No. 646,690. Patented Apr. 3, 1900.

W. D. GHARKY.

INTERCOMMUNICATING TELEPHONE SYSTEM AND APPARATUS.

(Application filed Apr. 1, 1898.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.

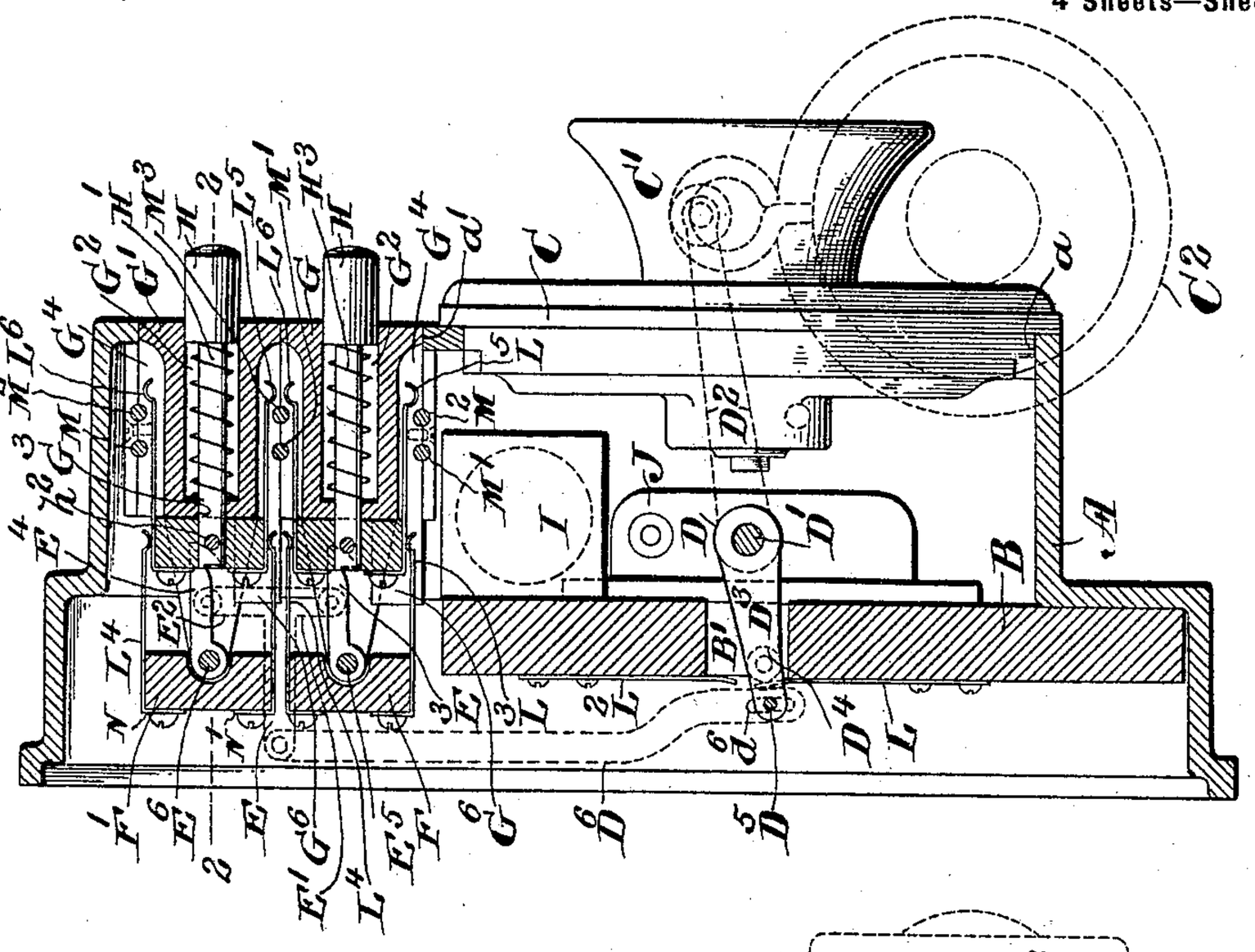
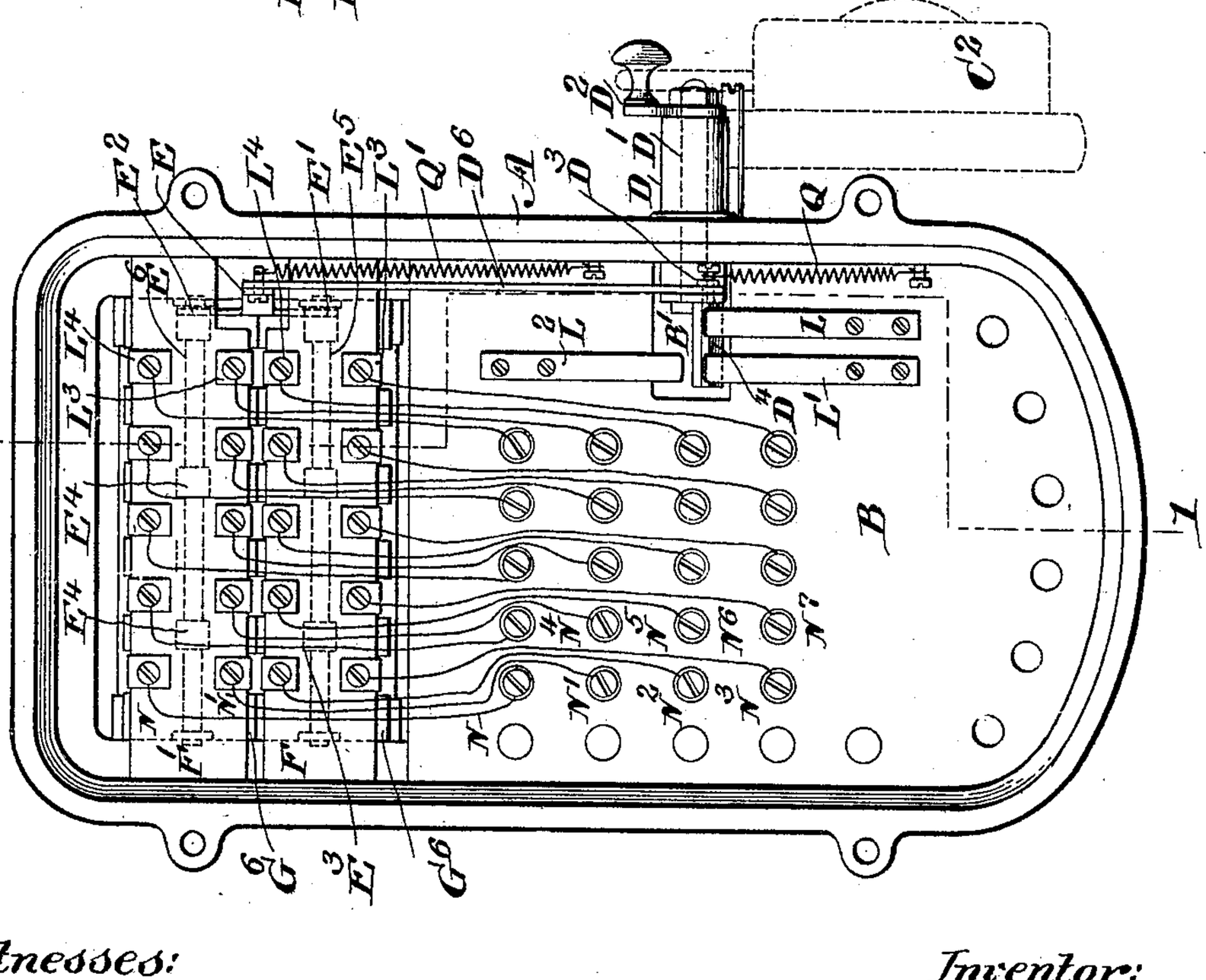


FIG. 2.



