

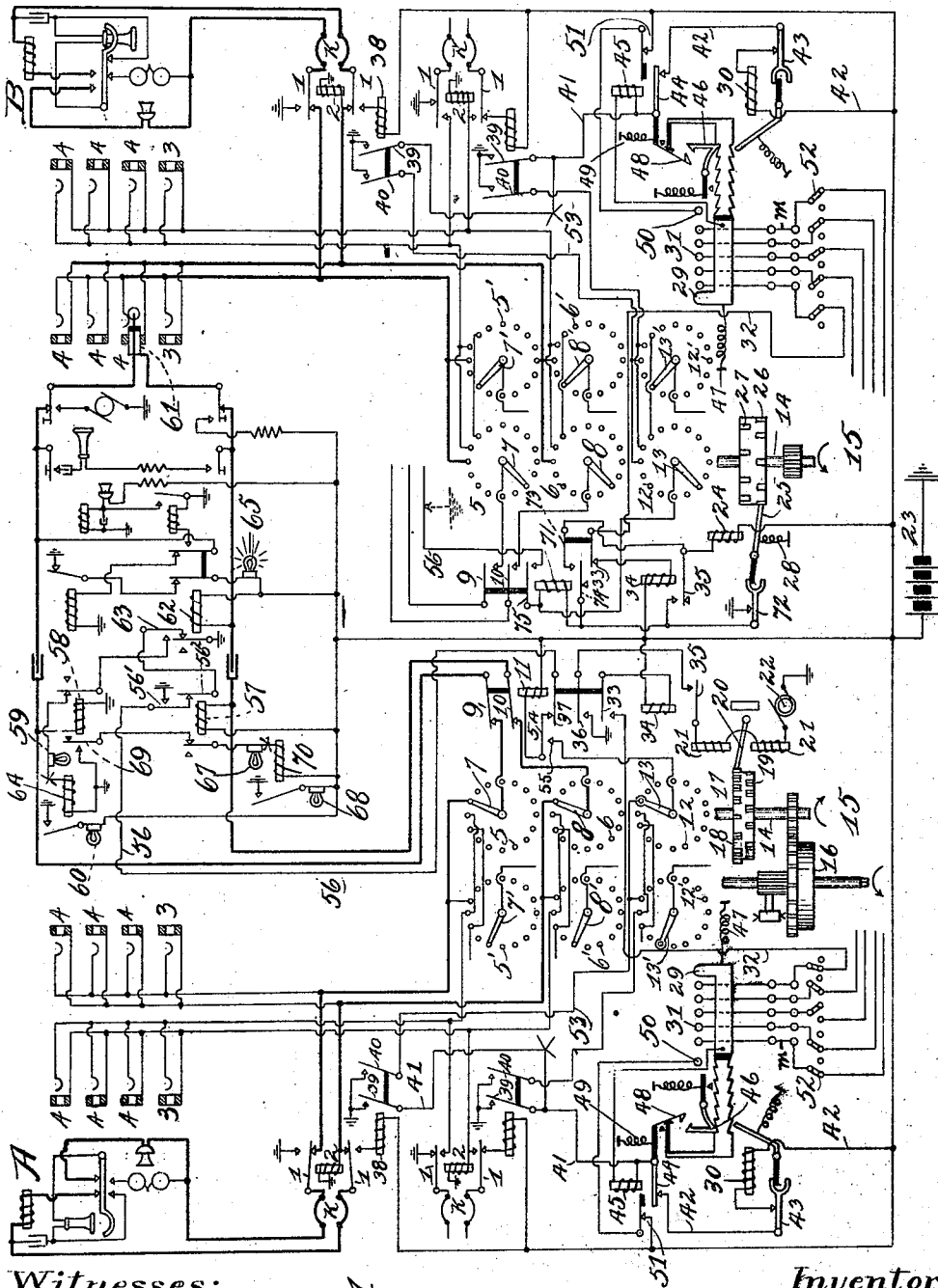
April 5, 1927.

F. W. DUNBAR
TELEPHONE SYSTEM

1,623,336

Filed Dec. 19, 1904

5 Sheets-Sheet 1



Witnesses:

Geo. W. Thomas
W. S. Cragg

Fig. 1

Inventor:

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Att'y.

April 5, 1927.

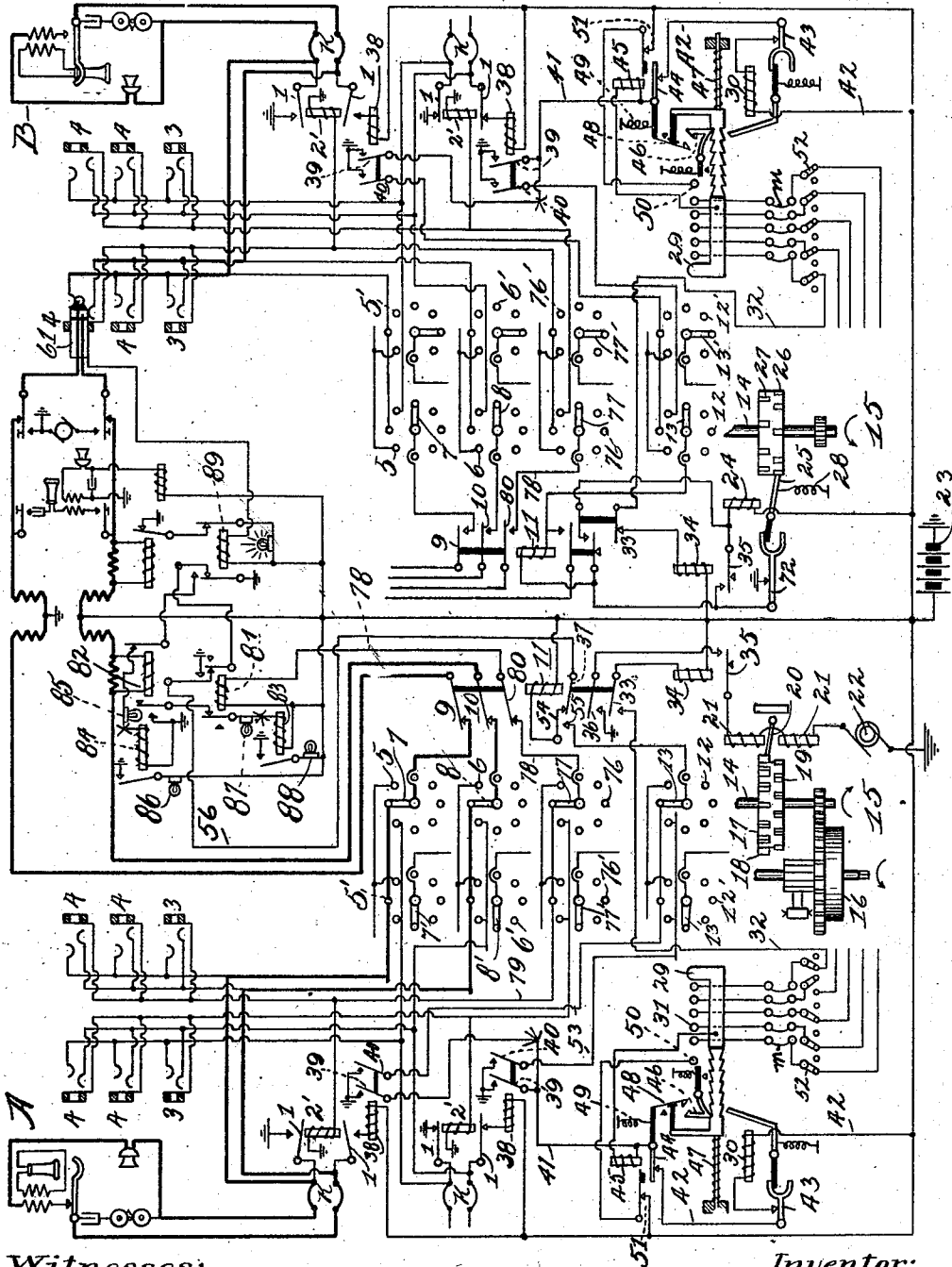
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1,623,336

TELEPHONE SYSTEM

Filed Dec. 19, 1904

5 Sheets-Sheet 2



Witnesses:

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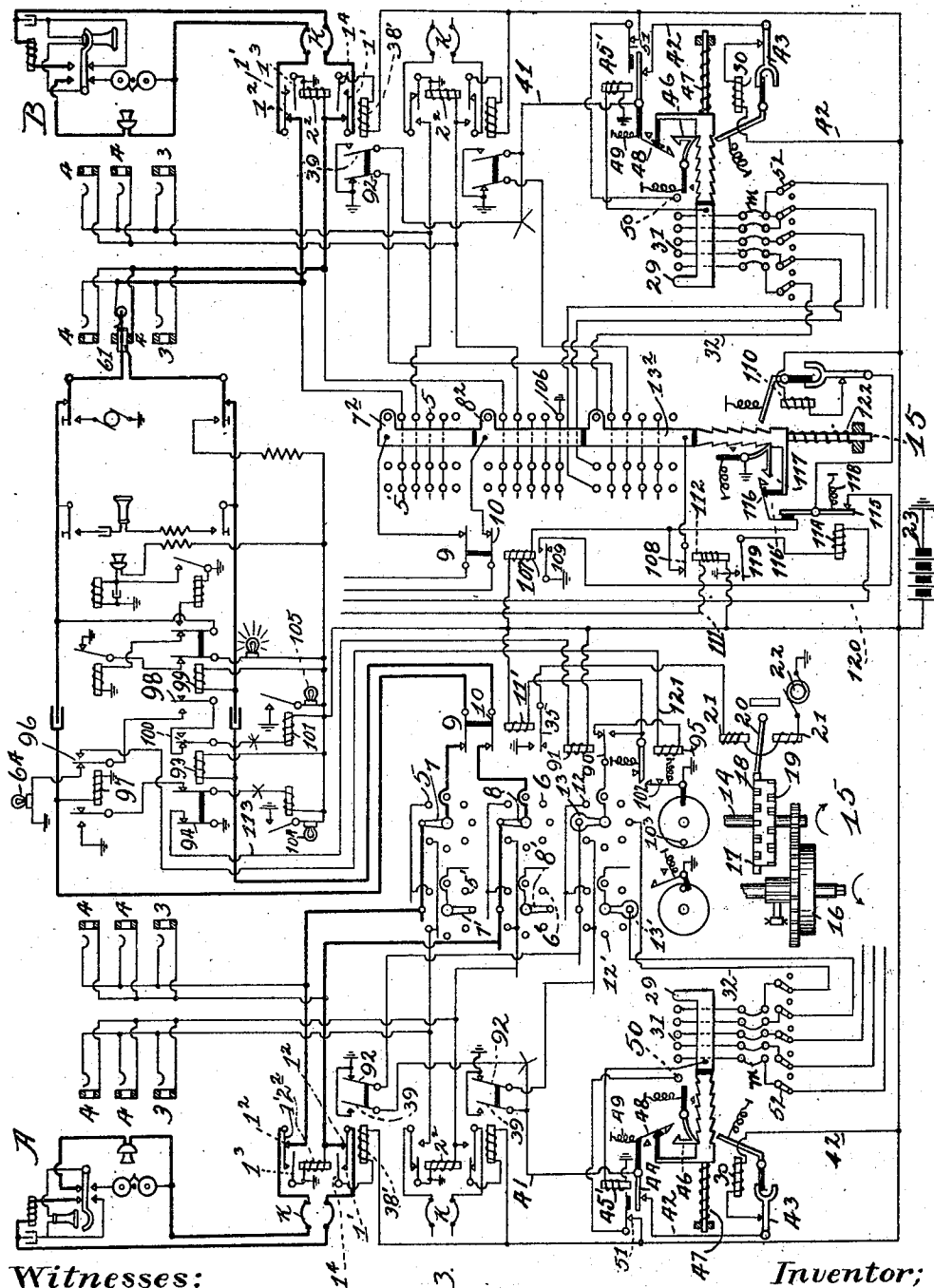
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TELEPHONE SYSTEM

Filed Dec. 19, 1904

5 Sheets-Sheet 3



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Fig. 3

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April 5, 1927.

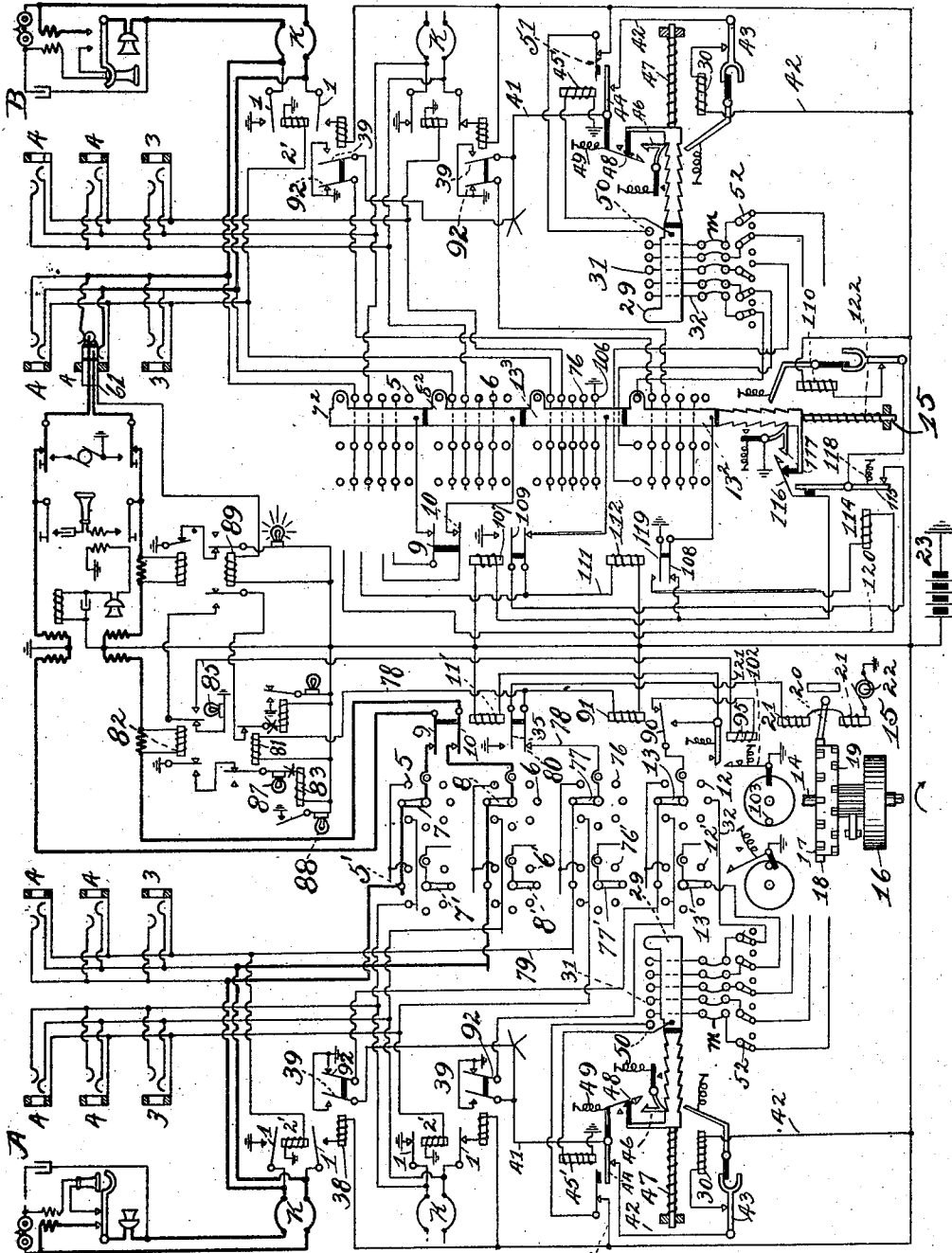
1,623,336

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TELEPHONE SYSTEM

Filed Dec. 19, 1904

5 Sheets-Sheet 4



Witnesses:

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M. I. Cragg

Fig. A

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April 5, 1927.

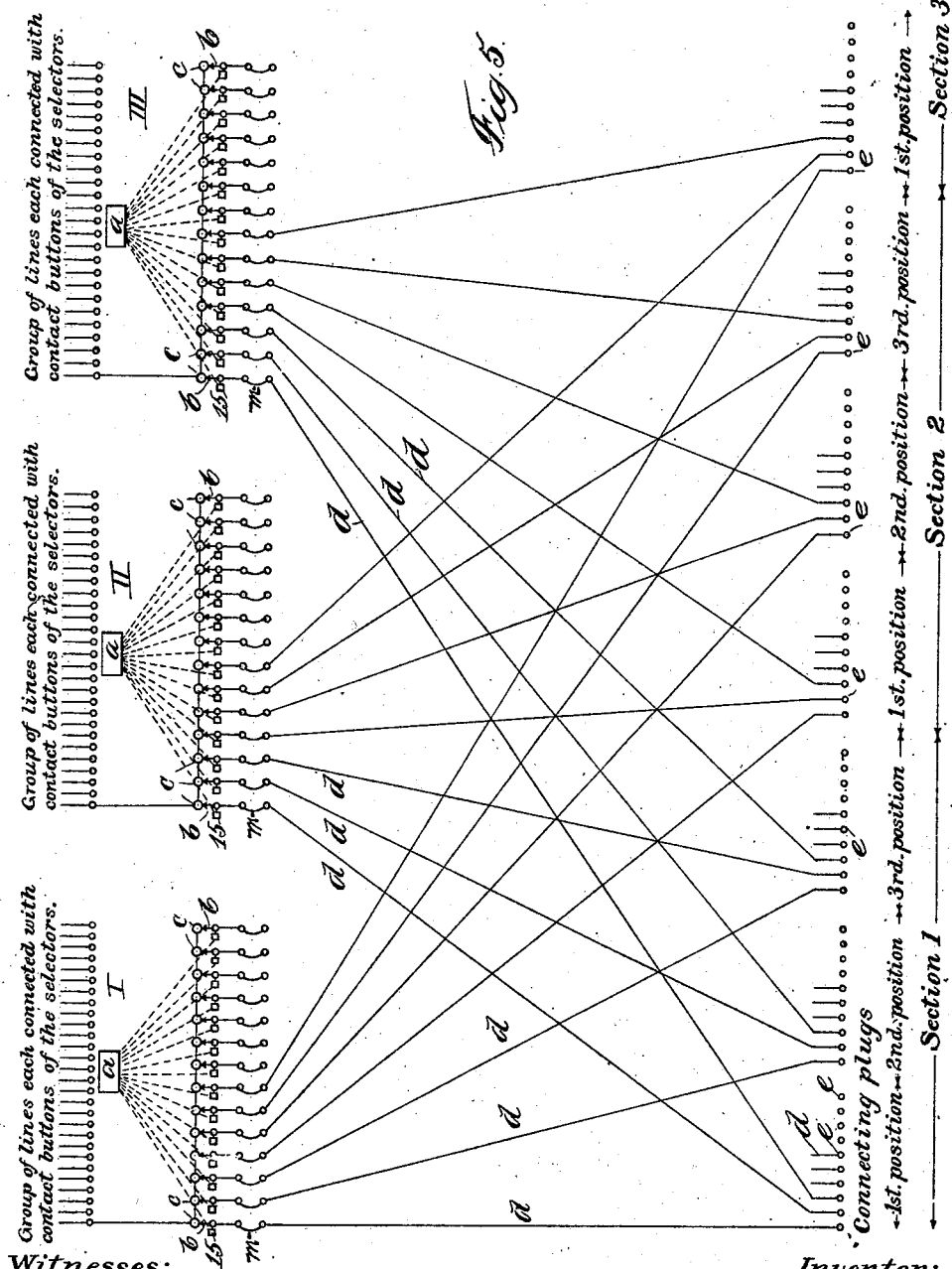
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1,623,336

TELEPHONE SYSTEM

Filed Dec. 19, 1904

5 Sheets-Sheet 5



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Patented Apr. 5, 1927.

