(No Model.) 2 Sheets—Sheet 1.

F. B. WOOD.

ELECTRIC CALL.

No. 424,635. Patented Apr. 1, 1890.

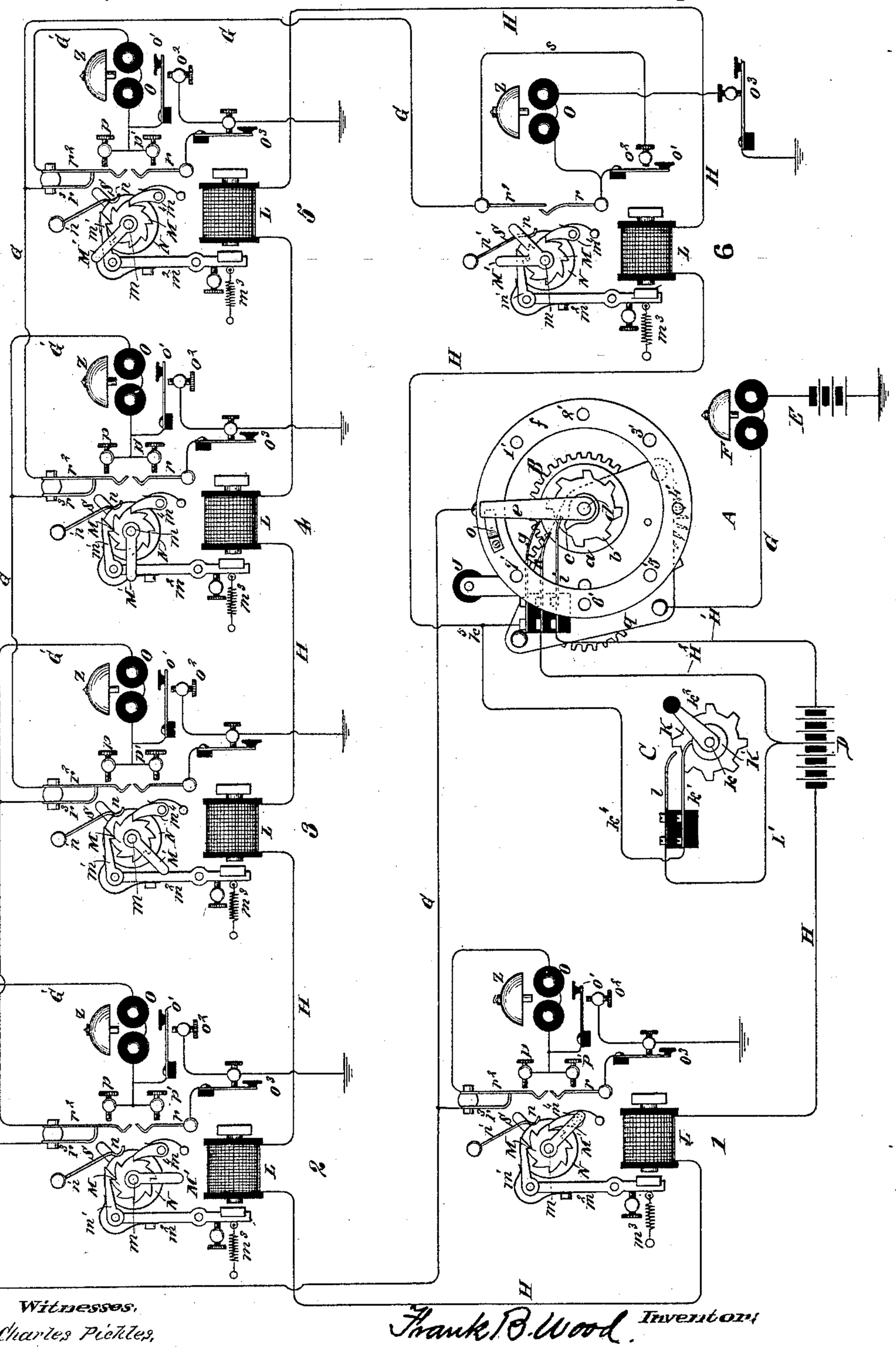

Fig. 1.

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Frank B. Wood. Inventor:

By his Attorney
Charles A. Gleason

(No Model.) 2 Sheets—Sheet 2.

F. B. WOOD.

ELECTRIC CALL.

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Fig II.

