No. 841,033. PATENTED JAN. 8, 1907.

F. J. & J. MERSMAN.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED APR. 14, 1906.

2 SHEETS—SHEET 1.

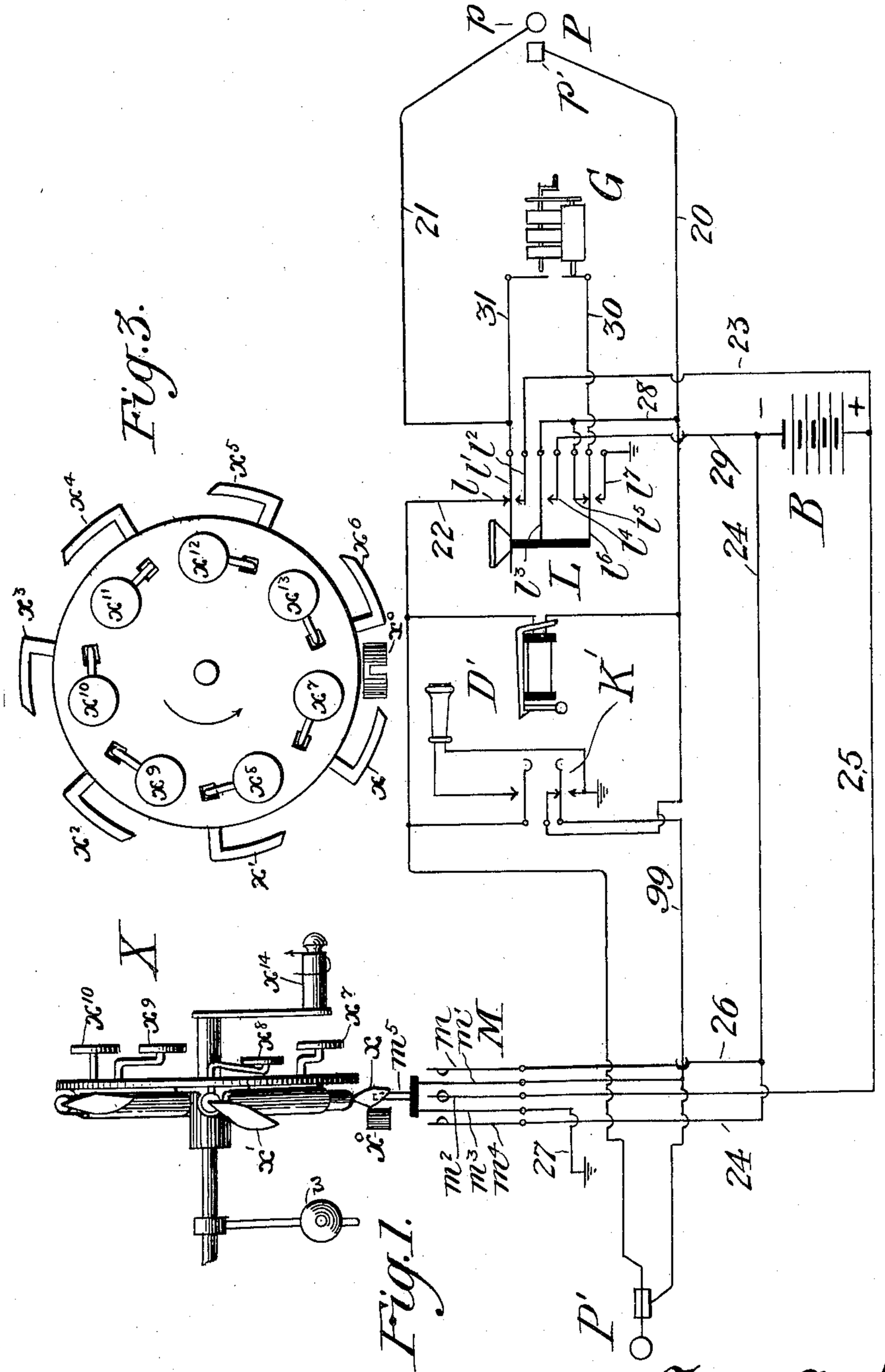

Fig. 3.

