H. D. CURRIER.

TELEPHONE SYSTEM.

APPLICATION FILED JAN. 29, 1914.

1,428,763.

Patented Sept. 12, 1922.

2 SHEETS—SHEET 1.

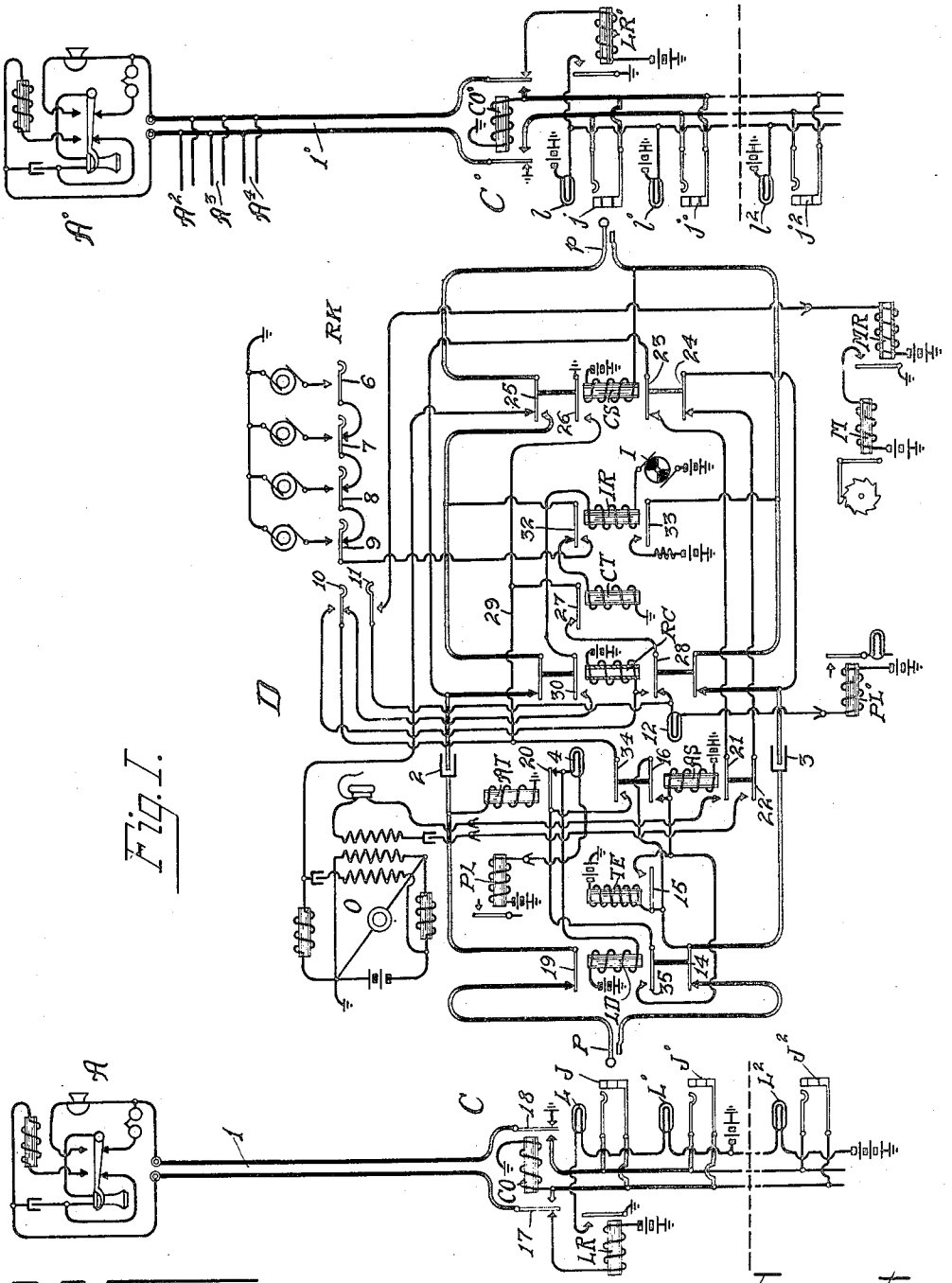

Fig. 1.

Witnesses:

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2 SHEETS—SHEET 2.

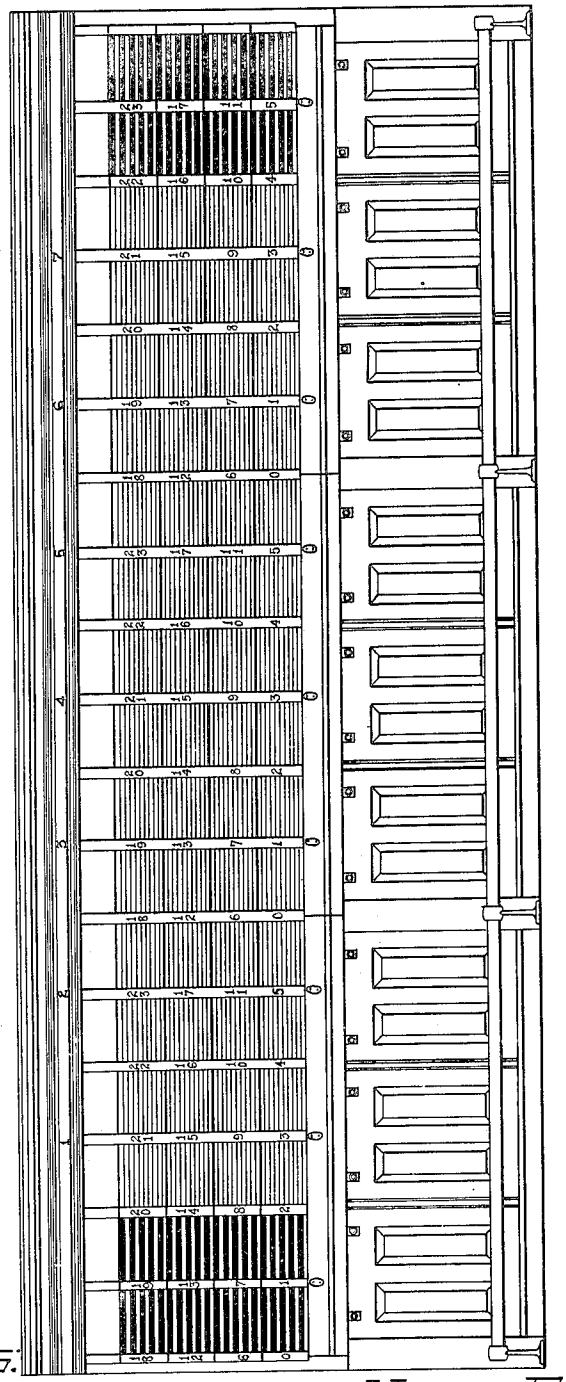

Fig. 2.

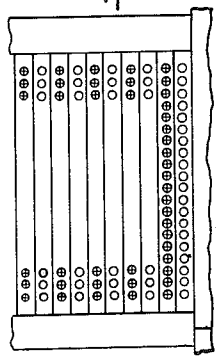

Fig. 5.

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Patented Sept. 12, 1922. 1,428,762

UNITED STATES PATENT OFFICE.

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

TELEPHONE SYSTEM.

Application filed January 29, 1914. Serial No. 815,123.

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 Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has to do more particularly with call distributing systems although certain of the features thereof are applicable to different kinds of telephone systems, one of the objects of my invention being to provide an improved and simplified call distributing system, and one in which I preferably use no electromagnetically operated distributing switches.

Hitherto in telephone call distributing systems electromagnetically operated switch mechanisms have been provided for interconnecting calling telephone lines and link circuits. Such systems are sometimes more expensive in installation and maintenance than the ordinary manual system on account of the switch mechanisms employed, and to obviate the disadvantages which arise in the use of such switches, I provide a system in which each call is extended to a plurality of operators, any of whom can connect with the calling line to extend the circuit thereof. To this end I preferably provide the telephone lines with a plurality of jack terminals each having an associated line lamp, each associated lamp and jack appearing at a different operator's position provided with link circuits so arranged that the first idle one of the attending operators who connects with the line excludes other operators and each of the jacks may be used as either an answering or a calling jack. That is for a given number of lines a number of operators' positions sufficient for handling the traffic are provided, and the line jacks and associated lamps of each line are distributed before these operators' positions so that any call may be taken by any one of a plurality of operators to the exclusion of others. In this way the calls which come in are distributed before the operators, the traffic thus being handled by the operators, each to the extent of her capabilities.

As the traffic varies, the number of attending operators is varied, and at night it is possible to have a single operator handle all calls from her own position.

As already outlined, each call may be answered by any one of a plurality of operators, and to more definitely and evenly handle the traffic I preferably divide the jacks to which each operator has access into different zones, and furthermore these zones are so arranged that the first zone of one operator will be the second zone of another operator, the third zone of another operator, etc. In this way an operator will first take care of the calls which appear in her first zone, but should there be no calls in her first zone and she is idle, she will answer any calls which appear in her second zone. Likewise should an operator be idle and there are no calls in her first or second zones, then she will take any call which may come in the third zone, etc. In this way each line appears in the first zone of some operator and then in the second and other zones of other operators, the number of zones and lines per zone depending of course upon the capacity of the switchboard.

When a call comes in before a number of different operators, there will be times when more than one of the operators are idle and several of such idle operators may start to make connection with the calling line at substantially the same time and therefore I provide means whereby as soon as one answering plug makes connection with the jack of a calling line, circuit changes are effected which will prevent a second operator's link circuit from operatively connecting with such line, even though the second answering plug is inserted. Therefore the second operator will be unable to converse with the subscriber of such calling line and will thus know that the line is already seized and will immediately withdraw the plug.

