E. WOLTMANN.

ELECTRIC TRAIN CONTROL SYSTEM.

APPLICATION FILED FEB. 19, 1909.

1,154,956. Patented Sept. 28, 1915.

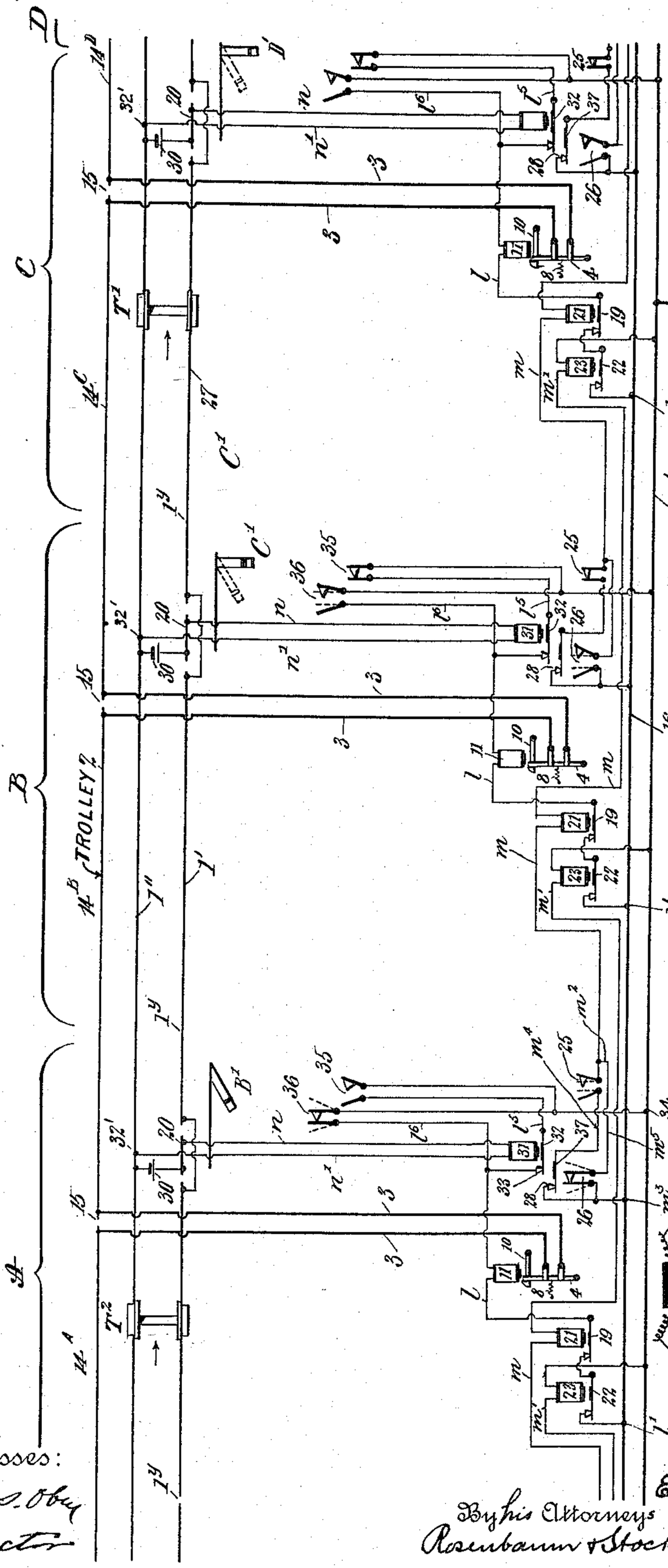

Fig. 1.

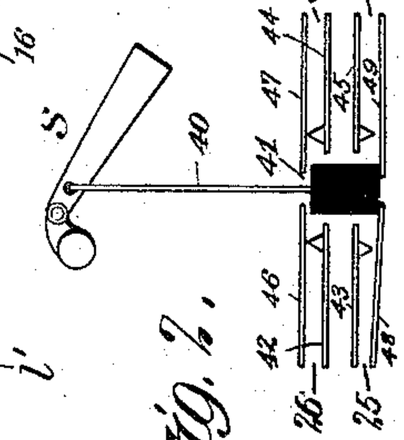

Fig. 2.

