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TELEPHONE EXCHANGE SYSTEM.

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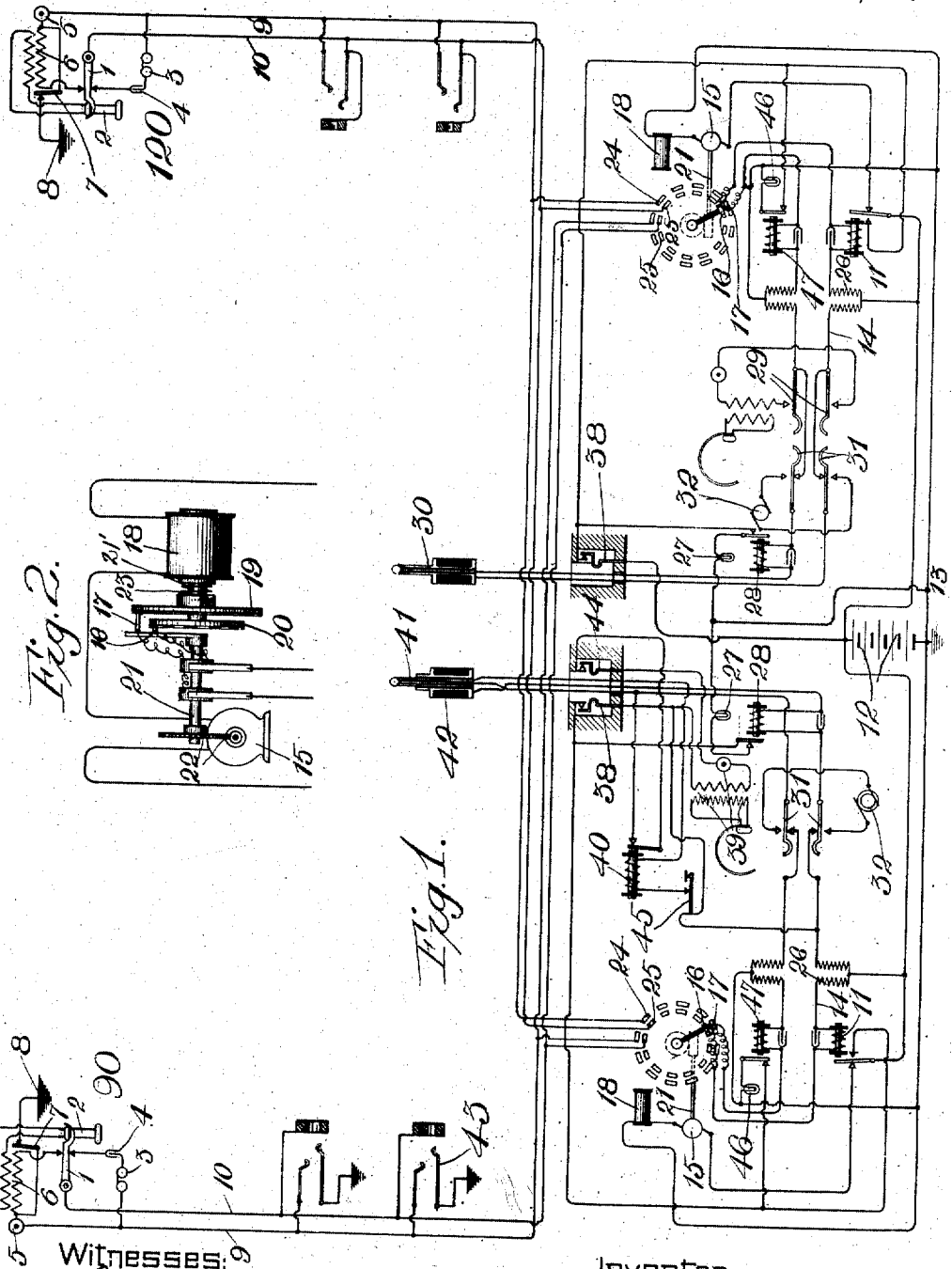

Fig. 1.

Fig. 2.

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TELEPHONE-EXCHANGE SYSTEM.

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To all whom it may concern:

Be it known that I, HAROLD D. STROUD, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone exchange systems, and has for its object the provision of automatic means for connecting subscribers' telephone lines with cord circuits, which cord circuits are also provided with manually operated means for uniting the same with telephone lines for completing connection between subscribers.

By means of my invention, I am enabled to have the calling subscriber's line automatically connected with the answering end of the cord circuit, the connecting end of the cord circuit being preferably provided with a connecting plug adapted for insertion within any of the line jacks.

In another application, Serial No. 69,681, filed July 25, 1901, I have disclosed a system wherein each subscriber's line is equipped with a traveling spring jack adapted to be operated through the agency of apparatus actuated when a call is initiated, which spring jack, in its movement, is brought into connection with the terminals of an idle cord circuit or connector, at the answering end thereof; whereupon an electromagnetic device has its operative condition changed to check the further movement of the traveling spring jack to maintain the same in engagement with the said cord circuit terminals, whereby the cord circuit constitutes a continuation of the calling subscriber's line, the spring jack being provided with springs connected with the sides of the said telephone line.

In my present invention, instead of equipping the subscribers' line with the traveling spring jacks, I equip one end of each cord circuit, the answering end, with what may be termed a traveling plug, or its electrical equivalent. In this I am enabled to greatly reduce the motor mechanisms required for effecting the traveling of the movable connecting devices, and consequently am able to greatly simplify the construction. The invention disclosed in my said co-pending application, I consider to be generic. The invention disclosed herein is also generic in general characteristics, but somewhat specific in some of its aspects.

In my present invention I employ, at the answering end of each cord circuit, a contact or contacts corresponding to the cord circuit, which contacts may be termed "answering contacts", meaning thereby that they constitute the terminals of the answering end of the cord circuit, motor mechanism being associated with these answering contacts preferably constantly effecting the travel of the answering contacts. These traveling contacts are caused to pass over a plurality of line contacts that register therewith. The motor mechanism for operating the answering contacts is preferably controlled in its operation by an electromagnet or relay, which electro-magnet or relay in turn is adapted for control from a calling sub-station, the arrangement being such that when a traveling answering contact engages a contact of an unselected calling line, the relay is placed in a condition of energization, owing to the removal of the telephone receiver from the switch hook at the calling substation, to cause the motor mechanism of the cord circuit to be disengaged from operative relation with the corresponding answering contacts, so that a calling subscriber's line, when thus automatically connected with the answering contacts, is maintained in such connection.

Each answering end of a cord circuit may be associated with fifty sets of line contacts, for example, while the line contacts that are for association with moving answering contacts may be multipled as many times as there are cord circuits to be connected therewith at a given section of board or operator's position.

The system that I have thus briefly outlined is one that is well adapted for multiple switchboard work or trunking systems. There is preferably associated with the relay that is governed by the calling subscriber for controlling the motor mechanism that actuates the answering contacts, a signal, there being thus preferably no relay mechanism and no signaling apparatus permanently associated with an idle line, there being only as many relays as there are cord circuits. A signal may thus serve in a double capacity of a line signal and a clear-

ing-out signal. When a call is initiated the signal acts as a line indicator, the plug at the connecting end of the cord circuit being in its seat corresponding in position to the indicator, which is preferably a small incandescent lamp. When conversation has been finished, or when a subscriber (now preferably the called subscriber) has restored his telephone, the lamp, again glowing, enables the operator to determine that the called subscriber has restored his telephone, as the plug no longer occupies a position corresponding to the signal, being inserted within the jack of the called subscriber. When conversation is finished, the replacing of the receiver at the calling telephone will release the traveling plug which will then continue in its travel. Should there then be another unselected calling subscriber in the same group, said traveling plug, or some other, will select the said subscriber. In case said calling subscriber be selected by said released traveling plug prior to the disconnection of its corresponding cord-circuit, the called subscriber having also hung up, the new call will be indicated by the signal upon the operator withdrawing the plug from its previously connected jack.

