C. J. ERICKSON.

PAY STATION TELEPHONE SYSTEM.

APPLICATION FILED NOV. 9, 1906.

1,196,847.

Patented Sept. 5, 1916.

2 SHEETS—SHEET 1.

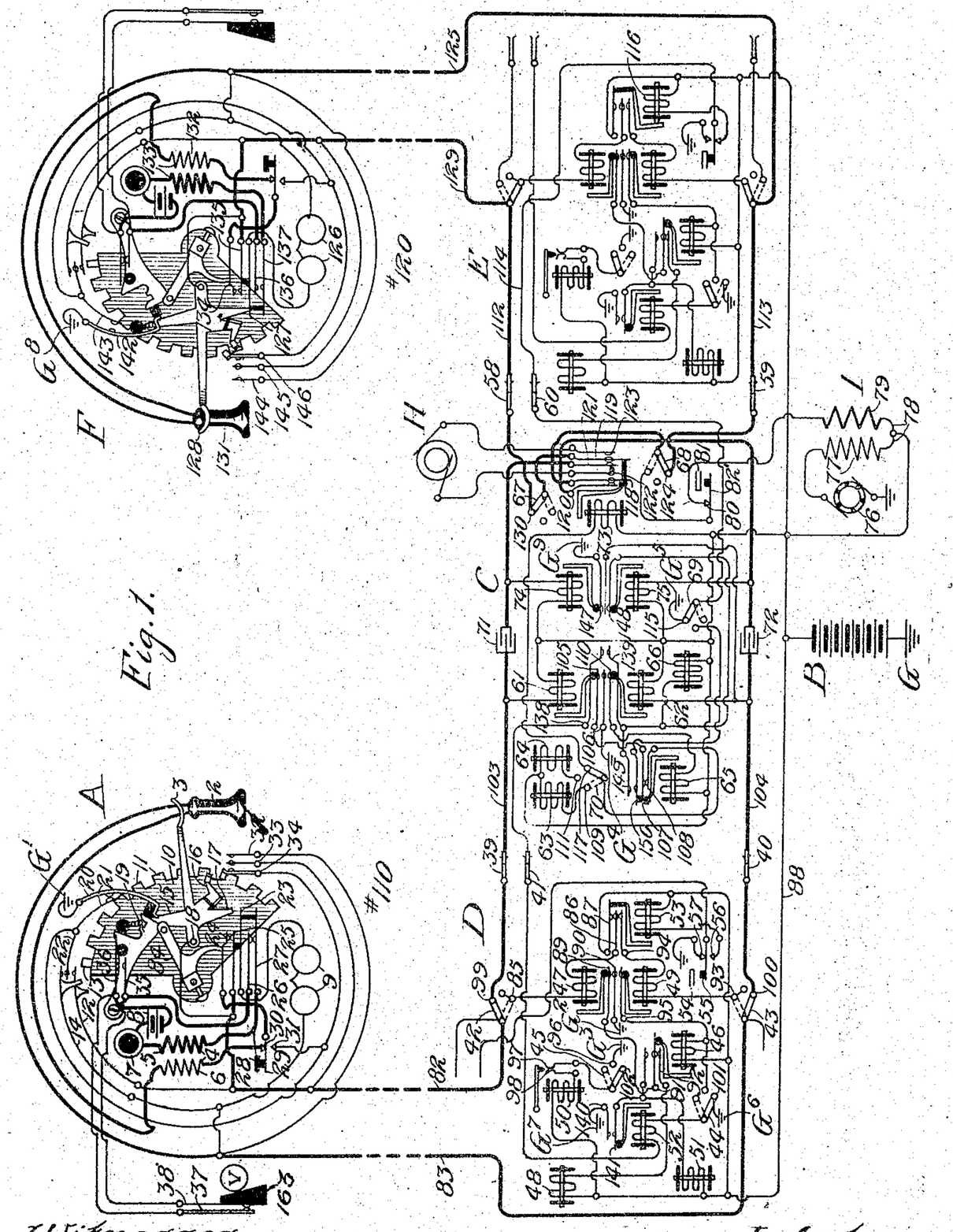

Fig. 1.

Witnesses.
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2 SHEETS—SHEET 2.

Fig. 3.

