No. 860,860. PATENTED JULY 23, 1907.

A. J. FARMER.

MULTIPLE STATION TELEPHONE SYSTEM.

APPLICATION FILED FEB. 4, 1902.

3 SHEETS—SHEET 1.

Fig. 1.

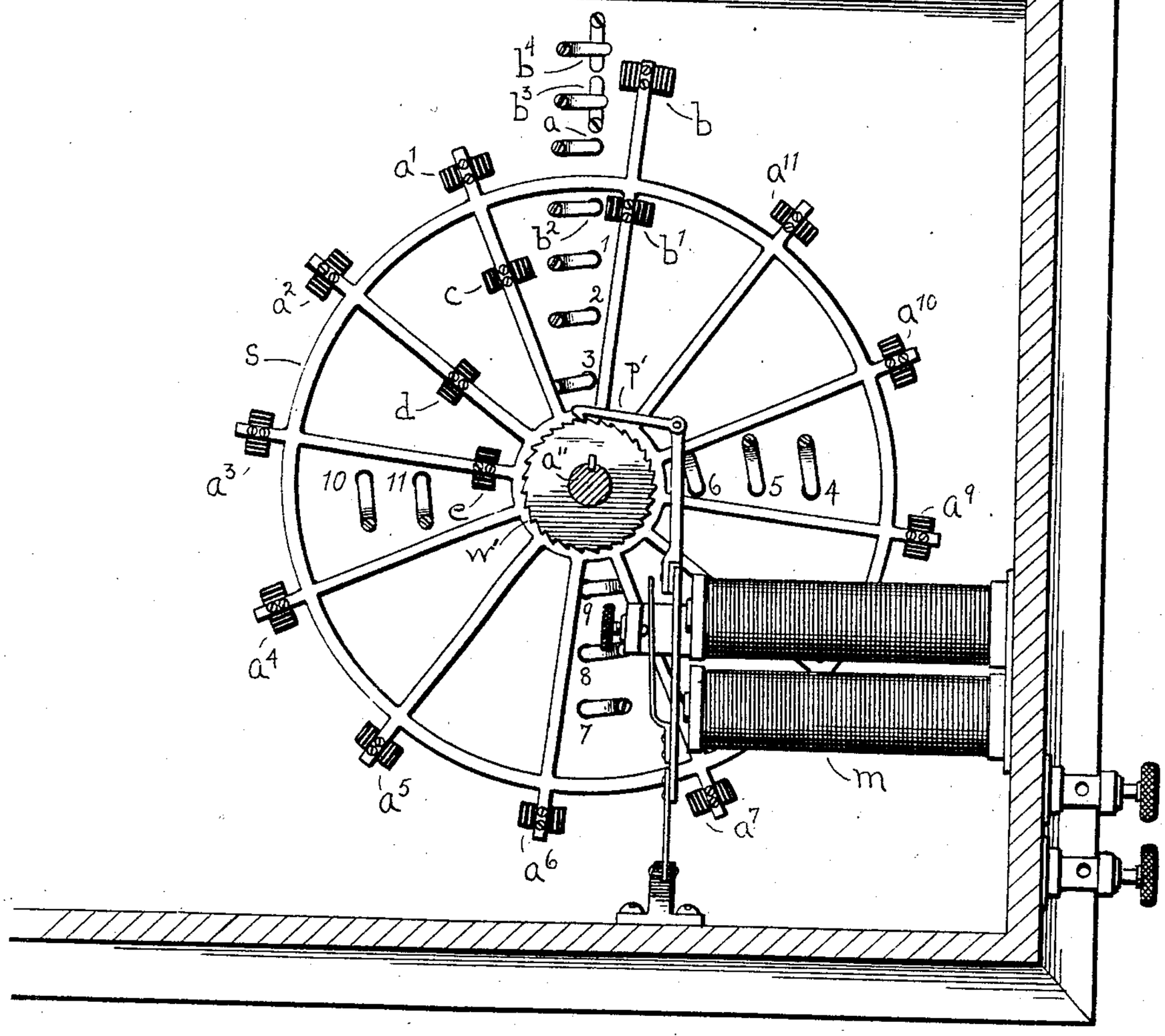
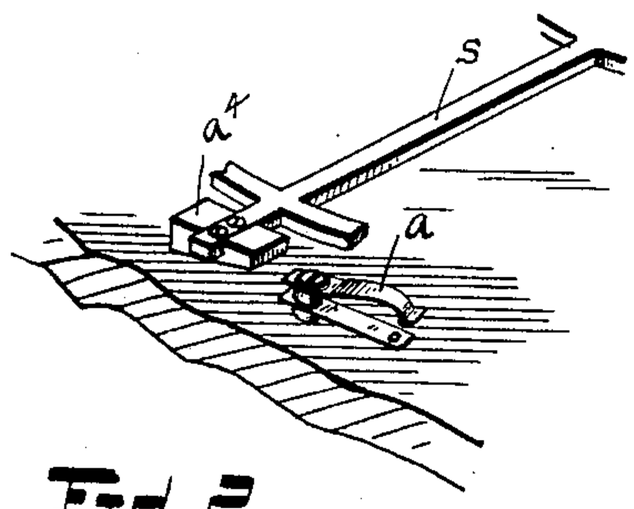


