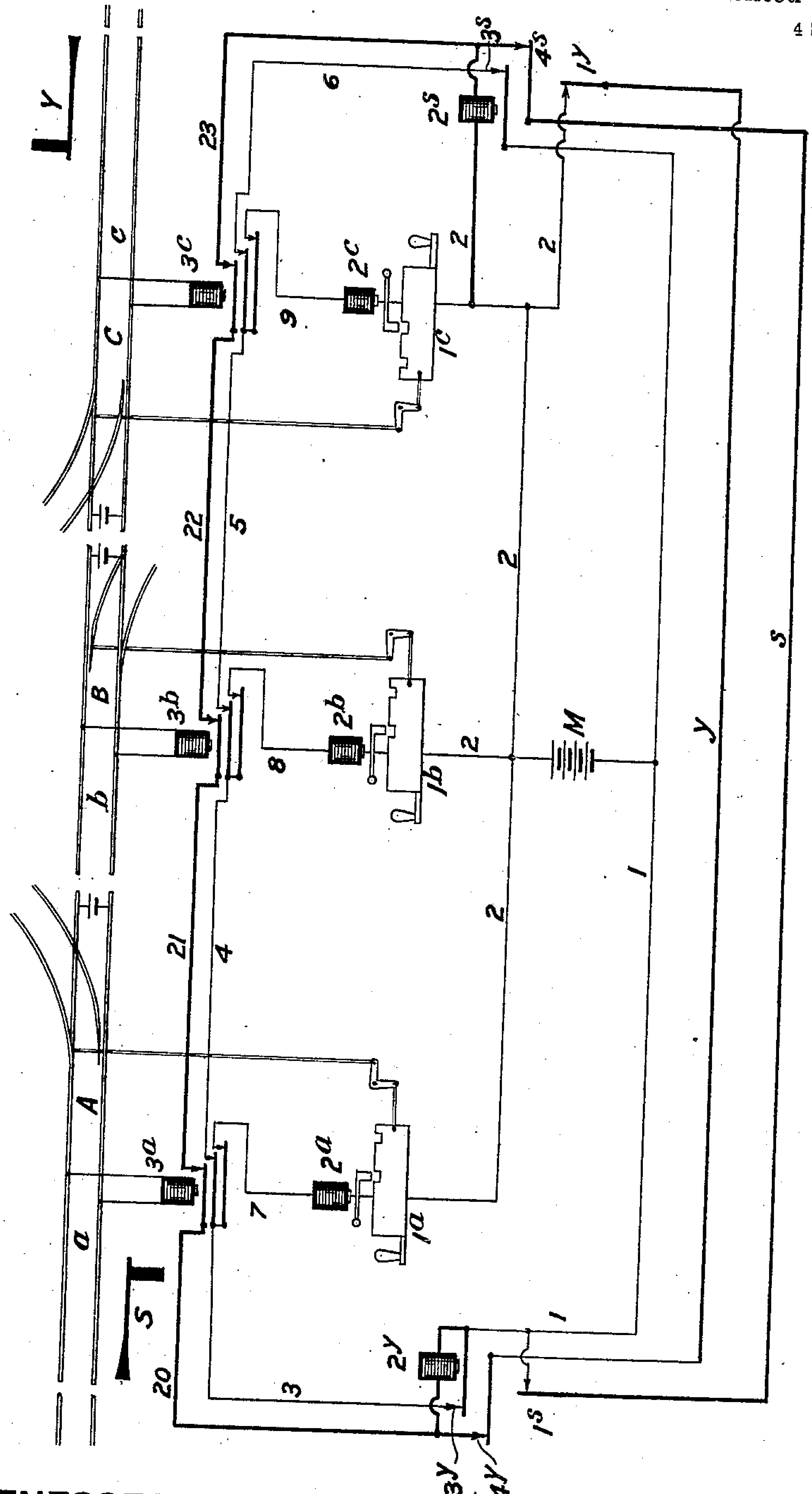
F. L. DODGSON & W. K. HOWE.
RAILWAY TRAFFIC CONTROLLING APPARATUS.
APPLICATION FILED AUG. 28, 1908.

915,081.

Patented Mar. 16, 1909.
4 SHEETS—SHEET 1.

FIG. I.



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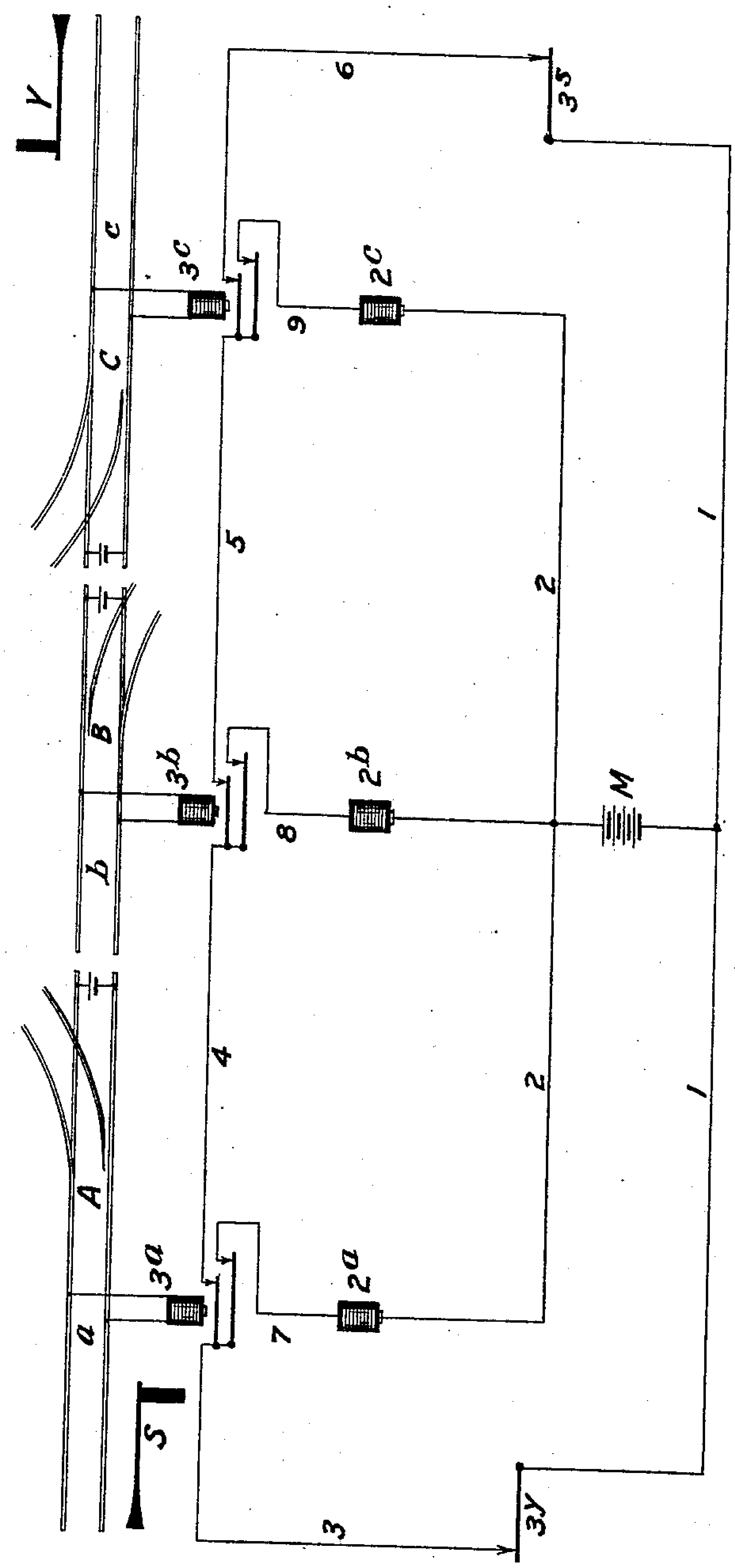

