H. D. CURRIER.

AUTOMATIC RINGING AND SECRET SERVICE TELEPHONE SYSTEM.

APPLICATION FILED APR. 10, 1913.

1,233,196.

Patented July 10, 1917.

4 SHEETS—SHEET 1.

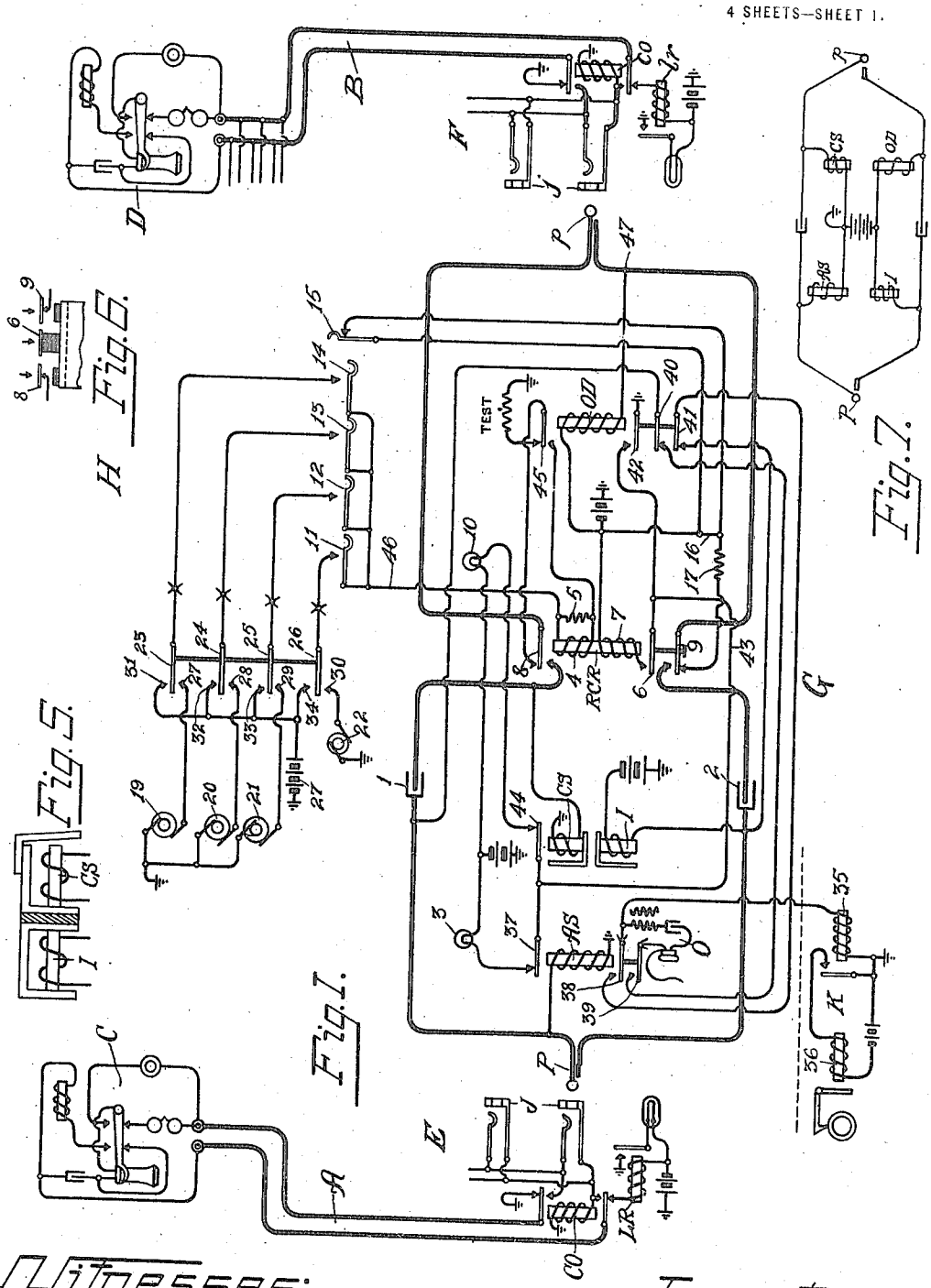

Fig. 1.

Fig. 5.

Fig. 6.

Fig. 7.

Witnesses:

G. E. Mueller

Wm. Berghahn

Inventor:

Hiram D. Currier:

By Curtis B. Camp

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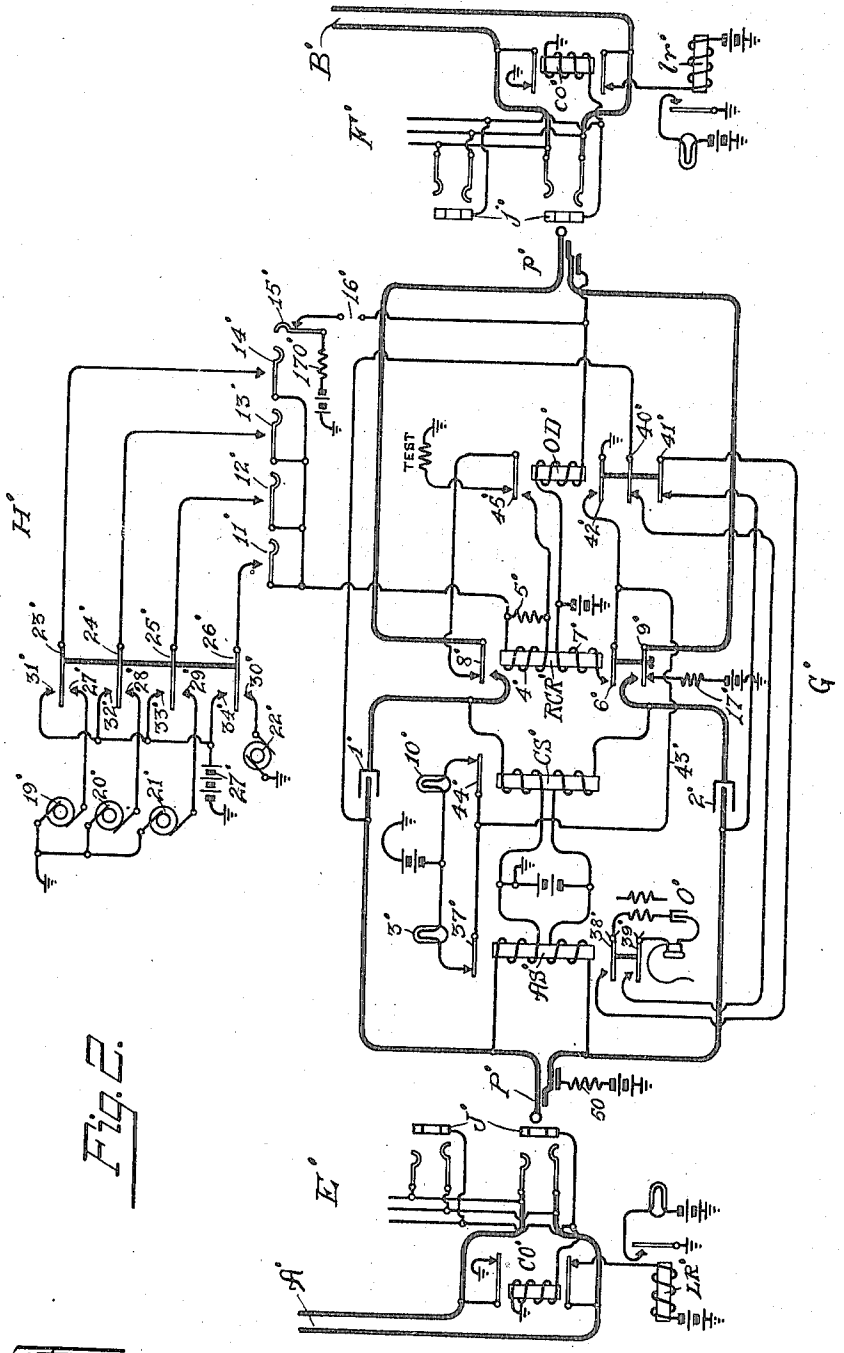

