No. 773,869. PATENTED NOV. 1, 1904.

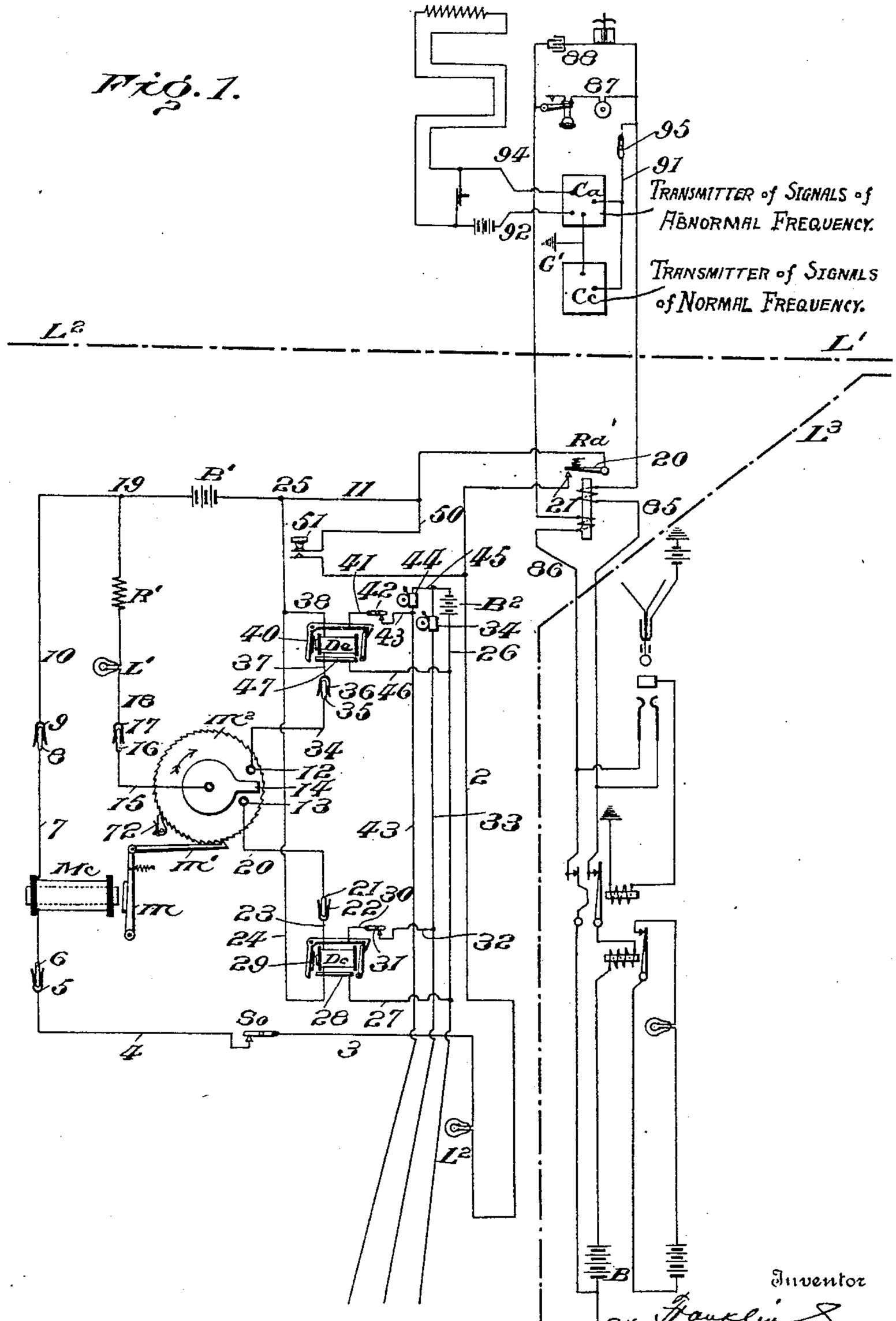
F. S. HOLMES.

AUTOMATIC ELECTRICAL SIGNALING SYSTEM.

APPLICATION FILED MAR. 19, 1904.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

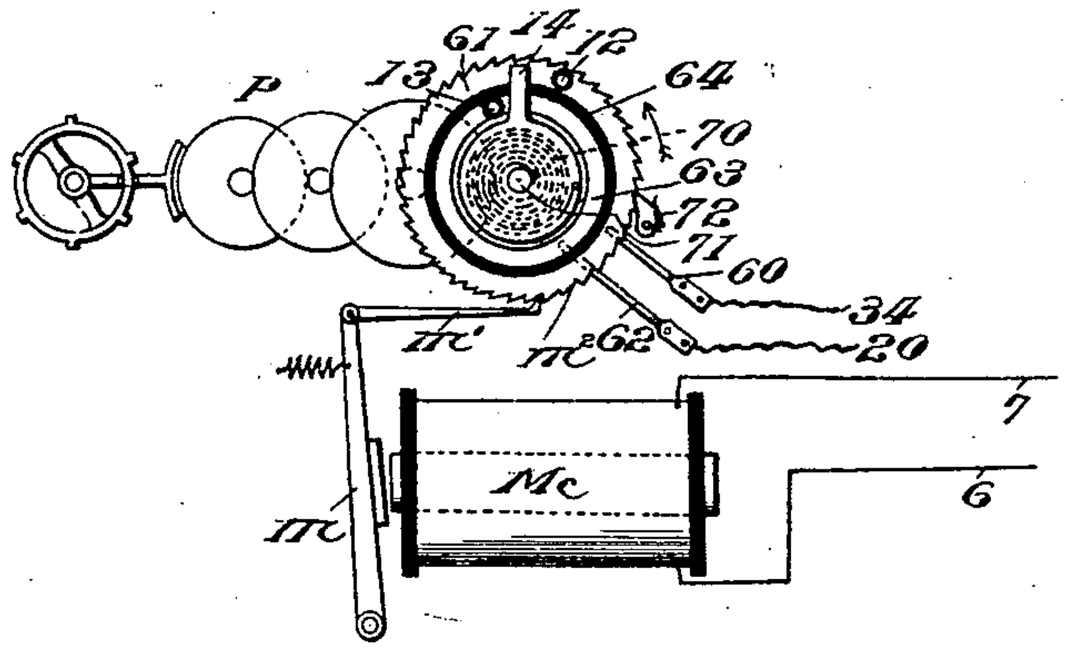


Fig. 3.

