No. 795,532. PATENTED JULY 25, 1905.

F. R. McBERTY.

SELECTIVE SIGNALING APPARATUS.

APPLICATION FILED APR. 4, 1901.

Fig. 1.

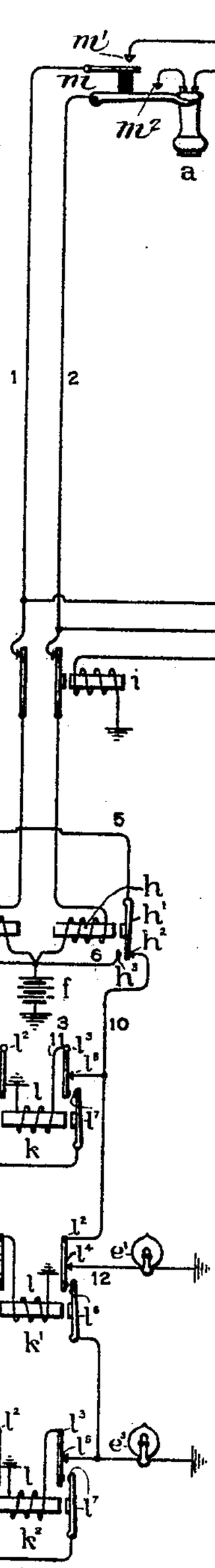



Fig. 2.

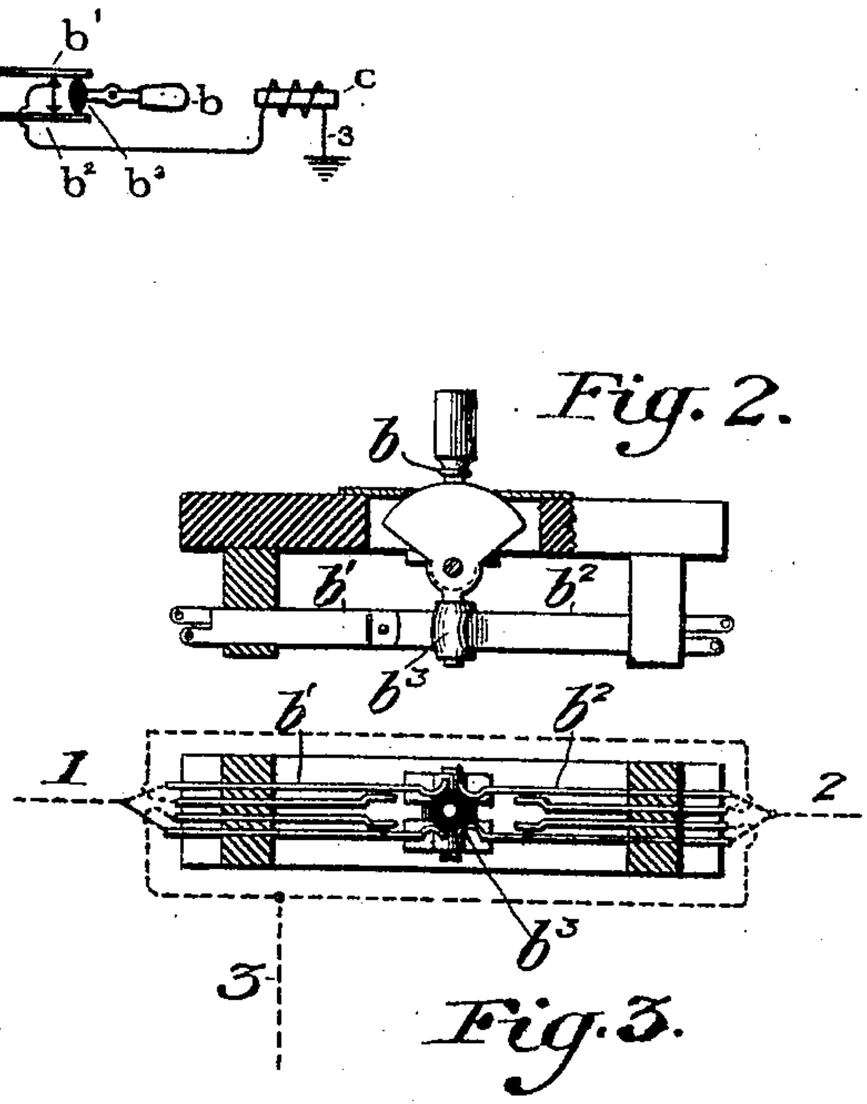
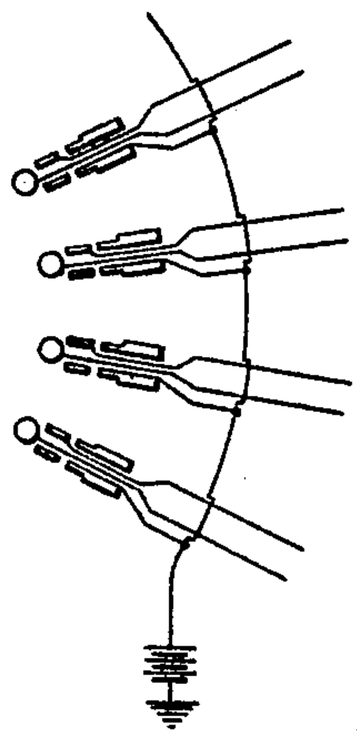