1,623,336

UNITED STATES PATENT OFFICE.

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TO KELLOGG SWITCHBOARD & SUPPLY CO., A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed December 19, 1904. Serial No. 237,445.

My invention relates to telephony, and has for its object the provision of an improved telephone exchange system wherein advantages of automatically and manually controlled line connectors are present and disadvantages in these classes of apparatus are eliminated. Broadly speaking, I obtain these results by making these line connectors partially under automatic control and partially under manual control. The end of each cord circuit that is placed under automatic control is the answering end. Traveling switching mechanism is employed for selectively effecting connection between the answering ends of idle cord circuits and calling telephone lines. The present invention (which I shall describe in connection with metallic telephone lines, the application of the invention to grounded lines being well understood by those skilled in the art) finds an embodiment in a pair of moving terminals for the answering end of each cord circuit and motor mechanism jointly controlled by the cord connecting apparatus and a calling subscriber's apparatus for effecting engagement between these terminals, which I shall call "answering terminals", and the terminals of a calling line. This motor mechanism has such an association with the cord circuits that only the idle cord circuits are automatically connected with calling lines. This motor mechanism is desirably not constantly operated, but is preferably only operated on the initiation of a call. I preferably employ motor controlled switching apparatus governed by a calling subscriber and governing the motor mechanism that operates or causes to travel the answering contacts or end of an idle, preferably the first idle, cord circuit. These answering ends of cord circuits may comprise traveling switch arms adapted to pass over terminals of the telephone lines and may, in one embodiment of the invention, be mounted on a rotating shaft operated by a motor mechanism, when set in operation by the motor controlled switching mechanism set into actuation by a calling subscriber. The traveling switch arms constituting the answering ends of cord circuits, have associated with them as many sets of line terminals as there are telephone lines assigned to a particular group of cord circuits. The motor controlled switching mechanism, which may easily be set into operation by a calling subscriber, is so inter-related with the cord circuits and electro-magnetic mechanism governing the operation of the motor mechanism actuating the answering terminals of the cord circuits, that only such cord answering terminals that are associated with idle cord circuits are operated by the motor mechanism in mechanical relation therewith. In other words, in the embodiment of the invention herein specifically set forth, the calling subscriber causes the motor in mechanical association with the answering end of an idle cord circuit to bring said terminals into connection with the terminals of a calling line. Upon such connection of the answering ends of an idle cord circuit with a calling line, the motor belonging to the cord circuit is caused to stop, preferably by means of electro-magnetic mechanism whose circuit conditions are changed upon this establishment of connection between an idle cord circuit and a calling line, such electro-magnetic mechanism thereupon effecting the stoppage of the motor, which result is accomplished where the motor is an electric motor, preferably by altering the circuit of said motor. Where an exchange has a large number of lines, the lines are preferably divided into groups, a particular number of cord circuits being assigned to each group. In order to prevent undue cost of the exchange equipments, the motor controlled switching mechanism governed by a calling subscriber is preferably common to all lines of the group, there being as many such switching mechanisms as there are groups. I do not wish, however, to be limited to such an arrangement. Where such motor controlled switching mechanism is made common to a group of lines, conductors from all the cord circuits belonging to a particular group are placed in electrical association therewith and said switching mechanism is caused to travel over terminals of these conductors. The electrical condition of these terminals depends upon the condition of use of the cord circuits. If the cord circuits are idle, the electrical character of the terminals is such that when the motor controlled switching device comes into contact with the first of such terminals associated with an idle cord circuit, the electro-magnetic mechanism is operated to permit the actuation of the cord circuit motor corre-

sponding to the said terminals whereby the answering terminals of the cord circuit corresponding to the cord circuit motor are caused to engage the terminals of a calling line, whereupon said cord circuit motor is thrown out of action. When the terminals engaged by the motor controlled switching device have their associated cord circuits busy, the electro-magnetic mechanism immediately governing the operation of the cord circuit motor has no operative effect upon said cord circuit motor, which thereby remains quiescent. I shall term the motor controlled switching device governed by calling subscribers, the subscriber's governor motor, and the motor which directly operates the answering terminals of a cord circuit, the cord circuit motor, as such terms have been previously used.

A very important advantage gained by means of my invention resides in the adaptability of my novel apparatus to telephone lines already equipped in which relays were originally installed for the purpose of operating line signals. In order that special line signals may be dispensed with, a signaling device, preferably a signaling lamp, is associated with each cord circuit and suitable governing apparatus whereby it may manifest a signal to the operator when a calling subscriber initiates a call. I have, thus, generally described the mechanism by which the answering ends of idle cord circuits are automatically connected with calling telephone lines. In order that a connection between a calling and a called subscriber thus initiated may be completed, the connecting ends of the cord circuits are provided with connecting plugs and the telephone lines are provided with line jacks adapted to receive connecting plugs. This provision of a line jack to each line, in addition to the multiplied terminals of each line that are associated with the traveling answering terminals of the cord circuits, is an important feature of my invention, inasmuch as by its provision the connecting end of each cord circuit may, in conjunction with its connecting plug, be under the manual control of the operator.

While my invention has found particular utility in connection with and is well adapted for application to multiple switch-board systems, it has other applications, which will be readily understood by those skilled in the art. Where the invention is employed in connection with multiple switch-board systems, the telephone lines may be connected with the different sections of the switch-board in accordance with any suitable practice, as the apparatus of my invention does not interfere in any way with the usual operation and arrangement of the operator's listening keys, ringing keys, testing facilities, and the supervision of the called subscriber's line. Inasmuch as the answering end of

each cord circuit is changed in the manner specified, I have provided supervisory signals for the calling line which are brought into operation by means of another feature of my invention. I do not wish to be limited, however, to the provision of any supervising means, but have employed the same as they have been found very desirable in modern practice of telephony.

When two connected subscribers are through with their conversation and have replaced their telephones, the supervisory signal will indicate to the operator that the manually operated connecting plug should be withdrawn, upon which withdrawal the cord connecting apparatus is made idle and is adapted for new connection.

In the preferred embodiment of my invention, the answering terminals of cord circuits are always restored to an initial position, which result is desirably accomplished through the agency of electro-magnetic apparatus governed by the cord circuit and having its operation dependent upon the withdrawal of the connecting plug.

Another feature of my invention relates to the distribution of work among the operators, and by this feature of my invention a wide range of flexibility in such distribution is effected, particularly in the case of multiple switch-boards. In multiple switch-board practice it is well understood by those skilled in the art that each line has, in addition to the multiple jacks distributed throughout the boards of the system, an answering jack and a line indicator, the answering jack and indicator of each line being collocated. These indicators and jacks are distributed in groups of uniform quantity among the different sections of the switch-board, so that there is disposed at all operators' positions the same number of answering jacks and the same number of line signals. It is, of course, apparent that telephone operators possess varying degrees of skill and speed in handling calls. The uniform distribution of answering jacks and line indicators renders it difficult and impracticable in accordance with present practice to apportion work to suit the capacity of the different operators. The ordinary skilled operator can properly attend to 270 calls in an hour if the calls be uniformly distributed throughout the sixty minutes. The average time or length of each call is, approximately, one minute and twenty seconds, thus, allowing each cord circuit to complete 45 calls per hour if kept busy throughout the sixty minutes. Six cord circuits kept uniformly busy throughout the hour can, therefore, handle 270 calls during the hour—the work of the ordinary operator. Certain operators can, however, handle in a proper manner more than 270 calls per hour, while others, less skilled, are unable to handle

properly as many as 270. I preferably provide means whereby one or more cord circuits at each operator's position may be thrown out of operation or out of operative
 5 relation with respect to the line circuits, whereby each operator may be given as many cord circuits in operative relation to the line circuits as can be properly handled by her. Thus, certain operators may have but
 10 three or four cord circuits in operative condition, while others, highly skilled, may have eight, nine, or even ten cord circuits placed in operative relation to the calling lines. By this means each operator may be
 15 kept as busy as her degree of skill will permit—and paid according to her ability or skill, the number of cord circuits which she can efficiently handle being a correct gauge or measure of the number of calls which she
 20 can efficiently handle per hour.

It may be properly assumed that one-eighth of the total number of calls made during the entire twenty-four hours of the day will occur during the busiest hour. The
 25 switch-board must be designed to handle the business at all hours of the day. Consequently the number of sections of switch-board is determined by the number of operators required to handle the business during
 30 this busiest hour. If, during this busiest hour—or moment,—each operator be employed at her maximum efficiency, the necessary switch-board equipment will be minimum. In the present systems of manual
 35 telephony it is customary to provide an "intermediate distributing board" whose function is to present facilities for distributing the answering spring-jacks and calling signals throughout the various sections of
 40 switch-board, so as to cause as uniform a distribution as possible of the calls during this busiest hour—or moment. At best, however, owing to the daily fluctuations in the amount of business from certain groups and
 45 from all classes of lines, it is impossible to distribute the said jacks and calling signals so as to secure more than a rough approximation to a uniform distribution of calls. By means of my invention, however, a distribution
 50 of calls may be automatically secured, such that when the number of cord circuits in operative relation with the calling lines is properly proportioned according to the skill of the individual operators, each operator
 55 will be working at her maximum efficiency not only during the busy hour, but at all hours. Consequently the necessary number of sections of switch-board will be decreased and fewer operators at all hours
 60 of the day will be required.

In all present manual systems of telephony the calls at all hours of the day are distributed throughout the entire switch-board, this requiring the presence of one or
 65 more operators at each section of the board

at all times save certain of the night hours when the business is so slack that from one to ten operators—depending upon the size of the exchange—can handle the entire
 70 number of calls by walking from section to section and picking up the various calls as they may come in. At all such times the efficiency of the operators—reckoned on a basis of number of calls answered per hour—is very low, the result being that the average
 75 number of calls handled per operator per hour throughout the twenty-four is less than half the number which the average operator is capable of handling efficiently were she kept uniformly busy. By means of my in-
 80 vention I am enabled to distribute the calls so that during the night hours all calls will appear at the first section of the switch-board—or at the first two or three—depending upon the size of the exchange and the
 85 volume of night business, so that as the business increases operator after operator may be added as required—the first or lower numbered sections being always busy and the higher numbered sections coming gradually
 90 into operation as the busier hours approach. I am, thus, enabled to secure the same average number of calls answered per operator per hour throughout the twenty-four as is secured during the busiest hour of the day—
 95 resulting in a decrease in operating expenses of 50% or more. I do not contemplate, however, in large exchanges providing the necessary switching facilities, so that each line may be connected with any one of all the
 100 cord circuits, although in smaller switch-boards it would be preferable to do so. In large exchanges I prefer to divide the lines into groups of several hundred each and divide the cord circuits into a corresponding
 105 number of groups, so that any line in a certain group may be connected with any cord circuit assigned to that group if the lower numbered cord circuits of that group already
 110 be busy, and if that particular one be not busy. The first idle cord circuit of that group being thus selected will automatically make connection with a calling subscriber. For example, I will assume an exchange of
 115 4,500 lines and provide a group of thirty cord circuits for each 500 lines, thus, making two hundred seventy cord circuits in all, divided equally between nine sections of
 120 switch-board, or thirty to the section and ten to the operator. During the night hours, therefore, all calls would appear at the first section of switch-board, unless in some particular group of 500 lines there were more
 125 than three calling lines simultaneously connected for conversation—in which case the fourth line of that group making a call, while the three other calling parties of the same group were still connected, would indicate at the first position of the second section. A fifth call from the same group oc-
 130

curing while the other four were still conversing, would appear at the second position of the second section and would necessitate the operator leaving her position at the first section to attend to it. Such a condition would not be apt, however, to arise as it would require, assuming one operator only was required for the business at this time, that five-sixths of the total business which this single operator could efficiently handle was originating in a group containing only one-ninth of the total number of lines.

In the example chosen as an illustration, I would employ thirty selector switches for each group of 500 lines, each selector switch including 500 sets of telephone line terminal contacts. The traveling answering terminals of the cord circuits move over their companion sets of line terminal contacts when their corresponding motors are set into operation. Thus, each line has thirty sets of line terminal contacts in cooperative relation with the traveling ends or terminals of thirty cord circuits and each cord circuit has its traveling answering terminals in cooperative relation with 500 sets of telephone line terminal contacts.

In the preferred embodiment of my invention, the first cord circuit has its answering end connected with the connecting plug appearing at the first operator's position of the first board, the second cord circuit having its answering end connected with the connecting plug at the second operator's position, the third cord circuit having its answering end connected with the connecting plug at the third operator's position, the fourth cord circuit having its answering end connected with the connecting plug at the first operator's position at the second section of the switch-board, the fifth cord circuit having its answering end connected with the connecting plug at the second operator's position of the second section, the sixth cord circuit having its answering end connected with the connecting plug at the third operator's position of the second section, and so on. I have indicated ten plugs at each operator's position, and, in order that no operator may receive calls to such an extent that she cannot attend to them, provision is made whereby cord circuits may be made to correspond with busy cord circuits, in order that when a less efficient operator has reached her capacity, the cord circuits which have been incapacitated, will not be connected with a calling line, but, on the other hand, such calling line will be connected with the cord circuit at another operator's position. It will be seen that if each of the thirty cord circuits is worked to its maximum efficiency, the cord circuits will be capable of handling forty-five calls per hour, or a total of one thousand three hundred fifty calls during the busy hour, represent-

ing an average of 2.7 calls per subscriber during the busy hour, or 21.6 per subscriber per day. Ample margin is, thus, present for a reduction in the total number of cord circuits in service to an average of seven or eight per operator, whereby facilities are furnished for handling a greater number of calls per day than will originate in an average exchange of the size chosen as an example.

As stated, my invention contemplates means associated with selected switches for rendering impotent those cord circuits at each or any operator's position which it may be desired to cut out of service, so that the selective switches will pass by those cord circuits thus rendered impotent as though they were already in use.

I will explain my invention more fully by reference to the accompanying drawings, in which—

Figs. 1, 2, 3 and 4 illustrate preferred embodiments of the invention.

Fig. 5 is a general diagrammatic view illustrating one distribution of the cord circuits, which may be varied to suit different exchanges.

Like parts are indicated by similar characters of reference throughout the different figures.

Each subscriber's station A—B is provided with customary common battery subscriber's apparatus, the switch hook at each station serving operatively metallically to unite the sides of the line when the receiver is removed. I do not deem a detailed description of the subscriber's station apparatus to be essential, as the illustration is sufficient to make the same understood by those skilled in the art. Although I have illustrated one arrangement of subscriber's station apparatus, it will be obvious to those skilled in the art that other arrangements may be employed at the sub-stations, and I do not wish to be limited to the arrangement and apparatus shown, nor do I wish to be limited in all embodiments of the invention to its application to a common battery system. The subscribers' lines indicated are metallic lines and each extends in two branches to the exchange, where they terminate in armatures 1—1 of a cut-off relay 2. The alternate contacts of the armatures, those contacts that are engaged by the armatures when the cut-off relay is energized, constitute terminals of the office end of the line which is supplied with the line jack 3 that I have spoken of. The system illustrated being a multiple switch-board system, there are also provided upon other sections of the board than where jack 3 is located, other jacks 4 in connection with the said alternate contacts and the office end of the line similar to the connection of jack 3. That which in a multiple switch-board

would correspond to an answering jack and in any other switch-board would correspond to a line jack, is found in the multiplied terminals 5—5' and multiplied terminals 6—6' which are connected with the alternate contacts of the cut-off relay and form what I have herein spoken of as the telephone line terminal contacts when the armatures 1—1 of said relay are attracted into contact with their alternate contacts. The contact buttons or terminals 5—6 are desirably arranged in circular rows over which sweep the answering terminals 7—8 and 7'—8', which answering terminals are desirably not normally connected with the balance of the cord circuit, but which, as indicated in connection with the terminals 7—8, are caused to form continuations of the cord circuit upon the operation of an armature switch including a tip switch contact 9 and a sleeve switch contact 10 governed in their movement by a relay 11 under circumstances to be hereinafter set forth. There is also an additional circular row of contact buttons 12—12' over which sweep contact arms 13—13' that take part in controlling the motion of the terminals 7—8 and 7'—8'. The number of contact buttons or terminals 5 and also 5', the number of contact buttons or terminals 6 and also 6' and the number of contact buttons or terminals 12 and also 12', each equals the number of telephone lines to which a group of cord circuits has been assigned. For example, if thirty cord circuits have been assigned to a group of 500 lines, the contact buttons 5 number 500, one connected with each line, the number of contact buttons 6 equals 500, one connected with each line, and the number of contact buttons 12 equals 500, one for each line. The contact arms or brushes 7, 8 and 13 constitute a set and there are as many sets of such contact brushes as there are cord circuits assigned to a group of telephone lines. Said contact arms of each set are desirably operated by a common prime mover, there being a shaft 14 forming a part of the common prime mover upon which it may be understood the arms 7, 8 and 13 are mounted. There are, thus as many prime movers as there are cord circuits. The prime mover 15 illustrated upon the left of each of the drawings is composed of a spring motor 16 in driving engagement with the shaft 14 and a wheel 17 upon said shaft, which wheel is provided with a plurality of off-set teeth 18—19 arranged in peripheral rows, across which teeth the polarized armature 20 of the motor is adapted to oscillate by the agency of the field windings 21 and the source of alternating current 22 when said source of current is included in a closed circuit with said windings. The said armature in operating, is removed from engagement with one tooth 18 into the path of an

off-set tooth 19, whereupon the spring motor may move the wheel a step, whereafter the armature is oscillated to its initial position into the path of a new tooth 18 that is off-set with respect to the previously engaged tooth 19, whereupon the spring motor may move the wheel 17 another step, and so on, until the source of current 22 has the circuit including the same opened.

In the motive device shown upon the right of Figs. 1 and 2, a source of direct current, as the common battery 23, may be employed to operate the field winding 24, which is alternately energized and de-energized, so that the armature 25 may be attracted from engagement with the teeth in the row 26 and brought into the path of the teeth in the row 27 off-set with respect to the teeth 26. Upon this attraction of the armature, the circuit through the magnet 24 is opened, whereupon the spring 28 restores the armature to its initial position.

In this way a spring motor, which is assumed to be in driving engagement with the wheel bearing the teeth 26—27, may cause the answering terminals of the cord circuit to move from one line contact to the next, upon the de-energization of the magnet 24, and as the result of the retraction of the spring 28.

I will explain the circuit arrangements of the magnets 21—24 and the apparatus by which such arrangements are controlled more fully hereinafter.