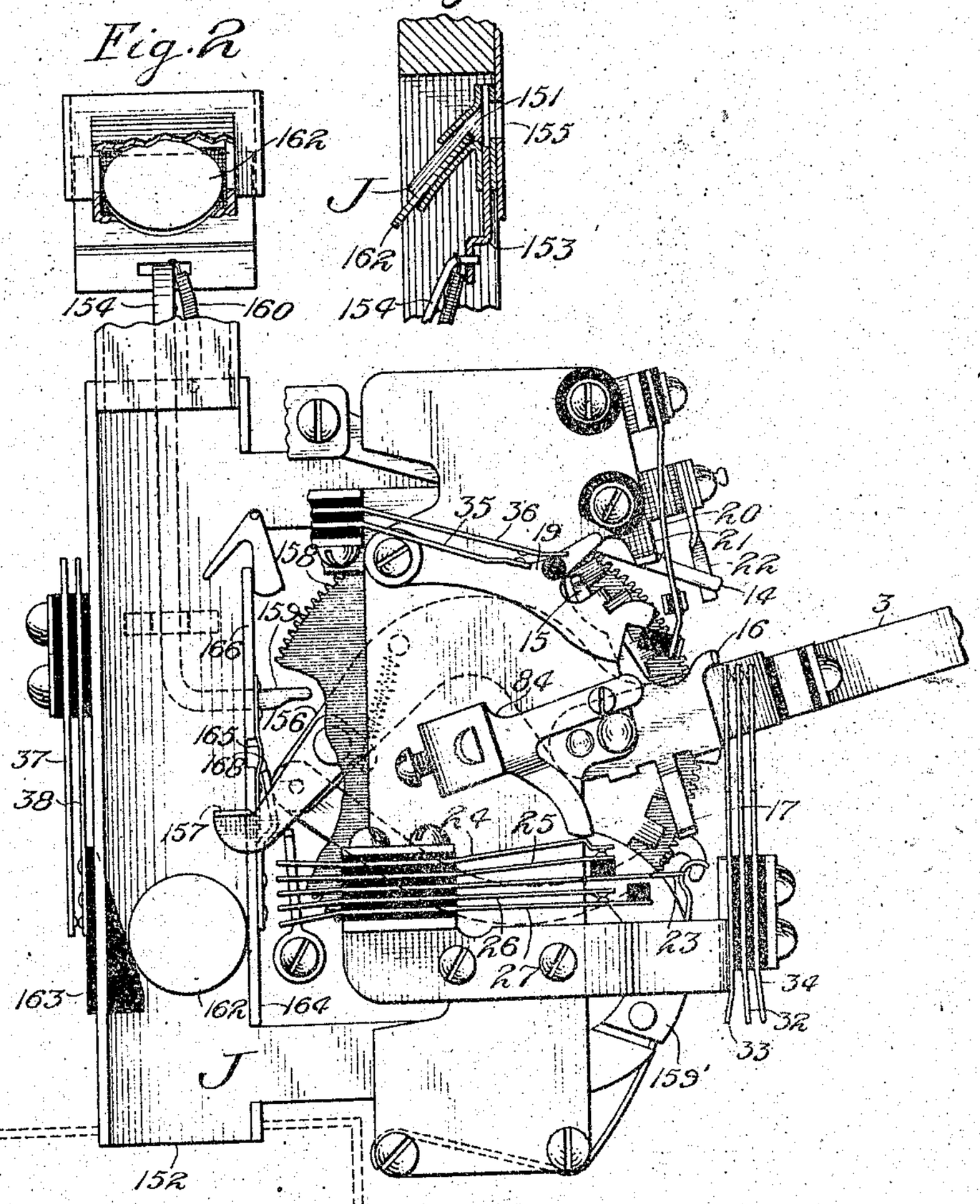
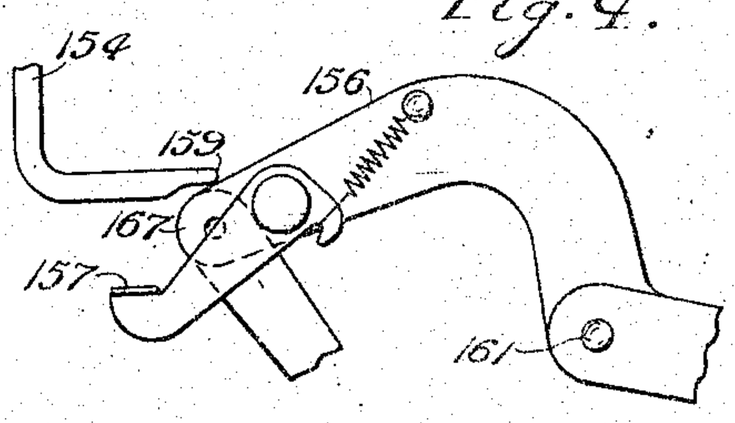


Fig. 4.



Witnesses.

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UNITED STATES PATENT OFFICE.

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PAY-STATION TELEPHONE SYSTEM.

1,196,847. Specification of Letters Patent. Patented Sept. 5, 1916.

Application filed November 9, 1906. Serial No. 342,682.

To all whom it may concern:

Be it known that I, CHARLES J. ERICKSON, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Pay-Station Telephone Systems, of which the following is a specification.

My invention contemplates an automatic telephone exchange system pay-station apparatus.

It also contemplates an improved telephone pay-station apparatus for use in connection with a telephone exchange system of any suitable or desired character.

More specifically considered, my invention contemplates an automatic telephone exchange system in which a calling subscriber employs electrically-propelled and step-by-step-actuated switching machines, such as individual switches, automatic selectors and connectors, for obtaining connection with the called subscriber's line; in which the subscribers are provided with rotatable dials or other impulse-transmitting devices for controlling the said switching machines in accordance with the digits of any called number; and in which the calling subscriber cannot converse with the called subscriber, after getting the desired connection, except by depositing a coin in the box of the pay-station apparatus.

Again, and more specifically considered, my invention contemplates a subscriber's pay-station arrangement involving a device by which the subscriber's telephone circuit is opened when he calls, but not when he answers, together with a coin-controlled mechanism for closing a parallel connection around said break or opening in the telephone circuit, whereby the calling subscriber cannot converse with the called subscriber until after a coin has been deposited in the receptacle or money-box at the calling substation. With such arrangement it will be seen that I provide an automatic system in which calling subscribers cannot converse with the called subscribers, even though they can hear the called subscribers answer, except by depositing coins in the boxes of the pay-station mechanism at the calling substations. When used in conjunction with a manual telephone exchange system it will be seen, however, that the calling subscriber must place the coin in the box before attempting to give the order for connection, as in this case the operator must receive the number of the called subscriber before connection can be extended through to the called subscriber's line. As stated, though, in an automatic system embodying the principles of my invention the calling subscriber does not deposit a coin in the box of his pay-station apparatus unless or until after he hears the called subscriber answer.

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

In the accompanying drawings, Figure 1 is a diagram showing two pay-station telephones connected by means of a central station. In this particular case the pay-station device is shown in connection with an automatic telephone system comprising the calling substation A, central station battery B, connector-switch C, first-selector switch D of the calling line, first-selector switch E of the called line, and the called substation F. Battery B of the central station has its positive terminal preferably grounded at G. The ringer generator for signaling purposes is shown at H, and the busy machine or device is indicated at I. Fig. 2 shows in detail the mechanical and operative arrangements of the pay-station mechanism. Fig. 3 shows the upper section of the pay-station device, the aperture through which the coins are passed, and a shutter arrangement for maintaining the said aperture normally closed. Fig. 4 is a detail of the mechanism employed for maintaining the shutter normally closed.

