

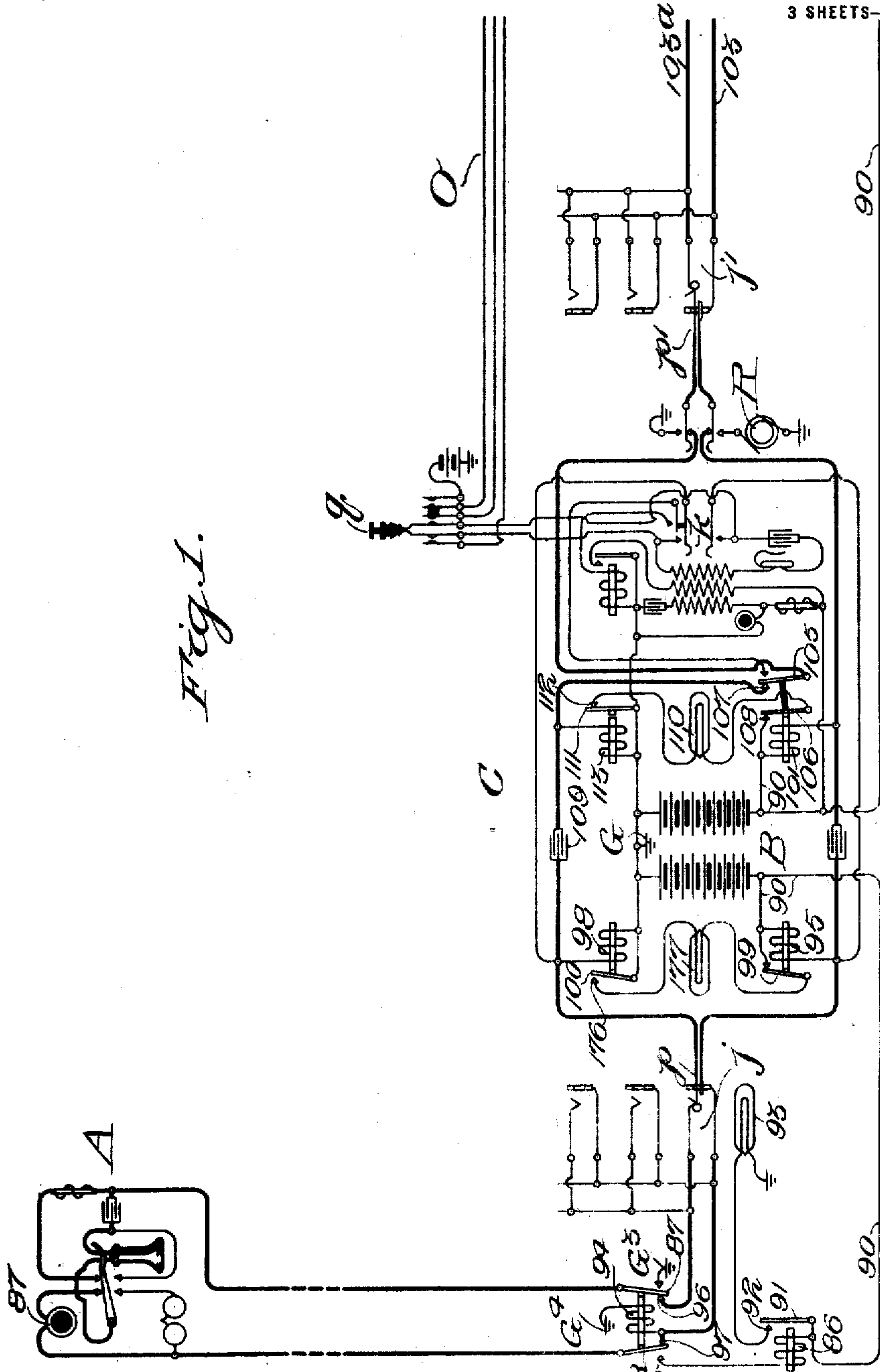
W. L. CAMPBELL & T. G. MARTIN.
AUTOMATIC AND MANUAL TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED APR. 23, 1907.

Patented Apr. 22, 1919.

3 SHEETS—SHEET 1.

1,301,648.



Witnesses:
R. A. Burfield
A. Andersen.

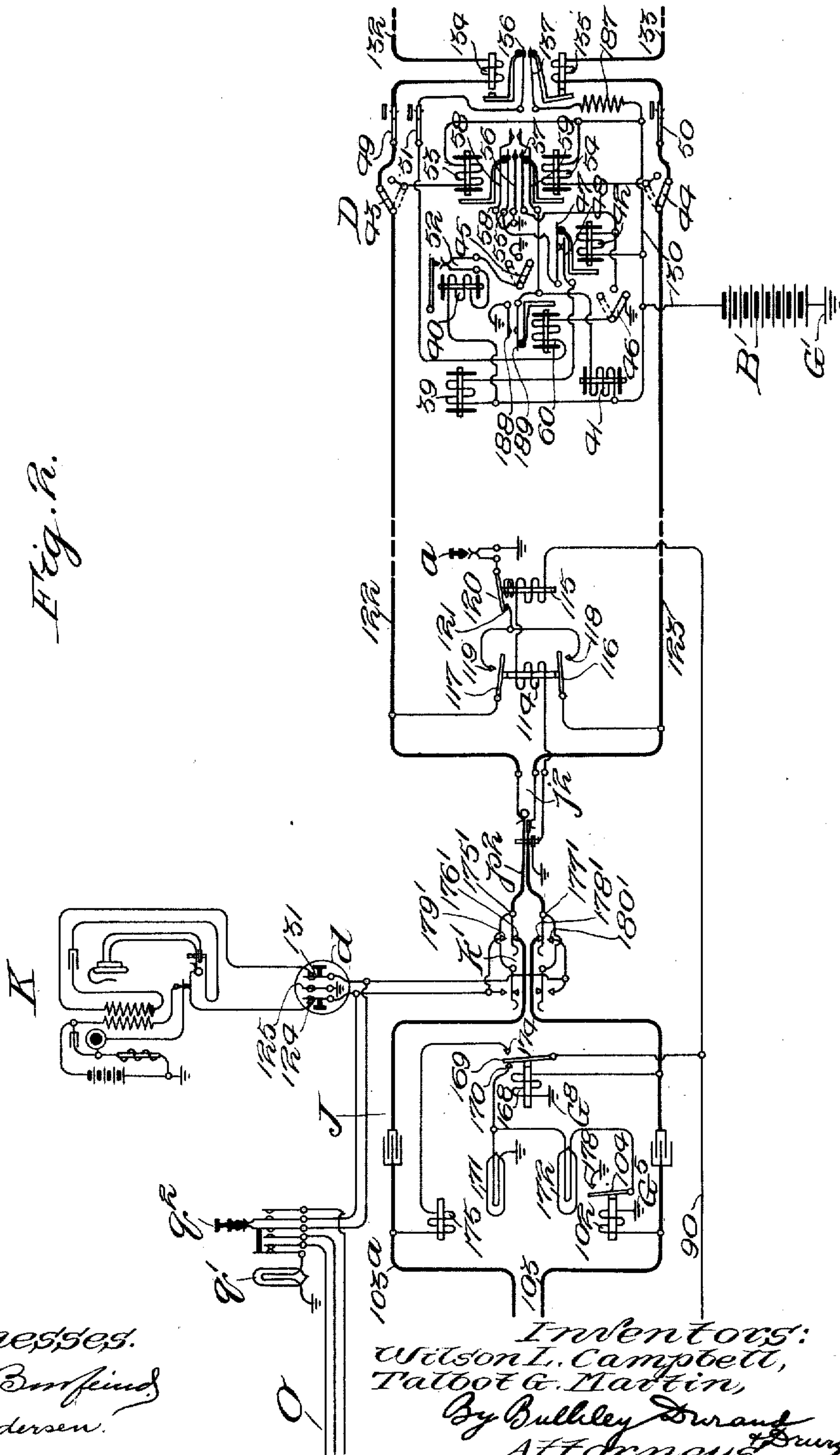
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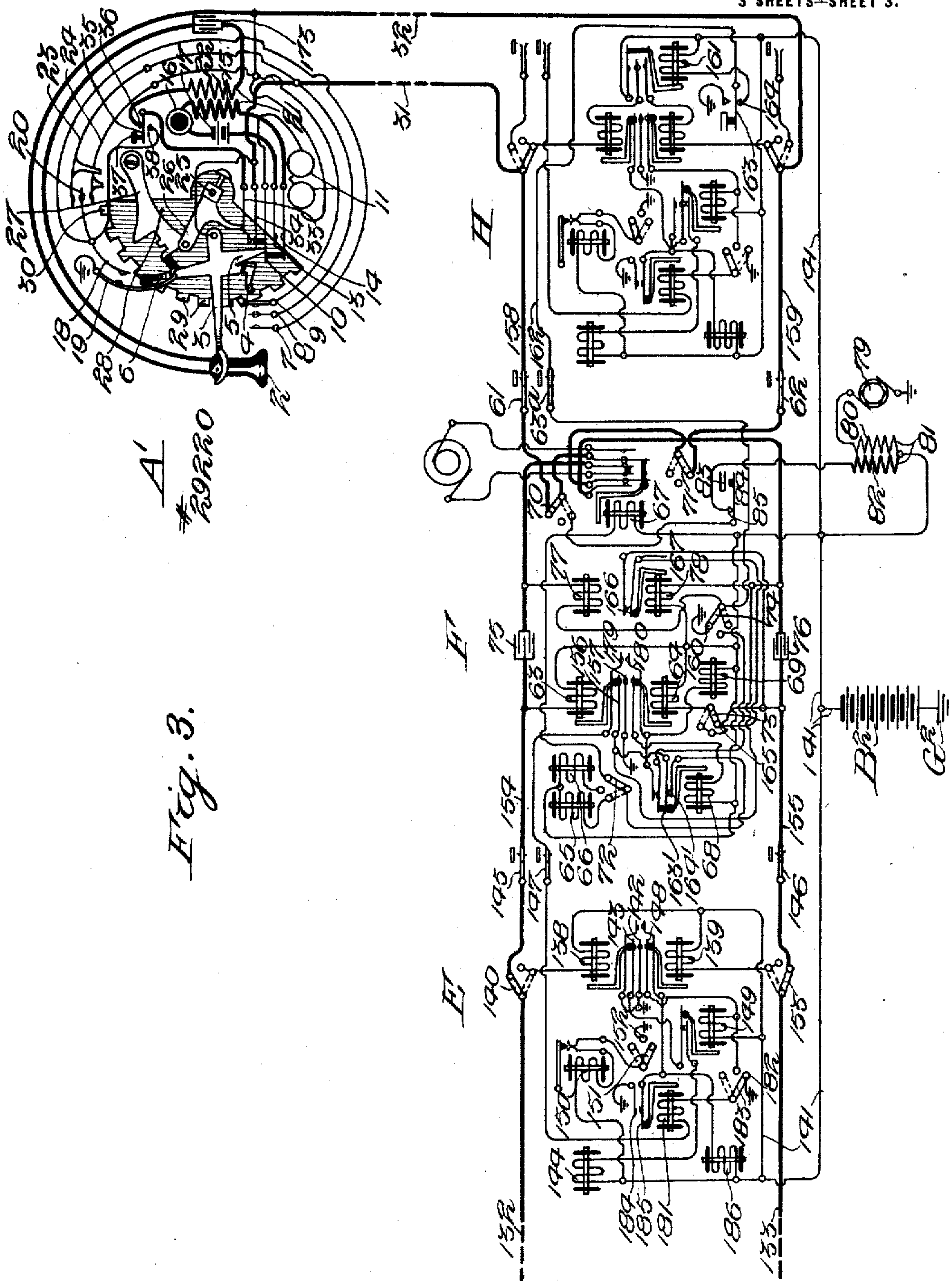