When a subscriber initiates a call, the answering end of an idle cord circuit in this case the first, is automatically connected with a set of terminal contacts, as the contacts 5—6, for example, this automatic connection being occasioned by the operation of the said cord circuit's motor. Only one cord circuit motor, that corresponding to an idle cord circuit, is preferably operated in automatically effecting the movement of the answering terminals of said cord circuit into contact with the terminals of a calling line. To this end, I preferably employ selective mechanism, constituting an electric motor, that serves to select the cord circuit motor that is to be operated; which selecting motor may be termed the "calling subscriber's governor motor" and there is preferably only one such motor common to a group of telephone lines. Referring again more particularly to the system illustrated in Fig. 1, this governor motor includes in one embodiment of the invention a traveling switch 29 operated by the armature of an electro-magnet 30, as will hereinafter be particularly set forth, which switch 29 rides over a series of contact buttons 31, constituting terminals of conductors extending to the various cord circuits of a group, there being as many contacts 31 as there are cords of a particular lot assigned to a group of

lines; there are in the example chosen thirty such contact buttons 31. A complete conductor 32 is shown extending from one of the contact buttons 31 to the cord circuit that is shown uniting the subscribers' stations A and B. Normally, that is, when its cord circuit is idle, this conductor 32 is connected with the grounded battery 23 by way of the switch 33 governed by the relay 11. The switch 29 is normally disconnected from ground, but, as will hereinafter be more fully set forth, has ground connected therewith by a subscriber in initiating a call, whereby the circuit including the conductor 32 is completed. The winding of a magnet 34 is included in the conductor 32, so that, when this conductor is included in a closed circuit, the armature switch 35, constituting a terminal of the generator 22, is attracted to complete the circuit through the magnet 21 and said generator, the switch 36 controlled by magnet 11, then being upon its grounded contact. When, therefore, the switch 29 is moved by a calling subscriber into connection with a conductor 32 that is completed at 33, the cord circuit motor of the cord circuit corresponding to said conductor is set into operation. But where the switch 29 encounters the terminal of a conductor 32 that is open at 33, as is always the case where the corresponding cord circuit has been automatically connected with a calling line, said switch is caused to pass said opened conductor and to continue its operation until it encounters a conductor that is closed at 33, that is, a place similar to 33. When the switch 29 encounters the terminal of a conductor 32 that is closed at 33 and the corresponding cord circuit motor has moved the switches 7—8 into connection with the telephone line terminals and the switch 13 into connection with the conductor associated with the calling telephone line the magnet 11 becomes energized in a manner more fully hereinafter to be set forth, to operate the armature switches 9—10 to complete the connection of the cord strands with the said line terminals, to open the conductor 32 at 33, to open the circuit of the cord circuit prime mover at 36, and to close a subsidiary path through the winding of magnet 11, to maintain it energized irrespective of subsequent changes occurring in the apparatus associated with the calling line, the armature switch 37 engaging its contact, which is a pivoted one, before said contact breaks connection with the contact it in turn normally engages. As one of the results of these circuit changes, the cord circuit motor ceases its operation, so that the answering end of the selected cord circuit may remain in the position to which it has been placed by its operating motor.

Having thus in a general way outlined some of the operations taking place in auto-

matically effecting connection between a calling subscriber and an idle cord circuit, I will now more particularly describe the operation of the apparatus entering into my invention.

The subscriber, as A, having initiated a call, includes the winding of a magnet 38 in circuit with a grounded battery 23, whereupon the armature switches 39—40 operated by said magnet 38 are moved against their grounded contacts, 39 being preferably grounded before 40. The switch 39 is connected with a conductor 41 that is common to all of the lines and which extends to the switch 29 and which is the conductor that is grounded in order to complete the circuit containing the conductor 32, when said latter conductor is closed at 33 as heretofore set forth, whereby results that have hitherto been specified are accomplished. This same conductor 41 has a branch 42 that is connected with the grounded battery 23, which conductor 42 includes the winding of the motor 30, the switch arm 43 governed in its operation by the armature of said motor 30 and the armature 44 with its contact, said latter armature belonging to the relay 45. Thus, the switch 29 is not only grounded at 39, but the magnet 30 is included in a grounded circuit, which circuit is intermittently opened by the separation of the lazy arm 43 from its contact due to the operation of the armature of the magnet 30 and the cooperation of an extension of said armature between the bifurcated ends of said arm. The arm 43 is forced away from its contact upon the attraction of the armature by the magnet 30 and is restored to engagement with its contact by the spring in connection with said armature, the said armature being thus intermittently attracted as long as the circuit containing the magnet 30 is otherwise closed. Said armature cooperates with the teeth of an extension of switch 29, whereby the said switch is caused to travel as the armature is intermittently attracted. The dog 46 engages the said teeth to prevent the restoring spring 47 from operating until required, so that the switch 29 is maintained in any position, for the time being, in which it has been placed by the magnet 30. When the switch 29 encounters a conductor 32 that is closed at 33, circuit through the magnet 45 is obviously closed, the winding of this magnet being included in the conductor 41, whereupon the armature 44 is attracted to bring the catch 48 into connection with the catch upon the dog or detent 46 preparatory to releasing the said detent from mechanical locking engagement with the switch 29 to permit the spring 47 to restore the said switch to its normal or initial position. The magnet 45 remains energized until the circuit containing the conductor 32 is open at 33, which only is

accomplished when the cord circuit motor selected by the subscriber's governor motor has brought the answering contacts of its associated cord circuit into connection with calling line terminal contacts. The connection of the cord circuit with the calling telephone line having thus been effected, circuit through the magnet 45 is opened at 33, whereupon the spring 49 lifts the dog or detent 46, permitting the spring 47 to withdraw or restore the switch 29 to its initial position. In order that the switch 29 may not through some fault in the operation of the apparatus, or in case all cords are busy pass all of the contacts 31 without causing the selection of a cord circuit and thereafter be not restored, I provide a supplemental contact button 50 which is engaged by the brush 29 on reaching the limit of its excursion, whereupon circuit is completed that may be traced from the ground at 39 occasioned by the calling subscriber, the magnet 45, the switch 29, the contact button 50 and the grounded battery 23, whereupon the armature 44 is attracted, with the results hitherto specified, the circuit through the magnet 45 is opened at 51 and the spring 49 is permitted to withdraw the detent 46, whereupon the spring 47 restores the switch 29. In order that some of the cord circuits may be rendered inoperative, so that work assigned to less efficient operators may be reduced, the conductors 32 may each include a switch 52 that may produce a break in said conductor similar to that produced at 33 when the magnet 11 is energized, so that the switch 29 will not pause at a contact terminal of said conductor, but will pass the same as if the cord circuit associated therewith were busy. In order that my invention may be effectively practiced, the magnet 11 (which is the one that determines the connection of the selected cord circuit with the calling telephone line, determines the continuity of the circuit including the governor motor, and controls the electrical character of the buttons 31 by controlling the conductors 32 at 33) is preferably included in a circuit that is distinct from the talking circuit, which circuit includes a conductor 53 that terminates in the armature switch 40, there being one such armature switch 40 and one such conductor 53 for each telephone line. This conductor 53 is connected with the contact buttons 12—12', etc. associated with the cord circuits, there being, as hitherto stated, as many such contacts 12 and as many such contacts 12' as there are telephone lines in a particular group. The switch arm 13, for example, cooperates with the contact buttons 12, the said switch arm moving with the switch arms 7—8 until it encounters the conductor 53 that is grounded at 40 by the calling subscriber, whereupon circuit is closed from said ground at 40 through the grounded battery 23 by way of the switch arm 13, the button 12 engaging the same and the pivoted switch contact 54 engaging its normal contact 55. The magnet 11 is thus energized to bring the switch arms 9—10 into connection with the contacts of the calling subscriber's line, while the armature switches 33, 36 and 37 are moved by said magnet when thus energized, whereby the said magnet is included in a circuit containing the battery 23, the contact 54, the switch 37, and the conductor 56 normally grounded at 56'. Circuit is also established from the grounded battery 23 through the cord circuit relay 57, the sleeve strand of the cord circuit, the armature switch 10, the answering terminal switch 8, the ground at the cutoff relay 2 and also the ground at the relay 58 that is connected with the tip strand of the cord circuit and which ground is reached over the subscriber's line by way of the answering terminal 7 and the armature switch 9. The magnet 11 will thus be unresponsive to any change in the position of the switch 40 and the cut-off relay 2 will be energized, whereupon the armatures 1—1' will be attracted and the switches 39—40 restored to their normal positions, the said armatures 1—1' being thus connected with their alternate contacts, whereby the connection between an idle cord circuit and a calling line is completely established. Upon such a completion of the connection of a selected cord circuit and a calling line, the calling indicators 59—60 are operated in a manner to be specified, whereupon the operator includes her telephone outfit in a manner well known, in circuit with the calling subscriber and, after having ascertained the connection he desires, inserts the connecting plug 61 of the cord circuit corresponding to the signals 59—60 into the line jack of the subscriber desired by subscriber A and thereafter signals the called subscriber in the usual way. Before the connecting plug 61 has been inserted, the magnet 62 is in open circuit, its armature falling away therefrom, whereby the pivoted contact 63 may rest against its normal contact, so that, when the magnet 58 is energized through the agency of the calling subscriber's apparatus, as has been specified, circuit through the calling lamp 59 may be traced as follows: from the grounded relay 64 through said lamp 59, the attracted armature of magnet 58, the normally placed pivoted contact 63, the contacts 56' 56², the conductor 56, to the grounded battery 23, causing the calling lamp 59 to glow. The supplemental calling lamp 60 has its circuit closed by way of the armature of the magnet 64 engaging its grounded contact and the grounded battery 23. When the operator inserts the plug 61 into the jack of a called subscriber, the

magnet 62 is energized by being included in a circuit that contains the grounded battery 23, the winding of said magnet 62, the sleeve strand of the cord circuit, the sleeve of the inserted plug and the winding of the grounded cut-off relay 2. The armature of the magnet or relay 62 is thereby attracted to move the pivoted contact 63 from its normal contact, thereby opening the circuit including the calling lamp 59 and the relay 64, whereby signals occasioned by the lamps 59—60 are effaced. The supervision over the called subscriber is had by the lamp 65 controlled by the well known cord circuit apparatus at the connecting end of the cord circuit illustrated. I do not, therefore, deem a particular description of the apparatus by which the lamp 65 is controlled to be essential. The supervision of the calling subscriber's telephone line is had by the lamps 67—68, which supervision may be generally described as follows: When the cord circuit has been automatically connected with a calling line, circuit through the magnet 57 is completed, the calling subscriber's telephone being off its hook, as has heretofore been specified, which circuit may be traced from the grounded battery 23 through the winding of the magnet 57, the sleeve strand of the cord circuit, both limbs of the telephone line, back to the tip strand of the cord circuit and the grounded magnet 58. The armature switch 69 operated by the magnet 58 is, therefore, attracted, so that the circuit including the lamp 67 is opened. When the calling subscriber is through and has restored his telephone, the connection of the magnet 58 with the battery 23 is interrupted at the calling subscriber's switch-hook, but the magnet 57 still remains in circuit with said battery, as it is included between the ground of the cut-off relay and the said battery. Release of the armature 69, therefore, completes circuit through the lamp 67, which may be traced from the grounded battery 23 through said lamp, the armature switch of the relay 57 connected with the lamp, the armature switch 69, to the grounded contact engaged by said armature switch when thus released. The signal 68 is a supplemental signal that is preferably employed, for which purpose a relay or magnet 70 is included in circuit with the lamp 67, so that circuit through the lamp 68 is established by the armature of magnet 70 when attracted, which circuit may be traced from the grounded contact engaged by said armature or armature switch, the lamp 68, to the grounded battery. The elements 70, 68, 64 and 60 are preferably common to a number of cords.

When the subscribers have finished conversation and have restored their receivers, the supervisory indicators 65, 67 and 68 indicate the fact, whereupon the operator

withdraws the plug 61. This withdrawal of the plug causes an opening of the circuit including the magnet 62 at the jack that contained the plug, whereupon the pivoted contact 63 is included in open circuit, as the armatures of magnet 58 are released, owing to the opening of the circuit including said magnet at the calling subscriber's switch-hook. As this contact 63 is included in the local circuit that contains the magnet 11 after a connection between calling and called subscribers has been put up, the magnet 11 has its circuit opened when the said contact 63 is disconnected from its circuit. The magnet or relay 11 becoming thereupon de-energized, releases the armature switches 9, 10, 33, 36 and 37, whereupon the calling line is automatically disconnected and the cord circuit is restored to its idle condition of use.

The selecting mechanism illustrated upon the right of Fig. 1 is generally similar to that illustrated upon the left. The cord circuit motor operating the answering end of the cord circuit shown in association therewith is of the same general character as that illustrated upon the left of the drawing, but the escapement 25 is operated through other agency than is the escapement 20, the escapement 20 being moved alternately altogether by magnetic attraction, while the escapement 25 is moved in one direction by the magnet 24 and in the other direction by the spring 28. Teeth 26—27 are also preferably spaced with respect to each other somewhat differently from the teeth 18—19, so that, when the detent 25 is disengaged from a tooth 26, the wheel carrying the teeth is moved a lesser distance than when said escapement is disengaged from a tooth 27, to be brought into connection with a tooth 26. This permits the answering end of the cord circuit to be very quickly operated without danger of moving the same beyond the line terminal contacts of a calling subscriber. The apparatus upon the right includes similar armature switches 9—10 associated with the answering terminal contacts 7—8 just as in the left of the drawing. The magnet 71 operates the armature switches 9—10 for the same purpose that the magnet 11 operates its armature switches 9—10. The magnet 24 is included in a circuit that contains the battery 23 and the bifurcated lazy arm 72 when engaged with its grounded contact through the agency of the spring 28.

The subscriber's governor motor upon the right of the drawing is similar in construction, operation and arrangement to that shown upon the left of the drawing, like parts and connections of both governor motors being given similar characters of reference. Other parts of apparatus and circuits illustrated upon the right of Fig. 1

that have functions and arrangements corresponding to similar parts upon the left of the figure, are also given similar characters of reference, though in some cases the mechanical association may not be absolutely identical. After circuit through the conductor 32 has been closed upon the selection of an idle cord circuit switch by the calling subscriber (now speaking of the apparatus upon the right), the magnet 34 is operated to attract its armature and complete circuit through the magnet 24, which may be traced from the grounded battery 23 through the magnet 24, the armature 35 of magnet 34, to the bifurcated lazy arm 72, when engaging its grounded contact. After each attraction of the armature 25, circuit through the magnet 24 is opened by the separation of the lazy arm 72 from its grounded contact, whereby the armature 25 is released and is thereupon removed to a reverse position by the spring 28, which spring at the same time causes the restoration of the lazy arm to its initial position, whereupon circuit through the magnet 24 is again closed, which operation is continued until the cord circuit motor has operated the answering ends of the idle cord circuit, to bring the same into connection with a calling subscriber's line terminal contacts. When this result is achieved, the arm 13 is grounded by way of the armature switch 40 of the calling subscriber, whereby the magnet 71 is included in a circuit that may be traced from the grounded battery 23 through the magnet 24, the armature 35, its contact, the magnet 71, the switch arm 13, to the grounded armature switch 40, whereby the armature 25 remains attracted by the magnet 24 and whereby the magnet 71 is energized. The energization of the magnet 71 establishes a supplemental circuit for the magnet 24 which may be traced from the grounded battery 23 through said magnet 24, the contact 73, the armature 74 of magnet 71, the winding of magnet 71, the armature 75, to the conductor 56 that has a ground established thereupon, the ground being indicated in dotted lines. After a calling line has selected an idle cord circuit, the magnets 24 and 71 are maintained energized until the cord again becomes idle. Another result of the energization of the magnet 71 is apparent in the de-energization of the magnet 34, whereby the governor motor may be restored without the danger of being re-stepped at the end of a connection. The provision of the circuit afforded by the armature 75 and the ground upon conductor 56 is for the purpose of maintaining circuit through the winding of magnets 71 and 24, which otherwise would be broken upon the disconnection of ground from the armature switch 40 upon the operation of the armature switches 9—10 which cause in the manner heretofore set forth, the opera-

tion of the cut-off relay 2 and the consequent removal of the armature switch 40 from ground.

Should there be two or more subscribers in any group calling at the same time, it is apparent that the cord circuit switch of the first idle cord would select and make connection with the first of the calling lines which the arms 7, 8 and 13 encountered and that the switch 29, being then released, would immediately select the next idle cord circuit, owing to the ground still present on conductor 41, this operation continuing until all of the calling subscribers in a group have been answered.

A feature of my invention resides in the provision of the supplemental sets of contacts 12—12' in addition to the talking terminals of each telephone line in conjunction with the switch arms 13—13' cooperating with said contacts.

A very useful feature of my invention is the provision of local circuits including subscriber operated switches, as 40, desirably located at the exchange and adapted to include a switch arm as 13 in circuit when placed in engagement with one of the said supplemental line contacts as 12 and apparatus included by said arms in any local circuit thus established, which apparatus will serve to effect the restoration of the cord selecting mechanism, so that said mechanism may be used in perfecting other connections.

In the precise embodiment of the invention illustrated there are, as has been stated, as many supplemental line contacts 12 and as many supplemental line contacts 12' as there are telephone lines in a particular group. There are as many sets of these contacts 12—12' and arms 13—13' as there are cords assigned to such group. In the embodiment of the invention illustrated, there are thus many more subscriber operated switches 40 provided for the local circuits than there are sets of contact buttons 12—12' and arms 13—13', but the said arms and contact buttons are adapted to be included in local circuit with switches 40 of calling lines. I do not wish to be limited, however, to the precise arranged illustrated.

The system illustrated in Fig. 2 is similar in general respects to that indicated in Fig. 1. The system illustrated in Fig. 2 has as a modification of the system shown in Fig. 1 additional sets of subscribers' contacts 76—76' equalling in number the contacts 5—5', 6—6', etc., the provision of switch arms 77—77' for sets of added contacts 76—76' and circuit conductors 78—79, in which conductor 78 there is included an auxiliary armature switch 80 and relay 81 and in which conductor 79 there is included the cut-off relay 2', the conductor 79 being extended to the multiplied spring jacks, the particular system shown being a multiple

switchboard system, whereby the cut-off relay may be operated from any section of the board as well as upon the connection of the answering end of a cord circuit with a calling line. In the system shown in Fig. 1 a side of the talking circuit is employed in the operation of the relay 2, whereas in the system illustrated in Fig. 2 the conductor that establishes the circuit for the relay 2' is not a section of the talking circuit, but is a third or supplemental conductor employed for the purpose of this control of the cut-off relay and the control of the supervisory apparatus associated with the cord circuit. The parts of the system illustrated in Fig. 2 having the same general purpose and arrangement as those illustrated in Fig. 1, are given similar reference characters. In general, the functions performed by the added conductor are similar to the functions performed by one of the talking conductors shown in the system of Fig. 1. The supervisory relay 81 corresponds in function to the supervisory relay 57, the supervisory relay 82 corresponds in function to the supervisory relay 58, the supplemental supervisory relay 83 corresponds in function to the supplemental supervisory relay 70, and the supplemental relay 84 corresponds in function to the supplemental relay 64. The lamps 85, 86, 87 and 88 correspond in function to the lamps 59, 60, 67 and 68. The apparatus associated with the connecting end of the cord circuit is well understood by those skilled in the art and need not further be described, except to state that a relay 89 corresponds in function to the relay 62 of Fig. 1 is added. The cord circuit is in accordance with well known practice. I have indicated in Figs. 1 and 2 those systems that are most commonly employed throughout the United States in large exchanges, the two being illustrated in order that the wide applicability of my invention may be readily understood. I do not deem it essential to illustrate further systems and the application of my invention thereto.

In the system illustrated in Figs. 3 and 4 the same general systems have been illustrated that are shown in Figs. 1 and 2 respectively.

It will have been observed that the main function of the switch 29 and the elements in cooperative relation therewith has been performed as soon as a cord circuit motor corresponding to an idle cord circuit has been set into operation, the said switch 29 being restored to its initial condition as soon as the selected cord circuit motor has brought the answering end of the cord associated therewith into connection with the contacts of a calling line, so that another subscriber may use the said switch in initiating another call. I have indicated one such switch 29 upon the left of the drawing and another upon the right of the drawing for

the purpose of clearness, but it is understood that I prefer to use only one such organization to a group of lines.