FIG. 2.

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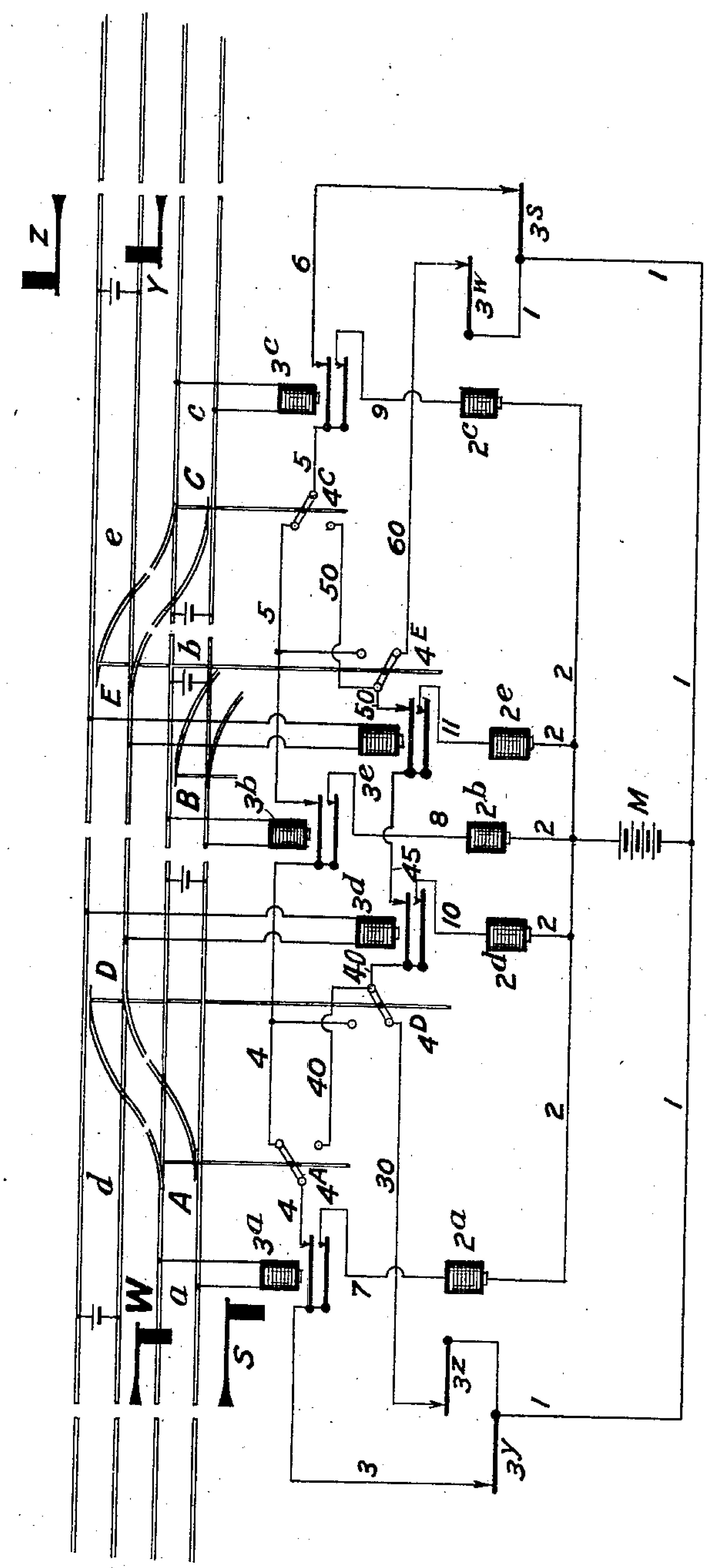
4 SHEETS—SHEET 3.

FIG.3.