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UNITED STATES PATENT OFFICE.

WILSON L. CAMPBELL AND TALBOT G. MARTIN, OF CHICAGO, ILLINOIS, ASSIGNORS, BY
MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC COMPANY, A CORPORATION OF
ILLINOIS.

AUTOMATIC AND MANUAL TELEPHONE-EXCHANGE SYSTEM.

1,301,648.

Specification of Letters Patent.

Patented Apr. 22, 1919.

Application filed April 23, 1907. Serial No. 869,808.

To all whom it may concern:

Be it known that we, WILSON L. CAMPBELL and TALBOT G. MARTIN, both citizens of the United States of America, and residents of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Automatic and Manual Telephone-Exchange Systems, of which the following is a specification.

Our invention relates to telephone exchange systems in general, but more particularly to systems in which both manual and automatic apparatus is employed, and especially to systems in which the subscriber of a manual exchange may call and obtain connection with the line of a subscriber of an automatic exchange.

One of the principal objects of our invention is, therefore, the provision of an arrangement whereby a manual subscriber may call an automatic subscriber, through the medium of originating and trunking operators' cord circuits, and whereby the originating operator may have complete supervision over the connection thus established.

As hereinafter described we accomplish this by providing an originating operator's switchboard to which are connected the lines of manual subscribers. Suitable line-signal apparatus is provided by which the subscribers may attract the attention of the operator, and on the same switchboard are one or more jacks connected with trunk lines extending to a trunking operator's position or switchboard.

At the trunking operator's position we provide one or more jacks connected with trunk lines leading to the automatic exchange, and at the said exchange these trunk lines terminate in second-selectors. In addition, the trunking operator is provided with an impulse transmitter or calling device by which the said selectors can be operated after connection is made with one of the trunk lines leading thereto. We

also equip the said automatic exchange with third-selectors and connectors, the third-selectors being interposed between the second-selectors and the connectors, and all of these automatic switches being responsive to the

impulse-transmitter or calling device included in the trunking operator's equipment. For the benefit of the automatic subscribers, and as a means of intercommunication be-

tween the same, first-selectors are provided, and other switches if necessary, and the subscribers are provided with impulse-transmitters or calling devices. However, when a manual subscriber calls an automatic subscriber, the manual trunking operation, accomplished through the trunking operation of the originating and trunking operators, corresponds to the first digit of the called number, and the automatic trunking and connecting operations corresponding to the other four digits of the called number are then accomplished at the automatic exchange, and are under the control of the trunking operator. The trunking connection thus afforded between manual and automatic subscribers is supervised by the originating operator at the cord circuit of the latter at the manual exchange, and disconnect signals are given when either or both subscribers hang up their receivers. In this way satisfactory service is given between the subscribers of manual and automatic exchanges, and at the same time, of course, the manual subscribers can call manual subscribers, and the automatic subscribers can call automatic subscribers.

It is also an object, of course, to provide certain details and features of improvement and combinations tending to increase the general efficiency of a telephone exchange system.

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

In the accompanying drawings Figure 1 represents diagrammatically a manual substation A connected with a central office involving equipment usually found in a central station of this character. An originating operator's cord circuit is shown at C. An order wire O leads to a trunking operator's position J in the same exchange, but shown in Fig. 2. At D (Fig. 2) is shown a second-selector of an automatic central office which will be designated as the main automatic central station. From this office trunk lines lead to the manual office and terminate at the trunking operator's position, one of which trunks is shown. Also leading from this automatic central office there are shown trunk lines to other automatic exchanges, such as the one the switches

of which are shown diagrammatically in Fig. 3 and which will be designated as the sub-automatic exchange.

Figs. 1, 2 and 3 taken together show an established connection extending from the manual substation A (Fig. 1) to the automatic substation A' (Fig. 3).

