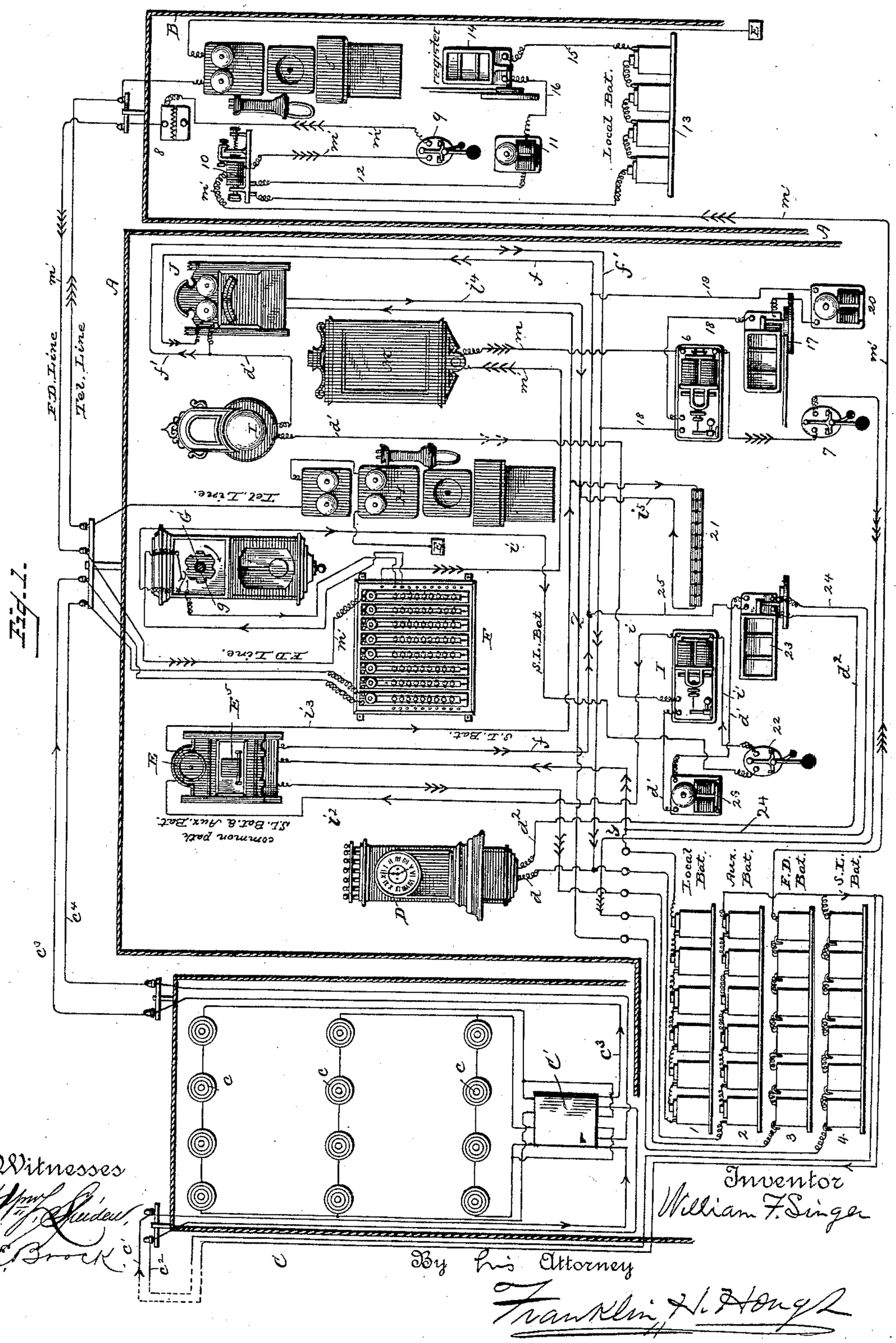
(No Model.)

4 Sheets—Sheet 1.

W. F. SINGER.

ELECTRICAL AUTOMATIC FIRE ALARM SYSTEM.

No. 436,640. Patented Sept. 16, 1890.



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(No Model.) 4 Sheets—Sheet 2.