Another feature of my invention is the provision of means whereby a calling subscriber who has replaced his receiver upon the termination of conversation, may initiate a recall without waiting for the operator to withdraw the answering plug. The line is also rendered available for called purposes as the busy potential is removed when the subscriber signals for disconnection.

Other features of my invention reside in the combinations of the above features and

other features shown and described in this application, such as automatic ringing, automatic listening, secret service, instantaneous recall, etc.

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

Fig. 1 illustrates the preferred circuit arrangement for carrying out my invention;

Fig. 2 illustrates the face of a multiple switchboard of three sections showing one form of arranging the jacks and associated lamps; and

Fig. 3 is an enlarged view of a portion of the switchboard face showing more particularly the detail arrangement of the lamps and jacks.

In the preferred circuit arrangement which I contemplate employing I provide operating arrangements which go to make up an efficient system and to this end I include automatic listening, secret service, automatic disconnect of the operator's telephone and automatic ringing, an automatic connection meter, automatic disconnect at the answering end of the cord so as to provide instantaneous recall, and instantaneous removal of the busy test at the calling line jacks upon restoration of the calling substation receiver.

Referring now more particularly to the circuit arrangement of Fig. 1, I have shown a well-known form of common battery substation A connceted by line limbs 1 to line circuit C which preferably includes the usual line and cut-off relays LR and CO respectively. I also provide a plurality of answering jacks J, J^1, etc., each having an associated line lamp L, L^1, etc., each jack and its lamp appearing at different operator's position, each line being multipled a sufficient number of times so that enough operators may be employed. Thus when a line relay LR is energized, the associated line lamps L are lighted, and I preferably employ a series arrangement of these lamps, although a multiple arrangement as shown at line circuit C^1 may be used. As each associated lamp and jack as L^2, J^2, is added to a line circuit with the increase of the exchange, the battery connections are varied according to the lamps added. Thus assuming two volt lamps are used, and with an original installation of two lamps L, L^1, four volts are applied and upon adding a third lamp and jack L^2, J^2 as is indicated below the dotted section line, the battery connections are increased two volts or to a total of six volts. This arrangement may of course be varied and it is also to be understood that I contemplate using a single source of current and tap off at the proper points according to the voltage desired.

Referring now to the line circuit C^1, it is similar to line circuit C except that the lamps 1, 1^1, etc., are connected in multiple in which case the voltage need not be changed as more line lamps as 1^2 are added, such an added lamp 1^2 and jack J^2 being indicated below the dotted line at line circuit C^1. The substation A^1 and line 1^1 are similar to the line and substation described except that party line substation terminals A^2, A^3, A^4 are shown.

Referring now to the preferred cord or link circuit D, employed, the usual answering and calling plugs P, *p*, are provided connected by the heavily marked tip and sleeve conductors having interposed inductive devices in the form of condensers 2, 3. At the answering end of the cord circuit I provide supervisory relays preferably in the form of an answering sleeve relay AS and an answering tip relay AT. A test relay TE is also provided which relay determines whether or not the link circuit will be operatively associated with the line when its answering plug P is inserted into the jack. That is, when a plug is inserted into a jack in response to a call, test relay TE is connected in series with the cut-off relay CO and if this line has not already been connected with by another answering plug, relay TE is energized thereby connecting the relay AS in series with the relay CO and causing both of these relays CO and AS to energize, the energization of CO effacing the line signals L, etc. I have preferably arranged the relay TE of a comparatively high resistance as to relay AS so that if another plug P had already been inserted into a jack of the calling line, then upon insertion of this second plug P due to the shunting effect of the first sleeve relay AS, sufficient current does not flow through the test relay TE of the second link circuit to energize it for connecting its relay AS. Thus the operator's telephone O is not connected and the operator receiving no reply to her inquiry knows that an operator has already taken the call. In practice I have found that with 24 volts, relay CO 500 ohms, relay TE 4000 ohms and relay AS 100 ohms, satisfactory operation is secured, although these values may be varied and still secure successful operation.

Also associated with the answering end of the link circuit is a link disconnect relay LD which relay operates when the calling subscriber replaces his receiver and thereby operatively disassociates the link from the line, causing de-energization of the cut-off relay and permitting a recall from this line. The operation of this relay LD also removes the busy potential from the sleeve of the connected jacks so that the associated line will not test busy and may be connected with as a called line.

In connection with the answering super-

visory signal 4, I provide a pilot relay PL which is adapted for closing one or more pilot lamps placed at the operator's position and also other positions such as chief operator's, as desired.

At the calling end of the cord circuit I provide a calling sleeve supervisory relay CS which is adapted to be energized when the calling plug p is inserted into the jack of the called line, this relay also serving to disconnect the operator's telephone O from the link circuit. Therefore as long as the calling plug p is in a jack, the operator cannot listen in, thus also providing secret service.

I have preferably included four-party line service and therefore a ringing key RK is provided having four sets of ringing contacts 6, 7, 8, and 9, each one being adapted when actuated to connect a generator of a different frequency according to the well-known harmonic principle. A common set of contacts 10, 11 are provided for the ringing key RK, which contacts are adapted to be actuated when the key is fully depressed, but upon the operator releasing the pressure upon the actuated ringing button it restores to its indicating position maintaining the actuated ringing contacts in their alternate position but permitting the common contacts 10, 11 to assume their normal position as illustrated. As previously referred to, automatic ringing is provided and to this end a ringing control relay RC is used which is adapted to be operated upon intial actuation of a ringing plunger whereby said relay operates to connect an interrupter I and interrupter relay IR in circuit, said relay IR alternately connecting ringing current and the calling tip relay CT in circuit with the called line. When the called subscriber responds relay CT energizes causing the restoration of the control relay RC which prevents further application of ringing current to the called line.

The supervisory signal 12 at the calling end of the cord circuit is connected through a pilot relay PL' which controls one or more pilot lamps positioned before different operators or supervisors, as desired. In connection with the supervision at the calling end, I preferably light the signal 12 when the calling plug p is inserted and again efface this signal when the ringing key is actuated, so that the lamp 12 at this time should only be lighted for a short period and thus the supervising operator by watching her pilot lamps knows just how long this part of the connection requires. When the called subscriber replaces his receiver the tip relay CT restores lighting the supervisory signal 12 and the associated pilot lamps which remain lighted until the calling plug P is withdrawn, thus indicating to the supervising operators the time required for disconnection. This method of supervision is desirable with automatic ringing, but it is to be understood that other ways of handling the supervisory signals may be used.

I also provide a meter relay MR for controlling a meter magnet M, said relay being operated upon the initial operation of the ringing key, in establishing each connection. The circuit arrangements are such that but a single actuation of this relay is effected for each connection, and any subsequent operations of the ringing key do not effect any further meter operations.

In Fig. 2 I have illustrated a three section switchboard showing an installation of 2400 lines, each line appearing once in each section, the numbering of the lines being indicated on the stile strips dividing the panels, the hundreds only being indicated by the numerals O to 23 inclusive. Ordinarily six operators are employed, the operators' positions being indicated by the numerals 1 to 6 inclusive shown at the top of the switchboard, the seventh position being reserved for a special operator who is employed only when the traffic is extra heavy. Each numeral on the stile strip indicates 100 lines, there being in the positions 1 to 7, five strips of connecting jacks and five strips of lamp jacks for each hundred group as is more clearly indicated in the enlarged section, Fig. 3. I preferably leave out the lamp jacks in the end sections, the connecting jacks only being provided for the use of the end operators for called line purposes so that they may have access to all lines.

As previously referred to I preferably divide the lines to which each operator has access into different zones, each zone including 400 lines, although the number of lines per zone may be varied. A table is presented herewith which will indicate one arrangement of the zones.

Zone 3	0— 1— 6— 7	12—13—18—19	2— 3— 8— 9
Zone 2	2— 3— 8— 9	4— 5—10—11	0— 1— 6— 7
Zone 1	14—15—20—21	16—17—22—23	12—13—18—19
	#4 oper.	#5 oper.	#6 oper.
Zone 3	4— 5—10—11	14—15—20—21	16—17—22—23
Zone 2	14—15—20—21	16—17—22—23	12—13—18—19
Zone 1	2— 3— 8— 9	4— 5—10—11	0— 1— 6— 7
	#1 oper.	#2 oper.	#3 oper.

From the above table it will be seen that the first zone of the #1 operator is the second zone of the #4 operator and the third zone of the #6 operator. Likewise the first zone of the #2 operator is the second zone of the #5 operator and the third zone of the #1 operator. The other groups of lines are distributed by zones in a like manner and although I have indicated but three zones with a total of 1200 lines for each operator, it will be apparent that they may be extended so that each operator has zones covering the entire capacity of the switchboard. With the above arrangement the #1 operator will first take care of all calls which appear in her first zone, and

when there are no calls in this zone then she will take calls coming in on the second zone. If she be idle and there are no calls in her first or second zones, then she will take the calls coming in at her third zone. The same method of handling the zones will also apply to the other operators' positions. In this way a plurality of operators have access to each call which comes in and therefore the operators may be kept uniformly busy and the calls equally distributed. Also due to the fact that each call appears at different parts of the switchboard and because they may be therefore evenly distributed, to the operators, no intermediate frame is necessary.

Should it be desired to close certain zones as calling lines to some of the operators, black lamp caps may be used to cover the corresponding lamps.