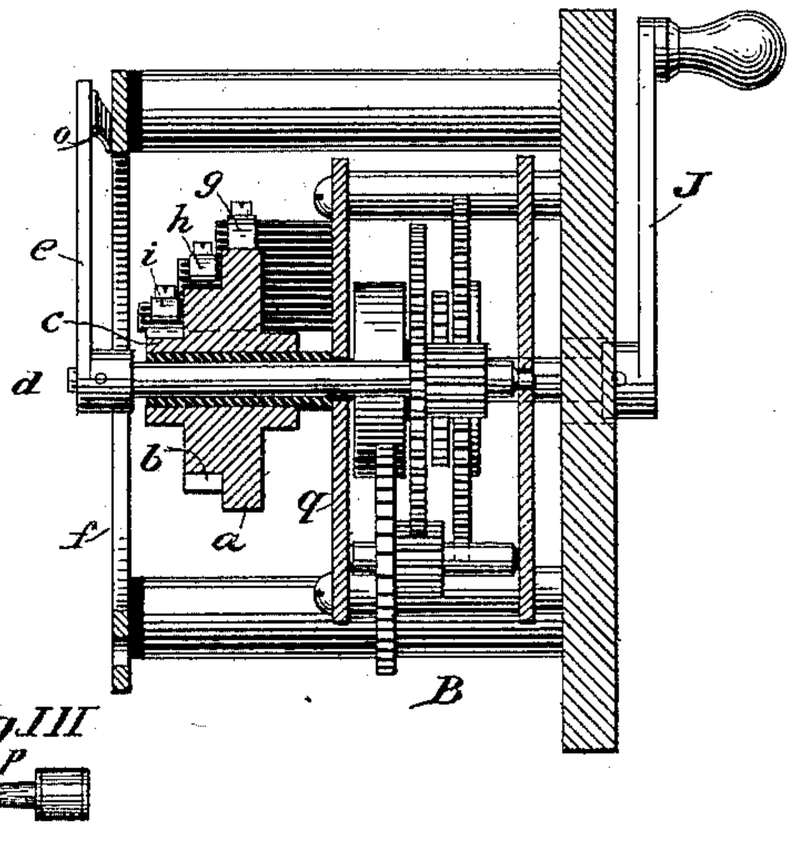


Fig III

Fig IV.

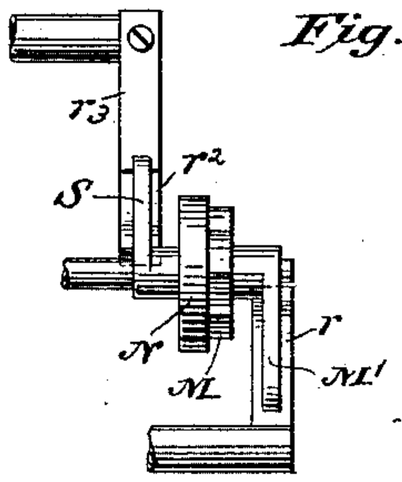
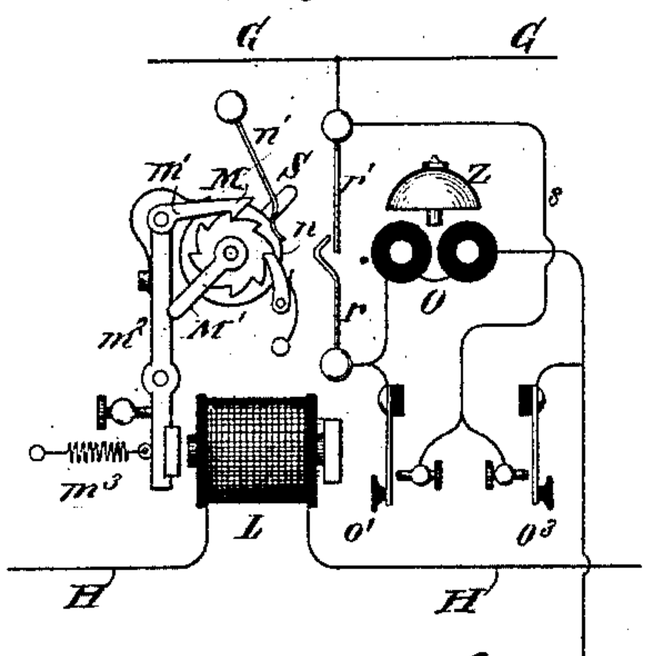


Fig. V.



Witnesses
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UNITED STATES PATENT OFFICE.

FRANK B. WOOD, OF NEW YORK, N. Y.

