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RAILWAY TRAFFIC CONTROLLING APPARATUS

Filed Feb. 24, 1927 2 Sheets-Sheet 1

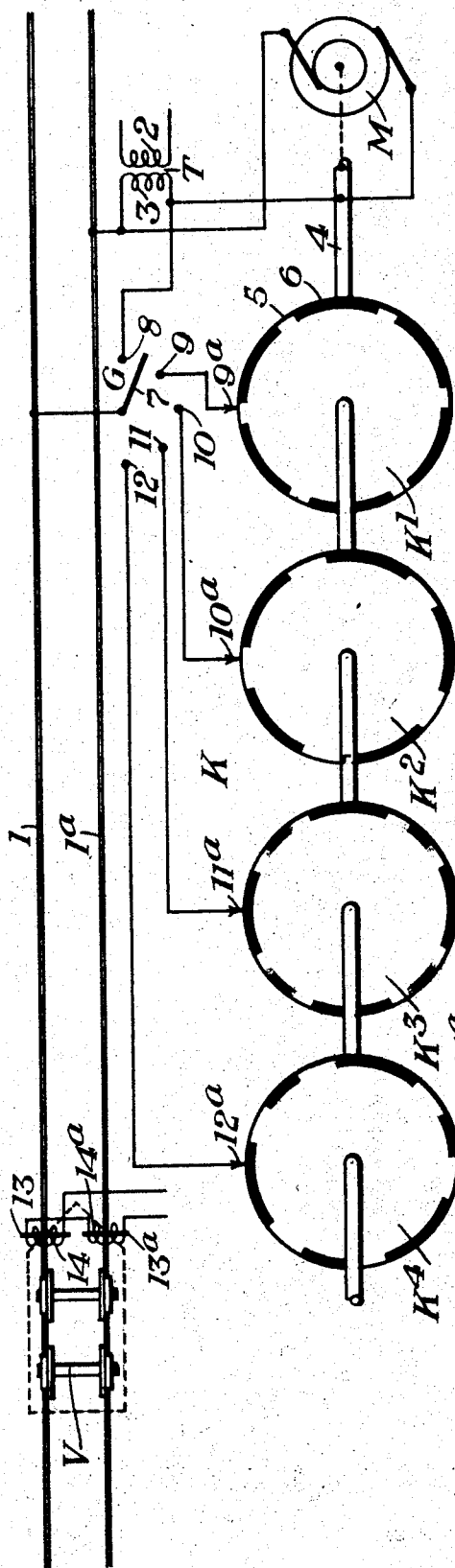


Fig. 1.

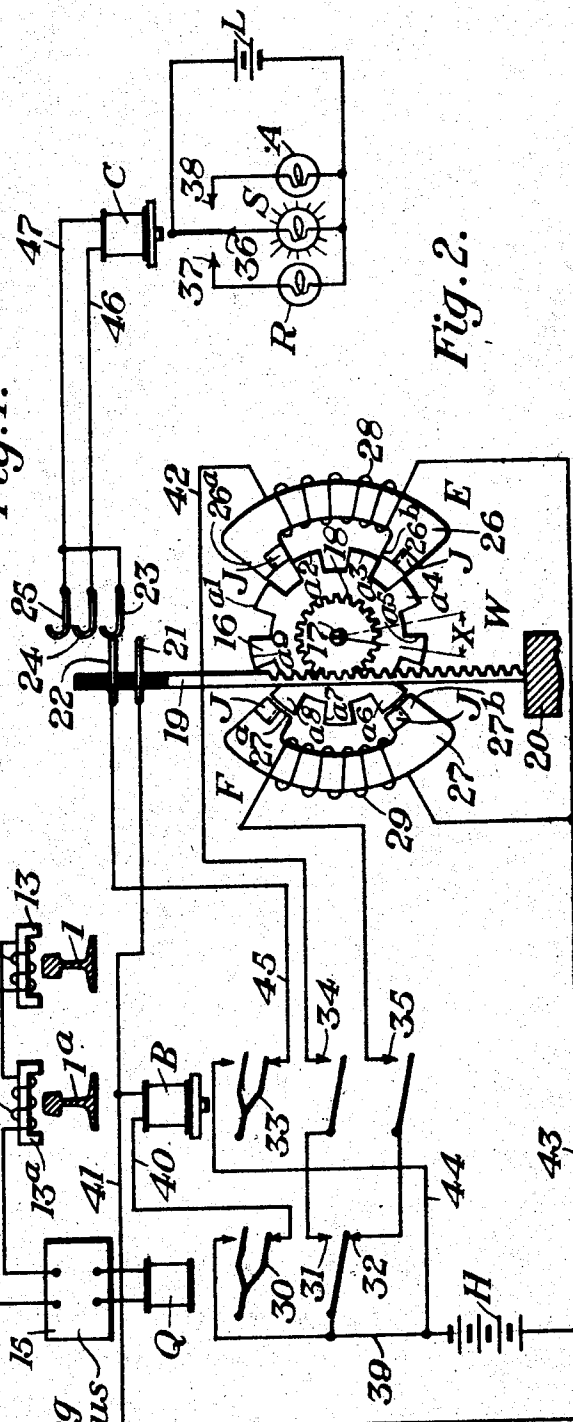


Fig. 2.

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Fig. 3.