Fig. 1.

Witnesses
J. L. Wright
James A. Marr

Inventors
Frank J. Mersman,
Joseph Mersman.
By Edward E. Clement
Attorney

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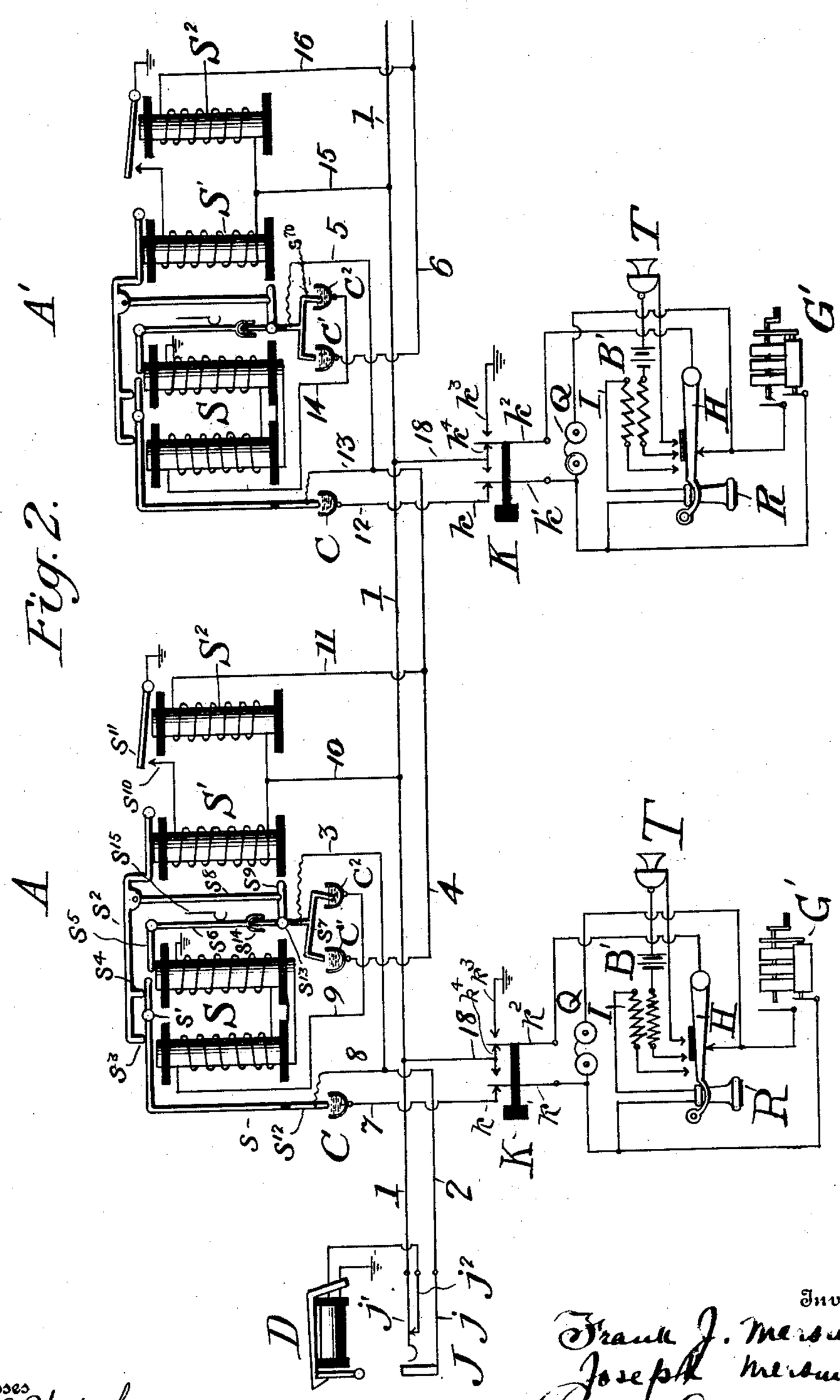
2 SHEETS—SHEET 2.

