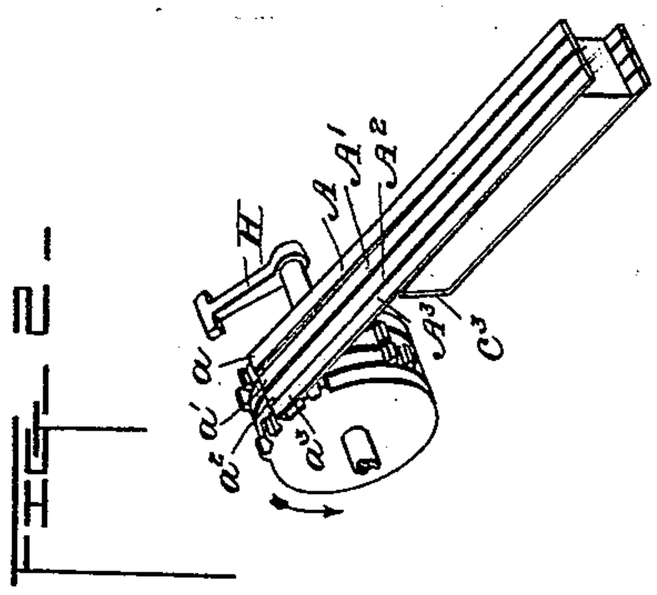
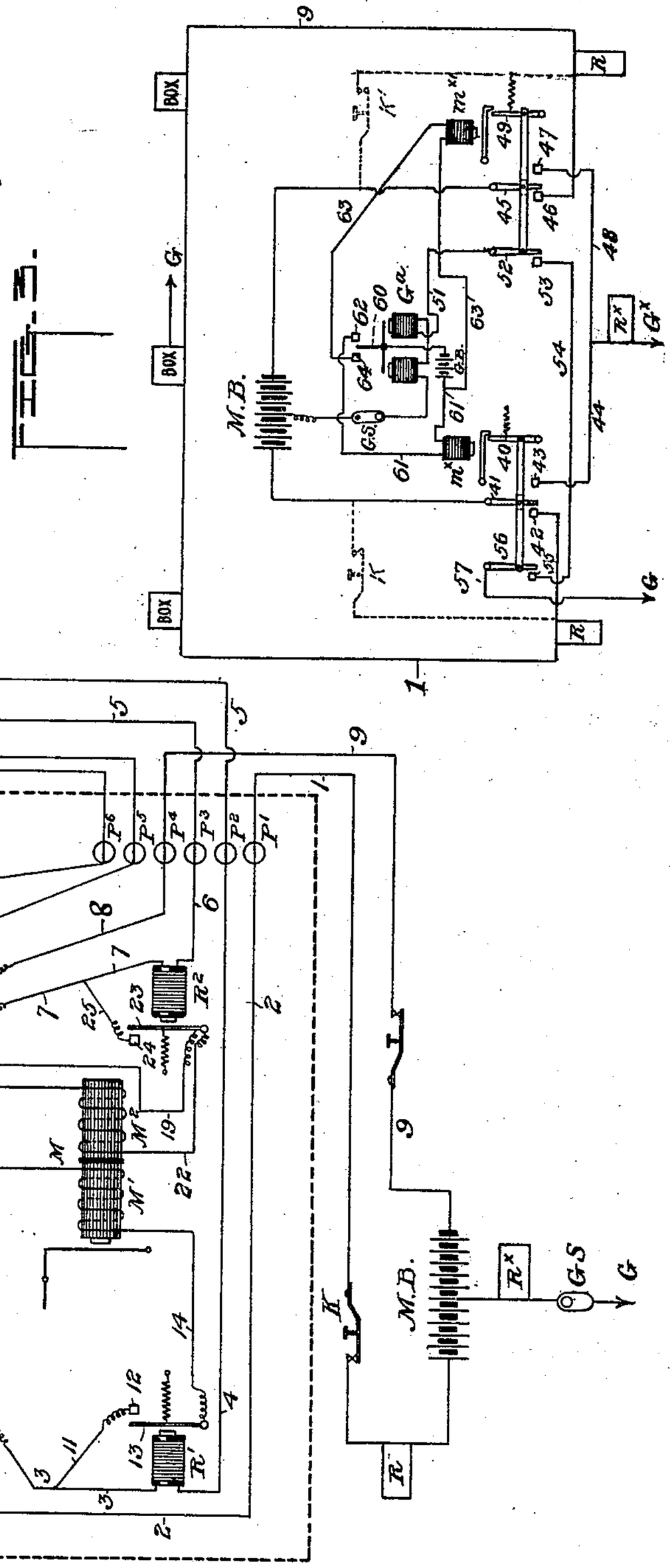
(No Model.)

