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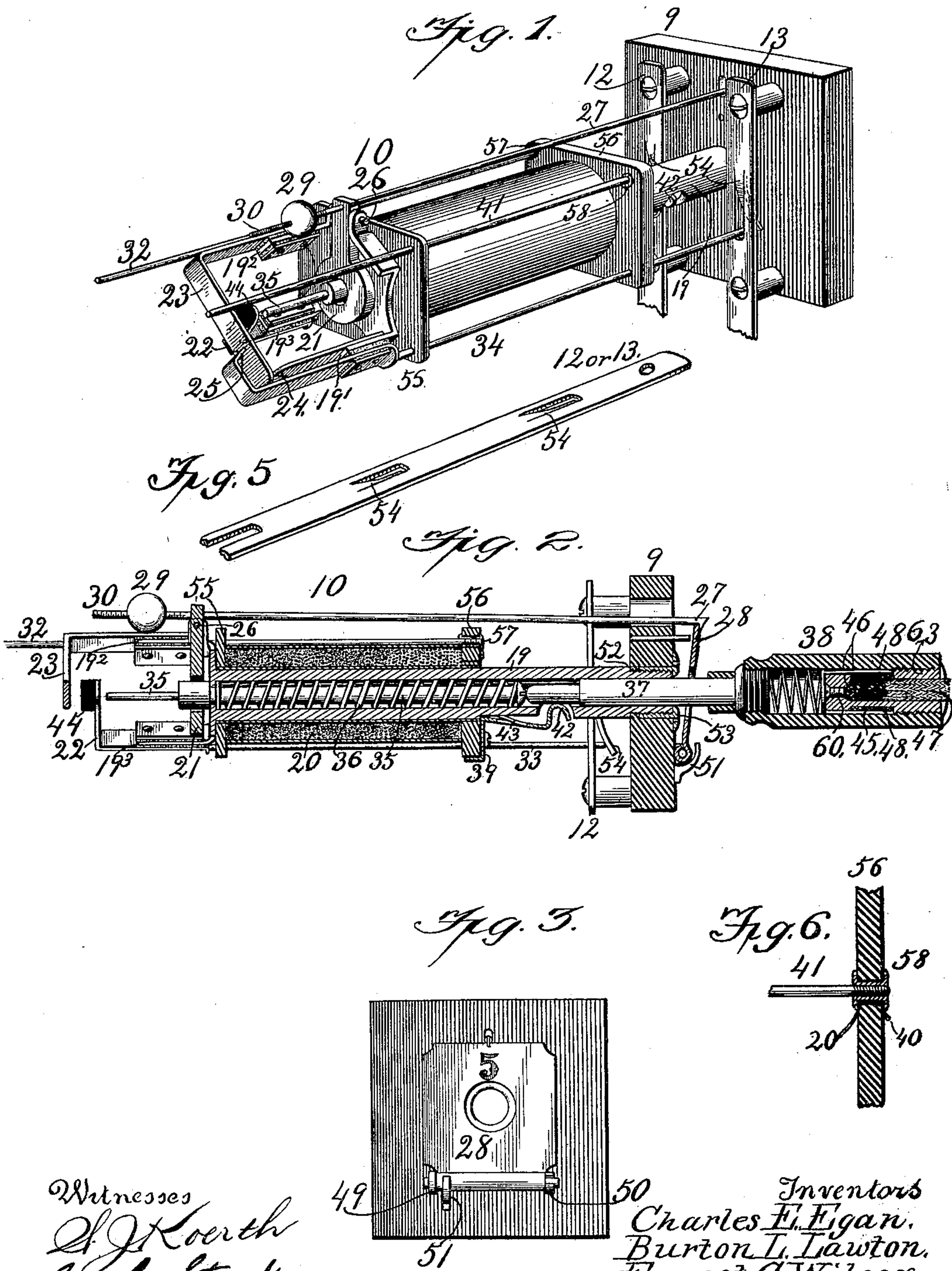
Patented Mar. 21, 1899.

C. E. EGAN, B. L. LAWTON & E. C. WILCOX.
TELEPHONE SYSTEM.

(No Model.)