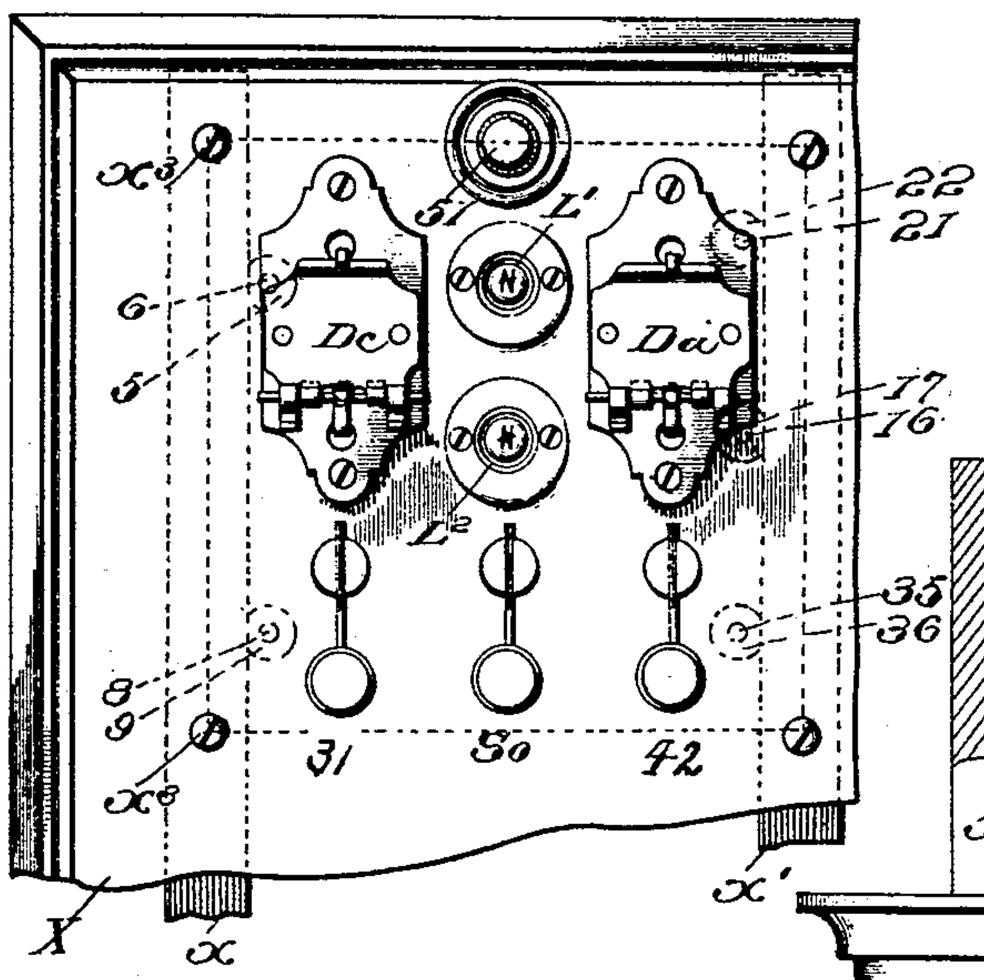
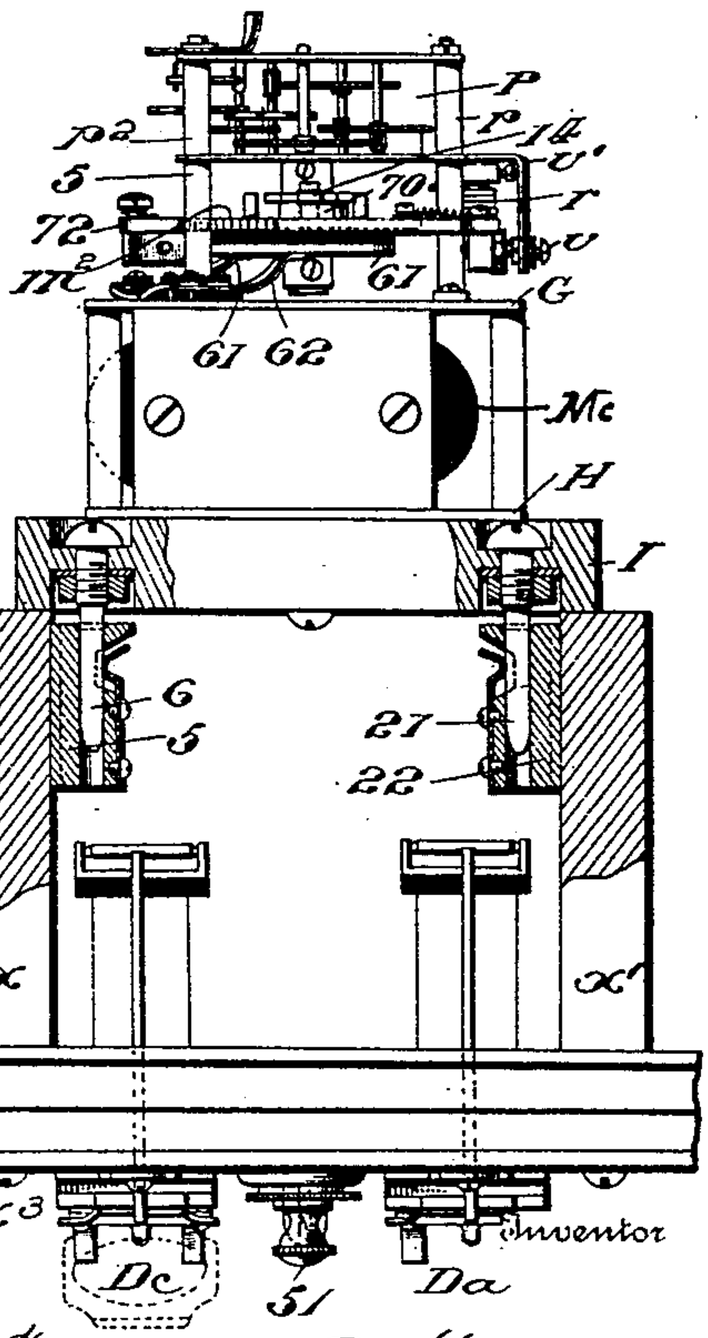


Fig. 4.