ELECTRIC CALL.

SPECIFICATION forming part of Letters Patent No. 424,635, dated April 1, 1890.

Application filed June 22, 1888. Serial No. 277,922. (No model.)

To all whom it may concern:

Be it known that I, FRANK B. WOOD, of the city, county, and State of New York, have made certain new and useful Improvements in Electric Calls for Fire-Alarm, District Messenger, and Telephone and Kindred Electrical Signaling Apparatus, of which the following is a specification.

My invention relates to a new electric system of individual call, by means of which any one desired sub-station can be called from a central office without interfering with or calling any other sub-station, or all the stations on the line can be called simultaneously at will.

It also relates to certain appliances located at each sub-station for calling the central office, as well as other instrumentalities and devices for the proper working of my invention, which will hereinafter be more fully specified.

In my invention I preferably employ two line-wires, extending through all the sub-stations on the circuit. I also employ in each sub-station a ground or return connection for one of these wires. This ground-connection is preferably made and broken by a step-by-step movement and a revolving arm attached thereto, so that as one sub-station is put into communication with the central office the preceding sub-station is cut out of circuit.

To more fully understand my invention, I make use of the accompanying drawings, in which—

Figure I is a diagram of the invention, showing a central office and several outlying stations. Fig. II is a sectional side view of the transmitting-instrument of call-box at the central office; Fig. III, a contact-plug adapted to be used with the call-box; Fig. IV, a side elevation of a portion of the mechanism at one of the outlying stations; Fig. V, a diagram of a modification of an outlying sub-station.

The same letters of reference indicate the same or corresponding parts throughout the several figures of the drawings.

The central office (shown in Fig. I) is provided with the necessary batteries, transmitter, unison device, and electric call-bell. The sub-stations are provided with call-bells and step-by-step mechanism for grounding the station required, so as to complete the circuit, and also have appliances for calling the central station from said sub-stations.

A represents the central office, at which is a transmitter B, unison C, batteries D and E, and a single-stroke bell F.

1, 2, 3 4, 5, and 6 represent series of outlying or sub stations, through which circuit-wires G and H run and connect them with the central office.

The transmitter B can be of any ordinary construction. I show, for convenience, a district-telegraph call-box movement, the operation of which is well understood. Upon the signal-shaft *d* of this call-box are the make-and-break wheels *a b c*, which are insulated from the rest of the call-box, as clearly shown in Fig. II. Upon this same signal-shaft *d* is also the revolving arm *e*, rigidly secured to the same.

The transmitter or call box B consists of a face-plate *f*, completely insulated from the rest of the box, which face-plate has plug-holes 1′, 2′, 3′, 4′, 5′, 6′, and 7′, which latter plug-hole is used to call all the stations at once.

o represents a spring, which is fastened to the face-plate, upon which the arm *e* normally rests. This corresponds to the zero-point. Secured to the call-box B are three contact-springs *g h i*, insulated from each other and from said call-box. The spring *g* is always in contact with and presses upon the wheel *a*, which has a smooth periphery, while springs *h* and *i* are brought into contact with the projections on the wheels *b* and *c* when said wheels are rotated. Spring *g* is connected to the main-line wire H, spring *h* to local circuit H^2, which is connected to the middle point of the battery D, and spring *i* to wire H′, which is in communication with one end of the battery D. The opposite pole of battery D is connected to the other end of wire H, which passes to electro-magnets L, located at each of the sub-stations. This circuit H is a complete metallic circuit, and its office is to control the step-by-step mechanism at the outlying stations, so as to position and put the apparatus at the sub-stations in communication with the central office. This circuit H, I denominate the "step-by-step circuit."

G is a second circuit, which passes from the

central office to each of the outlying stations, over which the signals are sent after the circuit is put in position therefor by the line H. This circuit G, I therefore call the "signaling-circuit."

The line G passes to ground at the last outlying station and is in electrical communication with the annular face-plate *f* at the central office. The circuit thereof is normally completed at the transmitter by the spring *o*, the metallic arm *e*, shaft *d*, plate *q*, bell F, and battery E to the ground. The circuit G may be grounded at any of the sub-stations by the means to be hereinafter described.

J is the handle of the winding-crank of call-box B, and when pulled down starts the signal-shaft *d* in the usual manner, the rotation being caused by clock-work, which is wound up by pulling the handle down. This clock-work is shown in Fig. II, and is of the same construction as ordinarily employed in call-boxes.

