G. F. MILLIKEN & F. W. COLE.

AUTOMATIC FIRE ALARM, BURGLAR ALARM, AND TELEPHONE SYSTEM.

APPLICATION FILED OCT. 16, 1905.

904,550.

Patented Nov. 24, 1908.

3 SHEETS—SHEET 1.

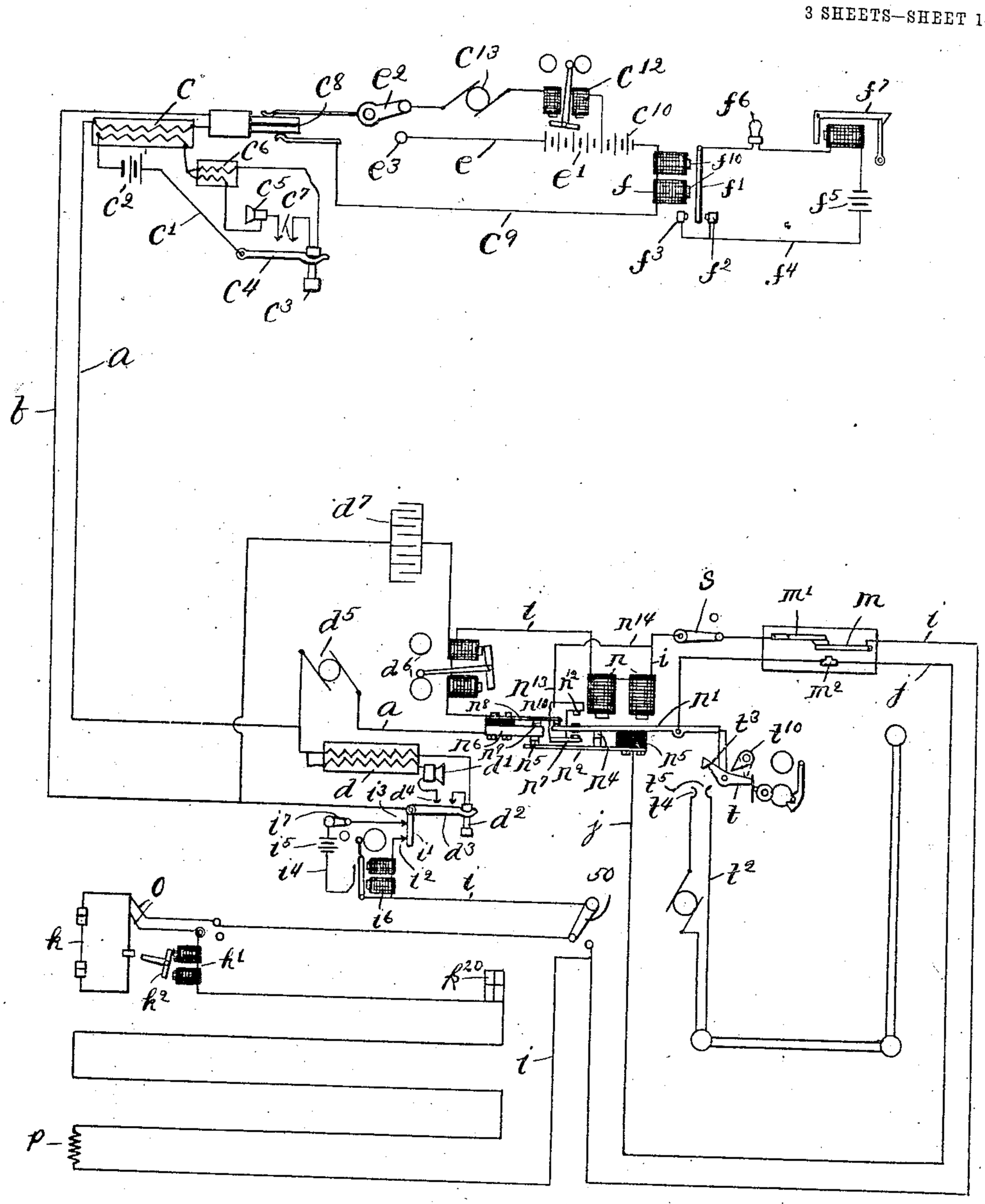

Fig. 1.

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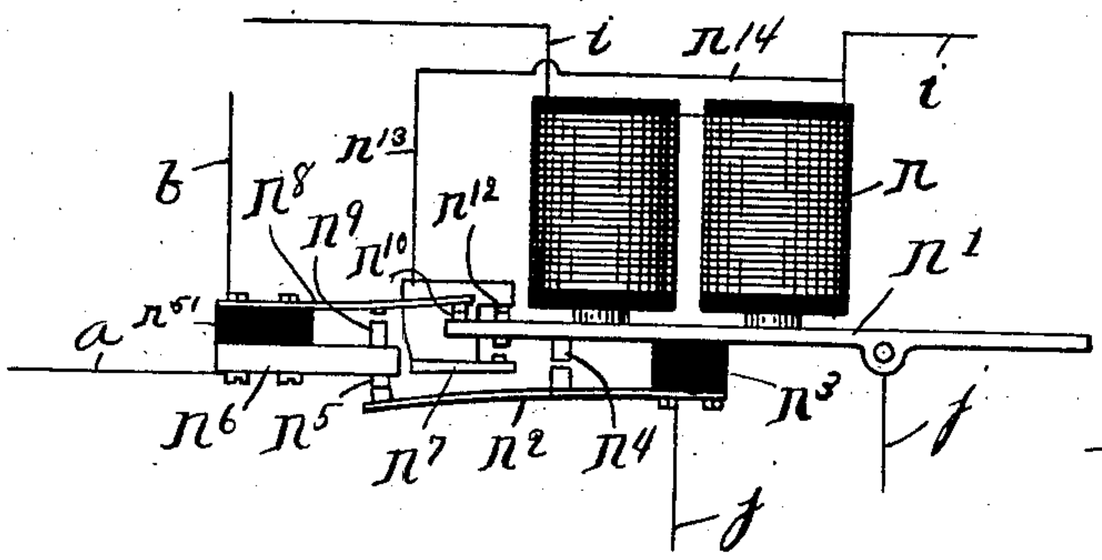

Fig. 2.

