A. GOLDSTEIN & H. E. RICE.

AUTOMATIC FIRE ALARM SYSTEM.

APPLICATION FILED MAY 23, 1903.

963,432.

Patented July 5, 1910.

3 SHEETS—SHEET 1.

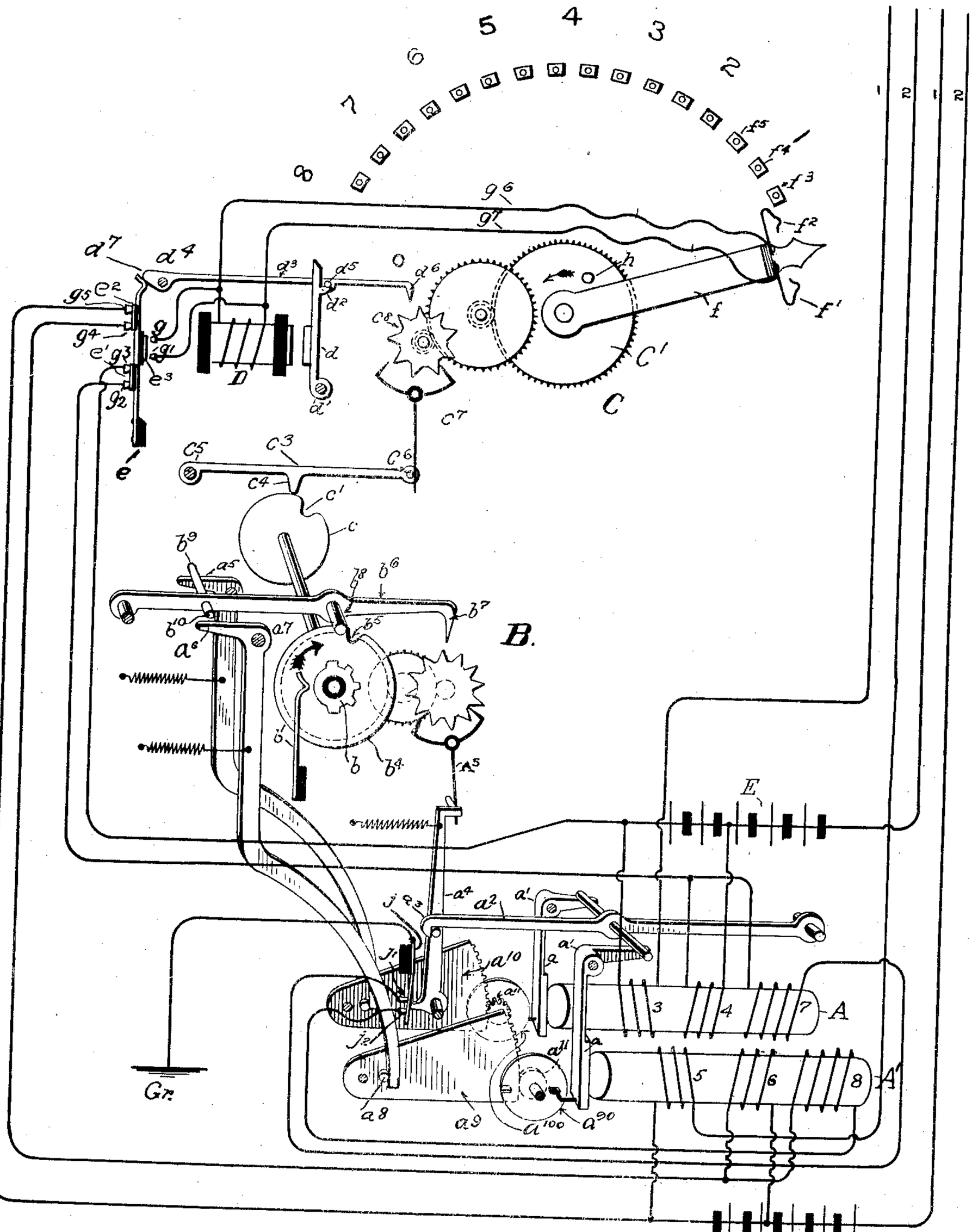

Fig. 1.

Witnesses

Frank S. Ober

Waldo M. Chapin

Inventors

Albert Goldstein & Horace E. Rice

By their Attorney

W. A. Redmond

A. GOLDSTEIN & H. E. RICE.

AUTOMATIC FIRE ALARM SYSTEM.

APPLICATION FILED MAY 23, 1903.

963,432.

Patented July 5, 1910.