Fig. 2.

Witnesses
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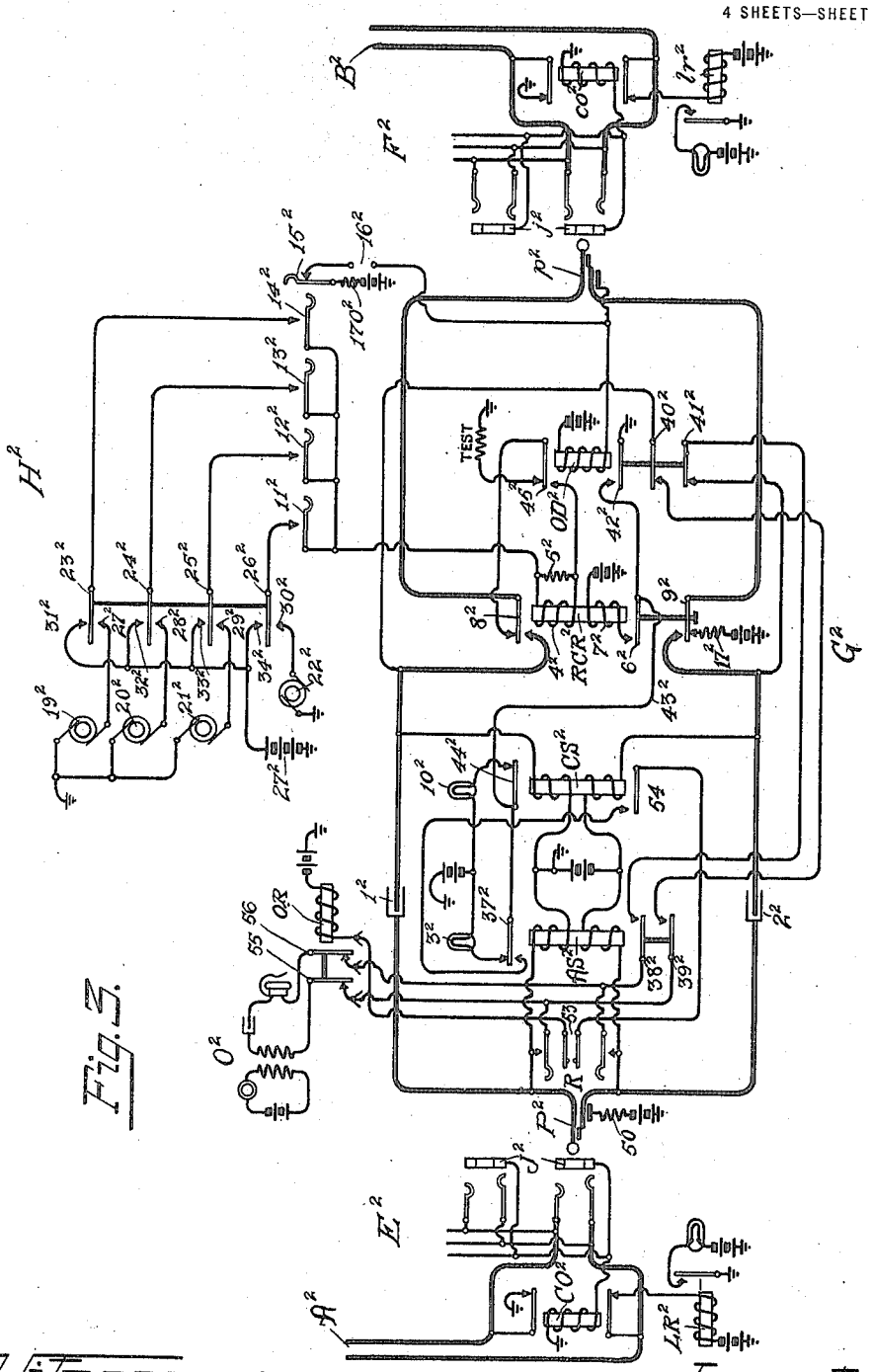

Fig. 3.