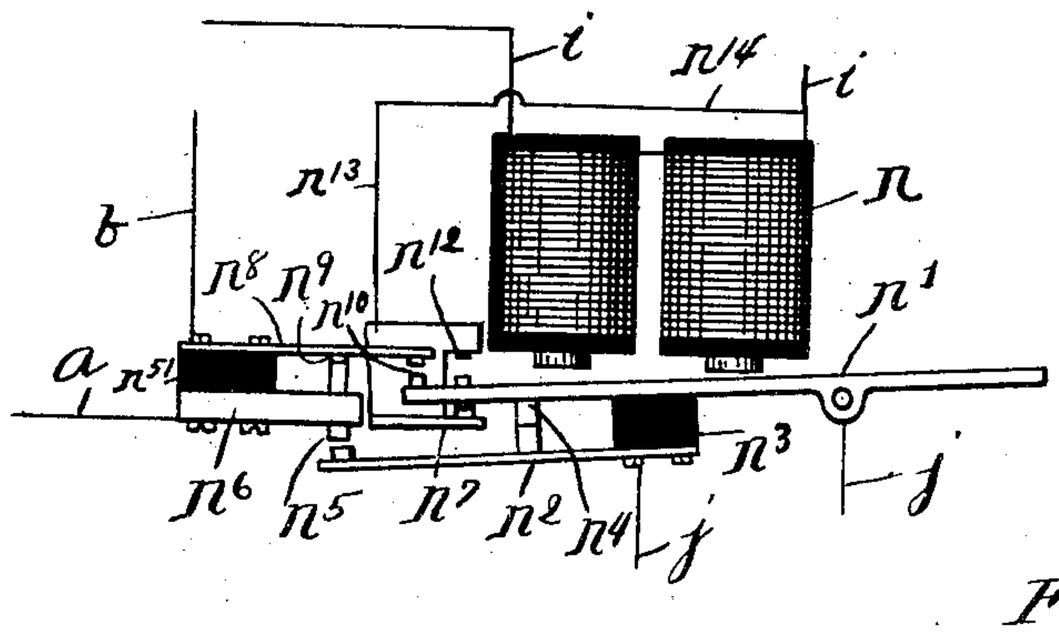

Fig. 3

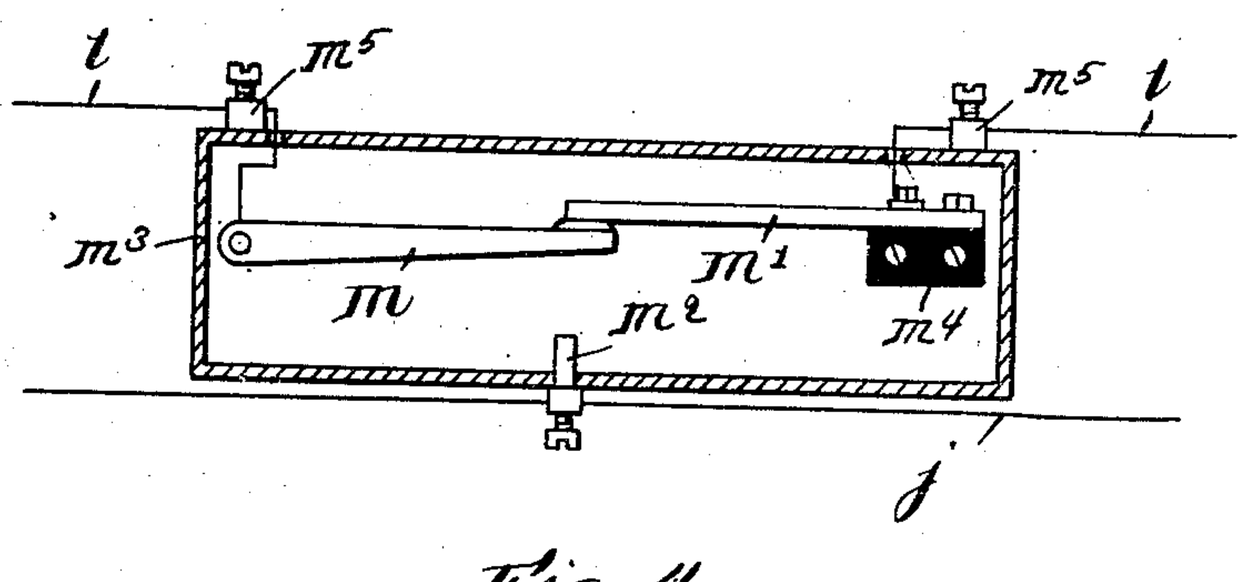

Fig. 4.

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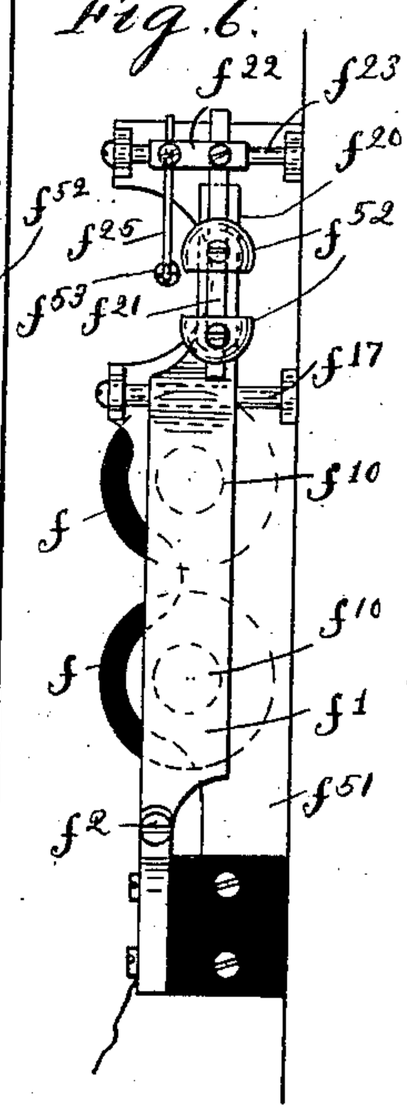
3 SHEETS—SHEET 3.

Fig. 6.



