(No Model.) 2 Sheets—Sheet 1.

C. COLEMAN.

ELECTRIC BURGLAR ALARM SYSTEM.

No. 598,049. Patented Jan. 25, 1898.

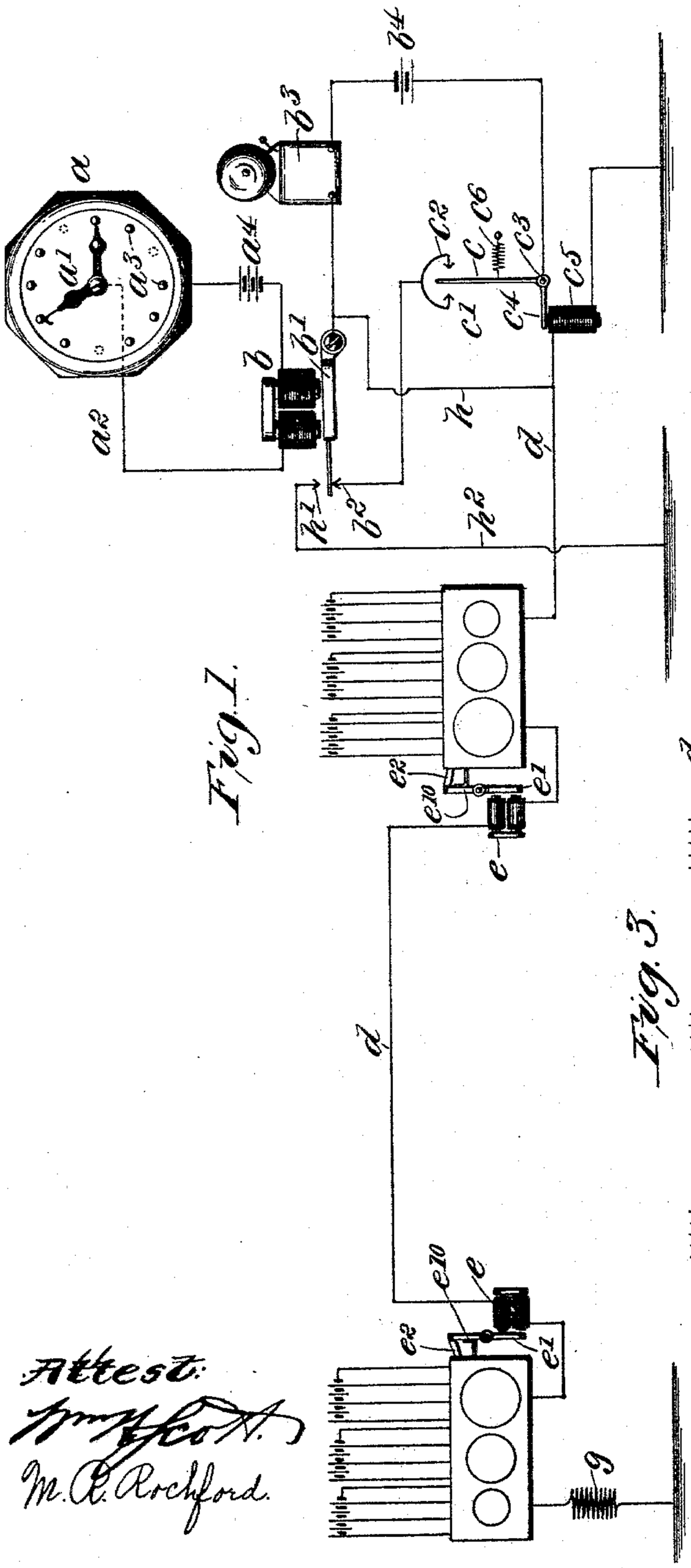

Fig. 1.