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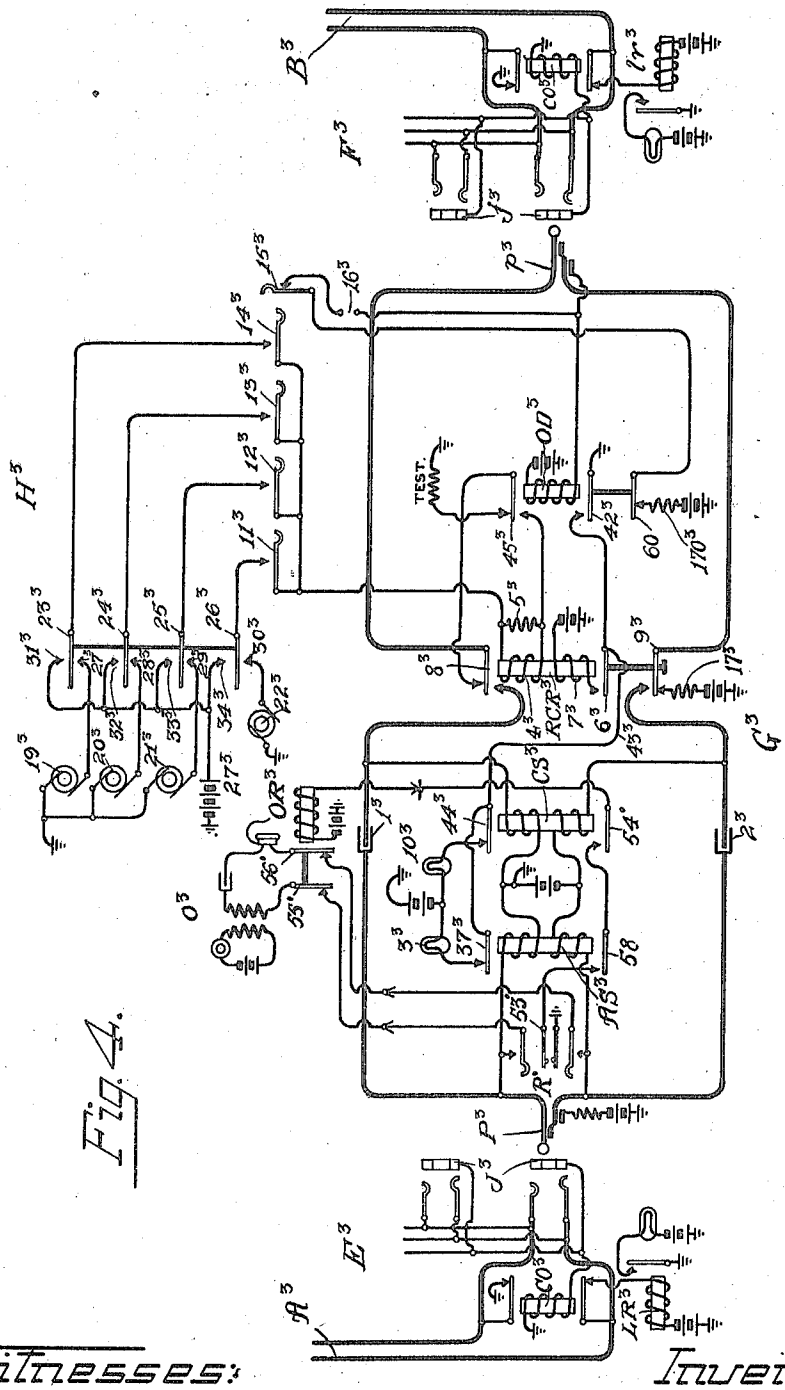

Fig. 4.

Witnesses:
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UNITED STATES PATENT OFFICE.

HIRAM D. CURRIER, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC RINGING AND SECRET-SERVICE TELEPHONE SYSTEM.

1,233,196. Specification of Letters Patent. Patented July 10, 1917.

Application filed April 10, 1913. Serial No. 760,119.

To all whom it may concern:

Be it known that I, HIRAM D. CURRIER, a citizen of the United States of America, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Automatic Ringing and Secret-Service Telephone Systems, of which the following is a specification.

My invention relates to link circuits for telephone systems, being directed more particularly to link circuits having automatic ringing and secret service. By secret service I mean a circuit in which the operator's telephone cannot be operatively associated with the link circuit while the link circuit is connecting a calling and a called substation in a conversational circuit. By automatic ringing systems I mean those systems in which after the ringing current has been applied to the called line, it is automatically disconnected when the subscriber at the called substation responds. One of the objects of my invention is to provide a link circuit of the above character in which four relays only are used for controlling the supervisory and secret service system and also the ringing system. Other objects of my invention will be hereinafter more particularly pointed out.

I have preferably embodied my invention in an operator's cord circuit and in carrying out my invention when applied to the so-called four relay arrangement I employ an answering supervisory relay which is energized when the answering end of the link circuit is connected to a calling line whereby the operator's telephone is connected in circuit with the calling substation. A second relay is also provided in the nature of an operator's disconnect relay which operates when the calling end of the link circuit is connected to the called line, such operation of the relay effecting the disconnection of the operator's telephone. A third relay in the nature of a ringing control relay is provided which is adapted to be operated upon a response from the called substation to disconnect the ringing current from the called line and a fourth relay in the nature of a calling supervisory relay is also provided by which a called-station supervisory relay is controlled from the called substation.

For a better understanding of my invention reference is to be had to the accompanying drawings in which like reference characters indicate parts having similar functions and in which:

Figure 1 is one embodiment of my invention in which no listening key is required and in which it is impossible to associate the operator's telephone with the cord circuit while it has its answering and calling ends connected to telephone lines;

Fig. 2 illustrates a cord circuit having the same method of operation as Fig. 1 but applied to a three conductor cord and line circuit;

Fig. 3 illustrates a three conductor cord circuit in which the operator's telephone is connected in operative relation with the cord circuit when the call is answered and disconnected upon being connected to a called line and then by the use of an operator's key may be again associated with the link circuit only if one or both receivers are on their switch-hooks;

Fig. 4 is a three conductor operator's cord circuit having the features of Fig. 4 but in which it is necessary for the operator to throw a key each time the operator's telephone is to be associated with the cord circuit;

Fig. 5 illustrates the manner of combining a relay and impedance coil so as to mount them on a single axis,

Fig. 6 illustrates the preferred adjustment of the ringing control relay; and

Fig. 7 illustrates diagrammatically the balanced cord circuit of Fig. 1.

Referring now to Fig. 1, I have illustrated two lines A and B of a well known so-called two-wire multiple type having well-known forms of substations C, D respectively and line circuits E, F, at the central office. Each of the line circuits includes a line relay LR and a cut-off relay CO together with multiply connected jacks J. The calling circuit E has its parts indicated by the large reference characters and the called line circuit F has its parts indicated by small reference characters.

