

Dec. 7, 1926.

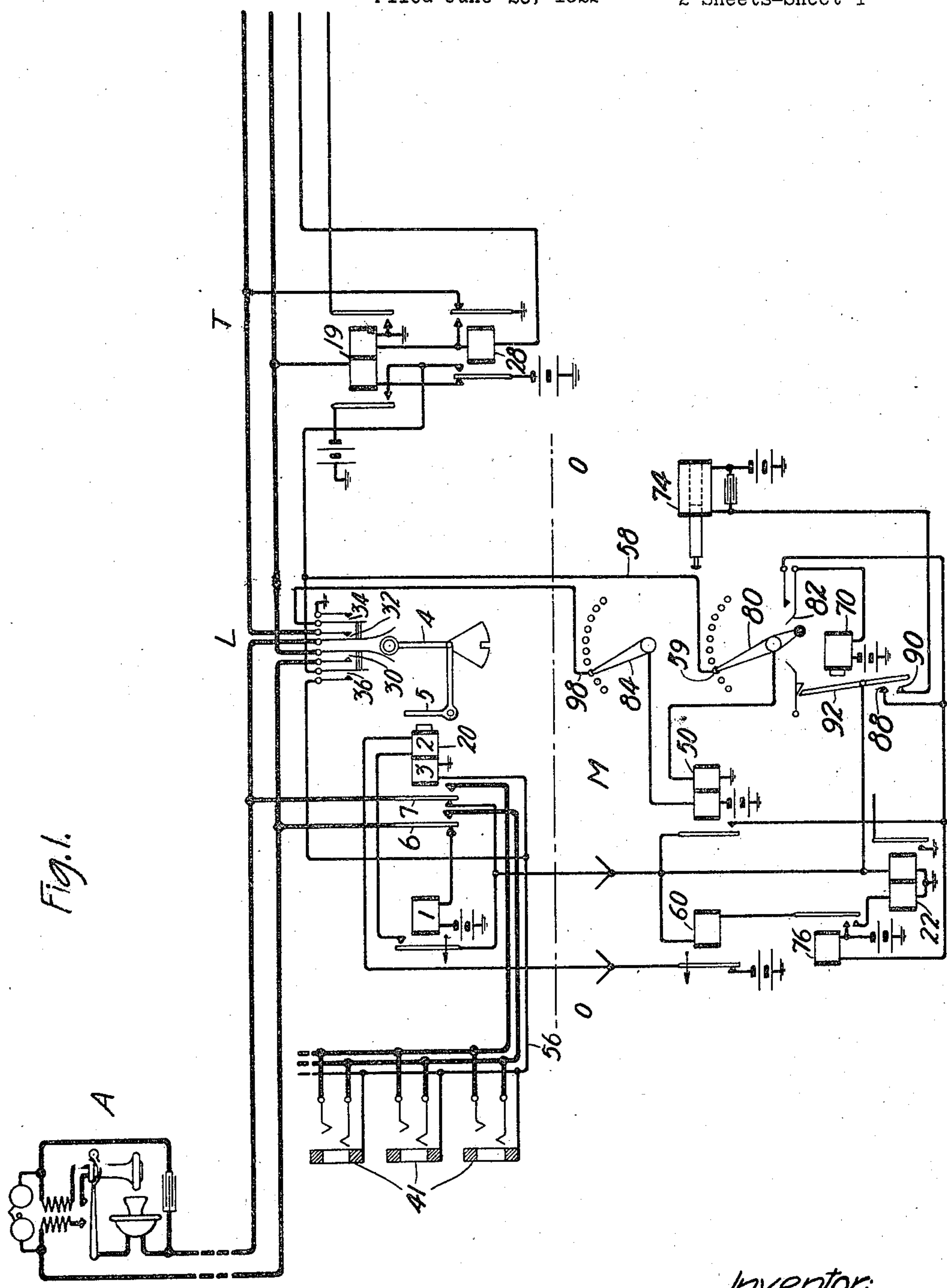
1,609,394

R. S. BAILEY

TELEPHONE SYSTEM

Filed June 29, 1922

2 Sheets-Sheet 1



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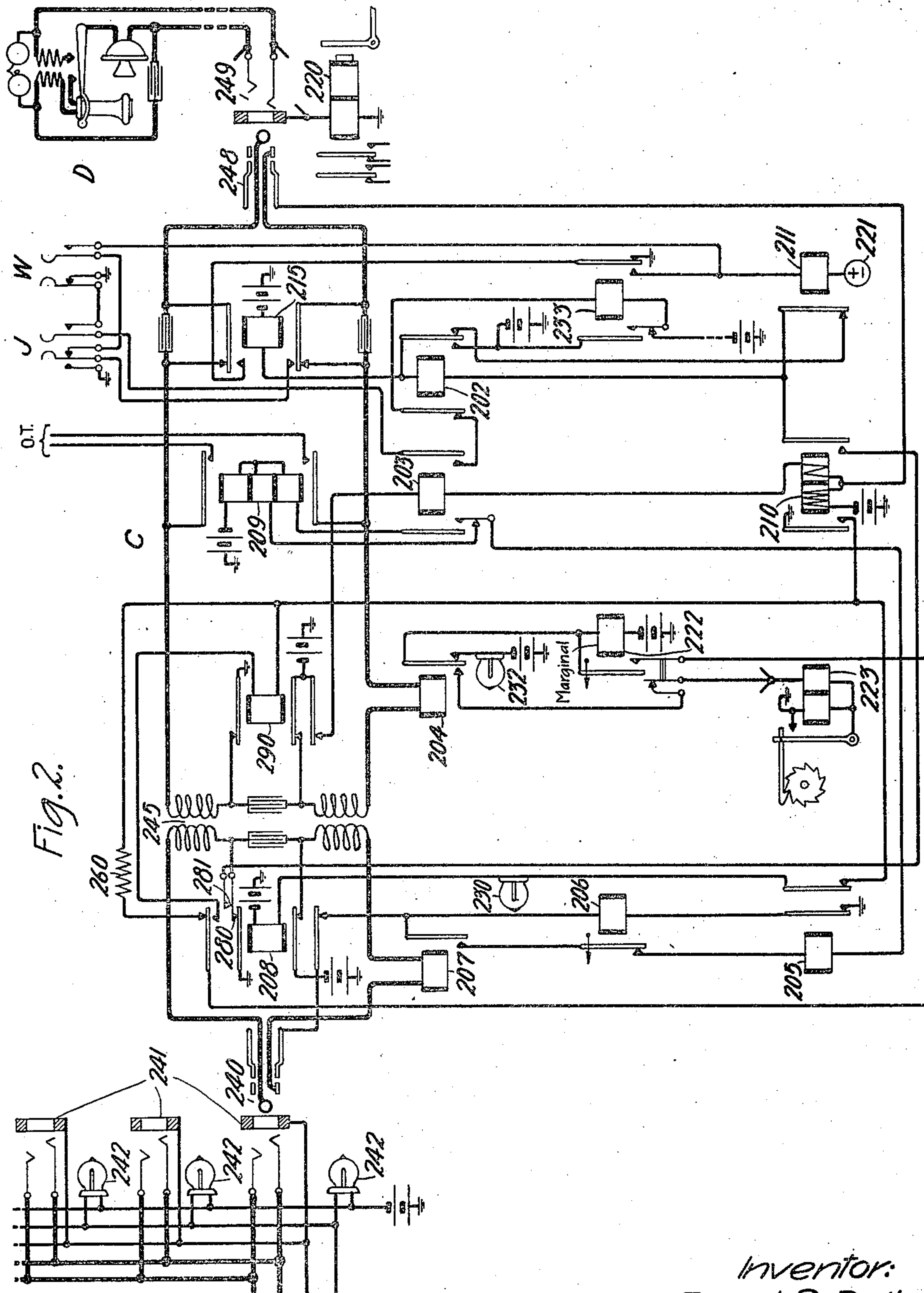
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TELEPHONE SYSTEM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed June 29, 1922. Serial No. 571,612.

This invention relates to telephone systems and more particularly to circuits in such systems for establishing connections between subscribers' lines.

5 An object of the invention is to provide improved circuit arrangements for rapidly and efficiently establishing connections between subscribers' lines.

10 One feature of the invention is the provision of an improved circuit arrangement such that all connections completed by an operator are automatically registered on a counting device.

