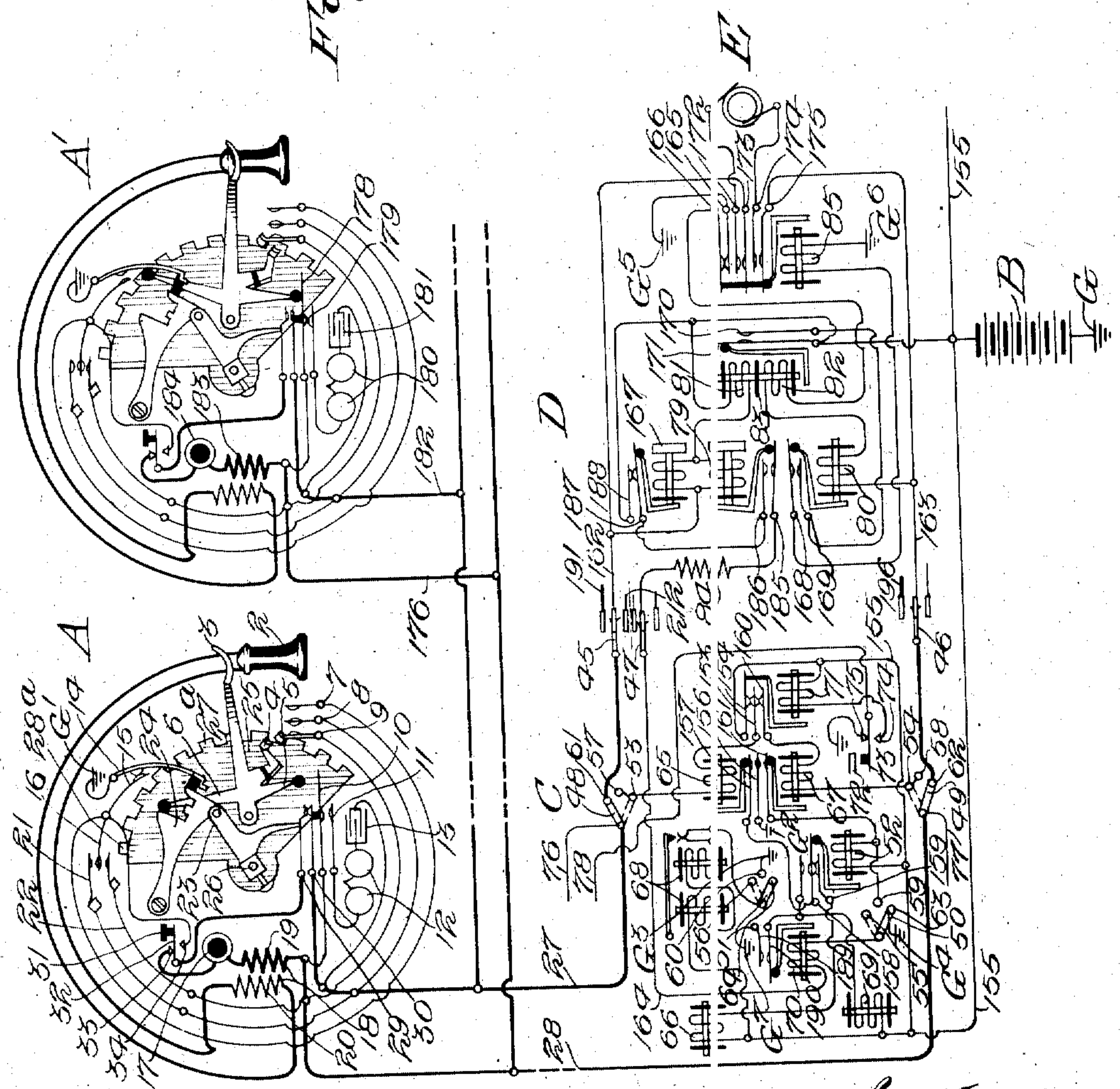


1,216,461.

G. E. KIMBALL.
TELEPHONE RING BACK OR REVERTING CALL SYSTEM.
APPLICATION FILED JUNE 23, 1909.

Patented Feb. 20, 1917.
2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
R. H. Bumpstead
A. B. Sperry.