3 SHEETS—SHEET 2.

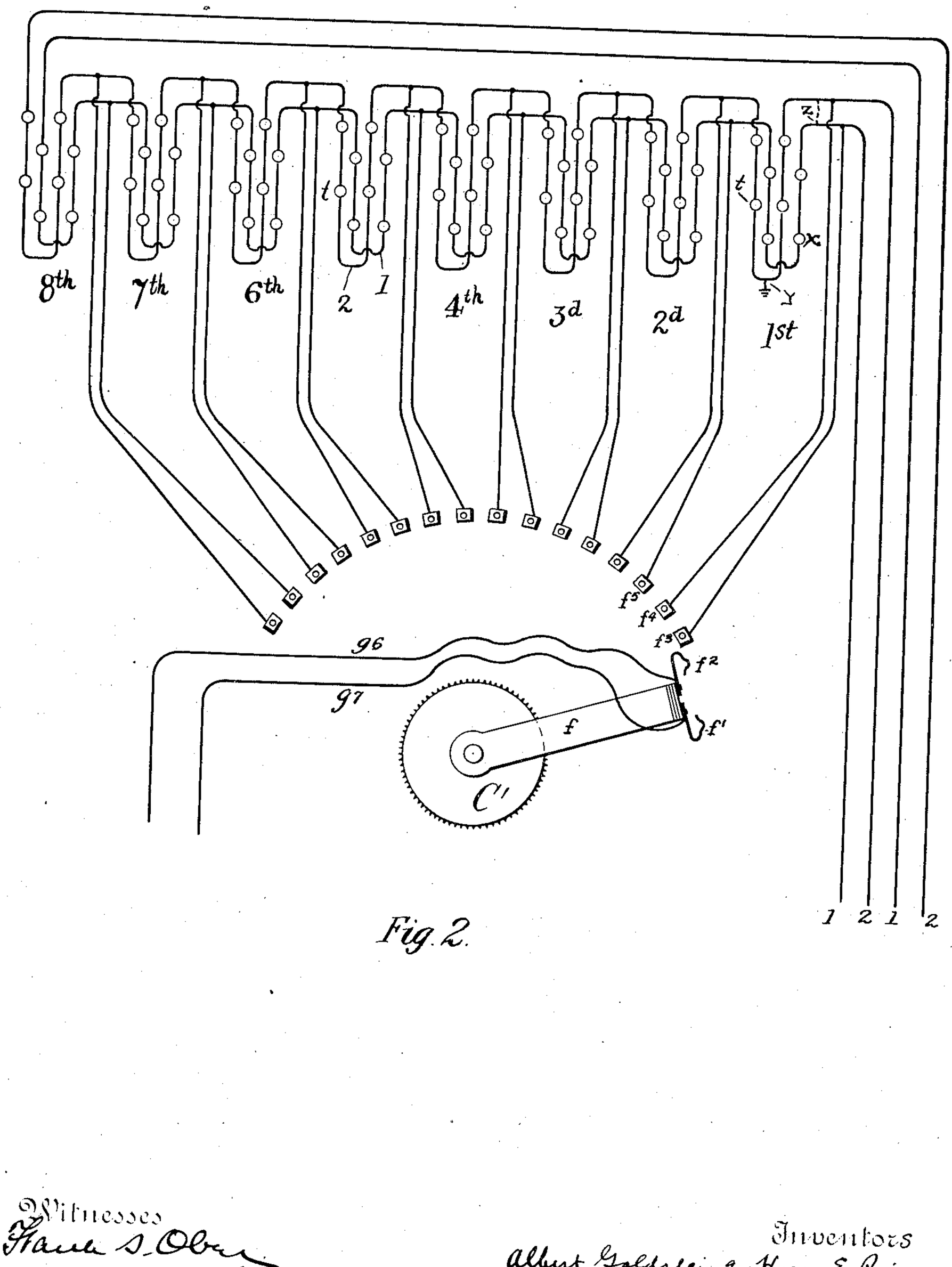

Fig. 2.

Witnesses
Frank S. Ober
Waldo M. Chapin

Inventors
Albert Goldstein and Horace E. Rice
By their Attorney
Wm. A. Rosenbaum

963,432.

A. GOLDSTEIN & H. E. RICE.
AUTOMATIC FIRE ALARM SYSTEM.
APPLICATION FILED MAY 23, 1903.

Patented July 5, 1910.
3 SHEETS—SHEET 3.

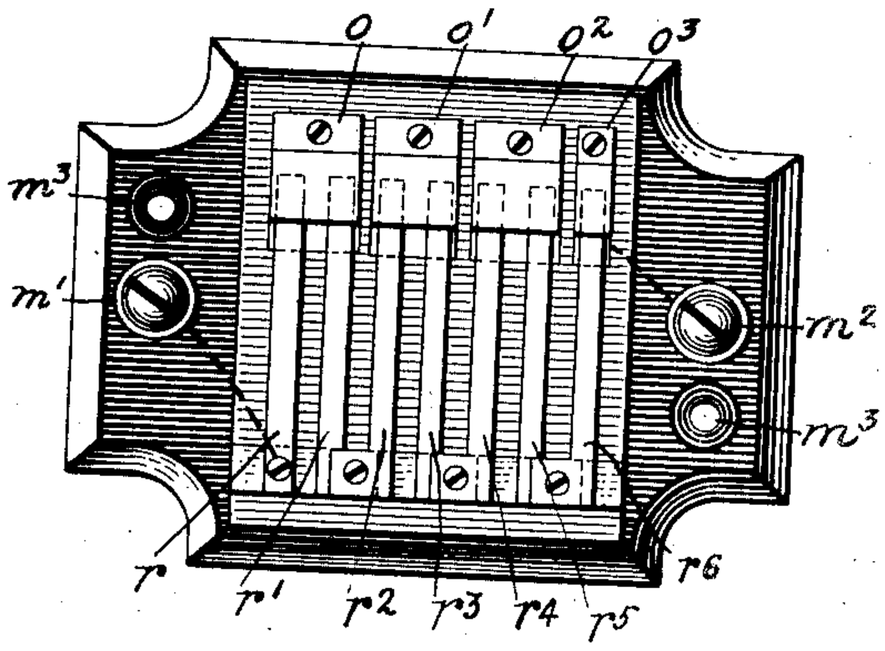

Fig. 4.

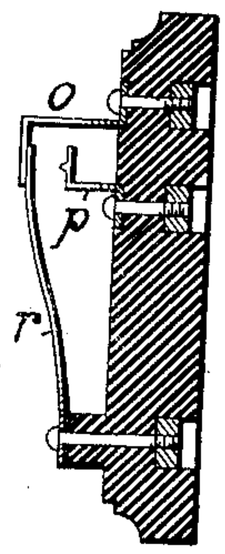

Fig. 6.