The unison C consists of the ordinary open-circuit call-box, carrying upon its signal-shaft *k* the brake-wheel K. The object of this unison-box is to provide a means for putting all the sub-stations in unison with the call-box at the central station. In practice it will be better to have more teeth on the wheel K than there are sub-stations on the line. This will insure putting all stations at unison. This unison-box shaft *k* also carries another wheel K′, which has a smooth periphery, and upon this wheel a contact-spring *k′* presses constantly. The spring *k′* is insulated from other parts of the box, and is connected by a local wire k^4 to the main line H at the point k^5. Another contact-spring *l*, insulated from the box, engages with the teeth of wheel K when the latter is rotated. This spring is connected to the middle of the battery D by local wire L′, which puts one-half of said battery to the line H. A handle k^2 is used for the unison-box, and when said handle is rotated one-half of the battery D will be thrown upon the line H each time one of the teeth of the wheel K comes in contact with the spring *l*.

The wheels *b* and *c* are so notched and arranged as to make eight makes and breaks in one rotation. The holes 1′ to 6′ in the face-plate *f* are for calling the six sub-stations individually, while hole 7′ is for calling all the stations at one and the same time. The eighth division of the plate (marked *o*) is the zero-point, as before stated.

Each sub-station is supplied with a step-by-step mechanism. I will only describe that of one sub-station, as the step-by-step mechanism are all alike at the different sub-stations and have the same circuits and circuit-controllers, except at station 6, which is the terminal sub-station. The step-by-step movement in brief consists of a toothed wheel M, mounted upon a shaft *m*, which carries a revolving circuit-controlling arm M′. To this toothed wheel is imparted a step-by-step motion by a pawl *m′* upon the armature-lever m^2, which pawl engages with one tooth at a time of the wheel M, the magnets L in line H and spring m^3, controlling the armature thereof, giving the necessary motion to the armature-lever m^2 and pawl *m′* whenever the circuit H is made or broken at the central office. This magnet L, adjusts through the intermediary of the step-by-step mechanism, the arm M′ to any point of its revolution in an obvious manner. The wheel M, which is rigidly secured to shaft *m*, is provided with a spring-actuated pawl m^4, for holding it in whatever position it is placed by the pawl *m′*. This step-by-step mechanism is old and well-known. The shaft *m* also carries the unison wheel or disk N, also rigidly connected to said shaft. The disk N has a notch *n*, into which the unison-spring *n′* slips whenever the wheel N is rotated to that point.

The operation of the unison is as follows: Whenever the unison-spring *n′* is out of the notch *n*, the spring *n′* rides over and presses upon the smooth surface of the wheel or disk N. As soon, however, as the spring *n′* slips into the notch *n* the normal power of the battery on the line H is not strong enough to overcome the tension of the spring *n′* and the shaft *m* is locked at unison with the call-box at the central office. An increase of battery-power over the line H will overcome the tension of the unison-spring *n′*. The object of this unison at each of the sub-stations is to insure the proper rotation of the arms M′, for it is upon these arms that the calling of the right sub-stations depends. These arms M′ must, therefore, respectively stand when at unison at an angle corresponding to the position and number of the sub-stations upon the dial of the call-box at the central office. Secured rigidly to the shaft *m* of the step-by-step mechanism are also arms S. The position of the arms S, which are arranged out of the plane of the arm M′, is clearly shown in Fig. IV, except in the terminal station 6, where the arm S is arranged in the same plane with the arms M′.

The object of the adjustable arms M′ and the mechanism with which they co-operate will now be set forth. I will remark beforehand, however, that the arm M′ is for grounding the individual stations so that they can communicate with the central office, at the same time giving an individual signal, and the object of the arms S is to call the sub-stations at once from the central office. The armature-lever of magnet O operates the signal at the sub-station, the signal in this case being an audible one. The operations of the signal are governed by the adjustable arm M′, which engages and actuates the circuit-completing springs *r* and r^2. The adjustment of the arm M′ is accomplished through means of a step-by-step mechanism having an operating-magnet L. The circuit G passes to the sub-stations and is connected with a spring r^3, which

normally bears against a spring r^2, which latter spring is connected to a continuation of the line G, so that the circuit is completed by the springs r^2 and r^3 at each sub-station, except at the terminal sub-station. From a point of the line G where spring r^3 is joined passes a sub-circuit G′, in which is placed a magnet O, which controls a bell Z. The sub-circuit G′ passes to two contact-stops p p'. The contact-stop p is arranged adjacent to and in the place of the spring r^2, which spring r^2 is also in the plane of the arm S, so that said arm may force the spring r^2 against the contact p. Opposite to the contact p' is arranged another spring r, which passes to ground by way of a strap-key o^3. The spring r and contact p' are in the same plane with the arms M′. The springs r and r^2 normally do not make contact with the stops p and p'.