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ELECTRICAL AUTOMATIC FIRE ALARM SYSTEM.

No. 436,640. Patented Sept. 16, 1890.

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(No Model.) 4 Sheets—Sheet 3.

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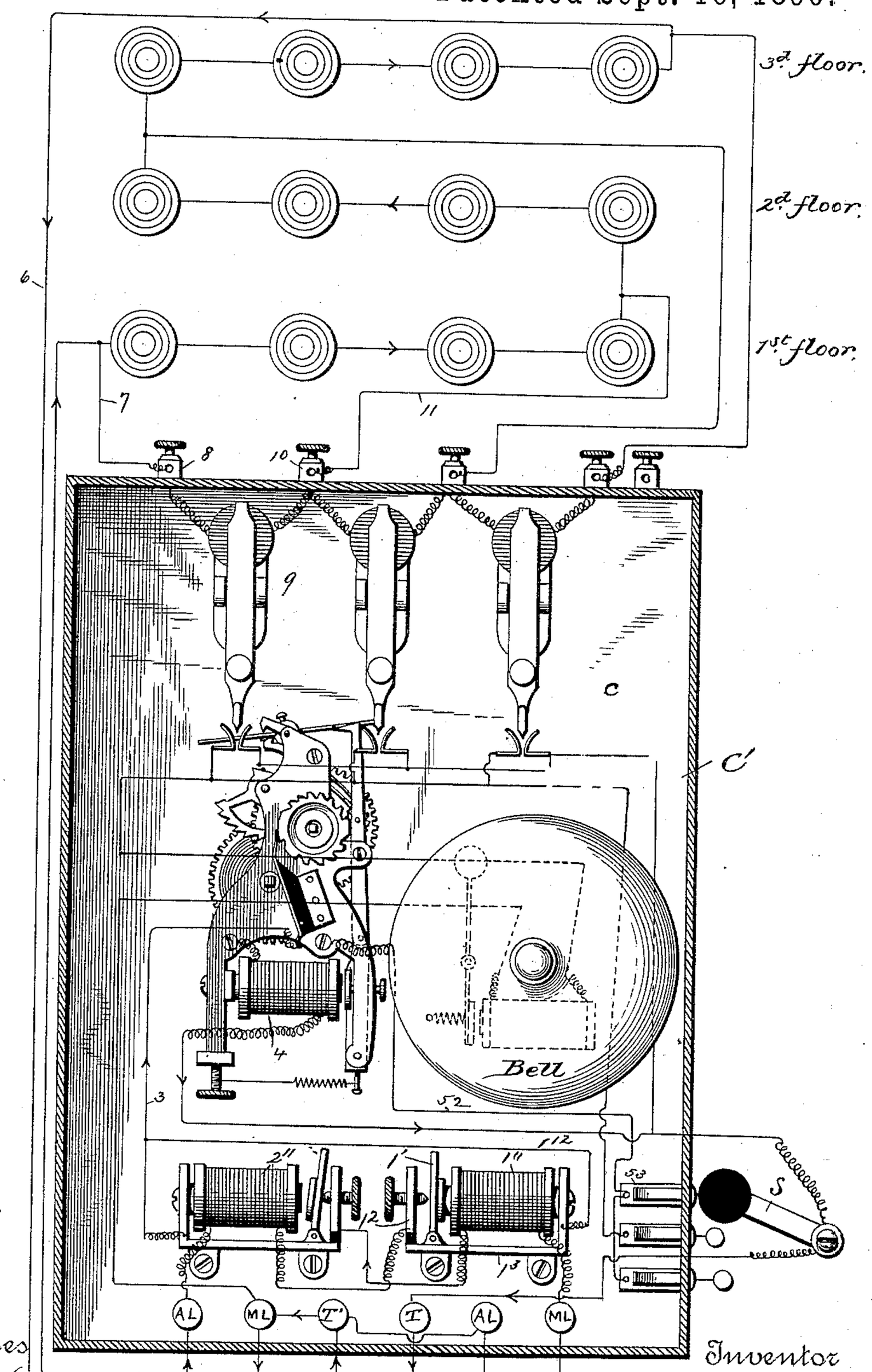
ELECTRICAL AUTOMATIC FIRE ALARM SYSTEM.

