

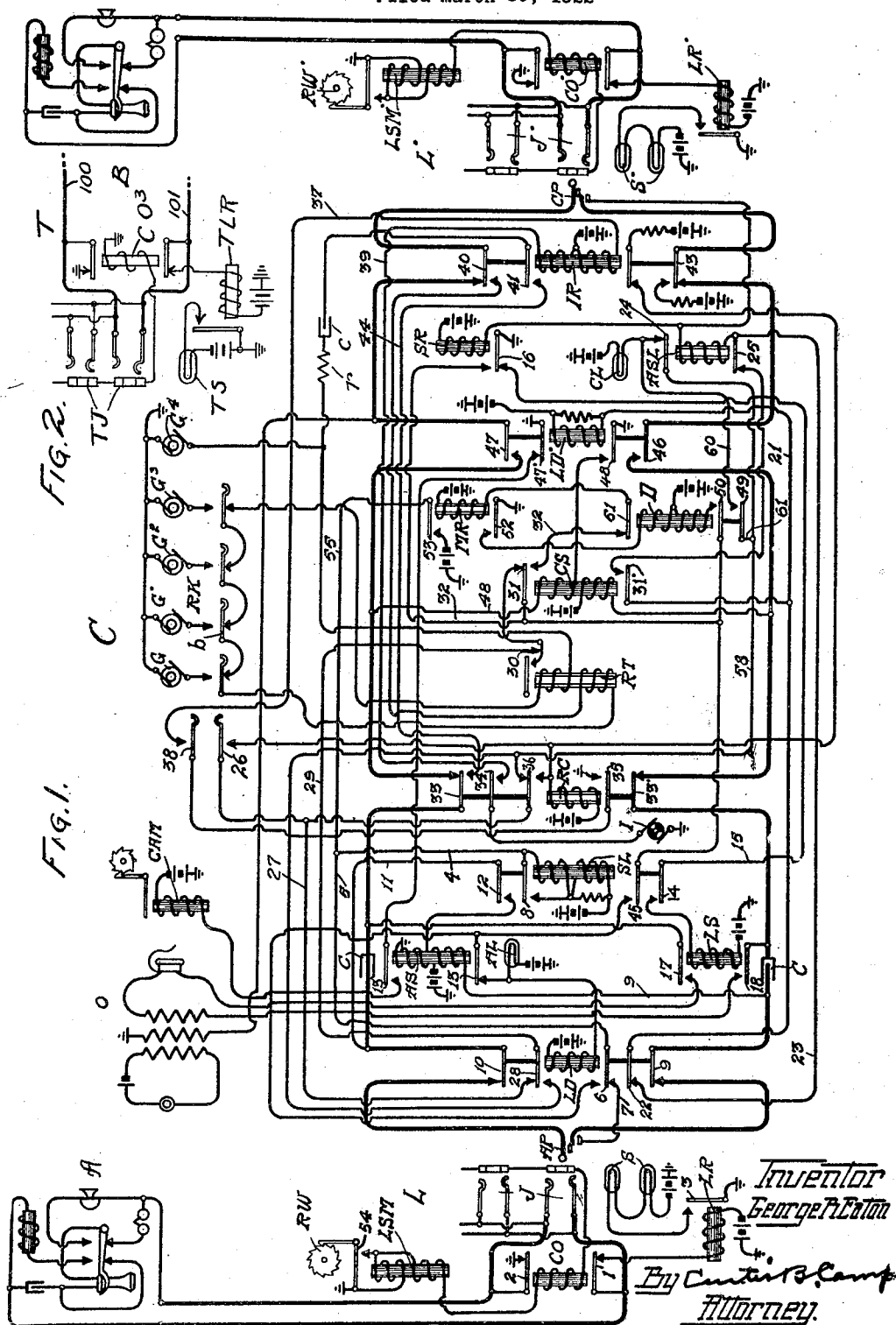
Jan. 6, 1925.

1,521,608

G. R. EATON

TELEPHONE SYSTEM

Filed March 30, 1922



UNITED STATES PATENT OFFICE.

GEORGE R. EATON, OF OAK PARK, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed March 30, 1922. Serial No. 548,016.

To all whom it may concern:

Be it known that I, GEORGE R. EATON, a citizen of the United States of America, and a resident of Oak Park, 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 in which link circuits are provided for interconnecting telephone lines as calling and called lines, and one feature has to do more particularly with the provision of an operator's link circuit which has link disconnect means at its answering end and at its calling end for disassociating the link circuit from the calling subscriber's line and called subscriber's line, whereby either subscriber may initiate a new call or be called, as the case may be, prior to the disconnection of the link circuit terminals from the jack terminals of the said telephone lines.