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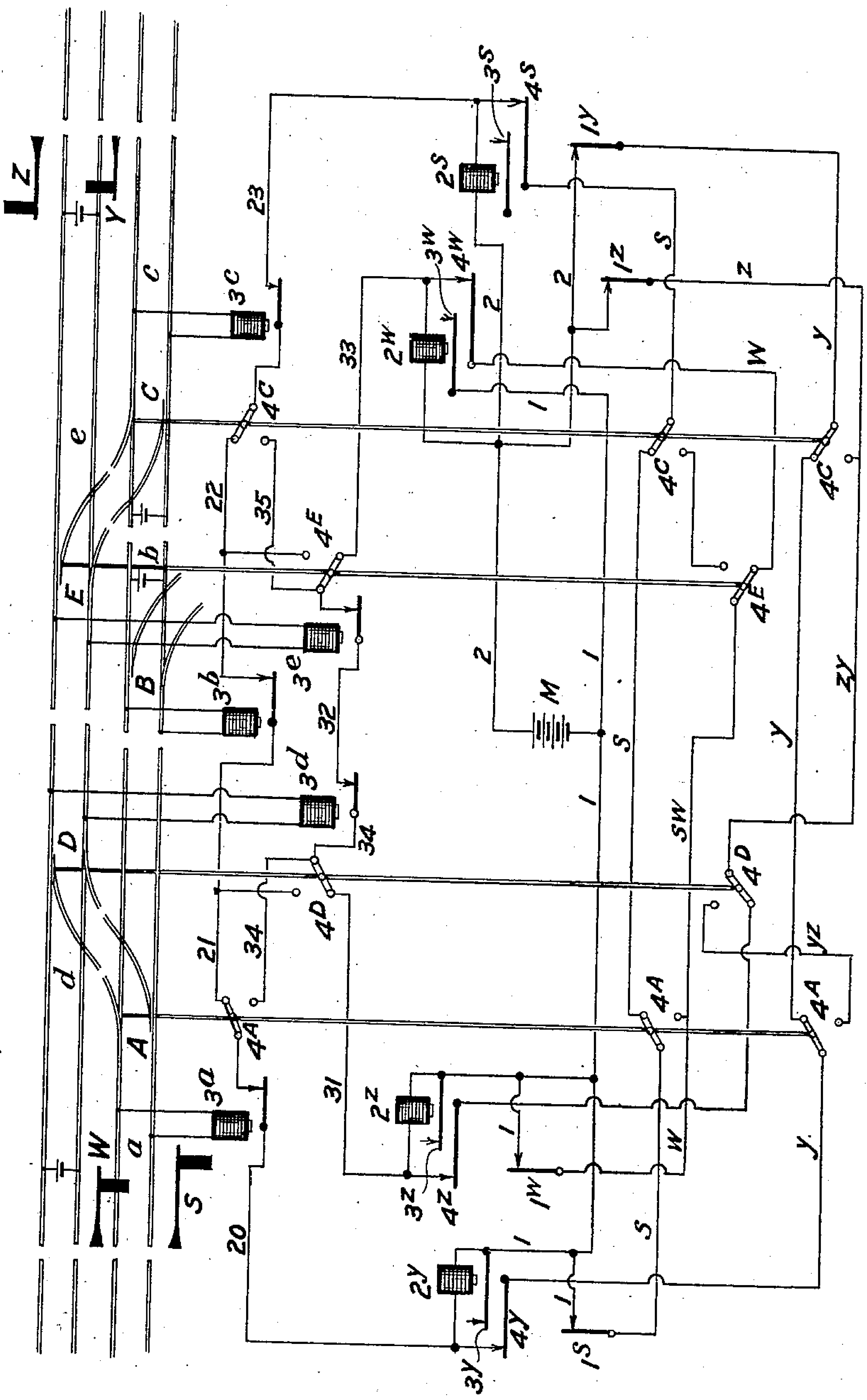
4 SHEETS—SHEET 4.

FIG. 4.



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UNITED STATES PATENT OFFICE.

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RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

No. 915,081. Specification of Letters Patent. Patented March 16, 1909.

Application filed August 28, 1908. Serial No. 450,752.

To all whom it may concern:

Be it known that we, FRANK L. DODGSON and WINTHROP K. HOWE, citizens of the United States, and residents of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Railway-Traffic-Controlling Apparatus, of which the following is a specification.

This invention relates to railway traffic-controlling apparatus and particularly to that branch of the art of railway signaling known as route locking for interlocked switches.

The interlocking of one or more signals with one or more switches relating to a possible route over the rails of a multiple-track yard, has long been known, and means, such as the well known detector bar, have been employed in order to prevent the throwing of a switch when a train is upon it. A modern substitute for the detector bar is a track circuit operating a lock for the apparatus that controls the movement of the rail switch. Of course, a single track circuit may control several switches and the levers therefor. In ordinary use, the electrical lock in an interlocking tower is operated by an electromagnet which when deënergized, causes the lock to engage and to hold the controlling lever for the switch. The operation just described may be called electric detector bar locking of switches.

It has been common practice to provide in interlocking plants, means whereby, when a train has entered, or is about to enter, upon a certain route, all the switches of that route are automatically locked by suitable means, such, for instance, as electric detector bar locks. The operation just described is termed in the art "route locking", and has been brought about by the necessity of providing for the increased speed of trains within the terminal yards of railways. Under the system just described, all the switches of the route remain locked until the train passes off the route, and then all the switches are simultaneously unlocked. But this prevents a second train from entering upon any portion of the route until the first train has passed off. In busy yards, the necessity for a modification of this practice has become necessary, and this invention has been produced in order to make it possible for a route to be locked and to allow any switch of the route to be unlocked automatically, immediately after the train has passed off the track section containing that switch, thus saving large amounts of time and the attention of the tower man.

This invention, therefore, provides means for unlocking each switch immediately after a train has passed it, and, as will be seen, by means (wires, relays, etc.) that are not too complicated nor prohibitive in cost, and that are capable of use in connection with ordinary electrical detector bar locking. In other words, a yard that is already provided with electrical detector bar locking may be provided with the additional features to which this invention is directed by adding to the plant there in place, additional mechanism for accomplishing the purposes hereof.

In the drawings: Figure 1 is a diagrammatic view of a single track line and the lock-circuit apparatus therefor in its simplest form and without the lock-circuit controlling apparatus. Fig. 2 is a diagrammatic view of the lock-circuit controlling apparatus used with the same track and apparatus of Fig. 1. Fig. 3 is a diagrammatic view of the lock-circuit apparatus of a two track route apparatus, and Fig. 4 is a like view of the controlling circuits and apparatus for said lock-circuit apparatus used with the same track and apparatus of Fig. 3.

Returning to Fig. 1, three switches are shown, A, B, and C, in a route governed by the signal S, and composed of three track circuits *a*, *b* and *c* relating to the respective switches. Each track circuit has its own battery and a track relay 3^a, 3^b, 3^c. A lever 1^a, 1^b, 1^c, is provided for each switch, and for each lever there is an electric lock 2^a, 2^b, 2^c, consisting in the present embodiment of the invention of an electromagnet controlling an armature having a part that drops into a notch in the corresponding lever 1^a, 1^b, 1^c, when the electromagnet is deënergized, and thus locks the lever in either the normal or reverse position of the switch. Under ordinary circumstances the track circuit apparatus for each track circuit controls the lock, so that it is disengaged when no train is on that track circuit, and is engaged whenever a train enters the same. A common source of electrical energy M is provided, which carries current by means of a main line wire. A circuit controller 1^s is so arranged that its circuit is broken when the signal S is placed in the "clear" position, in order to direct or permit a train to enter the route. This circuit closer 1^s controls a circuit that prevents the deënergization of a relay 2^s (called a stick relay). The circuits and functions of these parts will be described below.

