March 2, 1926. 1,575,604

W. T. POWELL

MANUAL TELEPHONE SYSTEM

Filed Jan. 30, 1924 2 Sheets-Sheet 1

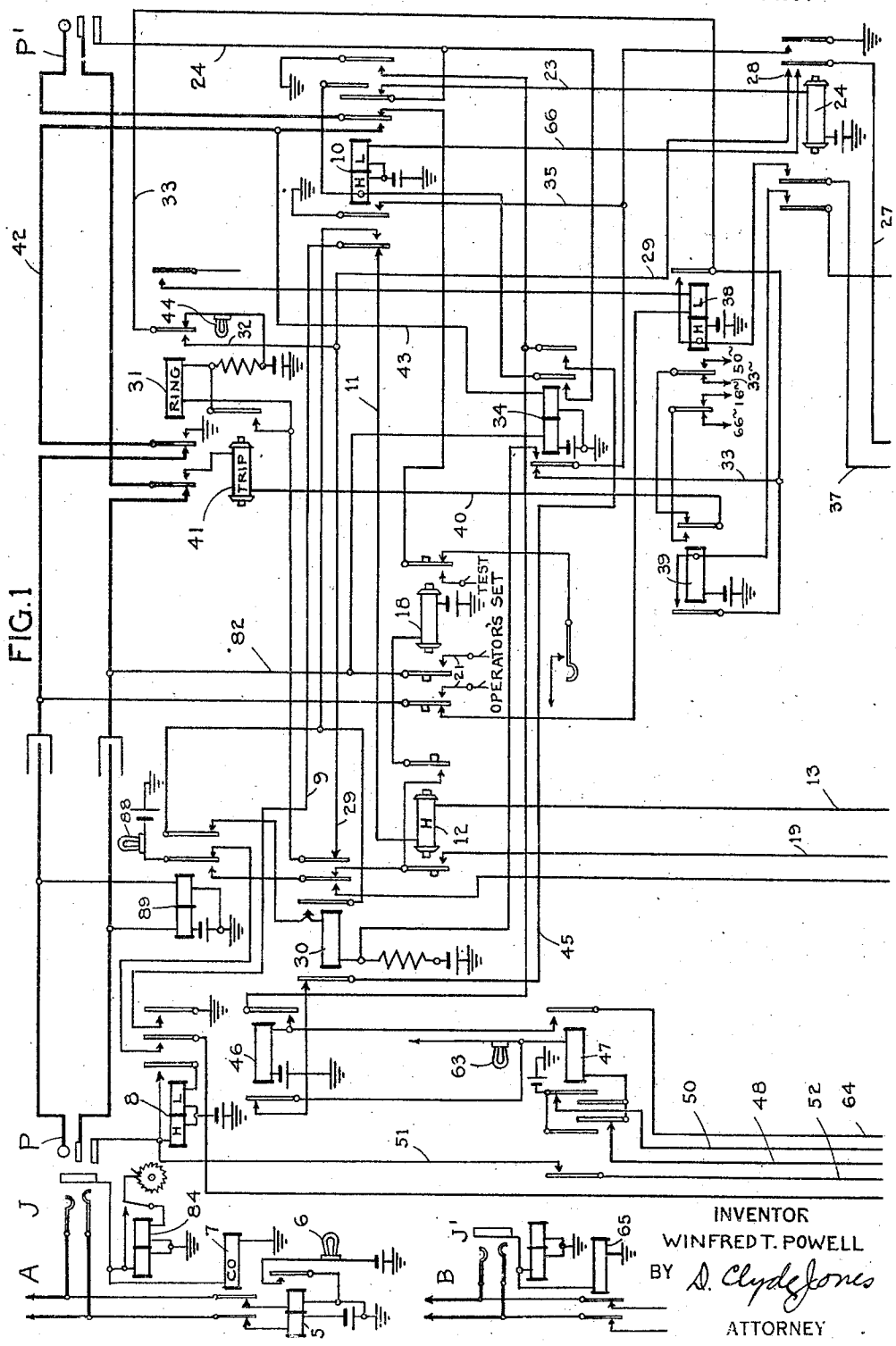


FIG. 1

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