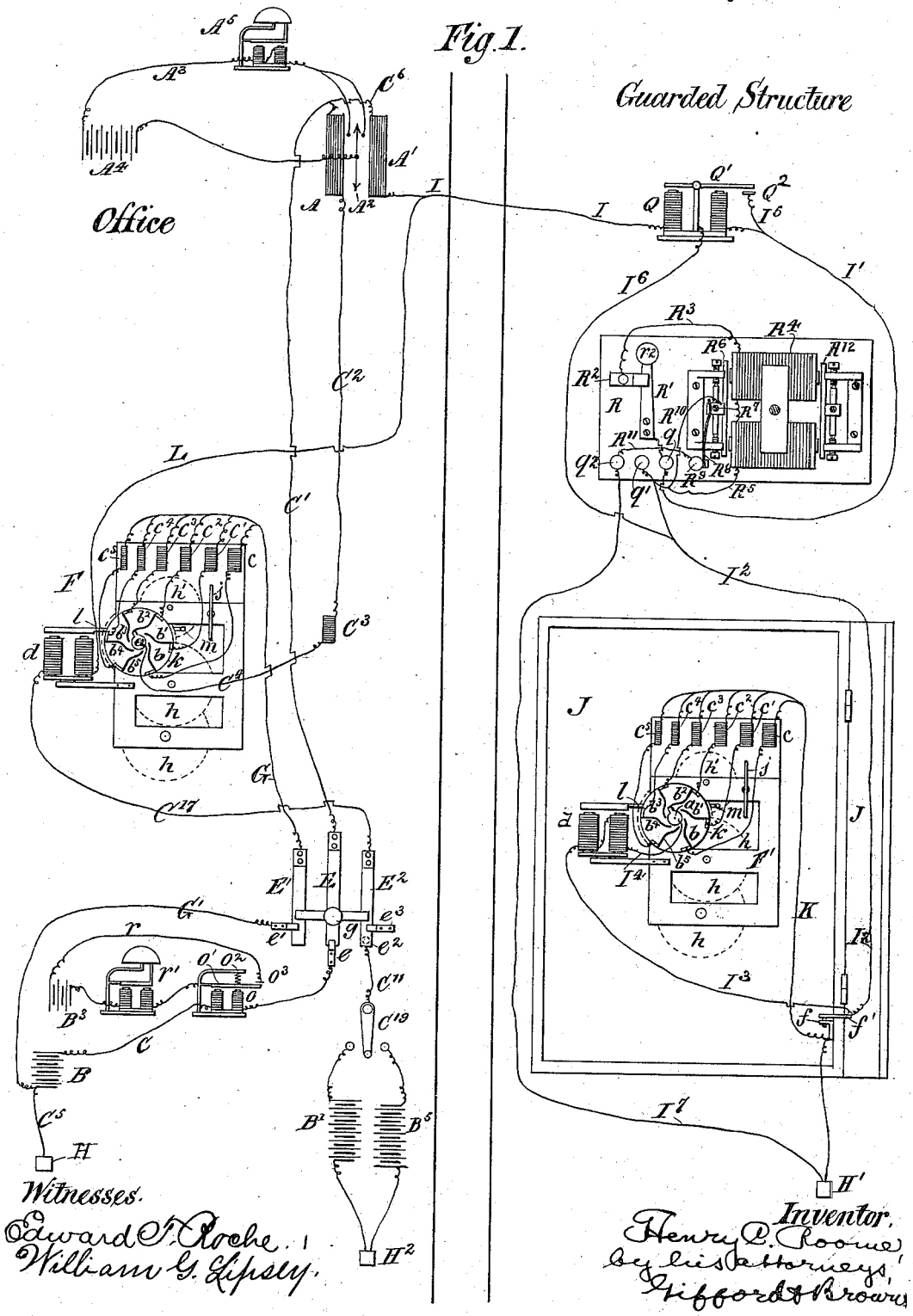
(No Model.) 4 Sheets—Sheet 1.

H. C. ROOME.

ELECTRIC BURGLAR ALARM.

No. 382,439. Patented May 8, 1888.

Fig. 1.



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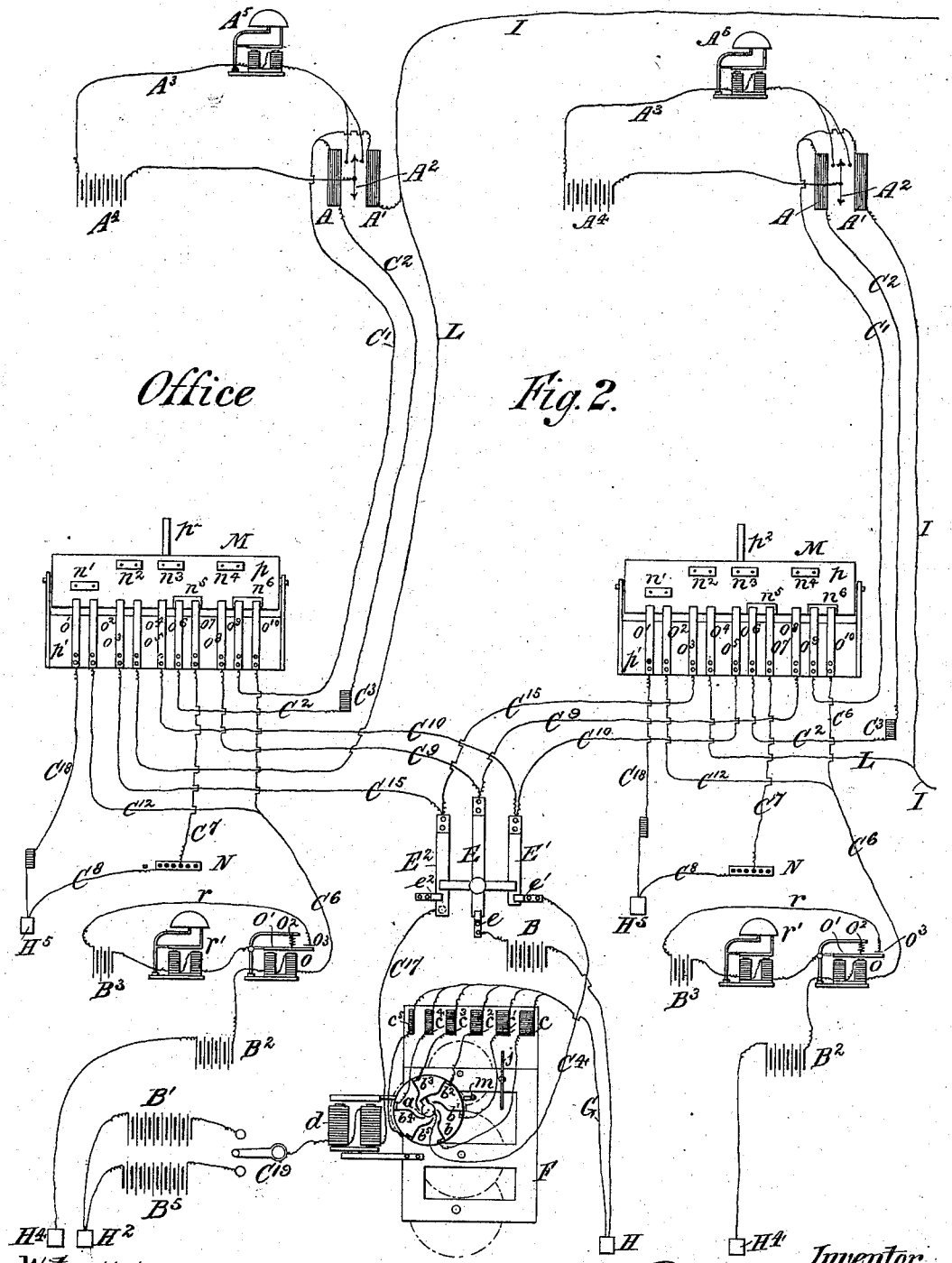