A feature of my invention relates to improved means for placing the link disconnect means in the answering end of the link circuit under the control of the calling subscriber and the link disconnect means in the calling end of the link circuit under the sole control of the calling subscriber only when the calling end of the link circuit is connected to a circuit having a low resistance cut-off relay, as, for instance, a trunk line, but when said calling end is connected to a line circuit having a high resistance cut-off relay, as, for instance, a local line, the calling end link disconnect means is under control of both the calling and called subscribers. In order to place the calling end link disconnect means under the control of the calling subscriber in one instance, and under the control of both calling and called subscribers in the second instance, I provide a relay in the link circuit which is operable when the link circuit is connected to a trunk line to place the said disconnect means under the sole control of the calling subscriber, but when the link circuit is connected to a local line, the said relay does not operate due to the high resistance of the cut-off relay in the line circuit of the local line, whereby the said relay failing to operate, the said link disconnect means is under the control of the calling and called subscriber.

Another feature of my invention is the provision of a meter service device in the line circuit of a calling subscriber's line and means in the link circuit operable to operate said meter service device, whereby the call between a calling and a called subscriber is registered only when the called subscriber responds to operate said link means. This feature is further characterized by the fact that means are also provided for preventing the registration of more than one completed call between the same subscribers' lines upon the same interconnection of said subscribers' lines.

The above features, as well as others not specifically pointed out above, will be more fully and particularly pointed out in the ensuing specification, reference being had to the accompanying drawings which show my invention diagrammatically and in which:

Fig. 1 shows the link circuit of my invention and a calling and called sub-station terminating in multiple jacks of a line circuit, respectively; and

Fig. 2 shows the outgoing end of a trunk circuit having a low resistance cut-off relay associated therewith.

Referring now more in general to my invention as illustrated in Fig. 1 of the drawings, it comprises a calling substation A connected at the exchange with a well-known line circuit L, comprising multiple answering jacks J, cut-off relay CO, line relay LR, multiple line lamps S, a call registering device RW, and its associated line service meter relay LSM. To the right of the drawing, I show a called substation B connected to a line circuit L', having the usual line relay LR', cut-off relay CO', multiple line lamps S', multiple call registering device RW', jacks J', and line service meter LSM'. The line circuits L and L' shown are provided with multiple line lamps S and answering jacks J so that a jack and signal S appear in a plurality of operators' positions. When a call is initiated a lighted line signal S appears before each jack J, and any one of a plurality of operators may answer the call to the exclusion of the others.

The cord circuit C illustrated in the drawing is arranged for interconnecting the telephone lines A and B and comprises an an-

swering plug AP and a calling plug CP interconnected by the heavily marked talking conductors with the condensers C interposed. The answering end of the cord circuit C comprises an answering supervisory relay AS for the usual supervisory purposes controlling the answering supervisory lamp AL, and the cord C is also provided with a sleeve relay SL for the purpose of preventing more than one operator from seizing the call, as well as for other purposes which will be hereinafter described. An operator's listening relay LS is provided which, when operated, connects the operator's set O to the talking conductors of the cord C. A call answering meter device CAM for registering each call answered by the operator is also shown. A link disconnect relay LD is energized when the subscriber at the calling substation replaces his receiver upon the switchhook to dissociate the cord circuit from line circuit L, giving the subscriber instantaneous recall facilities.

The calling end of the cord circuit C comprises a calling sleeve relay SL and a calling supervisory relay CS serving the usual supervisory purposes and for controlling the calling supervisory lamp CL. A ringing control relay RC is also provided which is energized when any one of the ringing key plungers of the party-line ringing key RK is depressed to connect interrupter relay IR in circuit with the interrupter I, whereby ringing current is intermittently applied to the called telephone line B. A ringing trip relay RT is provided for disconnecting ringing current from the called line should the called subscriber remove his receiver during a ringing period, the ringing current being disconnected by the supervisory relay CS should the called subscriber respond during a silent period. The calling end of the cord C is also provided with a link disconnect relay LD' and an auxiliary sleeve relay ASL. When the plug CP is inserted into a jack J', relay LD' energizes but relay ASL will not energize due to the high resistance of the cut-off relay CO'. Relay ASL failing to energize places the link disconnect means under the joint control of the calling and called subscribers, so that it is necessary for both subscribers to replace their receivers before the calling end of the line circuit is disassociated from the line circuit L'. Should the plug CP be connected to a jack other than jack J', as for example a trunk line having a low resistance cut-off relay, relays LD' and ASL will energize in series and will place the link disconnect means LD' under the control of the calling subscriber to the exclusion of the called subscriber, so as to give the local operator a disconnect signal as soon as the calling subscriber replaces his receiver so that the apparatus is avail-

able for establishing other connections, thereby making it unnecessary for the called subscriber to replace his receiver to effect a disassociation of the cord circuit C from the trunk circuit having a low resistance cut-off relay. By this arrangement, the trunk line may be immediately freed from the cord C upon the replacing of the calling subscriber's receiver upon its switchhook.

