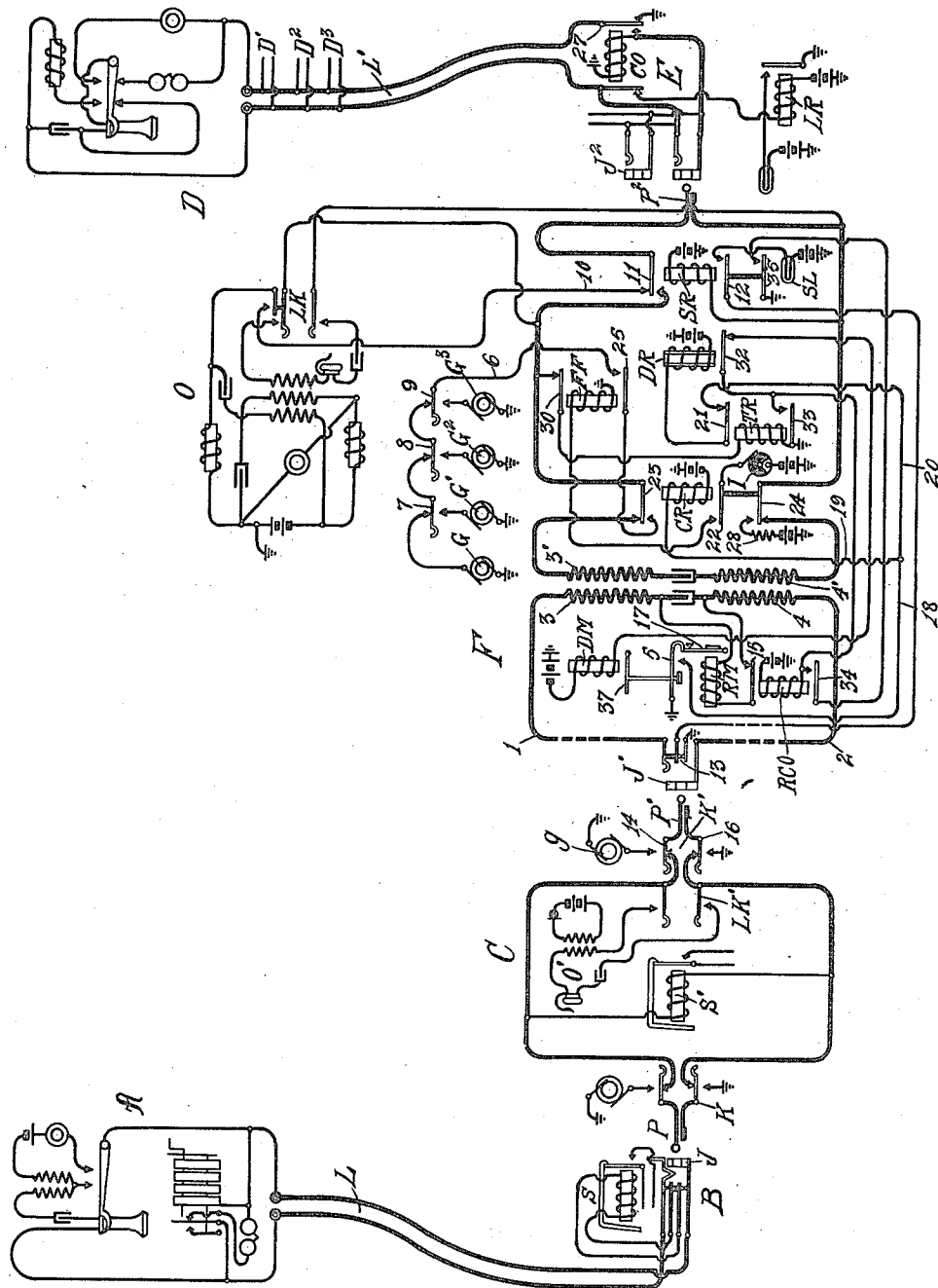


R. I. UTTER.
TELEPHONE SYSTEM.
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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, RICHARD I. UTTER, a citizen of the United States, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems, and more particularly to trunk circuits for interconnecting subscribers' lines terminating at different switch boards, or different operators' positions, being directed more particularly to circuits of the above character wherein the originating or A operator controls the application of ringing current to the terminals of the called line, through the medium of apparatus associated with the trunk circuit.