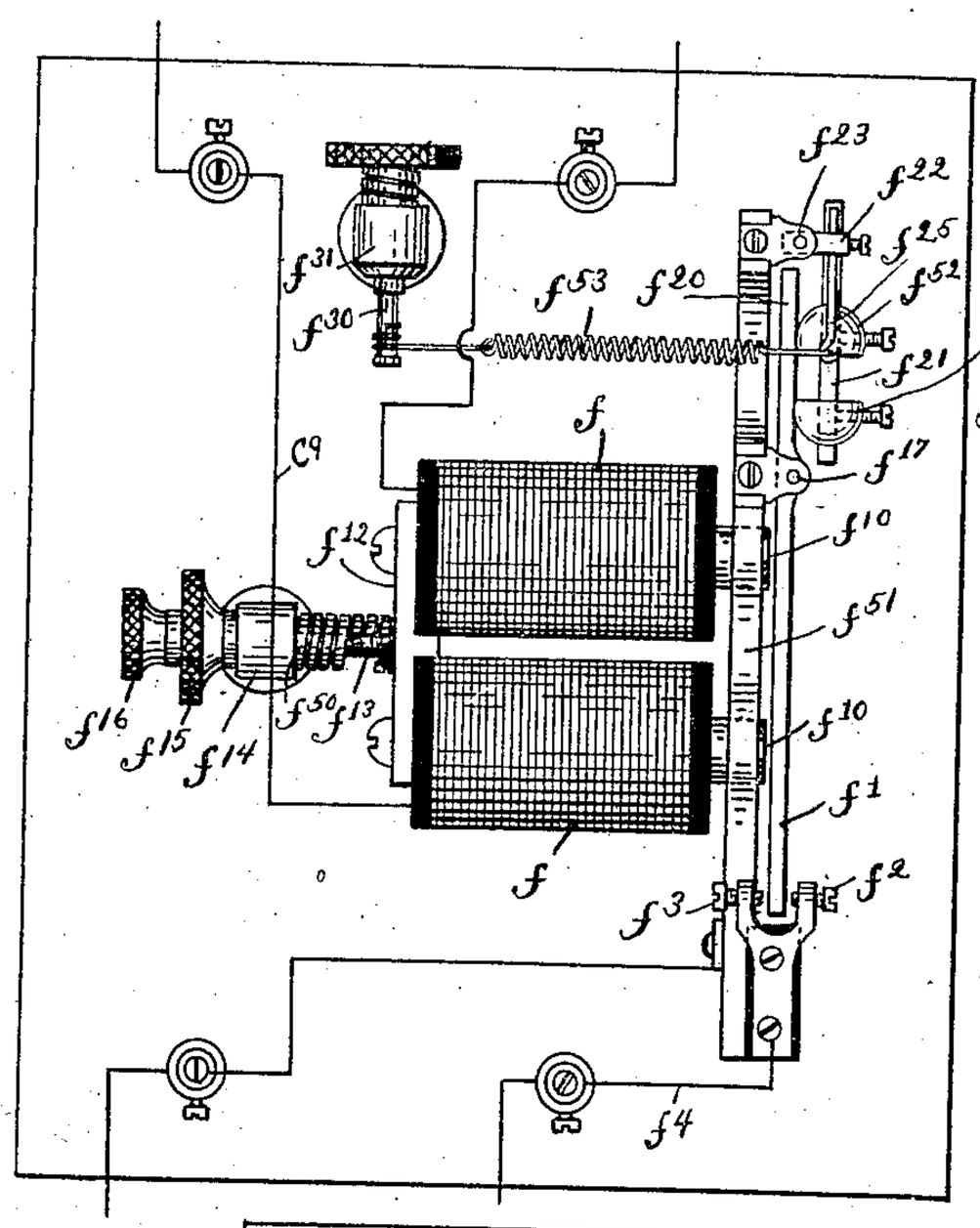
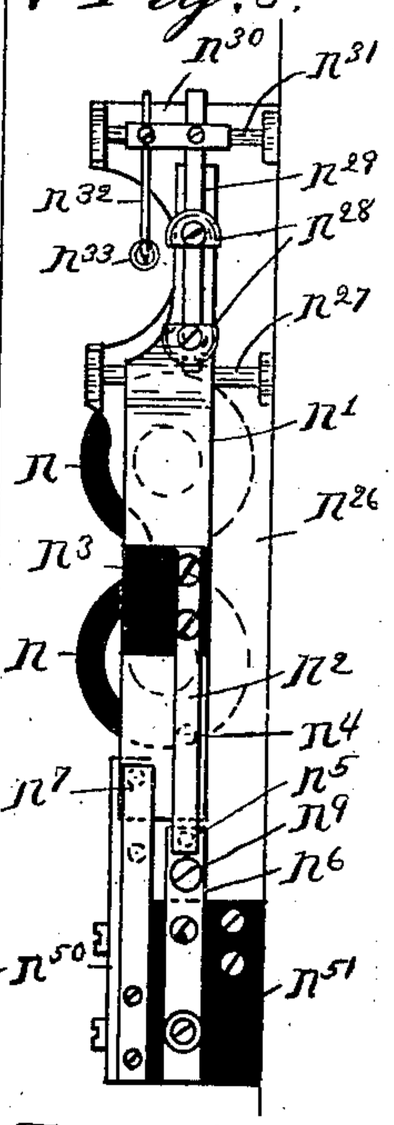


Fig. 5.

Fig. 8.



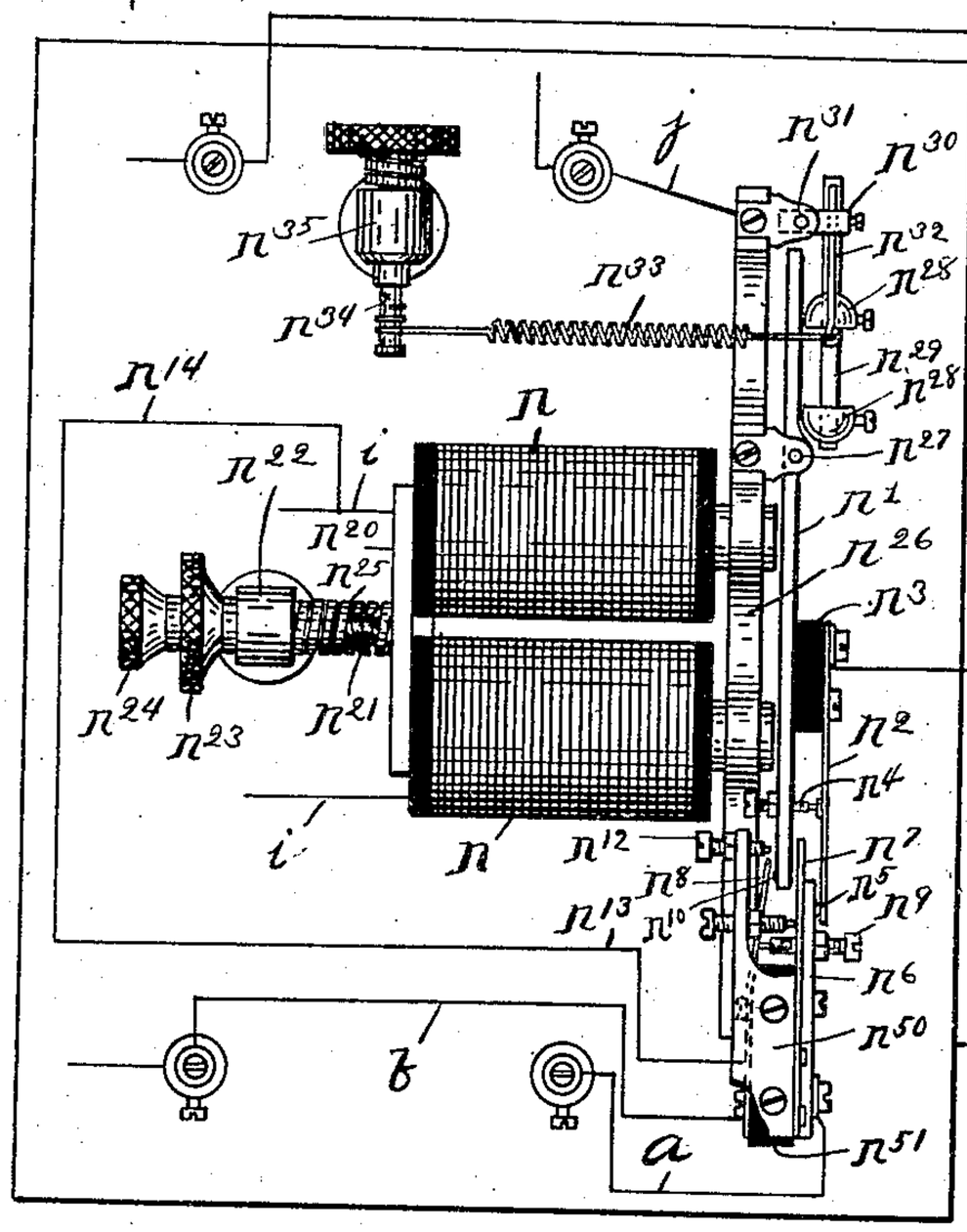


Fig. 7.