(Application filed Feb. 25, 1898.)

2 Sheets—Sheet 1.



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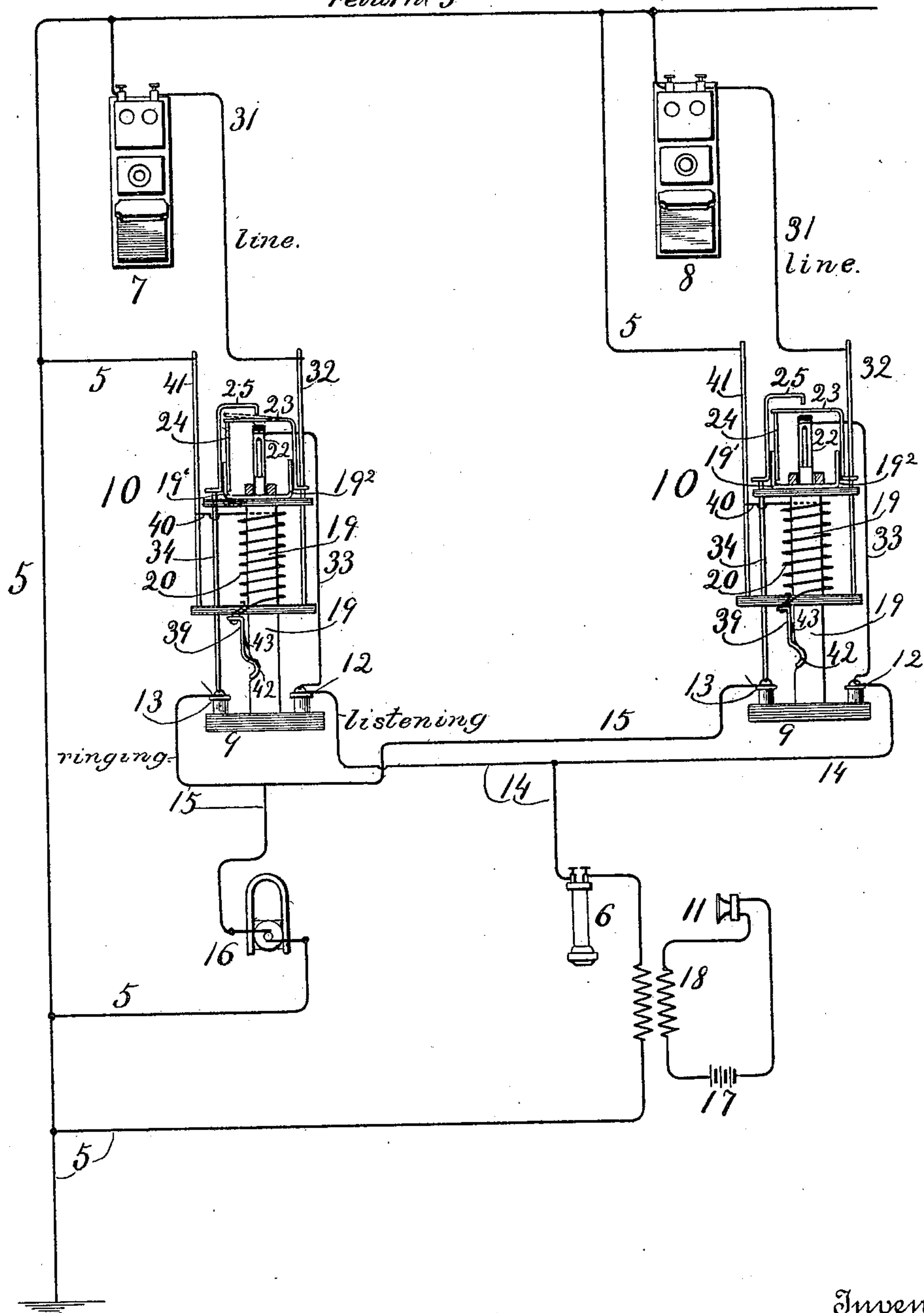
TELEPHONE SYSTEM.

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2 Sheets—Sheet 2.