In order to simplify the description of the mechanism, and the understanding of its functions, reference is now made to Fig. 2, which embodies the structure of Fig. 1, so far as it relates to the circuits and circuit controllers affecting the operation of the locks. In other words, the stick relays and their circuits, the switch actuating mechanism and the locks therefor are omitted. The magnets of the locks are, however, shown in said Fig. 2. Under normal conditions, that is, when no signal of a route is set to indicate clear, and when the track circuits of the route are unoccupied, the lock magnets are all energized, and consequently the locks are disengaged from their respective levers and the switches may be moved. Each lock magnet receives its energizing current from two possible directions. For example, the lock 2^a may receive current from the battery M through the wire 1, circuit controller 3^y, wire 3, front contact of track relay 3^a, wire 7, magnet of lock 2^a, and wire 2, back to battery. The other circuit above mentioned is from the battery M, wire 1, circuit controller 3^s, wire 6, front contacts of relay 3^c, wire 5, front contacts of relay 3^b, wire 4, front contact of relay 3^a, wire 7, magnet of lock 2^a, and wire 2, back to battery M. The lock 2^b may receive current from two possible directions, as follows: One may be through wire 1, circuit controller 3^y, wire 3, front contacts of track relay 3^a, wire 4, front contact of relay 3^b, wire 8, magnet of lock 2^b, and wire 2 back to battery. The other circuit for the magnet 2^b is by way of the circuit controller 3^s, the contacts of the relay 3^c, and a contact of the relay 3^b. The two circuits for the lock 2^c are, one, by the way of the controller 3^y, the front contacts of the relays 3^a, 3^b, 3^c; and the other circuit for said lock 2^c is by way of the controller 3^s and a front contact of the relay 3^c. It will thus be noted that the circuit in one direction through each of these locks passes through the controller 3^y, and the circuit in the other direction for each of these locks passes by way of the controller 3^s, consequently, if either one of these controllers is open, all current for the locks must pass by way of the other controller. Further, the circuit for any lock magnet through a closed controller is governed by the relay contacts between that controller and said magnet.

It will be noted that the lock magnets 2^a, 2^b, and 2^c (Fig. 2) are translating devices for producing a transformation of energy at desired points; that the said translating devices are connected in multiple between two conductors, one of which is the wire 2 and the second of which is the wire 4, 5; that the source of energy M has one pole connected to the first conductor 2 and has the other pole connected to second conductor 4, 5, by the two feed wires 1—3 and 1—6; that the "ends" of the second conductor, so far as function goes, are the points at which the first and the last translating devices are connected to it; that the traffic controlling devices of this invention are devices (which may include the said translating devices) for governing traffic on a railway, such for instance as, a switch and its lock as shown in Figs. 1–4 or an indicating or signaling device, such as a visual indicator operated by the translating device or used in place of said translating device. If, when a train enters from the left and is running toward the right in said drawing, and the circuit controller 3^s is open, when said train enters track section *a*, the front contacts of track relay 3^a are opened, and no current can reach any of the locks, because the two paths to each lock are all broken, those in one direction being broken at 3^s, and those in the other direction being broken at the track relay 3^a. This deënergizes all the lock magnets and locks all the levers, thus preventing the movement of any switch, either under or in front of the train. As the train moves off track section *a* upon track section *b*, the track relay 3^b is deënergized, and its front contacts are opened, but the track relay 3^a is reënergized, and its front contacts are closed. The closing of one of the front contacts of the track relay 3^a closes one of the circuits for the lock 2^a, to wit, the one through the controller 3^y, and said lock 2^a is now reënergized, and the switch A is free and can be moved for the accommodation of a train entering said section. When the track relay 3^b was deënergized, the locks 2^b and 2^c remained deprived of current, and the switches B and C therefore remained locked, because both of these locks must receive current under these conditions in one direction (by way of the controller 3^y) through the front contacts of the relay 3^b. In the other direction, as before stated, the circuit is broken by the controller 3^s. As the train proceedes off track section *b* and upon track section *c*, the track relay 3^b is reënergized and its front contacts are closed, so that the lock 2^b may receive current by way of the controller 3^y and the contacts of the track relays 3^a and 3^b, and thereby the switch is released. The track relay 3^c is deënergized by the presence of the train upon the track section *c*, and the front contacts of said track relay are opened, which deprives the magnet of the lock 2^c of current from either of its directions of supply, and the switch *c* remains locked till the train passes off the track section *c*, whereupon the magnet of the lock 2^c is reënergized by current, as soon as the track relay 3^c picks up its contacts. It is obvious that this construction is capable of indefinite extension through any number of track sections. For trains moving from right to left over the track section shown in Fig. 2, the circuit controller 3^y is open and the circuit controller 3^s is closed, and under these conditions the same operations will occur as have just been described in detail, in the reverse order. It will be noted that this system is entirely symmetrical, and is therefore obviously reversible in its operation.

