

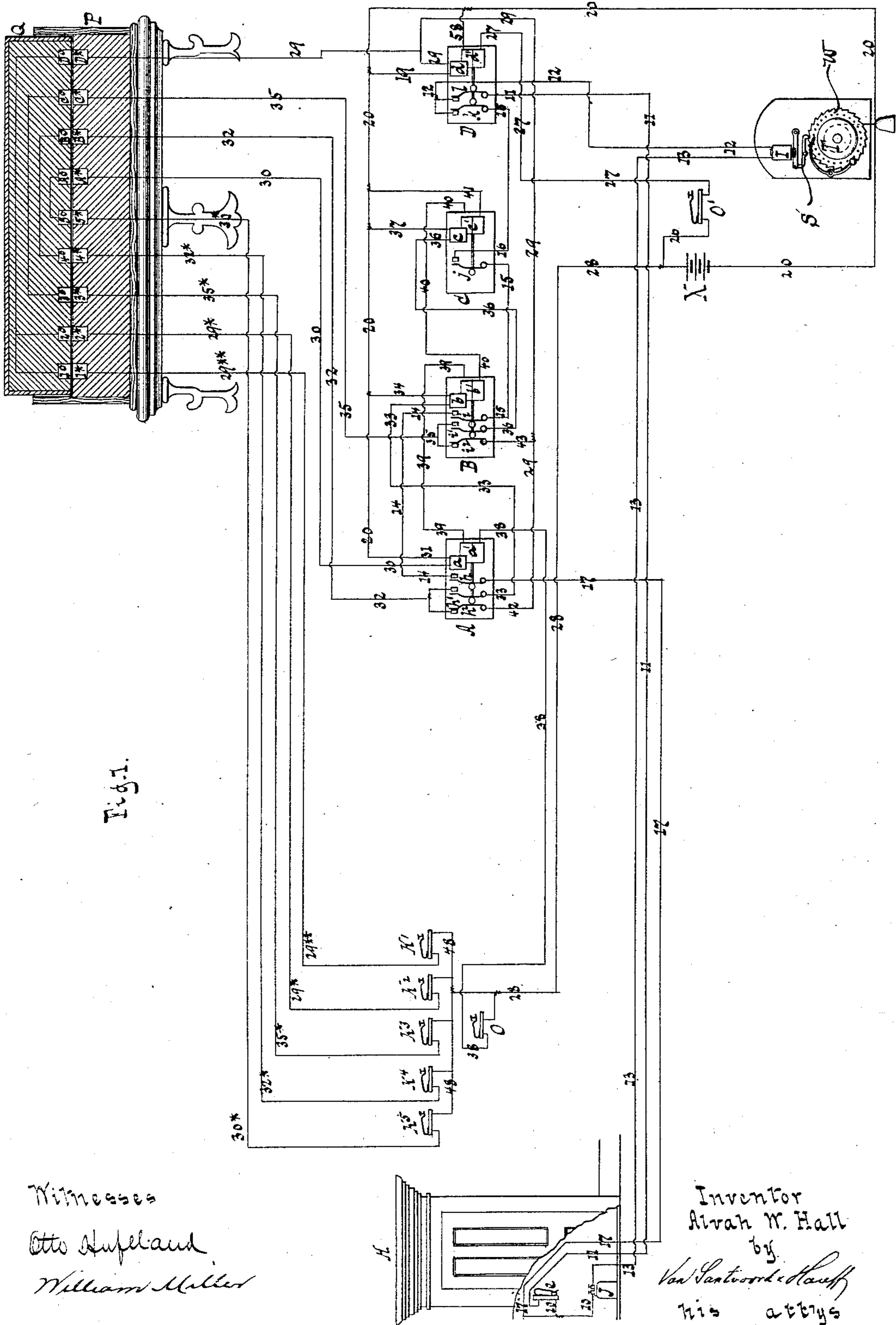
(No Model.)

3 Sheets—Sheet 1.

A. W. HALL.  
ELECTRIC BURGLAR ALARM.

No. 315,139.

Patented Apr. 7, 1885.



