S. B. FOWLER.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED MAY 27, 1907.

959,498.

Patented May 31, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

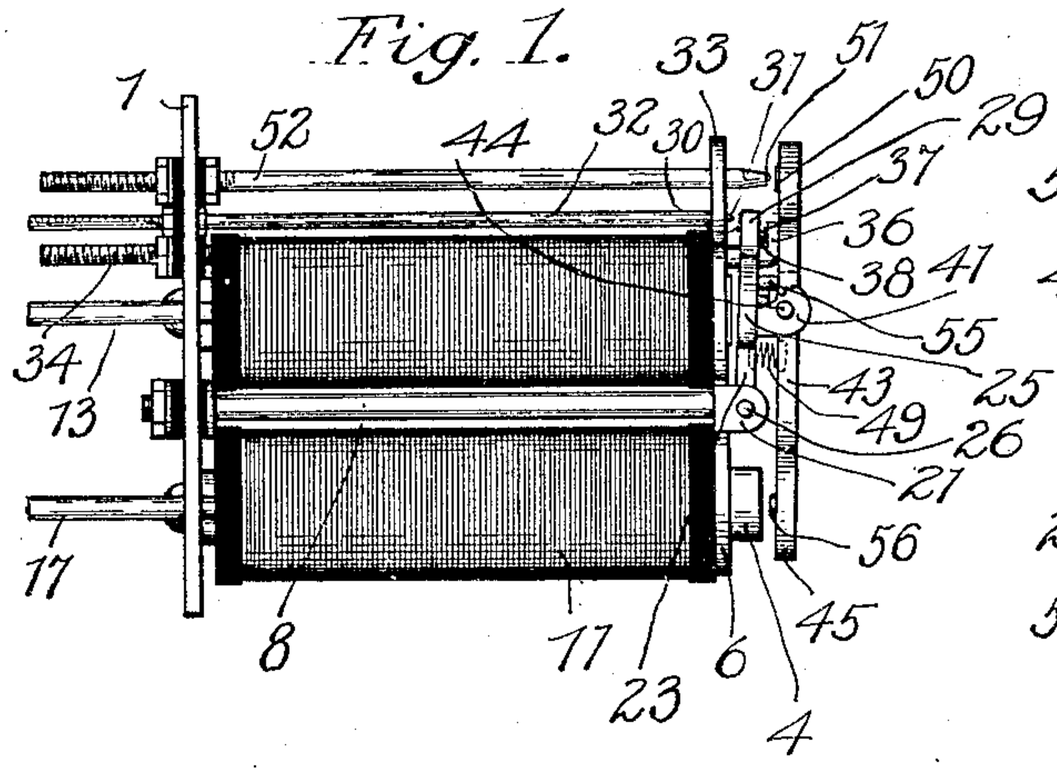


Fig. 3.

