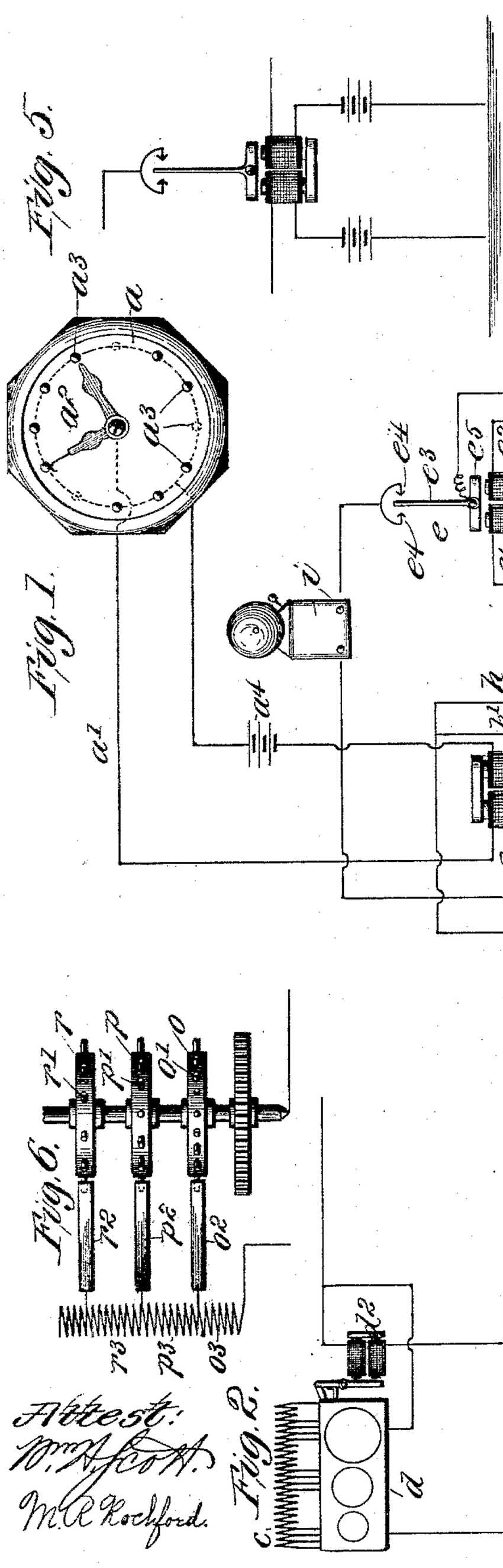
(No Model.)

C. COLEMAN.

ELECTRIC BURGLAR ALARM SYSTEM.

No. 598,063. Patented Jan. 25, 1898.



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UNITED STATES PATENT OFFICE.

CLYDE COLEMAN, OF CHICAGO, ILLINOIS, ASSIGNOR OF TWO-THIRDS TO ALBERT L. DEANE AND JAMES W. DONNELL, OF SAME PLACE.

ELECTRIC BURGLAR-ALARM SYSTEM.

SPECIFICATION forming part of Letters Patent No. 598,063, dated January 25, 1898.

Application filed December 14, 1896. Serial No. 615,573. (No model.)

To all whom it may concern:

Be it known that I, CLYDE COLEMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Electric Burglar-Alarm Systems, (Case No. 1,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to an electric burglar-alarm system.

My object is to provide an improved arrangement of the circuits and apparatus whereby successful tampering with the circuit may be effectually prevented.

Burglar-alarm systems have heretofore been constructed with a resistance in the circuit at the protected district, the cutting of which from the circuit is designed to sound the alarm. In such systems, however, it has been possible to measure the resistance and interpolate a similar resistance in the circuit exterior to the protected district without sounding the alarm. To overcome this difficulty, it has been proposed to provide in the protective circuit a resistance which is varied from time to time, a similarly-varied resistance being also provided in a separate or individual circuit at the central office, the currents in the two circuits acting upon a common alarm-sounding device. It has been possible in such systems to measure the changes of resistance during a complete cycle and substitute a resistance adapted to be similarly varied; and it is the object of the present invention to provide means whereby any attempt to determine the cycle of changes and construct similar apparatus will be frustrated.