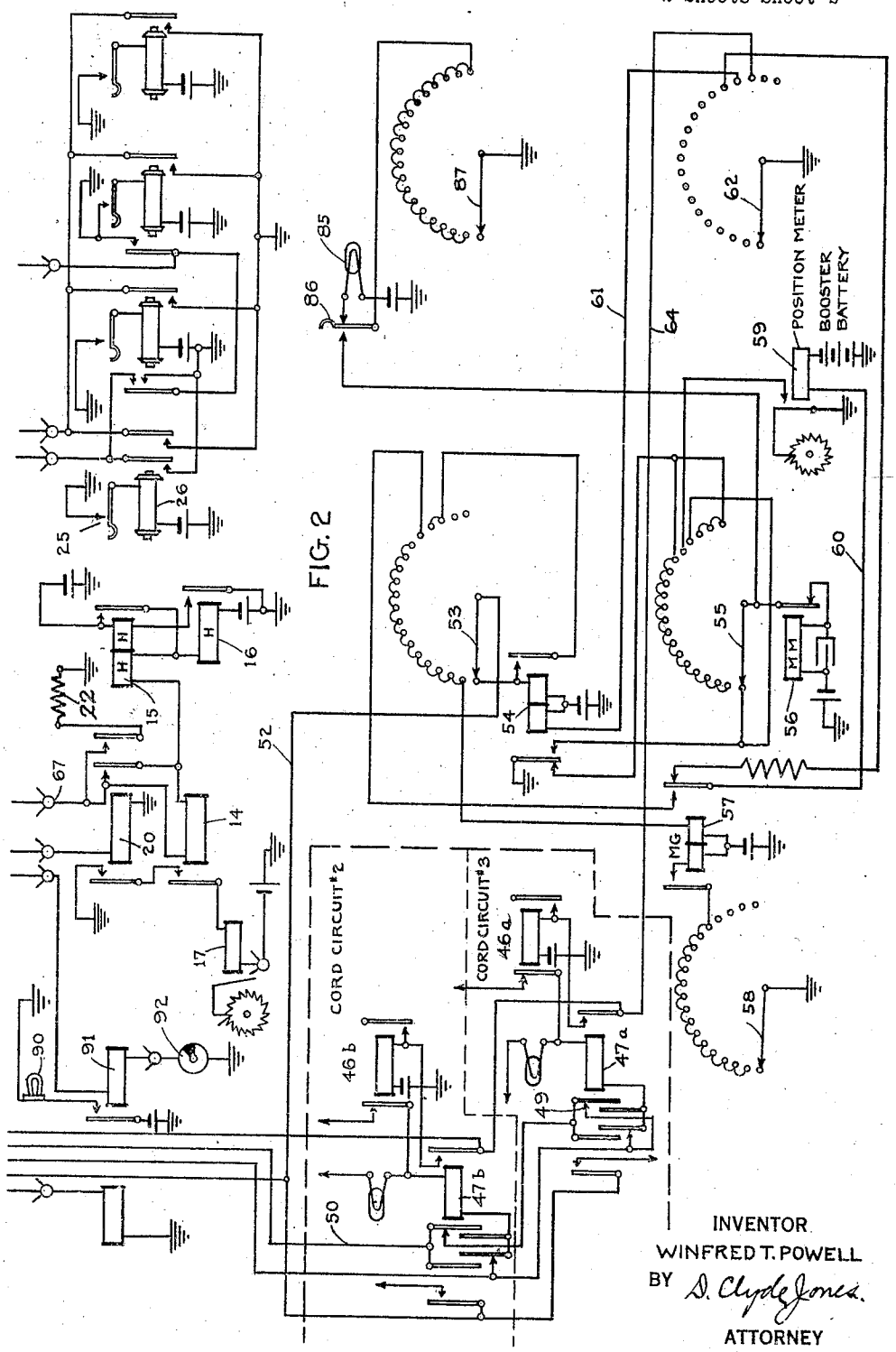


FIG. 2

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UNITED STATES PATENT OFFICE.

WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

MANUAL TELEPHONE SYSTEM.