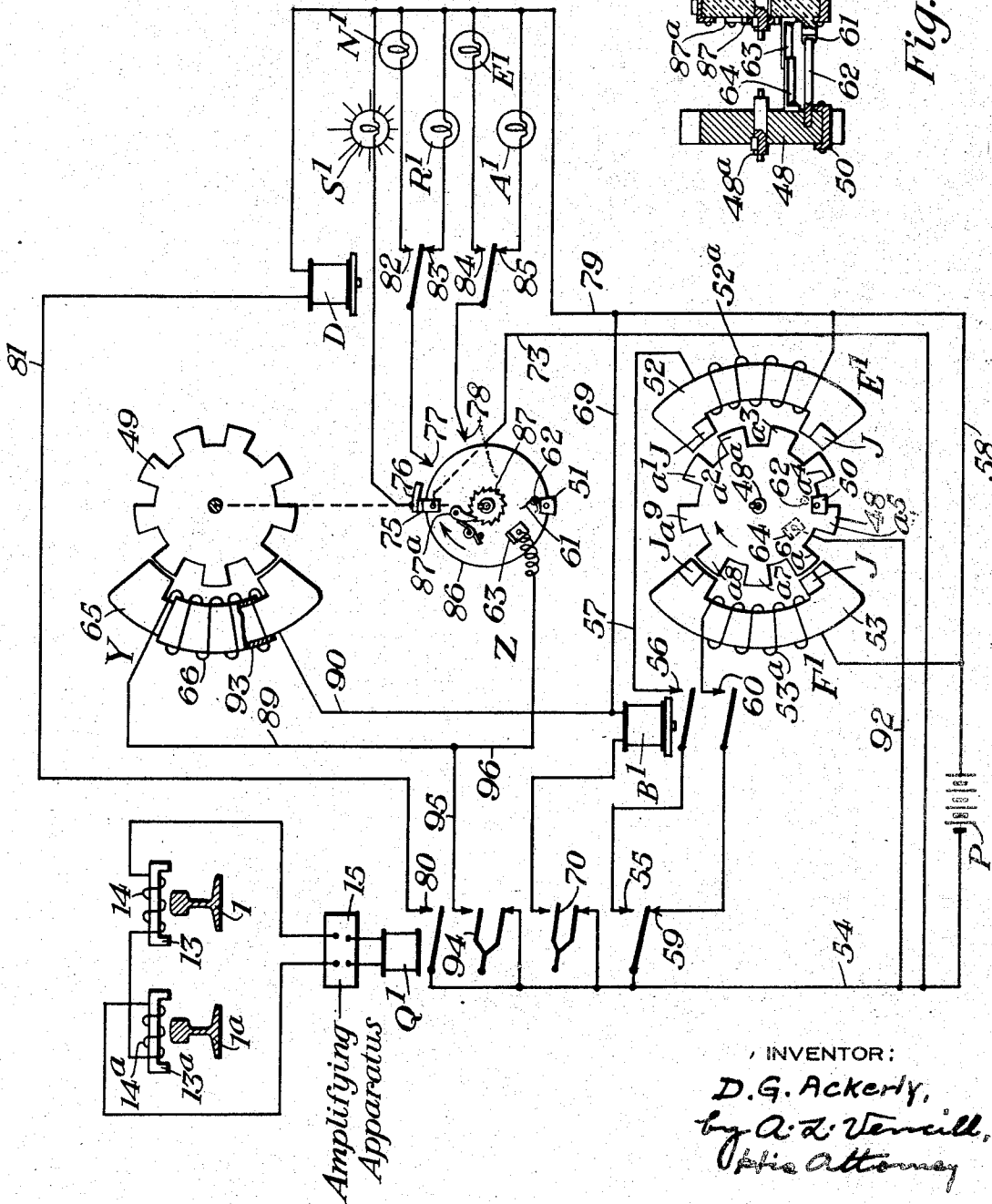


Fig. 4.

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UNITED STATES PATENT OFFICE

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RAILWAY TRAFFIC CONTROLLING APPARATUS

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My invention relates to railway traffic controlling apparatus, and particularly to apparatus of the type in which train carried governing means is controlled by energy received from the trackway in the form of code impulse combinations.

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

In the accompanying drawings, Fig. 1 is a diagrammatic view of one form of trackway apparatus suitable for co-operation with train carried apparatus embodying my invention. Fig. 2 is a view, partly diagrammatic, of one form of train carried governing apparatus embodying my invention, and suitable for co-operation with the trackway apparatus shown in Fig. 1. Fig. 3 is a view showing a modified form of train carried governing apparatus also embodying my invention. Fig. 4 is a detail sectional view of a portion of the apparatus shown in Fig. 3.