The operator's cord circuit G is adapted

for interconnecting the telephone lines and has an answering plug P and a calling plug p connected by so-called tip and sleeve conductors having the condensers 1 and 2 interposed. A relay AS is associated with the answering end of the cord circuit this relay serving as an answering supervisory relay and also for associating an operator's telephone set O with the link circuit when a call is answered. An answering supervisory signal 3 is controlled by relay AS. The relay AS which is controlled over the calling line is connected to one terminal of a central office telephone battery, the other terminal of battery being connected through an impedance coil I to the other strand of the link circuit so as to bridge the central office battery across the talking conductors for talking and supervisory purposes.

A third relay OD is connected to the calling end of the link circuit, being in the nature of an operator's disconnect relay in that it disconnects the operator's telephone from the link circuit when the calling plug p is connected to the called line. Due to the fact that in the present embodiment of my invention the operator's telephone is connected through normally closed contacts of relay OD, it will be apparent that as long as plug P is in connection with the terminals of a line circuit, the operator's telephone O is associated from the link circuit giving a so-called secret service in which the operator cannot listen in during a connection between two telephone lines. The operation of relay OD upon connecting to a called line also is effective to connect ringing current from one of the ringing generators of ringing apparatus H to the terminals of the called line and when a response is secured from the substation on this line the ringing control relay RCR is operated to disconnect the ringing current. The upper winding 4 is included in the path for ringing current but a non-inductive shunt 5, preferably wound upon the core of RCR, provides a more ready path for the ringing current. When connecting ringing current to the calling end of a link circuit, it is preferable to have the calling and answering ends disunited so that the ringing current will not flow back over the calling line and I have preferably provided contacts upon the relay RCR which are adapted to control the continuity of the talking conductors and to disconnect the ringing current. Furthermore, means must be provided whereby when the ringing current is disconnected upon response of the called subscriber such ringing current will not be again applied when the subscriber replaces his receiver upon its switch-hook and to this end a locking contact 6 and locking winding 7 are provided for control relay RCR so that when it once energizes it will remain energized until the calling plug p is withdrawn from the jack. This places considerable work upon the relay RCR, for a relay which must energize over the called line, and therefore I have provided an improved adjustment and control of relay RCR whereby the initial energizing circuit for this relay (which is over the called line) attracts its armature under the tension of a single spring 6 only until the alternate contact 6 is closed and the local energizing and locking circuit 7 included, at which time the continued attraction of the armature operates the other springs 8, 9, upon this relay as shown in Fig. 6. An advantage of such arrangement is that this relay RCR which is initially energized over the called line circuit starts the attraction of its armature under the tension of but a single contact spring until this local circuit is closed after which the other springs are operated and in this way a comparatively large number of contacts may be operated by a relay which is initially controlled over a circuit, which may vary considerably in resistance.

A supervisory signal 10 is associated with the calling plug p and this signal becomes lighted when the plug p is inserted into a jack j of the called line, which is the usual period, and when the called subscriber responds this lamp 10 must be effaced. To this end I have provided the calling supervisory relay CS which is adapted to be energized by current over the called line so that the subscriber at the called substation has control of this relay CS and therefore of lamp 10. Thus, when the called subscriber has responded, talking current is supplied to the called line from the central battery through the relays CS and OD.

To the end that the relays and impedance coil I of cord circuit G may be mounted in the least possible space, I combine the impedance coil I and one of the supervisory relays as is shown in Fig. 5, and I preferably choose the supervisory relay CS as the relay to be associated with impedance coil I as in this manner I secure a more evenly balanced talking circuit as indicated in Fig. 7. That is at the answering end of the cord circuit a full winding is connected to the tip side and a half winding to the sleeve side while at the calling end a half winding is connected to the tip side and a full winding to the sleeve side of the cord circuit.

Now as to the ringing apparatus as H, when applying my invention to party line ringing I provide a well-known form of party line indicating key having contact sets 11, 12, 13, 14, corresponding in number to the number of frequencies, these contacts being closed when the plungers are in their intermediate, locking or indicating position. A common contact 15 is also shown, this contact being adapted to be op-

erated when any of the ringing plungers are in their fully actuated position and when the plungers restore to their indicating or locking position the contact 15 again closes as shown. In the preferred method of operation of Fig. 1, the proper ringing plunger is depressed before the calling plug P is inserted into a jack this arrangement being preferred because in using a locking party line ringing key one of the ringing contacts is always closed so that I prefer to select the frequency before the plug is inserted into the called jack. In such case the contact 15 is not needed and is short circuited as shown at 16.

If it is desired to depend upon the operation of a ringing plunger after a plug *p* has been inserted, then this connection 16 may be removed and in which case the operation of the contacts 15 interrupts the circuit through the low resistance non-inductive winding 17 to permit the operation of relay OD. That is if it is desired that the ringing key should be operated after inserting the plug *p*, then connection 16 is opened and therefore relay OD does not operate upon inserting the plug *p* due to the low resistance shunt around OD through the winding 17, but when this contact 15 is interrupted after plugging in, the relay OD energizes and although the shunt circuit is again closed when contacts 15 restore it does not cause a deënergization of OD. This is because of the well known fact that a relay will hold up on a small part of the current which is required to give it an initial energization.

As I preferably use the well-known harmonic ringing system I have provided four ringing generators 19, 20, 21, 22 which of course correspond to the call bells of the party line substation telephones. Each of the ringing generators is connected through a periodically closed contact, there being therefore four such contacts 23, 24, 25, 26, which may be operated by any source of power to periodically close the ringing contacts 27, 28, 29, 30. In order to assure the operation of the relay RCR when the receiver is removed at the called substation, I provide a source of current 27 in connection with the ringing device H, which source is preferably a separate source from the talking battery, and may consist of dry cells, and has an opposite pole grounded so that when the vibrating contacts 23, to 26 are closed during the silent interval, this battery 27 is connected in series with the cord circuit battery giving a higher potential so that a more positive operation of relay RCR is secured. It will be apparent that the battery 27 may be left out and the other terminal of the cord circuit battery attached to these contacts 31 to 34 to secure the operation of RCR if desired. The test winding TEST is part of the operator's induction coil, being used in a well known manner apparent from the drawing.

