T. G. MARTIN.

COMBINED SELECTOR AND REPEATER APPARATUS FOR LOCAL BATTERY TELEPHONE EXCHANGE SYSTEMS.

APPLICATION FILED JULY 22, 1907. RENEWED SEPT. 19, 1917.

1,268,072. Patented May 28, 1918.

3 SHEETS—SHEET 1.

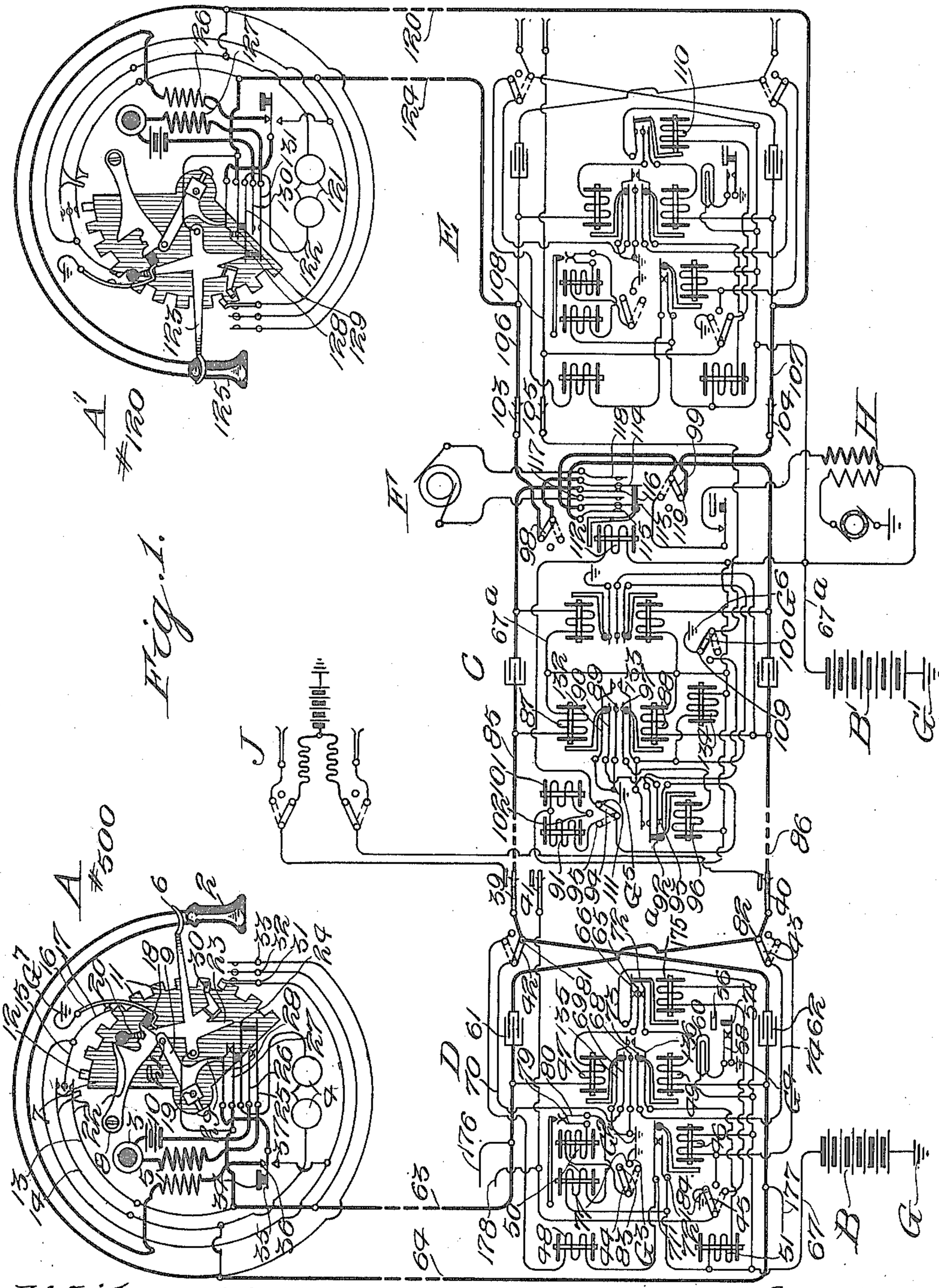

Fig. 1.