From the foregoing it will be seen that the stops p and p' are not arranged in the same plane. A strap-key o' is connected around the contact p and p' and the strap-key o^3. The strap-key o' normally stands away from the contact-point o^2; but when closed it grounds the bell-magnet, shunting the contacts p and p' and the strap-key o^3. The arms S are so arranged at all the stations that they engage with the springs r^2 at the same time, making one continuous circuit from station to station, including the bell-magnets therein. This continuous circuit passes to ground at the terminal station 6. At the terminal station 6 the arm S is placed in the same plane with the arm M′. The spring r is arranged as before, and a second spring r' is arranged adjacent thereto in the same plane with the spring r, but does not make contact therewith until forced thereagainst by the arms M′ and S. The circuit G passes to the spring r', and when the spring r is forced against the spring r' the circuit G is completed by way of the spring r to a wire connected to ground by way of the bell-magnet o' and strap-key o^3, as before. Around the springs r and r' is placed a shunt s, which is normally open, but may be completed by a strap-key o', connected with spring r. This strap-key o' makes contact with a stop o^2, connected with said shunt, so that when said strap-key o' is closed the wire s will be grounded by way of the bell-magnet and strap o^3, and will shunt the springs r and r'.

Fig. III shows a metallic plug P for use with the call-box B, which plug is adapted to be inserted in any of the holes in the face-plate f, and when so inserted and the call-box is rotated the arm e will come in contact with said plug and ground the circuit of the line G at the central office by way of the bell F and battery E.

Having detailed the working parts of my invention, I will now proceed to give a practical explanation of my system of calling, showing how an individual call can be sent over the line. The drawings show the apparatus with all the sub-stations at unison with the central-office call-box. In this position any of the sub-stations can call the central office, or the central office can call any sub-station: To illustrate, let us suppose that station 1 wants the central office. The operator at station 1 will press strap-key o' into contact with the point o^2, which is grounded at station 1, the current will flow from battery E through the single-stroke bell F, arbor d, arm e, spring o, line-wire G, sub-circuit G′, bell-magnet O, strap-key o', stop o^2, and ground. This will make bell F at the central office and bell Z at station 1 ring simultaneously, and by prearranged number of signals will let central office know that No. 1 wishes to communicate with him. The same will take place with stations 2, 3, 4, 5, and 6 if their keys o' are pressed into contact with their points o^2. In case the central office wishes to communicate with any sub-station the operator thereat first rotates the unison-box C by means of the handle k^2. This will cause the current from one-half of the battery D to flow over wire L′ to spring l, to wheel K, to wheel K′, to spring k', wire k^4, and line-wire H. This current, when the sub-stations are at unison with the central office, will not be able to rotate the step-by-step mechanism, for one-half of the current from battery D is not sufficient to rotate the wheel N when the spring n' is in the notch n, the tension of unison-spring n' being too great for half of battery D to overcome. If, however, any station should be out of unison, this one-half of the battery D will be sufficient to rotate the wheels N to the unison-point, whereupon the spring n' will snap into the notch and hold the wheel N from further movement. All the sub-stations being at unison with the central station, suppose it is desired to call any sub-station. The central-office operator places metallic plug P (shown in Fig. III) in the hole-plate f corresponding in number to the sub-station wanted. If station No. 3 is to be called, the plug P is placed in hole No. 3′, and the crank-handle J is pulled down. This winds the clock-work of call-box B, and it is in readiness for operation. The arm e therefore begins to revolve and finally strikes against the plug P in hole 3′, and the circuit of line G is completed to ground at the central office. The first closing of the circuit on the line H causes all the battery D to be thrown on the line. The object of this is to overcome the tension of the unison-spring n'. The manner and means of doing so are as follows: The first tooth of wheel b is cut away for the purpose of preventing spring h from making contact with it. This is done to throw all the current of battery D to line, so as to remove the wheel N from the restraining influence of the unison-spring n', so that the subsequent pulsations on the line H, operating through the adjusting-magnets L, may be sufficient to advance the step-by-step movement. In place of the tooth on wheel b that is cut away, is substituted a single