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APPLICATION FILED MAR. 19, 1904.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 5.

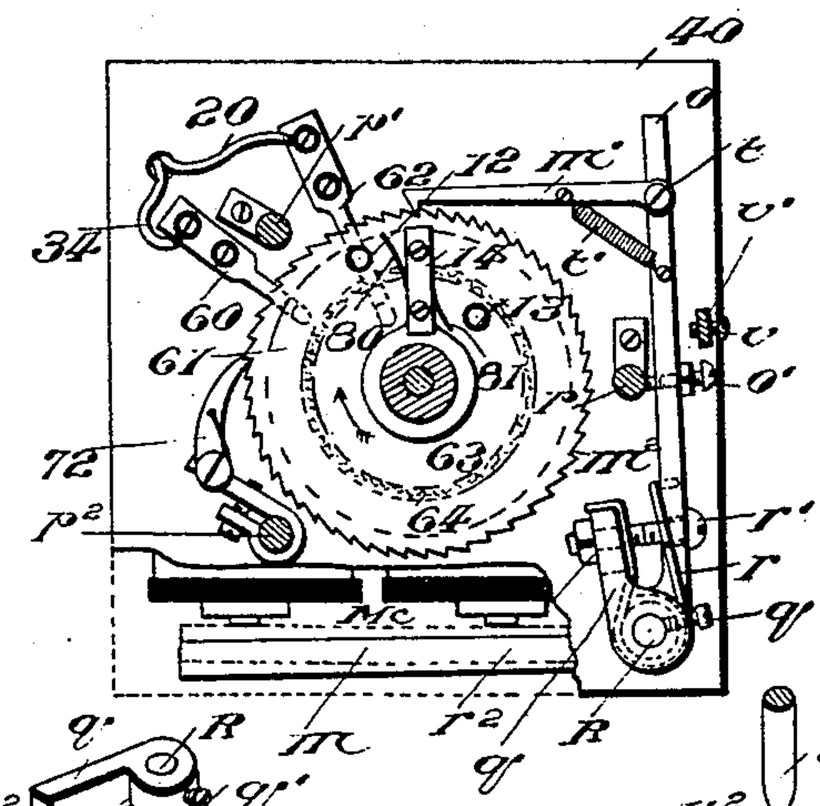


Fig. 6.

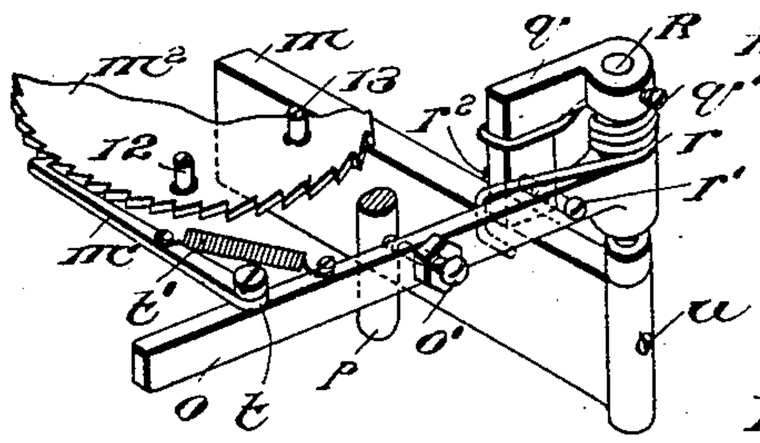


Fig. 8.