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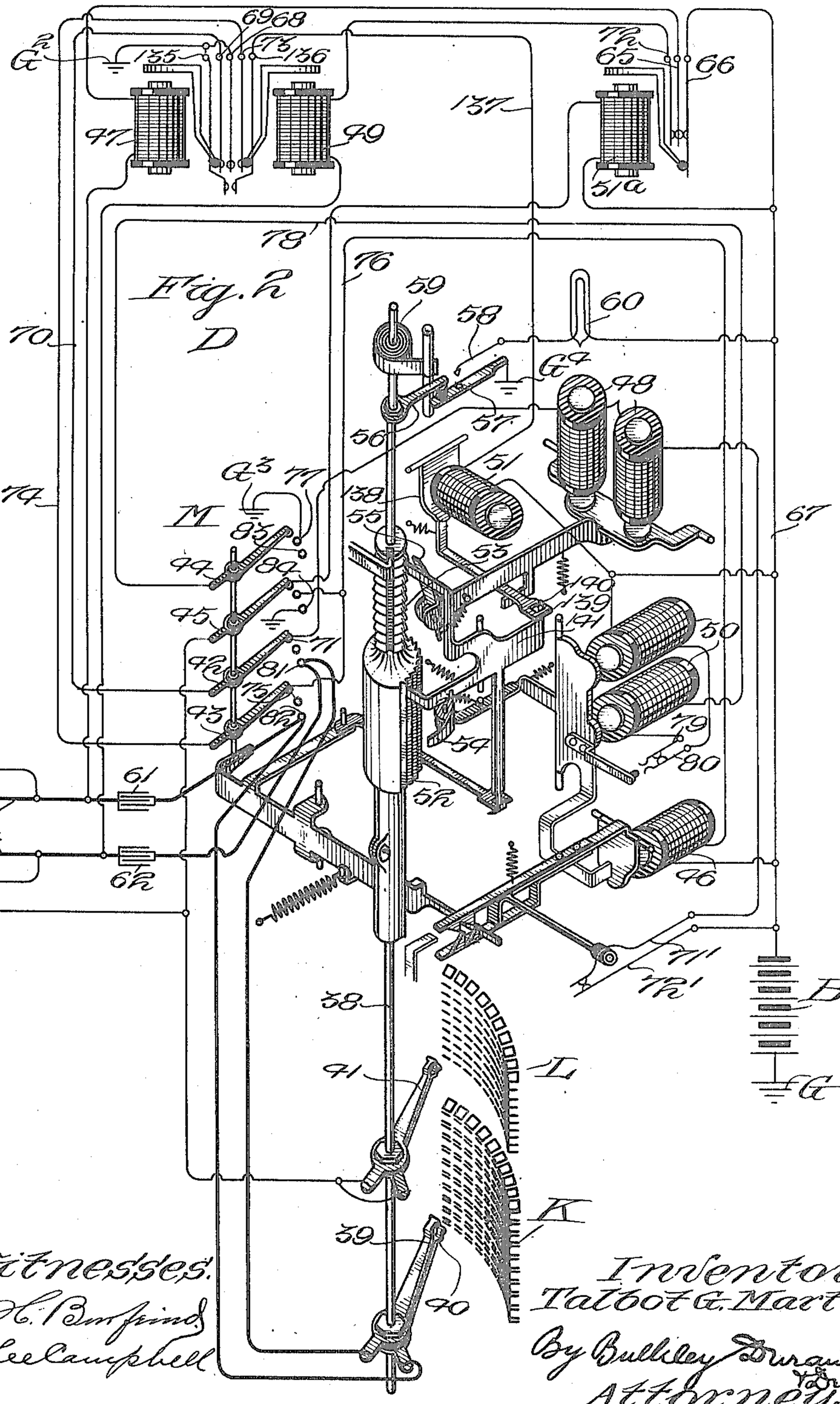
3 SHEETS—SHEET 2.

Fig. 2



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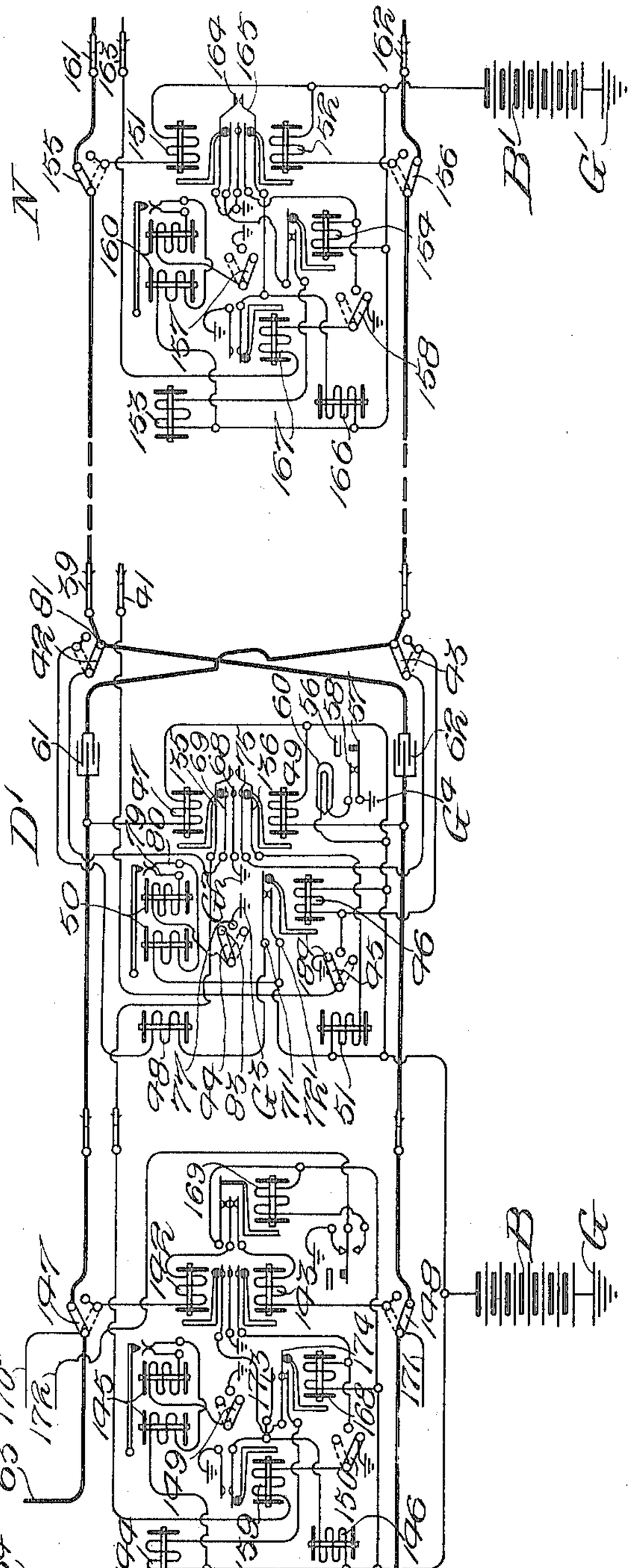

Fig. 3.