tooth-wheel *c*, which makes contact with the spring *i*. When the tooth *c* comes in contact with the spring *i*, it throws all of the battery D on the line H. Said current passes from the battery D to wire H′, spring *i*, wheel *c*, wheel *a*, spring *g*, line H to stations, and return. The parts are arranged so that the tooth *c* touches the spring *h* and throws all of the battery on the line as the arm *e* leaves the zero-point. This current advances all the arms M′ in the stations one step, and in station No. 1 will cause the arm M′ to engage with the key or ground, closing spring *r*, and force it into contact with the stop *p*′. This operation completes the circuit of the line G at said sub-station to ground by way of the sub-circuit G′ and bell-magnet O. No call is received at station No. 1, for the line G is broken, arm *e* having left zero and not yet reached the plug P in hole 3′ of face-plate *f*. The second step-by-step movement grounds station 2, and in so doing breaks the ground of station 1 by causing its arm M′ to pass beyond contact with the spring *r*. No call goes into station 2, for the same reason as set forth in connection with station 1. It will be noted that the second step-by-step movement is caused by one-half of the battery D passing over wire H^2 to spring *h*, wheel *a*, spring *g*, to the line H. This current will now be sufficient to actuate the step-by-step mechanism, for the first impulse over the line H has put all of the battery to said line, dislodged the unison-spring *n*′ from the notch *n* in the wheel N, and thus placed the step-by-step mechanism under the influence of one-half of the battery D. The third step-by-step movement of the call-box breaks the ground in No. 2, as in the case of station No. 1, and closes the ground of station No. 3, the one required by the central office. This last step-by-step movement also presses arm *e* in contact with the plug P, which is in hole 3′ of plate *f*. Line G now comes into play and is closed to battery E by way of plug P, arm *e*, &c. The line G is therefore grounded at the central office and also at sub-station 3. This will cause a current to flow from battery E to bell-magnet F, plate *q*, shaft *d*, arm *e*, plug P, wire G, sub-circuit G′, bell-magnet O of station 3, and thence to contact *p*′, spring *r*, strap-key o^3 to ground, causing central-station bell-magnet and the bell Z at station 3 to ring. The answer back from station 3 would be made by closing key o^3 and breaking the circuit just traced. This will stop both bells from ringing, and when closed will cause them to vibrate, and by a prearranged signal the central office will know that station 3 has answered. When this signaling is finished, the attendant at central office takes out plug P, and call-box B completes its revolution, bringing all stations to unison, leaving arm *e* in contact with the zero-point.

Having described the manner of calling each station separately from the central office, I will now briefly set forth how the stations can be called up at the same time from the central office. The manner of doing so is as follows: Central-office operator puts plug P in hole 7′ of plate *f* and pulls down the arm J, as before. This starts the call-box to revolving and brings the arm *e* finally in contact with plug P in hole 7′. The arms S are so arranged that at the seventh step-by-step movement they will all come against the springs r^2 at the different stations excepting the terminal station, where the arms S come in contact with the spring *r* at the same time that the arms S at the other stations come in contact with the springs r^2. This completes the circuit of the line G from station to station by way of the sub-circuits G′, bell O′, contact-spring r^2 until the terminal station is reached, at which station the line G is grounded through the bell-magnet O by means of the spring r^2 being forced into contact with the spring *r*′. Every bell-magnet is therefore in communication with the line G, and the circuit of said line is completed at the central office by the plug P in hole 7′, arm *e*, &c., as before described, to the battery E and ground. Thus all the bells ring and all stations are called up at once. It is obvious that the same arrangement can be used at the terminal station as in the other stations, if desired, the only requisite being that the line G as it leaves the spring r^2 should pass to ground. I have shown at station 6—the terminal station—a different arrangement, because said arrangement is simpler, and also because I wish to show another way in which the circuit could be controlled. A metallic circuit could be used for the line-wire G between the terminal station and the battery E, instead of a ground, if desired. It will be noted that the function of calling all the stations at once from the central office may be dispensed with by dispensing with the arms S, in which case springs r^3 and contact *p* would also be dispensed with, and the arrangement at the different stations would be similar to that shown at the terminal station 6, with the arms S left off. When it is not desired to have the apparatus possess this function of calling all the stations at once, the arrangement shown in Fig. VI should be used at all the stations without the arm S.

