E. D. FALES.

TELEPHONE AUTOMATIC TRUNKING SYSTEM.

APPLICATION FILED AUG. 10, 1907.

1,257,832.

Patented Feb. 26, 1918.

8 SHEETS—SHEET 1.

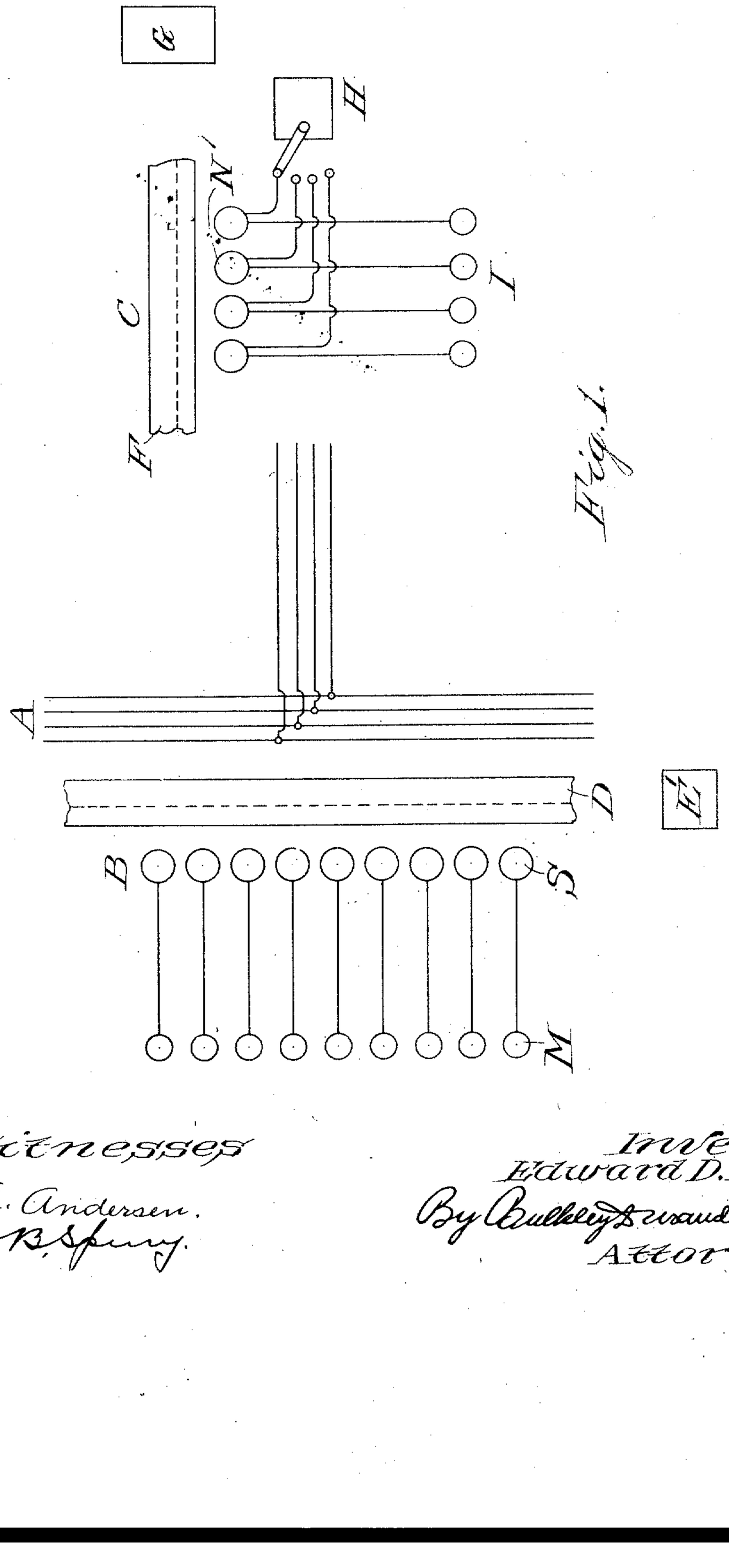

Fig. 1.

Witnesses

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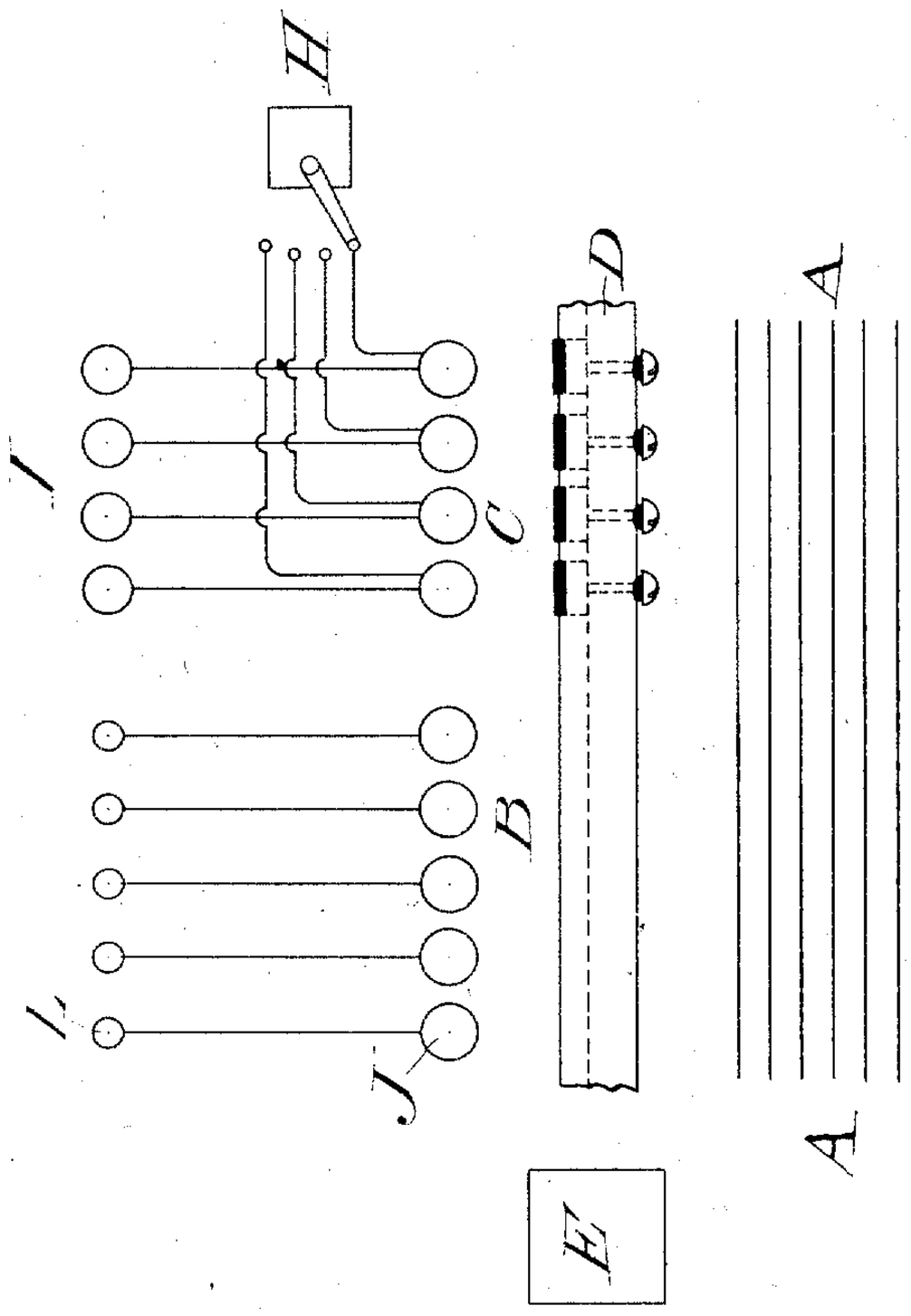

Fig. 2.

Fig. 3.

Witnesses
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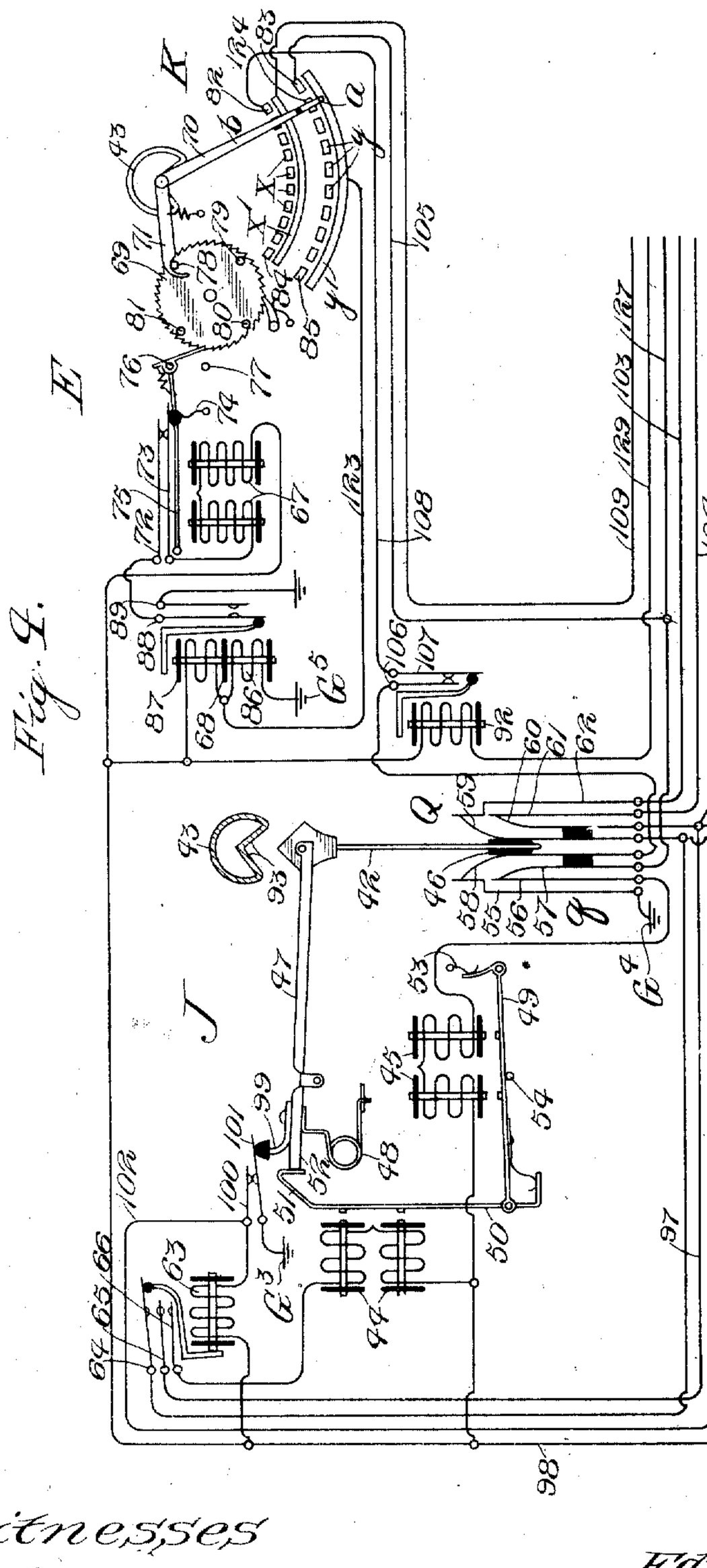

Fig. 4.

