No. 876,512. PATENTED JAN. 14, 1908.

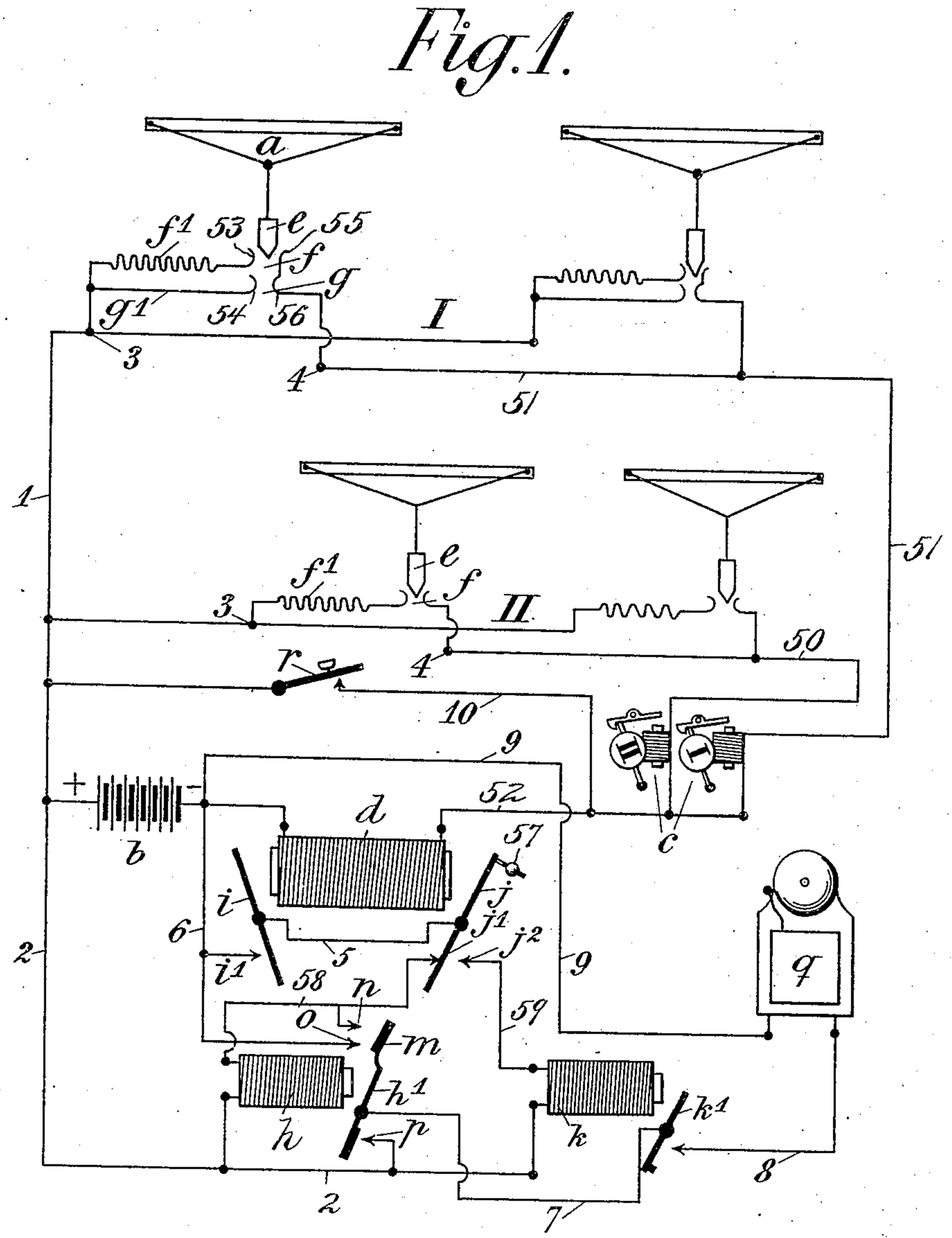
M. A. ABRAHAMSON.

FIRE ALARM SYSTEM.

APPLICATION FILED FEB. 1, 1905.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

H. L. Amer.

B. B. Sommers

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by Lacey Orth & Lacey atty.