The substation A' (Fig. 3) may be of any suitable or approved type. The one in connection with which we have elected to illustrate our invention 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 10, thereby bridging the ringer 11 across the line. Furthermore, when the switch-hook is down the said cam 5 disengages the springs 13 and 14, thus breaking the local circuit which includes in series the primary winding 15, transmitter 16 and local battery 17. The substation ground circuit is normally broken between the ground springs 18 and 19 by the cam-arm 6; but when said springs are together ground is provided to the ground post 20 and to the release spring 7, as is usually the case in telephones of this type. The said substation comprises the usual induction-coil 21 having the primary winding 15 and secondary winding 22. Being an automatic substation it is provided with the usual vertical and rotary impulse springs 23 and 24. Said substation is, of course, provided with a dial (not shown) which is secured to the shaft 25, together with the locking dog 26. Furthermore, there is a locking cam 27 that locks the dog 26, while the receiver is on the switch-hook, to prevent a rotation of the dial. For operating the impulse springs 23 and 24 the substation is provided with an impulse wheel 28 that is secured to the shaft, which impulse wheel carries on its periphery the so-called vertical impulse teeth 29 and one rotary impulse tooth 30. The said impulse teeth are so arranged that when the dial is drawn down the impulse springs 23 and 24 are not carried into contact with the ground post 20; but as the dial returns, first the vertical teeth engage the vertical impulse spring 23, and after they have completed their work the rotary impulse tooth 30 operates the rotary impulse spring 24. In this operation the subscriber's vertical line conductor 31 is first given a number of ground impulses, and then the rotary line conductor 32 is given one ground impulse. It will be noticed that as long as the dial is out of normal position the construction is

such that the dog 26 permits the primary circuit springs 33 and 34 to separate, thus preventing the impulses that are delivered to either line conductor from passing to the other. The means whereby the subscriber may signal the called subscriber comprises the push-button spring 35 which normally engages the contact point 36; but when the button 37 is pressed the spring 35 engages the contact point 38, whereby the vertical line conductor 31 may be grounded.

The second-selector D is substantially the same as the selector switch disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, with the exception that there are no normal conductors. There is no necessity in the second-selector for a bridge-cut-off relay, and it is also omitted, and the line relays are connected directly to the battery lead. The private normal conductor of the said selector patent is of no utility in connection with the second-selector, and is also omitted. Since the said selector is substantially like the one disclosed in said patent it is equipped with a vertical magnet 39 and a rotary magnet 40, a release magnet 41 and a private magnet 42, the operation of which will be understood. The said private magnet 42, of course, controls the side switch wipers 43, 44, 45 and 46, the said private magnet also controlling the circuit of the vertical magnet 39, in the usual manner, by means of the springs 47 and 48, 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 49, 50 and 51, is controlled by the vertical magnet 39; and the rotary motion by the rotary magnet 40, the rotary magnet circuit being provided with the usual interrupter springs 52. The operative magnets of the switch are, of course, controlled by the subscriber through the medium of the vertical and rotary line relays 53 and 54, as is well known. Said relays have under their control the usual springs 55, 56 and 57, and in addition the trunk-release springs 58 and 59, by means of which latter springs the said switch may be released when the side switch wipers are in first or second position. By means of the back-release relay 60 the release of the switch D is brought about after the side switch has passed to third position. The third-selector E (Fig. 3) is a duplicate of the second-selector switch D (Fig. 2).

The connector switch F is an improved form of the connector described in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson. The general mechanical details of the connector F are the same as those of the patented connector, but there are changes in the circuits. The connector

switch shaft (not shown), like the switch shaft of the selector D, carries the line wipers 61 and 62 and the private wiper 63^a. The connector switch is also controlled by the calling subscriber through the medium of the vertical and rotary line relays 63 and 64. The vertical line relay 63 directly controls the vertical magnet 65, and also the rotary magnet 66 and ringer relay 67. The office of the vertical magnet 65 is to give the shaft and shaft wipers their vertical motion, and the rotary magnet 66 imparts to the shaft and shaft wipers a rotary or circular motion. The rotary line relay 64 controls the private magnet 68, which latter, under certain conditions, controls in turn the vertical and rotary magnets 65 and 66, release magnet 69, and also the side switch wipers 70, 71, 72, 73 and 74. 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 69 is also controlled by the line relays 63 and 64 conjointly. By the condensers 75 and 76 the circuit through the connector is inductively divided into two sections. The connector F is also provided with the back-bridge coils 77 and 78, so arranged that when the side switch passes to third position an energizing circuit is closed through the relay 78, which operates to connect the rotary line relay 64 to the called line. The central office is equipped with a busy-signaling apparatus of any suitable design, such, for example, as the one comprising an interrupter 79 in series with the primary winding 80 of the induction-coil 81, whereby a busy-signaling current is induced in the secondary winding 82 of the said coil. The connector switch shaft also carries a normal post arm 83 which, when the connector shaft is off normal, allows the spring 84 to engage the contact point 85, whereby the busy-signaling current passes to the line of the calling subscriber when the side switch is in first position.

The first-selector H (Fig. 3) allotted to the line of the substation A' is of the type disclosed in said selector patent.

It will be understood that the manual exchange, which is shown in Fig. 1, and which may be designated as the main manual exchange, has allotted to it, of course, a plurality of subscribers each provided with a substation, such as the substation A. These subscribers may readily be put in connection with one another through the medium of cord circuits, such as the cord circuit C, or they may be put in connection with the automatic subscribers of the main automatic exchange (Fig. 2), or of the sub-automatic exchange (Fig. 3).

It will further be understood that the main automatic exchange to which the selector D (Fig. 2) belongs may have allotted

to it a plurality of automatic subscribers each provided with a substation, such as the substation A' (Fig. 3), each of which substations has allotted to it a first-selector, such as the first-selector H. The said first-selectors are adapted to be operated, in the manner well known, to establish connection with a second-selector, such as the second-selector D, and with other selectors if necessary, which last selector is in turn adapted to establish connection with local connectors, similar to the connector F, for obtaining connection with local subscribers. If it is desired to obtain connection with the automatic subscribers of the sub-automatic exchange (Fig. 3), a second-selector, similar to the second-selector D, is, of course, operated to a proper level from which trunk lines lead to the sub-automatic exchange (Fig. 3), among which is the trunk line that terminates in the selector E. The sub-automatic exchange also has allotted to it a plurality of substations, such as the substation A', each of which substations has allotted to it a first-selector, exactly as the substation A' has allotted to it a first-selector.

The method of operation of the system will be understood from the following: If the subscriber at the substation A (Fig. 1) wishes to call the subscriber at substation #29220 he will remove his receiver from the switch-hook, which will give a signal to his operator. The subscriber's operator will, upon observing the signal, answer in the usual manner by placing one of the answering plugs in the answering jack corresponding to the signaling device (which may be a lamp) and throwing a listening key *k*. Upon learning that substation A' or #29220 is wanted the operator will, by means of the order circuit, transmit the order to one of the outgoing trunking operators. The trunking operator upon receiving the order will designate to the subscriber's operator which trunk to take. The subscriber's operator thereupon will plug in the jack of the designated trunk at the same time that the trunking operator selects one of the trunk lines leading to the main automatic exchange. It will be understood that if an automatic subscriber were calling the number 29220 he would have to operate his dial five times, once in accordance with each digit; but when a call comes from the manual subscriber A the preliminary operations of the line and trunking operators, above explained, will correspond to the operations of the automatic subscriber for the first digit 2, and consequently when the trunking operator begins to operate her automatic calling device for calling the said line #29220 the first digit is omitted. The trunking operator then operates her automatic calling device in accordance with the digit 9 to operate the selector D; she next operates her

calling device in accordance with the second digit 2, for operating the selector E to connect with the connector F. Subsequently, the calling device is operated in accordance with the last two digits to operate the connector and for thereby completing the connection, if the line is idle.