Fig. 4.
return 5



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 621,449, dated March 21, 1899.

Application filed February 25, 1898. Serial No. 671,606. (No model.)

To all whom it may concern:

Be it known that we, CHARLES E. EGAN, BURTON L. LAWTON, and ERNEST C. WILCOX, citizens of the United States, residing at Meriden, in the county of New Haven and State of Connecticut, have invented a new and useful Improvement in Telephone Systems; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, in which—

Figure 1 is a perspective view of a spring-jack. Fig. 2 is a longitudinal vertical section of the same. Fig. 3 is a front view of the drop-shutter thereof. Fig. 4 is a diagram of our telephone system, showing the spring-jack and circuiting. Fig. 5 represents a listening or ringing rail with springs for connecting up two spring-jacks, and Fig. 6 represents a rod-joint in detail.

This invention relates to the armature, the hook; the drop-shutter, and other parts of the spring-jack and connections and means for securing the same to a switchboard as parts of a telephone system, also to the switch-plugs and to the circuiting of the system; and its objects are to render the armature very sensitive to the influence of a magnetic coil; to balance the drop-hook so that it will be operated even though the incoming current is attenuated by great resistance along the line; to adapt the drop-shutter to be readily removed from its hangings; to construct the spring-jacks so that a great many thereof may be easily attached to or removed from the back of the switchboard without interfering with each other, without interrupting the working of the system, and without injuring or soldering any connection; to adapt the switch-plugs for quick access to their interior parts and for forming sure electrical contact and connection between the tinsel of the switch-cord and the metal of the plug without the aid of solder, and to adapt circuits for sensitive operation for ringing up a called subscriber without ringing back on the line of either the caller or the central operator and for listening in by the central operator on the line of the two subscribers while talking.

To this end our invention consists in the construction and combination of parts form-

ing a telephone system hereinafter more fully described, and particularly set forth in the claims.

Let 5 represent the ground or return wire, 6 the central-operator's receiver, and 11 his transmitter.

7 and 8 represent subscribers' telephones, one limb having a ground, 9 a switchboard at the central station, and 10 a spring-jack for each subscriber's line, of which spring-jacks there may be any convenient number secured to the switchboard.

12 and 13 represent metallic rails mounted in pairs insulated upon the back of the switchboard and extending across the board either horizontally or vertically, one at each side of a line or column of spring-jacks. They are here shown as vertical, and all the rails 12 are connected by wires 14 with the central receiver and may be called "listening-rails." All the rails 13 are connected by wires 15 with a magneto-generator 16 and may be called "ringing-rails." The generator 16 is connected with the ground or return wire 5.

The body is provided at one end with a number of arms 19', 19², and 19³, forming therewith the frame of the spring-jack, upon which frame an armature 21, two springs 22, 23, and two contact-points 24 and 25 are supported. The armature 21 is pivotally hung at 26 to swing to and from the end of the core 19 and carries a hook 27, which holds the drop-shutter 28 normally raised or closed.

29 is a balance-weight screw-threaded upon a lever 30 opposite to the hook 27. This lever 30 is preferably the shank-rod of the hook extended through the armature, and by screwing the weight 29 to or from the pivotal center 26 the balance of the hook 27 may be so perfectly adjusted as to require much or little magnetic force to operate the armature and drop-hook. The incoming limb 31 from each subscriber's station is connected with its terminal spring 23 by means of a rod 32, and the contact-point 24, on which the spring 23 normally rests, is directly connected with the arm 19' of the core 19. The spring 23 is insulately supported on arm 19². The spring 22 is insulately supported on arm 19³ and is connected by a rod 33 with a listening-rail 12. These springs 22 are the terminals at the

