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TELEPHONE SYSTEM.

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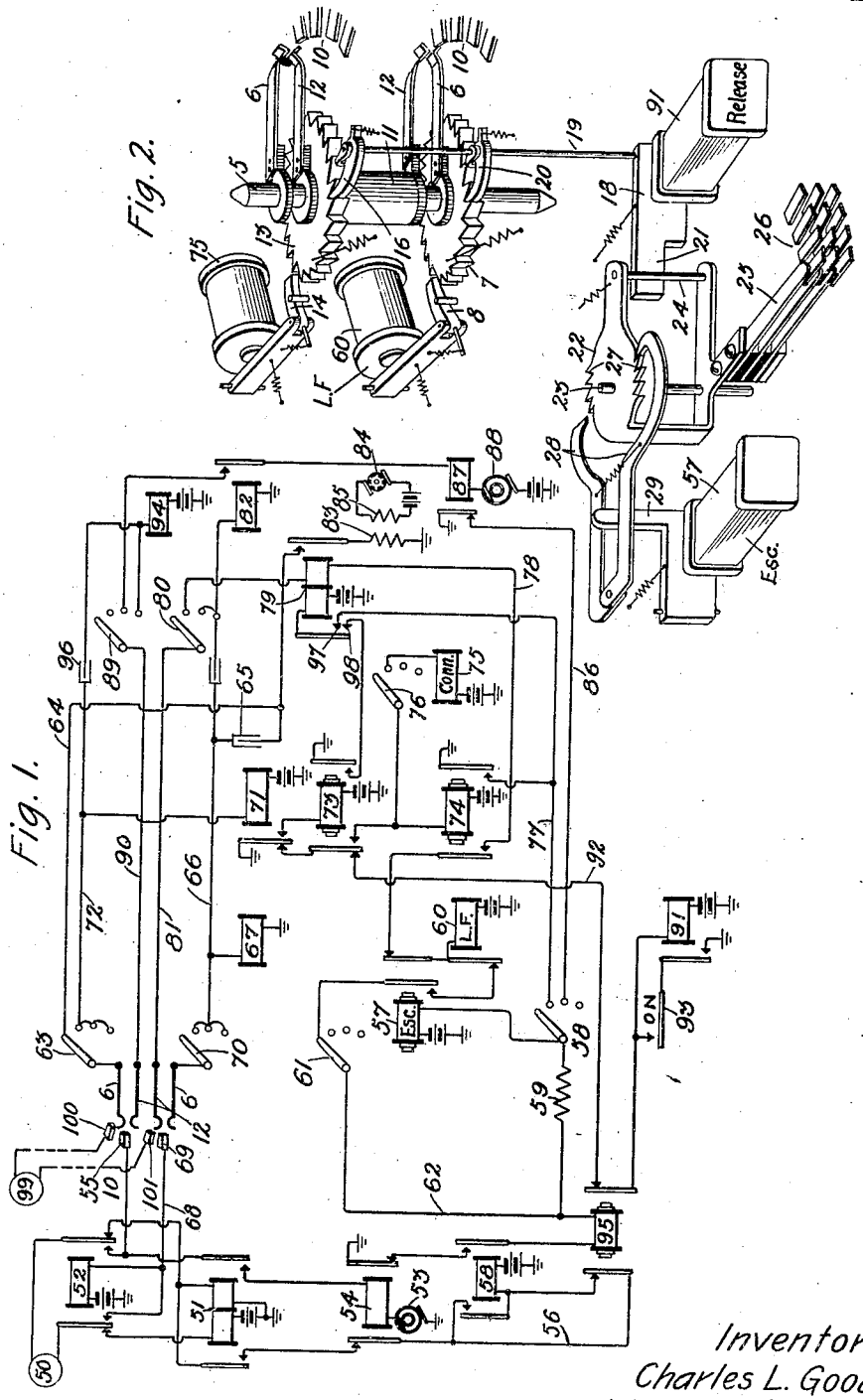


Fig. 2.

