

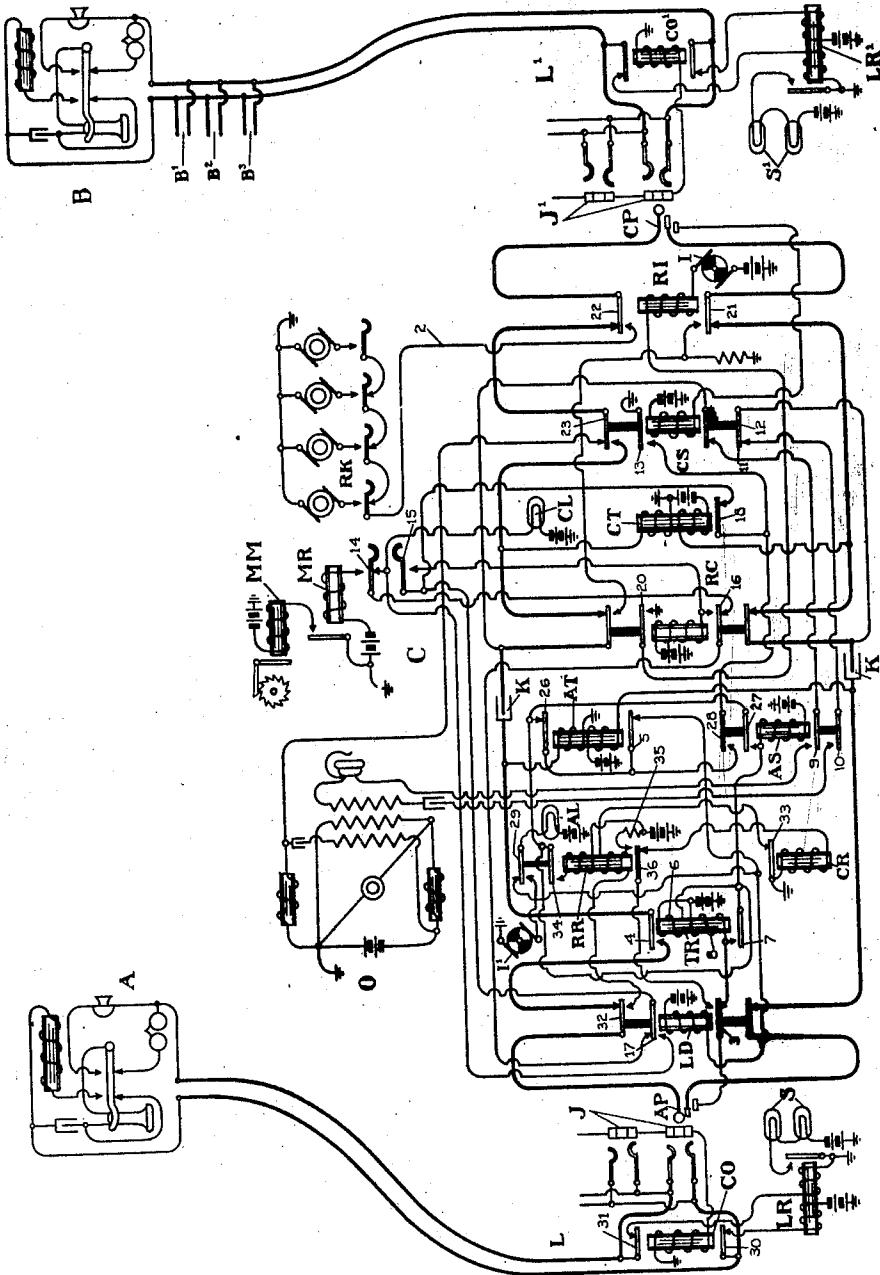
Aug. 19, 1924.

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TELEPHONE SYSTEM

Original Filed March 20, 1915

1,505,089



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Patented Aug. 19, 1924.

1,505,089

UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Original application filed March 20, 1915, Serial No. 15,835. Renewed March 10, 1920, Serial No. 364,872. Patent No. 1,439,071, dated December 19, 1922. Divided and this application filed September 27, 1922. Serial No. 590,760.

To all whom it may concern:

Be it known that I, HIRAM D. CURRIER, a citizen of the United States of America, residing at 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 in which link or cord circuits are employed, and has to do more particularly with so-called multiple line lamp systems in which automatic ringing, meter service registering means, secret service, instantaneous disconnect and recall are provided, and has for its object a new and improved system of the above character.