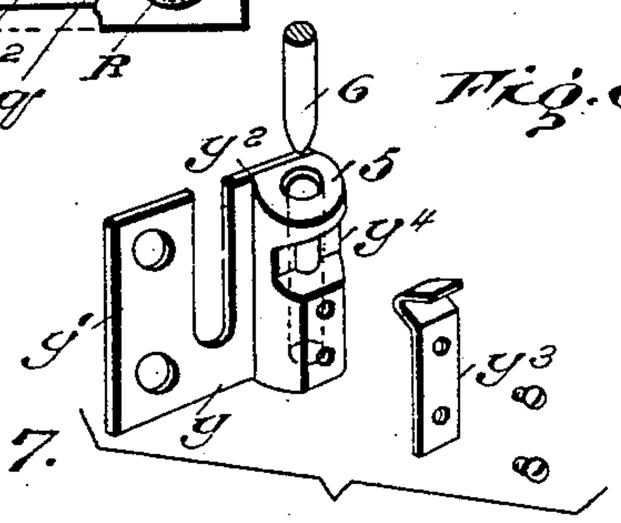
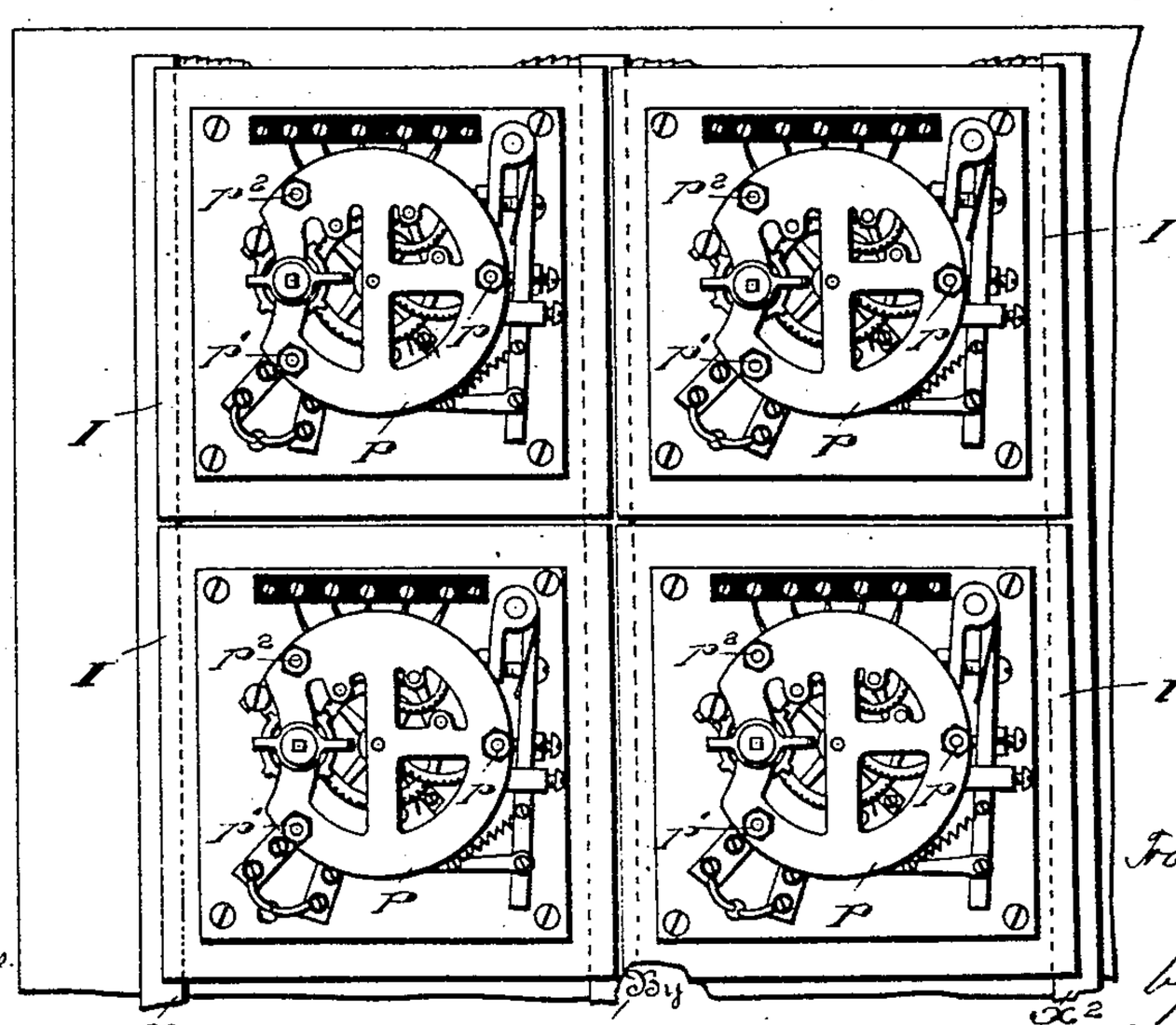


Fig. 7.



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No. 773,869. Patented November 1, 1904.

UNITED STATES PATENT OFFICE.

FRANKLIN S. HOLMES, OF NEW YORK, N. Y.

AUTOMATIC ELECTRICAL SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 773,869, dated November 1, 1904.

Application filed March 19, 1904. Serial No. 198,952. (No model.)

To all whom it may concern:

Be it known that I, FRANKLIN S. HOLMES, of New York, State of New York, have invented a new and useful Automatic Electrical Signaling System, which invention is fully set forth in the following specification.

This invention relates to means for automatically testing the integrity of electrical circuits and signaling thereon, the principal application therefor being to telephone, burglar, and fire alarm constructions.

It has been proposed heretofore to provide for sending periodic signals from protected structures to a central office, the regular arrival of the signals being designed to advise the office that the protected structure is in connected operation. The arrival of numerous signals coming frequently from many protected structures, simply announcing the negative fact that the circuit has not been disturbed, so adds to the confusion, complication, and required oversight of a large office as to make such a system impracticable. The invention described in my application filed April 16, 1903, Serial No. 152,953, was designed to overcome this difficulty by automatically measuring a predetermined time interval between the successive test-signals and giving an alarm when for any reason such interval is exceeded, thereby positively indicating a disconnection or short circuit in the protecting-line. My present invention, which is an improvement upon that described in said application, provides for giving an indication or alarm when said predetermined time interval between signals is not equaled as well as when it is exceeded, thereby positively indicating a disarrangement of the local alarm-circuits.

In carrying out the present invention I provide at the subscriber's station, preferably in conjunction with the usual telephone apparatus used with "central-battery" construction, automatic signaling apparatus adapted at regular intervals to ground a metallic telephone-circuit a definite number of times. This signaling apparatus is preferably of the construction described in my application for patent filed March 25, 1904, Serial No. 200,013. This grounding of the circuit energizes a normally neutral differentially-wound relay in the telephone-circuit, and said relay closes a local circuit which gives a signal, such as the lighting of a lamp at the protection-office. The primary purpose of the periodic closing of this local circuit is, however, to actuate an interval-measuring apparatus which is adapted to give an indication or alarm when the normal time interval between signals is not equaled or is exceeded. This apparatus, as in my application filed April 16, 1903, comprises a spring-motor mechanism, (such as ordinary clockworks,) which moves continuously and at uniform speed a controller-arm or movable contact, and two periodically-advanced pins or circuit-contacts, between which said arm operates; but according to my present invention each pin or contact represents a terminal of an alarm or indicating circuit. Under normal working conditions the arm does not make contact with either pin; but when the normal time interval between signals is not equaled the arm engages one pin, closing one alarm-circuit, or when said interval is exceeded the arm engages the other pin, closing the other alarm-circuit. Furthermore, according to my present invention the pins are advanced and the spring-motor mechanism wound by the power of an electromagnet in the local circuit controlled by the differentially-wound relay; but this winding may be effected in any suitable way.

The present invention contemplates a protection office apart from the telephone-exchange office, thereby avoiding confusion of signals.