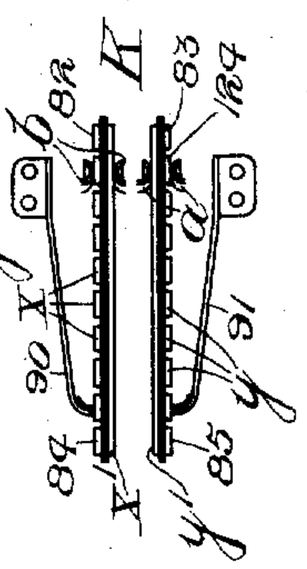

Fig. 5.

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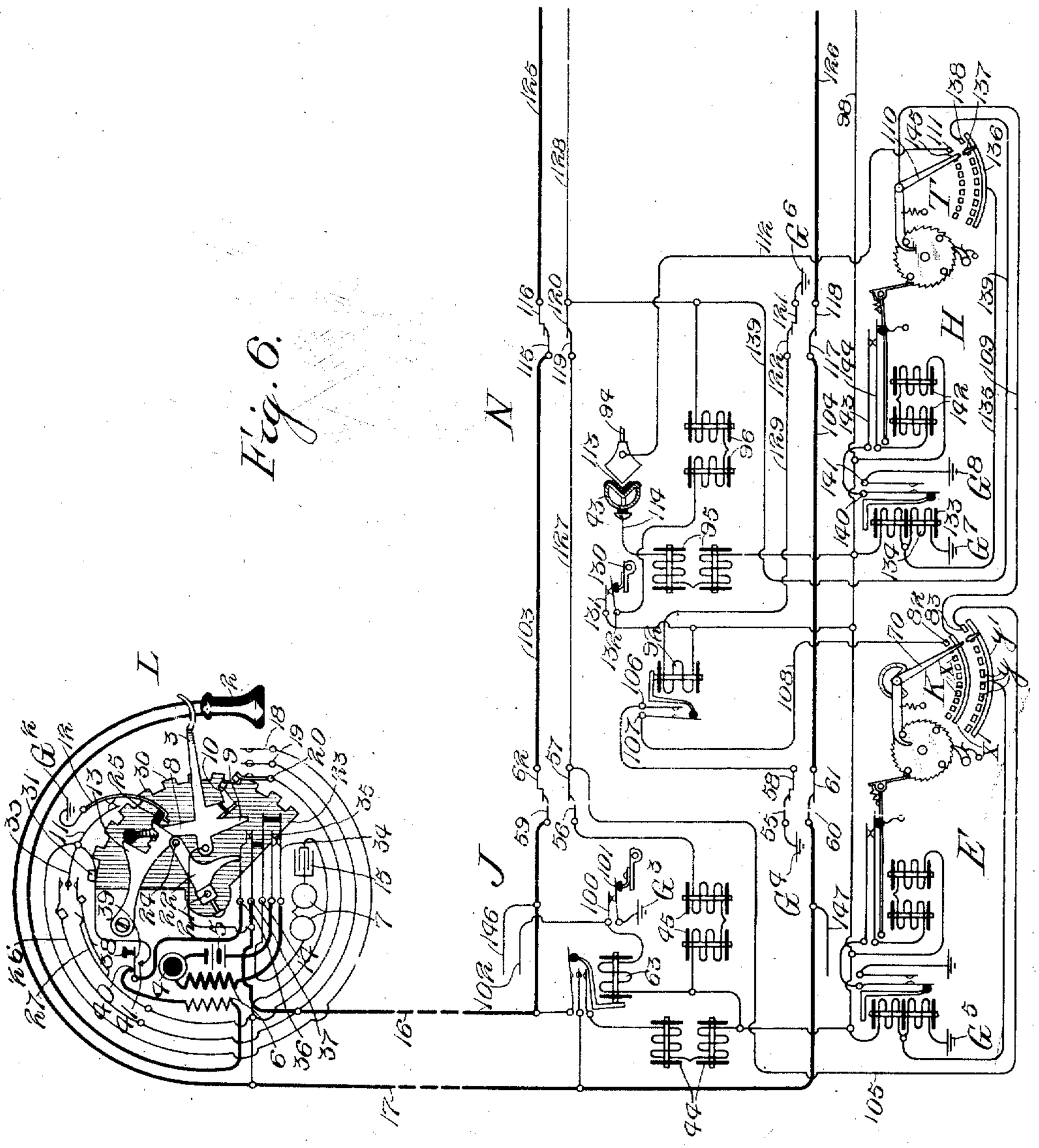
8 SHEETS—SHEET 4.

Fig. 6.



Witnesses
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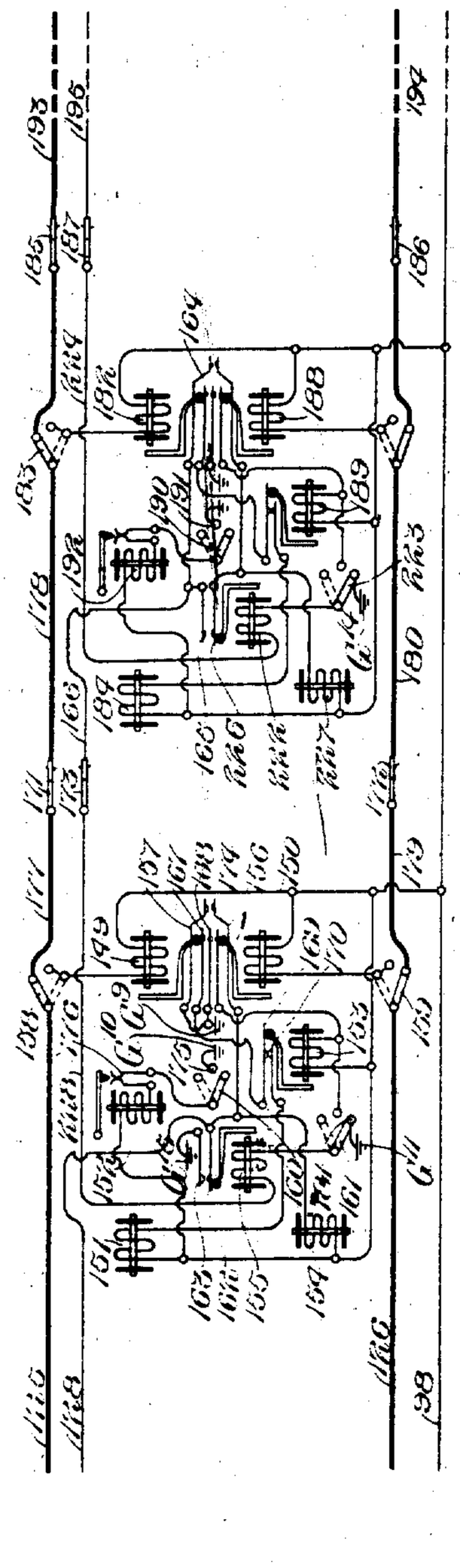
8 SHEETS—SHEET 5.

Fig. 7.



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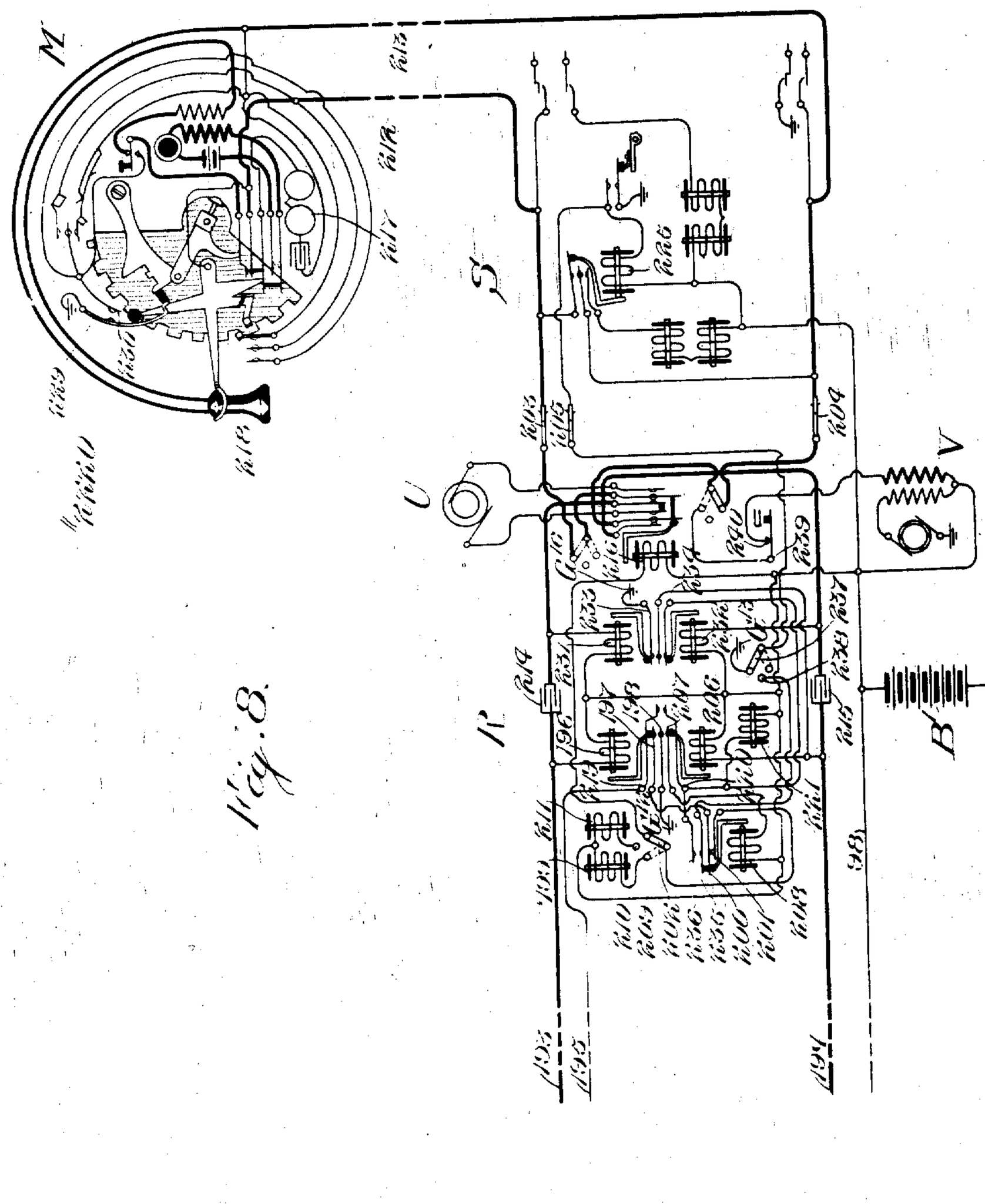

Fig. 8.