The circuit controllers 3^s and 3^y may be operated in any suitable manner, even by hand, as long as the following conditions are fulfilled for the complete protection of all the switches of a route, viz: The circuit controller 3^s must be opened as soon as a train traveling in the proper direction enters upon the route, and must be kept open as long as that train is upon that route, and for this same period the circuit controller 3^y must be kept closed. When a train is traveling in the opposite direction, the circuit controller 3^y must be opened as soon as the train enters the route and must be kept open so long as the train is upon that route; and the circuit controller 3^s must remain closed during the same period. It is to be understood that this arrangement of lock actuation is an important part of this present invention, which is not to be limited to any specific means of controlling the opening and closing of the controllers 3^s and 3^y. Another part of the present invention is a means of opening and closing said circuit controllers in the manner and for the periods above mentioned. For this purpose relays commonly called "stick relays" are employed. "Stick relays" are electromagnetic mechanisms in which the current passes through both an electromagnet and a contact, closed when the armature is attracted by the magnet, and inasmuch as the current flowing in this way maintains the closure of a contact, the contact is held or stuck. It is clear that if this stick circuit is broken, the magnet can not be reënergized, unless a separate circuit for energizing it is employed, and such a circuit reënergizing the electromagnet, is called the "restoring circuit" of the stick relay; and as soon as the contact controlled by the electromagnet is closed, the stick circuit automatically holds said contact closed. One mode of using these stick relays for controlling the lock circuits is shown in Fig. 1, in which the stick circuit and the restoring circuit are shown in somewhat heavier lines than the lock circuits. The said Fig. 1 embodies precisely the parts and the arrangement of parts shown in Fig. 2 as to the lock circuits. The stick relays, as well as the lock magnets, receive their current (in the embodiment shown in the figures of this application) from a central source of energy M. The wire 2 shown in Fig. 2 as a common return from the different lock circuits to the battery, is employed as a common return for both the stick circuits and the restoring circuits of the stick relays controlling the circuit controllers 3^y and 3^s. The circuit controller 3^s is controlled by the stick relay 2^s, which operates the stick contact 4^s. When the stick relay 2^s is energized and deënergized, the controller 3^s and the stick contact 4^s operate together. In like manner the stick relay 2^y controls the controller 3^y and also the stick contact 4^y. The stick circuit for the relay 2^s is controlled by a switch 1^s that must be opened before a train moving from left to right in Fig. 1 enters the first track section *a* of the route to be traveled. In like manner, a switch 1^y operated in a suitable way serves to control the stick circuit of the relay 2^y, which controls the circuit controller 3^y. The stick circuit for the relay 2^s passes from battery M through wire 1, switch 1^s, wire *s*, stick contact 4^s, relay coils 2^s, and wire 2 back to battery. The stick circuit for the relay 2^y is from battery M through wire 1, through the coils of the relay, stick contact 4^y, wire *y*, switch 1^y, and wire 2, back to battery.

Restoring circuits are provided for the two stick relays which are controlled by front contacts of all the track relays of the route, in series, so that if any track relay is deënergized and its front contact is broken, the restoring circuit of the stick relays cannot be made for reënergization of the stick relay. In the present embodiment of this invention, the restoring circuits of both stick relays are merged into one and pass from battery M, through wire 1, coils of relay 2^y, wire 20, front contact of track relay 3^a, wire 21, front contact of track relay 3^b, wire 22, front contact of track relay 3^c, wire 23, coils of relay 2^s, and wire 2, back to battery.

The operation of the mechanism shown in Fig. 1, so far as concerns the control of the circuit controllers 3^y and 3^s, is as follows: Before a train enters the first track section *a* of the route, and is moving from left to right, the switch 1^s is opened. This breaks the stick circuit of the relay 2^s, but inasmuch as the restoring circuit for this stick relay is complete, its armature will not be dropped, and the circuit controller 3^s and the stick contact 4^s will not be opened at this time. As soon as the train enters upon the track section *a*, the front contact of the track relay 3^a is broken, which breaks the restoring circuit of the stick relay 2^s, which completely deënergizes said relay, and the contacts controlled thereby will be opened. Now the circuit controller 3^s is opened, as described with reference to Fig. 2, and it cannot be closed again until all the track relays 3^a, 3^b and 3^c of the route are reënergized and all their contacts are closed. In other words, the stick relay 2^s can not be reënergized to close either its stick contact or the controlling contact 3^s, until the train is completely off the route. During the period above described, the stick relay 2^y remains energized, because its stick circuit above described remains closed, and the conditions are exactly as described with reference to the operation of Fig. 2. For trains moving from right to left in Fig. 1, the switch 1^y is opened before the train enters the track section *c*. This breaks the stick circuit through the relay 2^y, and as soon as said train enters on the track section *c*, the restoring circuit of the stick relay 2^y is broken at the front contact of the track relay 3^c, and said restoring circuit remains broken at one of the track relays until the train has passed off the route, and thereupon the stick relay is automatically reënergized and the contacts controlled by it are closed again. For trains moving from right to left on Fig. 1, the stick relay 2^s, remains energized and unaffected by the passage of the train. Thus all the necessary conditions for the actuation of the circuit controllers 3^s and 3^y are fulfilled by the employment of the stick relay mechanism and circuits above described.

The means for preventing the opening of one stick relay, when the other is open, is the interlocking connection between the levers or controllers for the signals at the ends of a route, whereby both signals cannot be set to safety simultaneously, and the stick relay controllers 1^s and 1^y are so controlled that when one is opened, the opening of the other is prevented.

It is probably best to open the switches 1^s or 1^y simultaneously with the setting of the signals S or Y to clear for permitting the train to enter upon the route in the proper direction, but this timing may be varied at will. It is obvious also that the route may be locked from one or more points in advance of the commencement of said route, and from such a distance as may be deemed desirable. This will be obvious if we suppose the switch A in Fig. 1 to be disabled and disused. Thereupon the track section *b* becomes the first track section of the route and the operations occur with reference to it exactly as have been described. So, too, the switches 1^s and 1^y may be controlled from any desired point in advance of the commencement of a route either automatically or otherwise.

The device shown and described above for locking the switch is an ordinary mechanical switch-actuator, provided with an electro-mechanical lock for said actuator. It will be obvious that any means whereby the movement of the switch is prevented upon a change of the electrical condition of the lock-magnet is an equivalent for the specific means herein set forth.

It will be understood by those skilled in the art of railway signaling that in yards, or other places where interlocking switches are installed, and where this invention is useful, there are, invariably, a large number of routes formed by different combinations of the switches of which the yard is composed. In applying our invention to such cases, it is not necessary to provide a complete set of apparatus like that shown in Fig. 1 for each of the possible routes. There will be provided, however, a switch lock like that described as 2^a in Fig. 1 for each of the switches to be protected, and also route lock circuit controllers like 3^y and 3^s of Fig. 1, for the beginning and end of all of the routes to be protected. There will also be provided means like that shown in Fig. 1 for operating the lock circuit controllers, and then, by means of circuit controllers operated in correspondence with the various switches, a complete apparatus for a route like that shown in Fig. 1, will be made up as desired; or, in other words, when the switches are moved so as to form a route, there will be an apparatus for that route arranged exactly like the apparatus shown in Fig. 1. In order to show how this arrangement of route apparatus is made, Figs. 3 and 4 are produced. In these figures a small interlocking plant is represented, which consists of two parallel tracks and two sets of switches connecting these two parallel tracks, with the necessary signals for governing the movements of trains over the various routes provided in such an arrangement. The signals shown in these figures govern the movement of trains over all the possible routes leading from those signals. For example, the signal S governs the movement of a train over the straight track and past the signal Y, or it governs the movement of a train over the switches A, D and past the signal Z, and governs also the movement of trains over the switches A, D, E and C and so past the signal Y. In order to simplify the circuits as much as possible, only the lock circuits are shown in Fig. 3, omitting the circuits which operate and control the lock-circuit controllers. In Fig. 4 are shown only the circuits which operate and control the lock-circuit controllers, omitting the lock circuits. The complete apparatus is composed of the apparatus and circuits shown in both figures. The tracks and switches, however, are the same in both.

