L. D. KELLOGG.

AUTOMATIC DISTRIBUTING SYSTEM.

APPLICATION FILED JUNE 15, 1907.

960,176. Patented May 31, 1910.

2 SHEETS—SHEET 1.

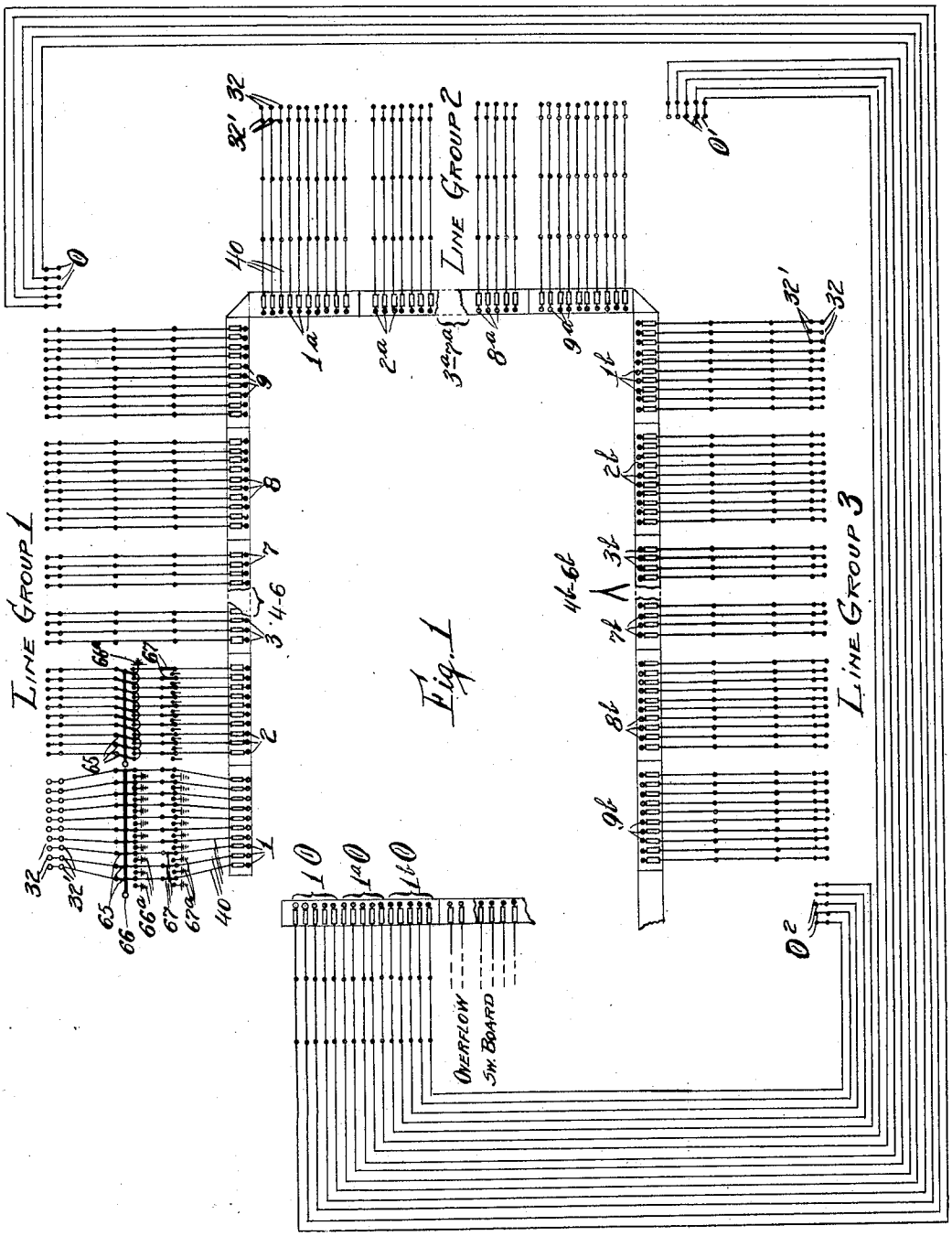

Fig. 1.

Witnesses

G. E. Muller

J. G. Kellogg

Inventor

Leroy D. Kellogg

L. D. KELLOGG.

AUTOMATIC DISTRIBUTING SYSTEM.

APPLICATION FILED JUNE 15, 1907.

960,176. Patented May 31, 1910.