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UNITED STATES PATENT OFFICE.

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COMBINED SELECTOR AND REPEATER APPARATUS FOR LOCAL-BATTERY TELEPHONE-EXCHANGE SYSTEMS.

1,268,072. Specification of Letters Patent. Patented May 28, 1918.

Application filed July 22, 1907, Serial No. 384,891. Renewed September 19, 1917. Serial No. 192,224.

To all whom it may concern:

Be it known that I, TALBOT G. MARTIN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Combined Selector and Repeater Apparatus for Local-Battery Telephone-Exchange Systems, of which the following is a specification.

My invention relates to telephone systems in general, but more particularly to automatic or semi-automatic telephone exchange systems, and especially to systems in which it may be found desirable to repeat or relay the electrical impulses by which one or more of the automatic switches are operated for the purpose of extending connection from the calling subscriber's line to the line of the called subscriber.

My invention contemplates certain improvements on the system disclosed in my prior application, Serial No. 352,694, filed January 17, 1907. It will be seen that in said prior application a combined trunk selector and repeater is employed in a common battery system. My present invention, as hereinafter described, contemplates a local battery system having combined selectors and repeaters, and having certain novel features and combinations necessary or desirable to the efficient working of a combined selector and repeater in a local battery system.

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

In the accompanying drawings Figure 1 shows diagrammatically a substation A (#500) allotted to one central office and terminating in my improved selector switch D, which latter may be of the general type shown in United States Patent No. 815,321, granted March 13, 1906, to Keith, Erickson & Erickson. The selector D is shown as having seized a trunk line leading to the connector C (in a second central station) which is like the connector switch disclosed in United States Patent No. 815,176, granted March 13, 1906, to Keith, Erickson & Erickson. The connector C is in turn illustrated as having established connection with the line #120 which leads to the substation A'. The selector E allotted to the called line #120 is like the selector switch D. The usual ringer generator and busy-signaling machine are shown at F and H, respectively. In the first central office the battery B is shown as having its positive pole, preferably grounded at G. Similarly, in the second central office the battery B' is shown with its positive terminal grounded at G'.

Fig. 2 is a diagrammatic perspective view of my improved first-selector and repeater D.

In Fig. 3 there is shown at D' a modification of my improved selector D, which is a second-selector for use in an exchange of larger size.

As thus illustrated, the substations A and A' may be of any suitable or approved type. The substation A, like the substation A', is provided with a receiver 2, transmitter 3, ringer 4, induction-coil 5, switch-hook 6, impulse wheel 7, cam latch 8 for normally locking the dial, a cam dog 9 and a battery 10. The impulse wheel 7 is, of course, provided with a set of vertical impulse teeth 11 and a rotary impulse tooth 12 for operating, respectively, the vertical impulse spring 13 and the rotary impulse spring 14 with respect to the ground post 15. The substation ground G^7 is permanently connected to the ground spring 16, which latter is normally held away from the ground spring 17 by the insulating tip 18 upon the end of the cam latch 8. Said insulating tip normally rests opposite the angled terminal of the ground spring 16, as shown at substation A'. It will be understood, of course, that the subscriber's dial (which is not shown) and the impulse wheel 7 and the cam dog 9 are all rigidly secured to the shaft 19. While the receiver is on the switch-hook the switch-hook cam arm 20 removes the ground spring 16 from the insulating tip 18, so that the cam latch 8 falls in front of the pin 21 on the end of the cam dog 9, whereby it becomes impossible to rotate the dial. When the receiver is removed, however, the switch-hook is raised by a suitable spring (not shown), and the cam arm 20, by engaging the face 22 of the cam latch 8, raises the latter sufficiently to permit the pin 21 to pass under the cam latch when the dial is rotated sufficiently. It will be understood, however, that when the cam arm 20 leaves its normal position the ground spring 16 falls against the insulating tip 18 and re-

mains there, out of engagement with the other ground spring 17, until the dial is rotated, since the cam arm 20 does not raise the cam latch 8 sufficiently to permit the tip 18 to clear the angled section on the end of the ground spring 16. The extreme end of the cam latch 8, which is engaged by the cam dog pin 21, is rounded off in such a manner that when the dial is rotated the pin 21 slides beneath the said rounded section and raises the cam latch 8 a trifle, so that the insulating tip 18 may now leave the ground spring 16, permitting the latter to engage the ground spring 17 and thus establish connection between ground G′ and the ground post 15. When the receiver is on the hook the cam 23 engages the spring 24 and thereby bridges the ringer 4 across the line. By engaging the spring 24 the said cam arm 23 not only closes the substation ringing circuit, but also opens the local primary circuit by separating the springs 25 and 26, and by separating the springs 27 and 28 opens the secondary circuit for removing the receiver 2 from across the line. But when the switch-hook is up the primary circuit is closed and the secondary circuit comprising the receiver 2 is bridged across the line. However, while the dial is being operated and, therefore, while the cam 29 of the cam dog 9 is out of normal position, the secondary circuit is opened at the point between the springs 27 and 28, so that no electric impulses that may be delivered to either of the subscriber's line conductors individually shall pass through the receiver to the other side of the line. The switch-hook cam 30 is provided for controlling the release springs 31, 32 and 33, which release springs are pressed into contact, grounding the subscriber's line conductors simultaneously when it becomes desirable to release the central office switching apparatus. The signaling button 34 has the function of controlling the spring 35 that normally rests in engagement with the contact point 36, but from which it is separated and carried into engagement with the ground contact 37 when the button 34 is pressed, whereby only the vertical side of the subscriber's line may be grounded when signaling.