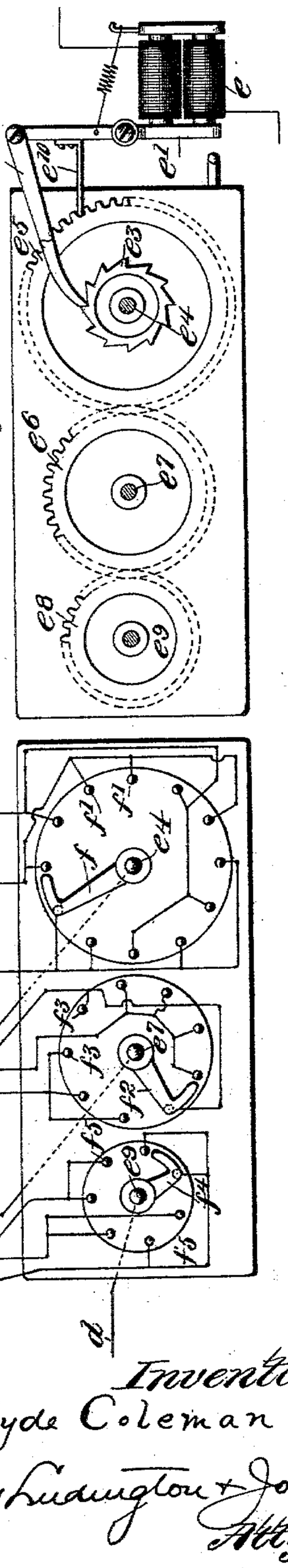

Fig. 4.

Fig. 3.

Fig. 2.

Attest:
M. L. Rochford.

Inventor
Clyde Coleman
By Ludington & Jones
Attys.

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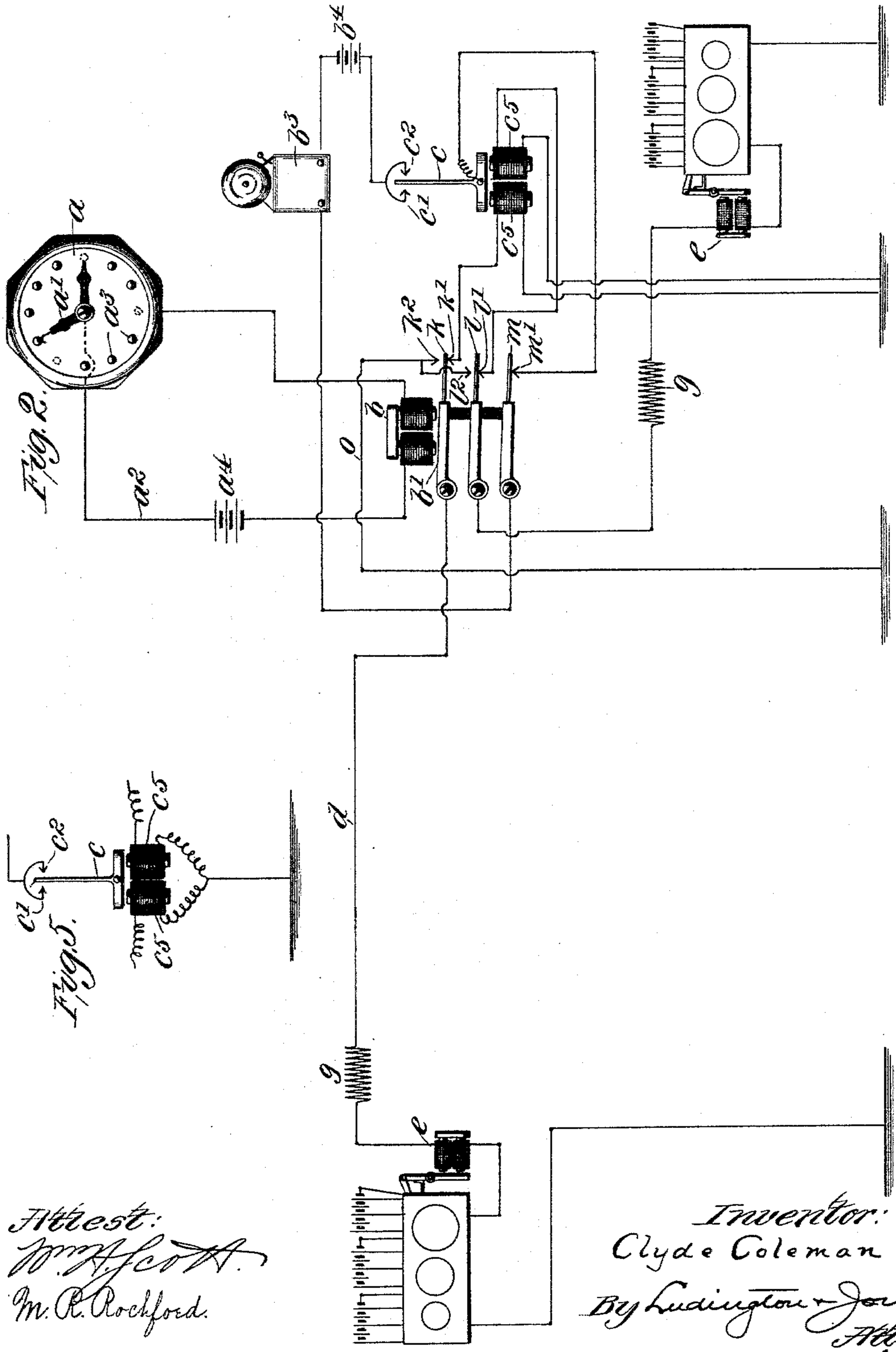

