combination, a stretch of railway track divided into a plurality of successive sections, a series of directional relays one located adjacent the junction of each two sections, local circuits for each section controlled in part by the associated traffic directional relay, a switch for controlling said directional relays, a polarized relay controlled by said directional relays, and locking means for said switch controlled by said polarized relay.

In testimony whereof I affix my signature.

RONALD A. McCANN.