Nov. 18, 1924.

1,515,837

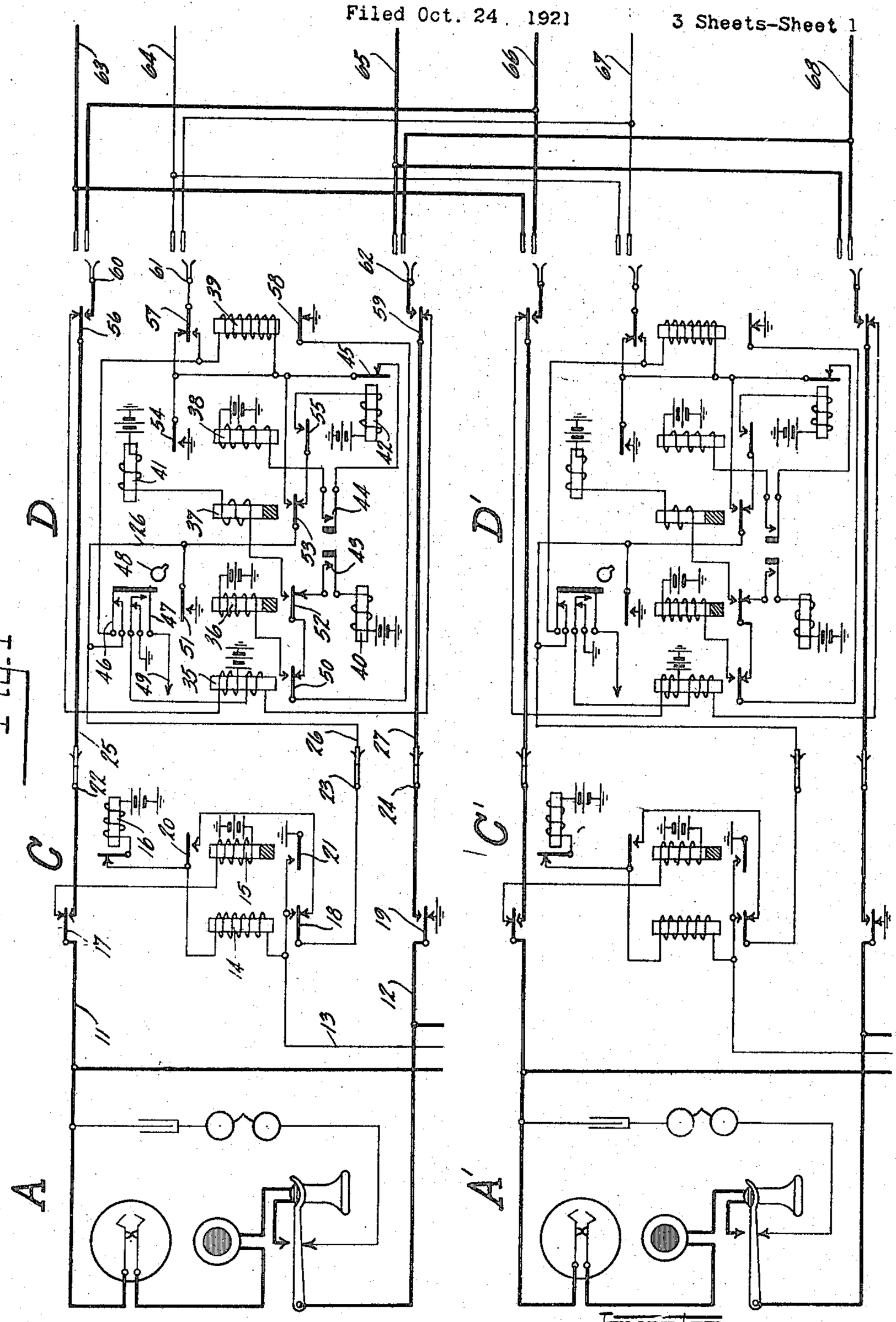
W. A. CHAPIN

PRIVATE AUTOMATIC EXCHANGE

Filed Oct. 24, 1921

3 Sheets-Sheet 1

Fig. 1



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Chas. Lee Cuddy Atty.