Attest:
W. A. Scott.
M. R. Rockford.

Inventor:
Clyde Coleman
By Ludington & Jones.
Attys.

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. 598,049, dated January 25, 1898.

Application filed December 14, 1896. Serial No. 615,574. (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. 2,) 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 being to provide a system wherein the surreptitious tampering with the circuit may be immediately detected.

My invention relates to that class of burglar-alarm systems wherein responsive mechanism is provided, responding to an abnormal electrical condition on the alarm-circuit to sound an alarm. In some systems a constant current has been maintained in the alarm-circuit by the inclusion of a constant resistance therein, the responsive device remaining quiescent during the flow of the constant current and responding to any change in the strength of the current caused by the cutting out of the resistance or otherwise tampering with the circuit. Such systems have not been effective in checking surreptitious tampering, since the resistance can be measured and a like resistance substituted in a position external to the protected district without disturbing the responsive alarm-sounding mechanism. To overcome this difficulty, systems have been devised wherein the normal electrical condition of the alarm-circuit is not one of the constant character, but is changed at intervals, the responsive device being arranged to remain quiescent under the predetermined periodic changes, but responding to any abnormal changes in the condition of the circuit to sound an alarm.

The present invention belongs to this latter class, and in accordance therewith I provide a producer or source of electromotive force and means for varying the electromotive force thereof in a predetermined manner and associate therewith a responsive device which remains irresponsive to the predetermined variations of electromotive force while responding to any abnormal variations thereof to sound an alarm.

To render the responsive device irresponsive to the predetermined variations of electromotive force, I preferably provide an additional producer of electromotive force, the two being arranged in the same circuit or in individual circuits, while means are provided for varying the electromotive forces in a predetermined manner to maintain their joint effect upon the responsive device constant, whereby the same remains irresponsive during the predetermined changes of the two electromotive forces. One of the variable sources or its counterbalancing device is placed within the protected structure, whereby the system can be defeated only by the substitution or interpolation of an equivalent variable source or counterbalancing device, and as the condition of the circuit within the protected structure is thus constantly changing it is impossible to interpolate an equivalent device in the circuit exterior to the protected structure, as would be possible were the portion of the circuit within the protected structure of fixed value by the provision, for instance, of a fixed source or resistance.

For varying the electromotive forces of the sources or producers of electromotive force I employ devices which I term "multiple permutating devices." Means may be employed, such as a switch-arm, acting to cut in and out certain of the units of electromotive force, as battery-cells; but entire immunity is not afforded thereby against surreptitious tampering with the circuit, since the variations of electromotive force during the cycle may be noted and apparatus constructed and interpolated in the circuit for duplicating the cycle of variations. I prefer, therefore, to employ a plurality of circuit-changers, such as a number of arms moving over contacts, arranged so that a large number of changes or permutations of circuit arrangements may be made not depending upon any single circuit-changing device, but upon the joint action of a plurality of such circuit-changing devices. Such a circuit-changing or electromotive-force-varying apparatus, depending upon a plurality of coöperating electromotive-force-varying devices, I term a "multiple permutating device." The circuit-changing device thus constructed cannot be duplicated without knowing the con-

struction and arrangement of each of the elements thereof, and any readings taken from the circuit indicate only the joint effect of the several independently-acting elements, and from the resultant reading no data can be obtained which will enable the determination of the construction and operation of the several parts of the multiple permutating device, and it is essential to know the operation of the several elements before the apparatus as a whole can be duplicated. By this means the number of variations or permutations may be increased to such an extent that it will require several years for the multiple permutating device to complete one cycle of changes, and it is thus impossible to determine the law of change of electromotive force in order to substitute a false source or producer of electromotive force.