In detail, the establishment of the connection is as follows: When the subscriber at substation A removes the receiver from the switch-hook an energizing circuit is closed through the line relay 86. This circuit extends from ground G^3 through the transmitter 87 of the substation A to the armature 88 and to the contact point 89, to the line relay 86 and thence to the battery lead 90, and through battery B to ground G. The line relay upon energizing operates to close in contact the armature 91 and contact point 92, whereby the circuit is closed through the line lamp 93. The operator upon observing this signal will answer in the usual manner by placing one of the answering plugs p in the answering jack corresponding to the lamp. She then throws her key k to listen. When the plug p engages the jack an energizing circuit is established through the line-cut-off relay 94. This circuit extends from ground G^4 through the relay 94, through the sleeve of the jack to the sleeve of the plug p , relay 95, battery lead 90, thence through battery B to ground G. The relay 94 upon energizing attracts its armatures 87 and 88 to engage with the contact points 96 and 97, whereby the subscriber's line conductors are extended to the operator's cord circuit. Also, when the line-cut-off relay thus operates, the substation A is supplied with battery current for talking purposes. This circuit extends from the grounded terminal of the battery B through the relay 98 to the tip of the plug p , to the tip of the jack j , through the contact point 96 and armature 87, through the substation transmitter to the sleeve side of the line, through the armature 88, contact point 97, sleeve of the jack and plug p , through the relay 95 to the battery lead 90, and through battery B to ground G. The relays 95 and 98, being included in this circuit, energize and attract their respective armatures 99 and 100. The operator upon learning that the substation #29220 is wanted will, by pressing the order wire button q , transmit the order over the line O to the outgoing trunking operator at J. The trunking operator at J upon receiving the signal will press the button q^2 and thus bridge the talking set k across the order wire. Said operator J upon receiving the order from the operator C will instruct the operator C which trunk to use. The subscriber's operator upon being assigned a trunk will insert the plug p' into the jack j' of the trunk designated. At the same time, furthermore, the trunking

operator will select one of the trunk lines leading to the automatic exchange and insert the plug p^2 , of the trunk assigned to the subscriber's operator, into the jack j^2 . When the plug p' engages the jack j' an energizing circuit is established through the relay 101 at the cord circuit C. This circuit extends from ground G^5 at the trunking operator's position J through the relay 102, trunk conductor 103, through the sleeve of jack j' and sleeve of plug p' , through the relay 101 to the battery lead 90, and through battery B to ground G. The relay 102 upon energizing withdraws its armature 104 from engagement with the grounded contact point 178, and the relay 101 upon energizing attracts its armatures 105 and 106 to engage the contact points 107 and 108, respectively. When the armature 105 and contact point 107 engage, the tip side of the cord circuit is then completed through the condenser 109 from the answering plug p to the calling plug p' . When the armature 106 and contact point 108 engage, a circuit is closed through the supervisory lamp 110. This circuit extends from the grounded terminal G of the battery through the armature 111, contact point 112, through the lamp 110, armature 106 and contact point 108 to the battery lead 90 and through battery B to ground G. It will be made to appear hereinafter that when the called subscriber answers, this circuit through the lamp 110 becomes broken upon the energization of the relay 113. Thus far the connections have been made manually—that is, through operators. The automatic continuation of the manual connection commences at the trunking operator's calling device d . When the plug p^2 is inserted in the jack j^2 an energizing circuit is established through the releasing relays 114 and 115. This circuit extends from the grounded ring of the plug p^2 through the ring of the jack j^2 , relay 114 in series with the relay 115, to the battery lead 90, and through battery B to ground G. The relays 114 and 115 are provided for bringing about the automatic release of the automatic switches when the plug p^2 is removed from the jack j^2 . The relay 114 is a quick-acting relay, while the relay 115 is arranged to operate slowly. When the relays thus energize in series the armatures 116 and 117 of the relay 114 disengage from the contact points 118 and 119 before the armature 120 of the relay 115 engages the contact point 121; and then when the relays deenergize, the armatures 116 and 117 of the relay 114 engage their respective contact points before the armature 120 disengages from the contact point 121. Having established connection with the selector D the first digit 2 of the number 29220 is eliminated, as already explained. The operator then throws the key k' so that the springs

175' and 177', respectively, are disconnected from the contact points 176' and 178' and carried into engagement with the contact points 179' and 180', from which last-named contact points conductors lead to the calling device *d*, which calling device is then operated in accordance with the remaining digits 9, 2, 2 and 0. Therefore, the so-called vertical push-button 124 is pressed onto the ground spring 125 nine times, whereby the vertical line relay 53 of the second-selector D is energized nine times over a circuit extending from the grounded spring 125 through the spring 124, through the key *k'* to the tip of the plug *p*² and the tip side of the jack *j*², conductor 122, side switch wiper 43, vertical line relay 53 to the battery lead 130, and through battery B' to ground G'. Each time that the vertical line relay 53 is energized the springs 55 and 56 are pressed into contact, whereby an energizing circuit is closed each time through the vertical magnet 39. The vertical magnet then operates to carry the shaft and shaft wipers 49, 50 and 51 nine steps and opposite the bank level in which terminate the trunk lines leading to the sub-exchange in which the line #29220 terminates. After the calling device has been operated for the vertical impulse the rotary push-button spring 131 is pressed onto the ground spring 125 once, whereby a momentary energizing circuit is established through the rotary line relay 54 of the selector D. This circuit extends from ground spring 125 through the push-button spring 131, key *k'* to the sleeve side of the plug *p*² and jack *j*², conductor 123, side switch wiper 44 to the rotary line relay 54, to the battery lead 130, and through battery B' to ground G'. The rotary line relay energizes and places the springs 56 and 57 in contact, whereby an energizing circuit is closed through the private magnet 42. The private magnet upon energizing and deenergizing operates in the usual manner to permit the side switch to pass from first to second position. When the side switch wiper 45 engages the grounded contact point in the second position an energizing circuit is closed through the rotary magnet 40. The rotary magnet now operates to carry the shaft wipers 49, 50 and 51 in a rotary direction and into engagement with the first set of trunk line contacts. If the first trunk line is busy an energizing circuit is established through the private magnet extending from the grounded shaft wiper 51, which engages the busy contact, through the release relay 60, side switch wiper 46, which is in second position, to the private magnet 42, thence to the battery lead 130, and through battery B' to ground G'. As long as the private wiper 51 engages busy or grounded contacts the energizing circuit is maintained, and the side switch is retained in second position, thus maintaining the energizing circuit through the rotary magnet 40. When the shaft wiper 51 passes onto the first idle contact the energizing circuit through the private magnet becomes broken and the side switch passes from second to third position, thus extending the trunk conductors 122 and 123 through the side switch wipers 43 and 44 to the trunk conductors 132 and 133 which lead to the third-selector E (Fig. 3) located in the sub-exchange. It will be seen by referring to Fig. 2 that in series with the trunk line conductors 132 and 133 there are the relays 134 and 135. These relays are provided in order that the release of the selector D may be brought about after the side switch has passed to third position. The said relays are so arranged that when either relay energizes, the springs 136 and 137 do not engage; but when the relays energize simultaneously the springs 136 and 137 are pressed into contact, thus closing a circuit through the release relay 60 of the second-selector D. The third digit being 2 the trunking operator presses the vertical push-button spring 124 onto the ground spring 125 twice, and the rotary push-button 131 is pressed onto the ground spring 125 once. This operation of the calling device closes an energizing circuit twice through the vertical line relay 138 of the third-selector E, and an energizing circuit through the rotary relay 139 is closed once. This circuit through the vertical line relay extends from the grounded spring 125 through the vertical impulse spring 124 to the trunk conductor 122, thence through the side switch wiper 43 and the shaft wiper 49, relay 134, trunk conductor 132, side switch wiper 140, through the relay 138 to the battery lead 141, and through battery B² to ground G². The vertical line relay 138 being operated twice the springs 142 and 143 are pressed into contact twice, whereby an energizing circuit is established each time through the vertical magnet 144 which operates to carry the shaft and shaft wipers 145, 146 and 147 two steps in a vertical direction and opposite the second level of bank contacts which lead to the connector switches. After the vertical magnet has thus operated, the momentary circuit that is closed through the rotary line relay 139 may be traced from the ground spring 125 at the calling device *d* (Fig. 2) to the rotary trunk conductor 123, thence through the side switch wiper 44 of the selector D and through the winding of relay 135 to the rotary trunk conductor 133, thence to the side switch wiper 153 of the selector E, and through the rotary line relay 139 to the battery lead 141, and through battery B² to ground G². When the rotary line relay 139 is energized the spring 148 is pressed into contact for a moment with the spring 142, 130

