

SEMI-AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED SEPT. 13, 1907. RENEWED NOV. 27, 1916.

Patented Jan. 15, 1918.

5 SHEETS—SHEET 1.



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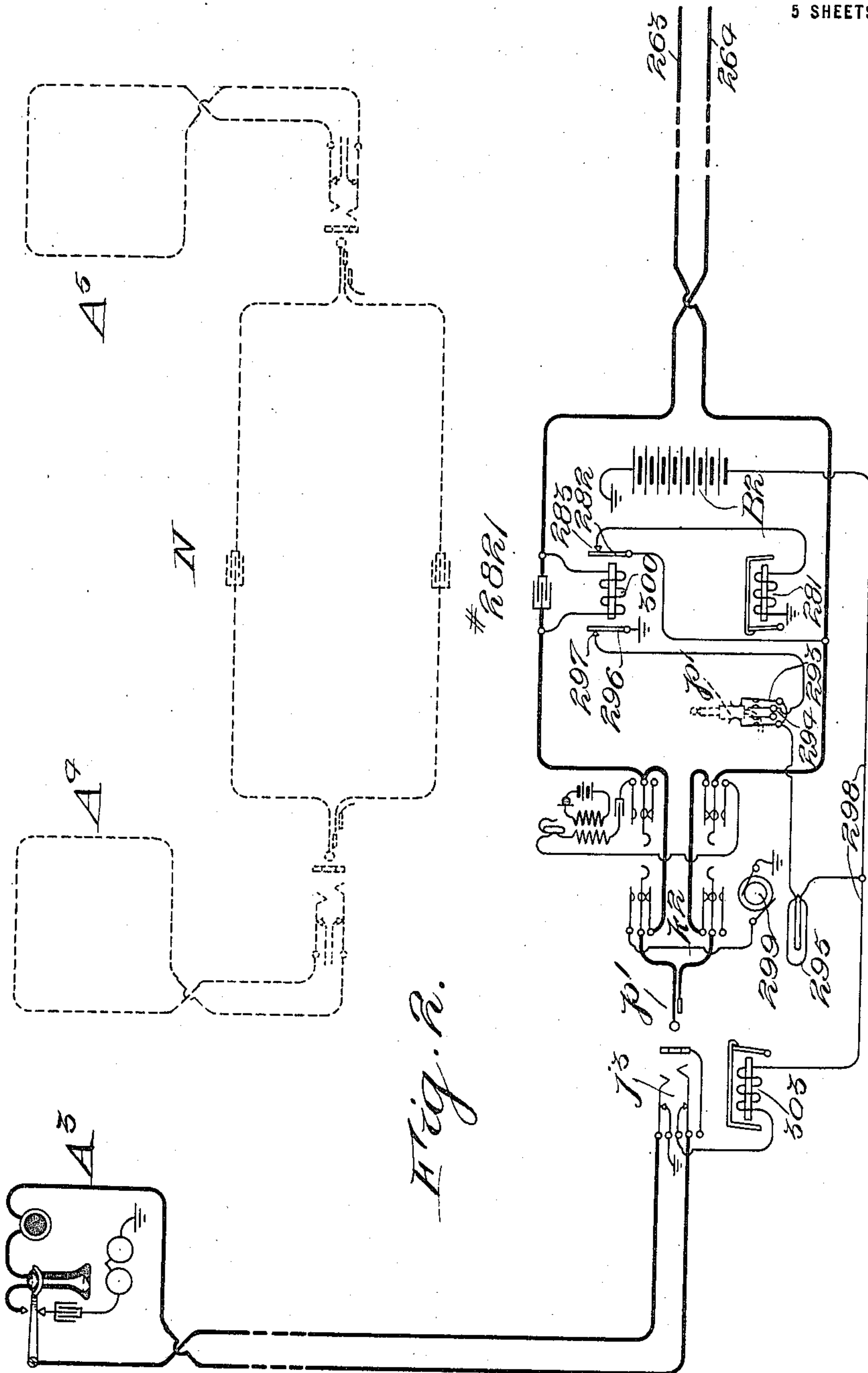
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Witnesses.

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5. SHEETS—SHEET 3.



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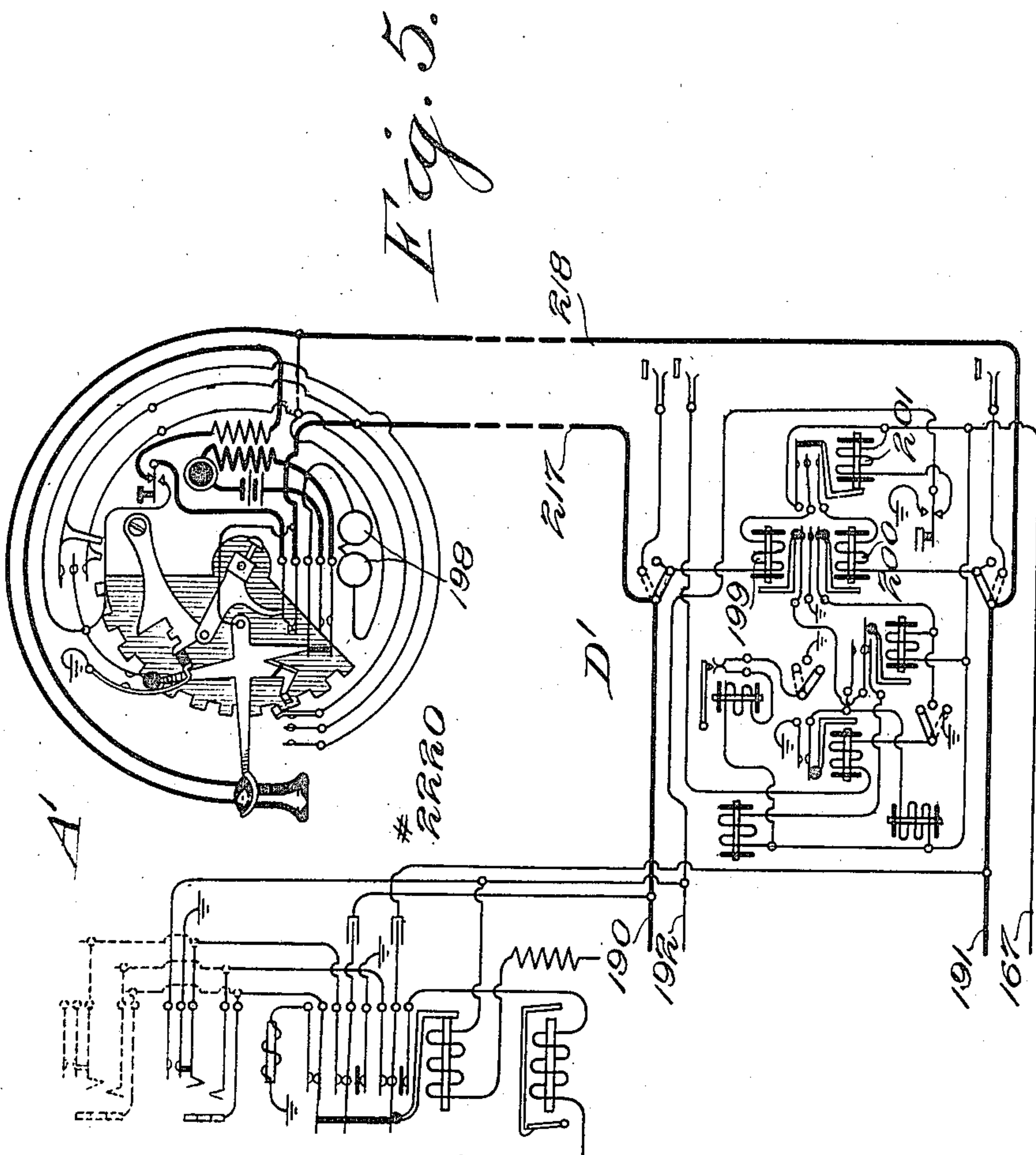
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5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

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SEMI-AUTOMATIC TELEPHONE SYSTEM.

1,254,012.

Specification of Letters Patent. Patented Jan. 15, 1918.

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To all whom it may concern:

Be it known that I, TALBOT G. MARTIN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Semi-Automatic Telephone Systems, of which the following is a specification.

My invention relates to an automatic telephone system in which both manual and automatic apparatus is employed, such systems being ordinarily known as semi-automatic telephone exchange systems. Systems of this kind are some times developed from either automatic or manual systems probably more often from a manual exchange system, inasmuch as the producer of automatic systems is now very often called upon to develop a manual system into an automatic system. A system of this kind is some times called a cut-over system—that is to say, a system which is gradually changed from one type to another, as from manual to automatic. The changing or cutting-over, of course, is done gradually, and as much as possible without interfering with the service between the different subscribers, so that during the period of alteration or change from one type to another some of the subscribers will be enjoying service that is purely automatic, others will be receiving semi-automatic service, and still others will still be subject to purely manual service. Situations of this kind, it will be seen, are calculated to make necessary many special provisions, both with respect to the automatic and the manual apparatus, because some of the manual apparatus must be modified for use in extending connection to or from automatic subscribers, while some of the automatic apparatus must be modified for use in extending connection to or from manual subscribers.

Generally stated, therefore, the object of my invention is the provision of an improved and highly efficient semi-automatic telephone exchange system.

Special objects of my invention are the provision of an improved rotary connector adapted to automatically select trunks running to a branch or private exchange, and adapted to operate either as a common battery or a local battery connector, as hereinafter explained; the provision of an im-

proved trunking cord circuit and trunk line system for giving semi-automatic service between manual and automatic subscribers, between automatic and automatic subscribers, and between manual and manual subscribers, as herein disclosed; the provision of an improved subscriber's telephone apparatus, the same being of such character that it is adapted for calling either manually or semi-automatically, and to be called either manually or semi-automatically; the provision of a subscriber's line relay equipment of such character that the line signal is blocked against operation when the subscriber calls automatically, and of such character that the subscribers can be called manually or automatically, as hereinafter explained; and the provision of certain details and features of improvement tending to increase the general efficiency of a telephone system of this particular character.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings Figure 1 represents diagrammatically a private branch exchange to which there are allotted both manual and automatic substations A² and A, respectively, and outgoing trunk lines which terminate in a combined automatic and manual main exchange, in a system embodying the principles of my invention.

Fig. 2 represents diagrammatically a manual common battery private branch exchange having trunk lines also leading to the main exchange.

Fig. 3 represents the manual section of the main exchange, comprising multiple terminals of all the private branch exchange trunks, the subscribers of which section are equipped with substations of the automatic type, but adapted to manual work.

Fig. 4 represents the automatic section of the central office or main exchange switching apparatus having multiple terminals of all private branch exchange trunks.

Fig. 5 represents one of the automatic substations, its selector D' allotted to the automatic section (Fig. 4), and its multipled manual equipment.

The automatic substations may be of any suitable or approved type, but the substations, like the substation A, in connection

with which I have elected to illustrate my invention, each comprises a receiver 2, a switch-hook 3 for controlling the substation circuits, which controlling operations are accomplished through the medium of any suitable means, such as the cam arms 4, 5 and 6. As the switch-hook is lowered the cam-arm 4 momentarily presses the release springs 7, 8 and 9 into engagement, whereby the substation line conductors may be grounded simultaneously. When the switch-hook is down the cam arm 5 engages the spring 32, thereby bridging the ringer 33 in series with the condenser 33^a across the line. Furthermore, when the switch-hook is down the said cam 5 disengages the springs 10 and 11, thus breaking the local circuit which includes in series the primary winding 12, transmitter 13 and local battery 14. The substation ground circuit is normally broken between the ground springs 15 and 16 by the cam arm 6, but when said springs are together, ground potential is provided to the ground post 17, and to the release spring 7, as is usually the case in telephones of this type. The said substation comprises the usual induction-coil 18 having the primary winding 12 and secondary winding 19. Being an automatic substation it is provided with the usual vertical and rotary impulse springs 20 and 21. Said substation is, of course, provided with a dial (not shown) which is secured to the shaft 22, together with the locking dog 23. Furthermore, there is a locking cam 24 that locks the dog 23 while the receiver is on the switch-hook to prevent a rotation of the dial. For operating the impulse springs 20 and 21 the substation is provided with an impulse wheel 25 that is secured to the shaft 22, which impulse wheel carries on its periphery the so-called vertical impulse teeth 26 and one rotary impulse tooth 27. The said impulse teeth are so arranged that when the dial is drawn down the impulse springs 20 and 21 are not carried into contact with the ground post 17; but as the dial returns, first the vertical teeth engage the vertical impulse spring 20, and after they have completed their work the rotary impulse tooth 27 operates the rotary impulse spring 21. In this operation the subscriber's vertical line conductor 28 is first given a number of ground impulses, and then the rotary line conductor 29 is given one ground impulse. It will be seen that as long as the dial is out of normal position, the dog 23 permits the secondary circuit springs 30 and 31 to separate, thus preventing the impulses that are delivered to either line conductor from passing to the other. The signaling device comprises the push-button 34 which, when pressed, carries the spring 35 from the contact point 36 to the grounded contact point 37. All of the automatic substations shown in the various

diagrams are of the type above described. The manual substations shown are of the common battery type, and are well known. At I (Fig. 3) there is represented one of these automatic substations, the ringing circuit of which is modified to work in connection with a manual board, as previously stated. The line conductors of the said substation I have multiple terminals in the manual board, and also in a first-selector of the automatic exchange. The ringer 114 has the ringer coils connected in multiple, and the local battery spring 115 is connected to ground, so that when the switch-hook is down the ringer spring 116 is pressed onto the spring 115. Also, on the cam-arm 117 there is an insulating bushing 118 which insulates the ringer connection from the vertical line conductor.