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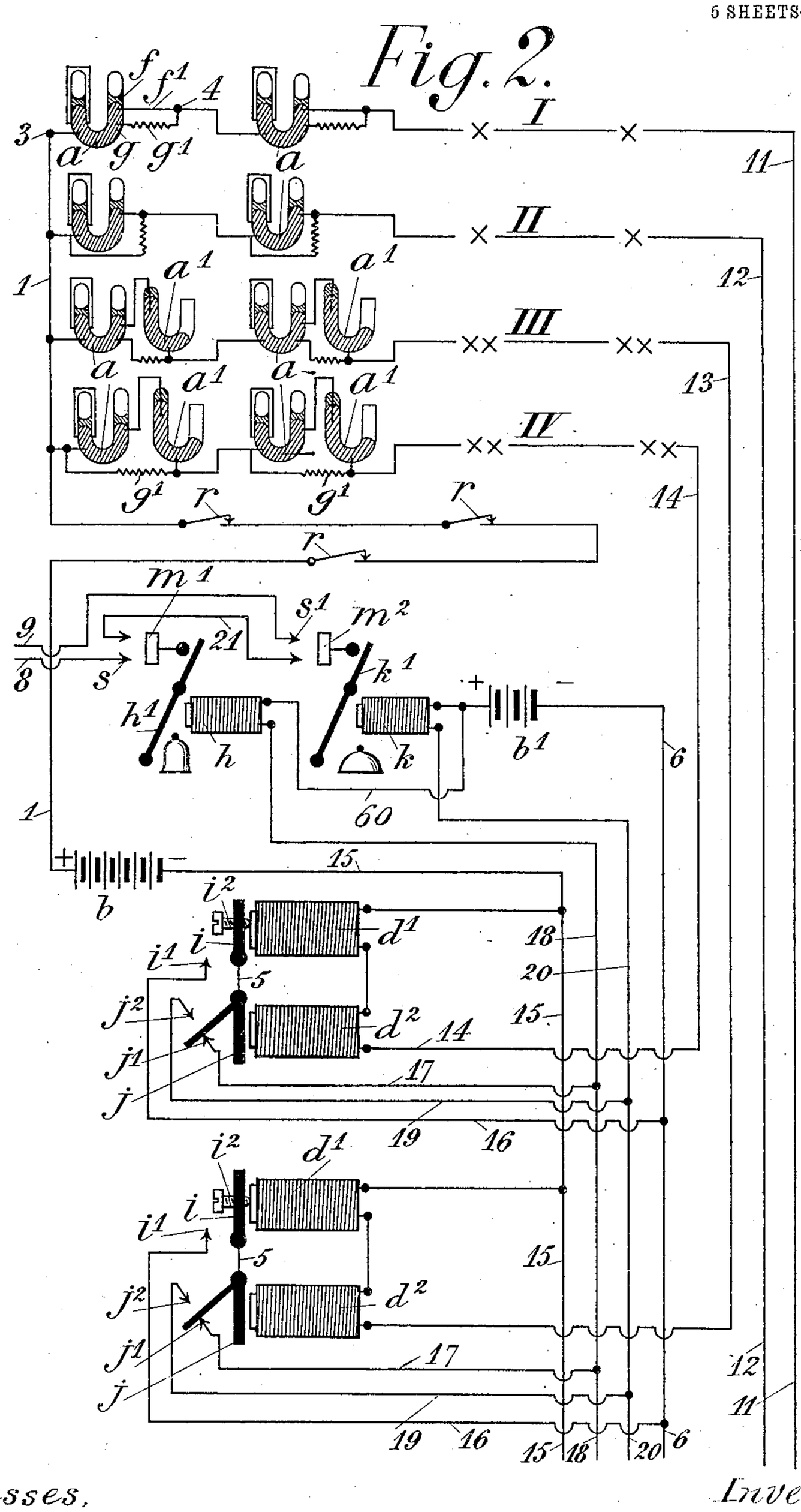
5 SHEETS—SHEET 2.

Fig. 2.