In Fig. V is shown substantially the arrangement illustrated at the station 6, showing the station connected with the line G the same as the arrangement shown at station 6 would be if used at intermediate stations, as described. The construction shown in Fig. V is slightly modified as to the arrangement of the strap-keys and circuits. In this case the shunt *s* terminates in two contacts arranged adjacent, respectively, to the strap-keys *o*′ and o^3. The bell-magnet O in this case is grounded by a line which passes directly through said magnet to ground from the spring *r* without passing through the strap-keys o^3, as in the previous instance. The strap-key o^3 is connected with the ground-wire of the

bell-magnet *o'* between said magnet and the ground. When the strap-key *o'* is closed, it completes the circuit of the line G by way of the shunt *s* through the bell-magnet O to ground, and when the strap-key o^3 is closed it shunts the bell-magnet. This arrangement of circuits I use when it is required not to have the sub-station bells ring when the operator at the sub-station answers the central office. The strap-key *o'* is used in all the figures by the station-operator to call up the central office, and the strap-key o^3 to answer when the central office has called the sub-station.

Various modifications may be made in the apparatus without departing from the substance of my invention. I do not wish, therefore, to confine myself to the exact mechanism and arrangement used.

What I claim as my invention is—

1. The combination, in an individual electric signaling apparatus, of two lines emanating from a central station, step-by-step mechanisms at the various stations governed by electro-magnets in one of said lines, adjustable arms controlled by said step-by-step mechanism, all of said arms being differently situated, signal-receivers at the various stations governed by electro-magnets controlled by the other line and by the aforesaid adjustable arms, and a transmitter at said central station governing the circuit of both of said lines.

2. In an individual signaling apparatus, the combination, with two electrical circuits leading from the central station and the local signaling devices, each having a magnet included in one of said circuits, a signal-operating armature-lever controlled by said magnet, an adjustable arm for said signaling devices, all of said adjustable arms being differently situated, and a magnet adjusting said adjustable arms by a step-by-step movement and included in the other said circuit, of the transmitting break-wheel in the circuit of said adjusting-magnets having an adjustable automatic circuit-controller affecting the circuit of both of said signal-controlling magnets, substantially as set forth.

3. In an individual signaling apparatus, the combination of signal-receivers, each having a movable arm, and all of said arms being differently situated, a signal-operating armature-lever whose movement is controlled by said arm, a magnet for moving said lever and a magnet for turning said arm, the transmitting break-wheel in the circuit of said adjusting-magnets carrying an adjustable automatic controller controlling the circuit of both of said signal-operating magnets, unison-stops for said arms, and a unison circuit-controller in the circuit of said adjusting-magnets, substantially as set forth.

4. The combination, to form an electro-magnetic call system, of a call-box at a central office, a step-by-step mechanism at the various stations, a line emanating from the call-box and controlling said step-by-step mechanism by means of magnets, a signaling-circuit also emanating from said call-box and controlled thereby, a call-bell and ground-wire at the different stations normally disconnected from said signaling-circuit, a circuit maker and breaker controlling said latter circuit, which circuit maker and breaker is governed by the aforesaid step-by-step mechanism, a unison for said step-by-step mechanism at each of the stations, consisting of a wheel having a smooth periphery with a notch therein, and a unison-spring which bears on said wheel and takes in the notch, and a unison-transmitter at the central office connected to the first-mentioned line.

5. The combination, as hereinbefore set forth, of an arbor *d*, carrying insulated wheels *a b c*, springs *g*, *h*, and *i* for said wheels, line H, connected with the first-mentioned spring, and the lines H^2 and H', connected, respectively, with the last two springs, the face-plate *f*, having plug-holes therein for the purpose described, the battery D, connected to said lines H^2 and H' and to the return-circuit of the line H, spring *o*, secured to said face-plate, arm *e* in electrical communication with the arbor *d*, rigidly secured to said arm and normally bearing against spring *o*, a signaling-circuit G, connected to the face-plate *f*, step-by-step mechanism controlled by electro-magnets at the different stations in a second line, a call-magnet normally out of said signaling-circuit at each station, a ground for the same at each station, a circuit maker and breaker governing said ground controlled by the step-by-step mechanism aforesaid, a circuit-making plug adapted to be inserted in said plug-holes, with which plug the arm *e* comes in contact when the box is rotated, and a battery and call-bell located at the central office and electrically connected with the arm *e*, for the purpose described.