In the system illustrated in Figs. 3 and 4 the subscriber's governor motor is restored to its initial condition immediately upon the selection of the cord circuit motor, so that the said governor motor is at once in a condition to be used by another calling subscriber, this arrangement being preferred to that illustrated in Figs. 1 and 2 in which the governor motor is thrown out of service until the cord circuit motor selected by it has finished its operation in connecting the answering end of the selected cord circuit with the line terminal contacts of a calling subscriber. In the arrangement illustrated in Figs. 3 and 4 the answering terminal contacts of the cord circuit have initial positions to which they are restored when their cord circuits are disconnected and placed out of service, this arrangement differing from that illustrated in Figs. 1 and 2, where the traveling answering ends of the cord circuits remain in the positions where they were last used. By this arrangement it is apparent that several cord circuit motors corresponding to a group of telephone lines may be successively started before the controlling ground at the switch 39 is removed. It will be apparent that by this apparatus the governor motor common to a plurality of lines may be operated in very quick succession, as it is released after starting a cord circuit motor without having to be maintained in the position to which it has been actuated by a calling subscriber until the cord circuit motor has effected connection between a calling subscriber and an idle cord circuit. Several cord circuit motors may thus be operating at the same time, the first selected idle cord circuits having connection effected with calling lines. That is, the idle cord circuits are connected with calling telephone lines in the order in which they have been selected by the subscriber's governor motor, those started by the governor motor in excess of the number calling, which are the last to be started, returning to their normal positions. By this arrangement the answering ends of the cord circuits in sweeping over the line terminal contacts of a number of calling subscribers stop at the nearest calling line terminal contacts independently of the cord circuit motors started by calling subscribers. That is, of a number of calling subscribers in a group of telephone lines, one subscriber may cause one cord circuit motor to start, which cord circuit motor may effect connection of another lower numbered calling subscriber with an idle cord circuit.

Referring now more particularly to Fig. 3, each subscriber's station, A-B, is provided with the customary common battery

subscriber's apparatus, a switch-hook at each station serving operatively metallic-ally to unite the sides of the line when the receiver is removed. I do not deem a detailed description of the subscriber's station apparatus to be essential, as the illustration is sufficient to make the same understood by those skilled in the art, and other arrangements may be employed at the sub-
 5 station. As in the case of the systems shown in Figs. 1 and 2, the system indicated need not be limited to common battery practice. Each subscriber's line indicated is a metallic line and extends in two branches to
 10 the exchange where it terminates in contacts 1'—1' of a cut-off relay 22. These contacts are normally engaged by the armatures of said cut-off relay and are preferably pivoted contacts and are swung upon their pivots by said armatures when unattracted, to
 15 discontinue the telephone line at the contacts 1²—1². The upper armature 1³ of the relay constitutes a terminal thereof and is grounded. The lower armature 1⁴ constitutes a terminal of the magnet 38'. The system illustrated being a multiple switch-
 20 board system, the contacts 1² constitute terminals of the office end of the line, which end is supplied with the line jacks 3 and there are also provided upon other sections
 25 of the board than where jack 3 is located, other jacks 4 in connection with the said contacts 1²—1². That which in a multiple switchboard would correspond to an answering
 30 jack and in any other switch-board would correspond to a line jack, is found in the multiple terminals 5—5' and multiple terminals 6—6' which are connected with
 35 the terminals 1²—1² and constitute the telephone line terminal contacts, as will be understood. The contact buttons or terminals
 40 5—6 are arranged in circular rows over which sweep the answering terminals 7—8 and 7'—8', which answering terminals are
 45 normally connected with the answering end of the cord circuit associated therewith, but which connection is preferably broken at the armature switches 9—10 in the course of
 50 the selection of a cord circuit, so that the apparatus illustrated may be effective for the purpose of the invention, the said armature
 55 switches 9—10 being included in the tip and sleeve strands of the cord circuit, respectively, and being serially included in circuit with the switch arms 7—8 and the contacts
 60 1²—1² when said contacts are in connection with said switch arms. There are also provided the additional rows of contact buttons 12—12' whose general purpose is simi-
 65 sweep over contact buttons 12—12', these contact arms being provided for the same general purpose for which the correspond-
 70 ingly designated contact arms of Fig. 1 are provided, the structural features of these arms being modified to suit the system of
 75 Fig. 3. These arms are pivoted at the centers of their circular rows of contacts and are flared or enlarged at their free ends, so that they will make contact with adjacent
 80 buttons at the same time, so that one button will not be freed from connection with a corresponding arm until after the succeeding
 85 button has been engaged thereby. In the system shown in Fig. 3 it may be understood, for example, that thirty cord circuits
 90 have been assigned to a group of 500 lines, that the contact buttons 5 number 500, one connected with each line, and that the number
 95 of contact buttons 6 equals 500, one connected with each line, and that the number
 100 of contact buttons 12 equals 500, one for each line. The contact brushes 7, 8 and 13 constitute a set and there are as many sets
 105 of contact brushes as there are cord circuits assigned to a group of telephone lines. Said
 110 contact arms of each set are desirably operated by a common prime mover 15; that is, there is one prime mover provided for each
 115 of said sets, which prime mover may include the shaft 14 upon which said brushes or
 120 arms 7, 8 and 12 are mounted, the spring motor 16, the wheel 17 upon shaft 14, the
 125 said wheel carrying teeth 18—19, arranged in peripheral rows, across which teeth the
 130 polarized armature 20 of the motor is adapted to oscillate by the agency of the
 135 field windings 21 and the source of alternating current 22 when said source of current
 140 is included in a closed circuit with said windings, this prime mover being similar in
 145 its operation to the prime mover illustrated upon the left hand of Fig. 1.

When a subscriber initiates a call, the answering end of an idle cord circuit, in this
 150 case the first, is automatically connected with a set of terminal contacts, this automatic connection being occasioned by the
 155 operation of the said cord circuit's motor. In order that the subscriber's governor motor may immediately be used after causing
 160 a cord circuit motor to start, so that another cord circuit motor may be soon started by
 165 another calling subscriber without waiting for the first cord circuit motor to complete
 170 its operation in selecting an idle cord circuit, the arrangement illustrated is preferably
 175 employed. The governor motor shown upon the left and that shown upon the right
 180 each includes a switch 29 operated by the armature of an electro-magnet 30, as will be
 185 hereinafter more particularly set forth, which switch 29 rides over a series of contact
 190 buttons 31 constituting terminals of conductors extending to the various cord circuits
 195 of a group, there being as many con-

tacts 31 as there are cords of a particular lot assigned to a group of lines, there being in the example chosen thirty such contact buttons. A complete conductor 32 is shown extending from one of the contact buttons 31 to the cord circuit that is shown uniting the subscribers' stations A—B. Normally, that is, when its cord circuit is idle, this conductor 32 is connected with the grounded battery 23 by way of the switch arm 13 whose normal position is upon the contact button that engages the switch arm 13 to effect connection of said conductor with said battery. In all of the drawings, for the sake of clearness, the contact brushes or arms are shown as travelling beneath the contact buttons associated with the same. The switch arm 29 is operated by the magnet 30 included in a circuit that may be traced from the grounded battery 23, over the conductor 42, the winding 30 adapted for intermittent inclusion in said conductor, the armature switch 44 of relay 45', the armature switch 39, to the ground placed upon said armature switch upon the initiation of a call by a calling subscriber, this armature switch being attracted to effect connection with said ground because a circuit is established by said subscriber through the magnet 38' operating switch 39 when he removes his telephone for the purpose of making a call, which circuit may be traced from the grounded battery 23, through the winding of magnet 38', the armature 14, over the subscriber's telephone line to the contact 12, to the grounded armature switch 13. The subscriber's governor motor including the switch 29, the operating magnet 30 and associated parts, is similar to the subscriber's governor motor described particularly in connection with Fig. 1 and a repetition of this description will not, therefore, be required. A calling subscriber in initiating a call, effects the travel of the switch arm 29 over the contact buttons 31 until a contact button that is connected with a conductor 32 that is associated with an idle cord circuit is encountered, whereupon the motor corresponding to said cord circuit is set into operation, as will be hereinafter set forth. As soon as the cord circuit motor is set into operation, that is, upon engagement of a contact 31 corresponding to an idle cord circuit (in the case of this system the first idle cord circuit becoming associated with the switch arm 29) the switch arm or switch 29 is immediately reciprocated to its initial position because the said switch arm is permanently grounded through the winding of a magnet 45', circuit through said magnet being therefore completed when a conductor 32, grounded, as has been specified, at the battery 23, is connected with the element 29, the magnet 45' serving to attract the armature 44 to engage the hook 48 with the detent 46. In order that the spring 49 may become effective in withdrawing the detent 46 from engagement with the serrated extension of the switch 29, the circuit established through the magnet 45' by the switch 29 must be open, so that the said spring will not be counter-acted by the attraction of said magnet. This result is accomplished by the movement of the switch arm, as 13, operated by the corresponding cord circuit motor from the contact of the conductor 32 engaged by said switch arm, thereby disconnecting the battery 23 from said conductor 32 to open the circuit including the magnet 45', whereafter the spring 49 may lift the detent 46 by pulling the catch 48 upwardly whereupon the switch 29 may be restored by the spring 47.

Thus, directly after a cord circuit motor has been started to operate by a governor motor operated by a calling subscriber, the said governor motor is released, permitting it to act without delay in starting another cord circuit motor in case another subscriber of the group to which the governor motor has been assigned initiates a call. A supplemental contact 50 is provided so that the switch arm 29 may be restored in case all the conductors 32 are associated with busy cords or the switch arm 29 has otherwise traveled its full course without having started a cord circuit motor. The contact button 50 is connected by way of the switch 51 with the grounded battery 23, so that, when the switch 29 engages said button 50, circuit through the magnet 45' will be completed to draw up the armature 44 and effect engagement of the catch 48 with the detent 46, immediately whereafter circuit through the magnet 45' is opened at 51 so that said magnet 45' is de-energized and the spring 49 is free to lift the detent 46 by the elevation of the catch 48, whereupon the spring 47 reciprocates the switch 29. The switch arm 13 operated by the selected motor, together with the companion switch arms 7—8, sweep about their associated circular rows of contacts until the contacts corresponding to the calling line are thereby engaged. Prior to the connection of the talking terminal contacts 7—8 at the answering end of a cord circuit with a calling subscriber's line, the armature switches 9—10 are attracted by the magnet 11' through which circuit is at once established, which circuit may be traced from the grounded battery 23, through the winding of said magnet 11' to the then unattracted armature switch 90 of magnet 91, to the contact button in engagement with the selected conductor 32, to the ground at the magnet 45'. In the system illustrated in Fig. 3 each of the contacts 12 is normally grounded at the armature switch 92 operated by the magnet 38', these grounds being

present when the corresponding telephone lines are idle, but being removed when the magnet 38' is energized, which occurs when a subscriber first initiates a call, the ground at 92 being restored as soon as the cut-off relay 2² is energized. There is thus only a brief interval in which the contacts 12 (also 12', etc.) are free of ground. The flared end of the arm 13 is consequently grounded at the points 92, maintaining the magnet 11' energized until the said flared end encounters a button 12 from which the ground at 92 has been removed by the operation of the magnet 38', whereupon the magnet 11' is de-energized to release the armature switches 9—10, which thereupon complete the connection of the selected cord circuit with a calling line. The magnet 91 serves to attract the armature switch 90 for the purpose of preventing the magnet 11' from becoming energized when the ground at 92 has been restored. The magnet 91 is not energized, however, until the magnet 93 has become energized, which energization of magnet 91 is effected by the closure of the circuit through said magnet 93 that may be traced from the grounded battery 23, through the winding of said magnet 93, the sleeve strand of the cord circuit, the armature switch 10, the arm 8, the winding of the cut-off relay 2², to the ground of said cut-off relay. Upon such energization, the armature switch 94 is operated to close circuit through the magnet 91 to open the circuit containing the magnet 11'. When the magnet 11' is energized, its armature switch 35 is grounded to set the selected cord circuit motor in operation. Such energization, as has been stated, is effected immediately upon the engagement of the switch 29 with a button 31 that is in connection with a switch, such as 13, in circuit with an armature switch 90 that is unattracted because of the association of its operating magnet 91 with an idle cord circuit, the ground having been removed at 94 from said magnet 91. In this way the selected cord circuit motor is started to operate at once when the subscriber's governor motor has performed its function, said governor motor thereupon being released as has been specified. When the magnet 11' has its circuit opened, the prime mover or cord circuit motor 15 is thrown out of service, as the circuit of the windings 21 is thereupon opened at 35. This opening of the circuit occurs, as has been stated, upon the attraction of the armature switch 90 which is occasioned upon the establishment of ground at 94, which latter result is not occasioned until the calling subscriber's line is connected with a cord circuit. In effecting the restoration of the traveling answering ends of the cord circuits, the switches 7, 8 and 13 continue in their previous direction of rotation, but the

polarized armature 20 for this purpose must again be set in motion, to which end the magnet 11' must again be energized to ground the switch 35.

This result is accomplished by means of the magnet 95 and its associated parts. Circuit through this magnet 95 may be closed through the agency of the calling subscriber before the insertion of the connecting plug 61 in the jack of the subscriber called for and it also is closed upon the withdrawal of the plug 61 (it being assumed, of course, that in either case the calling subscriber has restored his telephone), so that the restoration of the answering end of the cord circuit may be effected after a subscriber has called and before the connection of the selected cord circuit is completed as well as upon the withdrawal of the connecting plug in the event of its connection with the called subscriber's line. In either case the circuit through said magnet 95 may be traced from the ground at 92 (which has been previously restored), to the switch arm 13, the armature switch 90, the winding of the magnet 95, the armature switch 96 of the magnet 97 (which magnet 97 has been de-energized because its circuit has been opened at the calling subscriber's switch-hook), the armature switch 98 of de-energized magnet 99, the armature switch 100 of the magnet 93, the auxiliary signal magnet 101, thence to the grounded battery 23. This closure of the circuit through the magnet 95 depends upon the energization of the magnet 93. The magnet 95 when energized effects the closure of circuit through the magnet 11', but inasmuch as the magnet 95 is at once de-energized upon the separation of the switch 10 from the contact it engages, the circuit closed by the magnet 95 must be maintained, to which end I employ a catch 102 which is engaged by the armature of the magnet 95 when attracted. The catch 102 is preferably grounded and the armature of magnet 95 preferably forms a part of a circuit that includes the grounded catch 102, the winding of the magnet 11' and the grounded battery 23. The magnet 95 is thus energized mechanically to connect a ground with the winding of magnet 11', to complete its circuit, whereafter said magnet 95 is de-energized, which, however, does not cause the removal of the ground at 102. In this way the cord circuit motor or prime mover is again set into operation to secure the restoration of the switch parts 7, 8 and 13 to their initial positions. When the initial positions have been reached, the pin 103 strikes an insulated finger projecting from the pivoted contact or catch 102, thereby withdrawing the said catch from engagement with the armature of magnet 95 to open the circuit of magnet 11' and thereby cause a cessation of the polarized armature 20, so that the switch

parts 7, 8 and 13 remain in their initial or normal positions. In the system illustrated in Fig. 3 the operation of the calling lamp 64, the supervisory signals 104 and 105 and the relays governing the same, will be readily understood by an inspection of the diagram, and I do not, therefore, deem a specific description thereof to be essential. The balance of the cord circuit apparatus is also well understood by those skilled in the art.

The apparatus shown upon the lower right hand corner of Fig. 3 is similar in electrical function to and in some respects is different in mechanical construction from the apparatus illustrated upon the left of the figure. The arms 7², 8² and 13² correspond in function to the arms 7, 8 and 13, but the former arms are designed for rectilinear travel, to which end certain modification is required in the prime mover or cord circuit motor that effects the travel of said arms, for they must be adapted for reciprocation instead of travel in a continuous direction to effect their purpose. The contact buttons associated with the arms 7², 8² and 13² are similar in function to the contacts provided in association with the arms 7, 8 and 13, respectively. There is, however, an additional but ground contact 106 for each cord circuit equipped with the arms 7², 8² and 13², so that in case the said arms should travel their fullest extent without effecting the connection of a cord circuit with a calling line, said arm 8² will be grounded to effect the restoration of said contact arms 7², 8² and 13² as will be specified. The subscriber's governor motor upon the right of Fig. 3 is similar to that shown upon the left and similar parts are given similar characters of reference. When a conductor 32 has been engaged by a switch arm 13², circuit through the magnet 107 is closed, which circuit may be traced from the grounded battery 23, through the winding of magnet 107, the armature switch 108, the switch arms 13², the conductor 32, the switch arm 29, to the ground at magnet 45', with results that will be understood in view of the description of the left hand subscriber's governor motor. The armature switch 109 is thereby operated to close circuit through the winding 110 of the motor operating the switch arms 7²—8² and 13² in a manner that is obvious when the way in which the switch arm 35 is operated is understood from the description previously given, and I will not, therefore, describe the motor operating mechanism except to describe certain circuit changes that occur to change its operative condition. When a cord circuit has been connected with a calling line, circuit through the winding 110 is opened at 109 similarly to the opening of the circuit through the windings 20 at 35; hence, a detailed description of the operation of the magnet 107 will not be given. The

conductor 111 that includes the magnet 112 has the same circuit relations, connections and changes in connections that the conductor 113 leading to the switch 94 has; therefore, when the calling subscriber has been connected with a cord circuit, the magnet 112 is energized to close circuit through the magnet 114 to operate the armature switch 115 to effect connection of the catch 116 with the detent 117, so that the spring 118 may pull upon said catch and effect the withdrawal of the detent 117, so that the arms 7²—8² and 13² may be restored by the spring 122. Circuit through the magnet 114 may be traced from the ground thrown upon the armature 119 upon the energization of magnet 112 through the winding of said magnet 114, over a conductor 120 in association with the cord circuit selected, corresponding to conductor 121, to the armature switch corresponding to the armature switch 96 (now unattracted, as the magnet 114 is only to be energized when the answering end of a cord circuit is to be disconnected from the telephone line united therewith), the now released armature switch corresponding to 98, to the still attracted armature switch corresponding to 100, thence to the grounded battery 23. While the magnet 114 is energized only when the switches 7², 8² and 13² are to be restored, the magnet 112 is energized immediately upon the connection of a calling line with a cord circuit, whereby the circuit including the magnet 107 is opened at 108 to maintain magnet 107 de-energized until disconnection. The engagement of the parts 116 and 117 (occurring upon disconnection as above described), part 117 being grounded, effects the closure of circuit through magnet 107, which circuit may be traced from the grounded battery 23, to the magnet 107, the parts 116 and 117, to the ground upon part 117. The spring 122 restores the cord circuit motor switch arms when the dog 117 is withdrawn. Although such circuit is established, it will now have no control of the winding 110, circuit through which winding is opened at 115, but the switches 9—10 will be moved to disconnect the connecting end of the cord circuit from the calling line. The attraction of the switch 10 throws off the ground by which the magnet corresponding to magnet 93 has its circuit completed, which ground is at the cut-off relay, so that the armature switches of said magnet are released. In this way the circuit containing the magnet 114 is open at a point corresponding to the point 100, permitting the spring 118 to withdraw the detent 117. The insulating post 116' has separable engagement with the contact 116 for the mechanical purpose of effecting separation between the elements 116 and 117 when the restoration has been completed, this structural characteristic being similar

to the similarly illustrated parts of the subscribers' controller motors. In case the switch arms 7², 8² and 13² should travel to their extreme positions, as would occur should a cord switch fail to find any calling subscriber after having been started by the operation of switch 29, switch-arm 8² will engage the grounded contact 106 and the circuit through switch-arm 13² will be opened. The opening of said latter circuit will cause the de-energization of magnet 107 and the stopping of the motor magnet 110 just as though a calling line had been found. The closing of circuit through the ground 106 will cause the energization of the magnet corresponding to magnet 93 just as though a calling line has been selected, thus causing the energization of magnet 112 and the consequent operation of magnet 114 due to the then existing closed contacts in conductor 120 corresponding to contacts 96, 98 and 100 in conductor 121. The restoration of the switch arms to their normal positions is thus secured by the engagement of hook 116 with detent 117 and the consequent operation of magnet 107 and de-energization of magnets 112 and 114 just as though a disconnection were being completed after connection with a subscriber's line.