Fig. 2.



Witnesses
J. L. Wright
James A. Marr.

Inventors
Frank J. Mersman,
Joseph Mersman,
By Edward C. Clemens
Attorney

UNITED STATES PATENT OFFICE.

FRANK J. MERSMAN AND JOSEPH MERSMAN, OF OTTAWA, OHIO.

TELEPHONE-EXCHANGE SYSTEM.

No 841,033. Specification of Letters Patent. Patented Jan. 8, 1907.

Application filed April 14, 1906. Serial No. 311,734.

To all whom it may concern:

Be it known that we, FRANK J. MERSMAN and JOSEPH MERSMAN, citizens of the United States, residing at Ottawa, in the county of Putnam and State of Ohio, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to telephone-exchange systems, and has for its object the production of a selective party-line system wherein an operator at the central office may have entire control of the apparatus at any one of a number of stations on the same line.

We attain our object in the following manner: The telephone-line is a two-wire or metallic circuit-line continuous as to one side, over which any one of the subscribers can signal in to the central office, throwing the drop which is normally connected thereto and to ground, and discontinuous as to the other side at the first station, where we provide an arrangement of relays responding to impulses over the broken side of the line to extend the same from station to station until the desired station is reached, the telephone set at each station being cut out or cut in, according to the direction of current-flow, as determined by the operator.

The telephone sets we preferably employ are ordinary bridging magneto sets, each provided with a spring which normally keeps it connected across the line-wires for receiving calls, but which is adapted upon actuation to reverse the connection and ground one side of the telephone for signaling into the central office.

Our invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagrammatic representation of an operator's cord-circuit supplied with our calling device, a bridge clearing-out drop, and a hand-generator. Fig. 2 is a similar diagram complementary to Fig. 1, showing the line-circuit and two subscribers' stations thereon. Fig. 3 is a face view of the operator's signal device.

Before proceeding to a description of the circuits we will first point out the features of mechanical design in our operator's selector or signal device and in the substation-relays. Referring to Fig. 1, X is the selector which the operator uses when she wishes to call a party-line station. This comprises a disk of metal mounted upon a central spindle provided with an operating-crank carrying a handle x^{14}, by which the disk can be turned. Pivoted at intervals around the periphery of the disk and on the back thereof are the bent fingers x, x', x^2, x^3, x^4, x^5, and x^6, which are sufficient to call six stations on one line. The angular distances between the fingers are all equal, and each finger comprises a rocking shaft pivoted radially on the disk and carrying at its outer end a tangential or arc-shaped finger and at its inner end a bell-crank lever which projects up through an opening in the plate and after bending over receives upon its extremity a push-button. These push-buttons are marked x^7, x^8, x^9, x^{10}, x^{11}, x^{12}, and x^{13}, corresponding with the fingers x x', &c. The pivot of each finger-lever is so arranged that there is considerable friction and the fingers will stay in any position to which they are moved. The buttons when depressed rock the shafts, and thereby turn the fingers back away from the plate or disk. This will be understood by reference to the side view of the device X in Fig. 1, wherein the finger x is shown in its normal or forward position, while the finger x' has been rocked back by the operator depressing the button x^8.

