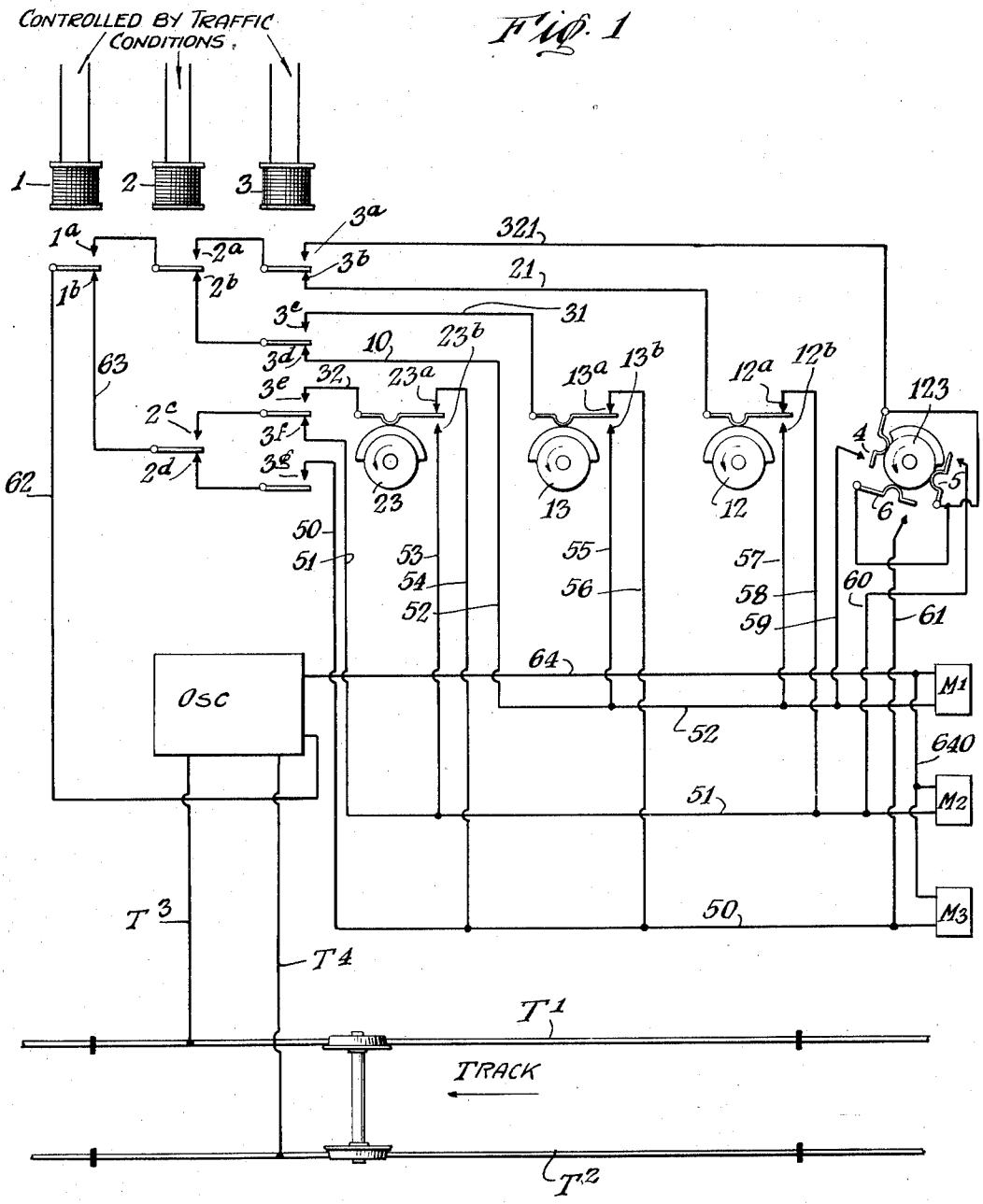
Aug. 15, 1933. A. J. SORENSEN 1,922,113

TRAIN CONTROL SYSTEM

Filed Dec. 12, 1931 2 Sheets-Sheet 1

FIG. 1



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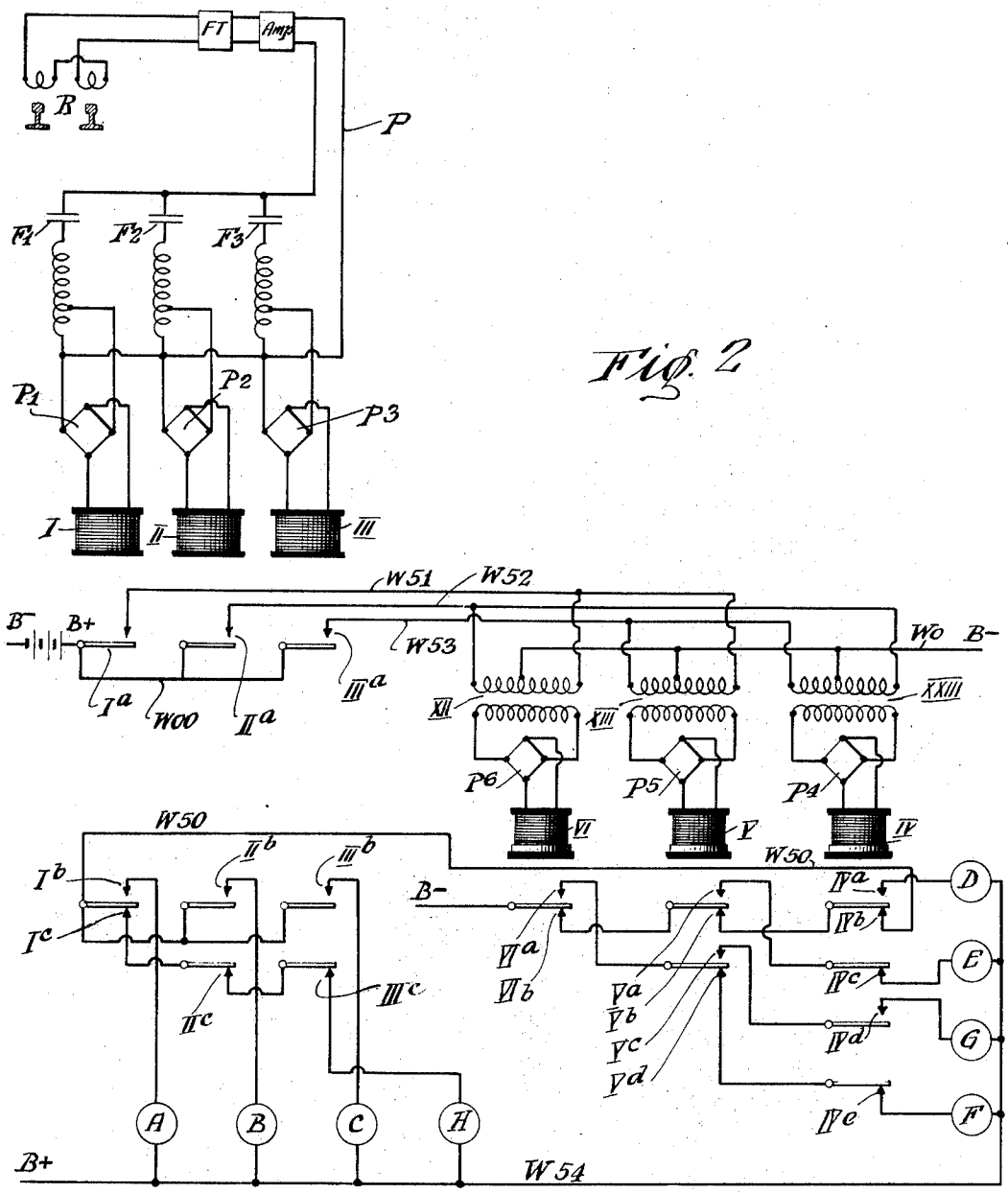


Fig. 2

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UNITED STATES PATENT OFFICE

1,922,113

TRAIN CONTROL SYSTEM

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Application December 12, 1931. Serial No. 580,663

29 Claims. (Cl. 246—63)

The present invention relates to train control systems and comprehends both trackway-circuit systems, train-carried equipment and a combination of the two.

The main, though not the only, object and feature of the invention is to obtain a great many indications by what may be called a system of permutation in the use of relatively few and simple means.

In the accompanying drawings the invention is disclosed in a concrete and preferred though somewhat diagrammatic form in which:

Fig. 1 is a diagrammatic representation of a trackway equipment embodying the invention; and

Fig. 2 is a diagrammatic representation of a train-carried equipment embodying the invention.