2 SHEETS—SHEET 2.

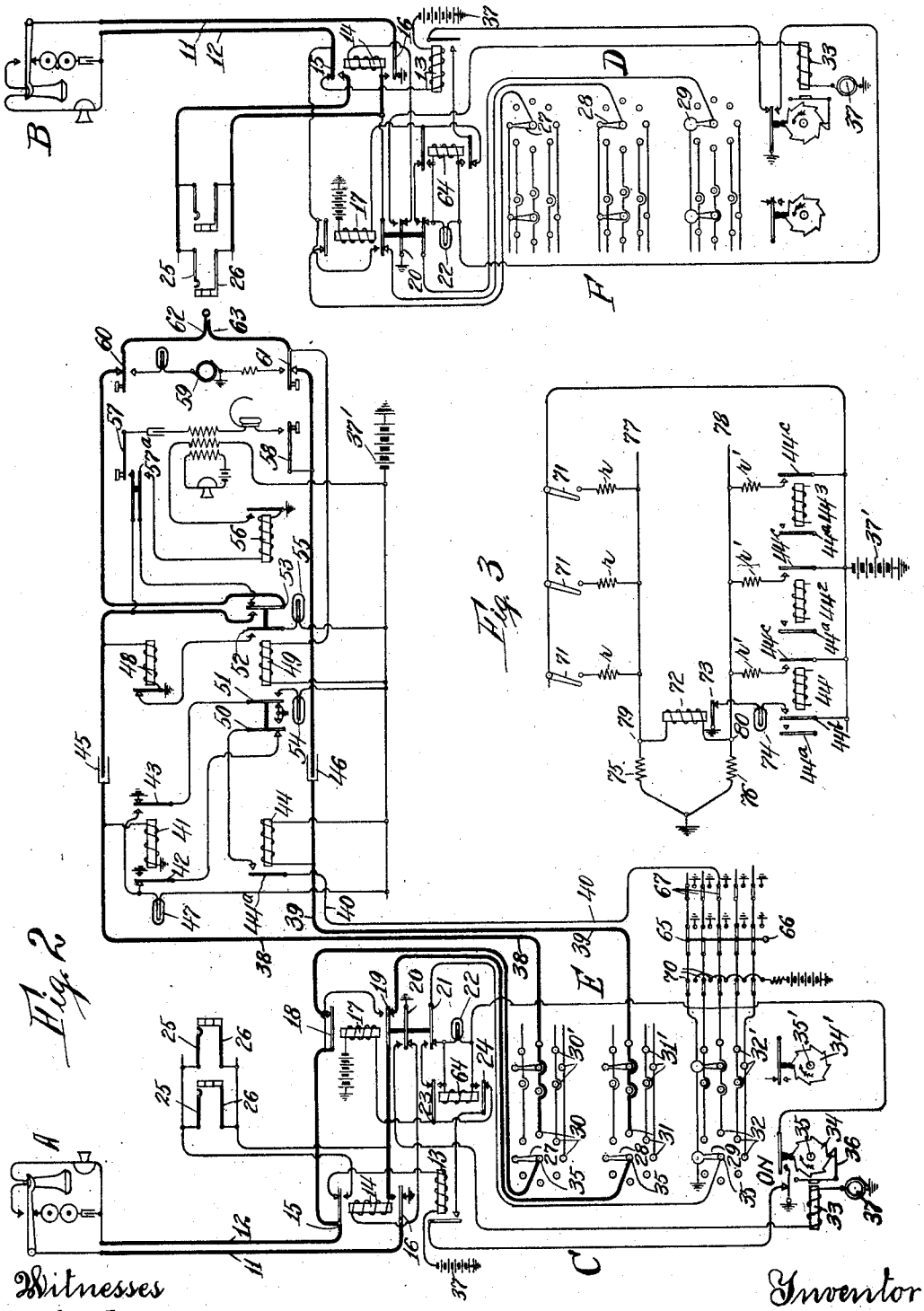

Fig. 2

Fig. 3

Witnesses

G. E. Mueller

J. G. Kellogg

Inventor

Leroy D. Kellogg

UNITED STATES PATENT OFFICE.

LEROY D. KELLOGG, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

AUTOMATIC DISTRIBUTING SYSTEM.

960,176. Specification of Letters Patent. Patented May 31, 1910.

Application filed June 15, 1907. Serial No. 379,233.

To all whom it may concern:

Be it known that I, LEROY D. KELLOGG, a citizen of the United States, and resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Automatic Distributing Systems, of which the following is a specification.

My invention relates to telephone systems wherein selective switches are employed to automatically distribute the incoming calls among the operators, concentrating the business before as many operators as are required to attend to the total business at a given period of the day, and has for its object the provision of means for producing certain economies in the operation of such system and a more complete concentration of calls.

In accordance with my invention, I provide a considerable number of cords, say, ninety-five in a group, in association with which is a selective switch to cause interchangeable connection of the cords with calling lines. Such a switch selectively picks out the particular cord to be used for any connection and is a restoring switch such that at its position of rest it has a definite serial relation to the cords of a group. I provide the cords with terminal contacts at the switch arranged in regular order so that when the switch starts from its position of rest, it tests the cords successively, making first a test of the cords to one operator's position, and thereafter a test of the cords to a second operator's position, and so on. If there is a contact of an idle cord of the first position, the selective switch will be sensitive to the electrical condition of that contact and will cause that cord to be used for the impending connection, and so for the other position.

The selective switch is started responsive to a call initiated over a subscriber's line and thus tests the cords for the purpose of causing the line to be connected to a cord at the first idle operator's position. Assume a group of lines capable, on initiation of calls, of causing the same cords to be tested after the manner described, and it will be apparent that the calls of the line-group will be condensed at a first operator's position until all its cords are busy, whereafter additional calls from said line-group coming in will go to a next operator's position, as long as all cords of the first are busy. For each call, a separate test of all cords serially from the first up to an idle cord is made, so that as soon as a cord becomes idle at the first position, the next initiated call will be lodged thereat.