My invention comprehends certain precautionary arrangements of the circuits and apparatus whereby entire immunity against successfully tampering with the alarm is secured, as will be fully set forth hereinafter.

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

Figure 1 is a diagram illustrating my invention in connection with producers of electromotive force arranged in a common circuit. Fig. 2 is a similar diagram showing the producers of electromotive force arranged in individual circuits. Fig. 3 is a diagram of the circuit arrangement of the multiple permutating device for varying the electromotive force. Fig. 4 is a view of the multiple permutating device. Fig. 5 is a modification of the circuit connection of the responsive device.

Like letters refer to like parts in the several figures.

At the central office of the system, or at the point from which the variations in electromotive force are to be controlled, I provide a clock mechanism a, having a hand a', connected to one side of a local circuit a^2 and adapted to make contact with a series of pins or contacts a^3, forming the other terminal of the circuit. When a clock is employed for this purpose, I preferably use the hour-hand as the circuit-closing arm.

In the local circuit are included a battery a^4 and the coils of an electromagnet b. The armature b' of the magnet normally rests against a contact-terminal b^2, the armature and contact being included in an alarm-circuit containing the bell or signal device b^3 and the battery b^4. One end of the circuit is connected with the index-finger or pivoted arm c of the responsive device adapted to make contact with the contacts c' c^2, forming the opposite terminal of the circuit, but normally resting in an intermediate position out of engagement with the contacts c' c^2. The arm c is pivoted at c^3 and carries the armature c^4, resting opposite the electromagnet c^5, which is normally energized to a sufficient degree to attract the armature against the tension of the spring c^6 and maintains the arm c midway between the contacts c' c^2. A weakening of the current traversing the magnet-coil permits the spring to move the arm into contact with the contact c^2, while an increase of the current causes a stronger attraction of the armature, thus moving the arm c into engagement with the contact c'. While I have described one form of the responsive device, other forms may be equally employed.

The coil c^5 of the electromagnet is included in the protective circuit d, which in the present instance is illustrated as a grounded circuit, though it may be wholly metallic. The protective circuit is extended to the protected district and is provided thereat and at the central office with producers of electromotive force. In practice I employ a number of cells of battery, either primary or secondary, and provide the multiple permutating circuit-changers for varying from time to time the number of cells included in the circuit to thus vary the electromotive force of the element. The cells of the two elements may be placed in the circuit, so that their electromotive forces oppose each other, one predominating over the other by a predetermined quantity to maintain a current of a definite value in the circuit. With the elements thus opposed the permutating circuit-changers act to cut cells into both elements alike and to cut the cells therefrom in the same proportion, thus maintaining constant the resultant electromotive force to which the flow of current is due regardless of the number of cells in circuit at any time. I prefer, however, to arrange the cells of the two elements so that their electromotive forces tend in the same direction, in which case the multiple permutating circuit-changers act to cut cells into one element while cutting the same number out of the other, thus maintaining constant the total number of cells in the circuit and thereby maintaining a constant current in the protective circuit.

Any form of circuit-changer may be employed which has the capacity of varying the number of cells or units of electromotive force in the elements, the circuit-changers being arranged to act in unison in varying the electromotive forces of the two elements in like degree directly or inversely to maintain the current flow such that the responsive device will not respond thereto to sound the alarm. In practice, however, for the reason above stated, I prefer to employ multiple permutating devices, and I have illustrated my invention in connection with multiple permutating circuit-changing devices comprising a plurality of switches which coact in producing a large number of arrangements or permutations of the cells of the batteries.

