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J. P. BUCHANAN.

AUTOMATIC ELECTRIC SIGNAL SYSTEM FOR RAILWAYS.

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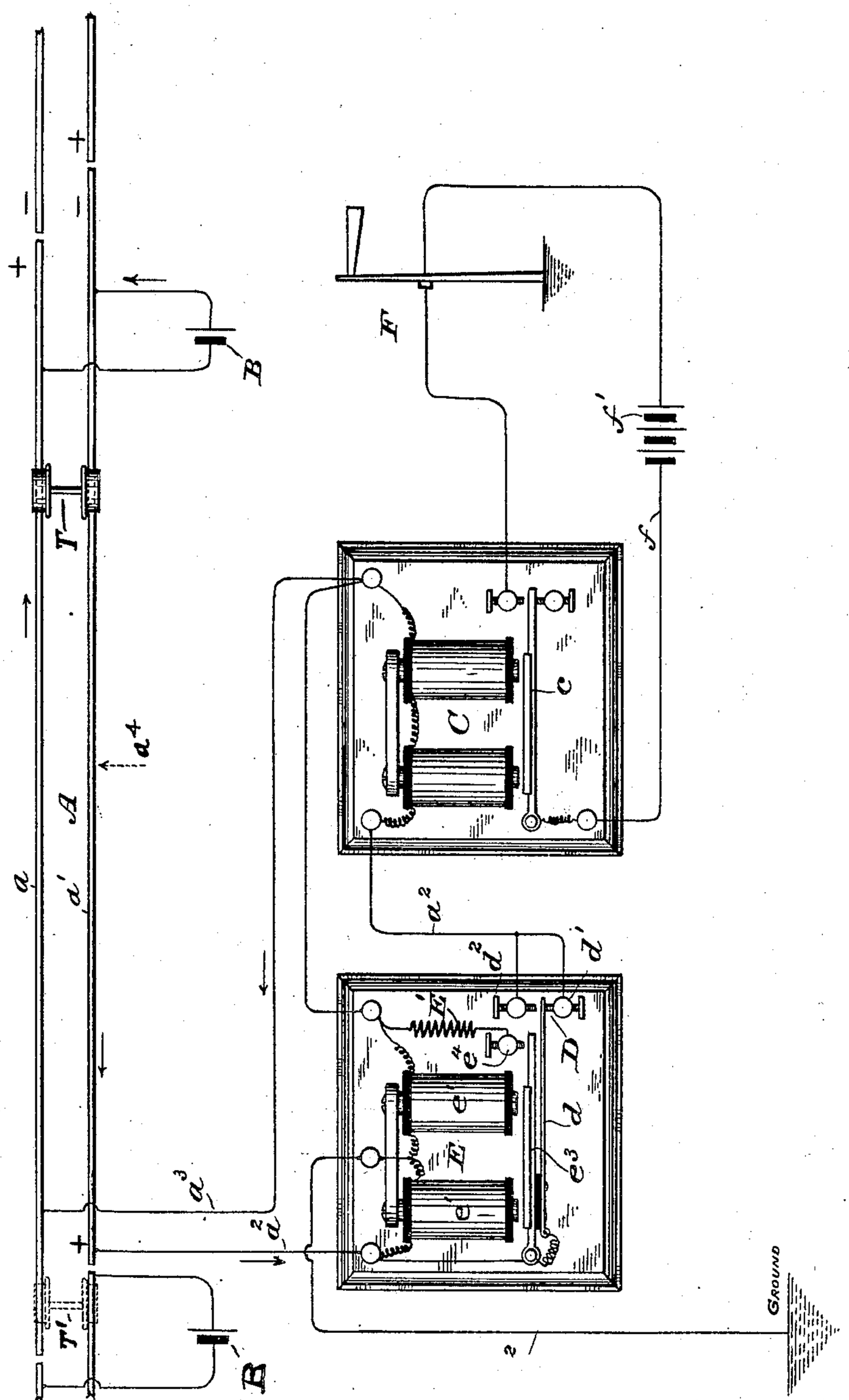

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AUTOMATIC ELECTRIC SIGNAL SYSTEM FOR RAILWAYS.