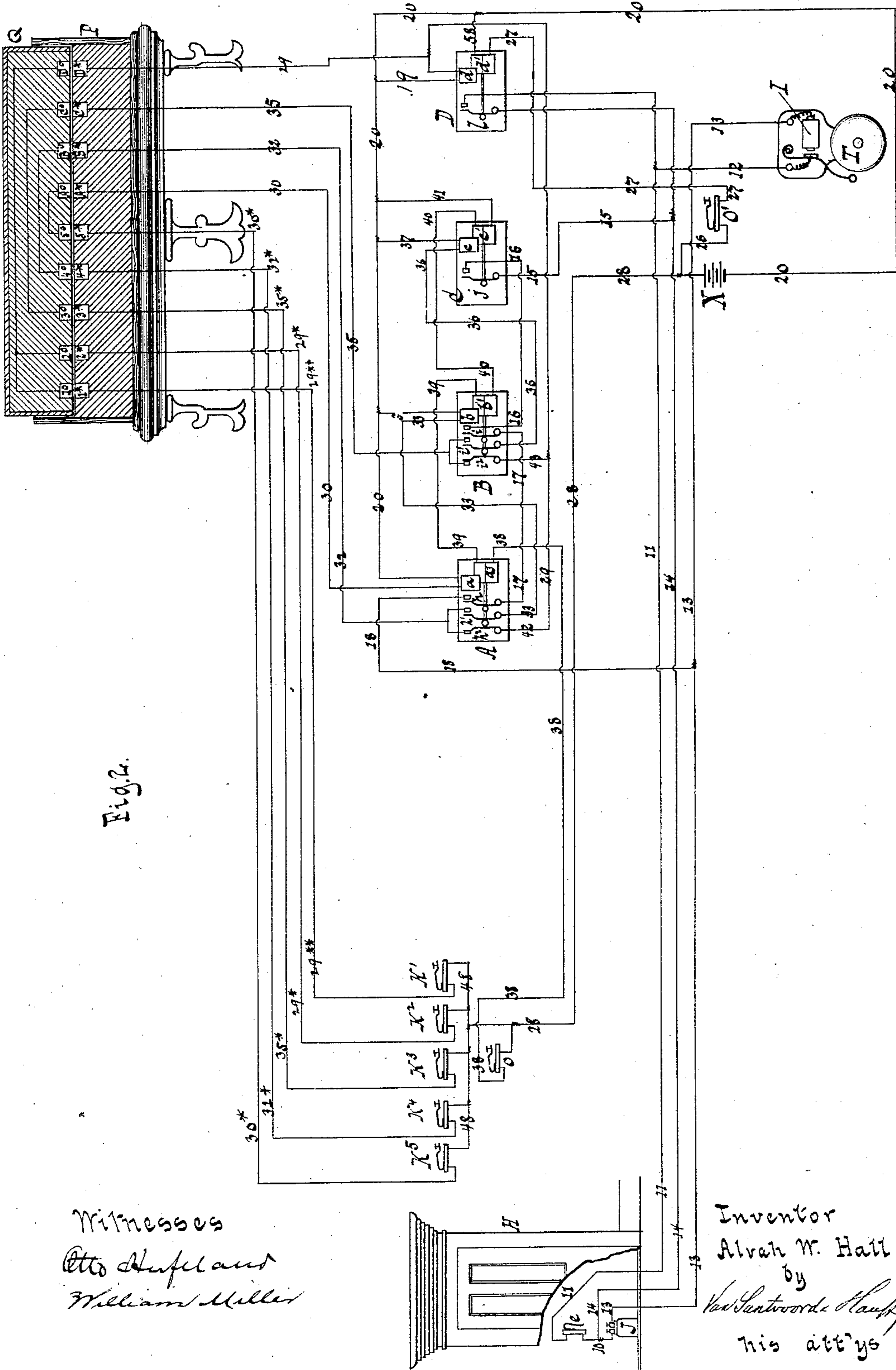
(No Model.)

3 Sheets—Sheet 2.

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(No Model.)

3 Sheets—Sheet 3.

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Fig. 3.

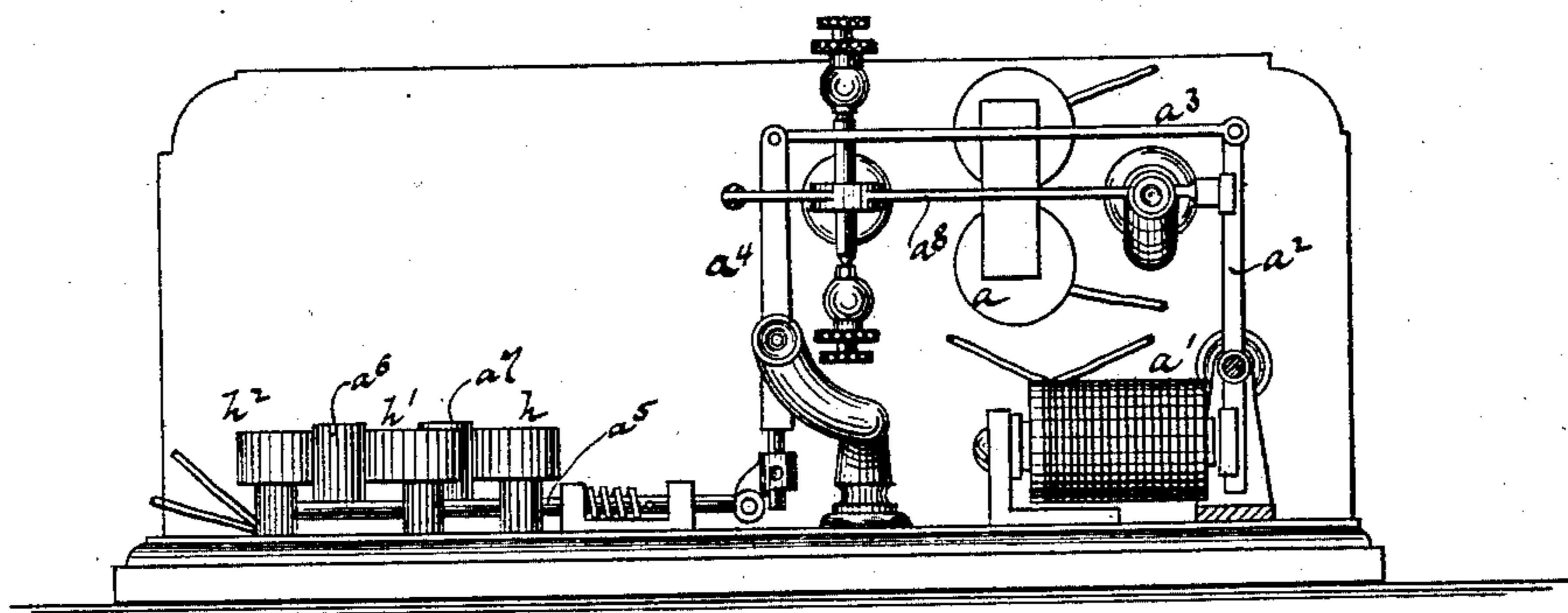


Fig. 4.