Each subscriber of the automatic section is provided with a first-selector, such as the first-selector D' (Fig. 5) or D (Fig. 4). These first-selector switches D and D' may be of any suitable or approved type, for example, of the general type described in United States Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson. Each selector embodies, among other details, the following well-known devices and circuits (see Fig. 4). The switch shaft (not shown) carries the vertical and rotary wipers 38 and 39, respectively, and the private wiper 40. The side switch is well known and comprises the side switch wipers 41, 42, 43 and 44, which may be designated as the vertical, rotary and private side switch wipers, and the rotary magnet wiper, respectively. The side switch is under the control of the private magnet 45, and when the side switch is in normal or first position the wipers 41, 42, 43 and 44 occupy the contact points 46, 47, 48 and 49, respectively. In the second position the wipers rest on the contact points 50, 51, 52 and 53, respectively, and in the third position the contact points 54, 55, 56 and 57 are engaged by their respective wipers. Through the medium of the vertical line relay 58, and while the side switch is in first position, the subscriber controls the vertical magnet 59, which latter operates to raise the switch shaft and wipers 38, 39 and 40 vertically. By means of the rotary line relay 60, and while the side switch is in the first position, the subscriber controls the private magnet 45, and, therefore, the side switch. While the side switch is in second position the rotary magnet 31, which operates to carry the switch shaft and wipers 38, 39 and 40 in a rotary direction, is energized. The vertical and rotary line relays 58 and 60, acting conjointly, provide means whereby the subscriber controls the release magnet 62 while the side switch is in the first or second position. If the side switch

126, which have allotted to their use suitable line and private banks. Said switch is also provided with vertical and rotary line relays 127 and 128 and the vertical and rotary magnets 129 and 130, the release magnet 131, private magnet 132, ringer relay 133 and the impedance coils 134 and 135. The side switch performs, as usual, switching operations through the medium of the side switch wipers 136, 137, 138 and 139. This connector is, in addition, provided with the private relay 140 which is controlled by the rotary line relay 128, which latter in turn controls the private magnet 132, as will be explained hereinafter. The object in providing the connector with this automatic selective feature is as follows: A business office, or private branch exchange, for example, may be provided with three lines each terminating in a different telephone, but all of which are given the same number. It then becomes necessary to so arrange the connectors that if one line is in use the connector switch will automatically carry the calling subscriber's line into connection with the second line, and if the second line is also in use the connection is carried to the third line, and so on; and if all the lines are in use the connection is extended to a busy-signaling circuit. The calling subscriber would, of course, have no control over the apparatus as to with which one of the set of lines he makes connection. This, of course, does not concern him, since, for the purpose of his call, any trunk line to the said office or private branch exchange will do. The arrangement of the connector banks is as follows: If one office to which the number 2811 (see Fig. 1), for example, is allotted wishes three telephones, he will be given three lines terminating, one in the first contact of the first level of the connector banks, another in the second contact of the first level, and the third in the third contact of the first level. Now, if the number 2811 is called the connector is raised to the first level and then rotated into engagement with the first contact of the first level; but if the said contact is busy the connector is automatically rotated onto the second set of contacts, or onto the third if the second is busy. It becomes desirable, as stated, to provide means for signaling the calling subscriber in the event that all three of the lines are busy. For this purpose the fourth set of bank contacts of the first level are connected with a busy-signaling circuit to the contacts of which the connector will rotate if all the lines are busy. A busy-signaling current is then sent out to the calling subscriber's line over a circuit including the fourth set of contacts of this level. It will be evident that any office may be equipped with a number of lines, depending upon the number of contacts in the bank reserving the last contact for the busy con-

tact. If it becomes desirable, one whole level may be reserved for one member, but ordinarily it is expected that each level would be divided into sets, one number for each set, the number depending upon the position of the first contact of the set in the bank. As shown in Fig. 3 the substation K has been cut over or changed from a manual station to an automatic station, and, therefore, changed from the manual exchange to the automatic exchange, that it may be operated automatically to establish connections, instead of having to call manually each time a connection is desired. To bring about this cut-over, the drop 119 is disconnected from the line conductors by the insertion of insulation between the springs 120, 121 and 122, 123, the condensers 280^a and 281^a are inserted in the manual line circuit, battery B' is connected to the springs of the bridge-cut-off relay of the first selector, and the wiring of the ringer connections at the substation K is changed from the wiring of the ringer 114 at substation I to that shown at K or at substation A. In short, I represents an automatic substation operating manually, and at K is shown an exactly similar substation after it has been cut over to operate automatically. My improved apparatus and system is not only adapted to semi-automatic work, but is also adapted for a change or cut-over from a common battery telephone system to a local battery automatic telephone system. Of course, and as already indicated, just before the cut-over all the subscribers whose stations are to become automatic are given, instead of a regular manual telephone, a specially arranged automatic telephone I, which may continue to work manually as long as it is desirable, and at a suitable time the telephone is in a few minutes changed to the form shown at K, from which it continues to work automatically, the line-signal relay springs having also been re-arranged, as already indicated.

The operation of the system may be more clearly understood by considering its operation when one subscriber calls another. Suppose that the subscriber at substation A, which is a substation of the private branch exchange shown in Fig. 1, desires to establish connection with the automatic substation A' shown in Fig. 5, on the line #2220 which is allotted to the main central exchange. In that event, the calling subscriber at substation A removes the receiver 2 from the switch-hook 3, whereby the secondary winding 19 in series with the receiver 2 is bridged across the line conductors 28 and 29. This closes an energizing circuit through the line relay 141, extending from ground G² through the jack springs 142 and 143, vertical line conductor 28, secondary springs 30 and 31, signaling device, secondary winding 19, receiver 2, rotary line conductor 29,

passes to the third position then, since the selector D is of the trunk-release type, the selector D is controlled through the next switch with which a connection is then established, and through the private wiper 40, and by means of the back-release relay 63. The bridge-cut-off relay 64 is provided to open the connection between the line relays 58 and 60, and between said relays and battery B'. This is desirable, because if the relays are not disconnected from each other and from the battery, the ringing current for signaling the subscriber may operate either or both of the relays 58 and 60 and cause some interference with the switch. It is also desirable to remove the bridge formed through the said relays from across the line to give the voice-currents as clear a path as possible. In a system of the size herein described the so-called second-selectors E (Fig. 4) are selected by the first-selectors and in turn pick out the connectors F, L, etc. The second-selector E is the same as the first-selector with the exception that there are no normal conductors, such as the normal conductors 65 and 66 of the selector switch D. There is also no necessity in the second-selector for a bridge-cut-off relay, such as the relay 64 of the selector D, and it is also omitted, and the line relays are connected directly to the battery lead. The private normal conductor, such as the private normal conductor 67 of the selector D, is of no utility in connection with the second-selector and is also omitted. Since like parts are likewise represented throughout the drawings, the vertical magnet 68 and the rotary magnet 69, the release magnet 70 and the private magnet 71 will be recognized and understood. The said private magnet 71, of course, controls the side switch wipers 72, 73, 74 and 75, the said private magnet also controlling the circuit of the vertical magnet 68, in the usual manner, by means of the springs 76 and 77, but not of the release magnet, for the release magnet spring is omitted. The vertical movement of the switch shaft, and, therefore, of the wipers 78, 79 and 80, is controlled by the vertical magnet 68, and the rotary movement by the rotary magnet 69, the rotary magnet circuit being provided with the usual interrupter springs 81. The operative magnets of the switch are, of course, controlled by the subscriber through the medium of vertical and rotary line relays 82 and 83, as is well known. Said relays have under their control the usual springs 84, 85 and 86, and in addition the trunk-release springs 87 and 88, whereby the said switch may be released when the side switch wipers are in first or second position.

The connector switch F may also be of any suitable or approved type, for instance of the general type described in United States

Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson. The connectors, of course, are used to complete the connection to some given telephone line leading to some subscriber's station or other line, as will be explained with reference to the connector L. The mechanical details of the first-selector and connector, as is well known, are very much the same. For example, the connector switch shaft (not shown), like the first-selector switch shaft, carries the line wipers 89 and 90 and the private wiper 91. The connector switch is also controlled by the calling subscriber through the medium of the vertical and rotary line relays 92 and 93. The vertical line relay directly controls the vertical magnet 94, and also the rotary magnet 95 and ringer relay 96. The function of the vertical magnet 94 is to give the shaft and shaft wipers their vertical motion, and the rotary magnet 95 imparts to the shaft and shaft wipers a rotary or circular motion. The rotary line relay controls the private magnet 97, which latter under certain conditions controls in turn the vertical and rotary magnets 94 and 95, release magnet 98 and also the side switch wipers 99, 100, 101 and 102. The side switch of the connector, like the side switch of the first-selector, has a normal or first position, a second position and a third position. The release magnet 98 is also controlled by the line relays 92 and 93 conjointly. By the condensers 103 and 104 the circuit through the connector is divided into two sections. The back-bridge relays 105 and 106 give to the called subscriber means whereby he may release the connector switch that has been connected with his line. The central office is equipped with a busy-signaling apparatus of any suitable design, as, for example, the one comprising an interrupter 107 in series with the primary winding 108 of the induction-coil 109, whereby a busy-signaling current is induced in the secondary winding 110 of the said coil. The connector switch shaft also carries a normal post arm 111 which, when the connector shaft is off normal, allows the spring 112 to engage the contact point 113, whereby the busy-signaling current passes to the line of the calling subscriber when the side switch is in first position. The connector switch L, shown in Fig. 4 is of the rotary type—that is, means are provided whereby the connector shaft may be made to automatically rotate to pass over a busy contact of a set of lines, and to stop on the first one of that group which is idle. In other words, the connector L combines the general features of the connector with those of the first-selector. The connector switch L is an improved form of the said general type. The usual switch shaft of said connector is provided with the line wipers 124 and 125 and the private wiper 130

through the jack springs 144 and 145, line relay 141 to the battery lead 146, thence through battery B and to ground G. The said relay, upon energizing, attracts its armature 147, whereby a circuit is closed through the line lamp 148. This circuit extends from ground G^2 through the lamp 148, contact point 149 and armature 147 to the battery lead 146, thence through battery B and to ground. The operator, in response to the signal, and learning that an outside connection is desired, inserts the plug p into the jack j , and operates the key k so that the springs 150 and 151 and 152 and 153 engage, whereby the condensers 154 and 155 are bridged or shunted by the coils 156 and 157. The substation A is now connected with the trunk line conductors 158 and 159, which terminate in the first-selector D (Fig. 4). The calling operation by which the subscriber A, for example, would call and signal subscriber A' is as follows: To call the number 2220, which is arbitrarily chosen as the number of the substation A', the subscriber at substation A operates his calling device in a suitable manner, corresponding to each digit. For each digit the vertical line is grounded a certain number of times, corresponding to the numerical value of the digit, and then the rotary side of the line is grounded once. The first digit being 2, the calling subscriber at substation A turns his dial for the first digit 2, thereby grounding the vertical line conductor 28 twice and the rotary line conductor 29 once upon the return motion of the dial. The ground potential to the line conductors 28 and 29 is then transmitted to the trunk line conductors 158 and 159. Grounding the vertical line conductor 28 energizes the vertical line relay 58 of the first-selector D. The circuit through said vertical line relay extends from ground G' through the ground springs 15 and 16 to the ground post 17, thence to the vertical impulse spring 20, vertical line conductor 28, jack spring 143, plug p , springs 172 and 173, conductor 174, through the key springs 153 and 152, relay 157, springs 175 and 176, vertical trunk conductor 158 to the side switch wiper 41, contact point 46, through the vertical line relay 58 to the bridge-cut-off springs 166 and 165, to the battery lead 167, thence through battery B' and to ground. Each time that the vertical line relay 58 is energized the vertical line relay springs 168 and 169 are pressed into contact, and an energizing circuit is each time established through the vertical magnet 59. The circuit through said magnet extends from ground G^3 to the relay springs 168 and 169, to the private magnet springs 170 and 171, through the winding of the vertical magnet 59 to the battery lead 167, thence through battery B and to ground. The vertical magnet 59 being operated twice,

the first-selector switch shaft and wipers 38, 39 and 40 are raised two steps. The said wipers are carried to a level with the contact points that constitute the terminal of the trunk line leading to the selector switch E. Following the vertical impulse the rotary impulse spring 21 is grounded once by the rotary impulse tooth 27, thereby grounding the rotary line conductor 29 once and energizing the rotary line relay 60. The path of this energizing circuit is from ground G' through the ground springs 15 and 16 to the ground post 17, rotary impulse spring 21 to the rotary line conductor 29, jack spring 144, springs 160 and 161, conductor 162, springs 150 and 151, relay 156, springs 163 and 164 to the rotary trunk line conductor 159, side switch wiper 42, contact point 47 to the rotary line relay 60, thence to the bridge-cut-off springs 177, 166 and 165 to the battery lead 167, thence through battery B' and to ground. The rotary line relay, upon energizing, presses the line relay springs 178 and 168 into contact, thereby establishing an energizing circuit through the private magnet 45. The current through said magnet passes from ground G^3 through the springs 168 and 178 to the private magnet 45 and battery lead 167, thence through battery B' and to ground. The private magnet being energized for a moment and then deenergized, the side switch of the first-selector passes to second position, permitting the side switch wiper 44 to close the energizing circuit through the rotary magnet 61. The current flows from ground G^4 through the contact point 53, side switch wiper 44 to the interrupter springs 179, thence through the winding of the rotary magnet 61 to the battery lead 167, thence through battery B' and to ground. The rotary magnet is energized one step, and the shaft wipers 38, 39 and 40 are carried into engagement with the bank contacts that constitute the terminal of a trunk line leading to the selector switch E. If the first trunk line is busy an energizing circuit is established through the private magnet 45, when the private wiper 40 engages the grounded contact, thereby retaining the side switch in second position and maintaining the circuit through the rotary magnet 61. The rotary magnet, by intermittent magnetization, causes the shaft wipers to rotate past the last busy trunk line. However, as soon as the private magnet deenergizes, the side switch is tripped into third position; or if there are no busy contacts to be passed over, the rotary magnet 61, as is well known, trips the side switch to third position, when the wipers engage the first trunk line, with the result that as soon as the side switch wipers 41 and 42 engage their respective contacts 54 and 55 the subscriber's line is extended to the selector switch E. Also, since the side switch