Fig. 1.

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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, CHARLES L. GOODRUM, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems, and more particularly to systems employing machine switches.

For small local exchanges or for private branch exchanges, it is desirable to employ a combined line finding and connecting switch for interconnecting calling and called lines. This arrangement reduces the amount of equipment necessary and provides a particularly efficient and rapid means of intercommunication.

The present invention has for its purpose the provision of novel circuit arrangements which reduce the amount of equipment and the number of relays and controlling magnets usually employed in automatic telephone systems.

Other features will appear from the detailed description and claims.

Referring to the drawings Figure 1 diagrammatically illustrates a telephone system employing the switch shown in Fig. 2; and Fig. 2 is a perspective view of a preferred form of the switch employed in the circuit arrangement of Fig. 1; the supporting frame of the operating parts of the switch has been omitted for clearness in illustration.

The switch disclosed in Fig. 2 serves as a combined line finder and a connector, and operates to interconnect calling and called parties. The line finder brushes contact with the outer surfaces of the line terminals, while the connector brushes contact with the inner surfaces of the same sets of line terminals. The structure of the switch is as follows; 5 designates a brush shaft rotatably mounted in a frame (not shown). To this shaft there are rigidly secured brushes 6 which serve as line finder brushes. A ratchet wheel 7 is secured to the shaft 5 and is engaged by the pawl 8 carried by the armature of the motor magnet 60 of the line finder. This magnet interrupts its own circuit to advance the brushes 6 until they engage one of the groups of terminals 10 in which the calling line terminates. A cylindrical member or collar 11 is loosely mounted for rotation on the shaft 5 against the action of a retractile spring. This collar 11 carries the connector brushes 12 and a ratchet wheel 13. A pawl 14 carried by the armature of the connector magnet 75 engages with the ratchet wheel 13 to advance the connector brushes into engagement with the terminals of the called line. A release magnet 91 is provided for armature 18, having an arm 21, the purpose of which will be hereinafter described. This armature near one end carries a vertical rod 19, on which there are loosely mounted tensioned holding dogs 16 and 20 which serve to hold the brushes 6 and 12 in the position to which they have been advanced by the motor magnets. The rod 19 has arms secured thereto, which are adapted to move the dogs 16 and 20 out of engagement with the ratchet wheels 7 and 13 when rod 19 is actuated. A mechanical relay or side switch is employed to control the operating circuits of the magnets previously described. This side switch comprises a U-shaped member 22 mounted for rotation on the rod 23. The free ends of the member 22 are connected by a rod 24 which is engaged by the arm 21 of the armature of release magnet 91 to restore the side switch to normal position at the close of the conversation. The lower arm of member 22 carries movable brushes 25 which engage fixed contacts 26 of the side switch. The upper arm of member 22 is provided with escapement teeth 27 which are engaged by escapement pallets 28. These pallets 28 are pivoted together near one of their ends and are drawn together by a spiral spring. An arm 29 carried by the armature of escape magnet 57 controls the movement of the member 28 to allow the side switch to be advanced step by step in the well-known manner.

In general, the operation of the switch is as follows: the line finder motor magnet 60 makes and breaks its operating circuit, causing the pawl 8 to engage the teeth of the ratchet wheel 7. The motor magnet 60 continues to rotate the ratchet wheel 7, the shaft 5 and brushes 6 until the brushes 6 engage the terminals of the calling line. Circuit changes which will be later described, now take place to cause the energization of escape magnet 57. This magnet, in attracting its armature, causes arm 29 to disengage one of the pallets from the teeth

27. The U-shaped member escapes the distance of one tooth and moves brushes 25 into engagement with a second set of fixed contacts 26. This operation prepares an operating circuit for motor magnet 75. The intermittent energization of motor magnet 75, under the control of the calling dial and the consequent operation of its armature, causes pawl 14 to advance the ratchet wheel 13. This wheel rotates the collar 11 and the brushes 12 mounted thereon, the desired number of steps. The escape magnet 57 allows the side switch to escape step by step to bring about other circuit changes. At the close of the conversation the release magnet attracts its armature. The rod 19 then operates to disengage holding dogs 16 and 20 and arm 21 to move the side switch to its normal position.