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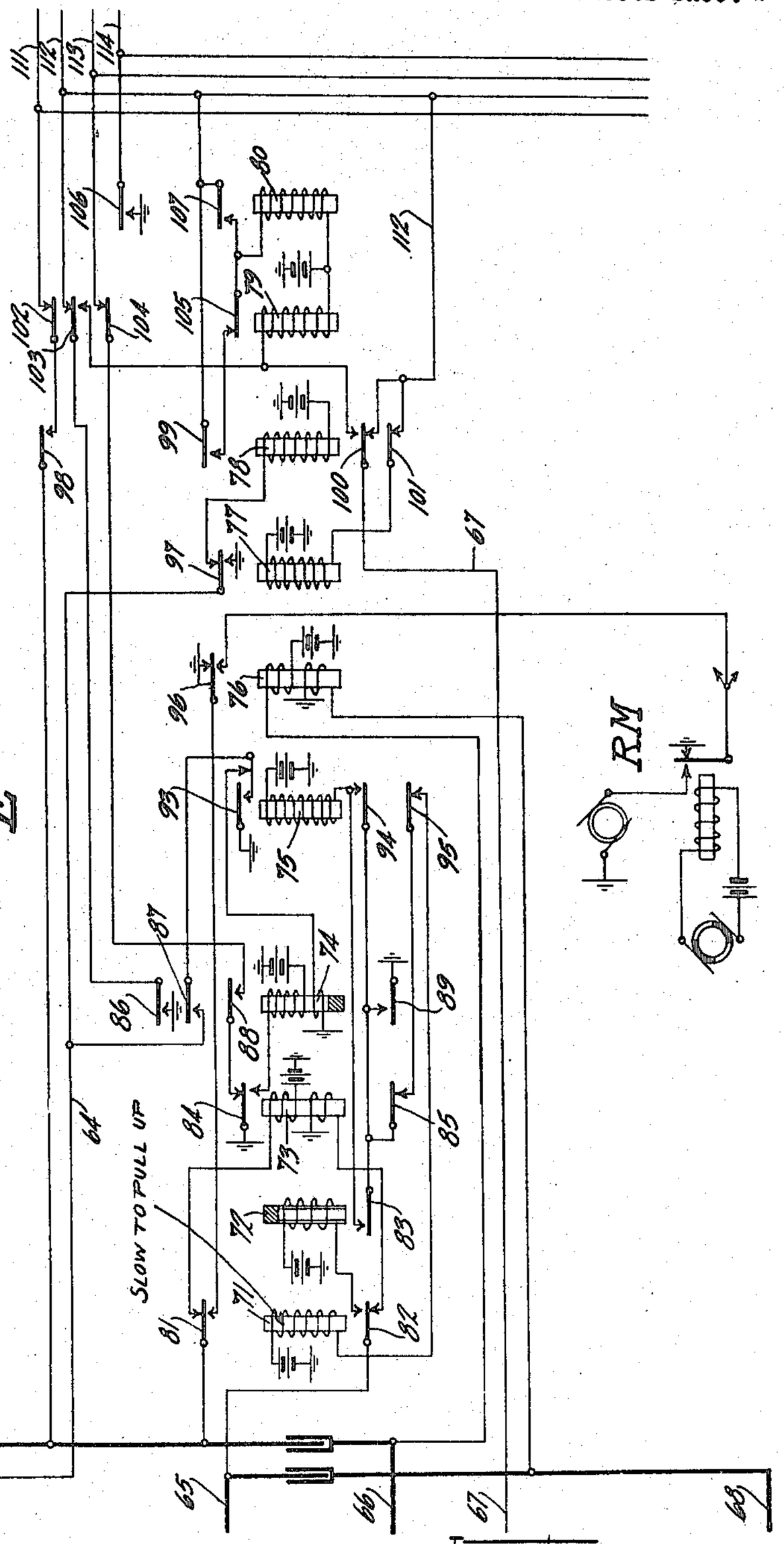
3 Sheets-Sheet 2

Fig: 2



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PRIVATE AUTOMATIC EXCHANGE

Filed Oct. 24, 1921 3 Sheets-Sheet 3

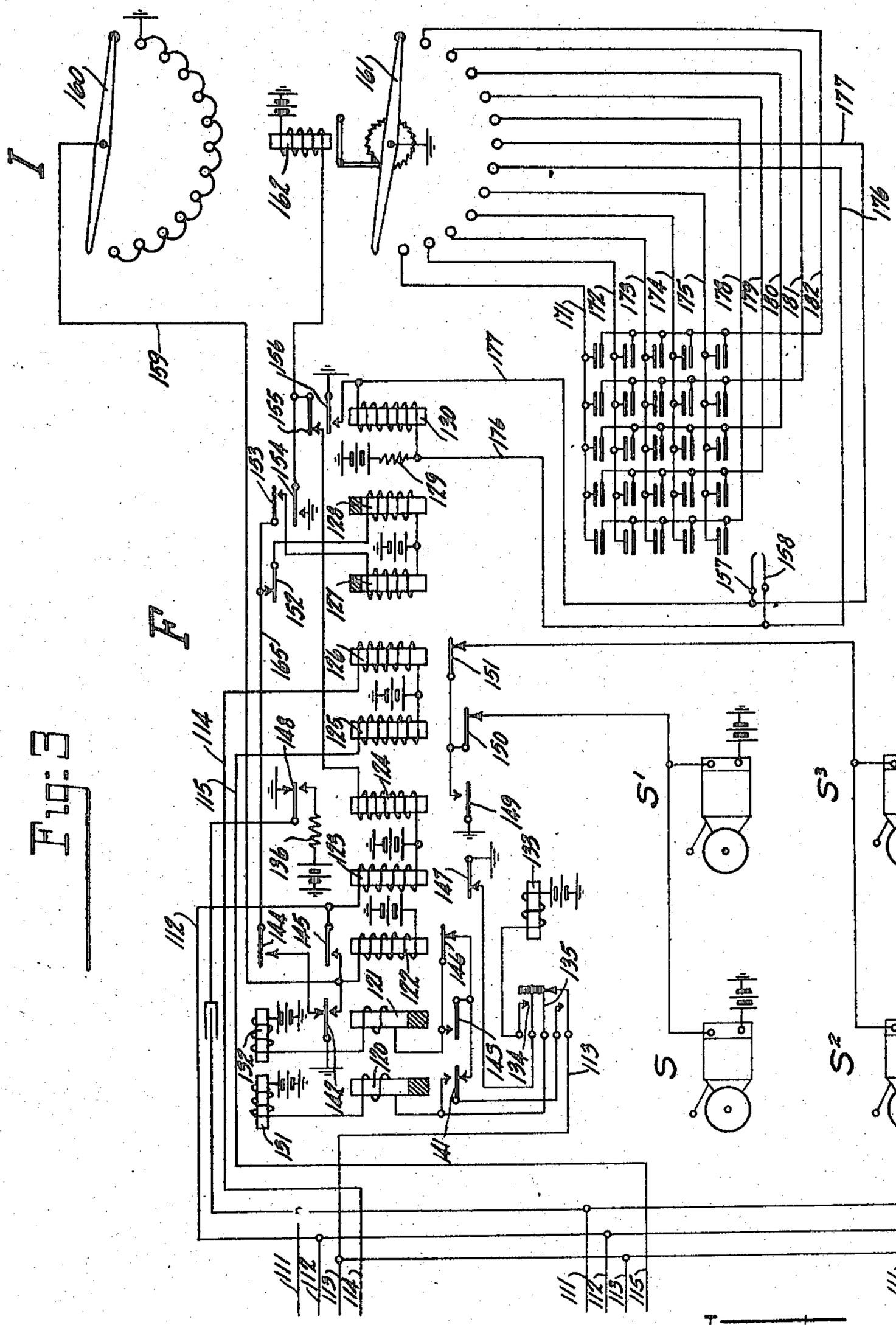

Fig. 3

Inventor

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Chas. Ti. Condy. Atty:

Patented Nov. 18, 1924. 1,515,837

UNITED STATES PATENT OFFICE.