The disk of the signal device normally stands in the position shown in Fig. 3, this being secured by means of a suitable notch in the periphery of the disk and a spring resting therein, or by means of a weight attached to the disk between the points x and x^6, or by attaching a weighted pendulum w to the spindle of the disk, as shown in Fig. 1. Associated with the disk and fingers is a pole-changing switch M, having intermediate springs m' and m^3, coöperating with the springs m, m^2, and m^4. The springs m' m^3 are connected together by an insulating-head-piece, upon which we provide a projecting stud m^5, which coöperates with the cam fingers or levers x x', &c. The arrangement is such that when the fingers are in their normal position, as shown in Fig. 1, they pass in front of the stud m^5 as the handle x^{14} is turned in the direction of the arrow in Fig. 3. When any button is depressed, however, its finger will be thrown back so as to pass behind the stud m^5 when it reaches the latter in the course of its rotation. Thus if any button is depressed corresponding to a station on the line and the handle is then turned through a complete revolution all the fingers up to the one whose button has

been depressed will pass in front of the stud m^5, the cam-face on each finger throwing the stud and its springs back, so that the springs m' m^3 will make contact for each such finger with the springs m^2 m^4. On the other hand, when that finger is reached whose button has been depressed it passes behind the stud and throws the same forwardly, so that the intermediate springs m' m^3 will make contact with the springs m m^2, respectively.

Referring now to the relays in Fig. 2, the specific mechanical design and finish of these instruments are non-essential, but their fitting and arrangement, as well as their connection in the circuits, are of the essence of our invention. There are three of these relays S, S′, and S^2 at each station. The first is constructed in the same manner as an ordinary polarized ringer, having a permanent magnet which polarizes the armature pivoted on a central point s' and provided with a long bent arm s, having a terminal insulated contact s^{12}. Coöperating with this contact is a mercury-cup C, forming the terminal of the wire 7, while the contact s^{12} forms the terminal of the wire 8. When current of one direction passes through the magnet of the relay S, it tilts the armature to throw down the arm s and plunge the contact s^{12} into the mercury-cup; but when current of the other direction passes through the magnet it tilts the armature in the reverse direction to withdraw the contact from the mercury. Associated with the same magnets is a bell-crank lever s^5, having its upper end or arm lying in contiguity to one pole of the magnet and its lower arm s^6 provided with a fork s^{14}, straddling the upper end of a lever pivoted at s^{13}. This lever has a forked lower end with its opposite points adapted to rock into the mercury-cups C′ and C^2, respectively, as the lever is tilted by the fork s^{14}. Contact-points are insulated from the body of the lever, and the latter is supplied with a laterally-projecting crank arm s^9, over which is suspended the pitman-rod s^8, pivoted at its upper end to the lever s^2 of the restoring-magnet S′. This lever has an extension over the armature of the magnet S, which is provided with two fingers s^3 and s^4 on opposite sides of the pivot s'. The relay S^2 is any ordinary type of relay and controls the circuit of the magnet S′.

It is of course well understood that when the armature of the polarized magnet is tilted in one direction or the other it will remain in the tilted position until the direction of current-flow in the magnet is reversed or until it is mechanically torn away from the pole to which it has been attracted. Hence in the present case when the armature s has been tilted to the left to close the circuit 7 8 it will remain so tilted until the magnet S′ is energized, when its armature s^2 will be drawn down, bringing the terminal fingers s^3 s^4 down upon the polarized armature and raising the same into a neutral position. In addition to this the tilting-lever s^7 is restored at the same time. This lever is thrown over by an impulse of current of either polarity through the magnet S, which attracts its arm s^5. When the magnet is inert, however, the spring s^{15} throws the lever s^6 to the left, and thereby tilts the lever s^7, so that its right-hand extremity leaves the mercury-cup C^2 and the left-hand extremity enters the cup C′. When the magnet S′ becomes energized, as already stated, it not only restores the lever s of the magnet S, but the pitman-rod s^8 comes down upon the crank-arm s^9 and throws the lever s^7 over, so that it again makes contact with the mercury in the cup C^2, and the lever s^6 is maintained pressed over to the right, although the magnet S be inert.

