

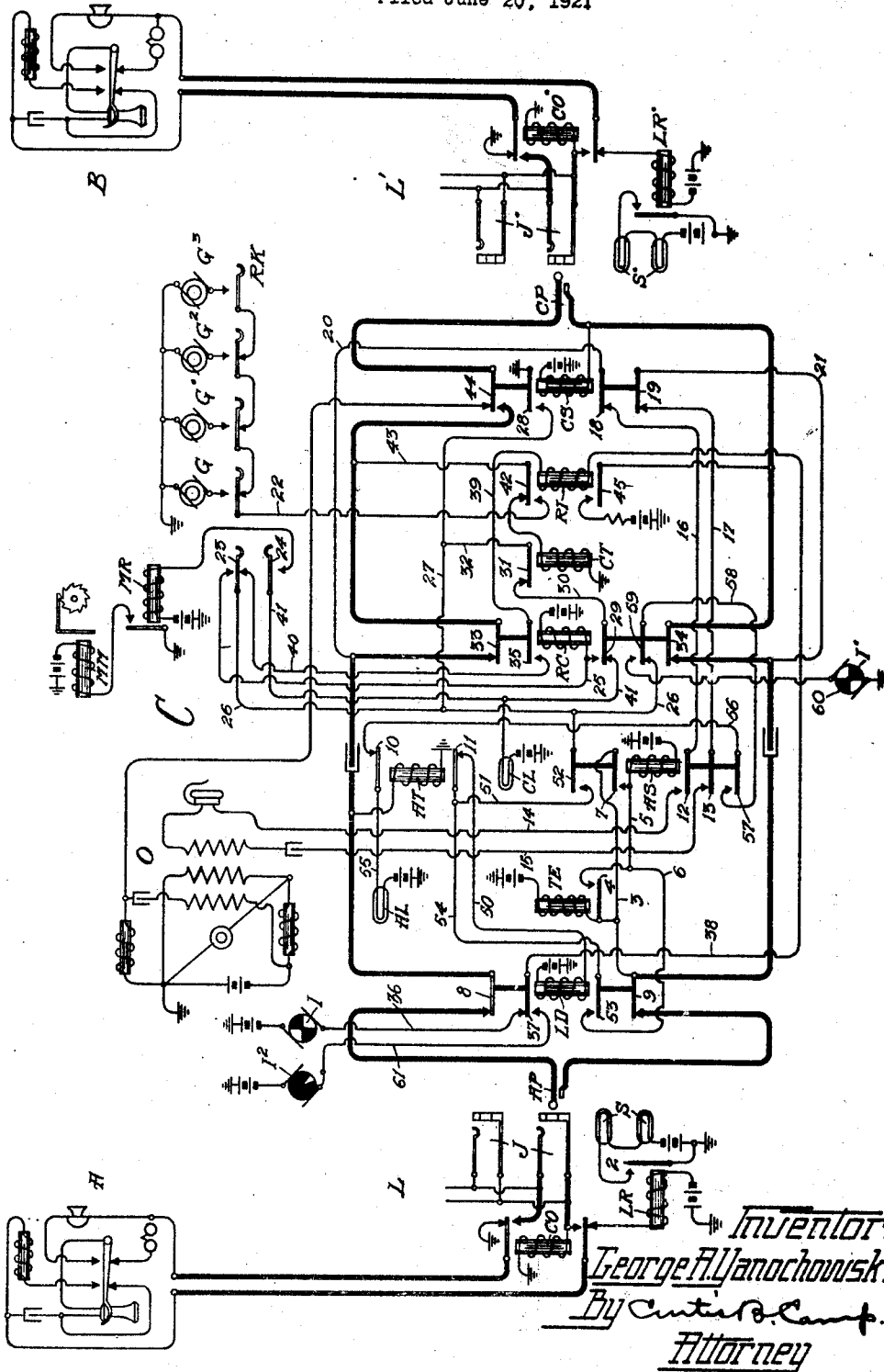
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G. A. YANOCHOWSKI

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TELEPHONE SYSTEM

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UNITED STATES PATENT OFFICE.