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(No Model.) 4 Sheets—Sheet 3.

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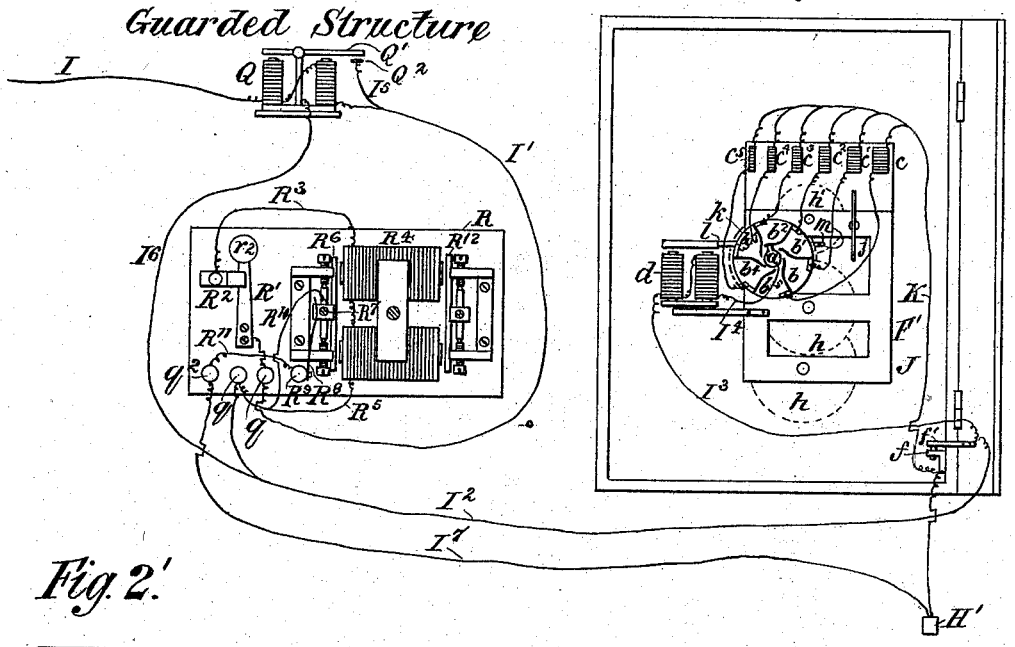
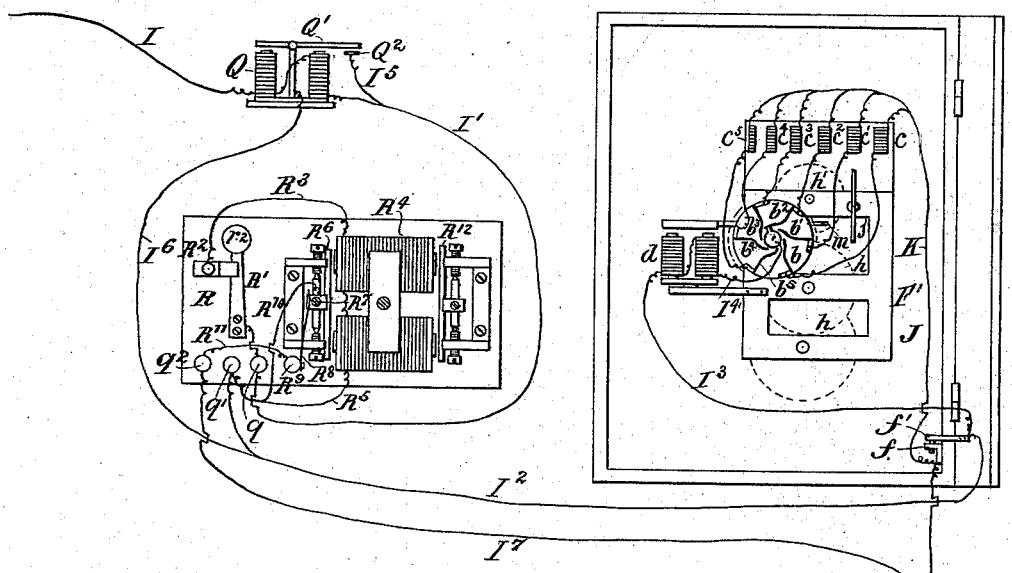


Fig. 2'.

Guarded Structure



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(No Model.) 4 Sheets—Sheet 4.

H. C. ROOME.

ELECTRIC BURGLAR ALARM.

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Fig. 3.

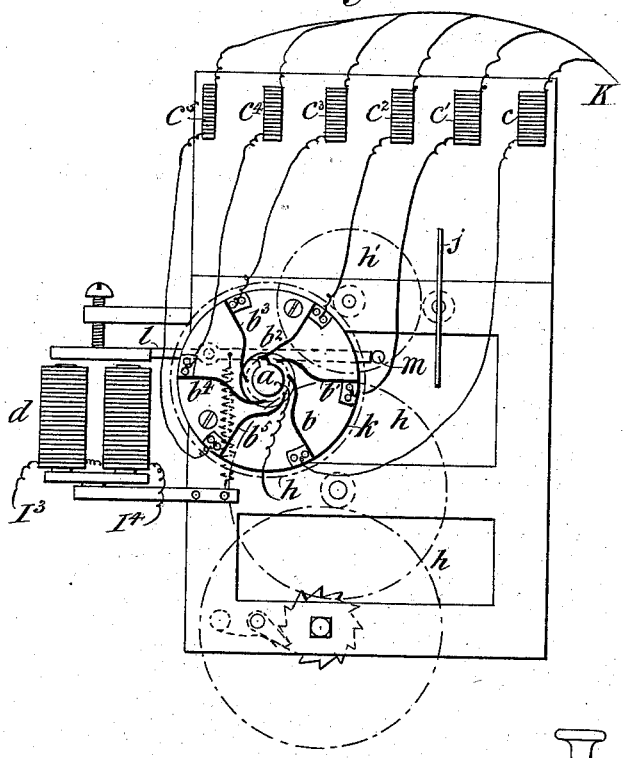


Fig. 5.