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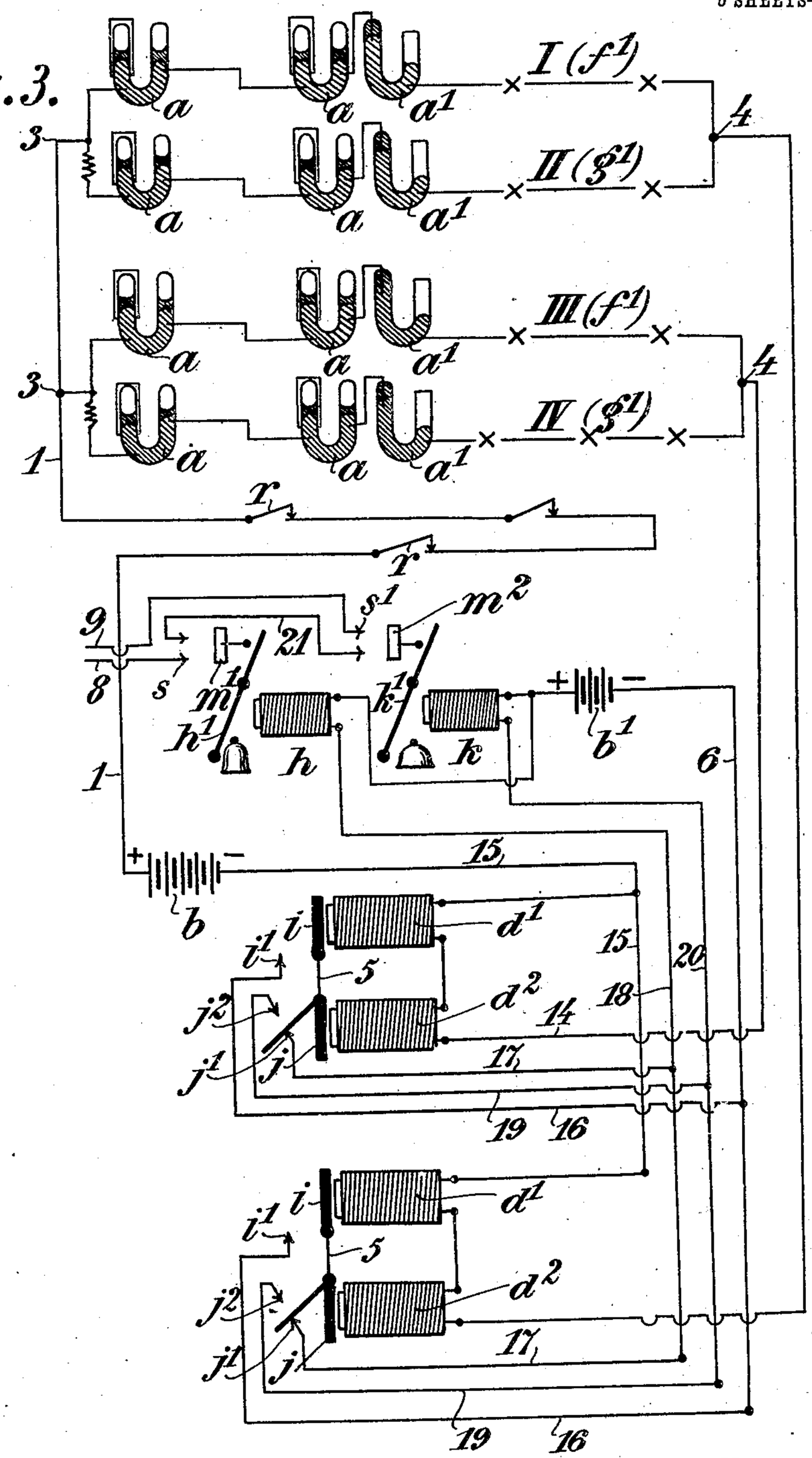
5 SHEETS—SHEET 3.

Fig. 3.



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FIRE ALARM SYSTEM.

