D. H. SCHWEYER.

TRAIN CONTROLLING APPARATUS.

APPLICATION FILED DEC. 21, 1917.

1,342,873.

Patented June 8, 1920.

4 SHEETS—SHEET 1.

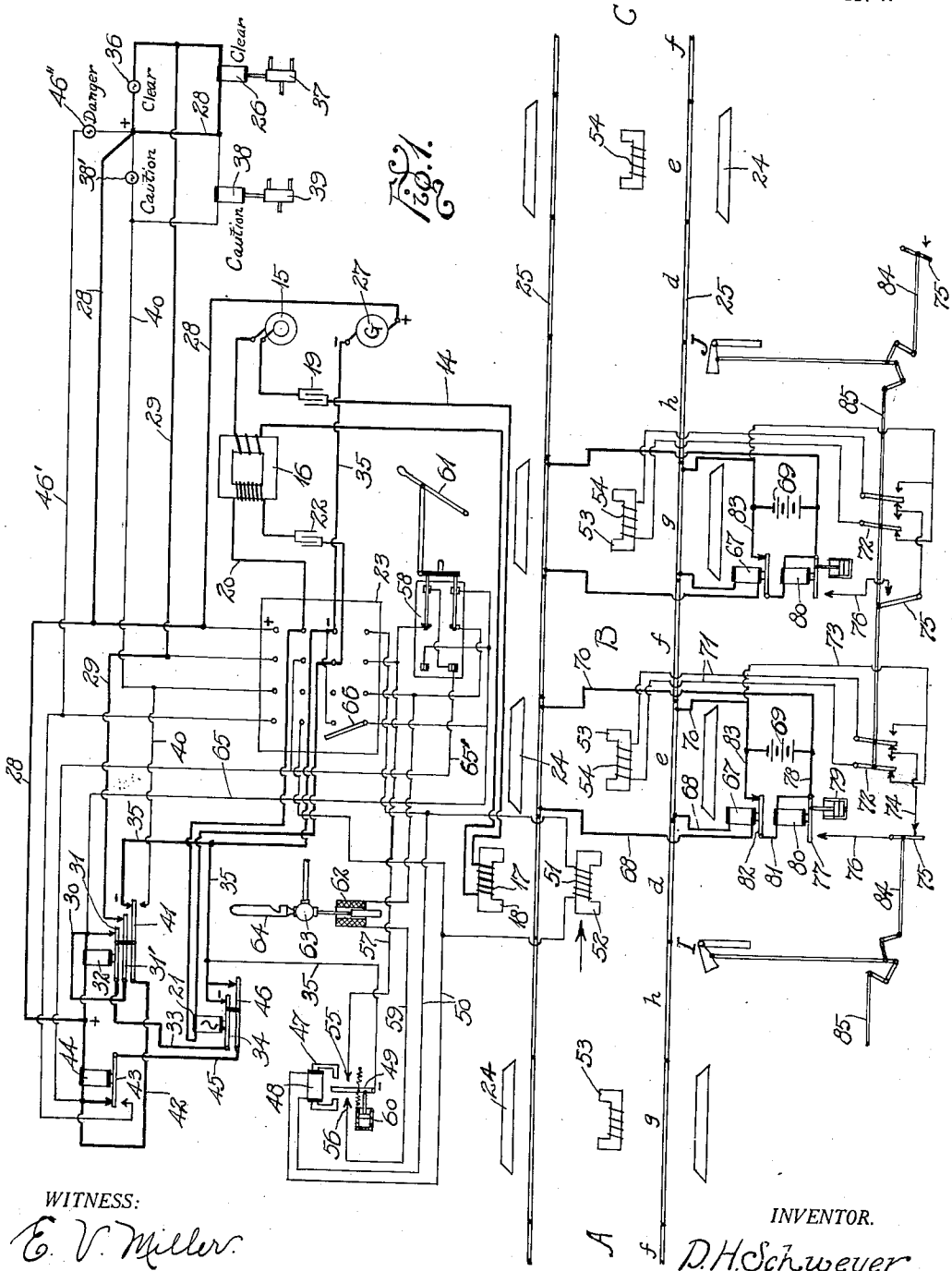


Fig. 1.

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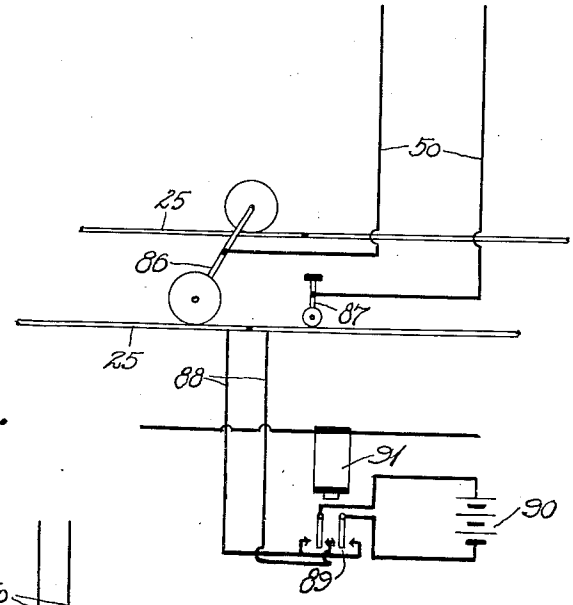


Fig. 2.

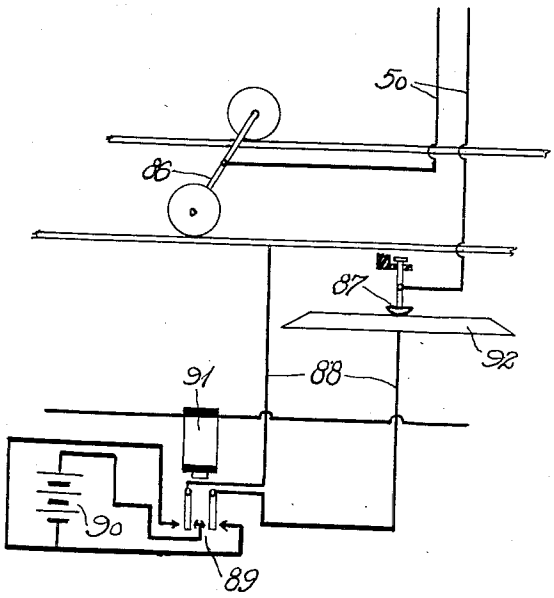


Fig. 3.

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Fig. 4.