Fig. 3.



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## SELECTIVE SIGNALING APPARATUS.

No. 795,532. Specification of Letters Patent. Patented July 25, 1905.

Application filed April 4, 1901. Serial No. 54,230.

*To all whom it may concern:*

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Selective Signaling Apparatus, of which the following is a full, clear, concise, and exact description.

My invention relates to the selective switching of circuits or actuation of mechanism electrically from a distant point; and its object is to provide an improved system by which a large number of responsive devices may be selectively controlled with ease and precision without undue complication of circuits and apparatus.

Generally speaking, my invention contemplates a series of electromagnetic switches arranged in pairs or groups, the members of each group being responsive selectively each to a particular actuating-current which is distinctive in kind or circuit. Each of said switches is adapted when actuated to bring the succeeding switch of the series into operative connection or condition, so as to respond to another or different current next to be applied, each switch also controlling means for maintaining its own shifted condition. Mechanism controlled at a distant point is provided for successively applying the different electrical agents or currents required to actuate the members of each group of electromagnetic switches, so that by applying such currents in consecutive order the several switches of the series may be shifted one after another until the desired one is reached. Each switch may control any desired responsive device—such, for instance, as a signal-indicator—and any one of said responsive devices may thus be selectively controlled from the distant point. Means are provided for subsequently restoring all the switches to their original conditions in readiness for another actuation.

A typical form of my invention is diagrammatically illustrated in the accompanying drawings, in which—

Figure 1 exhibits its practical application to the apparatus of a well-known call-distributing system for a telephone-exchange whereby any one of a number of signal-lamps at the central office may be selectively excited by the manipulation of a switch at the substation to indicate to the central-office operator the particular switchboard to which the call shall be trunked, so that oral communication between the distributing operator and the subscriber is rendered unnecessary; and Figs. 2 and 3 are detail views of the controlling-switch at the substation.

In the form of the invention shown in the drawings the electromagnetic switches at the central office are arranged in pairs, and the selective operation of the members of each pair is obtained by employing different electrical currents, which in this case are made distinctive in circuit rather than in character—that is to say, two actuating-circuits are required, which in this case are formed by the line conductors 1 2 of the telephone-line, together with a common or earth return 3. At the substation the line conductors 1 2 are extended through normally open contacts $m'$ $m^2$, respectively, to the switch-contacts $b'$ $b^2$ of a controlling-switch $b$, the telephones $a$ $a'$, being included in the circuit between the switch $b$ and the switch $m$. The switch-springs $b'$ $b^2$ normally rest upon contacts which are joined together and grounded by a conductor 3, which includes an impedance-coil $c$. A switch-lever $b$ is provided, which may be rocked to one side or the other to separate either of the switches $b'$ $b^2$ from their normal ground-contacts. The switch-lever is arranged so that in shifting from one alternative position to the other one set of contacts will be closed or returned to their normal grounded condition before the other set is opened. The telephone-receiver $a$ when resting upon the switch-hook $m$ breaks the circuits of both conductors 1 2 at the contacts $m'$ $m^2$, respectively, these contacts being closed when the telephone is taken from its hook for use.