Where double supervision is desirable, a special signal is added to the cord circuit, which preferably only gives a "disconnect" signal, which signal is under the control of the calling subscriber. There may be associated with the cord circuit an electro-magnetically controlled listening key, in association with a plug seat switch, or equivalent means, whereby, when a call is initiated, the operator will have her telephone partially connected with the calling subscriber's line, which connection of the operator's line with the cord circuit may be completed upon the removal of the connecting plug from its seat. In this way a number of calls may be received before any of them are responded to; while at the same time all the operations in establishing a connection may be performed in orderly sequence.

The ringing key, in association with these cord circuits, is preferably manually controlled owing to commercial conditions that now so largely obtain. A system of my invention will enable the operators to effect connections between telephone lines with very few movements to each given connection, effecting corresponding increase in the operators' capacity. As there is only one manually controlled plug, two plug movements for each connection are dispensed with. As there may be no manually operated listening key used in effecting a connection, another motion is dispensed with for each connection.

In modern practice, line indicators, even though very small in the aggregate occupy a great deal of space upon the switchboard, which, particularly where multiple switchboards are concerned, introduces a factor that is expensive in point of switchboard construction and capacity. By means of my invention, an indicator, associated with each cord circuit only, may act as the line indicator, and especially when acting as a supervisory indicator it may be located upon the switchboard shelf, the vertical portion of the switchboard being thus relieved of any apparatus except the jacks, enabling the space that has hitherto been occupied by line indicators to be occupied by multiple jacks, thus largely increasing multiple switchboard capacity. Further, the answering contacts of a multiple switchboard line, being associated with the movable answering contacts, are not located upon the vertical face of the switchboard, but together with the said answering contacts and the motor mechanism controlling the same may be located elsewhere in the exchange building.

I will explain my invention more fully by the drawing, in which Figure 1 illustrates the application of my invention to a telephone exchange system, and Fig. 2 somewhat diagrammatically indicates the motor mechanism and the relay mechanism for controlling the same. Like parts are indicated by similar characters of reference throughout both figures. At each of the substations, 90 and 120, is shown a telephone switch hook 1, a telephone receiver 2, adapted to be supported thereby, a signal bell 3, that may be of any well known type, as, for example, a polarized ringer, a condenser 4, in the same bridge with the bell, to prevent the flow of common battery, where employed, over the telephone lines, a transmitter 5, an induction coil 6, the primary of which is included in circuit with the telephone lines in a common battery system, while a secondary may be included in a closed local circuit with the receiver.

For purposes to be hereinafter set forth, the primary winding of the induction coil also preferably constitutes an energizing winding of an electromagnet for effecting the attraction of an armature 7, which, when released, serves to throw the ground connection 8 on one side of the telephone line 9. This side of the telephone line, however, has no instrumentality at the exchange corresponding to such ground connection. The companion side 10 of each telephone line is periodically grounded at the exchange, in a manner to be hereinafter fully set forth, through a relay 11 and battery 12. There is, however, interposed between each relay 11 and the ground 8 for connection with limb 10, a substation switch hook 1, which when depressed removes the ground 8 from the relay 11, but which, when elevated, throws this ground 8 on to the relay, thereby com-

pleting circuit through said relay. This relay circuit includes a common battery 12 that may also be employed for supplying transmitters 5 with battery current, the office ground for the relay 11, being indicated at 13. The relay 11 is preferably included in one strand, or the continuation of one strand 14, and has for its special and prime function the control of the motor mechanism 15, employed for effecting the travel of the answering contacts 16, 17. This control of the motor mechanism may be effected in a variety of ways. I have shown an electro-magnet 18, for the purpose of cooperating in this control, which electro-magnet is normally energized through the agency of the armature of magnet 11, and the normal contact engaged by this armature when the magnet 11 is deënergized. Magnet 18 by being thus normally energized, it being always energized so long as an unselected calling line is not in connection with an answering contact 16, effects the bodily movement of a plate 19 away from the traveling answering contact 17, permitting the plate 20 to remain in engagement with the traveling answering contact 16, but one of these plates being moved. For this purpose the plate 19 may be splined upon the non-driven shaft 21'. There is interposed between the magnet 18 and the plate 19 a coiled spring 23 to quickly thrust the plate 19 against the traveling contact 17, when the magnet 18 is deënergized to duly provide the maintaining circuit for relay 11 as hereafter specified. The plates 19 and 20 are provided with the line terminals 24 and 25 preferably circularly arranged, and around which the contacts 16, 17 are rotated by the motor 15 through the agency of gearing 22. Each pair of radially alined contacts 24 and 25 constitutes the connecting contacts of a calling subscriber's line.

There are several lines, fifty or more if desirable, thus represented by their connected contacts in association with a pair of traveling answering cord contacts. The answering end of each cord circuit is equipped with such a pair of answering contacts 16 and 17, and in order that any calling line may be automatically connected with answering cord contacts, each telephone line has as many pairs or sets of connecting contacts as there are cords to be connected therewith at an operator's position, or a section of switchboard. I have illustrated in Fig. 1 the connecting contacts 24 and 25 multipled for the cord circuits, but obviously the number of cord circuits and the number of pairs of connecting contacts of lines will be increased in actual practice. When a subscriber initiates a call, he removes his telephone from the hook lever and closes the common battery 12 into circuit with the relay 11, the circuit through this relay being traced from the ground 13, the battery 12, a winding 26 of a repeating coil (repeating coils limiting the subscriber's transmitter current to a tenth of an ampere being desirably employed in the cord circuits) the helix of the magnet 11, answering contact 16 (which has been brought by the previous constant operation of the motor mechanism into connection with the contact 25 of the calling subscriber 120, for example), a line contact 25, limb of the telephone line 10, telephone switch hook 1, primary winding of induction coil 6 and the ground 8, at the substation, now thrown on to the limb 10, by the elevation of the switch hook. When circuit has been thus established through the magnet 11, a further continued movement of the answering contacts 16 and 17 is prevented, when the motor 15 is an electric motor, by the movement of the armature toward the magnet 11, thereby opening the circuit that previously included the battery 12 and the motor 15, the pressure of the spring contacts 16 and 17 being sufficient to bring the motor to rest directly after it is placed on open circuit. The magnet 11 may further be caused to operate a signal 27 preferably in the form of a small forty volt incandescent lamp, this signal being operated when the armature of the magnet is attracted, the signal then being operated as a line indicator to show the operator that subscriber 120 desires connection. The circuit through this indicator may be traced from the battery 12 to the armature of magnet 11, the contact engaged by the armature upon its attraction, the contact and armature of magnet 28, the lamp, returning to the battery.

The operator having received a call, may operate her listening key 29, when the cord circuit, shown upon the right of the drawing, is employed to include her telephone in circuit with the calling subscriber's telephone, the resistance of the operator's circuit being such that it will not unduly shunt the subscriber's line. Having ascertained the connection desired, the operator removes the connecting plug 30 from its seat (this connecting plug comprising the connecting terminals of the cord circuit in telephonic connection with the answering contacts selectedly connected with the calling subscriber's line) and thereafter inserts this plug within the line jack of the called subscriber's telephone line, whereafter the operator depresses the ringing key 31 to include the calling generator 32 in circuit with the called subscriber's signal bell.

There is included in circuit with the lamp 27 a plug seat switch 38 which serves to maintain the circuit including this lamp open when the plug is normal. This is provided because the armature of the magnet 28 would otherwise constantly maintain the

signaling current through the lamp, the armature closing circuit when unattracted. The cord-connecting apparatus illustrated upon the left of the diagram is generally similar to that illustrated upon the right, similar parts being given similar characters of reference to those occurring upon the right hand side of the diagram. There is, however, provided, in addition to, or rather supplementing some of the features of the cord-connecting apparatus upon the right, a relay controlled operator's telephone appliance 39, the relay 40 for controlling the association of the operator's telephone set with the cord circuit being included in a circuit containing the intermediate contact 41 of the connecting plug 42, and, when said plug is inserted within a jack of a called subscriber, a grounded jack spring 43, the spring 43 thus constituting one grounded terminal of the magnet 40 while the other terminal of the magnet 40 is grounded through battery 12 at 13. The armature of this electromagnet, when unattracted, serves to close a break in the operator's telephone circuit, so that when a call is initiated the operator may listen. When the connecting plug that has been automatically connected with a calling subscriber has been inserted within the called subscriber's jack, the magnet 40 is energized, withdrawing its armature so as to open the circuit including the operator's telephone outfit.