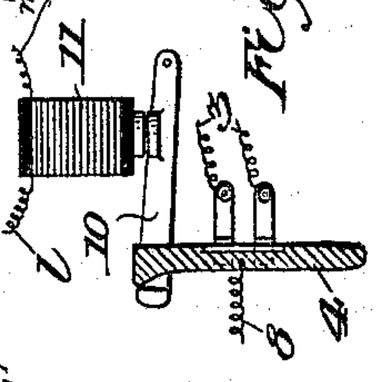

Fig. 3.

UNITED STATES PATENT OFFICE.

ERNST WOLTMANN, OF NEW YORK, N. Y., ASSIGNOR TO AUTOMATIC TRAIN STOP COMPANY, A CORPORATION OF MAINE.

ELECTRIC TRAIN-CONTROL SYSTEM.

1,154,956. Specification of Letters Patent. Patented Sept. 28, 1915.

Application filed February 19, 1909. Serial No. 478,869.

To all whom it may concern:

Be it known that I, ERNST WOLTMANN, a citizen of the United States, residing at the city of New York, in the borough of Manhattan and State of New York, have invented certain new and useful Improvements in Electric Train-Control Systems, of which the following is a full, clear, and exact description.

This invention relates to train control systems, being a system or installation by which signals or other prescribed traffic conditions are automatically enforced.

In my pending application No. 466,253, filed December 7, 1908, and in my Patent No. 875,028, granted December 31, 1907, I have set forth an installation having certain broad features or principles by which the sectional third-rail or trolley of an electric railroad is made use of as a line conductor for the power current transmission. All the installations proposed by me and above referred to having certain dominant characteristics which have been set forth with particularity in the patent and in the pending application, to which reference may be made for a more extended consideration of these general principles.

The invention of the present application relates primarily to securing the principal functions of the foregoing cases and some additional broad or generic functions, particularly the provision of normally closed operating circuits throughout, whereby all parts come to train stopping conditions in case of breakage of any circuit or conductor, or short circuiting, or failure of current in any source.

The drawing in the present case shows the invention designed to operate with and check the operation of what is known as a normal danger signal system, namely, in which the normal position of the signals is at danger when no trains are anywhere present in the vicinity, the signals being temporarily dropped to safety in advance of a train proceeding along the trackway in case conditions are actually safe. This latter characteristic is a common practice in signal systems. The present invention is applicable thereto or to any other ordinary system.

Briefly stated, the objects of the present invention are, first, to secure train stop or signal enforcing means by cutting out sections of the third rail or trolley, which normally serves as a line conductor for the power current transmission, the actuation being made so as to properly stop the trains under any and all conceivable circumstances which might arise, where it is proper that the trains should be automatically stopped, supposing the apparatus to be without fault, or defect or breakage. Second, to cause a train stop actuation in case of any fault, defect or breakage in the apparatus, of such a nature as to interfere with its proper working as first mentioned. If these two requirements are satisfied, it is evident that a practically perfect system is attained. The present application is generic, and is intended to include within the broader aspects of its scope, the modified structure set forth in application No. 431,388, filed Mar. 5, 1909, by H. N. Latey.

Figure 1 of the drawing shows, somewhat diagrammatically, a practical installation embodying the principles of my invention. Fig. 2 illustrates a detail of the signaling apparatus. Fig. 3 is an enlarged detail of one form of magnet-controlled switch.

Referring to the drawing in which like parts are indicated by the same reference sign, 1′ 1″ designates a trackway, it being evident that as many trackways as are available will be joined in the system. Almost all electric roads have at least two trackways and commonly a much greater number. Each trackway has a usual third-rail or trolley 2. Third or power rails ordinarily employed are heavily made of iron to stand the rough usage to which they are exposed in the engagement of the contact shoes of trains and in other ways, so that they necessarily have a large current carrying capacity; that is to say, each power rail, if continuous throughout its length, is adapted to serve admirably as a line conductor for the power transmitting system. This also obviously applies to overhead trolleys. It is practically very important, however, to have the third-rail or trolleys made in sections which can be cut out when desired. By the present invention the third-rail or trolley is made sectional but the sections are normally joined together to constitute a line conductor for the power current transmission. In conjunction with this sectional

third-rail, there is provided the various apparatus for carrying out the train stop functions already alluded to.