In Fig. 4 is illustrated a system that partakes of the characteristics of the systems shown in Figs. 2 and 3 and parts of the system and circuits of Fig. 4 corresponding in function to parts and circuits of Figs. 2 and 3 are given similar characters of reference and I do not deem a further description of the system shown in Fig. 4 to be essential in view of the extended descriptions hitherto given of the other systems, except that it might be stated that the magnet 91 corresponding in function to the similarly designated magnet of Fig. 3, is connected directly with the conductor 78 which includes the magnet 81 in its current, instead of being included in a local circuit controlled by the operation of relay 93, as is done in Fig. 3. In both cases the said magnet 91 is caused to operate as soon as the circuit through the cut-off relay 2' (Fig. 4) or 2² (Fig. 3) is completed. The winding of magnet 112 has a circuit arrangement similar to magnet 91.

In Fig. 5 I have illustrated the general arrangement of the circuits and apparatus that I prefer, but in this figure I have not had sufficient room to illustrate to the fullest extent all of the apparatus involved, but the general features of the system will be understood by reference to the following description.

I have illustrated three groups of telephone lines, I, II and III. Each group may be understood as containing 500 lines to carry out the illustration set forth in the introduction to this specification. The rectangular figures *a-a-a* each indicates a

subscriber's governor motor or selecting switching mechanism that may have suitable control, preferably by means of the circuits and apparatus illustrated (either in Figs. 1 and 2 or Figs. 3 and 4), of the cord circuit motors 15. The operative connections between the elements *a* and 15 are indicated by dotted lines. The answering ends of the cord circuits including the traveling switch arms 7-7', 8-8' and 13-13', etc., in the case of Figs. 1 and 3, and also the switch arms 77-77', etc., in the case of Figs. 2 and 4, are indicated at *b*. The contacts over which the traveling switch arms last mentioned move are indicated by the circles *c*, each circle indicating a complete group of line contacts in operative association with the answering end of the cord circuit, each telephone line having a set of contacts in each group *c*, all as hitherto fully set forth. The contact devices *b* are connected by the conductors *d*, representing talking strands of the cord circuits, with the connecting plugs *e*. It is understood that there are thirty devices *b* with their operating cord circuit motors to each group of telephone lines in the system shown as an example. It will be apparent by the description previously given and by the illustration in Fig. 5, that the first idle cord circuit is connected with a calling line, the busy cords or those cords made to correspond to busy cords by the elements 52 being skipped. Reading Fig. 5 from left to right, the answering end *b* of the first cord circuit (referring now to group I of the lines) is connected with the first plug at the first position of the first section of the board. The answering end of the second cord circuit is connected with the first plug at the second position of the first section of the board. The third answering end is connected with the first plug at the third position of the first section of the board. The fourth answering end is connected with the first plug at the first position of the second section of the board. The fifth answering end is connected with the first plug at the second position of the second section of the board. The sixth answering end is connected with the first plug at the third position of the second section of the board. The seventh answering end is connected with the first plug at the first position of the third section of the board; and so on throughout the thirty (there being thirty answering ends of the cord circuits at ten sections of the board).

Referring to group II, the first answering end is connected with the second plug at the first position of the first section of the board. The second answering end is connected with the second plug at the second position of the first section of the board. The third answering end is connected with the second plug at the third position of

the first section of the board. The fourth answering end is connected with the second plug at the first position of the second section of the board. The fifth answering end is connected with the second plug at the second position of the second section of the board. The sixth answering end is connected with the second plug at the third position of the second section of the board. The seventh answering end is connected with the second plug at the first position of the third section of the board; and so on.

The first answering end associated with group III for the lines is connected with the third plug at the first position of the first section of the board. The second answering end is connected with the third plug at the second position of the first section of the board. The third answering end is connected with the third plug at the third position of the first section of the board. The fourth answering end is connected with the third plug at the first position of the second section of the board. The fifth answering end is connected with the third plug at the second position of the second section of the board. The sixth answering end is connected with the third plug at the third position of the second section of the board. The seventh answering end is connected with the third plug at the first position of the third section of the board; and so on.

The answering ends corresponding to additional groups of telephone lines (not illustrated) are in the same order connected with the different plugs at the different positions of the different sections of the board.

In this way the cord conductors extending from the selective switching devices corresponding to each group of subscribers, are subdivided into a plurality of groups that are extended to connecting plugs at different sections of the board. Each group of cord conductors contains as many such conductors as there are groups of telephone lines, each group of telephone lines having one cord conductor in each group of cord conductors. The first group of cords is preferably assigned to the first board section, the second group to the second board section, the third group to the third board section, and so on. The first group of cords thus includes those cords extending to the first three answering ends corresponding to each group of telephone lines; the second group of cords includes the three cords extending to the second lot of the three answering ends corresponding to each group of telephone lines, and so on. Each group of subscribers' lines, therefore, has the answering ends of the cord circuits associated therewith subdivided into a plurality of groups corresponding in number to the board sections, the cords of each of such

groups being distributed, preferably in their order, among the different positions of the section to which the said cords extend.

The groups of cords corresponding to each group of lines are preferably connected with the board sections in the same order in which automatic selection is effected between the calling lines and the cord circuits, as indicated in the diagram and as has been explained, whereby each group of telephone lines has a group of cords extending to each of the board sections, the group extending to the first board section being first adapted for automatic connection with calling lines, as their answering ends are the first to encounter the line contacts of the calling lines, the operators at the second board section, therefore, having no work until the first operators have reached their capacities, the operators at the third board section having no work until the operators at the second board section are fully occupied, and so on. It will have also been observed that the cords of each group are distributed to the various operators' positions at the section to which said group of cords extend to equalize as far as possible the work of the operators at the sections receiving calls.

In the system of my invention there need not be any intermediate line distributing boards, the main distributing board, indicated at *k* in Figs. 1 to 4, inclusive, being, however, preferably retained. A cord distributing board, indicated at *m*, may, if desired, be employed to assist in the distribution of the cords.

While the different switch-board sections are arranged in serial order, it is obvious that my invention does not depend upon the physical disposition of the sections relative to each other.

It is obvious that my invention lends itself to a variety of arrangements, associations and groupings of cord circuits to suit differing practices, and I do not, therefore, wish to be limited to the precise grouping and arrangement shown, nor to the application thereof to multiple switch-board and common battery systems. It is also obvious that many changes may be made in the embodiments of my invention herein shown and particularly described without departing from the spirit of the invention, and I do not, therefore, wish to be limited to the embodiments shown, but having thus described my invention, I claim as new and desire to secure by Letters-Patents:—

1. A telephone exchange system including a plurality of telephone lines provided with jacks and divided into groups, a plurality of cord circuits for each group of telephone lines also divided into groups and extending to cord connecting plugs at different sections of the switch-board, automatically operated selective switching mech-

anism in circuit relation with the lines and including traveling answering terminals of the cord circuits and multiplied telephone line terminal contacts engaged by said answering terminals, whereby the answering ends of the cord circuits are connected with calling lines, and apparatus for changing the electrical character of the cord circuits to cause them, when idle, to cooperate with the selective switching mechanism as if they were busy, to enable the said mechanism to pass the same into cooperation with an idle cord circuit that may be used, substantially as described.

2. A multiple switch-board telephone exchange system including a plurality of telephone lines divided into groups and multiplied to different sections of the multiple switch-board and provided at each of such sections with a jack, a plurality of cord circuits for each group of telephone lines also divided into groups and extending to cord connecting plugs at different sections of the switch-board, automatically operated selective switching mechanism in circuit relation with the lines and including traveling answering terminals of the cord circuits and multiplied telephone line terminal contacts engaged by said answering terminals, whereby the answering ends of the cord circuits are connected with calling lines, apparatus for checking the operation of the selective switching mechanism and cord circuit apparatus governing the aforesaid apparatus to enable the selective switching mechanism to avoid busy cords, and apparatus for changing the electrical character of the cord circuits to cause them, when idle, to cooperate with the selective switching mechanism as if they were busy, to enable the said mechanism to pass the same into cooperation with an idle cord circuit that may be used, substantially as described.

3. A telephone exchange system including a plurality of telephone lines provided with jacks and divided into groups, a plurality of cord circuits for each group of telephone lines also divided into groups and extending to cord connecting plugs at different sections of the switch-board, automatically operated selective switching mechanism in circuit relation with the lines and including traveling answering terminals of the cord circuits and multiplied telephone line terminal contacts engaged by said answering terminals whereby the answering ends of the cord circuits are connected with calling lines, and apparatus for changing the electrical character of the cord circuits to cause them, when idle, to cooperate with the selective switching mechanism as if they were busy, to enable the said mechanism to pass the same into cooperation with an idle cord circuit that may be used, the first group of cords corresponding to each group of tele-

phone lines extending to the first switch-board section, the second group to the second switch-board section, and so on, said selective mechanism operating with the cord circuits to connect the idle cord circuits with calling lines in the order in which the groups of cord circuits are connected with the switch-board sections, substantially as described.

4. 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 multiplied telephone line terminal contacts engaged by said answering terminals, mechanism for connecting the idle cord circuits to cooperate with the selective mechanism as if said latter cord circuits were busy, whereby they may be passed by the selective mechanism, a calling signal apparatus operatively associated with the answering end of each cord circuit and operated by a calling subscriber, and relay mechanism operatively associated with the connecting end of each cord circuit and controlled by the operator's apparatus and serving to efface the calling signal, substantially as described.

5. 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 multiplied 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, said relay mechanism being jointly controlled by the apparatus of a connected subscriber and the operator's connecting plug, substantially as described.

6. 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 multiplied telephone line terminal contacts engaged by said answering terminals, and restoring relay mechanism connected with the cord circuits and operating to effect restoration of the answering ends of the cord circuits, said relay mechanism being jointly controlled by the apparatus of a connected subscriber and the operator's connecting plug, substantially as described.

7. 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 multiplied telephone line terminal contacts engaged by said answering terminals, and mechanism at the exchange for resetting the moving contacts of the selective switching mechanism to their normal or initial positions, whereby the first idle cord circuit in a series is automatically selected upon the reoperation of the selective switching mechanism, substantially as described.

8. A telephone exchange system including a plurality of telephone lines having line jacks and multiplied terminal contacts, a plurality of cord circuits for said telephone lines having switches at the answering ends of the cord circuits adapted for engagement with said contacts and each having a manually operated plug, cord circuit motors operating the answering ends of the cord circuits, a cord circuit motor selecting mechanism or governor motor in circuit relation with switches at substations of said lines, whereby said governor motor is operated on the initiation of a call, said governor motor operating to select a cord circuit motor to connect the answering end of a cord corresponding to said cord circuit motor with a calling line, relay mechanism effecting the operation of the cord circuit motors, circuits including said mechanism and regulated by the governor motor, apparatus for checking the operation of the cord circuit motors regulated by the cord circuits and set into action upon engagement of a traveling answering end with the line terminal contacts of a calling line, cord circuit relay mechanism operating to permit the cord circuit motors to actuate the answering ends of the cord circuits when said cord circuits are idle and to prevent the operation of said cord circuit motors when their associated cord circuits are busy, and apparatus whereby idle cord circuits may cooperate with the relay mechanism that prevents the operation of the cord circuit motors to cause idle cord circuits to act upon said relay mechanism as if said idle cord circuits were busy, substantially as described.

9. A telephone exchange system including a plurality of telephone lines having line jacks and multiplied terminal contacts, a plurality of cord circuits for said telephone lines having switches at the answering ends of the cord circuits adapted for engagement with said contacts and each having a manually operated plug, cord circuit motors operating the answering ends of the cord circuits, a cord circuit motor selecting mechanism

or governor motor in circuit relation with switches at sub-stations of said lines, whereby said governor motor is operated on the initiation of a call, said governor motor operating to select a cord circuit motor to connect the answering end of a cord corresponding to said cord circuit motor with a calling line, apparatus for checking the operation of the cord circuit motors set into action upon engagement of a traveling answering end with the line terminal contacts of a calling line, mechanism operating to permit the cord circuit motors to actuate the answering ends of the cord circuits when said cord circuits are idle and to prevent the operation of said cord circuit motors when their associated cord circuits are busy, and apparatus whereby idle cord circuits may cooperate with the mechanism that prevents the operation of the cord circuit motors to cause idle cord circuits to act upon said relay mechanism as if said idle cord circuits were busy, substantially as described.

10. A telephone exchange system including an electrical circuit, rotatable movable step by step selective switches, multiple terminals pertaining to said circuit at said switches, normally unselectable in character, a magnet individual to said circuit for operation to render said terminals selectable in character, means for operating said magnet, apparatus for starting a switch responsive to said magnet to select said circuit and a manually controlled terminal for extending a connection in the direction of a called line.

11. A telephone exchange system including an electrical circuit, rotatable step by step selective switches, multiple terminals pertaining to said circuit at said switches, normally unselectable in character, a magnet individual to said circuit for operation to render said terminals selectable in character, means for operating said magnet, apparatus for starting a switch responsive to said magnet to select said line, circuit connections effective on selection made to render said terminals unselectable, and a manually controlled plug for extending a connection in the direction of a called line.

12. A telephone exchange system including an electrical circuit, a magnet individual to said circuit, selective switches, multiple terminals pertaining to said circuit at said switches unselectable in character when said magnet is inert, means for operating said magnet responsive to currents over said circuit to render said terminals selectable by said switches, test means for said switches enabling them to select said terminals when said magnet is operated, and means automatically effective on selection made to render said magnet inert.

13. A telephone exchange system including a telephone line, a line relay normally operatively connected therewith and indi-

vidual thereto, selective switches adapted to select said line, multiple terminals pertaining to said line at said switches unselectable in character when said relay is inert, means for
 5 operating said relay responsive to currents over said line to render said terminals selectable by said switches, and test means for said switches enabling them when traveling to select the terminals of any line en-
 10 countered by them whose relay is operated.

14. A telephone exchange system including a telephone line, a line relay normally operatively connected therewith and individual thereto, selective switches adapted to
 15 select said line, multiple terminals pertaining to said line at said switches unselectable in character when said relay is inert, means for operating said relay responsive to cur-
 20 rents over said line to render said terminals selectable by said switches, test means for said switches enabling them when traveling to select the terminals of any line en-
 25 countered by them whose relay is operated, and means automatically effective on selection made to render said relay inert whereby said terminals of the selected line are again rendered unselectable.

15. A telephone exchange system including a telephone line, a line relay normally
 30 operatively connected therewith and individual thereto, selective switches adapted to select said line, multiple terminals pertaining to said line at said switches unselectable in character when said relay is inert,
 35 means for operating said relay responsive to currents over said line to render said terminals selectable by said switches, test means for said switches enabling them when travel-
 40 ing to select the terminals of any line encountered by them whose relay is operated, a cut-off relay for said line, a circuit therefor completed on selection made to energize said
 45 cut-off relay, and switch contacts operated on energization of said cut-off relay to render said line relay inert.

16. A telephone system including a subscriber's line, other subscribers' lines, a selective switch adapted to select said line when
 50 a calling line, a manually operated connection terminal for extending the circuit of the selected calling line to a desired called line, and mechanism for restoring said selective switch to normal effective on disconnection of said terminal from the called
 55 line.

17. A telephone system including a link-circuit, subscribers' lines, a selective switch at one end of said circuit, multiple terminals of subscribers' lines at said switch, test
 60 means for said switch enabling it to automatically select, and connect said link circuit to a calling line, a manually operated connection terminal at the other end of said link circuit adapted for connection to called
 65 lines, and mechanism operative to discon-

nect the selective switch from the calling line when the connection terminal is disconnected from the called line.

18. A telephone system including subscribers' lines, a series of selective switches
 70 adapted to select said lines, a distributor switch having a series of contacts corresponding to said series of switches and normally occupying a position preceding said series of contacts, mechanism controlled by
 75 currents over said lines for initiating travel of said distributor switch, test means for said distributor switch enabling it to select and start the first idle selective switch of
 80 said series, and mechanism for automatically restoring said distributor switch to its normal position.

19. A telephone system including subscribers' lines, a series of selective switches adapted to select said lines, a distributor
 85 switch having a series of contacts corresponding to said series of switches and normally occupying a position preceding said series of contacts, said switch being responsive to currents controlled at a substation to
 90 start the first idle selective switch of said series, and circuit connections controlled by the started switch for restoring said distributor switch to its normal position.

20. A telephone system including tele-
 95 phone lines, selective switches adapted to select said lines, a distributor switch for starting said selective switches, line relays, one for each line, a connection from each
 100 said relay to said distributor switch, connections from said distributor switch to all of said selective switches, and mechanism controlled over circuits including the relay con-
 105 nections for initiating travel of said distributor switch on operation of any relay.

21. A telephone system including tele-
 110 phone lines, selective switches adapted to select said lines, a distributor switch for starting said selective switches, line relays, one for each line, a connection from each
 115 said relay to said distributor switch, connections from said distributor switch to all of said selective switches, mechanism controlled over circuits including the relay con-
 120 nections for initiating travel of said distributor switch on operation of any relay, and apparatus for said distributor switch enabling it, when its travel has been initiated, to start an idle selective switch.

22. A telephone system including a sub-
 120 scriber's line, selective switches adapted to select said line, a line relay normally operatively connected with said line, a distributor switch sensitive to said relay, having a movable contact, contacts therefor adapted to be
 125 engaged by said movable contact when the distributor switch is operated, circuit connections to said contacts from mechanisms of said selective switches, each contact being
 130 connected to mechanism pertaining to a par-

particular switch, and means for altering the electrical condition of a contact pertaining to an idle selective switch when engaged by said movable contact to start the idle switch.

- 5 23. A telephone system including a subscriber's line, selective switches adapted to select said line, a line relay normally operatively connected with said line, a distributor switch sensitive to said relay, having a movable contact, contacts therefor adapted to be
10 engaged by said movable contact when the distributor switch is operated, circuit connections to said contacts from mechanisms of said selective switches, each contact being
15 connected to mechanism pertaining to a particular switch, means for altering the electrical condition of a contact pertaining to an idle selective switch when engaged by
20 said movable contact to start the idle switch, and mechanism controlled by the started selective switch for reacting upon its contact to alter the electrical condition thereof.

24. The combination with a telephone line, of a relay normally operatively connected
25 thereto, selective switches adapted to select said line, multiple terminals for said line at said switches, a device for distributively starting said switches, and switch contacts of said relay determining on operation
30 thereof the electrical condition of said terminals and the operation of said device.

25. The combination with a telephone line, of a relay normally operatively connected thereto, selective switches adapted to select
35 said line, multiple terminals for said line at said switches, a device for distributively starting said switches, armature controlled switch mechanism for said relay, and circuit connections for said mechanism rendering
40 the electrical condition of said terminals and of said device sensitive to the operation of said relay.

26. A telephone system including a telephone line, a line relay normally operatively
45 connected with and individual thereto, a selective switch, a terminal for said line at said switch, a central source of current, a contact of said relay, a circuit connection normally extending from said terminal to
50 one pole of said source via said contact, whereby said terminal is normally unselectable by said switch, and armature mechanism for said relay effective on operation of said relay to open said contact.

- 55 27. A telephone system including a telephone line, a line relay normally operatively connected thereto, a selective switch, a terminal for said line at said switch normally unselectable thereby, a switch contact of said
60 relay, and means controlled thereby on energization of said relay to render said terminal selectable.

- 65 28. The combination with a progressively movable step by step electrical circuit, of a selective switch, a terminal of said circuit at

said switch normally unselectable in character, a magnet and switch contacts controlled thereby associated with said terminals and individual to said circuit for operation to render said terminal selectable, mechanism
70 responsive to said magnet for starting said switch, means for operating said magnet, and a manual connection terminal for extending a call in the direction of a called line.

29. The combination with an electrical circuit, of a selective switch, a terminal of said circuit at said switch normally unselectable in character, a magnet individual to
80 said circuit for operation to render said terminal selectable by said switch, means for starting said switch, test devices for said switch enabling it to select said terminal when rendered selectable, and means for
85 automatically imparting an unselectable character to said terminal on selection made.

30. A telephone system including telephone lines, terminal contacts for said lines arranged in multiply related groups, selective
90 switches, one for each group of contacts, capable of selecting any contacts of their respective groups, magnets, one for each line at the exchange, controlled from the respective substations, mechanism operated by said magnets for altering the normal
95 electrical character of the terminals of their respective lines, and means for starting an idle switch.