I also show a meter relay MR, which energizes when the relay CS operates upon the response of the called subscriber to connect battery to the line meter relay LSM in the line circuit L to cause the same to operate and register the completed call. A relay D is also provided for opening the circuit of the meter relay MR after the meter relay MR is energized and also for closing a locking circuit for itself and a circuit for the calling supervisory lamp CL. Thus, it will be understood that it is impossible to register more than one call so long as the plug CP remains in the calling jack J'.

Referring to Fig. 2 in general, a trunk circuit T is illustrated which comprises a pair of conductors 100 and 101 extending from a distant exchange and terminating in multiple trunk jacks TJ at the exchange where the cord circuit C is located. A trunk signal TS is also provided which has a relay TLR associated therewith for controlling the same. A low resistance cut-off relay CO^s is also provided for controlling the relay TLR and is of such resistance to permit the relay ASL in the cord circuit C to energize when the plug CP is inserted into the trunk jack TJ, said relays CO^s and ASL energizing in series. Cut-off relay CO^s of the trunk circuit T will not, however, due to the high resistance winding of said relay SR.

Having described in general the apparatus employed in a preferred embodiment of my invention, I will now describe more in detail the operation of the system as illustrated in Fig. 1.

Assuming that the substation A initiates a call, the removal of the receiver thereat establishes an energizing circuit for the line relay LR of the line circuit L, traced from battery, winding of relay LR, normal contact 1 of cut-off relay CO, through the closed switchhook contacts of substation A, normal contact 2 of cut-off relay CO to ground. Line relay LR energizing closes its normally open contact 3, whereby a circuit is closed for the line signals S which light at the different associated jacks J, each jack J appearing at a different operator's position. The first operator to seize the call by the insertion of her answering plug AP into the jack J before which the signal S is lighted, closes an energizing circuit for the sleeve relay SL, traced from battery, through both its windings, conductors 4 and 5, normal

contact 6 of relay LD, conductor 7, sleeve contacts of the plug AP and jack J, winding of cut-off relay CO, both windings of meter service relay LSM, to ground. Relays SL and CO energize in series, but the upper winding of relay LSM being of high resistance, relay LSM will not operate over this circuit. Relay SR energizing closes its alternate contact 8 to shunt out its upper high resistance winding and is then held energized over the remaining part of the circuit just traced. The energization of cut-off relay CO opens normally closed contacts 1 and 2 to permit line relay LR to restore to normal whereby its alternate contact 3 is opened to cause the effacement of the line signals S. A further operation due to the energization of sleeve relay SL is the operation of answering supervisory relay AS over a circuit from battery, through its lower winding, normal contact 9 of relay LD, ring contacts of the plug AP and jack J, through the substation A, tip contacts of the jack J and plug AP, normal contact 10 of relay LD, conductor 11, alternate contact 12 of relay SL, upper winding of relay AS to ground. Relay AS energizing opens its normal contact 13 to prevent the premature lighting of the lamp AL and the operation of link disconnect relay LD, and also closes its alternate contact 13' to cause the operation of the call answering meter device CAM to register the call answered by the operator, over a circuit traced from battery, winding of the relay CAM, alternate contact 13' of relay AS to ground at normal contact 47' of relay LD'. Another result due to the energization of relay SL is the energization of the operator's listening relay LS, traced from battery, through the winding of relay LS, alternate contact 14 of relay SL, conductor 15, normal contact 16 of the calling sleeve relay SR to ground. Listening relay LS energizing closes its alternate contacts 17, 18 to connect the operator's head set O to the cord circuit C, whereupon the operator inquires the wants of the calling subscriber A.

The feature whereby all the operators who attempt to seize the call subsequently to the seizure of the call by the first operator, are excluded, will now be explained. When the first operator to seize the call inserted her answering plug AP into the jack J, the sleeve relay SL in her cord circuit operated over a circuit extended through its lower low resistance winding and its upper high resistance winding, and the energization of relay SL brings about the operation of relay LS to connect the operator's set O in conversational circuit with the calling substation A. Upon the energization of relay SL it closes its alternate contact 8, thus shunting out its high resistance winding and remains energized through its low resistance winding only. When an operator inserts

her answering plug AP into a jack J subsequently to the insertion of the plug AP, into the jack J, by the first operator, the sleeve relay SL in the second operator's cord circuit will not operate, due to the low resistance path of relay SL of the first cord circuit; and, therefore, sufficient current will not flow through the low or high resistance windings of the sleeve relay SL in the second operator's cord circuit to operate the same. The failure of relay SL in the second cord circuit to operate prevents the listening relay associated therewith to energize to connect the second operator's set to the calling line. The operator receiving no reply to her inquiry will know that the call has been seized by another operator, and will then withdraw her answering plug from the multiple jack J.