spring-jacks of the inside or central-station circuit through the switch cord and plugs. The contact-point 25 is insulately supported on the arm 19' and is connected with the ring-
 5 ing-rail 13 by a rod 34. The body or core 19 has a bore through its length. In the rear end of this bore a piston 35 is fitted to reciprocate longitudinally. 36 is a spring for retracting the piston to its normal position, as
 10 shown in the drawings. Into the forward end of the core the metallic nib 37 of the switch-plug 38 is to be inserted in service. One end of the winding of the coil 20 is secured under and in contact with the metallic spring 39.
 15 The other end 40 of the coil is connected with the ground or return wire 5 by means of a fixed rod 41. One free end 42 of the spring 39 projects through an opening in the side of the body 19 into the path of the switch-plug
 20 to bear on the plug and insure metallic contact between the plug and core, as well as between the plug and the coil-wire. Midway of its body portion the spring 39 has another free end or tongue 43, which projects against
 25 the outside of the core 19 to insure metallic connection between the coil-wire and the core. 44 is a buffer of insulating material secured to the spring 22 to enable this spring to press mechanically against the spring 23 without
 30 establishing electric communication between these two springs. The body 38 of the switch-plug is of insulating material, bored through its length and screw-threaded in each end. In its rear end is a metallic screw 63, which
 35 is also bored through its length and provided with a binding-screw 60 in its forward end. The screw 63 is reduced in size, forming a neck 45 near its forward end, and in this neck there is an opening 46 at one side ex-
 40 tending to the bore.

47 represents a switch-cord which is inserted as far as possible into the rear end of the screw 63. Then the insulating-covering is to be pulled off to fully expose the wire or
 45 tinsel conductor within at the opening 46. Now a thread or wire 48 is to be firmly wrapped around the neck 45, thereby binding the wire or tinsel firmly against the metal of the screw 63. Then the binding-screw 60 is
 50 to be screwed firmly against the forward end of the tinsel, crowding it back into a very solid bunch beneath the wrapping 48, whereby metallic contact between the cord and plug is insured without the aid of solder, and the cord
 55 thus bound and bunched is so firmly held in the plug that it cannot be withdrawn, nor can the contact of the metals be disturbed by the roughest usage of the switch plugs and cord in service.

60 The drop-shutter 28 is pivoted on trunnions in two bearings 49 and 50 of the switchboard, the latter of which bearings is open at its upper side, permitting the trunnion at that end of the shutter to be raised out of the bearing,
 65 and then by pulling endwise the shutter may be removed from the bearing 49. The reverse operation will insert the shutter in place

for service, and a bracket 51, secured to the switchboard, will hold the shutter at the de-
 70 sired angle when the shutter is dropped. The said opening in hanger 50 is at its upper side and nearly in the plane of the shutter when the latter rests on the said bracket 51 in order that the sudden striking of the bracket by the
 75 shutter in dropping may not pry the trunnion of the shutter out of the bearing. The body 19 of the spring-jack is reduced in size forward of the shoulder 52 to enter a hole in the switchboard and is screw-threaded to receive
 80 a nut 53, by means of which it may be firmly bound to the switchboard. Each of the rails 12 and 13 is provided with a spring 54 to register with the rods 33 and 34, respectively, so that when a spring-jack is put in place on
 85 the board the rods 33 and 34 will press against the springs 54 and meet with yielding resistance while the spring-jack nut 53 is being screwed home, and this yielding resistance in-
 90 sures metallic contact between these separable parts in service without the aid of solder to unite them. The rod 32, to which the line-
 95 wire is attached, is removably secured in the end pieces 55 and 56 of the spring-jack frame by means of an internally-threaded bushing 57. This bushing is a piece of tubing set
 100 firmly into the fibrous end piece 56 and headed at both ends to secure it. The rod 32 is threaded into the bushing. The end pieces 55 and 56 are hard rubber or other insulating material, called by the trade "fiber." The rod 41,
 105 which is connected with the ground-wire 5, is similarly secured in the spring-jack by means of another internally-threaded bushing 58, and this bushing performs the further service of forming connection with the magnetic-
 110 coil winding 20, one end of which is secured under the head of the said bushing. By this means either the line-wire or the ground-wire may be connected with or disconnected from the spring-jack without removing the latter
 115 from the board. This is a great convenience in case of any accident to the outside circuit—such, for example, as the breaking or burning out of a wire.