wiper 43 engages the grounded contact point 56, a guarding potential is established at the private wiper 40 for protecting the seized trunk line to the selector E from being molested by any other switch. This guarding potential also protects the calling trunk line by establishing a guarding potential at the connector bank over the private normal conductor 67. The second digit is called after the subscriber has established connection with the selector E, by way of the trunk conductors 180 and 181. The subscriber rotates the dial, as described, for the second digit 2, thereby grounding the vertical and rotary line conductors 28 and 29, which causes the energization of the selector vertical and rotary line relays 82 and 83. The selector switch E operates for the second digit in the same manner as the first-selector D, and the shaft wipers 78, 79 and 80 are carried to the second level and brought in contact with the terminals of an idle trunk line leading to the connector F. The third digit operation of the dial, since the subscriber's line conductors are extended to the connector F, is directed to the said connector. Grounding the vertical trunk conductor 158 for the third digit energizes the vertical line relay 92 of the connector F. The current through said relay flows from the substation ground G', as previously traced, to the vertical trunk conductor 180, to the vertical line relay 92, thence to the battery lead 167, and through battery B' to ground. The vertical line relay 92 in turn presses the line relay springs 182 and 183 into contact, and as a result the magnet 94 is operated. The current through the said magnet flows from ground G⁵ to the springs 182 and 183, private magnet springs 184 and 185, side switch wiper 102, contact point 186, vertical magnet 94 to the battery lead 167, and through battery B' to ground. The vertical magnet 94, as usual, operates to raise the switch shaft. Being operated twice the shaft is raised two steps, and the shaft wipers 89, 90 and 91 are carried to a point opposite the level in which the line of the substation #2220 is located. When the rotary trunk conductor 159 is grounded the rotary line relay 93 of the connector F is operated. The current flows through the rotary relay 93 from the substation ground to the rotary trunk conductor 159, as previously traced, rotary line relay 93 to the battery lead 167, thence through battery B' and to ground. The rotary line relay 93 in turn energizes the private magnet 97 upon pressing the line relay springs 188 and 182 into contact. The current through the said private magnet passes from ground G⁵ through the springs 182 and 188, private magnet 97 to the battery lead 167, thence through battery B' to ground. The private magnet being operated causes the side switch to pass from first to second position. As a result the side switch wiper 102 shifts into engagement with the contact point 189, thereby substituting the rotary magnet 95 for the vertical magnet 94 to bring the magnet 95 under the control of the vertical line relay 92. The fourth digit operation of the dial causes the vertical line conductor 28 to be grounded ten times, since the fourth digit is the digit 0. Each time that the vertical trunk conductor 158 is grounded the vertical line relay 92 of the connector F is operated over circuits that have been pointed out; but instead of operating the vertical magnet 94 it operates the rotary magnet 95 each time. The circuit through the said rotary magnet extends from ground G⁵ to the side switch wiper 102, thence through the contact point 189 to the said rotary magnet 95, to the battery lead 167, and through battery B' to ground. The switch shaft is thus rotated step by step until the wipers 89, 90 and 91 are carried into engagement with the normal conductors 190, 191 and 192 that extend to the first-selector D' of the called line. The conductors 190 and 191 continue to the called subscriber's line and to the substation #2220 (Fig. 5). Grounding the rotary line conductor 29 for the last time energizes the rotary line relay 93 of the connector F, the energization of which relay causes either the release of the connector switch if the called line is busy, or the release of the side switch from second to third position if the line is not busy. It will first be assumed that the energization of the rotary line relay 93 produces the latter result—that is, releases the connector side switch to third position, which latter operation places the side switch wipers 99 and 100 in engagement with the contact points 193^a and 194^a, thus placing the calling subscriber's line in connection with the called subscriber's line through the condensers 103 and 104. This connection is marked by heavy lines in Figs. 1, 4 and 5.

To signal the called subscriber the calling subscriber presses his signaling button 34, thereby grounding the vertical line conductor 28 over a circuit that extends from ground G' through the ground springs 15 and 16, contact point 37, spring 35 to the vertical line conductor 28. As a result the vertical line relay 92 of the connector F is energized. Since the side switch wiper 102 is in third position, said relay 92 causes the ringer relay 96 to become magnetized. The current through said ringer relay flows from ground G⁵ to the side switch wiper 102, thence through the ringer relay 96 to the battery lead 167, and through battery B' to ground. The ringer relay, upon attracting its armature, forces the ringer relay springs 193 and 194 onto the ringer relay springs 195 and 196, thus breaking the connection

between the calling subscriber and the called subscriber, and bridging the ringer generator 197 across the called subscriber's line for ringing the bell 198 at the station of the latter. In order to prevent the ringing current from interfering with the line relays 199 and 200 of the called first-selector D' the bridge-cut-off relay 201 is energized as soon as the connector side switch wiper 101 engages the grounded contact point 202. The circuit through said bridge-cut-off relay extends from ground G¹¹ through the side switch wiper 101 to the private wiper 91, to the bridge-cut-off relay 201, thence to the battery lead 167, and through battery B' to ground. The said relay 201, upon energizing, separates its springs, thereby breaking the connection between the said relays 199 and 200 and battery lead, and between each other, leaving the line clear at the selector D'. The same circuit that connects the side switch wiper 101 with the connector shaft private wiper 91 is used for establishing a guarding potential that protects the seized line from interference by some other subscriber. The two substations A and A' being thus connected, communication may be carried on over the connecting circuit shown in heavy lines in Figs. 1, 4 and 5.

The release of the central office switching apparatus occurs when the calling subscriber restores the receiver 2 to the switch-hook 3, thereby pressing the release springs 7, 8 and 9 into engagement for a moment. The contact of the said release springs grounds the vertical and rotary line conductors 28 and 29 simultaneously from ground G' to the release spring 7, thence through springs 8 and 9 to the vertical and rotary line conductors, thereby simultaneously energizing the connector vertical and rotary line relays 92 and 93, whereby the release relay 203 of the selector E is included in a series circuit with the release magnet 98 of the connector F. The path of the circuit extends from ground G³ at the selector E to the side switch wiper 74, release relay 203, selector shaft wiper 80, connector release springs 204 and 205, release magnet 98 to the battery lead 167, thence through battery B' and to ground. When the connector release magnet 98 is thus supplied with current it energizes, and as a result the switch shaft and side switch are restored to normal position, thus breaking the connection between the connector switch shaft wipers 89, 90 and 91 and the normal conductors 190, 191 and 192. The back-release relay 203 of the selector E, being in the same circuit with the release magnet 98, energizes simultaneously with the latter and presses the springs 209 and 210 into engagement, which in turn close an energizing circuit through the release magnet 70 of the selector E in series with the release relay 63 of the selector D. This circuit ex-

tends from ground G³ through the release relay 63, shaft wiper 40, springs 209 and 210, through the winding of the release magnet 70 to the battery lead 167, thence through battery B' and to ground. All of the relays and magnets thus energized attract their respective armatures and remain in readiness to release their respective switches, and as soon as the substation release springs 7, 8 and 9 separate and break the ground connection with the line conductors 28 and 29 they again deenergize. The calling subscriber thus restores all switching apparatus which he originally brought into use. When the line conductors 28 and 29 are grounded simultaneously the relays 156 and 157 of the private branch exchange energize simultaneously, whereby the springs 211 and 212 engage, as a result closing a circuit through the drop 213. At no other time do the springs 211 and 212 engage, the adjustment being such that only when the said two relays energize simultaneously, as during the release, are the springs 211 and 212 placed in contact. The circuit through the drop 213 extends from ground G¹⁰ through the drop 213, springs 211 and 212 to the battery lead 146, thence through battery B and to ground. The operation of the drop indicates to the operator that the subscriber at substation A has vacated the trunk line. The plug *p* is then removed from the jack *j* and the key *k* is restored to normal position, thereby returning the trunk line to normal condition.

If the called line #2220 is busy at the time that the calling subscriber attempts to establish connection, the connector F is released by the last impulse to the rotary line conductor 29 as follows: Said impulse energizes the rotary line relay 93 of the connector F, which relay in turn energizes the private magnet 97, pressing the private springs 202^a and 203^a into contact after the private wiper 91 has been carried onto the private bank contact. Of course, it is understood that whenever the line #2220 is busy the connector private bank contacts connected with the private normal conductor 192 are all connected to ground. Therefore, since the connector side switch is in second position when the private magnet springs 202^a and 203^a are brought into contact, an energizing circuit is established through the release magnet 98 from the said grounded private bank contact to the private wiper 91, thence to the side switch wiper 101 (which is in second position) to the private magnet springs 202^a and 203^a, through the winding of the release magnet 98 to the battery lead 167, thence through battery B' to ground. The connector switch shaft and side switch are thus released and connection is not established with the called line. Now, when the calling subscriber presses the signaling

button 34 the vertical line relay 92 becomes energized and operates to close a circuit through the vertical magnet 94. The vertical magnet operates to carry the switch shaft vertically, whereby the off-normal springs 112 and 113 engage to permit the busy-signaling current to pass to the calling subscriber's line, in the usual way. The subscriber, upon hearing the busy-signal, restores his receiver to the switch-hook, whereby the release springs 7, 8 and 9 are pressed into contact and an energizing circuit established through the connector vertical and rotary line relays 92 and 93, as already explained, producing the release of the switching apparatus, as stated. The operator is given the disconnect signal by the operation of the drop 213 in the manner explained above.

If the subscriber at substation A' (Fig. 5), for example, desires to speak to the subscriber A² of the private branch exchange (Fig. 1), the first-selector D' and some second-selector, E for example, are operated, in the manner just described, to establish connection with the trunk conductors 214, 215 and 216 which lead to the rotary connector L. These rotary connectors, of course, may be accessible only from some one second-selector level—in this case the eighth level—since the rotary connectors of the main automatic exchange are allotted to one particular hundred-group, and all of the trunk lines leading to the various private branch exchanges may terminate in this particular hundred-group to which the rotary connectors are allotted. Assume that the number allotted to the trunk lines leading to the private branch exchange (Fig. 1) is 2811; then, after the subscriber at substation A' has operated the first-selector switch D' for the first digit 2, and a second-selector for the second digit 8, and established connection with the conductors 214 and 215, the effect of grounding the line conductors 217 and 218 of substation A' for the last two digits is to operate the vertical and rotary line relays 127 and 128 of the connector L. The vertical impulse energizes the vertical line relay 127, and the vertical magnet 129 is in turn energized, and the shaft wipers 124, 125 and 126 are raised opposite the first level. The rotary impulse operates the rotary line relay 128, which upon energizing closes a circuit through the private relay 140. This circuit extends from ground G¹⁹ through the springs 206 and 207, through the private relay 140 to the battery lead 167, thence through battery B' and to ground. The private relay 140 energizes and closes a circuit through the private magnet 132, said circuit extending from ground G¹² through the springs 219 and 220, private magnet 132 to the battery lead 167, thence through battery B' and to ground. The

private magnet, upon energizing and de-energizing, permits the side switch to pass to second position. The last vertical impulse operates the rotary magnet 130 in the usual way, and the last rotary impulse energizes the private relay 140, which operates to close a circuit through the private magnet 132, which now operates to immediately release the side switch from second to third position, which closes connection with the first line of the group; or, possibly, the private magnet is energized to lock the side switch in second position to cause the connector shaft to automatically rotate onto the next idle contacts. Of course, if the second set of contacts leading to the office desired are busy, the connector shaft wipers are rotated to the third trunk line, etc. Furthermore, if all of the trunk lines to which the number 2811 is allotted are engaged, the shaft wipers are rotated onto a set of contacts to which the busy-signaling machine M is connected, and the calling subscriber receives the busy-signal. This automatic rotation is brought about as follows: When the private relay 140 energizes, the private magnet 132 is energized, as previously explained, and is maintained energized if the first private contact is grounded—that is, if the first trunk line is in use. The locking or holding circuit for the private magnet extends from the grounded contact to the private wiper 126, side switch wiper 138, contact point 221, private magnet springs 223 and 222, private magnet 132 to the battery lead 167, thence through battery B' and to ground. The private magnet 132 is thus energized by a locking circuit and retains the side switch wipers in second position as long as the wiper 126 engages a busy or grounded contact. Furthermore, when the private magnet is energized the spring 224 is shifted from the spring 225 to the spring 226, whereby a new energizing circuit is completed through the rotary magnet 130. This circuit extends from ground G¹³ through the interrupter springs 227^a, private relay springs 228^a and 229^a, private magnet springs 226 and 224, side switch wiper 139, contact point 227, rotary magnet 130 to the battery lead 167, thence through battery B' and to ground. The connector now operates to rotate automatically as long as the shaft wiper 126 engages a grounded contact point. When the shaft wiper 126 leaves the last busy contact the circuit through the private magnet is broken, whereby the said magnet deenergizes and the side switch passes to third position. If the first set of contacts is not in use there is no ground potential at the private wiper 126 to lock and hold the private magnet when the last rotary impulse comes, and therefore the side switch passes to third position. At any rate, when the side switch passes to third position, and