In order that a number of incoming signals may be received and to prevent confusion in the work of the operator, the telephone circuit at the left preferably also includes a plug seat switch 44, which while the plug is in its seat serves to maintain a second opening in the operator's circuit, this opening being closed when the plug is removed. If it should be desired to have the operator listen in at any time after connection is established, there is included in circuit with the magnet 40 a listening key 45, which, when depressed, will open the circuit containing the magnet 40, throwing the operator's telephone set into circuit by reason of the release of the armature of such magnet 40.

There may be provided in each of the cord circuits, when desired, an additional signal 46, controlled by a signal relay 47, included in the strand of the cord circuit, which lamp 46 is under the control of the calling subscriber. The lamp 27 being under the control of the called subscriber, there is thus provided a double supervision of each connection. It is apparent that when the transmitter is included in circuit with the common battery the armature controlled by the primary winding at the substation of the calling subscriber is attracted to remove the ground 8 from the line. This condition only arises when an automatic selection has been effected and the battery is flowing over the metallic circuit of the line.

As previously stated, the relay 11 is initially energized over a circuit extending to ground at the substation. It will also be observed that as soon as this ground is removed by the attraction of the armature 7, a maintaining circuit for the relay 11 is continued through the transmitter 5, line limb 9, contacts 17—24 (which are engaged upon the deënergization of magnet 18), the winding of relay 47 and a winding of repeating coil 26 to ground. Now, if a second switch, in search of a calling line, temporarily connects its trunk with contact 25 of an already selected line, the stopping relay 11 and a winding of the repeating coil 26 of the second trunk will be placed in shunt with the stopping relay 11 and the corresponding winding of the repeating coil 26 of the first trunk, thereby connecting the resistances of the line limb 10, coil 6, together with the resistance of the substation transmitter 5, line limb 9, relay 47 and a winding of repeating coil 26, in series with the said parallel paths through the relays 11. By reason of the inclusion of this additional resistance in circuit, the current flowing through the two relays 11 will be so far reduced as not to actuate the relay 11 of the second trunk and yet not to permit the release of relay 11 of the first trunk. It will also be observed that the temporary connection of a second trunk to contact 25 of a called line, similar to that runing to substation 90, results in forming a similar circuit having parallel and series portions. In this case, one parallel path includes a winding of repeating coil 26 and relay 11, and the other includes relay 28. The series portion of the circuit includes line limb 10, winding of induction coil 6, transmitter 5, line limb 9, and a winding of repeating coil 26. With these resistances, as before, the relay 11 of a second trunk will not be actuated and relay 28 will not release its armature. It will also be observed that the temporary connection of a second trunk to contact 25 of a called line, similar to that running to substation 120, also results in forming a circuit having parallel and series portions. In this case the parallel paths include on the one hand relay 11 and a winding of repeating coil 26, and on the other hand a winding of repeating coil 26 only. As before, the resistances are such that the relay 11 of the seeking trunk is not actuated. It will also be observed that the temporary connection of a second trunk to contact 25 of a called line, similar to that running to substation 120, assuming that the operator at that time has her listening key 29 depressed. also results in forming a circuit having parallel and series portions. In this case the parallel paths include, on the one hand, re-

lay 11 and a winding of repeating coil 26, and on the other hand a winding of repeating coil 26 only, while the series portion includes the operator's set and one winding of repeating coil 26. As before, the resistance of said operator's circuit and said winding of 26 are sufficient to prevent the actuation of the relay 11, of the seeking trunk. It is equally true that when the party of the said called line has removed his telephone from its hook, either prior to or subsequent to the restoration of the operator's listening key 29, the series portion of the said circuit necessarily comprises resistances sufficient to prevent the actuation of the relay 11, of a seeking trunk. Thus it will be seen that at all times except when the seeking switch engages the contact 25 of a calling line not yet connected, the relay 11 associated with the seeking switch will receive either no current or too little current to cause its initial operation, whereby improper connections will be prevented.

It is obvious that many departures may be made from the apparatus of my invention herein shown, without departing from the spirit of the invention; and I do not, therefore, wish to be limited to any of the details of construction or circuit arrangements herein specifically set forth, but having thus described my invention, I claim as new and desire to secure by Letters Patent:—

1. In a telephone exchange system, the combination with a plurality of telephone lines extending from substations to an exchange, of cord connectors at the exchange for uniting telephone lines in telephonic connection, each connector having a manually operated terminal plug, while each line has a switch for receiving said plug, traveling switches also constituting terminals of said cord connectors, each of said switches being provided with a contact maker capable of assuming a plurality of selective positions, and multipled terminals of said lines arranged in coöperative relation with said switches, substantially as described.

2. In a telephone exchange system, the combination with a plurality of telephone lines extending from substations to an exchange, of cord connectors at the exchange for uniting telephone lines in telephonic connection, each connector having a manually operated terminal plug, while each line has a switch for receiving said plug, traveling switches also constituting terminals of said cord connectors, multipled terminals of said lines arranged in coöperative relation with said switches, and means for arresting said switches when connected with the terminals of a calling line, substantially as described.

3. A telephone exchange system including a telephone line, an operator's circuit, a manually controlled terminal connected thereto, a call signal for said circuit, and a constantly driven switch connected to said circuit with means for arresting the same when engaging said telephone line.

4. A telephone exchange system including calling and called subscribers' lines, link-circuits at the exchange having manually operated terminals for connecting with called lines, selective switches having active contacts at the other ends of said link-circuits, line contacts for said lines adapted to be engaged by said active contacts, and means at each substation for changing the electrical character of its line contacts to arrest travel of the active contacts of a selective switch when engaging them.

5. A telephone exchange system including calling and called subscribers' lines, link-circuits at the exchange having manually operated terminals for connecting with called lines, selective switches having traveling contacts at the other ends of said link-circuits, line contacts for said lines adapted to be engaged by said traveling contacts, and means at each substation for changing the electrical character of its line contacts to arrest travel of the traveling contacts of a selective switch when engaging them.

6. A telephone exchange system including calling and called subscribers' lines, link-circuits at the exchange having manually operated terminals for connecting with called lines, selective switches having active contacts at the other ends of said link-circuits, non-traveling line contacts for said lines adapted to be engaged by said active contacts, and means at each substation for changing the electrical character of its non-traveling line contacts to arrest travel of the active contacts of a selective switch when engaging them.

7. A telephone exchange system including calling and called subscribers' lines, link-circuits at the exchange having manually operated terminals for connecting with called lines, selective switches having active contacts at the other ends of said link-circuits, line contacts for said lines adapted to be engaged by said active contacts, means at each substation for changing the electrical character of its line contacts to arrest travel of the active contacts of a selective switch when engaging them, and means automatically effective to thereafter extend a calling signal.

8. A telephone system including subscribers' lines each having multiple answering contacts and multiple called contacts, link circuits for use in connecting subscribers' lines for conversation, each of certain of said link circuits being connected to a manually controlled terminal for use in extending connections to certain of said called contacts, and said link circuits being con-

nected to traveling contact makers capable of assuming a plurality of selective positions for connecting with said answering contacts.

9. A telephone system including a calling line and a called line, a plurality of link-circuits at the exchange for use in interconnecting said lines, manually operated terminals for certain of said circuits for connecting with said called line, multiply related passive contacts of said calling line at the exchange, contact members for certain of said link-circuits adapted to be moved to engage said contacts, and apparatus at the calling station effective under control of the subscriber to control said contact members to automatically temporarily connect a link-circuit with the line.

10. A telephone system including a calling and a called line, a plurality of link-circuits at the exchange each adapted to interconnect said lines, manually operated terminals for said circuits for connecting with said called line, multiply related non-traveling contacts of said calling line at the exchange, traveling contact members for said link-circuits adapted to engage said non-traveling contacts, and apparatus at the calling station effective under control of the subscriber to control said contact members to automatically temporarily connect a link-circuit with the line.