whereby a momentary energizing circuit is closed through the private magnet 149, which latter now operates to shift the side switch from first to second position, whereby an energizing circuit is closed through the rotary magnet 150. When the side switch wiper 151 engages the grounded contact point 152 the rotary magnet 150 is operated to carry the shaft and shaft wipers 145, 146 and 147 into engagement with the first idle trunk line conductor leading to a connector. Assuming that connection is made with the connector F, then when the side switch wipers 140 and 153 pass to third position the trunk conductors 122 and 123 are extended to the conductors 154 and 155 leading to the connector F. The operations of the calling device for the last two digits (two and naught) are directed to the connector switch F. Grounding the vertical line conductor 122 for the digit 2 now energizes the vertical line relay 63 of the connector F. The vertical line relay 63, being energized twice, operates to close the springs 156 and 157 in contact, whereby an energizing circuit is established twice through the vertical magnet 65. The vertical magnet 65 now operates to carry the shaft wipers 61, 62 and 63^a in a vertical direction and opposite the bank level in which are located the terminals of the normal conductors 158 and 159 which lead to the substation conductors 31 and 32. When the rotary line relay 64 is operated the private magnet 68 is energized and the side switch passes from first to second position. When the side switch wiper 72 passes from first to second position the vertical magnet 65 passes from the control of the vertical line relay, and the rotary magnet 66 is substituted instead. Now, when the vertical line relay 63 is operated ten times for the last digit naught, the rotary magnet 66 becomes energized ten times and the shaft wipers 61, 62 and 63^a are rotated ten steps and onto the contacts which constitute the terminals of the normal conductors 158 and 159. Now when the rotary line relay 64 is energized for the last time the private magnet 68 is in turn energized, which now operates with one of two results, namely the release of the side switch from second to third position, or the so-called busy-release of the connector switch. It will be assumed that the first result takes place—that is, that the side switch passes from second to third position. If the called line is busy, then when the private magnet 68 energizes for the last rotary impulse the ground on the private contact of the called line is transmitted to the release magnet 69. An energizing circuit is then established extending from the grounded contact point to the shaft wiper 63^a, side switch wiper 74 to the second-position contact point, through the two upper springs of the private magnet 68 to the release magnet 69 and battery lead 141, thence through battery B² to ground G². The release magnet upon energizing operates to release the switch shaft and wipers, and to restore the side switch to first position. Now when the substation signaling button is pressed the vertical magnet is energized and the switch shaft is raised, and the normal arm 83 permits the springs 84 and 85 to engage, whereby the busy-signaling coil 81 is connected to the line and the busy-signaling current is transmitted to the calling subscriber. When the side switch wiper 74 engages the grounded contact point 160 a guarding potential is established at the private wiper 63^a to protect the called line. This guarding potential also closes an energizing circuit through the bridge-cut-off relay 161 of the first-selector H. This circuit extends from the contact point 160 through the side switch wiper 74, shaft wiper 63^a, conductor 162, through the spring 163, contact point 164, bridge-cut-off relay 161 to the battery lead 141, and through battery B² to ground G². It will be noticed that when the side switch passes to third position the rotary line relay 64 is disconnected from the rotary line trunk conductor 155, when the side switch wiper 73 passes onto the contact point 165. This circuit, however, is again closed as soon as the back-bridge relay 78 energizes, which relay controls the springs 166 and 167. Said relay energizes as soon as connection is closed with the called substation. The energizing circuit through the relay 78 extends from the grounded contact point 160, through the side switch wiper 74, back-bridge relay 77, through the ringer relay springs and side switch wiper 70, shaft wiper 61, through the normal conductor 158, line conductor 31, through the switch-hook 3 to the ringer spring 10, through the ringer 11 to the rotary line conductor 32, rotary normal conductor 159, shaft wiper 62, side switch wiper 71, ringer relay springs to the relay 78, thence to the battery lead 141 and through battery B² to ground G². The relay 78 energizes and closes in contact the springs 166 and 167, as explained. The supervisory relay 168 at the trunking operator's position now energizes over a circuit extending through ground G² to the relay 168, and through the sleeve side of the cord circuit to the key k', to the rotary trunk conductor 123, side switch wiper 44, shaft wiper 50, through the relay 135 to the rotary trunk conductor 133, side switch wiper 153, conductor 155, through the supervisory relay springs 166 and 167 to the side switch wiper 73, rotary line relay 64 to the battery lead 141, and through battery B² to ground G². It will be seen that the rotary line relay 64 is in this circuit, but the resistance of the coil 168 is so high that said relay 64 does

not operatively energize. The relay 168 upon energizing closes in contact the armature 169 and the contact point 170, whereby a circuit is closed through the back supervisory lamp 171. The back supervisory lamp 171 lights, but not the front supervisory lamp 172, as the relay 102 is energized over the sleeve conductor from the calling plug of the originating subscribers' operator, as explained. At the same time, at the subscriber's operator's position the back supervisory lamp 110 is glowing, because battery current is cut off from the tip trunk line conductor by the supervisory relay 168 at the trunking operator's position, and the relay 113 at the subscriber's operator's position cannot energize to attract its armature 111 from the contact point 112 until the supervisory relay 168 deenergizes. The trunking operator after having operated the central office switches to establish connection with the line conductors leading to substation #29220 presses the vertical impulse spring 124 onto the ground post 125, whereby an energizing circuit is again completed through the connector vertical line relay 63. The vertical line relay upon operating closes an energizing circuit through the ringer relay 67. This circuit extends from ground through the springs 157 and 156, through the private magnet springs 163' and 164', side switch wiper 72, through the winding of the ringer relay 67 to the battery lead 141, thence through battery B² to ground G². The ringer relay upon energizing operates to bridge across the line conductors of the called substation the terminals of the ringer generator, whereby the substation ringer 11 is operated. The subscriber at substation A', having been signaled by the trunking operator, removes the receiver 2 from the switch-hook 3, and upon referring to Fig. 3 it will be seen that a condenser 173 is in the receiver circuit, so that the circuit through the supervisory relay 78 in the connector F is broken. As a result the springs 166 and 167 separate and the rotary trunk conductor 155 is disconnected from the non-grounded pole of the battery. By this the supervisory relay 168 is deenergized and the armature 169 falls back against the contact point 174, the back supervisory lamp 171 is extinguished and the tip trunk line conductor 103^a is connected to the non-grounded pole of the battery. An energizing current now flows through the relay 113 of the originating operator's cord circuit. This circuit extends from the grounded terminal G of the battery B through the relay 113, contact point 107, armature 105, through the tip of the plug p' and tip spring of the jack j', tip conductor 103^a, through the relay 175, contact point 174, armature 169 to the battery lead 90, and through battery B to ground G. The relay 113 energizes and attracts its

armature 111 from contact with the point 112, whereby the circuit through the back supervisory lamp 110 becomes broken. The supervisory lamps in both the subscriber's and trunking operator's positions now being extinguished, the operators will understand that the subscribers are both on the line. After having finished the conversation the subscribers hang up their receivers. On the automatic side the back supervisory relay 78 of the connector is again energized, since the circuit is again closed through the relay 78 and the substation ringer, placing the springs 166 and 167 in contact, whereby the circuit through the supervisory relay 168 at the trunking operator's position is again completed. When this relay energizes, the armature 169 disengages from the contact point 174, whereby the circuit through the relay 113 of the subscriber's operator's cord circuit becomes broken. The deenergization of this relay 113 permits the armature 111 to engage the contact point 112, whereby the circuit through the back supervisory lamp 110 is again established. If now the manual subscriber at substation A hangs up his receiver also, the energizing circuit including the supervisory relay 98 becomes broken and the armature 100 engages the contact point 176, whereby a circuit is completed through the front supervisory lamp 177. The operator seeing both the front and back supervisory lamps lighted takes down the connection. When the calling plug p' is removed from the jack j' the circuit including the relay 102 of the trunking operator's position, in series with the relay 101 of the subscriber's cord circuit, becomes broken and the relay 102 deenergizes, permitting the armature 104 to engage the grounded contact point 178. The engagement of the armature 104 and grounded contact point 178 closes the circuit through the manual supervisory lamp 172 in the trunking operator's circuit. The trunking operator seeing both lamps lighted takes down the connection by pulling out the plug p² from the jack j², and as a result the energizing circuit through the release relays 114 and 115 is broken. The relay 114 being a quick-acting relay, as explained, permits the armatures 116 and 117 to engage the grounded contact points 118 and 119 before the armature 120 of the slow-acting relay 115 disengages from the contact point 121. By this action the trunk line conductors 122 and 123 are grounded simultaneously for energizing the vertical and rotary line relays of the connector F. When said vertical and rotary line relays 63 and 64 of the connector F energize simultaneously the trunk-release springs 179 and 180 are pressed into contact, whereby a series energizing circuit is completed through the release relay 181 of the selector E and the release magnet 69 of the