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

In Fig. 1 the reference characters 1 and 1^a designate the track rails of a stretch of railway track. Means are provided for supplying these rails with current in the form of code impulse combinations, the immediate source of such current being a transformer T, the primary winding 2' of which is constantly supplied with alternating current from a suitable source not shown in the drawings. The supply of energy from the transformer to the track rails 1 and 1^a is controlled by a transmitter designated generally by the reference character K, comprising, in the form here shown, a rotatable shaft 4 which is driven at constant speed by means of a motor M supplied with alternating current from the secondary 3 of transformer T. Secured to the shaft 4 and rotatable therewith are a plurality of code wheels K¹, K², K³ and K⁴. Each code wheel is provided with a plurality of alternately disposed conducting segments 5 and insulating segments 6 of various lengths. A circuit controller G having a movable arm 7 is arranged to co-operate with a plurality of stationary contacts 8, 9,

10, etc. Each of the contacts is connected to a brush designated by the same reference character as the contact but with the exponent *a*. Each brush bears on the periphery of one of the code wheels so that by suitably positioning contact arm 7, the secondary 3 of transformer T may be connected with the track rails 1 and 1^a through any one of the code wheels, and will then supply any one of a plurality of code impulse combinations to these rails. If it is desired to supply uninterrupted alternating current to the track rails, the arm 7 is connected to the contact 8.

The code wheel K¹ is arranged to supply separated impulses of current, the length of each impulse being, for example, one-fourth of a second, and the interval between each two impulses being one second. The code wheel K² supplies a code consisting of impulses of one-half of a second duration with one second intervals between impulses. Code wheel K³ supplies impulses in groups of two impulses each, each impulse being of one-fourth of a second duration, with one-fourth second intervals between the impulses in a group, but with one second intervals between the groups. The code wheel K⁴ supplies impulses in groups of two impulses each, each impulse being of one-half second duration, with intervals of one-half second between impulses in a group, but with intervals of one second between the groups. These codes are given merely by way of example, since it is obvious that any suitable combinations of impulses may be used and that any suitable length of impulse may be chosen.

Referring now to Fig. 2, the train carried governing means comprises a pair of cores 13 and 13^a carried in advance of the forward axle of a train V (Fig. 1) and disposed in inductive relation to the track rails 1 and 1^a, respectively. The core 13 is provided with a winding 14, the core 13^a with a winding 14^a, and the two windings 14 and 14^a are connected in series so that the electromotive forces induced therein by alternating currents flowing in opposite directions in the track rails at any instant, are additive. The two windings 14 and 14^a may be connected

by means of suitable amplifying apparatus 15 with a relay Q.

The relay Q is quick-acting, that is, it picks up and releases substantially without time lag when energized and de-energized. This relay has a bridging contact 30 which is closed only during transit from its open to its closed position and vice versa, and front and back contacts 31 and 32, respectively. The bridging contact 30 controls the supply of energy from a battery H to a second relay B. The circuit for relay B is from battery H, through wire 39, bridging contact 30, wire 40, winding of relay B, and wire 41 back to battery H. This circuit is closed momentarily during the transit of contact 30, so that the relay B is supplied with impulses of current of twice the frequency of the impulses supplied to relay Q. The contacts 31 and 32 of relay Q control the energization of a selector W, which will be described hereinafter.

The relay B has a bridging contact 33 similar to the contact 30 of the relay Q, and two front contacts 34 and 35. This relay has quick pick-up but slow-release characteristics, and is capable of holding its contacts 34 and 35 closed for one-half second following its de-energization. The bridging contact 33 controls the energization of a relay C over a set of contacts which are controlled by the selector W.

This selector W comprises a rotor 16 of magnetizable material having a plurality of spaced teeth a^1 , a^2 , etc., and preferably composed of several thin laminations. This rotor is mounted to rotate on a shaft 17 supported by any suitable means, not shown. Also mounted on the shaft 17 and rotatable with the rotor 16 is a pinion 18. A reciprocable rack 19 engages the pinion 18 and is normally biased by gravity to a position in which it engages a stop 20, as shown in the drawing. The rack 19 carries two contacts 21 and 22, which are suitably insulated from the rack and from each other, and are arranged to co-operate with stationary contacts 23, 24 and 25.

For the purpose of turning the rotor 16 in a clockwise direction and raising the rack 19, I provide two magnets E and F. The magnet E comprises a magnetizable core 26, having two legs 26^a and 26^b, the lower faces of which are provided with shading bands J. The core 26 carries a winding 28 which has a circuit from battery H, through wire 39, front contact 31 of relay Q, contact 34 of relay B, wire 42, winding 28 of magnet E, and wire 43 back to battery. This circuit is completed only when contacts 31 and 34 of relays Q and B, respectively, are closed. The magnet F comprises a magnetizable core 27 having legs 27^a and 27^b, the upper faces of which are provided with shading bands J. The core 27 carries a winding 29, which has

a circuit from battery H, through wire 39, back contact 32 of relay Q, contact 35 of relay B, winding 29 of magnet F and wire 43 back to battery. This circuit is closed when relay Q is de-energized and contact 35 of relay B is closed.

When the parts are in the positions shown in the drawings, the faces of legs 26^a and 26^b of magnet E are each directly opposite a space between the teeth of rotor 16. When the magnet E is supplied with an impulse of current the magnetic flux from core 26 passes from the unshaded portion of leg 26^a, through rotor tooth a^1 , a body of rotor 16, rotor tooth a^3 and the unshaded portion of leg 26^b, back to core 26. Some flux also passes through the shaded portions of legs 26^a and 26^b, through rotor teeth a^2 and a^4 , but due to the choking effect of the shading bands J, the flux through the unshaded path predominates and the rotor is turned clockwise until teeth a^1 and a^3 register with legs 26^a and 26^b, respectively of core 26. The angle through which the rotor turns during each energization of magnet E is equal to one-half of the whole pitch of the rotor, and is designated in the drawings as angle X. I will hereinafter refer to a rotation of rotor 16 through this angle as "one step". Movement of the rotor 16 through one step will bring the spaces between the teeth of rotor 16 opposite the legs of magnet F, so that when magnet F is supplied with an impulse of current the rotor will again be advanced one step to such a position that teeth a^1 and a^3 register with legs 27^a and 27^b, respectively, of core 27.