The operation of our system is as follows:
 115 Let us suppose 7 to be the calling subscriber. The current comes in over wire 31, rod 32, spring 23, contact-point 24, and arm 19' to the core 19 of the magnet. Thence it passes
 120 through springs 43 and 39 to the coil 20, from which it escapes through screw 58 and rod 41 to the ground or return wire 5. The circuit thus completed through the coil 20 magnet-
 125 izes the core 19 and attracts the armature 21, whereby the hook 27 is raised, permitting the shutter 28 to drop. The central operator noting the call takes a switch-plug and in-
 130 serts it in No. 7 spring-jack and pushes the piston 35 into contact with spring 22. This switches the circuit from the core 19 through piston 35, spring 22, rod 33, rail 12, and wire 14 to the central receiver 6, through which the operator listens for the number called. Let that be "8." Then the operator releases

the plug in jack 7, when that spring 36 will retract its piston 35 and break the listening-circuit at spring 22 of that jack. Then she takes the other switch-plug of the pair and inserts it in No. 8 spring-jack, and by pushing it entirely in that piston 35 will push spring 22, with its insulating-buffer 44, against spring 23, disconnecting it from contact-point 24 and making connection through contact-point 25, rod 34, rail 13, and bridge-wire 15 with the magneto-generator 16, whereby the bell of subscriber No. 8 will be rung. The operator releases the plug in spring-jack No. 8, and the circuit being completed through the two springs 42, switch-plugs, and connecting-cord from spring-jack 8 to spring-jack 7 the two subscribers' phones are in communication with each other. With this system of circuiting the operator may listen to hear if the wire is still in use by pushing either 7 or 8 switch-plug into contact with spring 22, or she may ring either subscriber's bell by pushing his plug all the way in, thus connecting that subscriber's bell with the magneto-generator 16; but this bell-circuit being independent of the listening-circuit the ringing-current cannot pass back over the line to the central receiver or to the caller's receiver. The armature 21 is circular to register with the whole end of the core 19 and is centrally perforated to permit free passage of the piston 35. By this means the full magnetic force of the core is utilized in attracting the armature. The screw-weight 29, which may be turned a fraction of a screw-thread or more, enables the armature 21 and its hook 27 to be adjusted to balance with perfect accuracy at the tension desired, so that when the current is very weak from coming over a long line or from being dissipated it will still energize the magnet 19 sufficiently to attract and operate the armature and hook thus nicely balanced; yet when under more favorable electric conditions the incoming current is strong the weight may be adjusted so as to require more force to operate the armature, thus insuring the instant receding of the armature from the magnet when its circuit is broken. By means of the listening-rails 12 and ringing-rails 13, permanently located on the switchboard, and the screw-ended body 19 of the spring-jack each spring-jack is rendered independent of all the others, and any spring-jack may be connected up with the board or be removed therefrom at any time without interfering with the operating of other lines on that board, the springs 54 insuring metallic contact with the removable rods 33 34 without the aid of solder, thus avoiding the danger of using a hot soldering-iron in the network of wires at the back of the switchboard. The circuits of the two rails 12 and 13 are independent of each other and cannot be connected together. All talking and listening are done through the spring-jack coils and cores, the points 24, and the line-termi-

nals 23; but when these terminals are switched to points 25 to throw a ringing-current from generator 16 onto the line the contact at 24 is broken and the coil and core circuits are cut out, so that central's ring goes only to the subscriber whose plug she has pushed in and cannot be heard at her own phone. While two subscribers are connected, central may listen to hear whether the line is in use by pushing either plug enough to bring the piston 35 in contact with terminal 22, and either subscriber may ring off and drop his shutter to notify central when he is done with the line. The operator closed the shutter by means of her finger extended when she inserted the plug, and she now closes it again by the same means when she withdraws the plug. One or more shutters constantly hanging dropped on a board would be disconcerting to an operator; but with this means of removing a shutter instantly that may be obviated. The removal of the shutter also gives free access to the screw-nut 53 for removing or securing the spring-jack. The whole operation of this switchboard is performed in using the switch-plugs. The insertion of one plug into the caller's jack restores that shutter by means of the operator's finger extended beside the plug and connects the central receiver, and the insertion of the other plug fully into the called subscriber's jack rings his bell, leaving both plugs inserted as they normally rest when retracted by the springs 36, opens communication between the subscribers, and cuts out the ringing-circuit.