when the side switch wiper 138 engages the contact point 228, a guarding potential is established at the connector private bank for protecting the seized line. Assuming
 5 that the connector L has engaged the terminal contacts of the normal conductors 65, 66 and 67 of the trunk line conductors 158 and 159, then this guarding potential closes an energizing circuit through the bridge-cut-
 10 off relay 64 of the first-selector D. Also, at the instant that the side switch wiper 138 engages the grounded contact point 228 an energizing circuit is established through the switching relay 229 to the battery lead 167,
 15 thence through battery B' and to ground. The said relay, upon energizing, operates to shift the springs 230 and 231 to the springs 232 and 233, respectively. The engagement of the springs 230 and 232 con-
 20 nects the back-bridge impedance coil 134 with the battery lead 301, and the engagement of the springs 231 and 233 connects the back-bridge impedance coil 135 with ground. After the shaft wipers 124 and 125 have con-
 25 nected with the normal conductors 65 and 66, respectively, then at the instant that the side switch wipers 136 and 137 engage the contact points 234 and 235 an energizing circuit is established through the signal relay 236
 30 (Fig. 1) at the private branch exchange. This circuit extends from ground G¹⁵ through the springs 233 and 231, coil 135, rotary conductor, through the ringer relay springs to the side switch wiper 137, shaft wiper 125,
 35 rotary normal conductor 66, rotary trunk conductor 159, springs 164 and 163, conductor 237, springs 239 and 238, relay 236 to the vertical conductor, springs 175 and 176 to the vertical trunk conductor 158, ver-
 40 tical normal conductor 65, shaft wiper 124, contact point 234, side switch wiper 136, through the ringer relay springs to the vertical conductor, impedance coil 134, springs 230 and 232 to the battery lead 301 (Fig. 3),
 45 thence through battery B³ and to ground. The relay 236, upon energizing, attracts its armature 240 against the contact point 241, whereby an energizing circuit is closed through the drop 213. This circuit extends
 50 from ground G¹⁰ through the said drop, contact point 241, armature 240 to the battery lead 146, thence through battery B and to ground. The operator, in response to the drop signal, operates the key k' to bridge
 55 her talking set across the extended trunk conductors 158 and 159, and upon learning that substation A² is desired inserts the plug p into the jack j². Of course, had the subscriber at substation A' desired connection
 60 with any other subscriber of the private branch exchange, such as the subscriber at substation A, the operator would insert the plug p into the jack corresponding to the desired line. However, when the ring of
 65 the plug engages the ring of the jack j² an

energizing circuit is closed through the re-
 leasing relays 242 and 243, as follows: From
 ground G¹⁶ through the jack j² and plug p
 to the conductor 244, springs 245 and 246,
 conductor 247, relays 242 and 243 to the bat- 70
 tery lead 146, thence through battery B and
 to ground. The said release relays attract
 their respective armatures, and when the
 armature 248 engages the contact point 249
 a circuit is closed through the supervisory 75
 lamp 250 extending from ground G²²
 through the springs 251 and 252, contact
 point 249, armature 248, conductor 253, con-
 tact point 254, armature 255, lamp 250 to
 the battery lead 146, thence through battery 80
 B and to ground. The further use of the
 release relays will be explained hereinafter.
 After the plug p is inserted into the jack j²,
 the key k' is operated to disconnect the ex-
 tended trunk line conductors 158 and 159 85
 from the line conductors of the called sub-
 station, and to bridge the ringer generator
 256 instead. The subscriber at substation
 A², in response to the signal, removes the re-
 ceiver from the switch-hook, whereby bat- 90
 tery current for talking purposes is supplied
 over a circuit extending from ground G¹⁷
 through the winding 257, springs 259 and
 153, conductor 174 to the sleeve of the plug
 p, then through the substation A² to the tip 95
 of the plug p, conductor 162, springs 150
 and 258, through the winding 260 to the
 battery lead 146, thence through battery B
 and to ground. The relay 261 now ener-
 gizes and attracts the armature 255 from the 100
 contact point 254, whereby the circuit
 through the supervisory lamp 250 is broken,
 thereby indicating to the operator that the
 subscriber at substation A² has answered.
 The release of the central office switching 105
 apparatus occurs, as previously explained,
 when the calling subscriber grounds both
 line conductors simultaneously upon the res-
 toration of the receiver to the switch-hook.
 When the subscriber at substation A² re- 110
 stores his receiver to the switch-hook the
 energizing circuit through the relay 261 is
 broken, and the armature 255 returns to
 normal position in contact with the point
 254, thereby completing the circuit through 115
 the supervisory lamp 250, indicating to the
 operator that the established connection has
 been abandoned. The operator then re-
 moves the plug p from the jack j² and also
 restores the drop 213. When the ring of the 120
 plug disengages from the ring of the jack
 the ground G¹⁶ is cut off from the release
 relays 242 and 243, thus permitting the said
 relays to deenergize, and the armatures to
 return to normal position, thereby breaking 125
 the circuit through the supervisory lamp 250
 when the armature 248 leaves the contact
 point 249.

When the subscriber at substation A' calls
 a subscriber, A³ for example, of the manual 130

private branch exchange (Fig. 2), the central office switching apparatus, including the first-selector D', a second selector E and a rotary connector L, is operated in the manner already explained, to establish connection with a trunk line leading to the branch exchange. The operator in turn, in the usual manner, completes the connection by inserting the plug p' into the jack of the desired line.

The substation A' may be operated, in the usual manner, to establish connection with the substations K and I. In each case there is a busy-test upon the corresponding jack at the manual board of called line. This busy test is provided by the corresponding switching relay on the manual board, the said relay being energized through the private wiper of the connector and the private normal. A busy test is also provided from the private wiper to all multiple connector private bank contacts, as usual. This is, of course, to protect the called line. The calling line is protected in a similar manner by the first-selector as soon as the switch shaft rises. This is true with regard to all lines operating automatically.

Suppose that the subscriber at substation A² desires connection with the substation A³ (Fig. 2) of the manual private branch exchange. In that event, the operator at the branch exchange shown in Fig. 1 is signaled and given the number of the exchange in Fig. 2. The operator answers the call with a local plug, but upon receiving a number of the exchange in Fig. 3 she removes the local plug and inserts the plug p into the jack j^2 . Assuming this number to be 2821 the key k is operated to move the springs 176 and 164 from the springs 175 and 163 to the springs 262 and 263^a, whereby the trunk conductors 158 and 159 are disconnected from the remainder of the trunk circuit and placed in connection with the operator's calling device d . The first-selector D and the second-selector E are then operated, as explained, to establish connection with the rotary connector L, which is operated by the last two digits (2 and 1) of the number 2821, to select the idle trunk line conductors 263 and 264 in the second level leading to the manual exchange (Fig. 2). As soon as the operator has finished transmitting impulses, the key k is restored to normal position, whereby the trunk conductors 158 and 159 are extended to the cord circuit conductors 174 and 162, respectively, to terminate in the condensers 155 and 154. The operator then throws the key k' (Fig. 1) to bridge her talking set across said conductors 174 and 162, to listen for the called subscriber. When the side switch wiper 138 engages the grounded contact point 228 a guarding potential is established at the private wiper 126, and, therefore, at the private contact 265, for protect-

ing the seized trunk line. Furthermore, an energizing circuit is closed through the switching relay 266 of the main manual exchange shown in Fig. 3, and at the same time an energizing circuit is closed through the relay 229 of the connector L for bridging the battery B³ across the trunk line leading to the trunking operator's cord circuit (Fig. 2). The circuit through the switching relay 266 extends from ground G¹⁴ to the private wiper 126, conductor 267, switching relay 266 (Fig. 3), resistance coil 268 to the battery lead 167, thence through battery B' and to ground. The circuit through the connector relay 229, of course, goes from ground G¹⁴ to the side switch wiper 138, thence through the coil 229 to the battery lead 167, and to battery B' (Fig. 4). The relay 266, upon energizing, operates to shift the springs 269 and 270 from the springs 271 and 272 to the springs 273 and 274. The disengagement of the said springs disconnects the drop 275 from the rotary line multiple of the trunk conductor 264, and removes the ground spring 271 from the vertical line multiple of the trunk conductor 263. The disengagement of the said springs connects the trunk line conductors 263 and 264 with the tip and sleeve springs of the jack j^4 . When the switching relay 266 operates, as above stated, the springs 276 and 277 also engage, whereby ground is placed upon the jack ring 278 for giving to the operator a busy-test should she test the jack j^4 while the line is busy. When the side switch passes to third position an energizing circuit is closed through the line drop 281 of the manual exchange (Fig. 2). This circuit extends from battery B³ to the battery lead 301, springs 232 and 230 at the connector L (Fig. 4), impedance coil 134, ringer relay springs 135^a and 134^a, side switch wiper 136, shaft wiper 124, conductor 263 (Fig. 3), through the sleeve conductor 263 (Fig. 2), armature 282, contact point 283, then through the line drop 281 to ground. The operator at the manual exchange (Fig. 2) throws the key k^2 to bridge the operator's set across the trunk line conductors 263 and 264, and upon learning that substation A³ is desired, inserts the plug p' into the jack j^3 . The plug p' normally rests in the position shown by the dotted lines, and when in this position the springs 293 and 294 are disengaged; but when the plug is removed the said springs engage and complete a circuit through the supervisory lamp 295, said circuit extending from ground through the armature 296, contact point 297, springs 294 and 293, lamp 295 to the battery lead 298, thence through battery B² to ground. After the plug is inserted into the jack, as stated, the key k^2 is operated in the opposite direction, whereby a signaling current passes from the grounded ringer generator 299

over the tip-side of the line and through the substation ringer to ground. As soon as the called subscriber answers, battery current for talking purposes flows over the following circuit: from ground G^{15} at the rotary connector L, springs 233 and 231, coil 135, through the ringer relay springs 280^a and 280 and shaft wiper 125 to the trunk conductor 264, supervisory relay 300, through the tip of the plug p' to the tip-side of the line, through the substation A^3 to the sleeve of the plug p' , to the trunk line conductor 263, connector shaft wiper 124, through the coil 134, springs 230 and 232 to the battery lead 301, thence through battery B^3 and to ground. The supervisory relay 300 being included in this circuit energizes and draws its armatures 296 and 282 from the contact points 297 and 283. The disengagement of the armature 282 and contact point 283 cuts off the drop 281 from the line conductor 263, and the disengagement of the armature 296 and contact point 297 breaks the circuit through the supervisory lamp 295, whereby the operator is notified that the subscriber at substation A^3 has answered. It will be seen that at the instant that the plug p is inserted in the jack j^2 , the substation A^2 is provided with battery current for talking purposes, over the following circuit: from ground G^{17} at the trunk cord circuit through the winding 257 of the relay 261 to the springs 259 and 153, springs 173 and 172 to the sleeve of the plug p , sleeve springs of the jack j^2 , through the substation transmitter and receiver, tip-spring of the jack j^2 , tip of the plug p , through the springs 160 and 161, springs 150 and 258, thence through the winding 260 of the relay 261 to the battery lead 146, thence through battery B and to ground. The said relay 261 energizes, thereby attracting the armature 255 from engagement with the contact point 254. Also, when the ring of the plug p engages the ring of the jack j^2 , a circuit is closed through the release relay 242 in series with the release relay 243. The circuit through the said relay extends from ground G^{16} through the jack ring of the plug, through the springs 245 and 246, through the relay 242, thence through the relay 243 to the battery lead 146, thence through battery B and to ground. Said relays, upon energizing, attract their armatures 248, 286 and 287, and 288 and 289. The relay 242 is a quick-acting relay, and the relay 243 is a slow-acting relay, and hence the armatures 286 and 287 disengage from the contact points 290 and 291 before the armatures 288 and 289 of the relay 243 engage the ground post 292. The two subscribers may hold conversation over the heavily marked conductors, and when the subscribers restore their receivers to the switch-hooks the operators of the respective private branch exchanges

are signaled as follows: When the receiver at substation A^3 (Fig. 2) is restored the circuit which supplies talking battery current to the said substation is broken, and accordingly the relay 300 deenergizes and its armatures return to normal position. The engagement of the armature 296 with the contact point 297 closes the circuit through the supervisory lamp 295, and the operator then removes the plug p' from the jack j^3 ; and when the plug returns to normal position (shown by dotted lines) the circuit through the lamp 295 is broken. When the receiver at substation A^2 (Fig. 1) is restored, the talking battery circuit, including the windings, 257 and 260 of the relay 261, is broken, thus permitting the armature 255 to close in contact with the point 254, whereby the circuit, as explained, through the supervisory lamp 250 is closed. The glowing or display of this lamp gives to the operator the disconnect signal. The plug p is then removed from the jack j^2 , whereby when the ring of the plug disengages from the ground ring of the jack the energizing circuit through the release relays 242 and 243 becomes broken. The said release relays deenergize, but the relay 242 being a quick-acting relay, and the relay 243 a slow-acting relay, as explained, the armatures 286 and 287 of the relay 242 engage the contact points 290 and 291 before the armatures 288 and 289 disengage from the ground post 292. Thus both trunk line conductors 158 and 159 are grounded simultaneously, which simultaneously energizes the vertical and rotary line relays 127 and 128 of the connector L (Fig. 4), thereby bringing about the release of the central office switches, as previously explained.

If the subscriber at substation A^2 desires connection with any other substation (A' , I or K) the branch exchange operator operates the calling device d and the central office switches in the usual manner to establish the desired connection.

At R in Fig. 1 there is shown a second release key which, when the button 302 is pressed, grounds both trunk line conductors 158 and 159. This arrangement is provided for an auxiliary release, should the quick and slow acting relay release fail to operate.