GEORGE A. YANOCHOWSKI, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCH-BOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, GEORGE A. YANOCHOWSKI, a citizen of the United States of America, resident of Chicago, in the 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 has to do more particularly with automatic ringing systems such as are provided for operators' cord circuits in which an interrupter relay is intermittently energized and de-energized to intermittently apply ringing current to the called line.

A feature of my invention is the provision of an improved circuit arrangement whereby, should a calling subscriber replace his receiver prior to receiving a response from a called substation a distinctive signal is given to the operator that established the connection in the form of a flash ring signal, advising her that she should immediately disconnect the calling cord from the called line as the calling subscriber has replaced his receiver.

Another feature of my invention is the provision of a pair of ringing interrupters in association with the usual interrupter relay, one being of the ordinary interrupter type as commonly used in automatic ringing systems for intermittently energizing and de-energizing the ringing interrupter or "flip flop" relay to intermittently connect ringing current to the called line. The second interrupter is provided with a short ringing period and a comparatively long silent period and is also rotated at a much slower speed than the ordinary interrupter. This signal is arranged to advise the called subscriber that the calling subscriber has replaced his receiver. Means in association with the pair of interrupters are actuated when a calling subscriber replaces his receiver before receiving a response from a called substation to disconnect the first of said interrupters from the circuit of the interrupter relay and connect in place thereof the second interrupter in circuit with the interrupter relay. The speed at which the ringing interrupter relay was energized and de-energized is greatly reduced due to this

substitution of this second interrupter, thus permitting longer silent periods between each application of ringing current which are of short duration to advise the called subscriber, as before mentioned, that the calling subscriber no longer desires connection with the called subscriber.

In the accompanying drawing I have illustrated a preferred embodiment of my invention and the system shown includes calling substation A, terminating in line circuit L, having the usual line relay LR, cut-off relay CO and the line jacks J and the multiple line lamps S and to the right of the drawing I show a called substation B terminating in a line circuit L' having the usual line relay LR', cut-off relay CO', line jacks J' and multiple line lamps S'. The line circuits L and L' shown are what are known as multiple line lamp circuits in which a line lamp S is provided for each jack, so that when a call is initiated a line signal appears before each of the calling line jacks J and any one of a plurality of operators may seize this 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 as calling and called lines and comprises answering plug AP and a calling plug CP connected by the heavily marked talking conductors. The answering end of the cord circuit C comprises an answering tip supervisory relay AT and an answering sleeve supervisory relay AS. The answering sleeve supervisory relay AS energizing connects the operator's set O to the cord conductors so that she may be placed in communication with the calling subscriber at substation A. Relays AT and AS upon energization also prevent the premature lighting of the answering supervisory lamp AL. A high resistance test relay TE is also provided, which relay TE is for the purpose of excluding any other operator that may attempt to seize the call after an operator has already established connection to the calling line. A link disconnect relay LD is also provided which is energized when the subscriber at a calling substation replaces his receiver upon the switchhook to disassociate the cord circuit

connected with his line from his associated line circuit which will permit the subscriber to recall, if he wishes to do so.

The calling end of the cord circuit C comprises the calling tip supervisory relay CT and the calling sleeve supervisory relay CS, said relays CT and CS being for the usual supervisory purposes for controlling the calling supervisory lamp. A ringing control relay RC is also provided, which relay is energized upon the depression of the ringing key plunger of the party line ringing key RK, to bring about the energization of the said relay RC to connect the constantly rotating interrupter I in circuit with a ringing interrupter relay RI to intermittently connect ringing current from one of a plurality of ringing generators G, G', G² or G³, to intermittently actuate the call bell at the called substation B. A meter relay MR is also provided in association with the meter magnet MM to register a connection.