Suppose each operator has ten cords; then when twelve co-existing calls from a line-group are present, one position will have ten cords used, and the next position but two. If a thirteenth call comes in at once, the second position will have three calls; but if, soon after, the first operator has two or three cords become idle, additional calls will temporarily stop coming to the second position; and with the fluctuations of the call load, the second operator will, for a time at least, have a small and irregular quantity of business to attend to, until a quite perceptible and steady increase in the number of calls from the line-group takes place. Similarly, if the load increases so that two operators are busy, on a further slight increase of business, a small amount of business will for a time irregularly go to a third position, and so on.

In carrying out my invention, I contemplate the employment of a number of groups of cords, each comprising, for example, ninety-five cords. Such a number of cords may be assigned to a group of, say, one thousand subscribers; and for a ten thousand subscriber exchange, there would be ten groups of ninety-five cords each, each group being tested responsive to calls initiated over one thousand lines. There would thus be at most times several of what may be called the ragged positions; and as the arrangement I have described has for its object the condensing of business, and its automatic distribution to as many operators as are located at the board to employ them to their full capacity, it will be seen at once that in the several ragged positions there would be an element of considerable waste of operators' time and consequent wages. It is to the taking care of this waste that my invention is particularly directed. I accomplish it, briefly stated, by providing

an overflow position or positions and causing what would otherwise be the ragged position business of all the trunk groups to be transferred automatically to the overflow board. The business at such board will, it is true, be to a certain extent fluctuating in character, and complete working efficiency of the operators thereat will at times not be had; but instead of being distributed among a maximum of ten slightly employed operators, it will be condensed at two or three operators' positions where the operators will be fairly busy, although fluctuatingly so. Thus in my invention, I add to the features of condensing calls before operators, the feature of condensing what would otherwise be ragged position calls, which I claim as my invention.

I have illustrated schematically in Figure 1 a specific embodiment of my invention, in which the mechanism to be employed may be that illustrated in Fig. 2, which shows circuits and mechanism of a specific cord testing telephone exchange system. In Fig. 3 is shown the circuit of a common lamp that may be employed in connection with the circuit of Fig. 2.

The preceding general description explains the scope of the invention claimed, while the following description of the figures will exhibit concretely a single specific embodiment thereof, it being understood that my invention has reference to the arrangement of operators' link-circuits with or without manually operated terminals, their testing, and the resulting distribution of calls, and not to any specific means for connecting the link-circuit to the calling line, although the calling line must be capable of influencing a testing switch. The invention is, in its general aspects, applicable to structures employing individual test switches for lines or a common test switch for lines.

In Fig. 2, I show the lines of two subscribers A and B with their respective individual test means C and D, which not only serve to determine which operator's circuit is to be used, but also include the connecting means for placing the line in connection with the link-circuit. This testing and connecting means takes the form of a selective switch individual to a calling line, and that of each line would be the same as that of line A, as shown at C, comprising the traveling connecting or line wipers 27 and 28 and the test or private wiper 29. These wipers are mounted on a rotary shaft 35 carrying also a ratchet 34, which, when actuated by the pawl 36 of magnet 33, is turned, carrying the shaft and wipers with it, the latter sweeping over their respective multiple contacts 30, 31, 32. Each set of contacts 30, 31, 32, other than the normal set, engaging which the wipers are shown, is connected by conductors 38, 39, 40, to the circuits of a plug terminal 62, 63, one only being shown in full. At C, I have shown for simplicity but seven sets of terminals 30, 31, 32 but it is to be understood that in practice a greater number could be provided; and in explaining my invention, each switch such as C or D will be assumed to comprise ninety-five sets of contacts 30, 31, 32, each set being connected to a different operator's circuit. At 30′, 31′, 32′, I have shown one set of multiples of the contacts 30, 31, 32, which multiples are included in the switch E, assumed to belong to the line of another subscriber. As ninety-five operators' circuits would provide sufficient facilities for one thousand lines, the contacts 30, 31, 32, would in practice be multiplied one thousand times, once to the switch of each subscriber in a thousand group. A second thousand group of subscribers would have multipled to their one thousand switches a second group of contacts 30, 31, 32, of ninety-five operators' circuits, and so on for the other thousand subscribers' groups. The wipers of the switch C of the line of A are shown in their normal position, to which they are returned after each use of the switch. When traveling, their motion is clockwise, or from left to right, and at each step they move from one set of contacts to the next.

Briefly, the operation of the system of Fig. 2 is as follows: The calling subscriber A removes his receiver, which automatically initiates travel of switch C whose wipers select the first idle operator's link, assumed to be that shown in full, whereon call signal 47 is displayed; the operator throws over keys 57, 58, to connect her receiver with the calling line, learns the number wanted, and completes the connection by inserting the plug 62, 63, into a multiple jack 25, 26, of the called line, it being understood that each line has a multiple jack within reach of every operator, in the usual way.

In Fig. 1, showing schematically the novel arrangement of connections, the contacts of each cord are represented by its private contact 32 only, and these are shown for simplicity as spread out in a straight line, instead of circularly disposed as shown in Fig. 2.

At 1 are shown the ten plug terminals for operator 1 of line-group 1, connected to the first ten sets of private multiples 32, 32′. At 2 are shown the plugs for the second operator connected to the second group of contacts 32, and so on up to operator 9, operators' positions 4—6 being interposed at the broken space.