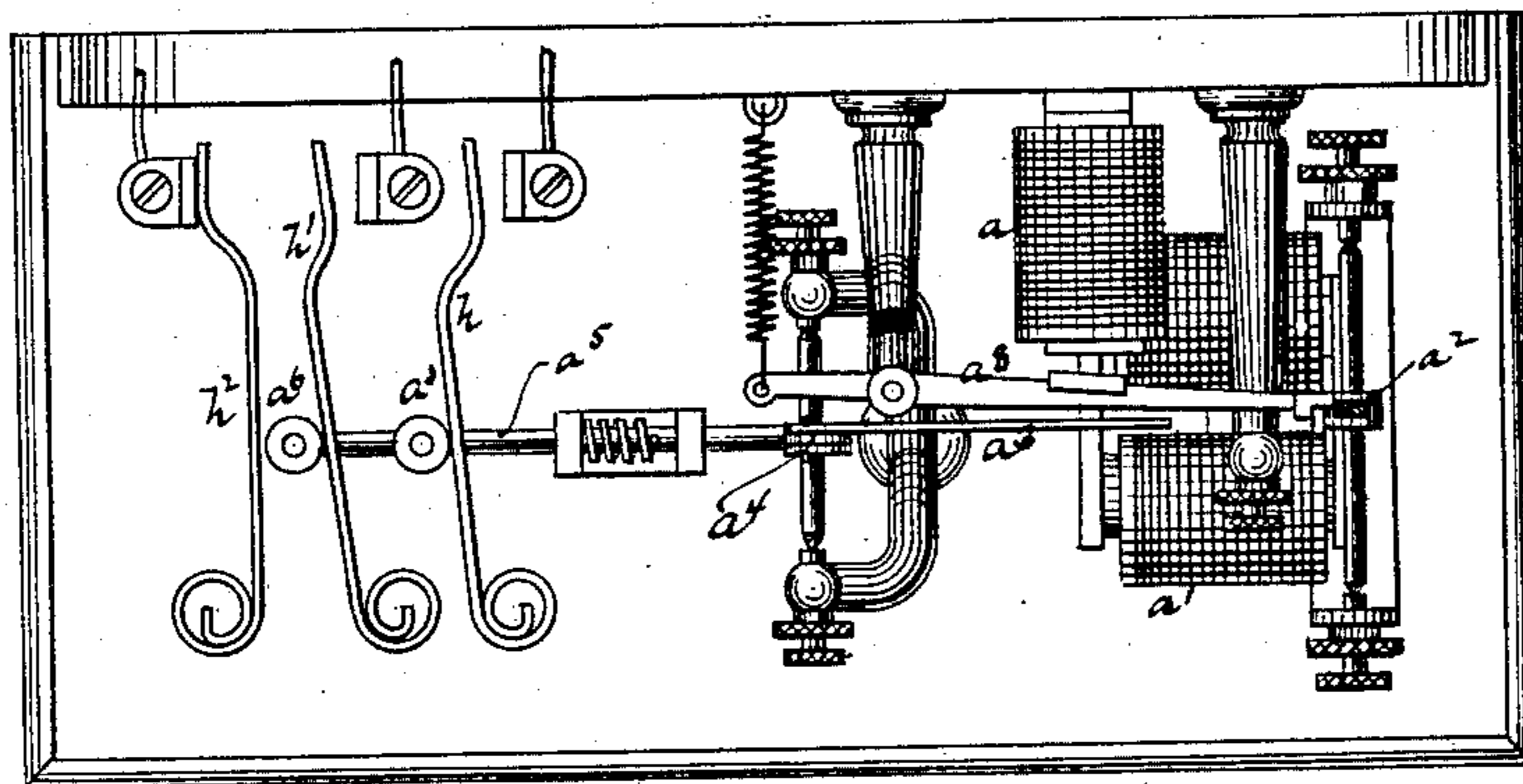


Fig. 5.