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UNITED STATES PATENT OFFICE

GEORGE F. MILLIKEN, OF BOSTON, AND FREDERICK W. COLE, OF NEWTON, MASSACHUSETTS, ASSIGNORS TO GAMEWELL FIRE-ALARM TELEGRAPH COMPANY, OF NEW YORK, N. Y.

AUTOMATIC FIRE-ALARM, BURGLAR-ALARM, AND TELEPHONE SYSTEM.

No. 904,550. Specification of Letters Patent. Patented Nov. 24, 1908.

Application filed October 16, 1905. Serial No. 282,911.

To all whom it may concern:

Be it known that we, GEORGE F. MILLIKEN and FREDERICK W. COLE, respectively of Boston and Newton, counties of Suffolk and Middlesex, State of Massachusetts, have invented an Improvement in Automatic Fire-Alarm, Burglar-Alarm, and Telephone Systems, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to an automatic fire and burglar alarm and telephone system; and has for its object to provide the telephone subscriber's station with automatic fire alarm and burglar alarm equipment, either or both, which is connected with the telephone subscriber's line, and to provide the central station with signal-receiving apparatus which is connected with the telephone circuit, and which is adapted to receive the automatic fire alarm and burglar alarm calls, either or both, in a manner easily distinguishable from each other, the automatic fire alarm and burglar alarm equipment at the subscriber's station and the signal-receiving apparatus at the central station all being so constructed and arranged and connected with the telephone line that the proper use of the telephone is permitted at all times without interference.

The invention also has for its object to provide the combined system with means for testing the circuits and also means for indicating derangements thereof.

Figure 1 shows a diagram of an automatic fire and burglar alarm and telephone system embodying this invention. Fig. 2 is a diagram showing the electro-magnetically operated vibrating circuit operating-device at the subscriber's station with the armature of its electro-magnet in its attracted position. Fig. 3 is a diagram showing said vibrating circuit operating-device with the armature of its operating electro-magnet in its retracted position. Fig. 4 is a detail showing one form of thermostat which may be employed as a circuit operating-device for the automatic fire alarm. Fig. 5 is a plan view of the signal-receiving relay, its armature being adjusted to its middle position. Fig. 6 is a side view of the signal-receiving relay, shown in Fig. 5. Fig. 7 is a plan view of the vibrating circuit operating device, its armature being adjusted to its middle position. Fig. 8 is a side view of the vibrating circuit operating device shown in Fig. 7.

a and *b* represent two wires of a telephone circuit extending from a central station to a subscriber's station. At the central station *c* represents the induction coil, one of the coils of which is connected with a local circuit c' containing a battery c^2, telephone receiver c^3, support c^4 therefor, transmitter c^5, induction coil c^6, and circuit contacts c^7 adapted to be closed by the receiver-support, and the other coil of said induction coil *c* is included in the wire *a*. The wires *a*, *b* are connected to a split plug switch c^8 by which they are connected to a circuit-wire or loop c^9, containing a light battery c^{10}, telephone bell c^{12}, and generator c^{13}.

At the subscriber's station *d* represents the induction coil, d' the telephone transmitter, d^2 the telephone receiver, d^3 the receiver support adapted to close the circuit contacts d^4, d^5 the generator, d^6 the telephone bell, and d^7 the condenser.

The telephone circuit thus described is adapted to be connected to the battery circuit c^9, at the central station by the switch plug c^8, and by means of said plug the circuit may be reversed at will, and at the subscriber's station the circuit thus established is connected to the opposite sides of the condenser d^7. At the central station a circuit wire *e*, containing a heavy battery e', is connected with the battery circuit wire c^9, which is adapted to be included in said battery circuit c^9 by the closing of a switch e^2 onto a contact e^3, and when the switch e^2 is thus closed the bell c^{12} and generator c^{13} will be disconnected from said battery circuit c^9, and the heavy battery will be included in circuit, in series with the light battery c^{10}. The heavy battery is employed essentially for testing purposes, as will be hereinafter described.

A signal-receiving relay *f* is included in the battery circuit c^9 at the central station, the armature f' of which is designed to occupy three different positions, viz., a middle position, an attracted position, and a retracted position. Normally, it occupies its

middle position, being adjusted to the normal current to occupy such position, and will be attracted by an increase and retracted by a decrease of the normal current. When in its middle position it is located between two contacts f^2, f^3, both of which are connected with a local circuit f^4, containing a local battery f^5, and any suitable indicating instrument or instruments, as for instance, it may contain a lamp f^6 and an annunciator f^7, either or both. The signal-receiving relay f, see Figs. 1, 5 and 6, is of special construction, particularly adapting it for the purposes of this invention, and as herein shown the cores f^{10} of the magnet coils f are rigidly joined together by a heel piece f^{12}, and a screw f^{13} extends from said heel piece, which passes through a smooth bored hole in a post f^{14} and receives upon its projecting end an adjusting nut f^{15} and a check nut f^{16}. A strong spiral spring f^{50} is interposed between the post and heel piece, the tendency of which is to thrust the heel piece and cores and magnet coils supported by it away from the post. The relay is thus adjustably mounted on the post f^{14}. In front of the magnet coils f, the two cores f^{10} project through holes in a plate f^{51}, which is stationarily supported, and at the outer side of this plate the armature f' is placed which is pivoted at f^{17}, and which extends across the ends of the cores f^{10} projecting through the plate, and its lower or free end occupies a position between the front and back contacts f^2, f^3. The upper or rear end of the armature f' is formed with an extension f^{20}, upon which a pressure device bears which is designed to exert a slight but continuous pressure upon the armature, and said pressure device consists of an arm f^{21} secured at one end to a block f^{22}, which is pivoted at f^{23} to the plate f^{51}, or other stationary support, said arm bearing a pair of hemisperical engaging blocks f^{52}, which are adjustably mounted upon it, so as to be moved independently along on the arm toward and from the pivot thereof, and which are adapted to bear upon the extension f^{20} of the armature. The pressure-device serves to exert essentially two different pressures upon the armature, as for instance, at the middle position of the armature both blocks f^{52} will engage the armature, but when the armature is moved on its pivot in a forward direction the block farthest from the pivot of the armature will engage the armature, and exert thereupon a very strong pressure, and when the armature is moved on its pivot in a backward direction the block nearest the pivot of the armature will engage the armature and exert thereupon a weak pressure, and these pressures which are exerted will be varied according to the positions of the blocks on the arm. Another arm extends from said block f^{22}, to the extremity of which one end of a tension spring f^{53} is attached, the opposite end of said spring being connected by a cord with a small revoluble cylinder f^{30} mounted in a post f^{31}, and by turning said cylinder said spring will be adjusted and the degree of pressure exerted by the pressure-device on the armature correspondingly varied. The cores f^{10} bearing the magnet coils are adjustable in a direction toward and from the armature f' by turning the nut f^{15} on the screw f^{13}, so that by means of the several adjustments thus described the armature may be adjusted to the current so as to occupy an intermediate or middle position between the two contracts f^2, f^3. The signal-receiving relay f is responsive to signals transmitted over the telephone circuit by suitable signal-transmitting apparatus which is provided at the subscriber's station, and which, when connected with the telephone circuit, as herein shown, or substantially so, does not in any way interfere with the operation of the telephonic instruments.