Operation.

Assuming now that a call is initiated at substation A, line relay LR is energized by current over the calling line thereby connecting lamps L in circuit and signalling the operators before whom the line jacks J are positioned whereupon an idle one of the operators inserts an answering plug in her jack of the calling line, thereby connecting the test relay TE in series with cut-off relay CO traced from battery through the winding of TE, normal contact 14, sleeve of plug and jack, and the winding of CO to ground. Relay TE energizes closing its alternate contact 15 and connecting supervisory relay AS in series with relay CO whereupon both relays CO and AS energize. Upon energization of CO the line lamps L are effaced and upon energization of AS its alternate contact 16 is closed connecting relay AS directly in circuit with CO independent of alternate contact 15. Also upon the energization of CO and upon the closing of its alternate contacts 17, 18 current from AS flows over the calling line and back through the tip conductors, normal contact 19 and the winding of tip relay AT to ground causing the energization of AT whereby its normal contact 20 is opened to prevent the lighting of signal 4 and the premature operation of link disconnect relay LD.

Referring again to relay AS upon its said energization its alternate contacts 21, 22 are closed connecting the operator's telephone O through said alternate contacts and normal contacts 23, 24 to the link circuit talking conductors and thus to the calling telephone line. The operator now requests the number of the wanted line and testing it in the usual manner and finding it idle, inserts the calling plug *p* into a jack *j* of the wanted line to which she has access thereby connecting calling supervisory relay CS and cut-off relay CO^1 in series to cause their energization. Responsive to CS, normal contacts 23, 24 are interrupted disconnecting the operator's telephone from the link circuit. The operation of contact 25 of CS disconnects the test conductor leading to the operator's telephone and closes the tip calling strand while the closing of alternate contact 26 connects ground through normal contacts 27, 28 and supervisory lamp 12 to battery. Lamp 12 thus remains lighted, as does also the pilot lamps controlled thereby, until the proper ringing plunger is depressed, whereupon alternate contacts 10, 11 of key RK are closed. The closing of alternate contact 11 connects meter relay MR in circuit with the grounded normal contact 28 whereupon relay MR energizes closing a circuit for meter magnet M and registering a connection. The closing of alternate contact 10 of the ringing key causes the energization of ringing control relay RC traced over a circuit established from battery through the winding of RC, alternate contact 10, conductor 29 and alternate contact 26 to ground. Relay RC therefore energizes interrupting its normal contact 28 whereby the supervisory lamp 12 is effaced and the circuit for meter relay MR interrupted. Upon closing of alternate contact 28 of RC, a locking circuit for itself is established independent of the initial circuit through the alternate contact 10 so that when the key RK is released, relay RC remains energized and due to the closing of its alternate contact 30 a circuit for interrupter relay IR is established from battery through interrupter I, the winding of IR, alternate contact 30, normal contact 10, conductor 29 to ground at alternate contact 26. Relay IR is therefore intermittently energized alternately connecting tip relay CT and the connected ringing generator in circuit with the called line. This ringing circuit may be traced from generator through the actuated ringing contact of key RK, alternate contacts 32, 25, tip of plug and jack, over the called line and through the bell of the desired substation, returning through the sleeve contacts of the jack and plug, alternate contact 33 and resistance to battery and ground. Thus upon each energization of IR the desired substation is signaled so that when the receiver thereat is removed, upon the next de-energization of IR, tip relay CT is connected in circuit with the called line and energizes over a circuit including said line and returning through sleeve relay CS to battery. Relay CT therefore operates to interrupt its normal contact 27 thereby causing restoration of relay RC and due to the interruption of its alternate contact 30 the circuit of IR is opened preventing further application of ringing current. The

two substations A and A¹ are now connected by a conversational circuit indicated by the heavily marked conductors, talking battery being supplied from the central source through the windings of the supervisory relays.

When the subscribers desire to effect a disconnection they will replace their receivers upon their respective switch-hooks, the replacing of the receiver at the called substation A¹ causing the restoration of tip relay CT whereupon a circuit for supervisory lamp 12 is established through normal contact 27 including the previously described circuit of the lamp. Lamp 12 is therefore lighted, as well as the pilot lamps controlled thereby. Upon replacing of the receiver at the calling substation A tip relay AT restores closing a circuit for supervisory lamp 4 traced from ground at alternate contact 26 of CS, conductor 29, alternate contact 34, normal contact 20, and lamp 4 through PL to battery, lighting said lamp and the pilot lamps controlled thereby. Also responsive to the restoration of tip relay AT, circuit for link disconnect relay LD is established traced from battery through the winding of LD, normal contact 20 to ground over the previously described path for lamp 4. Relay LD therefore energizes closing its alternate contact 35 whereupon a locking circuit for relay AS is established to the grounded normal contact 20 so that upon interruption of normal contacts 14, 19 of relay LD, although the link conductors are operatively disassociated from the line of substation A, supervisory lamp 4 remains lighted. The operator observing the two signals 4 and 12 withdraws plugs P and *p* from their respective jacks resulting in the restoration of relay CS whereupon the interruption of its alternate contact 26 causes the effacement of signals 4 and 12, and the restoration of relays LD and AS. During the connection relay TE also remains energized, and said relay also restores when alternate contact 26 interrupts.

Referring now to that feature of my invention whereby instantaneous disconnect and recall, and instantaneous removal of the busy test, at the calling line is secured, it will be noted that when the relay LD energized as just described, due to the interruption of its normal contacts 14, 19, the link conductors are disconnected from the calling line so that the cut-off relay CO thereof restores. Also due to the interruption of normal contact 14 and the removal of battery from the sleeve of jacks J, the busy potential is removed so that the line thereof is immediately available for use as a called line, and due to the fact that relay CO thereof has restored the associated line relay LR may be operated by a recall so as to again light the associated signals L.

Assuming that the subscriber at A has replaced his receiver after the connection and immediately removed it for a recall before plug P is removed, the line relay will of course operate to light the associated line lamps L. Although the operator of the link whose plug P is still in the jack of this calling line observes the signal L above this jack, it will be remembered that she has received a disconnect signal so that she will remove the plugs P and *p* irrespective of whether such a line signal appears above the connected jack J or not. Nevertheless should another operator in taking the recall insert a plug P into a multiply connected jack J¹ prior to the removal of this first said plug P, this second link circuit will connect to the calling line and operate relays CO and LR in the usual manner to efface all of the line signals L thereof. It will be apparent from this that upon a recall, it is immaterial whether the first plug is still in the jack or not as a second operator can connect with this recall line. This feature of instantaneous recall is important where a person desires to call a number of different subscribers successively, as it is unnecessary to wait for the operator to take down the connection but the calling subscriber need only hang up his receiver and immediately remove it to extend a recall to the switchboard.

In the preceding paragraph reference is made to the manner in which a second operator takes a recall and now will be described how the same or first operator may take a recall. Assuming that a connection has been established between two telephone lines as already described and the calling subscriber has replaced his receiver and immediately removed it for a recall, the connected link circuit apparatus will operate in a manner as before described and the recall will also extend signals to the attending operator as well as other operators as already referred to. Therefore a signal L will appear above the plug P which is still in the jack of this calling line and the operator is thus aware that a recall has been effected. Should she desire to take this recall, by removing the associated calling plug *p* from its jack the relay CS is restored effecting a restoration of relays LD, TE, and AS as before. Therefore if no other operator has as yet seized this recall, upon restoration of relay LD this recall is taken by the operation of the link circuit apparatus in the ordinary manner, thus effacing the line signals and also preventing any other cord from operatively connecting with this line, as will be more definitely described.

Assuming now that a call has been initiated from the substation A and all of the associated line signals L have operated, upon

insertion of a plug P into a jack J of such line, the associated test anl supervisory relays TE and AS will operate as before. Therefore should a second operator insert a plug P into a multiple jack as J^1, subsequent to the insertion of the first plug, this second link circuit cannot be connected to this line due to the fact that the low resistance sleeve relay AS of the first link circuit is connected to the sleeve of the multiple jacks J, J^1, etc., and therefore when the second plug P is inserted its high resistance test relay TE does not receive a sufficient current flow to cause its energization and therefore its alternate contact 15 does not close and so the operator's telephone is not connected. It will thus be seen that although the second operator may attempt to converse with the subscriber at the calling substation, due to the fact that the relay AS of this second link circuit has not operated, her telephone O is not connected and receiving no reply to her inquiry she is aware that some other operator has preceded her and she will of course immediately withdraw the plug of this second link circuit and the call is extended by the first operator in the usual manner.

It will be readily seen from the above that where a call has been extended from a party line, upon restoration of the calling receiver the line is available for recall by the same or any other substation thereon without awaiting the removal of the answering plug P from its jack.

In working out my invention I have employed preferred arrangements all of which go to make an efficient operating system but it is to be understood that I contemplate employing other circuit arrangements and switchboard lay-outs than that shown. Furthermore although a number of battery symbols are shown in the drawing it is to be understood that a single source of current may be employed and where different voltages are used taps taken off of this central source at the proper points. It will also be apparent that my invention is not limited in its use to a single switchboard, as the link circuits may be employed in connection with well-known forms of trunking circuits between different switchboards located in the same or different exchanges. Furthermore changes and modifications of the system illustrated will readily occur to those skilled in the art and therefore I do not desire to be limited to the 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 United States Letters Patent is:

1. In combination with a calling telephone line a plurality of multiple connecting terminals for said line located at a central office switchboard, a cut-off relay for said line, having its coil connected to one of said multiple terminals, operators' link circuits distributed among operators' positions of said switchboard, and means initially operated through a circuit including the coil of said cut-off relay whereby any one of said link circuits may be connected to any one of said multiple line terminals when answering a call to the exclusion of the remaining link circuits that attempt to answer the call.