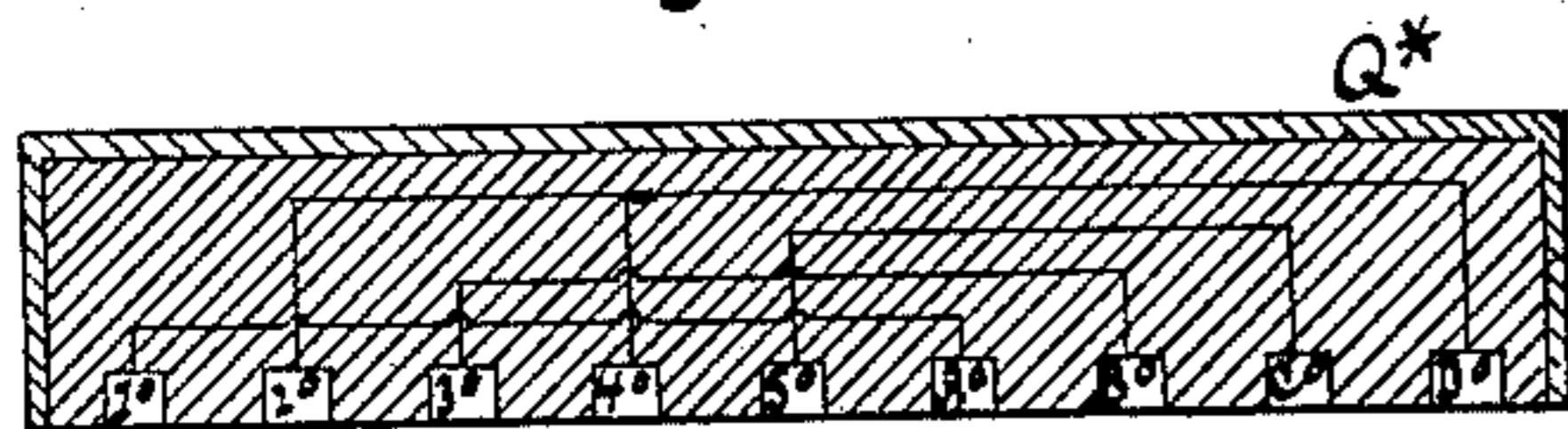
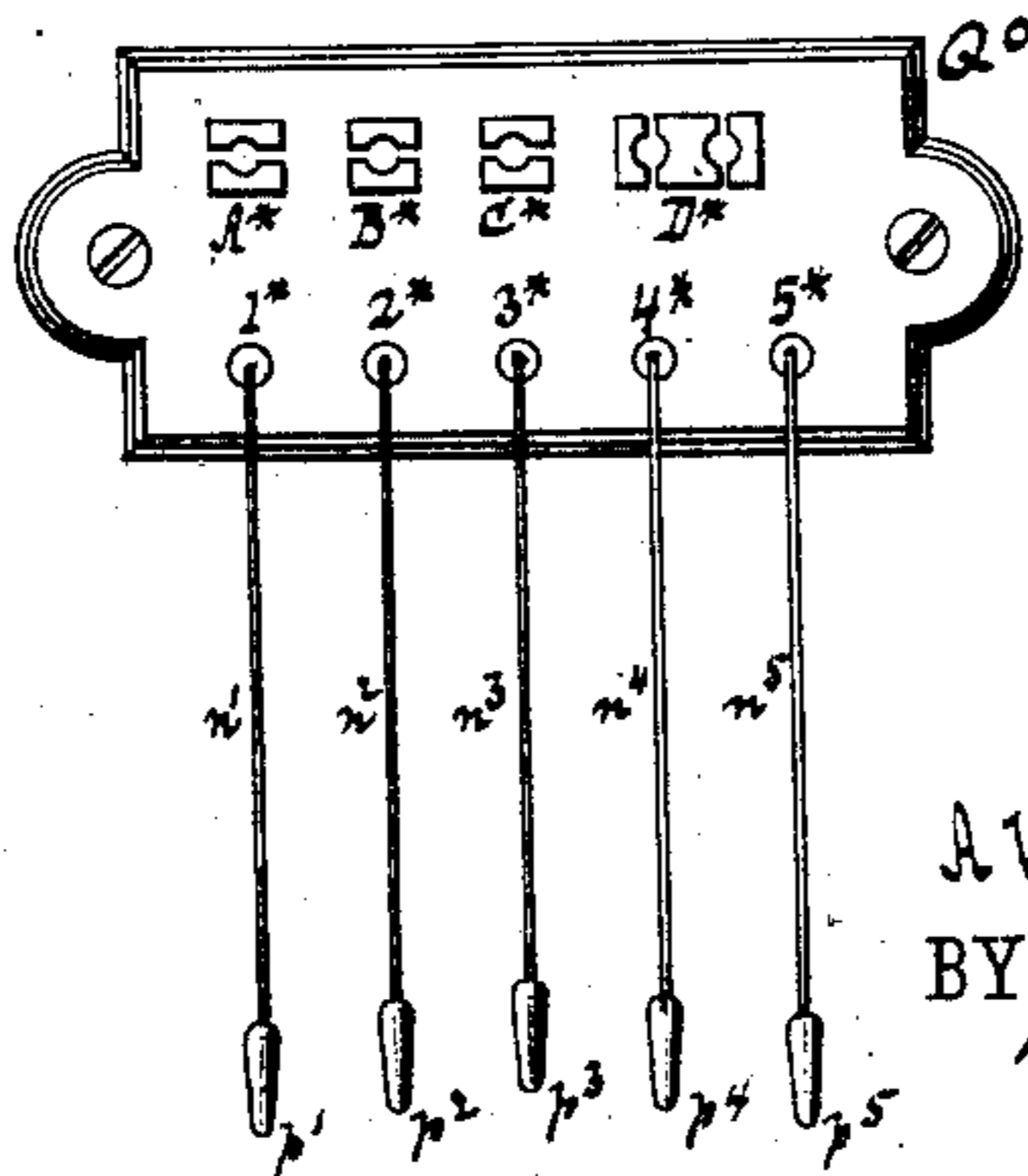


Fig. 6.



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# UNITED STATES PATENT OFFICE.

ALVAH W. HALL, OF MERIDEN, CONNECTICUT.

## ELECTRIC BURGLAR-ALARM.

SPECIFICATION forming part of Letters Patent No. 315,139, dated April 7, 1885.

Application filed August 21, 1884. (No model.)

*To all whom it may concern:*

Be it known that I, ALVAH W. HALL, a citizen of the United States, residing at Meriden, in the county of New Haven and State of Connecticut, have invented new and useful Improvements in Electric Burglar-Alarms, of which the following is a specification.

In what are commonly known as "electrical burglar-alarm systems," the object is to give intimation, by means of an audible or other signal at a given point, of any attempt to open a door, or in any way to gain access to the structure or receptacle which it is intended to protect against intrusion.

The applications of the system, while numberless, involve generally a circuit between the structure or receptacle to be guarded and the place where the signal is to be given, which circuit is broken or closed or otherwise affected by the act of or attempt at intrusion, and so caused to sound the alarm. For example, the doors and windows of a building are provided with circuit making or breaking devices, so that any movement of them operates the said devices and gives an alarm in a certain room in the building, or at some distant station communicating by an electric circuit with the building. In the same way the doors of safes, the lids of boxes or chests, and, in fine, all kinds of receptacles, are protected, so that unwarrantable intrusion cannot be effected without sounding an alarm at some more or less remote point.

To this system, in all of the various applications above described, my present invention is applicable, the main object of the same being to give instant warning at any predetermined point of the unauthorized entrance of or access to any electrically-protected building, safe, or other receptacle, and to provide a means whereby those authorized to open the doors of the protected structure may do so without sounding the alarm.