At the subscriber's station a signal wire i is provided, which consists of a loop, the ends of which are connected to the telephone circuit at opposite sides of the condenser d^7, so that said signal wire i forms a part of the telephone circuit, and when connected therewith a closed battery circuit is formed. One end of said signal wire i is herein shown as connected to the telephone wire at the bell d^6, and the other end at the receiver-support d^3, at which point a switch is provided for opening the circuit whenever the receiver is removed from its hook. This switch consists of an arm i' formed on the receiver-support d^3, which extends downward, and is adapted to close upon the circuit contacts i^2, i^3, the contact i^2 being connected with the signal wire i, through a vibrating bell magnet i^6 and the contact i^3 being connected to a local circuit i^4 containing a local battery i^5, the back contact, armature and magnet of the vibrating bell i^6, and a hand switch i^7. When the subscriber uses the telephone the signal circuit is automatically opened by the arm i' disengaging the contacts i^2, i^3, hence no interruption of the telephone service can occur while telephone communication is being carried on.

By means of the closed battery circuit e^9, a, b, i, it is herein designed to transmit two different signals or two classes of signals, viz. an automatic fire alarm and a burglar alarm signal, and to properly distinguish them from each other; also to test the circuits, and if found to be closed, to indicate the same by a different signal; and furthermore, to provide for indicating the fact of any increase in the normal current, due to eliminating any resistance; and, to accomplish all of these results without interfering with the telephone system.

The automatic fire alarm signal is trans-

mitted by means of a vibrating circuit operating-device, which is adapted to repeatedly open and close the circuit, and the armature of the signal-receiving relay *f* is responsive to the action of said vibrating-circuit operating-device; and the said vibrating circuit-operating-device is controlled by any one of several circuit-operating-devices, such, for instance, as thermostats, or manually operated switches, or both. The burglar alarm signal is transmitted by means of a circuit-operating-device which is adapted to simply break the circuit, and upon the ocurrence of such an alarm the armature of the relay *f* simply retracts. Thus the two signals are distinguished at the central station by the armature of the relay *f* rapidly vibrating upon the reception of the fire alarm and simply retracting upon the reception of the burglar alarm.

The test signal is transmitted by means of the vibrating circuit-operating-device which switches local circuits into the main circuit and thereafter repeatedly short circuits the magnet which operates it, and if all the circuits are closed the vibrations transmitted will be recognized by a distinct hum over the telephone circuit, and if the local circuits are open at such time then said device will transmit a regular vibrating call, as every time the local circuit is cut into the main circuit the telephone circuit will be opened. These test signals will be heard on the telephone receiver as a distinct hum or vibration as the case may be. The test signaling-device is operated by including a heavy battery in the circuit, which materially increases the normal current, or by eliminating resistance from the circuit, both of which produce like results. The same vibrating circuit-operating-device is employed for transmitting both the automatic fire alarm signal and the test signal, although it operates the circuits in a different manner, so as to be distinguishable at the central station. The vibrating circuit-operating-device is operated by an electro-magnet *n*, herein termed the signaling magnet, and said electro-magnet is included in the closed battery circuit, and for all practical purposes will be included in the signal wire *i* near the condenser d^7.

The signaling-magnet *n*, which serves as the means for operating the vibrating circuit-operating-device, has its armature *n'* arranged to occupy three different positions, viz. a middle position, an attracted position, and a retracted position, being adjusted to the normal current to normally occupy its middle position, and to be attracted by an increase in the normal current and to be retracted by a break in the circuit.

The signaling magnet *n* is constructed similar to the signal-receiving relay *f*, see Figs. 1, 7 and 8, and is adjustably mounted on post n^{22}. The front ends of the cores of the two magnet coils project through holes in a plate n^{26}, whereby they are supported, and can be moved longitudinally by the adjusting screw n^{21}. The armature *n'* is pivoted to ears projecting from plate n^{26} at n^{27}, and extends across the ends of the cores and it has a rearward extension at one side of its pivot, which is acted upon by a compound pressure-device comprising a pair of hemispherical engaging blocks n^{28} mounted adjustably on an arm n^{29} secured to a block n^{30} pivoted at n^{31} to the plate n^{26} and from said block an arm n^{32} extends, to the extremity of which one end of the adjustable tension spring n^{33} is attached. This compound pressure-device exerts upon the armature two different tensions; at its central position both blocks n^{28} engage it, but forward of such position the block farthest from the armature will engage it, exerting a very strong tension, while in backward position the block nearest the armature pivot will engage it thus exerting a weak tension. The armature *n'* has secured to it a spring acting contact pen n^2, which is attached to a block n^3 of insulating material secured to said armature, and said pen n^2 bears a contact, at a point intermediate its length, which is adapted to engage a contact n^4 on the armature, and the extremity of said pen n^2, extends over and is adapted to engage a contact n^5 on a block n^6 which is secured to a block n^{51} of insulating material on the plate n^{26}, and which is connected to the telephone wire *a*. The armature *n'* also bears a contact n^{10}, at its extremity, which is adapted to engage a contact at the extremity of a spring acting pen n^8, which is also secured to said block n^{51} of insulating material, opposite the block n^6, and which is connected to the telephone wire *b*, and said pen n^8 bears a contact, at a point intermediate its length, which is adapted to engage a contact n^9 on the block n^6. The armature *n'* also bears a contact which is adapted to engage a spring acting pen n^7, which is connected to a plate n^{50}, which is secured to said block n^{51} of insulating material and which is connected with a circuit wire n^{13}; and said armature also bears a contact, which is adapted to engage a contact n^{12}, which is borne by the plate n^{50}, to which said circuit wire n^{13} is connected, and which is connected by a circuit wire n^{14} with the circuit wire *i* at the remote side of the signaling magnet.

A branch wire *j*, preferably a loop, is provided at the subscriber's station, which extends along in parallelism with the signal wire *i*, either the entire length or for such portion thereof as desired. One end of said loop *j* is connected with the armature *n'* of the signaling magnet *n*, as for instance, it may be connected to the armature support, and the other end is connected to the pen n^2,

which is secured to the block n^3 on said armature n'.