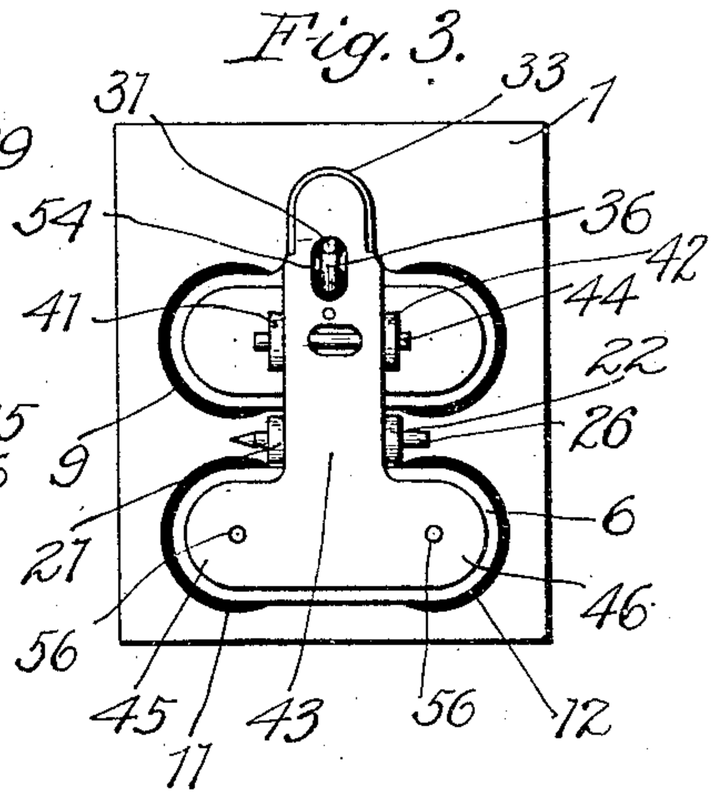


Fig. 2.

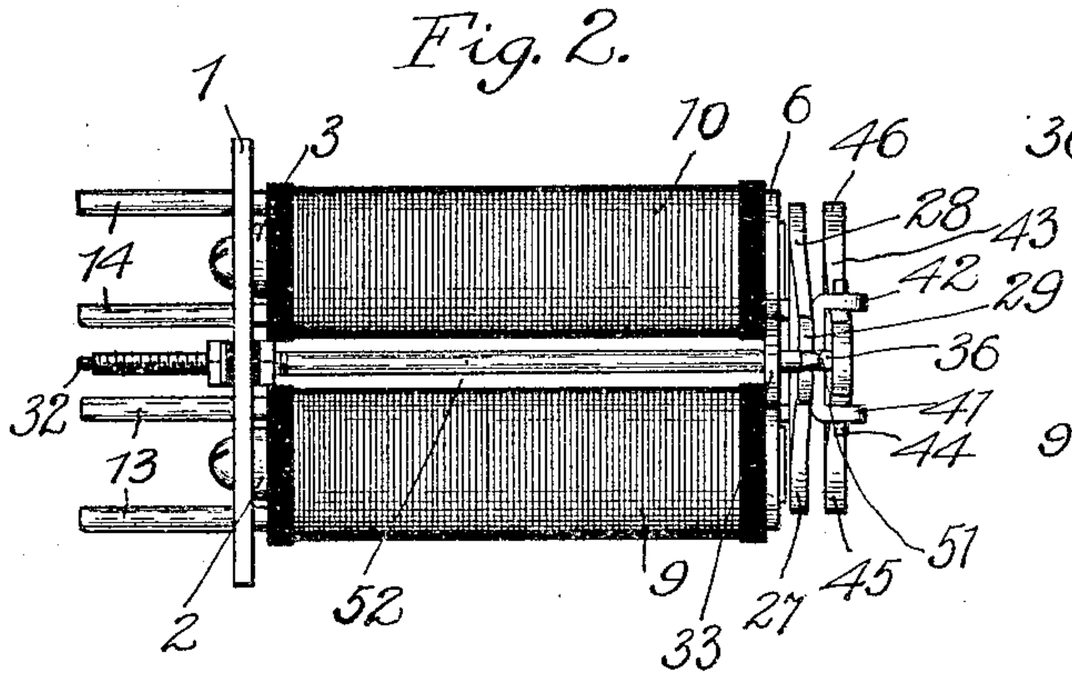


Fig. 5.