At the central station the line is connected with the usual spring-jack $d$ or switching-terminal in a switchboard. Four trunk-lines are shown, each of which may be assumed to lead to a different central station or switchboard. For the purpose of designating to an answering operator which of the several offices is called four signal-lamps $e$ $e'$ $e^2$ $e^3$ are provided in the switchboard near the spring-jack $d$. Extensions of line conductors 1 and 2 are led to one pole of a battery $f$ at the central office, whose other pole is connected with the grounded or common return-conductor 3. The extension of each conductor contains a relay, those of the two conductors being denoted $g$ and $h$, respectively, having rear and forward contacts and are controlled by a cut-off switch

*i*, which is actuated by a magnet whose winding is in a portion 4 of a local battery-circuit terminating in a contact-piece of spring-jack *d*.

For all but one of the selective devices as signals to be controlled there are provided relays or electrically-actuated switches, the switches for lamps $e'$, $e^2$, and $e^3$ being designated by $k$, $k'$, and $k^2$, respectively, while lamp *e* is controlled by relay *h*. Each switch consists of an actuating-magnet *l*, two switch-levers $l^2$ and $l^3$, and normal and alternate contacts $l^4$ $l^5$ and $l^6$ $l^7$ for the levers. The contacts $l^6$ $l^7$ are, in fact, the armature-levers. When attracted to the magnet, each makes contact with the corresponding switch-lever and then presses the latter away from its resting anvil.

The levers $g'$ and $h'$ of relays *g* and *h* are connected with a wire 5. The forward anvils $g^3$ and $h^3$ form terminals of conductors 6, leading to the pole of battery *f*. The rear contact $g^2$ is connected by wire 7 with the switch-lever $l^2$ of relay *k*. The resting contact $l^4$ of this lever forms the terminal of a wire 8, leading through lamp *e* to the common return of the system, and its alternate contact $l^6$ is connected by a conductor 9 with switch-lever $l^2$ of switch $k^2$ and by a branch from the same wire with the contact $l^5$ of relay $k'$. The rear contact $h^2$ of relay *h* is connected by wire 10 with switch-lever $l^2$ of switch $k'$ and with contact $l^5$ of switch *k*. The switch-lever $l^3$ of switch *k* is connected by wire 11 through magnet *l* with the grounded conductor 3, and its alternate contact $l^7$ is the terminal of a branch from wire 5. The connections of all the switches are alike; but the circuit relation of switches *k* and $k^2$ to secondary conductors 7 and 10 or to primary conductors 1 and 2, which constitute the actuating-conductors of the selective mechanism, is the reciprocal of the relation of switch $k'$ to the same conductors.

In general one of the actuating-conductors 7 or 10 is at the moment of performing a selection in connection with a selected circuit or device, while the other is in connection with the actuating-magnet of the corresponding switch and with the succeeding device or circuit. Each of the switches when operated by current shifts the actuating-circuit controlling its own magnet to the next selected circuit of the series and the actuating-circuit of the selected device corresponding to it to the next magnet in the series and at the same time alters the condition of the switch or magnet, so that the switch becomes self-maintaining or stable in its new position.

The operation of the system is as follows: The subscriber desiring to light one of the signal-lamps at the central office first takes his telephone *a* from the hook, thus closing the contacts $m'$ $m^2$, and then oscillates the handle of switch-lever *b* to alternately break and make the connection of conductor 1 2 with the grounded conductor 3—that is, to alternately open the circuit 1 or the circuit 2, which were both closed at contacts $m'$ $m^2$ when the telephone was taken from the hook. When both circuits 1 2 are closed, the relays *g h* are both excited, so that neither conductor 7 nor conductor 10 is connected with the battery. Assume that it is desired to light the lamp *e*. The lever of the switch *b* is turned to open the contacts $b'$, leaving contact $b^2$ grounded, so that the circuit 1 is broken and the circuit 2 remains closed, the result being that the armature $g'$ is retracted against its contact $g^2$, while armature $h'$ remains connected with the battery *f* by way of its front contact $h^3$. The battery *f* is thus applied to the conductor 5 and through the armature-lever $g'$ to the conductor 7, so that contacts $l^2$ $l^4$ of switch *k* being closed current flows by conductors 7 8 to the grounded pole of the battery *f*, lighting the lamp *e*. If it were desired to display signal $e'$ instead of signal *e*, the operation up to this point would be the same; but no pause would be made with the conductor 1 opened. The switch-lever would be moved back to close the circuit of conductor 1 and open that of conductor 2, or the switch-lever could be moved in such direction first without going through the intermediate step. Relay *g* would therefore be excited and an instant after relay *h* rendered inert, so that current from battery *f* would be cut off from conductor 7 and applied to conductor 10. From conductor 10 the current would find two paths to ground, one through the lamp $e'$ and the other by way of contacts $l^5$ $l^3$ through the magnet-winding of electromagnetic switch *k*. Magnet *k* being thus excited would attract its armatures $l^6$ $l^7$. The armature $l^6$ in closing against the switch-lever $l^2$ would disconnect the said lever $l^2$ from its contact $l^4$, thus cutting off the conductor 8, containing the lamp *e*, the conductor 9 being connected to conductor 7, and so with the back contact $g^2$ of relay *g*. The armature $l^7$ in drawing up would engage the lever $l^3$, thus connecting the magnet-winding *k* direct to the conductor 5 and establishing a locking-circuit to maintain the shifted condition of the electromagnetic switch while the contact at $l^5$ is broken, thus disconnecting conductors 10 and 11. Switch $k'$ and signal $e^2$ would not be operated at this stage, because the circuit 7 9 is open at the contact $g^2$. If it were desired to light lamp $e^2$ instead of lamp $e'$, the switching operation would be continued by changing the lever *b* to its alternate position to again complete the circuit 2 and open the circuit 1. Relay *h* being thus excited and relay *g* rendered inert, the circuit 6 5 7 9 13 would be completed, lighting lamp $e^2$, while conductor 10, extending to lamp $e'$, would be opened at the contact $h^2$ and the lamp $e'$ thus cut off. The circuit of electromagnetic switch