When the armature occupies its normal or middle position, see Fig. 1, the pen n^2 engages the contact n^4 on the armature, and also engages the contact n^5, on the block n^6; and when the armature is attracted, see Fig. 2, the extremity of said pen n^2 will be held in engagement with the contact n^5, and the contact n^4 on the armature will be disengaged from the pen n^2; and when the armature is retracted, see Fig. 3, the contact n^4 will engage the pen n^2, and said pen will disengage the contact n^5. Also, when the armature occupies its middle position, Fig. 1, the pen n^8 engages the contact n^9 on the block n^6, and also engages the contact n^{10} on the armature, and when the armature is attracted, Fig. 2, said pen n^8 will be disengaged from the contact n^9, but will remain in engagement with the contact n^{10}, and when the armature is retracted, Fig. 3, said pen n^8 will remain in engagement with the contact n^9, but will disengage the contact n^{10}. When the armature occupies its middle position, see Fig. 1, neither the pen n^7 nor contact n^{12} are engaged by it, but when attracted, Fig. 2, the contact n^{12} will be engaged by it, and when retracted, Fig. 3, the pen n^7 will be engaged by it. Therefore, with the armature of the signaling magnet in its normal or middle position, the signal circuit from wire a at one side of the condenser is as follows:—n^6, n^9, n^8, through bell d^6 to i, including the signaling magnet n, thence through bell magnet i^6 and switch i^1, i^2 to the wire b, at the opposite side of the condenser; and the branch wire or loop is as follows:—a, n^6, n^5, n^2, j, n', n^4, n^2. Thus, at such time, the branch wire j will be represented as a closed loop, both ends of which are connected to one of the telephone wires at the same side of the condenser. The branch wire j is made as a closed loop particularly for testing purposes, as for signaling purposes only, it may be made merely as a branch wire leading from one of the telephone wires or from the signal wire, as for instance it may lead from the pen n^2, parallel with the wire i, as far as desired, and instead of being connected to the armature n^1, may be left with an open end. The branch wire j, in any event, will include all that portion of the signal circuit containing the thermostats, which serve as the circuit operating-devices for the automatic fire alarm, or the manually operative fire stations.

The thermostats may be of any suitable construction, and as shown in Fig. 4, they consist essentially of a pair of arms m, m', one of which is pivoted to a shell or case m^3, and the other is attached to a block m^4 of insulating material secured to said shell or case m^3, and said arms overlap each other and are connected together at their overlapping portions by fusible solder or equivalent material, which is adapted to melt at a low temperature, and binding posts m^5 are attached to said shell or case to which the signal wire i is connected, and wires connect said binding posts respectively with the arms, so that the arms are included in the wire i, and said case contains a contact m^2 beneath one of said arms, and when the two arms become separated, by the melting of the fusible connection, one of them falls upon said contact m^2. The contact m^2 is connected to the branch wire j, and whenever the thermostat operates the signal wire i will be opened by the separation of the arms, and then the arm farthest from the signaling magnet n, will fall upon the contact m^2 and close a cross between the signal wire i and the branch wire j, and thereby close the circuit through the branch wire. Upon thus breaking the circuit by the separation of the arms m, m', the armature n' of the signaling magnet n will retract, see Fig. 3, opening the contacts n^{10}, n^5, and closing the contact n^7, and the circuit at such time will be as follows:—a, n^6, n^9, n^8, bell magnet d^6, i, through signaling magnet n, n^{14}, n^{13}, n^7, armature n', j, m^2, m, i, to b, at the receiver support. The circuit thus established being complete the armature of said signaling magnet n, will be attracted and will open the circuit at n^7, and thereupon the armature is caused to rapidly vibrate. This vibration, which repeatedly opens and closes the circuit, causes the signal-receiving relay f to correspondingly vibrate its armature, and thus give a distinct signal, which is not produced in any other way. The local circuit at central controlled by the relay f will be operated correspondingly, causing the annunciator to drop and the light to flicker. A manual switch s is also included in the signal circuit wire i which is adapted to open said circuit when desired, as the burglar alarm may not be needed at day time, but when the circuit is opened by said switch the fire alarm can still be transmitted by the thermostats. The central office is presumed to have been notified before opening the circuit by the switch s, so that the operator shall have disconnected the back contact of the relay f, to thereby prevent the burglar alarm signal being operated.

The circuit-operating-device for the burglar alarm is made as a circuit breaker, as for instance, it may be composed of a pair of contacts o, adapted to be separated by the opening of a door k or window k^{20}.

Many forms of circuit operating-devices adapted to break the circuit, may be substituted for the contacts o.

The burglar alarm signal therefore consists merely in a break in the circuit i, and

when it occurs, the armature of the signal-receiving relay f at the central station will retract and close the local circuit thereat, and thereby operate the indicating instrument included in or adapted to be operated by said local circuit. If a cross occurs on the circuit in such manner as to exclude a resistance, as for instance if it should exclude the resistance coil p, which is located at a remote part of a circuit, then the normal current will be correspondingly increased and the armature of the signal-receiving relay f will be attracted, and likewise operate the local circuit. Either or both causes must be interpreted as a burglar alarm to be immediately investigated. If a local alarm or indicator is red at the subscriber's station, which shall respond to a burglar alarm, a mechanical gong of any suitable construction may be provided, the releasing lever t of which is adapted to be engaged by the armature n' of the signaling magnet, and whenever said armature is retracted, as it will be by a break in the signal circuit, due to any of the aforesaid causes, said gong will be released, and permitted or caused to operate. Furthermore, if desired, a lamp circuit, as t^2, may be provided at the subscriber's station which is normally open and adapted to be closed by a switch operated by said releasing lever t. As herein shown, said switch consists of a switch arm t^3 on the releasing lever t, which is designed to engage contacts t^4, t^5, to close the lamp circuit. Above the releasing lever t a hand operated cam t^{10}, is provided, which may be turned into and out of position to engage the lever t and lock it against movement on its pivot. The dotted lines Fig. 1, represent said cam when turned to engage the lever.

A telephone call can be given by the usual hand generator which gives an alternating current to be received by a polarized bell e^{12} at central station. Hence the three signals viz. the fire alarm, burglar alarm and telephone signals, are all distinguishable, one from the other.

To test the signal circuit as well as the branch wire j which is connected therewith, the heavy battery e', at the central station, is connected in circuit in series with the light battery e^{10}, by operating the hand switch e^2, and the armature of the signaling magnet n will be attracted, see Fig. 2, by the increase in the normal current, and during the first part of the movement of the armature from its normal or middle position to its attracted position, the branch wire or loop j will be included in and form a part of the signal circuit, as follows:—a, n^6, n^5, n^2, j, n', n^{10}, n^8, d^6, i, b; and during the latter part of the movement of said armature the contact n^{12} will be engaged and the circuit will then be as follows: a, n^6, n^5, n^2, j, n', n^{12}, n^{13}, n^{14}, i, b. Any break in the closed circuit established during the first part of the movement of said armature, that is to say, after it has disengaged the contact n^9 and before it has engaged the contact n^{12}, which would manifestly be in the closed loop j, would be noted immediately by causing the armature of the sigaling magnet to retract and to rapidly vibrate, and correspondingly vibrate the armature of the receiving relay f. In order to be sure that the armature of the signaling magnet responded to the action of the heavy battery, said armature, when fully attracted, will engage the contact n^{12} after it has caused pen n^8 to disengage the contact n^9. This will close a short circuit around the signaling magnet. The armature of said signaling magnet n will then vibrate rapidly through a small distance, or hum, and this sound will be reproduced and be distinctly heard at the central station through the telephone receiver thereat, thus giving positive evidence that the entire circuit including the branch wire or loop is complete, and that the signaling magnet is in proper working condition. In case of a cross from the signal circuit i to the branch wire or loop j, the signaling magnet n will be short circuited through the connection to the line at n^5, n^{10} made with the armature in its normal or middle position, and said armature will then immediately retract from its normal or middle position, and in so retracting will open this short circuit, by opening these connections, causing the magnet to again attract its armature, which will then continue to hum while said cross remains, and which hum can be heard at the central station through the telephone receiver.