Referring now back to when the operator inquired the wants of the calling subscriber A, and assuming that the subscriber A desires to converse with substation B, the operator will test the jack J' to determine its idle or busy condition in the usual and well known manner. Assuming the called line is idle, the operator will insert the calling plug CP into the jack J'. The insertion of the calling plug CP into the jack J' brings about the energization of the sleeve relay SR over a circuit traced from battery, winding of relay SR, sleeve contacts of plug CP and jack J', winding of cut-off relay CO' to ground. Cut-off relay CO' energizing takes the line relay LR' and line lamps S out of the control of the called substation B. Relay SR energizing closes its alternate contact 16, thus opening the circuit of the listening relay LS to cause the same to restore and disconnect the operator's set O from the cord circuit to provide secret service. Another result due to the insertion of the plug CP into the jack J' is the operation of the link disconnect relay LD' to extend the talking conductors to the called line, the circuit being traced from battery, winding of relay LD', conductor 21, normal contact 22 of relay LD, conductor 23, winding of relay ASL, sleeve contacts of plug CP and jack J' to ground through the winding of cut-off relay CO' of line circuit L'. Relay ASL does not energize over this circuit due to the high resistance of the winding of cut-off relay CO'. Relay ASL failing to operate, a circuit is closed for the supervisory lamp CL which lights and remains burning until the operator depresses one of the ringing key plungers of the ringing key RK to cause the operation of ringing control relay RC to open the circuit of lamp CL to provide a dark keyshelf. The circuit for lamp CL may be traced from battery, through lamp CL, normal contact 24 of relay ASL, normal contact 36 of relay RC, conductor 27, normal contact 28 of re-

lay LD, conductor 29, normal contact 30 of relay RT, normal contact 31 of relay CS, conductor 32, to ground at alternate contact 16 of relay SR. Relays LD' and ASL are in this instance under the control of the calling subscriber, but when the called subscriber responds the relay LD' is under the joint control of the calling and called subscriber. In case the plug CP is inserted into a jack other than the jack J' such as one of the trunk jacks TJ (Fig. 2), which has a low resistance cut-off relay CO³, relay ASL will energize in series with relay LD', thereby placing the relay LD' under the control of the calling subscriber to the exclusion of the called subscriber, as will be more fully hereinafter described.

The plug CP having been inserted into the jack J' and the relays LD' and SR operating, the operator will now depress one of the ringing key plungers of the ringing key RK to connect ringing current of the proper frequency to the called line; and assuming generator G' to be of the frequency required to signal substation B, ringing key plunger b will be fully depressed, momentarily closing the end spring contacts 26 and 38 of the ringing key RK, closing an energizing circuit for the ringing control relay RC, traced from battery, winding of relay RC, the now closed contact 26 of the end springs, conductor 27, normal contact 28, conductor 29, contact 30 of ringing trip relay RT, normal contact 31 of relay CS, conductor 32, alternate contact 16 of relay SR to ground. Relay RC energizing closes its alternate contacts 33, 33', 34, 35 and 36, thereby closing a locking circuit for itself through its alternate contact 36 independent of the end spring contact 26, and over the previously traced circuit. A circuit for the interrupter relay IR is also established from battery, lower winding of relay IR, conductor 37, now closed contact 38 of the end springs, alternate contact 35 of relay RC to ground. Relay IR energizing connects ringing current to the called line, instantly upon the depression of a key plunger and upon the operation of relay RC, even though a dead segment of the interrupter I is in circuit with relay IR, thus giving an instantaneous first ring. When, however, the key plunger is restored to its intermediate position from its fully depressed position, contacts 26 and 38 are opened but an interrupter I is connected in circuit with interrupter relay IR due to the energization of relay RC, over a circuit traced from battery, upper winding of relay IR, conductor 39, alternate contact 34 of relay RC to ground, through the constantly rotating interrupter I. Relay IR is thus intermittently energized and deenergized over the last traced circuit to intermittently connect ringing current to the called line. The ringing cur-