Following the ninth operators' contacts, are five contacts marked O, which lead to plugs at the overflow board. Similarly, the first ten contacts 32 of line-group 2 are connected to plugs at the first operator's

position 1^a for the group; the next ten to plugs at position 2^a; and so on to position 9^a; whereafter the five contacts O′ lead to the overflow board. Similarly, the first ten contacts 32 of line-group 3 lead to the first operator's position 1^b for line-group 3; the next ten to position 2^b; and so on for nine positions, whereafter five contacts are connected to plugs at the overflow board.

Assuming that the foregoing is continued for ten subscribers' groups, each including one thousand subscribers' lines, and having each ninety-five cords, there would be nine hundred cords at the regular positions and fifty cords at the overflow board.

In the structure of Fig. 2, a subscriber's traveling switch selects the first cord whose contact 32 is ungrounded, the subscribers' switches passing beyond all grounded contacts 32.

As shown in Fig. 1, I provide a manually operated gang switch which may comprise the pivoted switch-arms 65, one inserted in the circuit of each contact 32 and provided with a bar 66 for shifting the arms 65 simultaneously to connection with their respective grounded contacts 66^a, or to connection with the link-circuit conductors 40. An individually operable switch-arm 67 is also provided in the circuit of each contact 32 for connecting the contacts to the ground connections 67^a, or to the conductors 40. The manually operated switches are preferably provided at a monitor's desk and she is enabled by the bars 66, one of which is to be provided for each operator's position, to render the link-circuits of a position artificially busy or idle. I have shown the gang switches and the individual switches for the link-circuits of positions 1 and 2 of line-group 1 only, those of position 2 being shown as rendering the link-circuits busy, while those of position 1 are in the positions rendering the circuits selectable, but it will be understood that corresponding switches are to be provided for the link-circuits of all positions of all line-groups.

In the idle hours of the day, the cords of all operators' positions of each line-group may have their manual switches shifted to the busy position, except the cords of the first position of each line-group. The overflow cords O, O′, O^2, etc., may be always left selectable. The first ten simultaneous connections of the line-groups will then go to the first positions of the respective groups; and as soon as more than ten calls co-exist from a group, the last ones will pass over the contacts of all intervening positions till they reach the overflow cords O, one of which will be selected and its signal displayed at the overflow board. I provide a common signal lamp preferably located at the monitor's desk operated when the five overflow cords of a line-group are all displayed, so that the monitor will then know that there is enough business from a line-group to keep an additional operator at least one half busy. The monitor may then if she desires, by her manual switches, cut in one or two cords of the position of operator 2, whose calls operator 1 may take care of. This will temporarily relieve the overflow position; and as soon as the common lamp is a second time displayed, the operator will know with certainty that an operator should be placed at position 2 of the line-group to which the common lamp belongs. Of course, if deemed advisable, an operator may be assigned to the second position as soon as the common lamp is displayed. Similarly, when two operators' positions are being kept busy, additional co-existing calls will be transferred to the overflow board, and so on for the other positions.

Assuming ten line groups having each five overflow cords at the overflow board, there would be fifty cords at that board upon which would be automatically switched all overflow or ragged position calls of the ten groups. Of course, when an additional operator has just been assigned to a line-group, there will for a time be no calls from that group reaching the overflow board. The cords there will thus rarely, if ever, be all in use and three or four operators at the overflow board would be sufficient to handle such overflow business.

It remains to describe in detail the specific system shown in Fig. 2. The calling subscriber at A, removing his receiver, causes the switch-hook to assume its alternate position, whereon current flows from battery 37, line relay 13, contact 15, limb 12, through transmitter and receiver, alternate switch-hook contact, returning over limb 11, contact 16 to ground. Relay 13 attracts its armature, establishing a circuit from ground at off-normal contact ON, armature of relay 13, contact 24, relay 17 to battery, which relay 17, by attracting armature 19, connects battery from contact 15 through alternate contact 19, to the sleeve contacts 26 of the line jacks, rendering them busy. By attracting armature 20, relay 17 completes a circuit including alternating current generator 37 and magnet 33; and successive impulses will be transmitted through magnet 33, causing the energization and deënergization thereof as long as relay 17 remains operated and contact 20 hence closed. Each actuation of magnet 33 effects a thrust of pawl 36, turning ratchet 34, shaft 35 and wipers 27, 28 and 29 a step, the wipers thus engaging terminal contacts 30, 31 and 32 of successive link-circuits terminating in plugs comprising contacts 62, 63. With the first step of the switch, the stud of insulation on ratchet 34 disengages the comple-

mentary stud on off-normal spring ON, whereon the spring, by its tension, leaves its normal contact and engages its alternate contact, thus opening the initial energizing circuit of relay 17. The said relay has, however, by the attraction of armature 21, completed a circuit extending from battery, through relay 17, contact 23, alternate contact 21 to test wiper 29; and as the test wiper is sufficiently broad to engage a next contact 32 before leaving the one previously engaged by it, relay 17 will be held operated until the wiper 29 has reached an ungrounded contact 32 which will pertain, of course, to an idle link-circuit, at which time line wipers 27, 28, will be engaging the talking contacts 30, 31, of the idle link-circuit. This is assumed to be the link-circuit shown in full in Fig. 2. Relay 17, having its circuit now opened at contact 29—32, becomes deenergized and its armature 21, in falling back to engage its alternate contact, connects ground from the now shifted spring ON through lamp 22 and relay 64 in parallel and normal contact 21 to wiper 29 and the multiple contacts 32, 32′, etc., of the selected link-circuit, rendering it busy, since any other selective switch engaging a multiple of contact 32 will find a locking circuit for its relay 17 extending to ground through a multiple engaged by wiper 29 of switch C at the alternate off-normal contact ON of said switch C. Such circuit will be of sufficiently high resistance not to permit the actuation of the relay 64 of the switch C, although enough current will flow to prevent the relay 17 of the other switch from releasing its already attracted armatures.