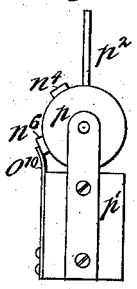


Fig. 6.

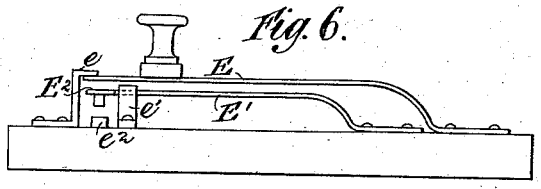
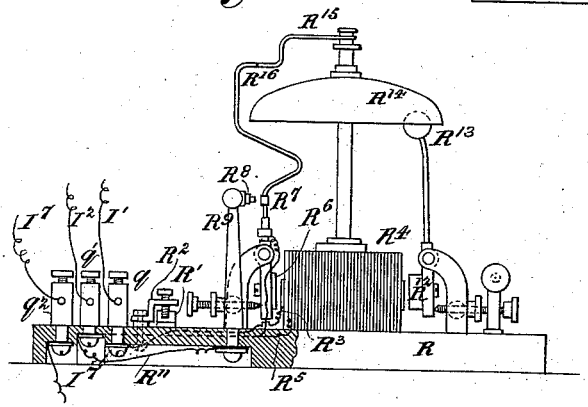


Fig. 4.



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UNITED STATES PATENT OFFICE.

HENRY C. ROOME, OF JERSEY CITY, NEW JERSEY.

ELECTRIC BURGLAR-ALARM.

SPECIFICATION forming part of Letters Patent No. 382,439, dated May 8, 1888.

Application filed September 15, 1884. Serial No. 143,063. (No model.)

To all whom it may concern:

Be it known that I, HENRY C. ROOME, of Jersey City, in the county of Hudson and State of New Jersey, have invented a certain new and useful Improvement in Electric Burglar-Alarms, of which the following is a specification.

This improvement relates to electric burglar-alarms of the kind wherein electric circuits extend between a number of buildings, which I shall herein refer to as "guarded structures," and an office where watchmen are kept, means being employed to indicate at the office any attempt which may be made to gain access to the guarded structures.

An important object of the improvement is to more effectually preclude the tampering with the electric circuits aforesaid in such manner as to interfere with the transmission of an alarm to the office on an attempt to gain access to a guarded structure being made.

In order to facilitate a clear understanding of my improvement, I shall designate the circuits within the office as "internal" circuits and the circuits extending to and through the guarded structure as "external" circuits.

The improvement partly consists in the combination, in an electric burglar-alarm comprising an internal circuit and an external circuit, of a mechanism at a guarded structure, whereby a number of different resistances may be successively thrown into the external circuit by means of increasing at the office the electric current passing through the circuits, a mechanism at the office, whereby on the increasing of the electric current a number of corresponding resistances will be thrown into the internal circuit, and means located at the office and serving to give an alarm there in case the external circuit is tampered with in an attempt to gain access to the guarded structure. By this feature of my improvement the resistances of the several external circuits extending to and through guarded structures may by a watchman at the office be from time to time changed without occasioning the sounding of any alarm at the office. Obviously the burglar-alarm will thus be rendered incalculably more safe, because even if burglars should by the treachery of a clerk or servant employed at a guarded structure or otherwise ascertain the amount of resistance in the structure at the time the same is closed they cannot rely on the amount of resistance being the same when the attempt to gain access to the structure is made; and, furthermore, because even if the resistance which is in the external circuit at the time of the commencement of an effort to gain access to the structure is known the change of resistance attempted to be made a few minutes later by a watchman at the office will indicate the burglar's presence and render their knowledge useless.

The improvement also consists in the combination in an electric burglar-alarm, comprising an internal circuit and an external circuit, of a mechanism at a guarded structure and a mechanism at the office, whereby corresponding resistances may be successively thrown into the external and internal circuits by means of an increase of the electric current passing through the circuits, effected at the office, and a galvanometer or differential relay-magnet located at the office and serving to give an alarm there in case the equilibrium of the resistances in the external and internal circuits is disturbed by an attempt to gain access to the guarded structure, and a compound key located at the office, whereby the galvanometer or differential relay-magnet employed for causing the sounding of an alarm may be cut out of the circuits and the electric current passing through the circuits may be subsequently increased to operate the mechanisms, whereby the resistances in the circuits are changed. This feature of my improvement will prevent any alarm being given at the office in case the mechanism for introducing a different resistance in one circuit operates before the mechanism in the other circuit operates to introduce a corresponding resistance in the latter circuit; and, as it is next to impossible to produce two mechanisms which will start and operate absolutely in unison, this feature of my improvement is of considerable importance.

The improvement also consists in the combination, in an electric burglar-alarm comprising internal circuits at the office, external circuits extending to and through guarded structures, of galvanometers or differential relay-magnets located at the office and connected with the external circuits for the purpose of giving alarms, a mechanism in the office for

successively introducing different resistances into one of the internal circuits, a similar mechanism in each of the external circuits for successively introducing different resistances into the said circuits, a system of switches and connections at the office so arranged that any one of the galvanometers or differential relay-magnets for giving alarms may be switched out of the circuit in which it is ordinarily operative and into a system of circuits comprising a supplemental battery, and the mechanism for introducing different resistances into the internal circuit aforesaid is rendered capable of being used at the office in connection with any one of the mechanisms, whereby different resistances are introduced into the external circuits.

The improvement also consists in the combination, in an electric burglar-alarm comprising internal circuits at the office and external circuits extending to and through guarded structures, of galvanometers or differential relay-magnets located at the office and connected with the external circuits for the purpose of giving alarms, a mechanism arranged in one of the internal circuits and comprising a train of wheels and a controlling electro-magnet, whereby different resistances may be introduced into this internal circuit, a number of rheostats arranged in the other internal circuits and comprising coils of different resistances, a mechanism arranged in each of the external circuits and comprising a train of wheels operating under control of an electro-magnet for introducing different resistances into the said external circuits, and a system of switches and connections at the office, whereby the internal circuit at the office, which is provided with the train of wheels and resistances, may be temporarily connected with any of the external circuits and subsequently replaced by one of the internal circuits, which are provided with rheostats. I am thus enabled to use a single mechanism comprising a train of wheels controlled by an electro-magnet in the office in conjunction with a number of such mechanisms in external circuits.

The improvement also consists in the combination, in an electric burglar-alarm comprising an internal circuit and an external circuit, of a mechanism at a guarded structure, whereby a number of different resistances may be successively introduced into the external circuit by increasing at the office the electric current passing through the circuits, a mechanism at the office whereby on the increasing of the electric current a number of corresponding resistances will be introduced into the internal circuit, a galvanometer or differential relay-magnet located at the office and serving to give an alarm there in case the external circuit is tampered with in an attempt to gain access to a guarded structure, a mechanism in the external circuit which if short-circuited in an attempt to gain access to a guarded structure will be maintained short-circuited, an electro-magnet having a polarized armature, connections, and two batteries adapted to send electric currents in different directions over the circuit, whereby the said short-circuiting mechanism may be shunted out of the circuit by a watchman at the office, so as to be rendered temporarily inoperative.