I have shown in connection with my invention, a so-called peg-count device K by which the number of answered calls of each operator is recorded. This device preferably comprises a relay 35 preferably of high resistance and impedance which is common to each operator's position and which is adapted to be energized each time a plug *p* of its corresponding position is inserted to answer a call. The operation of the relay 35 closes a circuit through a counter-magnet 36 and this records upon a meter, the answered call.

Having described in general the embodiment of my invention as illustrated in Fig. 1, its operation will now be described. Assuming a subscriber at substation C has removed his receiver to initiate a call, the line relay LR is energized over the calling line in a well known manner to operate the associated line signal whereupon the operator inserts an answering plug P into a jack J of the calling line. This operation establishes the energization of relays CO and AS. The operation of the cut-off relay CO is effected by a circuit traced from battery through the winding of impedance coil I, the answering sleeve conductor, sleeve contacts of the plug and jack and the winding of CO to ground. Relay CO therefore energizes to disconnect the line relay LR and, in the present embodiment of my invention extend the conductors of line A to the answering end of the cord circuit. The receiver at the calling substation being off the hook, there is a flow of current through impedance coil I and out over the calling line returning over the tip side of the circuit and through the winding of the answering supervisory relay AS to ground. Relay AS therefore energizes and interrupts its normal contact 37 so that the lamp 3 can not be operated while the receiver is off the hook. Also responsive to the operation of relay AS, its alternate contacts 38, 39 are closed connecting the operator's telephone O through the normally closed contacts 40, 41, to the answering end of the link circuit.

The operator now inquires the number of the wanted line and tests the jack *j* of the called line with the tip of plug *p* in the usual manner and finding the line idle inserts the plug *p* into the jack *j* after having pressed the proper ringing plunger. This connects the sleeve or operator's disconnect relay OD in circuit with the cut-off relay *co* causing the energization of these relays by current over a circuit traced from battery through the winding of OD, sleeve contacts of *p* and *j*, the winding of *co* to ground. The operation of *co* removes the substation control of the line relay in the

usual manner and the operation of OD effects a disconnection of the operator's circuit O by reason of the interruption of normal contacts 40, 41. Also, responsive to OD, its alternate contact 42 is closed lighting the calling supervisory lamp 10 by a circuit traced from grounded alternate contact 42, conductor 43, normal contact 44, and lamp 10 to battery.

Also, responsive to the operation of OD, ringing current is connected to the called line by reason of the closing of alternate contact 45, the path for ringing current being traced from generator 22 (which we will assume is the connected generator by reason of its operated contact 11) alternate contact 30, alternate contact 11, ringing conductor 46, winding 4 and 5 in multiple, alternate contact 45, normal contact 8, tip side of the circuit over the calling line including the substation call bell, returning over the sleeve side to point 47 where it divides, part of the current flowing through relay OD and battery to ground and part of the current flowing through normally closed contact 9, winding 17, connection 16 and battery to ground. Each periodic closure of alternate contact 30 of the ringing device of course causes an operation of the call bell and when the subscriber removes his receiver in response to the call, and upon the following closure of alternate contact 34 of the ringing device H, due to the removal of the condenser at the substation a path for direct current through the winding 4 of the ringing control relay RCR is established to cause the initial energization of this relay. As already stated, when the contact 34 is closed, the ringing battery 27, which by the way, may constitute dry cells as its circuit is only closed for short periods, is connected in series with the cord circuit battery, providing a higher potential for the operation of the ringing control relay than if only the cord circuit or talking battery only was used, this circuit being traced from battery 27, alternate contact 34 over the previously described path for ringing current, back through relay OD and resistance 17 to the cord circuit battery. This flow of current through the initial energizing winding 4 of relay RCR causes the attraction of its armature whereby its alternate contact 6 is first closed. The closing of this contact 6 connects the local energizing winding 7 in circuit and causes the continued attraction of the armature which interrupts normal contacts 8, 9, thereby disconnecting the ringing current and closing alternate contacts 8, 9, to establish the continuity of the talking circuit. The closing of alternate contact 8 connects the calling supervisory relay CS in circuit with the line so that battery flowing through the relay OD and out over the called line returns over the tip side and through alternate contact 8 and winding of CS to ground. Relay CS therefore operates to interrupt its normal contact 44 and effaces the signal 10. It will also be noted that relay RCR interrupts its own initial energizing circuit through its normal contacts 8, 9, but not until the local circuit is closed. The substations C and D are now connected in a conversational circuit the battery supply being as indicated in the diagram 6. During the connection of the link circuit with the calling and called line it is impossible for the operator to listen in due to the fact that her telephone has been disassociated from the link circuit by reason of the interrupted contact 40, 41, which cannot be closed again until the plug *p* is withdrawn from the connected jack.

After the subscribers have finished conversation they will replace their respective receivers upon their switch-hooks, this act at the calling substation C causing the restoration of answering supervisory relay AS and the lighting of the answering supervisory signal 3, while the restoration of the receiver at the called substation D causes the restoration of calling supervisory relay CS and the lighting of the calling supervisory signal 10. The operator in response to this signal knows that disconnection is desired and removes the plugs *p* and P from their respective jacks, the withdrawal of plug *p* causing the restoration of OD and by reason of the interruption of its alternate contact 42 the consequent restoration of relay RCR. The apparatus of cord circuit G is now at normal and the link circuit available for use in establishing other connections.

If it is desired to operate the ringing key after the plug *p* is inserted, then the connection 16 is disconnected so that the connection from battery through resistance 17, extends through the normally closed common contact 15 of the ringing key. Furthermore the resistance 17 is made sufficiently low to prevent the energization of OD in multiple with resistance 17 when the plug *p* is inserted in the jack and OD and 17 are connected with cut-off relay *co.* Therefore, with such arrangement when the operator inserts the plug *p* into the jack of a called line, the relay OD does not operate although the cut-off relay of the called line does. Upon operating the ringing key, common contact 15 is interrupted thereby interrupting the shunt circuit through resistance 17 whereby sufficient current will flow through OD to cause its operation. Now when the operator allows the ringing key to restore to its locking position and the contact 15 is again closed, although the shunt circuit through resistance 17 is again

closed, relay OD does not restore due to the well-known fact that a relay once energized can be maintained energized on a comparatively small amount of its initial energizing current. Therefore, when the relay OD operates, the subsequent application of ringing current and control of the supervisory lamps is the same as that previously described in connection with Fig. 1 with conductor 16 connected as shown.