No. 436,640. Patented Sept. 16, 1890.

Fig. 5.



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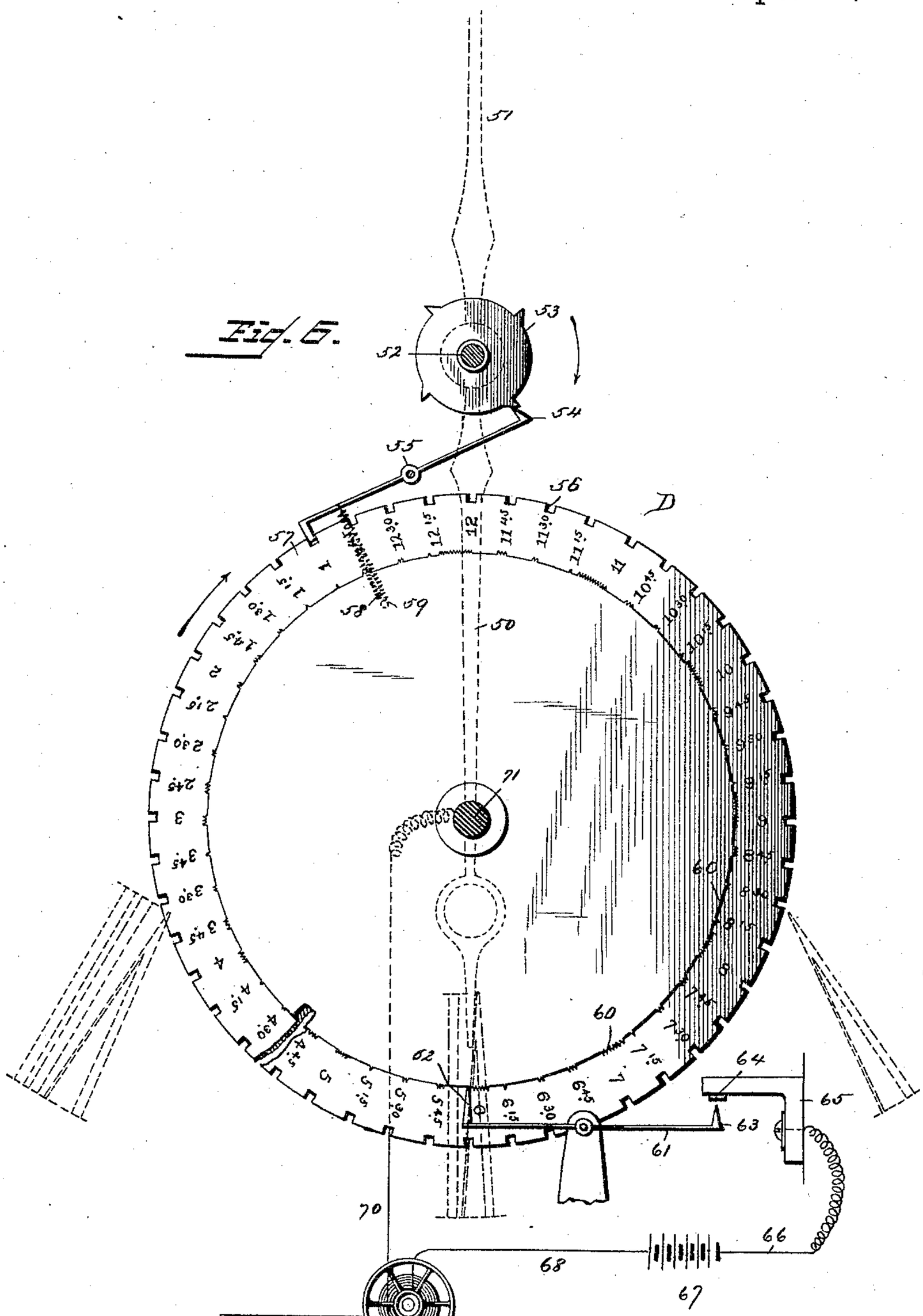
(No Model.) 4 Sheets—Sheet 4.

W. F. SINGER.

ELECTRICAL AUTOMATIC FIRE ALARM SYSTEM.