The pay-station attachment, as shown in the drawings, is used in connection with a substation of any suitable or approved type. Substation A comprises, in addition to the above, a receiver 2, switch-hook 3, induction-coil 4, which latter consists of the primary winding 5 and secondary winding 6, transmitter 7, local battery 8 and the ringer 9. There is also an impulse wheel 10 which has the usual vertical impulse teeth 11 that are adapted to operate the vertical impulse spring 12. The impulse wheel carries the rotary impulse tooth 13 which operates the rotary impulse spring 14. The switch-hook has radiating from its body a number of

cam arms 15, 16 and 17, and is pivotally secured to the keyboard (not shown) by the screw 18 about which it moves when the receiver is removed. The movement is produced by a spring (not shown) and the switch-hook is pushed up for the purpose of changing certain circuit connections to be described. The cam arm 15 controls the so-called locking arm 19 that normally rests in the position indicated at substation F. After the dial is rotated the locking arm 19 occupies the position shown at substation A, and the mechanical operations by which this is brought about are well known. The co-operating ground springs 20 and 21 engage, thus placing the ground post 22 in contact with the substation ground G^1, whereby when the subscriber releases the dial after pulling it down, the vertical impulse teeth 11 will cause the vertical impulse spring 12 to come in contact with the ground post 22; and immediately after, the rotary impulse tooth 13 causes the rotary impulse spring 14 to come in contact with the same ground post 22. When the switch-hook is down the cam arm 17 maintains a contact with the spring 23, thereby bridging the ringer 9 across the line. The springs 24 and 25 and 26 and 27 are then disengaged, and the primary circuit including the winding 5 in series with the transmitter 7 and local battery 8 is interrupted by the separation of the springs 26 and 27. The disengagement of the springs 24 and 25 removes the secondary winding 6, in series with the receiver 2, from across the line. The signaling device whereby one subscriber may signal another after a connection has been established comprises a push-button 28 and a spring 29, which latter normally engages the contact point 30; but when the push button 28 is pressed the spring 29 leaves the contact point 30 and engages the contact point 31 which is connected with the substation ground G^1. The means whereby the subscriber may release the central station apparatus brought into service comprises three springs 32, 33 and 34 known as the release springs and so controlled by the cam arm 16 that when the switch-hook descends the three release springs are brought into contact, thereby grounding both of the subscriber's line conductors simultaneously. In addition the primary circuit of the substation is provided with the springs 35 and 36 which are normally in contact, but are so controlled by the locking arm 19 that when the receiver 2 is removed from the switch-hook 3 and the dial rotated the locking arm 19 is forced upwardly, thus separating the springs 35 and 36. The said springs do not break contact when the receiver is removed from the switch-hook, but only when the dial is rotated. Furthermore, the said primary circuit is extended to the springs 37 and 38 of the coin-collecting attachment, which springs are normally disconnected.

The first-selector switch shown at D may be of any suitable or approved type, for instance of the general type described in Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson. It embodies among other details the following well-known devices and circuits: A switch-shaft (not shown) carries the vertical and rotary wipers 39 and 40, respectively, and the private wiper 41. The side switch is well-known and comprises the side switch wipers 42, 43, 44 and 45 which may be designated as vertical, rotary and private side switch wipers, and the rotary magnet side switch wiper, respectively. The side switch is under the control of the private magnet 46. Through the medium of the vertical line relay 47 and while the side switch is in first position the subscriber controls the vertical magnet 48, which latter operates to raise the shaft and shaft wipers 39, 40 and 41 vertically. By means of the rotary line relay 49 and while the side switch is in first or second position the subscriber controls the private magnet 46 and, therefore, the side switch. While the side switch is in second position the rotary magnet 50, which carries the shaft and shaft wipers in a rotary or circular direction, is energized. The vertical and rotary line relays 47 and 49 acting conjointly provide means whereby the subscriber controls the release magnet 51, while the side switch is in first or second position. After the side switch passes to third position, then since the first selector is of the trunk release type the said switch is controlled through the next switch with which a connection has been established, through the private wiper 41, by means of the back-release relay 52. The bridge-cut-off relay 53 is provided to open the connection between the line relays 47 and 49 and between said relays and battery B. This is desirable because if the relays are not disconnected from each other and the battery the ringing current for signaling the subscriber may then operate either or both of the relays 47 and 49 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-current as clear a path as possible. The first-selector switch-shaft is also provided with a normal post arm 54 which, when the shaft is in normal position, closes the spring 55 with the contact point 56; but when the shaft is raised one or more steps the spring 55 closes in contact with the point 57.

The connector switch C may also be of any suitable or approved type, for instance of the type described in Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson. The mechanical details of

the first-selector and connector, as is well known, are very much the same, although there is some material difference in the circuits. The connector switch shaft (not shown) carries, like the first-selector switch-shaft, the line wipers 58 and 59 and the private wiper 60. The connector switch is also controlled by the calling subscriber through the medium of the vertical and rotary line relays 61 and 62. The vertical line relay 61 controls the vertical magnet 63 and also the rotary magnet 64 and ringer relay 73. The office of the vertical magnet 63 is to give the shaft and shaft wipers their vertical motion, and the rotary magnet 64 imparts to the shaft and shaft wipers a rotary or circular motion. The rotary line relay 62 controls the private magnet 65, which latter under certain conditions in turn controls the vertical and rotary magnets 63 and 64, release magnet 66 and the side switch wipers 67, 68, 69 and 70. 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 66 is also controlled by the line relays 61 and 62 conjointly. By the condensers 71 and 72 the line circuit through the connector is divided into two sections. The back-bridge relays 74 and 75 give to the called subscriber means whereby he may release the connector switch which 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 76 in series with the primary winding 77 of the induction-coil 78, whereby a busy-signaling current is induced in the secondary winding 79 of the said coil. The secondary winding 79 is connected to the contact point 80. The connector switch-shaft also carries a normal arm 81 which, when the connector shaft is off normal, allows the spring 82′ to engage the contact point 80.