In the foregoing it has been shown how a main office automatic substation may be operated to establish connection with a second automatic substation at a private branch manual exchange. Suppose, now, that it is desired to connect the substation A^3 (Fig. 2) with the substation K (Fig. 3), the number of which latter, it is assumed, is 2550. When the receiver is removed at the substation A^3 a circuit is closed through the line drop 303, extending from the battery lead 298, through the drop 303 to the sleeve side of the line, through the substa-

tion and tip-side of the line to ground at the jack j^3 . The operator, upon learning that an outside connection is desired, inserts the plug p' into the jack j^3 , which extends the substation conductors to the trunk line conductors 263 and 264, whereby a circuit is closed through the line drop 275 (Fig. 3). This circuit extends from the ground G^{18} at the central manual exchange through the springs 271 and 269, to the conductor 263, through the cord circuit and substation A^3 , back through the cord circuit to the trunk conductor 264, springs 270 and 272, drop 275 to the battery lead 301, thence through battery B^3 and to ground. The central operator, in response, inserts the plug p^2 into the jack j^4 , which presses the springs 303^a and 304 into contact, whereby a circuit is closed through the switching relay 266 and a guarding potential is established at the connector private contact 265 (Fig. 4) over the conductor 267. This guarding potential protects the line conductors 263 and 264 from being seized by a subscriber calling automatically. The circuit through the switching relay extends from ground through the springs 303^a and 304, conductor 267 to the relay 266, resistance coil 268 and battery lead 167, thence through battery B' and to ground. This guarding potential at the connector private bank contacts, it will be seen, extends from ground through the springs 303^a and 304 to the conductor 267, thence to the private bank contact 265 (Fig. 4), and to all other multiple contacts. The switching relay 266, upon energizing, operates as before, and when the springs 269, 273 and 270, 274 engage, the trunk conductors 263 and 264 are extended to the jack j^4 , thence through the plug p^2 to the cord circuit, as shown. The operator throws the listening key k^3 , and learning that substation K on the line #2550 is wanted, inserts the plug p^3 into the jack j^5 . This operates the switching relay 305 of the line #2550 in the same manner in which the relay 266 is operated, and places a guarding potential at the connector private bank contacts to protect the line K. The key k is then operated to signal the substation K, and the subscriber, upon answering, may communicate with the subscriber at substation A^3 over the circuit shown by heavy lines in Figs. 2 and 3. When the subscriber A^3 restores his receiver to the switch-hook the operator at the main exchange (Fig. 3) is given the disconnect signal as follows: Restoring the receiver to the switch-hook breaks the talking circuit, whereby the supervisory relay 300 deenergizes, and the armature 282 engages the contact point 283 which is connected to ground through the drop 281. This ground causes an energizing current to flow from the battery B^3 (Fig. 3) through the winding 308 of the relay 309 to the tip of the plug and

jack, conductor 263, through the armature 282, contact point 283, through the drop 281 to ground. The relay 309 now operatively energizes and draws the armature 310 into contact with the point 311, whereby a circuit is closed through the supervisory lamp 312. The operator removes the plug p^2 from the jack j^4 , thus breaking the energizing circuit through the differential relay 309 and supervisory relay 300 of the private branch exchange (Fig. 2). Furthermore, the relay 300, upon deenergizing, permits the armature 296 to engage the contact point 297, whereby a circuit is closed through the lamp 295. The glowing or display of this lamp in turn gives a disconnect signal to the operator of the branch exchange. Of course, if substation I had been called instead, the operator would have established a connection with the line of substation I, and the switching relay of this line would have been pulled up instead, causing the operation of the circuits controlled thereby. Of course, just as the operator in Fig. 2 calls subscriber K or I, any subscriber similar to I may call the subscribers K or I in the main exchange, or even the subscriber A^3 may be called by subscriber I through the medium of the main exchange operator and the private branch exchange operator in a well-known manner. In like manner, subscriber I may call any substation at the private branch exchange in Fig. 1 by being plugged onto a trunk to said private branch exchange through the cord circuit (Fig. 3) by way of normal conductors 65 and 66 (Fig. 4), which conductors, of course, have multiple contacts in the connector banks and in the manual board.

Connection between any two local substations (Figs. 1 and 2) of the branch exchange is accomplished by means of an ordinary cord circuit. The substation I (Fig. 3) may be connected with any substation in the same manner in which the trunk conductors 263 and 264 were connected, by means of the cord circuit to the conductors of substation K.

When the subscriber at substation I desires connection with any substation A or A^2 of the private branch exchange (Fig. 1), the manual operator (Fig. 3) inserts the plug p^3 into the jack corresponding to one of the trunk line multiples leading to the private branch exchange, the multiple conductors 325, 326 and 327 (Fig. 4) for example. When the plug p^3 (Fig. 3) is inserted in the jack of these conductors an energizing circuit is established through the bridge-cut-off relay 64 of the first-selector D, extending from the allotted jack over the private conductor 327, through the relay 64 to battery B' . The bridge-cut-off relay, upon energizing, operates to disconnect the line relays 58 and 60 and to disconnect the said

relays from battery lead 167, thus leaving clear the trunk conductors 158 and 159 to the branch exchange. The line relay is also energized by the insertion of the plug p^3 to connect the calling line with the trunk conductors 158 and 159. It will be seen that the operator at the branch exchange is not signaled until the main exchange operator rings, in this way energizing the relay 236 which in turn operates to close a circuit through the drop 213. The branch exchange operator, upon learning the desired connection, inserts the plug p into the jack of the desired line A or A².

It will be observed that the line drop 119 allotted to the line of substation K has been cut away from the conductors 306 and 307 by the insertion of insulating strips between the springs 120 and 121, and 122 and 123. It will also be seen by referring to Fig. 3 that the springs 122 and 120 allotted to the cut-off relay 305 are separated from the line conductors 307 and 306 by the condensers 280^a and 281^a. This, of course, is true only after the substation K is operating automatically.

From the foregoing it will be seen that I provide a working telephone system in process of reconstruction from one type to another. If the system is being changed from manual to automatic, as described and illustrated, then the private branch automatic substations are installed, as shown in Fig. 1, at the private branch exchange, and all subscribers' lines terminating at the main exchange are provided with automatic substation equipment of the kind shown at I in Fig. 3, and with automatic selectors and connector contacts at the exchange or main central station. At this time it will be seen, however, that the operator at the private branch exchange shown in Fig. 1, and the automatic subscribers thereof, are the only ones who can operate the said automatic connectors and selectors, as at this time subscribers whose lines terminate directly at the main exchange can only call manually. Gradually, however, the subscribers' substation equipments at the main exchange are cut-over or altered in the manner shown at K in Fig. 3, or at A' in Fig. 5, and the manual equipment for these cut-over lines is rendered inoperative for calling into the exchange, but uniformly operative for calling out therefrom. In this way the said cut-over lines are still capable of being called manually, but can only call into the exchange automatically and are also capable of being called automatically. In this way the automatic equipment is prevented from interfering with the manual service, and the manual equipment is gradually and progressively rendered incapable of interfering with the automatic service. In time, all of the subscribers' lines at the central station

or main exchange are cut-over in the manner shown at K in Fig. 3, so that no lines thus terminating directly at the main exchange can call manually, although they can still be called manually. When the reconstruction is completed, any subscriber at the main exchange can automatically call any other subscriber at the main exchange, and can semi-automatically call any subscriber at either of the two private branch exchanges. A subscriber's telephone line is adapted to call or be called automatically when no manual switchboard apparatus is brought into play in the establishment of connection between the calling and called lines. A subscriber's telephone line is adapted to call or be called manually when no automatic apparatus is brought into play in the establishment of connection between the calling and called lines. It will also be seen that a subscriber's telephone line is adapted to call or be called semi-automatically or semi-manually when both automatic and manual apparatus is necessarily brought into play in the establishment of connection between the calling and called lines. For example, service from the main exchange to the private branch exchange shown in Fig. 2, after the reconstruction is complete, is semi-automatic. On the other hand, service from this particular private branch exchange to the said main exchange is always manual in character, and service from this private branch exchange to the private branch exchange shown in Fig. 1 is also manual. Service from the private branch exchange shown in Fig. 1 to the main exchange is always semi-automatic, as is also true of service from this private branch exchange through the main exchange to the branch exchange shown in Fig. 2. Service between the subscribers of the branch exchange shown in Fig. 2 is purely manual, while that between the subscribers of the branch exchange shown in Fig. 1 is also purely manual. The two-way trunks between the private branch exchange of Fig. 1 and the main exchange are equipped at the main exchange for selection and seizure either manually or automatically, but at the said private branch exchange a connection to or from any one of these trunks is purely manual. This is also true of the two-way trunks between the private branch exchange of Fig. 2 and the said main exchange or central station. It will also be seen, however, that the two-way trunks between the private branch exchange of Fig. 1 and the said main exchange are equipped with operators' calling mechanisms at the trunking cord circuits thereof, and with automatic first-selectors at their terminals in the main exchange. In this way the said trunks or trunk lines between the private branch exchange of Fig. 1 and the main exchange can be used for control-

ling the automatic equipment of the main exchange, which is not true of the trunks extending between the private branch exchange of Fig. 2 and the main exchanges.

5 Thus the trunks entering the main exchange from the private branch exchange of Fig. 1 terminate not only in first-selectors, but also in trunk jacks of manual boards, and in multiple contacts or terminals of auto-
10 matic rotary connectors, such as the connector shown at L in Fig. 4. At their other ends these trunks terminate in plugs for use in connection with the jacks of the subscribers' lines which terminate at the pri-
15 vate branch exchange of Fig. 1, in the manner explained. The trunks which enter the main exchange from the private branch exchange of Fig. 2 terminate in trunk jacks of manual boards, and also in the multiple
20 contacts or terminals of the said rotary connectors. In this way each connector of the character shown at L in Fig. 4 can have one level thereof appropriated for the automatic selection of trunks leading to one private
25 branch exchange, and can have another level thereof appropriated for the automatic selection of idle trunks leading to the other private branch exchange. Other arrangements can, however, be adopted for ena-
30 bling the automatic rotary connectors to automatically select idle trunks leading to the desired private branch exchange without departing from the principles of my invention.

35 It will be seen that the ground X at the substation I is used only for ringing and supervisory purposes. The supervising, it will be seen, with this kind of a manual circuit is dependent upon the grounding of the
40 line at the substation when the subscriber hangs up his telephone, for the purpose of energizing the relay of the cord circuit, and thereby closing the local circuit of the lamp 312, in the manner explained. It will be
45 seen that the bell 114 can be rung either by the generator Y of the cord circuit, or by the generator 197 for the connectors, as either generator is grounded at one side. Also, in the apparatus at the substation I
50 the springs 115 and 116 are adapted to normally contact with each other, when the receiver is hung up, to close the said ringing and supervisory circuit through the bell. When the line is cut over, however, it will be
55 seen that the contact between these two springs is eliminated, and the ground X is also taken off and the bell bridged across the line circuit, in the manner shown at the substation K, as previously explained.

60 It will be understood that Fig. 5 shows a cut-over line having a manual equipment of the kind shown for the substation K in Fig. 3. It will also be understood that this subscriber's line at the substation K has an au-
65 tomatic equipment of the kind shown in

Fig. 5. In other words, each line is a cut-over line, each line being adapted for full automatic service, and having provisions for being called manually.

It is evident that by my invention I provide a cut-over system in which the service is not interrupted during the process of reconstruction from one type to another. This, obviously, is an advantage, as it does not necessitate a temporary closing of the
75 exchange and cessation of service while the system is being remodeled.

Before the lines are cut-over—that is to say, at a substation like the one indicated at I—the selectors for such lines are rendered
80 inoperative by temporarily disconnecting them from the battery, such as the battery B'. The subscribers at the substations thereof cannot disturb the automatic switches—that is, cannot call automatically. The sub-
85 scribers' lines are said to be cut-over when they are ready for the new service. For example, the line of the substation I has both equipments, but has not been cut-over for automatic service—that is to say, it has not
90 been cut-over to permit the subscriber to call into the exchange by means of automatic apparatus. The line of the substation K has, however, been completely cut-over, as the subscriber of this line is now in a position to
95 call or be called automatically, although he can still be called manually. In other words, and although the subscriber at substation I can be called automatically by the subscriber
100 at substation A, or by the operator at the private branch exchange, it will be seen that the manual service over the line of the subscriber at substation I has not been disturbed in any way. For this reason the line
105 of this substation I is not a cut-over line, whereas the line of the substation K is a cut-over line, because the latter now has full automatic service, and the service through the medium of his old or manual
110 equipment has been disturbed and materially curtailed or limited.

In connection with the disclosure of the rotary connector L in Fig. 4 of the drawings, attention is called to my prior application Serial No. 364,699 filed March 26,
115 1907, wherein the broader aspects of a rotary connector are being claimed by me.

What I claim as my invention is:—

1. A working telephone system in process of gradual reconstruction or transition from
120 one type to another, without interfering with the service between any and all subscribers thereof, comprising subscribers' telephone lines, automatic and manual equipment for the exchange and substations of
125 one or more of said lines, means for calling automatically, and suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone
130

lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called manually.

2. A working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, comprising subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically.

3. A working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, comprising subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually.

4. A working telephone system in process of gradual reconstruction or transition from one type to another, without interfering with the service thereof, comprising subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, and suitable provisions for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of this character are in condition for calling and being called automatically.

5. In a working telephone system in process of gradual reconstruction or transition from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in au-

automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, and local batteries for talking at all substations having automatic equipment, as and for the purpose set forth.

6. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, and local batteries for talking at all substations having automatic equipment, as and for the purpose set forth.

7. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, and local batteries for talking at all substations having automatic equipment, as and for the purpose set forth.

8. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually, suitable provisions for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, and local batteries for talking at all substations having automatic equipment, as and for the purpose set forth.