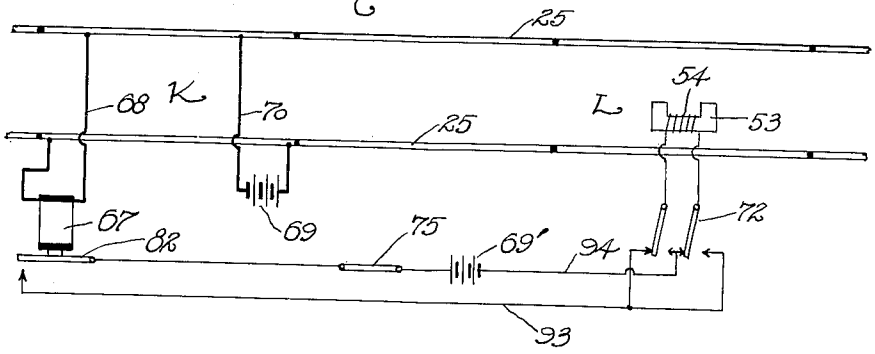


Fig. 5.

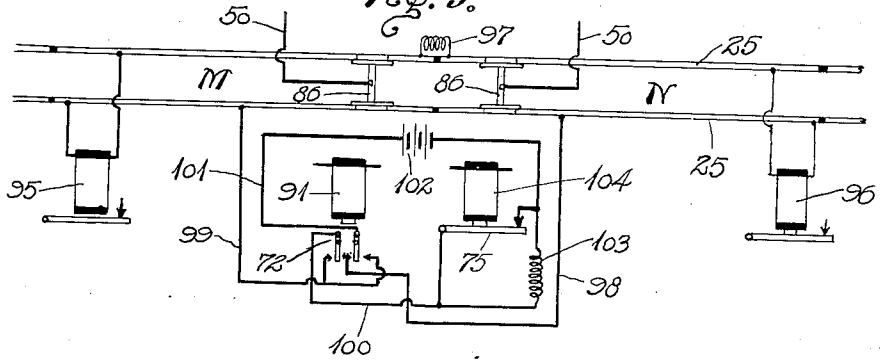
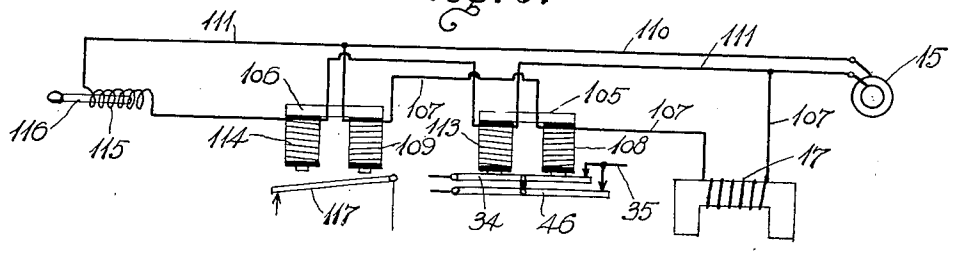


Fig. 6.



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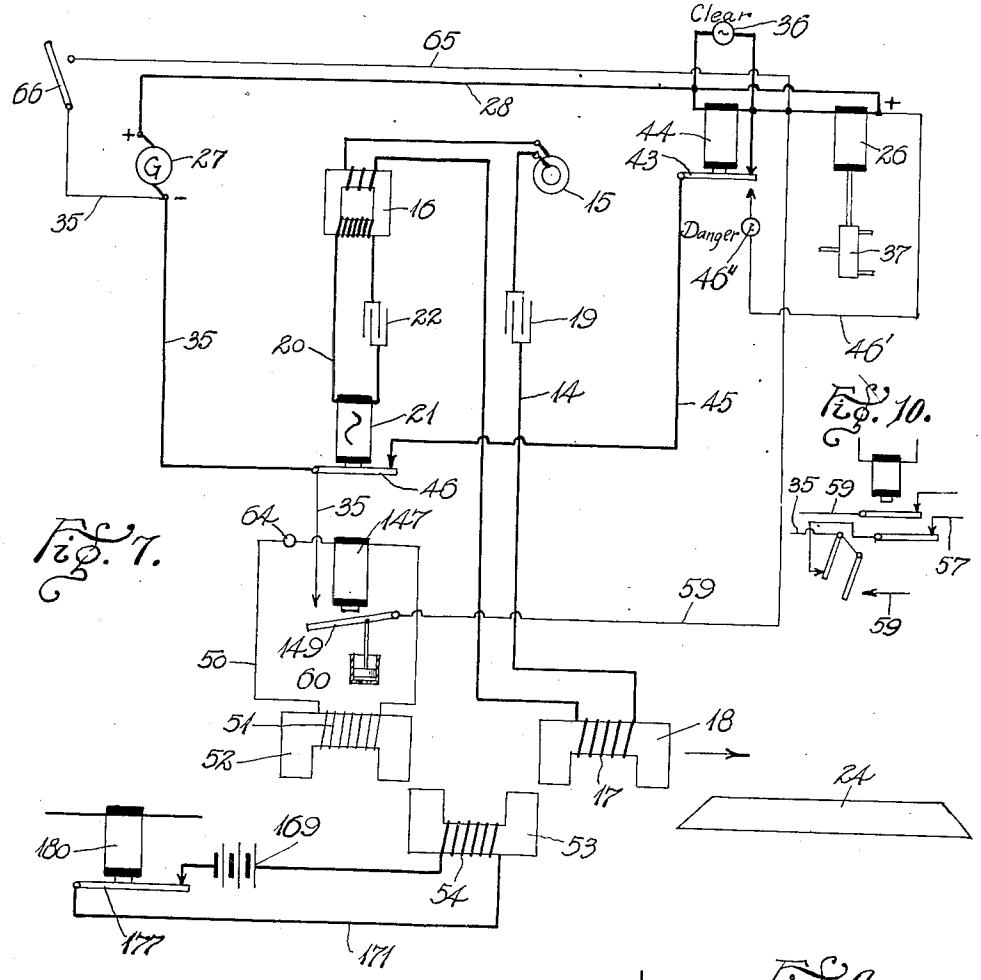


Fig. 7.

Fig. 10.

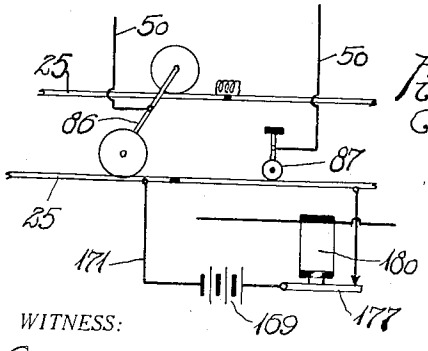


Fig. 8.