connector F. This circuit extends from the grounded contact point 182 through the side switch wiper 183, release relay 181, through the private shaft wiper 147, springs 179 and 180, release magnet 69 to the battery lead 141, and through battery B² to ground G². The release magnet 69, upon energizing, operates in a well-known manner to restore the connector shaft wipers and side switch to normal position. The release relay 181 of the selector E, upon energizing, closes the springs 184 and 185 in contact, whereby a circuit is closed through the release magnet 186. The selector release magnet 186, upon energizing, attracts its armature and remains in readiness to restore the shaft wipers and side switch to normal position, when the energizing circuit through the release relay 181 becomes broken, which occurs when the slow-acting relay 115 deenergizes. Also, when the trunk line conductors 122 and 123 are grounded simultaneously, the relays 134 and 135 at the selector D energize simultaneously, placing the springs 136 and 137 in contact, whereby an energizing circuit is established through the release relay 60 of the selector D. This circuit extends from ground through the side switch wiper 46, release relay 60, shaft wiper 51, springs 136 and 137, resistance coil 187 to the battery lead 130, and through battery B' to ground G'. The release relay 60 operates in turn to close in contact the springs 188 and 189, whereby a circuit is closed through the release magnet 41. The release magnet 41 energizes and attracts its armature, remaining in readiness to restore the selector shaft wipers and side switch to normal position, when the energizing circuit through the said magnet is broken—that is, when the slow-acting relay 115 deenergizes.

It will be seen that the supervision of these connections rests entirely with the subscriber's operator, because the trunking operator does not take down the connection until signaled by the originating operator. Supervision of the signaling of the called subscriber depends on the trunking operator, but the subscriber's operator is also afforded means to know when the called subscriber has answered. The button *a* (Fig. 2) is provided in order that the ground may be cut off from the armature 120. This provision is made in order that the operator may remove the plug *p*² and insert another without releasing the automatic selector switches. It will be remembered that when the plug is removed from the jack *j*² the energizing circuit through the release relays 114 and 115 is broken, and the armatures 116 and 117 are placed in contact with the points 118 and 119 before the armature 120 disengages from the contact point 121, thereby grounding both trunk conductors 122 and 123; but if the button *a* is pressed the ground connec-

tion is cut off from the armature 120, and the deenergizing of the release relays 114 and 115 is without effect, and the transfer of plugs and cords may be accomplished without taking down the connection.

Suppose that the subscriber at substation A desires connection with a subscriber of the manual exchange. In that event the calling end *p*' of the cord circuit C is inserted in the jack corresponding to the desired substation. The ringing key is operated, whereby ringing current from the ringer generator R is projected out on the called line.

It will be understood, of course, that in the automatic offices of this system the first-selectors, as well as the second-selectors, third-selectors and connectors, are arranged in groups, said second-selectors, third-selectors and connectors being arranged on a percentage basis. For example, in an automatic exchange of ten thousand capacity a somewhat common arrangement is to divide the subscribers and their allotted first-selectors into groups of thousands. Each thousand-group is sub-divided into groups of one hundred. Then the line hundreds—that is, the one hundreds, the two hundreds, etc.—of the various thousands are each arranged in a separate group, so that in a ten thousand system the one hundreds of the thousands form one group, the two hundreds a second group, etc. Furthermore, each bank level of each of these hundred-groups has allotted to it one group of second-selectors allotted to the thousands corresponding to the level—that is, the second-selector-group of the first-selector first bank level is allotted to the first thousand, the second level to the second thousand, etc., thus taking care of the thousands. Furthermore, the second-selector-groups of each thousand are arranged in one group, and each bank level in each of these second-selector-groups has allotted to it a group of connectors, which in turn are allotted to the hundred of the corresponding thousand corresponding to the level—that is, the connector-group of the second-selector first bank level falls in the first hundred of its thousand, and of the second level in the second hundred, etc., thus taking care of the hundreds; there being in a ten thousand system ten one-thousand-groups of first-selectors; ten one-hundred-groups in each thousand; ten cross-hundred-groups in the ten thousands; also ten groups of second-selectors, one for each thousand; and ten groups of connectors in each thousand, one for each hundred. With this arrangement it will be understood that the first level of the first hundreds in all thousands in the system are multiplied in a manner well understood; likewise the second level, etc. Also, all like levels of each second-selector-group (one of which, as stated,

is allotted to each thousand) are likewise multiplied. In each of the aforesaid connector-groups also, and in the same manner, the like levels are multiplied.

5 From the foregoing it will be seen that the originating operator at C has complete supervision over the trunking connection established between the calling manual subscriber and the called automatic subscriber.
 10 This trunking connection is established by both manual and automatic apparatus, and through the calling operation of the originating and trunking operators the trunking operator has complete control over the
 15 automatic portion of the operation—that is to say, the extension of the connection by automatic switches. The manual subscribers are furnished with talking current derived from a common battery at the exchange or
 20 central station, and, as herein disclosed, the automatic subscribers are equipped with local batteries for talking purposes. It will thus be seen that trunking connection is afforded between common battery and local
 25 battery subscribers, and that the common battery operators have complete supervision over the service thus afforded between the subscribers of two different types of exchanges.

30 What we claim as our invention is:—

1. A telephone exchange system comprising subscribers' lines, and means for trunking calling lines into connection with called lines, said means including an originating
 35 operator's cord circuit, a trunking operator's cord circuit, means controlled by the trunking operator for automatically extending connection from the trunking operator's position to the called line, means at the origi-
 40 nating operator's cord circuit for receiving a disconnect signal from the calling subscriber, means at the originating operator's cord circuit for receiving a disconnect signal from the called subscriber, and releasing
 45 means controllable by the trunking operator for automatically disconnecting between the trunking operator and the called subscriber.

2. A telephone system comprising an originating operator's cord circuit, a relay controlling the continuity of said cord circuit,
 50 a trunking operator's cord circuit, a trunk line connecting the two cord circuits, an automatic switch, means for manually extending connection from the trunking operator's cord circuit to said automatic switch,
 55 means by which the trunking operator controls the operations of said automatic switch, a relay associated with the trunking operator's cord circuit, and an energizing circuit
 60 including both of said relays in series with one side of the trunk line between the two cord circuits.

3. A telephone system comprising an originating operator's cord circuit, a trunk line
 65 adapted to be connected therewith provided

at one end with a trunking operator's cord circuit, a relay associated with said trunking operator's cord circuit, a signal controlled by said relay, an automatic switch, a trunk line leading from the trunking operator's
 70 cord circuit to the automatic switch, means at the trunking operator's position for controlling said automatic switch to find the called line, means for energizing said relay to display said signal when a connection is
 75 made between said trunking cord and trunk, and means for deenergizing said relay upon the response of the called subscriber.

4. A telephone exchange system comprising subscribers' lines, and means for trunk-
 80 ing calling lines into connection with called lines, said means including originating and trunking operators' cord circuits for extending the first portion of the trunking connection, a plurality of selectors and a connector
 85 for completing the trunking connection to the called subscriber's line, means at the trunking operator's position for controlling the operations of the selectors and connector, and a signal at said trunking operator's cord
 90 adapted to be displayed when a connection is made between said cord and one of said selectors and adapted to be extinguished upon the response of the called subscriber.