Fig. 2.



WITNESSES

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3 SHEETS—SHEET 2.

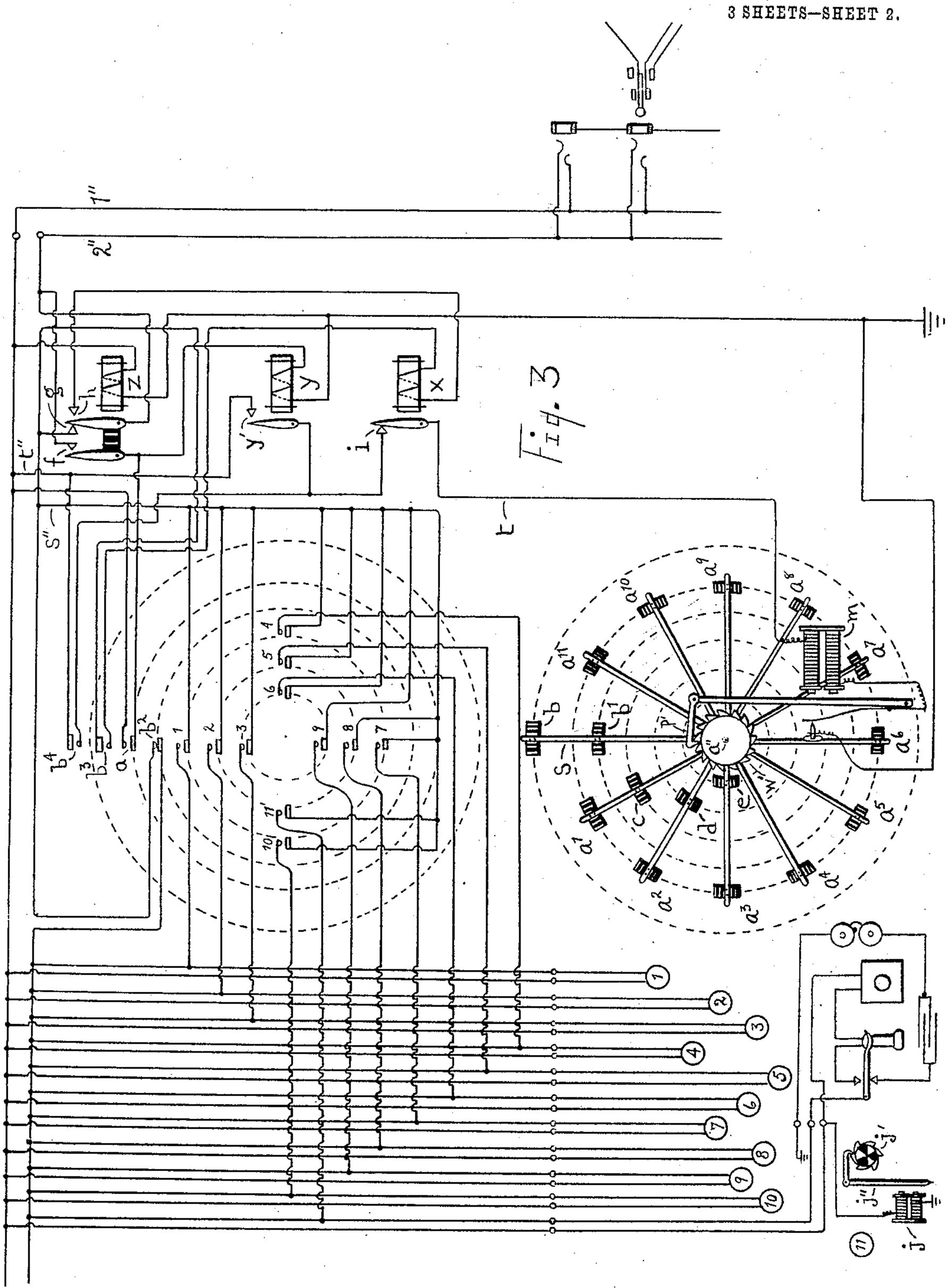

Fig. 3

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