In systems of the above character an originating subscriber has his call answered by a so-called A operator, who finding that the wanted line terminates at a different operator's position, or at a different switch-board, orders up a trunk circuit from the B operator and then makes connection with the incoming end of the trunk circuit which has already been connected at its outgoing end to the jack of the called line. The A operator then presses her ringing key in the usual manner, this act causing operation of relays associated with the trunk circuit which is effective to apply ringing current to the terminals of the called line. In such systems one of the relays is usually provided with a locking circuit to maintain the ringing current connected after the A operator has released her ringing key.

One of the objects of my invention is to provide improved control circuits whereby the ringing control of the trunk circuit is simplified both in the method of connecting the ringing current to the called line and in causing its disconnection upon response of the called subscriber, and to this end I provide at the trunk circuit a two magnet control relay with novel circuit arrangements whereby one magnet is operated to close an associated contact to cause application of ringing current to the called line and upon response of the called subscriber the other magnet is operated to restore the associated contact and interrupt the application of ringing current.

For a more complete understanding of my invention, reference is to be had to the

accompanying drawing in which only sufficient apparatus is shown for interconnecting a calling and called substation terminating at different operators' positions and in which a calling substation A is illustrated, connected by a line L with central office apparatus B terminating at a switch-board before an operator's position. Such operator's position may be provided with suitable cord circuits, the cord circuit C illustrated being of the ordinary magneto type having answering and calling plugs P and P¹, respectively. In connecting said substations as A with similar substations terminating at the same position, the operator may use cord circuits as C, while if connection is to be made with the substations as D terminating in apparatus as E at a different operator's position, a trunk circuit F is employed.

Referring now more in detail to the apparatus illustrated, which is a preferred embodiment of my invention, it comprises a substation A, of a well known local battery magneto type, connected by a line L with the spring jack J and suitable line signal S. In making a call, the subscriber at A operates a hand generator in a well known manner thereby throwing the drop S at the central office to attract the operator's attention. The cord circuit C is of a well known type, and comprises answering and calling plugs P and P¹, respectively, connected by heavily marked talking conductors, and provided with ringing keys K and K¹. A listening key LK¹ is also provided for connecting an operator's set O¹ in circuit with cord C. A drop signal S¹ is connected in bridge of the talking strands.

Trunk circuit F terminates at its incoming end in a jack J¹ connected by trunk wires 1 and 2 to windings 3 and 4 respectively of a repeating coil. A ringing magnet RM is normally connected in bridge of the incoming end of trunk circuit F and is adapted to be operated by current from ringing generator *g* of key K¹, whereby its armature is attracted to trip the spring 5 and close its alternate contact. The closing of alternate contact 5 causes the operation of a ringing control relay CR and a sluggish or slow acting so-called discharge relay DR. The operation of control relay CR is effected to connect the flip-flop or interrupter relay FF in circuit with inter-

rupter I, whereby ringing current from one of the generators G to G³ is connected in circuit with the tip strand of the calling or outgoing end of the trunk circuit F. A sleeve relay SR is also provided which is adapted to be energized when the B operator connects plug P² with the jack J² of the wanted line, while the tip relay TR is adapted to be energized when the called subscriber responds whereby the disconnect magnet DM is operated to cause disconnection of ringing current from the called line. Also upon response of the called subscriber a ringing magnet cut-off relay RCO is energized to disconnect magnet RM from the incoming end of trunk circuit F to prevent another operation thereof when the calling subscriber operates his hand generator for disconnection.

In party line systems wherein several substations have condensers in bridge of the line limbs, considerable capacity of the line results. After an application of ringing current to such a line, due to a discharge from the line, the tip relay TR tends to kick up its armature, and in some systems this results in a premature disconnection of the ringing current. To provide against this, a slow acting relay DR is connected in circuit in such a manner that a momentary or premature operation of tip relay TR is not effective to disconnect the ringing current.