In Fig. 3 a switch lock is provided for each of the switches, and lock circuit controllers are provided for the beginning and end of all routes. For example, the lock circuit controller 3^y is the circuit controller for all the routes which begin or end at the signal S, and the lock circuit controller 3^z is the lock circuit controller for all the routes which begin or end at the signal W. In like manner the circuit controller 3^s is the circuit controller for all the routes which begin or end at the signal Y, and the circuit controller 3^w is the lock circuit controller for all the routes which begin or end at the signal Z.

4^A, 4^D &c. are circuit controllers which are operated in correspondence with the switches. They are termed in the art "selector switches". These selector switches select which wires shall compose a circuit. For example, the selector switch 4^A, when the switch is in the normal position, connects wires 4 and 4, but when the switch is in the reverse position, the wires 4 and 40 are connected.

When all the switches of Fig. 3 are in their normal position; that is, set for the train to pass over the straight tracks, there are two routes which are independent of each other. It is obvious therefore that in this installation there must be two complete and independent sets of route apparatus like that shown in Fig. 1, one set for the lower track and one set for the upper track. For the sake of simplicity, the set of apparatus for the lower track has been shown the same as that shown in Fig. 1, and therefore requires no further explanation. In the upper track there are two switches D and E, and two track circuit sections d and e. These track circuit sections have the usual track relays 3^d and 3^e, and the locks 2^d and 2^e are provided for locking the switches D and E in any desired manner. The lock circuit controllers, as before explained, are 3^z and 3^w.

As explained with reference to Fig. 2, the locks 2^d and 2^e may receive current from two possible directions. For example, the lock 2^d may receive current from the battery M, through the wire 1, lock circuit controller 3^z, wire 30, selector switch 4^D in the normal position, wire 40, front contact of track relay 3^d, wire 10, coils of lock 2^d, and wire 2, back to battery. The lock may also receive current from wire 1, circuit controller 3^w, wire 60, selector switch 4^E in the normal position, wire 50, front contacts of track relay 3^e, wire 45, front contact of relay 3^d, wire 10, coils of the magnet 2^d, and wire 2, back to battery. The lock magnet 2^e may receive current from battery M by the way of lock circuit controller 3^z, or it may receive current from the battery M by the way of the lock circuit controller 3^w. The operation of this lock circuit is identical with the operation of the lock circuit of Fig. 1; that is, supposing a train to be running toward the left under the control of signal Z. When it passes on track circuit e, the lock circuit controller 3^z will be opened in the same manner that the lock circuit controller 3^s of Fig. 1 was opened when a train passed on the track circuit a of that figure. The track relay 3^e being demagnetized, and its contacts open, both locks 2^d and 2^e are deprived of current, but when the train is on track circuit d, and entirely off track circuit e, the lock 2^e is again magnetized, receiving its current from the battery M by the way of the lock circuit controller 3^w, and wire 60 &c. Let us assume now that a train is to move from the signal S over switches A and D and on past signal Z. In this case the switches A and D are reversed and the switch E remains in its normal position. The switches to be protected in this route are the switches A, D and E. The switch locks included in this circuit are the locks 2^a, 2^d and 2^e. The track circuit sections included are a, d and e, because these are the track circuit sections over which the train passes in moving over this particular route. The circuit controller at the entrance to the route is 3^y, and the circuit controller at the end of the route is 3^w, and the circuits for the various locks are as follows: Starting from the battery M, wire 1, circuit controller 3^y, wire 3, front contact of track relay 3^a, wire 7, to lock 2^a, and wire 2, to battery; or through the other contact of track relay 3^a, wire 4, selector switch 4^A in the reverse position, wire 40, front contact of relay 3^d, wire 10, to lock 2^d, and wire 2, to battery; or through the other contact of track relay 3^d, wire 45, front contact of relay 3^e, wire 11, to lock 2^e, and wire 2, to battery. These locks also receive current by the way of the lock circuit controller 3^w. It is thus seen that when the route from the signal S past the signal Z is set up, there is a route locking circuit which includes all the switches that it is necessary to protect, and that such route locking circuit is the same in principle as that shown in Fig. 2. The operation of such circuit is, of course, the same, and it is unnecessary to describe it. Suppose now that a train is to be sent from the signal Y over the switches C, E, D and A, out past the signal S. In this case the switches C, D, E and A are reversed, and the switch locks to be included in the circuit are the locks a, e, d and c. The track circuits over which the train passes in taking this route, are the track circuits c, d, e and a. The lock circuit controller at the beginning of the route is 3^s, and the lock circuit controller at the end of the route is 3^y. Under these conditions the lock circuits are as follows: from battery M, wire 1, lock circuit controller 3^s, wire 6, front contact of track relay 3^c, wire 9, to lock 2^c; or through the other contact of track relay 3^c, selector switch 4^c in the reverse position, wire 50, front contact of track relay 3^e, and wire 11 to lock 2^e; or through the other contact of track relay 3^e, wire 45, front contact of track relay 3^d, and wire 10 to lock 2^d; or through the other front contact of track relay 3^d, wire 40, to selector switch 4^A, through that switch in the reverse position, wire 4, front contacts of relay 3^a, and wire 7 to lock 2^a. This circuit furnishes current for all of the locks involved by the way of lock circuit controller 3^s. It will be noted that these same locks may all receive current from the battery M by the way of the lock circuit controller 3^y. It will thus be seen that in whatever position the switches may be arranged for the making up of a route, there will be a route locking circuit established which will comprise the proper switch locks, and these switch locks will be controlled by the proper track circuit sections, exactly as shown in Fig. 2.