Figure 1 in the accompanying drawings is a diagram illustrative of a burglar-alarm embodying certain features of my improvement. Figs. 2 and 2′ are diagrams illustrating a burglar-alarm embodying the improvement in a somewhat different form, Fig. 2 representing the different mechanisms at the office, and Fig. 2′ representing the corresponding mechanisms in the guarded structures. Fig. 3 is an enlarged plan view of a mechanism for introducing different resistances into the internal circuit. Fig. 4 is a sectional side elevation of what I term a "short-circuiting mechanism" employed in the burglar-alarm. Fig. 5 is an end view of a switch which is employed in the form of burglar-alarm which is illustrated in Fig. 2. Fig. 6 is an enlarged edge view of a key-board employed in the burglar-alarm.

I will first describe the form of burglar-alarm illustrated in Fig. 1.

A A′ A^2 designate a galvanometer comprising two coils, A A′, which are preferably of equal resistance and tend to deflect a needle, A^2, in different directions. When an electric current passing through the coil A preponderates over an electric current passing through the coil A′, the needle will be deflected to the left, and when an electric current passing through the coil A′ preponderates over an electric current passing through the coil A, the needle will be deflected to the right. In either case the needle will move against a contact-piece and close a local circuit, A^3, which extends to the pivot of the needle and to contact-points with which the needle operates. This local circuit is provided with a local battery, A^4, and an electro-magnetic bell, A^5. The latter may or may not be rheotomic. An audible alarm will be given whenever the galvanometer-needle closes the local circuit. The needle by its vibrations gives a visual alarm. The circuit which passes through the coil A of the galvanometer is the one which I designate as the "internal" circuit, and the one passing through the coil A′ is that which I designate as the "external" circuit. The galvanometer-needle will vibrate only when the resistance of the two circuits is different, and while the resistances in the two circuits are in equilibrium the needle will be held midway between the contact-pieces of the local circuit.

The main electric circuit extends from a battery, B, along a wire, C. This wire is interrupted and connected to the coils of an electro-magnet, O, the purpose of which will be presently described. From the electro-magnet O the said wire extends to a metallic contact-piece, *e*, which is made in the form of a keeper for a metallic key, E. Thence the circuit extends along the wire C′ to the coil A

of the galvanometer; thence through the said coil and along the wire C^2 to a resistance-coil, C^3, and thence along a wire, C^4, to a metallic finger on a shaft, *a*, comprised in a mechanism, F, for introducing different resistances into the internal circuit. From this shaft *a* the circuit is continued to one of a number of metallic springs, *b b'*, &c., comprised in said mechanism F; thence to one of a number of resistance-coils, *c c'*, &c., comprised in said mechanism; thence along a wire, G, which connects the said resistance-coils *c c'*, &c., with a metallic key E'; thence along this key to a contact-piece, *e'*, which is made in the form of a keeper therefor, and thence by a wire, G', to the battery B. The wire G', near where it connects with the battery B, is connected by a wire, C^5, to an earth-plate, H. The electric current divides at the point where the wire C' connects with the coil A of the galvanometer. Part of the electric current passes through the coil A and thence along the line C^2. Another part of the electric current passes along a wire, C^6, extending from the wire C' to the coil A' of the galvanometer, and thence through the coil A' and to a wire, I, forming part of the external circuit.

The wire I is connected to one end of the coils of an electro-magnet, Q, having a polarized armature, Q'. The object of this electro-magnet and its appurtenances I will describe fully hereinafter. From the other end of the coils of this electro-magnet a wire, I', extends to a binding-post, *q*, of a short-circuiting mechanism, R R', &c., the purpose of which will be explained presently. A wire, I^2, extends from a binding-post, *q'*, of the short-circuiting mechanism to the contact-piece *f'* of a pair of metallic contact-pieces, *f f'*, forming a circuit-closer on an electric envelope, J, designed to inclose a safe in a guarded structure. The contact-piece *f* is affixed to the body of the envelope J, and the contact piece *f'* is affixed to the door of the envelope. The contact-piece *f'* may be made in the form of a hook having the shank bent around into a curve which is concentric with the pintles of the hinges by which the door is connected to the body of the envelope; hence when the door is closed the hook-like end of the contact piece *f'* will be separated from the contact-piece *f*, and when the door is opened the hook-like end of the contact-piece *f'* will impinge against the contact-piece *f*. From the wire I^2 or the contact-piece *f'* a wire, I^3, extends to the coils of an electro-magnet, *d*, comprised in a mechanism, F', whereby different resistances are introduced into the external circuit. From the coils of the electro-magnet *d* the external circuit extends along a wire, I^4, to a metallic finger on the shaft *a* of the mechanism F' just mentioned; thence the external circuit extends to one of a series of metallic springs, *b b'*, &c., comprised in this mechanism, with which the said finger of the shaft *a* may be in contact; thence to one of a number of resistance-coils, *c c'*, &c., comprised in the mechanism F', and thence along a wire, K. This wire K extends from these resistance-coils *c c'*, &c., to the contact-piece *f* of the electric envelope J, and thence to an earth-plate, H'. The circuit is completed to the battery B through the earth from the earth-plate H' to the earth-plate H.

C^{11} designates a wire leading from a switch, C^{19}. This switch C^{19} has two contact-pieces with which batteries B' B^5 are connected by suitable wires. These batteries B' B^5 are intended to be of equal strength, but they are capable of producing electric currents in opposite directions through the switch C^{19} and thence to the wires in circuit with it. These batteries are of greater potential than the battery B. These batteries B' B^5 are connected by wires with an earth-plate, H^2. The object of providing for sending an electric current in reverse directions over the switch C^{19} will appear later. The wire C^{11} extends to a contact-piece, e^2, arranged below a metallic key, E^2, which normally is out of contact with this contact-piece and in contact with a keeper, e^3, which is not in the electric circuit. A wire, C^{17}, extends from the metallic key E^2 to the coils of the electro-magnet *d* of the mechanism F, whereby different resistances are introduced into the internal circuit. The other end of the coils of the electro-magnet *d* is connected by a wire, L, to the wire I of the external circuit.

I may here remark that the keys E and E' are normally in contact with the contact-pieces *e e'*, which constitute their keepers. The key E has a cross-bar, *g*, of insulating material, which is adapted to impinge against the keys E' E^2, so that these keys E' E^2 may be depressed by depressing the key E. These keys are in effect a single compound key. The key E may be depressed by clock-work periodically if desirable.