The trackway element to be supplied with current consists here of the traffic rails marked T1 and T2 which may be arranged in blocks in a well understood manner, the usual direction of traffic being indicated by an arrow. A source of current here represented by oscillator Osc is suitably connected to said rails by means of leads T3 and T4, and a plurality of current-modifying means are employed to modify the current delivered by the oscillator to the rails, said means being here indicated by modulators M1, M2 and M3 each of which imparts to the current a distinct characteristic different from that imparted by any other of the plurality of current-modifying means. As an example, the carrier current delivered by the oscillator or other source may be of a frequency of five-hundred cycles per second, and the three modifying means may modify the current by imparting to it a frequency of twenty, thirty and forty cycles per second respectively. It is unnecessary to describe the particular means to produce these effects as they are well understood. The means whereby different traffic conditions can be established may vary and can be controlled either manually as from a dispatcher's station, or automatically by the traffic conditions of other blocks as will be evident. In the exemplification given, three relays 1, 2 and 3 are shown, and these relays constitute a plurality of selective means which have contacts that directly control the modulators, and also have contacts that control circuits leading to a plurality of series of contacts controlled by timed circuit-closing means which in turn control the modulators in different groupings. The number of selective means, modulators and series of contacts may obviously vary according to the number of indications desired but, as pointed out previously, there are in the present case three selective means and three modulators. Associated with these are here four timed circuit-closing and opening means, represented by four constantly and relatively slowly rotating cams 23, 13, 12 and 123 which control contacts and circuits as will presently appear, it being pointed out here that cam 123 controls three contacts, while the other cams control only two, and further that no two contacts controlled by the same cam are simultaneously closed.

When relay 1 only is energized, modulator M1 is connected to the oscillator continuously during that traffic condition as follows: From oscillator Osc by wire 62, over front contact 1*a* and back contacts 2*b* and 3*d* in series, wires 10 and 52 to modulator M1, and then by wire 64 to oscillator Osc. The rail current is therefore modulated by M1.

When relay 2 only is energized, modulator M2 is connected continuously during that traffic condition as follows: From oscillator Osc by wire 62, over back contact 1*b*, front contact 2*c* and back contact 3*f* in series, and then by wire 51 to modulator M2, and by wires 640 and 64 back to oscillator Osc. The rail current is therefore modulated by M2.

When relay 3 only is energized, modulator M3 is connected to the oscillator continuously during that traffic condition as follows: from oscillator Osc by wire 62, over back contacts 1*b* and 2*d* and front contact 3*g* in series, and then by wire 50 to modulator M3, and by wires 640 and 64 back to oscillator Osc. The rail current is therefore modulated by M3.

When relays 1 and 2 are simultaneously energized, the rail current will be modulated alternately, during that traffic condition, by modulators M1 and M2 as follows: from oscillator Osc by wire 62 over front contacts 1*a* and 2*a* and back contact 3*b* in series, wire 21 and, when cam 12 closes contact 12*a*, by wires 58 and 51 to modulator M2 and wires 640 and 64 back to oscillator Osc; and, when cam 12 closes contact 12*b*, over wires 57 and 52 to modulator M1 and then by wire 64 back to oscillator Osc.

When relays 1 and 3 are simultaneously energized, the rail current will be modulated alternately, during that traffic condition, by modulators M1 and M3 as follows: from oscillator Osc by wire 62, front contact 1*a*, back contact 2*b* and front contact 3*c* in series, wire 31 and, when cam 13 closes contact 13*a*, by wires 56 and

50 to modulator M3 and wires 640 and 64 to oscillator Osc; and, when cam 13 closes contact 13*b*, by wires 55 and 52 to modulator M1 and by wire 64 back to oscillator Osc.

When relays 2 and 3 are simultaneously energized, the rail current will be modulated alternately, during that traffic condition, by modulators M2 and M3 as follows: from oscillator Osc by wire 62, over back contact 1*b* and front contacts 2*c* and 3*e* in series, by wire 32 and then, when cam 23 closes contact 23*a*, by wires 54 and 50 to modulator M3, and by wires 640 and 64 to oscillator Osc; and, when cam 23 closes contact 23*b*, over wires 53 and 51 to modulator M2 and then by wires 640 and 64 to oscillator Osc.

When relays 1, 2 and 3 are all simultaneously energized, the rail current will be modulated successively or in turn, during that traffic condition, by modulators M1, M2 and M3 as follows: from oscillator Osc by wire 62, over front contacts 1*a*, 2*a* and 3*a* in series, wire 321 and, when cam 123 closes contact 4, by wires 59 and 52 to modulator M1 and by wire 64 back to oscillator Osc; when cam 123 closes contact 5, by wires 60 and 51 to modulator M2 and then by wires 640 and 64 back to oscillator Osc; and, when cam 123 closes contact 6, by wires 61 and 50 to modulator M3 and then by wires 640 and 64 back to oscillator Osc.

When relays 1, 2 and 3 are all deenergized then, during that traffic condition, no modulator will be connected to the oscillator, and hence the unmodified carrier current from Osc will be impressed on the rails.