Application filed January 30, 1924. Serial No. 689,570.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Manual Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to manual telephone systems, in which certain telephone lines are provided with message charging devices.

The present invention has for its purpose novel means associated with the cord circuits of a manual telephone system for operating in a reliable manner the line meter or other charging device associated with a calling line.

One of the features of the present invention resides in the provision of a multi-position stepping switch cooperating with a manual cord circuit for operating the line meter associated with a calling line, once and once only during a completed connection.

Other features of this invention will appear from the detailed description and the appended claims.

The drawings, with Fig. 1 placed above Fig. 2, diagrammatically represent a portion of a telephone system employing the present invention. At the extreme left of Fig. 1 there are represented two telephone lines without substations. At the right of these lines there is shown the equipment individual to a cord circuit at an operator's position. Above and to the right of the dotted enclosure of Fig. 2 there is shown the equipment common to a plurality of cord circuits at a manual operator's position. Two dotted enclosures are shown in Fig. 2 in each of which there is represented two relays individual to a cord circuit, similar to that shown in Fig. 1. The progressively movable switch shown in Fig. 2 may be substantially similar to that described in the patent to Clement #1,107,153, granted August 11, 1914.

It is believed that the invention will best be understood by describing the method of extending a telephone connection from a calling line such as that designated "A" to a called line "B" which is a party line.

When the subscriber removes his receiver (not shown) from its switchhook (also not shown), a circuit is closed through both windings in series of the line relay 5, over the two sides of the calling telephone line. The line relay 5 is thus actuated and lights the line signal 6 in the well known manner. The operator on noting that a call is waiting attention inserts the plug P into the jack J of the calling telephone line. This operation is effective to close a circuit for the cut-off relay 7 from ground through the sleeve contacts of the jack J and plug P, left hand high resistance winding of the relay 8 to grounded battery. The relays 7 and 8 are energized in this circuit and the cut-off relay 7 disconnects the line relay 5 from the control of the calling line and thereby extinguishes the line lamp. The relay 8 on energization closes a locking circuit for itself from grounded battery, its right hand winding, its innermost armature and front contact through the previously described circuit to ground, through the winding of the cut-off relay 7.

It should be noted at this time that the high and low resistance windings of the relay 8 are provided to prevent an operator from obtaining a connection to a telephone line to which some other circuit has been previously connected. As soon as the low resistance winding of the relay 8 is included in the last described holding circuit, if the high resistance winding of a second cord circuit is connected in multiple therewith, as is the case when the answering plug of a second cord circuit is connected to the same calling line, then the second sleeve relay corresponding to 8 will not operate.

As soon as the relay 8 is energized it closes a circuit from ground, its outer armature and front contact, conductor 9, left hand armature and back contact of relay 10, conductor 11, winding of the relay 12, which is so designed that it is slow in attracting its armatures and likewise slow in releasing the same, conductor 13, winding of relay 14, left hand winding of relay 15, winding of relay 16 to grounded battery. The winding of relay 16 is of very high resistance so that the relays 12, 14 and 15 will not be energized in series therewith. The relay 16, however, is energized and attracts its armatures, thereby, closing a circuit from grounded battery, right hand winding of

relay 15, front contact and armature of relay 16 to ground. Relay 15 is thus energized and closes another circuit from grounded battery, its front contact and armature, its left hand winding, winding of relays 14 and 12 in series, to ground over conductor 11 as previously described.

Relays 14 and 12 are energized in the last described circuit and the relay 14 closes a break-point in the operating circuit of the peg-count meter 17, which counts the number of calls that the operator answers. Relay 12 on energization closes an actuating circuit for the relay 18 which is similar in design to relay 12. This circuit may be traced from grounded battery, winding of the relay 18, front contacts and armatures of relay 12, conductor 19, winding of relay 20 to ground. Relay 18 thus attracts its armatures and extends the conductors 21 to the answering end of the cord circuit, whereby the operator's head set is connected to the calling line. Relay 20 is also energized in series with relay 18 and at its inner armature and front contact, closes a circuit about the relay 14 causing this relay to deenergize, but before this has happened the meter 17 is operated from grounded battery, its winding, through the armatures and front contacts of relays 14 and 20 to ground. The resistance 22 is also connected in multiple with conductor 13 at this time, for a purpose to be described.