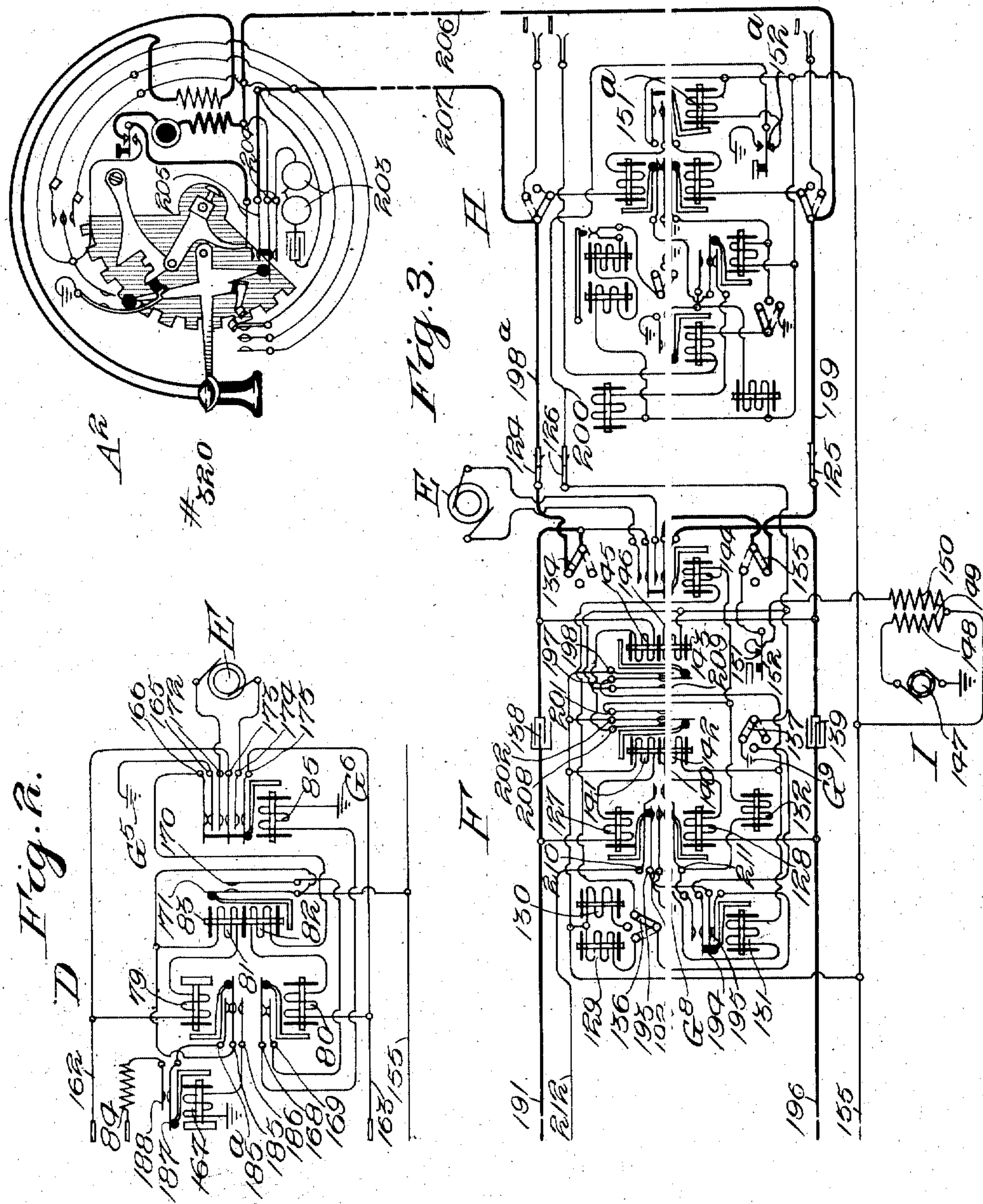
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

GEORGE E. KIMBALL, OF ROCHESTER, PENNSYLVANIA, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE RING-BACK OR REVERTING-CALL SYSTEM.

1,216,461.

Specification of Letters Patent.

Patented Feb. 20, 1917.

Application filed June 23, 1909. Serial No. 503,816.

To all whom it may concern:

Be it known that I, GEORGE E. KIMBALL, a citizen of the United States of America, and resident of Rochester, Beaver county, Pennsylvania, have invented a certain new and useful Improvement in Telephone Ring-Back or Reverting-Call Systems, of which the following is a specification.

My invention relates to telephone exchange systems of that particular character in which provision is made for enabling a subscriber to call and ring back on the calling line to signal another subscriber thereon.

Systems of this kind, employing automatic switches at the central station, are sometimes referred to as reverting call systems, because of the fact that the call, if it be for a party line subscriber, may revert to the line of the calling subscriber, so that two subscribers on the same line may converse with each other.

Objects of my invention are to provide an improved ring-back or reverting call arrangement whereby one subscriber may call another on the same line; to provide an arrangement whereby the party line is released from the ring-back arrangement by the opening of the line at the calling and called substations thereon; and to provide certain details and features of improvement tending to increase the general efficiency of a system of this particular character.

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

In the accompanying drawings Figure 1 represents diagrammatically an automatic party line system, embodying the principles of my invention, in which central energy is used for talking; the substations A and A' are allotted to the line which terminates at the central office in the selector switch C; in which at D there is shown my improved ring-back arrangement by means of which a subscriber of a party line may call and ring back upon his own line; in which a central battery for talking and operating purposes is shown at B having its positive terminal preferably grounded at G; and in which at E there is represented diagrammatically a central ring generator.

In Fig. 2 is shown a modified form of the ring-back or reverting call arrangement shown in Fig. 1.

Fig. 3 represents diagrammatically the

connector switch F by means of which subscribers may establish connection with different lines.

The substation A² is similar to the substations A and A' and, as shown, has allotted to it the first selector II which is the same as the first selector C. It will be understood that in the central office, in addition to the first selector and connector switches, which are of the general type shown in United States Letters Patent Nos. 815,321 and 815,176, issued March 13, 1906, to Keith, Erickson and Erickson, there may be added second selector switches, or even third or fourth selectors, etc., to increase the capacity of the system. In that case the bank levels of the first selector switches are provided with trunk lines leading to second selector switches, and likewise from the second selector bank level trunk lines leading to the connector switches, or to other selectors, as is customary. With my new system one level, either in the first or second selector bank, may be allotted to signaling by the use of the devices D—that is, the trunk lines from the contacts in some certain level, instead of leading to a selector or connector switch, lead to ring-back arrangements D (Fig. 1); and a subscriber, after having properly operated the central office switch or switches and established connection with said ring-back level, may cause ringing current to pass back over his own line to signal some other subscriber occupying the same line with him. In Fig. 1 this ring-back arrangement is shown allotted to the second level of the first selector banks. Any level, however, either of the first or second selector banks, may be equipped in the same manner.