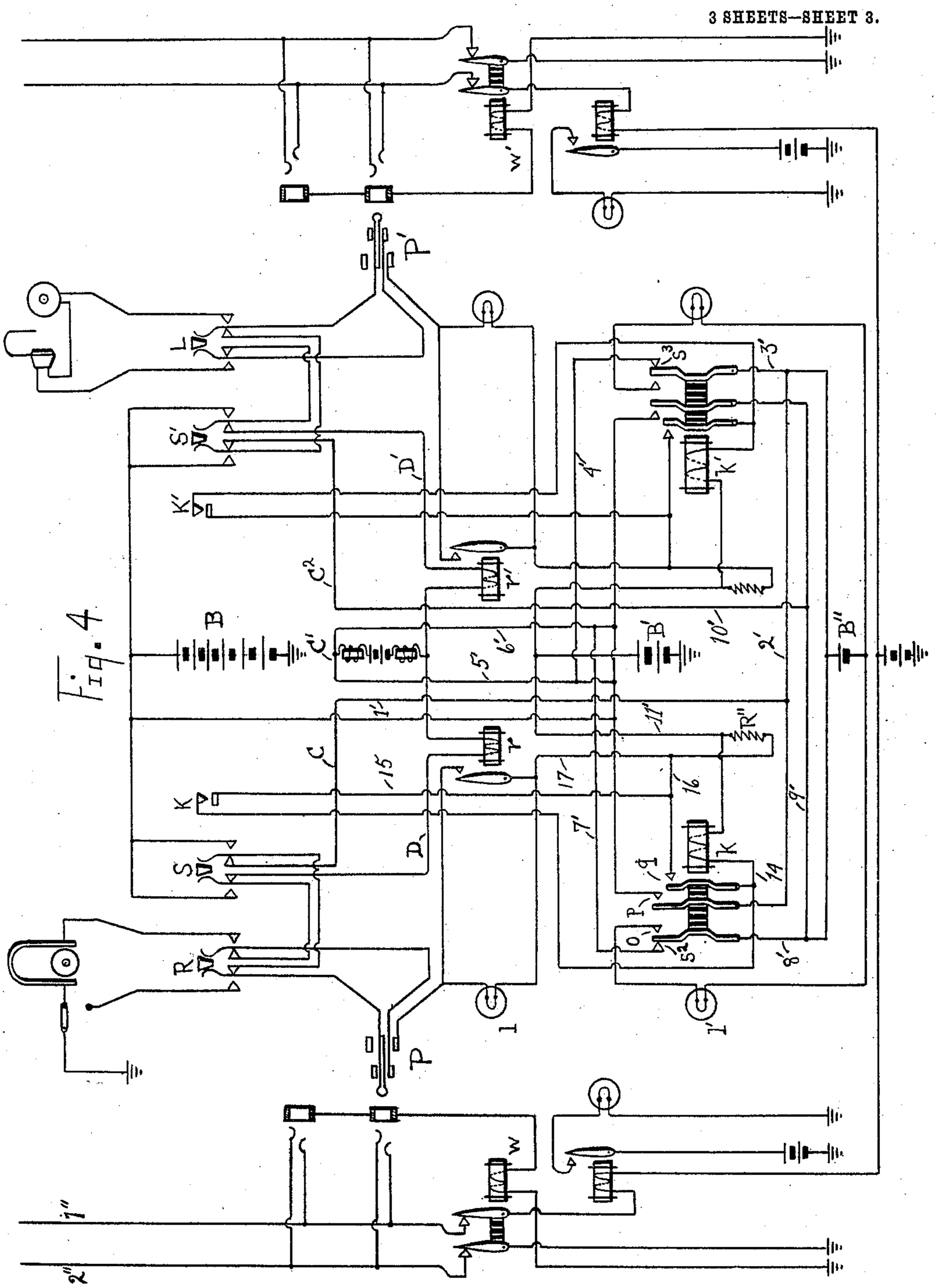

Fig. 4

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UNITED STATES PATENT OFFICE.

ARTHUR J. FARMER, OF DETROIT, MICHIGAN.

MULTIPLE-STATION TELEPHONE SYSTEM.