No. 436,640. Patented Sept. 16, 1890.

Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM F. SINGER, OF CARTHAGE, ASSIGNOR TO THE SINGER FIRE-ALARM COMPANY OF BUFFALO, LIMITED, OF BUFFALO, NEW YORK.

ELECTRICAL AUTOMATIC FIRE-ALARM SYSTEM.

SPECIFICATION forming part of Letters Patent No. 436,640, dated September 16, 1890.

Application filed March 11, 1889. Serial No. 302,876. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM F. SINGER, a citizen of the United States, residing at Carthage, in the county of Jefferson and State of New York, have invented certain new and useful Improvements in Electrical Automatic Fire-Alarm Systems; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to certain new and useful improvements in automatic fire-alarm systems; and it consists in the peculiar combinations, arrangement, and adaptation of parts, all as more fully hereinafter described, shown in the accompanying drawings, and then specifically defined in the appended claims.

The invention is clearly illustrated in the accompanying drawings, which, with the letters and figures of reference marked thereon, form a part of this specification, like letters of reference indicating like parts throughout the several views.

In the accompanying drawings, Figure 1 is a diagrammatic view of the entire system, including the central-office plant, street-circuit wires, and an equipped building, and showing the instruments used in connection with the system at fire headquarters. Fig. 2 is an enlarged sectional view of the automatic battery changer or switch for cutting in the auxiliary battery into the line in circuit. Fig. 3 is an enlarged detail view of a portion of the circuit-testing clock. Fig. 4 is an enlarged detail showing the interior construction of a battery-gage and line-relay. Fig. 5 is an enlarged sectional view of the call-box, showing the interior construction in side elevation and its connection with the thermostats. Fig. 6 is an enlarged diagrammatic view of the clock mechanism.

Reference now being had to the details of the drawings by letter, A designates the walls of the room containing the central-office equipment, B the walls of the fire-department headquarters, and C the walls of an equipped building.

Within the building C is arranged a series of thermostats *c c*, there being a given number upon each story and connected through the call-box C′, preferably in the manner described in my application of even date herewith, Serial No. 302,875. These thermostats maintain the line-circuit normally closed through the transmitter placed in a protected building.

The wires c' and c^2 (shown at the left of Fig. 1) are the outgoing main and auxiliary line circuit wires, respectively, and c^3 and c^4 (shown at the right of the equipped building in said figures) are the incoming main and auxiliary, respectively.

1 designates the local batteries, 2 the auxiliary, 3 the fire-department, and 4 a small line-battery sufficient to keep a constant light current upon the main line when the line is not in use. While the same number of cells are shown in the diagram for the several batteries, it will be understood that this is merely done for convenience of illustration, and that in practice the batteries will be adapted to the work they are intended to perform.

D is a clock of any known construction adapted for the purpose, and is designed to indicate and record the time of the arrival of the fire-alarm or line troubles at the central office. This clock is connected by means of the wire *d* with local battery 1 and by the wire $d^2\,d'$ with the recording and signaling instruments.

E is a battery changer or switch, whose office it is to cut out the small line-battery and the battery-gage and throw upon the line the large auxiliary battery 2.

Inside a suitable casing E′ is supported the magnet E^2 and the post or standard E^3, to the upper end of which is pivoted the armature E^4, the short arm or tail-piece *e* of which is connected to the standard by the coil-spring e', and the long arm of said armature is formed with a notch e^2, designed to engage the detent or lug e^3, carried by the annunciator-drop E^5, pivoted at e^4 and carrying the rubber pin e^5, projecting through a suitable hole in the casing E′ and designed to bear against the

flat spring e^6, secured at one end to the casing and carrying upon its opposite sides at the other end the contact-points e^7 and e^8. No claim is made herein to the construction of the battery changer or switch, as the same forms the subject-matter of a separate application filed August 26, 1890, Serial No. 363,082.

e^9 is a contact-point on the casing and connected to one pole of the auxiliary battery 2, the other pole of said battery being connected with the end of the spring e^6, attached to the casing.

E^6 is a flat spring carrying at its free end the contact-point e^{10}, the other side of said spring being connected with small line-battery 4.