An object of my invention is the provision of automatic meter service means for registering the number of connections set up by the operator between calling subscribers' lines and called subscribers' lines but which meter service means will not operate to register the established connection should the called subscriber's line be busy.

Another object of my invention is the provision of means for preventing the application of ringing current to the called subscriber's line, should the said called subscriber's line be busy, even though the operator has operated the ringing key to apply ringing current to the said called line, but should the said called line be idle when connection is made therewith, and the ringing key is operated, ringing current will be connected to said called line and at the same time the automatic service means will operate to register the established connection between the calling subscriber's line and the idle called subscriber's line.

The above-mentioned objects of my invention, as well as others will be more particularly pointed out in the following specification and claims.

The present application is a divisional application of my co-pending application Serial No. 364,872, filed March 10, 1920, renewal of Serial No. 15,835, filed March 20, 1915, now Patent Number 1,439,071, granted December 19, 1922.

For a better understanding of my invention, reference may be had to the accom-

panying drawing in which is shown the common battery substations A and B terminating in the central office in line circuits L and L' respectively. The common battery line circuit A consists of a double wound line relay LR, cut-off relay CO, the multiple line lamps S and multiple jacks J. The right hand winding of the line relay LR is of a comparatively high resistance while the left hand winding is of a comparatively low resistance, the reasons for having these windings of different resistances will hereinafter appear. The line circuit as illustrated is known as a multiple lamp line circuit in which the lamps S and jacks J appear before a number of operators so that any one operator may answer a call to the exclusion of the other operators. The substation B and the line circuit L' are similar in all respects to the substation A and line circuit L, except that the substation B is one of a plurality of like substations which are connected to the line conductors leading to the central office equipment.

The cord circuit C comprises the answering plug AP and calling plug CP, the two plugs being connected by the heavily marked conductors of the cord circuit and having the condensers K and K' interposed. Associated with the answering end of the cord circuit is the answering sleeve supervisory relay AS and the answering tip supervisory relay AT for controlling the circuit of the answering supervisory lamp AL. I also provide a test relay TR for controlling the circuit of the answering sleeve supervisory relay AS, which relay controls the connection of the operator's telephone set O to the strands of the cord circuit. The test relay TR comprises a pair of windings, one a comparatively high resistance winding 8 and the other a comparatively low resistance winding 6. I also provide a link disconnect relay LD for making possible instantaneous disconnect and recall, and a recall relay RR for segregating a recall to the particular operator that previously answered the original call. Associated with the calling end of the cord circuit I provide a calling tip supervisory relay CT and a calling sleeve supervisory relay CS for controlling the circuit of the calling supervisory lamp CL. The calling

sleeve supervisory relay SC also controls the disconnection of the operator's set O from the strands of the cord circuit. A party line ringing key RK is provided for connecting one of a plurality of generators to the common ringing lead 2 and for controlling the ringing control relay RC. The ringing control relay RC controls the ringing interrupter relay RI, which through the medium of the interrupter I applies ringing current from the common lead 2 to the line of the called subscriber. Associated with the cord circuit C is a service registering device comprising a meter magnet MM and a meter control relay MR.

Assuming that the subscriber at the substation A wishes to initiate a call, upon the removal of the receiver thereat, a circuit is closed through the line relay LR, the line relay upon energizing closes a circuit through the multiple line lamps S. An operator upon noting the line lamp S glowing inserts the answering plug AP into the jack J of the calling line. Upon the insertion of the answering plug AP into the jack J, an energizing circuit is closed through cut-off relay CO and through the high resistance winding of the relay TR. This circuit extends from battery through the high winding of said test relay, normal contact 3 of the link disconnect relay LD, through the sleeve contacts of the plug AP and jack J and through the cut-off relay CO to ground. The cut-off relay CO upon energizing disconnects the subscriber's line circuit from the line relay LR thereby causing the line lamps S to be effaced. The test relay TR, upon energizing, closes the tip strand of the cord circuit at its contact 4 and thereby closes an energizing circuit through the answering tip supervisory relay AT. The answering tip supervisory relay AT, upon energizing, prevents the premature glowing of the answering supervisory lamp AL by opening its normal contact 5 and also prevents the closing of an energizing circuit for link disconnect relay LD. A further result due to the energization of the test relay TR is the closing of a multiple circuit, through its locking winding 6 and through the answering sleeve supervisory relay AS to the sleeve conductor of the answering plug AP. This circuit extends from battery through the windings of the answering sleeve supervisory relay AS and the locking winding 6 of the test relay TR to the contact 7 of the said test relay TR, then through the normal contact 3 of the link disconnect relay LD, through the sleeve conductor of the answering plug AP and jack J, and through the cut-off relay CO to ground. This low resistance path, extending to the sleeve conductor of multiple jack J, prevents the test relay TR of another cord circuit from operatively energizing and connecting the oper-