The first-selector switch D, shown in Figs. 1 and 2, is an improvement upon the first-selector switch described in said selector patent. It embodies among other details the following well-known devices and circuits: A switch-shaft 38 which carries the vertical and rotary line wipers 39 and 40, respectively, and the private wiper 41. The said wipers are adapted to engage the banks K and L. The side switch M is well known and comprises the side switch wipers 42, 43, 45 and 44, 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 the first, second or third position. The bridge-cut-off relay 175 is provided for disconnecting the line relays 47 and 49 from each other, and from the battery, when the line to which the first-selector is allotted is called. Furthermore, the shaft 38 is provided with the vertical and longitudinal teeth 52 and 53, respectively, which are adapted to be engaged by the rotary and vertical armature pawls 54 and 55 when their respective magnets become operatively energized. The normal arm 56 controls the springs 57 and 58. The function of the coil spring 59 is to return the shaft 38 to normal position after the said shaft has been released by the operation of the release magnet 51. The lamp 60 is provided for indicating to the switch attendant whether or not the switch is in an operated position. By the use of the condenser 61 the incoming subscriber's vertical line conductor 63 is transposed to the outgoing rotary line. Similarly, by means of the condenser 62 the subscriber's incoming rotary line conductor 64 is transposed to the outgoing vertical line.

The operation of my improved selector switch may be more clearly understood from its action when one subscriber calls another. The calling operations by which one subscriber, A for example, may call and signal subscriber A′ are as follows: To call the number 120, which is arbitrarily taken as the number of the line leading from the central station to the substation A′, the subscriber A at substation #500 operates his calling device in a suitable manner corresponding to each digit. For each digit the vertical line 63 is grounded a certain number of times corresponding to the numerical value of the digit and the rotary line 64 is grounded once. The receiver 2 has, of course, been previously removed from the switch-hook 3, closing in contact the springs 25 and 26, and 27 and 28, and removing the ringer 4 from across the line and bridging

instead the secondary circuit. The first digit being 1, the subscriber at substation #500 turns his dial for the first digit 1, thereby grounding the vertical line conductor 63 once and the rotary line conductor 64 once upon the return motion of the dial. The ground post 15 is placed in connection with the substation ground G^7, in a well-known manner, by the action of the locking dog 9. Grounding the vertical line conductor 63 once energizes the vertical line relay 47 of the first-selector. The circuit through the said relay extends from substation ground G^7, ground post 15, vertical impulse spring 13, vertical line conductor 63 to the relay 47, through the bridge-cut-off springs 65 and 66 to the battery lead 67, thence through battery B and to ground G. Each time the vertical line relay 47 is energized the springs 68 and 69 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 68 and 69, conductor 70, side switch wiper 42, contact point 71, vertical magnet 48, through the private magnet springs 71′ and 72′ to the battery lead 67, 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 a level in which are located the contact points that constitute the multiple terminal of a trunk line leading to the connector C. Following the vertical impulse the rotary impulse spring 14 comes in contact with the ground post 15, thereby grounding the rotary line conductor 64 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^7 to the rotary line conductor 64, to the rotary line relay 49, bridge-cut-off springs 72, 65 and 66, to the battery lead 67, thence through battery B and to ground G. The rotary line relay 49, upon energizing, closes the springs 73 and 68 in contact, thereby closing an energizing circuit through the private magnet 46, which circuit extends from ground G^2 to the springs 68 and 73, conductor 74, side switch wiper 43, contact point 75, conductor 76, private magnet 46 to the battery lead 67, thence through battery B to ground G. The private magnet 46 being energized and deenergized, the side switch of the first-selector D passes from first to second position, thereby permitting the side switch wiper 44 to engage the contact point 77, thus closing a circuit through the rotary magnet 50. The current-flow is from ground G^3 to the contact point 77, side switch wiper 44, conductor 78, through the first coil of the rotary magnet to the interrupter springs 79 and 80, through the winding of the second coil of the rotary magnet 50, thence to the battery lead 67 and through battery B to ground G. The rotary magnet is energized once, and the shaft wipers 39, 40 and 41 are carried into engagement with the first set of bank contacts (of the first level) that constitute the terminal 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, then an energizing circuit is 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 magnetization, 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 deënergized 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, then 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 their respective contact points 81, 82, 83 and 84, thus extending the subscriber's line conductors 63 and 64 to the connector C. Also, since the side switch wiper 45 engages the ground contact point 84, a guarding potential is established at the private wiper 41 for preventing the seized trunk line from being molested by any other switch. Furthermore, when the shaft 38 is given the first vertical step the normal arm 56 permits the spring 57 to engage the spring 58, whereby a circuit is established through the signal lamp 60 extending from ground G^4, through the springs 57 and 58, signal lamp 60 to the battery lead 67, thence through battery B and to ground G. The glowing of this lamp indicates to the switchboard attendant that the allotted first-selector is in an off-normal position. The second digit is called after the subscriber has established connection with the connector C by way of the trunk conductors 85 and 86. The subscriber rotates the dial, as described, for the second digit 2, thereby grounding the vertical and rotary line conductors 63 and 64, which causes the energization of the first-selector vertical and rotary line relays 47 and 49 over previously traced circuits. The vertical and rotary line relays of the first-selector D, upon energizing, operate to repeat the impulses which are thus transmitted to the vertical and rotary line relays 87 and 88 of the connector C. When the springs 68 and 69 engage, then an energizing circuit is established through the connector vertical line relay 87, as follows: from ground G^2, springs 68 and 69, con-