J. P. McMAHON.

ELECTRICAL ALARM SYSTEM.

No. 459,591. Patented Sept. 15, 1891.





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ELECTRICAL ALARM SYSTEM.

SPECIFICATION forming part of Letters Patent No. 459,591, dated September 15, 1891.

Application filed January 24, 1891. Serial No. 378,926. (No model.)

To all whom it may concern:

Be it known that I, JOHN P. McMAHON, of Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Electrical Alarm Systems, of which the following is a specification.

The objects of my invention are to simplify and improve electrical alarm systems such as that described in my patent, No. 416,483, dated December 3, 1889, reducing still further the possibility of derangement of the system and reducing materially the cost of establishing the system.

The general objects of the improved system are the same as those of the previously patented system—namely, to indicate the exact location of the fire or other cause of the alarm; to insure the transmission of the alarm-signal whether the line connecting the building to be protected with the central office is broken, grounded, or short-circuited, and whether the wires in the building are broken or grounded; to indicate in the central office the existence of any such trouble with any part of the system; to distinguish absolutely between true alarms and trouble-alarms, and to prevent absolutely the transmission of false alarms.

The essential parts of the system are, first, a main circuit having ground branches in the protected building and in the central office with suitable receiving-instruments, which may be such as those described in my said patent, in the central office; second, a signal-box located at the building protected; third, circuit-controllers which may be of the push-button or other similar type or thermostats, such as are shown in my said patent; fourth, the system of wires connecting the circuit-controllers with the signal-box and with the central office.

The present invention relates particularly to the signal-box and its connections with the circuit-controllers and the main circuit, and to the devices in the central office, whereby, under certain conditions, the battery may be grounded automatically at one end or the other. The signal-box comprises, essentially, a motor which may be substantially like the motor described in my said patent, and need not be further described herein, a controlling-magnet therefor, a breaker or breakers actuated thereby, certain other magnets or relays, and a switch. The central-office apparatus comprises, essentially, receiving-instruments in the circuit and a source of electrical supply, such as a battery, other devices being employed for certain purposes, as hereinafter described.

In the accompanying drawings, Figure 1 is a diagrammatic representation of a complete system, the parts located in the box being inclosed by a heavy dotted line and the system being shown as adapted for a building with but two stories or sections. Fig. 2 is a view of the break-wheel and its breakers in proper relation, the same being separated in Fig. 1 for the sake of clearness; and Fig. 3 is a diagrammatic representien of the devices which may be employed in the central office to ground the battery at one end or the other when a ground is thrown on the system by a circuit-controller.

The devices represented in Fig. 3 have been shown and described by themselves for the sake of clearness; but it is to be understood that in practice they take the place of the merely essential instruments in the central office. (Indicated in Fig. 1.)

The receiving-instruments at the central office may consist of a relay R in the main circuit and a relay $R^{\times}$ in the ground branch, the said branch extending, preferably, from the middle of the battery MB, through the coils of said relay, and through a switch GS to the ground. The main line extends from the one pole of the battery to and through every building on the circuit back to the other pole of the battery.