$k'$ would also be completed first at contacts $l^3$ $l^5$ and then an independent locking-circuit established at contacts $l^3$ $l^7$, contact $l^5$ being immediately broken. The switch-lever $l^6$ of magnet $k'$ being drawn up, the conductor 12 including lamp $e'$ would be broken at contact $l^4$ and the conductor 10 extended to the lamp $e^3$ and electromagnetic switch $k^2$. Lamp $e^3$, however, would not be excited at this time, because conductor 10 would be broken at contact $k^2$. Similarly the lamp $e^2$ may in its turn be cut off and the lamp $e^3$ lighted by another movement of the switch $b$ to excite relay $g$ and deënergize relay $h$. Circuit 6 5 10 would thus be completed to the lamp $e^3$ and the magnet $k^2$, said magnet in drawing up its armature cutting off the lamp $e^2$. The magnet now closes a locking-circuit for itself by way of conductors 5 6.

To review briefly the organization, it will be seen that the electromagnetic switches are arranged in pairs, and the members of each pair are responsive to distinct electric currents—distinct in this case because supplied over distinct circuits—and means controllable from the substation—in this case the relays $g$ $h$—are provided for applying alternately the different currents to actuate the different members of each group. Each electromagnetic switch controls the operative connection of a responsive device or branch with a circuit fed from the actuating-battery $f$, and each switch is adapted when actuated to cut off the responsive device associated therewith and bring the magnet of a succeeding switch and another responsive device into operative connection with the circuit, so that the last-mentioned responsive device will be actuated when the other current shall be applied. It will thus be apparent that the subscriber may by a proper manipulation of the switch $b$ operate any desired one of the lamps $e$, $e'$, $e^2$, and $e^3$. In every case the subscriber first removes his telephone from its switch to close contact $m'$ $m^2$ and complete the circuit of battery $f$ through relays $g$ and $h$. Then if it be desired to light the lamp $e$ the switch $b$ is turned to open contacts $b'$, whereupon relay $g$ becomes deënergized and closes a circuit 6 5 7 8 from battery $f$ including lamp $e$. If lamp $e$ were to be lighted, the switch $b$ would be rocked to open contacts $b^2$, whereupon the magnet $h$ is rendered inert and completes a circuit 6 5 10 12 including lamp $e'$. If it be desired to light lamp $e^2$, the switch $b$ is first rocked to open contacts $b^2$, thus effecting the deënergization of magnet $h$, which serves to complete a locking-circuit for magnet $k$, said magnet when thus energized uniting at its contacts $l^4$ $l^6$ conductors 7 9 and disconnecting conductor 8, including lamp $e$, from conductor 7. The switch $b$ is now moved to open contacts $b'$, whereupon magnet $g$ becomes inert and closes a circuit 6 5 7 9 13 from battery $f$, including lamp $e^2$. Finally, if it be desired to light lamp $e^3$ switch $b$ is rocked to open contacts $b^2$, whereupn magnet $h$ is deënergized and brings about the completion of a locking-circuit for magnet $k$, said magnet upon being thus energized joining conductors 7 9 and cutting off lamp $e$. Switch $b$ is now turned to open contacts $b'$ and deënergize magnet $g$, which serves to complete a locking-circuit for relay $k'$. Relay $k'$ upon being excited completes the circuit of conductor 10 to earth through lamp $e^3$ and disconnects from said conductor the branch 12, including lamp $e'$. Another movement of the switch $b$ to open contacts $b^2$ deenergizes magnet $h$, which closes a circuit 6 5 10 from battery $f$ through lamp $e^3$.