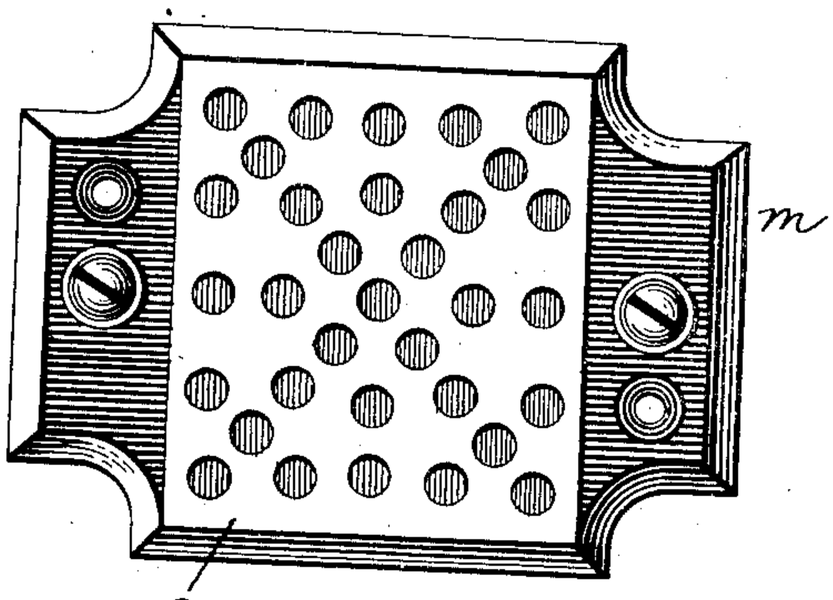

Fig. 3.

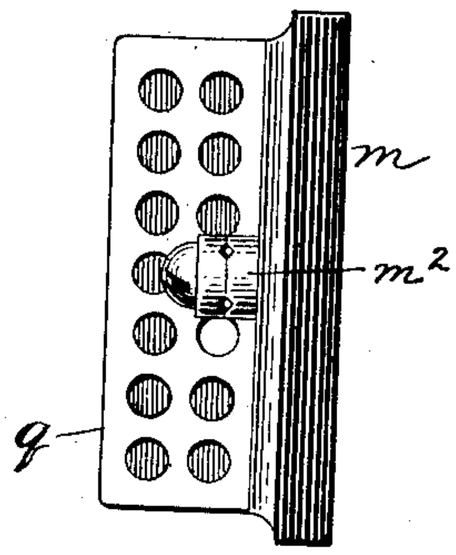

Fig. 5.

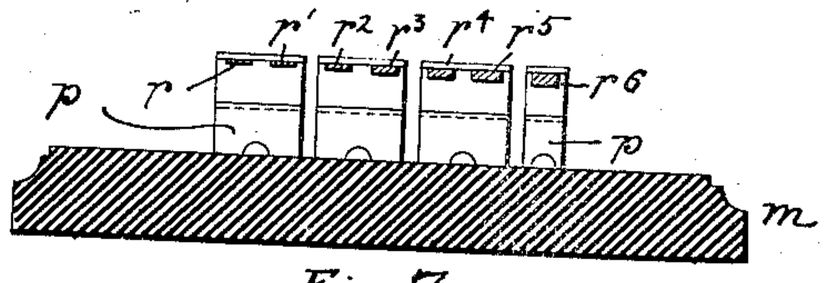

Fig. 7.

Witnesses
Frank S. Ober
Waldo M. Chapin

Inventors.
Albert Goldstein and Horace E. Rice
By their Attorney
M. A. Rosenbaum

UNITED STATES PATENT OFFICE.

ALBERT GOLDSTEIN, OF NEW YORK, N. Y., AND HORACE E. RICE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO AUTOMATIC FIRE PROTECTION COMPANY, A CORPORATION OF MAINE.

AUTOMATIC FIRE-ALARM SYSTEM.

963,432. Specification of Letters Patent. Patented July 5, 1910.

Application filed May 23, 1903. Serial No. 158,417.

To all whom it may concern:

Be it known that we, ALBERT GOLDSTEIN and HORACE E. RICE, citizens of the United States, residing in the city, county, and State of New York, and the city and county of Philadelphia, State of Pennsylvania, respectively, have invented certain new and useful Improvements in Automatic Fire-Alarm Systems, of which the following is a full, clear, and exact description.

The object of this invention is to provide an automatic fire alarm system consisting of a single wire for the thermostatic or protective circuit, together with a signal transmitting mechanism which transmits one character of signal for a defect in the circuit, such as a break, ground, cross or short circuit, or the weakening or failure of the battery, and a distinguishing signal for the operation of the thermostatic circuit from the effect of abnormal heat notwithstanding the presence of any of such defects.

It is wholly new in the art to accomplish the above object or differentiation of signals upon a single wire circuit, thereby effecting a great saving in the cost of construction and maintenance, as well as simplifying the system and making the same more reliable, as the greatly reduced length of conductor required in a single wire system, affords correspondingly less opportunity for trouble to arise upon and affect the same as compared with systems requiring either two conductors or three conductors connected to each thermostat.

A further object of the invention is to extend the economy and simplicity of the single wire system, to the protection of buildings of comparatively large floor area, without the disadvantage of the integrity of the system as a whole being dependent upon the continuity of the single conductor employed, a break in which would otherwise derange the entire circuit. To accomplish this object, the single wire system upon each floor is duplicated and the two wires applied to the ceilings in alternate parallel lines, thereby protecting parallel floor areas corresponding with the spacing requirements of the fire underwriting authorities, but by means of alternate circuits that are independent of each other; that is to say, each parallel thermostatic line is an independent unit of protection relative to the next adjacent line, but without such independence entailing any liability of interference or conflict of signals in the event of the simultaneous operation of thermostats in parallel circuits from a fire originating between any two adjacent circuits, such liability being safeguarded against by means of suitable "non-interference" provision in the transmitting mechanism.