In the particular illustration of the present case, the trackway is divided into blocks denominated A, B, C, etc., for which purpose one of the track rails 1′ has insulated joints (or their electrical equivalents) 1^y therein at the divisions between the separate blocks. The other track rail 1″ may be permanently continuous to constitute a ground return conductor for the power conductor transmission. It is to be noted that this arrangement of the track rails is adapted to the ordinary signal systems in use, and any ordinary signal system may be installed. Semaphores B′, C′ and D′ are illustrated in the drawing at points which will be termed the block entrances, and of course operate in the standard and well known manner.

The third-rail 2 is also divided into section 14^A, 14^B, 14^C, etc., corresponding in length to the blocks, but the joints 15 are lapped back somewhat from the block entrances. The connection between the adjacent rail sections 14 of the same trackway, is established by branch wires 3 and switches 4.

The various switches 4 are capable of being opened so as to cut out any third rail section. The means which I have adopted for operating the switches 4 serves to compel the observance of the signals and is furthermore designed to operate with normally closed circuits throughout so as to produce a train stop actuation in case of any defect. 10 denotes latches which restrain the switches 4 in their circuit closing relations against the tension of springs or equivalent means 8, which are adapted to open the switches 4 when the latter are released by the latches. The latches 10 are displaced to release the switches by deënergizing magnets which may be arranged in a normally closed circuit in any desired way. I have illustrated each switch actuated by a normally energized magnet 11 in the present case, which derives its current through a circuit of such a character as to cause the magnet to be deënergized in case of train stop conditions, or in case of a defect in the circuits. Each magnet 11 is shown in a circuit l which derives its current from a wire 16, which may be a circuit wire from the train despatcher's office. These circuits of the magnets 11 are completed to ground on a return wire 16′. These circuits l while normally closed, are provided with means by which they are interrupted in groups of two or three or other number, to cause an actuation of the train stop switches 4 in corresponding groups. Each of the circuits l is also adapted to be interrupted at one point and simultaneously shunted thereat to enforce the observance of the signals, in normal action, and effect a train stop in abnormal conditions. I will first consider the mere function of tripping the switches 4 in groups, and afterward consider the action of the trains and the signals in effecting a tripping of the switches.

The circuit l of each magnet 11 includes an armature 19 of a magnet 21 and an armature 22 of a magnet 23, being connected to the potential wire 16 at l'. Each magnet 21 derives its current from a circuit m which is continued to the block section in advance at m' where it includes the other magnet 23 at that advance station or section. The circuit m is also continued backward to the station behind at m^2, where it derives its current at m^3, but not until it has traversed a plurality of circuit closers 25, 26 and 28. These various circuit closers can have no other effect than to either open or close the circuit m, whatever their various positions may be. Their operation will be later taken up in detail, but for the present their combined function of opening or closing their single corresponding circuit m is all that need be considered. The foregoing apparatus is repeated throughout the system; accordingly the connections of any magnet, for instance, the magnet 23 at the entrance to block C, or the magnet 21 at the entrance to block D, will be understood without further description.

The circuits m are normally closed so that all the magnets 21 and 23 throughout the system are energized and their armatures 19 and 22 brought against the front stops to close the various circuits l and keep the switches 4 closed. The opening of any circuit m, for instance that of magnet 21 at the entrance of block C effects the deenergization of said magnet 21 and the magnet 23 at the entrance of block D. Their corresponding armatures 19 and 22 are therefore released, interrupting circuits l at the entrances to block C and block D. The result is to open the corresponding switches 4 cutting out the third rail section 14^c of block C. The foregoing occurs in case of accidental breakage of any circuit m. In the normal working of the train stop apparatus under the action of the circuit controllers 25, 26 and 28, it will be found that the switch 4 at the entrance to block B has been additionally opened, so that the third rail section of block B as well as block C, is cut out. I will now consider this part of the action more in detail. At the entrance to each block, one of the track rails has a local insulated rail sub-division 20, which is normally electrified by any suitable current source 30. From this insulated block entrance rail sub-division, a circuit n extends through a magnet 31, being completed to the ground rail 32′ by a wire n'. By this means the magnet 31 is normally energized and maintains its armature

32 against its front stop 33. This armature and front stop lies in a branch l^5 of the corresponding circuit l, already described, which branch is completed to the ground conductor 16′ at 34, there being an additional contact 35 in this same branch of the circuit l. The circuit l may, however, be completed independently of this branch l^5 by a branch l^6 and a contact 36, to ground at 34, as before. Each magnet 31 in addition to holding its armature 32 against the front stop holds an additional armature or blade 37 against a front stop to establish the contact 28, already described. This contact 28 lies in a branch m^4 of the circuit m, which branch also includes the contact 25 already described. The contacts 25 and 28 may, however, both be shunted by the closure of a contact 26 in a branch m^5 of the circuit m.