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8 SHEETS—SHEET 7.

Fig. 9.

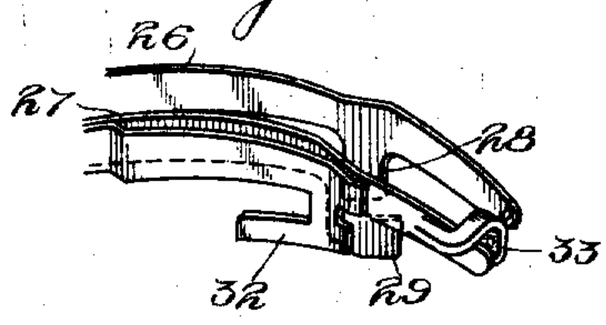


Fig. 10.

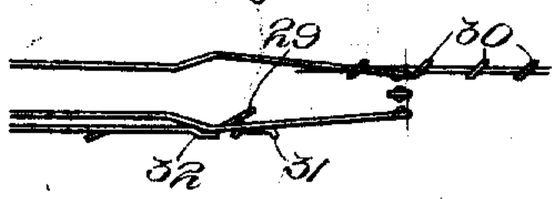


Fig. 11.

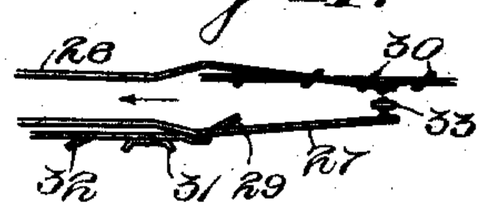


Fig. 12.

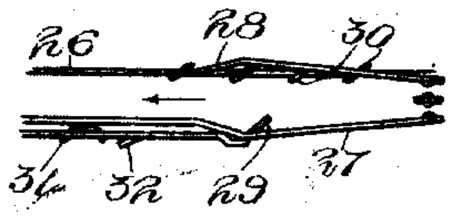


Fig. 13.

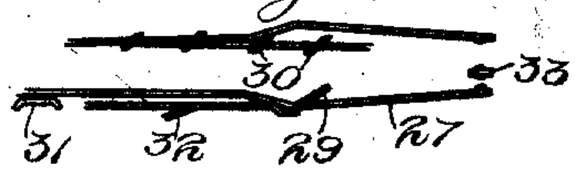


Fig. 14.

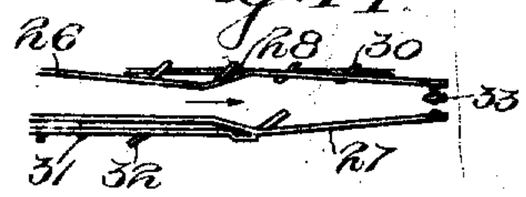
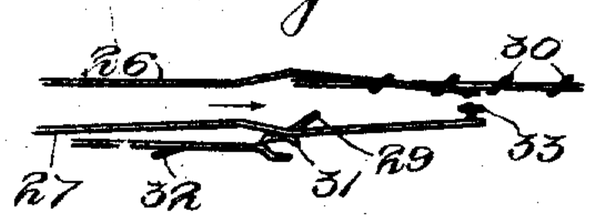


Fig. 15.



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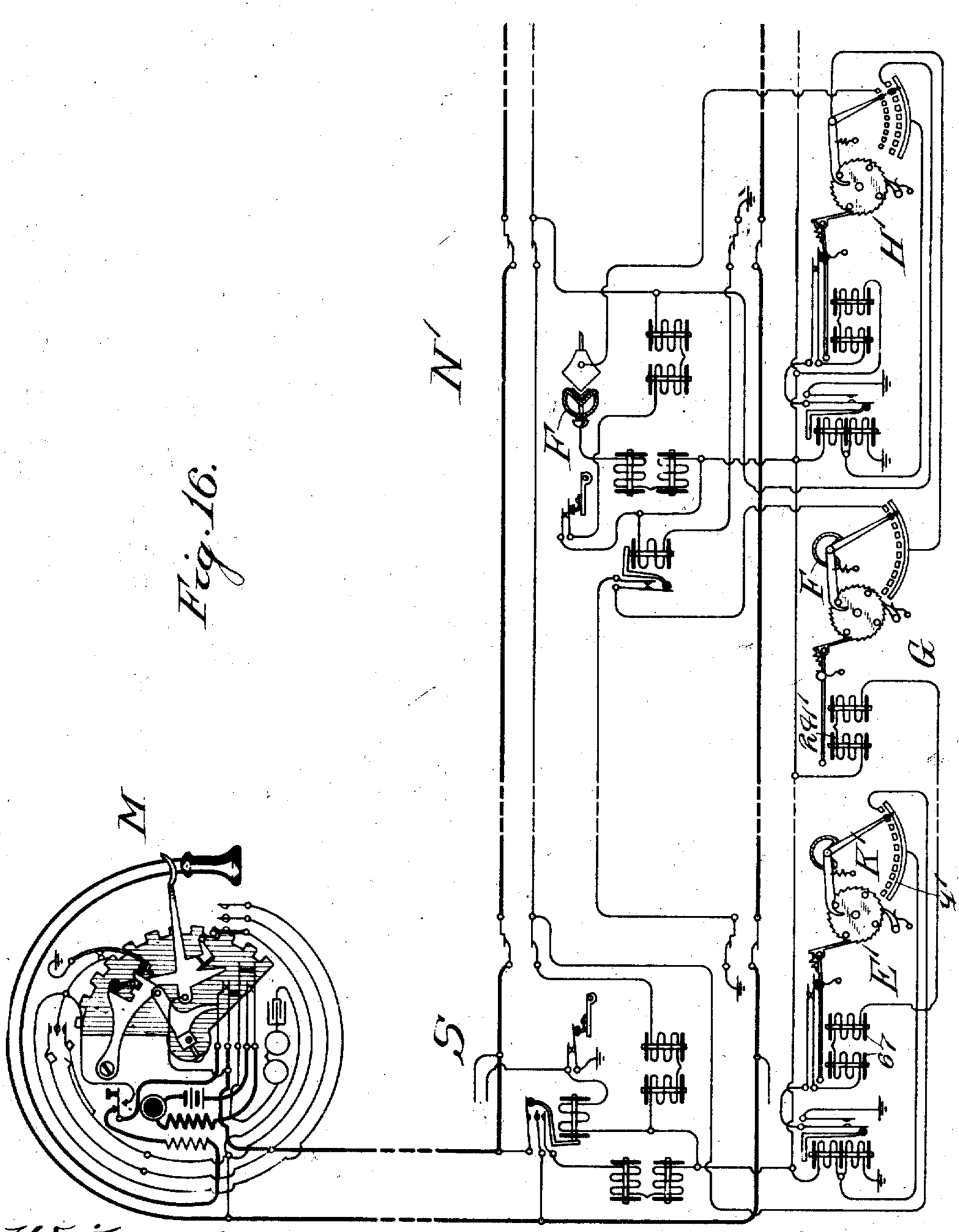
8 SHEETS—SHEET 8.

Fig. 16.



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UNITED STATES PATENT OFFICE.

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TELEPHONE AUTOMATIC TRUNKING SYSTEM.

1,257,832. Specification of Letters Patent. Patented Feb. 26, 1918.

Application filed August 10, 1907. Serial No. 387,948.

To all whom it may concern:

Be it known that I, EDWARD D. FALES, a citizen of the United States of America, and resident of La Grange, Cook county, Illinois, have invented a certain new and useful Improvement in Telephone Automatic Trunking Systems, of which the following is a specification.

My invention relates to automatic or semi-automatic telephone exchange systems of that character in which the subscribers are provided with means for controlling the automatic switches and other devices that are located at the exchange or central station, and which are employed for automatically trunking the calling telephone lines into connection with the called telephone lines. In systems of this kind it is old to provide the subscribers' lines with individual trunking switches for automatically selecting trunks leading to first-selectors. It has also been proposed to employ more than one preliminary trunking or non-numerical switch between the calling subscriber's line and the first-selector—that is to say, to employ subscribers' individual switches for selecting trunks leading to non-numerical switches, the latter being adapted to then select idle trunks leading to the first-selectors. The so-called first-selectors are the automatic switches that perform trunking operations corresponding to the first digit of any called number, and are well known and understood. In accordance with my invention, however, and as herein disclosed, primary and secondary preliminary trunking or non-numerical switches are employed between the subscribers' lines and the first-selectors, but the said secondary non-numerical trunking switches do not select trunks leading to the first-selectors. The said primary non-numerical trunking switches, which are individual to the subscribers' lines, select idle trunks, and the said secondary non-numerical trunking switches select the same trunks—that is to say, whenever a subscriber's individual switch seizes a trunk, a preselected secondary non-numerical trunking switch then promptly seizes the other end of the same trunk. In this way the intermediate trunks which extend from the primary non-numerical switches to the secondary non-numerical switches are provided at each end with multiple bank contacts, and the automatic trunking switches thus arranged at each end of said intermediate trunks are all common to each and every one of said trunks—that is to say, the said intermediate trunks are not provided with automatic switches which are individual thereto. A master switch or common selecting mechanism controls the selections made by the primary non-numerical trunking switches, so that each calling subscriber simply causes his individual switch to seize a preselected trunk running to the banks of the secondary non-numerical trunking switches. Another common mechanism controls the operations of the said secondary non-numerical trunking switches, whereby the calling subscriber also obtains connection with a preselected trunk running to a first-selector. This arrangement, I find, tends to distribute the work among the different trunk lines, and more evenly between the different first-selectors, so that no one trunk line or no one first-selector will be subject to more use and wear and tear than the others. The nature and advantages of my invention, however, will hereinafter more fully appear.

In the accompanying drawings Figure 1 is a diagram illustrating the arrangement of the switches used by a subscriber M, whose line terminates in a district or sub-central station, in a system embodying the principles of my invention. At A is indicated a group of trunk lines; at B a group of trunking switches to which said trunk lines are common; and at C a second group of trunking auxiliary switches which are adapted to shift from trunk line to trunk line. In this figure there is indicated a so-called plunger shaft D which is common to the group of switches B. At E^1 there is also shown a so-called master switch for controlling the plunger shaft D. At F there is shown another plunger shaft which is common to the group of switches C, and at G a master switch (similar to the master switch E^1) for controlling the shaft F, and, therefore, for controlling the position of the idle switches C with regard to the trunk lines A. At H there is a master switch the function of which is to pick out the switch C to be operated; and at I there is indicated a group of first selectors, one allotted to each of the switches C.