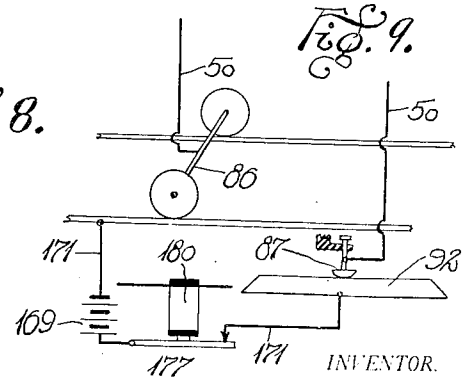


Fig. 9.

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UNITED STATES PATENT OFFICE.

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TRAIN-CONTROLLING APPARATUS.

1,342,873. Specification of Letters Patent. Patented June 8, 1920.

Application filed December 21, 1917. Serial No. 208,269.

To all whom it may concern:

Be it known that I, DANIEL H. SCHWEYER, a citizen of the United States, residing at Easton, in the county of Northampton and State of Pennsylvania, have invented new and useful Improvements in Train-Controlling Apparatus, of which the following is a specification.

The present invention relates to train controlling apparatus, and aims generally to improve such apparatus, in order to render same efficient, reliable and practical in use.

The invention has for its object the provision of a train controlling apparatus having means operable to stop the train in the event of dangerous track conditions or defects in the controlling system, means operable for producing caution indicating conditions when the train should proceed with caution, and means operable for producing clear indicating conditions and signals when the track is clear and the system in working order, the arrangement being such that the proper functioning of the apparatus is assured under the various conditions and that wrong signals are eliminated.

A further object is to influence the train circuits from the track according to the conditions existing, without necessitating physical contact between the train and track equipment, and yet in such manner as to insure that the desired influence will be strongly and reliably transmitted from the track to the train circuits.

Another object of the invention is to provide a varying or alternating current train-circuit for maintaining the train equipment in clear indicating condition and which will produce danger indicating conditions if interfered with by the track equipment or by short circuits, failure of current and the like, so that the train will be brought to a stop, unless the clearing and caution devices are in working order when passing the controlling points of the track and there are no dangerous conditions.

A still further object of the invention is to provide such an apparatus which is operable at predetermined controlling points of the track to produce danger indicating conditions in the train equipment so as to stop the train, unless the clearing and caution devices prevent such action and produce either clear or caution indicating conditions according to the conditions of the track equipment.

With the foregoing and other objects in view, which will be apparent as the nature of the invention is better understood, the invention resides in the combination and arrangement of parts as hereinafter described and claimed, it being understood that changes can be made in practice, within the scope of what is claimed, without departing from the spirit of the invention.

The invention is illustrated in the accompanying drawings, wherein—

Figure 1 is a diagrammatical view of the apparatus.

Figs. 2 and 3 are diagrammatical views of modified means for controlling the polarized relay.

Figs. 4 and 5 are diagrammatical views showing other modified means for operating the polarized relay.

Fig. 6 is a diagrammatical view showing a modified form of alternating current controlling means.

Fig. 7 is a diagrammatical view showing a simplified form of apparatus for two point control (clear and danger) instead of three point control (clear, caution and danger) as in the form shown in Fig. 1.

Figs. 8 and 9 are diagrammatical views showing modified means for controlling the clearing relay.

Fig. 10 is a diagrammatical view of still another variation in the polarized relay.

Referring in detail to Fig. 1, the train equipment includes a primary circuit 14 supplied continuously with varying or alternating current by an alternating current generator 15 driven by a steam turbine or other means, and said circuit includes the primary winding of a step-up transformer 16 and a choke coil 17 having the core 18. This choke coil can be carried by the locomotive or other vehicle at any suitable position to pass track devices as will hereinafter fully appear.

At predetermined controlling points along the track, there are provided stationary armatures or choke coil core sections 24 past which the choke coil core 18 moves in close proximity as the train moves along the rails 25 of the track. As shown in Fig. 1, the armatures 24 are located in pairs at opposite sides of the track and the choke coil at one side to take care of traffic in both directions.

In the primary circuit 14 a condenser 19 is inserted of sufficient capacity to balance or neutralize the inductive reactance of the

choke coil 17 under normal conditions. Thus, while the train is running between track armatures the capacity reactance of the primary circuit 14 due to the condenser 19, substantially offsets the inductive reactance due to choke coil 17, and the current and electrical force of such primary circuit are substantially in phase with each other.

However, when the choke coil 17 passes over one of the track armatures, the air gap between the ends of the core 18 is substantially bridged by the armature 24, thus completing a magnetic circuit of low reluctance for the choke coil and greatly increasing the inductive reactance thereof. Consequently the impedance of the primary circuit is greatly increased at this time. The current flowing through the primary circuit is therefore markedly cut down by the track armature, and in practice it has been found that a drop in currents of 70 to 75% may be readily obtained.

The secondary winding of the transformer 16 leads through a conductor 20 to the winding of an alternate current relay magnet 21, a condenser 22 preferably being also included in the secondary circuit. The normal flow of current through the primary of transformer 16 induces a secondary current through coil 21 sufficiently to insure that the relay 21 will be maintained closed while the train is passing between track armatures.

However, when the coil 17 passes over a track armature, the drop in primary current to say one quarter of its normal value, produces a drop in the secondary circuit which is proportionately greater, with the result that relay 21 is deënergized at this time.

Owing to the relatively large change in circuit conditions which is obtained with an arrangement of the above character, the normal current through relay 21 may be maintained at a high value to insure that the relay will not become accidently deënergized, and yet the action of track armatures 24 insures that the relay will be with certainty deënergized at the proper time.

The train equipment includes an electromagnet 26 normally energized to maintain clear conditions, and this magnet is supplied with electrical current by a generator 27, or other source of electrical energy, which has its positive terminal connected by a conductor 28 with one terminal of the magnet 26. From the magnet 26, the circuit is completed by a conductor 29, armature switch 31′ under the influence of an electromagnet 32, conductor 30, another armature switch 31 also held closed by the magnet 32, conductor 33, armature switch 34 normally held closed by the main control magnet 21, and a conductor 35 leading to the negative terminal of the generator 27. The clear magnet 26 is therefore normally energized, and a clear lamp 36 or the signal in the cab is also kept energized by being connected in parallel with the magnet 26, to indicate clear conditions. The magnet 26 may control any suitable means for allowing the train to proceed as usual, such as a valve 37 controlling a pneumatic equipment as disclosed in my copending application for patent on train controlling apparatus, Serial No. 118,731.