The substation A may be of any suitable or approved type. The substations A and A', like substations usually employed in connection with switches of the aforesaid type, are each provided with a dial which the subscribers operate for sending impulses over the lines to operate the switches at the central office. Each substation is also provided with the usual telephone switch hook through the medium of which the substation ground circuit, the release circuit and the primary, secondary and ringing circuits are controlled. The substations of the type in connection with which I have elected to illustrate my invention each comprise a re-

ceiver 2 and 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 maintains a contact between the springs 10 and 11, thereby bridging the ringer 12 in series with the condenser 13 across the line. The substation ground circuit is normally broken between the ground springs 14 and 15 by the cam arm 6; but when said springs are together ground is provided to the ground post 16 and to the release spring 7, as is usually the case in telephones of this type. The said substation comprises the usual transmitter 17 and induction coil 18, the latter having the primary winding 19 and secondary winding 20. Said substation is also provided with the usual vertical and rotary impulse springs 21 and 22, and is, of course, provided with a dial (not shown) which is secured to the shaft 26, together with the locking dog 23. Furthermore, there is a locking cam 24 that locks the dog 23 while the receiver is on the switch hook, to prevent a rotation of the dial. For operating the impulse springs 21 and 22 the substation is provided with an impulse wheel 25 that is secured to the shaft 26, which impulse wheel carries on its periphery the so-called vertical impulse teeth 27^a and one rotary impulse tooth 28^a. The said impulse teeth are so arranged that when the dial is drawn down the impulse springs 21 and 22 are not carried into contact with the ground post 16; but as the dial returns, first the vertical teeth force the vertical impulse spring 21 into engagement with the ground post 16, and after they have completed their work the rotary impulse tooth operates the rotary impulse spring 22. In this operation the subscriber's vertical line conductor 27 is first given a number of ground impulses, and then the rotary line conductor 28 is given one ground impulse. It will be seen that as long as the dial is out of normal position the construction is such that the dog 23 permits the primary circuit springs 29 and 30 to separate, thus preventing the impulses that are delivered to either line conductor from passing to the other. A calling subscriber may signal a called subscriber by means of the push button 31 which, when pressed, carries the spring 32 out of engagement with the contact point 33 and into engagement with the contact point 34, whereby the vertical line conductor 27 is grounded. The first selector switch shown at C is constructed as follows: The switch shaft (not shown) carries the vertical and rotary

wipers 45 and 46, respectively, and the private wiper 47. The side switch is well known and comprises the side switch wipers 48, 49, 50 and 51 which normally occupy the contact points 53, 54, 55 and 56, respectively. In the second position the wipers rest on the contact points 57, 58, 59 and 60, respectively, and in the third position the contact points 61, 62, 63 and 64 are engaged by their respective wipers. Through the medium of the vertical line relay 65, and while the side switch is in first position, the subscriber controls the vertical magnet 66, which latter operates to raise the switch shaft and wipers 45, 46 and 47 vertically. By means of the rotary line relay 67 the subscriber controls the private magnet 52, and, therefore, the side switch. While the side switch is in second position the rotary magnet 68, which operates to carry the switch shaft and wipers 45, 46 and 47 in a rotary direction, is energized. The vertical and rotary line relays 65 and 67, acting conjointly, provide means whereby the subscriber controls the release magnet 69 while the side switch is in the first or second position. If the side switch passes to third position, then, since the selector is of the trunk-release type, the release is controlled by means of the back-release relay 70 from the next switch with which a connection is at that time established, through the private wiper 47. The bridge-cut-off relay 71 is provided to open the connection between the line relays 65 and 67 and between said relays and battery B when the line associated therewith is called. This is desirable, because if the relays are not disconnected from each other and battery the ringing current for signaling the subscriber may operate either or both of the relays 65 and 67 and cause some interference with the switch. It is also desirable to remove the bridge formed through the said relays from across the line to give the voice currents as clear a path as possible. In addition, the first selector is provided with a normal arm 72 which, when the shaft is raised, permits the spring 73 to pass out of engagement with the spring 74 and into engagement with the spring 75. The normal conductors 76, 77 and 78, over which incoming calls are made, terminate in the connector banks, as is usually the case in systems of this general character.

The ring-back or reverting call arrangement shown at D comprises the vertical and rotary line relays 79 and 80 connected in series with the windings 81 and 82 of the differential relay 83 and to the battery terminals. A resistance coil 84 is provided in the trunk-release circuit to cut down the flow of current through the back release relay 70 of the selector, which relay is of one-half ohm resistance. The ringer relay 85 upon energizing operates to bridge the ter-

minals of the ringer generator E across the line conductors.

The connector switches are constructed as follows: In regard to the mechanical details, they are very much the same as those of the selectors, but there is some difference in the circuits. The connector switch shaft (not shown), like the selector switch shaft, carries the line wipers 124 and 125 and the private wiper 126. The connector switch is also controlled by the calling subscriber through the medium of the vertical and rotary line relays 127 and 128. The vertical line relay 127 directly controls the vertical magnet 129 and also the rotary magnet 130. The function of the vertical magnet 129 is to give the shaft and shaft wipers a vertical motion, and the rotary magnet 130 imparts to the shaft and shaft wipers a rotary or circular motion. The rotary line relay 128 controls the private magnet 131, which latter, under certain conditions, controls in turn the vertical and rotary magnets 129 and 130, the release magnet 132 and also the side switch wipers 134, 135, 136 and 137. The side switch of the connector, like the side switch of the selector, has a normal or first position, a second and a third position. The release magnet 132 is also controlled by the vertical and rotary line relays 127 and 128 conjointly. By the use of the condensers 138 and 139 in the connector the circuit through it is divided into two sections. The connector is provided with a differentially wound relay 140 which is composed of the windings 141 and 142. The function of this relay is to provide the calling subscriber with talking battery current when the back bridge relay 143 energizes, and also, in conjunction with the vertical line relay 127, to control the ringer relay 144 by means of which the ringer generator E is bridged across the terminals of the called line to signal the called subscriber. The back bridge relay 143, comprising the windings 145 and 146, provides the called subscriber with talking battery current when the primary circuit of the called substation is bridged across the line. The central station is equipped with the busy signaling apparatus I, of any suitable design, as, for example, the one comprising an interrupter 147 in series with the primary winding 148 of the induction coil 149, whereby a busy signaling current is induced in the secondary winding 150 of the said induction coil. The secondary winding 150 is connected with the side switch wiper 135 through the normal springs 151 and 152 when the switch shaft is raised and the side switch is in first position.