WILLIAM A. CHAPIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PRIVATE AUTOMATIC EXCHANGE.

Application filed October 24, 1921. Serial No. 509,974.

To all whom it may concern:

Be it known that I, WILLIAM A. CHAPIN, a citizen of the United States of America, and a resident of Chicago, Cook County, and State of Illinois, have invented certain new and useful Improvements in Private Automatic Exchanges, of which the following is a specification.

The present invention relates to private automatic exchanges in general, but is concerned more particularly with exchanges of this character which are provided with code signalling arrangements, whereby certain persons may be reached when they are absent from their offices on business in other departments; and the object briefly stated is the provision of new and improved circuit arrangements tending to make a code signalling system of this sort more flexible in operation and more desirable from the standpoint of the user.

In order to explain the object above set forth a little more fully it may be said that it has been common practice heretofore to provide a single code switch which has two sets of terminals. The so called calling set of these terminals is seized by an automatic switch under the control of a calling subscriber's calling device when a certain number is called. After this set of terminals is seized, one or two additional digits are dialled in order to set up the code switch and cause it to send out the desired code. This code, it will be understood, is sent out over a circuit onto which there may be multipled as many signalling devices as desired. When a subscriber hears his code being sent out he responds by dialling a certain other number with the result that an automatic switch connects with the code switch at the other or so called answering set of terminals. The two subscribers then proceed to converse with each other as desired. As long as they converse, however, the code switch remains tied up and cannot be used by any one else. According to the present invention, however, a plurality of repeaters are provided each having a set of calling and a set of answering terminals and each being normally connected to the code switch. Now when a subscriber who desires to send out the code of another subscriber dials a certain digit or combination of digits, one of these repeaters is seized at its calling set of terminals and in response to the calling of the two following digits the code switch is set up with the result that the desired code is sent out intermittently in the usual manner. Now as soon as the subscriber who hears his code being sent out responds by dialling a certain digit or combination of digits this same repeater is seized at its answering terminals with the result that it is entirely disconnected from the code switch and the two subscribers are free to converse with each other through the said repeater, leaving the code switch free to be used by any one else who desires to do so.

It happens many times that an establishment is physically or otherwise divided into two or more parts, for example, an establishment served by one private automatic exchange, or P. A. X. as it is commonly abbreviated, may comprise two buildings and in such cases it often happens that there are certain persons who have occasion to be away from their desks but who do not have any occasion to leave the building in which they are employed, while certain other persons may have business in either of the two buildings. This makes it unnecessary, when sending out a code of signals for a person who is absent from his department but who has no occasion to leave the particular building in which he is employed, to operate the signals in both buildings and accordingly it has been common practice under such circumstances to place the signals in one building on one circuit and the signals in the other building on another circuit, the signals in one building being operated by a code switch which has its terminals multipled in certain bank contacts, and the signals on the other circuit being operated by a second code switch which has its calling and answering terminals multiplied in other bank contacts; and for operating the two sets of signals simultaneously a third code switch is provided which has its calling and answering terminals multiplied in still other bank contacts. This arrangement, while obviously more or less satisfactory from the stand point of the subscriber, is wasteful in equipment and is further objectionable because of the fact that a separate answering number must be assigned for each of the three switches. In the present case, however, this difficulty is overcome by arranging the signals so that they are all normally connected onto one

circuit and are consequently operated simultaneously. In order to discriminate between one set or the other, separate groups of repeaters are provided from which the common code switch may be controlled. When the code switch is being operated from a repeater of one set, all the signals are operated simultaneously. When the said code switch is being operated from a repeater of a second group, a ground potential is placed upon a conductor individual to this group which operates a relay in the code switch to disconnect one set of signals; and when the code switch is being operated from a repeater in the third group, a ground potential is placed upon a conductor individual to that group which operates a relay in the code switch to disconnect the other set of signals.

In a simple system in which there is only one set of signals to be operated, the repeaters are all in one group and consequently all the calling terminals of the various repeaters may be multipled into one selector level and all the answering terminals may be multipled into another selector level. In installations, however, where there are two or more sets of signals to be operated separately or collectively, it is necessary to provide a separate selector level for the calling terminals of each group of repeaters. In all cases, however, the answering terminals of all the repeaters in the various groups are multipled into one common selector level as it is not necessary to use any discrimination whatsoever in answering a code.

There are various other features of the invention which will not be pointed out specifically at this time but which will be explained in detail in the course of the specification.

Referring now to the drawings comprising Figs. 1, 2, and 3, when they are arranged in order with the corresponding lines at the ends thereof in alignment, they represent by means of the usual circuit diagrams a sufficient amount of the apparatus in a system embodying the principles of the invention to enable the invention to be thoroughly understood. In Fig. 1, there is shown two subscribers' lines, together with their associated substations and individual line switches, and also two of the selector switches to which the individual line switches have access.

Fig. 2 shows one of the repeaters which is normally connected with the common code switch.

In Fig. 3, there is shown the code switch together with two signal circuits and their signals S—S^3, inclusive.

The substations A and A′ are of the usual automatic type, having the usual sending, signalling, and talking instrumentalities. The line switches C and C′ are mechanically of the well known rotary type in which the wipers have no normal position and move in a forward direction only. The impulse switch I, Fig. 3, which is associated with the code switch F, is mechanically similar to the line switches C and C′ but its circuit differs as shown.

The selectors D and D′ and also the code switch F are automatic switches of the well known vertical and rotary type and accordingly have their bank contacts arranged in horizontal rows or levels. The circuits of the selectors D and D′ are identical with each other and are of a well known type, but the circuits of the code switch F differ radically from the circuits of the selectors as will be pointed out fully hereinafter.