F is a switch-board of ordinary construction and forming no part of the present invention, excepting in its connection with the other parts.

G is the circuit-testing clock whose office it is to throw the battery from the main to the auxiliary lines for the purpose of testing the condition of said lines, for it is to be understood that the auxiliary line is a dead-line except when used to supply a deficiency caused by a break in the main line, and it is frequently necessary to determine as to whether the line is in condition for use. Although the construction of this clock forms no part of the present invention, I have shown in Fig. 3 sufficient of its mechanism to insure a perfect understanding of its operation in connection with the present system and which will be readily understood on reference to said Fig. 3, in which G′ is a wheel on the minute-hand shaft g and provided upon its periphery with notches g', and G^2 is a brush connected with the small line-battery 4 by means of the wire g^2 and arranged to bear upon the periphery of said wheel, as shown. G^3 is a contact-spring, and G^4 is another contact-spring provided with a contact-point g^4, and between these points the brush G^2 is arranged. The contact-spring G^3 is connected with the auxiliary line. Normally the brush G^2 is in contact with the outer periphery of the wheel G′, and the spring carrying the same is in contact with the contact-point g^4 at predetermined periods—in the present instance at intervals of ten minutes—the brush, owing to the revolution of the wheel G′ in the direction of the arrow in Fig. 3, thus throwing the current upon the auxiliary line in making a silent test. Since the springs G^3 and G^4 exchange contact with the brush G^2 without opening the main circuit, the only incident due to the clock is that the auxiliary circuit is cut out once in every ten minutes, and inasmuch as the line is not interrupted because of the completion of the auxiliary circuit no alarm will be given, unless the auxiliary line should be in bad condition, in which case an alarm will be given. Thus it occurs that if the lines are both in good working order the apparatus at the central office will be silent, and so the wheel G′ gives a silent test every ten minutes, the silence of the central-office apparatus at the periods of the tests indicating that both of the lines are in good working order.

In order to insure the contact of the brush G^2 with the contact-point g^3 before it leaves the contact-point g^4, I make its descent into the notch gradual, as shown in Fig. 3, the said notch being so proportioned that the period of time that the brush is therein and out of contact with the periphery of the wheel shall be in the present instance ten seconds, at the end of which time the circuit is again restored to the main line by the return of the brush to the periphery of the wheel and to the contact-point g^4.

H is a telephone of known construction, suitably connected by private line with the telephone 5 at fire-department headquarters.

I is an electro-mechanical gong of known construction, adapted to sound an alarm upon the opening of the relay I′, caused by the breaking of the current upon any part of either the main or auxiliary lines.

J is the battery-gage or line-relay, the interior construction of which is shown in Fig. 4 upon an enlarged scale, and in which J′ is a shaft designed to be supported upon slender pivots at its ends.

J^2 is a horseshoe magnet with non-magnetic metal (preferably brass) between the otherwise-open ends, as shown at J^3. This magnet is fast on the shaft J′, which works freely on its pivots and is provided with a counter-balance 50, through which the magnet swings or oscillates. These helices are connected by means of the wires j with the small line-batteries 4. The coils are so connected that the normal current existing on the line will exert sufficient power to hold the needle K in the position indicated in Fig. 4. This instrument is in effect a galvanometer-relay, which will be rendered operative by a variation in the current strength circulating through the controlling-magnet coils.

K is an indicating-needle on the shaft J′.

K′ and K^2 are perforated dials for receiving the pins k. These two dials are insulated from each other.

L and L′ are two bells to indicate change in resistance on the main line and auxiliary lines, which change is detected by the backward or forward movement of the horseshoe magnet J^2, said magnet being moved in one direction by the increase and in the other by the decrease in the resistance. The movement of the needle caused by the oscillation of the magnet causes it to strike a pin in one of the perforated dials or the other, according to the direction in which the said needle moves. The needle is connected with one pole of the local battery 1, and the other pole of said battery is connected through the bells L and L′ to each of the perforated dials K′ and K^2, as shown in Fig. 4.