A clearer understanding of my invention may be had by considering its action when one subscriber operates the central office switches to call back on his own line. It

will be assumed that subscriber A desires to signal the subscriber at substation A', in which event the selector switch C allotted to the line conductors 27 and 28 is operated to establish connection with the ring-back arrangement D which is allotted to the second level of the first selector banks. The subscriber at substation A removes the receiver 2 from the switch hook 3, whereby the springs 14 and 15 engage when the dial is turned, thus providing ground for the ground post 16. Since the ring back arrangement is allotted to the second level of the first selector, the vertical line conductor 27 is given two ground impulses and the rotary line conductor 28 is given one. The impulse to the vertical line conductor 27 causes the vertical line relay 65 to be energized by a flow of current from the substation ground G' through the ground springs 14 and 15 to the ground post 16, thence to the vertical impulse spring 21, vertical line conductor 27, side switch wiper 48, first position contact point 53 to the line relay 65, thence through said relay and through the bridge cut off relay springs 153 and 154 to the battery lead 155, and through battery B to ground G. The line relay 65 presses the line relay springs 156 and 157 into contact, whereby a flow of current is sent through the vertical magnet 66 from ground G² through the said springs 156 and 157, private magnet springs 158 and 159, vertical magnet 66 to the battery lead 155, and through battery B to ground G. In a manner well understood the switch shaft is raised one step at a time, whereby the shaft wipers 45, 46 and 47 are raised to the second bank level opposite the first trunk line thereof. The selector C being thus operated, the impulse to the rotary line conductor 28 causes the rotary line relay 67 to energize by a flow of current from ground G' to the ground post 16, and through the rotary impulse spring 22 to the rotary line conductor 28, thence through the side switch wiper 49, contact point 54 to the rotary line relay 67, thence through said relay and through the bridge cut off relay springs 160, 153 and 154 to the battery lead 155, and through battery B to ground G. The said line relay 67 operates to close connection between the springs 161 and 156, whereby a flow of current is sent through the private magnet 52 from ground G² through said springs 156 and 161, through said private magnet 52 to the battery lead 155, and through battery B and to ground G. The private magnet being thus operated permits the side switch to trip to second position, at which time the side switch wiper 51 engages the grounded contact point 60, whereby a circuit is established through the rotary magnet 68 from ground G³ through said rotary magnet to

the battery lead 155, and through battery B to ground G. The rotary magnet then begins to rotate the shaft, which latter then carries the private wiper 47 onto the first contact of the second level of the private bank. If the trunk line leading from the first bank terminal of the second bank level is busy, the private wiper 47 will find the private contact grounded, since there is a selector similar to the selector C in connection with the first trunk line of the second level, the private side switch wiper of which selector, similar to the side switch wiper 50, is in third position and in engagement with a grounded contact point similar to the contact point 63. Evidently, then, the guarding potential is established at the private bank contact through the described occupying selector by way of the back release relay of said selector, similar to the back release relay 70. Therefore, as soon as the private wiper 47 engages the said grounded contact an energizing circuit is established through the private magnet 52, which again energizes and locks the side switch in second position in order to hold the energizing circuit for the rotary magnet 68 until after the shaft wipers have been carried beyond the last busy trunk line and into engagement with some idle trunk line. This energizing circuit for the private magnet extends from the grounded private bank contact through the private wiper 47, and through the back release relay 70 to the side switch wiper 50, thence (since said side switch wiper is in second position) through the private magnet 52 to the battery lead 155, and through battery B to ground G. As soon as the private wiper 47 has been advanced by the rotary magnet 68 beyond the last busy or grounded private bank contact, the circuit through the private magnet 52 is again broken, at which time the side switch of the selector is permitted to pass to third position, at which instant the energizing circuit is broken through the rotary magnet 68, and the line conductors 27 and 28 are extended to the line wipers 45 and 46 which have previously engaged the trunk conductors 162 and 163. The subscriber is, therefore, directly connected with the ring back arrangement. Not only is the subscriber's line thus extended, but a guarding potential is also established at the private wiper 47, when the side switch wiper 50 passes onto the ground contact point 63, for protecting the seized trunk line against interference by other calling subscribers. This guarding potential is established from ground G through the side switch wiper 50, back release relay 70, conductor 164 to the private wiper 47. Furthermore, when the selector shaft is given a vertical step the normal arm 72 permits the spring 73 to engage the grounded contact point 75, whereby a guard-

ing potential is established at the connector bank for protecting the calling line against seizure by other subscribers. It will be seen, of course, that the energizing circuit for the rotary magnet 68, to which reference has already been made, is destroyed when the idle trunk line is seized—that is, when the side switch wiper 51 leaves the contact point 60. The calling subscriber has now extended the conductors 27 and 28 to the ring back arrangement shown at D, and the central office switches occupy the positions indicated in Fig. 1. When the subscribers' lines are thus extended to the ring back arrangement D a circuit is closed extending from ground G through the springs 165 and 166, through the winding 82 of the differential relay 83, rotary line relay 80, conductors 163 and 28, primary winding and transmitter of the substation to the vertical conductors 27 and 162, then through the vertical line relay 79 and relay 167 in multiple, and the winding 81 of the differential relay 83 to the battery lead 155, and through battery B to ground G. The line relays 79 and 80 energize and separate the springs they control, while the relay 167 energizes and closes the springs it controls in contact.