From the foregoing it will be understood that one feature of the invention resides in having a plurality of current-modifying means each capable of imparting to the current a distinct characteristic different from that imparted by any of the others, and circuit means to cause said plurality of current-modifying means to successively but not simultaneously modify said current under a given traffic condition. And further, that one of said current-modifying means may modify the current under another traffic condition, and still another may modify it under yet another traffic condition. It will also be seen that the system embodies a series of contacts such as 4, 5 and 6; 12*a* and 12*b*; 13*a* and 13*b*; and 23*a* and 23*b*, one series controlling one group of current-modifying means such as M2 and M3, and another series controlling another group of current-modifying means such as M1 and M3 etc., that the same current-modifying means is included in more than one group, and that each contact, such as 12*a* and 12*b*, of each series of contacts controls a circuit of a current-modifying means. Furthermore, that there are driven means, such as cams 12, 13 etc., to successively close and open the contacts of each series of contacts, and that there are selective means, such as relays 1, 2 and 3, to close a circuit leading to one or another series of contacts. Another aspect of the construction is that there is associated with the plurality of current-modifying means (M1, M2, M3) control means (relays, cams and circuits) whereby the current can be modified in a number of different ways greater than the number of current-modifying means, in fact greater than twice the number of current-modifying means.

Considering now the train-carried equipment shown in Fig. 2, it will be understood that this is constructed so as to cooperate with the trackway system just described. A plurality of control means, here represented by relays I, II and III, is provided, each of said control means being effectively responsive to current of a distinct characteristic, and no two being effectively responsive to current having the same characteristic. Thus relay I is responsive to the current modulated by M1 or to the traffic condition prevailing when relay 1 is energized; II is responsive to M2 etc. etc. Any suitable means can be utilized to render relays I, II and III responsive to the influence of the trackway current. As here shown, there is a pick-up circuit P in an inductive relation to the traffic rails by means of coil R, said circuit also including a suitable filtering means *Ft* or condenser that tunes the circuit to resonance at the frequency of the carrier current from Osc. Said circuit may also include an amplifier Amp that amplifies the current picked up from the traffic rails. Relays I, II and III are direct-current relays and are connected in parallel with circuit P, there being full-wave rectifiers P1, P2 and P3 interposed in the connections, and there being further suitable filtering or tuning means such as condenser-reactor units F1, F2 and F3 to tune each individual circuit to resonance at the frequency of the current to which the particular circuit is intended to respond; that is, the circuit of I is tuned to resonance at the frequency of modulator M1 and so on. A, B and C denote indication means, here represented by a series of lamps; and suitable contacts are controlled by relays I, II and III to light the lamps in accordance with the energization of said relays. D, E, F and G denote another indication means, here also represented by a series of lamps, to indicate when two or more of relays I, II and III are energized in turn during the same traffic condition. The means to control lamps D, E, F and G from relays I, II and III consist in this instance of three other relays IV, V and VI, each of which is energized only when at least two of the controlling relays I, II and III are being energized, but no two of which are effectively responsive to the same two controlling relays. This is accomplished by providing an iron core transformer (XII, XIII or XXIII) in connection with each of the controlled relays IV, V and VI and by effectively energizing the secondaries of said transformers only when two of the controlling relays are being alternately energized. To this end, each half of a primary of a transformer is controlled by a different controlling relay, and each controlling relay controls the halves of the primaries of at least two transformers. Relays IV, V and VI are here direct-current slow-release relays and are connected to the secondaries of the transformers through the intermediacy of full-wave rectifiers P4, P5 and P6. Relays IV, V and VI are sufficiently slow acting to remain effectively energized during the respective interruptions accomplished by cams 12, 13, 23 and 123.

When relay 1 of Fig. 1 is energized and modulator M1 is modifying the rail current, then relay I of Fig. 2 will be continuously energized, and current will flow from terminal B+ of a source of current, such as a battery, through front contact 1*a*, wire W51, right-hand halves of the primaries of transformers XII and XIII, to wire Wo and to terminal B— of the same source. This current will not effectively energize relays VI and V and hence these relays, as well as relay IV, will not pick up their contacts. Current will therefore flow from terminal B+ by way

of wire W54, indication lamp A, front contact Ib, wire W50, and back contacts IVb, Vb, and VIb in series, to terminals B—.

When relay 2 of Fig. 1 is energized and modulator M2 is modifying the rail current, relay II of Fig. 2 will be continuously energized, and current then will pass from terminal B+ by way of wire Woo, over front contact IIa, by way of wire W52 to lefthand half of primary of transformer XII and righthand half of primary of transformer XXIII to terminal B—. This current will not effectively energize relays VI and IV and hence these relays, as well as relay V, will not pick up their contacts. Current will therefore flow from terminals B+, by way of wire W54 to lamp B, over front contact IIb to wire W50 and back contacts IVb, Vb and VIb in series, to terminal B—.