Each of the mechanisms F F' comprises a train of gear-wheels, *h*, which have combined with them a weight or a spring, whereby they are caused to rotate. These wheels also have combined with them a retarding device—such as a fly, *j*—for preventing them from rotating too rapidly. The springs *b b'*, &c., are arranged upon a circular disk of insulating material, *k*, so that their ends will project in the way of the metallic finger of the shaft *a*. The rotation of the wheels is controlled by means of a lever, *l*, connected to the armature of the electro-magnet *d* and acting in conjunction with a pin, *m*, on a wheel, *h'*, comprised in the train of gear-wheels *h*. When the electro-magnet *d* is energized, the armature is attracted and the train of gear-wheels permitted to rotate. The resistance of the coils of the electro magnet *d* is such that the electric current from the battery B will not energize it sufficiently to enable it to attract its armature. It is only rendered operative when the battery B' or B^5 is put in circuit by depressing the key E^2 upon the contact-piece e^2, which is only done momentarily to effect the release of

the train of wheels *h*. The wheels, when released, therefore run only long enough for the wheel *h'* to make a single complete rotation and be arrested again by the lever *l*. This is only long enough for the metallic finger of the shaft *a* to move from one to another of the metallic springs *b b'*, &c.

The resistance coils *c c'*, &c., are severally made of different resistances, and those of the mechanism F are made to correspond in resistance and order of succession with those of the mechanism F'. The resistance-coil C^3 is placed in the internal circuit to equalize the resistance which would otherwise exist in the external circuit over and above the resistance of the internal circuit, owing to the greater length of wire in the external circuit and the presence of the electro-magnet Q and the electro-magnet *d* of the mechanism F' normally in the external circuit.

The key E is allowed to rise above the level of the other keys, E' E^2, owing to its keeper *e* being higher. When the key E is depressed, contact is broken between it and its keeper *e*, and subsequently the other keys are depressed, so that they will break contact with their keepers, and the key E^2 will impinge on its contact-piece e^2. Owing to this, the battery B is first cut out of circuit; next the communication of the key E' through the wires G' C^5 with the earth-plate H is broken, and finally the battery B' or B^5 is brought into circuit with the key E^2. Were it not for breaking the communication of the key E' through the wires G' C^5 with the earth-plate H prior to the bringing of the battery B' or B^5 into circuit, the electric current of the battery B' might pass along the wire I, thence along the coils of the galvanometer A A' A^2, thence along the wire C^2 to the mechanism F, and thence by the wire G, key E', and wires G' C^5 to the earth-plate H. This would be objectionable, because it would cause a deflection of the galvanometer-needle. When the keys E E' E^2 have been depressed, as described, the electric current from the battery B' or B^5 will pass to the key E^2; thence along the wire C^{17} to the coils of the electro-magnet *d* of the mechanism F; thence along the wire L to the wire I, along the wire I to the electro-magnet Q; thence along the wire I' to the binding-post *q* of the short-circuiting mechanism, R R', &c.; thence from the binding-post *q'* of the short-circuiting mechanism to the wire I^2, and along the latter to the contact-piece *f'* of the electric envelope J; thence along the wire I^3 to the electro-magnet *d* of the mechanism F'; thence along the wire I^4 to the finger of the shaft *a* of the mechanism F'; thence to whichever one of the springs *b b'*, &c., of the mechanism F' the finger of the shaft *a'* of said mechanism F' may happen to be in contact with; thence to the corresponding resistance-coil, *c c'*, &c., of the mechanism F', and thence along the wire K to the contact-piece *f* and the earth-plate H'.

The trains of wheels comprised in the mechanisms F F' will then be released because the electro-magnets *d* will then attract their armatures, and thereby cause the armature-lever to release the wheels *h'*, as explained before. The keys E E' E^2 will only be kept in their depressed positions momentarily, so as to enable such of the resistance-coils *c c'*, &c., as were in circuit to be cut out of circuit and other of these coils to be introduced into circuit. When the keys E E' E^2 are allowed to rise to their normal positions, the key E^2 breaks contact with its contact-point e^2 and cuts off the battery B', the key E' rises to its keeper *e'*, and the key E rises to its keeper *e* and establishes communication between the key and the battery B. As the battery B is by the above-described operation of the keys E E' E^2 cut off from both coils of the galvanometer before the resistance in the circuits is changed and is not reinstated in the circuit until after the change of resistance in the circuits has been made, the galvanometer-needle A^2 will not be affected even if a resistance-coil be introduced by the mechanism in one circuit with greater alacrity than by the mechanism in the other circuit, because the coils of the galvanometer will not be influenced by any battery-current until the resistances in both circuits have been equalized.

It is obvious that by frequently changing the resistances in the circuits it is made practically impossible for a burglar to effect an entrance into the guarded structure without giving an alarm at the office, even though he happen to learn what resistance was in circuit at any particular time, because if he should introduce into a circuit intended to replace the external circuit the resistance of which he had obtained knowledge, that would avail him nothing if the resistance of the circuits should have been changed subsequently to the time when he obtained knowledge of the resistance used.

In this example of my improvement a separate mechanism, F, and set of keys E E' E^2 need to be employed in the office for each guarded structure. While I have represented the burglar-alarm in connection with but one guarded structure, I intend to use it in connection with a number of guarded structures and one office.

It is hardly necessary to remark that if the battery B should become inoperative the whole efficiency of the burglar alarm would be impaired, because the galvanometer-needle would not be deflected, and hence no alarms would be given at the office, even if the internal or external circuit were severed. It is therefore very desirable to provide means for indicating such an accident. I will now describe a contrivance devised to secure that end. I have already explained that the wire C is connected to the coils of the electro-magnet O. It will be understood, therefore, that the electric current from the battery B passes along the coils of the electro-magnet O. From there it extends along the wire C to the keeper *e* of the key E. The electro-magnet O has an ar-

mature, O′, shown as pivoted in place at one end and adapted to swing toward and from the electro-magnet. It is drawn toward the electro-magnet by the force of the latter so long as the battery B is in working order; but if anything happens to impair the working of this battery, a spring, O^2, will move the armature away from the electro-magnet. When this occurs, a contact-piece with which the armature is provided will be moved into contact with a contact-piece, O^3, comprised in a local electric circuit, *r*. The other end of this electric circuit *r* is connected with the armature O′. In the electric circuit *r* are a battery, B^3, and an electro-magnetic bell, *r*′. Whenever the electric circuit *r* is closed, the electro-magnetic bell is sounded, and in that way an alarm is given as to the failure of the battery B to work. The electro-magnetic bell may or may not be rheotomic.

I will now describe the modification of my improvement shown in Fig. 2, premising that the same illustrates the improvement in conjunction with two guarded structures. Here one mechanism, F, and a single set of keys, E E′ E^2, in the office, similar to the mechanism F and the keys E E′ E^2 in Fig. 1, hereinbefore described, will suffice for use, in conjunction with mechanisms F′, in several guarded structures made like the mechanism F′, before explained.