11. A telephone system including a calling line and a called line, a plurality of link-circuits at the exchange for use in interconnecting said lines, operator controlled terminals for certain of said circuits for connecting with said called line, multiply related passive contacts of said calling line at the exchange, contact members for certain of said link-circuits adapted to be moved to engage said contacts, apparatus at the calling station effective under control of the subscriber to control said contact member to automatically temporarily connect a link-circuit with the line, and mechanism automatically effective to extend a calling signal.

12. A telephone system including subscribers' lines each having multiple answering contacts and multiple called contacts, link circuits for use in connecting subscribers' lines for conversation, each of certain of said link circuits being connected to a manually operated terminal for use in extending connections to said called contacts and certain of said link circuits being connected to traveling contact makers capable of assuming a plurality of selective positions for connecting with said answering contacts, and means at a substation for automatically bringing the traveling contact makers of a link circuit into a temporary continuing connection with the stationary contacts of the line.

13. A telephone system including a calling line, passive line contacts therefor at the exchange, operator controlled link-circuits for use in extending connections from calling to called subscribers and manually controlled terminals for certain of said link circuits, certain of said link circuits having selective switches provided with contact members adapted to be moved to engage said contacts, and means at the substation for automatically causing a continuing connection of one of said link-circuits with said line contacts.

14. A telephone system including a calling line, non-traveling line contacts therefor at the exchange, operators' link-circuits for extending connection from calling to called subscribers and manually controlled terminals therefor, said link-circuits having selective switches provided with traveling contact members adapted to engage said non-traveling contacts, and means at the substation for automatically causing a continuing connection of one of said link-circuits with said line contacts.

15. A telephone system including a calling line, passive line contacts therefor at the exchange, operator controlled link-circuits for use in extending connection from calling to called subscribers having selective switches provided with contact members adapted to be moved to engage said line contacts, means at the substation for automatically causing a continuing connection of one of said link-circuits with said line contacts, and means automatically effective to extend a calling signal to the operator.

16. A telephone system including a calling line, line contacts therefor at the exchange, operator controlled link-circuits having selective switches provided with contact members adapted to engage said line contacts, means at the substation for automatically causing a continuing connection of one of said link-circuits with said line contacts, means automatically effective to extend a calling signal to the operator, and a central source of current for operating and talking purposes.

17. A telephone system including subscribers' lines each having multiple answering contacts and multiple called contacts, link circuits for connecting subscribers' lines for conversation, each link-circuit being connected to a manually operated terminal for connecting with said called contacts and continuously traveling electrically controlled terminals for connecting with said answering contacts.

18. A telephone system including subscribers' lines each having multiple answering contacts and multiple called contacts, link-circuits for connecting subscribers' lines for conversation, each link circuit being connected to a manually operated terminal for connecting with said called contacts and continuously traveling electrically controlled

terminals for connecting with said answering contacts, and means at a substation for automatically bringing the electrically controlled terminals of a link-circuit into a temporary continuing connection with the stationary contacts of the line.

19. A telephone system including subscribers' lines each having multiple answering contacts and multiple called contacts, link-circuits for use in connecting subscribers' lines for conversation, each of certain of said link-circuits being connected to an operator controlled terminal for use in extending connections to said called contacts and certain of said link circuits being connected to traveling electrically controlled terminals adapted to assume a plurality of selective positions, for connecting with said answering contacts, means at a substation for automatically bringing the electrically controlled terminals of a link-circuit into a temporary continuing connection with the stationary contacts of the line, and means for automatically extending a calling signal thereon.

20. A telephone system including a subscriber's line, an operator controlled link circuit for use in extending connections from calling to called subscribers and a manually controlled terminal for use with said link circuit, and means whereby said link-circuit tests said line and automatically connects thereto when a calling line.

21. A telephone system including a subscriber's line, a link-circuit for use in extending connections from calling to called subscribers, a manually operated terminal for use with said link circuit, and means whereby said link-circuit tests said line and automatically connects thereto when a calling line.

22. A telephone system including a subscriber's line, a link circuit and an operator controlled terminal for use with said link circuit, a calling signal for said link-circuit, and means whereby said link-circuit tests said line and automatically displays said signal when said line is a calling line.

23. A telephone system including a line, a link-circuit, a manually operated terminal therefor, a calling signal therefor, and means whereby said link-circuit tests said line and automatically connects thereto to display said signal when said line is a calling line.

24. A telephone system including a calling line, an operator controlled link-circuit for use in extending connections from calling to called subscribers and a manually controlled terminal for use with said link circuit adapted to test said line, and an automatic test device for said link-circuit sensitive to the calling condition of said line to establish a continuing connection of said link-circuit and line.

25. A telephone system including a calling line, an operator controlled link circuit for extending connections from calling to called subscribers and an operator controlled terminal for use with said link circuit, means for causing said circuit to test said line, and a calling signal for said link-circuit operative on said test responsive to the calling condition of said line.

26. A telephone system including a calling line, a link-circuit for use in extending connections from calling to called subscribers adapted to test said line, a manually operated terminal for use with said link-circuit, and an automatic test device for said link-circuit sensitive to the calling condition of said line to establish a continuing connection of said link-circuit and line.

27. A telephone system including a plurality of lines, an operator's link-circuit for use in extending connections from calling to called subscribers adapted to test said lines, a manually controlled terminal for said link circuit for directly connecting to said called subscribers' lines, mechanisms at the substations of said lines adapted to change their electrical conditions when calls are initiated thereover, and means included in said link-circuit sensitive to the changed electrical condition of any line to establish an operative connection between said circuit and said line.

28. A telephone system including a plurality of lines, a link-circuit provided with a rotary switch for testing said lines, a calling signal included in said link-circuit, mechanism at the substations of said lines adapted to change their electrical conditions when calls are initiated thereover, and means included in said link-circuit sensitive to the changed electrical condition of any line to operate said signal.

29. A telephone system including a calling line, a link-circuit for use in extending connections from calling to called subscribers, a manually operated terminal for use with said link circuit, a testing device included in said link-circuit for automatically testing said line, and mechanism controlled by said testing device operated responsive to the calling condition of said line to establish an operative connection between said circuit and said line.

30. A telephone system including a calling line, a link-circuit, an operator controlled terminal for use with said link circuit, a calling signal for said link-circuit, a testing device included in said circuit for automatically testing said line, and mechanism responsive to said testing device and the calling condition of said line to automatically operate said signal.

31. In a telephone system, subscribers' lines, a link-circuit for use in extending connections from calling to called subscribers having a manually operated terminal, mechanism to cause said circuit to success-

ively test said lines, and apparatus operated responsive to the testing of a calling line to connect said link circuit and said calling line.

32. In a telephone system, subscribers' lines, a link circuit having a manually operated terminal, a calling signal individual to said link-circuit, mechanism to cause said circuit to successively test said lines, and apparatus responsive to the testing of a calling line to operate said signal.

33. In a telephone system, subscribers' lines, an operator controlled link circuit for use in extending connections from calling to called subscribers and a manually controlled terminal therefor, an active member for use with said link circuit adapted for progressive travel to test said lines, and apparatus responsive to the testing of a calling line to establish telephonic connection between said link circuit and said calling line.

34. In a telephone system, subscribers' lines, mechanisms at the respective substations to change the electrical conditions of lines when calls are initiated at the respective substations, a link circuit for extending connections from calling to called subscribers including a manually operated terminal, a conductor for use with said link circuit adapted to progressively test said lines, and apparatus effective in response to the changed electrical condition of a calling line when tested to cause a continuing operative connection of said link circuit and said calling line.

35. In a telephone system including subscribers' lines, test contacts for said lines, a link circuit having a manually operated terminal for use in extending connections to called lines, a testing conductor for use with said circuit, motor mechanism for effecting progressive movement of said conductor to successively connect with the test contacts of said lines, and apparatus responsive to the calling condition of a line effective when the test contact of said line is connected with said conductor, to telephonically unite said link circuit and said line.