Fig. 2 shows the arrangement of the switches used by a subscriber L, the line of whose telephone terminates directly in the

main central office; also the arrangement by which both groups of switches B and C are controlled by one master switch E, and, therefore, by one switch shaft D, the first-selectors being indicated at I.

Fig. 3 is a transverse section of the plunger shaft D (Fig. 2) alloted to the group of switches C.

Fig. 4 is a diagram of one of the line switches J of the group of switches B, and of the master switch E shown at the right. It will be seen that the circuit connections of these two switches, and the circuit connection between them, are shown. The master switch E comprises a bank K of circuit terminals in connection with which a suitable wiper operates.

Fig. 5 is a front or edge view of the said bank K.

Figs. 6, 7 and 8 are diagrams which, taken together, illustrate the apparatus brought into use (in a ten-thousand system embodying my invention) to establish and maintain a connection between the calling-subscriber L and the called subscriber M. This apparatus (following the arrangement indicated in Fig. 2) consists (Fig. 6) of a calling subscriber's station L, a calling subscriber's trunking individual or line switch J, a controlling master switch E, an auxiliary switch N, and an auxiliary master circuit-switch H; Fig. 7, a so-called first-selector O and a second-selector P; Fig. 8, a so-called connector R, the called subscriber's individual line switch S and the called subscriber's station M.

Fig. 9 is a perspective of the so-called impulse springs alloted to each subscriber's station, through the medium of which impulses are transmitted to the central station or stations for the purpose of operating the automatic switching devices.

Figs. 10, 11, 12, 13, 14 and 15 illustrate the positions of the said impulse springs at different stages of an operation.

Fig. 16 is a diagram showing the arrangement of the switching apparatus used by the district substation M in calling. This comprises the two master switches E^1 and G, as indicated in Fig. 1.

The substations in connection with which I have elected to illustrate my invention may be of any suitable or approved type. The substation L (Fig. 6), for example, is equipped with the ordinary receiver 2, switch-hook 3, transmitter 4, battery 5, induction-coil 6 and ringer 7. Being an automatic substation it is, in addition, provided with certain more or less well-known mechanical details, and with suitable circuits. It will be seen that the switch-hook 3 is provided with a set of cam arms 8, 9 and 10. The arm 8 is used for controlling the ground circuit at a point between the so-called ground springs 11 and 12, and is also used for controlling the cam latch through the medium of which the dial (which is not shown) is maintained normally locked, so that it will not be rotated while the receiver is on the switch-hook. This latch 13 also prevents the ground springs 11 and 12 from coming into contact until after the dial has been operated. The arm 9 acts as a contact arm which, when the receiver is on the switch-hook, engages the so-called circuit spring 14, whereby the ringer 7, in series with the condenser 15, is bridged across the line conductors 16 and 17. The arm 10 has under its control the so-called release springs 18, 19 and 20 through the medium of which the line conductors 16 and 17 are grounded simultaneously for the purpose of releasing the switching apparatus. Through the center of the apparatus there passes a shaft 21 to the rear end of which is rigidly secured the dog 22. The so-called impulse wheel 23 is secured near the middle of said shaft, and the dial, already mentioned, at the front end thereof. The dog 22 has a pin 24 on its end in front of which the latch 13 normally rests for the purpose of locking the dial, as already explained. It should be stated, however, that when the receiver is removed from the switch-hook the arm 8 barely raises the latch 13 enough to permit the dial to rotate, but not enough to cause the insulating tip 25 to clear the angled terminal of the ground spring 12. When the dial is rotated, however, the latch 13 is raised still a little higher by the pin 24 which passes under the rounded end of the latch 13, by which operation the insulating tip 25 is driven off of the spring 12, permitting the latter to engage the spring 11 and thus close the subscriber's ground circuit. This substation is equipped with the usual vertical and rotary impulse springs 26 and 27 (see Fig. 9) which are of a special construction. These springs 26 and 27 are provided on their under side with lugs 28 and 29, respectively. The former—namely the lug 28—is adapted to be engaged by the so-called vertical impulse teeth 30 on the periphery of the impulse wheel 23, while the lug 29 is adapted to be engaged by the so-called rotary impulse tooth 31 on the same wheel. It will be seen that the rotary impulse spring 27 is provided with an auxiliary lug 32 which, when the dial is turned down, is engaged by the rotary impulse tooth 31, and as a result the rotary impulse spring 27 is given a comparatively long contact with the so-called ground spring 33 (Fig. 11). At this operation the vertical impulse teeth 30 pass the lug 28 without carrying the vertical impulse spring 26 onto the ground spring 33 (Fig. 13); but as the dial returns each impulse tooth will press the vertical impulse spring 26 once onto the ground post 33. After the last vertical impulse has been delivered, then the

impulse tooth 31 again presses the rotary impulse spring 27 onto the ground post 33, but this time it does so by directly engaging the lug 29. This operation is clearly shown in Figs. 10 to 15, inclusive. For example, Fig. 10 shows the impulse-transmitting apparatus in normal condition. Fig. 11 shows the apparatus at the stage where the rotary impulse tooth 31 has engaged the auxiliary member 32, and it will be seen that the rotary impulse spring 27 is thereby pressed onto the ground post 33. Fig. 12 shows the rotary tooth 31 as having just cleared the member 32, and the rotary impulse spring 27 as having been released. One of the vertical impulse teeth is shown as having advanced beyond the lug 28 of the vertical impulse spring 26. Fig. 13 shows the dial still farther advanced. Fig. 14 shows one of the vertical teeth engaging the rotary impulse spring 26, pressing the latter onto the ground post 33. Fig. 15 shows the rotary impulse tooth 31 as having engaged the rotary impulse spring 27 directly on the return stroke, and as having passed behind the auxiliary member 32 and thus again pressed the impulse spring 27 onto the ground post 33. By referring to station L (Fig. 6) it will be seen that when the switch-hook is down the arm 9, upon engaging the spring 14, causes the latter to separate the primary circuit springs 34 and 35 and the secondary circuit springs 36 and 37. This is illustrated at substation M (Fig. 8). The substation L is further provided with a signaling button 38 that controls the spring 39, which latter normally rests in engagement with the contact 40 but which, when the button 38 is pressed, is shifted therefrom onto the ground contact 41.

The line switch J (see Fig. 4) comprises a spring terminal bank Q and an operating plunger 42, together with means for operating said plunger 42, which means consists in a plunger shaft 43 controlled exclusively by the master switch E, a trip magnet 44 and release magnet 45. In order to show clearly the relation between the bank terminal Q and the plunger 42 of the line switch, the bank Q is shown turned around from its true position with respect to the swing of the plunger 42, and, of course, the insulating terminal 46 on the end of said plunger is correspondingly turned. The plunger 42 is loosely pivoted on the end of the plunger arm 47, and is normally held in engagement with the shaft 43 in opposition to the tension of the spring 48. The release magnet 45, it will be seen, is provided with an armature 49 which, on its forward end, carries pivotally secured thereto a second armature 50 controlled by the trip magnet 44. Normally the forward end 51 of the trip armature 50 is adapted to engage the rear terminal 52 of the plunger arm 47, for the purpose of retaining the plunger 42 in engagement with the plunger shaft 43. The tension of the spring 48, it will be seen, is overcome by the tension of the spring 53, which latter is adapted to retain the release armature 49 normally against the stop 54. Of course, when the trip magnet 44 attracts its armature 50 the terminal 51 is disengaged from the rear terminal 52 of the plunger arm 47, thus leaving the plunger to the action of the spring 48. The bank Q, it will be understood, is made up of a plurality of jack-like sections, one of which is shown at *q* comprising the springs 55, 56, 57, 58, 59, 60, 61 and 62. In this bank, it should be explained, all the springs 55 of the jacks *q* are in multiple, likewise all springs 56, all springs 59, and all springs 60; while the springs 57, 58, 61 and 62 are not connected, but are all individual springs. The line switch J has, in addition, the so-called cut-off relay 63 which controls the springs 64, 65 and 66. It is obvious, of course, that the various parts (except the bank Q and shaft 43) may be mounted upon any suitable frame or base. The usual dimensions of this base are five inches long, four inches wide and one inch deep, the plunger-arm 47 extending out about two inches beyond the length. It is customary to mount the sections *q* in a row in front of the switches on a separate support.

The master switch E is a simple device comprising a motor magnet 67, a motor magnet relay 68, the bank K, the ratchet wheel 69, a wiper 70 and a cam arm 71. Said motor magnet is equipped with an interrupter which may be of any suitable character, for example of the type described in United States Patent No. 841,004, granted January 8, 1907, to John Erickson. This interrupter, as shown, comprises the springs 72 and 73 directly included in the circuit, and an auxiliary or latch spring 74. The motor magnet is also provided with an armature 75 on the end of which there is provided a pawl 76, the limit of stroke of which is marked by the stop 77. This pawl 76 is provided for the purpose of operating the ratchet wheel 69, which latter is equipped on one of its sides with a set of pins 78, 79, 80 and 81. It will be seen that the cam arm 71 is resting in engagement with the pin 78; but by causing the ratchet wheel 69 to advance a number of steps the pin 78 will be carried beyond the reach of the cam 71, which latter will then fall onto the pin 79; and then by another series of steps, preferably ten in number, the pin 79 will in turn pass beyond the reach of the cam arm 71, and the said cam will then fall against the pin 80, and so on. When the cam arm 71 first falls upon the pin 79 the wiper 70 is adjusted to engage the first set of contacts of the bank K, namely the contacts 82 and

83, and each time that the magnet 67 is energized thereafter the wiper 70 is advanced one step into engagement with another contact. In this way, it will be seen, nine successive steps of the wiper 70, after said wiper leaves the first set of contacts 82 and 83, will bring the wiper 70 onto the last set of contacts 84 and 85. It will be obvious that at the next step thereafter the cam arm 71 will leave the pin 79 and meet the contact point 80, at which operation the wiper 70 will pass back into engagement with the first set of contacts 82 and 83. It will be seen that the ratchet wheel 69 is provided with a pawl to insure the wheel against backward rotation. As shown, the motor magnet relay 68 is provided with two windings 86 and 87, the use of which will be explained. This relay 68, as shown, controls the springs 88 and 89 comprised in the energizing circuit of the motor magnet 67. The bank and wiper of the master switch E is shown diagrammatically in Fig. 4, but Fig. 5 shows one of the forms of construction of the bank as it appears in actual practice. The wiper 70 is shown made up of a front part *a* and a rear part *b*, the part *b* playing over the contacts *x* and the common segment *x'*, while the part *a* plays over the contacts *y* and the common segment *y'*. In Fig. 5 the section *a* is a wiper separate and distinct from the wiper *b*. These wipers *a* and *b* may be of the type described in connection with the connector switch shown in United States Patent No. 815,176, granted March 13, 1906, to Keith, Erickson & Erickson, and known as the private wiper, which consists of a spring finger with a bifurcated terminal, which terminal, as indicated, is the one that slides over the contacts on one side and the common segment on the other. It will be seen, furthermore, that on the return motion of the wipers to first position they do not pass over the contacts, but instead ride over the insulated springs 90 and 91, from which springs they drop upon reaching a position opposite the first set of contacts 82 and 83. It will be understood, of course, that the same motion that has been described for the wiper 70 is transmitted to the plunger shaft 43, which motion, as already explained, is oscillatory in character; but it should be borne in mind that at no time does the channel 93 of this shaft pass to a position where any plunger 42 may not assume its normal position in engagement therewith.