The transmitting device in the box may be constructed substantially as the corresponding device in my said patent, consisting of a series of brushes $a\ a'\ a^2\ a^3$, mounted upon a block of insulating material and resting against contacts $c\ c'\ c^2\ c^3$ and a break-wheel adapted to break the contact between the brushes and the contacts. The break-wheel is composed of a series of disks mounted upon a common shaft and insulated from said shaft and from one another The first and last disks of the series are provided with teeth arranged in such relation as to indicate the number of the box. The intermediate disks are provided with teeth to indicate the several stories or sections of the building.

At each building the leg 1 of the main line is brought to the binding-post P′ of the signal-box. Thence the circuit is continued by wire 2, brush a of breaker A, contact c, wire 3, coils of magnet or relay R′, and wire 4 to binding-post P^2. From binding-post P^2 it passes by wire 5 through all the stories of the building over the normally-closed contacts m^o m^o of all the circuit-controllers T′ T^2, back to the box at binding-post P^3. It is then continued by wire 6, coils of magnet or relay R^2, wire 7, brush a^3 of breaker A^3, contact c^3, and wire 8 to binding-post P^4, to which is connected the other leg 9 of the main line. So long as the system is in normal condition a continuous path is thus provided for the current, and the relays R′ and R^2 are continuously energized and their armatures held attracted. Any interruption of the continuity of this circuit, whether by an accidental break in the main line or in the wire 5 or by the interruption of the path 5 by the operation of a circuit-controller or by the short-circuiting of the main line outside of the signal-box, will cause these relays to be de-energized and their armatures to fall against their back contacts. This provides a new path for the current over the coils of the controlling-magnet M, as described below. A wire 11 leads from the wire 3 to the back contact 12 of the relay R′. From the armature 13 connection is made by the wire 14 with the coils M′ of the differential controlling-magnet M, and thence by wire 15, switch S, wire 16, armature 17 of magnet or relay R^3, its back contact 18, and wire 19 to armature 23 of relay R^2, back contact 24, wire 25, wire 7, breaker A^3, and wire 8 to binding-post P^4 and the return-leg 9 of the main line. A second path is also provided for the current from a point x in wire 15 by wire 21, coils M^2 of the differential controlling-magnet M, wire 22, armature 23, back contact 24 of relay R^2, wire 25, wire 7, breaker A^3, and wire 8 to binding-post P^4 and the return-leg 9 of the main line. However, owing to the resistance offered by the coils M^2, the current will take the path first described and the magnet M will be energized, the motor released, and the box-number will be transmitted to the central office. Upon some moving part of the motor, preferably upon the shaft of the break-wheel, is mounted an arm H, which, upon the completion of one rotation of the shaft, is adapted to open the switch S, thereby breaking the path first above described and compelling the current to take the second path over the coils M^2 of the differential controlling-magnet M. This magnet is a differential magnet of usual form and may be composed of two coils M′ and M^2, wound in the same direction upon a common core, whereby when current passes over both coils in opposite directions the magnet will be neutralized, and when the current passes in the same direction one coil will re-enforce the other. When, therefore, the switch S is opened and the current is compelled to take the second path above referred to, the controlling-magnet M is neutralized, its armature released, and the motor stopped after one round of the box-number has been sent in to the central office. The action just described takes place when the path offered by the wire 5 is interrupted. If a break occurred in the main line outside of the box, no current would pass over the magnet M and the motor would not be started; but such break would be indicated by a continuous opening of the relay R. If the building were short-circuited, the motor would not be started; but the existence of a short circuit would be indicated by a galvanometer at the central office by reason of the subtraction from the line of the resistance of the building and the relays in the box. At the same time the system will remain operative under all of these three conditions to transmit a true alarm (as distinguished from these trouble-alarms) from a circuit-controller should the occasion therefor arise, as will appear hereinafter. It will also be observed that, notwithstanding a break in the path 5, the continuity of the circuit is preserved, so that the condition of one building upon the circuit will not affect the operativeness of the other boxes on the same circuit. From a point x' on the wire 15 runs a wire 31 through the coils of relay R^3 and having by a wire 31′ a common connection with one side, as the brushes a' a^2 of all the breakers A′ A^2. One of these breakers may be provided for each story or section of the building to be protected and from the other side, as the contacts c' c^2 of each of these breakers runs a wire 32 33 to one side of the normally-open contacts n n of the circuit-controllers T′ or T^2 of the corresponding story or section of the building. From the other side of the normally-open contacts of each group of circuit-controllers (a single circuit-controller being represented in the drawings) connection is made to the ground, as by a wire 34. The action of a circuit-controller, as will be understood, is to close the normally-open ground branch, including its respective story-breaker A′ or A^2 and under certain conditions to throw this ground onto the main line over the controlling-magnet, release the motor, and cause the signal to be transmitted to the receiving-instrument in the ground branch at the central office, which signal consists of the box-number, followed by the story-number, repeated as many times as the break-wheel is allowed to rotate. While the system remains in normal condition this ground will not be thrown upon the main line, its path being broken between the back contacts 12 24 and their respective armatures 13 23. The path will be completed for this ground, however, whenever the relays (either or both) are de-energized, whether by a break in the path 5 or by a break in the main line or by a short-circuiting of the building. In the first case, a break in the path 5 having been indicated previously by