No. 886,676. Specification of Letters Patent. Patented May 5, 1908.

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To all whom it may concern:

Be it known that I, JOHN P. BUCHANAN, a citizen of the United States, resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Automatic Electric Signal Systems for Railways, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle so as to distinguish it from other inventions.

My invention relates to block signaling on railways and particularly to signal systems of the automatically electrically operated type.

The particular object of my invention is the provision, in connection with automatic electric signal systems of this sort, of means for controlling, or rather eliminating the harmful effects of, the so called "sneak" currents, that is of currents foreign to the established electric circuits whereby the normal operation of the signal apparatus is effected, or currents part of whose circuits or paths is the ground.

To the accomplishment of the above and related objects said invention consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawing and the following description set forth in detail certain means embodying the invention, such disclosed means constituting but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing, the figure there appearing represents in diagrammatic fashion a section of block signal apparatus with my several improverments incorporated therein.

An approved and quite generally adopted method of equipping a road with an automatic electric signal system, is to divide the track up into blocks of the desired length, a signal of the pattern adopted being placed at the entrance of each block. The rails of each block are then made into a track circuit by insulating the rails of one from those of the next block by means of fiber and pieces of the same size as the rail, and by using wooden or fiber splices instead of the iron fish-plates ordinarily employed in joining the ends of the rails together, each rail within a block being joined to the next one by a suitable bond wire. At the end farthest away from the signal, a battery of two cells is located, the two poles of which are respectively joined by wire to the two lines of rail. In practice, it should be stated, it has been found impossible to make the length of a circuit supplied from one battery equal to that of a whole block owing to the increase in leakage; consequently a block often includes several sub-circuits or sections, which, however, are so connected as to be in effect a single circuit. In the figure of the drawing, hence, but a single circuit is represented.

Such track circuit is merely a control circuit and includes a relay, usually placed at the signal end of the section, the armature of which controls the more powerful signal actuating circuit. As will appear, so far as the application of my invention is concerned, the pattern of signal employed is a matter of indifference and may be the pneumatically operated Westinghouse semaphore, the electrically operated disk signal of Hall, or any other type of signal, whether operated directly or indirectly by the current in the signal circuit.

The particular object of my invention is the elimination of "sneak" or foreign currents, as has been stated. As is well known in rail-road signal practice such currents are frequently met with, particularly when electric railways using rail circuits are located in the vicinity of the railroad; and they are an ever present source of trouble, not infrequently leading to serious disaster by the derangement of the working of the track or control relay which they produce. For, assuming a train to be on a block, the current through the track relay should normally be cut out and the signal at the entrance to the block indicate "danger." Now a foreign current, if present, generally gets onto the track from ground or earth and in its effort to reach a point of different potential often traverses the coils of the relay and energizes the same to close the signal circuit and change the danger signal to safety.

In the figure, A designates a section of track constituting a block of the signal system, the respective rail-sections a a' of which constitute the major portion of the track or control circuit, such circuit being completed by the battery B connected with the rails at one end of the block as shown, and two leads a^2 a^3 that connect the opposite ends of the rails with the coils of a track re-

lay C. Lead a^3 connects directly with one terminal of relay C; the other lead a^2, however, passes through a make-and-break contact device D. Such device is associated, in a manner presently to be set forth with a differentially wound relay E that bridges around the coils of track relay C, or that, in other words, is connected in parallel with such track relay. This differential relay, it is intended, should be of considerably higher resistance than such track relay. The wire joining the differentially wound coils e e^1 of this relay, forming the inductive center of such relay, is connected to ground by a conductor e^2 as shown in the figure. It is a projecting finger d, mounted on the armature e^3 of this relay that forms the movable member of make-and-break contact device D. When relay E is in its normal, un-energized state, such movable member d is in contact with back contact point d^1 of device D. When, however, the relay draws the armature to itself, such member is moved into contact with the second point d^2 incidentally momentarily breaking the circuit through track relay C, as is evident. When in this position, armature e^3, which is itself connected with lead a^2, is brought into contact with a contact point e^4 whereby a shunt E′, of lower resistance than the coils of relay C is closed around such coils.