An electromagnet e is included in the protective circuit or in a separate circuit. The pivoted armature e' thereof carries a pawl e^2, which engages the teeth of a ratchet-wheel e^3, carried upon a shaft e^4. Upon the shaft

e^4 is mounted a contact-arm f, adapted to be moved by a series of contact-terminals $f\ f'$. Upon the shaft e^4 is carried a gear-wheel e^5, which meshes with a gear e^6, carried on the shaft e^7. The gear-wheel e^6 also meshes with a gear-wheel e^8, carried on the shaft e^9. Upon the shaft e^7 is carried an arm f^2, moving over a series of contact-terminals $f^3\ f^3$, while upon the shaft e^9 is a contact-arm f^4, moving over a series of contact-terminals $f^5\ f^5$. The contact-arms are arranged to make contact with one terminal before breaking contact with the preceding terminal. The cells or units of electromotive force are arranged as illustrated in three groups, one corresponding to each of the switches or circuit-changing switches. The pole of the first group is connected with the protective circuit, that of the second to the arm f, and that of the third to the arm f^2, the arm f^4 being connected to the other wire of the protection circuit. The contact-terminals of the several switches are connected at intervals with the cells, some being connected with the pole of one cell, while others are connected with other and different cells. Accordingly when the electromagnet e is energized its armature is rocked to advance the pawl e^2 and rotate the several shafts, thus moving the contact-arms $f\ f^2\ f^4$ over the terminals and altering the arrangement of the cells to include a greater or less number in circuit. An arm e^{10}, carried on the armature, engages the teeth of the gear-wheel e^5 when the armature is attracted, to thereby prevent the movement of the gear-wheel through too great a distance due to the impact of the pawl e^2 against the ratchet.

The number of teeth on the gear-wheels e^5 e^6 e^7 are preferably chosen so that the numbers have no common multiple less than that obtained by multiplying the several numbers together. Thus one wheel may have forty-eight teeth, another forty-seven, and another forty-one. The number of terminals should be equal to the number of teeth or the number of teeth should be a multiple of the number of terminals. By so constructing the device the maximum number of permutations or rearrangements of the circuit are secured.

A resistance g is included in the protective circuit in proximity to the variable producer of electromotive force situated at the protected district, thus affording an additional safeguard against tampering with the circuit, since any attempt to substitute a producer of electromotive force without also substituting a resistance will unbalance the circuit and sound an alarm.

For operating the multiple permutating circuit-changers a conductor h is provided joining the protective circuit with the armature b' of the magnet b, and a back contact h' is provided, with which the armature makes contact when attracted, the contact h' being grounded by a conductor h^2. When the armature is attracted, due to the closing of the local circuit by the clock mechanism, circuit is closed over the conductor h, armature b', contact h', and conductor h^2 to ground, thus shunting the coil c^5 of the responsive device and permitting an increased current to flow, due to the shunting of said coil. The magnets $e\ e$ of the circuit-changers, while not responding to the current normally flowing over the protective circuit, respond to the increased current thus produced and actuate the circuit-changers to alter the electromotive force of the elements. The armature b', when attracted, serves also to open the alarm-circuit, thus preventing the alarm from sounding due to the decrease of the current traversing the coil of the responsive device while the circuit-changers are being operated.

In Fig. 2 I have illustrated a different form of my invention, in which the several producers of the electromotive force are arranged in individual circuits or paths instead of being included in a common circuit, the responsive device being provided with a coil in each of the individual circuits and remaining quiescent so long as the currents in the several circuits or paths remain unchanged. The multiple permutating devices are arranged to cut cells into and out of the several elements in like degree, thus maintaining the currents constant.

The armature b' of the magnet b carries three springs $k\ l\ m$, the spring k normally resting against contact k' and closing the protective circuit extending to the protected district. The spring l rests against l' and closes the circuit through the second producer of electromotive force. The third spring m rests against the contact m' and closes therethrough the alarm-circuit. Above the springs $k\ l$ are contacts $k^2\ l^2$, connected with a grounded conductor o. When the armature is attracted, the circuits through the coils of the responsive device are opened, the producers of electromotive force are connected directly to ground through the conductor o, thus decreasing the resistance and permitting increased currents to flow to operate the circuit-changers. At the same time the alarm-circuit is opened by the spring m, thus preventing the sounding of the alarm.

When the sources of electromotive force are placed in a single circuit, they may be arranged to oppose each other, in which case the permutating device varies the same by increasing and decreasing the electromotive forces together. When the sources are arranged to act in the same direction, the permutating device acts to vary the electromotive forces reciprocally—that is, by increasing one and decreasing the other in like degree. When the sources are placed in individual circuits, the permutating device acts to increase and decrease the electromotive forces together. In all of these arrangements the permutating device acts to vary the electromotive forces "correspondingly," and by this term as employed in the claims is contemplated the varying of the electromotive

forces of the several sources in such a manner as to leave the responsive device unactuated.