The various contacts 25, 26, and 35 and 36, are operated by the adjacent semaphore apparatus. In order to show diagrammatically the manner of their operation, I have illustrated in Fig. 2 a semaphore S with a depending link 40 attached to a block 41 engaging various spring blades 46, 47, 48 and 49 to cause a displacement of the latter with reference to stationary spring blades 42, 43, 44 and 45, when the semaphore comes to danger. 42 and 44 respectively break contact with 46 and 47 under these circumstances. 48 and 49 respectively make contact with 43 and 45 under these circumstances. The pair 42, 46 may be said to constitute contact 26; the pair 44, 47 may be said to constitute contact 36; the pair 43, 48 may be said to constitute contact 25, and the pair 45, 49 may be said to constitute contact 35. As shown the contacts 25 and 35 are closed slightly before 26 and 36 open.

The foregoing apparatus, duplicated or repeated of course throughout the system, is all that I need provide for carrying out the functions described in the preliminary part of the specification.

I will now consider a number of conditions which may arise in practice and show that this apparatus effects a proper working under all conditions.

It may first be assumed that no trains are present anywhere in the vicinity. In this case all the semaphores B′, C′, D′, will be at danger, because it has been assumed that a normal danger system is employed. Under these circumstances the position of all the contacts 25, 26, 35 and 36, will be as is illustrated at block entrances C and D. The magnets 31 will be energized by their connection with the insulated block entrance rail sub-divisions 20, so that each circuit l, is completed through its contacts 33 and 35. Each circuit m is also completed through its contacts 28 and 25, 28 being closed by the energization of the magnet 31. Current flowing in the circuits m maintains the armatures 19 and 22 attracted throughout the system, so that the circuits l are not interrupted at these points. All the switches 4 therefore remain closed, as is desired.

Assume now that a train T′ has proceeded through the blocks A and B and had entered the main portion 27 of block C. As a result, the signals behind the train T′ are set at danger, in which condition they continue or remain until the following train arrives to drop them to safety, assuming that safety conditions are established by that time. Suppose T^2 is a following train in block A. In accordance with the usual signal practice the result of this train in block A would be to drop the semaphore B′ to safety, closing contacts 26 and 36, and opening contacts 25 and 35. As the train T^2 passes onto the insulated block entrance rail sub-division 20, the magnet 31 is deënergized, but this fact does not break the corresponding circuit l because a path for the current flow in this circuit has just been established through the contact 36, as just described. The deënergization of the magnet 31 also breaks contact at 28, but this fact does not interrupt the current flow in the corresponding circuit m, because a path has just been established through the contact 26, closed by the semaphore B′ as just described. The various switches 4 controlled by the circuits l and m therefore remain closed as is proper when the semaphore B′ has fallen to safety. But now it may be assumed that the train T^2 attempts to enter block C, occupied by the train T′. The semaphore C′ being at danger, leaves the contacts 26 and 36 opened, so that the deënergization of the magnet 31 at the entrance to block C, breaks both of the corresponding circuits l and m. The result is to deënergize magnet 11 at the entrance to block C and open the switch 4 thereat. At the same time the magnet 21 at the entrance to block D and the magnet 23 at the entrance to block E (not shown) are deënergized by the opening of their common circuit m, breaking the respective circuits l at these block entrances, so that the switches 4 are opened thereat in the same manner as the switch 4 at the entrance to block C, just described. The result is to cut out the power rail sections 14^C and 14^D of blocks C and D. Blocks E, F., etc., will however still be supplied with current as the switches 4 of said blocks have been unaffected, current being supplied to such sections from some distant point in the line, in the usual manner.

By cutting out the power rail sections of blocks C and D, the train T^2 is deprived of current as soon as it enters the block C. It is therefore automatically stopped before a collision can take place with train T′ which is located in block C.

I will now consider various positions of train T′ in block C in order to show that a collision cannot take place under any circumstances.

First train T′ might be considered to be in a position where the collector shoes of different motor cars lapped over onto two rail sections 14^C and 14^D corresponding to blocks C and D. This would supply current to the power rail 14^C of block C were it not for the fact that the power rail 14^D of block D has already been cut out in the train stop actuations above described. This contingency is therefore provided for.