ductor 70, side switch wiper 42, contact point 81, shaft wiper 39, trunk conductor 85, connector vertical line relay 87, thence to the battery lead 67[a] and through battery B′ to ground G′. Each time that the vertical line relay 87 is energized the line relay springs 89 and 90 are pressed into contact, thereby closing an energizing circuit through the vertical magnet 91, over the following path: from ground G[5] to the springs 89 and 90, private magnet springs 92 and 93, side switch wiper 94, contact point 95, vertical magnet 91 to the battery lead 67[a], thence through battery B′ to ground G′. Each time that 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 and brought opposite the level in which are located the terminals of the line #120. When the rotary line conductor 64 is grounded, the first-selector rotary line relay 49 then becomes energized, as previously explained, and operates to repeat the impulse to the connector rotary line relay 88 from ground G[2] through the springs 68 and 73, conductor 74, side switch wiper 43, contact point 82, shaft wiper 40, trunk conductor 86, rotary line relay 88 to the battery lead 67[a], thence through battery B′ and to ground G′. The energization of the said relay causes the energization of the private magnet 96 over a circuit extending from ground G[5], springs 89 and 97, private magnet 96 to the battery lead 67[a], thence through battery B′ and to ground G′. The private magnet, upon deënergizing, permits the release of the side switch from first to second position, thus placing the wipers 98, 99, 100 and 94 in connection with their respective contact points in the second position. The last digit being naught, the subscriber operates the dial as previously described, grounding the vertical line conductor 63 ten times and the rotary line conductor 64 once. The vertical and rotary relays 47 and 49 of the first-selector are operated as previously explained, and the impulses again repeated to the connector vertical and rotary line relays 87 and 88 over previously traced circuits. However, when the line relay springs 89 and 90 engage, a circuit is closed through the rotary magnet 101 instead of through the vertical magnet 91. The energizing circuit extends from ground G[5] to the springs 89 and 90, private magnet springs 92 and 93, side switch wiper 94, contact point 102, rotary magnet 101 to the battery lead 67[a], thence through battery B′ to ground G′. Each time that the rotary magnet is energized it rotates the shaft and shaft wipers 103, 104 and 105 one step at a time until the said wipers are carried into engagement with the normal conductors 106, 107 and 108 that lead to the line terminals of the desired subscriber. The energization of the rotary line relay 88, as previously stated, completes an energizing circuit through the private magnet 96, which now operates with one of two results, namely the release of the side switch from second to third position, or the well-known busy-release of the connector. Assume the former result to occur, and the side switch to pass to third position, thus placing the side switch wipers 98, 99, 100 and 94 in contact with their 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[6] to the contact point 109, side switch wiper 100, to the shaft wiper 105 which engages the private contact of the called line. Also when the side switch wiper 100 engages the contact point 109 an energizing circuit is established through the bridge-cut-off relay 110 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 34, placing the spring 35 in contact with the substation ground G[7], thereby energizing the vertical line relay 47 of the first-selector D. The path of the energizing circuit extends from ground G[7] to the contact point 37, spring 35, springs 28 and 27 to the vertical line conductor 63, thence through the vertical relay 47, as previously traced, to battery B and to ground G. In turn, the vertical line relay 87 of the connector C becomes energized, as previously explained. It will be remembered that the connector side switch has passed from second to third position, and that the side switch wiper 94 is in engagement with the contact point 111, thereby placing the vertical line relay 87 in control of the ringer relay 112, in the same manner in which the rotary magnet 101 came under the control of the vertical line relay 87 when the side switch passed from first to second position. Therefore, when the vertical line relay 87 presses the springs 89 and 90 into contact the ringer relay 112 is energized by a flow of current from ground G[5] to the relay springs 89 and 90, private magnet springs 92 and 93, side switch wiper 94, contact point 111 to the ringer relay 112 and to the battery lead 67[a], thence through battery B′ and to ground G′. The ringer relay, upon energizing, shifts the springs 113 and 114 from the springs 115 and 116 and onto the springs 117 and 118. This results in separating the calling subscriber's line from the called subscriber's line, and in bridging across the line of the latter the terminals of the ringer generator F. A signaling current is, therefore, sent from the generator F to the ringer relay springs 117 and 113, side switch wiper 99, contact point

119, connector shaft wiper 104, normal conductor 107, rotary line conductor 120 to the ringer 121, spring 122 switch-hook 123 to the vertical line conductor 124, normal conductor 106, connector shaft wiper 103, side switch wiper 98, ringer relay springs 114 and 118, back to the generator F. As soon as the calling subscriber ceases to press the signaling button 34 the ringer relay 112 becomes deënergized, and the springs 113 and 114 resume their normal position in contact with the springs 115 and 116, respectively. In response to the signal the subscriber A′ removes the receiver 125 from the switch-hook 123, thereby removing the ringer 121 from across his line and bridging instead the secondary circuit, which includes the receiver 125, secondary winding 126 of the induction-coil 127, and secondary springs 128 and 129. The local transmitter circuit is closed as soon as the springs 130 and 131 engage. The two subsations #500 and #120 are now connected over the circuit shown by heavy lines in Fig. 1.