The repeater E, Fig. 2, as before intimated, is one of the repeaters which is used to enable the common code switch to be disconnected and used over again immediately after a wanted subscriber has answered his code by dialling the answering number. The circuits of this repeater are shown in full and will be described hereinafter.

The apparatus, having been described more or less in general, will now be described in connection with a detailed description of its operation. For this purpose it will be assumed that the subscriber at substation A has called a certain other subscriber by way of the telephone at the latter's desk and having received no response has released the connection and decided to try to reach the desired subscriber by sending out his code. It will be assumed further that the code of the man wanted is 45 which comprises four rings or buzzes, pause, and five rings or buzzes. It will be assumed also that this man is one whose business does not take him out of the building in which he works and in which the signals S and S′ are located.

When the receiver is removed at substation A, a circuit is closed over line conductors 11 and 12 for the line relay 15 of line switch C. Line relay 15, upon energizing, places ground upon private normal conductor 13 at armature 21, thereby causing the line of sub-station A to test busy to the automatic switches which have access to it, and also closing a circuit for switching relay 14 and stepping magnet 16 in series; and at armature 20 connects the test wiper 23 to a point between switching relay 14 and stepping magnet 16. The line switch C is now operated in the usual and well known manner to pick out an idle trunk line. Assuming that the trunk line extending to the selector D is the first one found to be idle, when the wipers 22–24, inclusive, arrive upon the set of bank contacts in which the trunk line comprising conductors 25–27, inclusive, terminates, switching relay 14 energizes in series with stepping magnet 16, not having

energized before on account of being short circuited by the ground potential which is present upon the test contacts of busy trunk lines. Stepping magnet 16, however, does not energize in series with switching relay 14 on account of its relatively low resistance and correspondingly stiff adjustment. Upon energizing, switching relay 14 disconnects test wiper 23 from the point between its own winding and that of stepping magnet 16 and connects it to the grounded private normal conductor 13 at armature 18, thereby making the seized trunk busy immediately by placing a ground potential upon release trunk conductor 26. As a further result of the energization of switching relay 14, it disconnects the line conductors 11 and 12 from the winding of line relay 15 and ground respectively, and extends them by way of armatures 17 and 19 and their working contacts, wipers 22 and 24, conductors 25 and 27, and armatures 56 and 59 and their resting contacts, to the upper and lower windings of line relay 35 of selector D. Line relay 35 now energizes over the calling subscriber's loop and at its armature 50 closes a circuit for release relay 36. Release relay 36, upon energizing, opens a point in the circuit of release magnet 40 and prepares a circuit for vertical magnet 41 at armature 52, and at armature 51 places ground upon release trunk conductor 26, thereby establishing a holding circuit for switching relay 14 of the line switch C before the slow acting line relay 15 has had time to deenergize

The calling subscriber may now manipulate his calling device in accordance with the digit which it is necessary to call preparatory to sending out a code upon the desired set of signals, thereby producing a corresponding number of interruptions in the circuit of line relay 35. Each time line relay 35 deenergizes in response to one of these interruptions, it completes a circuit for vertical magnet 41 as follows: From ground by way of the resting contact of armature 58 and said armature, armature 50 and its resting contact, armature 52 and its working contact, series relay 37, and vertical magnet 41 to battery. By the operation of vertical magnet 41, the shaft and wipers of the selector D are raised step by step until the latter come to rest opposite the desired level of bank contacts. Relay 37 is energized in series with vertical magnet 41 and being slow acting retains its armature attracted throughout the vertical movement. Off normal springs 44, upon closing as soon as the switch shaft is raised from its normal position, completes the following circuit for stepping relay 38: from ground by way of release trunk conductor 26, armature 53 and its working contact, interrupter contacts 45 of rotary magnet 42, off normal contacts 44, and stepping relay 38 to battery. Stepping relay 38, upon energizing, closes a locking circuit for itself at armature 54, and at armature 55 prepares a circuit for rotary magnet 42. At the end of the vertical movement, relay 37, upon deenergizing, completes the circuit of rotary magnet 42 at armature 53. Rotary magnet 42, upon energizing, advances the switch wipers 60–62, inclusive, into engagement with the first set of contacts in the level opposite which they are raised, and at interrupter contacts 45 opens the circuit of stepping relay 38. Stepping relay 38, upon deenergizing, opens the circuit of rotary magnet 42 at armature 55, whereupon the said rotary magnet deenergizes and closes its interrupter contact again. If the trunk line terminating in the first set of contacts is busy stepping relay 38 is energized again by way of test wiper 61 and armature 57 and its resting contact with the result that the wipers are rotated into engagement with the next set of contacts. This operation continues until an idle trunk line is reached which we shall assume, is the trunk line comprising conductors 63–65, inclusive, and extending to the repeater E. When the said idle trunk is reached there is no circuit closed for stepping relay 38 and switching relay 39, which heretofore has been short circuited, energizes over the following circuit: from ground by way of release trunk conductor 26, resting contact of cam spring 46 and said spring, switching relay 39, interrupter contacts 45, off normal contacts 44, and stepping relay 38 to battery. Stepping relay 38, however, due to its design and adjustment does not energize in series with switching relay 39. Switching relay 39, upon energizing, removes ground from the armature of line relay 35 at armature 58; opens the test circuit and prepares the holding circuit at armature 57, thereby placing ground upon release trunk conductor 64 of the repeater E; and disconnects trunk conductors 25 and 27 from the upper and lower windings of line relay 35 and extends them by way of armatures 56 and 59 and their working contacts, wipers 60 and 62, the bank contacts with which these wipers are in engagement, conductors 63 and 65, and armatures 81 and 82 and their resting contacts to the upper and lower windings of line relay 73 of the repeater E. Line relay 73, upon energizing over the calling subscriber's loop, closes a circuit for release relay 74 at armature 84. Release relay 74, upon energizing, places ground upon release trunk conductor 64 at armature 87, by way of the normally closed contacts controlled by armature 93, and its own low resistance lower winding, thereby establishing a holding circuit for the switching relays of the selector D and the line switch C before the slow acting release relay 36 of the selector D has had time to deenergize. This lower