rent may be traced from generator G', alternate contact of key plunger b, which remains closed until another key is depressed, lower winding of relay RT, alternate contact 40 of relay IR, tip contacts of plug CP and jack J', through the bell and condenser of substation B, ring contacts of jack J' and plug CP, alternate contact 43 of relay IR to battery and ground. Relay RT will not energize over this circuit due to the high resistance of the bell and condenser at substation B. During each time ringing current is applied to the called line, the calling subscriber A will receive a reverberative tone which will notify him that the called subscriber B is being signaled, this reverberative tone being given over a circuit traced from generator G', resistance and condenser C, alternate contact 41 of relay IR, conductor 44, alternate contact 33 of relay RC, tip conductor of cord circuit C, normal contact 10 of relay LD, tip contacts of plug AP and jack J, through receiver and condenser at substation A, ring contacts of jack J and plug AP, ring conductor of cord C, normal contact 9 of relay LD, to battery through the lower winding of relay AS. The call bell at substation B will be intermittently signaled until the subscriber thereat removes his receiver from the switchhook, whereupon ringing current will be automatically disconnected from the called line during either a ringing period or non-ringing period. Assuming the subscriber B responds during a ringing period, ringing trip relay RT will be energized now due to the bell and condenser being disconnected by the closure of the switchhook contacts which permits sufficient current to flow to energize said relay RT, and the relay RT energizing opens its normal contact 30, thereby opening the circuit of ringing control relay RC, which deenergizes and opens the circuit of the interrupter relay IR, with interrupter I at 34 to prevent the further operation of relay IR and the application of ringing current to the called line. Should subscriber B respond during a non-ringing period, calling supervisory relay CS will be energized over a circuit traced from battery, lower winding of relay CS, ring conductor of cord C, alternate contact 46 of relay LD', normal contact 43 of relay IR, ring contacts of plug CP and jack J' through the now closed switchhook contacts of substation B, tip contacts of jack J' and plug CP, normal contact 40 of relay IR, alternate contact 47 of relay LD', conductor 48, through the upper winding of relay CS, to ground at alternate contact 48' of relay LD'. Relay CS operating opens the locking circuit of relay RC at 31, whereupon relay RC restores and opens the circuit of relay IR as hereinbefore described. Ringing control relay RC restoring closes its nor-

mal contacts 33 and 33', relay IR its contacts 40 and 43, thus closing the continuity of the talking conductors and connecting subscribers A and B in conversational circuit.

Should the calling subscriber A hang up his receiver before subscriber B removes his receiver, ringing current will be automatically disconnected from the called line, due to the energization of relay LD over a circuit traced from battery, winding of relay LD, normal contact 13 of relay AS, which de-energizes when the switchhook contacts at substation A are opened, alternate contact 45 of sleeve relay SL, to ground at alternate contact 16 of relay SR. Link disconnect relay LD energizing opens the locking circuit of ringing control relay RC at normally closed contact 28, and relay RC de-energizing, the circuit of interrupter relay IR is opened at alternate contact 34, thereby preventing further application of ringing current to the called line.

I will now describe the operation of the meter service registering apparatus. When the called subscriber B responded and the calling supervisory relay CS operated, a circuit was closed for the slow-to-release meter relay MR, traced from battery, through the winding of relay MR, normal contact 51 of relay D, alternate contact 31 of relay CS, conductor 32, to ground at alternate contact 16 of relay SR. Relay MR energizing closes an energizing circuit for the line service meter relay LSM of line switch L from battery, alternate contact 53, conductor 55, conductor 5, normal contact 6 of relay LD, sleeve contacts of plug AP and jack J, winding of cut-off relay CO, winding of relay LSM to ground. Sufficient battery flows over this circuit to energize relay LSM, which attracts its armature to cause the pawl and armature to rotate the call registering wheel RW one step to register the call. Relay LSM operating closes its alternate contact 54, thereby closing a locking circuit for itself through its lower winding to ground at its alternate contact 54, thus shunting out its upper winding. Upon the energization of relay LMR and the shunting of its upper high resistance winding, relay LMR will remain energized in series with relays SR and CO over the circuit hereinbefore traced.

Meter relay MR operating closes an energizing circuit for relay D, which operates and the opening of its normal contact 51 opens the circuit of meter relay MR, the energizing circuit for relay D being traced from battery through the upper winding of relay D, alternate contact 52 of relay MR to ground. The relay D has its initial energizing circuit opened at contact 52 upon the de-energization of relay MR, but a locking circuit is established for it traced from bat-

tery, through its lower winding, its alternate contact 50, conductor 32 to ground at alternate contact 16 of relay SR. Relay D is quick-acting and energizes immediately upon the energization of relay MR to open its normal contacts 51, thus opening the energizing circuit of relay MR, but relay MR being slow-acting remains operated sufficiently long to permit the operation of the line service meter relay LMR to register the call. Relay D remains energized as long as plug CP is connected to the jack J'. Thus, it will be seen that the line service meter apparatus in the line circuit L can only operate to register one call, due to the circuit of relay MR being maintained opened at contact 51 of relay D.