The first-selector E of the called line is the same as the first-selector D of the calling line and, therefore, the description of selector D is applicable.

The substation F is, of course, a duplicate of substation A and requires no description.

The calling operation by which one subscriber A, for example, may call and signal subscriber F is as follows: To call the number 120, which is arbitrarily chosen as the number of the line leading from the central station to the substation F, the subscriber A at substation #110 removes his receiver and 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 the rotary line is grounded once. When the receiver 2 is removed from the hook 3 the ringer 9 is disconnected from the line when the cam 17 leaves the spring 23, and at the same time the secondary circuit is closed across the line by the closure of the secondary springs 24 and 25. The primary circuit is also closed by the closure of contact between the springs 26 and 27.

The first digit being 1 the subscriber at substation #110 turns his dial for the first digit 1, thereby grounding the vertical line conductor 82 once, and the rotary line conductor 83 once upon the return motion of the dial. The ground post 22 is placed in connection with the substation ground G^1 in a well-known manner by the action of the locking dog 84. Grounding the vertical line conductor 82 once energizes the vertical line relay 47 of the first-selector. The circuit through the said relay extends from substation ground G^1, ground post 22, vertical impulse spring 12, vertical line conductor 82, side switch wiper 42, contact point 85 to the relay 47, through the bridge-cut-off springs 86 and 87 to the battery lead 88, thence through battery B to ground G. Each time that the vertical line relay 47 is energized the vertical line relay springs 89 and 90 are pressed into engagement and an energizing circuit is each time established through the vertical magnet 48. The circuit through the said magnet extends from ground G^2 to the springs 90 and 89, to the private magnet springs 91 and 92, vertical magnet 48 to the battery lead 88, thence through battery B and to ground G. The vertical magnet being operated once the first-selector switch-shaft and wipers 39, 40 and 41 are carried to the level with the contact points that constitute the terminals of the trunk line leading to the connector C. Following the vertical impulse, the rotary impulse spring comes in contact with the ground post 22, thereby grounding the rotary line conductor 83 once and energizing the rotary line relay 49 of the first-selector once. The path of the energizing current may be traced as follows: from the substation ground G^1 to the rotary line conductor 83, side switch wiper 43, contact point 93 to the rotary line relay 49, bridge-cut-off springs 94, 86 and 87 to the battery lead 88, thence through battery B and to ground G. The rotary line relay 49 upon energizing closes in contact the springs 95 and 90, thereby closing an energizing circuit through the private magnet 46 which extends from ground G^2 to the springs 90 and 95, private magnet 46 to the battery lead 88, thence through battery B and to ground G. The private magnet 46 being energized for a moment, the side switch of the first-selector D then passes from first to second position, thereby permitting the side switch wiper 45 to engage the contact point 96, thus closing a circuit through the rotary magnet 50. The current-flow is from ground

G^3 to the contact point 96, side switch wiper 45, rotary magnet interrupter springs 97 and 98, through the winding of the rotary magnet 50, thence to the battery lead 88, and through battery B and to ground G. The rotary magnet is energized, and the shaft wipers 39, 40 and 41 are carried into engagement with the bank contacts that constitute the terminals of the trunk line leading to the connector switch C, assuming that the trunk leading to the said connector leads off from the first set of contacts of the first level. But if the first trunk line is busy, an energizing circuit is then established through the private magnet 46 when the private wiper 41 strikes the grounded private bank contact, thereby retaining the side switch in second position and maintaining the energizing circuit through the rotary magnet 50. The rotary magnet, by intermittent energization, thus causes the shaft to rotate step-by-step and carry the wipers past the last busy trunk line. However, as soon as the private magnet is deenergized, the side switch is tripped into third position; but if there are no busy contacts to be passed over, as assumed in the first instance, the rotary magnet 50, as is well known, trips the side switch to the third position, with the result that the side switch wipers 42, 43, 44 and 45 engage the contact points 99, 100, 101 and 102, respectively, thus extending the subscriber's line conductors 82 and 83 to the connector C. Also, since the side switch wiper 44 engages the grounded contact point 101, a guarding potential is established at the private wiper 41 for protecting the seized trunk line from being molested by any other switch.

The second digit is called after the subscriber has established connection with the connector C by way of the trunk conductors 103 and 104. The subscriber rotates the dial, as described, for the second digit 2, thereby grounding the vertical and rotary line conductors 82 and 83, which causes the energization of the connector vertical and rotary line relays 61 and 62. The current for energizing the vertical relay 61 flows over the following path: from ground G^1 to the vertical impulse spring 12, vertical line conductor 82, side switch wiper 42, contact point 99, shaft wiper 39, trunk conductor 103, vertical relay 61 to the battery lead 88, thence through battery B and to ground G. Each time the vertical line relay 61 is energized the line relay springs 105 and 106 are pressed into contact, thereby closing an energizing circuit through the vertical magnet 63 over the following path: from ground G^4 to the springs 106 and 105, private magnet springs 107 and 108, side switch wiper 70, contact point 109, vertical magnet 63 to the battery lead 88, thence through battery B and to ground G. Each time the vertical magnet is energized it operates to raise the shaft and shaft wipers one step at a time until said wipers are carried two steps to a position opposite the level in which are located the terminals of the line #120. When the rotary line conductor 83 is grounded the rotary line relay 62 becomes energized over the following path: from ground G^1 to the rotary impulse spring 14, rotary line conductor 83, side switch wiper 43, contact point 100, shaft wiper 40, trunk conductor 104, rotary line relay 62 to the battery lead 88, thence through battery B and to ground G. The energization of the said relay causes the energization of the private magnet 65 over a circuit extending from ground G^4, springs 106 and 110, private magnet 65 to the battery lead 88, thence through battery B and to ground G; and the release of the side switch from first to second position thus places the wipers 67, 68, 69 and 70 in connection with their respective contact points in the second position.