ator's set of the said second cord circuit to the line circuit of the calling subscriber. Answering sleeve supervisory relay AS, upon energizing, connects the operator's set O to the cord circuit through its alternate contacts 9 and 10 and through the normal contacts 11 and 12 of the calling sleeve supervisory relay CS. The operator now being in connection with the calling subscriber inquires the wants of the said calling subscriber. Assuming that it is the subscriber at the substation B that is wanted, the operator tests the line of the called subscriber and if it is idle she then inserts the calling plug CP into the jack J' connected to the line circuit of the called subscriber. If the line of the called subscriber is busy, the operator will receive the usual busy click in her receiver notifying her of the condition of the called line, and will thereupon notify the calling subscriber that the called line is busy. Upon the insertion of the calling plug CP into the jack J' an energizing circuit is closed through the calling sleeve supervisory relay CS and the cut-off relay CO' of the called line. This circuit extends from battery through the winding of the said calling sleeve supervisory relay CS, sleeve conductor of the calling plug CP and jack J', and through the winding of the said cut-off CO' to ground. The relay CO', upon energizing, disconnects the line relay LR' from the line circuit of the called subscriber. The calling sleeve supervisory relay, upon energizing, disconnects the operator's set O from the strands of the cord circuit at its contacts 11 and 12 and closes a circuit through the calling supervisory lamp CL at its contact 13. The circuit for lamp CL extends from battery through the said calling lamp CL, end contact 14 of ringing key RK, normal contact 16 of ringing control relay RC, normal contact 17 of the link disconnect relay LD, normal contact 18 of calling tip relay CT and through the alternate contact 13 of relay CS to ground. The calling lamp CL is the customary supervisory lamp for indicating to the operator when the called subscriber responds. The operator next depresses one of the ringing key plungers to connect one of the generators to the common ringing lead 2, to initiate the operation of the automatic ringing equipment, and to close a circuit for the meter control relay MR. The circuit for the meter control relay MR, extends from battery through the winding of said relay MR, alternate contact 14 of ringing key RK, normal contact 16 of ringing control relay RC, normal contact 17 of link disconnect relay LD, normal contact 18 of the tip supervisory relay CT and through the alternate contact 13 of the calling sleeve supervisory relay CS to ground. The meter relay MR, upon energizing, closes a circuit through

the magnet MM which then operates to register a call upon the service meter. When the operator releases the pressure from the plunger of the ringing key RK, the end springs 14 and 15 return to their normal position. The closing of the alternate contact 15 of the end springs of the ringing key RK closes a circuit through the ringing control relay RC. This circuit extends from battery through the winding of said relay RC, alternate contact of the end springs 15, normal contact 18 of the calling tip supervisory relay CT and through the alternate contact 13 of the calling sleeve supervisory relay CS to ground. The ringing control relay RC, upon energizing, closes a locking circuit for itself at its alternate contact 16 independent of the end spring 15, closes a circuit through the interrupter relay RI and separates the talking strands of the calling end of the cord circuit from the strands of the answering end of the cord circuit. The said locking circuit for ringing control relay RC extends from battery through the winding of said relay, through its alternate contact 16, through normal contact 17 of link disconnect relay LD, normal contact 18 of calling tip supervisory relay CT and through alternate contact 13 of calling sleeve supervisory relay CS to ground. The circuit for the interrupter relay RI extends from battery through the interrupter I, through the winding of said relay RI, through alternate contact 20 of the ringing control relay RC to ground. The ringing relay RI, upon energizing, connects ringing current from common ringing lead 2 to the line of the called subscriber.