15 Another feature of the invention is the provision of an improved arrangement for preventing false operation of the counting device.

20 Another feature of the invention is the provision of a circuit arrangement in a cord circuit such that the called supervisory lamp in the cord circuit is not operated when the cord circuit is first extended to the called party but depends for its operation on the preparation of a circuit in response to the answer of the called party.

25 Certain of the features of the present invention disclosed herein are protected by a copending application, Serial No. 718,564, filed June 7, 1924.

30 For a better understanding of the invention, reference may be had to the accompanying drawings in which:

35 Figures 1 and 2, when taken together with Fig. 1 placed to the left of Fig. 2, show circuits for interconnecting a calling and a called station.

40 In Fig. 1 of the drawings, the station A is shown connected to a non-numerical switch L which has access to a plurality of trunks, one of which is shown at T terminating in the multiple answering jacks 241, shown in Fig. 2, at an operator's position. Multiple jacks 41 for the station A are shown. In practice these jacks are located in the subscriber's switchboard and are accessible to the operator. Below the line O—O, a master switch M is shown which is common to a plurality of line switches such as L. The trunk line T is provided with a line relay 19 and a cut-off relay 28.

50 Referring now to Fig. 2 of the drawings, a called station D, a link or cord circuit C and a plurality of multiple answering jacks

241, each having an associated signaling device 242, or lamp, are shown. In the drawing, the lamps are shown connected in multiple but it is to be understood that a series arrangement may be employed.

The cord circuit C comprises an answering plug 240 and a calling plug 248 which are conductively separated but inductively united by a repeating coil 245. Associated with each of the plugs and each of the windings of the repeating coil is a source of current for talking and signaling purposes. Relays 208 and 290, associated with the answering and calling ends of the cord circuit respectively, control the connection of the current to the cord circuit. These relays operate, when the subscribers connected to the respective ends of the cord circuit, hang up their receivers after completion of conversation, to disconnect current from the talking conductors of the cord circuit thereby operatively disassociating the subscribers' stations from the cord circuit. Supervisory relays 207 and 204 associated with the answering and calling ends respectively of the cord circuit, control their respective supervisory signals or lamps 230 and 232.

80 The arrangement of the circuit is such that the calling supervisory lamp does not light until the called party hangs up his receiver after the completion of conversation. A counting or registering device 223, which is common to all of the cord circuits of the operators' positions and which registers all connections completed by the operator when the called party answers, is provided. Relay 209 is provided to automatically connect the operator's telephone set to the cord circuit when the answering plug 240 is inserted into the jack of a calling line. In order to prevent a second operator from operatively associating her head set with a calling line after a first operator has plugged into one of the multiple answering jacks of the calling line, means are provided to prevent the operation of the operator's head set connecting relay 209. The cord circuit C, in addition to being equipped for automatic ringing on single party lines, is also equipped for ringing on two party lines. A key unit comprising keys J and W for ringing two parties, such as J and W parties of a party line, is shown. The key W is nor-

mally operated so that if a single party is rung or the party W on any party line is rung, it is not necessary to actuate a key, the ringing being automatic in this case.

5 If, however, the party J of a two party line is desired, the operator, before plugging into the called line, will actuate the key J whereupon key W will be released. After completion of conversation by the party J the
10 operator actuates key W which releases key J.

The line switch L is of the general type of line switch shown in British patent to R. W. James No. 26,301 of 1906, the particular type shown, however, being similar
15 to that shown in U. S. Patent 1,136,912 to T. G. Martin, issued April 20, 1915 with the exception that the line relay and operating magnet are made separate, instead of
20 being combined in a single structure, similar to that shown in Reissue Patent 13,901 of April 13, 1915 to F. Newforth, Jr. and except as further described herein. Among
25 other details, the line switch comprises a plunger 4 carried upon the end of a plunger armature 5 which is adapted, when the plunger armature is attracted by the magnet
30 20, to cause the closure of some one of a plurality of groups of contact springs, such as 36, 30, 32 and 34. The magnet 20 also controls cut-off armatures 6 and 7 and comprises
35 two windings 2 and 3. The winding 2 is such that current passing therethrough will operate plunger armature 5. Current passing through the winding 3, however, will not
40 operate the plunger armature 5 from its normal position, but will cause the attraction of the armatures 6 and 7 and will hold the plunger armature 5 actuated after it has
45 once been operated. The line relay 1 is slow to deenergize so as to keep the operating winding 2 energized for a short time after the cut-off armatures 6 and 7 have operated to disconnect the line relay 1 from the line.