It is believed that the circuit arrangement shown in Fig. 1 will best be understood by establishing a connection between a calling and a called substation.

When the subscriber whose substation apparatus is indicated at 50 removes his receiver from the switchhook, the line relay 51 is energized over a circuit extending from free pole of battery, left-hand winding of relay 51, left-hand back contact and armature of cutoff relay 52, substation apparatus 50, right-hand armature and back contact of cutoff relay 52, right-hand winding of relay 51 to the grounded pole of battery. The relay 51 attracts its armatures and at its right-hand armature and front contact closes a break point in a test circuit which applies alternating current to the test terminal 55, which in this instance is one of the terminals of the talking circuit of the calling line. This incomplete circuit may be traced from ground, generator 53, the winding of relay 54, right-hand front contact and armature of line relay 51, to the terminal 55. At the left-hand armature and front contact of line relay 51 a circuit is completed which extends from ground, right-hand winding of relay 51, left-hand armature and front contact of relay 51, left-hand back contact and armature of relay 54, conductor 56, armature and back contact of relay 95, winding of relay 58 to grounded battery. The relay 58 attracts its armatures, and at its left-hand armature and front contact completes a locking circuit for itself which extends from ground battery, winding of relay 58, left-hand armature and front contact of this relay over the circuit previously described to ground at line relay 51. At the right-hand armature and front contact of this relay a break point is closed in the operating circuit of the escape magnet. This circuit is established from grounded battery, winding of escape magnet 57, resistance 59, winding of relay 95, right-hand armature and front contact of relay 58, right-hand back contact and armature of relay 54 to ground. The relay 95 attracts its armatures, and at its right-hand armature and back contact interrupts the circuit of the release magnet. Simultaneously the escape magnet 57 attracts its armature and thereby completes an operating circuit for the motor magnet of the line finder, which circuit extends from grounded battery, winding of motor magnet 60, armature and back contact of motor magnet 60, front contact and inner armature of escape magnet 57, side switch wiper 61 in its first position, conductor 62, winding of relay 95, right-hand armature and front contact, right-hand back contact and armature of relay 54 to ground. The motor magnet 60 of the line finder continues to interrupt its operating circuit to advance the brushes 6 over the group of terminals 10 in which the calling line terminates, until the upper brush 6 encounters the terminal of the calling line, whereupon the relay 54 is energized, its operating circuit extending from ground, generator 53, winding of magnet 54, front contact and right-hand armature of relay 51, terminal 55 of the calling line, brush 6, side switch wiper 63 in its first position, conductor 64, condenser 65, conductor 66, winding of resistance coil 67 to ground. Relay 54 attracts its armatures, thereby interrupting the energizing circuit of escape magnet 57 and the operating circuit of the motor magnet 60. Escape magnet 57, upon deënergization, moves the side switch wipers into their second position.

In position 2 of the side switch wipers an energizing circuit for the cutoff relay 52 is completed from grounded battery, winding of cutoff relay 52, conductor 68, line terminal 69, lower brush 6, side switch wiper 70 in its second position, winding of impedance coil 67 to ground. The cutoff relay 52, when energized, operates in the well-known manner. In this position of the side switch wipers the line relay 71 of the connector is energized over a circuit established from grounded battery, winding of relay 71, conductor 72, side switch wiper 63 in its second position, upper brush 6, terminal 55, right-hand armature and front contact of cutoff relay 52, substation apparatus 50, left-hand armature and front contact of the cutoff relay 52, conductor 68, line terminal 69, lower brush 6, side switch wiper 70, coil 67 to ground. The relay 71 is energized and attracts its armature and thereby completes an energizing circuit for the slow-releasing relay 73, which extends from grounded battery, winding of relay 73, front contact and armature of relay 71 to ground. Relay 73 attracts its armatures and at its left-hand armature closes a break point in the energizing circuit of slow-releasing relay 74, and in the operating circuit of the motor