6. The combination of the arbor *d*, the wheels *a b c*, insulated therefrom, the arm *e*, rigidly secured to said arbor, the springs *g h i* for said wheels, the first of which is connected to the line H, the two latter of which are connected with the battery D in electrical communication with the line H, the face-plate *f*, having plug-holes as described, the spring *o*, fastened to said face-plate and in electrical communication therewith, a plug adapted to be inserted in said plug-holes in the path of the arm *e*, a step-by-step mechanism controlled by means of electric magnets in the line-wire H, a battery and bell-magnet in electrical communication with the arm *e* at the central station, a signaling-circuit connected to the face-plate *f*, passing from station to station and grounded at the terminal station, a sub-station circuit connected to said latter circuit at the different stations, spring terminals governing said sub-station circuits and controlled by the step-by-step mechanism, bell-magnets located in the ground-wires at sub-stations having the circuits thereof nor-

mally disconnected by said spring terminals, and two finger-keys controlling the circuit of the bell-magnets at the sub-stations, by one of which the central office may be called from the sub-stations, and by the other of which an answer may be sent to said central office when a sub-station is called.

7. A sub-station apparatus comprising a line-wire and magnet controlling a step-by-step mechanism, a second line-wire over which signals are sent, a ground-circuit extending from said signaling-circuit, which ground-circuit is normally disrupted, a call-bell in said normally-disrupted ground-circuit, a circuit-completer controlled by said step-by-step mechanism, so as to complete the ground and put the bell-magnet in circuit, and two finger-keys at the sub-station located in said ground-circuit, whereby a call may be sent to the central office, and an answer returned when the circuit-completer is actuated by the step-by-step mechanism.

8. The combination of a transmitter located at a central office, one or more outlying stations, line-wires extending between said central office and said outlying stations, a step-by-step mechanism, and call-bells controlled by magnets located in said line-wires, circuit makers and breakers controlling the call-bell magnets, which circuit makers and breakers are governed by the step-by-step mechanism, supplementary circuit makers and breakers at each station also controlling the bell-magnet circuits, and supplementary arms connected with the step-by-step mechanism controlling all of said latter circuit makers and breakers at one and the same time, whereby the transmitter may be used to call any individual sub-stations or all of the sub-stations at once.

9. The combination, as hereinbefore set forth, of the arbor *d*, the wheels *a*, *b*, and *c* insulated therefrom, the arm *e* in electrical communication with said arbor and rigidly secured thereto, the springs *g*, *h*, and *i* for said wheels, the battery D, the line H, connected with the first of said springs, the latter two of which are connected to the battery D in electrical communication with the other end of said line-wire H, a unison-transmitter, substantially as described, connected to the middle point of said battery D, one terminal of which unison-transmitter is connected to the line H and the other terminal thereof to the spring *h*, the face-plate *f*, having plug-holes 1′, 2′, 3′, 4′, 5′, 6′, and 7′, and contact-spring *o*, normally in communication with the arm *e*, the battery E and bell F, also in communication with the said arm *e*, the line-wire G, connected to said face-plate and passing to bell-magnets at the sub-stations located in normally-disconnected ground-circuits, strap-keys for making and breaking the circuit at the sub-stations, as described, a step-by-step mechanism controlling said normally-disconnected ground-circuits, electro-magnets in the line-wire H, governing said step-by-step mechanism, a unison at each station, consisting of a wheel N, having smooth periphery and a notch *n* therein, upon which wheel a unison-spring *n′* bears, for the purpose described, supplementary contact-springs r^2 and r^3, connected with said line G, also controlling the circuit bell-magnets at the different stations, and supplementary arms S, secured to the step-by-step mechanism, as and for the purpose described.

10. A unison apparatus for a step-by-step mechanism, consisting in the combination of a notched unison-disk connected to a moving part of the step-by-step mechanism, a unison-spring normally taking in the notch of the disk and holding the said mechanism against movement under the normal current, a battery, line, and electro-magnet controlling the step-by-step mechanism, a unison-transmitter controlling a diminished amount of the battery-power transmitted to the step-by-step mechanism, and a second transmitter controlling the full amount of battery-power transmitted to said mechanism, whereby the unison-spring may be dislodged from the notch by the full amount of current and the step-by-step mechanism operated by the normal current, for the purpose herein set forth.

11. The combination of the electro-magnet L, line H, the battery, and the two transmitters controlling one the full amount of the battery-power thrown upon the line and the other a partial amount thereof, the spring-actuated armature-lever m^2, having the spring-pawl *m′* mounted thereon, the shaft *m*, provided with the ratchet M, having a detent, the unison disk or wheel N, mounted upon the shaft *m* and formed with the unison-notch *n*, and the unison-spring *n′*, holding the disk at unison under normal current, substantially as and for the purpose set forth.

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