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(No Model.) 4 Sheets—Sheet 2.

FIG. 3.

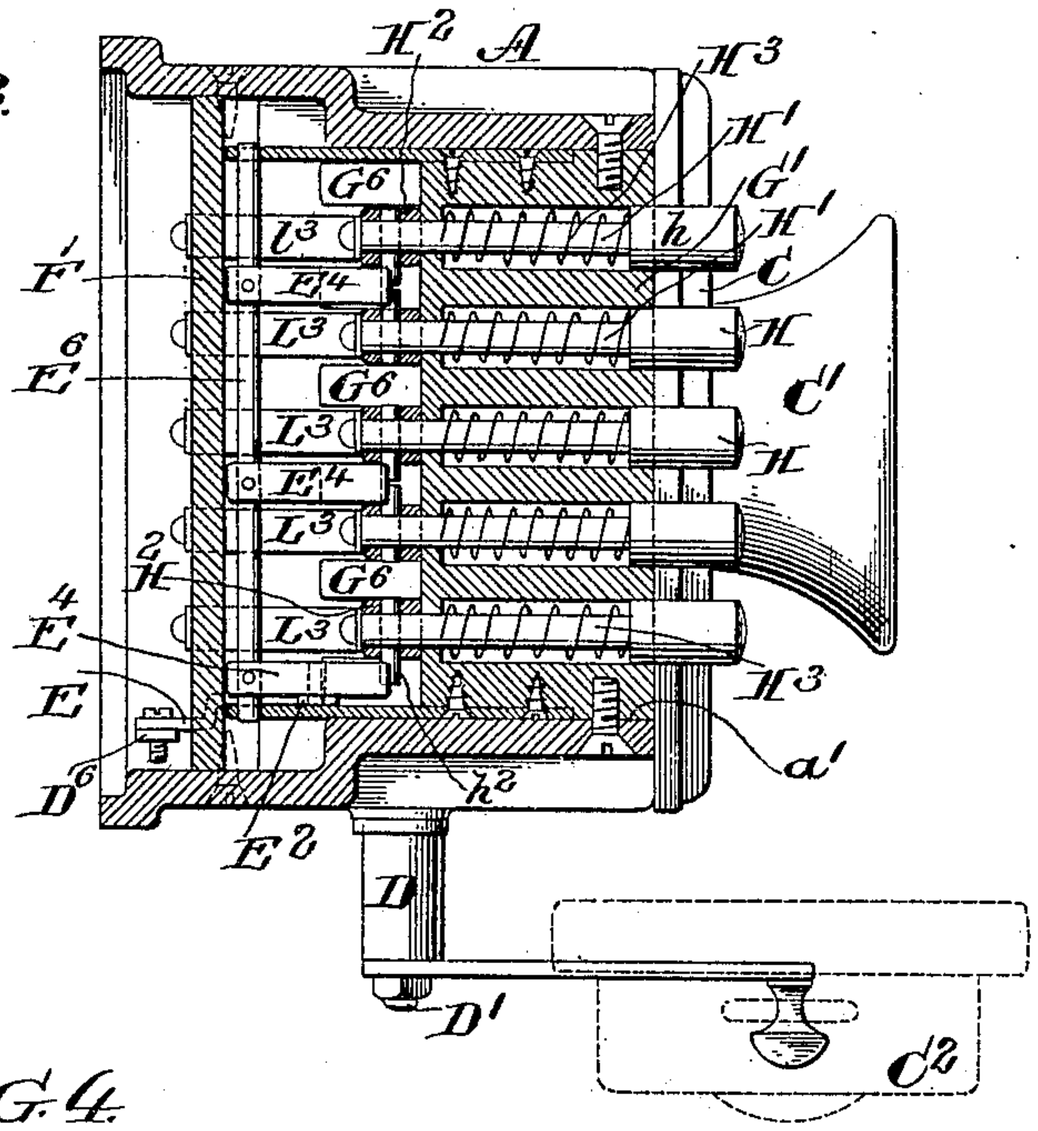


FIG. 4.

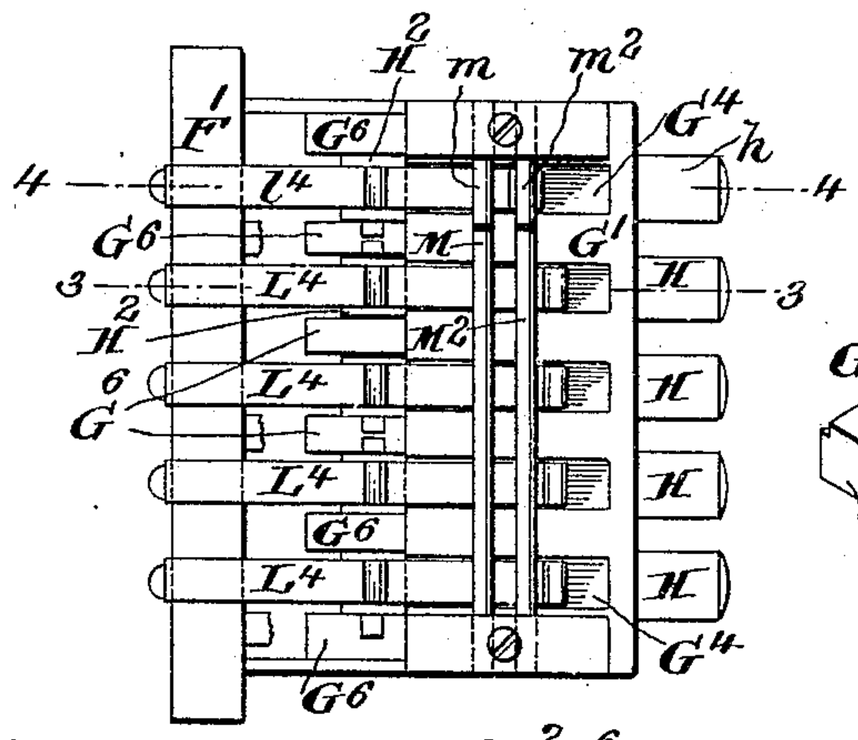


FIG. 5.