Inasmuch as a break is the only single defect that deranges any portion of the system, the latter is made self-restoring after the occurrence of such a defect, by suitable automatic provision in the signal transmitting mechanism, as follows: After transmitting a telegraphic trouble signal for a break, and indicating upon the local annunciator the particular floor, room or section in which the break is situated, the mechanism automatically shunts or short-circuits the break to the extent of confining it to the particular floor, room or section in which the break is situated, leaving the remainder of the same circuit on all other floors, as well as the other independent circuit on the same floor, intact and operative for subsequent signaling. Moreover, the signal transmitting mechanism may be combined with the local floor annunciator, in one dust proof and weatherproof case, and placed upon the outside of the building protected, in which case an inspector responding to a telegraphic trouble signal at a time when the building is locked or inaccessible, such as at night, Sundays or holidays, may without entering the building, make such tests of the interior circuits as he may desire. In the event of the defect being a break, which fact would be indicated by the annunciator, as well as the particular location of the break, he can make temporary repairs at the box by plugging into the sockets provided for the purpose, and then rewind and reset the trouble signal mechanism, whereupon the system is restored to a condition where it may transmit a telegraphic trouble signal for a subsequent break, as well as automatically shunt such subsequent break, therefore rendering it practicable for the system to be self-indicating and self-restoring for as-

many successive breaks as the inspector may respond to, until such time as it is possible for him to obtain access to the building, for the purpose of making permanent repairs upon the particular floor or floors affected.

A further object of this invention is to insure the transmission of a telegraphic trouble signal upon the occurrence of either a ground, cross or break or weakening of the battery, and at the same time automatically "clear out" the means by which all these troubles are detected, thereby (1) restoring the system by nullifying the effect of either of these defects, (2) preventing the accidental repetition or combination of defects from causing the transmission of a false alarm of fire by means of successive interruptions of the circuit, and (3) minimizing the number of interruptions required for the normal operation of the thermostat.

Our system consists, in general, of a thermostatic circuit controller adapted, when operated by heat, to successively break and make the circuit a number of times. Thermostats of this character are connected in series upon two independent main circuits supplied with current respectively by two independent batteries. The current in one circuit flows in an opposite direction to that in the other.

The transmitter consists of two electromagnets, each having three windings which, for purposes of identification, we will call #1, #2 and #3. Coil #1 of each magnet is connected in series with the main thermostatic circuit. Coil #2 is connected across a portion of the battery and in opposition to coil #1, thereby electrically balancing the magnet and making it neutral, from which it is clear that the opening of the thermostatic circuit will energize the magnet. Coil #3 is connected from the ground to the intermediate point between the battery and coil #1, so that in the event of a ground on either circuit, the current from the battery will flow through the #3 coil and energize the magnet of the circuit on which said magnet is connected. In the case of a cross between the two main circuits, the two #3 coils, being in series across the two circuits, will both be energized.

Owing to the fact that a portion of the battery discharges at a greater rate than the rest of the battery, such portion will become exhausted quicker than the remainder and will produce an unbalancing of the circuit in which said battery is situated.

From the above, it will be understood that troubles on the circuit will produce one movement of the armature of the corresponding magnet, whereas the succession of brakes and makes created by a thermostat will give a corresponding succession of movements of the armature. This difference in armature movements is utilized to distinguish between a "fire" and a "trouble" signal, as will be more fully described in connection with the following drawings.

Figure 1 is a conventional representation of a portion of the entire system, including apparatus and circuits; Fig. 2 is a similar representation of the remainder of the system and is to be read in connection with Fig. 1; Fig. 3 is a face view of the thermostat complete; Fig. 4 is a view of the thermostat with cover removed; Fig. 5 is an end view, and Figs. 6 and 7 are sectional views of the thermostat.

The various floors of the building to be protected are indicated by 1st, 2d, 3d, etc. on Fig. 2. Each floor is protected by a number of thermostats, which, it will be understood, are located certain distances apart in accordance with the underwriters' rules, the number of thermostats on each floor being determined by the area of the floor. As shown in the drawing, there are eight thermostats on each floor of an eight story building. At any suitable central location in or outside of the building, the transmitting mechanism is located. This consists in general, of two electro-magnets A and A', a signal train B, and an annunciator train C. 1 and 2 indicate the wires of two independent main electric circuits. The main circuit 1 includes in series one-half of the number of thermostats t, on each floor of the building and a battery E, while the main circuit 2 includes in series the remainder of the thermostats throughout the various floors, and the battery F. The polarities of the two batteries are so arranged in their respective circuits that in case of cross connections between the two main wires on either side of the batteries, they will be connected in series with each other.

Referring now to the transmitter, the magnet A is provided with two coils, 3 and 4, respectively, the former connected in circuit with the entire battery E, and the latter with a section thereof. Magnet A' is similarly provided with two coils 5 and 6 connected with battery F in a like manner. The resistance and number of turns of coils 4 and 6 is such that they balance with coils 3 and 5 respectively. Each magnet has an armature lever a pivoted at a' and adapted to lift a lever a^2 carrying a hook a^3 at one end and adapted to release a detent lever a^4 which controls an escapement A^5. This escapement controls a signal train, on the last shaft of which is a signal wheel b having projections suitably grouped to indicate a number, each projection serving to close connection with a contact b' and thus send an electrical impulse over the signal circuit to the alarm receiving headquarters. On the shaft with the signal wheel is a disk b^4 having a notch b^5 in its periphery. b^6 is a lever having a detent b^7 at its free end and a

pin b^8 at an intermediate point. The pin b^8 normally rides upon the rim of disk b^4 and is adapted to fall into the notch b^5 to stop the rotation of the signal wheel. When the pin b^8 is permitted to enter said notch, the detent b^7 likewise enters between the teeth of the escapement wheel and stops the train. Lever b^6 also carries pins b^9 and b^{10}, which are in positions to be lifted by either of two levers a^5 and a^6 hung upon centers at a^7. These levers normally rest against pins a^8 carried by segments a^9 and a^{10}. The segments are pivoted and have concentric racks engaged by pinions a^{11} the rotation of which is controlled by escapement disks a^{00} and a^{100} normally detained by fingers carried by the respective armature levers a, each movement of the armature forward or back permitting the disk to make a half revolution. The levers a^5 and a^6 overlap the pins a^8 sufficiently to allow the segment to move the full length of the rack before the levers are released, and when released they swing back and lift the lever b^6 so that its pin b^8 cannot enter notch b^5, under which circumstance the signal train is permitted to run down.

j is a spring plate resting upon and electrically connecting terminals j' and j^2, respectively, and is itself connected to ground.