In carrying out my invention I make use of a double circuit or system of circuits between the protected structure and the signal-station, one portion of such system being utilized, as is now done, for the transmission of signals; the other for controlling the first in such manner as to produce or to prevent the signal which gives intimation of the en-

trance to the protected structure, or any unauthorized tampering with the devices, the manipulation of which is a necessary preliminary to such entrance.

The signaling-circuit and apparatus connected therewith may be generally similar to any now used—that is to say, it comprises a battery, an alarm, and some device which is operated or brought into operation by a movement or displacement of that portion of the protected structure to which it is or may be applied.

The controlling-circuit, on the other hand, contains suitably constructed and applied apparatus to prevent the sounding of the alarm by the action of the devices connected with the protected structure, and keys or contact-makers at or in the vicinity of the protected structure so arranged that by a proper manipulation of the same the signal is prevented, but by an improper manipulation the signal is produced. My object in this is that the proper manipulation of the aforesaid keys or contacts may be a secret known only to the person or persons authorized to open the protected structure or receptacle, so that any one else in attempting either to prevent the sounding of the alarm or to enter the structure will at once set the alarm in action.

From the nature of the case it is evident that to afford adequate protection there must be a secret means of reaching or using the controlling-circuit. The number of such means is practically unlimited; but in describing more in detail the nature of the invention I shall describe only the special means which I employ in practice, and which I regard as the most practicable and efficient, and which consists of a series of electrically-controlled circuit-closers similar in principle to relays, which, together with the keys and circuit-connections, form an electrically-controlled combination, analogous in theory to those used in certain mechanical locks. These devices, which for convenience will be herein designated "double-circuit instruments," are arranged in such manner that through the instrumentality of one of the series the sounding of the alarm is prevented, whether by making or breaking the alarm-circuit, by shunting the current around the alarm-mag-

nets, or by such similar action as the case may require; but such condition or operation of the said instrument can only be maintained or effected by the previous operation of one of the others, or by more than one in a predetermined order, and the keys or contacts are connected with the several double-circuit instruments, so that this may be done; but if the wrong key be depressed the combination is disarranged and the alarm is sounded. This combination of keys and circuit-controlling instruments may be employed not only for sounding and preventing an alarm, but for a great number of other useful purposes, and constitutes an important feature of my invention.

In order to increase the utility of the system, I employ what I term a "key," to be used between the contact-keys and the double-circuit instruments for varying the combination. A general description of this is that it consists of a certain number of contact-surfaces connected by cross-wires in different ways, so that when used with the contact-keys the order of keys to be depressed to produce the proper operation of the double-circuit instruments will vary. By the use of these keys the combination can be varied from time to time.

In the accompanying drawings I have illustrated the general character and arrangement of the best means of which I am at present aware by which the invention is carried out, and also the specific construction and arrangement of certain details.

Figure 1 is a general plan of the system, involving the use of a normally-closed signaling-circuit. Fig. 2 is an illustration of the system containing a normally-open signaling-circuit. Fig. 3 is a side elevation of one of the double-circuit instruments which I employ. Fig. 4 is a plan or top view of the same. Fig. 5 is a sectional view of a detachable combination-key; Fig. 6, a plan of a modified form of the same.

Let H represent a structure or receptacle to be protected, and provided with a circuit-breaker, *e*, which may be of any ordinary description, and arranged to interrupt the circuit with which it is used when the door of the structure is moved. From this circuit-breaker run wires 10 11 13 to a station at which is located an alarm, the electro-magnet I of which is in the circuit of which these wires form a part. A galvanic battery, J, is also connected with these wires, and furnishes the current that operates the magnet I. In Fig. 1 the magnet controls a mechanical bell, T, this being done by connecting the armature of the magnet with a detent, S, that engages with the wheel W when the magnet is active, and which is thrown out of gear with the wheel when the magnet is inactive.

At the alarm-station are located a series of double-circuit instruments, A B C D, the number being an arbitrary one, as will hereinafter more fully appear. In principle of

operation these instruments are similar to that described by me in a patent granted September 11, 1883, No. 284,840.

In Figs. 3 and 4 the details of instrument A are illustrated. Referring to said figures, *a'* designates one electro-magnet. *a*<sup>2</sup> is its armature-lever, which connects by a rod, *a*<sup>3</sup>, with a lever, *a*<sup>4</sup>, the lower end of which connects with a rod, *a*<sup>5</sup>, which carries two roller-studs, *a*<sup>6</sup> *a*<sup>7</sup>.

The letter *a* designates another magnet, the armature-lever *a*<sup>8</sup> of which serves to lock the armature-lever of the magnet *a'* whenever the latter, being rendered active, moves or shifts its armature. The armature *a*<sup>2</sup> is held by the lever *a*<sup>8</sup> until magnet *a* is energized. When the circuit of magnet *a'* is closed, the roller-stud *a*<sup>6</sup> closes the front contact-spring, *h*<sup>2</sup>, while the back contact-springs, *h'* *h*, remain off their stops, and this condition is maintained after the interruption of the circuit of magnet *a'*, and until the magnet *a* is energized. Then the armature-lever *a*<sup>2</sup> falls back, the front contact-spring leaves its stop, and the back contact-springs, *h'* *h*, are brought into contact with their stops.

Instruments C and D differ from that described only in this respect, instrument C has a single back contact-spring, *j*, only, and the instrument D has two front contact-springs, *k* *l*, only. Instrument B is in all respects similar to that designated A.

The magnets *a'* *b'* *c'*, which may be regarded as the main magnets, are in a branch, 38 39 40 41 20, of the controlling-circuit 28, that runs to some point near the protected structure H. The main portion 28 of this circuit contains a battery, X, and is connected with the several branches that form the return-circuit by keys or contact-makers. The key O connects it with the branch 38, 39, 40, 41, and 20, which contains the magnets *a'* *b'* *c'*, and this key is depressed so as to energize the magnets and lock their armatures, in order to set the apparatus or bring it into operative condition.