2. A telephone call distributing system comprising a plurality of subscribers' telephone lines, a central office switchboard, a plurality of answering terminals and associated calling signals for each of said lines distributed among operators' positions at said switchboard, a cut-off relay for the line having its coil connected to similar contacts throughout the plurality of answering terminals, and means including the coil of said cut-off relay whereby any one of a plurality of operators may connect with one of the answering terminals of a calling line and prevent other operators from operatively connecting with said line to extend the circuit thereof.

3. A telephone system including telephone lines, a central office switchboard, a cut-off relay for each line, a plurality of connecting terminals and associated line signals individual to each of said lines, the connecting terminals and associated signals of each line being distributed among operators' positions of the switchboard, means controlled at a substation of said lines for operating the associated signals to extend a call to a number of said operators' positions, link circuits at each of said positions for extending the calls, and means included in said link circuit and initially operated through the coil of the cut-off relay of a calling line whereby when one of the link circuits is connected to a calling terminal a second one of said link circuits cannot be operatively connected to another terminal of the same calling line.

4. A telephone system including telephone lines, a central office switchboard, a cut-off relay for each line, a plurality of connecting terminals and associated line signals individual to each of said lines, the connecting terminals and associated signals of each line being distributed among operators' positions of said switchboard, means controlled at a substation of said line for operating the associated signals to extend a call to a number of said operators' positions, link circuits at each of said positions having answering terminals adapted for connection with said connecting terminals, and means initially operated through the coil of said cut-off relay whereby when one of said answering terminals is connected to a connecting terminal of a calling line a second one of said link

circuits cannot be operatively connected by its answering terminal to another connecting terminal of the same calling line.

5. A telephone system including telephone lines each having a cut-off relay and a plurality of connecting terminals, link circuits having manually operated answering terminals for connection with said link terminals, and means including a test circuit through the cut-off relay for said line for preventing the operative association of more than one answering terminal with the connecting terminals of any one line.

6. A telephone system including telephone lines, a cut-off relay and a plurality of connecting terminals for each of said lines, link circuits having manually operated answering terminals adapted for connection with said connecting terminals, and means initially operated through the coil of the cut-off relay when one of such answering terminals is connected to a connecting terminal of a calling line to prevent the operative association of a second link circuit when the answering terminal of such second link circuit is connected to another connecting terminal of the same line.

7. A telephone system comprising telephone lines each terminating at a plurality of positions on a central office switchboard in multiple jacks, operators' manual link circuits at each of such positions for connecting to said multiple jacks in answering calls, and test means included in said link circuits automatically operable upon connection of a link circuit with a terminal of the calling line in answering a call for determining its answered or unanswered condition, and supervisory means for said link circuits operable when disconnection is signaled for.

8. A telephone system comprising telephone lines, a cut-off relay for each line, a plurality of associated test terminals for each line connected with the coil of the cut-off relay for that line, line signals for each of said lines distributed among a plurality of positions on a central office switchboard, means responsive to a call from the substation of any of said lines for operating the associated line signals, operators' link circuits at each of such positions having answering terminals, test means included in each of said link circuits automatically operable upon connection of a link circuit with a test terminal of the calling line for determining its answered or unanswered condition, and means responsive to such test means whereby a link circuit is or is not operatively associated with a calling line, accordingly.

9. In combination with a calling party telephone line connected to a plug ended link circuit at the exchange, means whereby when a substation on said line hangs up for disconnection the line conductors are disconnected from said link circuit and the said line is available for recall before the link plug is withdrawn, and means for again connecting the said link circuit to said line prior to the disconnection of the link circuit plug from said line.

10. In combination with a calling two-conductor party telephone line connected to a plug ended link circuit at the exchange, means under the sole control of a substation on said calling line whereby when disconnection is signaled for both conductors of the line are operatively disconnected from the link circuit and the line is available for extending a calling signal before the link plug is withdrawn, and testing means for said link circuits for preventing the operative connection of more than one of said link circuits to said line at one time.

11. A two conductor telephone system comprising a telephone line extending to a connection terminal at a central office switchboard, a line signal for said line, link circuits for connection to said line, means whereby when a link circuit is connected to said line and a substation on said line is operated for disconnection both conductors of the line are disconnected from the link circuit and said line is available for use in operating said signal for calling before or after said link circuit is disconnected from the line, and means for permitting a second link circuit to be operatively connected to said line to extend a second call before said first link circuit has been restored to normal and for preventing the reconnection of the first link circuit to the line during the period that the second link circuit is connected thereto.

12. A telephone system including a plurality of telephone lines, a cut-off relay for each of said lines, a central office switchboard having a plurality of operators' positions, a plurality of test terminals for each line normally connected with the coil of the cut-off relay for said line, line signals individual to each of said lines associated with said test terminals, the test terminals and associated signals of each line being distributed among said operators' positions, means controlled at the substations of said lines for operating the associated signals to extend a call to a number of said operators' positions and means including two test terminals of a line for preventing two operators from seizing a call at one time.

13. A call distributing system comprising a plurality of telephone lines, a central office switchboard, a plurality of combined answering and calling terminals and associated line signals individual to each of said lines, said terminals being regularly grouped and multiply connected and distributed among operators' positions of said switchboard,

link circuits, having terminals which may be simultaneously and continuously connected to the same line circuit so arranged that only one operator at a time may operatively connect to one of such terminals to answer a call thereat and extend connection to a terminal of another line as a calling terminal, and automatic disconnect means for said link circuits for disassociating a connected link circuit and a telephone line when the subscriber at said line retires.

14. A call distributing system comprising telephone lines each terminating in a plurality of jacks and associated calling signals, means whereby said jacks are used interchangeably for answering and calling terminals in interconnecting said lines, means for making plural connections with a single line, but for preventing the operative association of two link circuits with said line simultaneously, and automatic means for disconnecting the link circuit operatively associated with said telephone line from said telephone line to permit the operative association of another link circuit and said telephone line.

15. A two conductor telephone system comprising a telephone line terminating in connecting jacks at a central office switchboard, operators' link circuits having manual connection terminals for extending the circuit of said line by way of said jacks, a busy potential placed upon said jacks responsive to the connection of a manual connection terminal thereto, a called telephone line adapted to be connected to the other manual connection terminal of the link circuit, and means under the sole control of the substation of said first line for removing said busy potential and for disconnecting both line conductors from the link circuit before the called telephone line signals for disconnection.

16. A telephone system including a calling two-conductor telephone line terminating in a connecting jack at a central office switchboard, a called telephone line, an operator's two-conductor link circuit having a manual connection terminal normally connected with the conductors of the link circuit for extending the circuit of said calling telephone line, a called manual connection terminal for connecting said link circuit to said called subscriber's line, and means under the sole control of the substation of said calling line for operatively disassociating said link circuit from said calling line at all times prior to the time that said called line signals for disconnection.

17. A telephone system including a calling two-conductor telephone line terminating in a connecting jack at a central office switchboard, a called telephone line, an operator's link circuit having a manual answering terminal normally connected with the conductors of the link circuit for connecting to said calling telephone line, a calling terminal for said link circuit for connecting to said called telephone line, and means under the sole control of the substation on said calling line for operatively disassociating said link circuit from said calling line after the conversational circuit between calling and called lines has been completed.

18. A call distributing system comprising telephone lines each terminating in a plurality of line jacks at a central office switchboard, a line signal for each of said jacks, operators' positions each including link circuits and terminal plugs, an operator's telephone at each of said positions, means responsive to the insertion of two or more plugs into the jack terminals of a calling line to connect the associated operator's telephone with one of the link circuits and prevent the second link circuit and associated operator's telephone from being operatively connected to the other jack terminal of said calling line, and means controlled over the calling line for rendering the connection of said first link ineffective to permit the connection of a second operator's telephone and said line.

19. In combination with a calling telephone line, a plurality of connecting terminals for said line located at operators' positions of a central office switchboard, operators' link circuits having associated operators' telephones, said link circuits including means effective whereby when one of said link circuits and associated operator's telephone is connected to one of said terminals a second link circuit which is physically connected to another terminal of said line cannot be operatively connected to another operator's telephone, and automatic means for rendering the connection of said first link circuit ineffective and to permit the connection of said second link circuit to be operatively effective to connect another operator's telephone.

20. A combination with a telephone line connected to a plug ended link circuit at the exchange, of means whereby when the substation on said line hangs up for disconnection, the conductors of the said link circuit are operatively disassociated from the line, means for permitting a reassociation of the link circuit and the line for extending a call prior to the withdrawal of the said link plug, and means for automatically connecting an operator's telephone with said line upon the said reassociation of the line and link circuits.

21. A combination with a two-conductor calling telephone line connected to a two-conductor plug-ended link circuit at the exchange, of a called telephone line connected

to the other end of said link circuit, means under the sole control of the substation of said calling line to disassociate the calling line conductors from the link circuit conductors and to render the calling line available for recall, when signaling for disconnection, at all times prior to the time when the called subscriber signals for disconnection.

22. The combination with a two conductor telephone line connected to a two conductor plug-ended link circuit at the exchange, of means whereby when the substation on said line signals for disconnection the link circuit conductors are operatively disassociated from the conductors of the said telephone line, and operator controlled means for causing the said telephone line and the said link circuit to again be united prior to the withdrawal of the said link plug.