The magnets A and A′ are provided with two other windings 7 and 8 one end of each being connected to main circuits 1 and 2 respectively, and the other ends to terminal j' and j^2 respectively, thus connecting coils 7 and 8 together across the two main circuits 1 and 2. Likewise each of the two main circuits are grounded through their respective branches and the spring j.

The detent lever a^4, which is normally held by hook a^3 on the end of lever a^2, carries a cam at its fulcrum which forces a spring j into electrical contact with two terminals j' and j^2 which when lever a^4 is released swings forward removing pressure from spring j and opening contacts j' and j^2.

On the same shaft with the disk b^4 is situated a similar disk c with notch c'. An ordinary lever c^3, pivoted at c^5 and carrying a pin c^6 detains an escapement c^7 of annunciator train C. A projection c^4 on lever c^3 rides normally on the periphery of disk c and is situated so as to drop into notch c' when the disk c revolves, thereby releasing escapement c^7, permitting train C to run down. On the last shaft of train C is situated an arm f carrying two brushes f' and f^2 which are insulated from arm f and from each other.

Along the radius of arm f are situated a number of contact posts f^3, f^4, f^5, etc., which are connected alternately to the main thermostatic circuits at regular intervals and which are traversed by brushes f' and f^2, said brushes are so spaced as to bring alternate contact posts under the brushes at the same time, so that when brush f' is in contact with post f^3, brush f^2 will be in contact with post f^5. Their contact posts are also provided with sockets for temporarily short-circuiting defective sections.

An electro-magnet D, has an armature lever d pivoted at d' and a projection d^2 at the other end, which supports lever d^3, pivoted at d^4, by means of a pin situated at the point d^5. The lever d^3 carries a hook d^6 which is normally disengaged from escapement wheel c^8. Lever d^3 has a cam d^7 which engages with a spring brush e carrying three contact strips e', e^2 and e^3, each of which is insulated from the other two, two contact strips e' and e^2 being on one side and held in electrical contact with posts g^2 and g^3, and g^4 and g^5, respectively, by the pressure of the cam d^7 against the spring e. Contact strip e^3 being on the opposite side of the spring is held off of contacts g and g'. Conductors g^6 and g^7 lead from brushes f' and f^2 to the winding on magnet D. Two wires running from g^6 and g^7 intermediate between brushes and winding, connect with contact posts g and g'. It will now be seen that train C will be released when projection c^4 on lever c^3 falls into notch c', and that an electrical current delivered to the magnet D will actuate said magnet, exerting a pull on armature lever d and releasing lever d^3, which, falling down, engages with the teeth in escapement wheel c^8 thereby stopping the train C, and the cam d^7 on the end of lever d^3 releasing spring e, contacts g^2 and g^3, and g^4 and g^5 are opened and g and g' are closed by plate e^3 thereby short circuiting the magnet winding D.

The arm f is mounted loosely on the main shaft of train C. A pin h on wheel c' is so situated that it will make a part of a revolution before engaging arm f, the direction of rotation being that of the arrow shown on wheel c', so that there will be a definite time interval between the release of train C and the rotation of arm f.

Referring now to the construction of the thermostat, which is peculiar and novel, though not claimed in this application, m is a base of porcelain or other suitable insulating material, provided with binding screws m' and m^2 and with screw holes m^3 for fastening it to the wall or ceiling. Upon the face of this plate are mounted a number of metallic angle plates o, o', o^2 and o^3, and directly beneath the overhanging portion of each angle plate is a metallic anvil p; one for each of said plates.

r, r', r^2, r^3, r^4, r^5, r^6, are a series of spring tongues electrically connected together in pairs at their ends and projecting into the space between the angle plates and the anvils. Their free ends, which have a tendency to rest on the anvils are secured under tension to the under sides of the angle plates by means of fusible material such as solder.

These tongues are made of electrical conducting material, but are of successively increasing thickness, as shown more particularly in Fig. 7, so that the time interval required to heat the tongue sufficiently to fuse the solder will be successively greater from the first to the last tongue. The electrical circuit leads through these tongues successively in the following manner: From the binding post m' to the tongue r through the angle plate o to the tongue r', thence through tongue r^2, angle plate o', tongue r^3, tongue r^4, angle plate o^2, tongue r^5, tongue r^6, angle plate o^3 and binding post m^2. The tongues are protected from mechanical injury by a cover q which will freely admit heat in case of fire. Such heat entering the thermostat will attach all of the tongues at practically the same instant, but the tongue r will become most rapidly heated and the heat will melt the solder holding it first, allowing it to spring into contact with the anvil p immediately beneath it and the circuit will thus be broken. Tongue r' will be the next to yield and in falling against the anvil p, will close the circuit. Tongue r^2 will next yield and break the circuit, which will be closed by tongue r^3. In like manner the tongues will successively leave the angle plates and make contact with the anvils, thus successively opening and closing the circuit a number of times, depending upon the number of tongues used.