It will now be clear that for each impulse of current supplied to the relay Q the rotor 16 will be advanced two steps, the first step by magnet E to which current is supplied over front contact 31 of relay Q, and the second step by magnet F to which current is supplied over back contact 32 of relay Q. It will also be clear that the rotor 16 is held in the position to which it is moved by one of the magnets E or F as long as such magnet remains energized. When the rotor 16 is advanced two steps, the rack 19 is raised far enough for the contacts 21 and 22 to engage stationary contacts 23 and 24, respectively, and when the rotor is advanced four steps, the rack is raised far enough for contacts 21 and 22 to engage contacts 24 and 25, respectively. These contacts are at times included in a circuit for a relay C, this relay being supplied with impulses of current only at the time that relay B releases its bridging contact 33 one-half second following the end of the last impulse of each code group.

The relay C is of the three-position polarized type, having quick pick-up but slow-release characteristics, and capable of holding its contact closed between impulses supplied to it over bridging contact 33 of relay B when

this contact is released at the end of any code group. This hold-over period may be as much as two seconds in one example which I have chosen. When relay C is de-energized, it closes a neutral contact 36 and lights a lamp S supplied with current from a battery L over a circuit which is obvious from the drawings. When this relay receives an impulse of current over bridging contact 33 of relay B, with contacts 21 and 22 engaging contacts 23 and 24, respectively, the left-hand contact 37 is closed and lamp R is lighted. The circuit for relay C is then from battery H, through wire 44, bridging contact 33 of relay B, wire 45, contact 22—24, wire 46, winding of relay C, wire 47, contact 21—23, and wire 41 back to battery. When the contacts 21 and 22 engage the stationary contacts 24 and 25, relay C is energized to close its contact 38 and light the lamp A. The circuit for relay C is then from battery H, through wire 44, bridging contact 33 of relay B, wire 45, contact 22—25, wire 47, winding of relay C, wire 46, contact 21—24 and wire 41, back to battery. It will be understood that the circuits for relay C just traced can be closed only during the transit of the contact 33 of relay B when relay B releases.

In describing the operation of the apparatus I will first assume that the movable arm 7 of circuit controller G is moved into engagement with the contact 8, so that uninterrupted alternating current is supplied to the track rails 1 and 1^a from the secondary 3 of transformer T. Current will then be supplied continuously to the winding of relay Q, so that this relay will be continuously energized. Relay B will pick up when contact 30 of relay Q bridges, so that contact 34 of relay B will be closed. Magnet E will therefore be energized and will advance the rotor 16 one step. After one-half second, relay B will release and de-energize magnet E so that rack 19 will return to its position against the stop 20. Relay C will remain de-energized with the result that lamp S will be lighted and will remain lighted until the position of circuit controller arm 7 is changed.

When no current is being supplied to the track rails, the parts will occupy the positions shown in the drawings and lamp S will be lighted.

If the movable contact arm 7 of circuit controller G engages the contact 9, code impulse combinations in the form of one-fourth second impulses separated by intervals of one second will be supplied to the track rails through code wheel K¹. During each of the impulses the relay Q will receive current from the track for one-fourth of a second and in picking up will cause relay B to be energized over the contact 30. When relay B is energized, its contacts 34 and 35 are closed, and since contact 31 of relay Q is also closed, current will be supplied to the magnet E and

the rotor 16 will be advanced one step to raise the rack 19. The movement of rack 19 due to the impulse received by magnet E will be insufficient to cause contacts 21 and 22 to engage with contacts 23 and 24. When relay Q releases, another impulse of current is supplied to the relay B over bridging contact 30 and relay B therefore remains energized. Rotor 16 and rack 19 are advanced another step, due to the energization of magnet F over the back contact 32 of relay Q, so that contacts 21 and 22 engage contacts 23 and 24. Magnet F remains energized over back contact 32 of relay Q and holds rack 19 up, so that when the relay B opens, the bridging contact 33 momentarily completes a circuit for the relay C through contacts 21—23 and 22—24. Relay C is therefore supplied with an impulse of current of such polarity as to cause contact 37 to close and so to light lamp R. During the one second interval between impulses, rack 19 and rotor 16 will return to the position shown in the drawing, because relay B will open after one-half second, and when relay Q picks up and releases with the next impulse of current which it receives, the contacts 21—23 and 22—24 will again be closed and relay C will receive another impulse of current over the bridging contact 33 when relay B releases. Each time that relay Q receives an impulse, the rotor 16 and rack 19 are advanced to close contacts 21—23 and 22—24, and relay C receives an impulse each time that relay B opens. Relay C holds over the interval between these impulses and lamp R remains lighted as long as code impulses are supplied to the track rails through code wheel K¹.