5. In an automatic and manual telephone
 95 exchange system, a trunking operator's cord circuit terminating at one end in a multiple jack and at its other end in a plug having a voice-current conductor normally connected to non-grounded battery, a front supervisory
 100 relay and a back supervisory relay, a pair of signals controlled thereby, the front supervisory relay adapted to energize as soon as an originating operator plugs into the jack to prevent the front supervisory signal from
 105 lighting, a trunk provided with an automatic switch at the end thereof, means causing the back supervisory relay to energize as soon as the trunking operator plugs into said trunk leading to an automatic switch
 110 for causing the back supervisory signal to be displayed, the back supervisory relay being adapted to remain energized after connection is made with the called line, means causing it to deenergize as soon as the called
 115 subscriber answers, whereby the back supervisory signal is extinguished, and means whereby non-grounded battery potential is removed from said voice-current conductor while said relay is energized, as set forth. 120

6. In an automatic and manual telephone exchange system, automatic switches, quick and slow acting relays 114 and 115 controlling the release of said switches, a cord circuit J, a push-button α for cutting off the
 125 ground from the quick and slow acting relays 114 and 115, so that after a connection has once been set up the trunking operator at J may change cords without initiating the release, substantially as set forth. 130

7. In an automatic and manual telephone exchange system, a subscriber's line, a trunking operator's cord circuit, a back supervisory relay therefor, a first selector, a second selector and a connector, a rotary line relay for each of said selectors and connector, and means for energizing said back supervisory relay in series with said rotary line relays, as set forth.
8. In an automatic and manual telephone exchange system, manual and automatic substations, an originating operator's cord circuit, a trunking operator's cord circuit, a back-bridge relay 113 at said originating operator's cord circuit, a signal lamp controlled thereby, a back supervisory relay 168 at the trunking operator's cord circuit, a signal controlled thereby, and a connector F having a back-bridge relay 78 controlled from an automatic substation, which relay in turn controls the back supervisory relay 168 at the trunking operator's cord circuit, which relay 168 when energized is adapted to deenergize the back-bridge relay 113 at the originating operator's cord circuit, thereby displaying the signal controlled thereby, and said relay 168 adapted when energized to display the signal associated therewith.
9. In an automatic and manual telephone exchange system, manual and automatic substations, an originating operator's cord circuit, a trunking operator's cord circuit, a back-bridge relay 113 at said originating operator's cord circuit, a signal lamp controlled thereby, a back supervisory relay 168 at the trunking operator's cord circuit, a signal controlled thereby, a connector F having a back-bridge relay 78 controlled from an automatic substation, means whereby the connector back-bridge relay 78 energizes as soon as connection is made with the called line, the back-bridge relay 168 of the trunking operator's cord circuit being thereby energized to cause a display of the signal controlled thereby, the signal at the originating operator's cord circuit being displayed at the same time, and means whereby when the called subscriber answers at the automatic substation the connector back-bridge relay 78 and the trunking operator's back signal relay 168 deenergize, thus retiring the signal lamps at the trunking and originating operators' cord circuits.
10. In an automatic and manual telephone exchange system, a manual subscriber's station A, an originating operator's cord circuit C with a front supervisory lamp 177 and a back supervisory lamp 110, a trunking operator's cord circuit J with a front supervisory lamp 172 and a back supervisory lamp 171, an order wire O, a connector switch F with a back-bridge relay 78, an automatic substation A', means whereby when the manual subscriber A removes his receiver the front supervisory lamp 177 is displayed at the cord circuit C, means including the order wire O whereby the manual operator at C may signal the trunking operator at J and place an order for connection to an automatic subscriber, and whereby the trunking operator at J may assign to the operator at C a trunk terminating in the cord circuit J, means whereby when the operator at C plugs into the trunk leading to the cord circuit J the front supervisory lamp 102 of the cord circuit J is displayed, trunks allotted to the trunking operator at J and terminating in an automatic exchange, means whereby when the trunking operator at J plugs into one of said automatic trunks the back supervisory lamp 171 of the cord circuit J is displayed, means whereby at the same time the back supervisory lamp 110 of the cord circuit C is displayed, means allotted to the trunking operator at J for establishing an automatic connection including a selector D and a selector E and a connector F, means whereby the back supervisory lamps 171 and 110 remain displayed after the trunking operator J plugs into the automatic trunk and until the called subscriber answers, means whereby when the called subscriber answers said back supervisory lamps 171 and 110 are retired, means whereby when the manual subscriber at A hangs up his receiver the front supervisory lamp 177 is again displayed, means whereby when the automatic subscriber at A' hangs up his receiver the back supervisory lamps 171 and 110 are again displayed, giving the originating operator at C a disconnect signal by means of lamps 177 and 110, means whereby when the originating operator at C disconnects from the trunk circuit J the front supervisory lamp 172 is also displayed, giving the trunking operator at J a disconnect signal, and means whereby when the trunking operator at J disconnects from the automatic trunk leading to the automatic exchange a release of the automatic switches is automatically accomplished.
11. A telephone system comprising an automatic switch, a trunk line leading thereto, a spring jack for the other end of said trunk line, a normally closed low resistance bridge across said trunk line between the jack and the automatic switch, a normally open connection between said bridge and the ground, a relay for opening said bridge, a relay for closing said ground connection, and an operator's key for opening said ground connection.
12. A telephone exchange system comprising subscribers' lines, and means for trunking calling lines into connection with called lines, said means including an originating operator's cord circuit, a trunking operator's cord circuit, means controlled by the trunking operator for automatically extending

connection from the trunking operator's position to the called line, operated by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, means at the originating operator's cord circuit for receiving a disconnect signal from the calling subscriber, means at the originating operator's cord circuit for receiving a disconnect signal from the called subscriber, and releasing means controllable by the trunking operator for automatically disconnecting between the trunking operator and the called subscriber.

13. A telephone system comprising an originating operator's cord circuit, a relay controlling the continuity of said cord circuit, a trunking operator's cord circuit, a trunk line connecting the two cord circuits, an automatic switch operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, means for manually extending connection from the trunking operator's cord circuit to said automatic switch, means by which the trunking operator controls the operations of said automatic switch, a relay associated with the trunking operator's cord circuit, and an energizing circuit including both of said relays in series with one side of the trunk line between the two cord circuits.

14. A telephone system comprising a trunk line terminating at one end in a trunking operator's cord circuit, a relay associated with said cord circuit, a signal controlled by said relay, an automatic switch operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, a trunk line leading from the trunking operator's cord circuit to the automatic switch, means at the trunking operator's position for controlling said automatic switch, means for energizing said relay to display said signal when a connection is made between said trunking cord and trunk, and means for deenergizing said relay upon the response of the called subscriber.

15. A telephone exchange system comprising subscribers' lines, and means for trunking calling lines into connection with called lines, said means including originating and trunking operators' cord circuits for extending the first portion of the trunking connection, a plurality of selectors and an automatic connector for completing the trunking connection to the called subscriber's line, operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, means at the trunking operator's position for controlling the operations of the selectors and connector, and a signal at said trunking operator's cord adapted to

be displayed when a connection is made between said cord and one of said selectors and adapted to be extinguished upon the response of the called subscriber.

16. A telephone system comprising an automatic switch operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, a trunk line leading to said switch, a spring jack for the other end of said trunk line, a normally closed low resistance bridge across said trunk line between the jack and the automatic switch, a normally open connection between said bridge and the ground, a relay for opening said bridge, a relay for closing said ground connection, and an operator's key for opening said ground connection.

17. In an automatic and manual telephone exchange system, a trunking operator's cord circuit terminating at one end in a multiple jack and at its other end in a plug having a voice-current conductor normally connected to non-grounded battery, means including an automatic switch for extending a connection from said cord to a called line, a front supervisory relay and a back supervisory relay, a pair of signals controlled thereby, the front supervisory relay adapted to energize as soon as an originating operator plugs into the jack to prevent the front supervisory signal from lighting, means causing the back supervisory relay to energize as soon as the trunking operator plugs into a trunk leading to said automatic switch for causing the back supervisory signal to be displayed, the back supervisory relay being adapted to remain energized after connection is made with the called line, means causing it to deenergize as soon as the called subscriber answers, whereby the back supervisory signal is caused to light, and means whereby non-grounded battery potential is removed from the voice-current conductor when said relay is energized, said automatic switch operative by one motion to select groups and by a second motion to connect with a line in a selected group.