No. 860,860. Specification of Letters Patent. Patented July 23, 1907.

Application filed February 4, 1902. Serial No. 92,567.

To all whom it may concern:

Be it known that I, ARTHUR J. FARMER, a citizen of the United States of America, and a resident of Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Multiple-Station Telephone Systems, of which the following is a specification.

My invention relates to improvements in multiple station, or party line telephone system, and has for its object the provision of apparatus embodying selective, secrecy, and busy signal features, and for simplifying the work of the operator at the central office.

It has been my design to depart from the standard exchange circuits and apparatus only in simple and necessary particulars, thus enabling me to use the invention in systems already installed.

The selective feature of my system, I obtain by interposing between the central office and the several parties served by a given line, a junction-box containing switching mechanism for alternatively connecting in circuit all of the parties upon the line, or merely the single party called or calling for connection. The actuation and restoration of the junction-box apparatus are controlled by the exchange operator through a key connected with the operating battery; in which operations she is guided by means of a supervisory lamp or signal.

In selecting a party, current is transmitted to the junction-box over both sides of the line to ground; while for effecting its restoration, but one side is used, the apparatus automatically stopping in its normal position for calling, or receiving a call from any of the parties. Each party is informed of the condition of his line by means of an automatic busy signal.

The invention will be more readily understood by reference to the accompanying drawings, illustrating apparatus, and a telephone system embodying my improvements.

Figure 1 thereof shows in elevation, the junction-box apparatus for switching the various subscribers or parties into and out of circuit. Fig. 2 is a detail, showing the preferred form of switching contacts. Fig. 3 is a diagram of the junction-box and subscribers' circuits showing one party-line station in some detail, and, Fig. 4 diagrammatically illustrates the central office apparatus.

The same character of reference is employed throughout the drawings to indicate similar parts.

Referring first to Fig. 1; it will be seen that the principal feature of the junction-box switching apparatus is a spider s rotatably mounted upon a shaft a'' which bears a ratchet-wheel w' controlled by electro-magnet m. The ratchet-wheel is engaged and operated by a pawl p' carried by the armature of the electro-magnet. The radial limbs of the spider bear variously positioned engaging shoes a^1—a^{11}—b, b^1—c, d, e, adapted, during the rotation of the spider, to close the contacts a, b^2, b^3, b^4, also contacts 1—11 corresponding to and connected with the party line stations of similar number indicated at the left of Fig. 3. The shoes for closing station contacts are so positioned that no two of the latter can be closed at the same time; *i. e.* during any one position of the spider. By observing the concentric dotted circles in said figure, it will be at once apparent which contacts are actuated by any given shoe. The actuating electro-magnetic apparatus is of the vibrating type, so that the operator may, by depressing a key S, throw current from battery B to line, and step around the spider to the position necessary for connecting in circuit the desired subscriber.

In Fig. 3 the spider and acutating mechanism are shown in normal position below or vertically displaced from the several junction-box contacts, circularly arranged near the upper part of the diagram. The contact b^2 is then closed by the engaging shoe b^1 which insures the completion of the circuit from the exchange to all the stations 1—11 when the line is not in use. Immediately spider s is rotated out of its initial position, however, contact is broken at b^2, disconnecting all the stations from circuit until some one of the contacts 1—11 has been closed by the shoes c, d, or e. This will serve to connect the corresponding station to line, through conductor s'. In its initial position, also, the spider maintains open the contacts b^4 and b^3, and accordingly, to complete circuit through wire t to magnet m, it is necessary to energize relay y; thus closing a shunt about contact b^4. Relay y is bridged between line and ground; the continuity of the circuit being controlled at contact f, which will be closed immediately relay z is energized. In order to rotate the spider from its initial position, accordingly, it is necessary to send current over line wires $1''$ $2''$ in parallel; but immediately this occurs, contact b^4 is closed and the flow of current over line wire $1''$ alone is required to continue the rotation of the spider, and restore it to its initial position; when it will be automatically stopped by the re-opening of the circuit to magnet m at b^4. The energization of relay z closes the contacts at f, forming a part of a bridge between the line conductors, which is in turn controlled by contact a. This bridge is between the exchange and the breaks in the line conductors. Whenever one of the party-line contacts 1, 2, 3, etc. is closed, contact a is simultaneously closed by one of the shoes a^1, a^2, a^3, etc.; hence, while current is being sent over line wire $1''$, the supervisory lamp at the central station will be extinguished each time a station is connected in circuit, by reason of the closure of this low-resistance bridge; therefore the operator presses her