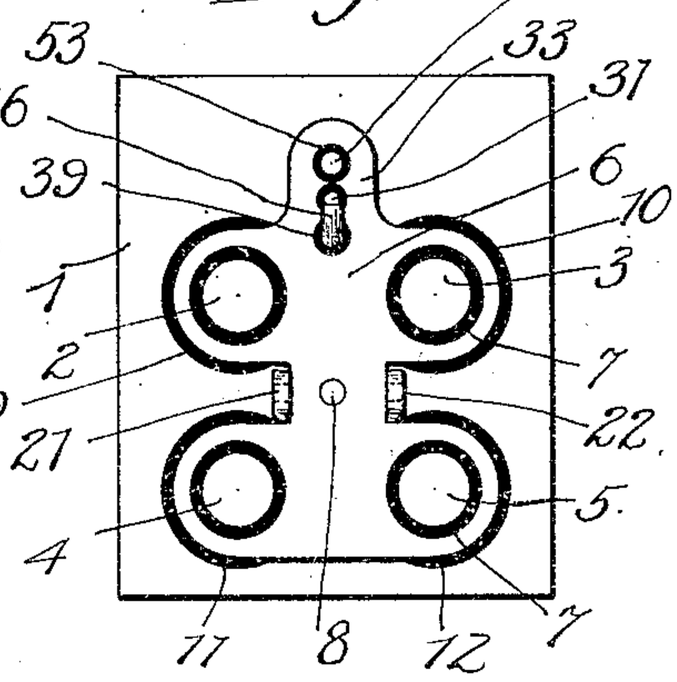


Fig. 4.

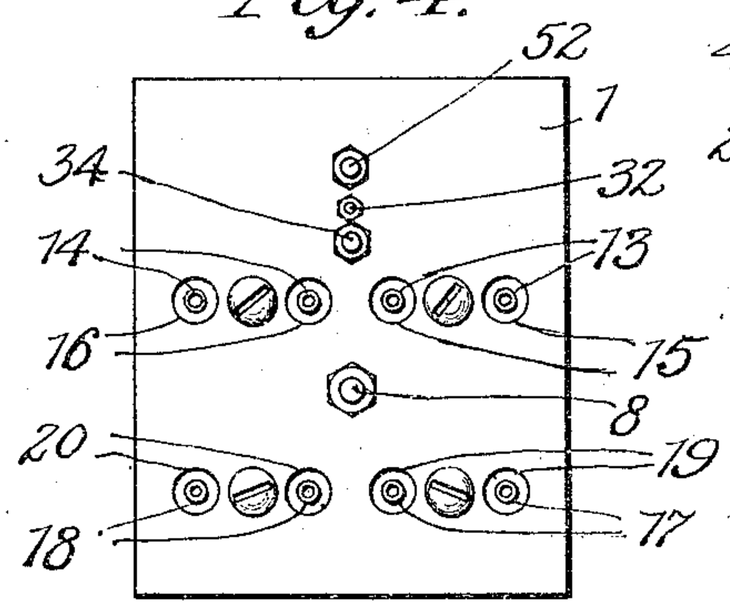


Fig. 6.

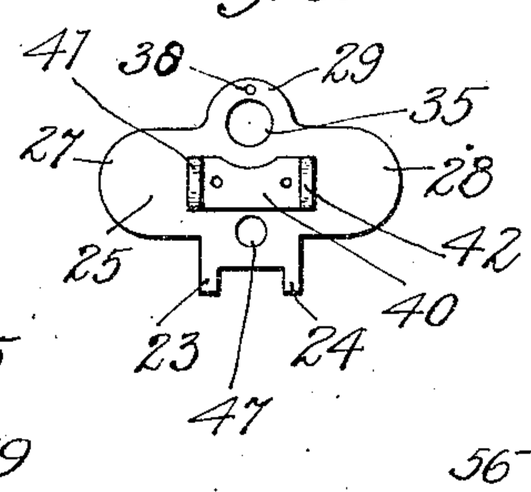
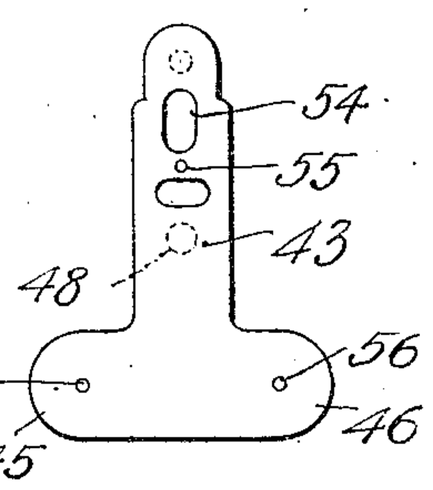


Fig. 7.



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2 SHEETS—SHEET 2.