9. In a working telephone system in process of reconstruction from one type to another, without interfering with the service

thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

10. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

11. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

12. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one

or more of said lines, means for calling manually, suitable provisions for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

13. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, local batteries for talking at all substations having automatic equipment, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

14. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, local batteries for talking at all substations having automatic equipment, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

15. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equip-

ment for the exchange and substations of one or more of said lines, suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, local batteries for talking at all substations having automatic equipment, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

16. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually, suitable provision for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, local batteries for talking at all substations having automatic equipment, and centralized means of electrical supply for furnishing talking current to all substations which are purely manual and not provided with automatic equipment, as and for the purpose set forth.

17. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for render the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said system including two-way trunks leading to a branch exchange thereof, as and for the purpose set forth.

18. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of

one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including two-way trunks leading to a branch exchange thereof, as and for the purpose set forth.

19. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including two-way trunks leading to a branch exchange thereof, as and for the purpose set forth.

20. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually and suitable provisions for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including two-way trunks leading to a branch exchange thereof, as and for the purpose set forth.

21. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, and suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' tele-

phone lines of the system are in condition for calling and being called, said system including two-way semi-automatic trunks leading to a branch exchange thereof, as and
5 for the purpose set forth.

22. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into
10 the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion
20 of the system is working automatically, said system including two-way semi-automatic trunks leading to a branch exchange thereof, as and for the purpose set forth.

23. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called
30 manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including two-way semi-automatic trunks leading to a branch exchange thereof, as and for the purpose set forth.
40

24. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually, and suitable provisions for then
50 rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including two-way semi-automatic trunks leading to a branch exchange thereof, as and for the purpose set forth.
60

25. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers'

telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, and suitable provisions for then rendering the automatic portion of said
70 equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, said system including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for selecting and
80 seizing said trunks, as and for the purpose set forth.

26. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of
90 said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for
100 selecting and seizing said trunks, as and for the purpose set forth.

27. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion
110 of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for
120 selecting and seizing said trunks, as and for the purpose set forth.

28. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually, and suitable provisions for then
130

rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunks, as and for the purpose set forth.

29. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, and suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, said system including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, as and for the purpose set forth.

30. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, as and for the purpose set forth.

31. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' tele-

phone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, as and for the purpose set forth.

32. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually, and suitable provisions for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, as and for the purpose set forth.

33. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, and suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, as and for the purpose set forth.

34. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out

therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, as and for the purpose set forth.

35. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, as and for the purpose set forth.

36. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually, and suitable provisions for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, as and for the purpose set forth.

37. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, and suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering

with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, as and for the purpose set forth.

38. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, as and for the purpose set forth.

39. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, as and for the purpose set forth.

40. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling manually, and suitable provisions for then rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone

lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, as and for the purpose set forth.

41. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said system including two-way trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

42. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including two-way trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

43. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system

is still working manually, said system including two-way trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

44. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including two-way trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

45. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said system including two-way semi-automatic trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

46. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said sys-

tem including two-way semi-automatic trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

47. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including two-way semi-automatic trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

48. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including two-way semi-automatic trunks leading to a branch exchange thereof, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

49. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said sys-

tem including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunks, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

50. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunks, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

51. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunks, each said trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

52. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange

equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called
 5 either automatically or semi-automatically, said system including two-way trunks leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunks, each said
 10 trunk being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

53. In a working telephone system in
 15 process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of
 20 one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic ex-
 25 change equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said sys-
 30 tem including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, each said trunk being
 35 provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

54. In a working telephone system in
 40 process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of
 45 one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone
 50 lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically
 55 said system including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, each said trunk being provided with an operator's
 60 calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

55. In a working telephone system in
 process of reconstruction from one type to another, without interfering with the service
 65 thereof, the combination of subscribers' telephone lines, automatic and manual equip-

ment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling
 70 into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually,
 75 said system including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, each said trunk being provided with an operator's
 80 calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

56. In a working telephone system in
 85 process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one
 90 or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equip-
 95 ment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said
 100 system including two-way trunks leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunks, each said trunk being provided with an operator's
 105 calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

57. In a working telephone system in
 110 process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one
 115 or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic ex-
 120 change equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said system in-
 125 cluding suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, each said trunk-line
 130 being provided with an operator's calling mechanism for controlling the automatic ex-

change equipment, as and for the purpose set forth.

58. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, each said trunk-line being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

59. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, each said trunk-line being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

60. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either

automatically or semi-automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including automatic means for selecting and seizing said trunk-lines, each said trunk-line being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

61. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, each said trunk-line being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

62. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, each said trunk-line being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

63. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable

provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, each said trunk-line being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

64. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines, terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including suitable two-wire trunk-lines for talking purposes leading to a branch exchange thereof, and said equipment including manual means for selecting and seizing said trunk-lines, each said trunk-line being provided with an operator's calling mechanism for controlling the automatic exchange equipment, as and for the purpose set forth.

65. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling automatically, and suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, said system including trunk-lines leading to a branch exchange, and the said equipment including automatic rotary connectors for automatically selecting and seizing idle trunk-lines.

66. In a working telephone system in process of reconstruction from one type to

another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including trunk-lines leading to a branch exchange, and the said equipment including automatic rotary connectors for automatically selecting and seizing idle trunk-lines.

67. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including trunk-lines leading to a branch exchange, and the said equipment including automatic rotary connectors for automatically selecting and seizing idle trunk-lines.

68. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including trunk-lines leading to a branch exchange, and the said equipment including automatic rotary connectors for automatically selecting and seizing idle trunk-lines.

69. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, means for calling

automatically, suitable provisions for then rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called, said system including trunk-lines leading to a branch exchange, trunking cord-circuits for said trunk-lines, condensers in said cord-circuits, and means for shunting said condensers to enable a branch exchange subscriber to control said automatic equipment.

70. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including trunk-lines leading to a branch exchange, trunking cord-circuits for said trunk-lines, condensers in said cord-circuits, and means for shunting said condensers to enable a branch exchange subscriber to control said automatic equipment.

71. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of the system is still working manually, said system including trunk-lines leading to a branch exchange, trunking cord-circuits for said trunk-lines, condensers in said cord-circuits, and means for shunting said condensers to enable a branch exchange subscriber to control said automatic equipment.

72. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, suitable provisions

for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including trunk-lines leading to a branch exchange, trunking cord-circuits for said trunk-lines, condensers in said cord-circuits, and means for shunting said condensers to enable a branch exchange subscriber to control said automatic equipment.

73. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called either manually or semi-manually, said system including trunks terminating in trunking operators' cord-circuits at a branch exchange, and said equipment including supervisory apparatus for enabling the operators at said cord-circuits to supervise all connections established over said trunk-lines.

74. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said system including trunks terminating in trunking operators' cord-circuits at a branch exchange, and said equipment including supervisory apparatus for enabling the operators at said cord-circuits to supervise all connections established over said trunk-lines.

75. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equip-

ment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling
 5 into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of
 10 the system is still working manually, said system including trunks terminating in trunking operators' cord-circuits at a branch exchange, and said equipment including supervisory apparatus for enabling the operators at said cord-circuits to supervise all
 15 connections established over said trunk-lines.

76. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of
 25 said equipment inoperative for calling into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called either automatically or semi-automatically, said system including trunks terminating in trunking
 30 operators' cord-circuits at a branch exchange, and said equipment including supervisory apparatus for enabling the operators at said cord-circuits to supervise all connections established over said trunk-lines.

77. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling
 45 into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the manual service while all subscribers' telephone lines of the system are in condition for calling and being called
 50 either manually or semi-manually, said equipment including manual means by which an operator puts a subscriber having automatic substation equipment in direct control of the automatic exchange equipment, and
 55 means by which the operator controls said automatic exchange equipment for a calling subscriber having only manual substation equipment.

78. In a working telephone system in

process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of
 70 said equipment inoperative for calling into the exchange, over subscribers' telephone lines adapted to call or be called automatically, but uniformly operative for calling out therefrom, and incapable of interfering with the automatic service after a portion of the system is working automatically, said equipment including manual means by which
 75 an operator puts a subscriber having automatic substation equipment in direct control of the automatic exchange equipment, and means by which the operator controls said automatic exchange equipment for a calling subscriber having only manual substation
 80 equipment.

79. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the automatic portion of said equipment inoperative for calling
 85 into the exchange, over subscribers' telephone lines adapted to call or be called manually, but uniformly operative for calling out therefrom, and incapable of interfering with the manual service while a portion of
 90 the system is still working manually, said equipment including manual means by which an operator puts a subscriber having automatic substation equipment in direct control of the automatic exchange equipment, and means by which the operator controls said automatic exchange equipment for a calling subscriber having only manual
 95 substation equipment.

80. In a working telephone system in process of reconstruction from one type to another, without interfering with the service thereof, the combination of subscribers' telephone lines, automatic and manual equipment for the exchange and substations of one or more of said lines, and suitable provisions for rendering the manual portion of said equipment inoperative for calling
 100 into the exchange, over subscribers' telephone lines terminating in automatic exchange equipment, and incapable of interfering with the automatic service after all subscribers' telephone lines of the system are in condition for calling and being called
 105 either automatically or semi-automatically, said equipment including manual means by which an operator puts a subscriber having automatic substation equipment in direct
 110
 115
 120
 125

control of the automatic exchange equipment, and means by which the operator controls said automatic exchange equipment for a calling subscriber having only manual sub-
5 station equipment.

81. A telephone system comprising a subscriber's telephone line, automatic exchange and substation equipment for said line, manual equipment for said line, means for rendering the automatic equipment inoperative for
10 calling into the exchange, the manual equipment of the line including a normally grounded ringer at the substation, and a ground on the line at the exchange, the last-
15 mentioned ground also serving as part of the said means for rendering the automatic equipment inoperative for calling into the exchange.

82. A telephone system comprising a subscriber's telephone line, automatic exchange and substation equipment for said line, manual equipment for said line, means for rendering the automatic equipment inoperative for calling into the exchange, the manual
20 equipment of the line including a normally grounded ringer at the substation, a ground on the line at the exchange, the last-mentioned ground also serving as part of the said means for rendering the automatic
25 equipment inoperative for calling into the exchange, and a circuit for said ringer, the said manual equipment also comprising a subscriber's switch-hook excluded from the said ringing circuit.

83. A telephone system comprising a subscriber's telephone line, automatic equipment for the exchange and substation thereof, manual equipment for said line, and means for rendering said manual equipment
30 inoperative for calling into the exchange, but operative for calling out therefrom.

84. A telephone system comprising a subscriber's telephone line, a spring jack for said line whereby the line may be called, an
35 automatic progressively movable switch associated with said line, and a condenser in each side of the line circuit between the jack and the substation of said line to prevent improper operation of the said switch.

85. A telephone system comprising a subscriber's telephone line, a spring jack for said line, a condenser in each side of the line circuit between the jack and the sub-
40 station of said line, and suitable equipment for enabling said line to call and be called automatically.

86. A telephone system comprising a subscriber's line, an automatic switch for said line, a spring jack for said line, and con-
45 densers interposed between the jack and the automatic switch.

87. A telephone system comprising a trunking operator's cord-circuit, a signal associated therewith, means by which a call-
50 ing subscriber connected with said cord-cir-

cuit may operate said signal for disconnecting purposes, and means by which a subscriber calling into said cord-circuit from the opposite direction may operate said signal for connecting purposes.

88. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit
70 calling impulses through the cord-circuit in the direction of the called subscriber, and a local battery for supplying talking current to the substation of the calling subscriber.

89. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit call-
80 ing impulses through the cord-circuit in the direction of the called subscriber, and a local battery for supplying talking current to the substation of the called subscriber.

90. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit calling impulses through the cord-circuit in the direction of the called subscriber, a local
90 battery for supplying talking current to the substation of the calling subscriber, and centralized means of electrical current supply for furnishing talking current to the called subscriber.

91. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit call-
105 ing impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the called subscriber, and centralized means of electrical current supply
110 for furnishing current to the calling subscriber.

92. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit call-
115 ing impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the calling subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber.

93. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit call-
120 ing impulses through the cord-circuit in the direction of the called subscriber.

direction of the called subscriber, a local battery for supplying talking current to the substation of the called subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber.

94. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit calling impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the calling subscriber, centralized means of electrical current supply for furnishing talking current to the called subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber.

95. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit calling impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the called subscriber, centralized means of electrical current supply for furnishing current to the calling subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber.

96. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit calling impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the calling subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber, said connector having provisions adapting it for use in conjunction with either common battery or local battery subscribers.

97. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit calling impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the called subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber, said connector having provisions adapting it for use in conjunction with either common battery or local battery subscribers.

98. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord-circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit calling impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the calling subscriber, centralized means of electrical current supply for furnishing talking current to the called subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber, said connector having provisions adapting it for use in conjunction with either common battery or local battery subscribers.

99. A telephone system comprising a trunking operator's cord-circuit, condensers in said cord circuit, means by which the operator temporarily shunts said condensers to permit a calling subscriber to transmit calling impulses through the cord-circuit in the direction of the called subscriber, a local battery for supplying talking current to the substation of the called subscriber, centralized means of electrical current supply for furnishing talking current to the calling subscriber, and a rotary connector for automatically selecting and seizing an idle trunk-line leading to the exchange of the called subscriber, said connector having provisions adapting it for use in conjunction with either common battery or local battery subscribers.

100. A telephone system in process of reconstruction from one type to another, without interfering with the service thereof, comprising both automatic and manual equipment for an exchange and one or more of the substations thereof, means for confining or limiting one or more of the subscribers to use of the old equipment for calling, but not for being called, until after their lines are cut-over to the new equipment, and means for confining or limiting one or more of the subscribers to use of the new equipment for calling, but not for being called, after their lines are cut over from the old equipment.