Having thus fully described our invention, what we believe to be new, and desire to secure by Letters Patent, is the following:

1. In a telephone system, metallic rails insulately supported in pairs upon the back of a switchboard, each rail being provided with metallic springs, each spring-jack provided with rods fitted to register with the said springs, and electrical connections with the said rods on the one side and electrical connections with the said rails on the other side; substantially as described.

2. Rails in pairs unconnected and insulated upon a switchboard, each rail provided with contact-springs and having a line connection; and spring-jacks fitted to be removably secured to the switchboard and having line connections and contact-points, and adapted to register each point with one of the said contact-springs when the spring-jack is secured to the switchboard.

3. Electric rails having each a series of contact-springs and secured upon a switchboard, and spring-jacks fitted for attachment to the said switchboard, each jack having one or more contact-points adapted to engage respectively with one or more of the said springs while the jack remains secured to the board.

4. A switchboard and a telephone at a central station; a listening-rail upon the switchboard and electrically connected with the said

telephone and having a contact-spring; a ringing-rail having a contact-spring and located on the said switchboard; a magneto-generator connected with the ringing-rail; a subscriber's spring-jack removably secured to the said board and having contact-points to engage the said contact-springs when so secured; a subscriber's line connected with the said spring-jack, and a switch adapted to engage the subscriber's line with either the said listening-rail or the said ringing-rail.

5. A switchboard having a perforation through it; a spring-jack having a core fitted to the said perforation and a shoulder to abut against the board, and a nut screw-threaded upon the said core and having a shoulder or flange to engage the said board on the side opposite to the shoulder on the core.

6. A switchboard having a perforation through it; a spring-jack having a body fitted to engage the said perforation at one side of the board, and a nut made to enter and fit the said perforation at the other side of the board; the spring-jack body having a shoulder and the nut having a shoulder between which two shoulders the switchboard is clamped to secure the spring-jack thereon.

7. A spring-jack body having contact-points permanently secured to it; a line-wire connected with a spring having normal contact with one of the said points; a coil surrounding said body as a core, one end of the coil-winding being connected with the said core and the other end having a ground or return wire connection; an armature hung adjacent to the core, and shutter-drop connections with the armature.

8. A spring-jack body longitudinally bored for a switch-plug; a piston fitted to reciprocate in and project from the bore at the rear end of the body; a retracting-spring for the piston; a magnetic coil, an armature, a drop-shutter-retaining hook and a contact-point connected with the said body; a spring connected with a line-wire and normally resting on the said contact-point, and another spring having connection with a central-operator's receiver and interposed between the said piston and the line-wire spring; substantially as specified.

9. A spring-jack body bored longitudinally for a switch-plug and having a side opening; a coil wound on the body as a core; a spring connected with one end of the coil-winding and having a resilient bearing on the core, and also having a free end projecting into the bore; substantially as specified.

10. A spring-jack body bored to receive a switch-plug; a magnetic coil, and a spring connected with one end of the coil-winding, the spring having two free ends, one end bearing on the core of the coil and the other end projecting into the path of the switch-plug in the body of the spring-jack; substantially as specified.

11. A switch-plug body of insulating material bored through longitudinally and screw-

threaded in each end; a metallic nib screwed into the forward end; a metallic screw bored through its length, necked near the forward end, open at one side of the neck to the interior bore, and fitted into the rear end of the plug-body; a switch-cord entering the bore of the screw, the wire or tinsel of the cord being laid bare at the open side of the said neck and a thread or wire wound firmly around it and the neck binding it in contact with the screw, a binding-screw threaded into the bore of the necked screw and forced against the wire or tinsel and a metallic spring between the metallic point of the plug and the necked screw; substantially as specified.

12. A metallic screw-body fitted as a portion of a switch-plug and bored longitudinally, necked and open through the neck to the bore; winding material for the neck and a binding-screw threaded into one end of the bore substantially as specified whereby a switch-cord may be fixed in a switch-plug and metallic contact be secured without solder.