When the code wheel K^a is connected to the track rails by contact arm 7 and contact 11, code impulse combinations consisting of groups of two one-fourth second impulses separated by a fourth second interval and with one second intervals between the groups are supplied to the relay Q, and lamp A is lighted in the following manner. The first impulse of current supplied to relay Q closes the bridging contact 30 of this relay, picking up relay B and closing its contacts 34 and 35. Contact 31 of relay Q is also closed, so that magnet E is energized to advance the rotor 16 one step. When the relay Q releases at the end of the first impulse, contact 31 opens and contact 32 closes. Relay B holds over the ensuing one-fourth second interval, therefore contact 35 of relay B remains closed and magnet F is energized to advance the rotor 16 another step, raising the rack 19 and bringing contacts 21 and 22 into engagement with contacts 23 and 24. Relay C does not receive an impulse of current, because relay B holds over the interval between impulses so that contact 33 of relay B does not bridge. Rack 19 is held in its advanced position during the interval, because magnet F

remains energized over back contact 32 of relay Q and contact 35 of relay B, so that, at the end of the interval when another one-fourth second impulse is supplied to relay Q, rotor 16 will be advanced two more steps, one step by magnet E and one step by magnet F, bringing contacts 21 and 22 into engagement with contacts 24 and 25, respectively. When relay B releases following the fourth impulse of current which it receives by release of relay Q, an impulse of current will be supplied to relay C over bridging contact 33 of relay B, closing the contact 38 of relay C and lighting the lamp A. The relay C holds the contact 38 closed during the interval while rack 19 returns to its bottom position and is again being advanced by the next group of impulses, and this relay receives an impulse of current each time that relay B releases following the second impulse of each group, hence lamp A remains lighted as long as code impulse combinations are supplied to the track rails by the code wheel K³.

It will be understood that if a failure of any of the circuits should occur, relay C would release, closing contact 36 and lighting the lamp S.

The apparatus shown in Fig. 2 is designed to give three indications. If a greater number of indications are desired, I may make use of the modified form of train carried apparatus shown in Fig. 3.

Referring now to Fig. 3, the main relay, which is here designated Q¹, has front contacts 80 and 55, bridging contacts 70 and 94 and a back contact 59. The bridging contacts 70 and 94 are closed momentarily during transit from open to closed position and vice versa, and contact 94 when closed completes a circuit for a brake magnet Y which will be described hereinafter. When contact 70 is closed a circuit is completed for a relay B¹, which circuit is from battery P, through wire 54, bridging contact 70 of relay Q¹, winding of relay B¹, and wires 69 and 58 back to battery P. Whenever this circuit is closed, an impulse of current is supplied to the relay B¹, and these impulses are of twice the frequency of the impulses supplied to relay Q¹. The relay B¹ is similar to relay B in Fig. 2, and has two front contacts 56 and 60, which are closed whenever the relay is energized, and remain closed for one-half second after the relay is deenergized. The contacts 56 and 60 are included in the control circuits for a selector Z.

The selector Z comprises a rotor 48 of magnetizable material and having a plurality of spaced teeth a^1 , a^2 , etc. This rotor is secured to a shaft 48^a, mounted in suitable journals not shown, and is biased to the position shown in the drawings by means of a counterweight 50. The rotor 48 may be rotated in a clockwise direction by means of two magnets E¹ and F¹, which are similar to the magnets E and F, shown in Fig. 2, and operate in a

similar manner. The magnet E¹ comprises a magnetizable core 52 having two projecting legs provided with shading bands J, and carries a winding 52^a. This magnet has a circuit from battery P through wire 54, front contact 55 of relay Q¹, contact 56 of relay B¹, wire 57, winding 52^a of magnet E¹ and wire 58 back to battery. When this circuit is closed, the magnet is energized and the rotor 48 is advanced clockwise one step, bringing two of the rotor teeth into registration with the two legs of core 52. The magnet F¹ comprises a magnetizable core 53 having two projecting legs provided with shading bands J. The core 53 carries a winding 53^a. The circuit for magnet F¹ is from battery P, through wire 54, back contact 59 of relay Q¹, contact 60 of relay B¹, and winding 53^a of magnet F¹ back to battery P. When this circuit is closed with the rotor 48 in an advanced position in which two spaces between the rotor teeth are opposite the legs of core 53, the rotor is advanced one step, so that two teeth of the rotor register with the two legs of core 53. If, for example, the parts are in the positions shown in Fig. 3, and magnet E¹ is energized, the rotor will be advanced until teeth a^1 and a^3 register with the legs of core 52 and will be held in this position until the circuit for magnet E¹ is opened. If magnet F¹ is then energized, rotor 48 will be advanced another step until the teeth a^5 and a^7 register with the legs of core 53 and will remain in this position until magnet F¹ is deenergized. It will, therefore, be seen that the magnets E¹ and F¹ are so placed with respect to rotor 48, that when these magnets are alternately energized the rotor will be advanced by successive steps.