The master switch M is of the general type of master switch disclosed in Patent 1,186,823 of June 13, 1916, to Frank Newforth, Jr. It includes a starting relay 50, a locking
50 magnet 76, a supervisory relay 22, a solenoid 74 and a battery cut-off relay 60. A switch bank consisting of two sets of ten contacts each is also provided for the master switch, the upper set of contacts being multiplied together. Each contact of the lower
55 set of contacts is associated with one of the trunks to which the line switches have access.

60 A general description of the central office apparatus having been given it will now be explained how a connection may be made between a calling substation A and a called substation D. Since the automatic switching apparatus disclosed herein is, in general,
65 well known in the art, and is described

in publications herein referred to, its operation will be explained in a more or less general manner.

Upon the removal of the receiver from the switchhook at the substation A, the talking circuit of the substation is bridged
70 across the line whereupon a circuit is completed for the line relay 1 of the line switch over a path extending from grounded battery, through the winding of relay 1, back
75 contact and armature 6 of magnet 20 through the substation loop, armature 7 and back contact of magnet 20, and the right-hand winding of relay 22 to ground. Relay 1 thereupon energizes and closes a
80 circuit through the operating winding 2 of magnet 20 whereupon said magnet 20 energizes and thrusts the plunger 4 into the bank terminals of the trunk before which
85 it is being held by the master switch M, and attracts its armatures 6 and 7 to disconnect the line relay 1 from the calling line. The actuation of plunger 4 extends the line conductors of the calling station through the
90 line switch contacts 30 and 32 to the trunk line relay 19. Relay 19 thereupon energizes over a path extending from grounded battery, through the left-hand normal contacts of relay 28, left-hand winding of relay
95 19, contacts 30 of switch L, through the substation loop, contacts 32 of switch L and right-hand normal contacts of relay 28 to ground. Relay 19, in closing its left-hand contacts, completes a circuit through the
100 holding winding 3 of the magnet 20 of the line switch L before the slow to release relay 1 opens the circuit of the operating winding 2 of the magnet 20, and extends a guarding potential over the conductor 58
105 to the test contact 59 of the master switch M. Relay 19 in attracting its right-hand armature completes a circuit through the lamps 242 in multiple whereupon said lamps, each of which is located in front
110 of a different operator at the switchboard, light to indicate to the operators that a call has arrived. When the plunger 4 of the switch L operates, a circuit is also completed for starting relay 50 over a path extending from grounded battery, through
115 the left-hand winding of relay 50, through the arm 84 and contact 98 of the master switch M and through the contacts 34 of line switch L to ground. Relay 50 thereupon operates and completes a circuit for
120 the energization of relay 76 over a path extending from grounded battery, through the winding of relay 76, contacts of relay 50 and right-hand winding of relay 22 to ground. Relay 76 thereupon operates and
125 completes a circuit for relay 60 over a path extending from grounded battery, through the upper contacts of relay 76, winding of relay 60 and right-hand winding of relay 22 to ground. Relay 60, in operating, dis-

connects the operating windings of all the switches of the group to which the switch L belongs, from battery. Relay 76 in operating causes the plungers of the idle line switches to be moved away from the trunk seized by the switch L in the manner well known. When the plungers have been moved away from this trunk line, the arms 84 and 80 pass off the contacts associated with the trunk T and should the next trunk be idle, the relay 50 deenergizes, thereby leaving the plungers standing opposite the next trunk line. However, should the next trunk line be busy, the relay 50 remains energized. When the plungers of a line switch are carried to the last line terminal, the arm 80 closes the contacts 82 thereby closing the circuit of relay 70 as soon as the last trunk is put in use. This circuit extends from grounded battery, through the winding of relay 70, contacts 82, contacts of relay 50 and right-hand winding of relay 22 to ground. The relay 70, upon energizing, closes the circuit of the solenoid 74, which, upon energizing, operates to restore the plunger shaft and plungers back to their starting position. When the relay 70 is energized, its contacts 88 and 90 become locked by the armature 92. When the arms 80 and 84 reach their starting positions, the armature 92 is released and the contacts 88 and 90 are opened, thereby permitting the solenoid 74 to deenergize. It will thus be seen that the plunger shaft is caused to complete its entire movement once, thereby causing all the idle plungers which it controls to become locked in engagement therewith.