36. A telephone system including subscribers' lines, test contacts for said lines, a link-circuit including a call signal individual thereto, an operator controlled terminal therefor for use in extending connections to called lines, an electrically operated terminal for use with said link circuit and adapted to connect with calling lines, a testing conductor associated with said electrically operated terminal, motor mechanism for effecting progressive travel of said conductor to connect with the test contacts of said lines, and apparatus responsive to the calling condition of a line, effective when a test contact of said line is connected with said conductor, to operate said call signal.

37. A telephone system including subscribers' lines, terminals therefor at the exchange, a link-circuit for use in extending connections from calling to called subscribers at the exchange, and a manually controlled terminal for use with said link circuit, a traveling switch individual to said link circuit adapted to engage terminals of successive lines, and means for arresting said switch when engaging terminals of desired lines.

38. A telephone system including a subscriber's line, a terminal therefor at the exchange, means at the substation for impressing an abnormal electrical condition upon said terminal, a link circuit for use in extending connections from calling to called subscribers, an operator controlled terminal therefor, an electrically operated contact for use with said link-circuit adapted to connect with said line terminal independently of the normal or abnormal condition thereof, and mechanism individual to said link-circuit sensitive to the abnormal condition of said line terminal to continue connection of said terminal and contact.

39. A telephone system including a subscriber's line, a link-circuit for use in extending connections from calling to called subscribers at the exchange, an operator controlled terminal therefor, automatic mechanism actuated independently of the line to connect said link-circuit with said line, and mechanism for said circuit sensitive to the calling condition of said line to cause a continuing connection of said link-circuit and said line.

40. A telephone system including a calling and a called subscriber's line, a link-circuit at the exchange having an operator controlled terminal for use in extending connections to said called line, an automatic switch actuated independently of the calling line to connect therewith, means at the calling substation adapted to effect an abnormal condition of the line and mechanism for said switch adapted, responsive to the abnormal condition of the calling line, to cause a continuing connection of said link-circuit and said line.

41. A telephone system including a subscriber's line, a link-circuit for use in extending connections from calling to called subscribers and a manually controlled terminal therefor, contacts associated with said line at the exchange, means to create an abnormal electrical condition of said contacts, and electromagnetic means for use with said link-circuit, operated in response to said abnormal condition to operatively connect said line and circuit.

42. A telephone system including subscribers' lines, contacts for said lines at the exchange, means at the substations to create abnormal electrical condition of the contacts

of the respective lines, link-circuits for use in extending connections from calling to called subscribers provided with operator controlled terminals, and continuously traveling automatic means associated with said link circuits operated in response to said abnormal conditions to connect link-circuits and lines.

43. A telephone system including a subscriber's line, passive contacts individual to said line adapted to be placed in an abnormal electrical condition under substation control, a link-circuit and a manually controlled terminal therefor, and automatic means operating responsive to said abnormal electrical condition to connect said link-circuit to said line.

44. A telephone system including a subscriber's line, a link-circuit at the exchange provided with a contact maker capable of assuming a plurality of selective positions, a coöperating manually operated terminal, advancing motor mechanism individual to said link-circuit for advancing said contact maker to connect said circuit and terminal in circuit with said line, and apparatus individual to said line at the exchange adapted under substation control to automatically govern said motor mechanism.

45. A telephone system including a subscriber's line, a link-circuit for use in extending connections from calling to called subscribers, a manually operated terminal at the exchange, motor mechanism individual to said link-circuit to connect it and said terminal in circuit with said line, an electromagnet for controlling said motor, and a conductor individual to said line at the exchange for controlling said magnet.

46. A telephone system including a subscriber's line, a conductor individual thereto at the exchange, a link-circuit for use in extending connections from calling to called subscribers, a manually operated terminal, motor mechanism for said link circuit to connect said circuit and terminal in circuit with said individual conductor, an electromagnet belonging to said circuit for controlling said motor and means at the substation for producing an abnormal electrical condition of said conductor to control said magnet.

47. A telephone system including a subscriber's line, a link-circuit for use in extending connections from calling to called subscribers and an operator controlled terminal therefor at the exchange, automatic mechanism operating independently of said line to produce an exclusive operative relation between said circuit and line, and apparatus included in said mechanism sensitive to a calling condition of said line, effective when said relation exists to cause continuing connection of said circuit and said line.

48. A telephone system including subscribers' lines, a link-circuit at the exchange provided with an operator controlled terminal for use in extending connections to called lines, motor mechanism for establishing independently of said lines, and successively, exclusive operative relations between said circuit and the different lines, and means at the substation for controlling said motor mechanism.

49. A telephone system including a subscriber's line and a link-circuit at the exchange provided with a manually operated terminal, mechanism including passive contacts individual to said line, mechanism individual to said link-circuit having a traveling contact maker capable of assuming a plurality of selective positions for coöperation with said passive contacts, and means whereby the operation of said line mechanism causes a subsequent operation of the latter mechanism to connect said link-circuit to passive contacts.

50. A telephone system including subscribers' lines, a link-circuit and a manually operated terminal for use in extending connections from calling to called subscribers, mechanism for connecting said link-circuit consecutively with each line and apparatus responsive to the calling condition of a line to cause a continuing connection.

51. A telephone system including subscribers' lines, a link-circuit and a manually operated terminal for use in extending connections from calling to called subscribers, a selective switch for said link-circuit adapted to place said link-circuit in operative relation with each line consecutively and means sensitive to the calling condition of a line to connect said circuit with said line.

52. A telephone system including subscribers' lines, terminals therefor at the exchange, means at the substations adapted to effect abnormal electrical conditions of said terminals, link-circuits for use in extending connections from calling to called subscribers adapted for connection to said terminals, traveling switches individual to said circuits and automatic test means for said switches responsive to the normal and abnormal conditions of line terminals successively engaged by said switch.

53. A telephone system including subscribers' lines, means at the substations for changing the electrical conditions of lines, a link-circuit for use in extending connections from calling to called subscribers at the exchange, a traveling switch individual thereto, and test means for said switch whereby it avoids terminals of lines in one electrical condition and rests in engagement with terminals of lines in the other electrical condition.

54. A telephone system including a calling line, a contact pertaining thereto, a selective switch at the exchange, a manually

controlled switch, a link for use in extending connections from calling to called subscribers between said switches, a source of power for effecting a progressive movement of said selective switch and means for automatically rendering said source inoperative when said selective switch engages said contact of said calling line.

55. A telephone system including a calling line, a contact pertaining thereto, a selective switch at the exchange, an operator controlled switch, a link intermediate of said switches, a signal for said link, a source of power for effecting a progressive movement of said selective switch, means for automatically rendering said source inoperative when said selective switch engages said contact of said calling line, and mechanism for simultaneously displaying said signal.

56. In a signaling system, the combination with a plurality of subscribers' stations, of operator controlled circuits provided with manually controlled terminals for use in connecting stations, the number of said circuits being less than the number of said subscribers' stations, and selective means corresponding in number to that of the said circuits for connecting any of said stations with any of said circuits.

57. A telephone system including a calling line, a contact pertaining thereto, a called line, a selective switch at the exchange, an operator controlled switch for use in extending connections to said called line, a link intermediate of said switches, a signal for said link, a source of power for effecting a progressive movement of said selective switch, and means for automatically rendering said source inoperative when said selective switch engages said contact of said calling line.

58. A telephone system including a calling line, a contact pertaining thereto, link-circuit for use in extending connections from calling to called subscribers at the exchange, a manually controlled switch for use with said link circuit, an electrically controlled switch for said link-circuit, means for causing an independent progressive movement thereof to connect with said contact, and an automatic test device for said electrically controlled switch sensitive to the calling condition of said line to continue connection of said link-circuit and line.

59. A telephone system including a calling line, a contact pertaining thereto, link-circuit at the exchange, an operator controlled switch for use with said link circuit, an electrically controlled switch for said link-circuit, means for causing an independent progressive movement thereof to connect with said contact, an automatic test device for said electrically controlled switch sensitive to the calling condition of said line to continue connection of said link-circuit and line, a signal for said circuit, and means for displaying the same when said connection is continued.

60. In a signaling system, the combination with a plurality of subscribers' stations, of operator controlled circuits for use in connecting said stations, the number of said operator controlled circuits being less than the number of said subscribers' stations, selective means corresponding in number to that of the said operator controlled circuits for connecting any of said stations with any of said operator controlled circuits, signaling circuits and means controlled through the signaling circuits for governing the said selective means.