one round of the box, as described, the magnet M will be again energized and a true alarm will be sent into the central office. This ground being continuous, the alarm, consisting of the box-number, followed by the story-number, will be repeated until the motor is stopped, preferably at the end of the fourth complete rotation of the break-wheel, by some such means as are fully described in my said patent. Thus a true alarm may be sent in after a break has occurred in the path 5 and while the break remains unrepaired, and will be known as a "true alarm" from the fact that it consists of three full rounds after the one round which indicated the break. In the case above described current is compelled, by the breaking of the path 5, to flow over the coils M′ of the controlling-magnet and so release the motor, the ground having nothing to do with the action until after the completion of the first round. As before described, the switch S is opened and the path 16 broken at the completion of the first round, and if the ground is then completed it must of necessity flow over the coils of the controlling-magnet. Previous to the releasing of the motor, however, the ground, if it came on under certain conditions, as a break in the leg 1 of the main line, might find a path to the other ground by way of the wire 16 without passing over the controlling-magnet. Therefore it is desirable to break the path 16 19 whenever one of the normally-open ground branches in the building is completed. To that end I interpose in the connection between the circuit-controllers and the controlling-magnet a magnet or relay, as R^3, the armature 17 of which, with its back contact 18, (or it might be a breaker actuated by the armature,) normally completes the path from wire 16 to wire 19, the said magnet normally having no connection with the main circuit or with the ground. As soon as the ground comes on the armature 17 will be attracted and the possible path 16 19 will be broken, compelling the ground-current to flow over the controlling-magnet. In the event of the building being short-circuited the armatures 13 and 23 will fall against their back contacts (the relays being de-energized) and the ground-current coming on, as described, will flow over the coils of the controlling-magnet. The signal thus transmitted will consist of four rounds of the box-number followed by the story-number and will be received upon the receiving-instrument in the ground branch at the central office. In the event of a break in the leg 1 of the main line both armatures 13 and 23 will fall against their back contacts, as before, and the ground-current thrown on by a circuit-controller will take the path 21 from the point *x* over the coils M^2 of the controlling-magnet by wire 22, armature 23, back contact 24, wire 25, breaker A^3, wire 8, leg 9 of main line, and its included battery to earth at the central office. The full four rounds of the box-number, followed by the story-number, will be transmitted and will be received on the instrument in the ground branch at the central office and on any instrument which may be in the leg 9 of the main line. In the event of a break in the leg 9 of the main line a ground-current thrown on by a circuit-controller will take a corresponding path over the leg 1, which need not be further described herein. In the case of a true alarm, when the system is in normal condition, or of a true alarm following a break in the path 5, the ground thrown on by a circuit-controller finds current passing over both coils of the controlling-magnet in opposite directions and the said magnet neutralized. In the case of a short-circuiting of the building the ground so thrown on finds the current of the main line flowing over the main line, but shunted from the controlling-magnet. In either case, under certain conditions, as when the resistance of the main line on one side of the ground is about equal to the resistance of the line on the other side, it is desirable to cause the current to flow over one leg only of the main line when the ground is thrown on. Hereinafter I describe certain means for accomplishing this automatically; but the same end can be reached by breaking the main line in the central office by a key, as K. The existence of a ground anywhere on the system is made known at the central office by the closing of the relay or the corresponding action of some other receiving-instrument in the ground branch in the central office. It would therefore be the duty of the operator in the central office whenever he receives the indication of a ground to open the key K for a moment. If the indication thereafter received is continuous, he will know that a foreign ground has been thrown on the system; but if the ground exists on one of the wires 33 in the building the ground-current established by one-half of the battery will flow over one coil or the other of the controlling-magnet and release the motor, and the current will be alternately broken and completed by the transmitting device, giving a corresponding signal at the central office. The key K, it will be understood, is opened only long enough to allow the motor to start. If the ground is thrown on the wire 33 by the operation of a circuit-controller of the class represented in the drawings, the path 5 is broken at the same time, the armatures of relays R′ and R^2 fall back, the ground-current continues to pass over the controlling-magnet, and the motor will continue to run until four rounds of the signal (a true alarm) have been given. On the other hand, if the ground is thrown on the wire 33 by an accidental crossing with some other grounded conductor the path 5 remains intact. Therefore as soon as the key K is released and the main circuit completed thereby the armatures of the relays R′ and R^2, which fell back when the circuit was broken by opening the key, will be attracted, and the path from the ground in the building