M designates a switch located in the office and consisting of a cylinder or block, *p*, of wood or other non-conducting material, having at the ends journals mounted in bearings, permitting it to be adjusted axially in either of two positions. Upon the face of this block are metallic plates n' n^2 n^3 n^4 n^5 n^6. A number of springs, o' o^2 o^3 o^4 o^5 o^6 o^7 o^8 o^9 o^{10}, extending from the base-piece p' of the switch, bear on the face of the block *p*. The arrangement of the metallic plates will be made clear hereinafter.

N designates a rheostat composed of a number of resistance coils corresponding to the resistance-coils *c c*′, &c., of the mechanisms F F′ and arranged in the same order. One end of its coils is connected by a wire, C^8, to an earth-plate, H^5. A wire, C^7, leading from the spring o^7, may be connected with the other end of either of the coils of this rheostat by fitting a plug, with which such wire is provided, into any one of a series of holes in the rheostat.

I will assume for the present that the block *p* of the switch M is turned, so that its handle p^2 will be in an upright position.

An electric battery, B^2, is connected at one pole with an earth-plate, H^4, and at the other pole with one end of the coil of an electro-magnet, O. From the other end of the coil of the electro-magnet the circuit extends along a wire, C^6, to the spring o^{10} of the switch M; thence over the metal plate n^6 to the spring o^9 of the switch M; thence by wire C′ to the coils A A′ of the galvanometer A A′ A^2. Part of the electric current passes through the coil A′ of the galvanometer to the wire I of the external circuit, and another part of the electric current passes through the coil A of the galvanometer to the wire C^2, and thence to and through the resistance-coil C^3 to the spring o^6 of the switch M. From the spring o^6 this part of the electric current passes over the plate n^5 to the spring o^7 of the switch M. Thence it passes by the wire C^7 through the rheostat N, and thence by a wire, C^8, to an earth-plate, H^5. The resistance in the coil of the rheostat along which the current passes is equal to the resistance in the coil of the mechanism F′, which is in the external circuit through which the current is passing. The resistance-coil of the rheostat, which is in the internal circuit, will then balance the resistance-coil of the mechanism F′ in the guarded structure, and the resistance-coil C^3 will counterbalance any extra resistance that may exist in the external circuit owing to extra length of wire and the presence of the coils of the electro-magnet Q and the electro-magnet *d* of the mechanism F′. Hence there will be no deflection of the galvanometer-needle.

If it is desired to change the resistance in the internal and external circuits belonging to any guarded structure, the block *p* of the switch M belonging to that guarded structure is shifted so as to bring its handle p^2 into a horizontal position. This will cause the springs o' o^2 to make contact with the metal plate n', the springs o^3 o^4 to make contact with the plate n^2, the springs o^5 o^6 to make contact with the plate n^3, the springs o^8 o^9 to make contact with the plate n^4, and the springs o^7 o^{10} to make contact with the block *p*. The battery B^2 is thus cut off from communication with the wire C′. A wire, C^{12}, extending between the wire C^6 and the spring o^2, is, however, put into communication with a wire, C^{13}, which leads from the spring o' to the earth-plate H^5, and hence the electro-magnet O is kept energized and no alarm will be sounded by the electro-magnetic bell *r*′. The metal plate n' is so arranged on the block *p* that it will be brought in contact with the springs o' o^2 before the springs o^9 o^{10} have broken contact with the metal plate n^6, in order that the electro-magnet O will always be kept charged, and no alarm will be given by the bell *r*′ when the switch-block is thus shifted. The electro-magnet O, the appurtenances thereof, the circuit *r*, and the electro-magnetic bell *r*′ are the same in construction and function as the correspondingly-lettered parts illustrated in Fig. 1.

The communication between the rheostat N and the wire C^2 will be cut off when the switch M is thus manipulated. The electric current will now pass from a battery, B, along a wire to the contact-piece or keeper *e* of the key E, thence along this wire to a wire, C^9, and thence to the spring o^8 of the switch M. From the spring o^8 it extends over the plate n^4 to the spring o^9, thence along the wire C′ to the coil A of the galvanometer. Here it divides, part

passing through the coil A and thence along the wire C^2, and part passing through the coil A′ and thence along the wire I.

The electric current which passes to the wire C^2 passes thence to and through the resistance-coil C^3, thence further along the wire C^2 to the spring o^6, thence over the plate n^3 to the spring o^5, thence along a wire, C^{10}, to the key E′, and thence to the keeper or contact-piece e' of the latter. From the keeper or contact-piece e' of this key E′ a wire, C^4, extends to the shaft a of the mechanism F. From the resistance-coils c c', &c., of this mechanism F a wire, G, extends to an earth-plate H. The battery B is shown as connected by another wire with the same earth-plate H. From the key E^2 a wire, C^{15}, extends to the spring o^3 of the switch M. It will be borne in mind that when the block of this switch occupies the position last described the plate n^2 establishes communication between the spring o^3 and the spring o^4. A wire, L, extends from the spring o^4 and connects with the wire I. The contact-piece e^2 of the key E^2 is connected by a wire, C^{17}, with one end of the coils of the electro-magnet d of the mechanism F, before mentioned. The other end of the coils of the said electro-magnet d is connected with a switch, C^{19}, which is like the switch similarly lettered in Fig. 1. This switch has two contact-pieces connected by wires with batteries B′ B^5. These batteries are also connected with an earth-plate, H^2. By shifting the switch onto either of the contact-pieces one or the other of the batteries may be put into communication with the contact-piece e^2 of the key E^2. When the key E^2 is depressed so as to impinge against its contact-piece e^2, it will be put into electrical communication with whichever of the batteries B′ or B^5 happens to be connected with the contact-piece e^2 of the said key. Ordinarily the battery B′ will be connected to the contact-piece e^2 of the key; but under certain circumstances, hereinafter to be fully discussed, the battery B^5 will be connected to the said contact-piece e^2. Both the batteries B′ B^5 are of the same size; but they are adapted to send electric currents in reverse directions over the line.

If while the block of the switch M occupies the position last described the key E be momentarily depressed to its full limit, said key will be removed from its contact-piece e, and the battery B will be cut out, the key E′ will be separated from its contact-piece e', and communication cut off between the wires C^{10} and C^4, the mechanism F, and the earth; hence there will no longer be any communication between the coil A of the galvanometer and the earth. The key E when depressed thus causes the key E^2 to make a contact with its contact-piece e^2. During this contact an electric current will pass from the battery B′ or B^5 through the electro-magnet d of the mechanism F, the key E^2, the wire C^{15}, the spring o^3, the plate n^2, and spring o^4 of the switch M, the wire L, and along the wire I. From thence the electric current will pass to the electro-magnet Q; thence to or past the short-circuiting mechanism R R′, &c.; thence to the contact-pieces f f' of the electric envelope J and the mechanism F′ and to the earth, all as I have explained in relation to Fig. 1.