31. The combination with a telephone line, of multiple contacts therefor, automatic selecting
100 switches for making connection therewith, a relay individual to and sensitive to currents over said line, and mechanism responsive to said relay for altering the normal electrical character of said terminals and starting an idle one of said
105 switches.

32. The combination with a group of telephone lines, of relays each individual to a particular line, multiple terminals for said
110 lines, automatic selecting switches adapted to select said terminals, starting mechanism for said switches, a switch contact for each relay adapted, when the relay is operated, to alter the normal electrical character of its
115 terminals, and means controlled by said relay for operating said starting mechanism.

33. A telephone system including telephone lines, selective switches associated with and adapted to select said lines, a starting
120 circuit common to said switches and lines, line relays one for each line, and branch connections from said starting circuit to each of said relays, whereby any line may operate said starting circuit.

34. A telephone system including telephone lines, selective switches associated with and adapted to select said lines, a starting
125 device for initiating travel of said switches, line relays, one for each line, and
130

a conductor extending from each line relay to operative connection with said device, whereby any line relay may operate said device.

5 35. A telephone system including telephone lines, selective switches associated with and adapted to select said lines, a distributor switch common to said selective switches and lines and adapted to start said switches one by one, line relays, one for
10 each line, and branch connections from said relays to said distributor switch, whereby any line relay may operate said switch.

15 36. A telephone system including telephone lines, terminals for said lines disposed in multiply related groups, selective switching mechanisms, one for each group normally at rest, a distributor switch common to said switches and lines, line relays, one
20 for each line, a connection extending from the line relay of each line to its multiple terminals, a conductor for said distributor switch, branch connections from said conductor to said line relays, armature mechanism for each relay controlling said connections adapted, when a relay is operated by
25 currents over its line, to alter the normal electrical condition of the multiple terminals of its line to render them selectable and actuate said distributor switch, and connections between said distributor switch and said selective switching mechanism whereby the actuation of said switch is effective to
30 start an idle mechanism.

35 37. A telephone exchange system comprising a plurality of telephone lines, a plurality of associated link circuits, automatic switching means for extending the circuit of an idle one of said link circuits to include
40 a calling one of said telephone lines, electrically controlled master switch mechanism common to a plurality of said link circuits and responsive to a control exercised over a circuit including said calling telephone line to select an idle one of said link
45 circuits and to actuate said switching means to establish connection between it and said calling telephone line, and operators' means for extending the circuit of the selected link circuit to a desired called telephone line.
50

38. A telephone exchange system comprising a plurality of telephone lines, a plurality of associated link circuits, automatic switching means for extending the circuit
55 of an idle one of said link circuits to include a calling one of said telephone lines, electrically controlled master switch mechanism common to a plurality of said link circuits and responsive to a control exercised over a circuit including said calling telephone line
60 to select an idle one of said link circuits and to actuate said switching means to establish connection between it and said calling telephone line, and connecting plugs and jacks constituting terminals of said link circuits
65

and certain of said telephone lines respectively by which a selected link circuit may be connected to a desired telephone line.

39. A telephone exchange system comprising a plurality of telephone lines, a plurality of associated link circuits, interconnecting means for uniting calling telephone lines and idle link circuits comprising automatic selecting switches each having an active contact and a plurality of passive contacts severally assigned to said telephone lines, electrically controlled master switch mechanism common to a plurality of said link circuits and responsive to a control exercised over a circuit including a calling telephone line to select an idle one of said link circuits and to actuate the active contact of an idle selecting switch to cause it to seek out and establish connection with the passive contact of the calling line to which it has access, and operators' means for extending the circuit of the selected link circuit to a desired called telephone line.

40. A telephone exchange system comprising a plurality of telephone lines, a plurality of associated link circuits, interconnecting means for uniting calling telephone lines and idle link circuits comprising automatic selecting switches, each having an active contact and a plurality of passive contacts severally assigned to said telephone lines, electrically controlled master switch mechanism common to a plurality of said link circuits and responsive to a control exercised over a circuit including a calling telephone line to select an idle one of said link circuits and to actuate the active contact of an idle selecting switch to cause it to seek out and establish connection with the passive contact of the calling line to which it has access, and connecting plugs and jacks constituting terminals of said link circuits and certain of said telephone lines respectively by which a selected link circuit may be connected to a desired telephone line.
110

41. In a call-distributing telephone exchange system, the combination of an automatic switch having a movable testing wiper; of a testing and connecting relay connected with said wiper; an armature contact of said relay adapted to stop the movement of said testing wiper; a local circuit controlled by an armature contact of said relay by which the energization thereof may be continued independently of said testing wiper, substantially as described.
115

42. In a call-distributing telephone exchange system, an automatic switch having a movable testing wiper; waiting contacts adapted to be connected with by said wiper; a source of current; a circuit connecting said waiting contacts to said source; means for isolating said contacts from said source of current; a testing and connecting relay having a winding connected between said source
120
125
130

of current and said testing wiper, and adapted to be energized when said testing wiper engages a waiting contact connected to said source; and a local circuit controlled
5 by an armature contact of said relay whereby the energization of said testing relay may be continued independently of the isolation from the current source of said engaged waiting contact, substantially as described.

10 43. In a signaling system, the combination with a subscriber's station, of a cord circuit, a "common" battery connected to said cord circuit, a set of movable contacts fixed with relation to each other and means
15 for controlling said movable contacts, said set of movable contacts comprising contacts for connecting the subscriber's station with said cord circuit and a contact adapted to close a circuit for the said means for controlling the set of contacts through said
20 "common" battery simultaneously with the connection of the subscriber's station with the cord circuit and means actuated by current in the signaling circuit for closing a local circuit through said "common" bat-
25 tery and means for controlling the movable contacts but not passing through any of the contacts of said set.

44. In a signaling system, the combination with a subscriber's station provided with the usual receiver hook, of signaling
30 conductors, a set of movable contacts fixed with relation to each other and means for controlling said movable contacts, said set of movable contacts comprising contacts for
35 connecting said signaling conductors with said subscriber's station and a contact adapted to close a circuit for the said means for controlling the said set of contacts simultaneously with the connection of the sub-
40 scriber's station with the signaling conductors and contacts at the subscriber's station actuated by the receiver hook for controlling the said means for controlling the said set of movable contacts.

45. In a signaling system, the combination with a subscriber's station having a receiver hook, of a cord circuit, a "common"
50 battery connected to said cord circuit, a set of movable contacts fixed with relation to each other and means for controlling said movable contacts, said set of movable contacts comprising contacts for connecting the subscriber's station with said cord circuit
55 and a contact adapted to close a circuit for the said means for controlling the set of contacts through said "common" battery simultaneously with the connection of the subscriber's station with the cord circuit and
60 contacts at the subscriber's station actuated by the receiver hook for controlling the said means for controlling the said set of movable contacts.

46. In a telephone call distributing sys-

tem, the combination with a plurality of 65 telephone lines extending to appropriate connection terminals at a central office, a connecting circuit provided with means adapted to be moved manually for complet-
ing connection with any line at the connec- 70 tion terminals thereof, an automatic switch upon which said connecting circuit terminates, said switch also having connection with said telephone lines and being adapted to unite said connecting circuit with any of 75 said lines, a switch controlling said connecting circuit and normally maintaining the conductors thereof open, and electrically actuated means adapted to effect the operation of said switch to close the conductors of 80 the connecting circuit after said automatic switch has operated.

47. In a telephone call distributing system, the combination with a plurality of 85 telephone lines each extending from a substation to a connection terminal at a central office, a connecting cord circuit provided with a terminal adapted to make connection with any of said lines at the connection 90 terminal thereof, a finder switch having movable terminals associated with said connecting cord circuit and cooperating stationary terminals connected with the aforesaid tele-
phone lines, means actuated in initiating a call of said lines adapted to alter the elec- 95 trical condition of a stationary switch terminal associated with that line, means for causing the movable terminals of said finder switch to traverse the stationary terminals thereof, and an electrically actuated switch 100 responsive to the altered electrical condition of said stationary terminal associated with the calling line, said switch having its contacts included in the conductors of said connecting circuit and adapted to close the same 105 when said switch is actuated.

48. In a telephone call distributing system, the combination with a plurality of telephone 110 lines each extending from a substation to a spring jack at a central office, of a plug terminated connecting cord circuit adapted to complete connection with any of said lines at the spring jack thereof, a finder switch hav-
ing movable terminals on which said connec- 115 ting cord circuit terminates and stationary terminals connected with the aforesaid telephone lines, mechanism for causing said movable terminals to traverse said station-
ary terminals, means associated with each line adapted to alter the condition of an as- 120 sociated stationary switch terminal in the act of initiating a call in said line, a device adapted to arrest the movement of said movable terminals, an electro-magnetic switch having its contacts included in the conduc- 125 tors of said connecting circuit, and adapted to close the same when said switch is actuated, and means responsive to the said altered

condition of the switch terminal associated with the calling line adapted to actuate said electro-magnetic switch.

49. In a telephone call distributing system, the combination with a plurality of finder switches each provided with stationary and movable terminals, and each having a connecting circuit associated with the movable terminals thereof, of a plurality of telephone lines multiplied to the stationary terminals of said switches, a relay associated with each line and made operative in the initiation of a call therein, said relay being adapted to change the electrical condition of a stationary terminal associated with said line on each of said finder switches, electrically operated mechanism adapted to cause the movable terminals of said finder switches to traverse the stationary terminals thereof, an actuating circuit for said mechanism, a relay associated with the movable terminals of each of said switches adapted to control the actuating circuit of said mechanism, said relay being responsive to the changed electrical condition of the terminal of a calling line when connection is completed therewith and a circuit closed by said relay when the same is energized adapted to restore to normal the electrical conditions of the aforesaid changed stationary terminals of said line on each of said switches, whereby the other switches are prevented from completing connection with the calling line.

50. In a telephone call distributing system, the combination with a finder switch having stationary and movable terminals, of a connecting circuit associated with the movable terminals of said switch, a plurality of telephone lines connected to the stationary terminals thereof, an electro-magnetic switch having its contacts arranged in said connecting circuit to normally maintain the same discontinuous, mechanism for causing the movable terminals of said switch to traverse the stationary terminals thereof, an electrically actuated device for arresting the movement of said movable terminals, means associated with each of said lines adapted to change the electrical condition of a stationary terminal associated therewith on said finder switch in initiating a call therein, and an actuating circuit for the aforesaid electro-magnetic switch and said stopping device energized by the changed electrical condition of said stationary terminal when the same is engaged by the cooperating movable terminal of the switch.

51. In a telephone call distributing system, the combination with a finder switch having stationary and movable terminals, of a plug terminated connecting circuit associated with the movable terminals of said switch, a plurality of telephone lines connected with the stationary terminals there-

of, said lines also being connected with connection terminals on a central switchboard, an electro-magnetic switch having its contacts arranged in said connecting circuit to maintain the same normally discontinuous, mechanism for causing the movable terminals of the switch to traverse the stationary contacts thereof, an electrically actuated device adapted to arrest the movement of said movable terminals, and an actuating circuit for said device and the aforesaid electro-magnetic switch, controlled jointly through the medium of the aforesaid connecting circuit plug and the associated connection terminal, and the telephone line with which the movable terminals of said switches have completed connection.

52. In a telephone call distributing system, the combination with a plurality of telephone lines each extending from a substation to a spring jack on a central office switchboard, of a plug terminated connecting circuit adapted to complete connection with any of said lines at the connection terminal thereof, a finder switch having movable and stationary contact terminals, said connecting circuit being connected to said movable terminals and said telephone lines being connected with the stationary terminals of the switch, electrically actuated mechanism for causing said movable terminals to traverse said stationary terminals, means made operative in initiating a call over any of said telephone lines adapted to alter the condition of an associated stationary switch terminal, and to effect the actuation of said mechanism for moving the movable switch terminals, and means for arresting the movement of said movable terminals responsive to the changed condition of said stationary terminal.

53. In a telephone call distributing system, the combination with a plurality of lines each extending from a substation to a connection terminal at a central office, a connecting circuit provided with a terminal adapted to make connection with any of said lines at the connection terminal thereof, a finder switch having movable contacts associated with said connecting circuit and stationary contacts connected with the aforesaid telephone lines, mechanism for causing the movable contacts of said switch to traverse the stationary contacts, a device adapted to stop the movement of said movable contacts and cause them to rest upon particular ones of said stationary contacts to extend the line terminating through to said connecting circuit, and means actuated in the withdrawal of said connecting circuit terminal from the connection terminal of a line with which it is connected to render inoperative said stopping device to permit the movable switch contacts to continue their movement.

54. In a telephone call distributing sys-

tem, the combination with a plurality of telephone lines extending to appropriate terminals at a central office, and a connecting circuit provided with a terminal for making connection with said lines, of an automatic finder switch adapted to extend the circuit of said lines to said connecting circuit, a motor for operating said finder switch, a device adapted to stop said motor in any predetermined position of said switch, and an actuating circuit for said stopping device controlled in registering contacts of said connecting circuit terminal and the terminal of the line with which it is connected.

55. 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 automatic finder switches to which said lines are multiplied, a plurality of connecting cord circuits to a particular one of which each of said finder switches is adapted to extend the connection of any of the aforesaid lines, said cord circuits being located on different operators' positions, a terminal for each of said connecting cord circuits wherewith connection may be completed with any of the aforesaid lines at the connection terminal thereof, mechanism adapted to cause the movement of said finder switches, actuating means for said mechanism controlled in initiating a call in any of the aforesaid lines, and means adapted to arrest the movement of the finder switch to complete connection with the calling line.

56. In a telephone call distributing system, the combination with a plurality of telephone lines extending to connection terminals at a central office, of a plurality of finder switches to which said lines are multiplied, a plurality of connecting cord circuits with a particular one of which each of said finder switches is adapted to connect any of the aforesaid lines, said cord circuits being located at different operators' positions, a terminal connected with each of said cord circuits and adapted to cooperate with the connection terminal of any of said lines to complete connection therewith, electrically operated mechanism for effecting the movement of said finder switches, an actuating circuit for each of said mechanisms, and a manually operated switch in each circuit adapted to prevent or permit the operation of the same, whereby the calls may be caused at will to fall to the cord circuits at any operator's position.

57. 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 distributing switches to which said line is multiplied, a connecting cord circuit for each of said distributing switches to which said line is

adapted to be extended, a terminal for each of said cord circuits adapted to be moved manually to complete connection between the aforesaid line and other lines, mechanism for simultaneously moving said switches to cause one or another to extend the connection of the aforesaid line to its associated cord circuit, and means for causing the actuation of said mechanism made operative in the act of initiating a call in the aforesaid line.

58. In a telephone call distributing system, the combination with a plurality of distributing switches, each of said switches having stationary terminals, and movable terminals adapted to traverse said stationary terminals and make contact therewith, of a connecting cord circuit associated with the movable terminals of each of said switches, a plurality of telephone lines multiplied to the stationary terminals of the aforesaid switches, mechanism for actuating said switches to cause the movable terminals to traverse the stationary terminals, means associated with each switch adapted to arrest said movement, leaving said movable terminals in contact with certain of the stationary terminals of the switches, means associated with each distributing switch and adapted to alter the condition of a terminal of said line on each of said switches, means made operative in initiating a call in any of said lines to start the movement of said actuating mechanism, said means for stopping the movement of said switches being responsive to the changed condition of the terminals of the calling line, and means actuated by the completion of connection between the movable members of any of said switches and the terminals of the calling line to neutralize or restore to normal the altered condition of the terminals of said line, whereby the movable members of only one of said switches is stopped in contact with the terminals of the calling line.

59. In a telephone call distributing system, the combination with a plurality of telephone lines extending to a distributing switch at a central office, a connecting cord circuit having a terminal adapted to make connection with any of the aforesaid lines, said connecting cord circuit terminating upon a movable member of said distributing switch and being adapted thereby to be brought into connection with any of said lines, mechanism for moving the movable member of the switch from its normal position to a position where it may establish connection between the cord circuit and any of said lines, and means made operative in disconnecting the terminals of said connecting cord circuit from any line with which it may be connected to return the movable member of the switch to its normal position.

60. The combination with a plurality of

telephone lines, a connecting cord circuit, and a distributing switch adapted to extend the circuit of any of said lines to the connecting cord circuit of mechanism adapted to restore said distributing switch to its normal resting position after it has been moved to complete connection with any line, cooperating terminals of said telephone lines and said connecting cord circuit for completing connection between the same, and means for energizing said switch restoring mechanism made operative in the act of disconnecting the cooperating terminals of said cord circuit and any telephone line with which it is temporarily associated.

61. In a telephone call distributing system, the combination with a plurality of telephone lines extending to stationary terminals of a distributing switch, of a connecting circuit terminating upon movable terminals of said switch, a terminal device for said connecting circuit adapted to cooperate with said line connection terminals, mechanism for causing the movable terminals of the distributing switch to traverse the stationary terminals thereof, a device adapted to stop said movement to extend the connection of any predetermined line to said connecting circuit, and means for neutralizing said stopping device to permit the continued movement of said movable terminal, said neutralizing means being rendered operative upon the withdrawal of the line connection terminal from the connection terminal of any associated telephone line.

62. In a telephone call distributing system, the combination with a plurality of telephone lines extending to the stationary terminals of a distributing switch, and also having connection terminals on a central office switchboard, of a connecting circuit terminating at one end on movable terminals of said distributing switch, and at the other end on a terminal device adapted to cooperate with the aforesaid line connection terminals, mechanism for causing the movable terminals of said distributing switch to traverse the stationary terminals thereof, means for stopping said mechanism to cause said movable terminals to come to rest upon any predetermined one of said stationary terminals, and a device controlled by said mechanism itself for rendering the same inoperative after a predetermined movement of said movable switch terminals.

63. The combination with two telephone lines extending to appropriate terminals at a central office, of a connecting circuit adapted to connect said lines for conversation, a terminal device at one end of said connecting circuit adapted to be moved manually to complete connection with the terminal of one of said lines, an automatic switch at the other end adapted to join said connecting circuit with the other telephone line, means for moving said switch to establish and disestablish connection between said lines, and means under the joint control of the manually moved terminal device of said connecting circuit and the line associated with said automatic switch for actuating said mechanism to sever the connection between the lines after its establishment.

64. The combination with a finder switch, of a plurality of telephone lines extending to stationary terminals thereof, and switchboard connection terminals to which said lines are also joined, of a connecting circuit terminating at one end on movable terminals of said switch and at the other end on a terminal device adapted to be moved manually to complete connection with any of said lines at the connection terminal thereof, electrically operated mechanism for moving said movable terminals to establish and disestablish connection between any of said lines and said connecting circuit, an actuating circuit for said mechanism, and means under the joint control of the line with which connection is established by said connecting circuit, and of cooperating contacts of said manually moved terminal device and the connection terminal of another line, adapted to control said actuating circuit to bring about the disconnecting movement of said mechanism.

65. In a telephone call distributing system, the combination with a switch having stationary and movable terminals, of a connecting circuit having a source of current therein associated with said movable terminals, a telephone line connected with said stationary terminals and also having an independent connection with said source of current, a cut-off relay controlling the connection of the source of current with the telephone line, and an actuating circuit for said cut-off relay completed in contacts of the aforesaid switch when the same is operated, whereby the operation of said switch to apply current to the line by way of said connecting circuit operates said cut-off relay to sever the connection through which current is normally applied to the line.

66. The combination with a telephone line extending from a telephone switch at a substation to a central office, of a distributing switch having stationary contacts and a finding arm adapted to move over the stationary contacts and complete connection therewith, said line being connected to certain of the stationary contacts of said switch, means for moving said arm controlled in said telephone switch, means controlled by the telephone switch for changing the electrical condition of a terminal of said line, and means for stopping the

movement of said arm responsive to the changed electrical condition of the terminal determined by said telephone switch.