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

Assuming that the subscriber at the substation A initiates a call, the removal of the receiver at the substation A establishes an energizing circuit for the line relay LR and the line relay LR energizing closes its alternate contact 2, whereby the line signals S before the different associated jacks J are lighted. The first operator to seize the call by the insertion of an answering plug AP into one of the jacks J connects the high resistance test relay TE and cut-off relay CO in series, from battery through the winding of the relay TE, conductor 3, sleeve contacts of the connected plug AP and jack J to ground through the winding of the cut-off relay CO. Relay TE is energized over this circuit, and the closing of its alternate contact 4 connects the low resistance answering sleeve supervisory relay AS in series with the cut-off relay CO, the circuit being traced from battery through the winding of the relay AS, conductors 5 and 6, alternate contact 4 of the relay TE, conductor 3, to ground through the winding of the cut-off relay CO, over the previously described path.

The closing of alternate contact 7 of the relay AS connects the winding of the said relay AS directly to the sleeve strand of the cord circuit C independent of the contact 4 of the test relay TE and relay AS remains energized until disconnection takes place. Due to the flow of current through the windings of the relays AS and TE over the calling line, the answering tip supervisory relay AT is also energized over the circuit traced from ground through the

winding of relay AT, normal contact 8 of the link disconnect relay LD, the tip contacts of the connected plug AP and jack J, through the closed contacts at the substation switchhook and back through the sleeve contacts of the connected jack J and plug AP, normal contact 9 of the relay LD, conductor 3, alternate contact 7 of the relay AS, to battery through the winding of the said relay AS. The relay AT energizes over this circuit and opens its normal contact 10 to prevent the premature lighting of the answering supervisory lamp AL, and the opening of its normal contact 11 prevents the premature energization of the link disconnect relay LD. The closing of alternate contacts 12 and 13 of the answering sleeve supervisory relay AS connects the operator's set O in bridge of the talking conductors of the cord C, over conductors 14 and 15, alternate contacts 12 and 13 of the relay AS, conductors 16 and 17, normal contacts 18 and 19 of the calling sleeve supervisory relay CS, and conductors 20 and 21 to the tip and sleeve conductors of the cord circuit C. Should a second operator insert an answering plug AP into another jack J of the calling line subsequent to the insertion of the plug AP of the cord circuit C, the test relay TE of this second cord does not energize due to the shunting of its winding by the low resistance relay AS of the cord circuit C, so that the second operator is unable to communicate with the calling subscriber because her operator's set is not connected due to the failure of the answering sleeve supervisory relay AS of the second cord to energize, and the second operator receiving no response again withdraws the answering plug AP of the second cord from the connected jack. The first operator being connected with the calling subscriber at substation A, as just described, now inquires the wants of the calling subscriber thereat.

Assuming that it is the subscriber at the substation B that is wanted, the operator tests the jack J' of the called line in the usual manner, and, if busy, receives the customary click in her head set. Assuming that the line is idle, the operator inserts the calling plug CP into the jack J' of the called line B, thus establishing a series energizing circuit for the calling sleeve supervisory relay CS and the cut-off relay CO' of the line circuit L' associated with the called substation B, from battery through the winding of the relay CS, sleeve contacts of the connected plug CP and jack J', to ground through the winding of the cut-off relay CO'. The relay CS energizing opens its normal contacts 18 and 19 to disconnect the operator's set O from the cord. The operator now depresses the proper key plunger of the ringing key RK whereby the selected frequency generator, which we will