101. A telephone system in process of reconstruction from one type to another, without interfering with the service thereof, comprising both the old and the new equipment, means for preventing the subscribers whose lines are not cut-over from using the new equipment, although connected therewith, and means for preventing the subscribers whose lines are cut-over from using the old equipment, although connected therewith.

102. A telephone system in process of reconstruction from one type to another, without interfering with the service thereof, comprising both the old and the new equip-

ment, and temporary provisions for preventing either equipment from interfering with the service of the other while the system is gradually being put on a working basis with the new equipment.

103. A telephone system in process of reconstruction from one type to another, without interfering with the service thereof, comprising both automatic and manual equipment for an exchange and one or more of the substations thereof, and suitable temporary provisions for preventing one equipment from interfering with the service of the other while the system is gradually being put on a working basis with the new equipment.

104. In a telephone system, subscribers' lines, means for establishing connection between said lines, said means including a trunk terminating at one end in a plug and at the other end in an automatic switch, and another trunk terminating at one end in a plug and at the other end in a jack.

105. In a telephone system, the combination of common battery lines; stations thereon; a central source of current; each of said common battery stations having a receiver and transmitter; said transmitters being in series with said central source of current; local battery lines; local battery stations thereon; each local battery station having a receiver and transmitter, each of said transmitters being in series with a local source of current; automatic means for use in uniting said common battery lines and said local battery lines for conversational purposes, a manual switchboard at which said common battery lines terminate; and means at the local battery stations for controlling said automatic means.

106. In a telephone system, the combination of common battery lines; stations thereon; a central source of current; each of said common battery stations having a receiver and transmitter; said transmitters being in series with said central source of current; local battery lines; local battery stations thereon; each local battery station having a receiver and transmitter, each of said transmitters being in series with a local source of current; automatic means for use in uniting said common battery lines and said local battery lines for conversational purposes; a manual switchboard at which the common battery lines terminate, and another manual switchboard at which the local battery lines terminate.

107. In a telephone exchange system, a plurality of subscribers' lines, a number of first selector switches less than the number of subscribers' lines, means manually controlled for bringing said first selector switches into connection with calling lines, together with means whereby the first selector switches may then be controlled by the

subscribers to select the lines wanted, and to restore the switches after use, and signal devices connected with the manual portion of the apparatus to indicate to the operators the necessity for connection and disconnection, said manual apparatus being also adapted for completing connection to called lines, substantially as described.

108. In a telephone exchange system, a plurality of subscribers' lines, a number of first selector switches less than the number of subscribers' lines, operators' cord circuits for connecting said first selector switches with the calling lines, together with sending devices at the substations, and responsive devices at the central station, whereby the said selector switches may then be controlled by the subscribers to select the lines wanted, and to restore the switches after use, line annunciators and clearing-out annunciators connected with the lines and cords, respectively, to indicate to the operators the desire of the respective subscribers for connection and disconnection, said manual apparatus being also adapted for completing connection to called lines, substantially as described.

109. In a telephone system, an automatic main exchange, a private branch exchange, a trunk line connecting the main exchange with the branch exchange and terminating at the main exchange in automatic switching apparatus, and at the branch exchange in a cord circuit, said cord circuit comprising means whereby an automatic subscriber may be placed in connection with the trunk line and then permitted to complete the call automatically, and means whereby if one of the manual subscribers wants a connection to the main exchange the operator completes the connection automatically and then places the calling subscriber in connection with the trunk line, signals controlled from all of said subscribers' lines, and a common source of energy for operating all of said signals.

110. In a telephone system, a main exchange, a private branch exchange, manual and automatic subscribers' lines allotted to the private branch exchange, a trunk line connecting the main exchange with the private branch exchange, a terminal for said trunk line, automatic subscribers' line signals and manual subscribers' line signals, a cord circuit having an automatic calling device whereby if a manual subscriber wants to make a call to the main exchange the operator completes the call automatically over said trunk line, each automatic subscriber at the branch exchange being also provided with an automatic calling device whereby if he wants to make a call to the main exchange he may be placed in connection with the trunk line and then permitted to make his own call, said cord circuit also

adapted, if a subscriber in the main exchange wants to call a subscriber in the branch exchange, to be called automatically by the calling subscriber of the main exchange, whereby the operator may then connect the calling main exchange subscriber with any one of the private branch exchange subscribers, signals controlled from all of said subscribers' lines, and a common source of energy for operating all of said signals.

111. In a telephone system, a private branch exchange comprising a manual subscriber's station and an automatic subscriber's station and a cord circuit, a main automatic exchange, a trunk line connecting said cord circuit with said automatic exchange, subscribers' lines allotted to said automatic exchange, said automatic exchange comprising automatic apparatus by means of which one line may automatically be put in connection with another, means whereby either the automatic or manual subscribers may, through the cord circuit, be put in connection with any of the automatic subscribers of the main exchange, the automatic subscriber being provided with means whereby after a connection is once established with one of said main exchange subscribers the connection may then be automatically broken by the calling subscriber, releasing means allotted to the trunk line whereby the operator at the cord circuit may release the automatic apparatus, signals controlled from all of said subscribers' lines, and a common source of energy for operating all of said signals.

112. In a telephone system, a trunk line, a trunking operator's cord circuit connected with said trunk line, condensers in said cord circuit, an automatic switch, a calling telephone line connected with said cord circuit, an operator's key switch provided with means for closing connections around said condensers, means at the calling substation for transmitting electrical impulses over the telephone line and said connections and trunk line to operate said automatic switch, a signal controlled from said telephone line, and a common source of energy for operating said signal.

113. In a telephone system, an automatic switch, a calling substation suitably connected with said switch, condensers in the circuit between the substation and the switch, means for manually closing connections around said condensers to permit the calling subscriber to operate said switch, a signal controlled from said substation, and a common source of energy for operating said signal.

114. In a telephone system, a calling substation including a calling device, an automatic switch, a circuit connecting said switch with said calling device, condensers

in said circuit, means for closing connections around said condensers to permit the calling impulses to pass to the automatic switch, a signal controlled from said substation, and a common source of energy for operating said signal.

115. In a telephone system, an automatic switch, a trunk line leading thereto, a trunking operator's cord circuit for the other end of said trunk line, condensers in said cord circuit, a telephone line connected with the cord circuit, means for closing parallel connections around said condensers to permit the calling subscriber to operate said automatic switch, suitable inductive resistance in said parallel connections, a signal controlled from said telephone line, and a common source of energy for operating said signal.

116. In a telephone system, a calling substation, an automatic switch, a trunk line leading thereto, a cord circuit terminating in a plug individual to the other end of said trunk line, a key switch controlling the connection between the cord circuit and the trunk line, and an operator's calling device at the cord circuit adapted for controlling said automatic switch over the trunk line, said calling device adapted to be connected with the trunk line by the actuation of said key switch, a signal controlled from said substation over the cord circuit, and a common source of energy for operating said signal.

117. In a telephone system, an automatic switch, a trunk line leading thereto, a trunking operator's cord circuit provided with means for calling over the trunk line to operate said automatic switch, condensers in said cord circuit, a telephone line, means controlled by the operator for connecting the telephone line around the said condensers to permit the subscriber of said line to operate the said automatic switch over the trunk line, a signal controlled from said telephone line, and a common source of energy for operating said signal.

118. In a telephone system, an exchange comprising manual switchboard apparatus, subscribers' lines terminating at said manual switchboard apparatus, one or more of said lines being provided with means for transmitting impulses suitable for calling automatically, another exchange comprising automatic switches and subscribers' lines provided with means for calling automatically, a trunking operator's cord circuit, a trunk line for connecting the first-mentioned exchange with the last-mentioned exchange, a trunking operator's calling mechanism for calling automatically over the trunk line to operate the switches at the last-mentioned exchange, means by which the trunking operator connects a telephone line with the trunk line to permit the calling subscriber to control the said automatic switches, signals

nals controlled from all of said subscribers' lines, and a common source of energy for operating all of said signals.

119. In a telephone system, a two-way trunk line, suitable instrumentalities by which either a calling subscriber or an operator may transmit calling impulses over said trunk line in one direction, means by which some other subscriber may automatically connect his line to the said trunk line to extend a calling connection thereover in the opposite direction, signals controlled from said subscribers' lines, and a common source of energy for operating said signals.

120. In a telephone system, a trunk line, a trunking operator's cord circuit connected with said trunk line, condensers in said cord circuit, an automatic switch, a calling telephone line connected with said cord circuit, an operator's key switch provided with means for closing connections around said condensers, means at the calling substation for transmitting electrical impulses over the telephone line and said connections and trunk line to operate said automatic switch, and supervisory relay mechanism for said cord circuit, said mechanism comprising front and back supervisory relays, as set forth.

121. In a telephone system, a trunk line, a trunking operator's cord circuit connected with said trunk line, condensers in said cord circuit, an automatic switch, a calling telephone line connected with said cord circuit, an operator's key switch provided with means for closing connections around said condensers, means at the calling substation for transmitting electric impulses over the telephone line and said connections and trunk line to operate said automatic switch, and supervisory relay mechanism for said cord circuit, said mechanism comprising front and back supervisory relays, as set forth, a signal controlled from said substation, and a common source of energy for operating said signal.

122. In a telephone system, an automatic switch, a trunk line leading thereto, a cord circuit at the outer end of said trunk line, a telephone line, a key switch for operatively connecting the cord circuit with the trunk line to permit the calling subscriber to operate said automatic switch, and supervisory relay mechanism comprising front and back supervisory relays, as set forth.

123. In a telephone system, an automatic switch, a trunk line leading thereto, a cord circuit at the other end of said trunk line, a telephone line, a key switch for operatively connecting the cord circuit with the trunk line to permit the calling subscriber to operate said automatic switch, supervisory relay mechanism comprising front and back supervisory relays, as set forth, a signal controlled from said telephone line, and a com-

mon source of energy for operating said signal.

124. In a telephone system, an automatic switch, a trunk line leading thereto, a cord circuit terminating in a plug for the other end of said trunk line, a key switch controlling the connection between the cord circuit and the trunk line, an operator's calling device for operating said automatic switch, said calling device adapted to be connected at any time with the trunk line by the actuation of said key switch, and supervisory relay mechanism for said cord circuit, said mechanism comprising front and back supervisory relays, as set forth.

125. In a telephone system, an automatic switch, a trunk line leading thereto, a trunking operator's cord circuit provided with means for calling over the trunk line to operate said automatic switch, condensers in said cord circuit, a telephone line, means controlled by the operator for connecting the telephone line around the said condensers to permit the subscriber of said line to operate the said automatic switch over the trunk line, and supervisory relay mechanism for said cord circuit, said mechanism comprising front and back supervisory relays, as set forth.

126. In a telephone system, an automatic switch, a trunk line leading thereto, a trunking operator's cord circuit provided with means for calling over the trunk line to operate said automatic switch, condensers in said cord circuit, a telephone line, means controlled by the operator for connecting the telephone line around the said condensers to permit the subscriber of said line to operate the said automatic switch over the trunk line, and supervisory relay mechanism for said cord circuit, said mechanism comprising front and back supervisory relays, as set forth, a signal controlled from said telephone line, and a common source of energy for operating said signal.

127. In a telephone system, an exchange comprising manual switchboard apparatus, subscribers' lines terminating at said manual switchboard apparatus, one or more of said lines being provided with means for transmitting impulses suitable for calling automatically, another exchange comprising automatic switches and subscribers' lines provided with means for calling automatically, a trunking operator's cord circuit, a trunk line for connecting the first-mentioned exchange with the last-mentioned exchange, a trunking operator's calling mechanism for calling automatically over the trunk line to operate the switches at the last-mentioned exchange, means by which the trunking operator connects one of said telephone lines with the trunk line to permit the calling subscriber to control the said automatic switches, and supervisory relay mechanism

for said cord circuit, said mechanism comprising front and back supervisory relays, as set forth.

128. In a telephone system, an exchange
5 comprising manual switchboard apparatus, subscribers' lines terminating at said manual switchboard apparatus, one or more of said lines being provided with means for transmitting impulses suitable for calling auto-
10 matically, another exchange comprising automatic switches and subscribers' lines provided with means for calling automatically, a trunking operator's cord circuit, a trunk line for connecting the first-mentioned ex-
15 change with the last-mentioned exchange, a trunking operator's calling mechanism for calling automatically over the trunk line to operate the switches at the last-mentioned exchange, means by which the trunking op-
20 erator connects a telephone line with the trunk line to permit the calling subscriber to control the said automatic switches, and supervisory relay mechanism for said cord circuit, said mechanism comprising front
25 and back supervisory relays, as set forth, signals controlled from all of said subscribers' lines, and a common source of energy for operating all of said signals.

129. In a telephone system, a calling and
30 a called subscriber's line, means including an operator's cord circuit and an automatic switch for extending a connection between said lines, means for connecting one end of said cord with said calling subscriber's line,
35 the other end being connected with said automatic switch, a pair of condensers in the two sides of said cord, thereby preventing direct connection between said subscribers' lines and said automatic switch, and means
40 for short-circuiting said condensers, whereby a straight connection is established from the subscriber's line to said switch, whereby said subscriber may control the operation of said switch.

130. In a telephone system, a trunk line,
45 means including a manual connective terminal at one end and a second manual connective terminal and a call signal at the other end for completing connections over
50 said trunk line in one direction, and means including said second manual connective terminal at one end and an automatic switch at the other end controllable over said trunk line for completing connections over said
55 trunk line in the opposite direction.

131. In a telephone system, a trunk line,
60 means including a manual connective terminal at one end and a second manual connective terminal and call signal at the other end for completing connections over said trunk line in one direction, and means including said
65 second manual connective terminal at one end and an automatic switch at the other end controllable over said trunk line for completing connections over said trunk line in

the opposite direction, and means for rendering the said first manual connective terminal busy to an operator when the said switch is operated.