The last digit being O the subscriber operates the dial, as previously described, grounding the vertical line conductor 82 ten times and the rotary line conductor 83 once. The vertical and rotary relays 61 and 62 are operated over previously traced circuits. However, when the line relay springs 105 and 106 engage, a circuit is then closed through the rotary magnet 64 instead of through the vertical magnet 63. The energizing circuit extends from ground G^4 to the springs 106 and 105, private magnet springs 107 and 108, side switch wiper 70, contact point 111, rotary magnet 64 to the battery lead 88, thence through battery B and to ground G. Each time the rotary magnet is energized it rotates the shaft and shaft wipers 58, 59 and 60 one step at a time until the said wipers are carried into engagement with the normal conductors 112, 113 and 114 that lead to the line terminals of the desired subscriber. The energization of the rotary line relay 62, as previously stated, completes an energizing circuit through the private magnet 65, 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, which will be described. Suppose the former result occurs and the side switch passes to third position, thus placing the side switch wipers 67, 68, 69 and 70 in contact with the respective contact points in the third position. Furthermore, when the side switch passes to third position a guarding potential is established for protecting the called line. This potential extends from ground G^5 to the contact point 115, side switch wiper 69 to the shaft wiper 60, which engages the private contact of the called line. The said guarding potential also closes an energizing circuit through the

bridge-cut-off relay 116 of the first-selector E, thereby removing the bridge formed by the vertical and rotary line relays of the first-selector E.

To signal the called subscriber the calling subscriber presses the signaling button 28, placing the spring 29 in contact with the substation ground G^1, thereby energizing the vertical line relay 61. The path of the energizing circuit extends from ground G^1, contact point 31, spring 29, springs 24 and 25 to the vertical line conductor 82, side switch wiper 42, contact point 99, first-selector shaft wiper 39, trunk conductor 103, vertical relay 61 to the battery lead 88, thence through battery B and to ground G. It will be remembered that the connector side switch has passed from second to third position and that the side switch wiper 70 is in engagement with the contact point 117, thereby placing the vertical line relay 61 in control of the ringer relay 73 in the same manner in which the rotary magnet 64 came under the control of the vertical relay 61 when the side switch passed from first to second position. Therefore, when the vertical line relay 61 presses the springs 106 and 105 into contact the ringer relay 73 is energized by a flow of current from ground G^4 to the relay springs 106 and 105, private magnet springs 107 and 108, side switch wiper 70, contact point 117 to the ringer relay 73 and to the battery lead 88, thence through battery B and to ground G. The ringer relay upon energizing shifts the springs 118 and 119, respectively, from the springs 120 and 121 and onto the springs 122 and 123. This results in separating the calling subscriber's line from the called subscriber's line and bridging across the line of the latter the terminals of the ringer generator H. A signaling current is, therefore, sent from the generator H to the ringer relay springs 122 and 118, side switch wiper 68, contact point 124, connector shaft wiper 59, normal conductor 113, rotary line conductor 125 to the ringer 126, spring 127, switch-hook 128 to the vertical line conductor 129, normal conductor 112, connector shaft wiper 58, contact point 130, side switch wiper 67, ringer relay springs 119 and 123 back to the generator H. As soon as the calling subscriber ceases to press the signaling button 28 the ringer relay 73 becomes deënergized and the springs 118 and 119 resume their normal position in contact with the springs 120 and 121, respectively. The subscriber F in response to the signal removes the receiver 131 from the switch-hook 128, thereby removing the ringer 126 from across his line and bridging instead the secondary circuit which includes the receiver 131, secondary winding 132 of the induction-coil 133, and secondary springs 134 and 135. The local transmitter circuit is closed as soon as the springs 136 and 137 engage in contact. The two substations #110 and #120 are now connected with the circuit shown in heavy lines in Fig. 1. The local transmitter circuit at substation #120 being complete voice-currents may pass to the subscriber A, but A in turn, before he can be heard by subscriber F, must deposit in his substation #110 a coin or other suitable object, which closes the primary circuit through the springs 37 and 38. The primary circuit at substation #110, after a calling operation has taken place, is normally open at the springs 35 and 36, thereby leaving the local transmitter circuit open until closed at the coin-collecting device springs 37 and 38. In the latter case the primary circuit extends from battery 8 through the springs 37 and 38 and through springs 26 and 27 to the primary winding 5 of the induction-coil, and thence through said coil to the transmitter 7 and to battery 8.

The front release occurs when the calling subscriber restores the receiver 2 to the switch-hook 3, thereby pressing into engagement for a moment the release springs 32, 33 and 34. The contact of the said release springs grounds the vertical and rotary line conductors 82 and 83 simultaneously from ground G^1 to the release spring 34, thence through the springs 33 and 32 to the vertical and rotary line conductors, thereby energizing the vertical and rotary line relays 61 and 62 of the connector C. The springs 138 and 139 are pressed into contact, as a result closing a circuit through the back-release relay 52 of the first-selector D in series with the release magnet 66 of the connector C. The path of the circuit extends from ground G^6 to the contact point 101, side switch wiper 44, release relay 52, first-selector switch wiper 41, connector trunk release springs 138 and 139, release magnet 66 to the battery lead 88, thence through battery B and to ground G. When the connector release magnet 66 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 58, 59 and 60 and the normal conductors 112, 113 and 114. The back-release relay 52 of the first-selector D being in the same circuit with the release magnet 66 energizes simultaneously with the latter and presses into engagement the springs 140 and 141, which in turn close an energizing circuit through the release magnet 51 of the first-selector D. This circuit extends from ground G^7 through the release relay springs 140 and 141, through the winding of the release magnet 51 to the battery lead 88, thence through battery B and to ground G. All of the relays and magnets thus energized attract their respective armatures,

and as soon as the substation release springs 32, 33 and 34 separate and break the ground connection with the line conductors 82 and 83 they again deënergize. The calling subscriber thus restores all switching apparatus which he originally brought into use.