magnet 75 of the connector. When the calling party operates his sending device to transmit impulses corresponding to the number of the called line, the line relay 71 vibrates its armature. It will be understood that the slow-releasing relay 73 does not deënergize during these momentary interruptions in its energizing circuit, but holds its armature attracted. The slow-releasing relay 74 has its energizing circuit established from grounded battery, winding of relay 74, left-hand front contact and armature of relay 73, back contact and armature of relay 71 to ground. An operating circuit for the motor magnet 75 of the connector, in parallel with the circuit just described, extends from grounded battery, winding of motor magnet 75, side switch wiper 76 in its second position, to ground at the line relay. As soon as the relay 74 attracted its right-hand armature, an operating circuit for the escape magnet 57 is established from grounded battery, winding of magnet 57, side switch wiper 58 in its second position, conductor 77, right-hand contact and armature of relay 74 to ground. At the left-hand armature of relay 74 a circuit is closed which may be traced from grounded battery, winding of motor magnet 60, outer armature and back contact of escape magnet 57, left-hand armature and front contact of relay 74, conductor 78, right-hand winding of relay 79, side switch wiper 80 in its second position, conductor 81, lower brush 12, terminal 101, through the winding of a relay similar to 82 associated with another connector when the desired line is busy. The relay 79 attracts its armatures and at its right-hand armature closes a circuit to transmit a busy tone to the calling subscriber. This circuit may be traced from ground, secondary winding of induction coil 83, right-hand armature and front contact of relay 79, condenser 65, conductor 66, side switch wiper 70 in its second position, lower brush 6, terminal 69, conductor 68, left-hand front contact and armature of relay 52, substation apparatus 50, right-hand front contact and armature of relay 52, contact 55, upper brush 6, side switch wiper 63 in its second position, conductor 72, condenser 96, resistance winding 94 to grounded battery. The busy tone device, consisting of the well-known interrupter 84 and the primary winding 85 of the induction coil, is operated in the well-known manner to impose a tone in the circuit just described by means of the secondary winding 83 of the induction coil.

At the left-hand armature of relay 79 a circuit is completed to prevent the escape magnet 57 from deënergizing, and thus permit the side switch to move into position 3. If the side switch moved into position 3, under these conditions, ringing current would be projected over a busy subscriber's line. The circuit for escape magnet 57 extends from grounded battery, winding of magnet 57, side switch wiper 58, conductor 77, left-hand armature of relay 79, contacts 97 and 98, front contact and right-hand armature of relay 73 to ground.

At the close of the directive impulses, when the relay 74 has its energizing circuit interrupted at the back contact and armature of relay 71, if the desired line is idle, relay 79 will not be energized, so that a busy tone will not be transmitted to the calling subscriber. The escape magnet deenergizes and removes the side switch wipers into their third position.

In the third position of the side switch wipers, an energizing circuit for the escape magnet 57 extends from grounded battery, winding of magnet 57, side switch wiper 58 in its third position, conductor 86, back contact and armature of ringing trip relay 87, to ground. As soon as the side switch wipers reach position 3, the relay 82 is energized to control a break point in the ringing circuit. The energizing circuit for the relay 82 extends from ground, winding of relay 82, side switch wiper 80 in its third position, conductor 81, lower brush of set 12, terminal 101, to battery through the cutoff relay of the called line. In this position of the side switch wipers, ringing current is applied to the called subscriber's telephone line. This circuit for applying ringing current extends from grounded battery, ringing generator 88, winding of ringing trip relay 87, armature and front contact of relay 82, side switch wiper 89 in its third position, conductor 90, upper brush 12, contact 100, through the telephone line and substation apparatus 99 of the called subscriber's line, contact 101, lower connector brush 12, conductor 81, side switch wiper 80 in its third position, relay 82 to ground. The ringing trip relay 87 is marginal and does not operate until the called subscriber removes his receiver from the switchhook, whereupon relay 87 attracts its armature and thereby interrupts the operating circuit of escape magnet 57. This magnet moves the side switch wipers into their fourth or talking position.