A branch, 26, 27, 58, and 20, containing a key, O', includes the magnet *d'*, and is to be closed at the outset, or after the alarm has been sounded, in order to set the instrument D and complete the signaling-circuit through the wires 10, 11, and 12 and spring *l*.

In order to permit the door of the structure H to be moved without sounding the alarm, I place in the vicinity of the structure a certain number of keys or contact-makers, *k'* *k*<sup>2</sup>, &c., one of the points of each being connected with the battery X by wires 28 48. From the other points or contacts run wires 30<sup>x</sup>, 32<sup>x</sup>, &c., back to the double-circuit instruments and through the connections of a combination-key, when so desired. A wire, 17, runs from the wire 10 to the first of the series of double-circuit instruments. This wire forms a branch of the circuit from battery J around the circuit-breaker *e*, and when in connection with wire 12 the magnet I remains energized when the circuit through wire 11 is inter-

rupted. The object in the present case, then, is to extend through the series of double-circuit instruments a path for the current between wires 17 and 12. Assume that the connections be such that keys  $K^5$ ,  $K^4$ , and  $K^3$  must be depressed in the order named to operate first the instrument A, then B, and finally C. The operation is as follows:

Depressing key or contact  $K^5$  closes the branch  $30 \times 30 \times 20$ , which includes the secondary or releasing magnet of instrument A. Normally the strip or spring  $h^2$  of this instrument is in contact with its stop and springs  $h$   $h'$  out of contact with their respective stops; but as soon as magnet  $a$  is energized this condition of things is reversed. Wire 17 is connected to spring  $h$ , so that it is brought into connection with a wire, 14, leading to instrument B, and the wire 32 of the branch, including key  $K^4$ , is connected by spring  $h'$  with wire 33. Key  $K^4$  is then depressed. This completes the circuit through the branch  $32 \times 32, 33, 34$ , and 20, energizes magnet  $b$  of instrument B, connects wires 17 and 14 with wire 25 through spring  $i$  and wire 35 from key  $K^3$  with wire 36. By depressing then key  $K^3$  the circuit is completed through branch  $35 \times 35, 36, 37$ , and 20, and magnet  $c$  of instrument C energized. This connects wire 15 with wire 16, which completes the circuit 12, 13, 10, 17, 14, 15, and 16, through spring  $k$  of instrument D. A circuit through magnet I and around the circuit-breaker  $e$  being thus formed, the structure H may be opened without sounding the alarm-bell T. When the building or receptacle is closed, the combination is sent by depressing key O, which energizes magnets  $a' b' c'$  and reverses the order of connections, as above described.

If any other key than those designated  $K^5$   $K^4$   $K^3$  be depressed in attempting to operate the combination, or if these keys be depressed in the wrong order, the result will be the sounding of an alarm. For instance, if after depressing key  $K^5$ , a key, as  $K^2$ , be touched instead of key  $K^4$ , the branch  $29 \times 29$ , and 20, including the magnet  $d$  of instrument D, is closed, the springs  $h$   $l$  carried away from their stops, the circuit of magnet I broken, and the alarm sounded. So, if one of the keys, as  $K^4$ , be depressed out of its proper order, the branch  $32 \times 32, 42, 29$ , and 20 is closed through the spring  $h^2$  of instrument A and the alarm sounded. These examples serve as illustrations of the working of the system. After the magnet  $d$  has broken the alarm-circuit the circuit is closed again by key O', that controls a circuit, 26 27 58 20, including the main magnet  $d'$ .

In order to provide for different combinations, the wires 30, 32, 35, and 29 are connected with terminals  $A \times B \times C \times D \times$ , set in a suitable insulating base or support, P, and the wires  $30 \times, 32 \times, 35 \times, 29 \times$ , and  $29 \times \times$  connected with other terminals,  $1 \times 2 \times 3 \times 4 \times 5 \times$ . The special manner of supporting or arranging these terminals may be greatly varied, it be-

ing only necessary to place them so that by means of what I term a "key" the proper connections between wires  $30 \times 30 \times 32 \times 32$ , &c., may be readily and easily made. This key consists of a metal holder, 2, filled with an insulating compound and having terminal plates or pins corresponding in number and position to the terminals in the base P. These terminals are connected by wires embedded in the insulating material in different ways, according to the combination it is desired to form. If the combination is to be a certain number, the connections are so made between terminals  $1^0 2^0 3^0 4^0 5^0$ , which come in contact with the terminals connected with the wires from the keys and terminals  $A^0 B^0 C^0 D^0$ , which rest on  $A \times B \times C \times D \times$  respectively, that the plate or terminal bearing the figure which corresponds to the operating-key which has to be closed first must be connected to plate  $A^0$ , the plate bearing the figure of the operating-key which has to be closed next must be connected to the plate  $B^0$ , and the plate bearing the figure of the operating-key which has to be closed last must be connected to plate  $C^0$ , while the two remaining plates bearing figures in the combination-key are connected to plate  $D^0$ . In Fig. 1, according to this arrangement, the combination is 543, while in Fig. 5 the connections are made to form the combination 135.

Instead of the permanent key, I can use the variable key 2<sup>0</sup>, shown in Fig. 6. In this key, the metallic plates or terminals  $1 \times 2 \times 3 \times 4 \times 5 \times A \times B \times C \times D \times$  are connected to the operating-keys  $K^1 K^2 K^3 K^4 K^5$ , and to the double-circuit instruments A B C D, precisely as shown in Fig. 1; but in addition thereto the plates  $1 \times 2 \times 3 \times 4 \times 5 \times$  are also connected by flexible cables  $n^1 n^2 n^3 n^4 n^5$  with metallic plugs  $p^1 p^2 p^3 p^4 p^5$ , and the plates  $A \times B \times C \times$  are provided each with one hole, while the plate  $D \times$  has two holes, all said holes being of such a size that the plugs can be readily and snugly inserted into them.