61. In a signaling system, the combination with a plurality of subscribers' stations, of operator controlled circuits to which said stations are adapted to be connected, manually controlled terminals for said operator controlled circuits for use in completing connections, the number of said circuits being less than the number of the said subscribers' stations, selective means corresponding in number to that of the said circuits for connecting any of said stations with any of said circuits, driven means for actuating said selective means and means for automatically arresting each of the said selective means in connecting position.

62. A telephone system including a calling line, a contact pertaining thereto, a link-circuit at the exchange, an operator controlled switch for use with said link circuit, an electrically controlled switch for said link-circuit, means for causing an independent progressive movement thereof to connect with said contact, a signal for said circuit, and means for displaying the same when said connection is established.

63. A telephone exchange system comprising telephone lines, a link circuit normally disconnected from said lines having an operator controlled terminal, a signal individual to said link-circuit, and an electrically controlled switch having an independent progressive movement for interchangeably associating said signal with different lines when calling lines.

64. A telephone exchange system comprising telephone lines, a link-circuit normally disconnected from said lines, a signal individual to said link-circuit, and means including an electrically controlled switch having an independent progressive movement, for interchangeably associating said signal with different lines when calling lines, and an operator controlled switch for said link-circuit for connecting with said lines when called lines.

65. A telephone system comprising telephone lines, a signal at the exchange, an

automatic switch individual to said signal, means whereby said switch consecutively tests said lines to associate said signal with a calling line, test contact for said lines, a link circuit for extending the circuit of a calling toward a called line, and having apparatus controllable over a connected line for controlling said signal.

66. A telephone system comprising telephone lines, test contacts for said lines, a signal at the exchange, an automatic switch individual to said signal, driving means for causing said switch to consecutively engage said contacts, and mechanism for rendering said driving means ineffective when a contact of a calling line is engaged, and a link circuit for extending the circuit of a calling toward a called line and having apparatus controllable over a connected line for controlling said signal.

67. A telephone system comprising telephone lines, test contacts for said lines, a signal at the exchange, an automatic switch individual to said signal, driving means for causing said switch to consecutively engage said contacts, circuit connections and a source of current for operating said driving means, mechanism for interrupting said circuit connections and thereby rendering said driving means ineffective when a contact of a calling line is engaged, and means for thereon displaying said signal.

68. A telephone system including telephone lines, a signal common to said lines, a traveling selector switch individual to said signal and having a contact maker capable of assuming a plurality of selective positions, means responsive to the altered condition of a calling line for causing said switch to seize said line and display said signal while in association with the calling line to indicate a call and a link circuit for extending the circuit of a calling toward a called line and having apparatus controllable over a connected line for controlling said signal.

69. A telephone system including telephone lines, a call signal common thereto, a traveling contact maker capable of assuming a plurality of selective positions individual to said signal and adapted to interchangeably associate said signal with different ones of said lines to indicate calls thereover, and a link circuit for extending the circuit of a calling toward a called line and having apparatus controllable over a connected line for controlling said signal.

70. A telephone system including telephone lines, a call signal common thereto, a traveling contact maker capable of assuming a plurality of selective positions individual to said signal for temporarily rendering said signal individual to a calling line, and a link circuit for extending the circuit of a calling toward a called line, and having apparatus controllable over a connected line for controlling said signal.

71. A telephone system including telephone lines, a calling telephone line, a call signal common to all said lines, a traveling selector switch individual to said signal, mechanism therefor sensitive to the altered condition of said calling line to individualize said signal to said line displaying it to indicate the call, and a link circuit for extending the circuit of a calling toward a called line and having apparatus controllable over a connected line for controlling said signal.

72. In a signaling system, the combination with a plurality of subscribers' stations, of cord circuits, for connecting stations, the number of said cord circuits being less than the number of said subscribers' stations, and selective means corresponding in number to that of the said cord circuits for connecting any of said stations with any of said cord circuits.

73. In a signaling system, the combination with a plurality of subscribers' stations, of signals at the central station, said signals being of a less number than that of the subscribers' stations, and selective means corresponding in number to that of the said signals for connecting any one of said subscribers' stations with any one of said signals.

74. In a signaling system, the combination with a plurality of subscribers' stations, of cord-circuits for connecting said stations, the number of said cord-circuits being less than the number of said subscribers' stations, selective means corresponding in number to that of the said cord-circuits for connecting any of said stations with any of said cord-circuits, signaling circuits and means controlled through the signaling circuits for governing the said selective means.

75. In a signaling system, the combination with a plurality of subscribers' stations, of signals at the central station, said signals being of a less number than that of the subscribers' stations, selective means corresponding in number to that of the said signals for connecting any one of said subscribers' stations with any one of said signals, signaling circuits and means controlled through the signaling circuits for governing the said selective means.

76. In a signaling system, the combination with a subscriber's station, having passive terminals associated therewith, of a link circuit at the central station having a manually controlled connecting terminal and an automatic connecting terminal for connecting subscribers' stations, a source of electricity connected to the said link circuit and adapted to furnish transmitter currents to connected stations, and means adapted to be

energized by said source of electricity for controlling said automatic terminal for connecting to the passive terminals of said substation.

77. In a signaling system, the combination with a subscriber's station, of a link circuit at the central station for use in connecting subscribers' stations, a source of electricity connected to the said link circuit and adapted to furnish transmitter currents to connected stations, means individual to said link circuit for connecting said subscriber's station with said link circuit, means for driving said connecting means and means adapted to be energized by said source of electricity for controlling said connecting means, and a manually controlled terminal for said link circuit for completing a connection.

78. A telephone exchange system whose telephone lines have connecting jacks and have cord-circuits provided with connecting plugs for insertion within said jacks, selective switching mechanism in circuit relation with the lines for uniting calling telephone lines with idle cord-circuits and including traveling answering terminals of the cord-circuits and multipled telephone line terminal contacts engaged by said answering terminals, and calling subscribers' supervisory signaling apparatus connected with the cord-circuits, substantially as described.

79. A telephone exchange system whose telephone lines have connecting jacks and have cord-circuits provided with connecting plugs, selective switching mechanism in circuit relation with the lines for uniting calling telephone lines with idle cord-circuits and including traveling answering terminals of the cord-circuits and multipled telephone line terminal contacts engaged by said answering terminals, and relay mechanism connected with each cord-circuit and governing the selective switching mechanism to release the same, substantially as described.

80. In a signaling system, the combination with a plurality of subscribers' stations, of cord-circuits to which said stations are adapted to be connected, the number of said cord-circuits being less than the number of the said subscribers' stations, selective means corresponding in number to that of the said cord-circuits for connecting any of said stations with any of said cord-circuits and continuously driven means for actuating said selective means.

81. In a signaling system, the combination with a plurality of subscribers' stations, of cord-circuits to which said stations are adapted to be connected, the number of said cord-circuits being less than the number of the said subscribers' stations, selective means corresponding in number to that of the said cord-circuits for connecting any of said stations with any of said cord-circuits, continuously driven means for actuating said selective means and means for automatically arresting each of the said selective means in connecting position.

82. In a signaling system, the combination with a subscriber's station, of a cord-circuit at the central station for connecting subscribers' stations, a source of electricity connected to the said cord-circuit and adapted to furnish transmitter currents to connected stations, means for connecting said subscriber's station with said cord-circuit, continuously driven means for actuating said connecting means and means adapted to be energized by said source of electricity for arresting the movement of said connecting means.

83. In a signaling system, the combination with a subscriber's station, of a link circuit at the central station provided with a manually controlled terminal for use in connecting subscribers' stations, a source of electricity connected to the said link circuit and adapted to furnish transmitter currents to connected stations, means including a rotary switch individual to said link circuit for connecting said subscriber's station with said link circuit, driven means for actuating said connecting means and means adapted to be energized by said source of electricity for arresting the movement of said connecting means.