The effect of connecting resistance E′ across the terminals of track relay C is to shunt past the track relay the major portion of all superfluous or foreign current flowing through the relay circuit. The resistance of the shunt is so calculated as to allow a working current to flow through the track-relay only when the normal battery current is added to the anticipated foreign current. It is of course understood that the effects of excessive foreign currents, such as might follow the contact of a broken trolley wire with the track circuit, are guarded against by means of fuses in the usual manner. It may be found desirable, where for instance the anticipated foreign currents can not be accurately gaged, to cut out the track relay altogether when such current is encountered, even though delay in the operation of trains results by the lack of a clear block while the "sneak" current is flowing. The only change involved in the apparatus would be to dispense with front contact point d^2, as also with the shunt circuit E′, although the latter may be retained if desired.

The signal, diagrammatically represented only, in view of what has been previously said, is designated by reference letter F and is included in the signal circuit f energized by battery f' and controlled by armature c of track relay C in the usual manner.

The operation of my device as thus far described may now be conveniently shown. Under normal working conditions, the operation of the track relay will not be affected by the presence of the differential relay, for, due to the higher resistance of the latter not enough current will be shunted through its coils to seriously impair the strength of the track circuit current. Such current as does flow will flow through the respective coils of the differential relay in series and so will obviously not establish a magnetic circuit therein due to their differential winding. The armature will only be attracted when one of the coils is energized separately, thus breaking the balance. This result however will occur whenever a difference in potential arises between the rails of the track section in relation to foreign currents. In such case, that is whenever a foreign or "sneak" current manifests itself, ground wire e^2 forms in connection with the coils of the differential relay a bridge to the respective rails, and a current is set up through one of the coils until an equal potential relation-ship of the rails to the earth is again established. Such unequal flow of current through the coils sets up a magnetic circuit in the relay and thereby serves to actuate armature d to close low resistance shunt E′ around the coils of the track relay C. Practically all the foreign current thus passes by such track relay, which accordingly maintains its normal condition. If the foreign current be transient, as soon as it ceases flowing the differential relay armature drops back to its normal position.

A situation where trouble would arise were it not for my device is represented in the figure by assuming a break in the track circuit, as at a^4 in rail section a', and the presence of a train, designated by T, between such break and the battery B. The train, by short, circuiting the battery current and thereby de-energizing track-relay C should leave the signal at the entrance to the block standing at danger. Should now, however, even a slight difference in potential relation-ship with the ground arise between the broken rail-section and the other rail a current would flow through the track-relay in all probability strong enough to actuate the same to restore the signal to safety although the block was still occupied. The manner in which my device would operate under these circumstances has been fully pointed out.

In practice it has been found that the resistance of a relay should very nearly equal the external resistance of the relay circuit, the resistance of the track circuit in this case being negligible, the track relay is usually made of the same resistance as a cell, or four ohms. From this as a datum the proper resistance for use in the differential relay E of my apparatus, and for shunt E′, may be readily reduced. On the same assumption, it will be found that a current of sixty mil-amperes will ordinarily be required to actu-

ate the main relay, but that once actuated twenty-five mil-amperes will suffice to hold the same. It is because of the fact just stated that I introduce the make-and-break contact device D, which comes into play every time shunt E′ is thrown in or cut out of the track relay circuit. The continuity of the current through the track relay is thus momentarily broken and such relay will not be actuated again until the requisite sixty mil-amperes are again flowing. It is then to the elimination of the harmful effects of foreign currents on the track relay circuit that I should in conclusion place emphasis. For by means of the improved signal-control apparatus hereinbefore set up I am enabled to remove practically the only element of uncertainty, other than mechanical imperfection, that remains in the operation of trains on railroads, equipped with the automatic electric signal system. The advantages hence accruing from an early installation of my system on all roads thus operating will be clearly evident. It scarcely needs to be pointed out that other systems than those employed in connection with railway blocks, provided their principle of operation be similar, can be protected equally well by the incorporation therein of my several improvements; and I do not mean to imply any limitation of the field of usefulness of such improvements by having described them in one particular connection only.