In order to adjust the key to the combination 543, for example, plug  $p^5$  into plate  $A \times$ , plug  $p^4$  into plate  $B \times$ , plug  $p^3$  into plate  $C \times$ , and plugs  $p^1 p^2$  into the plate  $D \times$ .

It will be understood from the foregoing description that the number of figures constituting a combination is practically unlimited. As an instance of one single arrangement, suppose a number of operating-keys or contacts are used and only one of the number is to be used for preventing the alarm, it would be necessary to use only two double-circuit instruments. The operating-key bearing the figure corresponding to that selected as the combination would connect with the first double-circuit instrument, and the circuits from all the other keys would run to the second double-circuit instrument. In order to open the receptacle without sounding the alarm, the proper key must be depressed. If any other key is depressed, the alarm will be sounded. In the same manner if it is desired to use two

keys to make the combination, three double-circuit instruments would be used, which should be connected upon the same principle as described. By increasing the number of  
5 keys and the number of the double-circuit instruments an unlimited number of combinations may be provided for.

In Fig. 2 the system as arranged for controlling a normally-open signal-circuit is illustrated. The devices employed are practically  
10 the same as in case of a closed signaling-circuit, the distinction being mainly in a different arrangement of circuits and connections.

On moving the door of the structure H the  
15 alarm is sounded by the completion of circuit through wires 10 11 12 13; but to prevent this the instrument C is adapted to shunt out the alarm by closing the circuit between wires 13 and 14—the latter a branch from wire 10—  
20 through wire 18, connecting wire 13 and the stop of spring *h* of instrument A, wire 17 connecting spring *h* with the stop of spring *i* of instrument B, wire 16 connecting stop of spring *i* with the stop of the single spring of instrument C, and wire 15 connecting this spring  
25 with wire 14. The instrument D has but one contact-spring, *l*, and one stop. Wires 14 and 11 connect, respectively, with the spring and its stop, so that if the magnet *d* be energized,  
30 and the spring and stop thereby brought into contact, the circuit through the bell-magnet is closed.

The method of operating this system is the same as that above described with reference to  
35 Fig. 1, the depression of the wrong key acting to release the armature of magnet *d'* and close the circuit of the bell-magnet.

It is obvious that the series of double-circuit instruments may be employed for controlling  
40 or sounding the alarm in a great variety of ways; nor is the use of these devices confined to this particular purpose alone, as it is evident that they may be employed under many and various conditions for operating or  
45 controlling the operation of other devices, whether electrical or mechanical, wherever the ability to operate or control the operation of such devices involves a knowledge of a pre-arranged manipulation of the intermediate  
50 mechanisms for bringing them into the proper relations for obtaining the desired result. In all cases it will be observed that the final instrument of the series, or that designated by the letter D, while it performs no part directly  
55 in the control of the alarm or other device, operates as a check on the improper manipulation of the devices composing the combination.

As I have before stated, the device connected  
60 with the structure or receptacle to be protected may be a simple circuit-breaker or contact-maker, or any instrument that affects the electrical conditions of a circuit to a degree sufficient to operate an alarm either directly  
65 or indirectly.

The exact point at which the double-circuit instruments are connected into the controlling-

circuit is evidently a matter determined by the conditions of particular cases.

I am aware that it has been proposed to include in a burglar-alarm circuit a device for  
70 preventing the alarm from being sounded when the structure protected by the circuit is opened, such device being in the nature of a combination-lock, or a mechanism the proper  
75 manipulation of which is a secret, and which when properly operated maintains that portion of the circuit that includes the alarm either open or closed, as the case may be, so that the operation of opening the protected  
80 structure has no effect upon the alarm. The nature and objects of my system are, however, widely different from this.

I may also state that what for convenience is herein designated as a "station" may be such  
85 as is generally used at present as a signal-station, or any room or place more or less remote from the protected structure.

What I now claim as my invention is—

1. The combination, with a structure or receptacle to be protected and an alarm or signal station, of two electric circuits connecting  
90 the same, burglar-alarm mechanism in one of said circuits and electro-magnetic mechanism in the other, and means for operating the same arranged to control the operation of the alarm,  
95 substantially as herein set forth.

2. The combination, with a structure or receptacle to be protected and a signal-station,  
100 of two electric circuits connecting the same, of burglar-alarm mechanism included in one circuit, a series of co-operating electro-magnetic instruments, and means for operating the same connected with the other circuit and  
105 arranged to control the operation of the alarm mechanism, substantially as herein set forth.

3. The combination, with a structure or receptacle to be protected and a signal or alarm  
110 station, of two electric circuits connecting the same, of burglar-alarm mechanism in one circuit, a series of electro-magnetic circuit-closers, and keys or contact-makers in branches of the other circuit for controlling the alarm-circuit, and electrical connections so formed  
115 that a predetermined order of operation of the circuit-closers is necessary to prevent the sounding of the alarm, as and for the purpose specified.

4. The combination, with a structure or receptacle to be protected and a signal or alarm  
120 station, of two electric circuits connecting the same, burglar-alarm mechanism in one circuit, a series of double-circuit instruments and keys or contact-makers for operating the same included in branches of the other circuit, and  
125 electrical connections to one of said instruments so arranged that its operation sets the alarm in action, and to the other instrument or instruments so arranged that the proper operation of the same prevents the alarm from  
130 sounding, as and for the purpose specified.