winding of release relay 74 is low enough to allow the various test contacts into which release trunk conductor 64 is multipled to remain sufficiently near a ground potential to cause them to test busy. The reason for bringing the holding ground through the lower winding of release relay 74 will be explained more fully hereinafter. A branch of this holding circuit extends by way of armature 97 to relay 77 and its resting contact, to battery by way of relay 78. Relay 78, upon energizing, disconnects the release trunk conductor 67 of the answering set of terminals from conductor 112 which, together with conductors 111 and 113, is common to all the repeaters of the various groups, and connects it to relay 79 at armature 100, and at armature 101 disconnects relay 77 from conductor 112. As a further result of the energization of release relay 74 it places ground upon conductor 112 at armature 86, by way of armature 103 and its resting contact.

In the code switch F, release relay 123, upon energizing, in response to the placing of ground upon conductor 112, opens a point in the circuit of release magnet 133 at armature 147.

Since conductor 112 is common to all the repeaters, all that are idle are made busy at both their answering and calling terminals. Assuming, for the purpose of illustration, that the repeater E is one of the other repeaters, the ground potential, coming in by way of conductor 112, extends by way of the resting contact of armature 100 and said armature to the answering release trunk conductor 67, and by the way of the resting contact of armature 101 and said armature, to battery by way of relay 77. Relay 77, upon energizing, places ground upon the calling test conductor 64. This, of course, occurs only in the repeaters that are idle.

To continue with the operation of the repeater E, as a result of the ground potential being placed upon conductor 112, a circuit is closed for relay 80 by way of armature 99 and its working contact and the resting contact of armature 105 and said armature. Relay 80, upon energizing, closes a locking circuit for itself at armature 107, and at armature 106 places ground upon conductor 114, thereby closing a circuit for relay 126 of the code switch F which, upon energizing, disconnects the signals S^2 and S^3 at armature 151.

The calling subscriber may now operate his calling device in accordance with the first digit 4 of the desired code, thereby producing a corresponding number of interruptions in the circuit of line relay 73. Each time line relay 73 deenergizes in response to one of these interruptions, it completes a circuit for vertical magnet 131 of the code switch F as follows: from ground by way of armature 84 and its resting contact, armature 88 and its working contact, armature 104 and its resting contact, conductor 113, resting contact of off normal spring 135 and said spring, relay 120, and vertical magnet 131 to battery. By the operation of vertical magnet 131, the shaft and wipers of the code switch F are raised step by step until the latter come to rest opposite the desired level of bank contacts, which in this case is the fourth. The low wound relay 120 is energized in series with vertical magnet 131 and being slow acting retains its armature attracted throughout the vertical movement, thereby maintaining its own circuit and that of vertical magnet 131 intact after the off normal springs have been shifted, as they do upon the first vertical step. At the end of the vertical movement, slow acting relay 120 deenergizes and transfers the operating circuit from the vertical to the rotary magnet.

In the repeater E, it will be noted that each time line relay 73 deenergizes it closes a circuit for relay 71 as follows: from ground by way of armature 89 and its working contact, armature 85 and its resting contact, armature 95 and its resting contact, and relay 71 to battery. Relay 71, however, being stiffly adjusted and having a highly inductive winding, does not energize as long as armature 85 is vibrating.

The calling subscriber now manipulates his calling device in accordance with the second and last digit 5 in the desired code, thereby producing five interruptions in the circuit of line relay 73 of the repeater E. Each time relay 73 deenergizes in response to one of these interruptions it closes a circuit for rotary magnet 132 of the code switch F as follows: from ground by way of armature 84 and its resting contact, and thence by way of the previously traced circuit to conductor 113, and thence by way of the normally open contacts controlled by off normal spring 135, armature 141 and its resting contact, resting contact of armature 146 and said armature, relay 121, and rotary magnet 132 to battery. By the operation of the rotary magnet the wipers 157 and 158 are rotated into engagement with the fifth set of contacts in the fourth level. Relay 121 is energized in series with rotary magnet 132 and, being slow acting, retains its armature attracted throughout the rotary movement. Upon energizing, relay 121 places a shunt around the resting contact of armature 146 and said armature at armature 143, and at armature 142 closes a circuit for relay 122.

Relay 122, upon energizing, closes a locking circuit for itself at armature 145, and at armature 144 prepares a starting circuit for the interrupter relays 127 and 128. At the end of the rotary movement, relay 121 de-

energizes; opens its own circuit and that of rotary magnet 132 at armature 143 so that any further movement of the subscriber's calling device will be ineffective in operating rotary magnet 132; opens the initial circuit of relay 122 at armature 142, at the same time placing ground upon starting conductor 165 by way of the working contact of armature 144 and said armature. As soon as ground is placed upon starting conductor 165, a circuit is closed by way of the resting contact of armature 152 and said armature for relay 128. Relay 128, upon energizing, closes a circuit for relay 127 at armature 153. Relay 127, upon energizing, opens the circuit of relay 128 at armature 152. Relay 128, however, being slow acting, retains its armature attracted for an interval after which it falls back and opens the circuit of relay 127 at armature 153. Relay 127, being slow acting, retains its armature attracted for an interval after which it falls back and closes the circuit of relay 128 again. This alternate operation of relays 127 and 128 continues as long as there is a ground potential upon conductor 165. Each time relay 128 energizes, in addition to closing the circuit of relay 127, it closes the circuit of stepping magnet 162 of the switch I. Each time magnet 162 energizes, it attracts its armature, thereby causing it to engage another notch on the associated ratchet wheel which drives the wipers 160 and 161. Each time stepping magnet 162 deenergizes, the associated wipers 160 and 161 are advanced into engagement with the next set of bank contacts.