A second possibility is that train T^2 might have motor cars spaced back far enough from its front end to lap onto the power rail 14^B of block B. This is provided for by the fact that the insulated joints 15 between the power rail sections 14 are spaced back from the block entrances a sufficient distance to prevent a train deriving current in this manner.

A third possibility is that train T′ might be located so near the insulated block entrance rail sub-divisions 20, that the momentum of the following train would carry it into a collision in spite of the cutting out of its power rail. This contingency is provided for by having the track rail joints 1^y which define the block entrances proper, spaced along from the block entrances for a distance equal to the maximum braking distance of a train. The result of this is that unless the rear of the advancing train T′ has got beyond the point 1^y, the signal at the entrance to block B would not have been cleared, and the following train would have been held at block B instead of block C. In other words, unless the advance train T′ is beyond the point 1^y, the following train would have been stopped a block further back on the trackway. If on the other hand, the advance train T′ has proceeded beyond the point 1^y the following train is deprived of current the instant that its front end passes onto the insulated block entrance rail sub-division 20 of block C, and the momentum of the train will never be sufficient to carry its front end beyond the point 1^y. Reference may be made to my application 466,253 in which the brakes are automatically applied upon failure of the power current, so as to make the stoppage within the required distance certain and positive.

The foregoing, it is believed, are all the conditions which might arise in practice, and it will be seen that they are all provided for.

While I have referred in the foregoing description and in the claims to power rail or trolley sections normally joined together in an unbroken series, it is of course to be understood that in a complete railway system of the ordinary character with various power stations and power distribution points, occasional interruptions are necessary, but the words of the claims apply of course to any one of the division or units in this case, which are each virtually a complete railway in all practical purposes.

What I claim, is:

1. An electric railway system comprising a sectional power conductor, switches normally joining the ends of the sections of said conductor in an unbroken series, switch operating devices and electric circuits for controlling said devices, said circuits including circuit opening parts, auxiliary electric circuits including electro-magnetic appliances for controlling said circuit opening parts, said auxiliary circuits each including two branches, means for altering the circuit conditions in one of said branches when a train passes a determined point and means for altering the circuit conditions in the other of said branches when a second train approaches to within less than a determined distance from the point first mentioned.

2. An electric railway system comprising a sectional power conductor, switches normally joining the ends of the sections of said conductor in an unbroken series, switch operating devices and electric circuits having current normally flowing therethrough for controlling said devices, said circuits including circuit opening parts, auxiliary electric circuits including electro-magnetic appliances for controlling said circuit opening parts, said auxiliary circuits each including two branches, means for altering the circuit conditions in one of said branches when a train passes a determined point and means for altering the circuit conditions in the other of said branches when a second train approaches to within less than a determined distance from the point first mentioned.

3. An electric railway system comprising a sectional power conductor, switches normally joining the ends of the sections of said conductor in an unbroken series, switch operating devices and electric circuits for controlling said devices, said circuits including circuit opening parts, auxiliary electric circuits, through which current normally flows, including electro-magnetic appliances for controlling said circuit opening parts, said auxiliary circuits each including two branches, means for altering the circuit conditions in one of said branches when a train passes a determined point and means for altering the circuit conditions in the other of said branches when second train approaches to within less than a predetermined distance from the point first mentioned.

4. An electric railway system comprising a sectional power conductor, switches nor-

mally joining the ends of the sections of said conductor in an unbroken series, switch operating devices and electric circuits for controlling said devices, said circuits each having two branches and each branch having a set of contact making elements therein, a set of elements in one branch and a set of elements in the other branch being operable substantially in unison, one set of elements closing the circuit through one branch while the other opens circuit through the other branch, means for operating the number of sets of elements associated with one circuit from a determined point along the track, and means for interrupting the circuit when a train approaches within less than a determined distance of said point.

5. An electric railway system comprising a sectional power conductor, switches having a bias to open position, electrically operated devices for holding said switches normally closed, the ends of the respective sections of said conductor being normally electrically joined together by said switches in an unbroken series, a series of circuits each of which includes a solenoid through which currents normally flow, said devices being held in operative position by the action of said solenoids, and means including a plurality of normally energized relays and contact making parts controlled by said relays, for simultaneously altering circuit conditions in a determined number of the circuits aforesaid, whereby a determined plurality of the said switches may move to open position.