The rotor 48 carries a contact 64 suitably insulated therefrom, and a pin 62. (See also Fig. 4.) The pin 62 and the contact 64 are arranged to co-operate with a shoulder 61 and a contact 63, respectively, on a contact disk 86. This disk is of insulating material and carries, in addition to the shoulder 61 and contact 63, a contact 75 and a counterweight 51. The disk 86 is freely mounted on a rotatable shaft 49^a and carries a pawl 87^a which co-operates with a ratchet wheel 87 fixed to the shaft, thus permitting the disk to rotate in one direction independently of the shaft 49^a when the disk is driven by the rotor 48. The shaft 49^a also carries a rotor 49 similar to the rotor 48, and controlled by a brake magnet Y. This magnet comprises a core 65 of magnetizable material provided with a winding 66. The magnet Y has a circuit from battery P, through wire 92, contact 64 on rotor 48, contact 63 on disk 86, wires 96 and 89, winding 66, and wires 90, 69 and 58 back to battery. This circuit is closed only when contacts 64 and 63 on rotor 48 and disk 86 respectively, are in engagement. Magnet Y also has a circuit from battery P through wire 54, bridging contact

94 of relay Q¹, wires 95 and 89, winding 66 of magnet Y, and wires 90, 69 and 58 back to battery, and this circuit is completed each time that contact 94 is closed by relay Q¹ picking up or releasing. The purpose of the bridging contact 94 is to decrease the length of time that brake magnet Y must hold after the circuit of the energizing winding 66 is opened, particularly when the selector Z is changing from one code to another. When the magnet Y is energized by closing either of the circuits just traced, flux passes from one end of the core 65 through the rotor 49 and back to the other end of the core, and holds the rotor in a position in which two of the rotor teeth register with the ends of the core. When the rotor is locked in this manner, the disk 86 may rotate clockwise without turning the shaft 49^a, because the pawl 87^a will ride freely over the teeth of ratchet wheel 87. The magnet Y is designed to have slow-release characteristics, the core 65 being provided with a short-circuited conducting sleeve 93, so that the rotor 49 is not released until substantially three-fourths of a second after the circuit for winding 66 is opened. When the rotor 48 is driven clockwise it carries the contact disk 86 along with it, the pin 62 engaging shoulder 61, but since the contacts 63 and 64 complete a circuit for the brake magnet Y, this magnet is energized and the rotor 49 and shaft 49^a are locked in position. After the rotor 48 has been advanced and the circuits for both magnets E¹ and F¹ are opened, and sufficient time has elapsed for the brake magnet Y to release the rotor 49, the disk 86 will return under the action of counterweight 51 and will carry with it the shaft 49^a and the rotor 49, because the pawl 87^a will engage the ratchet wheel 87 for this direction of rotation. A spring 91 is mounted between the rotor 49 and the contact disk 86 and loosely engages these members for the purpose of absorbing shocks which might cause the disk 86 to vibrate.

The contact 75 on disk 86 is arranged to engage with any one of several stationary contacts 76, 77 and 78 for controlling signals, here shown as lamps S¹, N¹, etc. This contact 75 is connected with one terminal of the battery P by means of a wire 73. When the disk 86 is in the normal position shown in the drawings, the contact 75 engages the contact 76 thus completing a circuit for the lamp S¹. This circuit is from battery P, through wire 73, contact 75—76, lamp S¹, and wires 79 and 58 back to battery. When the disk 86 is moved to a position in which contact 75 engages contact 77, either of the lamps N¹ or R¹ may be lighted, depending upon which of the contacts 82 or 83 is closed. When disk 86 occupies such a position that contact 75 engages contact 78, either of the lamps E¹ or A¹ may be lighted, depending

upon which of the contacts 84 or 85 is closed. The circuits for lamps N¹, R¹, E¹ and A¹ will be obvious from the one just traced. The contacts 82, 83, 84 and 85 are controlled by a relay D. This relay has slow-pick-up and slow-release characteristics, and is so adjusted that it will not pick up when impulses of one-fourth second duration are supplied to it, but it will pick-up when impulses of one-half second duration are supplied to it. This relay is capable of holding its contacts closed for substantially one second following its de-energization. The circuit for this relay is controlled by front contact 80 of relay Q¹. This circuit is from battery P, through wire 54, front contact 80 of relay Q¹, wire 81, winding of relay D, and wires 79 and 58 back to battery, and is closed whenever the relay Q¹ is energized. When relay D is receiving one-fourth second impulses with contact 75—77 closed, contact 82 will be open and contact 83 closed, hence the lamp R¹ will be lighted, but if one-half second impulses are being received, the contact 82 will be closed and lamp N¹ will be lighted. The contacts 84 and 85 of this relay control the lamps E¹ and A¹ in a similar manner when contact 75—78 is closed.

In tracing the operation of the apparatus shown in Fig. 3, I will assume that the arm 7 of circuit controller G engages contact 8, so that uninterrupted alternating current is supplied to the track rails. When the first impulse of current is supplied to relay Q¹ this relay will pick up, closing the bridging contact 70 and supplying an impulse of current to the relay B¹ over a circuit from battery P, through wire 54, bridging contact 70 of relay Q¹, winding of relay B¹, and wires 69 and 58 back to battery. Relay B¹ will pick up closing its contacts 56 and 60, and since contacts 55 of relay Q¹ is also closed current will be supplied to the magnet E¹ over the contacts 55 and 56. The rotor 48 will therefore be advanced in a clockwise direction one step, carrying with it the contact disk 86 by means of pin 62 and shoulder 61. During this movement the pawl 87^a will ride over the teeth of ratchet wheel 87 because the magnet Y will be energized due to the engagement of contacts 63 and 64, and also due to the closing of bridging contact 94, so that rotor 49 and shaft 49^a are held stationary. This movement of disk 86 will advance contact 75 but will not disengage the contacts 75 and 76 to de-energize the lamp S¹ because of the width of contact 76. After a half second interval the relay B¹ will open its contacts and magnet E¹ will be de-energized, so that the rotor 48 will return to its normal position under the action of counterweight 50 and will disengage shoulder 61 and pin 62, as well as the contacts 63 and 64. Opening of the contacts 63 and 64 will break the circuit for magnet Y, which will