To signal the subscriber at substation A' the calling subscriber at substation A presses the signaling button 31, whereby the series circuit through the line relays 79 and 80 is broken; but an energizing circuit is established through the vertical relay of the ring-back arrangement, said circuit extending from ground G through the springs 14 and 15, contact point 34, push button spring 32, through the springs 29 and 30 to the vertical line conductor 27, through the side switch wiper 48, shaft wiper 45, trunk line conductor 162, vertical line relay 79 in multiple with the relay 167, winding 81 of the differential relay 83 to the battery lead 155, thence through battery B to ground G. The relay 80, therefore, restores to normal position, but the differential relay 83 energizes, since one winding only carries current. The relay 80 upon deenergizing permits the springs 168 and 169 to engage, and the relay 83 upon energizing closes the springs 170 and 171 in contact. A circuit through the ringer relay 85 is now completed extending from ground G through the relay 85, springs 168 and 169, springs 170 and 171 to the battery lead 155, and through battery B to ground G. The ringer relay 85 thereupon energizes and places the springs 172 and 173, 174 and 175 in contact, whereby the terminals of the ringer generator E are bridged across the conductors 162 and 163. A signaling current then passes from the generator E through the springs 174 and 175, conductors 163, 28 and 176, springs 178 and 179, ringer 180 and condenser 181 to the conductors 182, 27 and 162, springs 173 and 172 back to the gen-

erator E. The subscriber at substation A', in response to his signal, which may be two rings, removes his receiver from the switch hook and bridges his primary circuit across the main line conductors 27 and 28 in multiple with the primary circuit of the substation A. Talking battery current for these two multiple primary circuits is established as soon as the ringing key at substation A is returned to normal over a circuit extending from ground G⁵ through the springs 165 and 166, through the winding 82 of the relay 83, rotary line relay 80, through the conductors 163 and 28, then through the primary windings 19 and 183, transmitters 17 and 184 to the vertical line conductor 27, side switch wiper 48, shaft wiper 45, conductor 162, through the vertical line relay 79 and relay 167 in multiple, and winding 81 of the differential relay 83 to the battery lead 155, thence through battery B to ground G. The windings 81 and 82 of the relay 83 are so arranged that when both windings carry current, as before explained, the said relay does not operatively energize. The two substations being thus provided with talking current, conversation may be carried on in the well known manner. After the subscribers have finished their conversation the subscriber who last restores his receiver to the switch hook brings about the release of the central office switching apparatus, as follows: Suppose subscriber A restores his receiver last. In that event the cam-arm 4 presses the release springs 7, 8 and 9 into contact momentarily, whereby the vertical and rotary line conductors are simultaneously grounded. The grounding of the rotary line conductor 28 short circuits the winding 82 of the differential relay 83, whereby the said relay becomes unbalanced and operates to shift the spring 171 into engagement with the spring 170. Thus far, however, nothing has occurred to initiate the release, but when the ground is removed by the disengagement of the release springs 7, 8 and 9, the last energizing circuit established is broken and the vertical line relay 79 and relay 167 deenergize. The relays 79 and 167, as shown, are both slow acting relays, but the relay 167 is slower to restore to normal than the relay 79; hence, when the springs 185 and 186 engage, before the springs 187 and 188 disengage, an energizing circuit is closed through the back release relay 70 of the selector switch C, said circuit extending from ground G⁴ through the back release relay 70, conductor 164, shaft wiper 47, dead resistance 84, springs 185 and 186, springs 187 and 188 to the battery lead 155, thence through battery B to ground G. The back release relay 70 upon energizing places the springs 189 and 190 in contact, whereby an energizing circuit is in turn provided for the release magnet 69, this circuit extending from ground G⁷ through the springs 189 and 190 and through the release magnet 69 to the battery lead 155, thence through battery B to ground G. All of the relays and magnets thus energized attract their respective armatures and remain in readiness to return to normal position as soon as the relay 167 deenergizes and the springs 187 and 188 disengage. In this releasing operation it will be seen that the grounding of the two sides of the line by the hanging up of the receiver has no particular function. It is the deenergization of the relays 167 and 79 which initiates the release and these relays do not deenergize until the last subscriber has hung up to open the last bridge across the line. If the subscriber at substation A, however, desires to establish connection with a subscriber on some other line, the selector C is operated to seize some idle trunk line leading to a connector or to another selector, and finally to a connector, which is operated to establish connection directly with the desired line. For example: To call the number 320 (substation A²) the subscriber at substation A removes his receiver from the switch hook and operates the calling device once for each digit in the well-known manner. When the device is operated for the first digit the first selector switch C is operated to establish connection with an idle trunk line leading to the connector switch F. The impulses for the last two digits are directed toward the connector switch F, which operates to place the shaft wipers in connection with the contacts corresponding to the desired line. The first digit being 3 the impulse spring 21 is pressed onto the ground post 16 three times. As a result the vertical line relay 65 of the first selector C is energized each time by a flow of current from the substation ground through the vertical line relay 65 to the battery lead 155, as previously explained. The vertical line relay in turn operates to energize the vertical magnet 66, whereby the shaft wipers are raised opposite the bank contacts of the third level. Following the vertical impulses the rotary line relay 67 is energized as before, and the private magnet in turn operates to carry the side switch from first to second position, whereby the rotary magnet becomes energized, and the shaft wipers 45, 46 and 47 are operated to select an idle trunk line leading to the connector switch F. The grounding of the line conductors 27 and 28 for the last two digits affects the connector by operating the vertical and rotary line relays 127 and 128. When the vertical line conductor 27 is grounded the vertical line relay 127 is energized by a flow of current from substation ground G⁷ through the vertical line conductor 27, side switch wiper 48, shaft wiper 45, trunk conductor 191, vertical line relay 127 (Fig. 3), winding 141 of