It also embraces structural features affording compactness of arrangement, ready accessibility to and removability of the mechanism, and other advantages, also other features of improvement, all of which will be described in detail in connection with the accompanying drawings, wherein—

Figure 1 is a diagrammatic view of a system embodying the invention. Fig. 2 is a diagrammatic view of the pin-advancing and motor-winding magnet and associated parts. Fig. 3 is a front elevation, and Fig. 4 a top view, partly in section, of a portion of a board at the protection office. Fig. 5 is a section on

line 5, Fig. 4. Fig. 6 is a detail perspective of the armature and its actuating connections. Fig. 7 is a rear view, on a small scale, of part of the protection-office board; and Fig. 8 is a detail of one of the sockets and plugs for connecting the removable portion of the mechanism to the rear of the board.

Referring to Fig. 1, the apparatus at the substation or protected structure is shown above line $L' L^2$, the apparatus at the protection-office below said line and to the left of line $L^3 L^4$, and the apparatus at the telephone-exchange office to the right of line $L^3 L^4$. 85 and 86 are the conductors of a telephone-circuit connected by two bridges 87 and 88 at the substation, the former containing the telephone transmitter, receiver, and hook-switch and the latter containing a bell and condenser. These parts are arranged and operate in the usual manner. In addition to the usual telephone equipment at the substation a branch wire 91, containing a switch 95, leads to ground G' through signal-sending mechanism C*a* and C*c*. The function of this mechanism, which is preferably that described in my application filed March 25, 1904, Serial No. 200,013, is to periodically and at regular intervals during normal working of the system complete the ground connection at C*c* or in case of a disturbance in the local protection-circuit 94 to 92 to complete the ground connection through C*a*. The protection-circuit includes various resistances and springs in a manner well known in burglar-alarm systems. The establishment of this ground connection at the substation completes a grounded circuit by way of conductor 85, battery B, conductor 81 to ground G^2 at the central station. This circuit includes one coil of a balanced or differentially-wound relay R*d*, the other coil of which is included in conductor 86. This relay remains inactive at all times when there is no ground connection at the substation whether the telephone is in use or not. This is so because as each of the coils has the same number of turns the same current passing out and coming back through them, respectively, produces a neutralizing effect in one upon the other; but the passage of current only through one coil by way of conductor 85 energizes the relay, so that it attracts its armature. The differential relay R*d* controls a local circuit at the protection-office leading from relay-contact 21 by conductor 2, lamp L^2, conductor 3, switch S*o*, conductor 4, socket 5, pin 6, winding of actuating-magnet M*c*, conductor 7, pin 8, socket 9, conductor 10 to one pole of battery B' and from the other pole of said battery by conductor 11 to the other contact 20 of said relay. The sending of the regular signals over telephone-line conductor 85 will close the circuit of battery B' at predetermined intervals at the relay-contacts 20 and 21, thereby periodically lighting lamp L^2 and actuating armature *m* of magnet M*c*, causing it through its pawl *m'* engaging ratchet-wheel m^2 to intermittently advance two pins 12 and 13, connected with said ratchet-wheel. So long as the signal impulses indicating normal condition of the protected structure are regularly sent a continuously-rotated contact-arm 14, working between the pins 12 and 13, will not engage either of said pins. In case, however, the time interval between signal impulses sent from the substation over wire 85 is not equaled, due to a disturbance in the connections preventing the transmitting mechanism from effecting connection to ground at C*c* at the predetermined time interval, the actuating-magnet M*c* will not be energized to advance pins 12 and 13. Consequently the arm 14 will overtake pin 13, thereby effecting the closure of an alarm-giving circuit in the following manner: A conductor 15, electrically connected with arm 14, leads to pin 16, engaging socket 17. Conductor 18 leads from said socket through lamp L', resistance R', to a point 19 on the conductor 10. Conductor 20 leads from pin 13 to pin 21, socket 22, conductor 23, winding of annunciator-drop D*c*, conductor 24 to point 25 on conductor 11. It will therefore be seen that when the arm 14 engages pin 13 a local circuit is closed through battery B' over the path traced above including lamp L' and the annunciator D*c*. The glowing of the lamp and the dropping of the annunciator-shutter indicates to the attendant at the protection office that there has been a disturbance of the protection-circuit. This fact is also announced by the giving of an alarm included in a local circuit closed by the operation of the annunciator-drop. This circuit is traced as follows: battery B^2, conductor 26, branch conductor 27, plate 28, armature 29 to annunciator D*c*, conductor 30, switch 31, conductors 32 and 33, the latter including a bell or buzzer 34, to the other pole of the battery. In case disturbances at the protected structure is such as to close the ground connection at C*a*, thereby causing impulses to be sent over telephone-conductor 85 at greater than normal frequency, or, in other words, causing the signals to be sent with such frequency that the predetermined time interval is not equaled, the circuit of battery B' will be closed with such frequency at the relay-contacts 20 and 21 as to cause the actuating-magnet M*c* to advance the pins 12 and 13 with such rapidity that the latter pin, 12, will overtake the contact-arm 14. Said pin 12 being connected with one pole of battery B' by way of conductor 34, pin 35, socket 36, conductor 37, winding of annunciator-drop D*a*, conductors 38, 25, and 11 and the arm 14 being connected with the other pole of the same battery by the path previously traced the contact of said arm and pin closes the circuit of said battery, thereby energizing annunciator-drop D*a* and causing its shutter to fall. At the same time the lamp L' will be lighted. The operation of annun-

ciator D*a* also closes an alarm-circuit by way of its armature 40, conductor 41, switch 42, conductor 43, bell or buzzer 44, conductor 45 to battery B^2 and from the other pole of said battery by conductors 26 and 46 to plate 47. The character of the disturbance at the protected station may be distinguished by causing the signals sent from the protected structure to be made up of different combinations of impulses, according to the nature of the disturbance, producing corresponding effects in the flashing of the lamp L′. Switch 95 at the substation in conductor 91 may be used to connect or disconnect the protection-circuits from the telephone-line. At the protection-office a conductor 50, bridged between conductors 11 and 2, includes a normally open switch or push-button 51, which may be operated to establish a shunt in the circuit of battery B′ around the relay-contacts 20 and 21. By manipulating this push-button the operator at the protection office may operate the mechanism in the same manner as it is operated by impulses over the telephone-line 85. The operation of this push-button is sometimes desirable for the purpose of testing and setting the apparatus. The apparatus at the protection-office may be at any time thrown out of operative connection with the telephone-line by opening switch S*o*, thereby preventing signals sent over telephone-conductor 85 from producing corresponding closure of the circuit of battery B′. The engagement of arm 14 with either of pins 12 or 13 will continue until the progress of the clock mechanism or the rotation of the ratchet-wheel disengages said parts. So long as the parts remain in engagement the annunciator-magnet of the corresponding pin will remain energized and the circuit of battery B^2 through bell or buzzer 44 or 34 remain closed. The operator being advised of the disturbance at the protection-office opens switch 42 or switch 31, thereby breaking the local circuit through the alarm and discontinuing the sounding of the latter.