to the main line will be broken. Consequently the motor will stop at the end of the first round, and the fact, as well as the exact location of the accidental ground on a ground branch in a building, will be indicated at the central office. The signal will be distinguished clearly from that caused by an accidental break in the path 5 by reason of the fact that it consists of the box-number followed by the story-number, while the latter consists of the box-number alone. Thus it becomes possible at any time to test from the central office the condition of the ground branches in the buildings, for upon the opening of the main circuit at the key a foreign ground on any of such branches would at once declare itself. In case of a foreign ground coming on the system elsewhere than on the wire 33, as by the crossing of a telephone-wire, the office ground will be removed by opening the switch GS, and the system will be operative over the metallic circuit and over the new ground circuit which may be established between the foreign ground and the ground thrown on by a circuit-controller, as fully explained in my said patent.

It is sometimes desired that the section or story of a building in which the alarm originates should be indicated visually at the signal-box. To this end I may include in the path from each story-breaker to the ground an annunciator-magnet $m' m^2$, &c. When the ground is completed by a circuit-controller, the armature of this magnet will be held attracted and so indicate visually the exact location of the cause of the alarm. It is obvious that each one of such story-magnets might be made to do the work of the relay R^3, and so enable the use of an extra relay to be dispensed with. Normally these story-magnets are not connected with the main circuit or with the ground.

I have herein indicated the circuit-controllers as of the kind shown in my said patent; but it is obvious that the normally-closed contacts and the normally-open contacts might be separately located if convenience should render it desirable, the result being the same—namely, to break the path 5 and to complete the ground branch at the proper time.