M is a transmitter, of known construction,

located at the central office, and is designed to transmit alarms of fire from the central office to the fire-department. It is connected by means of the wire *m* with the fire-department headquarters-battery 3 through the relay 6 and key 7 and by means of the wire *m'* with the switch-board F, and thence out and to the fire-department headquarters B, to the lightning-arrester 8, of any suitable construction, thence to key 9, to the relay 10, out from the relay back to the other pole of the fire-department battery 3 at the central office, thus completing the metallic connection.

11 is a bell in the local circuit at the fire-department headquarters connected by the wire 12 to the back contact of the relay 10, and thence by wire to the local battery 13 at the fire-department headquarters. In the same circuit is the register 14, of known construction, for the purpose of recording the signals received from the central office. This register is connected by means of the wire 15 to one pole of the local battery 13 and by means of the wire 16 with the bell.

17 is a register, of any suitable construction, located at the central office, connected by wire 18 through the back contact of the armature of relay 6 to the pole of the local battery 1, and through the wire 19 to the opposite pole of said battery.

20 is a single-stroke table-bell in the local circuit just described.

21 is a variable resistance, of known construction, arranged in a closed circuit from the small line-battery 4. This resistance is in a shunt around the coils of relay J, as shown. The relay I' is connected by means of the wire *i* through the battery changer or switch E with one pole of the small line-battery 4, and by means of the wire *i'* through the key 22, through the circuit-testing clock G to the switch-board F, and thence out by the main or auxiliary line c^2 or c^4 to the opposite pole of the small line-battery 4.

23 is a register, of any suitable construction, adapted for the purpose of recording signals of any kind received from outside circuits. This is a double pen-register, of ordinary construction, having one of the registering-pen magnets in a circuit controlled by clock D over the following path: from the left pole of local battery 1, by wire *d* to normally-open circuit-closer in clock D, by wire *d'* to the registering-pen, and by wire 24 to the right pole of local battery 1. The other registering-pen is in the following circuit: left pole of battery 1, over the path marked by double arrow-heads to galvanometer-relay J, where two normally-open return branches exist, one being through the needle K of the relay J and the other through the magnet of the switch E back to the local battery, and the other through the gong I, relay-contacts I', bell 26, register 23, and wire 25 to automatic switch to the other pole of local battery. The first of the circuits is normally open at J and the other is normally open at I', the former being closed by a variation in the current strength and the latter by a break in the line.

26 is a single-stroke table-bell, of known construction, arranged in the same local circuit.

The operation of the system is as follows: The line-circuit is normally closed with the small line-battery holding the armature of relay I' against the front stop, and the needle K of the galvanometer-relay is held at a point between its co-operating pins, as explained in connection with Fig. 4, and this condition of affairs exists whether the normal or the auxiliary circuit is active. Let us suppose that the wheel G' of the testing-clock is in the position shown in Fig. 3, so that the springs G^2 and G^4 are in contact and the main line is in circuit. Then the current will flow from the right-hand pole of the small line-battery at the central office out over the line, as indicated by the single arrow-heads, to the protected building, where it enters the signal-box, passes through 1'' to the back-stop of the relay 2'', thence to the relay-armature and frame, thence by wire 3'' to the brush of the break-wheel, from the break-wheel to the frame, and thence by wire 52 to the switch-contact 53, pivot of switch-post S, through all of the thermostats in the series, back on wire 6 to post T', thence out from post ML to line-wire c^3 to the switch-board F, thence to contact-spring G^4 (see Fig. 3) to G^2, wire *i'* to key 22, through the key which is normally closed to coils of relay I', to wire i^2, thence to springs E^6 and e^6 of the automatic switch E (see Fig. 2) to wire i^3, thence to coil J^4 of galvanometer-relay J, and thence by wire i^4 back to the left pole of small line-battery 4. It will thus be seen that the small line-battery keeps the main line charged with a weak current, but strong enough to hold open the contacts of relays I' and J. Should this current be weakened, it will be understood from the description of J that its needle will drop back and make contact with the pin *k*. This weakening of the line-current occurs when any one of the thermostats in the protected building is opened by heat, when the circuit will be broken through all the thermostats on that story of the building, and current will be forced to flow through a shunt of higher resistance—namely, the story-magnet in the signal-box—the shunt being as follows: Supposing one of the lower-story thermostats to have operated through wire 7 to binding-post 8, then through story-magnet 9 to binding-post 10, thence back by wire 11 to a point between the first and second story thermostats, the path through all of the other thermostats in the building being normal and complete, current will have its normal course already traced from this point. The increased resistance of the line, due to the cutting in of the story-magnet, weakens the line-current enough to permit needle K of the galvanometer-relay to drop back and make contact with its co-operating pin, which closes