23. A call distributing system comprising telephone lines, each terminating in a plurality of jacks at the central exchange, signals for said jacks, operators' link circuits divided into groups, an operator's telephone associated with each group of link circuits, and means responsive to the simultaneous connection of two or more link circuits to the terminals of a calling line to connect the operator's telephone associated with one of said link circuits and thereby to prevent the operative association of a second operator's telephone with the remainder of said link circuits.

24. In a telephone system a calling subscriber's two conductor line, a plug ended link circuit, an operator's telephone, manual means for connecting said link circuit to said subscriber's line whereby said operator's telephone is automatically connected to said subscriber's line, means under the control of the calling subscriber for disassociating the said link circuit from both conductors of the said line, and operator controlled means for reassociating the said link circuit with said line to extend a call prior to the removal of the said link plug.

25. In a telephone system a subscriber's two conductor line, a plug ended link circuit adapted to be connected to said line, an operator's telephone normally disconnected from said link circuit, means responsive to the connection of said link circuit to said subscriber's line for automatically connecting the said operator's telephone to said subscriber's line, means controlled from said line for operatively disconnecting both conductors of the said line from the link circuits, conductors and means for reconnecting said line and link circuits prior to the withdrawal of said plug.

26. In a telephone system, a telephone line, a plug-ended link circuit, an operator's telephone, means for connecting said link circuit to said line through the medium of said plug, means under the control of the substation on said line for disconnecting said line from said plug, and means for reconnecting said line and said link circuit prior to the withdrawal of the said plug and for connecting the operator's telephone to the said telephone line.

27. In a telephone system, a telephone line, a plug ended link circuit, means for connecting said link circuit to said line through the medium of said plug, an operator's telephone, means under the control of the substation on said line for disconnecting said line from said link circuit, and automatic means for reconnecting said line and said link circuit prior to the withdrawal of the said plug and for connecting the operator's telephone to the calling line.

28. In a telephone system, a two conductor subscriber's telephone line, an operator's telephone, a plug ended link circuit adapted to be connected to said line, automatic means responsive to the connection of said link circuit to said telephone line to connect said operator's telephone to said telephone line, means under the control of the subscriber for disconnecting said line from the said link circuit, and means under the control of a central office operator for reuniting the subscriber's line and the link circuit before the plug is withdrawn whereby said operator's telephone is reconnected to said subscriber's telephone line.

29. A telephone system comprising telephone lines, a plurality of connecting terminals and line signals for each of said lines distributed among a plurality of positions on a central office switchboard, means responsive to a call from the substation of any of said lines for operating its associated line signals, link circuits at each such position having answering terminals, means included in each of said link circuits automatically operable upon connection of a link circuit with a terminal of the calling line for determining its answered or unanswered condition, means responsive to said last means whereby a link circuit is or is not operatively associated with said calling line and electromagnetic means for automatically disassociating a link circuit operatively associated with said calling line.

30. In a telephone system a calling and a called subscriber's line, a link circuit for connecting said lines, means controlled from the substation of the calling line for disconnecting the link circuit from the said calling line, and means responsive to the disconnection of the said called line from the said link circuit for causing the calling line to be again connected to said link circuit.

31. A telephone system comprising a plurality of telephone lines, a central office

switchboard, a plurality of terminals and associated signals individual to each of said lines, the terminals and associated signals of each line appearing before operators' positions on said switchboard, means controlled from the substation of one of said lines for operating its associated signals at said positions, link circuits at each of said positions, means included in said link circuits whereby when one of them is operatively connected to a terminal of said calling line and a second one of said circuits is physically connected to another terminal of said calling line the latter connection will be inoperative, and means for automatically disassociating said first link circuit and calling line and to permit the connection of said second link circuit and said calling line to become operative.

32. In a telephone system a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines, an operator's telephone adapted to be automatically connected to and disconnected from said link circuit upon connection to the calling and called lines respectively, means responsive to the replacing of the receiver at the substation of one of said lines for disconnecting said line from the said link circuit, and means responsive to the disconnection of the link circuit from the other of said lines for again associating the operator's telephone with the said link circuit.

33. In a telephone system a subscriber's line, another subscriber's line, a link circuit for connecting said lines, an operator's telephone adapted to be automatically connected to and disconnected from said link circuit, means controlled from the substation of one of said lines for disconnecting the line and the link circuit, and means responsive to the disconnection of the other of said lines from the link circuit, for again connecting the first said line with the said link circuit and for connecting the operator's telephone to the said link circuit.

34. In a telephone system a calling subscriber's line and a called subscriber's line, a manual link circuit for connecting said lines, an operator's telephone, means responsive to the connection of said link circuit to the calling line for connecting said telephone with said link circuit and means responsive to the connection of said link circuit to said called telephone line for disconnecting said operator's telephone from said link circuit, means operative to disconnect said calling line from said link circuit when the substation of said line signals for disconnection whereby the line is available for recall, and means responsive to the disconnection of the link circuit from the called subscriber's line for again connecting the operator's telephone with the link circuit.

35. In a telephone system, a calling subscriber's line, multiple terminals for said line, link circuits divided into groups, answering terminals for said link circuits for connection to said multiple terminals, means controlled from said calling line for extending a call to said multiple terminals, means controlled by the connection of the answering terminal of a link circuit of one of said groups to a terminal of said line for preventing the operative connection of answering terminals of link circuits of the other of said groups of link circuits to said line when they are physically connected therewith, and electromagnetic means controlled over said calling line to render said first connection inoperative to permit another operative connection.

36. In a telephone system, a calling subscriber's line, a plurality of terminals for said line, link circuits divided into groups, answering terminals for said link circuits for extending connections from said line, means responsive to the operative connection of the answering terminal of a link circuit of one of said groups of link circuits to a terminal of said line for preventing the operative connection of the answering terminals of the link circuits of the other groups of link circuits to the said line through permitting the continued physical connection therewith, and automatic means for rendering the first connection inoperative and to render another connection operative.

37. In a telephone system, a calling subscriber's line provided with a plurality of terminals, link circuits provided with answering terminals for extending connections from said lines, means responsive to the seizure of said line by the connection of an answering terminal of one of said link circuits to the line to exclude the operative connection of all other of said answering terminals to said line at all times while said first answering terminal is connected thereto and said calling subscriber's receiver is off the switch hook, and electromagnetic means for disassociating said first connection when the calling subscriber's receiver is replaced on the switchhook.

38. In a telephone system, a calling subscriber's line provided with terminals through which said line may be seized to extend connections, link circuits provided with answering terminals for connecting to said line terminals, means responsive to and operative throughout the operative connection of the answering terminal of one of said link circuits to a line terminal of said line for preventing the operative connection of all other of said link circuits to said

line and electromagnetic means operative to permit the connection of a terminal of one of said other link circuits to said line terminal.

39. In a telephone system, a calling subscriber's line, a plug ended link circuit connected to said line, means under the control of the substation of said line for disassociating the said link circuit from the said line whereby the line is rendered available for recall, means for permitting a second plug ended link circuit to seize a recall through the multiple line jack before the withdrawal of said first link plug, and means for excluding the reconnection of said first link circuit to said line after said second link circuit has seized said call.

40. A combination with a two conductor telephone line connected to a plug ended link circuit at the exchange, of means under the control of the substation on said line whereby when said substation signals for disconnection the conductors of the line are disconnected from the link circuit and the line is available for recall, and means for permitting a second plug ended link circuit to seize said recall through a multiple line jack before the first said link plug is withdrawn and for preventing the seizure of the recall by said first link circuit.

41. In a telephone system, a two conductor calling subscriber's line provided with a plurality of terminals and associated line signals, a plug ended link circuit connected to said line, means under the control of the substation on said line whereby when said substation signals for disconnection the conductors of said line are disconnected from the line circuit and the line rendered available for recall, and means for permitting either a second plug ended link circuit or said first plug ended link circuit to seize said recall prior to the withdrawal of said first link plug.

42. A combination of a calling telephone line provided with multiple answering terminals and a plug ended link circuit connected thereto at the exchange, of means under the control of the substation of said telephone line whereby when the said substation hangs up for disconnection the said line is disconnected from said link circuit and the line is available for recall, a second plug ended link circuit, and means for permitting either of said link circuits to seize said recalling telephone line to the exclusion of the other link circuit.

43. In a telephone system, a calling subscriber's line provided with terminals through which said line may be seized to extend connections, link circuits divided into groups, answering terminals and testing means for said link circuits, said testing means serving to prevent the operative connection of the answering terminals of link circuits of different groups to the said line when a connection is signaled for, and means controlled over said calling line to permit the terminal of a link circuit of one of the other groups to be operatively connected to said line.

44. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of link circuits at the main station, supervisory apparatus associated with said link circuits at the main station, an operator's set adapted to be associated with each link circuit, and means including a portion of said supervisory apparatus of a busy link circuit to prevent two operators from simultaneously being connected to said telephone line.

45. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of link circuits at the main station, supervisory apparatus associated with the answering ends of said link circuits at the main station, an operator's set adapted to be associated with each link circuit, and means including a portion of the supervisory apparatus associated with the answering end of a busy link circuit to prevent two operators from simultaneously being connected to said telephone line.

46. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of link circuits at the main station, supervisory apparatus associated with the answering ends of said link circuits at the main station, an operator's set adapted to be associated with each link circuit, a listening relay associated with each link circuit and controlled by a portion of the supervisory apparatus thereof for associating the operator's set with the link circuit, and means including the listening relay control portion of said supervisory apparatus of a busy link circuit to prevent two operators from simultaneously being connected to said telephone line.

47. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cord circuits arranged in groups, switching means to connect the answering end of each cord circuit to a line terminal, an operator's set associated with each group of cord circuits, a plurality of connecting devices, one of which is associated with each cord circuit, each device controlling the connection of its associate operator's set with the cord circuit, current resisting apparatus associated with each device and shunts for disassociating said current resisting apparatus from said devices and mechanism to connect said devices in parallel branches of a circuit, said devices

being inoperative when one of said shunts has been completed.

48. In a telephone system the combination of a plurality of telephone lines, substation apparatus on each line, a main station to which the lines lead, a plurality of terminals at the main station for each line, a plurality of line interconnecting mechanisms at the main station, relay mechanism at the main station comprising two windings one of higher resistance than the other, means to close a circuit through the high resistance winding, and a shunt about the high resistance winding including a low resistance winding and controlled by the high resistance winding, an operator's set adapted to be connected to a telephone line, relay contacts maintained operated by current through said low resistance winding and connected in circuit between said operator's set and the telephone line, and other relay mechanism for automatically disconnecting said operator's set from said telephone line independently of said first relay mechanism.

49. In a telephone system the combination of an operator's set adapted to be placed in telephonic communication with a telephone subscriber, a high resistance winding and a low resistance winding controlling the connection of said set with said subscriber, means to cause the energization of the high resistance winding, a pair of contacts maintained operated by current through the low resistance winding and in circuit with said operator's set, a shunt about the high resistance winding connecting the low resistance winding and controlled by current through said low resistance winding, and a third electromagnetic winding for automatically disconnecting said set from said subscriber independently of said pair of electromagnetic windings, said third winding controlling a contact in the circuit of said low resistance winding.

50. In a telephone system the combination of a main station, a plurality of telephone lines leading from substation sets to said main station, where each line terminates in a plurality of line terminals, a plurality of telephone line interconnecting mechanisms at the main station, and devices for connecting said mechanisms to said line terminals, operator's sets at the main station adapted to be placed in telephonic communication with a subscriber's set, apparatus for permitting the connection of one operator's set only to a particular subscriber's set at a time, and for preventing the connection of a second operator's set to such subscriber's set as long as the first operator's set is connected thereto, said apparatus including a pair of electromagnetic windings associated with each interconnecting mechanism, one of the said windings of each mechanism being higher in resistance than the other, a circuit for said high resistance winding, controlled by the connecting device associated with the interconnecting mechanism with which the said winding is associated, a shunt about said high resistance winding including the low resistance winding and controlled by the current through the high resistance winding, a pair of contacts maintained operated by the current flow in said low resistance winding and included in the circuit between said operator's set and the subscriber's set with which it is temporarily connected, and a third electromagnetic winding for disconnecting said operator's set from said subscriber's set, said third electromagnetic winding controlling the establishment of a circuit for said low resistance winding mechanism.

51. In a telephone system the combination with a plurality of telephone lines, each having multiple terminals at the central office, of a plurality of connecting devices for connection with lines at different multiple terminals, a plurality of operator's sets for connection with the different connecting devices, a plurality of relays one for each connecting device, said relays having contacts for completing the circuit between a connected line and an operator's set, a low resistance winding for each of said relays, and a high-resistance winding the energization of which connects said low resistance winding in a shunt circuit about the said high resistance winding.

52. In a telephone system the combination of a telephone line terminating at a main station in a plurality of terminals, a plurality of link conductors adapted to be connected to said line through said terminals, an operator's set for each cord and normally disconnected therefrom, electromagnetic means for connecting said operator's set to each cord circuit, other electromagnetic means for disconnecting said operator's set from each cord circuit, means including a relay for preventing the connection of two operator's sets simultaneously to the same telephone line through the answering ends of said link conductors, a circuit for said relay including a portion of a talking strand of one of said link conductors and automatic disconnect means for destroying the effect of said third means when the calling subscriber retires to permit a second operator to connect her set to the same telephone line.

53. In a telephone system, the combination of a telephone line terminating at a main station in a plurality of terminals, a plurality of cord circuits at the main station each provided with an answering terminal adapted to co-operate with a terminal of the line to connect the cord to the line, a relay for automatically disconnecting the cord from said answering terminal when the subscriber on said line retires, an operator's set

adapted to be connected to each cord to place the operator in communication with the calling subscriber, means including a second relay controlling the connection of an operator's set to its associate cord, means controlled by said relay for preventing the contemporaneous connection of two operator's sets to the same telephone line, a circuit for the second relay controlled by the first relay and a third relay for automatically disconnecting said operator's set from its associated cord independently of said second relay, said third relay partially controlling the circuit of said first relay.

54. In a telephone system the combination of means including a relay for preventing the contemporaneous connection of two operator's sets to a single telephone line, means for automatically interrupting the strands of the link conductors with which said relay is associated when the calling subscriber retires, a circuit for said relay including contacts of the cord and line terminals, and means for maintaining said relay energized after the operation of said disconnect means.

55. In a telephone system the combination of a plurality of cord circuits, a plurality of operators' circuits, an operator's circuit connecting relay for each cord circuit, a high-resistance relay for each cord circuit controlling the circuit of the connecting relay, a shunt for the high-resistance relay initially closed by its own actuation but later maintained closed by the actuation of the connecting relay, means to connect the high-resistance relay of one cord circuit and the connecting relay of another cord circuit in parallel circuits, and a current-limiting device in the main branch of said parallel circuits for preventing the operation of the high-resistance relay.

56. In a telephone system the combination of a plurality of cord circuits, a plurality of operators' sets, a marginal and non-marginal relay for each cord circuit, the latter serving to connect one of said operators' sets with the cord circuit, the marginal relay when operated being adapted to close a shunt about itself, and the non-marginal relay when actuated being adapted to maintain the shunt about the marginal relay, means to connect the marginal relay of one cord circuit in parallel with the non-marginal relay of another cord circuit, and a current-limiting device in the divided portion of the circuit of said relays for preventing the operation of the marginal relay.

57. In a telephone system the combination with a plurality of cord circuits of a plurality of operators' circuits, a high and low-resistance relay for each cord circuit, means to connect the high-resistance relay of one cord circuit and the low-resistance relay of another cord circuit in parallel branches of the same circuit, a current-limiting device in the common branch of said circuit for preventing the actuation of the high-resistance relay, the low-resistance relay serving to connect its cord circuit with an operator's set and to maintain one of the branches of said parallel circuit.

58. In a telephone system a plurality of marginal and of non-marginal relays, a plurality of circuits directly controlled by the non-marginal relay and a single circuit directly controlled by the marginal relay, said single circuit including the coil of the non-marginal relay, means to connect one of said non-marginal relays and one of said marginal relays in parallel branches of the same circuit, and a current-limiting device in the common branch of said circuit for preventing the operation of the marginal relay of the connected parallel branches.

59. In a telephone system, the combination of a main station, a calling telephone line terminating at the main station in a plurality of terminals, a plurality of link conductors at the main station provided with answering terminals through which each cord may be connected to the calling line, supervisory apparatus associated with the answering end of each link conductor, an operator's set associated with each link conductor, means including a relay and a portion of said supervisory apparatus to prevent two operators from simultaneously being connected to said calling line and a circuit for said relay including a portion of a talking strand of the link conductors associated with said relay, and electromagnetic disconnect means for the link conductors for effectively disconnecting the link conductors from association with calling subscribers' lines.

60. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cord circuits at the main station, supervisory apparatus at the main station, a plurality of operator's sets, one associated with each cord, means including a relay and a portion of said supervisory apparatus to prevent the contemporaneous connection of two operator's sets to said telephone line and a circuit for said relay including a portion of a talking strand of one of said cord circuits, and electromagnetic disconnect means for the link conductors for effectively disconnecting the link conductors from association with calling subscribers' lines.

61. In a telephone system, the combination with the conductors of a telephone line, of an operator's set adapted to be placed in a branch circuit across said conductors, means to prevent a second operator connecting her set in branch circuit with said telephone line to which another cord is connected while the subscriber is on the line, and automatic cut-off apparatus in the first cord

connected to the line operating when the subscribers have retired to permit the second operator to connect her set with said line.

62. In a telephone system, the combination of a main station and a plurality of substations, telephone lines leading from the substations to the main station, a cord circuit at the main station, an operator's set for said cord circuit and normally disconnected therefrom, an answering plug for the cord circuit, switching means for connecting the calling end of the cord circuit to a called line, supervisory signal means in the answering end of the cord, including a supervisory relay, means to automatically disconnect the answering plug from the cord circuit when the calling subscriber retires, apparatus including a second relay controlling said automatic disconnect means, a circuit for said second relay in the calling end of the cord local to the main station and including contacts of said calling switching means, and automatic means for connecting the operator's set to the calling line when the answering plug is connected to the calling line and for disconnecting the operator's set when the switching means is associated with the called line.

63. In a telephone system, the combination of a main station and a plurality of substations, telephone lines connecting the substations to the main station, link conductors adapted to be connected to the telephone lines to place subscribers upon the telephone lines in connection with each other, an operator's set for said link conductors and normally disconnected therefrom, means for automatically and permanently interrupting the connection of the link conductors to one of said subscriber's lines when the subscriber on the line retires, means controlling said automatic disconnect means, a circuit for said last named means local to the main station, said circuit being controlled by the connections of the link conductors to the called line, and automatic means for connecting the operator's set to the calling line when the answering plug is connected to the calling line and for disconnecting the operator's set when the switching means is associated with the called line.