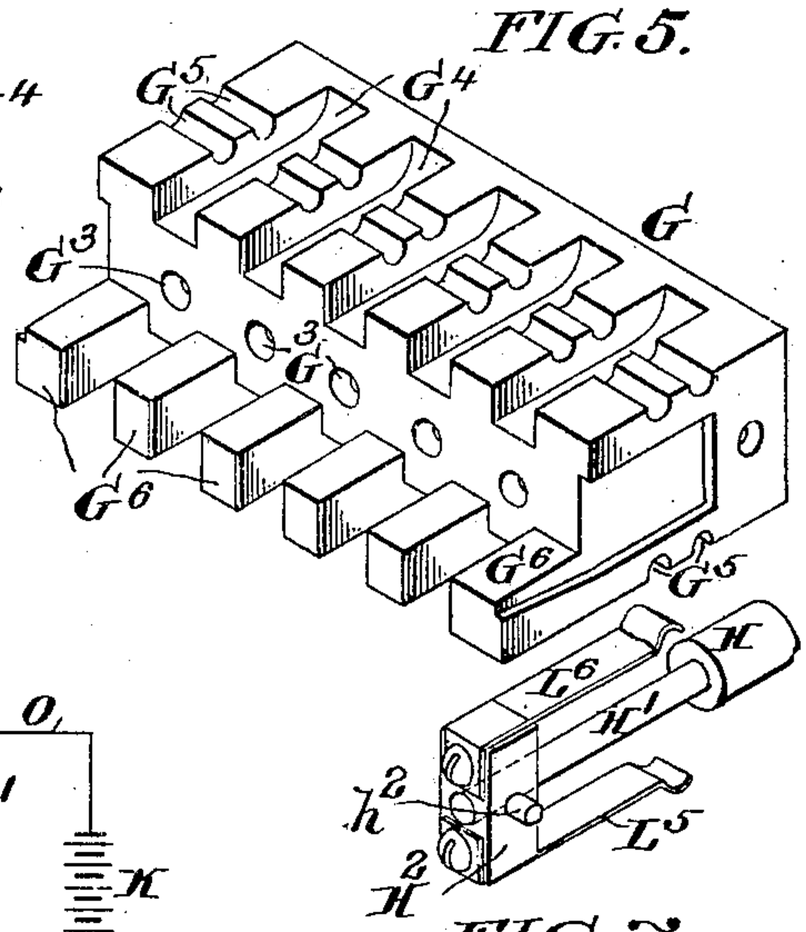
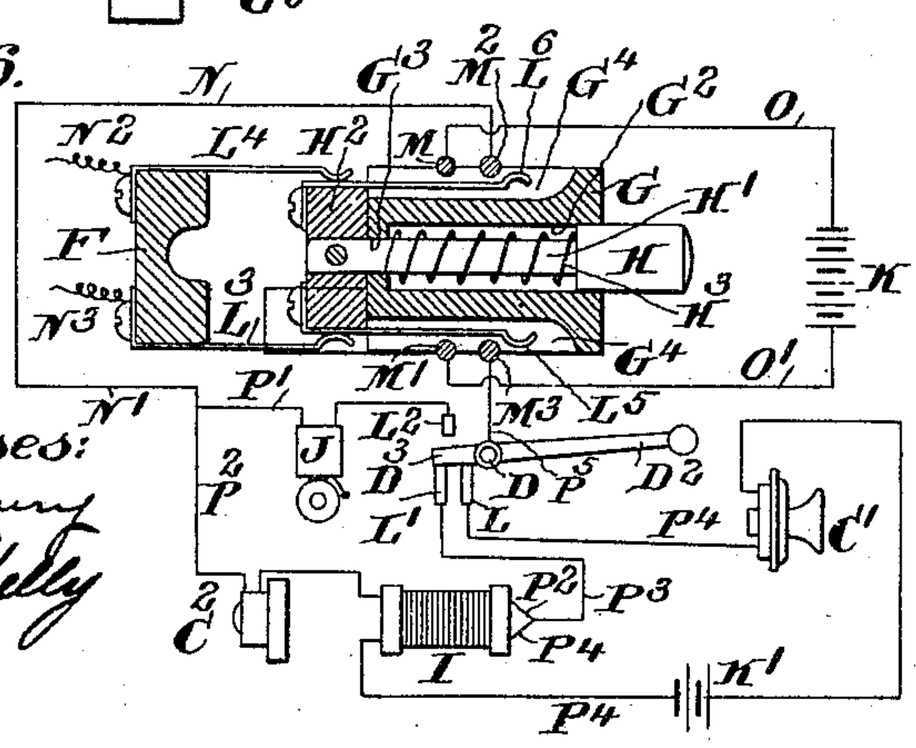


FIG. 7.

FIG. 6.



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(No Model.) 4 Sheets—Sheet 3.

FIG. 8.

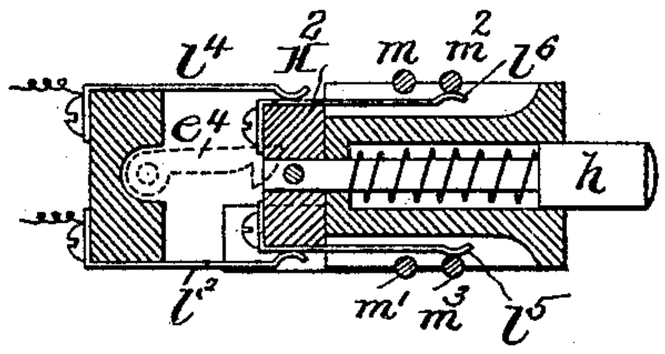


FIG. 12.