The front release of the central office switching apparatus occurs when the calling subscriber restores the receiver 2 to the switch-hook 6, thereby pressing the release springs 31, 32 and 33 into engagement for a moment. The contact of the said release springs grounds the vertical and rotary line conductors 63 and 64 simultaneously from ground G^7 to the release spring 31, thence, through the springs 32 and 33 to the vertical and rotary line conductors, thereby energizing the vertical and rotary line relays 47 and 49 of the first-selector D. The said relays, upon energizing simultaneously, close an energizing circuit through the connector vertical and rotary line relays 87 and 88 (previously described), thereby energizing, as before, the connector line relays 87 and 88 simultaneously, whereby the trunk-release springs 132 and 133 are brought into contact, thus closing an energizing circuit through the connector release magnet 134. The said magnet 134, upon energizing, brings about the release of the connector switch, which is well understood. The first-selector line relays 47 and 49, upon energizing simultaneously press the release springs 135 and 136 into engagement, thereby closing an energizing circuit through the first-selector release magnet 51 extending from ground G^4 through the springs 135 and 136, conductor 137, through the said magnet to the battery lead 67, thence through battery B and to ground G. The release magnet, upon energizing, attracts its armature 138, whereby the link 139 engages the pin 140 of the double dog 141 and remains in readiness to release the switch shaft and restore the side switch when the energizing circuit through the release magnet is broken. Suppose that it is desired to release the first-selector D while the side switch M is in first position. Then when the vertical and rotary line relays 47 and 49 become energized upon grounding both line conductors simultaneously, the energizing circuits through the vertical and private magnets become established, as explained; but before the vertical magnet 48 becomes sufficiently energized to operate, the energizing circuit of the said magnet is interrupted at the springs 71′ and 72′ when the private magnet operates. The line relays 47 and 49, upon energizing simultaneously, operate, as previously explained, to restore the first-selector D.

As shown in Fig. 3 my selector switch may also be employed as a so-called second-selector. When used in this capacity the bridge-cut-off relay 175 is omitted, the vertical and rotary line relays being connected directly with the battery lead. Also, the trunk-release spring 135, instead of being connected to ground, is connected to the private bank contacts. Furthermore, since the said selector is not allotted to a subscriber's line, the normal conductors are also omitted. Otherwise the selector D′ is the same as the selector D.

In said Fig. 3 the calling subscriber's line is supposed to terminate in the first-selector I, which is practically the same as the selector switch disclosed in said selector patent. The mechanism of this selector I and the mechanism of the selector D (Fig. 1) are, of course, very much the same. The said selector I comprises, as usual, the vertical and rotary line relays 142 and 143, the vertical magnet 144, the rotary magnet 145, the release magnet 146 and the back-release relay 159. The side switch comprises the side switch wipers 147, 148, 149 and 150, the private magnet 168 and the bridge-cut-off relay 169. The said first-selector I is shown as connected through to my improved second-selector D′, while the second-selector D′ is shown connected to a third-selector N, which latter is a modified form of the selector I. The modification consists in the removal of the normals, such as the normals 170, 171 and 172, the omission of a bridge-cut-off relay, such as the bridge-cut-off relay 169, and the provision of the trunk-release springs 164 and 165 for obviating the necessity of a trunk-release conductor between the selectors D′ and N. The trunk-release spring 165 being connected directly to the release magnet 166, and the trunk-release spring 164 being connected directly to ground, said springs are, of course, adapted to engage only when both the line relays 151 and 152 energize at the same time. As shown, the said selector N, like the selector I, is equipped with vertical and rotary line relays 151 and 152, the vertical magnet 153, the private magnet 154, the side switch which comprises the side switch

wipers 155, 156, 157 and 158, the rotary magnet 160, the switch shaft wipers 161, 162 and 163, the trunk-release springs 164 and 165, the release magnet 166 and the back-release relay 167. There is practically no difference in the mode of operation between the first-selector I and the second-selector N, except that the release magnet of the selector N, while the side switch is in first or second position, is controlled directly by the vertical and rotary line relays 151 and 152 conjointly, instead of through a couple of private springs 173 and 174.

Fig. 3 is intended to represent two exchanges, exactly as Fig. 1 represents two exchanges—that is, the switches I and D′ belong to one exchange, and the switch N belongs to another exchange, which latter is, of course, also equipped with a connector switch C. The arrangement and provision of these switches, however, depends altogether upon the size of the exchange. It will be understood, of course, that, the system being a percentage system, the switches are arranged in groups, and that the bank contacts of the switches in the same group are all multipled together, as is usually the case. In order to simplify the illustration and description as much as possible, the exchanges shown in Fig. 1 are very small; but in actual practice a selector switch like the selector switch D would be most advantageously used in connection with a very large system, for example, a one-hundred-thousand system comprising a number of exchanges of ten-thousand subscribers each. In that event, the subscribers would be provided with first-selectors, such as the selector D, and the trunks from each level would lead to a given exchange. For example, the trunks leading from the first level would lead to the exchange comprising the first ten-thousand subscribers; the trunks leading from the second level would lead to the exchange comprising the subscribers of the second ten-thousand or of the twenty-thousand; and the third level would lead to the exchange of the thirty-thousand subscribers, and so on. Also, in that event, the selector switches D would have one level for local calls only, and the other nine levels would be used for trunking calls to the other exchanges. It will be evident, of course, that even in making local calls the local switches beyond the selector D would be operated by repeated impulses, as already explained. In such a large system, of course, between the selector D and the connector C there will be interposed a second-selector, like the selector N (Fig. 3), and then a third-selector, also like the switch N, except that the trunk-release spring 164 will be connected to the third or trunk-release conductor, such as the conductor that leads from the switch D′ to the back-release relay 159 of the selector I.

It will be understood, of course, that each level of the first-selector D (Fig. 1) is provided with ten trunks, in the case of the large system mentioned; and if the first trunk, for example, to the switch C is busy, the selector automatically reaches and seizes a second switch J (Fig. 1).

It has been stated that the line relays 47 and 49 are connected to the battery B through the springs 65, 66 and 72. However, when the subscriber A is called, the bridge-cut-off relay 175 is then energized, and the said springs are separated for well-known reasons. The said relay 175 remains energized, of course, as long as the connection is maintained with substation A. The energizing circuit for said bridge-cut-off relay extends from ground to the connector private wiper, thence to the private normal 178, side switch wiper of the switch D while in first position thence to the said relay 175 and through battery B to ground G. Running parallel with the private normal conductor 178 are, of course, the normal line conductors 176 and 177. This arrangement is usual and will be readily understood.