The back-release is provided in order that called subscribers will not remain helplessly tied up, so to speak, while the bridge-cut-off relay 116 is energized. Should he desire, before the calling subscriber releases, to make an independent call he may break the established connection and secure control of the first-selector E. After establishing connection between the ground springs 142 and 143, by operating the dial, he may then ground the line conductors 129 and 125 simultaneously by restoring the receiver 131 to the switch-hook 128, thus pressing into engagement the release springs 144, 145 and 146. As a result an energizing current will pass through the vertical back-bridge relay 74 and the rotary back-bridge relay 75 of the connector C. The circuit through the vertical back-bridge relay extends from the substation ground G^8 to the ground springs 142 and 143, to the springs 146 and 145, vertical conductor 129, normal conductor 112, shaft wiper 58, contact point 130, side switch wiper 67, ringer relay springs 119 and 121, vertical back-bridge relay 74 to the battery lead 88, thence through battery B and to ground G. The energizing circuit of the back-bridge relay 75 extends from ground G^8, release springs 146, 145 and 144 to the rotary line conductor 125, normal conductor 113, shaft wiper 59, contact point 124, side switch wiper 68, ringer relay springs 118 and 120 and rotary back-bridge relay 75 to the battery lead 88, thence through battery B and to ground G. The back-bridge relays 74 and 75, upon energizing simultaneously, press into contact the back-release springs 147 and 148, which completes an energizing circuit to the release magnet 66 from ground G^9 to the springs 147 and 148, through the release magnet 66, battery lead 88, thence through battery B and to ground G. The release magnet is thus energized and the switch shaft wipers 58, 59 and 60 and side switch are restored to normal position. The energizing circuit through the bridge-cut-off relay 116 is broken when the shaft wiper 60 leaves the private bank contact; thus the connector switch C is released and the first-selector E is restored to the control of substation #120. The subscriber A by grounding the line conductors 82 and 83 may restore the first-selector D.

The busy release of the connector C follows as a result of the energization of the rotary line relay 62, if the called line is busy, as follows: The said relay 62 upon energizing energizes the private magnet 65, as previously described, which latter in turn presses the springs 149 and 150 into contact. As soon as the said springs 149 and 150 engage the release magnet 66 is placed in connection with the private wiper 60 (since the side switch wiper 69 is now in second position), which wiper 60 has previously been rotated onto a grounded contact. As a result a flow of current is sent through the release magnet 66 from the grounded private wiper 60 to the side switch wiper 69, to the private magnet springs 150 and 149 to the release magnet 66, to battery lead 88, thence through battery B and to ground G. The release magnet 66 upon energizing releases the connector switch shaft and restores the connector side switch to its first position, returning the vertical magnet 63 to the control of the vertical relay 61. Therefore, if the calling subscriber (Fig. 1) presses the signaling button 28 and grounds the vertical line conductor 82 he operates the vertical line relay 61, which latter in turn operates the vertical magnet 63. The vertical magnet armature raises the switch shaft so that the normal post arm 81 permits the switch shaft spring 82′ to come into contact with the spring 80, and the busy-signaling current is sent to the calling subscriber's station. The calling subscriber upon hearing the busy-signal will understand that the desired line is in service and will release the switching apparatus over the same circuits previously described by hanging up his receiver. Of course, on hearing the busy-signal the calling subscriber does not deposit a coin as he would if the called subscriber had answered. Busy lines may be either calling or called and the manner by which protecting guarding potentials are established is as follows: The calling line is protected by a guarding potential established by the first-selector at the instant the switch shaft is moved one or more steps from its normal position, thus permitting spring 55 to engage the grounded contact point 57. The called line is protected by a guarding potential established by the connector switch when the side switch passes to third position and the shaft wipers come in contact with the called line terminal.

The pay-station attachment for controlling the coins which in turn control the primary circuit springs 37 and 38 (Fig. 2) comprises a channel J that terminates at the upper section in the slot 151 (Fig. 3) and at the lower extremity in a slot 152 within the box K. In front of the slot 151 there is a shutter 153 controlled by the link 154 to which latter it is attached. Normally the said shutter is raised so that no coins may be dropped through the outer slot 155 into the inner slot 151 and down the channel J. The mechanism by which the said shutter is retained normally closed is as follows: When

the receiver is on the switch-hook 3 the member 156, that carries the ratchet 157 for engaging the toothed wheel 158 that engages the governor 159′, is raised so that it strikes the lower extremity 159 of the link 154. The link is, therefore, driven upwardly, which in turn raises the shutter 153 over the slot 151. When the receiver is removed from the switch-hook the member 156 leaves the link 154, and the retracting spring 160 then withdraws the shutter 153 from in front of the slots 151 and 155, whereby a coin may be inserted. The member 156 that constitutes part of the switch-hook is more clearly shown in Fig. 4 and swings pivotally about the support 161. When the switch-hook is down and the member 156 has operated to raise the link 154 and the shutter 153, the terminal 159 of said link 154 rests upon the member 156, as shown in Fig. 4. When a subscriber has made a call and the called subscriber has answered, the former drops a coin 162 through the slots 155 and 151 and into the channel J, which coin falls against the insulating member 163, pressing the latter outwardly and causing the spring 38 to engage the spring 37, closing the primary circuit, as already described. The insulating member 163 is wedge-shaped, as shown, and riveted to the spring 38.