Upon the response of the called subscriber, a circuit is closed through the calling tip supervisory relay CT, this circuit extends from battery through the lower winding of said relay CT, normal contact 21 of interrupter relay RI, ring contact of the calling plug CP and jack J', through the substation B, tip contacts of the jack J' and plug CP, normal contact 22 of ringing relay RI, alternate contact 23 of relay CS, and through the upper winding of the calling tip supervisory relay CT to ground. The relay CT, upon energizing, opens the locking circuit for the ringing control relay RC and for the supervisory lamp CL at its contact 18. The ringing control relay, upon de-energizing, opens the circuit of the ringing interrupter relay RI at its contact 20 and connects the strands of the calling and called ends of the cord circuit, so that conversation may now take place between the calling and called subscriber over the heavily marked conductors. The effacement of the calling lamp CL indicates to the operator that the called party has responded.

Assuming now that the operator received a click in her ear, when she tested the called

line, due to its being busy, and that the operator did not pay any attention to the click but inserted the calling plug CP into the jack J' and then operated the ringing key RK, to connect ringing current to the called subscriber's line, ringing current will not be connected to the called line in this instant, for the calling tip relay CT will energize, since an energizing circuit will be closed for it through the closed switchhook contacts of the busy substation on the called line, to open the energizing circuit of the ringing control relay RC at normal contact 18 of said relay CT. The circuit of relay RC being open at normal contact 18 of relay CT, said relay RC will not energize when the ringing key RK is operated, to apply ringing current to the called line. The meter relay MR will not energize to bring about the operation of the meter magnet MM due to its energizing circuit being opened at normal contact 18 of relay CT. Thus it will be obvious that no harm can be done by an operator plugging into a jack leading to a busy line even though she attempts to apply ringing current to the called line, nor will the connection be registered by the service meter device.

Assuming now that conversation has been finished, the subscriber at the substation A, upon replacing the receiver upon its switchhook, opens the energizing circuit of the answering tip supervisory relay AT at the switchhook contacts. The supervisory relay AT, upon de-energizing, closes an energizing circuit for the link disconnect relay LD at its contact 5 and closes a locking circuit for the test relay TR and for the sleeve supervisory relay AS at its contact 26. The locking circuit for the sleeve supervisory relay AS extends from battery through the winding of said relay, its alternate contact 27, normal contact 26 of relay AT, alternate contact 28 of relay AS and alternate contact 13 of relay CS to ground. The locking circuit for the test relay TR extends from battery through the winding of said relay, alternate contact 27 of relay AS, normal contact 26 of relay AT, alternate contact 28 of relay AS and alternate contact 13 of relay CS to ground. A further result due to the de-energization of the answering tip supervisory relay AT is the closing of a circuit through the answering supervisory lamp AL. This circuit extends from battery through the said lamp AL, normal contact 29 of relay RR, normal contact 5 of relay AT, alternate contact 28 of relay AS and alternate contact 13 of relay CS to ground. The circuit for the link disconnect relay LD extends from battery through the winding of said relay, normal contact 5 of relay AT, alternate contact 28 of relay AS and alternate contact 13 of relay CS to ground. The link disconnect relay LD, upon energizing,

disassociates the talking strands of the link circuit from the line circuit, opens the circuit of the cut-off relay CO at its normal contact 3 and connects the control relay CR to the sleeve of the answering plug AP. The called subscriber B, upon replacing his receiver upon the receiver hook, opens the circuit of the calling tip supervisory relay CT at the switchbook contacts. The supervisory relay CT, upon deenergization, closes a circuit for the calling supervisory lamp CL. The circuit for the calling supervisory lamp extends from battery through the said lamp, alternate contact 17 of link disconnect relay LD, normal contact 18 of relay CT and alternate contact 13 of relay CS to ground. The operator, upon noting the glowing of the answering supervisory lamp AL and the calling supervisory lamp CL, removes the answering plug AP and the calling plug CP from their respective jacks J and J'. The removal of the calling plug CP from the jack J' allows the cut-off relay CO' and the calling sleeve supervisory relay CS to de-energize. The relay CS upon de-energizing, opens the locking circuit for the link disconnect relay LD, answering sleeve supervisory relay AS, test relay TR and for the supervisory lamps CL and AL. The relays, upon de-energizing, permit the apparatus of the cord circuit to return to normal as soon as the answering plug AP is removed from the jack J.