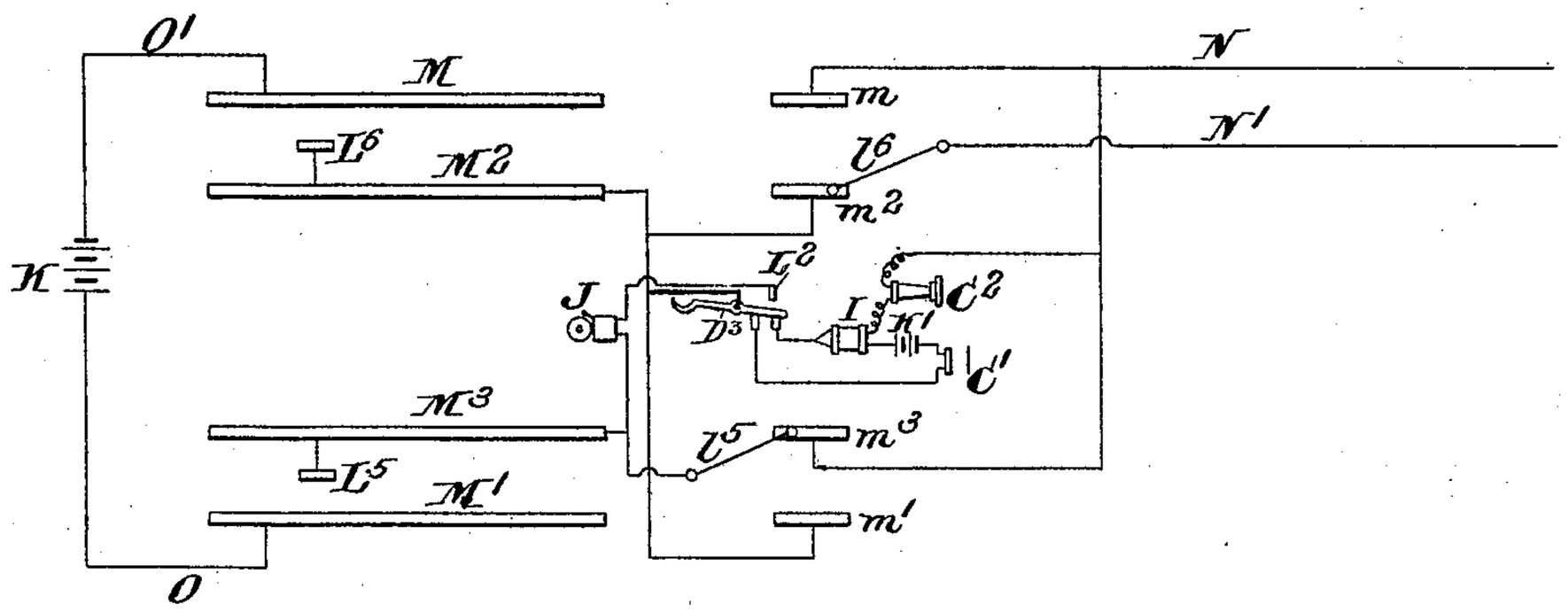
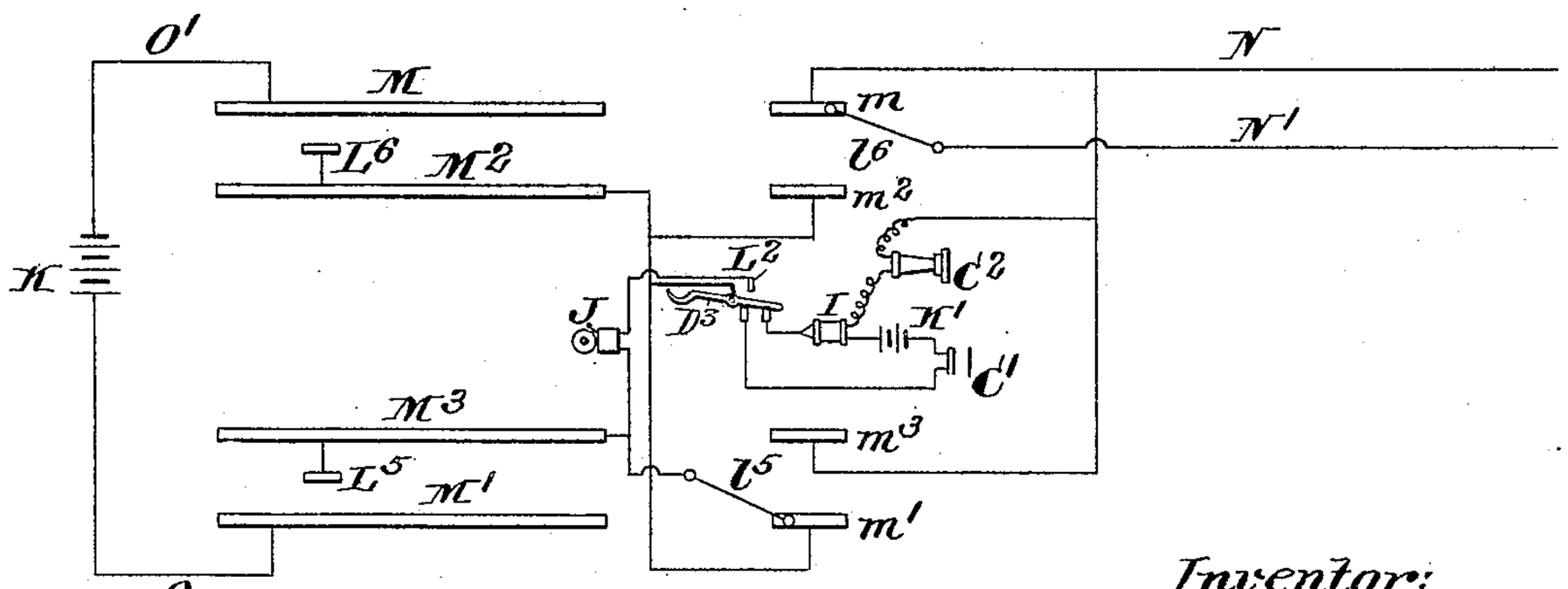


FIG. 13.



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INTERCOMMUNICATING TELEPHONE SYSTEM AND APPARATUS.

(Application filed Apr. 1, 1898.)

(No Model.) 4 Sheets—Sheet 4.

FIG. 9.

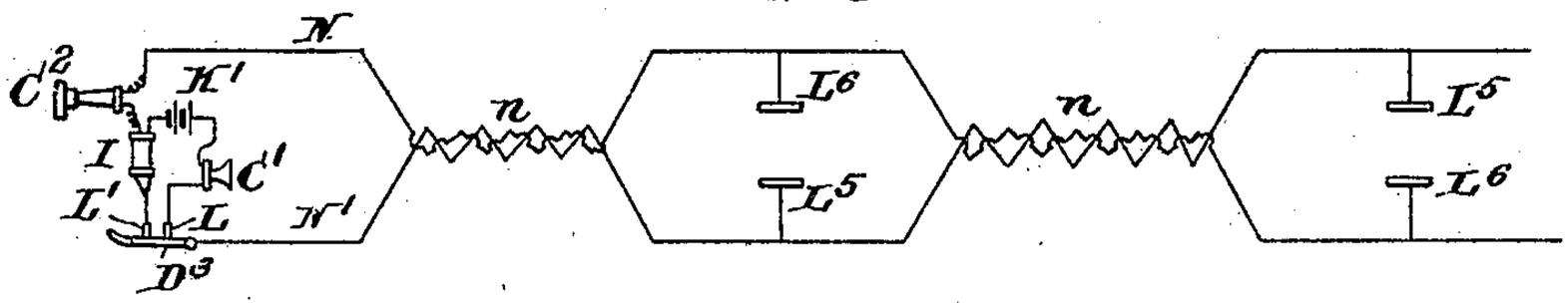


FIG. 10.

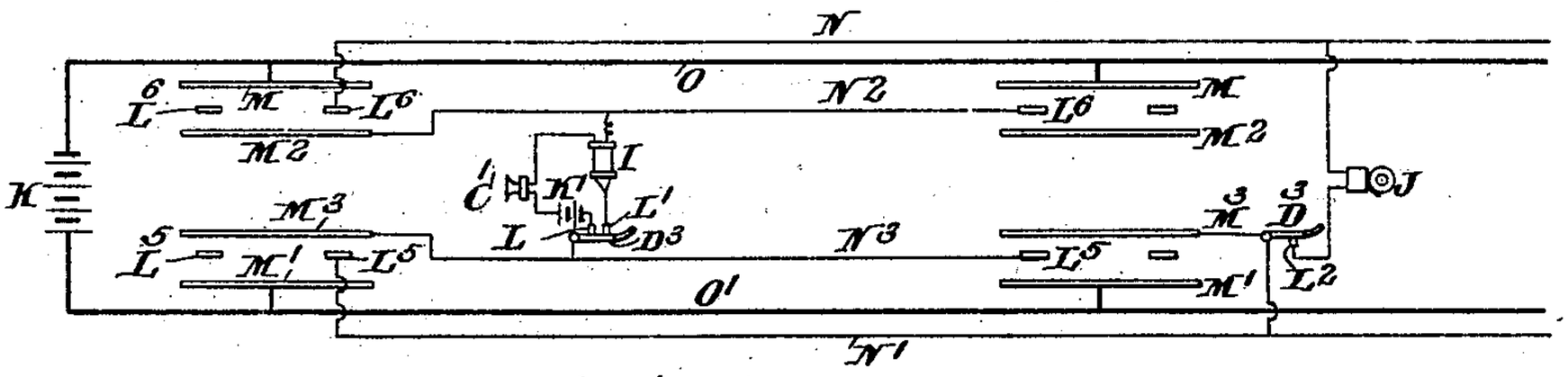


FIG. 11.