It will be noticed that the coin 162 is held between the insulating wedge 163 and the member 164 and is therefore unable to pass. The said member 164 is secured to a flexible spring 165, which spring is in turn secured to the portion 166 of the telephone frame. When the switch-hook is up the elbow 167 of the member 156 advances sufficiently to engage the pin 168, preventing the member 164 from being driven inwardly by the coin 162 when it falls, since the said pin 168 is riveted to the said member 164. It will be evident that as long as the subscriber's switch-hook is up his primary circuit will be held closed by the coin 162; but as soon as the switch-hook descends and the elbow 167 leaves the pin 168 the member 164 is then driven to one side by the weight of the coin, which latter drops into the box K. At the same time the shutter 153 is raised and the aperture 151 is closed to prevent anyone from dropping anything into the channel while the switch-hook is down. Of course, when the coin falls through, the springs 37 and 38 then separate, opening the primary circuit at that point.

From the foregoing it will be understood, of course, that it is necessary that the primary circuit springs 35 and 36 controlled by the locking cam 19 close in contact as soon as the switch-hook descends, so that the subscriber at the station may be able to talk if another subscriber should ring him. As soon as a calling operation is begun, however, the said springs 35 and 36 separate, as described, with the result already explained.

From the foregoing it will be seen that each subscriber of an automatic system embodying the principles of my invention is provided with a device by which he opens his telephone circuit when he calls, but which permits the telephone circuit to remain closed when he answers. In addition each subscriber is provided with coin-controlled mechanism for closing a parallel connection around the break or opening in the telephone circuit, whereby he may, by then depositing a coin in the box of the pay-station apparatus, then render his telephone equipment operative for talking purposes after he hears the called subscriber answer. Of course, when an automatic subscriber thus equipped answers a call he does not disturb his rotatable dial or calling mechanism, but simply takes down his receiver and consequently does not produce the opening or break in his telephone circuit, and does not at such time need to deposit a coin in order to use his telephone. When used in a manual system my improved pay-station apparatus would require the depositing of a coin in the box before the calling subscriber attempts to give the order for connection, and would require the provision of some special means for opening the telephone circuit when the subscriber calls, but not when he answers. For this reason, and as it may have utility outside of automatic systems, I have claimed the different features and combinations of my invention broadly as well as specifically.

Broadly considered, it will be seen that my invention consists of an automatic telephone exchange system provided with a measured service device at the substations for each subscriber, or for each telephone line, if only one telephone is used to a line, it being obvious that any device which will register or in any way keep track of the number of calls is what may be termed a device for measuring the service.

All measured service systems must, of course, have toll devices of some sort, either meters, registering devices or coin mechanisms. For the broader purposes of my invention any sort of toll device may be employed in combination with the subscriber's rotary dial or calling device. Specifically, the toll device herein disclosed is a coin-controlled mechanism.

What I claim as my invention is:—

1. An automatic telephone exchange system comprising subscriber-controlled means for connecting calling lines with called lines, and toll devices at the subscribers' stations for preventing the use of the telephones thereof by calling subscribers except when proper toll is assessed at the calling substations.

2. In a telephone exchange system, the combination of subscriber-controlled means for connecting calling lines with called lines, subscribers' telephone transmitters, subscribers' calling devices each adapted also to open the transmitter circuit of any calling substation, and a toll device by which the calling subscriber closes a parallel connection around the said break or opening in the transmitter circuit.

3. In a telephone exchange system, the combination of subscriber-controlled automatic switching means for connecting calling lines with called lines, subscribers' telephones, circuits for said telephones, subscribers' calling devices each adapted also for opening the circuit of its associated telephone, and subscribers' toll devices by which any calling subscriber closes the said break or opening in the telephone circuit of the calling substation.

4. In a telephone exchange system, the combination of subscribers' lines, trunk lines, exchange apparatus including automatic selectors and connectors for establishing trunk line connections between calling and called lines, subscribers' telephones, subscribers' rotatable dials or calling devices for controlling the operations of said exchange apparatus, battery circuits for said telephones, means by which the operation of any dial or calling device opens the telephone circuit of the calling substation, and toll devices by which any calling subscriber closes a parallel connection around the break or opening produced in the telephone circuit of the calling substation.

5. A telephone exchange system comprising a subscriber's telephone circuit, means adapted to open the telephone circuit when the subscriber calls, but not when the subscriber answers, means to prevent closing the circuit at such opening during the continuance of the connection within the exchange, and a toll device by which the subscriber closes a parallel connection around said break or opening in said telephone circuit.

6. In a telephone exchange system, the combination of a subscriber's telephone circuit, a subscriber's calling device, a line relay responsive to said calling device, means for opening the telephone circuit when the calling device is used, adapted to permit the telephone circuit to remain closed when the subscriber answers a call, means to prevent closing the circuit at such opening during the continuance of the connection with the exchange, and a toll device by which the subscriber closes a parallel connection extending around the said break or opening in the telephone circuit.

7. A telephone exchange system comprising a subscriber's telephone circuit, a normally closed switch in said circuit, means for opening said switch when the subscriber calls, a normally open parallel connection extending around said switch, and a toll device for closing said parallel connection.

8. In a telephone exhange system, the combination of a subscriber's line, an individual switch for said line, a called line, switching machinery for connecting the individual switch with the called line, a subscriber's rotatable dial or calling device for controlling the operations of said individual switch and switching machinery, a subscriber's telephone circuit, means for opening said telephone circuit when the subscriber operates said dial or calling device, and a toll device by which the subscriber closes a parallel connection extending around the said break or opening in the telephone circuit.

9. In a telephone exchange system, the combination of a plurality of substations, means for connecting calling substations with called substations, a telephone circuit for each substation, said telephone circuits each comprising an auxiliary circuit used in answering normally in operative condition, each telephone circuit also comprising a second auxiliary circuit used in calling normally in inoperative condition, dial-controlled means adapted to render inoperative the said answering auxiliary circuit, when a call is made, a circuit-controlling device adapted to be used by the calling subscriber to set up the said calling auxiliary circuit by a toll-assessing operation, and switch-hook-controlled means for restoring the calling and answering auxiliary circuits to normal condition.