The general operation of the system will be clearly understood from the foregoing description.

Figs. 2 and 5 show more clearly the details of the connections of conductor 34 with pin 12 and of conductor 20 with pin 13. Conductor 34 is connected with a brush 60, which bears against the under side of an outer ring 61 of ratchet-wheel m^2, to which ring the pin 12 is fixed. Conductor 20 leads to a brush 62, which bears against the under side of a second ring 63, separated from ring 61 by an insulating-ring 64. The pin 13 is fixed to ring 63. Both of the conducting-rings are insulated in any suitable manner from the works of the spring-motor, through which the circuit to wire 15, Fig. 1, leads to arm 14.

Spring-motor mechanism of any suitable character may be employed for moving contact-arm 14. I have found ordinary clock-works P, Figs. 2 and 4, to be well adapted to the purpose.

70 is the actuating-spring, (dotted lines in Fig. 2,) connected at one end to a shaft 71, carrying arm 14, and at its other end to ratchet-wheel m^2. A spring-actuated retaining-pawl 72 acts to catch and retain ratchet-wheel m^2 in its advanced positions.

In practice it has been found desirable to provide a yielding electrical engagement of the arm 14 and the pins 12 and 13. This is effected by spring-wings 80 and 81 on opposite sides of arm 14, as shown in Fig. 5, which results in prolonging electrical contact of either pin 12 or 13 with arm 14, and therefore the length of alarm-signals through lamp L′ and either annunciator D*a* or D*c*.

As shown in Figs. 4 and 5, the spring-motor mechanism, ratchet-wheel, brushes 61 and 62, and pawl m' are mounted on or located at one side of a square plate G, while the magnet M*c* and its armature are located between plates G and H, the latter being secured to a square base-plate I.

p, p', and p^2 are posts of the spring-motor mechanism.

Referring to Figs. 5 and 6, R is a rock-shaft passing through and having a bearing in plate 40. At one side of said plate the shaft carries the armature m, fixed thereon by a screw u. At the other side of said plate it carries a pawl-arm o, loose thereon, also an arm q, fixed by a screw q'. Spring r, coiled about shaft R, bears at one end against arm q and at its other end against arm o, the tendency of the spring being to force the latter arm into parallelism with armature m. The normal position of the arm relative to shaft R is, however, determined by screw r', passing through both arms o and q and carrying a nut r^2. Pawl m' is pivoted on arm o and t and held in engagement with ratchet-wheel m^2 by spring t'. Upon cessation of current through the magnet M*c* the weight of the armature m causes it to promptly drop away from the magnet-poles, moving arm o to the left, Fig. 5, and causing pawl m' to engage a new tooth of the ratchet-wheel. This movement of the pawl is limited as desired—for example, to prevent it from passing over more than one tooth—by a stop-screw o', passing through arm o and striking against post p. In case the clock mechanism has for any reason stopped the escapement will be jarred into action by the arm o striking the stop-screw v, passing through a bracket v', depending from the clockworks. (See Fig. 4.) As will be noted, the armature m and arm o stand approximately at right angles to each other and with the disposition of the other parts conduces to compactness of the mechanism. Furthermore, the mechanism is mounted in such position, Fig. 5, that the weighted armature will promptly fall away from the magnet-poles upon deënergization of the latter. To set the

arm *o* and ratchet *m'* to proper positions relative to the armature *m*, the latter is pressed against the magnet-poles and the screw *r'* turned, thereby adjusting arm *o* around the shaft toward or from fixed arm *q*. As will be understood, the movement of the armature is transmitted to arm *o* through spring *r* under normal working of the mechanism. In case, however, movement of the ratchet-wheel is blocked by pin 12 engaging arm 14 movement of the armature will simply compress spring *r* without transmitting movement to arm *o*. The yielding connection therefore avoids injury to the mechanism under these conditions.

While I have herein particularly described the spring-motor mechanism and the pin-propelling and motor-winding magnet as constituting parts of signal-receiving equipment at the central protection-office, this apparatus may be used to advantage in other relations. In my application filed March 25, 1904, Serial No. 200,013, similar apparatus is utilized as part of the signal-transmitting mechanism at the substation or protected structure.

It is very desirable to arrange the apparatus at the protection office upon a switchboard in as compact and convenient manner as possible, and thus make the mechanism at the same time easily accessible and exchangeable. The arrangement and means whereby this object is attained constitute important features of the invention. The switchboard is two-sided, the front side carrying the annunciators, lamps, and switches and the rear side the interval-measuring and alarm-giving mechanism. Referring to Figs. 3, 4, and 7, X is a portion of the front of a switchboard, and $x\ x'\ x^2$ are three of a series of vertical strips secured to part X by screws x^3. Fig. 3 shows within a square space at the front of the board the shutters of the two annunciators D*c* and D*a*, the two incandescent lamps L' L², the three switches 42, S*o*, and 31, and push-botton 51, all pertaining to one substation. The corresponding motor mechanism, circuit-controlling pins, brushes, and arm are mounted in "steeple" within a similar space upon the base-plate I at the rear of the board. Said base-plate bears at its edge against the vertical strips *x x'* and is fastened thereto by pins 6, 8, 16, 35, and 21 on the plate engaging in sockets 5, 9, 17, 36, and 22 on the strips. As we have already seen, Fig. 1, these five pins and sockets, all of which are shown in dotted lines, Fig. 3, constitute separable circuit connections to the mechanism mounted on the base-plate. Should such mechanism fail to work properly, it can be readily removed (the pins slipping out of the sockets) and replaced by a duplicate thereof. Fig. 7 shows the manner in which a number of mechanisms corresponding to as many different protected structures or substations are closely assembled on the switchboard. As shown in Fig. 4, the annunciator-magnets project through the front X of the board in to the space between the same and base-plate I and between the strips *x* and *x'*. No attempt has been made to show in this figure the circuit-wiring to the pins, sockets, push-button, switches, lamps, and annunciators, which is in practice mostly located in the space between the vertical strips. These connections have already been described in connection with Figs. 1 and 2. The five sockets are preferably of special construction. (Shown in Fig. 8.) A spring-metal plate has a reduced portion or neck *y*, connecting parts *y' y²*, the former being secured to one of the vertical strips and the latter carrying the socket proper. A spring y^3 projects into a notch y^4 in the socket, so as to bear with considerable friction against the pin when inserted therein. By virtue of the flexibility of the neck *y* the pin when pushed into the socket will automatically move the latter to a position of proper alinement.