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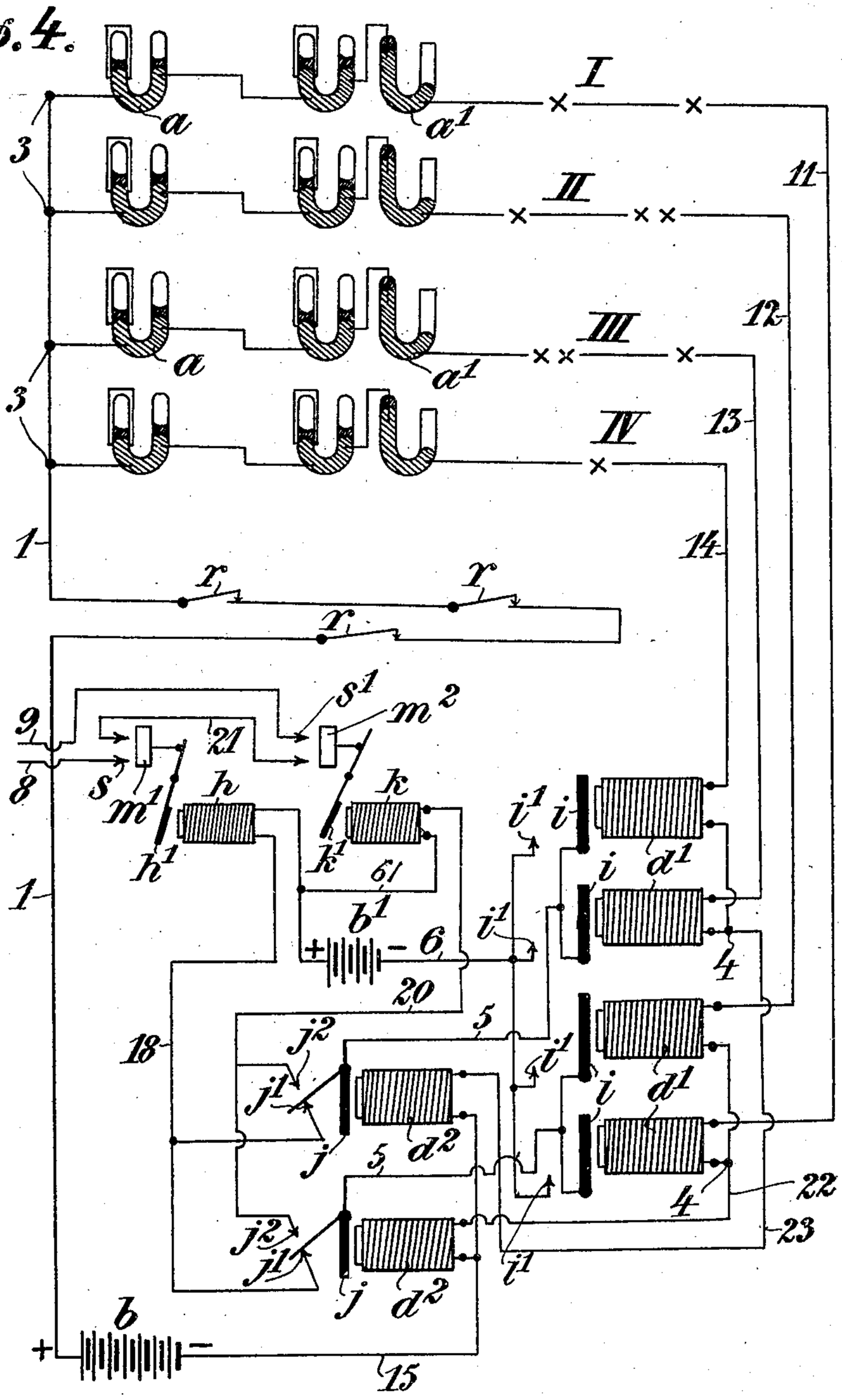
5 SHEETS—SHEET 4.

Fig. 4.



Witnesses.