The diagrammatic connections will now be readily understood; but we will proceed to describe them. Referring to Fig. 1, P and P′ represent a pair of terminal plugs belonging to the operator's connective cord-circuit 20 21. The plug P′ is the answering-plug, and its companion is a calling-plug. The sleeve side of the cord is provided with a grounding-key K′, whereby the sleeve-conductor 99 of the plug P′ can be disconnected from the conductor 20 and grounded to enable the operator to converse with a calling subscriber. The operator's telephone is preferably connected in the ground-tap from the key. The pole-changer M has its springs m m^4 connected to the negative pole of the main battery B, the spring m^2 connected to the positive pole thereof, and the spring m^3 grounded. The spring m' is connected to the sleeve-conductor 99 of the cord-circuit. L is another key for the operator's use, which when depressed connects the main battery B across the calling end 20 21 of the cord and at the same time grounds one side of the generator G and connects the other through the wire 31 to the tip-conductor 21. This is for the purpose of restoring the subscribers' relays, as we will presently point out. Bridged across the cord-circuit is the clearing-out drop D′, which may also be in the ground-tap, if desired. Turning now to the subscribers' line, J is the terminal jack thereof, provided with the usual spring j', thimble-contact j, and anvil-spring j^2, the last-named being connected to the annunciator D, which is grounded on the other side. We have shown two subscribers' stations A and A′, each fitted with the relays already described and each also provided with a telephone-transmitter T, receiver R, switch-hook H, hand-generator G′, battery B′, ringer Q, and induction-coil I, all of the usual or any desired type. In addition to these the key K is used to move the terminal springs k' k^2 from their normal resting contacts k k^4 when it is de-

sired to call the central office. Upon such movement the spring k^2 comes into contact with the grounded terminal k^3, and its companion spring k' makes contact with the terminal k^4 of the wire 18, leaving its normal contact k. The switch controlled by the button K is thus a pole-changing switch itself. The terminal k is connected by wire 12 to the mercury-cup C, and the wire 18 passes to the continuous line-wire 1, which we should here state constitutes the tip side of the line. At each station this wire is connected, through the branch 10 or 15, to the magnet-windings S′ and S². The latter is bridged across the metallic circuit. This bridge at station A is marked10 11. At station A′ it is marked 15 16. When the magnet S² becomes energized, it closes the circuit of the magnet S′, which has a ground-tap from the wire 1.