When relay 3 of Fig. 1 is energized and modulator M3 is modifying the rail current, relay III of Fig. 2 will be continuously energized, and current will then flow from terminal B+, by way of wire Woo and front contact IIIa to wire W53 and to the left-hand halves of the primaries of transformers XIII and XXIII and thence by wire Wo back to terminal B—. This current will not effectively energize relays V and IV and hence these, as well as relay VI, will not pick up their armatures. Current will therefore flow from terminal B+, by way of wire W54 to lamp C, front contact IIIb, wire W50, and back contacts IVb, Vb and VIb in series to terminal B—.

When relays 1 and 2 of Fig. 1 are both energized and modulators M1 and M2 are alternately modifying the rail current, relays I and II of Fig. 2 are alternately energized. As has been pointed out previously, when relay I is energized current passes through the right-hand halves of the primaries of transformers XII and XIII, and every time relay II is energized current will pass through the left-hand half of the primary of transformer XII and right-hand half of the primary of transformer XXIII. It will therefore be seen that the two halves of the primary of transformer XII are energized alternately in such relative directions as to magnetize the iron core of the transformer in opposite directions and said core will undergo periodic reversals of flux whereby an alternating current is caused to flow in the secondary of said transformer and in the full-wave rectifier associated therewith. The secondaries of transformers XIII and XXIII will however not be effectively energized. In other words: only relay VI is energized, and current will therefore flow from terminal B+, by wire W54, lamp F, back contacts IVe and Vd and front contact VIa in series, to terminal B—.

When relays 1 and 3 of Fig. 1 are both energized and modulators M1 and M3 are alternately modifying the rail current, relays I and III of Fig. 2 are alternately energized. As previously described, relay I will energize the right-hand halves of the primary of transformers XII and XIII and relay III will energize the left-hand halves of the primaries of transformers XIII and XXIII. Thus relay V only will be energized and consequently current will flow from terminal B+, by wire W54, lamp E, back contact IVc, front contact Va and back contact VIb in series, to terminal B—.

When relays 2 and 3 of Fig. 1 are both energized and modulators M2 and M3 are alternately modifying the rail current, relays II and III of Fig. 2 are alternately energized. Relay II will therefore energize left-hand half of primary of transformer XII and right-hand half of primary of transformer XXIII, and relay III will energize the left-hand halves of the primaries of transformers XIII and XXIII. Thus only relay IV will be energized and therefore current will flow from terminal B+, by wire W54, lamp D, front contact IVa, and back contacts Vb and VIb in series, to terminal B—.

When relays 1, 2 and 3 of Fig. 1 are all energized and modulators M1, M2 and M3 are in turn modifying the rail current, relays I, II and III of Fig. 2 are energized in turn and it will be apparent from what has gone before that both halves of the primaries of all three transformers XII, XIII and XXIII will be energized in such a manner that all three relays IV, V and VI become energized. Current will therefore pass from terminal B+, by wire W54, lamp G, front contacts IVd, Vc, and VIa in series, to terminal B—.

When relays 1, 2 and 3 of Fig. 1 are all deenergized, and unmodified carrier current is transmitted to the rails of oscillator Osc, or if no current is transmitted to the rails, then relays I, II and III of Fig. 2 also remain deenergized and so will relays IV, V and VI. Current will therefore flow from terminal B+, by wire W54, lamp H, back contacts IIIc, IIc and Ic in series, wire W50 and back contacts IVb, Vb and VIb in series, to terminal B—.

I claim:

1. A circuit system including: a source of current, a plurality of current-modifying means each capable of imparting to the current a distinct characteristic different from that imparted by any other of the plurality of current-modifying means, a plurality of selective means, capable of individual actuation one to cause one and another to cause another of the plurality of current-modifying means to modify the current, and capable of simultaneous actuation to thereby cause the plurality of current-modifying means to act in turn to modify the current, a plurality of control means each responsive to the influence of current of a distinct characteristic and no two control means responsive to current having the same characteristic, and means to indicate the energization of a single control means or the energization in turn of a plurality of control means.

2. A circuit system including: a source of current, a plurality of current-modifying means each capable of imparting to the current a distinct characteristic different from that imparted by any other of the plurality of current-modifying means, a plurality of selective means, capable of individual actuation one to cause one and another to cause another of the plurality of current-modifying means to modify the current, and capable of simultaneous actuation in different groupings to thereby cause the plurality of current-modifying means to act in turn, and in different groupings, to modify the current, a plurality of control means each responsive to the influence of current of a distinct characteristic and no two control means responsive to current having the same characteristic, and means to indicate the energization of a single control means or the energization in turn of a plurality of control means in different groupings.