132. In a telephone system, a trunk line, 70
manual equipment including a call signal and connective apparatus for handling connections to or from said trunk line at one end, and means including a manual connective terminal and an automatic switch con- 75
trollable over said trunk line for handling connections, respectively, to or from said trunk line at the other end.

133. In a telephone system, a trunk line, 80
manual equipment including a call signal and connective apparatus for handling connections to or from said trunk line at one end, means including a manual connective terminal and an automatic switch control- 85
lable over said trunk line for handling connections, respectively, to or from said trunk line at the other end, and means for rendering the said second manual connective terminal busy to an operator when the said switch is operated. 90

134. In a telephone system, a trunk line, means including a manual connective terminal at one end and a second manual connective terminal and a call signal at the other end for completing connections over said trunk line 95
in one direction, means including said second manual connective terminal at one end and an automatic switch at the other end controllable over said trunk line for completing connections over said trunk line in 100
the opposite direction, and means for rendering the said switch inoperative when the said first manual connective terminal is seized by an operator.

135. In a telephone system, a trunk line, 105
manual equipment including a call signal and connective apparatus for handling connections to or from said trunk line at one end, and means including a manual connective terminal and an automatic switch 110
controllable over said trunk line for handling connections, respectively, to or from said trunk line at the other end, and means for rendering the said switch inoperative whenever the said second manual connective 115
terminal is in use by an operator.

136. In a telephone system, a trunk line, manual equipment for extending connections to or from said trunk line at one end, and automatic equipment comprising a pair of 120
automatic switches one of which is controllable over the said trunk line for extending connections to or from said trunk line at the other end.

137. In a telephone system, a trunk line, 125
an automatic switch at one end of said trunk line for connecting a calling line thereto, a call signal and manual connective apparatus at the other end of said trunk line for receiving the call and for extending the same 130

to a called line, said manual apparatus also adapted to connect a second calling line with said trunk line, and a second automatic switch associated with said first switch and
5 controllable over said trunk line to extend the said second calling line to a second called line.

138. In a telephone system, a trunk line, manual equipment for extending connections
10 to or from said trunk line at one end, and automatic equipment comprising a pair of automatic switches one of which is controllable over the said trunk line for extending connections to or from said trunk line at the
15 other end, and a circuit closed when one of said switches is operated for rendering the said trunk line busy to the other of said switches.

139. In a telephone system, a trunk line,
20 an automatic switch at one end of said trunk line for connecting a calling line thereto, a call signal and manual connective apparatus at the other end of said trunk line for receiving the call and for extending the same
25 to a called line, said manual apparatus also adapted to connect a second calling line with said trunk line, a second automatic switch associated with said first switch and controllable over said trunk line to extend the
30 said second calling line to a second called line, and a circuit closed when the said second switch is operated for rendering the said trunk line busy to the said first switch.

140. In a telephone system, a trunk line,
35 manual equipment for extending connections to or from said trunk line at one end, automatic equipment comprising a pair of automatic switches one of which is controllable over the said trunk line for extending connections to or from said trunk line at the
40 other end, and means for rendering one of said switches inoperative whenever a connection is extended to the said trunk line by means of the other switch.

141. In a telephone system, a trunk line,
45 an automatic switch at one end of said trunk line for connecting a calling line thereto, a call signal and manual connective apparatus at the other end of said trunk line for receiving the call and for extending the same
50 to a called line, said manual apparatus also adapted to connect a second calling line with said trunk line, a second automatic switch associated with said first switch and controllable over said trunk line to extend the said
55 second calling line to a second called line, and a relay for rendering said second switch inoperative controlled by the said first switch.

142. In a telephone system, a trunk line,
60 means including an automatic switch for seizing said trunk line at one end and a manual connective terminal and a call signal at the other end for completing a connection over the said trunk line in one direc-

tion, and means including the said manual connective terminal and a second automatic switch at the other end controllable over said trunk line for completing a connection over
70 said trunk line in the opposite direction.

143. In a telephone system, a trunk line, means including an automatic switch for
seizing said trunk line at one end and a manual connective terminal and a call signal at the other end for completing a con-
75 nection over the said trunk line in one direction, means including the said manual connective terminal and a second automatic switch at the other end controllable over said
80 trunk line for completing a connection over said trunk line in the opposite direction, and a circuit for making the trunk line busy to said first switch when the said second switch is operated.

144. In a telephone system, a trunk line,
85 means including an automatic switch for seizing said trunk line at one end and a manual connective terminal and a call signal at the other end for completing a connection over the said trunk line in one direc-
90 tion, means including the said manual connective terminal and a second automatic switch at the other end controllable over said trunk line for completing a connection over said trunk line in the opposite direction, and
95 means including a circuit for rendering said second switch inoperative when the said trunk line is seized by said first switch.

145. In a telephone system, a trunk line having three branches at one end thereof,
100 first and second automatic switches containing fixed and movable terminals for two of said branches, respectively, a spring jack for the other branch, means including said
105 switches for extending connections over said trunk line in either direction, and means including operator's equipment and the said jack for completing connections over said trunk line manually.

146. In a telephone system, a trunk line
110 having three branches at one end thereof, first and second automatic switches containing fixed and movable terminals for two of said branches, respectively, a spring jack for the other branch, means including said
115 switches for extending connections over said trunk line in either direction, means including operator's equipment and the jack for completing connections over said trunk line manually, and means effective to render the
120 said branch extending to said jack busy when the trunk line is in use by way of either of the other branches.

147. In a telephone system, a trunk line having three branches at one end thereof,
125 first and second automatic switches containing fixed and movable terminals for two of said branches, respectively, a spring jack for the other branch, means including said
130 switches for extending connections over said

trunk line in either direction, means including operator's equipment and the said jack for completing connections over said trunk line manually, and means effective to render the branch extending to said first switch busy when the said second switch is operated.

148. In a telephone system, a trunk line having three branches at one end thereof, first and second automatic switches containing fixed and movable terminals for two of said branches, respectively, a spring jack for the other branch, means including said switches for extending connections over said trunk line in either direction, means including operator's equipment and the said jack for completing connections over said trunk line manually, and means effective to render the branch extending to said first switch busy when the trunk line is in use by way of said jack.

149. In a telephone system, a trunk line having three branches at one end thereof, first and second automatic switches containing fixed and movable terminals for two of said branches, respectively, a spring jack for the other branch, means including said switches for extending connections over said trunk line in either direction, means including operator's equipment and the said jack for completing connections over said trunk line manually, and means for rendering said second switch inoperative whenever the trunk line is in use by way of said jack or by way of said first switch.

150. In a telephone system, a trunk line having three branches at one end thereof, a manual connective terminal for one of said branches, an automatic switch provided with a movable terminal for another of said branches, a second automatic switch provided with a fixed terminal for the last of said branches, means including said first switch for extending connections automatically over said trunk line in one direction, means including said second switch for extending connections automatically over said trunk line in the other direction, and means including said manual connective terminal for completing manual connections over said trunk line.

151. In a telephone system, a trunk line having three branches at one end thereof, a manual connective terminal for one of said branches, an automatic switch provided with a movable terminal for another of said branches, a second automatic switch provided with a fixed terminal for the last of said branches, means including said first switch for extending connections automatically over said trunk line in one direction, means including said second switch for extending connections automatically over said trunk line in the other direction, means including said manual connective terminal for

completing manual connections over said trunk line, and means including busy test circuits for preventing interference between the several branches.

152. In a telephone system, a trunk line, means including a manual connective terminal at one end and a second manual connective terminal and a call signal at the other end for completing a connection over said trunk line in one direction, means including an automatic switch for seizing said trunk line at one end and the said second manual connective terminal and call signal at the other end for completing a connection over said trunk line in the same direction, and means including said second manual connective terminal and a second automatic switch at the other end of said trunk line and controllable thereover for completing a connection over the said trunk line in the opposite direction.

153. In a telephone system, a trunk line, means including a manual connective terminal at one end and a second manual connective terminal and a call signal at the other end for completing a connection over said trunk line in one direction, means including an automatic switch for seizing said trunk line at one end and the said second manual connective terminal and call signal at the other end for completing a connection over said trunk line in the same direction, means including said second manual connective terminal and a second automatic switch at the other end of said trunk line and controllable thereover for completing a connection over the said trunk line in the opposite direction, and circuits for preventing interference between the said switches and between either switch and the said first manual connective terminal.

154. In a telephone system, a trunk line having three branches at one end thereof, first and second automatic switches containing fixed and movable terminals for two of said branches, respectively, a manual connective terminal for the other branch, a second manual connective terminal for the other end of said trunk line, means including said last terminal and said switches for completing connections over said trunk line in either direction, and means including both of said manual connective terminals for completing connections over said trunk line manually.

155. In a telephone system, a trunk line having three branches at one end thereof, first and second automatic switches containing fixed and movable terminals for two of said branches, respectively, a manual connective terminal for the other branch, a second manual connective terminal for the other end of said trunk line, means including said last terminal and said switches for completing connections over said trunk line in either direction, means including both of said man-

ual connective terminals for completing connections over said trunk line manually, and an interference preventing circuit having a multiple in each of said branches.

5 156. In a telephone system, means for connecting calling and called lines comprising an automatic switch and a trunk line, means controlled by a calling subscriber for operating said switch to connect with the
10 trunk line at one end, a manually operable terminal at the other end of said trunk line for completing connection to the called line, and means in said switch for supplying the substation on the called line with talking
15 current.

157. In a telephone system, trunk lines of two kinds, an automatic switch operable by a calling subscriber to connect with a trunk line of either kind, means in said switch for
20 bridging a source of talking current across the line conductors of a connected trunk, common and local battery subscribers' lines accessible to the two different kinds of trunk lines, respectively, and condensers included
25 in the line conductors of those trunk lines which have access to the local battery subscribers' lines.

158. In a telephone system, a first exchange and a second exchange, automatic and manual subscribers' lines in the first exchange, a trunk line terminating in an automatic switch at the second exchange and provided with a manually operable terminal adapted for connection with a calling line in
30 the first exchange, means for rendering the said switch controllable by the calling subscriber when the calling line is an automatic line, and means for rendering the same switch controllable by the operator when the
35 calling line is a manual line.

159. In a telephone system, a trunk line terminating at each end in a manual connective terminal, incoming and outgoing branches of said trunk line at one end terminating, respectively, in movable and fixed
40 contacts in separate automatic switches, and means for completing connections over said trunk line by way of either of the three branches at one end and the said manual
45 connective terminal at the other end.

160. In a telephone system, a two-way trunk line, subscriber-controlled means for connecting with one end of said trunk line, for calling over the trunk line in one direction, a manual switchboard for connecting
50 a subscriber to the other end of said trunk line, to call over the trunk line in the opposite direction, and suitable instrumentalities for supplying talking current over the trunk
55 line to a calling subscriber.

161. In a telephone system, a two-way trunk line, means for automatically establishing connection with said trunk line to extend connection thereover in one direction,
60 means for enabling an operator to connect

a subscriber with the other end of said trunk line, and to transmit calling impulses over the trunk line in the opposite direction, and suitable instrumentalities for supplying talking current over the trunk line to a calling subscriber.

162. In a telephone system, a two-way trunk line, suitable instrumentalities by which either a calling subscriber or an operator may transmit calling impulses over
70 said trunk line in one direction, means by which some other subscriber may automatically connect his line to the said trunk line to extend a calling connection thereover in the opposite direction, and suitable instrumentalities for supplying talking current over the trunk line to a calling subscriber.

163. In a telephone system, an automatic switch, a trunk line leading thereto, a trunking operator's cord circuit for the other end
80 of said trunk line, condensers in said cord circuit, a telephone line connected with the cord circuit, means for closing parallel connections around said condensers to permit the calling subscriber to operate said automatic switch, suitable inductive resistance in said parallel connections, and supervisory relay mechanism for said cord circuit, and mechanism comprising front and back supervisory relays, as set forth.

164. In a telephone system, a manual exchange, a second exchange, subscribers' lines terminating in said second exchange, a trunk line terminating in said first exchange and extending to said second exchange, means
90 for manually extending a connection from said trunk line to a subscriber's line terminating in said second exchange, and automatic means controlled over said trunk line for extending a connection from said trunk
95 line to a subscriber's line terminating in said second exchange.

165. In a telephone system, a manual exchange, a second exchange, subscribers' lines terminating in said second exchange, a trunk
100 line terminating in said first exchange and extending to said second exchange, means for manually extending a connection from said trunk line to a subscriber's line terminating in said second exchange, automatic means controlled over said trunk line for extending a connection from said trunk line to a subscriber's line terminating in said second exchange, and means for establishing a connection over said trunk line from
105 said second exchange to said first exchange.

166. In a telephone system, a manual exchange, a second exchange, subscribers' lines terminating in said second exchange, a trunk line terminating in said first exchange and extending to said second exchange, means for manually extending a connection from said trunk line to a subscriber's line terminating in said second exchange, automatic means controlled over
110
115
120
125
130

said trunk line for extending a connection from said trunk line to a subscriber's line terminating in said second exchange, and means for preventing said trunk line being employed for establishing one connection when it is employed in establishing a second connection.

167. In a telephone system, a manual exchange, a second exchange, subscribers' lines terminating in said second exchange, a trunk line terminating in said first exchange and extending to said second exchange, means for manually extending a connection from said trunk line to a subscriber's line terminating in said second exchange, automatic means controlled over said trunk line for

extending a connection from said trunk line to a subscriber's line terminating in said second exchange, means for establishing a connection over said trunk line from said second exchange to said first exchange, and means for preventing said trunk line being employed for establishing one connection when it is employed in establishing a second connection.

Signed by me at Chicago, Cook county, Illinois, this 6th day of September, 1907.

TALBOT G. MARTIN.

Witnesses:

EDWARD D. FALES,
ARTHUR B. SPERRY.