64. In a telephone system, the combination of a main station, a calling telephone line, substation apparatus on said line, a called telephone line, substation apparatus on said line, a cord circuit at the main station for connecting said lines together, plug and jack switching mechanism for connecting the cord circuit to the calling line and plug and jack switching apparatus for connecting the cord to the called line, an operator's telephone set, electromagnetic means for connecting the set to the cord, means controlling said connecting means and means operable by the calling substation apparatus for automatically disconnecting the calling line plug and jack switching mechanism from the cord, said last named means being controlled by the means which controls the connection of the operator's set to the cord circuit.

65. In a telephone system, the combination of a main station, a plurality of telephone lines including a calling line substation apparatus on said calling line a cord circuit at the main station for connecting telephone lines together, plug and jack switching mechanism for connecting the cord to the calling line, an operator's set adapted to be connected to the cord circuit, a relay having contacts in the connections of the operator's set to the cord circuit, electromagnetic means for automatically disconnecting said switching mechanism from the cord circuit, said electromagnetic means being controlled by said relay.

66. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit for connecting telephone lines together, an operator's set at the main station, conductors for connecting the set to the cord circuit, normally open switches in said conductors, a magnet for closing said switches when the cord circuit is connected to a calling line and a magnet for opening said conductors, said last named magnet being operated by the act of connecting the cord to a called line, said last named magnet controlling said first named magnet.

67. In a telephone system, the combination of a main station, a called telephone line, a calling telephone line, substation apparatus on each line, a cord circuit at the main station, an answering plug for said cord circuit and a calling plug for said cord circuit, said plugs adapted to connect the cord to the jacks of said lines, said cord including talking strands, means for automatically disconnecting the answering plug from the cord circuit and interrupting the strands of the cord circuit, said means including a relay under the control of the calling subscriber and a circuit for said relay, a second relay controlling the circuit of the first-named relay and a circuit for said second named relay local to the main station and including a portion of one of the talking strands of the cord circuit.

68. In a telephone system, the combination of a main station, telephone lines leading to the main station, substation apparatus on the telephone lines, a cord circuit at the main station including talking strands, jacks for the telephone lines, an answering and a calling plug for connecting the cord circuit to such jacks, a source of current associated with the cord circuit, means including a relay, the magnet of which is in a cir-

cuit local to the main station controlled by substation apparatus for automatically disconnecting the answering end of the plug from the cord circuit, and mechanism for retiring said means and restoring the cord circuit, said mechanism including a circuit which includes a portion of one of the talking strands of the cord circuit.

69. In a telephone system, the combination of a main station, telephone lines, substation apparatus on the telephone lines, switch-board jacks in which the lines terminate, a cord circuit at the main station including talking strands, and an answering and a calling plug in which the cord terminates, means under the control of the calling subscriber for automatically disconnecting the answering plug from the cord circuit, said last named means including a relay and a circuit therefor, means to complete said circuit and maintain the disconnection of the answering plug from the cord circuit, said last named means including a relay and a circuit therefor, which last named circuit includes a portion of a talking strand of the cord circuit.

70. In a telephone exchange system, including telephone lines extending from substations to an exchange, line signaling apparatus at the exchange for said telephone lines, connecting apparatus at the exchange for uniting lines in conversation, a cut-off relay governed by said connecting apparatus for preventing the presentation of the line signal of a calling line, and means, operable under the joint connection of two lines for removing the control of the cut-off relay over the line signal of the calling line, thereby permitting the calling station to regain control of the line signal of the calling line and means including a circuit for withholding the control of said line signal from said cut-off relay.

71. In a telephone system, the combination with a central office cord connecting circuit, of calling and called lines to be connected thereby, movable connecting devices for the answering and calling ends of the cord circuit, each having a pair of connecting terminals adapted to make contact with terminals of the lines, a central source of current, a relay having contacts normally connecting the connecting terminals of the answering connecting device with the voice current conductors of the cord circuit and with said source of current, a single operating circuit for said relay, a second relay, alternate contacts for said second relay for closing a break point in said first relay circuit, a single circuit for said second relay local to the central office and arranged to be closed only through contacts of the called line terminals, and a third relay operated responsive to the retirement of the calling subscriber for rendering said second relay effective to complete said first relay circuit.

72. In a telephone system, the combination with a central office cord connecting circuit, of calling and called lines to be connected thereby, movable connecting devices for the answering and calling ends of the cord circuit, each having a pair of connecting terminals adapted to make contact with terminals of the lines, a central source of current, a relay having contacts normally connecting the connecting terminals of the answering connecting device with the voice current conductors of the cord circuit and with said source of current, a single operating circuit for said relay, a second relay, alternate contacts for said second relay for closing a break point in said first relay circuit, a single circuit for said second relay local to the central office and arranged to be closed only through contacts of the called line terminals, and a third relay operated responsive to the retirement of the calling subscriber for rendering said second relay effective to complete said first relay circuit, and a supervisory signal in a circuit in parallel with the coil of said first relay, the display of which indicates the retirement of the calling subscriber.

73. In a telephone system, the combination with a central office cord connecting circuit, of calling and called lines to be connected thereby, movable connecting devices for the answering and calling ends of the cord circuit, each having a pair of connecting terminals adapted to make contact with terminals of the lines, a central source of current, a relay having contacts normally connecting the connecting terminals of the answering connecting device with the voice current conductors of the cord circuit and with said source of current, a single operating circuit for said relay, a second relay, alternate contacts for said second relay for closing a break point in said first relay circuit, a single circuit for said second relay local to the central office and arranged to be closed only through contacts of the called line terminals, and a third relay operated responsive to the retirement of the calling subscriber for rendering said second relay effective to complete said first relay circuit, a supervisory signal in a circuit in parallel with the coil of said first relay, the display of which indicates the retirement of the calling subscriber, and a separate signal to indicate a calling subscriber's recall.

74. In a telephone system, the combination of a plurality of telephone lines, substation apparatus on each line, a main station to which the lines lead, a plurality of terminals at the main station for each line, a plurality of line interconnecting mechanisms at the main station, including a pair of talking

strands, relay mechanism at the main station comprising two windings, one of higher resistance than the other, means to close a circuit through the high resistance winding, and a shunt about the high resistance winding including the low resistance winding and controlled by the high resistance winding, an operator's set adapted to be connected in a branch circuit across said talking strands, and relay contacts maintained operated by current through said low resistance winding and included in said operator's branch circuit.

75. In a telephone system, the combination with the conductors of a telephone line, of an operator's set adapted to be placed in a branch circuit across said conductors, high and low resistance electromagnetic windings controlling the connection of said set with said telephone line, means to cause the energization of the high resistance winding, a pair of contacts maintained operated by current through the low resistance winding and in said branch circuit with the said operator's set, and a shunt about the high resistance winding connecting the low resistance winding and controlled by current through said low resistance winding.

76. In a telephone system, the combination of a telephone line terminating at a main station in a plurality of terminals, a plurality of cord circuits at the main station, each provided with an answering terminal adapted to cooperate with a terminal of the line to connect the cord to the line, a relay for automatically disconnecting a cord from said answering terminal when the subscriber on said line retires, an operator's set normally disconnected from said cord circuit and adapted to be connected to the cord circuit to place the operator in communication with the calling subscriber, a second relay having contacts included in the connection of an operator's set to its associate cord, means controlled by said relay for preventing the contemporaneous connection of two operators' sets to the same telephone line, and a circuit for the second relay controlled by the first relay.

77. In a telephone system, the combination of a telephone line terminating at a main station in a plurality of terminals, a plurality of link conductors adapted to be simultaneously and continuously connected to said line through said terminals, an operator's set for each link normally disconnected from the link conductors, means including a relay for connecting one and for preventing the connection of two operator's sets simultaneously to the same telephone line through the answering ends of said link conductors, and a circuit for said relay including a portion of a talking strand of one of the said link conductors.

78. In a telephone system, the combination of a main station, a calling telephone line terminating at a main station in a plurality of terminals, a plurality of link conductors at the main station provided with answering terminals through which each cord may be placed in simultaneous and continuous association with the calling line, supervisory apparatus associated with the answering end of each link conductor, an operator's set associated with each link conductor, means including a relay and a portion of said supervisory apparatus for connecting one operator's set to a calling line and to prevent two operators from simultaneously being connected to said line, and automatic disconnect means individual to each link conductor for disassociating a calling line and cord circuit when the calling subscriber retires.

79. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cord circuits at the main station, means for substantially simultaneously and continuously connecting two cords to the same line, supervisory apparatus at the main station, a plurality of operators' sets, one associated with each cord, means including a relay and a portion of said supervisory apparatus to connect one operator's set to said calling line and to prevent two operators from simultaneously being connected to said calling line, and a circuit for said relay including a portion of a talking strand of one of said cord circuits, and automatic disconnect means individual to said cord circuits operable when the calling subscriber retires to free the calling line from a cord circuit connected thereto.

80. A telephone system including subscribers' telephone lines, a manual switchboard having a plurality of operators' positions, circuits having multiple answering jacks and call signals at said operators' positions, subscriber-controlled means for operating the signals associated with one of said circuits when initiating a call, operator's manual link circuits at each of said positions for connecting to one of said lines through one of the multiple answering jacks, test means included in said link circuits automatically operable upon connection of one of the link circuits with one of the multiple answering jacks in answering a call for determining the answered or unanswered condition of the call, and supervisory means for said link circuit operable when disconnection is signaled for.