As stated above, it is desirable under certain conditions to ground the battery at one end or the other when a ground is thrown on by a circuit-controller. To accomplish this automatically is the object of the means described below. One end of the battery MB is connected to a movable contact 41, which may be either a pivoted or a spring strip and which rests normally against a stop 42, to which is brought the leg 1 of the main line. By means hereinafter described the contact 41 may be moved to a stop 43, which is connected by wire 44 with the ground $G^{\times}$. The other end of the battery has similar connections over contact 45 and stop 46 with the leg 9 of the main line or by stop 47 and wire 48 with the ground $G^{\times}$. The common ground branch may include a receiving-instrument $R^{\times}$. The ground branch from the middle of the battery includes a switch GS and a magnet, preferably in the form of a differential galvanometer or other equivalent device G^a. It then passes by wire 51 to movable contact 52, stop 53, wire 54, stop 55, movable contact 56, and wire 57 to the ground G. The movable contacts 41 56 are actuated or released by a drop 40, as indicated, and the contacts 45 52 by a drop 49. The said drops are under the control, respectively, of the magnets $m^{\times}$ and $m^{\times'}$. The galvanometer-needle 60 is connected with one end of the battery GB. Thence connection is made by wire 61 through the coils of the magnet $m^{\times}$ with the stop 62 for the end of the needle. Connection is also made by wire 63 through the coils of the magnet $m^{\times'}$ with the other stop 64 for the end of the needle. When there is no ground upon the system other than the office ground G, the galvanometer is not affected; but if another ground is thrown on it will take the shortest path to the office ground over one half or the other of the battery MB. The needle will then be deflected to one side or the other, completing the circuit through magnet $m^{\times}$ or $m^{\times'}$ and releasing the corresponding drop. The effect of this, as will be seen readily, will be to break the ground from the middle of the battery at the point 53 or 55, to break the main line at the point 42 or 46, and to connect the other end of the battery with the ground from the point 43 or 47. Thus, if the leg 9 of the main line be broken and a ground comes on, the ground branch from the middle of the battery will be broken at the point 53, ground connection will be completed for the corresponding end of the battery, and the battery will be thrown on the leg 1 of the main line. In case of a short-circuiting of a building the ground subsequently thrown on by a circuit-controller will take the path of least resistance to the office ground, the galvanometer will be deflected, and one leg of the main line will be broken, while the battery will be thrown on the other. When a foreign ground occurs, indicated by continuous action of the receiving-instrument in the ground branch, the office ground is disconnected and the system operates as described in my said patent for like conditions.

It may be desirable to leave the breaking of the main circuit to be done by the operator rather than automatically, as described above. In that case the two legs of the main circuit, after passing through the relays RR, are connected directly to the poles of the battery over keys K and K′, as indicated by dotted lines in Fig. 3.

I claim—

1. The combination of a main circuit, a transmitting device having a series of breakers, a controlling-magnet therefor, a connection between one side of all of said breakers

and said circuit, said connection including the said magnet, and a separate ground branch from the other side of each of said breakers, substantially as described.

2. The combination of a main circuit, a ground branch, a transmitting device having a series of breakers, a controlling-magnet therefor, a connection between one side of all of said breakers and said circuit, said connection including said magnet, a separate ground branch from the other side of said breakers, and a circuit-controller in each of said ground branches, substantially as described.

3. The combination of a main circuit, a ground branch therefrom, a transmitting device comprising a series of breakers, there being one breaker in each leg of said circuit and the intermediate breakers being connected on one side to said circuit between the two breakers first referred to, and a separate ground branch from the other side of said intermediate breakers, substantially as described.

4. The combination of a main circuit, a ground branch therefrom, a transmitting device comprising a series of breakers, there being one breaker in each leg of said circuit, and the intermediate breakers being connected on one side to said circuit between the two breakers first referred to, a separate ground branch from the other side of said intermediate breakers, and a circuit-controller in each of said last-named branches, substantially as described.

5. The combination of a main circuit, a motor, a differential controlling-magnet, a shunt from one leg of said circuit to the other, including one member of said magnet, a switch in said shunt, adapted to be opened by said motor, and a path from said shunt between the magnet and the switch to said other leg of the main circuit and including the other member of said magnet, substantially as described.

6. The combination of a closed metallic circuit including a battery, a ground branch from said battery, a differential magnet having both its members included in the circuit with said battery, a normally-open ground branch from a point on said circuit between the members of said magnet, and a circuit-controller in said branch, substantially as described.

7. The combination of a metallic circuit, a ground branch therefrom, a circuit-breaker therein, a motor for actuating said breaker, a differential controlling-magnet for said motor, having both its members included in said circuit, and a normally-open ground branch from said circuit between the members of said magnet, substantially as described.

8. The combination of a metallic circuit, a ground branch therefrom, a differential magnet having both its members included in said circuit, a normally-open ground branch from said circuit between the members of said magnet, a circuit-breaker in said branch, and a motor for actuating said breaker, controlled by said magnet, substantially as described.