In Fig. 4 there is shown a relay 92 which neither belongs to the line switch J not to the master switch E, but which is provided for every bank jack *q*—that is, one is provided for every trunk line leading from the bank terminal *q*. The object and function of this relay will become apparent.

The auxiliary line switch N (Fig. 6) is substantially the same mechanically as the line switch J. The circuits, however, are modified to accomplish certain purposes, as will be seen. As shown, said switch N is provided with the usual plunger 94, trip magnet 95 and release magnet 96. The plungers of these auxiliary switches N, with the arrangement shown in Fig. 6, are controlled by the same plunger shaft 43 that controls the switches J. This, however, is not always essential, as will be explained in connection with Fig. 6.

By referring to Fig. 2 it will be seen that the section of the shaft allotted to the auxiliary switches C is of different construction from the section of the shaft allotted to the switches B. The group of switches B are permitted to bring their plungers directly in contact with the shaft, but the plungers of the switches C are not permitted to thus come into contact with the main shaft. Each plunger of the auxiliary switches C has allotted to it an insulated metallic strip *c* (Fig. 3). Therefore, when the plunger of one of the auxiliary switches C is in normal position, the plunger is in electrical connection with the bolt *d*, but insulated from the main section of the shaft 43.

The master switch H is substantially the same as the master switch E, with the exception that it has no plunger shaft to control, as does the plunger shaft 43 of the master switch E. This master switch H is purely a circuit-controlling device.

The first and second selectors O and P (Fig. 7) are a modified form of the selector disclosed in United States Patent No. 815,321, granted March 13, 1906, to Keith, Erickson & Erickson; while the connector switch R (Fig. 8) is of the type described in said connector Patent No. 815,176.

In Fig. 16 the trunking switches S and N^1 are the same those in Fig. 6; and the master switch E^1 is the same as the master switch E of Fig. 6, with the exception that one row of bank contacts has been removed and given to the control of the master switch G, which master switch G is given control of the plunger shaft F that controls the auxiliary trunking switches C (see Fig. 1).

The method of operation, when one subscriber calls another, in a system arranged as indicated in Figs. 2 and 6—that is, where all of the switching apparatus is located at one exchange—is as follows: The master switch E is shown with its wiper in second position, having been driven from the first position by the seizure of the first trunk line by the individual switch J. It will be seen that the wiper of the master switch H is likewise shown resting on the second contact. The wipers of these two switches E and H, however, operately absolutely independent of each other, there being no relation between the two as far as their positions

relative to their bank contacts are concerned. It will be assumed that the subscriber at substation L (Fig. 6) calls the subscriber M (#2220), Fig. 8. The calling subscriber removes his receiver from the switch-hook, thus unlocking the dial, inserts his finger in the finger-hole marked 2, corresponding to the first digit to be called, turns down the dial and then releases it. Upon drawing the dial down the rotary impulse tooth 31 presses the rotary impulse spring 27 onto the ground post 33, and thereby causes a momentary impulse circuit to be established through the trip magnet 44 of the line switch J, including the central station battery B′. The impulse circuit through said trip magnet 44 extends from ground G^2 through the ground springs 12 and 11 to the rotary impulse spring 27, rotary line conductor 17, conductor 97 (Fig. 4), bridge-cut-off relay springs 65 and 66, trip magnet 44 to the battery lead 98, and through battery B′ to ground G′. The trip magnet 44, upon energizing, attracts its armature 50 and releases the plunger arm 47, at which instant the spring 48 forces the plunger 42 into one of the jacks q of the bank Q. It will be assumed, in this case, that the jack q is the first jack and corresponds with the contact 83 of the master switch bank K. As soon as the plunger 42 enters the terminal q, the springs 55 and 58 are pressed into contact, as well as the springs 59 and 62, the springs 56 and 57, and the springs 60 and 61. Furthermore, the projection 99 on the plunger arm 47, upon rising, closes the springs 100 and 101 into contact. The closure of contact between the springs 100 and 101 closes an energizing circuit through the cut-off relay 63 from ground G^3 through the springs 101 and 100, through the cut-off relay 63 to the battery lead 98, and through battery B′ to ground G′. The said springs 100 and 101 are susceptible of adjustment and, if desired, may be so adjusted that the relay 63 may become energized before the plunger 42 closes the bank springs, already mentioned, into contact. As soon as the cut-off relay 63 energizes, its armature separates the springs 64, 65 and 66, thereby removing the short-circuit bridged across the line conductors 16 and 17, and at the same time disconnecting the trip magnet 44 from the lines in order to prevent further energization of the said trip magnet. The closure of contact between the springs 100 and 101, furthermore, sets up a guarding potential over the so-called private normal conductor 102 that leads to the private bank contacts of all connectors through which the substation L may be called, in order to prevent any subscriber from calling-in upon this calling line L after a call has been started. The closure of contact between the springs 59 and 62 extends the subscriber's vertical line conductor 16 to the vertical trunk conductor 103. The closure of contact between the springs 60 and 61 extends the subscriber's rotary conductor 17 to the rotary trunk conductor 104. When the springs 55 and 58 close into contact a circuit is established through the trip magnet 95 of the auxiliary line switch N, over the following circuit, for tripping said switch: from ground G^4 through the springs 55 and 58, through the cut-off relay springs 106 and 107 (the relay 92 being deënergized), conductor 108, contact point 82 of the master switch bank K, master switch wiper 70, common segment x', conductor 109, master switch wiper 110, contact point 111 of the master switch bank T, conductor 112, plunger 94, socket 113, conductor 114, trip magnet 95 to the battery lead 98, and through battery B′ to ground G′. At the instant that this circuit is closed, it will be understood that the master switch wipers 70 and 110 are in engagement with the first contacts of their respective banks K and T. Also, the closure of contact between the springs 56 and 57 sets up a non-grounded guarding potential at the master switch bank contact 83, through the release magnet 45 of the line switch J, as follows: from the contact point 83 to the conductor 105, bank springs 57 and 56 to the release magnet 45, thence through said magnet to the battery lead 98 and to battery B′. This guarding potential drives the master switch E from the seized trunk line, the conductors 103 and 104 of which have been indicated, and also prevents the master switch from subsequently selecting this trunk line before it becomes idle. The operation by which the master switch E is driven from the seized trunk line is as follows: As soon as the springs 56 and 57 establish the guarding potential at the master switch bank contact 83 a flow of current is set up through the motor magnet relay 68 of the master switch E from ground G^5 through the winding 86 of the relay 68 to the conductor 123 to the common segment y', thence to the wiper section a and to the contact 83, thence through the springs 57 and 56 and through the release magnet 45 to the battery lead 98, and through battery B′ to ground G′. The relay 68, upon energizing, causes the springs 88 and 89 to come into contact, thereby closing the energizing circuit for the motor magnet 67, which magnet thereupon attracts its armature and rotates the ratchet wheel 69 one step, thereby causing the master switch wipers a and b to advance to the second position, as indicated in Figs. 4 and 5. Of course, the energizing circuit through the auxiliary relay 68 is broken at the instant that the wiper a leaves the contact 83, but it will be evident that if the next trunk line happens to be busy the next bank contact 124 will also have a guarding potential

and the circuit will not be broken until the motor magnet 67 has caused the wiper to advance another step, or a series of steps, until an idle position is found. The advance of the master switch, however, does not take place before the trip magnet 95 of the auxiliary line switch N has time to operatively energize. As soon as the trip magnet 95 energizes, the plunger 94 is released and the bank springs 115 and 116 are brought into contact and also the bank springs 117 and 118, springs 119 and 120, and springs 121 and 122. The closure of contact between the springs 115 and 116, it will be seen, extends the connection from the trunk conductor 103 to the trunk conductor 125; the closure of contact between the springs 117 and 118 extends the connection from the trunk conductor 104 to the trunk conductor 126; and the closure of connection between the springs 119 and 120 extends the connection from the trunk-release conductor 127 to the trunk-release conductor 128. Also, the closure of connection between the springs 121 and 122 sets up an energizing circuit for the cut-off relay 92 from ground G^6 through the springs 121 and 122, conductor 129, cut-off relay 92 to the battery lead 98, and through battery B′ to ground G′ The relay 92, upon energizing, separates the springs 106 and 107 in order to break the ground connection between ground G^4 at the line switch J and the bank contact 82 of the master switch bank K of the master switch E. The reason for breaking this ground connection will be explained. The projection 130 on the rear end of the plunger shaft that supports the plunger 94 is, like the projection of the line switch J, equipped with means for closing in contact a set of springs. These springs 131 and 132, as soon as they are brought into contact, establish an energizing circuit through the motor magnet relay 133 of the master switch H. This energizing circuit includes the release magnet 96, but the resistance of the winding of the relay 133 is so great that this said release magnet 96 does not operatively energize. The energizing circuit for said relay 133 extends from ground G^7 at the master switch H through the winding 134 of the relay 133, conductor 135, to the common segment 136 of the master switch bank T, through the tip section 137 of the master switch wiper to the contact 138, conductor 139, release magnet 96, springs 132 and 131 to the battery lead 98, and through battery B′ to ground G′. The relay 133, upon attracting its armature, closes the springs 140 and 141 in contact, thereby closing the energizing circuit for the motor magnet 142 from ground G^8 through the springs 141 and 140, through the interrupter springs 143 and 144 to the motor magnet 142, thence to battery lead 98, and through battery B′ to ground G′. The motor magnet then attracts its armature, and in the same manner described in connection with the master switch E the wiper 110 is advanced onto the next set of contacts, breaking the energizing circuit for the relay 133 as soon as the wiper terminal 137 leaves the contact point 138, thereby bringing the master switch to a standstill. It will be evident that when the master switch E operates, as previously described, all idle switches B (Fig. 1) are advanced to a position opposite the next trunk line leading to the auxiliary switches C. It will also be evident that all idle auxiliary switches C will be advanced by the same master switch E to a position opposite the same trunk line. It will also be apparent that when the master switch H stops, the wiper 110 thereby selects another auxiliary switch, which will be operated or tripped by the next line switch B that makes a call. The relay 92 is made to break the ground connection between the ground G^4 and the master switch contact 82 for this reason: The wiper 110 of the master switch H being in engagement with the second bank contact 145, there is a trip magnet 95 of some other auxiliary line switch, similar to the switch N, connected with the common member x' of the master switch K. Then, if for any reason the master switch E acts in advance of the master switch H, so that the wiper 70 returns to the contact point 82, while the master switch H remains with the wiper 110 in engagement with the contact point 145, this second auxiliary switch would be tripped by the closure of the circuit between the contact point 82 and the common member x', and the springs 106 and 107 separated by the relay 92, even though the master switch E could not remain on the said contact 82. The passing contact would be sufficient to cause a tripping of the line switch, and it is for this reason that this arrangement is provided. After the subscriber's line is extended to the trunk conductors 125 and 126, and, therefore, to the first-selector O, the said selector switch O is operated in the usual manner by the vertical impulses corresponding to the first digit 2 of the number 2220, which impulses are transmitted as the dial returns. This selector O, it will be understood, differs from the selector of the patent aforesaid in that the so-called normal conductors are omitted from across the conductors 125 and 126. Such normal conductors are, however, shown at 146, 147 and 102 (Fig. 6) and are known as the vertical, rotary and private normals. Another difference is that the line relays 149 and 150 are connected directly to the battery instead of through the contacts controlled by a so-called bridge-cut-off relay. This selector O is, of course, in addition to the line relays 149 and 150, provided