It is obvious that many modifications may be made in the details and arrangement of the apparatus and circuits without departing from the spirit of the invention.

What I claim is—

1. In an electric circuit, the combination with an automatic periodic signaling mechanism, of a device controlled by the signals for automatically measuring the interval between signals and indicating when the normal interval is not equaled or is exceeded.

2. In an electric circuit, the combination with an automatic periodic signaling mechanism, of a device controlled by the signals for automatically measuring the interval between signals, and a signal-circuit closed by said device when the normal interval is not equaled or is exceeded.

3. In an electric circuit, the combination with an automatic periodic signaling mechanism, of a device controlled by the signals for automatically measuring the interval between signals, and circuits through two signal devices respectively, one closed by said interval-measuring device when the normal interval is exceeded and the other closed by said device when the normal interval is not equaled.

4. In an electric circuit, the combination with an automatic periodic signaling mechanism, of a device controlled by the signals for automatically measuring the interval between signals, and two circuits each containing an annunciator and respectively closed by said device when the normal interval is not equaled or is exceeded.

5. In an electric circuit, the combination with an automatic periodic signaling mechanism, of a device controlled by the signals for automatically measuring the interval between signals, and two circuits each containing an audible alarm and respectively closed by said interval-measuring device when the normal interval is not equaled or is exceeded.

6. In an electric circuit, the combination with an automatic periodic signaling mechanism, of a device controlled by the signals for automatically measuring the interval between signals, two circuits each containing an annunciator and respectively closed by said interval-measuring device when the normal interval is not equaled or is exceeded, and two circuits each containing an audible alarm and closed by the operation of the annunciators respectively.

7. In an electric circuit, the combination with an automatic periodic signaling mechanism, of means for automatically measuring the interval between signals and for indicating when the normal interval is not equaled or is exceeded, said means comprising two relatively fixed but movable terminals, a third movable terminal between the other terminals and traveling in the same path therewith, motor mechanism for regularly advancing the third terminal at a predetermined speed, means actuated by electric signals in said circuit for advancing the two relatively fixed terminals at the same speed as the third terminal when the signals are separated by the normal time interval, but advancing said terminals at greater or less speed than the third terminal when said time interval is exceeded or not equaled, and a signal-actuating circuit closed by engagement of said terminals.

8. In an electric circuit, the combination with an automatic periodic signaling mechanism, of means for automatically measuring the interval between signals and for indicating when the normal interval is not equaled or is exceeded, said means comprising two relatively fixed but movable terminals, a third movable terminal between the other terminals and traveling in the same path therewith, motor mechanism for regularly advancing the third terminal at a predetermined speed, means actuated by electric signals in said circuit for advancing the two relatively fixed terminals at the same speed as the third terminal when the signals are separated by the normal time interval, but advancing said terminals at less or greater speed than the third terminal when said time interval is exceeded or not equaled, and a circuit containing an incandescent lamp closed by the engagement of said terminals.

9. In an electric circuit, the combination with an automatic periodic signaling mechanism, of means for automatically measuring the interval between signals and for indicating when the normal interval is not equaled or is exceeded, said means comprising two relatively fixed but movable terminals, a third movable terminal between the other terminals and traveling in the same path therewith, motor mechanism for regularly advancing the third terminal at a predetermined speed, means actuated by electric signals in said circuit for advancing the two relatively fixed terminals at the same speed as the third terminal when the signals are separated by the normal time interval, but advancing said terminals at less or greater speed than the third terminal when said time interval is exceeded or not equaled, and two signal-actuating circuits closed respectively by engagement of said terminals.

10. In an electric circuit, the combination with an automatic periodic signaling mechanism, of means for automatically measuring the interval between signals and for indicating when the normal interval is not equaled or is exceeded, said means comprising two relatively fixed but movable terminals, a third movable terminal between the other terminals and traveling in the same path therewith, motor mechanism for regularly advancing the third terminal at a predetermined speed, means actuated by electric signals in said circuit for advancing the two relatively fixed terminals at the same speed as the third terminal when the signals are separated by the normal time interval, but advancing said terminals at less or greater speed than the third terminal when said time interval is exceeded or not equaled, two signal-actuating circuits each containing an annunciator and closed respectively by engagement of said terminals, and an incandescent lamp contained in both of said circuits.

11. The combination with a main circuit and an automatic signaling mechanism for sending periodic signals over said circuit, a local circuit, means actuated by the signal impulse in the main circuit for opening and closing the local circuit, and interval measuring and indicating mechanism actuated by said local circuit for automatically measuring the interval between signals and indicating when the normal interval is not equaled or is exceeded.

12. The combination with a main circuit and an automatic signaling mechanism for sending periodic signals over said circuit, a local circuit, means actuated by the signal impulse in the main circuit for opening and closing the local circuit, a switch in the local circuit adapted to be opened to throw the same out of operation, and interval measuring and indicating mechanism actuated by said local circuit for automatically measuring the interval between signals and indicating when the normal interval is not equaled or is exceeded.