18. In an automatic and manual telephone exchange system, subscribers' lines divided into groups, a trunking operator's cord circuit, a back supervisory relay therefor, a second selector, a third selector and a connector, a rotary line relay for each of said selectors and connector, and means for energizing said back supervisory relay in series with said rotary line relays, said connector operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, as set forth.

19. In an automatic and manual telephone exchange system, subscribers' lines divided into groups, manual and automatic substations, an originating operator's cord circuit

cuit, a trunking operator's cord circuit, a back-bridge relay 113 at said originating operator's cord circuit, a signal lamp controlled thereby, a back supervisory relay 168 at the trunking operator's cord circuit, a signal controlled thereby, and a connector F having a back-bridge relay 78 controlled from an automatic substation, which relay in turn controls the back supervisory relay 168 at the trunking operator's cord circuit, which relay 168 when energized is adapted to deenergize the back-bridge relay 113 at the originating operator's cord circuit, thereby displaying the signal controlled thereby, and said relay 168 adapted when energized to display the signal associated therewith, said connector operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein.

20. In an automatic and manual telephone exchange system, subscribers' lines divided into groups, manual and automatic substations, an originating operator's cord circuit, a trunking operator's cord circuit, a back-bridge relay 113 at said originating operator's cord circuit, a signal lamp controlled thereby, a back supervisory relay 168 at the trunking operator's cord circuit, a signal controlled thereby, a connector F having a back-bridge relay 78 controlled from an automatic substation, means whereby the connector back-bridge relay 78 energizes as soon as connection is made with the called line, the back-bridge relay 168 of the trunking operator's cord circuit being thereby energized to cause a display of the signal controlled thereby, the signal at the originating operator's cord circuit being displayed at the same time, and means whereby when the called subscriber answers at the automatic substation the connector back-bridge relay 78 and the trunking operator's back signal relay 168 deenergize, thus retiring the signal lamps at the trunking and originating operators' cord circuits, said connector operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein.

21. In an automatic and manual telephone exchange system, a manual subscriber's station A, an originating operator's cord circuit C with a front supervisory lamp 177 and a back supervisory lamp 110, a trunking operator's cord circuit J with a front supervisory lamp 172 and a back supervisory lamp 171, an order wire O, a connector switch F with a back-bridge relay 78, said connector operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, an automatic substation A', means whereby when the manual subscriber A removes his receiver the front

supervisory lamp 177 is displayed at the cord circuit C, means including the order wire O whereby the manual operator at C may signal the trunking operator at J and place an order for connection to an automatic subscriber, and whereby the trunking operator at J may assign to the operator at C a trunk terminating in the cord circuit J, means whereby when the operator at C plugs into the trunk leading to the cord circuit J the front supervisory lamp 102 of the cord circuit J is displayed, trunks allotted to the trunking operator at J and terminating in an automatic exchange, means whereby when the trunking operator at J plugs into one of said automatic trunks the back supervisory lamp 171 of the cord circuit J is displayed, means whereby at the same time the back supervisory lamp 110 of the cord circuit C is displayed, means allotted to the trunking operator at J for establishing an automatic connection including a selector D and a selector E and said connector F, means whereby the back supervisory lamps 171 and 110 remain displayed after the trunking operator J plugs into the automatic trunk and until the called subscriber answers, means whereby when the called subscriber answers said back supervisory lamps 171 and 110 are retired, means whereby when the manual subscriber at A hangs up his receiver the front supervisory lamp 177 is again displayed, means whereby when the automatic subscriber at A' hangs up his receiver the back supervisory lamps 171 and 110 are again displayed, giving the originating operator at C a disconnect signal by means of lamps 177 and 110, means whereby when the originating operator at C disconnects from the trunk circuit J the front supervisory lamp 172 is also displayed, giving the trunking operator at J a disconnect signal, and means whereby when the trunking operator at J disconnects from the automatic trunk leading to the automatic exchange a release of the automatic switches is automatically accomplished.

22. In a telephone system, a calling and a called subscriber's line, an automatic connector switch for establishing connection with a called line, means including a plurality of operators' circuits for extending a connection from the calling line to said connector switch, and means consisting of signals by which the originating operator supervises the connections thus established, each signal being adapted to be displayed when the corresponding receiver is hung up at the substation.

23. In an automatic and manual telephone exchange system, subscribers' lines divided into groups, a manual operator's trunking cord, means operative by vertical motion from one level to another to select groups and by rotary motion in any selected level

to connect with a line therein, electrically controlled release equipment for said means, release circuits for controlling said equipment, energized quick and slow acting relays for controlling the release of said means, and means including a push button for rendering the release circuit inoperative so that after a connection has once been set up the trunking operator may change cords without initiating the release.

24. A telephone system comprising an originating operator's cord circuit, a trunk line adapted to be connected therewith provided at one end with a trunking operator's cord circuit, a relay associated with said trunking operator's cord circuit, a signal controlled by said relay, an automatic switch, a trunk line leading from the trunking operator's cord circuit to the automatic switch, an impulse sender at the trunking operator's position for controlling said automatic switch to find the called line, a circuit for energizing said relay to display said signal when a connection is made between said trunking cord and trunk, and a switch for deenergizing said relay upon the response of the called subscriber.

25. A telephone exchange system comprising subscribers' lines, and trunking circuits for trunking calling lines into connection with called lines, said trunking circuits including originating and trunking operators' cord circuits for extending the first portion of the trunking connection, a plurality of selectors and a connector for completing the trunking connection to the called subscriber's line, an impulse sender at the trunking operator's position for controlling the operations of the selectors and connector, and a signal at said trunking operator's cord adapted to be displayed when a connection is made between said cord and one of said selectors and adapted to be extinguished upon the response of the called subscriber.

26. A telephone system comprising a trunk line terminating at one end in a trunking operator's cord circuit, a relay associated with said cord circuit, a signal controlled by said relay, an automatic switch operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, a trunk line leading from the trunking operator's cord circuit to the automatic switch, an impulse sender at the trunking operator's position for controlling said automatic switch, a circuit comprising the called subscriber's line for energizing said relay to display said signal when a connection is made between said trunking cord and trunk, and a switch controlled by the called subscriber for controlling said circuit to de-

energize said relay upon the response of the called subscriber.

27. A telephone exchange system comprising subscribers' lines, and trunks less in number than the subscribers' lines for trunking calling lines into connection with called lines, said trunks including originating and trunking operators' cord circuits for extending the first portion of the trunking connection, a plurality of selectors and an automatic connector for completing the trunking connection to the called subscriber's line, operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, an impulse sender at the trunking operator's position for controlling the operations of the selectors and connector, a signal at said trunking operator's cord, a circuit for controlling said signal so that the same is displayed when a connection is made between said cord and one of said selectors and retired upon the response of the called subscriber.

28. In a telephone system, a calling and a called subscriber's line, an automatic connector switch for establishing connection with a called line, trunking circuits less in number than the lines including a plurality of operators for extending a connection from the calling line to said connector switch and a signal for the originating operator for supervising connections thus established, a circuit for said signal, said signal being under the control of the subscriber on the line called through the medium of said circuit whereby the signal is displayed to indicate that the called subscriber is through talking.

29. In a telephone exchange system, the combination with a plurality of subscribers' lines terminating in different central offices, trunk lines of the two and three conductor type, automatic selector switches, sending mechanism at one of said offices adapted to direct said switches to interconnect said subscribers' lines by means of said trunk lines, an established connection including both two-conductor and three-conductor trunk lines and leading through a plurality of offices, the trunk lines extending to the controlling office and from the controlling office to another office through which the calling line is extended being of the two-conductor type, and signals at said controlling office for supervising connections.

Signed by us at Chicago, Cook county, Illinois, this 17th day of April, 1907.

WILSON L. CAMPBELL.
TALBOT G. MARTIN.

Witnesses:

J. NORBY,
ARTHUR B. SPERRY.