Both mechanisms F F′ commence running as soon as the electric current is caused to flow by the operation of the key E^2, and the resistance in the internal and external circuits is thereby changed. Suppose the mechanisms F F′ have stopped with their resistance-coils c^3 in circuit. This may be ascertained by looking at the mechanism F in the office. The plug of the wire C^7 will then be inserted in the rheostat in such hole as to cause the proper coil thereof to be in circuit. The block p of the switch M is now reversed so as to bring its handle p^2 into an upright position. By thus shifting the switch-block the keys E E′ E^2 and the mechanism F will be cut out of the circuit, and the battery B^2, the appurtenances thereof, and the rheostat N will be thrown into circuit. It will be understood that the change in the resistance has been made without deflecting the needle of the galvanometer. The resistances in the internal and external circuits will now be equal.

I have designated the external circuits for the two guarded structures shown and the appurtenances of these two external circuits by the same letters of reference. The foregoing description may be regarded as having related to either. It will of course be understood that there is an internal circuit in the office for each external circuit. After the keys E E′ E^2 and the mechanism F have been used in conjunction with one external circuit they may be similarly used with the other, the necessary initial operation for this purpose being merely to shift the block of the switch M in such way as to bring its handle into a horizontal position, and the subsequent operations being exactly as I have already described in connection with the guarded structure first described. The circuits of many guarded structures may be treated in the same way with the use of the one set of keys E E′ E^2 and the single mechanism F.

It will be seen that the single set of keys E E′ E^2 are similarly connected with the circuits of the two guarded structures shown. The circuits for all the guarded structures which will be used with this single set of keys E E′ E^2 will be similarly connected with the keys.

I will now give a detailed description of the electro-magnet Q having a polarized armature, and the short-circuiting mechanism as used in the burglar-alarm shown in both Figs. 1 and 2.

I have already explained that the wire I is connected to one end of the coils of the electro-magnet Q; that a wire, I′, leads from the other end of the coils of this electro-magnet to the binding-post q of the short-circuiting mechanism, and that a wire, I^2, leads from the binding-post q' of the short-circuiting mechanism to the contact-piece f' of the electric envelope

J. The armature Q′ of the electro-magnet Q is polarized—or, in other words, consists of a permanent magnet. It is fulcrumed between the ends to a metallic support arranged about midway between the poles of the electro-magnet Q. It can therefore rock toward either pole of the electro-magnet Q. A wire, I^5, extends from the wire I′ to a contact-piece, Q^2, mounted upon a suitable support. When the armature Q′ is rocked in one direction, it impinges upon the contact-piece Q^2. When rocked in the other direction, it is separated from the contact-piece Q^2. A wire, I^6, leads from the metallic support of the armature Q′ to the wire I^2, which extends from the binding-post q' of the short-circuiting mechanism to the contact-piece f' of the electric envelope J. When the switch C^{19} (see Figs. 1 and 2) is in communication with the battery B′, the electro-magnet Q will be so energized as to rock its armature Q′ away from the contact-piece Q^2. Consequently the electric current from said battery will pass from the coils of the electro-magnet Q to the wire I′; thence into the short circuiting mechanism R R′, &c., and thence along the wire I^2 to the contact-piece f' of the electric envelope J. If, however, the switch C^{19} be put into communication with the battery B^5, the electro-magnet Q will be so energized that it will rock its armature Q′ against the contact-piece Q^2. Then the electric current will pass from the coils of the electro-magnet Q to the wire I′, thence to the wire I^5 and contact-piece Q^2, thence along the armature Q′, thence along the metal support to which the said armature is fulcrumed, and thence along the wire I^6 to the wire I^2, which leads to the contact-piece f' of the electric envelope J. In such case the short-circuiting mechanism is shunted out.

After describing the short-circuiting mechanism I will make clear the object of sometimes thus shunting it.

From the binding-screw q, with which the wire I′ is connected, a wire extends to a circuit-breaker consisting of a resilient metallic strip, R′, secured at or near one end to the base-piece R, and provided with a thumb-piece or button, r^2, whereby it may be manipulated. This circuit-breaker is combined with a keeper, R^2, consisting of a metal arm projecting over the circuit-breaker, so that the latter will when in its normal position maintain a contact with it. This keeper may be pivoted to the base-piece R so that it can be swung aside out of contact with the circuit-breaker when desirable to retain the circuit broken for any length of time without holding the circuit-breaker depressed. From the keeper R^2 a wire, R^3, extends to an electro-magnet, R^4, whence a wire, R^5, extends to the binding-screw q'. The wire I^2 extends to the contact-piece f' of the electric envelope J, as I have already explained. From the contact-piece f' the wire I^3 extends to the coils of the electro-magnet d of the mechanism F′, whereby different resistances are introduced into the external circuit. From the coils of the electro-magnet d a wire, I^4, leads to the metallic finger on the shaft a of the mechanism F′. Thence, as I have shown, the electric circuit is continued through one of the springs b b', &c., and one of the coils c c', &c., of the mechanism F′, and thence along the wire K to the contact-piece f and the earth-plate H′. A wire, I^7, connects the earth-plate H′ with the binding-post q^2 of the short-circuiting mechanism.

R^6 designates a vibratory armature arranged in proximity to one end of the electro-magnet R^4 and pivoted to a supporting-bracket, so that it can be attracted by the magnet into contact with it, or, when released, may swing away from it.

Extending from the armature R^6, (see particularly Fig. 4,) in this instance above the same, is an arm, R^7, of conducting material—such as metal—which when the armature is attracted to the electro-magnet comes in contact with an arm, R^8, of conducting material, extending from a post, R^9, of conducting material, erected on the base-piece R. A wire, R^{10}, extends from the armature R^6 to the wire R^5, which is fastened, as here shown, in the binding-screw q', and another wire, R^{11}, extends from the post R^9 to the binding-screw q^2, connecting there with the wire I^7, which leads to the earth-plate H′. When the windows and doors of the structure are closed properly, the electric current will enter on the line-wire I′, pass through the circuit-breaker R′, keeper R^2, and wire R^3 to the electro-magnet R^4. From thence it passes along wire R^5 to wire I^2, to the contact-piece f' of the electric envelope J; thence along the wire I^3 and the coils of the electro-magnet d, comprised in the mechanism F′; thence along the wire I^4 to the shaft a of the said mechanism F′, and thence through a spring, b or b', &c., and coil c or c', &c., to the wire K, and along it to the earth-plate H′. Then any momentary change in the resistance of the circuit outside the structure will cause only a momentary alarm to be given at the office with which the line-wire I communicates. If, however, the electric envelope be opened, the electric circuit will be short-circuited through the contact-points f f', and the coil c or c', &c., of the mechanism F′, which was formerly in circuit, will be shunted out.