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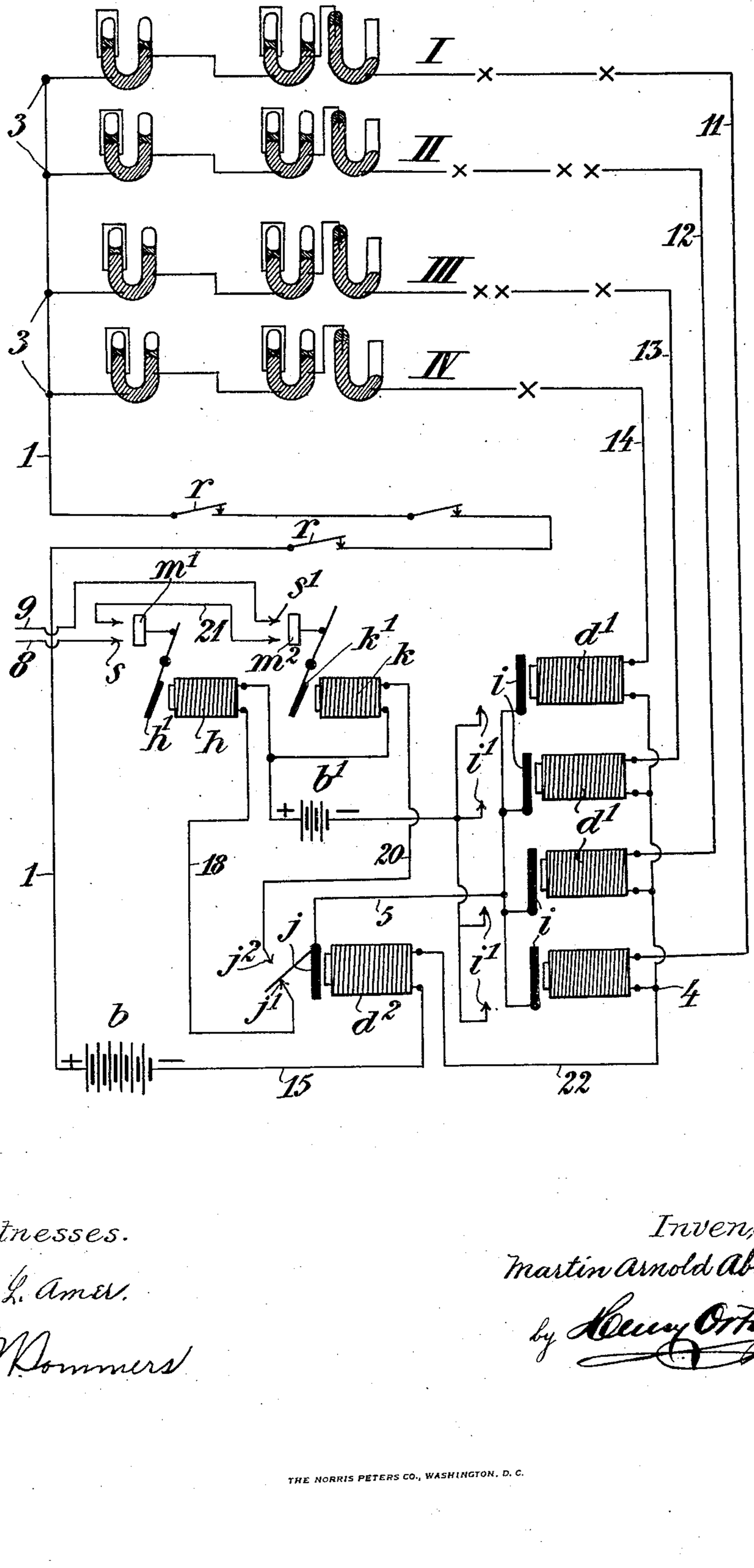
M. A. ABRAHAMSON.

FIRE ALARM SYSTEM.

APPLICATION FILED FEB. 1, 1905. 5 SHEETS—SHEET 5.

Fig. 5.



Witnesses.

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B. B. Sommers

Inventor.

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UNITED STATES PATENT OFFICE.

MARTIN ARNOLD ABRAHAMSON, OF COPENHAGEN, DENMARK.

FIRE-ALARM SYSTEM.

No. 876,512. Specification of Letters Patent. Patented Jan. 14, 1908.

Application filed February 1, 1905. Serial No. 243,642.

To all whom it may concern:

Be it known that I, MARTIN ARNOLD ABRAHAMSON, civil engineer, subject of Great Britain, residing at Copenhagen, in the Kingdom of Denmark, have invented new and useful Improvements in Fire-Alarm Systems, of which the following is a specification.

My invention has for its object the construction of a fire alarm system for buildings, and more especially relates to that class of systems known as "automatic" fire alarms, and the principal objects of the invention are—1. To automatically register in a building distinctive trouble signals when any part of the system in the building is grounded or otherwise impaired so as to prevent the transmission of a fire signal. 2. To automatically register when the voltage of the source of energy has fallen so much as to require renewal. 3. To obtain an immediate or continuous alarm in such cases. 4. To automatically register a distinctive danger call in cases of excessive heating or an abnormal rate of increase of temperature in any part of the building where the thermostats are located. 5. To automatically register at one or more central stations when the conditions under 4 are increased.

Referring to the drawings in which like parts are similarly designated—Figure 1 is a diagrammatic representation of an open circuit system illustrating my invention. Fig. 2 is a similar view of a closed circuit system. Figs. 3 to 5 are similar views of modifications illustrating the thermostats arranged in groups.

The thermostats *a*, Fig. 1, are of a well known type and carry a circuit closing plug or contact *e*.