Fig. 2.

In Fig. 2 I have illustrated my invention embodied in a so-called three wire system, that is a system in which three conductors are provided for the multiple jacks, and the cut-off relay is connected to a contact of the jack independent of the talking circuit; and likewise three contacts are provided for the connecting plugs, two of the contacts of the answering and calling plugs being connected together by the talking conductors while the third contact of each of the plugs is connected to a terminal of the battery so as to effect an energizing circuit for the cut-off relay independent of the talking circuit. In the apparatus of Fig. 2, on parts which correspond to parts of Fig. 1, I have used reference characters similar to that of Fig. 1, but with the exponent prime so that the system of Fig. 2 will be easily understood after an understanding of the system of Fig. 1.

In the embodiment of my invention as illustrated in Fig. 2, due to the fact that the cut-off relay is energized over a circuit independent of the talking strands, I preferably use double wound supervisory relays as AS^1 and CS^1, bridging them across the talking conductors of their respective ends. Therefore, in this particular embodiment, no construction as of Fig. 5, is necessary. Also in Fig. 2 the operator's disconnect relay OD^1 is connected to the third conductor of the calling plug so that when the plug is inserted into the jack, the cut-off and disconnect relays are connected in series and energized.

The protective resistance 50 which is connected between battery and the third contact of the answering plug may be a non-inductive resistance and wound upon the core of one of the cord relays in order to follow out the four unit relay principle. This is also true of resistances 17^1 and 170^1.

Also in Fig. 2, the connection from key contact 15^1 differs slightly in that a separate shunt resistance is provided but the control of relay OD^1 by the ringing key is the same. It will be noted that the connection at 16^1 is open, so that the ringing key must be depressed before plugging in, but to arrange Fig. 2 so as to operate the ringing key after plugging in the connection 16^1 is closed.

Operation of Fig. 2.

Assuming now that a subscriber at the substation of line A^1 desires to communicate with a substation on line B^1, preferably substation as D^1, which is like D of Fig. 1 but not shown, the receiver is removed at the calling substation to energize the associated line relay LR^1 and light the line signal. The operator in response to this signal inserts the answering plug P^1 into the jack J^1 of the calling line, whereby the cut-off relay CO^1, resistance 50 and battery are connected in circuit causing the energization of the cut-off relay and consequently the restoration of the line relay and lamp signal. Also upon inserting plug P^1 in the jack, the answering supervisory relay AS^1 and the cord circuit battery are connected in bridge of the calling line, and therefore relay AS^1 energizes to close its contacts 38^1, 39^1, and due to the fact that the disconnect relay OD^1 is still at normal, and its normal contacts 40^1, 41^1 are still closed, the operator's telephone O^1 is connected in bridge of the answering end of the cord circuit so that the operator may ascertain the wants of the calling subscriber. Finding that the substation D^1 is the wanted substation, after testing in the usual manner and finding B^1 idle, the operator inserts the calling plug p^1 into a jack j^1 of the wanted line, thereby connecting the disconnect relay OD^1 and the cut-off relay co^1 in series over the third conductor, causing their energization. Upon energization of OD^1, its normal contacts 40^1, 41^1 are interrupted to disconnect the operator's telephone O^1. Having previously depressed the proper ringing plunger, which we will assume is the one that closed contacts 11^1, calling generator 22^1 is connected to the called line to ring the bell of substation D^1 in a manner as described in connection with Fig. 1.

Upon response of the called subscriber, the ringing relay RCR is operated in a manner as described in connection with Fig. 1 whereby the ringing current is disconnected and the calling supervisory relay CS^1 and cord circuit battery are connected in bridge of the called line, and current therefor flows through the windings of CS^1 and over the calling line to cause relay CS^1 to operate and efface the supervisory signal 10^1. It will be apparent that as long as plug p^1 is in connection with a called line, the disconnect relay OD^1 remains energized and thus the operator's telephone O^1 cannot be operatively associated with the cord circuit G^1, this arrangement giving a secret talking service.

Now when the subscribers have finished conversation, they replace their receivers upon their respective switch hooks, this act

interrupting the energizing circuit of the supervisory relays AS^1 and CS^1 causing their restoration and the relighting of supervisory signals 3^1, 10^1. The operator in response to this disconnect signal withdraws the connecting plugs, thus restoring all of the apparatus to normal.

Fig. 3.

In Fig. 3, I have illustrated another embodiment of my invention, differing in some respects from the systems of Figs. 1 and 2. In the present embodiment of my invention when the operator responds to a call, her telephone set O^2 is automatically connected in bridge of the cord circuit, and when the cord is connected to the called line the telephone set is automatically disconnected as before. But in the present system I provide means whereby the operator is able to connect her telephone to the cord circuit while it is connecting two telephone lines, but she may only do this if either one or both of the substations are out of conversational association. That is to say, with two lines connected by a cord circuit G^2, as long as the two receivers are off the switch hooks, and the substations are connected in a conversational circuit, the operator is unable to connect her telephone to the cord circuit, but should either one or both of the receivers be on their switch-hooks, then she is able to connect her telephone to the connected cord circuit. To this end I have added a manual key R to each cord circuit, and a common operator's relay OR to each position, the relay OR being connected as indicated.

A reason for the above listening-in arrangement is that although the operator is unable to listen in during a conversational connection between two substations, should one of the subscribers hang up for disconnection and the other subscriber signal the operator for further communication, the operator may again associate her telephone O^2 with the connected cord circuit without withdrawing the calling plug p^2 from the jack of the called line as would be necessary in the systems of Figs. 1 and 2.

Each cord circuit G^2 is provided with a manually operated key R, and for each operator's position of a plurality of cord circuits, a common operator's relay OR is provided, which is multiply connected to each of the key contacts 53 and corresponding alternate contacts 54, 37^2 of the supervisory relays CS^2, AS^2, to ground at alternate contact 42^2 of relay OD^2. Thus with the connecting plugs inserted in the line jacks, as long as the receivers are off the switch hooks of a connected pair of lines, the relays AS^2 and CS^2 are energized so that if an associated operator's key R is operated, a circuit for the common relay OR is established causing its energization and therefore the interruption of its alternate contacts 55, 56, to disconnect the operator's telephone O^2. If either of the relays AS^2, CS^2 is back, the closing of contacts 53 of an operator's key does not operate relay OR to disconnect the operator's circuit. While I have shown a specific arrangement for controlling relay OR through the listening-in key and the line controlled relays AS^2, CS^2, many other circuit arrangements will readily suggest themselves, and therefore I do not wish to be limited to the particular arrangement shown.