therefore become de-energized, and after an interval of approximately three-fourths of a second the rotor 49 will be released, hence the disk 86, together with shaft 49^a and rotor 49, will be returned to the position shown in the drawings by means of counterweight 51. When no current is being supplied to the track rails the lamp S¹ is lighted, contacts 75 and 76 being in engagement, as shown in the drawings.

When the contact arm 7 engages contact 9, a series of impulses of one-fourth second duration separated by intervals of one second are supplied to the track rails through the code wheel K¹. With the parts in the positions shown the first impulse of current supplied to relay Q¹ will cause it to pick up, closing contacts 55 and 80. When contact 70 bridges during transit, an impulse of current will pick up the relay B¹ thus closing its contacts 56 and 60, so that current is supplied to the winding 52^a of magnet E¹ for a period of one-fourth second and rotor 48 is advanced one step, carrying disk 86 around with it. The contacts 63 and 64 are in engagement hence the circuit for the brake magnet Y remains closed during this movement, and rotor 49 is held stationary. At the end of the one-fourth second impulse, relay Q¹ drops closing its back contact 59, and since the relay B¹ is slow releasing, current will be supplied to the winding 53^a of magnet F¹ over the contact 60 of relay B¹, and this magnet will advance the rotor 48 another step bringing contact 75 into engagement with contact 77. A circuit will therefore be completed for the lamp R¹. This circuit is from battery P, through wire 73, contact 75—77, contact 83 of relay D, lamp R¹ and wires 79 and 58 back to battery. After relay Q¹ is de-energized, the relay B¹ holds over the ensuing one-half second, then releases and counterweight 50 returns the rotor 48 to its initial position. Contact 64 is carried away from contact 63 so that the circuit of magnet Y is opened but the rotor 49 is not rotated by the counterweight 51 on disk 86, because the magnet Y holds over the remaining one-half second of the one second interval before it is again energized over bridging contact 94 when relay Q¹ picks up. At the end of the one second interval rotor 48 is again advanced two steps until pin 62 and shoulder 61 engages and until contacts 63 and 64 re-engage to again complete the circuit for magnet Y. The contact disk 86 is therefore held in the position in which the contacts 75 and 77 engage, and the rotor 49 is locked in position by the magnet Y, hence the lamp R¹ remains lighted. As long as code impulses are supplied to the track rails by code wheel K¹, the rotor 48 is periodically advanced two steps by the magnets E¹ and F¹, and then returned to its normal position under the action of counterweight 50, and each time

that relay Q¹ picks up or releases an impulse of current is supplied to the brake magnet Y over bridging contact 94 and current is also supplied to this magnet whenever the contacts 63 and 64 engage. Energization of the magnet Y prevents the disk 86 from returning so that the lamp R¹ remains lighted as long as this code is supplied to the relay Q¹.

When the arm 7 or circuit controller G engages contact 10, and code impulses are supplied to the track rails by code wheel K², the operation of the apparatus is similar to that just described in connection with code wheel K¹, except that the impulses of current supplied to the track rails are of one-half second duration so that relay D picks up, closing contact 82 and lighting lamp N¹.

If circuit controller arm 7 engages contact 11, the code wheel K³ supplies current to the track rails in the form of a code consisting of groups of two one-fourth second impulses separated by one-fourth second intervals, the groups being separated by one second intervals. The first impulse of current of each group picks up relay Q¹, closing its contacts 80 and 55. Contact 70 of relay Q¹ bridges in transit and supplies an impulse of current to relay B¹ which picks up, closing its contacts 56 and 60. Magnet E¹ is then energized to advance the rotor 48 and disk 86 one step, and at the end of the one-fourth second impulse when relay Q¹ releases, the magnet F¹ advances the rotor 48 and disk 86 another step. The relay B¹ holds its contacts closed during the ensuing one-fourth second interval, so that magnet F¹ remains energized and holds the rotor 48 in its advanced position in which contact 75—77 will be closed. At the beginning of the second impulse of the group when relay Q¹ picks up, rotor 48 and disk 86 are again advanced one step by the magnet E¹ and at the end of this one-fourth second impulse when relay Q¹ releases, they are advanced another step by the magnet F¹. It will therefore be clear that for each group of impulses the rotor 48 is advanced four steps, carrying with it the disk 86 and bringing contacts 75 and 78 into engagement. Each time that bridging contact 94 is closed and whenever the rotor 48 advances the disk 86, a circuit is completed for the brake magnet Y, so that the rotor 49 is held in fixed position. When the contacts 75 and 78 engage, a circuit is completed for the lamp A¹. This circuit is from battery P, through wire 73, contact 75—78 contact 85 of relay D, lamp A¹, and wires 79 and 58 back to battery. Relay D is not energized by the one-fourth second impulses of this code, hence the lamp A¹ is lighted and remains lighted as long as the track rails are supplied with current from the code wheel K³.