In the present embodiment of my invention, the trunk circuit F is ordered up by an A operator over an order wire and the B operator then inserts plug P² of the assigned trunk into a jack J² of a called line before the A operator has connected with the other end J'. Therefore means are provided in the nature of a signal lamp SL which is lighted when plug P² is inserted into the jack J² of a called line, and is effaced only if the A operator inserts the connecting plug P¹ into the jack J' at the other end of the assigned trunk, thus indicating to the B operator that the A operator has connected with the proper trunk F.

Trunk circuit F is preferably arranged to ring substations on single or party line systems, and the four generators G to G³ are shown, the generator G being normally connected with the ringing strand 6, while the other generators G¹, G², G³ may be connected with the ringing strand by the operation of the associated ringing springs 7, 8, 9. Thus if connection is to be made to a single party line, or to a substation whose call bell corresponds in frequency to generator G no operation of a ringing key is necessary, but where a party line is to be rung any of the generators may be connected in circuit as will be apparent.

An operator's telephone O is provided for trunk circuit F, being of a well known type adapted for testing a wanted line to de-

termine its idle or busy condition. That is, if the called line is busy, upon touching the jack sleeve with the tip of the calling plug P², its jacks J² will be of a potential to cause a click in the receiver of the operator's telephone, while if the called line is idle, the potential upon its jack J² will be such that no click in the operator's receiver will occur. The called line is of a well known common battery type, comprising a well known Kellogg substation D, connected by means of a line L¹ with the central office apparatus comprising line relay LR, cut-off relay CO and jack J². The taps D¹, D² and D³ shown leading from the line L' represent connections which may extend to other substations as D when party line service is provided.

I preferably employ harmonic signaling and therefore generators G, G', G², G³ correspond in frequency to the bells of substations D, D¹, D² and D³, respectively.

Operation: Having described in detail the apparatus employed in the preferred embodiment of my invention as herein illustrated, a connection from a calling to a called station will now be described.

Assuming a subscriber at calling substation A desires a connection, he will remove his receiver from its switch hook and operate the associated hand generator, whereby current will flow through the magnet winding of drop S causing its operation and indicating to the operator that substation A is calling. The operator therefore inserts plug P of a cord C into the jack J of the calling line, disconnecting drop S. The operator then throws her listening key LK' to ascertain the wants of the calling subscriber. Finding that the wanted line terminates before an operator at a different switch board, the A operator by means of an order wire, not shown, asks for the number of the wanted line. The B operator receiving the order picks out a plug P² of an idle trunk circuit F and tests the wanted line in the usual manner which is by touching the tip of plug P² to the sleeve of a jack J² of the wanted line (after throwing her listening key LK) and finding the wanted line is idle, the B operator notifies the A operator which trunk F has been assigned, at the same time inserting plug P² into the jack J² of the called line.

Before describing what occurs at the incoming end of trunk F, I will refer to what occurs at the outgoing end. The B operator having inserted the plug P², cut-off relay CO and sleeve supervisory relay SR are connected in series over the sleeve strand, causing the operation of these relays. The operation of CO disconnects line relay LR, thus removing the control thereof from the called line L'. Upon energization of SR, the test conductor 10 is disconnected from normal contact 11, while due to the closing

of alternate contact 12, signal lamp SL is lighted, due to the connection extending through normally closed contacts 13 of jack J' to ground.

5 The A operator after having trunk F assigned, inserts plug P' into jack J', interrupting contacts 13 to efface signal-lamp SL, and thus notifying the B operator that she has connected with the proper trunk circuit F.