assume is G, is connected to the ringing conductor 22. The actuation of the ringing key plunger to its fully depressed position also momentarily actuates the end spring contacts 23 and 24. The closing of alternate contact 23 of the end spring contacts establishes an energizing circuit for the ringing control relay RC, traced from battery through the winding of the relay RC, conductor 25, alternate contact 23 of the end spring contacts, conductors 26 and 27, to ground at alternate contact 28 of the calling sleeve supervisory relay CS. The relay RC energizing closes its alternate contact 29, establishing a locking circuit for itself traced from battery through its winding, its alternate contact 29, conductor 30, normal contact 31 of the relay CT, and conductors 32 and 27, to ground at alternate contact 28 of the relay CS. The relay RC energizing interrupts its normal contacts 33 and 34 to interrupt the talking strands of the cord, and the closing of its alternate contact 35 establishes a circuit for the ringing interrupter relay RI, traced from battery through the constantly rotating interrupter I, conductor 36, normal contact 37 of the relay LD, conductor 38, through the winding of the ringing interrupter relay RI, conductor 39, alternate contact 35 of the relay RC, conductor 40, normal contact 23 of the end spring contacts, conductors 26 and 27, to ground at alternate contact 28 of the relay CS.

The interrupter I is of the usual type used in connection with automatic ringing and its period of interruption is, say for the purpose of illustration, one second on and four seconds off, that is, the interrupter will energize the relay RI for one second to permit the application of ringing current for one second and permit the relay to remain de-energized for four seconds, in which no ringing current will be transmitted to the called substation.

The momentary closure of alternate contact 24 of the end spring contacts upon the depression of a plunger of the ringing key RK closes an energizing circuit for the meter relay MR from battery through the winding of the relay MR, the closed contact 24 of the end spring contacts, conductor 41, normal contact 29 of the relay RC, conductor 30, normal contact 31 of the relay CT, conductors 32 and 27, to ground at alternate contact 28 of the relay CS. The meter relay MR energizing now closes its alternate contact to energize the meter magnet MM, which meter magnet actuates the meter mechanism.

The ringing interrupter relay RI is intermittently energized over the circuit just described, and the ringing current to the called substation B may be traced from the generator G through the now closed ringing key

plunger contact, ringing conductor 22, alternate contact 42 of the ringing interrupter relay RI, conductor 43, alternate contact 44 of the relay CS, tip contacts of the connected plug CP and jack J', through the call bell and condenser of the called substation B, and back through the sleeve contacts of the connected jack J' and plug CP to battery and ground through alternate contact 45 of the relay RI.

Upon the response of the called subscriber at the substation B and following the de-energization of the relay RI, a circuit is established for the calling tip supervisory relay CT, traced from ground through the winding of the relay CT, normal contact 42 of the relay RI, conductor 43, alternate contact 44 of the relay CS, tip contacts of the connected plug CP and jack J', through the now closed contacts at the substation switchhook, back through the sleeve contacts of the connected jack J' and plug CP, to battery through the winding of the calling sleeve supervisory relay CS. The relay CT energizing opens its normal contact 31, which interrupts the locking circuit for the ringing control relay RC, and the said relay now de-energizes, and the opening of its alternate contact 35 disconnects the constantly rotating interrupter I from the ringing interrupter relay RI, thus preventing further application of ringing current to the called substation B. The closing of normal contacts 33 and 34 of the now de-energized relay RC re-establishes the continuity of the talking conductors, and the calling subscriber at the substation A and the called subscriber at the substation B are now in conversational circuit, which may be traced over the heavily marked conductors.

Assuming now that a connection has been extended to the called substation B, as just described, and that the call bell at said substation B is being actuated, but that the calling subscriber at the substation A replaces his receiver prior to receiving a response from the subscriber at the called substation B, the replacing of the receiver at the calling substation A by the subscriber thereat opens the energizing circuit of the answering tip supervisory relay AT at the switchhook contacts, and the closing of its normal contact 11 establishes an energizing circuit for the link disconnect relay LD, traced from battery through the winding of the relay LD, conductor 50, normal contact 11 of the relay AT, conductor 51, alternate contact 52 of the relay AS, conductors 26 and 27 to ground at alternate contact 28 of the relay CS.