The operation of the supervisory apparatus and ringing apparatus of cord circuit G^2 otherwise is the same as that of Fig. 2, the like parts being indicated by like reference characters, except that in Fig. 3 the reference characters have the suffix "2." With this explanation it is thought that the operation of Fig. 3 will be apparent without again going into the detailed operation thereof.

Fig. 4.

In Fig. 4 I have illustrated another embodiment of my invention, the automatic ringing control of this system being the same as that of Fig. 3, but the control of the operator's telephone O^3 differs slightly from that of Fig. 3 in that the operator's key R^1 must be closed to connect the operator's telephone in answering a call, while in Fig. 3 it will be remembered that the operator's telephone was automatically associated with the cord circuit when an answering plug was inserted in a jack in answer to a call. The subsequent control of the operator's telephone O^3 in Fig. 4 is the same as that of Fig. 3 in that after a connection is established the operation of the key R^1 can only connect the operator's telephone to the cord circuit if either one or both of the substations are out of conversational association with the cord circuit. In the present figure the common operator's relay OR^3 is connected through alternate contacts 54^1, 58 of the calling and answering supervisory relays and then through alternate contacts 53^1 of the key R^1, this circuit being in series through said contacts so that if the key R^1 is thrown with both of the supervisory relays AS^3 and CS^3 energized, a circuit for the operator's relay OR^3 is established causing its energization and preventing connecting the telephone set to the cord circuit. But if either relay AS^3 or CS^3 is back, the closing of contacts 53^1 of key R^1 does not energize OR^3 and therefore the operation of R^1 connects the telephone O^3 in circuit with the cord.

In the operation of the system of Fig. 4 when the operator answers a call by inserting the answering plug P^3 into a calling

jack, she will throw the key R^1 thereby connecting the telephone O^3 through the contacts of key R^1 to the answering end of the cord circuit. At this time it will be understood although relay AS^3 is energized, relay CS^3 has not energized as yet, so that no circuit can be closed for the operator's relay OR^3 and therefore an answering connection is established. After the calling plug p^3 is inserted into the jack of a called line, and before the relay CS^3 energizes, the operator may at any time by throwing the key R^1, connect her telephone in circuit with the cord circuit G^3, but after the called subscriber has responded and the calling supervisory relay CS^3 has energized so that the two lines are in a conversational connection, the operation of the key R^1 will close contacts 53^1 and therefore an energizing circuit for relay OR^3 is established because contacts 54^1, 58 are closed, causing it to interrupt its normal contacts 55^1, 56^1 so that the operation of key R^1 is ineffective. Of course, as long as one or both of the receivers are upon their switch-hooks and one or both of the supervisory relays deënergized, the operation of key R^1 is effective because no energizing circuit for the common relay OR^3 is established.

From the above it will be seen that in the system of Fig. 4, the operator must always throw her key R^1 whether it be an answering, or subsequent listening-in operation, to connect her telephone to a cord circuit as distinguished from Fig. 3 in which the operator's key R need be thrown only upon a subsequent listening-in connection.

In Fig. 4, I have connected the ringing key common contact 15^3 through a normally closed contact 60 on OD^3 so that when using the system with a subsequent ringing key operation, the ensuing operation of OD^3 interrupts contacts 60 thereby removing the shunt circuit of OD^3 which includes resistance 170^3 and effecting a more positive holding circuit for OD^3.

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

1. A metallic circuit telephone system comprising telephone lines, a two conductor link circuit having answering and calling terminals for interconnecting said lines, ringing apparatus and a pair of supervisory signals for the link circuit, an answering supervisory relay for said link circuit, means for placing said relay under the control of a calling line upon the connection to said line by the answering end of the link circuit for controlling one of said signals, a second relay having an energizing circuit including a calling terminal of the link circuit and a connected called line for connecting said ringing apparatus to a called line, a third relay having contacts operated upon response from a called substation for disconnecting said ringing apparatus, a locking circuit for said last relay for preventing its reoperation, and a fourth relay controllable over the two conductors of the called line in series for controlling the other supervisory signal.

2. A telephone system comprising telephone lines, a link circuit for interconnecting said lines having answering and calling ends normally disconnected, ringing apparatus and a pair of supervisory signals for the link circuit, an answering supervisory relay for said link circuit, means for placing said relay under the control of a calling line upon connection to said line by the answering end of the link circuit for controlling one of said signals, a second relay responsive to the connection of the calling end of the link circuit to a called line for connecting said ringing apparatus to the called line, a third relay having contacts operated upon a response from a called substation for disconnecting said ringing apparatus and for connecting the ends of said link circuits, and a fourth relay controllable over the called line for controlling the other supervisory signal.

3. A telephone system comprising telephone lines, a secret service and automatic ringing link circuit for interconnecting said lines, an operator's telephone and ringing apparatus for the link circuit, said link circuit comprising four relays, a relay operated upon connection of said link circuit with the calling line for automatically connecting the operator's telephone to the link circuit, a second relay operated upon connection with the called line by the link circuit for automatically disconnecting the telephone and connecting said ringing apparatus to the called line, a third relay operated upon response from the called substation to automatically disconnect said ringing apparatus. and a fourth relay normally disconnected from the calling end of the link circuit but controllable over the called line for controlling a supervisory signal.

4. A telephone system comprising telephone lines, a link circuit for connecting to said lines, a control relay, means for connecting said relay in circuit with one of said lines upon connection made therewith, an initial energizing circuit for said relay including normally closed contacts thereof, said telephone line and a source of current, a maintaining circuit for said relay having a normally open contact controlled by said relay whereby when said relay is initially energized said normally open contact is closed to render said maintaining circuit effective to cause a continued operation of the control relay to interrupt the normally closed contacts.

5. A telephone system comprising telephone lines, a link circuit for connecting to

said lines, a control relay, means for connecting said relay in circuit with one of said lines upon connection made with said line by the link circuit, an initial energizing circuit for said relay including said telephone line and a source of current, a maintaining circuit for said relay also including said source and having a normally open contact controlled by said relay whereby when said relay is initially energized said normally open contact is closed to render said maintaining circuit effective to cause a continued operation of the control relay, and other contacts for said relay operated only by such continued operation of the control relay.