The battery *b* composed of any suitable cells or an accumulator battery, (the latter is preferred, on account of its constancy of potential,) is connected by wire 1 whose parallel branches 10, 50 and 51 are united to wire 52, relay magnet or magnets *d* back to battery. In the branches 50 and 51, of which there may be any desired number, are placed the thermostats *a* in parallel groups I and II which are preferably placed a group for each floor of the building. The several thermostats *a* of each group are connected in parallel to their respective branches 50, 51, in open circuit in such a manner that current reduced in voltage may be sent through the line to indicate trouble, or if followed by full potential current to send a fire alarm, and to this end I have shown the thermostats *a* wired for both kinds of signals in group I, and for trouble signals only in group II.

At the thermostat *a* are two pairs of contacts, 53, 55 and 54, 56, the one, 53, connected through resistance *f'* and the one 54 connected through wire *g'* to the point 3 in the main wire 1 and in parallel. The contacts 55 and 56 are connected in series to point 4 in return wire 51. The thermostat *a* carries the circuit closer *e* capable of bridging the spaces *f* and *g* between the two pairs of contacts, so that when the space *f* is bridged contacts 53 and 55 are connected and current reduced in voltage by the resistance *f'* is closed through the circuit, and when the other two contacts are bridged full strength current is closed through line. Each group, I and II contains a magnetically released indicator *c* to indicate in which group I or II the trouble or fire is located. In group II I have shown the thermostats *a* wired only for trouble indications, and if the trouble should be found to be a fire, the fire alarm is manually sent in by closing the circuit at *r* in the shunt circuit branch 10. The relay magnet *d* which is the equivalent of the magnets operates two armatures *i* and *j*, one at each end, the one *j* being weighted at 57 and electrically connected by wire 5 to the one *i*. The armature *i* is therefore attracted by reason of low potential current and both are attracted by the high potential current in magnet *d*.

Low potential current will act to operate armature *i* to close a local branch circuit as follows: battery *b* wire 2, magnet *h*, wire 58 armature *j*, wire 5, armature *i* contact *i'* wire 6 back to battery. Magnet *h* will be energized to actuate its armature *h'* that carries the insulated circuit closer *m* to connect *n* and *o*, thereby short circuiting the former path through the two armatures *i* and *j* and holding the apparatus in readiness to receive the fire signal by the higher potential current, the wires 2 and 7 being connected by the armature *h'* to close one of the two normally open points in the alarm circuit. Should the stronger potential current now be sent through the main circuit 51 or short circuit branch 10, armature *j* will be attracted, closing a parallel local branch circuit as follows: battery *b*, wire 2, magnet *k* wire 59 contact j^2 armature *j*, wire 5, arma-

ture i, contact i' wire 6 back to battery; this will energize magnet k to attract its armature k' to complete the following parallel alarm circuit battery b, wire 2, contact p, armature h' wire 7 armature k' wire 8, signal bell q wire 9 back to battery. Should the high potential current be sent in the first instance by accidentally closing r or by forming a short circuit, electro magnet k alone becomes operative, and circuit will not be closed at p, magnet h being cut out by opening its branch circuit at j'.

The armatures h' and k' are preferably provided with indicators, either of which acting singly indicates trouble, but when acting together indicate fire and show that the fire-signal circuit is closed. The breakage of the manual contact r or of an indicator c will have no effect on the alarm circuit.

In Fig. 2 I have shown a closed circuit system, there being shown by way of example four groups of thermostats, one group for each floor of a building, the groups being included in parallel between the battery wires 1 and 15, so that a description of the operation and arrangement of one of the groups will be sufficient.

Consideration of space on the drawing has made it possible to show only magnets of groups III and IV, the magnet for the other groups are identical in operation and connection.

The thermostats are of a well-known construction, comprising U-tubes of glass closed at both ends with sealed-in platinum wires and filled with a volatile liquid and mercury, the latter under normal conditions maintaining all contacts closed, those in groups I and III producing both trouble and fire signals, similar to group I, Fig. 1, and groups II and IV are arranged to produce trouble signals only, the fire signal being sent in by breaking circuit at the manually operated circuit breaker r.

The thermostats a in group I, Fig. 2, contain the mercury g having a volatile liquid f above it the mercury being connected from one leg of the tube to the main wire 1 at 3, and the other leg closes circuit through two wires connected at 4 to branch 11 or the other thermostats in series in said branch, as circumstances may require or demand, one of said wires f' designed to transmit full potential current and the other containing a resistance g' so that when the mercury is depressed below wire f' by the volatilized liquid the potential in the branch line 11 is lowered, and when the mercury is depressed below g' the circuit is entirely broken. In group III there are two similar thermostats a and a' connected in pairs and in series; when the mercury in a' breaks contact it causes the current to pass through the resistance g' and send a trouble signal, and when the one a in each pair breaks its contact g the current is broken and a fire signal is sent in. In groups II and IV. the thermostats can, as already stated, only send a trouble signal as they can only diminish the current by means of resistance g' while they cannot break the circuit totally. If the trouble should be found to be fire, the fire alarm is manually sent in by breaking the circuit at r in wire 1. Each parallel branch circuit 11, 12, 13, 14 is connected to a pair of relay magnets d' and d^2 in series, which in turn are connected to the return battery wire 15 common to all of them.