The subscribers A and B are now in conversational circuit and upon termination of conversation they replace their respective receivers upon their switchhooks. When the subscriber A replaces his receiver upon its switchhook, the energizing circuit for supervisory relay AS is opened at the switchhook contact, whereby relay AS restores to normal and closes a circuit for the link disconnect relay LD, whereby the cord circuit is dissociated from the calling line and the calling subscriber is free to call or be called even though the plug AP of the cord circuit C remains in the jack J; the circuit for relay LD may be traced from battery through the winding of relay LD, normal contact 13 of relay AS, alternate contact 45 of relay SL, conductor 32, alternate contact 16 of relay SR to ground. Relay SL does not de-energize when relay LD operates but is maintained energized over a substitute circuit traced from battery through its lower winding alternate contact 8 of relay SL, conductors 4 and 5, alternate contact 6 of relay LD, which closes before relay SL has an opportunity to de-energize, alternate contact 45 of relay SL, conductor 32, to ground at alternate contact 16 of relay SR. When relay LD energized, the energizing circuit for link disconnect relay LD' was opened at contact 22 of relay LD, causing relay LD' to restore to normal, if the called subscriber has replaced his receiver, it being remembered that relay ASL is not energized during this connection. The relay LD operating, its normal contacts 9 and 10 are opened, disassociating the cord circuit C from the line circuit L, thereby making it possible for subscriber A to initiate another call or be called, as the case may be, prior to the withdrawal of the plug AP from the jack J. The disconnection of the cord C and the line circuit L at the contacts controlled by the link disconnect relay LD, due to the energization of said relay LD, opens the circuit of relays CO and LSM, permitting them to restore. Relay LSM restoring, releases its armature which permits the pawl

associated therewith to engage the next tooth of the register wheel RW to be prepared to register the next call.

When the called subscriber replaces his receiver, relay CS de-energizes to open the locking circuit of link disconnect relay LD' at alternate contact 31' of relay CS; relay LD' will not, however, de-energize if the calling subscriber has not replaced his receiver, as relay LD will not have operated and the primary energizing circuit of relay LD' as hereinbefore traced will remain closed to prevent the de-energization of relay LD', but if relay LD has operated, both energizing circuits for relay LD' will be opened and relay LD' will de-energize to disassociate the link circuit from called line circuit L'. Relay CO', although in circuit with relay SR will not remain operated since battery at relay LD' is not now in circuit with relay CO' and sufficient current will not flow from battery through relay SR to maintain relay CO' energized. Relay CO' de-energizing replaces the line circuit L' under the control of the subscriber B. The subscribers having replaced their receivers, the supervisory lamps AL and CL are lighted. The answering supervisory lamp AL is now lighted over a circuit traced from battery, through the lamp AL, normal contact 12 of relay AS, alternate contact 45 of relay SR, to ground at alternate contact 16 of relay SR, and the calling supervisory lamp CL is lighted over a circuit traced from battery through the lamp CL, normal contact 24 of relay ASL, conductor 58, alternate contact 28 of relay LD, conductor 29, contact 30 of relay RT, normal contact 31 of relay CS, conductor 32, to ground at contact 16 of relay SR. The operator observing the two lighted lamps AL and CL, will know the conversation has terminated, and will withdraw the plugs AP and CP from their respective jacks, thereby causing the apparatus to restore to normal in the well-known manner. Since the resistance of the cut-off relay CO' is such that it does not remain energized when relay SR is only in series with it and relay LD' is not in series circuit with cut-off relay CO', the called subscriber's line circuit L' is free, and subscriber B may initiate a call or be called.

Assuming now that the plug CP is inserted into one of the trunk jacks TJ having the low resistance cut-off relay CO³ associated therewith, relay SR will energize through said cut-off relay CO³ and relays ASL and LD' will energize in series with the low resistance cut-off relay CO³ of the trunk line T. This circuit may be traced from battery, through the winding of relay LD', conductor 21, normal contact 22 of relay LD, conductor 23, winding of relay ASL, sleeve contacts of plug CP and jack TJ of the trunk circuit T to ground through the

low resistance winding of the cut-off relay CO³. Relay ASL energizes over this circuit and opens its contacts 24 and 25, and in this case the lamp CL does not burn prior to the depression of the ring key, as was the case when the plug CP was inserted into the jack J'. The cut-off relay CO³ energizing over this circuit opens the circuit of relay TLR to prevent relay TLR and signal TS from operating. The rest of the operation in establishing the connection is the same as hereinbefore described up to and until the calling party replaces his receiver. Relays ASL and LD' are under the sole control of the link disconnect relay DL associated with the calling end of the cord C at its contact 22, and when the calling subscriber replaces his receiver, line relay LD is energized as before described and the opening of normal contact 22 of relay LD allows relays LD' and ASL to restore, and as sleeve relay SR is now the only relay connected to the sleeve of the calling plug CP the cut-off relay CO³ of the trunk restores due to the high resistance of relay SR and permits the trunk circuit apparatus to restore so as to make it immediately available for use in establishing other connections. The response of the called party operates the meter LSM in the manner before described. In this instance relay ASL energizes and the opening of its normal contact 25 places the control of the relay LD' under the control of the calling subscriber, it being remembered that in the previous description the relay LD' of the calling end of the cord C was placed in locking circuit through alternate contact 31' of relay CS and both subscribers A and B would have had to replace their receivers upon their respective switchhooks to bring about the de-energization of relay LD'. The calling subscriber having replaced his receiver, relay LD has energized and LD' has de-energized, the answering supervisory lamp is lighted over the previous circuit and supervisory lamp CL will light over a circuit traced from battery through lamps CL, conductor 60, alternate contact 49, conductor 61, conductor 58, alternate contact 28 of relay LD, normal contact 30 of relay RT, normal contact 31 of relay CS to ground at contact 16 of relay SR. The operator seeing the two lamps AL and CL burning will know that the calling subscriber has replaced his receiver, and she will now withdraw the plugs AP and CP to permit the cord circuit to restore to normal.