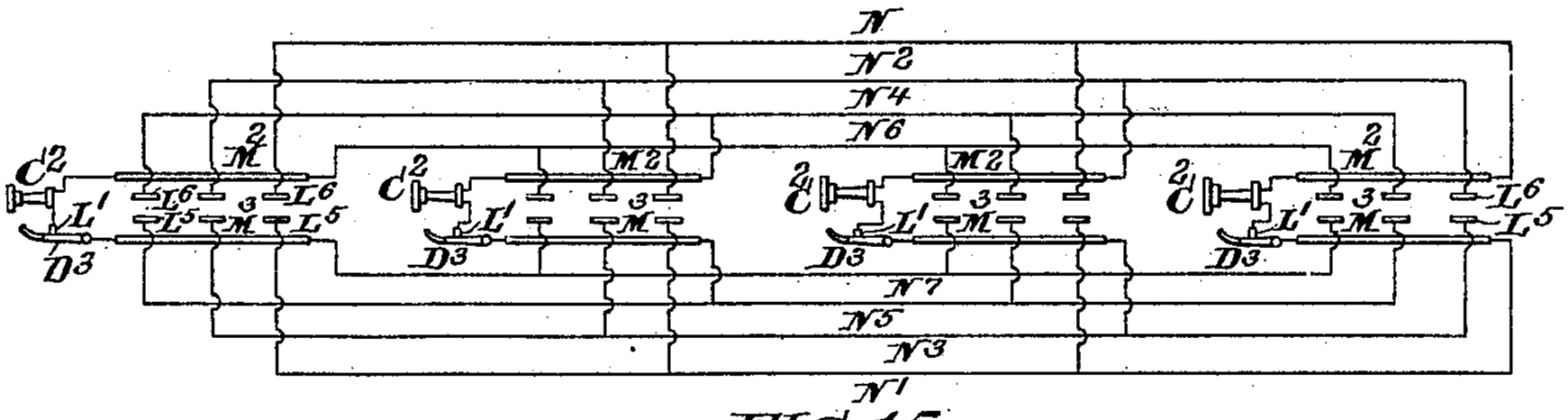


FIG. 15.

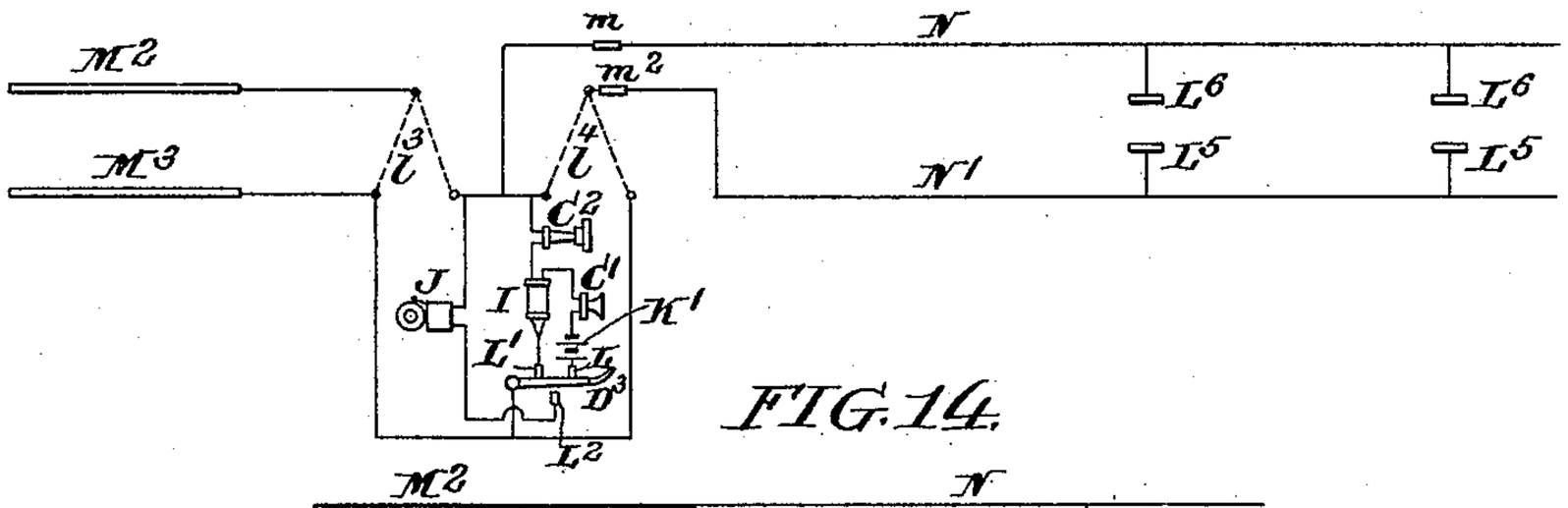


FIG. 14.

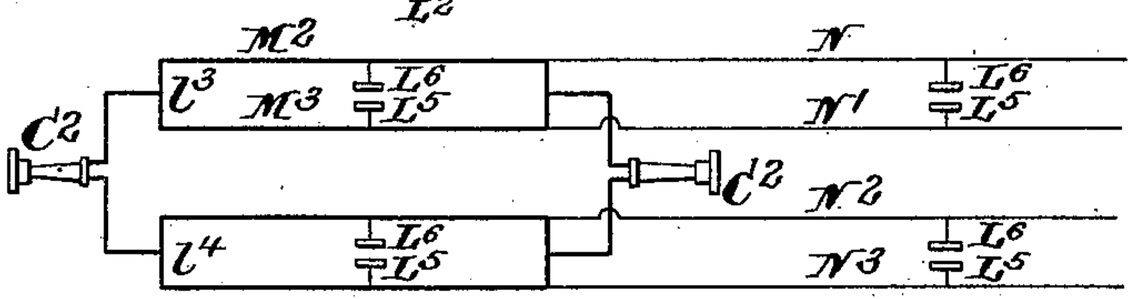
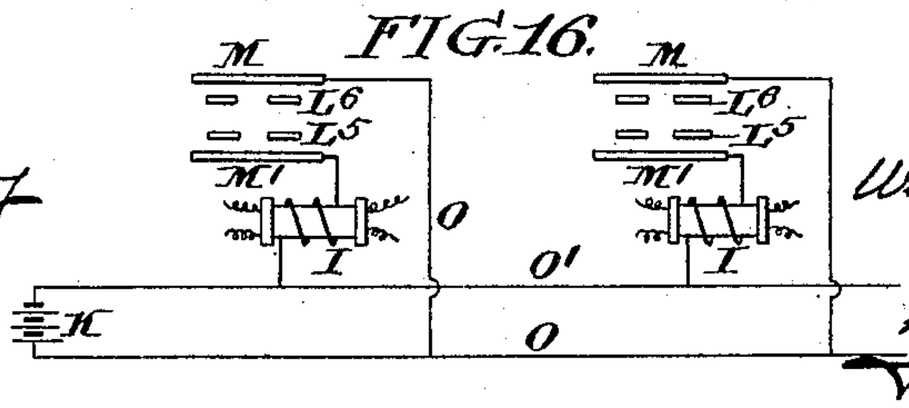


FIG. 16.