The present circuit is so arranged that the operator can insert the answering plug of a second cord circuit into a jack of a second calling line before she has completed the connection on the first cord circuit. For this purpose, means are provided to prevent the operator's telephone set from being connected to more than one cord circuit at a time but to permit the disconnection of the operator's telephone set from the first cord circuit and to connect it to the mentioned cord circuit, as soon as the first connection is completed. It will be remembered that the relay 12 on operation, controls means by which the operator's telephone set is connected to a cord circuit. When this relay is operated, its left hand armature and front contact closes a circuit including the relay 20 and this last relay on operation establishes a connection from the common terminal 67, through the winding of the resistance coil 22 to ground. This last described circuit places a shunt across the winding of a relay such as 12 of a second cord circuit whose answering plug has been connected to the jack of the calling line. This renders the relay similar to relay 12 at the second cord circuit inoperative, due to the fact that all the relays such as 12, at an operator's position are supplied with battery through the relatively high resistance left hand winding of relay 15. The failure to operate of the relay similar to 12 at the second cord circuit prevents the connection of the operator's telephone set to this cord. When, however, the relay 12 of the first cord circuit is released, due to the fact that the connection through the first connection is completed, then the relay similar to 12 of the second cord circuit functions to connect the operator's telephone set to that cord. The resistance values of the relays 14, 15, 16 and 20, as well as the resistance coil 22 are such that the system will not function if more than one answering cord circuit in advance is connected to a calling line. If the operator attempts to plug in more than one answering cord in advance at a time, then all calls are blocked from this operator's position until the operator reduces the number of calls in the course of connection to the proper number.

The operator as soon as her head set is connected to the calling line requests the number of the wanted line, tests this line by touching the tip of the plug P′ to the sleeve of the jack J′ in accordance with the usual practice and if idle inserts the calling plug into the multiple jack J′. When the plug P′ is inserted in the jack J′ of the called line a circuit is closed from ground at the cut-off relay 65 of this line, sleeve of the plug P′, continuity spring and back contact of relay 10, conductor 23, winding of the slow releasing relay 24 to grounded battery.

The operator now depresses some one of the four ringing keys, shown in Fig. 2, one ringing key being provided for each of the sources of ringing current indicated as sixteen, thirty-three, fifty and sixty-six cycle current in the lower right-hand corner of Fig. 1, which keys are common to several cord circuits. For the purpose of this description it is assumed that key 25 is depressed. This is effective to operate the slow releasing relay 26 and this last named relay then closes a circuit from ground, its front contact and armature, conductor 27, armature and contact 28 of relay 24, conductor 29, outer back contact and armature of relay 30, winding of the ringing relay 31 to grounded battery. The ringing relay by its operation, closes a locking circuit for itself from grounded battery, resistance, its winding, outer armature and back contact of relay 30, conductor 29, conductor 32, inner right hand front contact and armature of relay 31, conductor 33, left hand back contact and armature of relay 34, conductor 35, inner left hand front contact and armature of relay 10 to ground. This locking circuit serves to hold the ringing relay operated during the ringing interval until the called party responds. At this time the relay 10, is energized through its right hand winding and conductor 66 in multiple with the op-

erating circuit of the ringing relay 31. Relay 10, when operated, locks itself in this condition, through its middle armature and continuity spring, to ground over conductor 24. Also in response to the operation of relay 26 a circuit is closed from ground, inner front contact and armature of relay 26, conductor 37, inner armature and front contact of relay 24, left hand winding of relay 38 to ground battery. Relay 38 on operation, closes a locking circuit for itself through its left hand winding, its right hand front contact and armature to ground over the conductor 33. The actuation of the frequency selection relay 38 closes a ringing circuit from the 50 cycle source of ringing current, inner left hand armature and front contact of relay 38, right hand back contact and armature of relay 39, conductor 40, winding of the trip relay 41, outer front contact and armature of the ringing relay 31 over the lower side of the calling end of the cord circuit, through the called line B and its substation (not shown) over the upper side 42 of the calling cord, innermost armature and front contact of relay 31 to ground. Ringing current is supplied over this circuit until the called party responds. At this time the relay 41 attracts its armature, to short circuit the ringing relay 31, causing its to release its armatures to close break-points in the calling end of the cord circuit and at the same time to discontinue the application of ringing current to the wanted line.