The operation of our system will now be understood. We will assume that the operator desires to call station A, this being the first station on the line. The plug P is inserted in the jack J, the conductors 1 and 21 being thereby joined together, as well as the conductors 2 and 20. The operator then presses in the first button marked x^7, and the first finger x is thereby thrown back. She then grasps the handle x^{14} and turns it in a counter-clockwise direction, as shown by the arrow, through the whole revolution. The first finger x passes behind the stud m^5, forcing the same forward, grounding the spring m^2 and thence the positive side of the battery through the spring m^3 and connecting the negative side of battery to the sleeve conductor 20, and so through the line-wire 2 to the relay S by the following circuit: ground, 27, m^3, m^2, 25, B, 24, 26, m, m', 99, 20, p', j, 2, 3, s^7, C², 9, S, and ground. This pulsation of current is of the proper direction to cause the magnet S to tilt its armature down on the left, depressing arm s and plunging the terminal s^{12} into the mercury, completing the talking-circuit of the telephone set at the station A as follows: 20, p', j, 2, 8, s^{12}, C, 7, k, k', R, I, H, k^2, k^4, 18, 1, j', p, and 21. Of course either the operator can come in on this circuit or it will be continued through the cord to the plug P′, and so to the calling subscriber. In order to ring the subscriber thus selected, the generator G is operated, whereupon ringing-current passes out over conductors 21, 1, 2, and 20, the key L remaining closed. We may provide another key for opening the cord-circuit back when ringing forward, so as to prevent annoyance to the calling subscriber. It will be observed that while the first station A′ is thus called the line is not connected through to the second station, because the lever s^6 remains in the position shown, its arms s^5 sticking to the magnet-pole. This arm also may be polarized, if desired, but we have found it sufficient to have it touch the magnet-pole. We will now assume that the operator wishes the second station on the line. She sets the second button x^8, thereby moving back the second cam-finger x' instead of the first. The first finger x passes in front of the stud m^5 instead of behind it, and the latter being thereby moved back the negative side of the battery is grounded and positive current goes to line by the following circuit: ground, 27, n^3, m^4, 24, B, 25, m^2, m', 99, 20, p', j, 2, 3, s^7, C², 9, S, and ground. This current is of the wrong direction to close the circuit of the telephone set, since it tilts the armature in the other direction and lifts the arm s. If the arm s^5 is polarized, which we may make it, this current will cause it to be forced away from the magnet-pole, so as to tilt the lever s^7, and as the current is then cut off by the finger of the operator's signaling device passing off of the stud m^5 the arm s^5 at the substation will remain away from the pole of the magnet because of the spring s^5. This operation closes the following circuit to station A′, commencing with the jack J: 2, 3, s^7, C′, 4, 5, s^{70}, C², 14, S, and ground. The next finger of the operator's signal device x' passes behind the stud m^5, forcing the same forward and producing a pulse of negative current in the sleeve side 2 of the line, which passing over the circuit described will cause the magnet S at station A′ to tilt its armature down to the left and close the talking-circuit at that station as follows, commencing with the jack: 2, 3, s^7, C′, 4, 13, C, 12, k, telephone set, k^4, 18, 1, and back to central. The operator may now ring station 2, as before, station 1 remaining cut off because of the arm s being lifted up. By thus setting any one of the fingers the operator may cause the relays S S S successively to connect their sections until any desired station is reached. At the conclusion of the conversation the subscriber may ring off in the ordinary way, throwing down the bridge clearing-out drop D′. The operator then restores all of the signal devices at the substations by depressing her key L, which bridges the main battery B across the cord conductors 20 21 and at the same time grounds the conductor 30 leading to the generator. Current from the battery then flows out from the metallic circuit as follows: B, 23, l^2, l', 21, p, j', 1, 10, S², 11, 4, C′, s^7, 3, 2, j, p', 20, 28, l^3, l^4, 29, and battery; also, B, 23, l^2, 1, 21, p', j', 1, 15, S², 16, 6, C′, 5, 4, C′, s^7, 3, 2, J, j, p', 20, 28, 29. All of the bridge-relays S² are thereupon attracted, closing the grounding-circuits of their respective restoring-magnets S′. While holding down the key L the operator grinds the generator G, and current thereupon circulates therefrom through the restoring-magnets by the following path: ground, l^7, l^6, 30, G, 31, 21, p, j', 1, 10, 15, &c., to the magnets S′, and so to ground through contacts s^{10} and s^{11} at each station, all of which

are closed. Each magnet S′ thereupon pulls down its armature-lever S^2 and straightens out the armature of magnet S, disconnecting the wires 7 and 8. At the same time the pitman-rod s^8 comes down on the crank-arm s^9 and tilts the lever s^7 into its normal position, as shown in Fig. 2. All of the stations are thus restored to normal. Lastly, we will assume that the subscriber wishes to call in to central. Since the line-wire 2 4 6 is normally broken at the several stations, he is forced to resort to the key K, which he depresses, and then turns his generator-crank, sending current thereby to the drop-annunciator D through the following path: ground, k^3, k^2, H, G′, k', k^4, 18, 1, j, j^2, D, and ground, back to the generator. The operator thereupon plugs in with the answering-plug P′ and by depressing the key K′ connects her telephone O from ground to the tip conductor. The key K′ may obviously be an ordinary listening-key with means to ground the sleeve side of the cord.

The operator's signal device shown in Figs. 1 and 3 not only remains normally in the zero or starting position, but its fingers are restored as they pass a fixed cam x^0. This permits any finger which has been depressed to pass behind the stud m^5, but throws it out afterward, so as to restore it to normal position as it lifts the stud.

We are aware that many changes may be made in the details, and particularly in the arrangement of our circuits. We are not confined to the specific forms of apparatus or circuits herein shown, since the same may be varied in many ways without departing from the spirit of our invention.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a selective signaling system, a metallic circuit subscriber's line having one side normally continuous and the other side normally broken at each station, a telephone at each station a polarized relay at each station normally connected to the end of the broken conductor leading to the next preceding station, means controlled by said relay for closing the telephone-circuit and for completing the broken conductor to the next succeeding station, and means controlled by an operator to send current impulses over the line, substantially as described.