The wipers 160 and 161 are shown in their normal position and consequently as soon as the magnet 162 has energized and deenergized once the wipers are rotated onto the first set of contacts. As soon as this occurs a ground potential is placed upon the pick up conductor 171 which is multipled to the top contact of each set of contacts in the fifth level of the code switch F. Since the wipers 157 and 158 are not in engagement with any contacts in the fifth level this does not produce any result at this time. As soon as stepping magnet 162 has energized and deenergized again, the wipers 160 and 161 are advanced into engagement with the second set of associated bank contacts and a ground potential is placed upon conductor 172 which is multipled to the upper contact of each set in the fourth level of the bank of the code switch F. Since the wiper 157 is in engagement with the upper contact of the fifth set in the fourth level, the following circuit is closed: from ground by way of wiper 161, the second associated bank contact, conductor 172, the upper bank contact of the fifth set in the fourth level of the switch F, wiper 157, pick up conductor 177, pick up relay 130, and resistance 129 to battery. Upon energizing, pick up relay 130 prepares a circuit for impulsing relay 124 at armature 155, and closes a locking circuit for itself at armature 156. As soon as interrupter relay 128 operates again, stepping magnet 162 causes its armature to engage another notch on the associated ratchet wheel and impulsing relay 124 is energized in multiple with stepping magnet 162, by way of armature 155 and its working contact, and closes a circuit for the signals S and S′ by way of armature 149 and its working contact and armature 150 and its resting contact. The signals S^2 and S^3, however, are not operated because they are disconnected at armature 151 of relay 126. As soon as interrupter relay 128 deenergizes, stepping magnet 162 advances the wipers 160 and 161 into engagement with the third set of contacts and impulsing relay 124 deenergizes, thereby opening the circuit of the signals S and S′. The wipers 160 and 161 continue to advance and the signals S and S′ continue to be operated until the said wipers have been advanced into engagement with the sixth set of contacts in their associated bank, when the signals S and S′ will have been operated four times.

As soon as the wiper 161 comes into engagement with its sixth bank contact, the following circuit is closed: from ground by way of wiper 161, the sixth associated bank contact, stop conductor 176, and resistance 129 to battery. It is evident that when this circuit is closed relay 130 is short circuited. Upon deenergizing, relay 130 opens its previously closed locking circuit and disconnects impulsing relay 124 at armature 155. The next time interrupter relay 128 energizes, stepping relay 162 causes its armature to be attracted but impulsing relay 124 is obviously not operated. Stepping magnet 162, upon deenergizing, advances the wiper 161 into engagement with the next set of contacts, whereupon a ground potential is placed on pick up conductor 177 and pick up relay 130 is again operated. Accordingly the next time relay 128 closes a circuit for stepping magnet 162, a branch of this circuit extends by way of armature 155 and its working contact to impulsing relay 124, and the said relay, upon energizing, operates the signals S and S′. When relay 128 deenergizes, the signals S and S′ are disconnected and the wipers 160 and 161 are advanced into engagement with the eighth set of contacts, whereupon ground is placed upon stop conductor 178. This stop conductor, is multipled to the lower contact of the first set in each level of the bank of the switch F, but since the wiper 158 is not in engagement with any of these contacts, pick up relay 130 is not affected. Interrupter relay 128 continues to operate and the signals S and S′ continue to be op-

erated in the manner described until the wipers 160 and 161 come into engagement with the twelfth set of associated bank contacts at which time the signals S and S′ will have finished sending out the second digit five in the code 45. As soon as wiper 161 arrives upon the twelfth contact the following circuit is closed: from ground by way of wiper 161, the twelfth associated bank contact, stop conductor 182, the lower contact of the fifth set in the fourth level of the bank of the switch F, wiper 158, stop conductor 176, and resistance 129 to battery. In response to the closure of this circuit, pick up relay 130 deenergizes, thereby disconnecting impulsing relay 124. The wipers 160 and 161 continue to advance with the result that the code 45 is sent out by the signals S and S′ each time the said wipers make one half of a revolution. It will be noted that each time relay 124 energizes to close the circuit of the signals S and S′ it disconnects conductor 111 from ground and connects it to battery by way of the resistance 136. There is a condenser connected in series with conductor 111 and accordingly a momentary charge and discharge through this condenser is effected each time relay 124 operates. This is done so as to apprise the calling subscriber of the fact that the desired code is being sent out.

The calling subscriber after listening in the receiver to make sure that he has made no mistake in operating his calling device and that the desired code is being sent out, may replace his receiver while waiting for the called man to answer. When the receiver is replaced at substation A, the circuit of line relay 73 of the repeater E is opened. Line relay 73, upon deenergizing, opens the circuit of the upper winding of release relay 74 at armature 84. Release relay 74, however, does not deenergize at this time for the reason that it is held up by the current flowing through its lower winding. As a further result of the deenergization of line relay 73, it closes the circuit of relay 71 at armature 85. Relay 71, upon energizing, disconnects conductors 63 and 65 from the windings of line relay 73 and connects them to ground and to battery respectively, ring cut off relay 72 being in series with conductor 65. This, however, does not produce any further result at this time for the reason that there is no direct current circuit closed across the conductors 63 and 65, which extend back through the established connection to the bridged bell at the substation A.

When the called man hears his code being sent out, he responds by taking the receiver off the nearest substation which we shall assume is the substation A′. When this occurs, the line switch C′ operates in the usual manner to extend the connection to an idle selector, which we shall assume is the selector D′, whereupon the line and release relays of the said selector energize and prepare the switch for operation in the usual manner.