A caution electromagnet 38 controls a valve 39 or other device, whereby as disclosed in said application, or accomplished in any other manner, the magnet 38 in being energized with the magnet 26 deënergized will produce caution conditions and allow the train to proceed below a given velocity, whereas when the magnets 26 and 38 are deenergized this will produce danger conditions and stop the train. As far as the present invention is concerned, the devices 37 and 39 and parts controlled thereby need not be considered in detail, as this is fully disclosed in said application, and furthermore, the device 37 can be taken to represent diagrammatically any suitable means operable when the magnet 26 is deënergized to shut off the motive power and apply the brakes, as will be readily appreciated by any one versed in the art, as such means are well known and different ones can be used; while the device 39 can be taken to represent diagrammatically any suitable means, such as already known or as shown in said application, which will permit the train to proceed slowly when the magnet 38 is energized. The devices 26, 37 and 38, 39 can therefore be taken as synonymous with the respective devices 36 and 38′, as the signals or indicating means and the controlling means are substantial equivalents, so far as the electrical equipment is concerned. A lamp 38′ or other signal is connected in parallel with the magnet 38 to indicate when caution conditions exist. One terminal of the magnet 38 is connected to the positive conductor 28, and its other terminal to a conductor 40. The magnet 32 controls a third armature 41 normally removed from contact with the conductor 40, and normally closing the circuit between conductor 35 and a conductor 42 connected to an electromagnet 44 and by way of an armature switch 43 normally attracted and held by the magnet 44, with a conductor 45. The conductor 45 is normally connected with the negative conductor 35 by a second armature switch 46 normally held closed by the control magnet 21. The magnets 44 and 32 are both connected to the positive conductor 28 so as to be normally supplied with current for holding their switches closed. The magnet 32 is connected in parallel with the clear magnet 26 between

the conductor 28 and armature switch 31, so that the magnets 26 and 32 will be energized and deënergized simultaneously. The magnet 44 is normally held energized by current flowing therethrough from the conductor 28 and by way of the switch 43, conductor 45 and switch 46 to the negative conductor 35. Even though switches 34 and 46 may be released by the magnet 21, the magnet 44 will still remain energized if the magnet 32 stays energized, the circuit from magnet 44 to the negative conductor 35 being completed by the conductor 42 and switch 41.

The armature switch 43 when released moves into contact with a conductor 46′ having a danger lamp 46″ or other signal therein to indicate danger, and said conductor is connected to the positive conductor 28 to be supplied with current when the switch 43 is released.

In combination with circuits of the above described character, there may be employed suitable auxiliary circuits and devices adapted to produce changes in the first mentioned circuits corresponding to track conditions. In the embodiment of the invention illustrated in Fig. 1, this is accomplished by means of a polarized relay, through the coil of which current is reversed, or cut off, depending on track conditions, and the armature of which cuts in or out auxiliary, energizing circuits for the coils 32 and 44 according to the direction of current through the polarized relay coil. Thus the signaling or train controlling devices are respectively energized or cut out as track conditions require.

The polarized relay, which produces either clear or caution conditions, embodies a core 47, winding 48 thereon, and a magnetized armature switch 49, which is moved in opposite directions from a normal intermediate position, by a reversal in the flow of current through the relay winding 48. Said winding 48 is disposed in a normally dormant or dead circuit 50 having therein a receiving inductance coil 51 disposed on a core 52 carried by the train at any suitable location. The core 52 is arranged to move past cores 53 disposed at intervals along the track at the controlling points where the armatures 24 are located. The cores 53 are so located that when the choke coil 17 moves past one of the armatures 24, the receiving coil core 52 moves past the corresponding core 53 in close proximity therewith or in inductive relation. Each of the cores 53 has a winding 54 thereon, and means, hereinafter described, are employed for supplying current in opposite directions through the windings or inducing coils 54, to reverse the flow of magnetic flux in the cores 53. Therefore, when current flows in one direction through a coil 54 it induces or impresses a magnetic field in the corresponding core 53 flowing in one direction and when the core 52 passes said core 53, the two of them complete a metallic magnetic circuit, with the exception of a slight clearance between said cores, and as a result the magnetic field is suddenly led through the core 52, thereby inducing, through the medium of the receiving coil 51, a flow of current in one direction in the circuit 50 and its polarized relay. This will move the armature switch 49 in one direction, whereas if the current in the coil 54 flows in the opposite direction, the current induced in the circuit 50 will flow in the opposite direction and move the armature switch 49 likewise. The flow of current of the circuit 50 is only momentary, and disappears as soon as the core 52 passes out of influence of the magnetic field of the track coil 54 at each controlling point. The armature switch 49 will therefore ordinarily return and remain in intermediate position between its contacts 55 and 56.

The external circuit controlled by the polarized relay includes a conductor 57 leading from the contact 55 to a reversing switch 58 and a conductor 59 leading from the contact 56 through a solenoid 62 to said reversing switch. The core of the solenoid 62 is connected to a controlling valve 63 of a whistle 64 in the cab, for opening said valve when the solenoid is energized and permitting pressure fluid to operate the whistle. Any other audible or desired signal can be operated by the solenoid or translating device 62, for signaling to the engineer or operator whenever passing a controlling point in clear position, that such condition exists. Should signal fail at any controlling point, the engineer will be informed that caution or danger conditions exist, even though the apparatus should fail. The reversing switch 58 is connected to the reversing lever 61 of the locomotive or vehicle, whereby the circuits controlled by said switch are reversed as the direction of movement of the vehicle is reversed. In one position of the reversing switch, it connects the conductors 57 and 59 with the respective conductors 65′ and 65, as seen in Fig. 1, with the train moving toward the right, whereas when the train is reversed, the switch 58 will reverse the connections as will be apparent. The conductor 65 is connected to the conductor 30, while the conductor 65′ is connected to the conductor 42, so that said conductors are connected in the circuit of the respective magnets 32 and 44. A clearing switch 66 is operable manually for closing a circuit between conductors 65 and 35, for clearing the apparatus, such as when the train has been stopped.

The operation of the above described embodiment of the invention is as follows:—

The primary circuit from generator 15 through transformer 16, choke 17 and capacity 19, will of course be energized by normal current flow whenever the train is passing between armatures 24. As is stated above, the capacity 19, under such conditions, neutralizes the inductive reactance of coil 17 in such a way as to permit a current of relatively high value to pass through the circuit. Relay 21 is therefore kept closed by the induced current through the secondary of transformer 16 and conductor 20.