13. The combination with a main circuit and an automatic signaling mechanism for sending periodic signals over said circuit, a local circuit, means actuated by the signal impulse in the main circuit for opening and closing the local circuit, an incandescent lamp in the local circuit, and interval measuring and indicating mechanism actuated by said local circuit for automatically measuring the interval between signals and indicating when the normal interval is not equaled or is exceeded.

14. The combination with a metallic circuit normally used for another purpose and permanently grounded at one pole of its battery

or potential generator, of a differentially-wound relay having one coil in each conductor of said circuit, an automatic signaling mechanism for sending periodic and varying signals by grounding the conductor leading from that pole of said generator which is not permanently grounded, thereby closing a ground-circuit from the generator through one coil of the differentially-wound relay to actuate said relay and so close a local circuit normally open at armature-contacts of the relay, and interval measuring and indicating mechanism actuated by said local circuit for automatically measuring the interval between signals, and indicating when it is not normal.

15. The combination with a metallic circuit normally used for another purpose and permanently grounded at one pole of its battery or potential generator, of a differentially-wound relay having one coil in each conductor of said circuit, an automatic signaling mechanism for sending periodic and varying signals by grounding the conductor leading from that pole of said generator which is not permanently grounded, thereby closing a ground-circuit from the generator through one coil of the differentially-wound relay to actuate said relay and so close a local circuit normally open at the armature-contacts of the relay, interval measuring and indicating mechanism actuated by said local circuit for automatically measuring the interval between signals, and indicating when it is not normal, a shunt of the local circuit around the relay-armature contacts, and a normally open circuit-closing device in said shunt.

16. The combination with a main circuit, of a local circuit and means actuated by signal impulses in the main circuit for closing said local circuit, a signaling-circuit leading from one pole of a generator to a rotatable terminal and from the other pole of the generator by two branches to two rotatable relatively fixed terminals on opposite sides of the terminal arm, signal-actuating means in each of said branches, motor mechanism for rotating the terminal arm at predetermined speed, an electromagnet in the local circuit for causing the other terminals to rotate at the same speed as the arm when the signals in the main circuit are separated by the normal time interval.

17. The combination with a main circuit, of a local circuit and means actuated by signal impulses in the main circuit for closing said local circuit, a common generator in said local circuit, a signaling-circuit leading from one pole of the generator to a rotatable terminal arm and from the other pole by two branches to two rotatable relatively fixed terminals on opposite sides of the terminal arm, signal-actuating means in each of said branches, motor mechanism for rotating the terminal arm at predetermined speed, an electromagnet in the local circuit for causing the other terminals to rotate at the same speed as the arm when the signals in the main circuit are separated by the normal time interval.

18. The combination with a main circuit, of a local circuit and means actuated by signal impulses in the main circuit for closing said local circuit, a common generator in said local circuit, a signaling-circuit leading from one pole of the generator to a rotatable terminal arm and from the other pole by two branches to two rotatable relatively fixed terminals on opposite sides of the terminal arm, signal-actuating means in each of said branches, motor mechanism for rotating the terminal arm at predetermined speed, an electromagnet in the local circuit for winding the motor and rotating the other terminals at the same speed as the arm when the signals in the main circuit are separated by the normal time interval.

19. The combination with a main circuit, of a local circuit and means actuated by signal impulses in the main circuit for closing said local circuit, a common generator in said local circuit, a signaling-circuit leading from one pole of the generator through an incandescent lamp to a rotatable terminal arm and from the other pole by two branches to two relatively fixed terminals on opposite sides of the terminal arm, an annunciator in each of said branches, circuits through two audible alarms closed respectively by the operation of said annunciators, motor mechanism for rotating the terminal arm at predetermined speed, an electromagnet in the local circuit for rotating the other terminals at the same speed as the arm when the signals in the main circuit are separated by the normal time interval.

20. The combination with an electric circuit, of means for sending signals thereover at regular and varying intervals, of local alarm-circuits having movable terminals intermittently advanced by the action of said signals, and a movable arm adapted to make contact with said terminals and close said alarm-circuits when said interval is not equaled or is exceeded.

21. The combination with circuit-terminals, of motor mechanism for moving one terminal, an electromagnet and its armature for moving the other terminal, and connections between said armature and terminal comprising a power-arm and a yielding connection through which the armature imparts its working stroke to said power-arm.

22. The combination with circuit-terminals, of motor mechanism for moving one terminal, an electromagnet and its armature for moving the other terminal, and connections between said armature and terminal comprising a rock-shaft to which the armature is secured, a power-arm loose on said shaft, and a spring through which rotary movement of the shaft in one direction is imparted to said arm.

23. The combination with circuit-terminals, of motor mechanism for moving one terminal,

an electromagnet and its armature for moving the other terminal, and connections between said armature and terminal comprising a power-arm, a yielding connection through which the armature imparts its working stroke to said power-arm, adjusting means for determining the relative positions in which the armature and power-arm are held by the tension of the spring, and a stop limiting the movement of the power-arm in its non-working stroke.

24. The combination with circuit-terminals, of motor mechanism for moving one terminal, an electromagnet and its armature for moving the other terminal, and connections between said armature and terminal comprising a power-arm approximately at right angles to the armature, and a yielding connection through which the armature imparts its working stroke to said power-arm.

25. The combination with circuit-terminals, of motor mechanism for moving one terminal, an electromagnet and its armature for moving the other terminal, and connections between said armature and terminal comprising a rock-shaft to which the armature is secured, a power-arm loose on said shaft, a fixed arm on the shaft, a spring bearing at its ends against said arms respectively and tending to force them apart, and a loose connection between said arms limiting their separation by the spring but permitting them to move toward each other against the tension of said spring.

26. The combination with circuit-terminals, motor mechanism for moving one terminal, an actuating-electromagnet for moving the other terminal, and a base upon which said mechanism is mounted, of pins on said base engaging sockets on a switchboard or analogous support to removably hold said mechanism in operative position, said pins and sockets constituting circuit connections to the mechanism on the base.

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

FRANKLIN S. HOLMES.

Witnesses:

G. M. LOCKWOOD,

THOMAS C. BEHAN.