Armatures 18, 19 and 20 of relay 17 of switch C were also retracted on its deënergization, whereupon a circuit is completed as follows: from battery 37′, through relay 44, over conductor 39, contact 31—28, normal contact 19, cut-off relay 14 to ground through normal contact 20. This operates relays 44 and 14, whereon the latter operatively disconnects the line relay 13 by attracting its armatures 15 and 16. Armature 19 of relay 17 also connected battery 37′ with the sleeve contacts 26 of the line jacks so that they continue busy. Circuit is also at this time closed through relay 41 extending from ground over conductor 38, contact 30—27, normal contact 18, over the line limbs, returning to battery through alternate contact 16 and relay 44. Attracted armature 43 of relay 41 completes a circuit extending from ground at normal contact 51 and through call-signal lamp 47 to battery, causing its display whereupon the operator throws over levers 57 and 58 of her listening-key and ascertains the number of the called subscriber's line from the calling subscriber A, the talking circuit of the calling substation being indicated by the heavily marked conductors. The operator now touches tip contact 62 of her calling plug to sleeve contact 26 of the called line—that of B. If this pertains to a busy line, the said contact 26 will be at a potential other than ground and current will flow through contact 62, normal contact 60, normal contact 53, alternate contact 57ª, high wound test relay 56 to ground, the test relay then attracting its armature to close the circuit of the tertiary winding of the operator's induction coil, whereupon she will hear the usual busy "click" and know that the called line is busy. The calling subscriber, being then advised of this fact by the operator, will replace his receiver, which will be effective to deënergize the relay 41 whose circuit included the limbs of the line. Circuit will thereupon be completed as follows: from battery 37′, through lamp 47, normal contact 42, normal contact 50, attracted armature 44ª, over conductor 40, contact 32—29, normal contact 21, relay 64 to ground at the shifted off-normal contact ON. The resistance of this circuit is such that relay 64 will be energized, attracting its armature 23 to close a circuit from battery, through relay 17, alternate contact 23, said relay 64 to ground at shifted off-normal contact ON. These two relays will obviously remain operated until the switch C has continued its travel around to its normal point, when the stud of ratchet 34 engages the stud of off-normal spring ON, shifting said spring from its alternate to its normal contact, and the switch proceeds to thus travel, the circuit for its magnet 33 being closed through attracted armature 20 of relay 17. It will be seen that while the switch is traveling, relay 17 is always operated; and by its attracted armatures 18 and 19, maintains wipers 27 and 28 on open circuit, preventing interference with existing conversations as they wipe over contacts of busy link-circuits.

Assuming that the called line was idle rather than busy, the operator inserts the plug into the springjack of the called line, asumed to be B, closing contacts 63—26 and 62—25, current then flowing from battery 37′, through relay 49, contact 63—26, cut-off relay 14, to ground through contact 20 of the called line circuit, operating the cut-off relay 14, which disconnects the line relay 13 from line limbs 11—12 and connects the said line limbs through the alternate contacts of armatures 15 and 16 with contacts 25, 26, of the line jacks. The operator now throws over levers 60 and 61 to include generator 59 in circuit with the called-for line, current from said generator passing out over contact 62—25, alternate contact 15, line limb 12, through condenser and bell of the substation, ringing the bell, returning over

limb 11, alternate contact 16, contact 26—63, contact 61 to ground. The operator then releases levers 60 and 61 and the calling supervisory signal 55 will remain displayed until the called subscriber answers the call, its circuit being traced from ground at the back contact of the armature of relay 48, alternate contact 52, to battery 37'. The relay 49 was operated on the insertion of the plug into the springjack, to attract its armatures whereon 53 completed a normally open contact in the tip strand of the cord, and 51 completed a break in the circuit of answering supervisory signal 54, which would be operated were not relay 41 at this time energized. By the attraction of armature 50, the control of the releasing circuit, before described, is removed from the calling subscriber and an additional and low resistance ground placed from alternate contact 50 via alternate contact 44^a upon the multiple contact 32.

When the called subscriber answers the call, the removal of his receiver, causing the elevation of the switch-hook, completes a circuit for relay 48 extending therethrough from ground, alternate contact 53, contacts 60, 62—25, over the line limbs, returning through contact 26—63 to battery, through relay 49. The two subscribers A and B are now in conversation, the talking circuit being traced from substation to substation through the exchange by the heavily marked conductors, the energization of relay 48 having opened the circuit of calling supervisory signal 55, rendering it inert, to notify the operator that the call is answered.