From the foregoing it will be seen that the apparatus D is in the nature of a combined repeater and selector, being capable of first responding to the calling subscriber by selecting an idle trunk line, and of then repeating or relaying the electrical impulses by which the subsequent switching apparatus is controlled by the calling subscriber. The automatic switch thus constructed is adapted for use in a local battery system, and in which there is no battery current on the lines during use of the same for conversational purposes. The line relays of the said combined repeater and selector are not energized during conversation, and this is also true of the bridge-cut-off relay 175, except as previously explained. Furthermore, it will be seen that the side switch wipers of the said combined repeater and selector are adapted to engage directly with the line circuit, so that no relay contacts are required between the said line circuit and the said side switch wipers in order to cut off the ground connections. This, it will be seen, is due to the fact that the line relays 47 and 49 are not energized during use of the talking circuit for conversational purposes. In this way the simultaneous energizing of the line relays 47 and 49, when the subscriber hangs up his telephone, is sufficient to close the local release circuit for the purpose of releasing the connection.

It will be understood, of course, that the repeaters shown in Figs. 1 and 3 can be used in one and the same system.

What I claim as my invention is:—

1. In a telephone system, a combined selector and repeater, a grounded battery, a pair of line relays for said combined se-

lector and repeater normally connected with said battery, a private normal conductor, a cut-off relay permanently connected at one end with said battery, means for connecting the other end of said relay with said private normal conductor, whereby when said private normal conductor is grounded the cut-off relay may energize to disconnect the line relays from said battery, an automatic switch, and means by which a calling subscriber uses said line relays to successively control said combined selector and repeater and said switch.

2. In a telephone system, a plurality of subscribers' stations, a battery local to each of said stations for supplying current thereto for talking purposes, trunk lines, a combined selector and repeater for selecting a trunk line comprising a pair of line relays, a pair of operating magnets, and a pair of switch wipers, said wipers controlling circuit connections whereby said relays first control said operating magnets and then control the transmission of impulses over said selected trunk line.

3. In a telephone system, a battery local to each subscriber's station for supplying current thereto for talking purposes, a combined selector and repeater for each subscriber, other switches whereby any subscriber may obtain connection with any other subscriber, a pair of condensers in opposite sides of the talking circuit, each said combined selector and repeater including a pair of line shaft wipers permanently connected with the subscriber's line through said condensers.

4. In a telephone system, a subscriber's station, a local battery for the same, trunk lines, an automatic trunk selector, and a suitable automatic switch, said trunk selector provided with line relays for controlling its own operations to seize said switch and also to control the operation of the said automatic switch.

5. In a telephone system, a subscriber's line, trunk lines terminating in automatic switches, a trunk selector subject to the control of the subscriber and provided with one or more line relays for controlling its own operations to seize a trunk line and also to control the said automatic switches over seized trunk lines, and a central battery for operating said selector, said line being free from said battery current during use of the same for conversational purposes.

6. In a telephone system, a subscriber's line, a subscriber's telephone therefor, a local battery for operating said telephone, trunk lines and automatic switches, and a trunk selector comprising means for automatically selecting idle trunks, and provided with a pair of bridged line relays for controlling the operations of said automatic switches over the seized trunks.

7. In a telephone system, the combination of a subscriber's telephone, a local battery for the same, trunk lines, a combined trunk selector and repeater, and switching means controllable through the medium of the said combined selector and repeater, when the same is used as a repeater, after having selected an idle trunk.

8. In a telephone system, a calling subscriber's line, a relay bridge across said line, automatic switch mechanism controlled by said relay bridge, a trunk line terminating in a second automatic switch, means for energizing the bridge relay to control said second automatic switch, and a bridge-cut-off relay energized only when the said line is called.

9. In a telephone system, a combined selector and repeater provided with a normally closed relay bridge, a trunk line terminating in an automatic switch, means for energizing the bridged relay to operate said selector repeater to seize said trunk line and control the automatic switch thereover, and means for preserving the normal condition of said bridge during use of the trunk line for conversational purposes.

10. In a telephone system, a line circuit, a combined repeater and selector provided with ground connections for repeating or relaying the electrical impulses, a side switch for closing the said ground connections, and relays for controlling the ground connections to transmit the impulses, said side switch provided with contacts permanently connected with the line circuit, and with movable wipers included in the ground connections and adapted to engage said contacts.

11. In a telephone system, a combined repeater and selector provided with a local release circuit, and with a pair of line relays controlling the single normally open switch point in said release circuit and for controlling the selecting and repeating operations of said combined selector and repeater, and switching means responsive to said repeater.

12. In a telephone system, a combined selector and repeater, an automatic switch, a release circuit, a third trunk conductor included in said release circuit, a pair of line relays in said combined repeater and selector for controlling the selecting and repeating operations, and means for energizing said relays to close the release circuit, said release circuit, when the subscribers are talking, having but a single normally open switch point, said switch point controlled by said relays, whereby the energizing of said relays is sufficient to close the release circuit to restore the automatic switch and the combined repeater and selector.

13. In a local battery telephone system, a combined selector switch and repeater, means for controlling said switch in accordance

with a digit of the called number, means for then controlling said switch in accordance with another digit of the called number to repeat the impulses received, switching means responsive to said repeated impulses, and local battery means for supplying talking current.

14. In a telephone system in which the subscribers are divided into groups, means having one motion to select groups and another motion to connect with the called line found in the selected group, a subscriber's station, a local battery for the same, trunk lines, an automatic trunk selector, and a suitable automatic switch, said trunk selector provided with line relays for controlling its own operations to seize a trunk line and also for controlling the operation of the said automatic switch thereover.