10 The ringing generator *g* being the one adapted to operate the call signal of the substation D, the B operator does not actuate any of the ringing keys. Therefore, 15 the A operator after plugging in, actuates her ringing key K' to connect ringing generator *g* in circuit with trunk circuit F to cause the operation of ringing magnet RM, the circuit thereof being traced from ringing generator *g*, alternate contact 14, tip 20 contacts of plug and jack, conductor 1, coil winding 3, the winding of RM, normal contact 15, winding 4, conductor 2, sleeve contacts of jack and plug and alternate contact 16 to ground. This application of 25 ringing current is only momentarily, but upon the attraction of the armature 17 of magnet RM, spring 5 is tripped closing the alternate contact 5 which remains locked in its closed position, due to the armature 17 30 catching beyond the hook end of spring 5. An energizing circuit for relays CR and DR is therefore provided, traced from ground through alternate contact 5, conductor 18, conductor 19, and the winding of 35 CR to battery, while the path for current for relay DR extends over conductor 20, normal contact 21 and the winding of DR to battery, causing the energization of said 40 relays CR and DR. CR therefore closes its alternate contact 22, connecting interrupter I in circuit with flip-flop or interrupter relay FF causing its alternate energization and deenergization. Also responsive to the 45 energization of CR, its alternate contacts 23, 24 are closed so that upon each closure of alternate contact 25 of FF, ringing current is applied to the terminals of the called line to ring the call signal of substation D. 50 This path for ringing current may be traced from generator G, normal contacts 7, 8, 9, conductor 6, alternate contacts 25, 23, 11, tip contacts of plug and jack, line L' and substation D, alternate contact 27 of CO, 55 sleeve contacts of the jack and plug, sleeve strand and alternate contact 24 to the non-inductive resistance 28 and battery to ground.

60 Upon each deenergization of FF, following the application of ringing current as described, due to the capacity of the line, a discharge of current will take place upon the closure of normal contact 30 of FF, this discharge being through the winding 65 of TR to ground. This discharge has a

tendency to kick up the armature at TR, and would cause a premature disconnection of the ringing current were it not that slow acting relay DR is provided to prevent this. Should such a premature operation of TR 70 interrupt its normal contact 21, the circuit for relay DR would be momentarily interrupted but not of a sufficient length of time to allow DR to retract its armature and close the disconnect circuit through its normal contact 32. 75

The subscriber at D in response to the signal will remove his receiver from its switch hook whereby a path for direct current will be provided to cause the energization of tip 80 relay TR, this path being traced from battery through the winding of SR, sleeve strand of cord circuit, over the previously described path including substation D (the receiver thereat being removed), tip strand 85 of the trunk circuit, alternate contact 11, normal contact 30 and the winding of TR to ground. TR therefore energizes, closing its alternate contact 33, whereby a circuit for RCO is established and by the closing of 90 its alternate contact 34, a locking circuit is provided through ground at alternate contact 35 of sleeve relay SR. The operation of RCO disconnects ringing magnet RM from in circuit with trunk circuit F until 95 plug P² is withdrawn from the jack of the called line, so that magnet RM will not be operated again when the subscriber at A rings off. The operation of tip relay TR is also effective to bring about the disconnection of ringing current, the interruption 100 of its normal contact 21 allowing slow acting relay DR to restore to close the disconnect circuit through its normal contact 32 and disconnect magnet DM. This circuit 105 may be traced from ground through alternate contact 33, normal contact 32 and the winding of DM to battery. Magnet DM therefore energizes, attracting its armature 37, whereby spring 5 is lifted out of engagement 110 with its alternate contact, allowing armature 17 to restore and thus contact 5 is maintained open. By the interruption of said contact 5, the circuit for control relay CR is opened, allowing said relay to restore 115 and by the interruption of its alternate contact 22, rendering flip-flop relay FF inert. The two substations are now connected for conversation, the conversational circuit being traced over the heavily marked conductors 120 and includes windings 3, 4 and 3', 4' of the repeating coil.

After the subscribers finish conversation, they replace their receivers upon their respective switch hooks, the subscriber at A 125 also giving a ring off operation to his hand generator.