Should the calling subscriber wish to recall before the answering plug AP is removed from the jack of the line circuit L, he may do so. The subscriber, upon removing his receiver for a recall, closes a circuit through the recall relay RR extending from battery through the left-hand winding of the line relay LR, normal contact 30 of cut-off relay CO through the calling subscriber's substation, tip contact of the jack J and plug AP, alternate contact 32 of relay LD through the lower winding of said recall relay RR and the normal contact 33 of control relay CR to ground. The subscriber upon removing his receiver also closes a circuit through the high resistance winding of the line relay LR, this circuit extending from battery through the left-hand winding of the relay LR, normal contact 30 of the cut-off relay CO, through the calling subscriber's substation, normal contact 31 of relay CO and through the high resistance right-hand winding of the relay LR to ground. The line relay LR does not energize at this time owing to the low resistance path extending through the recall relay RR and owing to the special adjustment of contact 34 of relay RR. The relay RR is so adjusted that upon the first slight movement of its armature its contact 34 is closed before its other contacts are moved. The relay RR, upon energizing, closes a lock-

ing circuit for itself extending from battery through its upper winding, its alternate contact 34, normal contact 26 of relay AT, alternate contact 28 of relay AS and alternate contact 13 of relay CS to ground. The relay RR also closes an energizing circuit for the cut-off relay CO of the recalling subscriber's line. This circuit extends from ground through the winding of said cut-off relay, sleeve conductor of jack J and plug AP, alternate contact 3 of relay LD, alternate contact 36 of recall relay RR and through the resistance 35 to battery. The cut-off relay, upon energizing, disconnects the line relay LR from the subscriber's line circuit L before it has had time to energize and cause the line signals S to be operated. A further result due to the energizing of the recall relay RR is to flash the supervisory lamp AL. The flash circuit for the supervisory lamp AL extends from battery through the said lamp AL, alternate contact 29 of the recall relay RR and through the interrupter I' to ground. The operator, upon noting the flashing of the answering supervisory lamp AL, removes the calling plug CP from the jack J' thereby allowing the calling sleeve supervisory relay CS to de-energize. The relay CS, upon de-energizing, opens the locking circuits for answering sleeve supervisory relay AS, testing relay TR, recall relay RR and link disconnect relay LD. The link disconnect relay LD is made slightly slow-acting to allow relays AS, TR and RR to de-energize before it de-energizes. The recall relay RR, upon de-energizing, opens the circuit of the supervisory lamp AL at its alternate contact 29. Link disconnect relay LD, upon de-energizing, immediately closes a circuit through the high resistance winding of the test relay TR at its normal contact 3 before the cut-off relay CO has had time to allow the line relay LR to energize and cause the line signals S to glow. The test relay TR, upon again energizing, closes a multiple circuit through its winding 6 and through the answering sleeve supervisory relay AS to the sleeve conductor of the answering plug AP in the same manner as hereinbefore described. The link disconnect relay LD upon de-energizing, also connects the talking conductors of the answering plug AP to the strands of the link circuit C. The recall is then handled by the operator in the same manner as previously described for handling an original call.

Assuming now that the conversation has been terminated, that the calling subscriber A and the called subscriber B have replaced their receivers, and that a second operator has received a call for the calling subscriber A, the operator first tests the line of the subscriber A and finding it idle inserts the calling plug of a cord circuit into a jack J con-

connected to the line circuit of subscriber A. Upon inserting the calling plug of the second operator's link circuit into the jack J, an energizing circuit is closed through the control relay CR of the cord circuit C. This circuit extends from battery through the calling sleeve supervisory relay of the second operator's cord circuit, the sleeve of the calling plug, the sleeve of the jack J, sleeve of the answering plug AP of cord circuit C, alternate contact 3 of the link disconnect relay LD, normal contact 36 of recall relay RR and through the winding of control relay CR to ground. The control relay CR energizes over this circuit and removes ground from the lower winding of the recall relay RR so that when the second operator applies ringing current to the tip conductor of the calling plug CP, it will not cause the recall relay RR to be operated to cause the answering supervisory lamp AL to signal a false recall.

Assuming now that a connection has been established, if an operator should attempt to listen in upon a busy line by inserting the answering plug of an idle link circuit into a multiple jack of the busy line and then touch the tip of another answering or calling plug to the sleeve of the busy line in an attempt to energize the answering sleeve supervisory relay AS to connect the operator's set O with the strands of the cord circuit that she has connected to the busy line, she will find that she will be unable to energize the supervisory relay AS to connect her set O, as ground is normally disconnected from the tip conductors of both the answering and calling plugs.