The man who has been signalled, may now operate the calling device at the substation A′ in accordance with the digit which it is necessary to call in order to answer a code, thereby producing a corresponding number of interruptions in the circuit of the line relay of the selector D′. The selector D′ now raises its wipers to the desired level and rotates them in the usual manner to find the terminals of the repeater E. The said selector will not stop upon a set of bank contacts in which any of the other answering terminals are multipled for the reason that they are all made busy at this time. When the wipers of the selector D′ arrive upon the set of bank contacts in which the conductors 66–68, inclusive, terminate, it cuts through in the usual manner, thereby placing ground upon conductor 67 and extending the connection through to the upper and lower windings of back bridge relay 76. In response to the placing of ground upon conductor 67, a circuit is closed for relay 79 of the repeater E by way of armature 100 and its working contact. Relay 79, upon energizing, disconnects ground from conductor 112 and closes a locking circuit for itself at armature 103. The closing of this locking circuit establishes the usual holding circuit for the selector D′ and the line switch C′. As a further result of the energization of relay 79 it opens the initial energizing circuit of relay 80 at armature 105, and at armatures 102 and 104 disconnects the conductors 111 and 113. When conductor 112 is disconnected at armature 103, relays 122 and 123 of the code switch F and relay 80 of the repeater E deenergize provided the wipers of the impulse switch I happen to be in normal position at this time. If they are not in normal position, there is a ground potential upon conductor 159 associated with the wiper 160, which ground potential extends direct to the relay 122 and through the working contact of armature 145 and said armature to relay 123 and by the way of conductor 112 to the winding of relay 80 and as a result these three relays are maintained energized for the time being, and the impulse switch I continues to operate and the code continues to be sent out in the usual manner until the wipers 160 and 161 reach the normal position shown in the drawings, at which time ground is removed from conductor 159, whereupon the three relays mentioned deenergize. Relay 122, upon deenergizing, removes ground from conductor 165, whereupon relays 127 and 128 cease to operate.

Relay 123, upon deenergizing, closes the circuit of release magnet 133 at armature 147. By the operation of release magnet 133, the shaft and wipers of the switch F are restored to normal position in the usual manner, the circuit of release magnet 133 being opened at off normal contacts 134 by the switch shaft when it reaches normal position.

In the repeater E, relay 80, upon deenergizing in response to the removal of the ground potential from conductor 112, removes ground from conductor 114 at armature 106, whereupon relay 126 of the switch F deenergizes and connects up the signals S^2 and S^3 again. As a further result of the removal of ground from conductor 112 the busy potential is removed from the release trunk conductors of all the other repeaters and any one else who desires to use the code switch may do so.

To continue with the operation of repeater E, as a result of extending the connection to back bridge relay 76 the said back bridge relay energizes and at armature 96 disconnects conductor 63 from ground and connects it to the lead running to the ringing machine RM. Ringing current is now sent out intermittently to ring the bridged bell at the substation A.

When the subscriber at substation A responds by removing his receiver, a direct current bridge is closed across conductors 11 and 12 and consequently across the conductors 63 and 65 of the repeater E, whereupon ring cut off relay 72 energizes and closes the circuit of relay 75. Relay 75, upon energizing, closes a locking circuit for itself at armature 94, and at armature 93 places direct ground upon release trunk conductor 64 and opens the locking circuit of release relay 74. Release relay 74, however, being slow acting does not deenergize immediately. As a further result of the energization of relay 75, it opens the circuit of relay 71 at armature 95. Relay 71, upon deenergizing, disconnects conductors 63 and 65 from the ringing machine RM and ring cut off relay 72 respectively, and connects them to the upper and lower windings of line relay 73 again. Line relay 73, upon energizing, closes again the initial circuit for release relay 74 at armature 84 before the said relay has had time to deenergize. The calling and called subscribers may now converse with each other as desired, the talking circuits being outlined by the heavy conductors.

Referring now again to Fig. 3, it may be said that when it is desired to operate the signals S^2 and S^3 without operating the signals S and S′, a different preliminary number is dialled with the result that a repeater is seized which is connected with the code switch F by way of the multiple comprising conductors 111–113, inclusive, and conductor 115. It may be said also that when it is desired to operate both sets of signals simultaneously, a third preliminary called number is used with the result that a repeater is seized which is connected with the code switch F by way of the multiple which comprises only the conductors 111–113, inclusive.

Referring now again to the selector D, Fig. 1, the operation of the selector, in case a subscriber attempts to establish a connection with one of the repeaters associated with the code switch while a code is being sent out will be considered. It will be remembered that while a code is being sent out all the release trunk conductors associated with the calling terminals of the various repeaters are grounded. Assuming now that the selector D is seized by a line switch such as the line switch C and that a digit is dialled, corresponding to one of the levels in which the calling terminals of a group of repeaters is connected, during the time that all the release trunk conductors are grounded, the wipers of the said selector are rotated in the usual manner but not finding an idle trunk they continue to rotate until they pass off the last set of contacts, whereupon the shaft operated cam 48 operates the springs 46 and 47. Spring 46, upon being operated, opens the circuit of switching relay 39 so as to prevent it from energizing at this time. Spring 47, upon being operated, connects the lead 49 with the lower winding of line relay 35 and disconnects direct ground therefrom. The lead 49 extends to ground by way of the secondary winding of a transformer which is associated with a busy signalling machine of any well known type such, for example, as is shown in the United States Patent 1,352,605, issued to Jacobsen September 14, 1920. Consequently the calling subscriber hears a busy signal to inform him that he cannot obtain the desired connection. When the calling subscriber hears the busy signal he may replace his receiver thereby initiating the release of the connection in the usual manner, and call again later. The operation of the selector D′ is the same under similar circumstances.

The various features of the invention, having been described and ascertained, will now be pointed out in the appended claims.

What is claimed is:

1. In a telephone system, a common signalling system, two groups of terminals connected therewith and telephonically connected together in pairs, one terminal of each pair being in one group and the other terminal in the other group, a call number assigned to one group and an answer number assigned to the other group, automatic switching mechanism controllable by a calling subscriber in accordance with the call number for seizing one terminal in the group to which

the call number is assigned, means responsive to said seizure for making all the terminals busy except the terminal paired with the seized terminal, means controllable thereafter by the calling subscriber in accordance with a predetermined code for operating the said signalling system to signal the called subscriber, and automatic switching mechanism controlled by the called subscriber in accordance with the answering number for connecting with the calling subscriber by seizing and making busy the idle terminal.