As before explained, Fig. 4 shows the stick relay circuits for the route lock circuits shown in Fig. 3. It will be remembered that it was stated in relation to Fig. 1 that the manner in which the lock circuit controller should be operated is as follows: The lock circuit controller at the beginning of the route must be closed and kept closed, while the train is passing over the route; and the lock circuit controller at the end of the route must be opened and kept open, until the train has passed entirely off the route. As in Fig. 1, the stick relay 2^y is made to control the lock circuit controller 3^y, and the stick relay 2^s is made to control the lock circuit controller 3^s. Stick relays 2^w and 2^z are provided for controlling the lock circuit controllers 3^w and 3^z respectively. It will be remembered that the stick relays shown in Fig. 1, each had what is called a stick circuit, and that these stick circuits are controlled by circuit controllers operated in correspondence with the signals. For example, the stick circuit for stick relay 2^s is controlled by circuit controller 1^s, which is operated in correspondence with the signal S. In a like manner, the stick relay 2^y is controlled by a circuit controller 1^y operated in correspondence with the signal Y. It will also be remembered that when a train is to pass over the route under the protection of signal S, the stick circuit for the stick relay 2^s is broken, so that that relay opened the circuit controller 3^s at the end of the route. This may be said to be one of the principles of operating the stick relay. Each stick relay must have a stick circuit and a restoring circuit, and when a stick relay is acting to control the lock circuit controller at the end of the route, its stick circuit must be broken; and also it is obvious that if this lock circuit controller is not to be closed until the route is free, or rather until the train has passed entirely off from it, the restoring circuit of this relay must be controlled by all of the track relays of the track sections composing the route.

Returning now to Fig. 4, the stick relays 2^y, 2^z, 2^w, and 2^s are provided for operating the lock circuit controllers 3^y, 3^z, 3^w, and 3^s, respectively, and there are also provided circuit controllers 1^s, 1^w, 1^z, and 1^y, which are operated in correspondence with the signals S, W, Z, and Y, respectively, and, by means of selector switches, stick circuits and restoring circuits are formed for these stick relays as they are required. For example, suppose in Fig. 4 a train is to pass from signal S over the straight track by signal Y. The stick relays to be operated are the relays 2^y and 2^s. The relay to be held closed is the one at the entrance of the route, which is the relay 2^y, and the one to be opened is at the end of the route, or the stick relay 2^s. These two relays under these conditions must have stick circuits and restoring circuits. The stick circuit for the relay 2^s must be controlled by the signal S, and the stick circuit for the relay 2^y must be controlled by the circuit controller on the signal Y. With the switches A and C in the normal position (as they would have to be for a route from the signal S to the signal Y) the stick circuit for the relay 2^s is as follows: starting from the battery M, to wire 1, circuit controller 1^s, wire *s*, selector 4^A in the normal position, wire *s*, selector 4^C in the normal position, wire *s*, stick contact 4^s, coils of relay 2^s, and wire 2, back to battery; and the stick circuit for the stick relay 2^y is as follows: starting from the battery M, wire 1, coils of relay 2^y, stick contact 4^y, wire *y*, selector switch 4^A in the normal position, wire *y*, selector switch 4^C in the normal position, wire *y*, selector switch 4^C in the normal position, wire *y*, circuit controller 1^y, wire 2, back to battery. The restoring circuit for the relays 2^y and 2^s is as follows: battery M, wire 1, coils of relay 2^y, wire 20, front contact of track relay 3^a, selector switch 4^a in the normal position, wire 21, front contact of relay 3^b, wire 22, selector switch 4^C in the normal position, front contact of relay 3^c, wire 23, coils of stick relay 2^s, and wire 2, back to battery.

Now supposing a train is to pass from signal S out past signal Y. When the signal S is placed in the clear position, the circuit controller 1^s is opened, so that the stick circuit for the stick relay 2^s can no longer act. When the train enters the track circuit *a*, the track relay 3^a is demagnetized, and the restoring circuit for 2^s and 2^y is broken, but the stick circuit for stick relay 2^y is still made, so that this relay is not demagnetized, and the lock circuit controller 3^y is held closed while the lock circuit controller 3^s is opened. The stick relay 2^s cannot be magnetized again until the restoring circuit is completed, and, as before explained, this restoring circuit cannot be completed until the train has passed entirely off the track circuits involved in the route. It will thus be seen that the lock circuit controllers 3^y

and 3^s for this route are controlled under the conditions before described for the operation and control of these circuit controllers. Suppose now that a train is to pass from the signal S by way of the switches A and D and out past the signal Z. The circuit controller at the entrance of the route is the circuit controller 3^y and the circuit controller at the end of the route is the circuit controller 3^w. The stick relays, therefore, to be controlled in this particular route circuit are the relays 2^y and 2^w, and the stick circuit for the relay 2^w must be controlled by the circuit controller which is operated by the signal at the entrance to the route, to wit: the circuit controller 1^s. Under these conditions the switches A and D are reversed, and the stick circuit for the stick relay 2^w is as follows: starting from the battery M, through wire 1, circuit controller 1^s, wire *s*, selector switch 4^A in the reverse position, wire *s w*, selector switch 4^E in the normal position, wire *w*, stick contact 4^w, magnet of relay 2^w, and wire 2, back to battery. Under these conditions there must be also a stick circuit for the relay 2^y, and the circuit must be controlled by the circuit controller operated by the signal Z, to wit: the circuit controller 1^z. This circuit is as follows: starting from battery M, wire 1, coils of relay 2^y, stick contact 4^y, wire *y*, selector switch 4^A in the reverse position, wire *y z*, selector switch 4^D in the reverse position, wire *z y*, wire *z*, circuit controller 1^z and wire 2, back to battery. As before explained with reference to Fig. 3, the track circuits which compose this route are the sections *a*, *d* and *e*. It is obvious, therefore, that the restoring circuit for these stick relays must be controlled by the track relays of these track circuit sections. This restoring circuit is traced as follows: starting from battery M, wire 1, coils of relay 2^y, wire 20, front contact of relay 3^a, selector switch 4^A in the reverse position, wire 34, front contact of relay 3^d, wire 32, front contact of relay 3^e, selector switch 4^E in the normal position, wire 33, coils of stick relay 2^w, and wire 2 back to battery. When the signal S is cleared for a train to pass over this route, and the circuit controller 1^s is opened, the stick circuit for the relay 2^w can no longer act; consequently that relay will be demagnetized when its restoring circuit is opened by the track relay 3^a, and, as before explained, the restoring circuit cannot be completed again until the track circuits involved in the route, to wit: circuits *a*, *d* and *e* are unoccupied. It will thus be seen that as the switches are moved to set up the various routes, there are made at the same time the necessary stick-relay restoring circuits and stick-relay stick circuits, as well as the necessary lock circuits for that particular route, the complete circuit operating in exactly the same manner explained with reference to the complete circuits of Fig. 1.