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UNITED STATES PATENT OFFICE.

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INTERCOMMUNICATING-TELEPHONE SYSTEM AND APPARATUS.

SPECIFICATION forming part of Letters Patent No. 646,690, dated April 3, 1900.

Application filed April 1, 1898. Serial No. 676,041. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. GHARKY, a citizen of the United States of America, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Intercommunicating-Telephone Systems and Apparatus, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to intercommunicating-telephone systems which are known in the Patent Office classification as "house systems."

My invention has for its object the production of a system of this kind and of instruments therefor which shall give maximum efficiency in service, compactness in construction, secrecy in operation, and simplicity of parts.

In order to attain my objects I use the devices hereinafter described in detail and broadly as follows:

Supposing there are a number of stations connected together in accordance with my invention, a cable passes through all the stations, having for its entire length a twisted pair of insulated wires for each station and an extra pair carrying battery-current for calling purposes. At each station a metallic box or casing is provided, containing the entire mechanism required, except the receiver and the local talking-battery—that is, the transmitter, the induction-coil, the bell, the switch-hook, and a small push-button switchboard. The instrument shown in the accompanying drawings is adapted for use with ten stations and the outside dimensions are about three by four by eight inches. Compactness is thus fully attained. From each wire in the cable a tap is taken off at each station to an appropriate terminal. At each station are the usual line and local circuits, with connections for the call-bell, the transmitter, and receiver, controlled by a switch-hook in the usual manner. Each substation has two pairs of bus-bars, constituting part of the little switchboard. One pair of bus-bars is connected to the local circuits and also to the line-wires belonging to the particular station. Arranged to coöperate with these bus-bars are push-buttons carrying pairs of contact-springs, each pair corresponding to some other station and being connected to the taps from the wires belonging to that station. From this it is obvious that it is only necessary to operate any given push-button in order to connect the wires leading to the corresponding station to the local circuits through the bus-bars. The second pair of bus-bars are connected to the battery-wires in the cable. Thus if any push-button is depressed until its springs come in contact with the battery bus-bars obviously battery-current will immediately flow out over the corresponding line to ring the bell at the appropriate station.

Thus far I have described a simple system, using metallic circuits throughout, with induction-coils and local batteries, thus having a very high efficiency; but without the provision of some further device to prevent listening in the system would be open to a grave objection. Such provision I make as follows: Suppose station 3 has pushed in button No. 8. No. 8's wires are connected to No. 3's local circuits through his bus-bars and the conversation is over No. 8's metallic circuit. If secrecy is desired, No. 8 also depresses his No. 3 button, thus connecting No. 3's line-wires to his bus-bars. Each of the two then also depresses an additional button, which I call the "secrecy-switch." The effect of this at each station is to connect the local instruments in a bridge from the bus-bars in multiple to the individual line-wires in multiple. A complete circuit is thus formed between the two stations, having each side composed of the pair of wires belonging to one station. Conversation then may proceed without fear of interruption, for if any outsider should connect himself by the appropriate push-button at his station to one of the pairs thus in use he would hear nothing, as he would simply be bridged across two component elements of a single conductor.

Referring to the accompanying drawings, Figure 1 is a vertical sectional view of the shell or case at one station, with its contained apparatus, taken on the line 1 1 of Fig. 2. Fig. 2 is a rear view of the same. Fig. 3 is a horizontal sectional view on the line 2 2 of

Fig. 1. Fig. 4 is a plan view of one of the blocks for the push-buttons with its connected apparatus. Fig. 5 is a perspective view of said block. Fig. 6 is a combination view showing a section of the block on the line 4 4 of Fig. 4 and a diagram of the local-station circuits. Fig. 7 is a perspective view of one push-button of the ordinary type, and Fig. 8 is a section through the secrecy-button. Fig. 9 is a diagram of the circuit of one station, showing its connections to other stations. Figs. 10 and 11 are diagrams of several circuits with their station connections. Figs. 12, 13, 14, and 15 are diagrams illustrating the connections for secrecy. Fig. 16 is a partial diagram of two stations, showing the method of connecting the battery to the calling bus-bars with a turn around the induction-coil.

I shall first describe the mechanical construction of my station apparatus; second, the circuits under various conditions, and, third, the operation of the whole.

Referring to Fig. 1, A is a shell or casing of substantially-rectangular shape and of a sufficient depth to accommodate the apparatus to be described. In the face of this casing, which is preferably of metal, I form two openings a and a'. In the lower one, a, I fit a transmitter having a flange C, which overlies the edge of the opening and which has the usual mouthpiece C'. In the upper opening a' I fit a block or blocks G and G', of insulating material, secured to the casing, as shown in Fig. 3, by side screws.

Back of the transmitter a vertical panel B, of insulating material, is provided, which serves to support the induction-coil I, the terminals of the wires coming into the instrument (shown at N' N^2, &c., in Fig. 2) and the springs L, L', and L^2 of the local circuit. In the chamber formed between the panel B and the transmitter the station call-bell is placed, together with the induction-coil, the former being shown at J in Fig. 1 and the latter at I.

Journaled within a boss D on the side of the shell A is a spindle D', carrying upon its outer end the hook-lever D^2 and upon its inner end an oppositely-extending arm D^3, thus constituting a lever of the first order. Upon the arm D^3 a transverse pin D^4 is mounted, which as it moves up and down with the hook-lever makes contact with either the springs L L' or the spring L^2. In Fig. 6 the connections of these springs are clearly shown, the spring L^2 constituting the terminal of the circuit P' of the circuit-bell J and the springs L and L' constituting the terminals for the primary P^4 P^3 and the secondary P^2 P^3. It will be understood that the weight of the receiver (shown in dotted lines at C^2 in Figs. 1 and 2) moves the switch-lever in one direction and a spring Q in the other.

By referring to Fig. 2 it will be observed that there is a terminal on the panel B for every wire, and from these terminals, constituting distributing-terminals, short jumper-wires are led up to the appropriate connections in the switchboard at the top of the casing. This switchboard consists, essentially, of a series of push-buttons for the purpose of making connections, together with detents controlled by the switch-hook, and serving to retain the buttons depressed as long as the receiver is off the hook.