Under normal running conditions, relays 32 and 44 will also be closed between track armatures 24, or in starting, the switch 66 may be temporarily thrown in to close circuit to coils 32 and 44 from generator 27 through wire 28 to coil 32, conductor 65, switch 66 and back through return conductor 35 to generator 27. Coil 32 will then attract its armatures, including armature 41 which closes circuit through coil 44 from generator 27 through conductor 28, coil 44, conductor 42, armature 41 and return conductor 35 back to generator 27. Armature 43 of relay 44 is then drawn up, and, after switch 66 is thrown out, a holding circuit for each of the relays 32 and 44 is established respectively through the armatures 31 and 43, conductors 33 and 45, armatures 34 and 46 of the coil 21, back through return conductors 35 to generator 27.

When the train passes over a track armature 24, the inductive reactance of the choke coil 17 is increased as above described in such a way as to produce a marked drop in the current flowing from generator 15 through the primary of transformer 16, and this change in current is intensified by the transformer action to produce a drop in current in the secondary circuit of transformer 16, which will insure that relay 21 will release its armatures 34 and 46. Thus the holding circuit for relays 32 and 44 through armatures 34 and 46, is broken each time a train passes over a track armature, and such relays will be deënergized by the opening of relay 21, unless auxiliary circuits are established.

In the form of invention illustrated in Fig. 1, it will be noted that an auxiliary circuit for coil 32 is possible, leading from generator 27, conductor 28, coil 32, conductor 65, reversing switch 58, signal 62, conductor 59, contact 56, armature 49 (in case such armature is attracted toward the left in Fig. 1), and return conductor 35 back to generator 27.

An alternative circuit for the coil 44 is also possible, leading from generator 27, through conductor 28, coil 44, conductor 65′, reversing switch 58, conductor 57, contact 55, armature 49 (in case such armature is attracted toward the right in Fig. 1), and return conductor 35 back to generator 27.

However, if the armature 49 remains in neutral position, no alternative circuits for either of the relays 32 and 44 will be established. In such case, after choke coil 17 has passed beyond a track armature 24, the reëstablishing of normal current through the primary and secondary circuits of transformer 16 and consequently closing of relay 21, will not close either of the magnets 32 or 44 since the armatures 31 and 43 will be released and thus break the holding circuits for their respective coils which will therefore remain open.

In the present form this condition, that is to say, the condition when the polarized relay receives no impulse when the train passes over a station, has been selected to signify danger conditions. With the relays 32 and 44 both open, the caution and clear indicating circuits are both broken, the clear indicating circuit being broken at armature 31′ of relay 32, which is out of engagement with the conductor 29 for the clear indicating circuits and the caution indicating circuit being broken at the armature 43. The danger indicating circuit, however, is closed by means of a circuit from generator 27, through conductors 28 and 46′ armature 43, conductor 45, armature 46 (which is reattracted by magnet 21 as soon as the train passes beyond the track armature), and return conductor 35 back to generator 27.

If however, the receiving coil 51 for polarized relay 48 receives an impulse when the train passes over a station, which will move armature 49 to the left, clear conditions will be indicated in the present arrangement. As above described, the holding circuits through the armatures of relay 21 for the relays 32 and 44 will be broken when coil 17 passes over track armature 24, but if armature 49 of the polarized relay be attracted toward the left in Fig. 1, an alternative holding circuit for coil 32 will be established from generator 27, through conductor 28, coil 32, conductor 65, reversing switch 58, signal 62, conductor 59, contact 56, armature 49 and return conductor 35 back to generator 27. The armatures of relay 32 will therefore be attracted, and the closing of armature 41 will complete the circuit from generator 27 through conductor 28, coil 44, conductor 42, armature 41 and return conductor 35 back to generator 27, and coils 32 and 44 accordingly will be kept energized until the holding circuits through the armatures of relay 21 are reëstablished after coil 17 passes beyond track armature 24. With both of the above relays energized, the caution and danger indicating circuits are broken respectively by armatures 41 and 43, but the clear indicating cir-

cuit is closed from generator 27 through conductors 28, 29, armature 31′, conductor 30, armature 31, conductor 32, armature 34, and return conductor 35 back to generator 27.

If, on the other hand, the receiving coil 51 for polarized relay 48 receives an impulse which will attract armature 49 toward the right in Fig. 1, when the train passes over a station, the holding circuits through the armatures of relay 21 for coils 32 and 44, will be broken as above described, but no alternative circuit for coil 32 will be established owing to the break between armature 49 and contact 56, and the relay 32 therefore will remain open. An alternative circuit for coil 44 however, is established from generator 27 through conductor 28, coil 44, conductor 65′ reversing switch 58, conductor 57, contact 55, armature 49 and return conductor 35 back to generator 27. Relay 44 will therefore be held closed by this last mentioned circuit until coil 17 has passed beyond track armature 24, and relay 21 has been again energized to reëstablish its holding circuit for coil 44 through armatures 34 and 46. Relay 32 will remain deënergized however, since its circuit is broken through open armature 31. Under such conditions, the clear and danger indicating circuits will be broken respectively by the open armatures 31′ of relay 32 and the closed armature 43 of coil 44, but the caution indicating circuit will be closed from generator 27 through conductors 28, 40, armature 41, conductor 42, armature 43, conductor 45, armature 46 and return conductor 35 back to generator 27.

Thus the train circuits are selectively energized according to the impulses received by polarized relay 48, when the receiving coil 51 passes over its coöperating fixed coil 54.