13. A drop-shutter having trunnions journaled in bearings; a bracket to support the shutter when dropped, and an opening in one of the bearings nearly in the plane of the supporting-face of the said bracket for the passage of a trunnion into or out of the hanger.

14. A spring-jack structure having a portion of insulating material; a bushing secured in the insulating material and internally screw-threaded, and a rod for securing a conducting-wire, screw-threaded to engage the said bushing.

15. A spring-jack structure having a portion of insulating material; a metallic bushing having a flanged head and secured in the said insulating material; a magnetic coil having one end of its winding secured under the said bushing-head, and a rod for connecting a conducting-wire, screw-threaded into the said bushing.

16. A spring-jack having a body longitudinally bored and wound with a wire coil as a core for an electromagnet; a portion fitted to reciprocate in and project from the said core, and an armature provided with a drop-shutter hook and having a central opening registering with the core-bore; substantially as described.

17. In a telephone system, the circuiting comprising a subscriber's phone with one limb having ground or return wire connection; a line-wire a spring and contact-point electrically connecting the other limb with the core of the magnetic coil of a spring-jack; and electric connections between one end of the winding of the coil and the core and between the other end of the winding of the coil and the ground or return wire; and a ringing branch having a terminal to contact with the said spring substantially as described.

18. The circuiting comprising two subscribers' circuits containing each a telephone set having ground connections by the first limb and extending the second limb to the central

station; a signal device connected by a switch with each second limb and having ground connection; a magneto-generator grounded at one limb and its other limb having normally open connections with the said switches at the spring-jack; a central-station telephone-circuit having normally open connections with the second limb of the subscribers' lines at the spring-jack; switch plugs and cords for connecting the second limbs through the signaling-circuit; the said switches being adapted to connect the central telephone with a subscriber's second limb whereby central may listen to the subscriber's call also to connect the magneto-generator bridge with a subscriber's line whereby that subscriber's call-bell will be sounded, the other connections being open so that the bell will not sound on any other phone than that of the subscriber called; and whereby either subscriber may operate the signaling device to ring off while his phone is in talking-circuit substantially as described.

19. A spring-jack comprising a body of magnetic material bored to receive a switch-plug; a coil wound upon the body and connected as described; and a frame integral with or secured directly upon one end of the body and comprising arms for supporting electrically-connected springs and pivotal supports for an armature; substantially as described.

20. A spring-jack body adapted to be secured directly to the switchboard and fitted as a magnetic core and arms secured permanently upon one end of said body fitted to support electrically-connected springs; substantially as described.

21. In a telephone system, spring-jacks each having a core bored to receive a switch-plug; a piston fitted to reciprocate in line of the plug and provided with a retracting-spring; a central listening-circuit having a terminal spring in line of the said piston; a magnet-

core provided with a contact-point and located in the path of the listening terminal spring, and connected with a subscriber's line; an armature and a drop-shutter connected with the said magnet, and a ringing branch circuit having a terminal located in the path of the subscriber's line-spring; the central listening-spring and the subscriber's spring having insulating material interposed for mechanical action, substantially as described whereby a subscriber's call will drop his shutter at any time before, during, or after the talking-circuit is in use, and whereby the central operator may listen at any time to find out whether a line is in use, without interrupting the use of the line, and whereby the central operator may ring a call to any subscriber before or after that subscriber's line is in use, or may interrupt the subscriber while using the line without the ring sounding along the line to any other subscriber or sounding back over central's line.

22. In a telephone system, subscribers' lines with phones and bells; a ringing generator-circuit; a central circuit and phone; spring-jacks each connected with a subscriber's circuit, a branch of the ringing-circuit, and the central circuit; pistons and switch-plugs for the jacks; the springs and piston being located in line of the plug in each jack, and insulating material located between the central-circuit terminal spring and the subscriber's circuit-spring and attached to move with one of them, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

CHARLES E. EGAN.
BURTON L. LAWTON.
ERNEST C. WILCOX.

Witnesses:

T. RAYMOND STUART,
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