The relay LD energizes over this circuit and opens its normal contact 9, interrupting the energizing circuit of the answering sleeve supervisory relay AS, but a substitute circuit is established for the said relay

AS, traced from battery through the winding of the relay AS, its alternate contact 7, conductor 3, alternate contact 4 of the relay TE, conductor 6, alternate contact 53 of the relay LD, conductors 54 and 51, alternate contact 52 of the relay AS, conductors 26 and 27, to ground at alternate contact 28 of the relay CS. The energizing circuit of the relay TE is also interrupted at normal contact 9, but the relay TE has a substitute circuit established for it from battery through the winding of the relay TE, its alternate contact 4, to ground at alternate contact 28 of the relay CS over the path as just described.

The closing of normal contact 10 of the answering tip supervisory relay AT establishes a circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, conductor 55, normal contact 10 of the relay AT, conductor 56, alternate contact 57 of the relay AS, conductor 58, alternate contact 59 of the relay RC, over conductor 60 to ground through the constantly rotating interrupter I'. The relay RC is not de-energized as the called subscriber has not answered, and therefore, the calling tip supervisory relay CT is still at normal and the locking circuit of the relay RC is maintained. The circuit for the answering supervisory lamp AL just described includes the rotating interrupter I' and causes the same to flash, indicating to the operator that the connection needs immediate attention and that she should immediately withdraw the calling plug CP as the calling subscriber at substation A has replaced his receiver prior to the response of called subscriber at the substation B.

The link disconnect relay energizing opens its normal contact 37, disconnecting the interrupter I in circuit with the interrupter relay RI, but the closing of alternate contact 37 of the relay LD connects a slow speed interrupter I² in circuit with the relay RI, traced from battery through the slow-speed interrupter I², conductor 61, alternate contact 37, conductor 38, through the winding of the ringing interrupter relay RI, conductor 39, alternate contact 35 of the ringing control relay RC, conductor 40, normal contact 23 of the end spring contacts, conductors 26 and 27, to ground at alternate contact 28 of the sleeve supervisory relay CS.

The interrupter I² that is now substituted in place of the interrupter I' is of slower speed and its period of on and off may be of any desired length, and for illustration, the period during which the ringing interrupter relay is energized to apply ringing current to the called line may be of one second duration, and the period during which the relay RI remains de-energized may be of any desired length, as thirty seconds.

The ordinary ringing interrupter I having been disconnected from the circuit with the ringing interrupter relay RI and being now connected with the slow-speed interrupter I², due to the closure of alternate contact 37, upon the energization of the link disconnect relay LD, this connection permits the ringing interrupter relay RI to remain de-energized for a longer period of time than when the interrupter I is connected in circuit, so that only a few applications of ringing current are extended to the called substation B during the time that the operator receives the flashing disconnect signal from the answering supervisory lamp AL until the time she removes the calling plug CP from the connected jack J'. Under ordinary circumstances disconnection takes place immediately upon receiving the disconnect signal, and ringing current to the called line after the calling subscriber replaces his receiver will not be transmitted as the period of time will be very short between the time that the disconnect signal flashes and the time of the removal of the calling plug CP.

The withdrawal of the calling plug CP from the jack J' opens the series energizing circuit for the calling sleeve supervisory relay CS and the cut-off relay CO', and the relay CS de-energizing opens its alternate contact 28, opening the locking circuit of the ringing control relay RC. The ringing control relay RC de-energizing opens its alternate contact 59 and disconnects the interrupter I' from the answering supervisory lamp AL to prevent further flashing of the said lamp. The relay LD will de-energize upon the removal of the plug CP from the jack J' due to the opening of its circuit at alternate contact 28 of relay CS. Relays TE and AS will also de-energize momentarily due to the opening of alternate contact 28 of relay CS but will again energize upon the closure of normal contact 9 of relay LD as a circuit will be closed for these relays through the now closed contact 9 of relay LD and the winding of relay CO as described hereinbefore. Should the answering plug AP of another cord circuit be connected to a multiple jack J while the relay LD of cord circuit C is in its energized position, the relays TE and AS de-energizing upon the removal of the plug CP from the jack J' will not again energize upon the closure of normal contact 9 of relay LD, due to the fact that relay AS of the said other cord circuit connected to one of the jacks J will be energized and will shunt out the high resistance relay TE of the cord circuit C, and because of the failure of said relay TE to energize, relay AS of cord circuit C will be prevented from energizing thus avoiding any disturbance of the connection by said other cord circuit.