Any of the well known forms of disconnect supervision may be employed, but I preferably employ supervision at the cord 130

circuit C in the form of a well known drop signal S' which operates by current from the ring-off operation of generator at sub-station A. The operator of the cord circuit C in response to the operation of S' withdraws plugs P and P' from their respective jacks J and J', the withdrawal of plug P' closing contacts 13, whereby lamp signal SL is again operated indicating to the B operator that disconnection is desired. Therefore, she withdraws plug P² from jack J², interrupting the series circuit including relays SR and CO, whereby these relays restore. Upon restoration of SR, its alternate contact 12 is interrupted effacing signal SL, while due to the interruption of its alternate contact 35, the ringing magnet cut-off relay RCO has its locking circuit interrupted, causing the restoration of said relay, whereby magnet RM is again connected in bridge of the incoming end of trunk circuit F.

While I have illustrated a preferred embodiment of my invention, it is apparent that it may be applied in various ways, also many changes and modifications will readily suggest themselves to those skilled in the art. Therefore, I do not desire to be limited to the exact structure as shown, but aim to cover all that which comes within the spirit and scope of the appended claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:—

35 1. A link circuit including a ringing magnet controlled over a talking conductor from one end, a disconnect magnet controlled over a talking conductor from the other end, a contact common to both magnets, means 40 whereby the operation of said ringing magnet will operate and hold said contact independent of the ringing magnet and whereby said disconnect magnet restores the said contact, and electrical ringing apparatus 45 having a control circuit including said contact.

2. A link circuit including a ringing magnet controlled from its incoming end, a disconnect magnet controlled from its outgoing end, a contact common to both magnets, means whereby the operation of said ringing magnet will operate and hold said contact independent of the ringing magnet and whereby said disconnect magnet restores said contact, and a ringing control relay 55 having an energizing circuit including said contact.

3. A link circuit including a ringing magnet controlled from its incoming end, a disconnect magnet, a contact common to both magnets, a ringing control relay having an energizing circuit including said contact, and a calling tip relay for controlling said disconnect magnet.

65 4. A link circuit including incoming and

outgoing talking conductors, a ringing magnet connected to an incoming talking conductor and controlled thereover, a disconnect magnet, a calling tip relay for controlling the disconnect magnet operatively associated with the outgoing conductors, a contact common to said magnets, and ringing apparatus having a control circuit including said contact.

5. A link circuit including incoming and outgoing conductors, a ringing magnet connected in bridge of the incoming conductors, a disconnect magnet, a contact common to said magnets, a ringing control relay having an energizing circuit including said contact, and a calling tip relay for controlling said disconnect magnet.

6. A link circuit including a ringing magnet controlled from one end, a disconnect magnet controlled from the other end, a contact mechanically connected to the armatures of said magnets and controlled by each of them, means whereby the operation of the ringing magnet will operate and lock said contact independent of the last said magnet, electrical ringing apparatus having a control circuit including said contact, and means whereby the operation of the disconnect magnet will render said locking means ineffective.

7. A link circuit including a ringing magnet operatively associated with the incoming end, a disconnect magnet operatively associated with the outgoing end, a contact, mechanical means for closing said contact by one of said magnets and hold it closed independent of said closing magnet and opening it by the other of said magnets, and a ringing control relay having a control circuit including said contact.

8. A trunk circuit comprising incoming conductors, a ringing magnet connected in bridge of said conductors and adapted to be operated by current over said conductors, a source of ringing current associated with said trunk circuit, a contact operable by said ringing magnet when energized, and means responsive thereto for connecting said source to the outgoing end of the trunk circuit, a mechanical latch for holding said contact closed, a tip relay associated with the calling end of the trunk circuit, a disconnect magnet controlled by said tip relay, and unlatching means for said contact controlled by said disconnect magnet to restore said contact.

9. A telephone system comprising a calling and called substation line, a link circuit for connecting said lines, a ringing magnet, means for operating said magnet over the incoming end of said circuit, a disconnect magnet, a contact common to said magnets, a ringing control relay having a circuit including said contact, said relay being operated responsive to said operation of the

ringing magnet, a source of ringing current
connected to the called line responsive to
said relay, and means actuated upon re-
sponse from the called substation to operate
5 said disconnect magnet and said contact
whereby said ringing source is disconnected.

Signed by me at Chicago, county of Cook

and State of Illinois, in the presence of two
witnesses.

RICHARD I. UTTER.

Witnesses:

G. E. MUELLER,
M. R. ROCHFORD.