15. In a telephone system in which the subscribers are divided into groups, means having one motion to select groups and another motion to connect with the called line found in the selected group, a subscriber's line, a subscriber's telephone therefor, a local battery for operating said telephone, trunk lines and automatic switches, and a trunk selector comprising means for automatically selecting idle trunks, and provided with a pair of bridged line relays for controlling the operations of said automatic switches over said trunks.

16. In a telephone system in which the subscribers are divided into groups, means having one motion to select groups and another motion to connect with the called line found in the selected group, the combination of a subscriber's telephone, a local battery for the same, trunk lines, a combined trunk selector and repeater, and switching means controllable through the medium of the said combined selector and repeater, when the same is used as a repeater, after having selected an idle trunk.

17. In a telephone system in which the subscribers are divided into groups, means having one motion to select groups and another motion to connect with the called line found in the selected group, a combined repeater and selector provided with ground connections for repeating or relaying the electrical impulses, a side switch for closing the said ground connections, and switching relays for controlling the ground connections to transmit the impulses, said side switch provided with contacts permanently connected with the line circuit, and with movable wipers included in the ground connections and adapted to engage said contacts.

18. In a telephone system in which the subscribers are divided into groups, means having one motion to select groups and another motion to connect with the called line found in the selected group, a combined selector and repeater, an automatic switch, a release circuit, a third trunk conductor included in said release circuit, a pair of line relays in said combined repeater and selector, and means for energizing said relays to close the release circuit, said release circuit, when the subscribers are talking, having but a single normally open switch point, said switch point controlled by said relays, whereby the energizing of said relays is sufficient to close the release circuit to restore the automatic switch and the combined repeater and selector after the combined repeater and selector has been operated as a selector.

19. In a telephone system, trunk lines divided into groups, an automatic switch associated with each of said trunk lines, a combined selector and repeater, a grounded battery, a pair of line relays for said combined selector and repeater normally connected with said battery, a private normal conductor, a cut-off relay permanently connected at one end with said battery, means for connecting the other end of said relay with said private normal conductor, whereby when said private normal conductor is grounded the cut-off relay may energize to disconnect the line relays from said battery, said selector-repeater having motion in one plane to select groups and motion in a plane at right-angles thereto to automatically select an idle trunk in the selected group, and means by which a calling subscriber uses said line relays to successively control said combined selector and repeater and the switch associated with the said selected trunk.

20. In an automatic telephone exchange trunking system divided into groups, a subscriber's station, a local battery for the same, trunk lines, an automatic trunk selector, and a suitable automatic switch, said trunk selector provided with line relays for controlling its own operations to select a trunk line and also for controlling the said automatic switch thereover, said selector having one motion to select groups and another motion to automatically select an idle trunk in the selected group.

21. In an automatic telephone exchange trunking system divided into groups, a subscriber's line, trunk lines terminating in automatic switches, a trunk selector subject to the control of the subscriber and provided with one or more line relays for controlling its own operations and also those of the said automatic switches over trunk lines selected thereby, said selector having one motion to select groups and another motion to automatically select an idle trunk in the selected group, and a central battery for operating said selector, said line being free from said battery current during use of the same for conversational purposes.

22. In an automatic telephone exchange trunking system divided into groups, a subscriber's line, a subscriber's telephone therefor, a local battery for operating said telephone, trunk lines and automatic switches, and a trunk selector comprising means for automatically selecting idle trunks, and provided with a pair of bridged line relays for controlling the operations of said automatic switches over a selected trunk, said selector having one motion to select groups and another motion to automatically select an idle trunk in the selected group.

23. In an automatic telephone exchange trunking system divided into groups, the combination of a subscriber's telephone, a local battery for the same, trunk lines, a combined trunk selector and repeater, and switching means controllable through the medium of the said combined selector and repeater, when the same is used as a repeater, after having selected an idle trunk, said selector having one motion to select groups and another motion to automatically select and idle trunk in the selected group.

24. In an automatic telephone exchange trunking system divided into groups, a combined selector and repeater provided with a permanently closed relay bridge, a trunk line terminating in an automatic switch, means for energizing the bridged relay to control the automatic switch, and means for preserving the normal condition of said bridge during use of the trunk line for conversational purposes, said selector having one motion to select groups and another motion to automatically select an idle trunk in the selected group.

25. In an automatic telephone exchange trunking system divided into groups, a combined repeater and selector provided with ground connections for repeating or relaying the electrical impulses, a side switch for closing the said ground connections, and relays for controlling the ground connections to transmit the impulses, said side switch provided with contacts permanently connected with the line circuit, and with movable wipers included in the ground connections and adapted to engage said contacts, said selector having one motion to select groups and another motion to automatically select an idle trunk in the selected group.

26. In an automatic telephone exchange trunking system divided into groups, a combined repeater and selector provided with a local release circuit, and with a pair of line relays controlling the single normally open switch point in said release circuit, and for controlling the selecting and repeating operations of said switch, and an automatic switch responsive to said repeater, said selector having one motion to select groups and another motion to automatically select an idle trunk in the selected group.

27. In an automatic telephone exchange trunking system divided into groups, a combined selector and repeater, an automatic switch, a release circuit for the switch and the selector repeater, a third trunk conductor included in said release circuit, a pair of line relays in said combined repeater and selector, and means for energizing said relays to close the release circuit, said release circuit, when the subscribers are talking, having but a single normally open switch point, said switch point controlled by said relays, whereby the energizing of said relays is sufficient to close the release circuit to restore the automatic switch and the combined repeater and selector after the selector repeater has been operated as a selector, said selector having one motion to select groups and another motion to automatically select an idle trunk in the selected group.

Signed by me at Chicago, Cook county, Illinois, this 13th day of July, 1907.

TALBOT G. MARTIN.

Witnesses:

J. NORBY,

ARTHUR B. SPERRY.