81. A telephone system including a calling subscriber's telephone line, a manual switchboard having a plurality of operators' positions, multiple connecting termi-

nals for use of said line at said operators' positions, a relay having its coil connected to a contact of said multiple terminals, operators' link circuits distributed among said operators' positions, and means initially operated through a circuit including the coil of said relay whereby any one of said link circuits may be connected through one of said multiple terminals to said line when answering a call to the exclusion of the remaining link circuits that may attempt to answer the call.

82. A telephone system including a calling telephone line connected to a plug-ended link circuit at the exchange, means under the sole control of the substation on said calling line whereby when disconnection is signaled for both conductors of the line are operatively disconnected from the link circuit and the line is available for extending a calling signal before the link plug is withdrawn, other link circuits having access to said telephone line, and testing means for the link circuits for preventing the operative connection of more than one of said link circuits to said line at one time.

83. A telephone system including subscribers' telephone lines, a manual switchboard, a plurality of terminals and associated calling signals for each of said lines appearing at two or more operators' positions upon said switchboard, link circuits at each of said operators' positions having terminals which may be substantially simultaneously connected to the multiple terminals of one of said subscriber's lines in answering a call from the substation on said line, test means for said link circuits so arranged that only one operator at a time may operatively connect to the calling subscriber's line and extend a connection to a terminal of another line, automatic ringing means for said link circuits, operator-controlled means for initiating the operation of the automatic ringing means to signal the called subscriber when the link circuit is connected to the called line, and subscriber-controlled means responsive to the removal of the receiver at the called substation for preventing further application of ringing current to the called subscriber's line.

84. A telephone system including a subscriber's telephone line terminating in multiple jacks and answering signals at a central office switchboard, an operator's link circuit having an answering manual connection terminal for extending the circuit of said line via one of said jacks, a busy potential placed upon said jacks responsive to the connection of said manual connection terminal thereto, a called telephone line, a calling manual connection terminal for said link circuit for extending a connection to said called telephone line, and means under the sole control of the substation of said first line for removing said busy potential and for disconnecting both line conductors of the line from the link circuit prior to the time that the called telephone line signals for disconnection.

85. A telephone system including a calling subscriber's telephone line, a manual switchboard having a plurality of operators' positions, multiple line jacks and answering signals for said line appearing at a plurality of said operators' positions, an operator's telephone at each of said positions, a plurality of link circuits at each of said positions, manual connection terminals for said link circuits, test means for said link circuits including a low resistance winding and a relatively high resistance winding brought into operation responsive to the connection of two or more of said manual connection terminals to the terminals of said calling line to connect the operator's telephone associated with one of said link circuits to said telephone line and prevent the operative connection of a second of said link circuits and its associated operator's telephone to the said telephone line.

86. A telephone system including subscribers' telephone lines, each terminating in a plurality of jacks at the central exchange, signals for each of said lines associated with said jacks, operators' link circuits divided into groups, an operator's telephone associated with each group of said link circuits, and means responsive to the connection of two or more link circuits to the terminals of a calling line to connect the operator's telephone associated with one of said last link circuits to said calling telephone line, and to prevent the operative association of a second operator's telephone associated with another one of said two or more link circuits to said subscriber's telephone line.

87. A telephone system including subscribers' telephone lines, a plurality of connecting terminals and line signals for each of said lines distributed among a plurality of operators' positions on a central office switchboard, means responsive to a call from the substation of one of said lines for operating its associated line signals, link circuits at each of said operators' positions having answering terminals, means including a low resistance winding and a relatively high resistance winding in said link circuits operable upon connection of one of said link circuits with a terminal of the calling line for determining its answered or unanswered condition, said relatively high resistance winding operating to connect in circuit said low resistance winding if said call is unanswered, but failing to operate to connect said low resistance winding if said call has been answered.

88. A telephone system including a calling subscriber's line, multiple terminals for said line, a manual switchboard having link circuits divided into groups, answering terminals for said link circuits for connection to said multiple terminals of said line, means including a low resistance and a relatively high resistance winding of one of said link circuits whereby, upon the connection of the answering terminal of the link circuit to a multiple terminal of said line, the high resistance winding operates to connect the low resistance winding in circuit so that when a second link circuit is physically connected to another multiple terminal of said line said second link circuit is prevented from being operatively connected to said line.

89. A telephone system including a calling subscriber's line provided with terminals through which said line may be seized as a calling line to extend connections therefrom, link circuits divided into groups, answering terminals for said link circuits, testing means for said link circuits including a testing winding of relatively high resistance and a winding of lower resistance, the relatively high resistance winding of said testing means serving to establish a circuit including said lower resistance winding to prevent the operative connection of the answering terminals of link circuits of different groups to said line when attempting to answer a call.

90. In a telephone system the combination with a plurality of cord circuits of a plurality of operators' circuits, a high and low resistance winding for each cord circuit, means to connect the high resistance winding of one cord circuit and the low resistance winding of another cord circuit in parallel branches of the same circuit, a current-limiting device in the common branch of said circuit for preventing the effective actuation of contacts controlled by the high resistance winding, the low resistance winding serving to connect its cord circuit with an operator's set and to maintain one of the branches of said parallel circuit.

91. In a telephone system a plurality of marginal and of non-marginal windings, a plurality of circuits directly controlled by the non-marginal winding and a single circuit directly controlled by the marginal winding, said single circuit including the non-marginal winding, means to connect one of said non-marginal windings and one of said marginal windings in parallel branches of the same circuit, and a current-limiting device in the common branch of said circuit for preventing the operation of the marginal winding of the connected parallel branches.

92. A telephone system including a two-conductor calling subscriber's telephone line and a called subscriber's telephone line, a link circuit provided with manual connection terminals for extending connection from said calling subscriber's line to said called subscriber's line, electromagnetic means for said link circuit for disconnecting one of the manual connection terminals thereof from the strands thereof, a relay for said link circuit controlled over one of said subscribers' lines, a second relay for said link circuit operated responsive to the connection of one of said manual connection terminals to one of said lines, and a circuit for said electromagnetic disconnect means controlled by said two relays.

93. A telephone system including a calling subscriber's telephone line and a two-conductor called subscriber's telephone line, a link circuit having manual connection terminals for connecting said lines in conversational circuit, electromagnetic disconnect means for said link circuit for effectively disconnecting the link circuit from one of the subscribers' lines, a relay controlled over one of said subscribers' lines for operating said electromagnetic disconnect means, said relay being inoperative to actuate said electromagnetic disconnect means until a second relay in said link circuit has been operated in response to the connection of one of the manual connection terminals of the link circuit to one of said lines, and locking means for maintaining said electromagnetic disconnect means in an operative position subsequent to an operation thereof by said first relay.

94. A telephone system including a two-conductor calling subscriber's telephone line and a called subscriber's telephone line, a link circuit provided with manual connection terminals for extending connection from said calling subscriber's line to said called subscriber's line, electromagnetic means for said link circuit to disconnect one of said manual connection terminals from the strands of said link circuit, a relay for said link circuit controlled over one of said subscriber's lines, an operator's listening switch having auxiliary contacts, and a circuit for said electromagnetic means controlled by said relay and passing through said auxiliary contacts of the listening switch.

95. A telephone system including a two-conductor calling subscriber's telephone line, and a called subscriber's telephone line, a link circuit provided with manual connection terminals for extending connection from said calling subscriber's line to said called subscriber's line, electromagnetic disconnect means for said link circuit for disconnecting one of said manual connection terminals from the strands of said link circuit, a relay for said link circuit controlled over one of said subscriber's lines, an operator's listen-

ing switch having auxiliary contacts, and a circuit for said electromagnetic disconnect means controlled by said relay and by said auxiliary contacts of said listening switch.

96. A telephone system including a two-conductor calling subscriber's telephone line and a called subscriber's telephone line, a link circuit provided with manual connection terminals for extending connection from said calling subscriber's line to said called subscriber's line, electromagnetic disconnect means for said link circuit for disconnecting one of said manual connection terminals from the strands of said line circuit, a relay for said link circuit controlled over one of said subscriber's lines, a second relay for said link circuit actuated during the process of connecting said first subscriber's line to said second subscriber's line, a locking circuit for said second relay closed and held closed until one of said connection terminals is removed from the jack of one of said lines, and a circuit for said electromagnetic disconnect means controlled by said two relays.

97. A telephone system including a two-conductor calling subscriber's telephone line and a called subscriber's telephone line, a link circuit provided with manual connection terminals for extending connection from said calling subscriber's line to said called subscriber's line, electromagnetic disconnect means for said link circuit for disconnecting one of said manual connection terminals from the strands of said link circuit, a relay for said link circuit controlled over one of said subscriber's lines, a second relay for said link circuit actuated during the process of connecting said first subscriber's line to said second subscriber's line, a third relay operated upon the connection of one of said connection terminals to one of said lines, a locking circuit for said second relay controlled by said third relay, and a circuit for said electromagnetic disconnect means controlled by said first and second relays.

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

HIRAM D. CURRIER.

Witnesses:
GEORGE E. MUELLER,
M. R. ROCHFORD.

DISCLAIMER

1,428,762.—*Hiram D. Currier*, Chicago, Ill. TELEPHONE SYSTEM. Patent dated September 12, 1922. Disclaimer filed November 20, 1934, by the assignee, *Kellogg Switchboard & Supply Company*.

Hereby enters this disclaimer to that part of the claim in said specification as follows:

Petitioner disclaims claims numbered 1, 5, 6, 7, 9, 15, 16, 17, 20, 21, 22, 24, 25, 26, 27, 28, 30, 32, 33, 34, 77, 81, 84, 92, 93, 94, 95, 96, and 97.

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