with the vertical, rotary, private and release magnets 151, 152, 153 and 154, and also with the back-release relay 155. It will be seen that another difference in the selector O is that the release magnet has one terminal connected with the battery lead 98, and the other terminal connected to the so-called trunk-release spring 156 instead of the private magnet spring. When both the line relays 149 and 150 are energized simultaneously the trunk-release spring 156 is adapted to engage the spring 157, for the purpose of energizing the release magnet 154 before the side switch passes to second position. The side switch, of course, comprises the side switch wipers 158, 159, 160 and 161. These wipers are all rigidly connected and are controlled by the private magnet 153. The side switch is adapted to assume any one of three positions known as the first position, indicated by the dotted line, the second position and the third position, indicated by the full lines. It will be seen that the back-release relay 155 is adapted to energize the release magnet 154 by pressing the spring 162 onto the grounded spring 163. The second-selector P is exactly the same as the selector O, with the exception that the trunk-release spring 164 and the back-release relay spring 165 are connected to the trunk-release conductor 166 instead of to ground. Since two vertical impulses are delivered to the vertical line conductor 16 when the vertical impulse teeth press the vertical impulse spring 26 onto the ground post 33 twice, upon the return motion of the dial, the vertical line relay 149 of the selector O is energized twice. The vertical impulses pass over the following circuit: from ground G^2 through the ground springs 12 and 11 to the ground post 33, thence to the vertical impulse spring 26, vertical line conductor 16, line switch bank springs 59 and 62, trunk conductor 103, auxiliary switch bank springs 115 and 116, vertical trunk conductor 125 to the side switch wiper 158, vertical line relay 149 to the battery lead 98, and through battery B′ to ground G′. The vertical line relay 149, upon energizing, presses the line relay spring 167 onto the ground spring 168, thereby energizing the vertical magnet 151 by a flow of current from ground G^9 through the springs 168 and 167, through the private magnet springs 169 and 170 to the vertical magnet 151, and thence through said magnet to the battery lead 98, and through battery B′ to ground G′. The vertical magnet 151, upon attracting its armature, raises the switch shaft (not shown) two steps, and, of course, the shaft wipers 171, 172 and 173 to the second level of the switch banks and opposite the first contact of said second level. After the vertical impulses have thus been transmitted, the rotary impulse tooth 31 then presses the rotary impulse spring 27 onto the ground post 33, thereby delivering one impulse to the rotary line conductor 17, whereby the rotary line relay 150 of the selector O is energized once. The circuit of this impulse extends from ground G^2 at the substation to the ground post 33, thence to the rotary impulse spring 27, rotary line conductor 17, line switch bank springs 60 and 61, trunk conductor 104, auxiliary switch bank springs 117 and 118 to the trunk conductor 126, thence to the side switch wiper 159 and rotary line relay 150 to the battery lead 98, and through battery B′ to ground G′. When the rotary line relay 150 energizes, the spring 174 is pressed onto the ground spring 168, whereby a circuit is closed through the private magnet 153 from ground G^9 through the springs 168 and 174 to said private magnet, and thence to the battery lead 98, and through battery B′ to ground G′. The private magnet, upon energizing, causes the side switch to trip to second position, by which operation an energizing circuit is established for the rotary magnet 152 when the side switch wiper 160 engages the contact point 175. This energizing circuit for the magnet extends from ground G^{10} to the contact point 175, side switch wiper 160, interrupter springs 176, rotary magnet 152 to the battery lead 98, and through battery B′ to ground G′. It may be stated at this juncture that any of the interrupters used in this system may be of the type shown. As soon as the rotary magnet 152 attracts its armature the shaft wipers 171, 172 and 173 are rotated into engagement with the first set of contacts of the second bank level. If the trunk line terminating in this set of contacts is idle the rotary armature, by depressing and releasing the armature of the private magnet 153, causes the side switch to trip from second to third position, thereby destroying the energizing circuit for the rotary magnet 152. But if the first trunk line is busy the bank contact engaged by the private wiper 173 will be grounded, for reasons to be explained, and as a result an energizing circuit is closed through the private magnet 153, said circuit extending from the said contact to the private wiper 173, through the back-release relay 155 to the side switch wiper 161, thence through the private magnet 153 and to the battery lead 98, thence through battery B′ to ground G′. The private magnet 153 is of such high resistance compared with that of the back-release relay 155 in this circuit that the latter (155) will not operatively energize. The private magnet 153, upon energizing, relieves the rotary magnet of its control over the private magnet armature before the rotary magnet deënergizes. As a result the side switch is retained in second position, even

after the rotary arm falls back, with the result that the rotary magnet is again energized and the shaft wipers advance another step. This operation continues, of course, as long as the private wiper 173 continues to find busy contacts. But at the instant that an idle contact is found the trip magnet circuit is broken and the private magnet armature is brought under the control of the rotary magnet armature which, upon falling back, permits the side switch to trip to third position. As soon as the side switch reaches the third position it will be seen that the trunk conductor 125 is extended to the shaft wiper 171, by way of the conductor 177, and the connection is, therefore, extended to the trunk conductor 178 leading to the second-selector switch P. At the same time, the rotary trunk conductor 126 is placed in connection with the wiper 172, by the conductor 179, and through said wiper 172 with the trunk conductor 180 also reaching to the switch P. Furthermore, when the side switch wiper 161 passes into engagement with the contact point 181, which is grounded, a guarding potential is established at the private wiper 173 from ground G^{11} through the back-release relay 155, which is of low resistance, to the private wiper 173. As a result the engaged bank contact is also grounded, and, therefore, all other contacts connected in multiple therewith, for the purpose of preventing the switch P from being seized by some other switch. The subscriber having advanced the call thus far, again rotates the dial for the digit 2, sending a preliminary impulse to the rotary line conductor 17 and two impulses to the vertical line conductor 16, and again another impulse to the rotary line conductor 17. At this stage of the operation it should be explained that the first impulse to the rotary line conductor 17 for the second digit is of no consequence. However, the impulses to the vertical line conductor 16 pass through the bank springs 59 and 62, vertical trunk conductor 103, bank springs 115 and 116, vertical trunk conductor 125, side switch wiper 158 (Fig. 7), conductor 177, shaft wiper 171, trunk conductor 178 to the side switch wiper 183, thence to the vertical line relay 182 and to the battery lead 98, thence through battery B′ to ground G′. The vertical line relay 182 operates to energize the vertical magnet 184 in the manner already described in connection with the switch O, and as a result the shaft wipers 185, 186 and 187 are raised to a position opposite the first contact of the second bank level. After this has been done the last impulse to the rotary line 17 energizes the rotary line relay 188 over the following circuit: from ground G^2 to the rotary line conductor 17, thence through the springs 60 and 61, rotary trunk conductor 104, bank springs 117 and 118, rotary trunk conductor 126, side switch wiper 159 (Fig. 7), conductor 179, wiper 172, trunk conductor 180 to the rotary line relay 188, thence to battery lead 98, and through battery B′ to ground G′. The rotary line relay 188, upon energizing, in turn energizes the private magnet 189, by which operation the side switch is tripped to second position, whereby the side switch wiper 190 is put in engagement with the grounded contact point 191, and the energizing circuit for the rotary magnet 192 thereby closed. The rotary magnet then operates, in the manner explained in connection with the selector O, to rotate the shaft wipers 185, 186 and 187 into engagement with some idle trunk line the conductors 193, 194 and 195 of which are shown terminating in the connector switch R. Having thus extended the line to the connector R the subscriber again operates his dial for the third digit 2, grounding the line conductors 16 and 17 as before. The first impulse to the conductor 17, of course, is of no consequence; but the two impulses that are given to the vertical line conductor 16 energize the vertical line relay 196 of the connector R. The energizing circuit, it will be seen, extends from the substation ground G^2 over the conductors 16, 125, 178 and 193 (Figs. 6, 7 and 8) on the vertical side of the main line to the vertical line relay 196, and thence through battery B′ to ground G′. This relay 196, upon energizing, forces the spring 197 onto the ground spring 198, thereby energizing the vertical magnet 199 by a flow of current from ground G^{12} through the springs 198 and 197, and through the private magnet springs 200 and 201 to the side switch wiper 202, vertical magnet 199 to the battery lead 98, thence through battery B′ to ground G′. The vertical magnet operates to raise the shaft wipers 203, 204 and 205 to a position opposite the first contact of the second level of the connector banks. The rotary impulse to the line conductor 17, after this has been done, energizes the rotary line relay 206 by a flow of current from ground G^2 over the rotary conductors 17, 104, 126, 180 and 194 to the said relay 206, thence through battery B′ to ground G′. The said relay 206 then presses the spring 207 onto the ground spring 198, thereby energizing the private magnet 208 by a flow of current from ground G^{12} through said magnet 208 to battery B′. As a result the side switch is tripped to second position, when the magnet 208 energizes and deënergizes. By this operation the side switch wiper 202 is shifted from the contact point 209 of the first position to the contact point 210 of the second position, thereby substituting the rotary magnet 211 for the vertical magnet 199, bringing