It will be remembered that with the operation of the line switch L, the line connection has been extended through to the jacks 241 and that the line lamps associated with said jacks have been lighted. An idle operator at one of the positions of the switchboard noting that a lamp has lighted may insert the answering plug 240, of one of a plurality of cord circuits, such as C, at her position, into the jack 241 at her position. The supervisory relay 207 associated with the answering end of the cord circuit C then operates over a path extending from grounded battery, through the inner lower armature and back contact of relay 208, lower left-hand winding of repeating coil 245, winding of relay 207, rings of plug 240 and jack 241, contacts 30 of switch L, through the loop of substation A, contacts 32 of switch L, tips of jack 241 and plug 240, upper right-hand winding of repeating coil 245 and contacts 280 of relay 208 to ground. Relay 207, in operating, completes a circuit for the energization of relays 28, 205 and 209 over a path extending from ground, through the right-hand winding of relay 19, winding of relay 28, sleeves of

jack 241 and plug 240, lowermost contacts of relay 208, contacts of relay 207, contacts of relay 206, winding of relay 205, left-hand normal contacts of relay 203 and middle and upper windings of relay 209 to grounded battery. Relay 28, in operating, disconnects battery and ground at its normal contacts from the trunk line T and short-circuits at its right-hand alternate contacts the right-hand winding of line relay 19 whereupon said relay releases. The energizing circuit of relay 28 includes one winding of the line relay 19 so as to insure that the cut-off relay operates before the line relay releases. Battery potential for the multiple jacks 41 is supplied through the left-hand alternate contacts of relay 28 when relay 19 releases. Relay 19, in releasing, causes the extinguishment of the lamps 242. Relay 209, in operating, connects the operator's telephone set (not shown) across the talking conductors of the cord circuit.

The operator may now converse with the calling subscriber and upon ascertaining the number desired, may insert the calling plug 248 into a multiple jack 249 of the called line. Magnet 220 and relays 210 and 203 then operate over a path extending from ground, through the left-hand winding of magnet 220, sleeves of jack 249 and plug 248 and thence in parallel one path extending through the left-hand winding of relay 210 to grounded battery and the other path extending through the right-hand winding of relay 210, the winding of relay 203 and the lowermost contacts of relay 290 to grounded battery. Magnet 220, in operating, disconnects the called line from its line magnet in the manner well known in the art. Relay 203, in attracting its left-hand armature, opens at its normal contacts, the original energizing circuit for relay 209, and closes a circuit through the left-hand alternate contacts of relay 203 and the upper and lower windings of relay 209 whereupon said relay 209 releases, due to said windings being connected in opposition, thereby disconnecting the operator's telephone set (not shown) from the cord circuit. Relay 210, in operating, completes a circuit for the energization of relay 215 which connects a source of machine ringing current to the called station. The circuit for the energization of relay 215 may be traced as follows: grounded battery, winding of relay 215, right-hand normal contacts of relay 202, contacts of relay 211, right-hand contacts of relay 210 and contacts 281 and 280 of relay 208 to ground. It will be noted that a path for current also exists through the winding of relay 202 at this time but due to the shunt path including the right-hand normal contacts of relay 202 and the contacts of relay 211, said relay 202 does not energize at this time.

The called station is then signalled by

current flowing over the following path: from ground through the right-hand normal contacts of relay 233, upper alternate contacts of relay 215, tips of plug 248 and jack 249 through the called substation loop, rings of jack 249 and plug 248, lower alternate contacts of relay 215, normal contacts of key J, the normally operated right-hand contacts of key W and the winding of relay 211 to the source of ringing current 221.

Upon the response of the called party relay 211 operates due to an increase in current flow through the winding thereof thereby opening the shunt path around the winding of relay 202, whereupon said relay 202 operates in series with relay 215. Relay 202, in closing its right-hand alternate contacts, connects battery directly to its winding thereby shunting the relay 215, whereupon said relay 215 releases. Relay 215, in retracting its armatures, disconnects the source of ringing current 221 from the talking conductors of the cord circuit and renders the talking conductors conductively continuous.