the relay 140 to the battery lead 155, thence through battery B to ground G. The winding 141 of the relay 140 being included in this circuit, the said relay energizes, but this operation is without effect at this particular time. Each time that the vertical line relay 127 operates for the second digit the vertical magnet 129 operatively energizes to carry the shaft wipers 124, 125 and 126 in a vertical direction one step at a time until the said wipers are carried two steps and thus brought opposite a level in which are located the terminals of the line #320. The circuit through the vertical magnet 129 extends from ground G^s through the springs 192 and 193, private magnet springs 194 and 195, side switch wiper 136, vertical magnet 129 to the battery lead 155, thence through battery B to ground G. When the rotary line conductor 28 is grounded following the grounding of the vertical line conductor, the connector rotary line relay 128 becomes energized through a circuit from ground G' to the rotary line conductor 28, side switch wiper 49, shaft wiper 46, rotary trunk conductor 196, rotary line relay 128, winding 142 of the differential relay 140, through the springs 197 and 198 to the battery lead 155, thence through battery B to ground G. The winding 142 of the differential relay 140 being included in this circuit, said relay 140 energizes, but with no effect. The rotary line relay 128 upon energizing operates to close an energizing circuit through the private magnet 131, which latter in turn operates to release the side switch from first to second position. For the last digit the subscriber operates the calling device as previously described, grounding the vertical line conductor 27 ten times and the rotary line conductor 28 once. The vertical and rotary line relays 127 and 128 are operated over previously traced circuits. However, when the vertical line relay operates, a circuit is closed through the rotary magnet 130 instead of through the vertical magnet 129, since the side switch wiper 136 is now in second position. Each time that the rotary magnet is energized the shaft wipers 124, 125 and 126 are rotated one step at a time until the said wipers are carried into engagement with the normal conductors 198^a, 199 and 200, the first two of which lead to the line terminals of the desired substation. The rotary line relay 128 upon energizing completes an energizing circuit through the private magnet 131 as before, which latter 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. It will be assumed that the former result occurs, and that the side switch passes to third position, whereby the side switch wipers 134 and 135 are placed in connection with the shaft wipers 124 and 125, respec-

tively. 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^o through the side switch wiper 137 to the shaft wiper 126 which engages the private bank contact of the seized line. Furthermore, when the side switch passes to third position an energizing circuit is closed through the bridge cut-off relay 151^a of the first selector switch H. This circuit extends from the guarding potential ground G^o to the shaft wiper 126, normal springs 152^a of the first selector H, through the winding of the bridge cut off relay 151^a to the battery lead 155. The bridge cut off relay operates to disconnect the line relays from each other and from the battery lead to give as clear a line as possible. In order to signal, the subscriber at substation A presses the signaling button 31, whereby the vertical line conductor 27 is grounded and the connector vertical line relay 127 and the differential relay 140 become energized as before. It has been assumed that the side switch has passed from second to third position, and that the side switch wiper 136 is in engagement with the third-position contact point, thereby placing the vertical line relay 127 in control of the ringer relay 144 in the same manner in which the rotary magnet 130 came under the control of the vertical line relay when the side switch passed from first to second position. Therefore, when the vertical line relay presses the springs 192 and 193 into contact, the ringer relay 144 is energized from ground G^s through the springs 192 and 193, private magnet springs 194 and 195, side switch wiper 136, ringer relay 144, springs 201 and 202 (bearing in mind that the differential relay 140 is energized) to the battery lead 155, thence through battery B to ground G. The ringer relay upon energizing operates to bridge the terminals of the ringer generator E across the conductors of the desired line. A signaling current is therefore sent from the ringer generator H to the substation ringer 203. In response to the signal the subscriber at substation #320 removes his receiver from the switch hook, whereby the switch hook rises, permitting the springs 204 to disengage and the springs 205 to engage, thereby removing the ringer 203 from across his line and bridging instead the transmitter and primary winding. When the primary winding and transmitter come across the line an energizing circuit is established through both windings of the relay 143, said circuit extending from ground G^o through the side switch wiper 137, through the winding 146 of the relay 143, through the ringer relay springs and side switch wiper 135 to the rotary normal conductor 199, rotary line conductor 206, through the primary winding and transmitter to the ver-

tical line conductor 207, vertical normal conductor 198^a, shaft wiper 124 and side switch wiper 134, through the winding 145 of the relay 143, through the springs 208 and 202 to the battery lead 155, thence through battery B to ground G. The relay 143 upon energizing operates to shift the spring 197 from the spring 198 (which latter is connected with the battery lead 155) to the spring 209, which in turn is connected with ground. The reversal of polarity in the spring 197 sets up a circuit which provides the calling subscriber with battery current for talking purposes. This circuit may be traced from ground G^a through the side switch wiper 137, springs 209 and 197, through the winding 142 of the relay 140, rotary line relay 128, conductors 196 and 28, through the primary winding and transmitter of substation A to the vertical line conductors 27 and 191, vertical line relay 127, winding 141 of the differential relay 140 to the battery lead 155, thence through battery B to ground G. Both windings of the relay 140 now carry current, but the windings are so arranged that the said relay does not operatively energize. The vertical and rotary line relays 127 and 128, being included in the above circuit, operatively energize and place their springs in contact, and the release springs 210 and 211 are also brought into contact, but the simultaneous action of these relays at this particular time is without effect, since no energizing circuits are established thereby. The two substations A and A² being thus provided with battery current for talking purposes, conversation may be carried on over circuits shown by the heavy line conductors in Figs. 1 and 3. The release of the central office switching apparatus is brought about when the calling subscriber restores the receiver 2 to the switch hook 3, thereby pressing the release springs 7, 8 and 9 into engagement for a moment. The contact of the said release springs grounds the vertical and rotary line conductors 27 and 28 simultaneously from ground G' to the release spring 7, thence through the springs 8 and 9 to the vertical and rotary line conductors. The grounding of the rotary line conductor 28 produces a short-circuit of the rotary line relay 128 in series with the winding 142 of the differential relay 140. The said circuit extends from ground G^a at the connector to the side switch wiper 137, springs 209 and 197, through the winding 142, rotary line relay 128, conductors 196 and 28, through the release springs 9, 8 and 7 to the substation ground G'. Therefore, since the winding 141 of the differential relay 140 alone carries current, the said relay becomes energized and attracts its armature, which shifts the spring 202 out of contact with the spring 208 and into contact with the spring 201.