A switch 50 may be provided for disconnecting the burglar alarm circuit, or both the fire alarm and burglar alarm circuits, whenever desired, the central office having had this notification of the operation of said switch. The vibrating bell t^6 has its back contact connected with the local battery circuit i^4, and when the main circuit is closed the armature of said magnet will be held in its attracted position, but when the main circuit breaks, then said armature will retract and close upon its back contact, and thereby close the local circuit, and at such time said armature will rapidly vibrate, and said vibration will continue until the main circuit is again closed and may be used as a local alarm for telephone calls when the fire alarm circuit is closed. The local circuit i^4 may be opened by the switch i^7.

The door k of the house at the substation may be provided with a magnetic lock, and as herein shown k' represents a polarized electro-magnet for said lock and k^2 its armature. The polarized electro-magnet k' is included in the circuit wire i, and when the current passes through the magnet in one direction the armature k^2 will prevent the

latch from being thrown to open the door, thus placing the control of opening the door in the care of the central station, as for instance, during regular hours of the day. This also prevents a person from accidentally or unnecessarily operating the alarm by opening the door, or it might be a window, while the alarm is set.

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

1. A normally closed electric circuit connecting a central station with a subscriber's station, having at each station telephonic equipment, a branch wire leading from said circuit at the subscriber's station, circuit operating-devices connected with said circuit and with the branch wire, adapted to open the circuit, and to connect it with the branch wire, other circuit operating-devices adapted to open said circuit, only, a vibrating-circuit operating-device for repeatedly opening and closing the circuit, means for operating it responsive to any one of the first named circuit operating devices, and a signal-receiving relay at the central station, the armature of which vibrates in response to the action of said vibrating circuit operating-device, and retracts in response to the action of the other circuit operating-devices, substantially as described.

2. A normally closed electric circuit connecting a central station with a subscriber's station, having at each station telephonic equipment, a branch wire leading from said circuit at the subscriber's station, circuit operating-devices connected with said circuit and with the branch wire, adapted to open the circuit and to connect it with the branch wire, other circuit operating-devices adapted to open said circuit only, a signaling magnet in the circuit responsive to any one of the circuit operating devices, means operated by said magnet for repeatedly opening and closing the circuit and for opening the circuit only, a signal receiving relay at the central station, the armature of which vibrates in response to the repeated opening and closing of the circuit by said signaling magnet, and retracts in response to the opening of the circuit only by said signaling magnet, substantially as described.

3. A normally closed electric circuit connecting a central station with a subscriber's station, having at each station telephonic equipment, a branch wire leading from said circuit at the subscriber's station, circuit operating devices connected with said circuit and with the branch wire, adapted to open the circuit and to connect it with the branch wire, other circuit operating-devices adapted to open said circuit only, a signaling magnet in the circuit responsive to any one of the circuit operating devices, means operated by said magnet for repeatedly opening and closing the circuit and for opening the circuit only, a signal receiving relay at the central station, the armature of which vibrates in response to the repeated opening and closing of the circuit by said signaling magnet, and retracts in response to the opening of the circuit only by said signaling magnet, and a local alarm at the subscriber's station operated by said signaling magnet, substantially as described.

4. A normally closed electric circuit connecting a central station with a subscriber's station, having at each station telephonic equipment, a branch wire leading from said circuit at the subscriber's station, circuit operating-devices connected with said circuit and with the branch wire, adapted to open the circuit and to connect it with the branch wire, other circuit operating-devices adapted to open said circuit only, a signaling magnet in the circuit responsive to any one of the circuit operating devices, means operated by said magnet for repeatedly opening and closing the circuit and for opening the circuit only, a signal receiving relay at the central station, the armature of which vibrates in response to the repeated opening and closing of the circuit by said signaling magnet, and retracts in response to the opening of the circuit only by said signaling magnet, and a local alarm at the subscriber's station operated by the retracted armature of said signaling magnet, substantially as described.

5. A telephone circuit connecting a central station with a subscriber's station, having a condenser and other telephonic equipment, and a battery, a signal circuit connected to said telephone circuit, at opposite sides of the condenser, to form a closed battery circuit, a branch wire leading from said signal circuit at one side of the condenser, circuit operating-devices connected with said signal circuit and branch wire, adapted to open the signal circuit and to connect it with the branch wire, other circuit operating-devices adapted to open said circuit, a vibrating-circuit operating-device for repeatedly opening and closing the circuit, means for operating it, responsive to any one of the first named circuit operating-devices, and a signal-receiving relay at the central station, the armature of which vibrates in response to the action of said vibrating circuit operating-device, and retracts in response to the action of any one of the other circuit operating-devices, substantially as described.

6. A normally closed electric circuit connecting a central-station with a subscriber's-station having at each station telephonic equipment, a signaling magnet in said circuit at the subscriber's station, a branch wire leading from said circuit at one side of said magnet, circuit operating-devices connected with said circuit and with the branch wire for opening said circuit and for connecting

it with the branch wire to thereby operate the signaling-magnet, means operated by the retracting armature of said signaling-magnet for disconnecting the branch wire from the circuit at one side of the magnet and for connecting it therewith at the opposite side of the magnet to thereby include the magnet in the circuit whenever one of the circuit operating-devices operates, and a signal-receiving relay at the central-station responsive to the action of said signaling-magnet, substantially as described.

7. A telephone circuit connecting a central station with a subscriber's station, having a condenser and other telephonic equipment, a signal circuit connected to said telephone circuit at opposite sides of the condenser, a signaling magnet in the signal circuit, a branch wire leading from the signal circuit at one side of said magnet, circuit operating-devices connected with said signal circuit and branch wire, adapted to open the signal circuit and to connect it with the branch wire, to thereby operate the signaling magnet, means operated by the retracted armature of said signaling magnet for disconnecting the branch wire from the signal circuit, at one side of the magnet, and for connecting it therewith at the opposite side of said magnet, to thereby include the magnet in circuit, whenever one of the circuit operating-devices operates, and a signal-receiving relay at the central station responsive to the action of the signaling magnet, substantially as described.

8. A normally closed battery circuit connecting a central-station with a subscriber's-station having at each station a telephone transmitter and receiver and other telephonic equipment, circuit operating-devices at the subscriber's station, a signal-receiving relay at the central-station responsive to the action of said circuit-operating devices, an electro-magnet at the subscriber's station, means for holding the armature of said magnet partially retracted against the influence of the normal current, a heavy battery at the central station, means for including it in circuit to attract said armature, and means operated by the attracted armature for closing a short circuit around the magnet whereby said armature is caused to rapidly vibrate, substantially as described.