Supervisory relay 204, associated with the calling end of the cord circuit, then operates over a path extending from ground, upper normal contacts of relay 290, upper right-hand winding of repeating coil 245, upper normal contacts of relay 215, tips of plug 248 and jack 249 through the loop of called substation D, rings of jack 249 and plug 248, lower normal contacts of relay 215, winding of relay 204, lower right-hand winding of repeating coil 245 and lower inner normal contacts of relay 290 to grounded battery. Relay 204, in attracting its armature, completes a circuit for relay 222 and the position message register or counting device 223 over a path extending from grounded battery, through the winding of slow-to-release relay 222, alternate contacts of relay 204, normal contacts of slow-to-release relay 222, and right and left-hand windings of register 223 to ground. The register 223 operates in this circuit but relay 222, which is of the marginal type does not operate until the left-hand winding of the register is short circuited by the armature of the register. Relay 222 then operates and locks. The locking circuit extends from grounded battery, through the winding and alternate contacts of relay 222, upper outer armature and back contact of relay 208, resistance 260, and front contact and left-hand armature of relay 210 to ground. Relay 222, in operating, opens its normal contacts thereby opening the circuit for the position register 223. It will be noted that due to the opening of this circuit and the locking of relay 222, it is impossible to again operate the register 223 should the called subscriber flash during a connection.

Upon completion of conversation and restoration of the receiver to the switchhook

at the calling and called stations, supervisory lamps 230 and 232 associated with the calling and called ends respectively of the cord circuit C are lighted to indicate to the operator that conversation has ceased.

Restoration of the receiver to the switchhook at the calling station A causes the deenergization of relays 207 and 205. Lamp 230 then lights, over a path extending from ground, through the left-hand contacts of relay 210, outer contacts of relay 205, lamp 230, and winding of relay 208 to grounded battery. Relay 208 also operates in this circuit to disconnect, at its upper and lower inner armatures, ground and battery respectively from the talking conductors of the cord circuit. At the lowermost contacts of relay 208, the circuit for cut-off relay 28 is opened whereupon said relay is released. Relay 28, in releasing, at its left-hand armature opens the holding circuit for magnet 20 and removes battery potential from the multiple jacks 41. The opening of the holding circuit for magnet 20 restores the line switch to normal position. The closure of the normal contacts of cut-off relay 28 again places the trunk line relay 19 in condition for operation. The circuit of the calling subscriber and the circuit of the trunk circuit T are thus in condition for reoperation immediately upon the restoration of the receiver to the switchhook at the calling station A so that, if the subscriber at station A desires to recall he may do so before the operator has disconnected in response to the operation of her disconnect signal. If the subscriber at station A recalls before the plug 240 is removed from the jack 241, line relay 1 operates as previously described causing in turn the seizure of an idle trunk such as T, whereupon the line of the calling station is extended to an idle set of answering jacks and the lamps associated with said jacks thereupon light. If the trunk T is seized the operator at whose position cord circuit C terminates or another operator may answer the recall. If the former answers, she will remove plug 240 whereupon all operated relays in the cord circuit release and then reinsert it in the jack after which the relays in the trunk circuit are operated as previously described.

Restoration of the receiver to the switchhook at the called station D causes the deenergization of the supervisory relay 204, the lighting of lamp 232, and the energization of relay 290 over a circuit extending from grounded battery through lamp 232, normal contacts of relay 204, alternate contacts of relay 222, uppermost alternate contacts of relay 208, winding of relay 290 and left-hand contacts of relay 210 to ground. If the called party hangs up his receiver before the calling party, the circuit for lamp 232 extends from the alternate contacts of relay

222, through the uppermost normal contacts of relay 208, resistance 260, and the left-hand contacts of relay 210 to ground. Lamp 232, in lighting, indicates to the operator that the called party has disconnected. Relay 290 in operating, disconnects at its inner armatures ground and battery from the talking conductors of the cord circuit and opens at its lowermost armature the circuit for relays 203, 210 and magnet 220. Relay 203 de-energizes but relay 210 remains energized through its high resistance left-hand winding. The insertion of this high resistance winding in series with the winding of magnet 220 causes the release of magnet 220 and the connection of a line relay similar to the line relay 1 at the calling station A to the line of the called station D. The circuit of the called station is thus in condition for instantaneous recall should the operator fail to withdraw the calling plug 248 before such time as the called party desires to make a call after completion of the conversation with the subscriber's station A. If the subscriber at station D calls before the plug 248 is received from jack 249, a line relay (not shown) associated with station D will operate to cause a line switch to extend the line of station D to a set of jacks at the switchboard whereupon the line signals will be operated as described in connection with the description of a call from station A.