The operation may now be described as follows: The parts are illustrated in their normal positions. Let us assume that a fire occurs on the first floor of the building and that the thermostat marked X is the one to send in the alarm. The thermostat operates in the manner before described, creating a series of breaks and makes in the circuit 1, following each other in more or less rapid succession, depending on the amount of heat. Each break and make of the circuit causes a forward and backward movement of the armature lever a of the transmitter. The first forward movement of the armature lever releases lever a^4 and permits the signal train to start. The signal wheel b sends in to the alarm receiving headquarters the number which is formed by the group of projections on the said signal wheel. This signal is repeated as many times as the wheel is permitted to rotate and this may be controlled by winding the spring which drives the train to give a certain number of rotations of the signal wheel and then stop, or any other means can be devised to stop the wheel after it has sent in the number a given number of times. This signal informs the alarm receiving headquarters where the building is situated. In the meantime the armature lever continues to vibrate by reason of the makes and breaks of the thermostat. This causes the escapement disk a^{100} to operate intermittently, thereby permitting segment a^{10} to gradually fall, finally releasing lever a^5 which is pulled over and holds lever b^6 from dropping into notch b^5. Thus the signal wheel b is rotated the full number of times. This fact is an indication to the alarm receiving headquarters that the alarm is caused by a fire and not, as will be shown later, by a trouble. Meanwhile, disk c (which has made the same number of rotations as disk b^4, lug c^4 meanwhile riding into and out of notch c') having come to rest with projection c^4 resting in notch c', train C is permitted to run down. After a time element, which is secured by means of the lost motion device on wheel C', the arm f begins its rotation, its brushes making contact with alternate contact posts, so as to bridge magnet D across each floor or thermostatic section. Owing to the fact that there is a comparatively small difference of potential between the two ends of a normal floor, the magnet will not be energized, but when the arm f has rotated so as to bridge the floor on which the open circuit is situated, the magnet will be connected across the break, thereby receiving the full available current of the main battery and will be energized thereby, locking train C and stopping arm f with the magnet D bridging the floor on which the break is situated. The spring e being released, contact plate e^3 connects terminals g and g', thereby restoring the continuity of the thermostatic circuit, and the index hand will point to the floor on which the fire is situated.

The operation in case of trouble is as follows: Let us assume that one of the main lines has become grounded and that the ground occurs at the point y in the main wire 2. This will create a circuit from ground y through battery F, contacts g^4 and g^5, winding 8, contact j^2, spring j, and ground Gr. Battery F will therefore be grounded through the winding 8. This will energize magnet A' and cause it to draw armature a' inward. Lever a^4 is released and immediately opens the ground circuit at j^2. Magnet A' then becomes dead and the segment a^9 is moved but one step of the number required to release lever a^6. The release of lever a^4 permits the signal train to start, but the lever b^6, not now being supported by either lever a^5 or a^6, pin b^8 drops into notch b^5 at the end of the first revolution of the signal wheel b, and pin b^7 engages the escapement wheel, thus stopping the signal train after the signal has been transmitted but once. This indicates at the alarm receiving headquarters, not a fire, but a defect in the system which requires attention. It will be observed here that inasmuch as the ground circuit was immediately opened by the lifting of the spring j, the apparatus automatically restored itself since it removed

one of the grounds, leaving the whole of main circuit 2 intact and still capable of operation in case of fire.

In the event of a cross between the two main wires at any point in the building, substantially the same result follows as in the case of a ground; for instance, if there is a cross at the point Z on one side of the battery, a cross being already established on the other side by reason of the fact that the coils 7 and 8 are practically in series across the main wires on that side, a complete circuit will be established for both batteries through said coils 7 and 8 of the magnets which will result in sending the signal in once as before described. Likewise an abnormal weakening of the battery will unbalance the magnet of the system on which it occurs, by reason of the fact that the section of the battery around which coils 4 and 6 are connected is discharged more rapidly than the remainder of the battery, and will therefore exhaust the quickest. Any drop in the voltage of either section of the battery will energize the magnet causing the transmission of a trouble signal. It is also obvious that a break on either main circuit will cause a trouble signal.

In the event of either a trouble signal or a fire alarm, annunciator train C is released. In the case of any other trouble except a break, the arm *f* makes its full rotation, being stopped by a pin after it has passed all of the contacts. In the case of a fire or an open circuit, the arm *f* rotates until its brushes bridge the floor on which the break or fire exists, when the total battery current from the main battery will flow through winding D, stopping the mechanism, and by means of spring *e* opening the circuit of coils 4 and 6, which are connected to contacts g^2 and g^3 and to g^4 and g^5 respectively, and short circuiting the floor and the magnet D by means of strip e^3 thereby restoring the continuity of the circuit, this coil being in series with the main line and its battery. The system is now reduced to a simple series circuit and both magnets are energized. It will now be evident that the operation of a thermostat on either circuit will alternately release and energize the magnet as before.

An important feature of this invention is the peculiar and novel arrangement or distribution of the two circuits throughout a given area to be protected. Take, for instance, one floor or room of a building; the rules of the fire underwriters require that the thermostats shall be located not more than a certain distance apart in each of two directions. If, for instance, a given space is fifty feet square and the maximum distance permitted between thermostats is twelve feet, it will require four rows of thermostats with four thermostats in each row to protect the area. Now if the two wires of an ordinary circuit on which the thermostats are connected in multiple are run through this area, it will require eight lengths of wire, two for each row. If the thermostats are connected in series in the circuit, it will only require four lengths of wire, or one for each row, but a single series circuit does not afford sufficient protection because a break will throw the entire circuit out of operation, and it has heretofore been impossible to so equip a single wire series circuit that it will obviate this condition. An important feature of this invention therefore is the peculiar system of wiring wherein the advantage of economy of wire afforded by a single wire circuit is obtained in conjunction with efficient means and apparatus to render such a system free from complete derangement as to breaks, as well as self-restoring on the occurrence of such defects. This is accomplished by using a plurality, preferably two, single wire or series circuits and distributing them successively or alternately throughout the area to be protected. Thus in the instance above mentioned of four rows of thermostats, the first and third rows will be in one circuit and the second and fourth in the other, the total length of wire being substantially the same as if one series circuit were run back and forth to form all four of the rows.