9. A telephone circuit connecting a central-station with a subscriber's-station having a telephone transmitter and receiver at each station and having a condenser and other telephonic equipment and also having a battery, a signal-circuit connected to said telephone circuit at opposite sides of the condenser, circuit-operating devices in the closed battery circuit thus formed, a signal-receiving relay at the central-station responsive to the action of said circuit-operating devices, an electro-magnet in the battery circuit at the subscriber's-station, means for holding the armature of said magnet partially retracted against the influence of a normal current, a heavy battery at the central-station, means for including it in circuit to attract said armature, and means operated by the attracted armature for closing a short circuit around the magnet whereby said armature is caused to rapidly vibrate, substantially as described.

10. An electric circuit, circuit-operating devices, a vibrating circuit-operating device having an electro-magnet for operating it to repeatedly open and close the circuit which is responsive to said circuit-operating devices, means for holding the armature of said electro-magnet partially retracted against the influence of a normal current, a signal-receiving relay responsive to said vibrating circuit-operating device, a telephone-receiver in said circuit, a heavy battery, means for including it in circuit, and a short circuit around said electro-magnet adapted to be repeatedly closed by its attracted armature when the normal current is increased, substantially as described.

11. An electric circuit, circuit-operating devices, a vibrating circuit-operating device having an electro-magnet for operating it to repeatedly open and close the circuit which is responsive to said circuit-operating devices, means for holding the armature of said electro-magnet partially retracted against the influence of a normal current, a signal-receiving relay responsive to said vibrating circuit-operating device, a telephone-receiver in said circuit, a heavy battery, means for including it in circuit, and a short circuit around said electro-magnet adapted to be repeatedly closed by its attracted armature when the normal current is increased, and other circuit-operating devices in said circuit for opening it to which said signal-receiving relay is also responsive, substantially as described.

12. An electric circuit and a signal-receiving relay and a telephone-receiver included therein, a signaling-magnet in the circuit, means for holding its armature partially retracted against the influence of the normal current, circuit-operating devices for opening the circuit permitting the armature of said magnet to fully retract, means operated by said retracted armature for repeatedly including the magnet in circuit whereby the armature is caused to vibrate rapidly, a heavy battery, means for including it in circuit to increase the normal current and thereby cause said magnet to attract its armature, and means operated by the attracted armature for repeatedly including the magnet in circuit, substantially as described.

13. A normally closed electric circuit connecting a central station with a subscriber's

station, having at each station a telephone transmitter and receiver and other telephonic equipment, and containing a battery, a closed loop connected to said circuit at the subscriber's station, circuit operating-device connected with said circuit and with the loop, adapted to open the circuit and to connect it through the loop, a signaling magnet, the attracted armature of which closes a short circuit around said magnet, whereby said armature is caused to vibrate rapidly whenever the normal current is increased, and the retracted armature of which closes a circuit through said magnet, whereby said armature is caused to vibrate rapidly and repeatedly open and close the circuit, and a signal-receiving relay at the central station, the armature of which vibrates in response to the repeated breaks in the circuit, a heavy battery at the central station, and means for including it in circuit, substantially as described.

14. A normally closed electric circuit connecting a central station with a subscriber's station having at each station a telephone transmitter and receiver and other telephonic equipment and containing a battery, a closed loop connected to said circuit at the subscriber's station, a signaling-magnet, means for holding the armature thereof partially retracted against the influence of the normal current, a circuit operating device adapted to open the circuit and to connect it with the loop to thereby cause the armature of said magnet to fully retract, means operated by said retracted armature for repeatedly operating the circuit, a heavy battery and means for including it in circuit to cause said magnet to attract its armature, a normally open short circuit around said magnet adapted to be repeatedly closed by said attracted armature, and a signal-receiving relay at the central station, the armature of which vibrates in response to the breaks in the circuit, substantially as described.

15. A telephone circuit connecting a central station with a subscriber's station, containing at each station a telephone transmitter and receiver and other telephonic equipment, and containing a battery and a condenser, a signal circuit connected to said telephone circuit at opposite sides of the condenser, a closed loop at the subscriber's station connected to the circuit at one side of the condenser thereat, circuit operating-device connected with said circuit and with the loop, adapted to open the circuit and to connect it with the loop, a signaling magnet in the circuit, the attracted armature of which closes a short circuit around said magnet, whereby said armature is caused to vibrate rapidly whenever the normal current is increased, and the retracted armature of which closes a circuit through said magnet, whereby said armature is caused to vibrate rapidly and repeatedly open and close the circuit, a signal-receiving relay at the central station the armature of which vibrates in response to the repeated breaks in the circuit, a heavy battery at the central station, and means for including it in circuit, substantially as described.

16. A normally closed battery circuit connecting a central station with a subscriber's station having at each station a telephone transmitter and receiver and other telephonic equipment, circuit-operating devices at the subscriber's station, an electro-magnet at said station responsive to the action of said circuit-operating devices, means for holding the armature of said magnet partially retracted against the influence of the normal current, a normally open short circuit around said magnet adapted to be repeatedly closed by the armature when the latter is attracted by an increase in the normal current, a signal-receiving relay in said circuit at the central station, means for holding the armature thereof partially retracted against the influence of the normal current, said relay being responsive to the action of the armature of the electro-magnet at the receiving station when retracted by the circuit-operating devices and when attracted by an increase in the normal current, substantially as described.

17. A telephone circuit connecting a central station with a subscriber's station, having a condenser, and other telephonic equipment, and a battery, a signal-circuit connected to said telephone circuit, at opposite sides of the condenser, to form a closed battery circuit. a branch wire leading from said signal-circuit at one side of the condenser, circuit operating-devices connected with said signal circuit and branch wire, adapted to open the signal-circuit and to connect it with the branch wire, other circuit operating-devices adapted to open said circuit, a vibrating-circuit operating-device for repeatedly opening and closing the circuit, means for operating it, responsive to any one of the first named circuit operating-devices, and a signal-receiving relay at the central station, the armature of which vibrates in response to the action of said vibrating circuit operating-device, and retracts in response to the action of any one of the other circuit operating-devices, and means operated by removing the telephone from its supporting hook for disconnecting the signal-circuit from the telephone circuit, substantially as described.

18. A closed electric circuit containing a source of energy and a magnet, an independent circuit, and means controlled by the forward motion of the armature of said magnet to connect said circuits in series, substantially as described.

19. An electric circuit containing a source of electricity and a magnet, an independent

circuit and means controlled by the forward motion of the armature of said magnet to connect the circuits in series and a shunt circuit for the magnet also controlled by the armature and which will be closed around said magnet after the independent circuit is introduced, substantially as described.

In testimony whereof, we have signed our names to this specification, in the presence of two subscribing witnesses.

GEORGE F. MILLIKEN.
FREDERICK W. COLE.

Witnesses:
B. J. NOYES,
H. B. DAVIS.