The closure of the break points in the calling end of the cord circuit is effective to energize the calling supervisory relay 34 in a circuit traceable from grounded battery, left hand winding of this relay, conductor 82, outer back contact and armature of relay 31, ring contact of the plug P′, ring contact of the jack J′ and through the called substation (not shown) over line B, tip contacts of the jack J′ and plug P′, inner right hand armature and front contact of relay 10, conductor 43, right hand winding of relay 34 to ground. The relay 34 is energized in this circuit and at its left hand armature and back contact opens the holding conductor 33, which prevents the supervisory lamp 44 from lighting, and also permits the release of the ringing frequency selector relay 38.

Also when the supervisory relay 34 is operated it indicates that the call has been extended to the wanted subscriber and that the calling party should be charged for this connection. This charge is made on a line meter 84, which is operated and controlled in a manner which will now be described. As soon as the supervisory relay 34 is operated, a circuit is closed from ground at the outermost right hand front contact and armature of relay 10, outer right armature and front contact of relay 34, conductor 45, left hand armature and back contact of relay 30, back contact and armature of relay 46, winding of relay 47, its continuity spring and back contact, conductor 48, back contact 49 and continuity spring of relay 47^a, back contact and continuity spring of relay 47^b, conductor 50, back contact and continuity spring of relay 48 to grounded battery. This chain circuit through the relays 47, 47^a and 47^b, insures that if several calling supervisory relays, such as 34, are operated at the same time, only one cord circuit is connected with the common apparatus of Fig. 2. This provides that there will be no confusion in operating the line meters. The operation of charging for the call is effected so quickly that there will be no appreciable delay in such a case, due to the fact that the common charging circuit functions in a fraction of a second. As soon as the relay 47 is operated, it extends the sleeve contacts of the cord in a circuit extending from ground, left hand winding of the line meter 84, sleeve contacts of the jack J and the plug P, conductor 51, outer front contact and armature of relay 47, conductor 52, switch brush 53 in its first position, right hand winding of relay 54 to grounded battery. Relay 54 is thus operated and closes a circuit from ground, armature and front contact of relay 54, switch brush 55 in its first position, armature, back contact and winding of the motor magnet 56 to grounded battery. This circuit operates the magnet 56 which advances the brushes of the switch into their second position. This last operation opens the operating circuits of relay 54 at brush 53 and causes the release of this last named relay. When relay 54 thus retracts its armatures it closes a circuit from ground, its armature and back contact, switch brush 55 in any of its positions from 2 to 15 inclusive, armature, back contact and winding of motor magnet 56, to grounded battery. This circuit causes the motor magnet 56 to advance its brushes progressively, into their sixteenth position. While the switch is advancing its brushes into position 16, a circuit is closed from grounded battery, right hand winding of the marginal relay 57, brush 53 in any of its positions 2 to 15 inclusive, conductor 52 and thence over the circuit previously described, to ground through the left hand winding of the meter 84. Sufficient current flows in this last described circuit, through the meter magnet and through the cut-off relay 7 in multiple therewith, to operate the marginal relay 57, during the time that the switch is passing through positions 2 to 15. The operation of relay 57 closes a locking circuit for itself to ground at brush 58, thus preventing the release of this relay, after the conductor 52 is disconnected from its

right hand winding, when the brush 53 has moved to position 16.

With the switch brushes in position 16 a circuit is closed from the booster battery through the position meter 59, conductor 60, right hand armature and front contact of relay 57, brush 53 in position 16, conductors 52 and 51 through the plug and jack sleeve contacts, left hand winding of the line meter 84 to ground. The booster battery is effective to operate the line meter, but is not effective to operate the position meter 59. When the line meter 84 is operated it closes a circuit for connecting its second winding in multiple with the first, and locks itself in this condition, in a circuit closed through the right hand winding of relay 8 to grounded battery. In this way, if the operator plugs in and out with the calling plug of this cord circuit the line meter will not be falsely operated.