With such a system it is only necessary to have an alarm transmitting apparatus which will operate without interference; that is to say, which after one thermostat starts the transmitter, its operation shall not be interfered with by a thermostat on an adjacent circuit. This non-interference of operation might be accomplished by using independent signal trains so connected that the first train released would have precedence and lock the other from interference, or, separate transmitters for each single wire circuit might be employed but so related that one transmitter will repeat the number more times than the other, and thereby enable the receiving headquarters to get at least one or more distinct numbers, or, in fact, any other known or yet to be devised plan of non-interference might be adopted, but it is preferred to utilize one transmitting apparatus for both or all circuits and incorporate therein the non-interfering idea, as fully hereinbefore explained. It must be understood, however, that the invention is of sufficient scope to include any kind of alarm transmitting apparatus in combination with the alternate or successive distribution of the circuits throughout the protected area, since this distribution affords the greatest possible protection, in that it exposes to the fire thermostats located in two or more different circuits, either of which is capable of action, whether one or more of the others

are at the moment operative or not. This may be best illustrated by assuming that one of the wires is actually broken and that a fire occurs immediately under it. It will be seen that owing to the proximity of an entirely independent circuit on either side of the broken circuit, the delay in sending the alarm will be very little, if any.

It is obvious that the particular construction of thermostat shown is not essential to the invention so long as it is of such a nature as to interrupt the circuit a number of times in succession. Each thermostat might, for instance, embody a short gear train or combination of levers set in motion by heat and adapted to open and close the circuit a number of times in succession.

Having described our invention, we claim:—

1. In an automatic fire alarm telegraph system, the combination of transmitting apparatus, a release for said transmitting apparatus, stopping means for said transmitting apparatus, a protective circuit including thermostats adapted to interrupt the circuit a definite number of times when operated and means whereby any interruption of the circuit will cause said transmitting apparatus to be released and other means whereby any number of interruptions less than said definite number will permit the stopping means to act to disable the transmitting apparatus before completion of the full operation which transpires when the said definite number of interruptions occur.

2. In an automatic fire alarm telegraph system, the combination of transmitting apparatus, a release for said transmitting apparatus, stopping means for said transmitting apparatus, a protective circuit including thermostats adapted to interrupt the circuit a definite number of times when operated by the continued application of heat and means whereby any interruption of the circuit will cause said transmitting apparatus to be released and other means whereby any number of interruptions less than said definite number will permit the stopping means to act to disable the transmitting apparatus before completion of the full operation which transpires when the said definite number of interruptions occur.

3. In an automatic fire alarm system, the combination of two transmitter electro-magnets, a single transmitter controlled equally and completely by either magnet, two normally closed independent circuits respectively including two windings on said magnets and extending to the locality to be protected, and thermostats connected in series in the respective circuits.

4. In an automatic fire alarm system, the combination of two transmitter electro-magnets, a single transmitter therefor, two normally closed independent circuits respectively including two windings on said magnets and extending to the locality to be protected, thermostats connected in series in the respective circuits and adapted when subjected to heat to open and close their respective circuits a number of times, and transmitter-controlling means actuated only by the thermostat-response of either magnet to condition the transmitter to send a complete alarm signal.

5. In an automatic fire alarm system, the combination of two independent alarm circuits and a battery in each, said circuits extending to the protected locality, a branch from one of said circuits leading to ground and a branch from the other circuit also leading to ground and an alarm transmitter in each branch, for the purpose set forth.

6. In an automatic fire alarm system, the combination of two independent alarm circuits and a battery in each, said circuits extending to the protected locality, a branch from one of said circuits leading to ground and a branch from the other circuit also leading to ground, an alarm transmitter in each branch and a switch normally connecting said branches together to form a connection across the two independent circuits, for the purpose set forth.

7. In an automatic fire alarm system, the combination of an electro-magnet, an alarm circuit including a winding on said magnet, a branch from said circuit including another winding on said magnet and a circuit controller, and means whereby the energization of the magnet will operate said circuit controller.

8. In an automatic fire alarm system, the combination of two transmitter electro-magnets, two normally closed independent circuits respectively including two windings on said magnets and extending to the locality to be protected, thermostats connected in series in the respective circuits and adapted when subjected to heat to open and close their respective circuits a number of times, a branch circuit forming a connection across said independent circuits, two windings respectively on said magnets and included in said branch circuit and a ground connection for the branch circuit located between the two windings.

9. In an automatic fire alarm system, the combination of a signal transmitting mechanism, a single wire protective circuit in series therewith, a thermostat in said circuit adapted to open and close the circuit each a plurality of times upon continued application of heat thereto, and means whereby such operation of a thermostat will cause a distinctive number signal to be repeated a plurality of times while a defect in the circuit will give the number signal but once.

10. In an automatic fire alarm system, the combination of a signal transmitter, an elec-

tro-magnet controlling the same, a circuit including a coil on said magnet and one or more thermostats each adapted when operated by heat to open and close the circuit a number of times, a trouble circuit including a coil on said magnet, a detent for the signal transmitter adapted to be released by the magnet and means whereby the number of impulses traversing the magnet coils will determine the number of times the signal is repeated by the signal transmitter.

11. In an automatic fire alarm system, the combination of a signal transmitting train, a detent therefor, an electro-magnet and means for intermittently energizing it in case of fire, said detent being adapted to be released by the magnet, means for automatically stopping the transmitter, and means whereby the successive energizations of the magnet will prevent the stopping means from acting.

12. In an automatic fire alarm system, the combination of a thermostat adapted to interrupt the circuit a number of times in succession each time by the continued application of heat, and a signal transmitting mechanism in series therewith, adapted to send one character of signal for a single interruption, and a distinguishing signal for successive interruptions of the same circuit.

13. In an automatic fire alarm system, the combination of a thermostat adapted to cause a succession of interruptions of a circuit each time by the continued application of heat, and a signal transmitting mechanism in series therewith adapted to send one character of signal for a single interruption and a distinguishing signal for the successive interruptions effected by the operation of the thermostat.

14. In an automatic fire alarm system, the combination of a circuit extending to the locality to be protected, a neutral electro-magnet in series therewith normally balanced so that each single interruption of the electrical condition of the circuit will unbalance the magnet, a thermostat in series in said circuit adapted when subjected to heat to successively interrupt the circuit, and a signal transmitting mechanism adapted to send distinguishing signals depending upon whether the electro-magnet is affected by a single interruption or a number of interruptions of the circuit.