10. In a telephone pay-station, the combination of a telephone circuit, a dial, a combined toll and circuit-controlling device, a switch-hook, dial-operated means adapted to render inoperative the telephone circuit when a call is made, said toll device adapted to restore the telephone circuit, and switch-hook-controlled means for restoring the telephone circuit to the control of the dial, and for returning the toll device to normal condition.

11. In a telephone exchange system, the combination of a plurality of subscribers' telephones, a telephone circuit for each telephone, lines for each telephone, means for connecting any two lines, means at each telephone for maintaining the telephone talking circuit open while the telephone is not in use, means for closing the said circuit when a call is answered, means adapted to render the telephone circuit inoperative when a call is made, means including a toll device adapted to close the telephone circuit at the calling subscriber's station for restoring the calling subscriber's telephone circuit to operative condition, means for breaking an established telephone connection, and switch-hook controlled means for controlling said

toll device to render said telephone circuit inoperative.

12. In a telephone exchange system, the combination of telephone pay-stations, central office means for connecting a calling station with a called station, a telephone circuit for each station comprising an answering and a calling auxiliary circuit, the former normally in operative condition and the latter in inoperative condition, means whereby when a calling subscriber makes a call the answering auxiliary circuit is rendered inoperative, a combined toll and circuit-controlling device for each substation, each toll device adapted to set up the calling auxiliary circuit, means at the called substation whereby when a called subscriber answers the answering auxiliary circuit at the called telephone is brought into use, and means at the calling substation for restoring the calling and answering auxiliary circuits to normal condition.

13. In a telephone exchange system, the combination of subscribers' pay-stations, means for connecting a calling subscriber with a called subscriber, a telephone circuit for each pay-station, lines for each pay-station, an answering and a calling auxiliary circuit for each substation telephone circuit, the former normally in operative condition and the latter in inoperative condition, means whereby when a subscriber uses his telephone for calling the answering auxiliary circuit of his station is first closed and then opened, a combined toll and circuit-controlling device for each station, each toll device adapted to close the calling auxiliary circuit, means whereby when a subscriber uses his telephone to answer a call the answering auxiliary circuit at his telephone is closed, a switch-hook for each substation, and means whereby when a switch-hook is depressed at any substation the auxiliary circuit then closed at the telephone is opened.

14. In a telephone system, in combination, central office connecting apparatus, telephone lines, and pay stations allotted thereto; each station comprising a dial, a switch hook, a combined toll and circuit controlling device, a telephone circuit, an answering and a calling auxiliary circuit therefor, said circuits normally out of use; each switch hook controlling the answering auxiliary circuit associated therewith whereby the auxiliary circuit may be connected for use with its line, each dial controlling means for operating the central office apparatus in making a call and for putting the answering auxiliary telephone circuit associated therewith out of use when a call is made, the toll device of each telephone controlling the auxiliary circuit of its telephone when operated to bring the latter into use, each switch hook when depressed after its associated dial has been operated to make a call controlling the central office switches and the calling and answering auxiliary telephone circuits to restore them, and the telephone switch hook of the called subscriber controlling the answering auxiliary telephone circuits alloted thereto to restore the latter.

15. In a telephone system, the combination of subscribers' telephones, central office means for connecting a calling telephone with a called telephone, means at each telephone whereby the called subscriber's telephone is made ready to answer any call upon the removal of the receiver, means whereby the calling subscriber's transmitter is put out of service automatically when he makes a call, means including a toll device for restoring the same to use, and switch hook controlled means for controlling said toll device to render said transmitter inoperative.

16. In a telephone exchange system, the combination of automatic switches for connecting calling subscribers with called subscribers, subscribers' calling devices for controlling said switches, a toll device at the subscriber's station individual to each subscriber, and a talking circuit controlled by said toll device.

17. In a telephone exchange system, the combination of telephone lines, substations on said lines, automatic means for trunking calling lines into connection with called lines, a toll device at the subscriber's station individual to each substation, and a talking circuit controlled by said toll device.

18. In a telephone system, the combination of lines arranged in groups, a connector having motion from group to group to find the desired group, and motion from line to line to then find the called line in the predetermined group, a measured service circuit connection associated with and allotted to one of said lines, and mechanism for controlling said circuit connection whereby toll may be assessed for any successful call from the measured service substation through said connection to another line.

19. In a telephone system, the combination of trunks arranged in groups, a selector having one motion from group to group to find a desired group, and another motion from trunk to trunk to automatically select an idle trunk in the predetermined group, telephone lines, a measured service circuit connection associated with one of said telephone lines, and mechanism for controlling said circuit connection whereby toll may be assessed for any successful call from the measured service substation through said selector to another telephone line.

20. In a telephone system, means including an automatic switch for establishing a talking connection from a calling line to a called line, mechanism allotted to the call-

ing line and associated therewith for assessing toll for successful calls from a measured service substation through said switch to another line, means controlled by said toll mechanism for controlling said talking circuit and means whereby the calling subscriber can have the called subscriber anwer before toll is assessed.

21. A telephone exchange system comprising a subscriber's telephone circuit, means adapted to break the telephone circuit when the subscriber calls, but not when a subscriber answers, a toll device by which the subscriber closes a parallel connection around said break in said telephone circuit, and switch hook controlled means for breaking said parallel connection.

22. In a telephone system, the combination of a subscriber's telephone circuit, a subscriber's calling device, a line relay responsive to said calling device, means for opening the telephone circuit when the calling device is used and adapted to permit the telephone circuit to remain closed when the subscriber answers a call, a toll device by which the subscriber closes a parallel connection extending around the said break or opening in the telephone circuit, and switch hook controlled means for breaking said parallel connection.

Signed by me at Chicago, Cook county, Illinois, this 1st day of November, 1906.

CHARLES J. ERICKSON.

Witnesses:

EDWARD D. FALES,

BERNARD D. WILLIS.