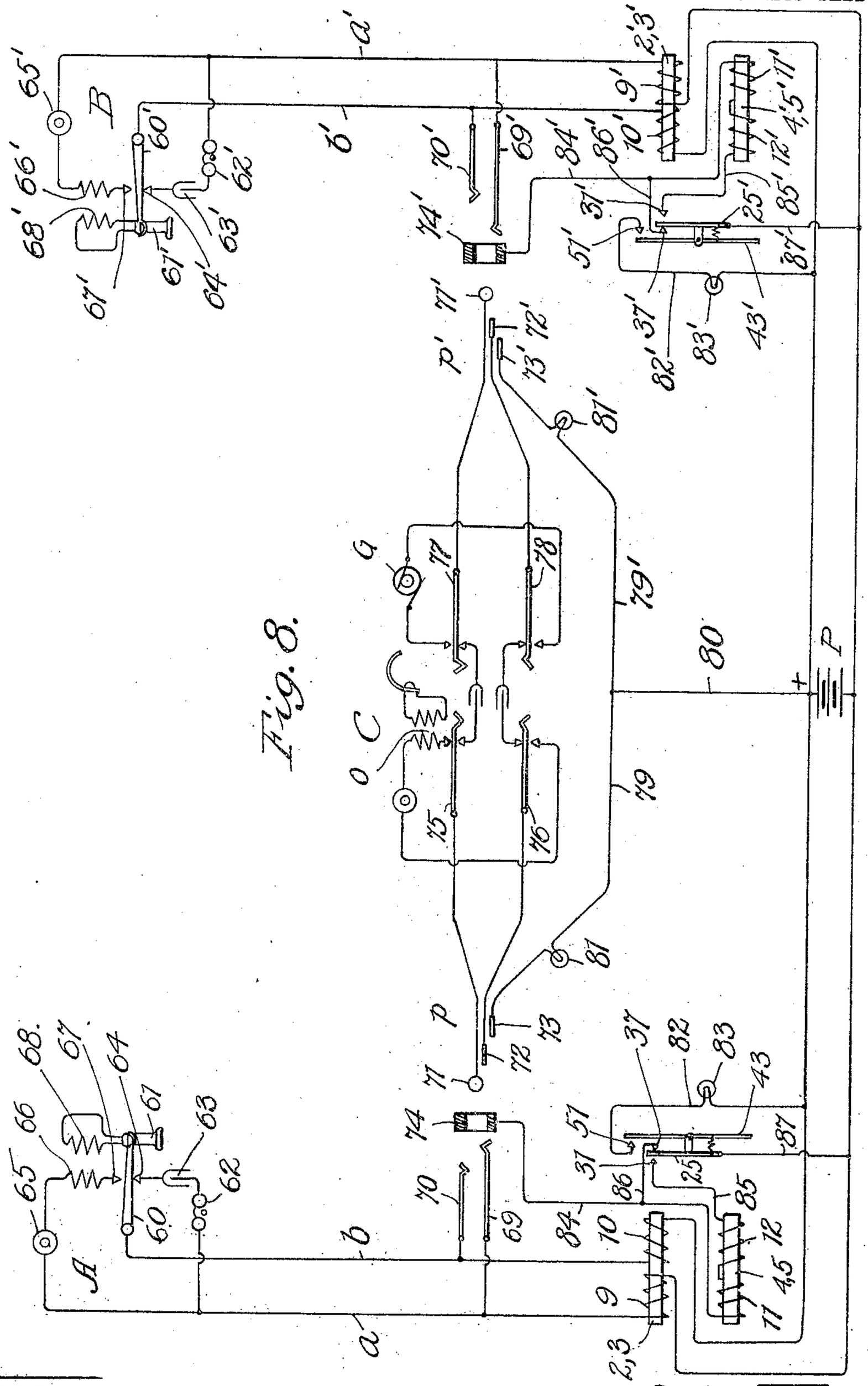

Fig. 8.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

959,498. Specification of Letters Patent. **Patented May 31, 1910.**

Application filed May 27, 1907. Serial No. 375,811.