the former under the control of the vertical line relay 196. The subscriber now operates the dial for the last digit naught, whereby ten successive impulses are delivered to the vertical line conductor 16 and one to the rotary line conductor 17. The vertical impulses energize vertical line relay 196, as before. This relay, however, now energizes the rotary magnet 211 ten steps, which magnet operates to rotate the shaft wipers 203, 204 and 205 onto the tenth set of contacts of the second level, which constitute the terminal of the desired telephone line. This having been accomplished the impulse to the rotary line conductor 17 again energizes the rotary line relay 206 at the connector R by a flow of current over the circuit previously described. The rotary line relay 206 in turn operates, again energizing the private magnet 208, whereby the side switch is tripped from second to third position, with the result that the trunk conductors 193 and 194 are extended into connection with the shaft wipers 203 and 204, respectively, whereby the calling subscriber's line is thus placed in connection with the called subscriber's line. It will be seen that by this operation the vertical line conductor 16 of the calling line is placed in connection with the vertical line conductor 212 of the called line, and that the rotary line conductor 17 of the calling line is placed in connection with the rotary line conductor 213 of the called line. The circuits connecting the conductors 16 and 17 and the conductors 212 and 213 are indicated by the heavy conductors in Figs. 6, 7 and 8 and, as shown, include the condenser 214 on one side, and the condenser 215 on the other side. When the side switch passes to third position, then not only is the calling line extended into connection with the called line, but a guarding potential is also established at the private wiper 205 from ground G^{13}, whereby all private bank contacts allotted to the called line are provided with means for preventing any other subscriber from calling the line #2220 while it is busy. Also, when the side switch wiper 227 passes to third position, while the private wiper 205 engages the private contact of the called line, an energizing circuit is established through the cut-off relay 225 of the line switch S of the called line, whereby the short-circuit that normally exists across the line is opened, and at the same time the trip magnet is disconnected from the line. After this circuit has been established the calling subscriber may signal the called subscriber by pressing the button 38 and thus grounding the vertical line conductor 16. As a result the vertical line relay 196 of the connector R is energized, which in turn causes the energizing of the ringer relay 216 by a flow of current from ground G^{12}_{1} to the side switch wiper 202, thence through the ringer relay 216 to battery B′ and to ground G′. The relay 216, upon energizing, it will be seen, disconnects the calling line from the called line and bridges the ringer generator U across the latter, whereby the bell 217 of the substation #2220 is rung. When the called subscriber answers it will be seen that the ringer 217 is disconnected from across the line, and that the circuit including the receiver 218 is bridged instead, whereby the called and calling subscribers may converse over the heavily marked circuit indicated in Figs. 6, 7 and 8. After the subscribers are through talking, either the calling or called subscriber may release the connection. If the calling subscriber hangs up his receiver first, he will release the connection by grounding the line conductors 16 and 17 simultaneously when the release springs 18, 19 and 20 come into contact. Grounding these conductors simultaneously energizes the line relays 206 and 196 of the connector R simultaneously, whereby the trunk-release springs 219 and 220 are pressed into contact. As a result the release magnet 221 of the connector R and the back-release relay 222 of the second-selector P (Fig. 7) are energized in series by a flow of current from ground G^{14} at the selector P through the side switch wiper 223 to the back-release relay 222, thence over the conductor 224 to the private wiper 187, trunk-release springs 219 and 220 of the connector R, thence through the release magnet 221 to the battery lead 98, and through battery B′ to ground G′. The release magnet 221, upon energizing, attracts its armature and thereby restores the connector side switch and switch shaft, as is well known. Upon the restoration of the shaft the wipers thereof are disengaged from the bank contacts, and among other results the circuit through the bridge-cut-off relay 225 is broken, whereby the said relay 225 is restored. At the same time that the release magnet 221 energizes, the back-release relay 222 of the second-selector P also energizes, which relay 222 then drives the springs 226 and 165 into contact. A circuit is thereby established, including in series the release magnet 227 of the selector P and the back-release relay 155 of the selector O. This circuit extends from ground G^{11} at the selector O to the side switch wiper 161, then through the back-release relay 155 to the conductor 228, private wiper 173, trunk-release conductor 166, back-release relay springs 165 and 226 to the release magnet 227, thence to the battery lead 98, and through battery B′ to ground G′. The release magnet 227 of the selector P then attracts its armature and remains in readiness to release the switch P as soon as the

energizing circuit is broken. The back-release relay 155 of the selector O in turn forces the springs 162 and 163 into contact, thereby closing an energizing circuit through the release magnet 154 of the selector O, and another circuit including in multiple the release magnets 96 and 45 of the switches N and J (Fig. 6). The release magnet 154 of the selector O being energized attracts its armature and remains in readiness to release the switch O as soon as the energizing circuit is broken, and the same is true with regard to the release magnets 96 and 45 of the switches N and J. The energizing circuit for the release magnet 154 extends from ground G^{15} through the springs 163 and 162 to the release magnet 154, thence through said magnet to the battery lead 98, and through battery B′ to ground G′. The energizing circuit for the release magnet 96 of the switch N also extends from ground G^{15} through the springs 163 and 162 to the trunk-release conductor 128, and thence through the release magnet 96 and the springs 132 and 131 to the battery lead 98, and through battery B′ to ground G′. The vertical magnet 45 of the switch J is in multiple with the magnet 96 and its energizing circuit extends from the trunk-release conductor 128 through the bank springs 120 and 119 to the trunk-release conductor 127, thence through the bank springs 57 and 56 to the release magnet 45 to the battery lead 98, thence through battery B′ to ground G′. The energization of all of these release magnets, of course, is practically instantaneous, and occurs at the time that the switch-hook, on descending, retains the release springs 18, 19 and 20 in contact. As the switch-hook 3 descends the said release springs 18, 19 and 20 disengage and the line relays 196 and 206 of the connector R deënergize, completely restoring the said connector. As soon as the trunk-release springs 219 and 220 separate, the energizing circuit for the back-release relay 222 of the selector P is broken, which in turn, upon deënergizing, breaks the energizing circuit of the release magnet 227, and of the back-release relay 155 of the selector O. This relay 155 in turn, upon deënergizing, destroys the energizing circuits for the release magnet 154 of the selector O, the release magnet 96 of the switch N, and the release magnet 45 of the switch J. By this operation the switches P and O are completely released and restored to normal condition, and also the switches N and J. By referring to Fig. 4 it will be seen that when the release magnet 45 energizes, the portion 51 of the trip magnet armature 50 rises and latches the rear portion 52 of the plunger arm 47. Then when the release magnet 45 deënergizes, the plunger arm 47 is, of course, drawn down so that the plunger 42 is withdrawn from the bank Q and restored to engagement with the plunger shaft. The releasing operation of the switches J and N (Fig. 6) being the same, it will be clear how the switches are restored by their respective release magnets upon deënergization of the same. If the called subscriber had restored his receiver 218 before the calling subscriber, nothing would have occurred unless he had previously operated his dial so as to bring the ground springs 229 and 230 into contact. In this event the back-bridge relays 231 and 232 would have energized simultaneously, so that the back-bridge relay springs 233 and 234 would have been brought into contact, with the result that the release magnet 221 of the connector would have been energized, and the connector switch restored, thereby breaking the energizing circuit of the bridge-cut-off relay 225 of the line switch S of the called line. The energizing circuit for said release magnet, in that case, would extend from ground G^{16} through the springs 233 and 234 to the release magnet 221, thence through battery B′ to ground G′. Of course, the calling subscriber, upon hanging up his receiver subsequently, would energize the line relays 196 and 206 of the connector R, causing the release of the remaining switches, as previously explained.

It will be evident that if the called subscriber's line is busy the connector switch R will be released at the instant that the last rotary impulse is sent in. As previously described, this rotary impulse energizes the private magnet 208, and as a result the private magnet springs 235 and 236 are brought into contact, thus completing an energizing circuit through the release magnet 221, said circuit extending from the grounded busy contact through the private wiper 205, side switch wiper 237, contact point 238 (the side switch being in second position), springs 235 and 236 to the release magnet 221, and to battery B′. In this way the connector switch would be released, and subsequently, when the calling subscriber presses his signaling button and grounds the vertical line conductor, the vertical line relay 196 of the connector R energizes the vertical magnet 199, which in turn causes the switch shaft to be raised, thereby closing into contact the switch shaft springs 239 and 240 at the connector R, and establishing a busy-signaling circuit from the busy machine V through the calling substation to notify the calling subscriber that the line is busy. Upon hanging up his receiver, of course, the calling subscriber will initiate the release already described.

The foregoing, therefore, describes how the subscriber L, whose line terminates in the main exchange, may call the subscriber M, whose line terminates in a district or auxiliary exchange. Now it remains to ex-

plain how the subscriber M of the district exchange may call any other subscriber. As far as the subscriber M is concerned the mode of operation is the same as that described in connection with the subscriber L, but the arrangement of the apparatus by means of which the subscriber M obtains connection with a first-selector is slightly different from that illustrated in Fig. 6. This arrangement is clearly shown in Fig. 16. There is substantially no difference in the circuits, the difference being in the mechanical arrangement. In Fig. 16, of course, the line switch S is the line switch of the subscriber M, which is also shown in Fig. 8. The auxiliary switch N′ is exactly the same as the auxiliary switch N (Fig. 6). Also, the master switch H′ (Fig. 16) is exactly the same as the master switch H (Fig. 6), while the master switches E′ and G take the place of the master switch E (Fig. 6). The only difference between the master switch E′ and the master switch E is that the upper half of the bank K, comprising the contacts x and the common segment x', has been removed and given to the master switch G. This master switch G is located at the main exchange and has a wiper, similar to the wiper of the master switch E, which travels over the bank contacts. Furthermore, this master switch G controls the plunger shaft F that controls the plungers of the auxiliary switches of the group of which the auxiliary switch N′ is a member. One difference in the electrical circuits, to which reference has been made, is that the motor magnet 241 for operating the master switch G (Fig. 16) has no interrupter of its own, but is connected in series with the motor magnet 67 of the master switch E, for the purpose of always maintaining the wipers of these two master switches in synchronism, so as to insure the idle switches of the group C being always opposite the same trunk line.

From the foregoing it will be seen that I provide primary and secondary non-numerical automatic trunking switches, with trunks between them, whereby any calling subscriber must extend a connection through two non-numerical trunking switches before obtaining connection with an idle first-selector. The primary non-numerical trunking switches J are the same in number as the subscribers' telephone lines, and the secondary non-numerical trunking switches N′ are the same in number as the first-selectors. The intermediate trunk lines, such as the trunk line comprising the conductors 103 and 104, can be arranged on a percentage basis, relative to the number of telephone lines, and can be either more or less in number than the secondary non-numerical trunking switches N, according to requirements. Furthermore, I find that with this arrangement the work is more evenly distributed between the different trunk lines and the first-selectors, so that the subscribers in the group are not liable to use one trunk and one first-selector more than the others, as the calls are more evenly distributed between the different trunks and switches. It will be seen that the said intermediate trunks are each provided with a set of multiple bank terminals at each end thereof, and that there are no automatic switches each of which is individual to one of said intermediate trunks. These intermediate trunks are one-way in character, being adapted for calling only in one direction, and do not terminate in switches for selecting other lines or trunks. In this way the only automatic switches associated with these intermediate trunks are the switches that are employed for selecting said trunks, and there are no selectors or trunking switches in which these intermediate trunks terminate for selecting other trunks. A calling subscriber, therefore, causes his individual switch to automatically select an idle trunk, and at the same time causes another automatic switch to select the same trunk, preferably at the other end thereof.