The operator now withdraws the answering plug AP from the jack J of the calling line and the apparatus used in establishing the connection is now at normal and available for use in establishing other connections.

It will be observed that when the subscriber A replaces his receiver upon the switchhook prior to receiving a response from the called substation, the relay LD is energized to open its normal contacts 8 and 9 to disconnect the cord conductors from the calling line. Cut-off relay CO, therefore, restores so that substation A is available for immediate recall. Therefore, if the subscriber at the substation A desires to initiate a recall immediately after replacing his receiver upon the switchhook, and before the removal of the plugs AP and CP from their respective jacks, the removal of the receiver at the recalling substation A again establishes a circuit for the line relay LR, and the line relay LR is energized to light the associated line signals S so that the same or another operator may take the call.

When a connection has been established between two subscribers at the substations A and B in the manner as before described, and both receivers are off their switchhooks, the conversational circuit may be traced over the heavily marked conductors. At the termination of the conversation the replacing of the receiver at the substation A opens the energizing circuit of the answering tip supervisory relay AT, and the relay AT now restores to close its normal contacts 10 and 11.

The closing of normal contact 11 of the relay AT establishes an energizing circuit for the link disconnect relay LD over a circuit as previously described, and the relay LD energizing opens its normal contacts 8 and 9 to interrupt the tip and sleeve cord conductors, and the opening of normal contact 9 opens the series energizing circuit of the cut-off relay CO and the answering sleeve supervisory relay AS, but a substitute energizing circuit is established for the said relay AS due to the closure of alternate contact 53 of the relay LD. The relay TE is also held energized through the alternate contact 53 and thus the answering supervisory relay AS and the relay TE remain energized.

The closing of normal contact 10 of the relay AT establishes an energizing circuit for the answering supervisory lamp AL, from battery through the lamp AL, conductor 55, normal contact 10 of the relay AT, conductor 56, alternate contact 57 of the relay AS, conductor 58, normal contact 59 of the relay RC, conductors 26 and 27 to ground at alternate contact 28 of the relay CS.

The replacing of the receiver at the called substation B opens the energizing circuit

of the calling tip supervisory relay CT at the switchhook contacts, and the relay CT de-energizing closes its normal contact 31, establishing an energizing circuit for the calling supervisory lamp CL, traced from battery through the lamp CL, conductor 41, normal contact 29 of the relay RC, conductor 30, normal contact 31 of the relay CT, conductors 32 and 27 to ground at alternate contact 28 of the relay CS.

The operator noting the two lighted line signals AL and CL now withdraws the answering plug AP and calling plug CP from their respective jacks J and J'. The withdrawal of the plug CP from the jack J' opens the energizing circuit of the relay CS, and the relay CS restoring opens the circuits of the relays LD, TE and AS. The removal of the plug AP from the jack J places the apparatus that was used in establishing the connection at normal, which may now be used for establishing other connections.

While I have illustrated and described my invention in connection with a preferred form of cord circuit, it is to be understood that it is applicable for use with other circuits than that shown. It will also be apparent that changes and modifications will suggest themselves by those skilled in the art, and I, therefore, do not wish to be limited to the exact structure as shown, 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 United States Letters Patent is:

1. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, operator controlled means for applying ringing current to a called line, an interrupter and an interrupter relay for intermittently applying said ringing current, a second interrupter, and means under the control of the calling substation for disconnecting said first interrupter and connecting said second interrupter in said circuit.

2. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, operator controlled means for applying ringing current and continuing such application to a called line, an interrupter and an interrupter relay in circuit with said interrupter for intermittently applying said ringing current, means for interrupting the application of ringing current by a control exercised at the called line, a second interrupter, and means under a control exercised by the calling line for disconnecting said first interrupter and connecting said second interrupter in said circuit.

3. A telephone system including a call-

ing subscriber's telephone line and a called subscriber's line, an operator's link circuit for use in interconnecting said lines, a source of ringing current, an interrupter and an interrupter relay in circuit for intermittently connecting said ringing current to said called subscriber's line, a second interrupter, a link disconnect relay under a control exercised by the calling subscriber for disconnecting said first interrupter and connecting said second interrupter to change the intermittent period of energization and de-energization of said interrupter relay prior to a response of the called subscriber.

4. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, an operator's link circuit for use in interconnecting said lines, a source of ringing current, an interrupter and an interrupter relay in circuit therewith for intermittently connecting said ringing current to said called subscriber's line, control means exercised by the response of said called subscriber to disconnect said ringing current, a second interrupter, a disconnect relay under the control of the calling subscriber to disconnect said first interrupter and connect in circuit the second interrupter when the calling subscriber disconnects prior to the response of the called subscriber to change the period of intermittent energization and de-energization of said interrupter relay.

5. A telephone system including a calling subscriber's line and a called subscriber's line, an operator's link circuit for interconnecting said lines, supervisory relays under the control of the respective subscribers and supervisory lamps controlled by said relays, interrupter means connected in circuit with the supervisory lamp under the control of the calling subscriber when the said subscriber disconnects prior to the response of the called subscriber, and automatic means for said link circuit for freeing the calling subscriber's line from said link circuit independently of the switchboard operator at said link circuit.

6. A telephone system including a calling subscriber's line and a called subscriber's line, an operator's link circuit for use in interconnecting said lines, supervisory relays under the control of the respective subscribers and supervisory lamps controlled by said relays to give the operator the disconnect signal when disconnection takes place between calling and called lines, an interrupter connected in circuit with one of said supervisory lamps under the control of the calling subscriber when the said subscriber disconnects prior to the response of the called subscriber to cause

the flashing of said supervisory lamp, and means controlled by the calling subscriber for operatively disassociating said calling line and link circuit even though a physical connection exists between said line and link circuit.

7. A telephone system including a calling and a called subscribers' line, a circuit for connecting said lines, a supervisory device, means controlled by one subscriber for differently operating said device according to whether or not the other subscriber has affected means under his control.

8. A telephone system including a pair of lines, a circuit for connecting said lines, a supervisory device, means controlled by one subscriber for intermittently operating said device when he signals for disconnection if the other subscriber has not responded and for causing a continuous operation of said device if the other subscriber has responded.

9. A telephone system including a pair of lines, a circuit for connecting said lines, a signal, means controlled by one subscriber for flashing said signal if the other subscriber has not responded, and means controlled by said other subscriber for afterwards causing a continuous operation of said signal.

10. In a telephone system including a pair of telephone lines, a link circuit for interconnecting said lines, a signal for said link circuit having a steady glow and an intermittent glow for denoting various signals to the switchboard operator, means controlled by the calling subscriber for effecting the operations of said signal, electromagnetic means for said link circuit for automatically applying ringing current to the called line of said pair of telephone lines, and means for freeing said calling line from said link circuit independently of said switchboard operator, said last means controlling said electromagnetic means.

11. A telephone system including a calling and called subscribers' lines, a link circuit for interconnecting said lines, a signal having a steady glow and an intermittent glow for denoting different connection conditions to the switchboard operator, electromagnetic means for said link circuit for automatically applying ringing current to the called line of said pair of telephone lines, and automatic means for freeing the calling line from the link circuit to permit said calling subscriber to recall prior to the disconnection of said link circuit and calling subscriber's line, said last means controlling said electromagnetic means.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 17th day of June, 1921.

GEORGE A. YANOCHOWSKI.