If the arm 7 of circuit controller G engages contact 12 so that current is supplied

to the track rails by code wheel K⁴, the relay Q¹ will receive groups of impulses made of two one-half second impulses separated by intervals of one-half second, the groups being separated by one second intervals. The operation of the apparatus will be the same as when the supply of current is controlled by code wheel K³, except that the relay D will be picked up by the one-half second impulse and will close its contact 84 so that lamp E¹ is lighted.

I will now assume that arm 7 of circuit controller G engages contact 11 and that code impulses are being supplied to the track rails through code wheel K³, so that lamp A¹ is lighted, and that arm 7 of circuit controller G is suddenly shifted to engage the contact 9, so that code impulses are supplied to the track rails through code wheel K¹, the change being made so that an interval of one second intervenes between the last one-fourth second impulse from code wheel K³ and the first one-fourth second impulse from code wheel K¹. At the end of the last impulse from code wheel K³, relay Q¹ will release to close its back contact 59, so that magnet F¹ is energized and holds the rotor 48 in its advanced position. Contact disk 86 will occupy a position in which contacts 75 and 78 engage and lamp A¹ will be lighted. Magnet Y will be energized and rotor 49 will be locked in position. When relay B¹ releases after one-half second magnet F¹ will be de-energized and rotor 48 will immediately be returned to its normal position by counterweight 50 and will disengage contacts 63 and 64 to cut off the supply of current to brake magnet Y. Brake magnet Y will hold the rotor 49 in its position and will prevent contact disk 86 from being rotated by counterweight 51. After another half second and before magnet Y releases, the first one-fourth second impulse through code wheel K¹ will pick up relay Q¹, again supplying current to magnet Y over bridging contact 94. Magnet E¹ will advance the rotor 48 one step, and at the end of the impulse when relay Q¹ releases magnet Y will receive another impulse to continue to hold contact 75—78 closed. Magnet F¹ will advance the rotor 48 another step and will hold the rotor in this advanced position because relay B¹ will remain energized for one-half second during the first one second interval. The contact disk 86, however, occupies a position corresponding to four steps of the rotor 48, hence the impulses from code wheel K¹ will not advance the rotor 48 far enough to close contacts 63 and 64. After approximately three-fourths of a second following the release of relay Q¹ at the end of the first impulse through code wheel K¹, magnet Y will release the rotor 49 and counterweight 51 will rotate the disk 86, together with shaft 49^a and rotor 49, backward until the shoulder 61 on disk 86 engages the pin 62 on rotor

48, this rotor now being in its starting position, and contacts 63 and 64 re-engage to complete a circuit for the brake magnet Y, and to lock the rotor 49. The operation will now be the same as explained in connection with the code wheel K¹ starting with the parts in the positions shown in the drawings. Each impulse of current supplied to the relay Q¹ from code wheel K¹ will advance the rotor 48 two steps, so that disk 86 will return to such a position that contacts 75 and 77 are brought into engagement and a circuit is completed to light the lamp R¹. The lamp R¹ will then remain lighted as long as code wheel K¹ is connected to the track rails. A similar action takes place in making other changes between codes and will be readily understood without further explanation. I have illustrated apparatus for giving only five indications, but it is obvious that my apparatus is not limited to this number.

Although I have herein shown and described only two forms 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 relay Q, means for supplying said relay with groups of energy impulses of variable number of impulses in the groups, the time interval between groups being relatively long and the time interval between the impulses in each group being relatively short, a momentary bridging contact operated by the armature of said relay, a relay B having a release period longer than said interval between impulses of a group and shorter than said interval between groups, a circuit for relay B including said bridging contact, a step-by-step motor having a movable member biased to an initial position and two windings arranged when alternately energized to move said member step-by-step away from initial position, a circuit for one of said windings including front contacts of relays Q and B connected in series, a circuit for the other winding including a back contact of relay Q and a front contact of relay B, whereby said motor member is moved two steps away from its initial position for each impulse in each group and returns to its initial position between each two groups of impulses, and signaling means selectively controlled by the relay B upon its release at the end of each group of impulses and by the position assumed by the movable member at the end of the impulse group in response to the number of impulses in the group.

2. In combination, a relay Q, means for supplying said relay with groups of energy impulses of variable number of impulses in

the groups, the time interval between groups being relatively long and the time interval between the impulses in each group being relatively short, a momentary bridging contact operated by the armature of said relay, a relay B having a release period longer than said interval between impulses of a group and shorter than said intervals between groups, a circuit for relay B including said bridging contact, a step-by-step motor having a movable member biased to an initial position and two windings arranged when alternately energized to move said member step-by-step away from initial position, a circuit for one of said windings including front contacts of relays Q and B connected in series, a circuit for the other winding including a back contact of relay Q and a front contact of relay B, whereby said motor member is moved two steps away from its initial position for each impulse in each group and returns to its initial position between each two groups of impulses, a circuit controller variably positioned by said member at the end of each impulse group depending upon the number of impulses in the group, a relay C having a release period longer than said interval between groups of impulses, a momentary bridging contact operated by the armature of relay B, upon its release and circuits for said relay C controlled by said circuit controller in its various positions at the end of the impulse groups and by said bridging contact of relay B.

In testimony whereof I affix my signature.
DONALD G. ACKERLY.