When the subscribers finish conversation, they replace their receivers, which acts will cause the deënergizations of relays 41 and 48 and the consequent display of the two supervisory signals 54 and 55, the deenergization of relay 41 failing, however, to release switch C because alternate contact 50 will remain open until the operator withdraws the calling plug. In response to the display of the signals, the operator now removes said plug, whereon relays 49 and 14 are deënergized, the deënergization of the former causing the retraction of its armatures, whereon 52 and 51 open the circuits of signals 55 and 54 which become inert, while the retraction of armature 50 closes the before-described release circuit extending from battery 37', through call lamp 47, normal contact 42, normal contact 50, attracted armature 44^a, conductor 40, contact 32—29, normal contact 21, release relay 64 to ground through alternate contact ON. The switch C, therefore, is restored to normal as before described, circuit through relay 44 and lamp 47 being opened as soon as the switch wipers leave the contacts 30, 31, 32, of the cord which is used in the connection. As soon as this occurs, ground, of course, will be removed from the multiple contacts 32, 32', of the cord and it will be available for further connection.

The switches 70 are provided in the circuits of conductors 40, which switches may be manually operated to momentarily put battery on contacts 32 to release a switch as desired, whether the calling subscriber replaces his receiver or not.

The signal lamp 22 is placed in shunt of the release circuit and is displayed while the switch C is operating under the influence of its release relay 64. In case of an accidental ground upon limb 12, relay 13 would be continuously held energized; and after the switch started to operate with relay 64 energized, a continuous operation would be produced because the restoring circuit, including relays 17, 64, has a branch extending through the armature of relay 13 to ground at spring ON, which spring, in shifting from its normal to its alternate contact, or vice versa, has preferably the well-known make-before-break method of operation.

In Fig. 3, I show one arrangement which may be associated with the overflow link-circuits of a cord group to produce the warning signal at the monitor's desk, before referred to, when a pre-determined number of overflow cords are simultaneously employed. 74 is the common signal at the monitor's position. 72 is a common relay controlling the said signal and bridged across the conductors 77 and 78: 75 and 76 being equal resistances interposed in the extensions of the grounded conductors 77 and 78. The resistances r, r, r, and r', r', r', are all equal, the resistances r being associated with manual switches 71 at the monitor's desk, by which a desired number of branch circuits may be extended to battery 37'.

The relays 44', 44^2, 44^3, are those of three overflow link-circuits corresponding in arrangement and function to the relay 44 of the link-circuit shown in Fig. 2. The relay 44', assumed to be that of the first overflow cord, as an additional armature-contact 44^b, controlling a contact in the circuit of lamp 74, while each of the relays 44', 44^2, 44^3, assumed to be those of the first three overflow link-circuits, has its armature 44^c controlling the circuit of one of the resistances r'. Assume the signal 74 is to be displayed as soon as the first three overflow cords are simultaneously in use; the three switches 71 will accordingly be shifted to connect the three resistances r with conductor 77, and current will flow from battery 37', through the three resistances r, over conductor 77, passing to ground over the parallel branches extending through resistance 75, and through relay 72 and resistance 76, whereon relay 72 will attract its armature, which will be

effective to prevent the display of signal 74 when the first overflow cord is selected and relay 44′ operated. At such time, armature 44^c will connect battery through one resistance r' with conductor 78, and the potential across the points 79—80 will be lessened and part of its current taken from relay 72, but not enough to allow retraction of its armature 73. When, on selection of two cords, relays 44′ and 44^2 are simultaneously energized, the inclusion of two resistances r' will still further reduce the potential across said points; but not until a number of relays 44 have connected resistances r' to branch 78, equal in number to resistances r of conductor 77, will the potential across the points 79—80 be equal, and relay 72 deprived of current, it being then in substantially the galvanometer branch of a balanced Wheatstone bridge. At this time, armature 73 will be retracted and lamp 74 displayed, so that the attendant will know that the pre-determined number of cords are all in use.

Obviously, if desired, such an arrangement as that shown in Fig. 3 may be provided at every operator's position and the lamp arranged to respond to as many simultaneous calls as desired.

If an overflow cord becomes idle, on the consequent deënergization of its relay 44, one resistance r' will be disconnected from battery, producing a difference of potential across conductors 77, 78, the energization of relay 72, and the putting out of lamp 74.

Having thus described my invention, I claim:—

1. A telephone system including a plurality of groups of subscribers' lines, a switchboard having a number of operators' positions for each group of lines, overflow positions included in said switchboard, a number of main groups of operators' link-circuits, one for each group of subscribers' lines, a plurality of sub-groups included in each main group of link-circuits, each main group being distributed by sub-groups among the operators' positions of the respective line group and to the overflow positions, signals for said link-circuits, automatic testing means whereby any calling line of a group may cause the testing of, first, the circuits of a first sub-group, then the circuits of a second sub-group, and so on, and finally the circuits of the last sub-group leading to the overflow positions, to find an idle link-circuit, switching means for connecting the first link-circuit found idle with the calling line and displaying its signal, and manually operated switches for rendering the link-circuits of the sub-groups of a main group extending to positions other than the overflow positions artificially busy, whereby the calls of the line groups may be turned at will to the overflow positions.