At the close of the conversation, when the calling subscriber replaces his receiver on the switchhook, the energizing circuit of line relay 71 is interrupted, and this relay retracts its armature. This completes an energizing circuit for the release magnet 91, which circuit extends from grounded battery, winding of relay 91, right-hand armature and back contact of relay 95, conductor 92, left-hand back contact and armature of relay 73, back contact and armature of relay 71 to ground. Release magnet 91 attracts its armature and closes a locking circuit for itself which is established from grounded battery, winding of relay 91, off-normal con-

tact 93, armature and front contact of release magnet 91 to ground. The release magnet 91, by attracting its armature, withdraws the holding pawls 16 and 20, and moves arm 21 to engage the rod 24 of the U-shaped member 22 of the side switch to restore this switch to its normal position.

The talking battery for the calling party is supplied from the lower side of the line through the winding of relay 71 and resistance 67, and the talking battery for the called party's line through resistance 94 through the upper side of the line.

What is claimed is:

1. In a telephone system, a plurality of telephone lines, a single unitary automatic switch having contacts in which said telephone lines terminate, means for operating said switch, and an auxiliary switch for controlling the operation of said automatic switch to interconnect any one of said lines with any other of said lines.

2. In a telephone system, a plurality of telephone lines, an automatic switch having contacts in which said telephone lines terminate, means for operating said switch to interconnect any one of said lines with any other of said lines, pawls for maintaining said automatic switch in the position to which it has been advanced, and a single electromagnetic means for operating said pawls.

3. In a telephone system, a plurality of telephone lines, an automatic switch having contacts in which said telephone lines terminate, means for operating said switch to interconnect any one of said lines with any other of said lines, said automatic switch having two sets of independently movable brushes, means for operating each of said sets of brushes, and a multiposition auxiliary switch for controlling the operating circuits of both of said sets of brushes.

4. In a telephone system, a plurality of lines, a switch having contacts in which said lines terminate and also having two sets of independently movable brushes for connecting any one of these lines with any other line, means for operating each of said sets of brushes, pawls for holding said sets of brushes in the position to which they have been operated, and a single releasing means for operating said pawls.

5. In a telephone system, a plurality of lines, fixed contacts in which said lines terminate, a switch for connecting any one of said lines to any of the others of said lines, said switch having a shaft, a set of brushes carried by said shaft, a second set of brushes rotatable on said shaft, means for operating each of said sets of brushes, a single release mechanism for releasing both of said sets of brushes, and a side switch for controlling the sequence of operation of each of said sets of brushes.

6. In combination, a plurality of telephone lines terminating in fixed contacts, a switch having two sets of brushes, one set of brushes mounted to engage certain faces of said fixed contacts, the other set of brushes mounted to engage other faces of said fixed contacts, the first set of brushes operating to seize any one of said lines when it is a calling line, the second set of brushes operating to seize any of said lines when it is a called line, means for operating each of said sets of brushes, pawls for maintaining said switch in the position to which it has been moved, and a single release magnet for actuating said pawls.

7. In a telephone system, a group of telephone lines, a single unitary automatic switch having contacts in which said telephone lines terminate, means for operating said switch, and an auxiliary switch for controlling the operation of said automatic switch to interconnect any one of said lines of the group with any other lines of the same group.

In witness whereof, I hereunto subscribe my name this 16th day of November, A. D. 1916.

CHARLES L. GOODRUM.