2. In a selective signaling system, a metallic circuit subscriber's line having one side normally continuous and the other side normally broken at each station, a polarized relay at each station normally connected to the end of the broken conductor leading to the next preceding station, means controlled by said relay for completing the broken conductor to the next succeeding station, a restoring-magnet for each station, and means controlled by an operator for sending pulsations of current to work both the relay and the magnet, substantially as described.

3. In a selective signaling system, a metallic circuit subscriber's line having one side normally continuous and the other side normally broken at each station, a polarized relay at each station normally connected to the end of the broken conductor leading to the next preceding station, means controlled by said relay for completing the broken conductor to the next succeeding station, a restoring-magnet for each station, a high-wound relay bridged across the metallic circuit and controlling the circuit of the restoring-magnet, and means controlled by an operator for sending pulsations of current to operate said magnets and relays, substantially as described.

4. In a selective signaling system, a metallic circuit subscriber's line having one side normally continuous and the other side normally broken at each station, a polarized relay at each station normally connected to the end of the broken conductor leading to the next preceding station, means controlled by said relay for completing the broken conductor to the next succeeding station, a restoring-magnet connected on one side of the continuous side of line and having a normally broken ground connection on its other side, a high-wound relay bridged across the line at each station and adapted when energized to complete the ground connection of the restoring-magnet, and means controlled by an operator to send proper pulsations of current to energize the several magnets, substantially as described.

5. In a party-line telephone system a metallic circuit with a plurality of subscribers' stations thereon, a polarized relay at each station, a telephone talking set also at each station, one side of the line being continuous through all the stations and the other side broken at contacts at each station, means controlled by movement in one direction of said relay to close the local telephone-circuit across the line, and to maintain succeeding stations disconnected, said means serving upon a reversal of current to open the local telephone-circuit and to complete the metallic circuit to the succeeding station, a restoring-magnet for said means, and a controlling-relay for said restoring-magnet, said controlling-relay being high-wound and permanently bridged across the metallic circuit, substantially as described.

6. In a party-line telephone system a selective relay at each station, a restoring-magnet in a normally incomplete circuit, and a bridged controlling-relay for the restoring-magnet, substantially as described.

7. In a party-line telephone system a line-circuit, a plurality of substations on said circuit, means at each station to selectively complete the local telephone-circuit, restoring

means therefor, a controlling-relay therefor high-wound and permanently bridged across the line, a source of current a key controlled by an operator for bridging said source of current to operate said controlling-relay, and a generator also controlled by the operator to energize the restoring means, substantially as described.

8. In a party-line telephone system, a circuit extending to a plurality of stations and being in part discontinuous at each station, a relay at each station responsive to current in the continuous portion of the line for controlling the local telephone-circuit at its own station, and means actuated by said relay for also controlling the circuit at the next station, substantially as described.

9. In a party-line telephone system, a metallic line-circuit extending to a plurality of stations, one side of said circuit being continuous through all the stations and the other side normally broken at each station, a polarized magnet normally connected to the broken side of the circuit at each station, an armature controlled by said magnet and itself controlling the local telephone-circuit at said station, together with a second armature for the same magnet and a circuit-closer actuated thereby for controlling the continuity of the normally broken circuit to a succeeding station, substantially as described.

10. In a selective device for telephone systems, a polarized switching-relay having a tilting armature and a permanent magnet in combination with a restoring-magnet having an armature adapted to engage the tilting armature of the said relay with equal force at points on opposite sides of its fulcrum, so as to restore it to neutral position after it has been tilted either way, substantially as described.

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

FRANK J. MERSMAN.
JOSEPH MERSMAN.

Witnesses:
J. C. LEUSURE,
DAVID N. POWELL.