The operator noting that the lamps 230 and 232 are lighted, will understand that the conversation is completed whereupon she will remove the plugs 240 and 248 from their associated jacks and all operated relays in the cord circuit will be restored to normal.

Due to the provision of multiple answering jacks and associated line lamps, it may occur that two or more operators may attempt either intentionally or unintentionally to answer a call and it will now be explained how a second operator is barred from a call answered by a first operator. If one cord circuit is connected to a line and the answering plug of a second cord is inserted into a multiple answering jack of that line, battery potential on the sleeve of the multiple answering jack will cause the operation of the relay 206 over a path extending from grounded battery on the sleeve of the jack 241, sleeve of plug 240, lowermost contacts of relay 208, winding of relay 206 to ground at the inner armature and back contact of relay 205. Relay 206, in operating, opens the circuit for relays 205 and 209 so that relay 209 is prevented from operating and consequently it is impossible to associate the operator's telephone set of the second position with the cord circuit thereat.

What is claimed is:

1. In a telephone system, in combination, subscribers' lines terminating in a central

office, a cord circuit thereat for interconnecting said lines, a supervisory relay in said cord circuit controlled by a called subscriber on one of said lines, a registering device at the central office actuated by the first operation of said relay, and a supervisory signal for said cord circuit first displayed when said relay is released.

2. In a telephone system, in combination, subscribers' lines terminating in a central office, a cord circuit thereat for interconnecting said lines, a supervisory relay in said cord circuit first operated when a called subscriber on one of said lines removes his receiver from the switchhook and released when the receiver is replaced on the switchhook, a registering device at the central office actuated when said supervisory relay is first operated, and a supervisory signal for said cord circuit first displayed when said relay is released.

3. In a telephone system, in combination, subscribers' lines terminating in a central office, a cord circuit thereat for interconnecting said lines, a supervisory relay in the calling end of said cord circuit controlled from a connected substation and actuated when the called subscriber answers, a registering device at the central office associated with said cord circuit and operated upon the actuation of said supervisory relay, and a supervisory signal for said cord circuit first operated when said supervisory relay is released due to the called subscriber replacing his receiver on the switchhook.

4. In a telephone system, in combination, subscribers' lines terminating in a central office, a cord circuit thereat for interconnecting said lines, a supervisory relay in the calling end of said cord circuit controlled from a connected substation and actuated when the called subscriber answers, a registering device at the central office associated with said cord circuit and operated upon the actuation of said supervisory relay, a supervisory signal, and a circuit therefor, said circuit being prepared when said register is operated and completed only in response to the replacement of the called subscriber's receiver.

5. In a telephone exchange system, in combination, subscribers' lines terminating in a central office, a cord circuit thereat for interconnecting said lines, a supervisory relay in the calling end of said cord circuit and actuated when the called subscriber answers, a registering device at the central office associated with said cord circuit and operated upon the actuation of said supervisory relay, a relay mechanism actuated upon the operation of said registering device to disconnect said registering device from said cord circuit, a supervisory signal for said cord circuit, and means including normal contacts of said supervisory relay, effective only when the called subscriber has replaced his receiver

on the switchhook, for operating said supervisory signal.

6. In a telephone system, in combination, telephone lines including subscribers' stations, an operator's cord circuit for interconnecting said lines, a meter for said cord circuit, a relay controlled from a called one of said subscribers' stations for actuating said meter, means for preventing further actuation of said meter by said subscribers' sta-

tions until said cord circuit is restored to normal, a supervisory signal for said cord circuit, and means including said relay for operating said signal effective only when the called subscriber's receiver has been replaced on the switchhook. 15

In testimony whereof, I have signed my name to this specification this 28th day of June 1922.

RAND S. BAILEY.