To all whom it may concern:

Be it known that I, SAMUEL B. FOWLER, citizen of the United States, residing at La Fayette, in the county of Tippecanoe and State of Indiana, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone exchange systems, its object being to provide more simplified and more efficient arrangement and operation of the line and supervisory signals.

For the purposes of my invention I preferably combine the line and cut-off relay mechanism in a unitary structure so that their armatures may control the line and supervisory signals, this arrangement greatly simplifying the central exchange arrangement, as well as reducing the cost of central station equipment.

On the accompanying drawings I have shown relay mechanism which I employ, and, diagrammatically, the circuit arrangement for the telephone system.

In detail Figure 1 is a side elevation view of the relay mechanism; Fig. 2 is a top view thereof; Fig. 3 is a front end view thereof; Fig. 4 is a rear view; Fig. 5 is a front end view with the armatures removed; Fig. 6 is a front view of one of the armatures; Fig. 7 is a front view of the other armature, and Fig. 8 diagrammatically represents a telephone exchange system.

Extending from a magnetic supporting plate 1 are the cores 2, 3 and the cores 4, 5, the cores 2 and 3 lying in one horizontal plane and the cores 4 and 5 in another horizontal plane. A supporting frame or plate 6, preferably of non-magnetic material, engages and supports the front ends of the cores but being insulated therefrom by insulating bushings 7. A tie rod 8 extends between the supporting plate 1 and the front plate 6, as is shown, this arrangement forming a rigid structure. On the cores 2 and 3 are the energizing coils 9 and 10, respectively, and on the cores 4 and 5 are mounted the energizing coils 11 and 12, respectively. From the coils 9 and 10 extend contact pins 13 and 14, respectively, through the openings 15 and 16, respectively, in the supporting plate 1, which openings are of sufficiently larger diameter than the pins to prevent contact of the pins with the plate 1. In a similar manner contact pins 17 and 18 extend from coils 11 and 12, respectively, through the openings 19 and 20 in the plate 1.

Extending forwardly from the front plate 6 between the upper and lower core ends are the bearing lugs 21 and 22 to which are pivoted the ends 23, 24 of the armature 25, by means of a common pin 26. This armature is T-shaped, its ends 27 and 28 being opposite the ends of cores 2 and 3, so that upon magnetization of these cores the armature will be rocked in its pivot and its upper end drawn to the cores. The armature has the upward extension 29 which carries a platinum contact plate 30 adapted, when the armature is attracted, to engage the contact point 31 at the end of contact rod 32 supported from the plate 1 and extending forwardly through the upward extension 33 on the front plate 6, this rod 32, however, being insulated from the plates 1 and 6 but extending beyond plate 1 to form a contact terminal for engagement with conductors. Also supported from the plate 1 is a conductor bar 34 which extends forwardly through the front plate 6 and through an opening 35 in the armature 25, the end 36 being turned upwardly and carrying a platinum contact plate 37 for engaging in the platinum contact point 38 on the armature when the armature is in its normal unattracted position. This bar 34, however, is insulated from plate 6 by the insulating washer 39. Secured to the front end of armature 25 is the bearing frame 40 having the bearing lugs 41, 42 between which is pivoted the armature 43 by means of a pin 44 passing through the armature and lugs as shown. This armature 43 has the shape of an inverted T, the lower extensions 45 and 46 being disposed opposite the ends of cores 4 and 5, so that upon energization of the lower coils the armature will be swung about the pivot pin 44 and toward the cores 4 and 5. In armature 25 is a pocket 47 and opposite in armature 43 is a pocket 48, which pockets serve to support a compression spring 49 inserted between the armatures, so that normally the lower end of armature 43 will be held away from the cores 4 and 5. Armature 25 will be held away from the upper cores 2 and 3 by gravity, the center of gravity of the united armatures being in

front of the pivot pin 26. The upper end of armature 43 carries a platinum contact plate 50 for engaging the contact point 51 at the end of conductor rod 52 supported from the rear plate 1 and extending forwardly through the front plate 6 but insulated from the front plate by the washer 53 and also suitably insulated from the rear plate 1, the end extending beyond plate 1 for connection with suitable circuits. In the upper end of this armature 43 there is also an opening 54 for receiving the contact end 36. A stop 55 also extends from the armature below the opening 54 engaging the armature 25 to limit the movement of armature 43. Non-magnetic stops 56 also extend from the lower end of armature 43 to prevent sticking of the armature to the cores.