selecting key S until the supervisory lamp has flashed the required number of times; releasing the same after the flash occurs corresponding in number to that of the station desired. In order to automatically stop the spider when selecting a calling station, additional contacts and relay x are provided. To secure this result the relay is so placed that it will be switched into the circuit with the main line wire $2''$ by means of contact h when selecting current is sent over line wire $1''$. The current over the former passes to ground via contact f and relay y there being no path from $2''$ to ground for direct current beyond this point, while the bridge between wires $1''$ and $2''$, which is closed by shoes a^1—a^{11} at a, is on the exchange side of relay x. Accordingly said relay, when thus in circuit, is energized only by current traversing the complete metallic circuit which will not occur until the spider has completed circuit to the calling station. The current then which ordinarily controls the supervisory signal relay at the exchange, will also pass through relay x, energize the same, and cause the circuit to be broken at i. This will serve to cut out magnet m and prevent further rotation of the spider. The operating battery then being disconnected from line, the armature of relay z is restored and a shunt around relay x is closed at g. When one of the party line subscribers desires a connection, selecting current is sent to line and relay x would be immediately cut in, thus disconnecting magnet m, were it not for the fact that shoe b in its initial position separates contacts b^3 which control the circuit through relay x.

In Fig. 4 is shown diagrammatically a typical exchange circuit with auxiliary relays and circuits for use in operating the party-line junction-box apparatus. It will be noticed that the continuity of the ordinary metallic cord and plug circuit requires merely to be broken at certain points for permitting the use of auxiliary keys and relays; provided for special purposes. My description will be directed principally toward these alterations, in order to set forth more clearly my improvements, since those skilled in the art will at once appreciate the features common to other systems. It will be recognized that P is the calling, and P′ the answering plug, with which are respectively connected keys R, S, K and K′, S′, L adapted to control the ringing and listening circuits, and the several circuits of the operating batteries. In practice said keys will be combined as suitable selecting and ringing, and selecting and listening keys. B′ is an auxiliary battery, and l, l' are the supervisory and auxiliary signal lamps. Other suitable signals may, of course, be substituted for said lamps, if desired. k, k' are multiple-contact restoring relays whose purpose will later be explained.

Recurring briefly to Fig. 3, before proceeding with any further explanation, it will be seen that the station apparatus of subscriber 11 is diagrammatically indicated in the left hand lower portion of said figure. This is duplicated at each of the other party-line stations, which may be indefinitely multiplied in number as required, with a corresponding number of additional pairs of contacts and the necessary shoes properly arranged at the junction-box. Connected in circuit with line conductor $2''$ is the bell, between which and ground is interposed a condenser. The bell if desired, may be connected to provide a full metallic ringing circuit therefor. The highwound magnet j of the subscriber's busy-signal is connected between the other line conductor, or its extension beyond the junction-box, and the ground. This signal comprises simply a rotatable disk j' provided with alternating sectors of white and black, one of which will always be displayed at an opening in the subscriber's instrument box. Each time the magnet j is energized its armature j'', by means of a pawl engaging the ratchet-wheel associated with disk j', advances said wheel and disk one step, thereby indicating the condition of the line, a black sector, for example, showing when the party-line is busy.

After reading the foregoing, a somewhat detailed description of the operation of my improved system, which I shall now make, will be readily understood by those conversant with telephone practice. Assuming now that the exchange operator finds, upon plugging into the jack of a calling line that station 3 is desired; plug P is inserted in the jack of the party-line and key S is depressed, which serves to connect battery B with both sides of the line in parallel to ground via the several bridges upon the line already alluded to. Initially, current over line wire $1''$ reaches ground via relay z, and also through the several busy-signal magnets j at the subscribers' stations. Relay z is thus energized to close circuit at f; affording a path for current from conductor $2''$ through relay y and to ground, which serves to excite the latter relay and complete a bridge from conductor $1''$ to ground via wire t'', contacts y', i and the windings of actuating magnet m. Thus excited, said magnet rapidly makes and breaks the circuit through its windings, intermittently attracting its armature and thereby stepping around spider s in a clockwise direction; this action continuing as long as pressure is maintained on key S.

As before explained, shoes a^1, a^2, a^3, etc. will complete circuit through contacts a at the same time that shoes c, d, e successively close the contacts 1, 2, 3, etc., controlling circuits to the corresponding partiy-line stations. This closure of contacts a completes each time, a low-resistance bridge between the line conductors by way of contact f, causing the supervisory lamp to be extinguished whenever a station is selectively connected in circuit.