2. A telephone system including a plurality of groups of subscribers' lines, a switchboard having a number of operators' positions for each group of lines, overflow positions included in said switchboard, a number of main groups of operators' link-circuits, one for each group of subscribers' lines, a plurality of sub-groups included in each main group of link-circuits, each main group being distributed by sub-groups among the operators' positions of the respective line group and to the overflow positions, signals for said link-circuits, automatic testing means whereby any calling line of a group may cause the testing of, first, the circuits of a first sub-group, then the circuits of a second sub-group, and so on, and finally the circuits of the last sub-group leading to the overflow positions, to find an idle link-circuit, switching means for connecting the first link-circuit found idle with the calling line and displaying its signal, manually operated switches for rendering the link-circuits of the sub-groups of a main group extending to positions other than the overflow positions artificially busy, whereby the calls of the line groups may be turned at will to the overflow positions, and operators' switching mechanism associated with said link-circuits for extending link-circuits connected to calling lines to any desired line.

3. A telephone system including a group of subscribers' lines, a switchboard having operators' positions, an overflow position included in said board, a number of groups of operators' link-circuits and signals therefor, each operator's position having signals of one group, automatic testing means for said lines for testing, first, the link-circuits of a first group, thereafter the link-circuits of a second group, etc., and finally the link-circuits of the group assigned to the overflow position, when calls are initiated over said lines, to find an idle circuit, switching means for connecting the first link-circuit found idle with a calling line and displaying its signal, and manually operated switches for rendering the link-circuits extending to positions other than the overflow position artificially busy, whereby the calls of the line group may be turned at will to the overflow position.

4. A telephone system including a group of subscribers' lines, a switchboard having operators' positions, an overflow position included in said board, a number of groups of operators' link-circuits and signals therefor, each operator's position having signals of one group, automatic testing means for said lines for testing, first, the link-circuits of a first group, thereafter the link-circuits of a second group, etc., and finally the link-circuits of the group assigned to the overflow position, when calls are ini-

tiated over said lines, to find an idle circuit, switching means for connecting the first link-circuit found idle with a calling line and displaying its signal, manually operated switches for rendering the link-circuits extending to positions other than the overflow position artificially busy, whereby the calls of the line group may be turned at will to the overflow position, and operators' switching mechanism for extending the selected link-circuit to connection with a called line.

5. A telephone system including a plurality of groups of subscribers' lines, corresponding groups of operators' link-circuits, one for each group of lines, a switchboard to which said circuits extend having operators' positions with link-circuits individual to particular groups of lines, another operator's position having link-circuits of a plurality of groups of lines, automatic test means for the line groups responsive to initiation of calls for serially testing the link-circuits of their respective line groups beginning at normal points having definite serial relations with the link-circuits of the respective groups, means whereby the link-circuits of said other operator's position will be last tested, and manually controlled switching means for, at will, artificially rendering the link-circuits busy other than those of said other operator's position.

6. A telephone system including a plurality of groups of subscribers' lines, corresponding groups of operators' link-circuits, one for each group of lines, a switchboard to which said circuits extend having operators' positions with link-circuits individual to particular groups of lines, another operator's position having link-circuits of a plurality of groups of lines, automatic test means for the line groups responsive to initiation of calls for serially testing the link-circuits of their respective line groups beginning at normal points having definite serial relations with the link-circuits of the respective groups, means whereby the link-circuits of said other operator's position will be last tested, manually controlled switching means for, at will, artificially rendering the link-circuits busy other than those of said other operator's position, and automatically controlled connecting means for establishing connections between calling lines and the first idle link-circuits tested by said test means.

7. A telephone system including a plurality of groups of subscribers' lines, corresponding groups of operators' link-circuits, one for each group of lines, a switchboard to which said circuits extend having operators' positions with link-circuits individual to particular groups of lines, another operator's position having link-circuits of a plurality of groups of lines, automatic test means for the line groups responsive to initiation of calls for serially testing the link-circuits of their respective line groups beginning at normal points having definite serial relations with the link-circuits of the respective groups, means whereby the link-circuits of said other operator's position will be last tested, manually controlled switching means for, at will, artificially rendering the link-circuits busy other than those of said other operator's position, automatically controlled connecting means for establishing connections between calling lines and the first idle link-circuits tested by said test means, and signals for said link-circuits displayed on establishment of connections and operator controlled connecting means for extending link-circuits to called lines.

8. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, and switching means for each group responsive to each call to test first the link-circuits leading to the regular positions and then those leading to said special position.

9. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, and switching means for each group responsive to each call to test first the link-circuits leading to the first regular position, then the second, and so on throughout the regular positions and finally those leading to said special position.

10. A telephone system comprising groups of telephone lines, testing means for each group comprising a moving contact and a series of fixed contacts, said moving contact being operative to test said fixed contacts serially from a fixed or normal point upon each initiation of a call in its group, link-circuits for each group leading from said fixed contacts, a series of regular operators' positions for each group in which a portion of the link-circuits for that group terminate, and a special operator's position in which the remainder of the link-circuits of the plurality of groups terminate.

11. A telephone system comprising groups of telephone lines, testing means for each group comprising a moving contact and a series of fixed contacts, said moving contact being operative to test said fixed contacts serially from a fixed or normal point upon each initiation of a call in its group, link-

circuits for each group leading from said fixed contacts, a series of regular operators' positions for each group in which a portion of the link-circuits for that group terminate in an order corresponding to that of said fixed contacts, and a special operator's position in which the remainder of the link-circuits of the plurality of groups terminate.

12. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the regular positions and then those leading to said special position, circuit connections for automatically impressing a potential on the terminal of a link-circuit when tested by said means and found idle, to render it busy, and manually controlled switching means for, at will, impressing a potential upon said terminals to render them artificially busy.

13. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the regular positions and then those leading to said special position, and operator controlled devices for connecting said link-circuits to wanted lines.

14. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the first regular position, then the second, and so on throughout the regular positions and finally those leading to said special position, circuit connections for automatically impressing a potential on the terminal of a link-circuit when tested by said means and found idle, to render it busy, and manually controlled switching means for, at will, impressing a potential upon said terminals to render them artificially busy.

15. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the first regular position, then the second, and so on throughout the regular positions and finally those leading to said special position, and operator controlled devices for connecting said link-circuits to wanted lines.

16. A telephone system comprising groups of telephone lines, a group of selective switches for each group of lines, means responsive to currents over calling lines to initiate travel of said switches, traveling test members for said switches, coöperating stationary contacts adapted to be engaged and tested thereby, a series of regular operators' positions for each group of lines, an overflow position common to the several groups, link-circuits extending from the said contacts of switches of each group to the corresponding series of regular operators' positions, and link-circuits extending from the said contacts of switches of all the groups to said overflow position.

17. A telephone system comprising groups of telephone lines, a group of selective switches for each group of lines, means responsive to currents over calling lines to initiate travel of said switches, traveling test members for said switches, coöperating stationary contacts adapted to be engaged and tested thereby, a series of regular operators' positions for each group of lines, an overflow position common to the several groups, link-circuits extending from the said contacts of switches of each group to the corresponding series of regular operators' positions, link-circuits extending from the said contacts of switches of all the groups to said overflow position, means for automatically placing a busy potential upon the contacts of the first idle link-circuits tested by said traveling members and manually controlled switches for impressing a busy potential upon said contacts.

18. A telephone system comprising groups of telephone lines, a group of selective switches for each group of lines, means responsive to currents over calling lines to initiate travel of said switches, traveling test members for said switches, coöperating stationary contacts adapted to be engaged and tested thereby, a series of regular operators' positions for each group of lines, an overflow position common to the several groups, link-circuits extending from the said contacts of switches of each group to the corresponding series of regular operators' positions, link-circuits extending from the said contacts of switches of all the groups to said overflow position, and means for connecting link-circuits, tested and found idle by said traveling test members, with calling lines.

19. A telephone system comprising groups of telephone lines, a group of selective switches for each group of lines, means responsive to currents over calling lines to initiate travel of said switches, traveling test members for said switches, coöperating stationary contacts adapted to be engaged and tested thereby, a series of regular operators' positions for each group of lines, an overflow position common to the several groups, link-circuits extending from the said contacts of switches of each group to the corresponding series of regular operators' positions, link-circuits extending from the said contacts of switches of all the groups to said overflow position, means for connecting link-circuits, tested and found idle by said traveling test members, with calling lines, and means for restoring said selective switches to normal.

20. A telephone system comprising groups of telephone lines, a group of selective switches for each group of lines, means responsive to currents over calling lines to initiate travel of said switches, traveling test members for said switches, coöperating stationary contacts adapted to be engaged and tested thereby, a series of regular operators' positions for each group of lines, an overflow position common to the several groups, link-circuits extending from the said contacts of switches of each group to the corresponding series of regular operators' positions, link-circuits extending from the said contacts of switches of all the groups to said overflow position, signals for said link-circuits displayed responsive to their connection with calling lines, and devices for extending said link-circuits to desired points.

21. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the regular positions and then those leading to said special position, and means for connecting link-circuits, tested and found idle by said switching means, with calling lines.

22. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the regular positions and then those leading to said special position, means for connecting link-circuits, tested and found idle by said switching means, with calling lines, signals for said link-circuits displayed responsive to their connection with calling lines, and devices for extending said link-circuits to desired points.

23. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the first regular position, then the second, and so on throughout the regular positions and finally those leading to said special position, and means for connecting link-circuits, tested and found idle by said switching means, with calling lines.

24. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the first regular position, then the second, and so on throughout the regular positions and finally those leading to said special position, signals for said link-circuits displayed responsive to their connection with calling lines, and devices for extending said link-circuits to desired points.

25. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the first regular position, then the second, and so on throughout the regular positions and finally those leading to said special position, and manually controlled switches for placing the link-circuits of said special position in operative contiguity to any desired one of said regular positions.

26. A telephone system comprising a plurality of series of regular operators' positions, a special operator's position common to said plurality, groups of telephone lines each corresponding to one of said series, link-circuits for each said group leading to its series of regular positions and to said special position, switching means for each group responsive to each call to test first the link-circuits leading to the first regular po-

sition, then the second, and so on throughout the regular positions and finally those leading to said special position, manually controlled switches for placing the link-circuits of said special position in operative contiguity to any desired one of said regular positions, and means for automatically connecting the first idle link-circuit tested to the calling line and for effecting extensions thereof to called lines.

In witness whereof, I hereunto subscribe my name this 13th day of June, 1907.

LEROY D. KELLOGG.

Witnesses:

THOMAS H. FERGUSON,

CAROLYN WEBER.