Having thus described my invention in detail, that which I particularly point out and distinctly claim is:—

1. In apparatus of the class described, the combination with an actuating circuit, of means responsive to an established current adapted to control said actuating circuit, and other means not responsive to such established current but to a current part of whose circuit or path is the ground likewise adapted to control said circuit.

2. In apparatus of the class described, the combination with an actuating circuit, of a control circuit including means not responsive to the established current in said circuit but to a current part of whose circuit or path is the ground and adapted independently to control said actuating circuit.

3. In apparatus of the class described, the combination with an actuating circuit, of a control circuit therefor, said control circuit including a relay not responsive to the established current in said circuit but to a current part of whose circuit or path is the ground and adapted to control said actuating circuit independently of said control circuit.

4. In apparatus of the class described, the combination with an actuating circuit, of a control circuit therefor, responsive to an established current, and independent means for controlling said actuating circuit, the operation of said means depending upon the relative potential relation of the leads of said control circuit to the ground.

5. In apparatus of the class described, the combination with an actuating circuit, of a control circuit therefor, responsive to an established current, and independent means for controlling said actuating circuit, said means comprising a relay operatively dependent upon the relative potential relation of the leads of said control circuit to the ground.

6. In apparatus of the class described, the combination with an actuating circuit, of a control circuit therefor responsive to an established current, and a differential relay in said control circuit adapted independently to control said actuating circuit, said differential relay not being responsive to the established current in said control circuit but its operation depending upon the potential relation of the leads of said control circuit to the ground.

7. In apparatus of the class described, the combination with an actuating circuit, of a control circuit therefor, said control circuit including a differential relay adapted to independently control said actuating circuit, said relay being connected so as not to be responsive to the established current in said control circuit but to a sneak or foreign current.

8. In apparatus of the class described, the combination with an actuating circuit, of a control circuit therefor including a relay responsive to an established current therein, and a differential relay connected with said control circuit and also with ground so as not to be responsive to an established current in said circuit but to be operatively dependent upon the potential relation of the leads of such circuit to the ground.

9. In apparatus of the class described, the combination with a control circuit including a relay, of means adapted to control the flow of current through said relay, the actuation of said means depending upon the potential relation of the leads of said circuit to the ground.

10. In apparatus of the class described, the combination with a control circuit including a relay, of means adapted to disconnect said relay, the actuation of said means depending upon the potential relation of the leads of said circuit to the ground.

11. In apparatus of the class described, the combination with a control circuit including a relay, of means adapted to automatically break the connections of said relay when a difference in potential arises between the leads of said circuit in relation to the ground.

12. In apparatus of the class described, the combination with a control circuit including a relay, of means adapted to auto-

matically momentarily break the connections of said relay when a difference in potential arises between the leads of said circuit in relation to the ground.

13. In apparatus of the class described, the combination with a control circuit including a relay, of a make-and-break contact for connecting said relay, and means adapted to be actuated by a difference in potential between the leads of said circuit in relation to the ground to momentarily break said contact.

14. In apparatus of the class described, the combination with a control circuit including a relay, of a make-and-break contact device for connecting said relay, and a differentially wound relay in parallel with said first relay and adapted to operate said contact device.

15. In apparatus of the class described, the combination with a control circuit including a relay, of a make-and-break contact device for connecting said relay, a differentially wound relay in parallel with said first relay and adapted to operate said contact device, and a connection between the inductive center of said differentially wound relay and ground.