With the two windings of the line meter 84 in multiple with the circuit including conductor 51, sufficient current flows through the position meter 59 to operate the same and when operated it advances the switch to position 17. The circuit for effecting this operation extends from ground at the armature and front contact of meter 59, brush 55 in position 16, armature, back contact and winding of the motor magnet 56 to grounded battery. As soon as the brush 58 leaves position 16 the relay 57 deenergizes. With the switch brushes standing in position 17, the relay 54 is actuated from grounded battery, left hand winding of this relay, conductor 61, switch brush 62 in position 17, to ground. The relay 54 is thus operated and closes a circuit from ground, its left hand armature and front contact, switch brush 55 in position 17, armature, back contact and winding of motor magnet 56 to grounded battery. This operates magnet 56 to advance the switch brushes into position 18, which interrupts the circuit through the left hand winding of relay 54 at brush 62, but relay 54 is locked operated through its right hand winding and brush 53 in position 18. With relay 47 operated and with the switch in position 18, relay 46 is actuated over conductor 64 to ground through brush 62. Operation of relay 46 opens the circuit of relay 47, causing it to release and preventing its operation again on this call. Therefore, if the operator plugs in and out with the answering plug, the line meter releases and does not operate again to register a false record.

The lamp 63 in multiple with relay 47, may be a red lamp for the purpose of giving the operator or supervisor a visual indication that metering is taking place. It flashes every time a called party answers and if relay 47 remains energized for an appreciable time, indicating that it is blocking other cord circuits from the use of the common metering circuit, it burns steadily.

The release of relay 47 described above, opens the locking circuit of the relay 54 which closes a circuit for advancing the switch to its normal position. This circuit extends from ground at the armature and back contact of relay 54, brush 55 in positions 18 to 20, armature, back contact and winding of the motor magnet 56 to grounded battery. The apparatus is now in condition for use on a succeeding call.

In the preceding description it has been assumed that the calling line is provided with a line meter. In the event that this line is not provided with such a meter, the marginal relay 57 does not obtain sufficient current to operate, while the switch moves to position 16. Under this condition, a circuit is closed through brush 62 in position 16 to operate the position meter 59, which counts the number of connections completed by the operator. When this meter operates, it closes a circuit to advance the switch to position 17. It will be seen that the booster battery is not connected to the circuit including conductors 52 and 51, sleeve contacts of the answering plug and jack contact. The remainder of the operation of the common equipment on this class of calls is exactly the same as previously described, during the time that the switch is advancing through position 17 to normal.

In the event that the calling party abandons the call and the called party answers before the connection is taken down, the metering equipment is not operated, since the relay 30 is operated and the circuit for actuating the common metering equipment of Fig. 2, is through a back contact of this relay.

In the event that the progressively movable switch fails to complete its cycle of operation, the lamp 85 burns for an abnormally long period. This is a signal to the operator that there has been a failure in the stepping switch. The operator on noting this signal depresses the key 86. This closes a circuit from ground through the switch brush 87 in any of its off-normal positions, normally open key contacts 86, armature, back contact and winding of motor magnet 56 to grounded battery. Under the control of this circuit the motor magnet advances the brushes of this switch to their normal position.

At the termination of the conversation by the calling subscriber at A, the supervisory lamp 88 is lighted in the well known manner. Likewise when the called subscriber at B terminates the connection the supervisory lamp 44 is also lighted in the well known manner. The lighting of these lamps is a signal to the operator that the connection is terminated, whereupon she removes the

plugs P and P′ from the jacks J and J′. This operation releases the apparatus of the cord circuit into its normal position.