According to the present invention I provide, in addition to the protective circuit, an individual circuit, the responsive device controlling the alarm being subjected to the combined action of the currents in the two circuits. In each circuit is provided a variable resistance, the resistance being varied by an apparatus which I term a "multiple permutating device." Such a device is provided in connection with each resistance, and they are operated at predetermined intervals by means of a clock mechanism or other automatically-actuated device for intermittently operating the multiple permutating devices at predetermined times. Instead of varying the resistance by a single switch or circuit-changing device I employ a plurality of such circuit-changing switches acting together to produce a large number of different arrangements or permutations of the sections of the resistance. The variation of resistance thus depends not upon the action of a single circuit-changer, but upon the joint action of a plurality of such circuit-changers producing a long series of different arrangements of the resistances which will baffle any attempt at reproduction. The circuit-changing device thus constructed with a plurality of independently-acting elements or parts cannot be duplicated without knowing the construction and operation of each part and any readings taken from the circuit indicate only the joint effect of the several parts. Thus no data can be obtained which will enable the determination of the construction of the several independently-operating devices, and consequently the apparatus cannot be duplicated. By this arrangement a single cycle of changes may be made to extend over one or more years, so that any extended measurement will not enable the determination of the law of variations. Such a device, which varies the resistance by a plurality of individual switches or circuit-changers acting together to produce different combinations or permutations of the units of resistance, I term a "multiple permutating device."

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is a diagram of the circuit arrangement of the system of my invention. Fig. 2 is a view of a modified circuit arrangement for the operating-magnet of the multiple permutating device. Fig. 3 is a view of the operating mechanism of the multiple permutating device. Fig. 4 is a view of the circuit arrangement thereof. Fig. 5 is a modification of the circuit arrangement through the coils of the responsive device. Fig. 6 shows a modification of the multiple permutating device.

Like letters refer to like parts in the several figures.

A clock or constantly-driven mechanism *a* is provided for closing the local circuit *a'* at

predetermined intervals. I preferably employ a clock the hour-hand a^2 of which is connected with one side of the circuit and makes contact with a series of terminals a^3 a^3, connected with the opposite side of the circuit. In the local circuit are included a battery a^4 and the coil b of an electromagnet, through which current is sent at predetermined intervals by means of the clock mechanism a.

At the protected district is provided the variable resistance c, the variation of resistance being produced by the multiple permutating device d, the protective circuit c' extending to the central station, where it is connected with a spring b^2, carried on the armature b' of the magnet b. The spring normally rests against the contact b^3, from which the circuit extends through the coil e' of the responsive device e and through battery f to ground. I have illustrated a grounded protective circuit; but a wholly metallic circuit may be employed. In a separate or individual circuit at the central station is provided a variable resistance g and a multiple permutating device d' for operating the same, the circuit extending to a spring g', moved by armature b', normally resting against contact g^2, the circuit then extending through the coil e^2 of the responsive device and through battery f to ground. The coils d^2 d^2 of the multiple permutating devices d d' may be connected in series with the variable resistances, as shown in Fig. 1, or in multiple, as shown in Fig. 2. When the armature b' of magnet b is attracted, the springs b^2 and g' are moved in contact with contacts h h', connected, through battery h^2, to ground, thus sending current from battery h^2 over the circuits and through the electromagnets d^2 d^2, thus operating the multiple permutating devices.

The responsive device e is provided with an arm e^3, normally resting out of contact with the contacts e^4 e^4, but adapted to engage one or the other when the effect of the coils e' e^2 upon the armature e^5 is unbalanced by a change of one of the currents. In the alarm-circuit is included a signal device or alarm i, which is sounded when the circuit of battery f is closed therethrough by the responsive device. In order that the responsive device may not be actuated when increased currents are sent over the circuits to operate the magnets d^2 d^2, a spring k, normally resting against contact k', is mounted to move with armature b' of magnet b, thus opening the alarm-circuit when armature b' is attracted.