2. In a telephone system, a common signalling system, two groups of terminals associated therewith and telephonically connected together in pairs, one terminal of each pair being in one group and the other terminal in the other group, a call number assigned to one group and an answer number assigned to the other group, automatic switching mechanism controllable by a calling subscriber in accordance with the call number for seizing one terminal in the group to which the call number is assigned, means responsive to said seizure for making all the terminals busy except the terminal paired with the seized terminal, means controllable thereafter by the calling subscriber in accordance with a predetermined code for operating the said signalling system to signal the called subscriber, automatic switching mechanism controllable by the called subscriber in accordance with the answering number for connecting with the calling subscriber by seizing and making busy the idle terminal, and means responsive to the last named seizure for disassociating the seized terminals from the signalling system and for making the remaining unseized terminals idle.

3. In a telephone system, a common signalling system, a pair of terminals associated therewith, telephone call and answer numbers assigned to said terminals, respectively, automatic switching mechanism controllable by a calling subscriber in accordance with the call number for extending a connection to one of said terminals and for making said terminal busy when said calling subscriber extends a connection thereto, means controlled thereafter for operating the said signalling system in accordance with a predetermined code to signal a called subscriber, automatic switching mechanism controlled by the called subscriber in accordance with the answer number for extending a connection to the calling subscriber by seizing and making busy the other of said terminals, and means responsive to the seizure of the last named terminal for dissociating both terminals from said signalling system.

4. In a telephone system, a common signalling sytem, a plurality of groups of signals and a plurality of groups of terminals associated therewith, a separate call number assigned to each of said groups of terminals, another group of terminals equal in number to all the first named terminals, an answering number assigned to said last group of terminals, all of said terminals being telephonically connected together in pairs, one terminal of each pair being in the last mentioned group and the other terminal in one of the other groups, automatic switching mechanism controllable by a calling subscriber in accordance with one of the call numbers for seizing one terminal in the group to which the call number is assigned, means responsive to said seizure for making all the terminals in the several groups busy except the terminal paired with the seized terminal, means controllable thereafter by the calling subscriber in accordance with a predetermined code for operating the said signalling system to signal the called subscriber through the medium of one of the groups of signals, the group of signals used depending upon the call number used, and automatic switching mechanism controllable by the called subscriber in accordance with the answering number for connecting with the calling subscriber by seizing and making busy the idle terminal.

5. In a telephone system, a common signalling system, a plurality of groups of signals and a plurality of groups of terminals associated therewith, a separate call number assigned to each of said groups of terminals, another group of terminals equal in number to all of the first named terminals, an answering number assigned to said last group of terminals, all of said terminals being telephonically connected together in pairs, one terminal of each pair being in the last mentioned group and the other terminal in one of the other groups, automatic switching mechanism controllable by a calling subscriber in accordance with one of the call numbers for seizing one terminal in the group to which that call number is assigned, means responsive to said seizure for making all the terminals in the several groups busy except the terminal paired with the seized terminal, means controllable thereafter by the calling subscriber in accordance with a predetermined code for operating the said signalling system to signal the called subscriber through the medium of one of the groups of signals, the group of signals used depending upon the call number used, and automatic switching mechanism controllable by the called subscriber in accordance with the answering number for connecting with the calling subscriber by seizing and making busy the idle terminal, and means responsive to the last named seizure for disassociating the seized terminals from the signalling system and for causing the remaining unseized terminals to test idle.

6. In a telephone system, a common signalling system, a plurality of groups of signals and a plurality of groups of terminals associated therewith, a separate call number assigned to each of said groups of terminals, another group of terminals equal in number to all the first named terminals, an answering number assigned to said last group of terminals, all of said terminals being telephonically connected together in pairs, one terminal of each pair being in the last mentioned group and the other terminal in one of the other terminal groups, automatic switching mechanism controllable by a calling subscriber in accordance with one of the call numbers for seizing one terminal in the group to which that call number is assigned, means responsive to said seizure for making all the terminals in the several groups busy except the terminal paired with the seized terminal, means controllable thereafter by the calling subscriber in accordance with a predetermined code for operating the said signalling system to signal the called subscriber through the medium of all the signals in the several groups in case a particular call number has been used, and automatic switching mechanism controllable by the called subscriber in accordance with the answering number for connecting with the calling subscriber by seizing and making busy the idle terminal.

7. In a telephone system, a common signalling system, a pair of terminals connected thereto, telephone call and answer numbers assigned to said terminals, respectively, automatic switching mechanism controllable by a calling subscriber in accordance with the call number for extending a connection to one of said terminals and for making said terminal busy when said calling subscriber extends a connection thereto, means controllable thereafter by the calling subscriber for operating said signalling system in accordance with a predetermined code to signal a called subscriber, automatic switching mechanism controllable by the called subscriber in accordance with the answering number for connecting with the calling subscriber by seizing and making busy the other terminal, and means responsive thereto in case the calling subscriber has replaced his receiver for signalling the calling subscriber.

8. In a telephone system, subscribers' lines, a common signalling device accessible to said lines, automatic switching devices controlled by a calling subscriber for extending a connection to said device, for operating the same to signal any subscriber and for rendering the device busy to other subscribers, and other automatic switches controlled by the subscriber called for completing a connection with the calling subscriber and for again rendering said device idle responsive to said connection being completed.

9. In a telephone system, subscribers' lines, a line accessible in common to all of said subscribers' lines, signal controlling apparatus associated with said line, means for seizing said last line and for making it busy when seized, means including said apparatus and operable thereafter for signalling a called subscriber by means of a signal associated with said last line, means whereby the subscriber signalled may telephonically connect with the calling subscriber, and means responsive thereto for freeing the last mentioned line and for permitting said apparatus to be again used to signal the called subscriber.

In witness whereof, I hereunto subscribe my name this 19th day of Oct., A. D. 1921.

WILLIAM A. CHAPIN.