The cord circuit of Fig. 1 is also provided with an arrangement whereby the answering supervisory lamp 88 is flashed intermittently when the calling subscriber desires to regain the attention of the operator. To accomplish this result the calling subscriber temporarily opens the hookswitch contacts. This releases the answering supervisory relay 89 which in turn actuates the relay 30 from grounded battery, resistance, winding or relay 30, outer-back contact and armature of relay 89, outer-front contact and left hand armature of relay 10, conductor 9, outer front contact of relay 8 to ground. Relay 30 is then locked operated through its front contact and armature until relay 10 is released by the removal of the plug P′ from the jack with which it is in engagement. When the calling subscriber at A again removes his receiver from its switchhook, relay 89 again attracts its armatures so that a circuit is closed from grounded battery, lamp 88, inner armature and front contact of relay 89, middle armature and front contact of relay 30, winding of relay 91, through the interrupter 92 to ground. Under the control of this circuit the lamp 88 is intermittently flashed, as is also the pilot lamp 90 of Fig. 2.

It will thus be seen that a novel arrangement is provided for the charging of calls to the calling subscriber.

What I claim is:

1. In a telephone system, a telephone line provided with a message-charging device, a second telephone line, means including a cord circuit terminating at each end in a manual switch for interconnecting said telephone lines, a normally inoperative progressively movable switch associated with said cord circuit, automatic means responsive to the completion of a telephone connection between two telephone lines for operating said switch and means including said progressively movable switch for controlling the operation of said message-charging device.

2. In a telephone system, a plurality of telephone lines, certain of said telephone lines being provided with message-charging devices, means including a plurality of cord circuits each terminating at each end in a manual switch for interconneting said telephone lines, and a normally inoperative progressively movable switch common to said cord circuits and cooperating automatically therewith responsive to the completion of a telephone connection between two telephone lines for controlling the operation of the message-charging device associated with a telephone line when said telephone line is calling.

3. In a telephone system, a plurality of telephone lines, certain of said telephone lines being provided with message-charging devices, means including a plurality of cord circuits for interconnecting said telephone lines, each of said cord circuits terminating at each end in a manual switch, a series circuit extending through a plurality of said cord circuits, a normally closed set of contacts in said series circuit at each of said cord circuits, a relay in each cord circuit for controlling said set of contacts, a progressively movable switch common to said cord circuits, means including said progressively movable switch and one of the said relays for operating the message-charging device of the calling telephone line, and means including said last mentioned relay for opening said series circuit.

4. In a telephone system, a plurality of telephone lines, certain of said telephone lines being provided with message-charging devices, means including a plurality of cord circuits for interconnecting said telephone lines, each of said cord circuits terminating at each end in a manual switch, a progressively movable switch common to said cord circuits, a series circuit extending through a plurality of said cord circuits, a normally closed set of contacts in said series circuit at each of said cord circuits for insuring the association of said progressively movable switch with one cord circuit at a time, a relay in each cord circuit for controlling said set of contacts, means including said progressively movable switch and one of said relays for operating the message-charging device of the calling telephone line, and means including said last mentioned relay and its set of contacts for controlling said series circuit.

5. In a telephone system, an incoming line, a plurality of party lines, a plurality of cord circuits each terminating at each end in a manual switch, any one of said cord circuits being operable to interconnect said incoming telephone line with any of said party telephone lines, a plurality of sources of signaling current for selectively signaling parties on a party line, a key common to said cord circuits for each source of current, means actuated by the response of the party on the called telephone line for disconnecting said source of signaling current therefrom, a line meter associated with said incoming telephone line, and means including a normally inoperative, progressively movable switch common to said cord circuits and automatically controlled by the response of the called party for operating said line meter.

6. In a telephone system, an incoming line, a plurality of party lines, a plurality of cord circuits each of which terminates at each end in a manual switch for extending

said incoming line to a wanted party line, an operator's telephone set, means associated with said cord circuits for connecting said telephone set to one selected cord circuit at a time, a message-charging device associated with said incoming line, and a normally inoperative, progressively movable switch common to said cord circuits and cooperating automatically with the selected cord circuit under control of a called party for actuating said message-charging device.