Various means can be employed for operating the polarized relay, and Fig. 1 shows one form of means for sending current in opposite directions through the track coils 54. As shown, the track has blocks A, B, and C, and the rails 25 in each block are composed of sections *d*, *e*, *f*, *g*, and *h*, insulated from one another, and there are semaphores I and J, between the block B and blocks A and C, respectively. The track equipment of each block section is substantially the same, although the circuits of only two block sections are illustrated. Thus, referring to sections *e* and *g* of block B, a magnet 67 for each section is connected by conductors 68 with the opposite rail sections, and battery 69 or other source of electrical energy is also connected to the opposite rail sections by conductors 70, thus completing a circuit between battery 69 and magnet 67 to normally maintain said magnet energized, but when the train is in said section, it will short circuit the magnet 67, for energizing the coil 54, as will presently appear. Conductors 71 connect the coil 54 with a reversing switch 72 to reverse the connections between conductors 71 and two conductors 73 and 74. A switch 75 connects conductor 74 with a conductor 76, and an armature switch 77 normally removed from contact with conductor 76 is connected by a conductor 78 with battery 69. A high resistance magnet 80 is disposed in a conductor 81 between conductor 78 and an armature switch 82 normally attracted by magnet 67 in contact with conductor 83, leading to battery 69. This closes a high resistance shunt through magnet 80 to hold the switch 77 open, a dash-pot 79 or similar retarding means being connected to the armature switch 77 to retard its movement. Therefore, when the switch 77 is released and closes its circuit, current will flow from battery 69 through the coil 54 in the following circuit: battery 69, conductor 73, reversing switch 72, left hand conductor 71, coil 54, right hand conductor 71, reversing switch 72, conductor 74, switch 75, conductor 76, switch 77 and conductor 78. This results in a flow of current in one direction through the coil 54 under caution conditions, it being noted that the semaphore J has its arm raised at the far end of the block. Switches 72 of sections *e* and *g* are connected, as at 85, with the semaphore J in advance, as well as the switch 75 of section *g*, while switch 75 of section *e* is connected, as at 84, with the semaphore I. The connections 84 and 85 may be mechanical, electrical or pneumatic, and are operable for reversing switches 72 and opening and closing switches 75 according to the positions of the semaphores. Thus, should the semaphore J be in safety instead of danger position as illustrated, switches 72 would be reversed to clear position, so that the current in coils 54 would flow in the opposite direction. When the semaphores are in danger position, the switches 75 connected thereto are opened, and this prevents the flow of current in coils 54, resulting in danger conditions so that the polarized relay of the train receives no current.

Fig. 2 illustrates different means for sending current in opposite directions in circuit 50 of the polarized relay without using the inductance coils 51 and 54. Thus, one conductor of circuit 50 is connected to an axle or truck 86 of the train, while the other conductor of circuit 50 is connected to an insulated collector 87 to move along one rail 25 in contact therewith. When the train moves over an insulated joint of the track, as shown in Fig. 2, the conductors of circuit 50 are connected by way of axle 86 and collector 87 with the respective insulated rail sections and conductors 88 of the track equipment connected thereto. A reversing

switch 89 under the control of a polarized magnet 91 connects the conductors 88 with track battery 90, current flowing in one direction from the battery 90 in circuit 50 when current flows through the magnet 91 in one direction and in the opposite direction when the current flows through said magnet in the opposite direction. It is very evident that the circuit of magnet 91 can be controlled by a manual or automatic switch, or the current can be reversed therethrough in any well known manner. In fact, this magnet can be such as to move the switch to one position when the magnet is energized, and let the switch return to its other position when the magnet is deënergized. It is therefore irrelevant to consider the means for controlling the magnet, as this may be any one of many such means that are well known.

Fig. 2 illustrates a further modification doing away with the coils 51 and 54, in that the collector 87, at the controlling points of the track, has a wiping contact with a ramp or contact rail 92 to which one conductor 88 is connected, instead of employing the connections shown in Fig. 3.

Fig. 4 depicts means for controlling the current in coil 54 of one block by traffic in another block. Thus, with the electromagnet 67 and battery 69 connected to the insulated rails of block K, said magnet will be normally energized when said block is clear, to attract and open armature switch 82. When block K is occupied, however, a short circuit is established and magnet 67 is deenergized, so that switch 82 being released closes a circuit between conductors 93 and 94, the latter including battery 69′ and a switch 75 controlled by a semaphore or other means. Said conductors 93 and 94 are connected by a reversing switch 72 with the coil 54, so that the switch 72 in being reversed by any suitable means, will reverse the flow of current in coil 54 to reverse the impulse transmitted to the polarized relay. Should switch 75 be opened, coil 54 will remain dead even though switch 82 is closed. This installation economizes electrical energy, since battery 69 need only supply sufficient current for magnet 67, and battery 69′ has its circuit normally opened.

Fig. 5 illustrates still another variation in track installation eliminating the coils 51 and 54. The magnets 95 and 96 which control suitable train controlling circuits, such as above described, are connected to the rail sections of the respective blocks M and N, and resistance 97 is bonded between two alining rail sections while conductors 98 and 99 are connected to the other alining rail sections. A reversing switch 72 is employed for reversibly connecting conductors 98 and 99 with conductors 100 and 101 leading to a battery 102, and a polarized electromagnet 91 controls the reversing switch 72 for reversing the flow of current in the circuit comprising conductor 101, switch 72, conductor 99, one rail section of block M, magnet 95, the other rail section of block M, resistance 97, one rail section of block N, magnet 96, the other rail section of block N, conductor 98, switch 72 and conductor 100 having the parallel switch 75 and resistance 103 therein. Should either or both blocks M and N be occupied, the short circuit established will result in one or both of magnets 95 and 96 being deënergized. It is very evident that the circuits of magnets 91, 95, 96 and 104 can be controlled in any desired manner, which need not be gone into in detail. The polarized magnet 91 in reversing the flow of current will provide clear and caution conditions, and magnet 104 in being deënergized releases switch 75, which in opening, compels the current to flow through the resistance 103. Now, if a train is passing between blocks M and N, with the conductors of the circuit 50 connected to axle or trucks 86 insulated from one another, the current will flow from battery 102 through the circuit 50 by way of the axles or collectors 86. The resistance 97 is sufficiently great to compel the current to flow through the polarized relay circuit 50, and if the resistance 97 is short circuited or current fails, no current will flow in circuit 50, producing danger conditions in the train equipment. The resistance 103 is such as not to prevent the deënergization of magnets 95 and 96 when the blocks are clear, even though switch 75 is opened, but said resistance will, however, impede the flow of current to such an extent that no appreciable current in circuit 50 will flow when switch 75 is opened.