16. In apparatus of the class described, the combination with a control circuit including a relay, of a make-and-break contact device for connecting said relay, and a pair of differentially wound electro-magnets adapted to operate said device, each of said electro-magnets having one terminal connected with a terminal of said relay, respectively, and the other terminal connected with ground.

17. In apparatus of the class described, the combination with a control circuit including a relay, of a pair of resistances, each having one terminal connected with a terminal of said relay, respectively, and the other connected with ground.

18. In apparatus of the class described the combination with a control circuit including a relay, of a divided resistance connected in parallel with said relay, and a connection from the point of division of said resistance to ground.

19. In apparatus of the class described, the combination with a control circuit including a relay, of a pair of differentially wound electro-magnets, each having one terminal connected with a terminal of said relay, respectively, and the other terminal connected with ground.

20. In apparatus of the class described, the combination with a control circuit including a relay, of a differentially wound relay connected in parallel with said first relay, and a connection between the inductive center of said differentially wound relay and ground.

21. In apparatus of the class described, the combination with a control circuit including a relay, of a shunt, and means adapted to close said shunt around the coils of said relay, the actuation of said means depending upon the potential relation of the leads of said circuit to the ground.

22. In apparatus of the class described, the combination with a control circuit including a relay, of a shunt, and means adapted to be actuated when a difference in potential exists between the leads of said circuit in relation to the ground to automatically close said shunt around the coils of said relay.

23. In apparatus of the class described, the combination with a control circuit including a relay, of a shunt of lower resistance than the coils of said relay, and means adapted to be actuated when a difference in potential exists between the leads of said circuit in relation to the ground to automatically close said shunt around the coils of said relay.

24. In apparatus of the class described, the combination with a control circuit including the rails of a section of track and a track relay, of a shunt of lower resistance than the coils of said relay, and means adapted to be actuated when a difference in potential exists between the rails of said circuit in relation to the ground, to automatically close said shunt around the coils of said relay.

25. In apparatus of the class described, the combination with a control circuit and a relay interposed therein, of a shunt of lower resistance than the coils of said relay, and a differential relay connected in parallel with said aforementioned relay and adapted to close said shunt across the coils of the same.

26. In apparatus of the class described, the combination with a track circuit and a relay interposed therein, of a shunt of lower resistance than such track relay, and a pair of differentially wound electro-magnets each having one terminal connected with a terminal, respectively, of said track relay and the other terminal connected with ground, said magnets being adapted to close said shunt around the coils of said track relay.

27. In apparatus of the class described, the combination with a track circuit and a relay interposed therein, of a shunt of lower resistance than such track relay, a differential relay connected in parallel with said track relay and adapted to close said shunt around the coils of the same, and a connection between the inductive center of said differentially wound relay and ground.

28. In apparatus of the class described, the combination with a track circuit and a relay interposed therein, of a shunt of lower resistance than such track relay, a make-and-break contact device and a pair of differentially wound electro-magnets each having one terminal connected with a terminal, respectively, of said track relay and the other terminal connected with ground, said magnets being adapted to close said shunt around the coils of said track relay and incidentally actuate said contact device.

29. In apparatus of the class described, the combination with a track circuit and a relay interposed therein, of a shunt of lower resistance than such track relay, a differentially wound relay connected in parallel with said track relay and adapted to close said shunt around the coils of the same and to incidentally momentarily break the connection thereof with said circuit, and a connection between the inducting center of said differentially wound relay and ground.

30. In apparatus of the class described, the combination with a track circuit and a relay interposed therein, of a shunt of lower resistance than such track relay, a make-and-break contact device for connecting said track relay, a differential relay connected in parallel with such track relay and adapted to close said shunt around the coils of the same and to incidentally operate said contact device and a connection between the inducting center of said differential relay and ground.

Signed by me, this 31st day of July 1906.

JOHN P. BUCHANAN.

Attest:
G. W. SAYWELL,
JNO. F. OBERLIN.