To anyone skilled in the art and to any skilled electrician, it will be obvious that many changes may be made in the apparatus without departing from the invention. For example, it is obvious that the lock-circuits and the stick-relay circuits may employ common conductors; a ground return may be substituted for metallic return in various circuits; and other means may be employed for controlling the lock-circuits and the controllers thereof.

What we claim is:

1. In a traffic-controlling apparatus, the combination of a series of translating devices connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and its other pole connected to the second conductor by two feed wires which feed current from opposite directions to each translating device; and a circuit controller for a feed wire.

2. In a traffic-controlling apparatus, the combination of a series of translating devices connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and its other pole connected to the second conductor by two feed wires which feed current from opposite directions to each translating device; and a circuit controller for each feed wire.

3. In a traffic-controlling apparatus, the combination of a series of translating devices connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and its other pole connected to the second conductor by two feed wires which feed current from opposite directions to each translating device; a circuit controller for a feed wire; and a circuit controller in the branch running to each translating device.

4. In a traffic-controlling apparatus, the combination of a series of translating devices connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and its other pole connected to the second conductor by two feed wires which feed current from the opposite directions to each translating device; a circuit controller for the feed wire; a circuit controller in the branch running to each translating device; and a circuit controller in the second conductor operated simultaneously with any one of the last-mentioned circuit controllers.

5. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; a series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other

pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; and means for breaking the branch circuit to each lock mechanism by a track-circuit mechanism.

6. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; a series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; means for breaking the branch circuit to each lock mechanism by a track-circuit mechanism; and means for breaking the circuit in the second conductor by any one of said track-circuit mechanisms.

7. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; a series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; means for breaking the branch circuit to each lock mechanism by a track-circuit mechanism; and means for breaking the circuits to all of the lock mechanisms by the presence of a train on the first track section of a route.

8. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; a series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; means for breaking the branch circuit to each lock mechanism by a track-circuit mechanism; and means for closing the circuits to the lock mechanisms of a route successively as the train passes off one track-section after another.

9. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms and a series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; and means for operating each lock mechanism independently by a particular track-section of a route.

10. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms, an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; and means for preventing the opening of one lock-circuit controller so long as the other is open.

11. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms, an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; means for opening one of said lock-circuit controllers by the entrance of a train on the first track-section of a route; and means for preventing the closing of said lock-circuit controller while the train is on said route.

12. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; and means for breaking and keeping broken the lock-circuit controller for the end of a route while a train is on the route.

13. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; means for breaking and keeping

broken the lock-circuit controller for the end of a route while a train is on the route; and means for closing and keeping closed the lock-circuit controller for the beginning of said route while a train is on said route.

14. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; a series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors and the other pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in a feed wire; and means for operating said lock-circuit controller comprising a relay having two circuits, one controlled by the track-circuit mechanism of a route, and the other by the relay itself; and a circuit controller in the last-mentioned circuit.

15. In a traffic-controlling apparatus, a route-control mechanism comprising a series of rail-switch mechanisms; a series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the said locks being connected in multiple between two conductors; a source of energy having one pole connected to the second conductor by two feed wires which feed current from opposite directions to each lock mechanism; a lock-circuit controller in each feed wire; and means for operating each lock-circuit controller comprising a relay having two circuits, one controlled by the track-circuit mechanism of a route, and the other by the relay itself; and a circuit controller in the last circuit.

16. In a traffic-controlling apparatus, a route-control mechanism comprising two series of rail-switches, two series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the locks of each series being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors of each series and having the other pole connected to the second conductor of each series by two feed wires which feed current from opposite directions to each lock mechanism of the series; a lock-circuit controller in each feed wire; means for operating the lock-circuit controllers; and means for connecting the second conductors of each series to operate locks of both series in combination.

17. In a traffic-controlling apparatus, a route-control mechanism comprising two series of rail-switches; two series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the locks of each series being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors of each series and having the other pole connected to the second conductor of each series by two feed wires which feed current from opposite directions to each lock mechanism of the series; a lock-circuit controller in each feed wire; means for operating the lock-circuit controllers; means controlled by the rail-switch mechanisms of a route for connecting the second conductors of each series to operate locks of both series in combination corresponding to the route.

18. In a traffic-controlling apparatus, a route-control mechanism comprising two series of rail-switches, two series of track-circuit mechanisms; an electric lock for each rail-switch mechanism, the locks of each series being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors of each series and having the other pole connected to the second conductor of each series by two feed wires which feed current from opposite directions to each lock mechanism of the series; means for connecting the second conductors of each series to operate locks of both series in combination; a lock-circuit controller in each feed wire; means for operating each lock-circuit controller, comprising a relay having two circuits, one controlled by the track-circuit mechanisms of a route, and the other by the relay itself; a circuit controller in the last mentioned circuit of each relay; and means for connecting the circuits of different relays to control lock-circuit controllers in combination.

19. In a traffic-controlling apparatus, a route-control mechanism comprising two series of rail-switches; two series of track-circuit mechanisms; an electrical lock for each rail-switch mechanism, the locks of each series being connected in multiple between two conductors; a source of energy having one pole connected to one of the conductors of each series and having the other pole connected to the second conductor of each series by two feed wires which feed current from opposite directions to each lock mechanism of the series; means for connecting the second conductors of each series to operate lockt of both series in combination; a lock-circuis controller in each feed wire; means for operating each lock-circuit controller, comprising a relay having two circuits one controlled by the track-circuit mechanisms of a route, and the other by the relay itself; a circuit controller in the last-mentioned circuit of each relay; means controlled by the switch mechanisms of a route for connecting the circuits of different relays to control lock-circuit controllers in combination corresponding to said route.

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Witnesses:
S. M. Day,
R. Balconer.