67. The combination with a telephone
5 connecting cord circuit, of a finder switch
associated therewith having movable and
stationary terminals, said connecting cord
being connected to the movable terminals
of said switch, a plurality of telephone
10 lines connected with the stationary terminals
of said switch, mechanism for causing
the movable terminals of the switch to traverse
the stationary terminals thereof, means
associated with each of said telephone lines
15 adapted in the act of calling to render said
mechanism operative and to change the electrical
condition of the corresponding stationary
terminal on the finder switch, and
means adapted to stop the movement of
20 said movable terminal responsive to the
changed condition of the terminal of any
of said lines.

68. In a telephone call distributing system,
the combination with a plurality of
25 lines extending to stationary terminals of a
distributing switch, of a connecting circuit
terminating upon movable terminals of said
switch, mechanism for causing said movable
terminals to traverse said stationary
30 terminals, means made operative in initiating
a call in said line adapted to actuate
said switch moving mechanism and to
change the condition of an associated switch
terminal of said line, and means responsive
35 to the changed condition of the terminal of
the calling line adapted to arrest the movement
of the movable terminals and cause
them to extend the circuit of said line to the
aforesaid connecting circuit.

69. The combination with a group of telephone
lines, a plurality of switches associated
therewith, a plurality of operators'
positions, and groups of connecting circuits
for each position terminating at different
45 ones of said positions, the other ends of individual
members of each group being associated
with different ones of said switches,
and means for operating said switches in
response to calls whereby calls from said
50 lines may be distributed among the various
positions.

70. The combination with groups of telephone
lines, a group of finder switches for
each group of lines to which the lines comprising
the groups are respectively multiplied,
55 a connecting circuit associated with each
finder switch in each group, a number
of operators' positions, the connecting circuits
of the same group terminating each
before a different one of said operators'
60 positions, and means controlled by any of said
lines for causing the first connecting circuit
leading to an idle operator's position to be
associated with the calling line by its finder
65 switch.

71. In an automatic telephone system, the
combination with a plurality of normally
open instrument circuits having terminal
contacts arranged in a switch bank, another
70 bank of contacts comprising terminals corresponding
to each instrument circuit and normally
closed branch circuits leading therefrom,
separate wipers co-operating with each
bank of contacts, a relay associated
75 with each instrument circuit and adapted
to be operated to open the corresponding
branch circuit when its respective line
circuit is closed, of normally inoperative
electromagnetic operating mechanism
adapted to advance said wipers, a starting
80 circuit which is energized when an instrument
circuit is closed, said mechanism receiving
current to continue its subsequent operation
each time the wiper engages the terminal
of a closed branch circuit. 85

72. In an automatic telephone system, the
combination with a plurality of normally
open instrument circuits having terminal
contacts arranged in a switch bank, normally
closed operating circuit branches and
90 normally open starting circuit branches corresponding
to each instrument circuit, terminals
for the operating circuit branches arranged
in a switch bank and wipers co-operating
with said banks, automatic operating
95 mechanism for advancing said wipers
which is adapted to be actuated upon the
closing of a branch starting circuit and
to continue the movement of the wipers
during the successive engagement of one of
100 them with terminals of closed operating
circuit branches and means associated with
each instrument circuit and adapted to be
actuated when the latter is closed for
reversing the condition of the branch circuits
105 corresponding thereto.

73. In an automatic telephone system, the
combination with a plurality of normally
open instrument circuits having terminal
contacts arranged in a switch bank, normally
closed operating circuit branches and
110 normally open starting circuit branches corresponding
to each instrument circuit, terminals
for the operating circuit branches arranged
in a switch bank and wipers co-operating
with said banks, of a line relay bridged
115 to each instrument circuit and adapted to
open its corresponding branch operating
circuit, wipers co-operating with the
different banks of contacts and electromagnetic
operating mechanism for automatically
120 advancing said wipers progressively
which is adapted to be actuated by the
closing of a branch starting circuit and
to continue the movement of the wipers
125 during the successive engagements of one
of them with the terminals of closed
operating circuit branches and a cut-off
relay for each instrument circuit for
opening its line relay bridge which is
130 adapted to be actuated upon

the cessation of movement of the switching mechanism.

74. In an automatic telephone system the combination with a plurality of normally open instrument circuits, normally closed operating circuit branches and normally open starting circuit branches corresponding to each instrument circuit, terminals for the instrument circuits and the operating circuits arranged in switch banks, and wipers co-operating with them, of mechanism for advancing the wipers comprising a relay and a motor magnet having a normally open circuit provided with contacts controlled by the relay, a circuit for the latter adapted to be energized by the closing of any of the branch starting circuits to be subsequently energized while one of the wipers engages terminals of closed operating circuit branches, means for breaking the motor magnet circuit upon each step of the wipers and means for reversing the normal condition of the starting and operating circuit branches associated with each circuit.

75. In an automatic telephone system, the combination with a plurality of normally open telephone instrument circuits and a plurality of switching mechanisms having wipers and banks of contacts co-operating therewith in each of which appears a terminal for each instrument circuit, of normally inoperative electromagnetic devices for advancing said wipers which are adapted to be actuated when an instrument circuit is closed and to automatically advance said wipers over the terminals of open instrument circuits and to arrest them in engagement with the terminals of a closed instrument circuit, a starter switching mechanism common to all the instrument circuits having terminals corresponding to each switch mechanism and adapted to be placed in circuit with the operating devices thereof to permit their actuation, brushes co-operating with said terminals and means for advancing them onto the terminals of an inactive switch mechanism.

76. In a telephone exchange system, the combination with a plurality of normally open instrument circuits, of a switching mechanism comprising terminals for said circuits, a movable contact element co-operating with said terminals and electromagnetic operating mechanism therefor, an operating circuit for the operating mechanism, including a second contact element moving with the first and operating circuit branches, corresponding to each instrument circuit, terminals for said branches co-operating with said second element, a relay associated with each instrument circuit adapted to be energized when its respective instrument circuit is closed to open the corresponding operating circuit branch, means for starting the switch operating mechanism,

when an instrument circuit is closed, and a source of current supply for said circuits.

77. In a telephone exchange system, the combination with a plurality of subscriber's instrument circuits which are normally open, a bank of contacts containing separate terminals for each of said circuits and an additional terminal associated with each circuit terminal, of switching mechanism comprising two movable elements co-operating with said circuit terminals and associate terminals, respectively, and electromagnetic operating devices therefor, an operating circuit for the latter which is closed successively as one of the movable contact elements advances progressively over the associate terminals, a relay which is adapted to be operated, when a subscriber's circuit is closed, to render the operating circuit of the switching mechanism inoperative, when its contact elements respectively engage the terminal of said closed circuit and its associate terminal, and a source of current supply for said circuits.

78. In a telephone exchange system, the combination with a plurality of full metallic subscribers' circuits each of which is normally open and comprises two line conductors, a bank of contacts containing separate terminals for each of said conductors, arranged in sets, and an additional terminal associated with each set of line circuit terminals, of switching mechanism comprising movable contact elements co-operating with the sets of circuit terminals and associate terminals respectively, electromagnetic operating devices for moving said elements progressively, an operating circuit for said operating devices which includes one of the contact elements and the normally closed branches leading from each associate terminal, a relay associated with each subscriber's circuit which is operated, when its respective subscriber's circuit is closed, to open the corresponding operating circuit branch and a source of current supply for said circuits.

79. In a telephone exchange system, the combination with a plurality of normally open instrument circuits, of a switching mechanism comprising terminals for said circuits, a movable contact element co-operating with said terminals and electromagnetic operating mechanism for moving said element, other terminals on the switch one of each of which corresponds to each instrument circuit and normally closed circuit branches leading therefrom, of a second contact element co-operating with said terminals, an operating circuit connected to said second contact element and receiving current successively from the circuit branches to energize the operating mechanism, a relay for each instrument circuit which is operated when its respective instrument circuit is closed to open one of the operating circuit

branches, means for starting the switch-operating mechanism, when an instrument circuit is closed, and a source of current supply for said circuits.

5 80. In a telephone exchange system, the combination with a plurality of instrument circuits, an additional normally closed circuit branch corresponding to each instrument circuit, a switching mechanism comprising
10 separate sets of terminals for each instrument and branch circuit and separate wipers co-operating with the different sets of terminals, of an electromagnetic mechanism, for operating said wipers, an operating
15 circuit therefor which includes one of said wipers, means for starting the switch mechanism, when an instrument circuit is closed, means for opening the operating circuit branch corresponding to said closed instrument circuit to arrest the movement of
20 the wipers and a source of current supply for said circuits.

81. In a telephone exchange system, the combination with a plurality of instrument
25 circuits, an additional normally closed circuit branch corresponding to each instrument circuit, a switching mechanism comprising terminals for each instrument circuit and circuit branch arranged in separate sets
30 and separate contact elements co-operating with the different sets of terminals, of an electromagnetic mechanism for operating said elements, a normally open operating circuit therefor which includes one of said elements,
35 means for closing said circuit to start the operating mechanism, when an instrument circuit is closed, and open the operating circuit branch corresponding to said instrument circuit, to arrest the mechanism
40 when the operating circuit element engages the terminals of the open branch and a source of current supply for said circuits.

82. In a telephone exchange system, the combination with a plurality of normally
45 open instrument circuits, an additional normally closed circuit branch corresponding to each instrument circuit, and switching mechanism comprising terminals for each instrument circuit and circuit branch,
50 said terminals being arranged in sets, of separate contact elements co-operating with the separate sets of terminals, electromagnetic mechanism for operating the elements, a normally open operating circuit therefor
55 including one of the elements and each circuit branch as said element successively engages its terminals, means under the control of each instrument circuit which is actuated when the latter is closed to open its
60 associate circuit branch and close the operating circuit and a source of current supply for said circuits.

83. In a telephone system, the combination with a plurality of instrument circuits,
65 an actuating relay for each circuit and a

separate circuit for said relay adapted to be energized when its respective instrument circuit is closed, a cut-off relay controlling each actuating relay circuit and a separate circuit for each cut-off relay, of a switching
70 mechanism comprising contacts forming terminals for one part of each of the last mentioned circuits and a contact element co-operating therewith and forming the other part of each of said circuits, electromagnetic
75 mechanism for operating the element successively into engagement with the terminals, a circuit therefor which is controlled by each of said actuating relays and a source of current supply for said circuits.

84. In a telephone system, the combination with a plurality of instrument circuits, an actuating relay associated with each of said circuits, a separate circuit for said relay adapted to be energized when its
85 respective instrument circuit is closed and a cut-off relay controlling each actuating relay circuit, of a switching mechanism comprising a plurality of terminals and a movable contact element co-operating therewith,
90 a circuit for each cut-off relay which includes the element and one of the terminals, electromagnetic mechanism for operating the element, an operating circuit for said mechanism and means for rendering the cut-off
95 relays inoperative during the movement of the element, said operating circuit and said means being controlled by the actuating relay and a source of current supply for said circuits.

85. In a telephone system, the combination with an instrument circuit, an actuating relay, a circuit therefor which is energized when the instrument circuit is closed, a cut-off relay controlling said relay circuit, and
105 a switching mechanism comprising a terminal and a contact element co-operating therewith but normally disengaged therefrom, a conductor leading from the terminal to the cut-off relay and another conductor leading to the element, said two conductors forming
110 a circuit for the cut-off relay, when the element engages the terminal, of electromagnetic mechanism for operating the element, a starting circuit therefor having contacts which are closed when the element is in its normal
115 position and other open contacts adapted to be closed by the actuating relay to start the operating mechanism and to open the closed contacts, and a source of current supply for
120 said circuits.

86. In a telephone system, the combination with a plurality of instrument circuits, an actuating relay for each of said circuits having a circuit which is energized when the
125 instrument circuit is closed, a switching mechanism comprising a plurality of terminals and a movable contact element cooperating therewith, electromagnetic mechanism for operating the element, a starting circuit
130

therefor having normally open contacts adapted to be closed by each of the actuating relays and also having an opening which is closed only when the element is in its normal position, of an operating circuit which includes the element and the circuit branches, corresponding to the instrument circuits, leading from each terminal, said branches having normally closed contacts adapted to be opened when the corresponding starting circuit is energized and a source of current supply for said circuits.

87. In a telephone system, the combination with a plurality of instrument circuits, a switching mechanism comprising terminals corresponding to said circuits and a contact element co-operating therewith, of electro-magnetic mechanism for operating it, a starting circuit therefor comprising branches corresponding to each instrument circuit having normally open contacts, an operating circuit leading through the element and comprising branches having normally closed contacts through which the circuit is completed as the element moves over the terminals successively, a relay for each instrument circuit adapted to reverse the condition of the starting and operating circuit branches corresponding to its respective instrument circuit, means for opening the starting circuit after the operating circuit has been established and a source of current supply for said circuits.

88. A telephone system comprising a group of subscribers' stations, a normally at rest switch-operating machine allotted to said group and common to all of the stations included therein, subject to the control of any subscriber thereof, a suitable number of switching devices also allotted to said group, each provided with a bank of line terminals, suitable means whereby the said switch-operating machine may be set in operation by any subscriber in said group, a number of trunks, means whereby the said machine when set in operation causes one of said switches to establish connection between the line of the calling subscriber and one of said trunks, and means at the central exchange for supplying current over the subscriber's line for both talking and operating purposes.

89. An automatic telephone system comprising a plurality of subscribers' lines, a relay for each line, a plurality of switches of any suitable number, a normally at rest switch-operating machine provided with suitable means of communication for operating any one of said switches, said machine including an operating magnet controlled by and common to all of said relays, whereby the said machine may be used by any one of said lines for effecting the operation of one of said switches, and central office means

for supplying current through said switch to said line for talking purposes.

90. An automatic telephone system comprising a plurality of switches, a normally at rest switch-operating machine common to all of said switches, means through the medium of which said machine can operate any one of said switches independently of the others, without interfering with the subsequent use of said machine by other subscribers while one or more of said switches is or are in use for either talking or signaling purposes, each switch provided with a plurality of line terminals, and central office means for supplying current from the central office through said line terminals for talking purposes.

91. An automatic telephone system comprising a plurality of switches, a switch-operating machine, normally open means of communication between the said machine and the said switches, electro-magnetic means for opening and closing said means of communication, thereby permitting said machine to be employed for causing the desired operation of any one of said switches independently of the others, for closing a connection, automatic means whereby said machine, after causing the operation of one of said switches, is instantly disconnected therefrom and put in condition for use in operating other switches while the said operated switch remains in use for either talking or signaling purposes, each switch provided with a plurality of line terminals, and means located at the central office for supplying the current for talking purposes.

92. A step-by-step selective switching apparatus comprising a plurality of switches, a switch-operating machine common to all of said switches, means for employing the said machine to effect the operation of any one of said switches independently of the others, for closing a connection, automatic means whereby said machine, after operating a switch in the desired manner, is then available for use in operating other switches while the said operated switch remains in use for the desired purpose, each switch provided with a plurality of line terminals, and a central office battery adapted to be connected through said line terminals to furnish talking current for telephonic purposes.

93. An automatic telephone system comprising telephone lines, a plurality of switches associated with said lines, means for operating said switches, a relay allotted to each switch, each relay being adapted to both control the operation of said means and open and close communication between the same and one of said switches, and a central office battery for supplying talking current to said line through said switches.

94. A telephone system comprising a group

of telephone lines, a line-relay for each line, a group of trunk lines less in number than said telephone lines, a plurality of switches for connecting the telephone lines with said trunk-lines, a normally at rest mechanism or means for operating said switches, controlled by said relays, adapted for use by each calling subscriber in selecting an idle trunk-line, means for distinguishing between idle and busy trunk lines, substation devices for controlling the energizing of said relays, and a central office battery supplying current for talking purposes over said lines to the substations thereon.

95. In a telephone system, lines, non-numerical trunking switches associated with said lines, a common mechanism for controlling said switches, said mechanism being normally at rest, and a central office battery for supplying talking current through said non-numerical trunking switches independent of said common mechanism over said telephone lines to the substations thereon.

96. In a telephone system, a plurality of lines, a non-numerical trunk selecting mechanism associated with said lines comprising automatic means for connecting a line with an idle trunk, a common mechanism for controlling said means, said common mechanism provided with automatic means for selecting an idle trunk for said lines, relays at the central exchange, and means for supplying current from the central office battery through said relays to said lines for talking purposes.

97. In a telephone system subscribers' lines, finder switches less in number than said subscribers' lines, means for operating an idle one of said finder switches to cause it to connect with the calling subscriber's line when said calling subscriber removes his receiver, a trunk release circuit for said finder switch independent of the talking circuit, and a central office battery supply talking current to said subscribers' lines.

98. An automatic telephone system comprising a "selector" provided with four series of contacts, the contacts of two of said series being line-contacts, the third series consisting of "private-contacts", and the fourth series consisting of "release-trunk" contacts, together with a rotatable switch-shaft provided with wipers adapted to wipe over and engage the contacts of their respective series, and a manual connection terminal for extending a connection in the direction of a called line.

99. An automatic telephone system comprising calling and called subscribers' lines provided with call signaling devices, a central source of talking current, a selector provided with an electro-magnetic driving magnet and four series of contacts, two of said series being line-contacts, the third series consisting of "private-contacts", and the

fourth series consisting of release-trunk-contacts, together with a rotatable switch-shaft provided with wipers adapted to engage their respective series of contacts as they pass over the same, means for operating said signaling devices, means for temporarily disconnecting a called subscriber's line from the central source of talking current during the operation of producing a call-signal at the called subscriber's station, and a manual connection terminal for extending a connection in the direction of a called line.

100. An automatic telephone system comprising calling and called subscribers' lines connected up for conversation, a rotatable progressively movable step-by-step automatic switch included in said connection, one or more relay bridges located at the exchange and temporarily cut off from the talking circuit during conversation, the talking circuit being free from inductive resistance at points between the transmitting and receiving ends of the circuit, and a centralized source of current-supply connected to furnish talking current to the subscribers' lines.

101. A telephone system comprising calling and called subscribers' lines connected up for conversation, a rotatable progressively movable step-by-step automatic switch included in said connection, relays normally bridged across the talking circuit but detached therefrom during conversation, the talking circuit being free from inductive resistance in the path of the talking currents at points between the transmitting and receiving ends of the circuit, and a centralized source of current-supply connected for furnishing talking current to the subscribers' lines.

102. An automatic telephone system comprising subscribers' lines, rotatable progressively movable step-by-step automatic switches, a relay normally bridged across each line for controlling said switches, a talking circuit included in said lines, said talking circuit being at all times free from inductive resistance in the path of the talking currents at points between the transmitting and receiving ends of the circuit, means for cutting off or opening up the bridges in which said relays are located when the two lines are connected up for conversational purposes, and a centralized source of current-supply for furnishing talking currents to the subscribers' lines and for also furnishing the current necessary for operating the said relays before the bridges of the latter are cut off or opened up.

103. In a telephone exchange system, a series of line and multiple terminals and a series of automatically controlled switches, said multiple terminals being distributed among the banks of the respective switches, the terminals of each line being normally disconnected therefrom, and a cut-off relay

for each line controlled in making connection therewith to connect it with said terminals, substantially as described.

104. In a telephone exchange system, subscribers' lines, terminals for manual connection with the lines, automatic switches, connecting terminals distributed in the banks of automatic switches and normally disconnected from the lines, and means controlled through said connecting terminals to connect their line thereto.

105. In a telephone exchange system, subscriber's lines, manual terminals and multiple connecting terminals for each line, the former disposed in groups with line signals, and automatic switches having banks containing the latter, a relay for each line normally disconnecting the multiple terminals therefrom but adapted when connection is made with the line to connect the terminals thereto, and means for actuating the automatic switches adapted to be controlled by calling subscribers, substantially as described.