3. A train control system including: a trackway element, a source of current to be con-

nected to the trackway element, a plurality of current-modifying means each capable of imparting to the current a distinct characteristic different from that imparted by any other of the plurality of current-modifying means, a plurality of selective means, capable of individual actuation one to cause one and another to cause another of the plurality of current-modifying means to modify the current, and capable of simultaneous actuation to thereby cause the plurality of current-modifying means to act in turn, during the same traffic condition, to modify the current, a train, a plurality of train-carried control means each responsive to the influence of trackway current of a distinct characteristic and no two control means responsive to current having the same characteristic, and train-carried means to indicate the energization of a single control means or the energization in turn of a plurality of control means.

4. A train control system including: a trackway element, a source of current to be connected to the trackway element, a plurality of current-modifying means each capable of imparting to the current a distinct characteristic different from that imparted by any other of the plurality of current-modifying means, a plurality of selective means, capable of individual actuation one to cause one and another to cause another of the plurality of current-modifying means to modify the current, and capable of simultaneous actuation in different groupings to thereby cause the plurality of current-modifying means to act in turn and in different groupings to modify the current, a train, a train-carried plurality of control means each responsive to the influence of trackway current of a distinct characteristic and no two control means responsive to the influence of current having the same characteristic, and train-carried means to indicate the energization of a single control means or the energization in turn of a plurality of control means in different groupings.

5. A train control system including: a trackway element to be supplied with current, a source of current connected to the trackway element, two current-modifying means each capable of imparting to the current a distinct characteristic different from that imparted by the other, two selective means, capable of individual actuation one to cause one and the other to cause the other current-modifying means to modify the current, and capable of simultaneous actuation to thereby cause the two current-modifying means to act in alternation to modify the current, a train, three indication means on the train, and two train-carried controlling means, one effectively responsive to the influence of trackway current having one and the other effectively responsive to the influence of trackway current having another distinct characteristic and one of which when energized controls one indication means, and the other of which when energized controls another indication means, and both of which when energized in alternation control the third indication means.

6. A circuit system including: a source of current, two current modifying means each capable of imparting to the current a distinct characteristic different from that imparted by the other, two selective means, capable of individual actuation one to cause one and the other to cause the other current-modifying means to modify the current, and capable of simultaneous actuation to thereby cause the two current-modifying means to act in alternation to modify the current, three indication means, and two controlling means, one effectively responsive to the influence of current having one and the other effectively responsive to the influence of current having another distinct characteristic, and one of which when energized controls one indication means, and the other of which when energized controls another indication means, and both of which when energized in alternation control the third indication means.

7. A circuit system including: a source of current, two current modifying means each capable of imparting to the current a distinct characteristic different from that imparted by the other, two selective means, capable of individual actuation one to cause one and the other to cause the other current-modifying means to modify the current, and capable of simultaneous actuation to thereby cause the two current-modifying means to act in alternation to modify the current, and two controlling means, one effectively responsive to the influence of current having one and the other effectively responsive to the influence of current having another distinct characteristic, and one of which when energized gives one indication, and the other of which when energized gives another indication and both of which when energized in alternation give a third indication.

8. A train control system including: a trackway element to be supplied with current, a source of current connected to the trackway element, two current-modifying means each capable of imparting to the current a distinct characteristic different from that imparted by the other, two selective means, capable of individual actuation one to cause one and the other to cause the other current-modifying means to modify the current, and capable of simultaneous actuation to thereby cause the two current-modifying means to act in alternation to modify the current, a train, and two train-carried controlling means, one effectively responsive to the influence of current having one and the other effectively responsive to the influence of current having another distinct characteristic, and one of which when energized gives one indication, and the other of which when energized gives another indication and both of which when energized in alternation give a third indication.

9. A trackway circuit system including: a trackway element to be supplied with current, a source of current connected to said trackway element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of such current-modifying means, a series of contacts controlling one group of the plurality of current-modifying means, another series of contacts controlling a different group of the plurality of current-modifying means, the same individual current-modifying means being included in more than one group and each contact of each series controlling a circuit of a current-modifying means, means to successively close and open the contacts of each series, and means to close a circuit leading to one or another series of contacts.

10. A trackway circuit system including: a trackway element to be supplied with current, a source of current connected to said trackway

element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of such current-modifying means, a series of contacts controlling one group of the plurality of current-modifying means, another series of contacts controlling a different group of the plurality of current-modifying means, the same individual current-modifying means being included in more than one group and each contact of each series controlling a circuit of a current-modifying means, means to successively close and open the contacts of each series, and means to close a circuit leading to one or another series of contacts or to close one or another circuit controlling one or another mdifying means independently of the series of contacts.