9. The combination of a main circuit, a ground branch therefrom, a differential magnet, a shunt from one leg of said main circuit to the other, including one member of said magnet, a circuit-breaker in said shunt, a path from said shunt between the magnet and the circuit-breaker to said other leg of the main circuit and including the other member of said magnet, and a ground branch between the members of said magnet, including a relay adapted to operate said circuit-breaker, substantially as described.

10. The combination of a main circuit, a transmitting device and its motor, a controlling-magnet therefor, a relay, as R′, in said circuit, and connections from the armature of said relay to said circuit on one side of said relay and from the back contact of said armature to said circuit on the other side of said relay, said connections including said controlling-magnet, substantially as described.

11. The combination of a main circuit, a transmitting device and its motor, a controlling-magnet therefor, a relay, as R′, in said circuit, contacts controlled by said relay, connections from one of said contacts to said circuit on one side of said relay and from the other of said contacts to said circuit on the other side of said relay, said connections including a controlling-magnet, and a switch adapted to be shifted by said motor, substantially as described.

12. The combination of a main circuit, a ground branch therefrom, a transmitting device, a controlling-magnet therefor, a relay, as R′, in said circuit, contacts controlled by said relay, connections from one contact to said circuit on one side of said relay and from the other contact to said circuit on the other side of said relay, and including said controlling-magnet, and a branch from said last-named connection to the ground, substantially as described.

13. The combination of the main line, a ground branch therefrom, a building-wire, as 5, including a series of closed-contact circuit-controllers, a magnet, as R′, in the connection between said main line and building-wire, a normally-open branch from said main line on one side of said series of circuit-controllers to said main line on the other side thereof, a ground connection including a circuit-controller from said normally-open branch, and means controlled by said magnet to close said normally-open branch, substantially as described.

14. The combination of the main line, a building-wire, as 5, including a series of closed-contact circuit-controllers, a magnet, as R′, in the connection between said main line and said building-wire, a normally-open branch from said main line on one side of said series of circuit-controllers to said main line on the other side thereof, a magnet, as

M′, in said branch, and means controlled by said first-named magnet to close said branch, substantially as described.

15. The combination of a main circuit, a signaling mechanism, a differential controlling-magnet for said mechanism included in said circuit, a normally-open ground branch from said circuit between the members of said magnet, a battery in said circuit, a movable contact and stop therefor, one being connected to one end of said battery and the other to the ground, a ground branch from said battery, a magnet included in said branch, and means controlled by said magnet to shift the movable contact to said stop, substantially as described.

16. The combination of a main circuit including a battery, a movable contact and stop therefor, one being connected to one end of said battery and the other to the ground, a ground branch from said circuit including a movable contact, a magnet in said ground branch, and means controlled by said magnet to shift the first-named contact to said grounded stop and to shift the second-named contact to break the magnet-ground, substantially as described.

17. The combination of a main circuit, a signaling mechanism, a differential controlling-magnet for said mechanism included in said circuit, a normally-open ground branch from said circuit between the members of said magnet, a battery in said circuit, a movable contact in the connection between the main line and the battery, a ground branch from said battery, a magnet in said ground branch, and means controlled by said magnet to shift the movable contact to break the connection between the line and the battery, substantially as described.

18. The combination of a main circuit including a battery, a normally-open ground for each end of said battery, a ground branch from the middle of said battery, a magnet in said ground branch, and means controlled by said magnet to close one or the other of said normally-open grounds, substantially as described.

19. The combination of a main circuit including a battery, a movable contact in the connection between each end of the battery and the main line, a grounded stop for each contact, a ground branch from the middle of the battery, a magnet in said ground branch, a movable contact in said ground-branch corresponding to each of said first-named movable contacts, and means controlled by said magnet to shift one set or the other of said contacts, substantially as described.

In witness whereof I have hereunto set my hand.

JOHN P. McMAHON.

Witnesses:

GEORGE DANA WHITE,

EDWARD A. GREELEY.