From the foregoing, it will be readily understood that I have designed a system wherein a call is registered against the calling subscriber's line when the called subscriber responds and that only one call can be registered upon a single connection of the same subscribers. It will be further seen that the system above described contains

positive means for immediately disassociating the cord circuit from its connected lines upon the calling party replacing his receiver when the cord circuit C is connected to a trunk line or any line having a low resistance cut-off relay, but when the cord circuit is connected to a local line or to a line having a high resistance cut-off relay, the disassociation of the calling end of the cord circuit from said line is under the joint control of the calling and called subscribers.

It is to be understood that I do not desire to be limited to the exact arrangement of my invention as illustrated and described, as changes and modifications may readily suggest themselves to those skilled in the art, but I desire to cover such changes and modifications as come within the scope of the appended claims.

What I claim as new and desire to secure by United States Letters Patent, is:

1. In a telephone system having a local calling telephone line and a local called telephone line, a trunk line, a link circuit having a manual connection terminal at each end thereof for interconnecting said local lines and also for interconnecting one of said local lines as a calling line and said trunk line, called registering means for said calling line operable to register a complete call when the called subscriber responds, link circuit disconnect means including a relay in the answering end controlled by the calling subscriber and a relay in the calling end of said link circuit for disassociating said link circuit and said telephone lines, and means for placing the said relay in the calling end under the control of the calling and called subscriber's upon a local connection, said last means operable to place both of said relays under the sole control, of the calling subscriber upon a trunk connection.

2. In a manual telephone system comprising calling subscribers' telephone lines, local called subscribers' lines and called trunk lines, link circuits provided with manually operated connection terminals for interconnecting said lines, automatic call registering means for said calling lines, means in said link circuit for operating said call registering means, said second means responsive only when the called subscriber responds, means in said link circuit for preventing more than one operation of said call registering means upon a single connection of one of said link circuits with a calling line and a called line, link circuit disconnect means including a relay in the answering end controlled by the calling subscriber and a relay in the calling end of said link circuit for disassociating said link circuit and said telephone lines, for placing the said relay in the calling end under the control of the calling and called subscribers upon a local connection, said last means operable to place both

of said relays under the sole control of the calling subscriber upon a trunk connection.

3. In a telephone system including calling lines and called lines, link circuits for interconnecting the same, an automatic service meter device individual to each of said calling lines for registering completed calls, automatic means individual to each of said link circuits responsive to the response of the called subscriber to effect the operation of said service meter device, means individual to each of said link circuits for preventing the registration of more than one call upon a single connection of one of said link circuits and a calling and a called line, link circuit disconnect means including a relay in the answering end and a relay in the calling end of each of said link circuits for disassociating said link circuit and said telephone lines, and means for placing the said relay in the calling end under the control of the calling and called subscriber upon a local connection, said last means operable to place both of said relays under the sole control of the calling subscriber upon a trunk connection.

4. A telephone system comprising calling lines, local called lines and trunk lines, link circuits for interconnecting said lines, automatic means for registering calls completed between said lines, automatic link disconnect means individual to and for either end of each of said link circuits for disassociating a connected link circuit and said lines, said link disconnect means at either end of said connected link circuit being under the sole control of the calling subscriber when the link circuit is connected to a trunk line, and said link disconnect means in the calling end of said connected link circuit being under the control of both calling and called subscribers when said link circuit is connected to a local called line, and automatic means for registering a call against the calling line when the called subscriber responds.

5. In a telephone system including local telephone lines, trunk lines, link circuits for interconnecting said local telephone lines and for interconnecting said local telephone lines and said trunk lines, automatic call registering means individual to each of said local lines, automatic means individual to each of said link circuits operable to effect the operation of said call registering means at the calling subscriber's line when the called subscriber responds to a call extended to either a local line or to a trunk line, link disconnect means including a relay in the answering end and a relay in the calling end of each of said link circuits for disassociating said link circuits and said telephone lines, and means for placing the relay in the answering end of a connected link circuit under the control of the calling subscriber, and the said relay in the calling end under

the control of the called subscriber upon a local connection, said last means operable to place both of said relays under the sole control of the calling subscriber upon a trunk connection.