to the local battery 1 on the battery-switch E and throws down the drop of said switch, thus cutting the stronger auxiliary battery into the line-circuit. The local circuit operating the switch E may be traced as follows: from the right-hand pole of the local battery 1, over the wires marked by double arrows, through magnet E^2 of switch E, by wire *f* to the needle of galvanometer-relay J, thence to the pin K, through bell L′, out on wire *f′*, and back to the left-hand pole of local battery. This energizes the switch-magnet and actuates its drop, cutting the auxiliary battery into the main circuit. The course of current from the auxiliary battery is exactly the same as that from the small line-battery as far as the switch E. The spring e^6 of the switch E is no longer held back by the pin e^5, (see Fig. 2,) so that it bears against and makes electric contact with e^9. The auxiliary current therefore enters E on wire i^2, and passes thence by the wires marked with three arrow-heads directly back to the left pole of the auxiliary battery 2. The auxiliary battery increases the strength of the line-current sufficiently to cause magnet 4 of the signal-box to draw up its armature, releasing the clock-train. The break-wheel of the signal-box opens and closes alternately the main circuit. Instantly the circuit is opened by the break-wheel, the relay I′ is de-energized and its armature falls to the back-stop, closing a branch circuit from the local battery through the gong I and register 23, giving the alarm to the central office. This circuit may be traced as follows: from the right-hand pole of the local battery to and through the magnet of automatic switch E, to point Z, over wire 25, to recording-pen magnet of the registry, to wire *d′*, bell 26, wire *d′*, relay-contacts, wire *d′*, back to the left pole of the local battery. Thus the gong I will sound and the register record every time the main circuit is opened by the break-wheel and the local circuit by the relay I′. The register 23 keeps two records on its tape, one showing the source of the alarm as just traced, and the other indicating the time of the reception of alarm. The time is marked through the instrumentality of the clock D, which sends a series of electric impulses through the time-pen magnet of the register once every fifteen minutes. It should be noted that this circuit is open at the circuit-closer 61 in the clock D (see Fig. 6) at all times except when the disk of the clock is unlocked—that is to say, once every fifteen minutes. Current then flows from the right-hand pole of local battery to point *y*, and thence by wire 24 through the time-pen magnet of the register 23, wire d^2, circuit-closer in clock D, back by wire *d* to the left pole of local battery. The circuit-closing teeth 60 on the disk of clock D make marks on the register-tape indicating the hours and quarter-hours. A series of dots appears at intervals along the tape and will indicate and form a permanent record of the time an alarm comes in, said alarm being recorded on the opposite edge of the tape. The time-record would look somewhat thus: . . .., which would be read 1 o'clock, 1.15, 1.30, 1.45, 2, 2.15, 2.30, 2.45, 3, 3.15, 3.30, 3.45, the successive groups of one, two, or three dots indicating the quarters and the preceding group the hour. When a fire-record appears on the tape, it is only necessary to glance opposite to see the time of its reception. If the normal main line should break, the instruments at central office will immediately give notice as the relay I′ and J will operate and the gong I and bell 26 will ring continuously. In such a case the plugs of the switch-board will be arranged so as to throw the auxiliary line on the relays I′ and J, and then central office will be in condition to receive an alarm over the auxiliary line and the main line can be repaired without rendering the system inoperative. The outlying signal-box immediately adjusts itself to this change by permitting armature I′ to fall against its back-stop, and current will flow from small line-battery to the auxiliary line, to magnet 2, back-stop 1^2, frame of magnet 1^3, wire 12, thence over the same course traced for the main line and out at stop-post. The box-relays switch the auxiliary circuit in at the outlying stations, when the circuit-testing clock changes the central-office connections from main to auxiliary; but by reason of the two circuits being electrically connected on the outgoing side of the box a continuous circuit is preserved and the central-office relay I′ is not effected, the momentary transfer of the armature of the box-relays being too rapid to permit of the central-office instruments acting, and in point of fact the main relay-armature will have reached its back-stop before the auxiliary instrument will have received sufficient charge to draw up its armature.