6. A telephone system comprising telephone lines of various resistances. a link circuit for connecting to said lines, a relay for said link circuit, an initial energizing circuit for said relay including a connected one of said telephone lines and a source of current, a plurality of contacts for said relay, means for operating only one of said contacts upon the initial energization of said relay, a maintaining circuit for said relay also including said source and closed responsive to said contact whereby a continued operation of said relay is effective to cause the operation of the other contacts therefor.

7. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, an answering supervisory relay and an operator's disconnect relay for the link circuit, a supervisory lamp operated by each relay, an operator's telephone, means responsive to the connection of the answering end of the link circuit to a calling line for operating said answering supervisory relay for connecting the operator's telephone to the link circuit, means whereby the connection of the calling end of the link circuit to a called line will effect the operation of the disconnect relay for disconnecting the operator's telephone from the link circuit, and a responsive supervisory relay normally disconnected from the calling end of the link circuit and controllable over the called line for assisting in the control of one of said supervisory lamps.

8. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, an operator's telephone, a relay connected to each end of said link circuit, a source of current connected to said relays, circuit connections whereby when the answering end of the link circuit is connected to a calling line said current will flow through the associated relay to effect its energization and supply talking current to the calling telephone, contacts controlled by said relay when so energized for connecting the operator's telephone to the link circuit, circuit connections whereby when the calling end of the link circuit is connected to a called line said current will flow through the associated relay to effect its energization and supply talking current to the called telephone, and contacts interrupted by said last relay when so energized for disconnecting the operator's telephone from the link circuit, and supervisory lamps lighted and effaced by said relays.

9. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, an operator's telephone, an answering supervisory relay and a signal controlled thereby, an operator's disconnect relay, a calling supervisory relay controlled over circuit connections including normally interrupted contacts on the disconnect relay, a source of current for energizing the answering supervisory relay responsive to connection of the answering end of the link circuit to a calling line, contacts closed by said supervisory relay when so energized for connecting the operator's telephone to the link circuit, and circuit connections whereby the connection of the calling end of the link circuit to a called line will effect the operation of the disconnect relay for disconnecting the operator's telephone from the link circuit.

10. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, an operator's telephone, an answering supervisory relay energized responsive to the connection of the answering end of the link circuit to a calling line for connecting said operator's telephone to the link circuit, an operator's disconnect relay energized responsive to connection of the calling end of the link circuit to a called line for disconnecting the operator's telephone from the link circuit, supervisory apparatus operatively associated with the calling end of the link circuit responsive to such energization of the disconnect relay, and a response supervisory relay normally disconnected from the calling end of the link circuit for assisting in the control of said supervisory apparatus.

11. A telephone system comprising telephone lines, cut-off relays for said lines, an operator's link circuit for interconnecting said lines, a relay at each end of the link circuit, circuit connections whereby each link relay and a cut-off relay are energized when connection is made between the link circuit and calling and called lines, an operator's telephone connected to and disconnected from said link circuit by the operation of said link relays, and a source of talking current adapted to be connected to said lines through the windings of said relays.

12. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, an operator's telephone, an answering end supervisory relay for connecting said telephone to the link responsive to connection of said link and a calling line, a calling supervisory lamp, a relay energized responsive to connection of the calling end of the link to a called line for disconnecting the operator's telephone and lighting said lamp, and a source of talking current adapted to be connected to said lines through the windings of said relays.

13. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, supervisory signals for the link circuit, an operator's telephone, a pair of supervisory control relays for the link circuit for automatically connecting the operator's telephone to and disconnecting it from the link circuit, and a source of talking current adapted to be connected to said lines through the windings of said relays.

14. A telephone system comprising an operator's cord circuit having answering and calling plug terminals, answering and calling supervisory signals, normally inoperative circuits for said answering and calling signals controlled by said answering and calling relays respectively, a third relay having an energizing circuit connected to the calling terminal, and a circuit for rendering said signals operative including normally open contacts of said third relay.

15. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, an operator's telephone, an answering response supervisory relay for connecting said telephone to the link circuit when said link circuit is connected to a calling line, a calling sleeve supervisory relay for disconnecting said operator's telephone from said link circuit responsive to the connection of said link circuit to a called line.

16. A telephone system comprising telephone lines, an operator's link circuit for interconnecting said lines, an operator's telephone, an answering response supervisory relay for connecting said telephone to said link circuit when said link circuit is connected to a calling one of said lines, a calling supervisory relay responsive to the connection of said link circuit to a called one of said lines for disconnecting the operator's telephone from said link circuit, and supervisory signals for said link circuit controllable by said relays.

17. A telephone system including a calling subscriber's line and a called subscriber's line, an operator's link circuit provided with an answering terminal and a calling terminal, a response supervisory relay associated with said answering terminal for connecting an operator's telephone to said link circuit, a supervisory relay associated with said calling terminal responsive to connection of the calling end of the link to said called line for disconnecting the operator's telephone.

18. A telephone system comprising telephone lines, cut-off relays for said lines, an operator's link circuit provided with a pair of talking conductors for interconnecting said lines, a relay at each end of said link circuit, circuit connections whereby each link relay and one of said cut-off relays are energized when connection is made between the link circuit and calling and called ones of said lines, and an operator's telephone adapted to be bridged across and disconnected from the conductors of said link circuit by the operation of said link relays.

19. A telephone system comprising telephone lines, a two-conductor operator's link circuit for interconnecting said lines, an operator's telephone, an answering end relay for bridging said telephone across the conductors of said link circuit, a calling end relay energized responsive to connection of the calling end of said link circuit to a called line for disconnecting the operator's telephone from across the conductors of said link circuit, an answering supervisory signal and a calling supervisory signal, and circuits for said signals controllable by said calling end relay.

20. A telephone system comprising telephone lines, an operator's link circuit provided with a pair of talking conductors for interconnecting said lines, an answering and a calling supervisory signal for said link circuit, an operator's telephone, a pair of supervisory control relays for the link circuit for automatically bridging the operator's telephone across the conductors of said link circuit and for disconnecting it from the conductors of said link circuit, and circuits for said supervisory signals controllable by said supervisory control relays.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

HIRAM D. CURRIER.

Witnesses:
G. E. MUELLER,
B. O'BRIEN.