84. In a signaling system, the combination with a plurality of subscribers' stations, of cord-circuits to which said stations are adapted to be connected, the number of said cord-circuits being less than the number of the said subscribers' stations, selective means less in number than that of the said cord-circuits for connecting any of said stations with any of said cord circuits, driven means for actuating said selective means and means for automatically arresting each of the said selective means in connecting position.

85. In a signaling system, the combination with a subscriber's station, of a link circuit at the central station provided with a manually controlled terminal for use in connecting subscribers' stations, a source of electricity connected to the said link circuit and adapted to furnish transmitter currents to connected stations, means individual to said link circuit for connecting said subscriber's station with said link circuit, driven means for actuating said connecting means and means adapted to be energized by said source of electricity for arresting the movement of said connecting means.

86. A telephone system including a line, a link-circuit, an operator controlled terminal therefor, a signal, means whereby said link-circuit tests said line and automatically connects thereto, and means for controlling said signal over said line.

87. A telephone system comprising telephone lines, a signal at the exchange, a link circuit for use in extending connection from calling to called lines, an automatic switch associated with said signal, means whereby said switch consecutively tests said lines to associate said signal and said link circuit with a calling one of said lines, and test contacts for said lines.

88. A telephone system including telephone lines, a signal common to said lines, a link circuit for use in extending connection from calling to called lines, an automatic traveling switch associated with said signal and said link circuit, means responsive to the condition of encountered ones of said lines for determining the association of said signal and a link circuit therewith.

89. A telephone system including telephone lines, a signal common thereto, and a rotatably advancing switch associated with said signal and adapted to interchangeably associate said signal with different ones of said lines, said signal being thereafter under the control of an associated line.

90. A telephone system including telephone lines, a plurality of signals common thereto, and means including a rotatably advancing switch individual to certain of said signals for temporarily rendering any one of said signals individual to one of said lines.

91. A telephone system including telephone lines, manually operated link-circuits and automatic, rotatably advancing switches individual to certain of said link-circuits for connecting with and extending said lines.

92. A telephone system including telephone lines, link circuits, an operator's telephone set, and automatic switches provided with contact makers capable of assuming a plurality of selective positions individual to certain of said link circuits for associating an idle link circuit and said operator's telephone set with a calling line.

93. A telephone system including telephone lines, link circuits having operator controlled connecting terminals and automatic advancing switches for use with said link circuits for connecting with said lines, an operator's telephone set, means controlled by said operator controlled terminals for connecting said telephone set with any one of said link circuits and relay controlled means for disconnecting said set.

94. A telephone system including a calling line, a plurality of operator controlled link circuits, automatic switches provided with contact makers capable of assuming a plurality of selective positions individual to said link circuits, an operator's telephone set, circuit connections extending from said link circuits to said set, and means actuated responsive to a call over said line whereby one of said automatic switches connects its associated link circuit and extending circuit connections with said calling line.

95. A telephone system including telephone lines, link circuits having plug terminals and automatic advancing switches connected with said link circuits for connecting with and extending said lines, an operator's telephone set, plug seat switches associated with plug terminals of said link circuits for connecting said operator's telephone set with any one of said link circuits and relay controlled means for disconnecting said set.

96. In a telephone system, the combination with a plurality of telephone lines and a calling line, of link circuits and automatic advancing switches connected with said link circuits, an operator's telephone set, means actuated responsive to a call over said calling line whereby one of said automatic switches connects its link circuit with said calling line, means for connecting said operator's telephone with said connected link circuit, line terminals adapted to be connected with said link circuit for extending the circuit thereof, and means actuated responsive to the connecting of said link circuit with said terminals to disconnect said operator's telephone from said link circuit.

97. A telephone system comprising telephone lines, an operator's telephone common thereto, means including a traveling contact maker capable of assuming a plurality of selective positions for temporarily rendering said telephone individual to one of said lines, and a link circuit individual to said contact maker having talking strands connected with said operator's telephone, for extending the circuits of said lines.

98. In a telephone system, the combination with a calling and called telephone line, of manual terminals and automatic terminals for each of said lines, a link circuit having automatic advancing terminals and an operator controlled terminal, means actuated responsive to a call from said calling line to cause said advancing terminals to connect said link circuit with said calling line, whereby the circuit of the calling line may be extended by connecting the operator controlled terminal of said link circuit to the manual terminal of said called line.

99. A telephone call distributing system having a plurality of connecting circuits at different operators' positions, automatic finder switches having traveling connecting members individual to each connecting circuit, and subscribers' lines multipled to the said switches.

100. In a telephone call distributing system, the combination with a plurality of telephone lines each extending to a connection terminal on a switchboard, of an automatic finder switch having stationary contacts to which said lines are respectively

connected, a connecting cord circuit connected with movable terminals of said switch, and a terminal for said connecting cord circuit adapted to be moved manually to complete connection with the connection terminal of any of said lines.

101. In a telephone call distributing system, the combination with a plurality of telephone lines each extending to an appropriate terminal on a switchboard, of a cord circuit provided with a terminal adapted to be moved manually to complete connection with one of said lines, a finder switch having stationary and movable contact terminals, said connecting cord circuit being connected with said movable terminals, and said telephone lines being connected with different ones of said stationary terminals, and means for moving said switch to extend the circuit of any predetermined telephone line to said connecting cord circuit.

102. In a telephone call distributing system, the combination with a plurality of telephone lines each extending to a connection terminal on a central office switchboard, of a finder switch having stationary and movable contacts, each of said telephone lines having an extension to certain of said stationary contacts, a connecting circuit terminating at one end on the movable contacts of said finder switch, and at the other end on a plug adapted to be moved manually to make connection with the connection terminal of any of said lines, and means for moving the movable contact terminals of the finder switch to bring them into contact with the stationary terminals of a particular line, and thus extend said line to said connecting circuit.

103. In a telephone call distributing system, the combination with a plurality of lines provided with appropriate terminals at which connection may be made therewith, of a connecting cord circuit for interconnecting said lines, said cord circuit being provided at one end with a manually operated device for making connection with certain of the terminals of said lines, and an automatic switch having traveling members upon which the other end of said cord circuit terminates, said switch members being adapted to complete connection with another of said lines at an appropriate terminal thereof.

104. In a telephone call distributing system, the combination with a plurality of telephone lines each extending from a substation to connection terminals at a central office, of a connecting circuit, a device connected with one end of said circuit adapted to be moved manually to complete connection with the connection terminals of said lines, and a finder switch having a traveling member capable of assuming a plurality of selective positions associated with the other end of the circuit and having connection with the aforesaid telephone lines, said finder switch member being adapted to be actuated automatically to extend to said connecting circuit any one of said telephone lines which may be calling.

105. In a telephone call distributing system, the combination with a plurality of telephone lines, each being provided with means for calling and extending from a substation to a connection terminal on a central office switchboard, of a plug terminated connecting cord circuit adapted to complete connection with any of said lines at the switchboard connection terminal thereof, and an electrically controlled finder switch having movable contact terminals associated with said connecting circuit and stationary contact terminals connected with the aforesaid telephone lines, said switch being responsive to said calling means and being adapted to be actuated automatically to extend the connection of a calling line to said connecting circuit.

106. In a telephone call distributing system, the combination with a plurality of telephone lines, each extending from a substation to a connection terminal on a central office switchboard, of a connecting cord circuit at the central office provided with means adapted to be moved manually to complete connection between said circuit and any of said lines at the connection terminal thereof, a finder switch having movable terminals connected with said connecting circuit, and stationary terminals connected with said telephone lines, means associated with each telephone line adapted to change the electrical condition of the associated stationary switch terminal in the use of the line, mechanism for causing said movable switch terminals to traverse the stationary terminals, and means responsive to the changed electrical condition of the calling line adapted to arrest the movement of said movable terminals and cause them to complete connection with the stationary terminals of said calling line.

107. In a telephone call distributing system, the combination with a plurality of telephone lines each extending from a substation to a connection terminal on a central office switchboard, of a connecting circuit provided with means adapted to be moved manually to complete connection between said connecting circuit and any of said telephone lines at the connection terminal thereof, a finder switch having movable terminals connected with said connecting circuit and stationary contact terminals connected with the aforesaid telephone lines, mechanism for causing said movable terminals to traverse said stationary terminals,

means made operative in initiating a call over any of said lines adapted to alter the condition of one of said stationary switch terminals associated with said line, and mechanism for arresting the movement of said movable terminals responsive to the altered condition of the stationary terminal of the calling line.