In Fig. 5, G is a block of insulating material having depressions G^4 and G^5, rearwardly-extending projections G^6, and perforations G^3 in alinement with the depressions G^4. Each push-button has a spindle H', extending through one of the perforations G^3, and a head H. Within the block the perforations G^3 are enlarged, as at G^2, to a diameter sufficient to receive the head H and a spring H^3, which tends to keep the head projected forward. At the rear of the block G each spindle H' carries a cross-head H^2, which is adapted to work back and forth between two of the projections G^6 and which carries parallel contact-springs L^5 and L^6, which extend forward on opposite sides of the block and lie within the depressions G^4. Each cross-head carries a pin h^2, which when the push-button has been depressed engages with a hooked detent E^3 E^4, &c. These detents are in the form of small hooked pawls, carried upon and rigid with transverse pivoted shafts E^5 E^6. The pawls are all connected and controlled through a pivoted lever E, having arms E' and E^2, the arm E being connected to the switch-arm D^3 by a link D^6, whose lower end is slotted at d^6 to receive a pin D^5, sufficient lost motion being thus provided to allow a push-button to lift a pawl and be caught without moving the switch-hook.

Lying within the depressions G^5 of the block G and overlying all of the springs L^5 L^6, &c., are bus-bars M M' M^2 M^3. Two of these bus-bars M and M' are terminals of a calling battery-circuit. The other two, M^2 and M^3, are terminals of the local-station circuits. It will be observed upon reference to Fig. 1 that when a push-button H is depressed the springs L^5 L^6 will first come into contact with the bars M^2 M^3 and at the same instant will be latched. The effect of this is to connect the line-wires leading to the springs to the bus-bars and through them to the local circuits. If the button be further depressed, the springs will leave the bars M^3 M^3 and come into contact with the second pair, M M', connected to the battery-circuit, thus connecting the line-wires to battery.

Lying in rear of the blocks G G' are insulating-blocks F F', upon which are secured springs L^3 L^4, &c., which extend forwardly and rest upon the push-button springs. These springs L^3 L^4, &c., being directly connected by the jumper-wires to the terminals on the distributing-board, as clearly shown in Fig. 2, serve to connect the individual line-circuits each to its proper pair of push-button springs L^5 L^6. Moreover, a sliding contact is provided between the springs which is kept

clean by the movements of the respective buttons.

The secrecy-switch is shown as to its mechanism in Figs. 4 and 8. It consists of a push-button in every respect similar to the rest of the set. It will be observed that taking out this secrecy push-button there are only nine buttons left for the ten lines. This is, however, all that is necessary, because at each station it is only the other stations that are represented by buttons, the local and outgoing home line-circuits being connected to the bus-bars M^2 M^3. In Fig. 4 it will be observed that the ends of the bus-bars M M^2 are separate insulated portions m m^2. Beneath the block G' the other pair of bus-bars have similar insulated end portions. In Fig. 8 it will be observed that the push-button springs l^5 l^6 are somewhat shorter than the corresponding springs of the other buttons and normally rest upon the short insulated ends m^2 m^3 of the bus-bars. When the push-button h is depressed and retained by the detent e^4, these springs will pass into contact with the short insulated pieces m m'. The springs l^3 l^4 are the terminal springs for this button.

Turning now to the circuit connections, Fig. 9 shows the circuit of one station extending to two other stations. The conductors N N' are bridged by the telephone set through the hook D^3 and pass through the cable in a twisted condition, as indicated at n. At each of the other stations multiple taps from the conductors N N' are connected to the contacts L^6 L^5, which are the springs of the individual push-buttons belonging to the circuit at those stations.

Fig. 10 shows two stations, one of which is calling the other. The station at the left has conductors N^2 N^3, bridged by its telephone set and extending to the push-button springs L^6 L^5 at the other station. The station at the right, which is being called, has its hook down and the bell J bridged across its line-wires N N', which extend to push-button springs at the left-hand station. The battery K is connected through conductors O O' to the proper bus-bars M M' at both stations. Supposing that the left-hand station in this figure is calling the right-hand station, he has depressed the proper button until the springs L^6 and L^5 come into contact with the bus-bars M M', when current will immediately pass from battery K to bar M, to spring L^6, to conductor N, to bell J, to contact L^2, to hook D^3 by conductor N', to spring L^5, to bar M', and back to battery. Before the calling-station has produced this condition, however, he first partially depresses the push-button H to connect the springs L^6 L^5 with the bus-bars M^2 and M^3, whereby he was enabled to listen in across the wires N N' to determine whether the other station was busy. Fig. 11 shows more clearly the conditions which permit this. In this figure it will be observed that each station has its telephone C^2 connected across the bus-bars to which its line-wires are joined.

Now suppose that the two right-hand stations are conversing over the conductors N N' belonging to one of them. Suppose the extreme left-hand station desires to converse with the extreme right-hand. The springs L^6 L^5 are first pushed into contact with the bus-bars M^2 M^3, which obviously bridges telephone C^2 across the conductors N N'. The conversation going on can then be heard, showing the lines to be busy. Suppose, however, that the left-hand station had desired to converse with station No. 3. He connects conductors N^2 N^3 by the appropriate push-button to his bus-bars, when again he will be placed, through the bus-bars at the other station, in shunt of the connected telephones on circuit N N'.

Referring now to the connections of the secrecy-switch, Fig. 14 shows in its simplest form the circuit between a calling and a called station when the secrecy-button has been depressed. In this figure, N N' are the line conductors belonging to one station and terminating in its bus-bars, and N^2 N^3 are those of the other station. It will be observed that the telephones C^2 are so connected as to utilize each of the pairs in parallel as a single conductor. Now if any other station should attempt to connect springs L^6 L^5 to its bus-bars, thereby bridging its telephone across the pair N N' or N^2 N^3, nothing would be heard, for the reason that each of these pairs is but a single conductor in the secret circuit and both of its constituent wires are always at the same potential. In order that the calling-station may be apprised of the condition of affairs, I adopt the busy test. (Shown in Fig. 16.) The battery-wire O' before being connected to the bus-bar M' is given a few turns about the induction-coil I. Now if a substation operator should connect springs L^5 L^6 to the bus-bars M M' for the purpose of calling and a dead short circuit should be in existence on the individual pair, as shown in Fig. 14, there would be a sudden rush of current from the battery through the wires O O' and the branch around the induction-coil, which would produce a loud click in the local receiver, thus announcing "line is busy." Moreover, this induction-coil connection is useful in ordinary calling, as the making and breaking of the circuit by the vibrating bell at the distant station causes a humming or buzzing noise in the receiver, which announces that the call is being received. This operation depends entirely upon the capacity of the lines and cables and not upon the continuity of the receiver-circuit. The sudden rush of current in the case of a short circuit by the secrecy-switches or the rapid makes and breaks when the distant bell is in circuit cause the charging of the receiver-circuit, even though one end of it be open, sufficiently to produce the noises referred to.