Under the conditions assumed, the operator notes that the lamp l is twice extinguished, and releases the key the third time the lamp ceases to burn. It will be observed that the contact-making shoes of the spider are made of sufficient length to permit the operator to release the key before the spider can break the desired connection. Line conductor $2''$ is now open at b^2, but a shunt is established for the desired party at contact 3. Station 3 thus is the only station connected in circuit with the exchange, said circuit being traced as follows:—from the tip of plug P to conductor $1''$ and its extension to station 3, thence to contact 3 of the junction box, wire s'', line conductor $2''$ and contact g shunting the break therein, the exchange side of the breaks in said conductor $2''$, thence to the sleeve of plug P. The operator now rings subscriber 3 by depressing key R, who upon answering, connects a low-resistance bridge between conductors $1''$, $2''$, thus extinguishing the supervisory lamp and inform-

ing the operator that the subscriber has responded. The talking circuit thus established may be traced through the cord circuit as follows;—from the calling station to the sleeve of plug P′, key L, key S′, wire D′, relays r', r, wire D, key S; key R, sleeve of plug P, to the called station, thence to the tip of said plug, as already described, key R, key S, wire C, wires 1′, 2′, 3′, contacts s^3 of the unexcited relay k', wires 4′, 5′, C^1, 6′ 7′, contacts s^2 of the unexcited relay k, wires 8′, 9′, 10′, C^2, key S′ key L, and to the tip of the plug P′.

From the above it will be seen that contacts s^2 and s^3 are the only points at which the continuity of the circuit can be broken, other than those ordinarily opened when listening in, calling, or selecting a station, and said contacts s^2, s^3 remain closed until restoring current is sent to line upon the conclusion of the conversation.

Upon the subscribers' hanging up their receivers, the supervisory lamp is lighted in the well known manner, thus notifying the operator to disconnect. Before removing the plugs, however, the operator momentarily presses key K, transmitting current over the following circuit:—from battery B′, wire 11′, relay k, wire 14, key K, wire 15, wire 16, wire 17, supervisory lamp l, thimble of the party-line jack, relay w, and thence to ground. The relay k is excited and attracts its armature, closing its multiple contacts at o, p, and q, and also breaking contact at s^2. The closure of contact q closes circuit through the windings of relay k independently, as long as plug P remains in its jack, while the contact established by p serves to connect battery B to line conductor 1″, and also closes a shunt around contact s^3. Opening circuit at s^2 disconnects plug P′, so that no current from battery B can flow to that side of the cord circuit when key K has been closed, unless key K′ has also been closed and a shunt around S^2 has thus been closed at p'. The contact made by o closes the circuit including battery B″ and the auxiliary supervisory lamp l', which preferably is of different color than lamp l. These circuit conditions obtain until the plug P is removed from its jack, when the relay k will be restored to its normal position. The operating battery and resistance R″ are, of course, so proportioned as to insure the actuation of the apparatus serially connected therewith. The current supplied to line conductor 1″ flows to the junction-box and reaches ground by way of a bridge including relay z, and another including conductor t'', contacts b^4 and i, and actuating magnet m. Although relay z is incidentally energized, no operative function is thereby attained, but the current flowing through magnet m serves to rotate the spider s in continuation of its movement, until shoe b reaches its normal position to break contact at b^4. Since there is no current flowing over line conductor 2″ relay y remains inert, and the circuit to magnet m is thus automatically broken, and the spider is stopped in its initial position.

During the above recited operation contact a will be closed and opened at intervals during the rotation of the spider, causing the supervisory lamp l at the exchange alternately to burn and become extinguished until the spider has reached its normal position, when said lamp will remain lighted as a signal for the operator to disconnect. The function of the auxiliary supervisory lamp l' is to prevent the disconnection of a party-line until the restoring current has been transmitted to leave the line in normal condition for sending and receiving calls; and accordingly the operator must not take down a party-line connection until both the supervisory and auxiliary lamps are lighted. Upon receiving the subscribers' signal to disconnect, the operator, accordingly, will press key K, accomplishing the above described result; meanwhile attending momentarily to her other duties; and when the automatic restoration of the junction-box apparatus has been effected, and both lamps l and l' are lighted, the operator takes down the connection, knowing that the line is in normal condition. The current thus transmitted to effect the restoration of the junction-box apparatus, also flows in part through the busy signal magnets at the several subscribers' stations, thereby advancing the controlled disks one step to display a white sector and indicate that the line is free. It will be observed that the other, or answering side of the cord circuit, similarly is provided with selecting and restoring keys S′, K′, and that the multiple-contact restoring relay k' is present, so that a party-line subscriber calling for a connection, likewise has, temporarily, the exclusive use of the line, and the other stations upon said line are notified of the condition of the line by means of their busy signals. All this is accomplished in a manner exactly analogous to that of selecting a called party, with the exception that the operator, as explained, does not have to watch the number of flashes, but depends on the relay x and the junction-box apparatus to automatically select the calling station, and the restoration of the junction-box apparatus is similarly brought about. Therefore, it will be unnecessary to refer in further detail to these operations.