Fig. 6 illustrates the use of alternating current differential control and safety relays 105 and 106, respectively, the winding of each relay being opposed so that their magnetic fields oppose one another. A conductor 107 connected to one pole of the alternating current generator 15 includes the coil 17, one winding 108 of relay 105 which takes the place of magnet 21 in Fig. 1, and one winding 109 of relay 106 in series, and is connected to a conductor 110 leading back to the other pole of the generator. Another circuit includes a conductor 111 leading from the same pole of the generator as conductor 107 and including the other winding 113 of relay 105, the other winding 114 of relay 106, and an inductance coil 115 all connected in series, and the conductor 111 completes its circuit through the return conductor 110. The coil 115 has a manually adjustable core 116, for varying the inductive reactance. The relay 105 controls the armature switches 34, and 46 above described, while relay 106 controls a safety armature switch 117. In operation, the core 116 is

adjusted so that the opposing magnemotive forces of relay 106 are balanced, thereby releasing switch 117. When magnet 114 balances its mate 109, then the magnetic flux of magnet 113 is weaker than that of magnet 108, so that switch 117 is released while switches 34 and 46 are attracted, whereas when magnets 108 and 109 weaken, then magnets 108 and 113 approach a balance while the others lose their balance. When the train passes a controlling point, the choke coil 17 in passing a track armature as above described, causes a reduction in current in the winding 108 of relay 105 momentarily so that the magnemotive forces of windings 108 and 113 are balanced and the switches 34 and 46 are released for an interval like in Fig. 1, but are picked up again when the controlling point has been passed. The safety feature resides in the fact, that if either of the alternating current circuits are broken, short circuited, or otherwise interfered with, one winding of relay 106 will deënergize, and the other winding will therefore attract switch 117 and open any circuit which said switch may be disposed in. The switch 117 can naturally be arranged in any desired circuit as this is of no further importance and will be readily appreciated.

In Fig. 7, a simplified apparatus is shown, having only two point control, viz., clear and danger conditions. The alternating current relay 21 is controlled as before, and a simple electromagnet 147 and armature switch 149 replace the polarized relay, which simplifies the installation of both the train and track. The magnet 147 is located in circuit 50 with the receiving coil 51, and a suitable signal 64 is also disposed in said circuit to give a clear signal when current is induced in the circuit under clear conditions when passing a controlling point. The track coil 54 is in a simple circuit 171 having battery 169 and an armature switch 177 controlled by a track magnet 180 or other means. When switch 177 is closed, coil 54 is energized and transmits an impulse to coil 51 and magnet 147 in clear conditions, but when switch 177 is opened or current fails otherwise, coil 51 will receive no impulse from coil 54 and magnet 147 will remain deënergized, producing danger conditions in the apparatus. The switch 46 being normally closed keeps magnets 26 and 44 energized as well as the signal 36 connected in parallel with magnet 44, and said magnets are also connected in parallel. The circuit includes generator 27, conductor 28, magnets 26 and 44 in parallel, armature switch 43 of magnet 44, conductor 45, armature 46 of magnet 21, and conductor 35. When switch 46 opens at the controlling point, switch 149 is closed in clear conditions by the energization of magnet 147, and in connecting conductor 35 and conductor 59 leading to magnets 26 and 44 will shunt the switches 43 and 46 to keep the circuit of magnets 26 and 44 energized, until normal conditions are again restored. If switch 149 is not closed, however, magnets 26 and 44 will become dead, and stop the train since the valve or device 37 can be such as to shut off the steam or other power and apply the brakes. The danger signal 46'' is then energized because its circuit is completed as follows: conductor 28, conductor 46', released switch 43, conductor 45, switch 46 when again closed and conductor 35. The retarding means 60 of switch 149 holds it closed the required length of time under clear conditions for the reclosing of switch 46.

Figs. 8 and 9 illustrate modifications eliminating the coils 51 and 54 similar to Figs. 2 and 3, respectively, but the reversing switches 89 are eliminated, since they are unnecessary with the simplified apparatus shown in Fig. 7. In Fig. 8, the track battery 169 and switch 177 are in track circuit 171 connected to insulated rail sections for supplying current to circuit 50 when switch 177 is closed, by the magnet 180 or otherwise. When said switch is opened no current flows. Fig. 12 shows circuit 171 connected to a ramp or contact rail 92 for the engagement of a collector 87, to connect circuit 50 with track battery 169.

Fig. 10 shows the polarized relay as having four separate switches instead of one (49) as in Fig. 1, to connect the conductors 35, 57 and 59 in the same way, but by independent switches operating simultaneously.

The current used may be alternating, vibrating or of any other suitable variable nature, in connection with the coil 17 and accompanying parts, and such current may be supplied from the vehicle or from an exterior source.

Having thus described the invention, what is claimed as new is:

1. A vehicle circuit supplied with fluctuating current, a reactance coil carried by the vehicle and included in said circuit, in combination with plain armatures so located adjacent the path of movement of said reactance coil as to markedly decrease the reluctance of the magnetic circuit of said coil each time the latter moves past an armature, whereby the inductive reactance of said coil is so increased each time the coil moves past an armature as to produce a substantial drop in current in said circuit, means operable according to track controlled conditions by such drop in current, and other means operable to modify the operation of said means.

2. A vehicle circuit supplied with fluctuating current, a reactance coil carried by the vehicle and included in said circuit, in combination with plain armatures so lo-

cated adjacent the path of movement of said reactance coil as to markedly decrease the reluctance of the magnetic circuit of said coil each time the latter moves past an armature, whereby the inductive reactance of said coil is so increased each time the coil moves past an armature as to produce a substantial drop in current in said circuit, means to be operated according to track conditions, means responsive to the drop in current in said circuit controlling said means, and other means operable to modify the operation of the first named means.

3. A vehicle circuit supplied with fluctuating current, a reactance coil carried by the vehicle and included in said circuit, in combination with plain armatures so located adjacent the path of movement of said reactance coil as to markedly decrease the reluctance of the magnetic circuit of said coil each time the latter moves past an armature, whereby the inductive reactance of said coil is so increased each time the coil moves past an armature as to produce a substantial drop in current in said circuit, means to be operated according to track conditions, a step up transformer in said circuit, a secondary circuit for said transformer including a relay operable on said drop in current to control said means, and other means operable to modify the operation of the first named means.

4. A vehicle circuit supplied with fluctuating current, a reactance coil carried by the vehicle and included in said circuit, said circuit also including capacity sufficient to substantially neutralize the inductive reactance of said coil under normal conditions, in combination with plain armatures so located adjacent the path of movement of said reactance coil as to markedly decrease the reluctance of the magnetic circuit of said coil each time the latter moves past an armature, whereby the inductive reactance of said coil is so increased each time the coil moves past an armature as to produce a marked drop in current in said circuit, and other means operable to modify the operation of the first named means.

5. A vehicle circuit supplied with fluctuating current, a reactance coil carried by the vehicle and included in said circuit, said circuit also including capacity sufficient to substantially neutralize the inductive reactance of said coil under normal conditions, in combination with plain armatures so located adjacent the path of movement of said reactance coil as to markedly decrease the reluctance of the magnetic circuit of said coil each time the latter moves past an armature, whereby the inductive reactance of said coil is so increased each time the coil moves past an armature as to produce a marked drop in current in said circuit, means to be operated according to track conditions, means responsive to the drop in current in said circuit for controlling said means, and other means operable to modify the operation of the first named means.