My invention comprehends, broadly, the employment of a source of electromotive force with means, as a permutating device, for varying the electromotive force, whether the other force to which the responsive device is subjected and which is correspondingly varied so as to leave the responsive device unactuated is a source of electromotive force or other equivalent compensating device.

The multiple permutating device forming an element of some of the claims herein is embraced in its individual capacity in an application, Serial No. 607,129, filed by me September 26, 1896.

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 source of electromotive force within the protected district, of a responsive device controlled thereby, an alarm adapted to be actuated by said responsive device, means for varying the electromotive force of said source, and a compensating device situated at the alarm-station and acting in unison with said electromotive-force-varying means for counterbalancing the effect upon the responsive device of the normal variations of electromotive force to prevent the giving of an alarm during said normal variations, substantially as described.

2. In an alarm system, the combination with a source of electromotive force, of a responsive device controlled thereby, an alarm adapted to be actuated by said responsive device, a multiple permutating device for varying the electromotive force of said source in a predetermined manner, and a compensating device acting in unison with said multiple permutating device for counterbalancing the effect upon the responsive device of the normal variations of electromotive force to prevent the giving of an alarm during said normal variations, substantially as described.

3. In an alarm system, the combination with two or more sources of electromotive force, one of said sources being situated within the protected district and one at the alarm-station, of a responsive device subjected to the influence of several sources of electromotive force, an alarm adapted to be actuated by said responsive device, and means for correspondingly varying the electromotive forces of the sources, whereby the responsive device remains quiescent under the joint action of the several correspondingly-varying electromotive forces, substantially as described.

4. In an alarm system, the combination with two or more sources of electromotive force, of a responsive device subjected to the influence of said several sources of electromotive force, an alarm adapted to be actuated by said responsive device, a multiple permutating device associated with each of said sources of electromotive force, and means for operating said multiple permutating devices in unison to correspondingly vary the electromotive forces and thereby maintain the responsive device quiescent, substantially as described.

5. In an alarm system, the combination with two or more sources of electromotive force, of a responsive device subjected to the influence of said several sources of electromotive force, and an alarm adapted to be actuated by said responsive device, a multiple permutating device associated with each of said sources of electromotive force, and an automatically-operating predetermining mechanism for operating said multiple permutating devices in unison, substantially as described.

6. In an alarm system, the combination with two or more producers of electromotive force, of a responsive device subjected to the combined action of said producers of electromotive force, an alarm controlled by said responsive device, multiple permutating devices associated with said producers of electromotive force for correspondingly varying the electromotive forces thereof, electromagnetic devices included in circuit with said producers of electromotive force for operating said multiple permutating devices and means for altering the resistance to permit an increased current to flow through said electromagnetic devices to operate the same, substantially as described.

7. In an alarm system, the combination with two or more sources of electromotive force, one of said sources being situated within the protected district and one at the alarm-station, of a responsive device subjected to the combined action of said sources, an alarm controlled thereby, means for correspondingly varying the electromotive forces of said sources in a prearranged manner, and a resistance included in the protective circuit in proximity to the source of electromotive force located within the protected district, substantially as described.

8. In a multiple permutating device, the combination with a number of units of electromotive force included in an electric circuit, of two or more series of contact-terminals, the terminals of each series being connected with said units of electromotive force at intervals, and a contact element for each set of terminals moving relatively thereto and engaging the same to connect said units in circuit in varying orders due to the conjoint action of the two contact elements, substantially as described.

9. In a multiple permutating device, the combination with a number of units of electromotive force included in an electric circuit of two or more series of contact-terminals, the terminals of each series being connected with said units of electromotive force at irregular intervals, and a contact element for each set of terminals moving relatively thereto and engaging the same to connect said units in circuit in varying orders due to the

conjoint action of the two contact elements, substantially as described.

10. In an alarm system, the combination with a source of electromotive force, of a responsive device controlled thereby, an alarm adapted to be actuated by said responsive device, means for varying the electromotive force of said source, and a compensating device acting in unison with said electromotive-force-varying means for counterbalancing the effect upon the responsive device of the normal variations of electromotive force to prevent the giving of an alarm during said normal variations, said source of electromotive force and said compensating device being situated one within the protected district and the other at the alarm-station, 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.