106. The combination with a metallic telephone line, of a test terminal therefor, a relay for disconnecting said test terminal from the telephone line when the line is not in use, a connecting circuit and an automatically controlled line connecting switch, a source of electricity bridged across said circuit and adapted to send current over the metallic telephone circuit for talking purposes, and means for supplying current to said relay to connect the test terminal when the line is calling or is called and connected, substantially as described.

107. In a telephone exchange system, the combination of a subscriber's telephone line, a spring jack for said line, an automatic switch provided with voice current conductors, a cord and plug adapted for insertion in said jack, for extending a connection, means for controlling said switch to establish a connection with said line, and common battery means for supplying current through said voice current conductors to said line for talking purposes.

108. In a telephone exchange system, the combination of a subscriber's telephone line, a spring jack for said line, an automatic switch provided with voice current conductors, a cord and plug adapted for insertion in said jack for extending a connection, means for controlling said switch to establish a connection with said line, common battery means for supplying current through said voice current conductors to said line for talking purposes, and a common battery circuit including contacts of said jack and plug.

109. In a telephone system, a jack, a switch bank, a line normally disconnected from said jack and bank, and means for automatically closing the connection to both the jack and

bank when connection is desired with the line through either one.

110. In a telephone system, a line, a terminal therefor normally disconnected therefrom, means responsive to a calling subscriber for seizing said terminal, and means automatically operated thereby for connecting the terminal to the line.

111. In a telephone system having a jack normally disconnected from its line, a terminal allotted to said line, means for connecting said jack to its line, means for automatically trunking to said terminal, means for thereby automatically closing connection between said terminal and the line, and releasing means for disconnecting from said terminal and thereby opening the connection between said terminal and the line.

112. In a telephone exchange system, the combination of a telephone line, a jack for said line, an automatic switch, and means for establishing a testing potential at said jack when the switch is used for making connection between said line and some other line.

113. A telephone system comprising a subscriber's line, a plurality of multiple spring jacks normally disconnected from the said line, a plurality of line terminals permanently connected with said spring jacks, but normally disconnected from the said line, operators' cord connecting means for use in connection with said spring jacks, automatic switching machinery for use in connection with said line terminals, and means for connecting the multiple jacks and line terminals to said line.

114. A telephone system comprising a subscriber's line, a spring jack normally disconnected from the said line, an electrically propelled and step-by-step actuated switch also normally disconnected from said line, and automatic means for connecting the line with the spring jack and the switch immediately upon such operation of said switch or said jack as is intended for establishing a connection with said line.

115. A telephone system comprising a subscriber's line, a spring jack normally disconnected from the said line, a switch normally disconnected from the said line, a relay controlling the normally open connection between the said jack and the line, and between the said switch and the line, together with an operator's cord circuit provided with a switch plug adapted for insertion in said jack, and means whereby the said relay is energized and the line thereby connected with both the jack and the switch whenever the switch is suitably operated or the cord plug inserted in the said jack.

116. A telephone system comprising a subscriber's line, a connector normally disconnected from the said line, a relay controlling the normally open connection between the said line and the connector, and means

whereby the said relay is energized and the connection closed whenever the connector is actuated to a position corresponding to the said line.

117. A telephone system comprising a subscriber's line, a spring jack normally disconnected from the said line, a cut-off relay adapted when energized to connect the jack with the line, a switch provided with a line terminal corresponding to said subscriber's line, means for supplying all necessary current, and an energizing circuit for said relay, said circuit including one of the contacts of said switch-line-terminal.

118. A telephone system comprising a subscriber's line, a cut-off relay for the said line, two energizing circuits for said relay, a switch for controlling one of said circuits, a spring jack and cord plug for controlling the other energizing circuit, and automatic means preventing the two circuits from being retained closed at the same time when the last-mentioned circuit is closed first.

119. A telephone system comprising a subscriber's line, a plurality of line terminals normally disconnected from the said line, a relay adapted when energized to connect the line with the said line terminals, two energizing circuits for said relay, and automatic means preventing the two energizing circuits from being retained closed at the same time when a particular one is closed first.

120. A non-restoring-wiper switch for telephone systems comprising only contacts and co-operating wipers, motor mechanism including a step by step motor magnet for operating said wipers, simple relays each having individually controlled contacts, circuit connections controlled by the contacts of said relays for operating said motor mechanism and wipers and restoring said switch, a source of current bridged across a subscriber's line, and a relay in the bridge circuit responsive to the closing of a bridge across said subscriber's line for operating said switch.

121. A telephone system comprising a calling telephone line, an automatic switch having contacts and co-operating wipers, a line relay, motor mechanism, including a step by step motor magnet controlled thereby for operating said wipers to connect with a set of contacts, simple relays each having individually controlled contacts and circuit connections only, for rendering said switch available for another operation without moving said wipers, and a battery bridged across said line through said line relay, said line relay being responsive to the closure of a bridge across the telephone line.

122. A non-numerical non-restoring-wiper automatic switch comprising bank terminals and co-operating wipers, relays, contacts for said relays, said contacts being individually

controlled by their respective relays, motor mechanism including a step by step motor magnet for operating said wipers, circuit connections controlled by the contacts of said relays for operating said motor mechanism and wipers to connect with a set of said bank terminals and restoring said switch, and a relay bridged in a battery circuit across a telephone line and responsive to the closure of a bridge across said line for controlling said switch.

123. A telephone exchange system including telephone lines extending from substations to an exchange, call signal devices operable by the apparatus at the stations of calling subscribers, link circuits for uniting telephone lines in conversation including manually controlled terminals serving to act upon circuits of said call signal devices to effect effacement of the signals occasioned thereby, and selecting mechanism jointly controlled by the telephone lines and link circuits for interchangeably associating said signal devices with calling telephone lines.

124. A telephone exchange system including telephone lines extending from substations to an exchange, call signal devices operable by the apparatus at the stations of calling subscribers, a plurality of groups of link circuits for uniting telephone lines in conversation, each link circuit including manually controlled terminals serving to act upon circuits of said call signal devices to effect effacement of the signals occasioned thereby, and selecting mechanism jointly controlled by the telephone lines and link circuits for interchangeably associating said signal devices with calling telephone lines.

125. A telephone exchange system including telephone lines extending from substations in multiple to different board sections at an exchange, call signal devices operable by the apparatus at the stations of calling subscribers, link circuits for uniting telephone lines in conversation including manually controlled terminals serving to act upon circuits of said call signal devices to effect effacement of the signals occasioned thereby, and automatically operated selecting switching mechanism associated with the answering ends of the link circuits and the telephone lines for connecting said link circuits with calling lines.

126. A telephone exchange system including telephone lines extending from substations in multiple to different board sections at an exchange, call signal devices operable by the apparatus at the stations of calling subscribers, link circuits for uniting telephone lines in conversation including manually controlled terminals serving to act upon circuits of said call signal devices to effect effacement of the signals occasioned thereby, and selecting mechanism jointly controlled by the telephone lines and link cir-

cuits for interchangeably associating said signal devices with calling telephone lines.

127. A telephone exchange system including telephone lines extending from substations in multiple to different board sections at an exchange, call signal devices operable by the apparatus at the stations of calling subscribers, a plurality of groups of link circuits for uniting telephone lines in conversation, each link circuit including manually controlled terminals serving to act upon circuits of said call signal devices to effect effacement of the signals occasioned thereby, and selecting mechanism jointly controlled by the telephone lines and links circuits for interchangeably associating said signal devices with calling telephone lines.

128. A telephone system including a subscriber's telephone line, electrically controlled switching means associated with said line, and means under the control of the subscriber for establishing a condition such as to cause said switching means to establish a definite connection and for returning said switching means to normal in case said condition is removed before said connection has been established.

129. A telephone system including a traveling switch having a definite range of movement, means for starting said switch in response to a control exercised from a distant point, and releasing means for restoring said switch to normal in case it runs to the end of its range of movement.

130. A telephone system including a traveling switch having a definite range of movement, means for starting said switch in response to a control exercised from a distant point, and means responsive to a control exercised at a distant point to restore said switch to normal in case it runs to the end of its range of movement.

131. A telephone system including a traveling switch having a definite range of movement, a control switch, a starting circuit operative to start said traveling switch upon the movement of said control switch to one position, and a release circuit operative to restore said traveling switch to normal upon the arrival of said traveling switch at the end of its range of movement and upon the movement of said control switch to another position.

132. A telephone system including subscribers' telephone lines, a plurality of connecting circuits, a plurality of automatic switches responsive to the removal of the receiver at the substation of one of said lines for connecting said line to an idle connecting circuit, and means for extending a connection from said connecting circuit to a called one of said lines.

133. A telephone system including subscribers' telephone lines, primary switches, rotary secondary switches, connecting cir-

cuits, operating mechanism for said switches, and means controlled by the removal of a receiver at a calling one of said telephone lines for operating the mechanisms of said primary and secondary switches to connect an idle connecting circuit with the calling line.

134. A telephone system including a subscriber's telephone line, a connecting circuit, a plurality of non-numerical switches for extending a connection from said line to said connecting circuit, and means controlled by the removal of the receiver at the substation of said line for effecting said connection.

135. In a telephone system, a plurality of non-numerical progressively movable trunk selecting switches controlled over the two sides of a line circuit in series, each switch having only a single level of trunk circuits and co-operating wipers, a connecting circuit, and means for successively operating said switches to reach said connecting circuit.

136. A telephone system including a calling subscriber's line and a called subscriber's line, a connecting circuit for connecting said lines, a plurality of successively operable non-numerical switches provided with a single level of contacts controllable over said calling line for connecting said calling line to said connecting circuit, and means for connecting said connecting circuit to said called subscriber's line.

137. A telephone system including subscribers' telephone lines, a connecting circuit, a plurality of non-numerical automatic switches responsive to the removal of a receiver at the substation of a calling one of said lines for connecting said line to said connecting circuit, and means for completing the connection to a called one of said lines.

138. The combination of a group of electrical lines, a second group of lines, a connection-determining device associated with each of the lines of the second group, means for rendering inoperative the connection-determining devices of busy lines and means for rendering operative the connection-determining device of one idle line and one only when a connection is to be made and then only.

139. The combination of a group of electrical lines, a second group of lines, a number of connection-determining devices arranged in a definite order of precedence and associated one with each of the lines of the second group, means for rendering inoperative the connection-determining devices of busy lines, means for rendering that one of the connection-determining devices associated with idle lines which is first in precedence operative when a connection is to be made and then only and means for preventing the operation of such connection-deter-

mining devices of idle lines as are lower in the order of precedence.

140. The combination of a group of electrical lines, a second group of lines, a connection-determining device associated with each of the lines of the second group, and means for momentarily rendering operative the connection-determining device of one idle line and one only to bring about a connection.

141. In a telephone system, a subscriber's line, a non-numerical automatic switch associated with said line responsive to the closing of a bridge across said line, a second subscriber's line, means for establishing connection from said first to said second subscriber's line, or from said second line to said first line, operating means for said switch bridged across the line, a magnet for disconnecting said operating means from across the line when said first line is calling, said magnet also for disconnecting said operating means from across the line when said first line is called and a centralized source of current for furnishing talking current to said subscriber's line.

142. A telephone system including telephone lines, link circuits, non-numerical step by step selective switches individual to the link circuits provided with wipers for selecting calling subscribers' lines, and release means for terminating the connection of said link circuits with said lines without altering the selective position of said switches.

143. A telephone system including subscribers' telephone lines, connector circuit for connection to called subscribers' lines, non-numerical step by step finder switches provided with wiper contacts and individual to the connector circuits for connecting said circuits to calling subscribers' lines, movable contact makers for said finder switches, and means for terminating the connection of a calling line with a connector circuit without altering the selective position of the contact makers of the finder switch.

144. A telephone system including a calling subscriber's telephone line, a link circuit, a non-numerical step by step finder switch provided with wiper contacts and individual to said link circuit for connecting with the calling subscriber's line when the calling subscriber initiates a call, and contact makers for said finder switch adapted to remain in their antecedent progressive position at the time of disconnection, so that should the subscriber immediately recall, the same link circuit will again be used without moving the contact makers of the finder switch.

145. A telephone system including subscribers' telephone lines, connector circuits for extending connections from calling to called subscribers' lines, non-numerical progressively movable line finding switches having line wipers and release mechanism and

individual to said connector circuits for connecting said connector circuits to calling subscribers' lines, and movable contact makers for said line finding switches adapted to remain in connection with the last calling line connected with.

146. A telephone system including a subscriber's line, a connecting circuit, an automatic switch adapted to assume a plurality of selective positions for connecting said line and said connecting circuit, means whereby said line may be disconnected from said connecting circuit without altering the antecedent progressive position of said switch, and means whereby the said line may be again connected to said connecting circuit via said automatic switch without moving the switch from its antecedent progressive position.

147. In a telephone exchange system, the combination of a telephone line, a bridge across said line, a private normal for said line, a bridge-cut-off relay for said line, a circuit for energizing said relay when the line is called, said circuit including said private normal, and a non-numerical step by step switch adapted to select said line and controlled by said bridge across said line.

148. A telephone system comprising a suitable line, a relay for said line, an electromagnet to be maintained energized when connection is extended to the line and the said relay is not to be used, means for rendering the said relay inoperative when the said magnet is energized, means for retaining the relay in operative relation to the line when the latter is used for calling in the opposite direction, and a non-numerical switch for extending a connection from said line controlled by said relay.

149. In a telephone system, a line, a bridge individual to said line and containing switch operating elements normally closed across said line, a bridge cut-off magnet, a connector provided with a pair of talking wipers for finding said line, a third wiper independent of the talking wipers for closing a circuit through said cut-off magnet when the line is seized as a called line, and centralized means for furnishing talking current through said talking wipers to said lines for talking purposes.

150. In an automatic telephone system, the combination of a non-numerical progressively movable "selector-switch" provided with a bridge including a switch-operating element, said switch adapted to select a telephone line, a bridge cut-off relay, a battery, and a normally open circuit including said bridge cut-off relay and battery, together with a "connector-switch" provided with a plurality of wipers, whereof one is a so-called "private" wiper, the said "private" wiper, when the "connector-switch" is operated, being adapted to close the cir-

cut of the said bridge cut-off relay, and a centralized source of current for furnishing talking current to said line.

151. In a telephone system, a central office, a telephone line terminating in said office, a plurality of automatic switches having access to said line, an operator's switchboard at said office, a plurality of multiply connected jacks at said switchboard normally disconnected from said line, a plurality of manually operable link circuits at said switchboard, and means including a relay effective when one of said switches is not connected to said line to connect any one of said link circuits through any one of said jacks to said line.

152. In a telephone system, a manual switchboard, a contact bank for automatic switches, a line terminating in said contact bank, a jack at said manual switchboard associated with said line, and a relay individual to said line under control of an operator at said manual switchboard effective to extend said line to said jack at said manual switchboard.

153. In a telephone system, a subscriber's line, an automatic switch adapted to find and connect to said line, a second subscriber's line, means for establishing connection from said first to said second subscriber's line, or from said second line to said first line, a line relay individual to said first subscriber's line and bridged across the same for controlling said automatic switch, and a cut-off relay for disconnecting said line relay from across the line when said first line is calling, said cut off relay also for disconnecting said line relay from across the line when said first line is called.

154. In a telephone exchange system, the combination of a telephone line, a normally disconnected terminal for said line, a line relay individual to said telephone line and adapted to be cut off from the line, a cut-off relay, means for connecting the terminal with the line when the cut-off relay is energized, means for disconnecting the line relay when the cut-off relay is energized, automatic means including a step by step binder switch for energizing the cut-off relay when the line calls, controlled by the calling subscriber, and means for energizing the cut-off relay when the line is called, together with means by which a calling subscriber controls said last mentioned energizing means.

155. In a telephone exchange system, the combination of a telephone line, a bridge on said line including a relay individual to the subscriber's line and adapted to be energized over the two sides of said line in series, a bridge cut-off relay, automatic means including a non-numerical finder switch for connection to said line and for energizing said relay when the line calls, controlled by the

calling subscriber, and automatic means for energizing the relay when the line is called.

156. In a telephone exchange system, the combination of a telephone line, a line relay individual to the said telephone line and adapted to be cut off from the line, a cut-off relay, a circuit for energizing said cut off relay, automatic means including a non-numerical step by step line finding switch for closing said circuit when the line calls, controlled by the calling subscriber, another circuit for energizing the cut-off relay when the line is called.

157. In a telephone exchange system, the combination of a telephone line, a line relay individual to the said telephone line and energizable over the two sides of said line in series and adapted to be cut off from the telephone line, a trunk line, automatic means including a non-numerical step by step line finding switch controlled by said line relay for connecting the telephone line with the trunk line, a cut-off relay, means for energizing the cut-off relay simultaneously with the establishment of connection with the trunk line, and means for energizing the cut-off relay when the telephone line is called.

158. In a telephone exchange system, the combination of a telephone line, a normally disconnected terminal for said line, a line relay energizable over the two sides of said telephone line in series and adapted to be cut off from the line, a cut-off relay, means for connecting the terminal with the line when the cut-off relay is energized, means for disconnecting the line relay when the cut-off relay is energized, automatic means, a progressively movable non-numerical switch for energizing the cut off relay when the line calls, controlled by the calling subscriber, means for energizing the cut-off relay when the line is called, and a centralized source of current for supplying talking current over said telephone line to a substation on said line.

159. In a telephone system, a subscriber's telephone line, a progressively movable non-numerical finder switch for extending connection thereto, means for establishing connection to said line, a line relay individual to said line and normally connected thereto, a cut-off relay individual to said line, means for energizing said cut-off relay to disconnect said line relay from the line when said line is used for calling purposes, means for energizing said cut-off relay to disconnect said line relay from the line at the time a connection is extended to said line as a called line and a battery located at the central exchange for supplying talking current to said subscriber's line.

160. An exchange system comprising a central station, telephone lines extending thereto, non-numerical switching mecha-

nisms to which the lines are connected, a unitary device individual to each line at the central station for controlling any one of its switching mechanisms, means individual to each switching mechanism for transferring the line control from it to another switching mechanism, and a central source of current for supplying talking current to said telephone lines.

10 161. An exchange system comprising telephone lines, non-numerical step by step binder switching mechanisms to a plurality of which each of the lines is connected, each switching mechanism including a plurality
15 of sets of fixed contacts and a set of movable contacts adapted in its travel to successively engage the sets of fixed contacts, starting means associated with each switching mechanism, line controlled means individual to
20 each line adapted to directly control the starting means of any one of the switching mechanisms to which the line is connected, and a central source of current for supplying talking current to said telephone line.

25 162. In a telephone system, the combination of a plurality of trunk-lines, a trunk-selecting switch mechanism under the control of the subscribers and adapted for selectively and successively appropriating the different trunk-lines for use, and adapted
30 to skip any trunk-lines which are busy, a busy-release mechanism or means adapted for use by any subscriber for effecting a disconnection when all of the trunk lines are
35 busy, and a centralized source of current

adapted to be connected to the subscribers' lines to supply the subscriber's substation with talking current.

163. In a telephone system, a group of lines, the combination of a plurality of
40 trunk lines, a movable trunk-line terminal member for each trunk-line, electro-magnetically actuated selecting and actuating devices common to said lines for selectively operating said terminal members, devices for
45 permitting the said selecting and actuating devices to always skip any of said members which are connected with busy trunk-lines, release circuits for effecting a restoration of the apparatus, and a centralized source of
50 current adapted to be connected to said group of lines to supply the substations thereon with talking current.

164. In a telephone system, a group of calling lines, a trunk line, a movable member for said trunk line, as many terminals
55 on said member as there are calling lines, mechanism common to said calling lines for establishing connections between said terminals and said calling lines, said mechanism
60 provided with means for moving said member for making the connections, and a centralized source of current adapted to be connected to said calling lines for supplying the substations thereon with talking current.
65

In witness whereof, I hereunto subscribe my name this 16th day of December A. D., 1904.

FRANCIS W. DUNBAR.