6. A vehicle circuit supplied with fluctuating current, a reactance coil carried by the vehicle and included in said circuit, said circuit also including capacity sufficient to substantially neutralize the inductive reactance of said coil under normal conditions, in combination with plain armatures so located adjacent the path of movement of said reactance coil as to markedly decrease the reluctance of the magnetic circuit of said coil each time the latter moves past an armature, whereby the inductive reactance of said coil is so increased each time the coil moves past an armature as to produce a marked drop in current in said circuit, means to be operated according to track conditions, a step up transformer in said circuit, a secondary circuit for said transformer including a relay operable on said drop in current to control said means, and other means operable to modify the operation of the first named means.

7. In combination, vehicle-carried means to be operated according to the track conditions including a circuit supplied with fluctuating current and having a reactance choke coil, armatures arranged for repeatedly controlling said means at intervals as the choke coil moves past said armatures in succession, and additional means also operable at such intervals to modify the operation of the first named means.

8. In combination, vehicle-carried means to be operated according to track conditions including a circuit supplied with fluctuating current and having a reactance choke coil, armatures arranged for repeatedly controlling said means as the choke coil moves past said armatures in succession, other electrical means also controlling the first named means and operable to modify the operation thereof, and means for controlling the third named means at such intervals.

9. In combination, vehicle-carried means to be operated according to track conditions, a pair of devices each controlling said means to operate it for different track conditions by the operation of one of said devices or the joint operation thereof, said devices including a circuit supplied with fluctuating current and having a reactance choke coil, armatures arranged along the track of the vehicle for controlling one of said devices at intervals as the choke coil moves past said armatures in succession, and additional means along the track for controlling the other device at such intervals also.

10. In combination, vehicle-carried means operable according to track conditions including a circuit supplied with fluctuating current and having a reactance choke coil,

armatures arranged for repeatedly controlling said means for one condition as the choke coil moves past said armatures in succession, selectively operable means on the vehicle for selectively modifying the operation of the first named means for other conditions, and additional means for selectively controlling the third named means when the choke coil passes said armatures.

11. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, and circuit connections therefor, means for changing at intervals the current flowing through one of said circuits as the vehicle passes along a track including a circuit supplied with fluctuating current and having a reactance choke coil and armatures arranged for repeatedly controlling said means as the choke coil moves past said armatures in succession, and additional means also operable at such intervals as the vehicle passes the track, for changing circuit connections to said devices, whereby circuits are selectively established through said devices by the combined effect on the vehicle circuits of said two above mentioned means.

12. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, electrical means adapted to change circuit connections to said devices, means for breaking circuit to said means at each of predetermined intervals in succession as the vehicle passes along a track, and additional independently-controlled means also operable at such intervals as the vehicle passes along a track, for selectively establishing alternative circuit connections to the first named means according to track conditions, whereby said devices are selectively energized according to track conditions.

13. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, electrical means adapted to change circuit connections to said devices, means for breaking circuit to said means at each of predetermined intervals in succession as the vehicle passes along a track, a polarized relay adapted to selectively establish alternative circuit connections to the first named means, and independently-controlled means also operable at such intervals as the vehicle passes over a track, for producing different current conditions in the operating circuit of said polarized relay according to track conditions, whereby said devices are selectively energized according to track conditions.

14. In combination, a vehicle having electrically operated devices to be operated according to track conditions, electrical means adapted to change circuit connections to said devices, a vehicle circuit supplied with fluctuating current, a reactance coil carried by the vehicle and included in said last mentioned circuit, armatures so located adjacent the path of movement of said reactance coil as to affect the reactance of the coil when the coil passes over one of the armatures, to change current in said last mentioned circuit, a relay controlling circuit connections to said first mentioned means, means whereby said relay is operated by the above mentioned change in current, and other means operable to modify the operation of said devices.

15. In combination, a vehicle having electrically operated devices to be operated according to track conditions, relays adapted to change circuit connections to said devices, a vehicle circuit supplied with fluctuating current and including a reactance coil carried by the vehicle and capacity sufficient to substantially neutralize the inductive reactance of said coil under normal conditions, plain armatures so located adjacent the path of movement of said reactance coil as to markedly decrease the reluctance of said coil when the vehicle passes over one of the armatures, and thereby produce a marked drop in current in said last mentioned circuit, a relay controlling circuit connections to said first mentioned relays, and means whereby said relay is operated by the above mentioned change in current.

16. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, magnetic members located at intervals along the track, means carried by the vehicle for changing circuit connections to said devices and operated by coming within the influence of said magnetic members at intervals as the vehicle passes along the track, and additional means for changing circuit connections to said devices including a circuit supplied with fluctuating current and having a choke coil and armatures arranged for controlling said additional means at such intervals when the choke coil passes the armatures.

17. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, magnetic members located at intervals along the track, means carried by the vehicle for changing circuit connections to said devices and operated by coming within the influence of said magnetic members as the vehicle passes along the track, additional magnetic members also located at intervals along the track and circuits for reversing the flux produced by said additional magnetic members independently of the first mentioned magnetic members, and additional means for alternating circuit connections to said devices operated by coming within the influence of said last mentioned magnetic members, as the vehicle passes along the track.

18. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, a plurality of independent sets of magnetic members located at intervals along the track, one of said sets having means for varying the flux through the magnetic members independently of the other set, a plurality of vehicle circuits each having means for changing circuit connections to said devices, and means for operating each of said vehicle circuits to change circuit connections to said devices by coming respectively under the influence of said magnetic members as the vehicle passes along the track, including a coil inductively related to said variable flux magnetic members as the vehicle moves past them.

19. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, magnetic members located at intervals along the track, means carried by the vehicle for changing circuit connections to said devices and operated by coming within the influence of said magnetic members as the vehicle passes along the track, a plurality of coils located at intervals along the track, together with means for changing the flux to said coils according to track conditions, and an additional vehicle circuit including circuit changing means for said devices, said last mentioned circuit having a coil inductively related to first mentioned coils as the vehicle moves past them.

20. In combination, a vehicle having electrically operated devices to be operated selectively according to track conditions, a plurality of coils located at intervals along the track together with means for reversing the direction of flux through said coils under different track conditions, and a vehicle circuit including circuit changing means for said devices, said circuit having a coil inductively related to said first mentioned coils as the vehicle moves past them, whereby said circuit changing means is differently influenced under different track conditions.

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