It will be appreciated that, as nearly as possible, I have rendered automatic the selective, restoring and busy signal features of my system, in order to relieve the operator of extra labor and also insure greater accuracy. In the system as thus equipped, a comparatively large number of subscribers, having individually but few calls, may very economically be given the best of service; including the exclusive use of the exchange line, when required, and the absence of annoyances commonly incident to party-line service.

The improvements are readily applicable to various systems already installed; that herein described being merely illustrative.

The junction-box with its contained apparatus, may, of course, be disposed in the system to suit local conditions. Preferably it is situated as centrally as possible with respect to the group of parties served; thereby reducing the length of extension line conductors required. Thus it may be installed at some one of the party-line stations, if desired, or it may be equipped with a weather-proof housing or casing, and be placed upon a convenient pole. Suitable terminals for connecting up the entering lines, naturally will be mounted therein. Containing, as it does, all the additional actuating apparatus outside of the exchange, and this being of an extremely simple character, the junction-box is at once convenient for testing and repairing.

Modifications to suit arising conditions will suggest themselves to those skilled in the art, and I do not desire to be understood as setting forth herein, more than

illustrative apparatus and circuit arrangements embodying my invention; and accordingly claim, and desire to secure by Letters Patent, the following:

1. In a central energy telephone system, the combination with a plurality of lines extending to and connected with the instruments of the several subscribers served by a given exchange line, of an interposed electro-magnetic switching appliance wherein said lines are centered, line conductors extending therefrom to the exchange or central office, an actuating battery, and central office apparatus for actuating the switching appliance to connect any subscriber in circuit or all of the subscribers in common, and for connecting the line with other subscribers to the exchange, substantially as set forth.

2. In a central energy telephone exchange system, the combination with a party-line switching appliance, of a plurality of party-line stations connected therewith and adapted to be alternatively connected or connected in common with the exchange, associated telephone exchange apparatus, line conductors extending to the telephone exchange, an actuating battery thereat adapted to energize the switching appliance, a key controlling the same, and a signal controlled by said appliance for indicating the party connected in circuit and the restoration of the apparatus, substantially as set forth.

3. In a telephone exchange system, the combination with an operator's key for controlling a party-line switching appliance, of line conductors extending between the same, an actuating battery or source of current, a plurality of party-line subscribers, and an interposed electro-magnetic party-line switching appliance comprising a plurality of contacts respectively connected with the several party-line stations and with the line conductors, a rotatable contact-making part, an electro-magnetic device for effecting its rotation, and an additional contact controlled by the contact-making part adapted to be closed each time one of the party-line contacts is closed, and a signal at the central office adapted to be actuated thereby, substantially as set forth.

4. In a telephone exchange system, the combination with a party line switching appliance, of means provided in the cord circuit for sending actuating current over both line conductors in parallel to said switching appliance, relay apparatus for sending current over one side of the line thereto, and means controlled by the removal of the connecting plug for restoring said relay apparatus to normal condition, substantially as set forth.

5. In a party-line switching appliance, the combination with a plurality of contact parts respectively connected with the several party-line stations, of a rotatable contact-making part, an electro-magnetic device for effecting its rotation adapted to be connected with the exchange line conductors, said line conductors extending to an exchange, and an additional contact controlled by the rotatable contact-making part adapted to be closed each time one of the party-line contacts is closed, substantially as set forth.

6. In a party-line switching appliance, the combination with a rotatable part, of electro-magnetic actuating apparatus therefor, contact-making shoes mounted upon said part, a plurality of contacts adapted to be connected with corresponding party-line stations, a signal-controlling contact, relay-controlling contacts, said contacts being disposed in the path of, and adapted to be engaged by said shoes, and relay apparatus, substantially as set forth.