The disengagement of the springs 208 and 202 destroys the energizing circuit through the relay 143, and the spring 197 passes out of engagement with the spring 209 and into engagement with the spring 198, which removes the said short-circuit of the rotary line relay 128 and winding 142 and establishes an energizing circuit instead from the substation ground G' through the release springs 7, 8 and 9 to the rotary line conductor 28, thence to the rotary line relay 128, as previously traced, winding 142 of the differential relay 140, through the springs 197 and 198 to the battery lead 155, thence through battery B to ground G. The rotary line relay 128 now operates, and the springs 210 and 211 come into contact, whereby an energizing circuit is established through the release magnet 132 of the connector F and the release relay 70 of the selector C. However, the current now in passing, as above stated, through the winding 142 aids the winding 141 in maintaining the springs 201 and 202 in contact. The energizing circuit through the release magnet 132 extends from ground G^a at the selector C through the side switch wiper 50, back release relay 70, shaft wiper 47, conductor 212, through the release springs 210 and 211, release magnet 132, springs 201 and 202 to the battery lead 155, thence through battery B to ground G. The connector release magnet, upon being supplied with current, energizes, and as a result the switch shaft and side switch are restored to normal condition, thus breaking the connection between the connector switch shaft wipers 124, 195 and 126 and the normal conductors 198^a, 199 and 200. The back-release relay 70, being in the same circuit with the release magnet 132, energizes simultaneously with the latter and operates to close the circuit through the release magnet 69 of the selector C by pressing the back-release springs 189 and 190 together. The circuit through the release magnet 69 extends from ground G' through the springs 189 and 190, and through the release magnet 69 to the battery lead 155. When the ground to the line conductors 27 and 28 is interrupted all the magnets involved in the release are de-energized and all switches fully restored. The ring-back arrangement D shown in Fig. 2 is a modified form of D shown in Fig. 1 to this extent, namely that the slow-acting relay 167, instead of being in multiple with the line relay 79, is controlled by the line relay—that is, when the line relay 79 energizes it closes a circuit through the relay 167 which energizes and places the springs controlled thereby in contact. Now, when the line relay 79 de-energizes, the springs 185 and 185^a engage and close the release circuit, since the relay 167 is still in an operated position. When the relay 167 de-energizes, the release circuit is broken. In other

details and features the arrangement at D, Fig. 2, is similar to D, Fig. 1.

From the foregoing it will be seen that I provide a common battery system in which party line subscribers uniformly call the subscribers on the same line by a single movement of the calling dial. The ordinary common battery connectors having ringer relays can be employed for calling and signaling between different lines. The said ring-back arrangement not only controls the flow of both ringing and talking current to the substations of the party line, but also controls the trunk-release circuit extending back through the first selector in the manner explained.

It will be seen that one of the principal advantages of my invention is that in a common battery system having a ring-back arrangement of this kind the party line subscribers are furnished with a ring-back arrangement, and the system is such that further pressure of the ringing key at the calling substation, after the called subscriber has answered, will not release the connection, notwithstanding that only two wires are used between the different substations of the party line.

What I claim as my invention is:—

1. In a telephone system, suitable switches, release mechanism therefor, a trunk-release circuit, a talking circuit, a plurality of differently timed slow-acting relays controlling said release circuit, and a circuit for said relays in part coincident with both sides of said talking circuit in series.

2. In a telephone system, suitable switches, release mechanism therefor, a trunk-release circuit, a talking circuit, a pair of differently timed slow-acting relays controlling normally closed and normally open switch points in said release circuit, and a circuit for energizing said relays in multiple, said energizing circuit being in part coincident with both sides of the talking circuit in series.

3. In a telephone system, suitable switches, release mechanism therefor, a trunk-release circuit, a plurality of differently timed relays controlling said release circuit, a talking circuit, and connections whereby both of said relays are energized over the two sides of the talking circuit in series.

4. In a telephone system, a line circuit, suitable switches, release mechanism therefor, a trunk-release circuit, a plurality of differently timed relays controlling said release circuit, the quicker of said relays when energized serving to open said release circuit, which relay is energized over the two sides of the line circuit in series, whereby the opening of the line circuit causes said relay to close the release circuit before the same is opened by the deenergizing of the other or slower of said relays.

5. In a telephone system, a line, a plurality of substations thereon, a ring-back apparatus, and means for extending connection from said line to said apparatus, the said apparatus comprising means responsive to the opening of the line for releasing the connection, consisting of two differently timed relays, a release circuit having a switch point closed by the deenergizing of the quicker of said relays, a switch point opened by the deenergizing of the slower of said relays, and a circuit for energizing the said quicker relay over the two sides of the line in series.

6. In a common battery automatic telephone exchange system, suitable switches, release mechanism therefor, a trunk-release circuit, a talking circuit, a plurality of differently timed slow-acting relays controlling said release circuit, a circuit for said relays in part coincident with both sides of said talking circuit in series, and a central source of current connected to supply talking current through the winding of one of said relays.

7. In a common battery automatic telephone exchange system, suitable switches, release mechanism therefor, a trunk-release circuit, a talking circuit, a pair of differently timed slow-acting relays controlling normally closed and normally open switch points in said release circuit, a circuit for energizing said relays in multiple, said energizing circuit being in part coincident with both sides of the talking circuit in series, and a central source of current connected to supply talking current through the winding of one of said relays.

8. In a telephone system, a line having a pair of conductors, a substation for said line bridged across said conductors, means in said bridge for talking over said lines, a progressively movable switch, release mechanism for said switch, a circuit for controlling the operation of said release mechanism, a plurality of other lines, a set of differently timed relays associated with each one of said other lines, said switch having means for connecting said line with any one of said other lines, and for extending the said circuit to the set of relays associated with the other line to which said first line is connected, one of said relays energized over two sides of said talking circuit in series.