The armatures are normally in the position best shown in Fig. 1, the contact plate 50 at the end of armature 43 is disengaged from contact point 51 and the lower end of this armature is away from the core ends 4 and 5. Armature 25 is away from cores 2 and 3 and its contact 38 engages contact 37 on the end 36 of rod 34.

In practice, as will be shown later, the upper coils 9 and 10 are connected with the line circuit, while the lower coils are connected with local circuits. The upper coils are, therefore, energized first and armature 25 is attracted to break engagement between contacts 38 and 37 and to establish contact between contact plate 30 and contact point 31. Armature 43 is carried with armature 25 and its contact plate 50 comes into engagement with contact point 51. When the lower cores now become energized, armature 43 will be attracted and contact between plate 50 and point 51 will again be broken.

In Fig. 8 I have diagrammatically shown a telephone exchange system, showing a central exchange C adapted for connection with substations A and B. Each substation is provided in the usual manner with a switchhook 60 for supporting a receiver 61, and a signal bell 62 is shown as normally connected in series with a condenser 63 between the line limb *a* and contact 64 normally engaged by the switchhook. A transmitter 65 is also shown included in line limb *a* together with the primary winding 66 of the induction coil, this line limb *a* terminating in alternate contact 67 to be engaged by the switchhook upon removal of the receiver therefrom. The receiver is connected in circuit with the secondary winding 68 and the switchhook is connected with line limb *b*. Line limb *a* serially includes a winding, which may be winding 9 of the relay just described, and terminates at the negative pole of the central station battery P. Line limb *b* includes a winding, which may be winding 10 of the relay, and terminates at the positive pole of the central station battery. These windings 9 and 10 are connected in circuit to be cumulative in their effect. The cores 2 and 3 are diagrammatically shown as a common core, but the operation thereof is understood. The cores 4 and 5 are also diagrammatically shown as a common core which carry the windings 11 and 12, which are cumulative in their effect. The armatures and contacts are given the same reference characters as in the detail views of the relay. Extending from line limbs *a* and *b* are the tip and sleeve jack springs 69 and 70 for engaging the tip and sleeve contacts 71 and 72 of the answering plug *p* of the cord circuit. A third contact 73 of this plug engages the jack thimble 74 when the plug is inserted. Plug contacts 71 and 72 terminate in key springs 75 and 76, respectively, normally connected with ringing key springs 77 and 78, which terminate in tip and sleeve contacts 71′ and 72′ of calling plug *p*′. Plug contact 73′ engages its thimble 74′ when the plug is inserted into jack springs 70′ and 69′.

The reference characters for the called side of the circuit are the same as those of the calling side except that they are primed.

Upon actuation of springs 75 and 76 the operator's telephone set O will be connected in circuit in a well-known manner, and upon actuation of springs 77 and 78 ringing generator G will be connected with the cord circuit in a well-known manner. Conductors 79 and 79′ connect, respectively, with plug contacts 73 and 73′ and are connected together at their other terminal and through conductor 80 with positive terminal of battery P. Included in conductor 79 is the supervisory lamp 81, and in conductor 79′ is supervisory lamp 81′. A conductor 82 connects contact 51 of the relay with the positive bus bar of the battery and includes the line lamp 83. One terminal of windings 11 and 12 connects through conductor 84 with thimble 74, and the other terminal connects through conductor 85 with contact 31 of the relay. Contact 37 of the relay also connects through conductor 86 with conductor 84 and with the jack thimble 74.