15. In an automatic fire alarm system, the combination of a thermostat adapted to create a succession of interruptions of a circuit, a signal transmitting mechanism in series therewith adapted to transmit distinguishing signals for one interruption and a succession of interruptions, respectively, and means for automatically restoring the system after the transmission of a signal due to one interruption so that said interruption will not prevent the transmission of a fire alarm signal by a succession of interruptions.

16. In a fire alarm system, the combination of a plurality of independent single wire circuits arranged in alternate lines over the area to be protected, thermostats connected in series on each circuit independently and suitable alarm transmitting apparatus common to all circuits, operable by any circuit.

17. In a fire alarm system, the combination of a plurality of independent circuits each of which includes thermostats connected in series therein, said circuits being distributed throughout the area to be protected in succeeding parallel lines, and alarm transmitting apparatus common to all of said circuits and operable by any one thereof individually.

18. In a fire alarm system, the combination of a plurality of independent circuits each of which includes thermostats connected in series therein, said circuits being distributed throughout the area to be protected in succeeding parallel lines, alarm transmitting apparatus and means whereby any of said circuits alone or jointly can operate the alarm apparatus.

19. In a fire alarm system, the combination of a plurality of independent circuits each of which includes thermostats connected in series therein, said circuits being distributed throughout the area to be protected in succeeding parallel lines, alarm transmitting apparatus operated by said circuit and means whereby said circuits will individually actuate the alarm apparatus without interference.

20. In an automatic fire alarm system, a protective circuit divided into a plurality of sections, means for shunting any section normally potentiated for operation, means normally restraining said shunting means, a code-signal transmitter comprising a controlling magnet governed by the protective circuit, and a clock mechanism; and means controlled by said clock mechanism for releasing said restraining means.

21. In an automatic fire alarm system, a transmitter controlling electro-magnet energized by two neutralizing coils, in combination with a normally closed protective circuit including a battery and one coil and another normally closed circuit including a portion of the same battery and the other coil.

22. In an automatic fire alarm telegraph system, the combination of a single-wire normally-closed thermostatic circuit, a signal transmitting mechanism controlled thereby and means whereby said signal transmitting mechanism will transmit one character of signal for either of the following defects in the system, to wit: a break in the circuit, a ground on the circuit, or a weakening or

failure of the battery, and a different character of signal for a fire, substantially as described.

23. In an automatic fire alarm telegraph system, the combination of a single-wire normally-closed thermostatic circuit, a signal transmitting mechanism controlled thereby and means whereby said signal transmitting mechanism will transmit one character of signal for either of the following defects in the system, to wit: a break in the circuit, a ground on the circuit, or a weakening or failure of the battery, and a different character of signal for a fire, notwithstanding the existence of any of the defects named, substantially as described.

24. In an automatic fire alarm telegraph system, the combination of a plurality of independent protective circuits, independent sources of electricity for each circuit, said circuits being distributed throughout the protected area in alternate or succeeding parallel lines, and a transmitter controlled by either or any circuit without interference from the other.

25. In an automatic fire alarm telegraph system, the combination of a thermostatic protective circuit, transmitting devices controlled thereby, a loop circuit containing a locking magnet, a pair of bridging contacts forming the terminals of said loop circuit, mechanism for successively connecting said terminals with different portions of the thermostatic circuit and means whereby current flowing in the loop circuit will energize said locking magnet and cause the said terminals to be detained and locked, and means for short circuiting the locking magnet after its energization substantially as and for the purpose set forth.

26. In an automatic fire alarm telegraph system, the combination of a protective circuit including thermostats adapted to open and close the circuit a number of times, a transmitter controlled by said circuit, a loop circuit including an annunciator, mechanism for connecting the terminals of said loop circuit successively with various parts of the protective circuit, means whereby the transmitter when actuated will start said mechanism and means whereby the operation of bridging the various portions of the protective circuit will be delayed to first permit of the full operation of the transmitter.

27. In an automatic fire alarm system, the combination of two independent alarm circuits and a battery in each, said circuits extending to the protected locality, a branch from one of said circuits, and a branch from the other circuit, a switch normally connecting said branches together to form a connection across the two independent circuits and an alarm transmitter in said connection.

28. In an automatic fire alarm telegraph system, the combination of a single-wire normally closed thermostatic circuit including thermostats connected in series therein and adapted to interrupt the circuit a definite number of times when operated, and a signal transmitting mechanism adapted to send one character of signal when affected by a definite number of interruptions of the circuit within a definite interval of time, and a distinguishing signal for any number less than the required number of interruptions.

29. In an automatic fire alarm telegraph system, the combination of a normally closed thermostatic circuit, thermostats connected therein and adapted to open and close the circuit a definite number of times when operated, and a signal transmitting mechanism adapted to send a fire alarm signal when affected by a definite number of openings of the circuit within a definite interval of time, and a trouble signal for all interruptions differing from the foregoing either as to number or as to kind.

30. In an automatic fire alarm telegraph, the combination of a single wire normally closed thermostatic circuit including thermostats adapted to open and close the circuit a definite number of times when operated, and a signal transmitting mechanism adapted to send a fire alarm signal when affected by a definite number of openings of the circuit within a definite interval of time, and a trouble signal for all interruptions differing from the foregoing either as to number or as to kind.

31. In an automatic fire alarm system, the combination of two independent alarm circuits and a battery in each, said circuits extending to the protected locality, a normally closed branch circuit bridging the alarm circuits, and an alarm transmitter in said branch circuit, for the purpose set forth.

In witness whereof, we subscribe our signatures, in presence of two witnesses.

ALBERT GOLDSTEIN.
HORACE E. RICE.

Witnesses:
FRANK S. OBER,
WALDO M. CHAPIN.