9. In a common battery automatic telephone exchange system, a line circuit, suitable switches, release mechanism therefor, a trunk-release circuit, a plurality of differently timed relays controlling said release circuit, the quicker of said relays when energized serving to open said release circuit, which relay is energized over the two sides of the line circuit in series, whereby the opening of the line circuit causes said

relay to close the release circuit before the same is opened by the deenergizing of the other or slower of said relays, and a central source of current connected to supply talking current through the winding of one of said relays.

10. In a common battery automatic telephone exchange system, a line, a plurality of substations thereon, a ring-back apparatus, and means for extending connection from said line to said apparatus, the said apparatus comprising means responsive to the opening of the line for releasing the connection, consisting of two differently timed relays, a release circuit having a switch point closed by the deenergizing of the quicker of said relays, a switch point opened by the deenergizing of the slower of said relays, a circuit for energizing the said quicker relay over the two sides of the line in series, and a central source of current connected to supply talking current through the winding of one of said relays.

11. In a common battery automatic telephone exchange system, a party line having a plurality of substations thereon, a ring-back apparatus, means for extending connection from said line to said apparatus, the said apparatus comprising means for signaling over said connection, means responsive to the opening of the line circuit for releasing said connection, and a common battery for furnishing talking current through said last-mentioned means.

12. In a telephone system, a pair of line relays, a slow-acting relay supplemental to one of said relays, a trunk circuit controlled by said line relay and its supplemental relay, a ringer relay, a double-wound relay connected in series with said line relays, and a circuit through the ringer relay controlled by the double-wound relay and the other line relay.

13. In a telephone system, suitable switches, a pair of line relays, a slow-acting relay supplemental to one of said relays, a trunk circuit controlled by said line relay and its supplemental relay, a ringer relay, a double-wound relay, a circuit through the ringer relay controlled by the double-wound relay and the other line relay, a release relay in said trunk circuit, release mechanism controlled by said release relay, and a line circuit excluding said trunk circuit.

14. In a telephone system, a party-line having a plurality of substations thereon, a ring-back apparatus, means for extending connection from said line to said apparatus, the said apparatus comprising means for signaling over said connection, a differential relay connected to one limb of the line, and a line relay connected to the other side of the line for controlling said signaling means.

15. In a telephone system, a party-line having a plurality of substations thereon, a ring-back apparatus, means for extending connection from said line to said apparatus, a line relay and a differential relay, means for energizing said line relay, and means for signaling the called subscriber over said connection by first deenergizing said line relay and then energizing said differential relay.

16. In a telephone system, a party-line having a plurality of substations thereon, a ring-back apparatus, means for extending connection from said line to said apparatus, a line relay and a differential relay included in a bridge across said circuit, means for energizing said line relay, and means for signaling the called subscriber over said connection by first deenergizing said line relay and then energizing said differential relay.

17. In a telephone system, a party-line having a plurality of substations thereon, a ring-back apparatus, means for extending connection from said line to said apparatus, a pair of relays, and means for signaling over said connection by deenergizing one of said relays by opening the line circuit and then energizing the other of said relays by grounding one side of said line circuit.

18. In a telephone system, a party-line having a plurality of substations thereon, a ring-back apparatus, means for extending connection from said line to said apparatus, a pair of line relays and a differential relay included in a bridge across said line circuit, means for signaling over said connection, and means controlled by one of said line relays and said differential relay for controlling said signaling means.

19. In a telephone system, subscribers' lines, a calling and a called subscriber, a line relay and a differential relay bridged across said line, and means controlled by the calling subscriber to signal the called subscriber by first deenergizing said line relay by opening his line circuit and then grounding one limb of his line to thereby energize said differential relay.

20. In a telephone system, calling and called subscribers, means for establishing a talking connection between said subscribers, a pair of relays, and means for first deenergizing one of said relays and then energizing the other of said relays for jointly controlling the application of signaling current to said called subscriber.

21. In a telephone system, a subscribers' line, a plurality of stations on said line, another line, a switch having progressively movable wipers for connecting said first line with said other line, a line relay and a differential relay for said other line, and means under the control of one of said stations for

controlling said relays jointly to apply ringing current to another of said stations by way of said wipers.

22. In a telephone system, a line having a pair of conductors, a substation for said line bridged across said conductors, means in said bridge for talking over said line, other lines, a progressively movable switch for selecting and connecting with any one of said other lines, release mechanism for said switch, a plurality of differently timed relays individual to each of said other lines for controlling said release mechanism, said relays energized over the two sides of said talking circuit in series.

23. In a telephone system, a line, a progressively movable switch for said line, another line, means for operating said switch to connect said first and second lines, release means for releasing said switch, and a pair of magnets having different time constants for controlling said release means, said magnets energized by current over said first line.

24. In a telephone system, a line, a progressively movable switch for said line, another line, means for operating said switch

to connect said first and second lines, release means for releasing said switch, and a pair of magnets having different time constants for controlling said release means, said magnets energized by current over said first line, said magnets individual to said other line.

25. In a telephone system, a line having a pair of conductors, a substation for said line bridged across said conductors, means in said bridge for talking over said line, a progressively movable switch, release mechanism for said switch, a circuit for controlling the operation of said release mechanism, a plurality of other lines, a set of differently timed relays associated with said other lines, said switch having means for connecting said line with any one of said other lines, and for extending the said circuit to said relays, both of said relays energized over two sides of said talking circuit in series for controlling said release circuit.

Signed by me at Rochester, Beaver county, Pennsylvania, this 12th day of June, 1909.
GEORGE E. KIMBALL.

Witnesses:

E. RAY HEATH,
J. M. CARGO.