11. A track-circuit system including: a traffic track section the rails of which are to be supplied with current, a source of current connected to said rails, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, a series of contacts controlling one group of the plurality of current-modifying means, another series of contacts controlling a different group of the plurality of current-modifying means, the same individual current-modifying means being included in more than one group and each contact of each series controlling a circuit of a current-modifying means, means to successively close and open the contacts of each series, and means to close a circuit leading to one or another series of contacts.

12. A track-circuit system including: a traffic track section the rails of which are to be supplied with current, a source of current connected to said rails, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, a series of contacts controlling one group of the plurality of current-modifying means, another series of contacts controlling a different group of the plurality of current-modifying means, the same individual current-modifying means being included in more than one group and each contact of each series controlling a circuit of a current-modifying means, means to successively close and open the contacts of each series, means to close a circuit leading to one or another series of contacts, and means to close a circuit leading to one or another series of contacts or to close one or another circuit controlling one or another modifying means independently of the series of contacts.

13. A circuit system including: a plurality of controlling means each effectively responsive to current having a distinct characteristic and no two of them effectively responsive to current having the same characteristic, a plurality of transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, a plurality of relays each to be effectively energized when both halves of the primary of a transformer are being energized and no relay being controlled by more than one transformer, and a plurality of indication means each controlled by a relay different from that which controls any other indication means.

14. A circuit system including: a plurality of controlling means each effectively responsive to current having a distinct characteristic and no two of them effectively responsive to current having the same characteristic, a plurality of transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, a plurality of relays each to be effectively energized when both halves of the primary of a transformer are being alternately energized and no relay being controlled by more than one transformer, and a plurality of indication means each controlled by a relay different from that which controls any other indication means.

15. A circuit system including: a plurality of controlling means each effectively responsive to current having a distinct characteristic and no two of them effectively responsive to current having the same characteristic, a plurality of transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, a plurality of relays each to be effectively energized when both halves of the primary of a transformer are being energized and no relay being controlled by more than one transformer, a plurality of indication means each controlled by a relay different from that which controls any other indication means, and another plurality of indication means, each controlled by a controlling means different from that controlling any other indication means.

16. A circuit system including: a plurality of controlling means each effectively responsive to current having a distinct characteristic and no two of them effectively responsive to current having the same characteristic, a plurality of transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, a plurality of relays each to be effectively energized when both halves of the primary of a transformer are being alternately energized and no relay being controlled by more than one transformer, a plurality of indication means each controlled by a relay different from that which controls any other indication means, and another plurality of indication means, each controlled by a controlling means different from that controlling any other indication means.

17. A train control system including: a trackway element to be supplied with current, a source of current connected to said trackway element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said plurality of current-modifying means to successively but not simultaneously modify said current under a given traffic condition, a train, a train-carried plurality of controlling means each

effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plurality of train-carried relays each to be effectively energized only when at least two of the controlling means are being energized and no two of said relays being effectively responsive to the same two controlling means, and a plurality of train-carried indication means each controlled by a relay different from that which controls any other indication means.

18. A train control system including: a trackway element to be supplied with current, a source of current connected to said trackway element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said plurality of current-modifying means to successively but not simultaneously modify said current under a given traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plurality of train-carried transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, a plurality of train-carried relays each to be effectively energized when both halves of a transformer are being energized, and a plurality of indication means each controlled by a relay different from that which controls any other indication means.

19. A train control system including: A trackway element to be supplied with current, a source of current connected to said trackway element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said current-modifying means, one under one traffic condition and another under another traffic condition, to individually modify said current and to cause said plurality of current-modifying means to successively but not simultaneously modify said current under yet another traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plurality of train-carried relays each to be effectively energized only when at least two of the controlling means are being energized and no two of said relays being effectively responsive to the same two controlling means, a plurality of train-carried indication means each controlled by a relay different from that which controls any other indication means, and another train-carried plurality of indication means each controlled by a controlling means different from that controlling any other indication means.

20. A train control system including: a trackway element to be supplied with current, a source of current connected to said trackway element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said current-modifying means, one under one traffic condition and another under another traffic condition, to individually modify said current and to cause said plurality of current-modifying means to successively but not simultaneously modify said current under yet another traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plurality of train-carried transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, a plurality of train-carried relays each to be effectively energized when both halves of a transformer are being energized, a plurality of indication means each controlled by a relay different from that which controls any other indication means, and another train-carried plurality of indication means each controlled by a controlling means different from that controlling any other indication means.