The alarm at the fire-headquarters is controlled by a key 7, current passing from the fire-department battery 3 over the circuit marked by four arrow-heads. Upon receipt of said alarm at fire-headquarters the operator there sends back an "O K" signal, by means of key 9, which signal is recorded upon register 17 at the central office. Upon receipt of the O K signal the operator restores the drop of switch E, thus cutting out the auxiliary battery and leaving the line in its normal condition.

The telephones H and 5 are for the purpose of conversing with the fire-department when desired.

What I claim to be new is—

1. In an electric fire-alarm system, the combination, with a main circuit connecting outlying signal-stations with a central office, of an auxiliary circuit connecting the outlying stations and the central office by different routes, said auxiliary circuit being normally open at

the several stations, a relay at each station and connections for cutting in the auxiliary circuit and cutting out the main circuit upon rupture of the latter, and a switch at the central office for throwing the main or auxiliary circuit into operative relation to the receiving-instruments.

2. In a fire-alarm system, the combination, with a normally-closed circuit connecting outlying signal-transmitting boxes with the central office, of an automatic circuit-closer at a protected point for varying the strength of the current on the line, a relay at central office controlled by a change of current strength on the line, an auxiliary battery cut into circuit by said relay, and a releasing-magnet for the transmitting mechanism corresponding to the protected point, said releasing-magnet being responsive to the increase of current.

3. In a fire-alarm system, the combination, with a normally-closed circuit connecting outlying signal-boxes with a central office, of a thermostatic circuit through a protected building in a normally-closed shunt around a resistance in the main circuit, a relay at the central office controlled by a weakening of the main-line current, an auxiliary battery, means for cutting it into circuit by the relay, and a releasing-magnet for the signal-box actuated by the increased current due to the auxiliary battery.

4. In a fire-alarm system, the combination, with two independent circuits connecting the outlying signal-boxes with the central office, of an automatic switch at central office periodically closing the two lines alternately on the receiving-instruments, a relay at central office in a branch common to both circuits, and alarm-instruments controlled by the relay, whereby notice is given whenever either the main or the auxiliary circuit is out of order.

5. In a fire-alarm system, the combination, with two independent circuits connecting outlying signal-boxes with the central office, of a continuity-preserving switch at central office adapted to periodically connect one or the other of the circuits with a common returning branch to the main-line battery, and alarm-instruments controlled by said battery branch, whereby a silent test is periodically made as to the condition of the circuit.

6. In a fire-alarm system, the combination, with a circuit connecting outlying signal-boxes with the central office normally charged with a weak current, of a galvanometer-relay at central office, a contact-stop on each side of the relay-needle, a local circuit controlled by the relay, and means controlled by the relay for increasing the strength of the current on the line when the local circuit is closed.

7. In a fire-alarm system, the combination, with a circuit connecting the central office and outlying stations, said circuit being normally charged with a weak current, of current-varying devices at the outlying stations, a releasing-magnet controlled by a strong current, an auxiliary battery, and two relays at central office, one responding to a variation of current strength to cut in the auxiliary battery and the other controlling a local circuit containing alarm-instruments.

8. In a fire-alarm system, the combination of a circuit normally charged with a weak battery-current including thermostatic current-varying devices at protected points, a sensitive relay at central office responsive to a variation in current strength, alarm-instruments controlled by said relay, a variable resistance for graduating the effect of the line-current upon the relay, and a local alarm-circuit controlled by the relay, whereby said relay serves the dual function of a line-relay and a battery-gage.

9. In a fire-alarm system, the combination of a main circuit connecting outlying signal-boxes with central office, an auxiliary circuit provided with circuit-connections at each box, the two circuits being electrically connected on the outgoing side of each box, and a relay in each box for cutting the auxiliary circuit into line on the incoming side of the box when a rupture of the normal main circuit occurs.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM F. SINGER.

Witnesses:
FRANKLIN H. HOUGH,
VICTOR L. MASON.