7. In a telephone system, an incoming line, a message-charging device for said line, a plurality of party lines, a plurality of cord circuits terminating at each end in a manual switch, each of said cord circuits serving when selected to interconnect said incoming telephone line and a wanted party line, an operator's telephone set common to said cord circuits, means responsive to the connection of a selected cord circuit to said incoming telephone line for connecting said telephone set to said cord circuit, a second cord circuit connected to a telephone line, means for effecting the disconnection of said telephone set from said first cord circuit and for connecting same to a second cord circuit, means preventing the connection of said telephone set to any cord circuit if more than a predetermined number of connections of cord circuits to telephone lines are made simultaneously, and means including a normally inoperative, progressively movable switch common to said cord circuits and cooperating automatically with a selected cord circuit under control of a called party for actuating said message-charging device.

8. In a telephone system, a plurality of telephone lines, certain of said telephone lines being provided with message-charging devices, means including a plurality of cord circuits for interconnecting said telephone lines, each of said cord circuits terminating at each end in a manual switch, a progressively movable switch common to said cord circuits, a series circuit common to a plurality of said cord circuits, a normally closed set of contacts in said series circuit at each of said cord circuits, a relay in each cord circuit for controlling the associated set of contacts, a branch circuit for each cord circuit, said branch circuit including the relay thereof and arranged to be completed by the response of the called party on the line connected to its cord circuit, the relay of said last mentioned cord circuit on energization being effective to disable said series circuit for the other cord circuit relays, and means including said progressively movable switch and said last mentioned relay for operating the message-charging device of a calling telephone line.

9. In a telephone system, a plurality of telephone lines, certain of said telephone lines being provided with message-charging devices, means including a plurality of cord circuits for interconnecting said telephone lines, each of said cord circuits terminating at each end in a manual switch, a progressively movable switch common to said cord circuits, a series circuit common to a plurality of said cord circuits, a normally closed set of contacts in said series circuit, a cord circuit relay in each cord circuit for controlling the set of contacts thereof, a branch circuit for each cord circuit including its relay and arranged to be completed by the response of the called party on the telephone line connected to its cord circuit, the relay of said last mentioned cord circuit on energization being effective to disable said series circuit for the other cord circuit relays, means including said progressively movable switch and the cord circuit relay of said last mentioned cord circuit for operating the message-charging device of the calling telephone line, a second relay for each cord circuit operated on the actuation of the message-charging device of the calling line, and means responsive to the energization of said second relay for releasing said operated cord circuit relay to restore said series circuit to the control of said other cord circuit relays.

10. In a telephone system, a plurality of telephone lines, certain of said lines being provided with message-charging devices, means including a plurality of cord circuits for interconnecting said telephone lines, each of said cord circuits terminating at each end in a manual switch, a progressively movable switch common to said cord circuits, a series circuit common to a plurality of said cord circuits, a normally closed set of contacts in said series circuit at each of said cord circuits, a cord circuit relay in each cord circuit for controlling the associated set of contacts, a branch circuit for each cord circuit, said branch circuit including the relay thereof, a supervisory relay in each cord circuit energized by the response of the called party on the line connected to its cord circuit to complete said branch circuit, the cord circuit relay of said last mentioned cord circuit on energization being effective to disable said series circuit for the other cord circuit relays, and means including said progressively movable switch and said last mentioned relay for operating the message-charging device of a calling telephone line.

11. In a telephone system, a plurality of telephone lines, certain of said telephone lines being provided with message-charging devices, means including a plurality of cord circuits for interconnecting said telephone lines, each of said cord circuits terminating at each end in a manual switch, a progressively movable switch common to said cord circuits, a series circuit common

to a plurality of said cord circuits, a normally closed set of contacts in said series circuit at each of said cord circuits, a cord circuit relay in each cord circuit for controlling the set of contacts thereof, a branch circuit for each cord circuit including its relay arranged to be completed by the response of the called party on the line connected to its cord circuit, the relay of said last mentioned cord circuit on energization being effective to disable said series circuit for the other cord circuit relays, means including said progressively movable switch and the cord circuit relay of said last mentioned cord circuit for operating the message-charging device of the calling telephone line, a second relay for each cord circuit operated by the advance of said progressively movable switch, and means responsive to the energization of said second relay for releasing said operated cord circuit relay and for restoring said series circuit to the control of said cord circuit relays.

In witness whereof, I hereunto subscribe my name this 25th day of January A. D. 1924.

WINFRED T. POWELL.