6. In a telephone system comprising calling and called local telephone lines and trunk lines, link circuits for interconnecting said local lines, and for interconnecting said local lines and said trunk lines, automatic means for said local lines for registering completed calls between calling and called subscribers' lines, automatic ringing means for signaling the called subscriber, automatic means individual to each of said link circuits and operable upon the response of the called subscriber to prevent further application of ringing current to the called line and to effect the operation of said automatic call registering means at the calling subscriber's line to register the completed call, individual link disconnect means in either end of each of said link circuits, and means for placing the link disconnect means in both ends of a link circuit interconnecting a local line and a trunk line under the sole control of the calling subscriber, and for placing the disconnect means in the answering end and the link disconnect means in the calling end of said link circuit under the control of the calling subscriber and called subscriber respectively upon a local connection to said link circuit.

7. In a telephone system including local telephone lines and trunk lines, link circuits for interconnecting said local telephone lines and for interconnecting said local lines and said trunk lines, automatic service registering means for registering a call completed between a calling subscriber and a called subscriber, and automatic link disconnect means individual to and for either end of each of said link circuits, said link disconnect means at both ends of a connected link circuit controlled by the calling subscriber when the link circuit is connected to one of said trunk lines, said link disconnect means in the calling end of the connected link circuit controlled by both the calling and called subscribers when said link circuit is connected to a called local line.

8. In a telephone system comprising local telephone lines and trunk lines, link circuits for interconnecting the same, automatic means individual to each of said local lines for registering a call at the calling line when the called subscriber responds, link disconnect means individual to and for either end of each of said link circuits for disassociating a connected link circuit and telephone lines, and means individual to each of said link circuits operable to place the link disconnect means at the calling end of a link circuit connected to a trunk circuit under the sole control of the calling sub-

scriber, said last means operable when said link circuit is connected to a called local line to place the calling end link disconnect means under the joint control of the calling and called subscribers.

9. In a telephone system comprising local telephone lines and trunk lines, link circuits for interconnecting said lines, automatic service means for registering a call at the calling lines when the called subscriber responds, link disconnect means individual to each of said link circuits for disassociating a connected link circuit and calling and called telephone lines, means individual to said link circuits for placing said link circuit disconnect means at the calling end of a connected link circuit under the sole control of the calling subscriber when said link circuit is connected to a trunk line, said last means operable to place said last link disconnect means under the control of both calling and called subscribers when the link circuit is connected to a local line.

10. In a telephone system including local lines and trunk lines, link circuits for interconnecting said lines, automatic disconnect means individual to each of said link circuits and under the sole control of the calling subscriber for freeing the calling line and trunk line from the link circuit interconnecting said calling line and said trunk line, said disconnect means being under the control of the calling subscriber to free the calling line and under the joint control of the calling and called subscribers to free the called line when the said link circuit interconnects two local telephone lines, and automatic means for registering a call at the calling line when the called subscriber responds.

11. In a telephone system including local telephone lines and trunk lines, link circuits for interconnecting said lines, automatic link disconnect means individual to each end of each of said link circuits for disassociating a link circuit connected to a calling and called line from said calling and called line, the automatic link disconnect means at the answering end of said connected link circuit being controlled by the calling subscriber, the automatic link disconnect means at the calling end of said link circuit connected to a local line controlled jointly by the calling and called subscribers, said last disconnect means controlled by the calling subscriber exclusive of the called subscriber when said link circuit is connected to a trunk line, automatic registering means individual to said local lines, and means individual to each of said link circuits and operable when the called subscriber responds to effect the operation of said automatic means at the calling line to register the call against the calling subscriber.

12. In a telephone system including dif-

ferent classes of telephone lines, link circuits for interconnecting the telephone lines of the same class and for interconnecting telephone lines of different classes, automatic means for registering a call at the calling subscriber's line when the called subscriber answers, said call registering means operable regardless of whether the called subscriber's line be one of the same class as the calling subscriber's line, or of a different class, link disconnect means individual to each end of each of said link circuits for disassociating a connected link circuit from its lines, the automatic means for disassociating the calling end of said link circuit from a called line of the same class being controlled jointly by the calling and called subscribers, the said last disconnect means controlled by the calling subscriber exclusive of said called subscriber when the called line is of a different class, the link disconnect means in the answering end of said link circuit being always under the sole control of the calling subscriber whether the called line is of the same class or of a different class.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 28th day of March, 1922.

GEORGE R. EATON.