5. The combination, with a structure or receptacle to be protected and a signal or alarm station, of two electrical circuits connecting

the same, burglar-alarm mechanism included in one of said circuits, a series of double-circuit instruments and keys or contact-makers in branches of the other circuit, and electrical connections between the several instruments, and between the instruments and the alarm mechanism, as herein described, whereby the successive operation of the instruments in a predetermined order is necessary to prevent the sounding of the alarm, as and for the purpose set forth.

6. The combination, with a structure to be protected and a signal or alarm station, of two circuits connecting the same, burglar-alarm mechanism in one of said circuits, a series of double-circuit instruments and keys or contact-makers for controlling the alarm and included in branches of the other circuit, of a detachable key for varying the connections between the contact-makers and the double-circuit instruments, whereby the order of operation of the contact-makers for operating the double-circuit instruments in a given order may be varied, as and for the purpose set forth.

7. The combination, with an electrically-operated mechanism, of a series of double-circuit instruments for controlling the same, the said instruments being electrically connected in such manner that they must be successively operated in a given order to secure the control of the said mechanism, substantially as herein described.

8. The combination, with an electrically-operated mechanism, of a series of double-circuit instruments for controlling the same, the said instruments being electrically connected in such manner that they must be successively operated in a given order to secure the control of the said mechanism, and a double-circuit instrument electrically connected with the mechanism to be controlled and the double-circuit instruments in such manner that the operation of one or more of the latter out of a given order severs connection between the mechanism to be controlled and the double-circuit instruments, as set forth.

9. The combination, with an electrically-operated mechanism, of a series of double-circuit instruments for controlling the same electrically connected to form a combination, or a system in which the several instruments must be operated successively in a given order to secure the control of the said mechanism, and a double-circuit instrument electrically connected with the controlling-instruments in such manner that the operation of the latter out of a given order disarranges the combination, as and for the purpose set forth.

10. The combination, with an electrically-controlled mechanism in one circuit and a series of double-circuit instruments and keys or contact-makers adapted to control the said mechanism, and included in branches, of a second circuit and electrical connections through the instruments so arranged that the said instruments must be successively operated in a

given order to secure the control of the said mechanism, as and for the purpose set forth.

11. The combination, with an electrically-operated mechanism in one circuit, of a series of double-circuit instruments, and keys or contact-makers for operating the same, connected with branches of a second circuit, electrical connections so arranged that the double-circuit instruments must be operated successively in a given order to secure control of the said mechanism, and detachable combination-keys or sets of contacts electrically connected for varying the connections between the keys or contact-makers and the double-circuit instruments, as and for the purpose set forth.

12. The combination, with an electric circuit and burglar-alarm mechanism connected therewith, of a second or controlling circuit divided into a number of branches, double-circuit instruments electrically connected together and to the alarm-circuit, and included in the branches of the controlling-circuit, keys or contact-makers in other branches of the circuit, and a combination-key or set of electrically-connected contacts for connecting the branches containing the contact-makers with those containing the double-circuit instruments, as and for the purpose set forth.

13. The combination, with branches of an electric circuit, of a series of electro-magnetic instruments, each of which, when operated by an electric current, closes a normally-open path or circuit, contact-makers or keys for operating said instruments, and electrical connections between said instruments arranged to form an electrically-operated combination, or a system in which the instruments to be all operated must be operated successively in a given order, substantially as herein set forth.

14. The combination, with an electric circuit divided into a number of parts or branches, of a series of co-operating electro-magnetic instruments connected with a portion of said branches, circuit-connections between the instruments forming an electrically-operated combination, keys or contact-makers included in other branches of the circuit, and combination-keys for connecting in different orders the branches containing the keys with those containing the instruments operated by the same, as and for the purpose set forth.

15. The combination, with the alarm-circuit and an electro-magnetic alarm connected therewith, of a second or controlling circuit, a series of double-circuit instruments connected with branches of the same and arranged to control the alarm-circuit, operating-keys or contact-makers in branches of the circuit connected with the secondary or releasing magnets of the double-circuit instruments, and a restoring or setting key in a branch of the circuit including the main magnets of all the instruments, as and for the purpose set forth.

16. The combination, with the alarm-circuit and an electro-magnetic alarm connected therewith, of a second or controlling circuit, a se-

ries of double-circuit instruments connected with branches of the same and arranged to control the alarm-circuit, operating-keys or contact-makers in branches of the circuit connected with the secondary or releasing magnets of the double-circuit instruments, a restoring or setting key in a branch including the main magnet of one of said instruments, and a restoring or setting key in a separate branch including the main magnets of all the others of the series, as and for the purpose set forth.

17. The combination-key herein described, consisting of a metal holder filled with insulating material, and contact points or plates embedded in the material, a portion of the plates being connected together in pairs, and the rest in a group of three or more, as set forth.

18. The combination, with the key containing a number of contact-plates connected together partly in pairs and the rest in a group, of a socket or lock for the same containing contact-plates corresponding in number and position with those in the key, as set forth.

19. A burglar-alarm system comprising the following elements combined and arranged in the manner specified: a structure to be pro-

tected containing a circuit-breaker or equivalent, a signal or alarm station containing an electro-magnetic alarm operated by the movement of the part of the structure to be protected with which the circuit-breaker is connected, a second or controlling circuit, keys or contacts located in the vicinity of the structure to be guarded and included in branches of the controlling-circuit, a series of double-circuit instruments at the signal-station in branches of the controlling-circuit connected with those containing the keys, electrical connections between said instruments, a branch of the alarm-circuit controlled by the instruments for preventing or sounding the alarm, and branches of the controlling-circuit containing keys for restoring or resetting the double-circuit instruments after they have been operated.

In testimony whereof I have hereunto set my hand and seal in the presence of two subscribing witnesses.

ALVAH W. HALL. [L. S.]

Witnesses:

W. HAUFF,  
E. F. KASTENHUBER.