When current of reduced potential passes through the two magnets by reason of a thermostat automatically causing the current through its branch to pass through a resistance g', armature i will be released from relay magnet d' the screw i^2 preventing close contact between armature and magnet core thereby rendering it sensitive to current reduction, and closes a local battery circuit through contact i' as follows: local battery b' wires 6 and 16, contact i', armature i, wire 5, armature j contact j' wires 17 and 18, magnet h wire 60 back to battery b'. The magnet h is energized, attracts its armature h' giving a trouble signal on the bell and moving the circuit closer m' to bridge the contacts s at one of the open points on the fire alarm circuit wires 8 and 21 preparatory to sending in the fire alarm when other open point is bridged. The circuit closer m' when moved over by h' to bridge the contacts s stays in its operative position and cannot return to its original position even when h' goes back to original position. Now should the circuit in any of wires 11, 12, 13, 14 or 1 be broken, either automatically by one of the thermostats or manually at r, armature j is also released closing circuit at j^2 to close the following local branch circuit: battery b', wires 6 and 16, armature i, wire 5 armature j contact j^2 wires 19 and 20 and magnet k back to battery b'. Magnet k is also energized attracting its armature k' to ring the bell therefor and move circuit closer m^2 to close contacts s' and complete the circuit of the fire alarm 8 and 9, by bridging wires 21 and 9 at the other open point. The circuit closer m^2 is locked similarly as described for m'. Thus it will be seen that both k' and h' must be actuated to send a fire alarm, *i. e.*, first the trouble call must be sent in to operate armature h' and then the main branch circuit broken to actuate k'. Should any thermostat circuits be accidentally broken, only armature k' will be operated, the magnet h being cut out of circuit by the intermediate action of armature j breaking the circuit of magnet h at j'.

The auxiliary thermostats a' (being maximum temperature thermostats) in groups III and IV are of importance, where the temperature rises so slowly that the differential temperature thermostat a might possibly not act at all. They consist of U-shaped

tubes open at one end. In the closed leg there is a small quantity of a volatile liquid over the mercury, that will evaporate as soon as the temperature has risen to a certain point, whereby the mercury is depressed and the circuit through the platinum contacts is broken.

Fig. 3, is similar to Fig. 2 excepting that the thermostats are placed in their branch circuits in pairs of parallel circuits between the points 3 and 4 where one set, as groups I and III Fig. 3, correspond to the path of current f' in which there is substantially no resistance and are more sentitive than their companion thermostats in groups II and IV, which latter correspond to the parallel circuit through g' in Fig. 2, the upper set serving to send in the trouble call and the combined action of the two sets being necessary to send in the fire alarm. In other respects the two figures are identical.

In Fig. 4 I have shown a modification where the thermostats are connected in pairs of groups in parallel, I, II and III, IV, and each pair of groups is provided with the necessary pair of relay magnets d' so that they form a unit. Each unit has its relay magnet d' in closed series with the magnets d^2 by wires 22 and 23. Now if circuit is broken at group I the lowermost relay magnet d' becomes currentless, its armature i will drop closing contact at i' to close the local circuit as follows: local battery b', magnet h' wire 18, contact j', wire 5 armature contact i' armature i, wire 6 back to battery b', thereby energizing magnet h to bridge the contacts s between wires 8 and 21 preparatory to sending in the alarm signal. Since the upper relay magnet d' is still receiving current through group II and wire 12 current through d^2 is not cut off, but as soon as current through group II is also broken the second armature i will drop, closing contact at j^2 and closing the circuit through magnet k as follows: local battery b', wire 61, magnet k, wire 20, contact j^2, armature j, wire 5, through the pair of armatures i, their contacts i', wire 6 back to battery b', thus energizing k to attract its armature k' to operate m^2 to close circuit between 9 and 21 and send in the fire alarm. If current be suddenly broken as at r before the operation of the thermostats, magnet k only will be energized as stated in connection with Fig. 2.