In working out my invention I have employed preferred circuit arrangements, all of which go to make an efficient operating system, but it is to be understood that changes and modifications may be readily made without departing from the spirit and scope of my invention. Therefore, I do not desire to be limited to the exact arrangement shown and described but aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

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

1. A telephone system, including a plurality of telephone lines, link circuits for interconnecting said lines as calling and called lines, automatic ringing means and a connection register for said link circuits, operator-controlled means for actuating said ringing means to apply ringing current to the called line and for actuating said connection register when one of said link circuits is connected to an idle called line, and means to prevent the actuation of said ringing means and connection register by the

operation of said key when connection is made with a busy called line.

2. In a telephone system, a plurality of telephone lines terminating in jack terminals, link circuits for connecting to said jack terminals, automatic ringing means and a connection register for said link circuits, a key operable to actuate said ringing means to apply ringing current to a called line and to actuate said connection register when a link circuit is connected to an idle called line, and means for preventing the application of ringing current to the called line and the actuation of said connection register when connection of a link circuit is made with a busy jack terminal.

3. In a telephone system, a subscriber's telephone line terminating in multiple jack terminals, a link circuit for connecting to any one of said terminals, service meter means for registering a connection between said link circuit and one of said jack terminals, ringing means for applying ringing current to said subscriber's line, a manually operated key for actuating said ringing means and service meter means when said link circuit is connected to an idle jack terminal, and means for preventing the actuation of said ringing means and said service meter means when connection is made with a busy jack terminal.

4. In a telephone system, a calling subscriber's line and a called subscriber's line, a link circuit for interconnecting said subscriber's lines, ringing means for applying ringing current to said called subscriber's line, service meter means for registering the connection between said calling subscriber's line and said called subscriber's line if said called line is idle, and means for preventing the operation of said service meter means and said ringing means if said called line is busy.

5. In a telephone system, a calling subscriber's line and a called subscriber's line, a link circuit for interconnecting said lines, automatic ringing means for applying ringing current to said called line, connection register means for registering the number of connections between said subscribers' lines, a key for controlling the actuation of said ringing means and said service meter means, and means for preventing the operation of both of said means when said called line is busy and a connection is made therewith and said key operated.

6. A telephone system including a subscriber's line, a link circuit for connecting to said subscriber's line, ringing means for applying ringing current to said subscriber's line, connection registering means for registering the number of connections between said link circuit and said lines, a key for actuating said ringing means and said registering means, a relay

controlled over said subscriber's line, and operable to disconnect ringing current from said line when the subscriber thereon responds, and also operable to prevent the actuation of said ringing means and said registering means when said key is operated if the said called subscriber's line is busy when connection is made therewith.

7. In a telephone system including telephone lines, link circuits for interconnecting said lines, automatic ringing means for applying ringing current to said lines as called lines, service meter means for registering the number of connections between said lines and said link circuit, a key adapted to be operated to actuate said service meter means and ringing means when a link circuit is connected to an idle line, and electromagnetic means for preventing the actuation of said service meter means and said ringing means when connection is made with a busy line.

8. In a telephone system, including a calling subscriber's line and a called subscriber's line, a link circuit for interconnecting said subscribers' lines in conversational circuit, connection registering means operable to register a connection between said link circuit and said called line, ringing means operable to apply ringing current to said called line, manually operated means for effecting the operation of said registering means and said ringing means when said link circuit is connected to said called line and said called line is idle, and electromagnetic means for preventing the oper-

ation of said registering means and ringing means if said called line is busy.

9. In a telephone system including telephone lines, link circuits for interconnecting said lines, means for registering the number of connections between said link circuit and said lines, when said lines connected to are idle, ringing means for said link circuits for applying ringing current to said connected to idle lines, and electromagnetic means for preventing the registration of a connection and the application of ringing current when a connection is made with a busy line.

10. In a telephone system the combination with a plurality of telephone lines, a link circuit for interconnecting a calling one with a called one of the said lines, a connection register for the said link circuit, a ringing key adapted when operated to continuously apply a source of intermittent ringing current to the terminals of the called line to which the link circuit has been connected, means to cause the actuation of said register when the said ringing current has been applied to the called line terminals, and means to prevent the actuation of the said register and the said ringing means by the operation of the said key, when connection is made with a terminal of a busy desired line.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 25th day of September, 1922.

HIRAM D. CURRIER.