The operation of the system can now readily be followed. Suppose subscriber at substation A desires communication with subscriber at substation B. He removes his receiver from the hook and closes circuit through the line limbs *a*, *b*, windings 9 and 10 of the line part of the relay and through the main battery P. Armature 25 is then attracted to break engagement with contact 37 and to establish engagement with contact 31 and armature 43 is also carried into electrical engagement with contact 51. Thus far the only circuit closed will be the circuit through the indicating lamp 83, traced from positive bus bar, through lamp 83, contact 51, armature 43, through the armature sup-

porting framework and through conductor 87 to negative bus bar, the line lamp then illuminating to indicate to the operator that substation A has called. The operator inserts answering plug *p* into the springjack and thereby connects the answering cord strands with line limbs *a* and *b* and battery, and upon actuation of springs 75 and 76 connects her telephone set in circuit and ascertains the desired connection which, as assumed, is with substation B. Upon insertion of the plug in the jack the following circuit is closed: from positive terminal of battery, through conductors 80 and 79, through supervisory lamp 81, plug contact 73, jack thimble 74, conductor 84, through windings 11 and 12, through armature contact 31, armature 25 and conductor 87 to the negative terminal of the battery, this causing attraction of armature 43, which thereby disconnects from contact 51, thus opening the circuit through the line lamp 83. Supervisory lamp 81, however, will not illuminate, for the reason that the resistance of windings 11, 12 is such as will prevent sufficient current flow to illuminate lamp 81. Thus far, then, both line and supervisory lamps are unilluminated. The operator inserts plug *p'* into the jack connected with substation B and thereby causes closure of the supervisory circuit through lamp 81' as follows: from positive pole of battery through conductors 80 and 79', through supervisory lamp 81', plug contact 73', thimble 74', conductor 84', conductor 86', armature 25' and conductor 87' to negative bus bar. When the signal bell at substation B is rung upon actuation of springs 77 and 78 by the operator and the subscriber in reply answers, circuit will be closed through relay windings 10', 11', and armature 25' attracted to break connection with its front contact 37' and into engagement with its rear contact 31'. The supervisory circuit is therefore broken and circuit closed through the relay windings 11', 12', whereupon armature 43' will be attracted and will prevent closure through and illumination of line lamp 83'. All lamps are now unilluminated and the subscribers in conversation with each other. As soon as they have finished they hang up their receivers, which results in opening of the circuit through the line relay windings and release of armatures 25 and 25'. The supervisory circuits through lamps 81 and 81' are closed to give the disconnect signal. Circuit being broken through the windings 11, 12 and 11', 12', upon restoration of armatures 25 and 25', armatures 43 and 43' are also restored. In response to the supervisory signals the operator withdraws the plugs from the jacks, thereby breaking the circuits through the supervisory lamps and restoring the entire system to normal. Thus, instead of employing a plurality of relay mechanisms for controlling the line and supervisory signals, a simple unitary relay structure is employed whose armatures control the line and supervisory signals.

The line signal circuit is controlled directly by the cut-off relay part armature, this armature being bodily carried by the line relay part armature to close circuit through the line lamp when the subscriber calls, and when the operator inserts the plug, circuit is closed through the cut-off relay part to attract its armature to again open the line signal circuit. The supervisory signal circuit is controlled by the armature of the line relay part. When the plug is inserted to answer a call, the line relay part armature is attracted to close part of the circuit for the windings of the cut-off relay part, so that when the operator plugs in this circuit will be completed and the line lamp extinguished. When the subscriber hangs up the receiver the line relay part armature closes the supervisory circuit. Armatures 25 act as a magnetic shield toward armatures 43 and so prevent armatures 43 from being influenced by the magnetism set up in the cores of the line relay part.

I do not wish to be limited to the construction and particular arrangement which I have herein shown, as changes may be made without departing from the scope of my invention, and I desire to secure by Letters Patent the following claims:

1. In a telephone exchange system, the combination of a central exchange and lines leading therefrom to substations, a line signal, a supervisory signal, line relay mechanism, cut-off relay mechanism, and armature mechanisms for the relay mechanisms cooperating mechanically to control the line and supervisory signals.

2. In a telephone exchange system, the combination of a central exchange, substations connected with the exchange through telephone lines, a cord circuit at the exchange for connecting subscribers, a line signal, a supervisory signal, and a compound relay mechanism for controlling the operation of said signals.