The electro-magnet R^4 must be so constructed and the armature R^6 so adjusted in respect to its distance from the electro-magnet and the strength of the spring, whereby it is to be returned to its normal position, that when an electric current is flowing through one of the coils c c', &c., of the mechanism F′ from the battery B said armature will not be attracted, but that when the coil c or c', &c., which was in circuit is shunted out by the opening of the electric envelope the armature will be attracted. Whenever the electric circuit is short-circuited, through the contact-points f f' and the armature R^6 attracted to the electro-magnet, the electric current will be short-circuited again, this time through the wire R^5 to the wire R^{10}, from the latter to the arm

R^7, (see particularly Fig. 4,) thence to the arm R^8, thence through the post R^9 and wire R^{11} to the wire I^7, (see Fig. 2,) and to the ground. In consequence of the latter short-circuiting the electro-magnet will hold the armature even if the electric envelope after being opened be instantly closed again, because the electric current will take the shorter circuit, and the galvanometer-needle A^2 will continue to close the local circuit and cause the bell A^5 to sound an alarm until the existing short circuit is broken by the operator at the office opening the line or otherwise and the release of the armature effected, whereupon the circuit may be reinstated through a coil, *c* or *c'*, &c., of the mechanism F', and the mechanism in the structure to be guarded will be in condition for further use.

The short alarm given through a momentary change in the resistance of the electric circuit from any accidental or other cause outside the guarded structure, and the long-continued alarm given through a change in the resistance occasioned at or in the said structure from short-circuiting out a coil, *c* or *c'*, &c., of the mechanism F' may be easily distinguished from each other.

Although not essential, I have shown combined with the electro-magnet R^4 (see particularly Fig. 4) an armature, R^{12}, carrying a hammer, R^{13}, operating a bell, R^{14}, and conveying to inmates of the guarded structure some preconcerted message from the operator, or notifying them that their attention to the operator is desired. This armature R^{12} is so adjusted in respect to its distance and the force of the spring, whereby it is retracted, that an electric current of sufficient force to cause the electro-magnet to attract the armature R^6 will produce no effect on the armature R^{12}. I therefore use the battery B' (see Figs. 1 and 2) when the bell R^{14} is to be operated.

On the top of the bell I have also shown an arm or pointer, R^{15}, and extending from the arm R^7 an indicator, R^{16}, which, by being in contact with or close proximity to the pointer, or by being swung away therefrom, will indicate whether the doors and windows of the structure to be guarded are all closed by showing whether the electric circuit is short-circuited within the structure.

The object of using the battery B^5 as well as the battery B' and of employing in conjunction with said battery B^5 the electro-magnet Q, having a polarized armature and the appurtenances of these devices, is to enable a watchman at the office to shunt the short-circuiting mechanism out of circuit and still avail himself of a powerful battery for operating mechanisms, whereby different resistances will be introduced into circuit.

Differential relay-magnets would be equivalents for the galvanometers A A' A^2.

To conduce to clearness, I have drawn lines around the parts illustrated by Figs. 1 and 2, which are in the guarded structures, and marked these lines with the words "guarded structures." Likewise I have drawn lines around devices located in the office and marked the same with the word "Office."

I am aware of United States Letters Patent to J. Tourney for electric burglar-alarms, No. 289,471, December 4, 1883, and I do not herein lay claim to anything claimed therein.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an electric burglar-alarm comprising an internal circuit and an external circuit, the combination of a set of variable resistances in connection with the internal circuit, a set of variable resistances in connection with the external circuit, mechanism for varying the resistances in the internal and external circuits at predetermined intervals, a supplemental source of electric energy, and mechanism for throwing the supplemental energy into connection with the variable resistances at pleasure, substantially as set forth.

2. In an electric burglar-alarm comprising an internal circuit and an external circuit, the combination of a set of variable resistances in connection with the internal circuit, a set of variable resistances in connection with the external circuit, mechanism for varying the resistances at predetermined intervals, a supplemental battery, a switch for throwing the supplemental battery into and out of connection with the variable resistances, and an alarm under the influence of the internal and external circuits, whereby attention is called to any disturbance in the resistances in the external circuits, substantially as set forth.

3. In an electric burglar-alarm comprising an internal circuit and an external circuit, the combination of a set of variable resistances in connection with the external circuit, and a set of corresponding variable resistances in connection with the internal circuit, mechanism for changing the resistances at predetermined intervals, a supplemental source of electric energy, means for throwing said supplemental energy into connection with the said variable resistances, a galvanometer or analogous device located under the influence of both the internal and external circuits and held normally in equilibrium thereby, and a compound key in connection with the internal and the external circuits, whereby the internal circuit may be broken when the supplemental electric energy is thrown into connection with the variable resistances, substantially as set forth.

4. In an electric burglar-alarm comprising internal circuits at the office and external circuits extending to and through guarded structures, the combination of a galvanometer or analogous device located at the office and connected with the external circuits for the purpose of giving alarm, a set of variable resistances in connection with one of the internal circuits, mechanism in connection with the set of variable resistances for successively introducing different resistances into one of the internal circuits, a corresponding set of variable resistances in each of the external circuits,

mechanism for successively introducing different resistances into the said circuits, a supplemental battery, a switch to throw the supplemental battery into and out of connection with the set of variable resistances, switches for throwing any one of the galvanometers or analogous devices at the office out of its normal circuit and into the circuit comprising the supplemental battery, and a compound key for manipulating the several circuits, substantially as set forth.

5. In an electric burglar-alarm comprising internal circuits at the office and external circuits extending to and through guarded structures, the combination of a galvanometer or analogous device located at the office and connected with the external circuits for the purpose of giving alarm, a set of variable resistances in connection with one of the internal circuits, a train of wheels including a switch-wheel, and controlling electro-magnet for throwing the variable resistances into and out of circuit, adjustable rheostats arranged in other internal circuits, a set of variable resistances in connection with each of the external circuits, a train of wheels including a switch-wheel, and a controlling electro-magnet, in connection with each of the external sets of variable resistances for throwing the different resistances into and out of circuit, and a system of switches and connections at the office, whereby the set of variable resistances at the office may be temporarily connected with any of the external circuits and subsequently replaced by the circuit provided with the rheostats, substantially as set forth.

6. In an electric burglar-alarm comprising an internal circuit and an external circuit, the combination of a set of variable resistances in connection with the external circuit, mechanisms for introducing the several resistances successively into the external circuit, a set of variable resistances in connection with the internal circuit, mechanism for introducing the different resistances successively into the internal circuit, a supplemental battery for setting in motion the aforesaid mechanisms, a switch for throwing said battery into and out of connection with the sets of variable resistances, a galvanometer or analogous device under the influence of the internal and external circuits, and adapted to give an alarm in the event of a change in the resistances of the internal and external circuits, a short-circuiting mechanism in connection with the external circuit, an electro-magnet having a polarized armature, a battery arranged to send an electric current in the opposite direction from the said supplementary battery, and connections leading from the magnet, having the polarized armature to the battery arranged to send a reverse current and to the set of variable resistances in the external circuit, whereby the said short-circuiting mechanism may be shunted out of its circuit by the watchman at the office.

HENRY C. ROOME.

Witnesses:
W. G. LIPSEY,
E. T. ROCHE.