In Fig. 5 I have shown a case where more than two groups of thermostats are combined in parallel to form a unit, each group having its relay magnet d'. In this figure I have shown four groups in parallel similar to Fig. 4, there being but one magnet d^2 for all four of the groups. In case circuit through one of the groups is broken only magnet h can be energized—then upon the subsequent breaking of the circuit through one or more of the other groups, depending upon the strength of current required to keep armature j in normal position—the magnet k will also be energized to send in the fire alarm. In other respects the operation is like that in the figures just described for the closed circuit system, and further detailed description is deemed unnecessary.

I claim—

1. In a fire alarm system, a primary circuit, thermostats therein controlling the current through the system, electro-magnets energized by current in said circuit, armatures controlled by said magnets under different current conditions regulated by the thermostats, two auxiliary circuits controlled by said armatures, and a third circuit controlled by said two secondary circuits.

2. In a fire alarm system, a main circuit, thermostats therein controlling the current through the system, electro-magnets energized by current through the system, armatures controlled by said magnets under different conditions which are dependent upon the thermostats, two auxiliary circuits closed under different operative current conditions by said armatures, electro-magnets one in each of two said auxiliary circuits, armatures controlled by last mentioned electro-magnets, and a third circuit controlled by last mentioned armatures under one operative current condition to send a fire alarm.

3. In a fire alarm system, a main circuit, thermostats therein, a resistance in shunt with the circuit and included in the circuit by said thermostats, a pair of electro-magnets in the circuit, armatures for said magnets one of which is operated by current when directed through the resistance by said thermostats and the other armature operated under other current conditions controlled by the thermostats, an auxiliary circuit closed by the first mentioned armature to give a danger signal, a second auxiliary circuit closed by both armatures to give a trouble signal, and a third circuit closed by the two secondary circuits being closed in succession.

4. In a fire alarm system, a main circuit, thermostats therein to control three current conditions, no current, full current and an intermediate current condition, a pair of magnets and their armatures, a second circuit, a magnet therein and its armature operated by the intermediate current condition on one of the magnets in the main circuit to give a trouble signal, a fire alarm circuit open at two points, one of said points closed by the said magnet armature in the secondary circuit, a third circuit closed by the second magnet in the main circuit to give a fire signal and simultaneously close the second open point in the fire alarm circuit.

5. In a fire alarm system, the combination with a circuit containing thermostats, of relay magnets contained in said circuit, armatures therefor of different sensitiveness, a

local circuit having two branches, a magnet in each branch, an armature for each magnet, an alarm circuit open at two points, the relay armature of lesser sensitiveness adapted to close one of the branch circuits to operate the armature of the magnet therein to close one of the points to indicate a trouble call and the relay armature of greater sensitiveness to close the other branch circuit to operate the armature of the magnet therein to complete the alarm circuit, substantially as described.

6. In a fire alarm system, the combination with a normally closed circuit containing thermostats; of relay magnets therein their armatures operating under different current conditions, a local circuit having two branches, a magnet and its armature in each branch, an alarm circuit open at two points, the armature of one of the relay magnets closing one of the branches when current through the relay is reduced in voltage to cause the armature of the magnet in such branch to close one of the points in the alarm circuit, and the armature of another relay magnet closing the circuit in the other branch when current is further reduced to cause the armature of the magnet in such branch to complete the alarm circuit, substantially as described.

7. In a fire alarm system, the combination with a normally closed circuit containing thermostats and resistances automatically thrown in circuit by some of the thermostats; of a pair of relay magnets operating under different current conditions, and a manually operated circuit breaker in said circuit, a local circuit having two branches each containing a magnet and its armature, an alarm circuit having two normally open points each controlled by an armature of a magnet in a branch, one of the relay magnets operated when current is reduced to close one of the branch circuits and thereby close one of the open points, and upon subsequent reduction of the current or breakage of circuit the armature of the other relay magnet closes the second branch circuit to cause the armature of the magnet therein to complete the alarm circuit.

8. In a fire alarm system, a main circuit, a thermostat therein controlling the current through the system, two electro-magnetically operated circuit closing devices operated by different current conditions in the main circuit, two auxiliary circuits controlled by said devices and a third circuit controlled by the electro-magnetic circuit closing devices in the main circuit.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

MARTIN ARNOLD ABRAHAMSON.

Witnesses:

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ALBERT G. MICHELSON.