Referring now to Fig. 15, it should be observed that the line-wires N and N' are connected through the short insulated pieces m and m^2 to the bus-bars M^2 M^3, the telephones

C′ C² and the bell J being alternately bridged through the action of the switch-hook D³. When the secrecy-switch is depressed, however, the circuit from m^2 is adapted to be broken, as shown in dotted lines at l^4 and connected to m, while the circuit from bus-bar M² is adapted in the same way to be connected at l^3 to the bus-bar M³. The actual details of the connections are more clearly shown in Figs. 12 and 13, the former giving the conditions before and the latter after the secrecy-switch has been pushed in. In Fig. 12, it will be observed, the wire N is connected with both contacts m and m^3 and also with the telephone C². Conductor N′ is connected direct to the spring l^6, normally resting in contact with the contact m^2, connected to the bus-bar M². The spring l^5, normally resting in contact with the terminal m^3, is connected with the bus-bar M³. It will thus be apparent that with the receiver off the hook the telephone set is bridged across the two conductors N N′ and will be in metallic circuit with any one who at another station may connect those conductors to his bus-bars or with any other line whose springs L⁵ L⁶ may be connected with the home bus-bars. In Fig. 13 the conditions are shown which exist at each station after the secrecy-switch h has been pushed in. The spring l^6 has left the contact-terminal m^2, thereby being disconnected from the bus-bar M², and is in contact with the terminal m, thus crossing the conductors N N′ together and joining them both through the branch from N to the telephone C². The spring l^5 has left the contact m^3, thereby disconnecting conductor N from the bus-bar M³, and has completed the connection from the latter to the contact m'. A circuit may now be traced from conductors N N′ in parallel through the branch from N to the telephone C², through the induction-coil I, and the switch-hook D³ in one direction to the bus-bar M² direct and in the other through the contact m' and the spring l^5 to the bus-bar M³, the bus-bars thus being in parallel, thence, as shown, to springs L⁵ L⁶ in parallel and out to the other station whose button is depressed, where the conditions are supposed to be identical with those here described. The circuit shown in Fig. 14 is thus established.

Although I have described specific devices and have used specific terms for the sake of clearness, I wish it to be distinctly understood that I do not consider my invention as limited to the specific forms of apparatus or the specific circuit connections shown. I believe I am the first to employ metallic circuits in the manner described and for the purpose indicated.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an intercommunicating-telephone system having a series of stations, a metallic circuit for each station said circuit connecting with each other station, a battery and a metallic circuit from the battery, connected with each station; a pair or pairs of terminals, as M M′, in each station connected with the battery-circuit, in combination with a series of pairs of terminals, as L³ L⁴, one pair connected in each station with each other station-circuit, a pair or pairs of terminals, as M² M³, in each station each connected with the talking and ringing circuit of the home station, and with the circuit leading from the home station to each other station, spring-actuated switching mechanism normally held to sever connection between the terminals aforesaid but adapted to couple the terminals M M′ and L⁴ L³ and, alternatively, the terminals M² M³ and L⁴ L³ as specified and so as to connect the selected station-circuit alternately with battery and with the home talking-circuit, catches arranged to hold the switches in position to maintain the latter connection, and a common switch-releasing device whereby all switches of the series will be returned to normal position.

2. In an intercommunicating-telephone system having a series of stations and metallic circuits for each station connecting with all the other stations of the series, the combination at each station of a local primary-circuit and secondary-circuit connection, said secondary-circuit connection normally connecting in series with the metallic circuit peculiar to its station, means for coupling in series the said metallic circuit with each of the metallic circuits peculiar to the other stations, and means as described at each station whereby two coupled stations can shift the local secondary-circuit connection onto the metallic circuit-wires peculiar to the station joined in parallel as one wire, and connect these doubled metallic circuits in series at both coupled stations through the said local secondary-circuit connections, whereby listening in from a third station is prevented.

3. In an intercommunicating-telephone system having a series of stations and metallic circuits for each station connecting with all the other stations of the series, the combination at each station of a local primary-circuit and secondary-circuit connection, said secondary-circuit connection normally connecting in series with the metallic circuit peculiar to its station, means for coupling in series the said metallic circuit with each of the metallic circuits peculiar to the other stations, means as described at each station whereby two coupled stations can shift the local secondary-circuit connection onto the metallic circuit-wires peculiar to the station joined in parallel as one wire and connect these doubled metallic circuits in series at both coupled stations through the said local secondary-circuit connections, a ringing battery or batteries, a metallic circuit or circuits leading therefrom and connected with terminals in each station,

said battery circuit or circuits making several turns around the induction-coil of the station's local circuit, and means at each station for connecting said battery-terminals in series with the terminals of the metallic circuits of the other stations, all substantially as described, and so that listening in can be prevented but a signal given to the calling station of the condition of the called circuit.

4. In an intercommunicating-telephone call-box, one or more terminals connected to a ringing-circuit, and one or more terminals connected with the local circuit and with the line wire or wires peculiar to the box, in combination with a series of terminals connected one with each line wire or wires of connected stations and arranged when moved relatively to the other terminals to alternatively connect these wires with a local-circuit terminal and with a ringing-circuit terminal, springs to return said movable terminals to non-contacting position, and latches to hold them in position of contact with the local-circuit terminals, only.

5. In an intercommunicating-telephone call-box; one or more terminals connected to a ringing-circuit, and one or more terminals connected with the local circuit and with the line wire or wires peculiar to the box, in combination with a series of terminals connected one with each line wire or wires of connected stations and arranged when moved relatively to the other terminals to alternately connect these wires with a local-circuit terminal and with a ringing-circuit terminal, springs to return said movable terminals to non-contacting position, latches to hold them in position of contact with the local-circuit terminals, and latch-releasing mechanism acting on all latches at once to insure return of all movable terminals to non-contacting position.

6. In an intercommunicating-telephone box the combination, with bus-bars, as M and M^2, connecting respectively with a battery-circuit and with the local telephone-circuit, of a series of sliding springs, as L^6, each connecting with a line-wire leading to the box, a push-button, as H, connected to the spring, return-springs, as H^3, and latches, as E^4, arranged to hold the sliding springs in contact with the bus M^2, all substantially as specified.

7. In an intercommunicating-telephone box the combination with the bus-bars, as M and M^2, connecting respectively with a ringing-circuit and with the local telephone-circuit, of a series of sliding springs, as L^6, each connecting with a line-wire leading to the box, a push-button, as H, connected to each spring, return-springs, as H^3, latches, as E^4, arranged to hold the sliding springs in contact with the bus M^2 and latch-releasing mechanism controlled by the position of the telephone-hook, all substantially as specified.

8. In an intercommunicating-telephone box having provision for metallic circuits connecting it with similar boxes, the combination with terminals, as M^2 M^3, normally connected in series with the wires forming the metallic circuit peculiar to the box, means for coupling the circuit-wires in parallel as one wire, a local telephone-circuit normally bridged across and in series with the line-wires but arranged when said wires are coupled in parallel as one wire to be connected from them to both terminals M^2 M^3 in parallel as one and means for coupling said terminals with the line-wires of other stations, substantially as specified.

9. An intercommunicating-telephone-box casing having an opening *a* in its face and a transmitter inserted therein, a second opening *a'* and blocks as G and G' inserted therein, push-buttons, and stems therefor, carrying contacts, working in said blocks, and bus-bars for local circuits supported on the blocks in proximity to said contacts.

10. In combination with an intercommunicating telephone, line-terminal springs having forwardly-extending arms as L^4, with moving spring-switches as L^6 with which the said arms of the terminal springs maintain constant sliding contact, one or more bus-bar terminals as M M^2, with which the moving switch-springs are adapted to come in contact, and means to maintain them in such contact.

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Witnesses:
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