7. In a telephone exchange system, the combination with a junction-box containing selective switching apparatus, of a central station, a plurality of party-line stations, line and extension conductors connecting said junction-box with all of said stations, electro-magnetic actuating apparatus for effecting the selective switching and restoration of said junction-box, the same being connected with one side of the line, relay apparatus y and z connected in bridge to ground, relay x associated therewith, a source of current at the central station, and controlling switching appliances for effecting the selective and restorative operations of the junction-box apparatus, substantially as set forth.

8. The combination with a telephone line having a plurality of substations connected thereto, of a signal-bell connected with the line, a condenser in series therewith and an electro-magnetic busy signal appliance connected in a circuit distinct from the bell circuit at each of the substations, an electro-magnetic switching mechanism associated with the main line circuit adapted to selectively connect in circuit any one of the substations, and central office apparatus for simultaneously actuating said electro-magnetic switching mechanism and the several sub-station busy signals, substantially as set forth.

9. In a party-line selective switching mechanism, the combination with a movable controlling part, of electro-magnetic actuating mechanism therefor adapted to be electrically controlled, contact terminals controlled by the movement of said part adapted to be connected by individual circuits with a plurality of telephone sub-stations, and means for automatically checking the said controlling part in definite contact controlling positions substantially as set forth.

10. The combination with the two limbs of a telephone exchange line, of a plurality of telephone sub-stations associated therewith, a switch at each sub-station adapted to control the flow of current across said limbs, an electro-magnetically actuated switching mechanism interposed between the exchange and said sub-stations adapted to selectively connect to line any one of the sub-stations or connect all in multiple, and also control the flow of current across the limbs, and a switch controlled thereby connected between the exchange and the electro-magnetic switching mechanism, substantially as set forth.

11. The combination with a multiple station telephone line, of a relay connected with the line adapted to be excited by current flowing therein, a line signal controlled by the relay, an electro-magnetic switching mechanism connected between the terminal jack of the line and its sub-stations, said switching mechanism comprising means for normally maintaining a closed circuit to all of the sub-stations in multiple, whereby any station may actuate the line signal, and also means under control of the exchange operator for breaking this common circuit and establishing an individual circuit to any one of the sub-stations, substantially as set forth.

12. In a selective party line system, the combination with the cord circuit at the telephone exchange, of a source of current, a key adapted to open the cord circuit and send current in parallel over the limbs of a connected telephone line, and relay apparatus comprising a multiple-contact device connected in circuit to complete, when excited, the cord circuit of the side in use, open the opposite side, complete a circuit from the source of current to one strand of the cord circuit, and close a secondary supervisory signaling circuit, substantially as set forth.

13. In a party-line switching mechanism, the combination with a rotatable contact-controlling part, of electro-magnetic means for rotating the same, sub-station and signaling circuit contacts or terminals associated with said part and controlled by its movement, and a signal at the central-office or exchange electrically connected therewith, whereby any one of several sub-station lines may be exclusively connected with the main line and the signal at the exchange may be actuated each time one of said lines is thus connected, substantially as set forth.

14. The combination with a telephone line extending to a central station or exchange, of a plurality of sub-stations normally connected with the line, an automatic electro-magnetically actuated switching appliance interposed in the said line between the exchange and said sub-stations, whereby the normal circuit to the sub-stations may be broken and an individual circuit to any one of said sub-stations may alternatively be closed, and means provided at the exchange for actuating said switching appliance, substantially as set forth.

15. The combination with a telephone exchange, of a multiple station telephone line extending therefrom affording a metallic talking circuit, a plurality of sub-stations normally connected thereto upon individual circuits, a third conductor uniting the exchange and the sub-stations, and an electro-magnetic switching mechanism bridged between one of the line conductors and the third conductor, said switching mechanism being connected to control the individual circuits and adapted to selectively connect alternatively, any individual circuit with the main line or talking circuit, substantially as set forth.

16. The combination with a multiple station telephone exchange line, of a relay associated therewith at the exchange adapted to respond to current flowing over the line, a signal controlled by the relay, an electrically actuated switching appliance interposed between the telephone stations and the exchange, and means at the exchange for actuating the switching appliance, said appliance being adapted to be operated to close under predetermined conditions, a low resistance bridge across the line and thus actuate said signal, whereby the operator is informed of the condition of the switching appliance, substantially as set forth.

Signed at Detroit, Michigan, this 24th day of January 1902.

ARTHUR J. FARMER.

Witnesses:
S. E. THOMAS,
CHARLES F. ADAMS.