The form of multiple permutating device which I preferably employ is illustrated in Figs. 3 and 4, and comprises a plurality of contact-arms, each moving over a series of contact-terminals, the arms and terminals being connected with different coils of the resistance. I have illustrated three arms k l m, moving, respectively, over terminals k' k' l' l' m' m'. The terminals and arms are connected with different points of the resistance c. The arms are mounted upon shafts k^2 l^2 m^2, carrying the intermeshing gear-wheels k^3 l^3 m^3, the shaft k^2 also carrying a ratchet-wheel k^{13}, with which engages a pawl k^4, carried upon the armature-lever d^3, pivoted at d^4. Upon the lever d^3 is also pivoted a stop or arm d^5, which engages the teeth of gear-wheel k^3 upon the advance of the armature-lever to limit the movement of the gear-wheel and prevent the same from moving too far, due to the impact of the pawl against the ratchet. As the arms rotate the arrangement of the coils in circuit is constantly altered, the plurality of circuit-changers coacting to produce a large number of combinations or permutations in the arrangement of the coils in the circuit, the cycle of variations being thus so complicated and of so long duration that any attempt to reproduce the same will be frustrated. Furthermore, the clock mechanism may be arranged to close the circuit and operate the multiple permutating devices at uneven intervals, and its speed may be changed from time to time to introduce a variable time element in the variation of resistance which further guards the protective circuit against surreptitious alterations. The number of teeth on the gear-wheels are in practice chosen so that the numbers have no common multiple less than that obtained by multiplying the several numbers together, one wheel having, say, forty-eight teeth and another forty-seven and another forty-one. The number of terminals may be the same as the number of teeth, or the number of teeth may be a multiple of the number of terminals. By so arranging the parts the maximum number of permutations for the given number of parts is secured.

In Fig. 6 I have illustrated a modified form of multiple permutating device in which a plurality of driven wheels o p r, &c., carry upon their peripheries pins o' p' r', which make contact with the brushes o^2 p^2 r^2, connected with the coils o^3 p^3 r^3, &c., of the variable resistance. As the wheels rotate the pins engage the brushes in a continuously-changing combination, thus producing a long series of permutations of the resistance-coils.

The coils of the responsive device may be wound alike and currents of equal value maintained in the two circuits, or if the currents are of different valves the coils may be wound so that their effect upon the armature will be the same. In the latter case the resistances of the two circuits will not be varied by equal amounts, but will be varied proportionally to maintain the currents at their respective values. In both cases the resistances of the circuits will be varied in like degree, whether equally or proportionally.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an alarm system, the combination with a protective circuit, of an individual circuit, a responsive device subjected to the combined action of the currents flowing in

the two circuits, an alarm controlled by said responsive device, and a multiple permutating resistance for each of said circuits each comprising a number of units of resistance and a plurality or multiple of circuit-changing arms or elements conjointly acting to include said units of resistance in various and successive orders, substantially as described.

2. In an alarm system the combination with a protective circuit, of an individual circuit, a responsive device subjected to the combined action of the currents flowing in the two circuits, an alarm controlled by said responsive device, a multiple permutating resistance for one of said circuits comprising a number of units of resistance and a plurality or multiple of circuit-changing arms or elements conjointly acting to include said units of resistance in various and successive orders, and a counterbalancing device in the other circuit for counterbalancing the effect of said multiple permutating resistance upon the responsive device, substantially as described.

3. In an alarm system, the combination with a protective circuit, of an individual circuit, a responsive device subjected to the combined action of the currents flowing in the two circuits, an alarm controlled by said responsive device, a multiple permutating resistance for each of said circuits each comprising a number of units of resistance and a plurality or multiple of circuit-changing arms or elements conjointly acting to include said units of resistance in various and successive orders, and an automatically-operating predetermining mechanism for operating said multiple permutating devices in unison to increase and decrease the currents in the two circuits together and balance the effect thereof upon the responsive device while permitting the same to respond to abnormal variations, substantially as described.

4. In an alarm system, the combination with a protective circuit, of an individual circuit, a responsive device subjected to the combined action of the currents flowing in the two circuits, an alarm controlled by said responsive device, a multiple permutating resistance for each of said circuits each comprising a number of units of resistance and a plurality or multiple of circuit-changing arms or elements conjointly acting to include said units of resistance in various and successive orders, an electromagnet for operating each of said multiple permutating devices and arranged in separate circuits, and a clock mechanism for energizing said electromagnets in unison at intervals to increase and decrease the currents in the two circuits together and balance the effect thereof upon the responsive device while permitting the same to respond to abnormal variations, substantially as described.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

CLYDE COLEMAN.

Witnesses:
W. CLYDE JONES,
M. R. ROCHFORD.