The interruption of the conductors and the consequent restoration of the apparatus may be performed at the substation by means of the telephone-switch at any moment; but in the system shown it is automatically performed by relay $i$, which is excited in making connection with the telephone-line, and severs the normal connection of the line conductors with the relays $g$ and $h$.

To prevent the accidental return of the mechanism to its initial condition during the process of selection, the switch $b$ is preferably so constructed that it cannot open both line conductors at the same time. Relays $g$ and $h$ therefore operate in such sequence that the locking-circuit 5 6 is closed by one of said relays before it is opened at the other.

It will be apparent from this description of the control of the invention that any of the devices may be selectively operated, or the equivalent circuits may be selected by vibrating the lever of the controlling-switch a suitable number of times—that is to say, by opening the actuating-circuits alternately once for each of the devices to be passed over in the series—that the selected device may be actuated or not by maintaining or withholding the actuating-current, and that the entire mechanism may be returned to its initial condition by breaking both actuating-circuits 7 10 by interrupting conductors 1 and 2. It will also be apparent that the series of magnets for successive operation and the series of devices to be selected may be indefinitely extended, any desired device being selectively brought under control or operated by transmitting the requisite number of pulsations of current in the actuating circuit or circuits.

My invention is defined in the following claims:

1. In combination, a series of magnets arranged in groups, the members of each group being responsive to distinct electric currents, means for successively applying current to actuate the members of each group, a switch operated by each magnet controlling the circuit of the succeeding magnet in the series, to render said magnet operative when excited by another current, and a locking-circuit for each magnet closed in the operation of its

switch to maintain the shifted condition thereof, whereby the magnets may be successively excited to switch any desired one of the series.

2. In combination, a series of magnets in two or more groups adapted for operation by different electrical currents, and means for applying current for the excitement of any magnet, a selected device associated with each magnet, a switch controlled by each magnet adapted to render the succeeding magnet of the series responsive to a current different from that exciting said switch-controlling magnet, a locking-circuit for each magnet made operative in the movement of the switch controlled by said magnet adapted to maintain the shifted position of said switch, mechanism for each magnet adapted to render the selected device of the preceding magnet inoperative, and means for controlling the operative selected device; whereby any device of the series may be selected by successively actuating the magnets and may be operated, as described.

3. In combination, several magnets in a series connected in two different circuits, means for applying current in the circuits, switches controlled by the magnets adapted to render the magnets operative in reciprocal succession in the two circuits, a locking-circuit for each magnet closed by its switch when shifted, whereby the magnets may be excited in sequence to any desired number, and a selected circuit or device controlled by each magnet, as described.

4. In combination, several magnets in series in two circuits, means for applying current in the circuits for exciting the magnets, a switch actuated by each magnet, each switch controlling the succeeding magnet in the other circuit, a locking-circuit of each magnet closed by the corresponding switch when shifted, a selected circuit controlled by each switch and a selected device or mechanism therein, an exciting-circuit for the selected devices, the switch of each magnet being adapted to render the exciting-circuit ineffective for the excitement of the selected device preceding in the series, and means for breaking the locking-circuits, as described.

5. In combination, a series of magnets in several groups of which the members are responsive to different electrical currents, switches actuated by the magnets adapted to render the circuits through the magnets of the said groups operative in reciprocal succession, mechanism controlled by each magnet and a locking-circuit closed by each magnet, said locking-circuit being effective during the application of either of said currents, as described.

6. In combination two magnets in different circuits and mechanism controlled by the magnets, a locking-circuit for each magnet closed by the magnet when excited, means for applying current in either circuit, and a relay in each circuit, controlling both said locking-circuits, as described.

In witness whereof I hereunto subscribe my name this 12th day of January, A. D. 1901.

FRANK R. McBERTY.

Witnesses:
ELLA EDLER,
PEARLE B. CLENDENNING.