21. A train control system including: a traffic track section the rails of which are to be supplied with current, a source of current connected to said rails, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said plurality of current-modifying means to successively but not simultaneously modify said current under a given traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to trackway current having the same characteristic, a plurality of train-carried relays each to be effectively energized only when at least two of the controlling means are being energized and no two of said relays being effectively responsive to the same two controlling means, and a plurality of train-carried indication means each controlled by a relay different from that which controls any other indication means.

22. A train control system including: a traffic track section the rails of which are to be supplied with current, a source of current connected to said rails, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said plurality of current-modifying means to successively but not simultaneously modify said current under a given traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plu-

rality of train-carried transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers and no two transformers being controlled by the same two controlling means, a plurality of train-carried relays each to be effectively energized when both halves of a transformer are being energized, and a plurality of indication means each controlled by a relay different from that which controls any other indication means.

23. A train control system including: a traffic track section the rails of which are to be supplied with current, a source of current connected to said rails, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said current-modifying means, one under one traffic condition and another under another traffic condition, to individually modify said current and to cause said plurality of current-modifying means to successively but not simultaneously modify said current under yet another traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plurality of train-carried relays each to be effectively energized only when at least two of the controlling means are being energized and no two of said relays being effectively responsive to the same two controlling means, and a plurality of train-carried indication means each controlled by a relay different from that which controls any other indication means.

24. A train control system including: a traffic track section the rails of which are to be supplied with current, a source of current connected to said rails, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said current-modifying means, one under one traffic condition and another under another traffic condition, to individually modify said current and to cause said plurality of current-modifying means to successively but not simultaneously modify said current under yet another traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plurality of train-carried relays each to be effectively energized only when at least two of the controlling means are being energized and no two of said relays being effectively responsive to the same two controlling means, a plurality of train-carried indication means each controlled by a relay different from that which controls any other indication means, and another train-carried plurality of indication means each controlled by a controlling means different from that controlling any other indication means.

25. A train control system including: a traffic track section the rails of which are to be supplied with current, a source of current connected to said rails, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, circuit means to cause said current-modifying means, one under one traffic condition and another under another traffic condition, to individually modify said current and to cause said plurality of current-modifying means to successively but not simultaneously modify said current under yet another traffic condition, a train, a train-carried plurality of controlling means each effectively responsive to the influence of trackway current having a distinct characteristic and no two of them effectively responsive to the influence of trackway current having the same characteristic, a plurality of train-carried transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, a plurality of train-carried relays each to be effectively energized when both halves of a transformer are being energized, a plurality of indication means each controlled by a relay different from that which controls any other indication means, and another train-carried plurality of indication means each controlled by a controlling means different from that controlling any other indication means.

26. A circuit system including: a plurality of controlling means each effectively responsive to current having a distinct characteristic and no two of them effectively responsive to current having the same characteristic, a plurality of transformers, each half of each of the primaries of said transformers being controlled by a controlling means, each controlling means controlling one-half of each of the primaries of two transformers, and no two transformers being controlled by the same two controlling means, and a plurality of relays each to be effectively energized when both halves of the primary of a transformer are energized, and no relay being controlled by more than one transformer.

27. In a trackway circuit system, a trackway element to be supplied with current, a source of current connected to said trackway element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, and circuit means including: constantly driven circuit closing and opening means, and a plurality of relays, each of which when energized separately establishes a circuit, independently of the control exercised by the constantly driven means, between its complementary current-modifying means and the current source, and said relays when simultaneously energized establishing successively but not simultaneously, in combination with the constantly driven means, circuits between the plurality of current-modifying means and the current source.

28. In a trackway circuit system, a trackway element to be supplied with current, a source of current connected to said trackway element, a plurality of current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any other of the plurality of current-modifying means, and circuit means in-

cluding: constantly rotating circuit controlling cams, and a plurality of relays, each of which when energized separately establishes a circuit, independently of the control exercised by the cams, between its complementary current-modifying means and the current source, and said relays when simultaneously energized establishing successively but not simultaneously, in combination with the cams, circuits between the plurality of current-modifying means and the current source.

29. In a trackway circuit system, a trackway element to be supplied with current, a source of current connected to said trackway element, three current-modifying means each capable of imparting a distinct characteristic to the current different from the characteristic imparted by any of the others, and circuit means including: four constantly rotating circuit controlling cams, and three relays, each of which when energized separately establishes a circuit, independently of the control exercised by the cams, between its complementary current-modifying means and the current source, said relays when simultaneously energized in groups of two establishing, successively but not simultaneously, in combination with one of three of the four cams, depending upon which two of the relays are energized, different circuits between two of the three current-modifying means and the current source, and said relays when all are simultaneously energized establishing, successively but not simultaneously, in combination with the fourth cam, circuits between all three current-modifying means and the current source.

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