108. In a telephone call distributing system, the combination with a plurality of telephone lines each extending to a connection terminal at a central office, of a plurality of finder switches to which said lines are multipled, a plurality of connecting circuits each provided with means adapted to be moved manually to complete connection with any of said lines at the connection terminal thereof, one of said connecting circuits being associated with each of said finder switches and means for simultaneously moving said finder switches to cause one of them to complete connection between its associated connecting circuit and any of said lines.

109. In a telephone call distributing system, the combination with a telephone line extending from a substation to a central office, of a plurality of traveling automatic distributing switches to which said line is multipled, a connecting cord circuit for each of said switches connected with the traveling members thereof, to which said line is adapted to be extended, and a terminal for each of said cord circuits adapted to be moved manually to complete connection between the aforesaid line and other lines.

110. The combination with a telephone line extending from a substation to a connection terminal at a central office, of a distributing switch having stationary and movable contact terminals, said line terminating upon certain of said stationary terminals, means for causing the movable contact terminals to make contact with the stationary terminals upon which said line terminates, and a connecting cord circuit associated with said movable contact terminal and adapted to coöperate with the connection terminals of other lines.

111. The combination with a plurality of telephone lines each extending to a connection terminal at a central office, of a plurality of connecting cord circuits adapted to complete connection with any of said lines of the connection terminal thereof, distributing switches each provided with stationary and movable contacts, the movable contacts of each switch being connected with one of said cord circuits, and the stationary contacts being connected with said lines, and means adapted to actuate one or the other of said switches to establish connection between any of said lines and one of said connecting cords.

112. In a semi-automatic telephone exchange system, the combination with a group of lines, a group of finder switches to which said lines are multipled, each of said finder switches being provided with a rotary contact maker for testing the different multiple stationary terminals of said line, banks of multiple called terminals of said lines, a group of connecting circuits each terminating at one end in an individual one of said finders and at the other end in a manual connection switch, each of said switches being located before a different operator's position, and means actuated upon the connection of one of said finders with a calling line for establishing an abnormal condition of said line at the multiple called terminals thereof.

113. In a telephone exchange system, the combination with telephone lines terminating in a central station, of a group of connecting circuits at said central station less in number than the number of said lines, switching apparatus intermediate of said lines and connecting circuits controlled by any one of said lines when taken for use, for connecting such line to an idle one of said connecting circuits, means for uniting a connecting circuit taken for use with the terminals of a called line, and means operated upon the completion of such connection for temporarily rendering inoperative the control of said switching apparatus by the called line.

114. In an electric system, the combination of a plurality of lines, operator controlled link circuits provided with manually controlled terminals for direct connection with said lines, the number of said link circuits being less than the number of said lines, and selecting means corresponding in number to that of said link circuits for connecting any of said lines with any of said link circuits.

115. In a telephone system, the combination with telephone lines, link circuits for use in interconnecting said lines, an operator's telephone set, means actuated in response to a call over a calling one of said lines to connect said line and one of said link circuits, means for connecting said operator's telephone set with said connected link circuit, line terminals adapted to be connected with said link circuit for extending the circuit thereof, and means actuated in response to the connection of said link circuit with said terminals to disconnect said operator's telephone from said link circuit with said terminals to disconnect said operoperator's telephone from said link circuit.

116. A telephone system comprising telephone lines, test contacts for said lines, an operator controlled link circuit, an automatic switch individual to said link circuit,

driving means for causing said switch to consecutively engage said contacts, circuit connections and a source of current for operating said driving means, mechanism for interrupting said circuit connections and thereby rendering said driving means ineffective when a contact of a calling line is engaged, and a manually controlled terminal for said link circuit for connecting to a called one of said lines.

117. In a telephone system, the combination with telephone lines terminating in passive contacts at a central station, of a group of connecting circuits at said central station less in number than the number of said lines, switching apparatus including rotary selectors equal in number to the number of connecting circuits controlled by any one of said lines when taken for use for connecting such line to an idle one of said connecting circuits, means for uniting the connecting circuit taken for use with the terminals of a called line, and means operative upon the completion of such a connection for temporarily rendering inoperative the control of said switching apparatus by the called line.

118. In a telephone system, the combination with calling and called telephone lines terminating in passive contacts at a central station, of a group of connecting circuits at said central station less in number than the number of said lines for extending calls from said lines, switching apparatus including automatic selectors provided with active contacts and equal in number to the number of connecting circuits, said selectors being controlled over calling ones of said lines when taken for use in calling for connecting idle ones of said connecting circuits to such calling lines, means for uniting a connecting circuit taken for use with the terminals of the called line, and means operative upon the completion of such a connection for temporarily rendering inoperative the control of said switching apparatus by the called line.

119. A telephone system including subscribers' telephone lines terminating in passive contacts at a central office, subscriber controlled means for changing the electrical condition of said passive contacts, a group of link circuits at the central office less in number than the number of said lines, switching apparatus including line finding switches equal in number to the number of said link circuits, active contacts for said line finding switches adapted to wipe over said passive contacts, means for moving the contacts of a line finding switch into engagement with the passive contacts of a calling line that has had the electrical condition of its passive contacts changed, and means individual to the line finding switch operative responsive to the engagement of its said active contacts with the passive contacts of the calling line to prevent further movement of said line finding switch thereby connecting the link circuit associated with the line finding switch with the calling subscriber's line, means for uniting the link circuit taken for use with a called one of said lines, and means operative upon the completion of such connection for temporarily rendering inoperative the control of said switching apparatus by the calling line.

120. A telephone system including a calling subscriber's line and a called subscriber's line provided with passive contacts at a central station, means responsive to the removal of the subscriber's receiver at the calling substation for changing the electrical condition of the passive contacts associated with said calling subscriber's line, a group of link circuits at the central station, switching apparatus including line finders equal in number to the number of said link circuits, active contacts for said line finders for cooperation with the passive contacts of said subscribers' lines, means for moving an active contact of an idle one of said finder switches over the passive contacts of said subscribers' lines whereby when said active contact engages the passive contact of said calling subscriber's line which has had its electrical condition changed means is operated to prevent further movement of the active contacts of said finder switch thereby maintaining the link circuit associated with said line finder in connection with said calling subscriber's line, means for then extending the connection from said link circuit to said called subscriber's line, and means operative upon the completion of said connection to temporarily render inoperative the control of said switching apparatus by the called subscriber.

121. A telephone system including subscribers' telephone lines terminating in passive contacts at a central office, subscriber controlled means for changing the electrical condition of said passive contacts, a group of link circuits at the central office less in number than the number of said lines, switching apparatus including line finding switches equal in number to the number of link circuits, active contacts for said line finding switches, means for moving the active contacts of an idle one of said line finding switches into engagement with the passive contacts of a calling line, electromagnetic means responsive to the engagement of the active contacts of said line finding switch with the passive contacts of the calling subscriber's line for preventing further movement of the line finding switch, whereby said calling line remains temporarily in connection with the link circuit associated

with said line finding switch, means for uniting the link circuit taken for use with a called one of said lines, and means operative upon the completion of such a connection for temporarily rendering inoperative the control of said switching apparatus by the called line.

In witness whereof, I hereunto subscribe my name this twenty-second day of August, A. D. 1902.

HAROLD D. STROUD.

Witnesses:
GEORGE L. CRAGG,
HARVEY L. HANSON.

Corrections in Letters Patent No. 1,229,165.

It is hereby certified that in Letters Patent No. 1,229,165, granted June 5, 1917, upon the application of Harold D. Stroud, of Chicago, Illinois, for an improvement in "Telephone-Exchange Systems," errors appear in the printed specification requiring correction as follows: Page 15, line 55, claim 111, for the word "of" read *at;* same page, claim 115, strike out lines 123–124; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 16th day of April, A. D., 1918.

[SEAL.]

F. W. H. CLAY,

Acting Commissioner of Patents.

Cl. 179—27.