6. An electric railway system comprising a sectional power conductor, switches for joining the sections of said conductor in an unbroken series, said switches having a bias for open position, means including normally energized electro-magnetic devices for holding said switches closed, means, including movable contact members, for passing current through said devices, a series of circuits, each of which includes at least two electro-magnetic controlling elements, one of said two controlling elements in each circuit adapted to control one of the movable contact members through which current passes to one of the electromagnetic devices aforesaid, and the other of said two controlling elements adapted to control one of the movable contact members through which current passes to another of said electro-magnetic devices, the contact members controlled by each circuit being other than those controlled by the other circuits, said circuits also including a plurality of circuit closers, means for oppositely actuating two of said circuit closers, and train controlled means for actuating another of the same.

7. An electric railway block system comprising a sectional power conductor having one section for each block, switches for normally joining the ends of the sections together in an unbroken series, said switches having a bias for open position, normally closed circuits and means coöperating therewith for maintaining said switches closed, and a group of relays for each of said circuits, each group comprising two relays the armatures of which are in the circuit corresponding to such group, controlling circuits for said relays, each of which circuits includes two of said relays, said two relays being in each case respectively in different blocks, and means for varying the conditions in each of said last mentioned circuits at a block other than either of those in which is one of the said two relays corresponding to said circuit.

8. An electric railway block system comprising a sectional power conductor, switches normally joining the ends of the sections together in an unbroken series, track rails, including an insulated rail situated at the entrance of a block, a circuit completed therefrom through which current normally flows, means dominated by said circuit for maintaining a group of said switches closed, said means comprising an additional normally closed branched circuit having a portion thereof including a circuit breaker through which the current flow may be terminated by the presence of a train in advance, means for actuating said circuit breaker for terminating the flow of current in said portion, and means for opening said group of said switches in case the current flow in both of said circuits is terminated.

9. An electric railway system comprising a sectional power conductor, switches normally joining the sections of said conductor in an unbroken series, said switches having a bias for open position, means including normally energized electro-magnetic devices for holding said switches closed, means, including movable contact members, for passing current through said devices, a series of circuits, each of which circuits includes at least two electro-magnetic controlling elements, one of said two controlling elements in each circuit adapted to control one of the movable contact members through which current passes to one of the electro-magnetic devices aforesaid, and the other of said two controlling elements adapted to control one of the movable contact members through which current passes to another of the said electro-magnetic devices, the contact members controlled by each circuit being other than those controlled by the other circuits, each of said circuits also including at least three circuit closers, means for disposing one of said circuit closers in open position while closing another of the same, and train controlled means for independently controlling the third of said circuit closers, said train controlled means including a source of cur-

rent, an electro-magnetic apparatus normally in circuit therewith and connections between said source of current and said apparatus, said connections including portions of parallel railway tracks.

10. A railway block system comprising a track way divided into blocks and a sectional power conductor, said blocks each comprising a long and short length of track section corresponding in length to at least a train stopping distance, and a train length respectively, and an insulated track section interposed between said track sections, the sections of the power conductor, being each disposed opposite a short length and insulated track section of one block and the long length of track section of an adjacent block and means controlled by the traffic conditions and by the passage of a train over the insulated section of a block for cutting out of at least the conductor section opposite the insulated track section.

11. A railway block system comprising a track way divided into blocks; a normally energized sectional power conductor, said blocks each comprising a long length and short length of track section and an insulated track section interposed between the two; means controlled by two trains for cutting out at least the section of the power conductor which supplies power to the rear train before the trains are separated by a distance less than the length of one of the long length track sections.

12. An electric railway block system comprising a sectional power conductor having one section for each block, electro-magnetic switches for connecting the sections of the power conductor together, normally energized circuits one for each of said switches, an insulated track section in each block, track relays connected to each of said insulated sections, a contact in each of said circuits controlled by the track relay of the block; other contacts in each of said circuits arranged in parallel and controlled by the road side signals of the block when in different indicating positions, additional contacts in each of said circuits and means including over-lapping circuits, extending at least through two blocks for controlling said additional contacts, said last named circuits being controlled by the track relays and the road side signals of the blocks to the rear of the first named block.

In witness whereof, I subscribe my signature, in the presence of two witnesses.

ERNST WOLTMANN.

Witnesses:
WALDO M. CHAPIN,
WILLIAM LARY.