3. In a telephone exchange system, the combination of a central exchange, substations connected with the exchange through telephone lines, a line signal and a supervisory signal at the exchange, line relay mechanism and cut-off relay mechanism, an armature for the line relay mechanism and an armature for the cut-off relay mechanism, energization of the line relay mechanism causing movement of the cut-off relay mechanism armature to close the line signal circuit, energization of the cut-off relay mechanism causing movement of its armature to open the line signal circuit, the armature of the line relay mechanism controlling the supervisory signal circuit.

4. In a telephone exchange system, the combination of a central exchange, substations connected with the exchange through telephone lines, a line signal and a supervisory signal at the exchange, line relay mechanism and cut-off relay mechanism, an armature for the line relay mechanism and an armature for the cut-off relay mechanism, energization of the line relay mechanism causing movement of the cut-off relay mechanism armature to close the line signal circuit, energization of the cut-off relay mechanism causing movement of its armature to open the line signal circuit, the armature for the line relay mechanism when inert closing the supervisory signal circuit to cause illumination of the supervisory signal.

5. In a telephone exchange system, the combination of a central exchange, substations connected with the exchange through telephone lines, a cord circuit at the exchange for connecting with telephone lines, a line signal at the exchange, a supervisory signal at the exchange, a source of current at the exchange, line relay mechanism for each line controlled by the current flow therethrough, cut-off relay mechanism for each line, an armature for the line relay mechanism mechanically connected with the armature for the cut-off relay mechanism, energization of the line relay mechanism upon actuation of substation apparatus causing movement of the armatures, the movement of the cut-off relay mechanism armature causing closure of the line signal circuit, movement of the line relay mechanism armature and the connection of the cord circuit with the line causing closure of a circuit through the cut-off relay mechanism whereby its armature is attracted to open the line signal circuit, restoration of apparatus at the substation to its normal condition causing deënergization of the line relay mechanism to release its armature, and a supervisory circuit closed through the supervisory signal upon release of the line relay mechanism armature whereby the supervisory signal is actuated.

6. In a telephone exchange system, the combination of a central exchange, a substation connected with the exchange through a telephone line, a source of current at the exchange, electromagnetic mechanism at the exchange controlled by current flow through the telephone line, an armature for said electromagnetic mechanism, additional electromagnetic mechanism at the exchange whose circuit is controlled by the movements of said armature, an armature for the additional electromagnetic mechanism mechanically associated with the armature for the line electromagnetic mechanism, a line signal whose circuit is controlled directly by the movements of the armature for the additional electromagnetic mechanism, a supervisory signal whose circuit condition is controlled by the movements of the armature for the line electromagnetic mechanism, said armature in one position opening the supervisory signal circuit and when in its other position closing said circuit to cause operation of the supervisory signal.

7. In a telephone exchange system, the combination of a central exchange, a substation connected therewith through a telephone line, a cord circuit and a source of current at the exchange, electromagnetic mechanism at the exchange controlled by current flow through the telephone line, additional electromagnetic mechanism controlled locally at the exchange, an armature for the line electromagnetic mechanism, an armature for the additional electromagnetic mechanism, said second armature being pivoted to and carried by the first armature, a line signal at the exchange whose circuit is controlled by the movements of the second armature, current flow through the line electromagnetic mechanism causing attraction of the first armature to thereby move the second armature to close the line signal circuit, the first armature in its attracted position closing part of a circuit for the additional electromagnetic mechanism, connection of the cord circuit with the line causing final closure of the circuit for the additional electromagnetic mechanism whereby the second armature is attracted to open the line signal circuit, a supervisory signal at the exchange, and a supervisory circuit closed to cause operation of the supervisory signal upon connection of the cord circuit with the line and when the line electromagnetic mechanism is deënergized.

In witness whereof, I hereunto subscribe my name this 22nd day of May A. D., 1907.

SAMUEL B. FOWLER.

Witnesses:

W. R. COFFROTH,

A. K. KELLER.