In this system it will be obvious that the resistances of the magnets may be varied to any extent consistent with the successful operation of the same. Not only may the resistances of the line relays (for example, relays 196 and 206) of the connector be varied, but the resistances of the operating magnets (for example, the release magnets 221, 227, 154, 96 and 45) may likewise be varied. It is also obvious that the springs used as contacts may be adjusted in any desired manner, and their tensions varied to any extent in order to control the speed and operation of the armature associated with them. For example, the springs of the motor magnet relays 68 and 133 may be stiffened or weakened as may be found convenient or desirable.

What I claim as my invention is:—

1. In a telephone automatic trunking system, a calling telephone line, a plurality of trunk lines, a plurality of progressively movable automatic switches associated with said trunk lines for calling purposes, and means for selecting an idle trunk line ahead of the call, any one of said automatic switches being responsive to an impulse from the calling subscriber for seizing the said preselected trunk line.

2. In a telephone automatic trunking system, a calling telephone line, a plurality of trunk lines, a plurality of progressively movable automatic switches associated with said trunk lines for calling purposes, and means for selecting an idle trunk line ahead of the call, said automatic switches being responsive to an impulse from the calling sub-

scriber for seizing opposite ends of the preselected trunk line.

3. In an automatic trunking system, a calling line, a trunk, a set of multiple terminals for each end of said trunk for use in seizing the same, a separate non-numerical automatic switch for each terminal, a progressively movable switch, said non-numerical switches responsive to the calling line for extending connection from said line to the trunk and to said progressively movable switch, said last mentioned switch controlled from the line for extending a connection beyond the trunk.

4. In a telephone automatic trunking system, a plurality of trunk lines, subscribers' individual non-numerical trunking switches for seizing idle trunk lines, a progressively movable automatic switch, and other automatic switches for selecting and seizing the same trunk lines, whereby each trunk line when brought into use by a calling subscriber is always seized by the subscriber's individual switch and one of said other automatic switches, for extending connection from a line to the trunk and to said progressively movable switch, said last mentioned switch controlled from the line for extending a connection beyond the trunk.

5. In a telephone automatic trunking system, a plurality of trunk lines, subscribers' individual non-numerical trunking switches for seizing idle trunk lines, a progressively movable automatic switch, and other automatic switches for selecting and seizing the same trunk lines, whereby each trunk line when brought into use by a calling subscriber is always seized at one end by the subscriber's individual switch and at the other end by one of said automatic switches, for extending connection from a line to the trunk and to said progressively movable switch, said last mentioned switch controlled from the line for extending connection beyond the trunk.

6. In a telephone system, a plurality of subscribers' individual trunking switches, a plurality of first-selectors less in number than the subscribers' individual switches, trunk lines leading to the first-selectors, trunking switches at the other end of said trunk lines, and trunks leading from the individual switches to said last-mentioned switches, each trunk provided with a set of multiple terminals at each end thereof, each terminal located in a different switch, and each trunk adapted for one-way trunking only.

7. In an automatic telephone system, a plurality of first-selectors, trunk lines leading to said first-selectors, an automatic trunking switch at the other end of each trunk line, allotted thereto, and suitable instrumentalities for automatically selecting and trunking a calling subscriber to an idle one of said automatic trunking switches, said switches responsive to impulses from the calling subscriber to extend a connection to a called subscriber.

8. In a telephone automatic trunking system, a plurality of trunk lines, a plurality of automatic switches, a calling telephone line, means for causing said switches to select an idle trunk line ahead of the call, said automatic switches being responsive to the calling subscriber for seizing the said preselected trunk line, each trunk line comprising a third conductor, and trunk-release circuits including said third conductors.

9. In a telephone automatic trunking system, a plurality of trunk lines, a plurality of automatic switches, a calling telephone line, means for causing said switches to select an idle trunk line ahead of the call, said automatic switches being responsive to the calling subscriber for seizing opposite ends of the preselected trunk line, each trunk line comprising a third conductor, and trunk-release circuits including said third conductors.

10. In a telephone system, a trunk line, means for selecting opposite ends of said trunk line, non-numerical automatic switches responsive to a calling subscriber for seizing opposite ends of said trunk line in making a call, each trunk line comprising a third conductor, and trunk-release circuits including said third conductors.

11. In an automatic trunking system, a one-way trunk, a set of multiple terminals for each end of said trunk, a separate non-numerical automatic switch for each terminal, each trunk comprising a third conductor, and trunk-release circuits including said third conductors.

12. In a telephone system, a trunk line, a set of multiple terminals for each end of said trunk line, each terminal located in a different bank, suitable non-numerical switching instrumentalities for connecting with a terminal at each end of said trunk line whenever the latter is to be employed for extending connection from a calling to a called subscriber, each trunk line comprising a third conductor, and trunk-release circuits including said third conductors.

13. In a telephone system, a plurality of subscribers' individual trunking switches, a plurality of first-selectors less in number than the subscribers' individual switches, trunk lines leading to the first-selectors, trunking switches at the other end of said trunk lines, trunks leading from the individual switches to said last-mentioned switches, each trunk provided with a set of multiple terminals at each end thereof, each terminal located in a different switch, and each trunk adapted for one-way trunking only, each

trunk line comprising a third conductor, and trunk-release circuits including said third conductors.

14. In an automatic telephone system, a plurality of first-selectors, trunk lines leading to said first-selectors, an automatic trunking switch at the other end of each trunk line, allotted thereto, suitable instrumentalities for automatically selecting and trunking a calling subscriber to an idle one of said automatic trunking switches, trunks leading from said first selectors, means for connecting said trunks with called lines, each trunk line comprising a third conductor, and trunk-release circuits including said third conductors.

15. In a telephone automatic trunking system, a calling telephone line, a plurality of trunk lines, a plurality of progressively movable automatic switches associated with said trunk lines for calling purposes, means for causing said switches to select an idle trunk line ahead of the call, any one of said automatic switches being responsive to an impulse from the calling subscriber for seizing the said preselected trunk line, and automatic connectors less in number than the subscribers and adapted for switching in accordance with the last two digits of any called number to make the final connection with the called subscriber's line.

16. In a telephone automatic trunking system, a calling telephone line, a plurality of trunk lines, a plurality of progressively movable automatic switches associated with said trunk lines for calling purposes, means for causing said switches to select an idle trunk line ahead of the call, said automatic switches being responsive to an impulse from the calling subscriber for seizing opposite ends of the preselected trunk line, and automatic connectors less in number than the subscribers and adapted for switching in accordance with the last two digits of any called number to make the final connection with the called subscriber's line.

17. In an automatic trunking system, a one-way trunk, a set of multiple terminals for each end of said trunk, a separate non-numerical automatic switch for each terminal, and automatic connectors less in number than the subscribers and controlled therefrom for switching in accordance with the last two digits of any called number to make the final connection with the called subscriber's line.

18. In a telephone system, a trunk line, a set of multiple terminals for each end of said trunk line, each terminal located in a different switch bank, suitable non-numerical switching instrumentalities for seizing a terminal at each end of said trunk line, responsive to a calling subscriber, whenever the trunk is employed for extending a call, and automatic connectors less in number than the subscribers and adapted for switching in accordance with the last two digits of any called number to make the final connection with the called subscriber's line, each connector controllable over the said trunk by the calling subscriber.

19. In a telephone automatic trunking system, a plurality of trunk lines, subscribers' individual non-numerical trunking switches for seizing idle trunk lines, other automatic switches for selecting and seizing the same trunk lines, whereby each trunk line when brought into use by a calling subscriber is always seized by the subscriber's individual switch and one of said automatic switches, and automatic connectors less in number than the subscribers and controlled thereby for switching in accordance with the last two digits of any called number to make the final connection with the called subscriber's line.

20. In a telephone automatic trunking system, a plurality of trunk lines, subscribers' individual non-numerical trunking switches for seizing idle trunk lines, other automatic switches for selecting and seizing the same trunk lines, whereby each trunk line when brought into use by a calling subscriber is always seized at one end by the subscriber's individual switch and at the other end by one of said automatic switches, and automatic connectors less in number than the subscribers and controlled thereby for switching in accordance with the last two digits of any called number to make the final connection with the called subscriber's line.

21. In a telephone system, a plurality of subscribers' individual trunking switches, a plurality of first-selectors less in number than the subscribers' individual switches, trunk lines leading to the first-selectors, trunking switches at the other end of said trunk lines, trunks leading from the individual switches to said last-mentioned switches, each trunk provided with a set of multiple terminals at each end thereof, each terminal located in a different switch, and each trunk adapted for one-way trunking only, and automatic connectors less in number than the subscribers and adapted for switching in accordance with the last two digits of any called number to make the final connection with the called subscriber's line.

22. In a telephone system, a calling line, a plurality of subscribers' individual trunking switches, a plurality of first-selectors less in number than the subscribers' individual switches, trunk lines leading to the first-selectors, trunking switches at the other end of said trunk lines controlled from said calling line, trunks leading from the individual switches to said last-mentioned

switches, each trunk provided with a set of multiple terminals at each end thereof, each terminal located in a different switch, and each trunk adapted for one-way trunking only second-selectors for trunking in accordance with the second digit of any called number, and automatic connectors for switching in accordance with the last two digits of any called number, in response to impulses from said calling line.

23. In an automatic telephone system, a calling line, a plurality of first-selectors, trunk lines leading to said first-selectors, an automatic trunking switch at the other end of each trunk line, allotted thereto and controlled from said calling line, suitable instrumentalities for automatically selecting and trunking a calling subscriber to an idle one of said automatic trunking switches, trunks leading from said first selectors, means for connecting said trunks with called lines, said means including second-selectors for trunking in accordance with the second digit of any called number, and automatic connectors for switching in accordance with the last two digits of any called number, in response to impulses from said calling line.

24. A telephone trunking system comprising a master switch having a shaft, a plurality of trunking switches each provided with a plunger adapted to be operated by said shaft, an actuating magnet for each trunking switch, an energizing circuit for each magnet, and means for controlling said circuits by the operative engagement of said plungers with said shaft.

25. In a telephone system, a plurality of trunking switches, a master switch therefor, each trunking switch being provided with a plunger, an actuating magnet for each trunking switch, and an energizing circuit for each magnet, each energizing circuit including a portion of one of said plungers.

26. In a telephone system, a plurality of trunking switches each provided with a plunger, a long shaft for operating said plungers, an actuating magnet for each trunking switch, and contacts located on the shaft and adapted to be engaged by said plungers, each contact being connected with one terminal of one of said magnets.

27. In a telephone exchange system divided into groups, a plurality of trunk lines, a plurality of automatic switches, a calling telephone line, means for selecting an idle trunk line ahead of the call, said automatic switches being responsive to the calling subscriber for seizing the said preselected trunk line, and means controllable over the seized trunk line and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group in response to impulses from said calling line.

28. In a telephone exchange system divided into groups, a plurality of trunk lines, a plurality of automatic switches, a calling telephone line, means for selecting an idle trunk line ahead of the call, said automatic switches being responsive to the calling subscriber for seizing opposite ends of the preselected trunk line, and means controllable over the seized trunk line and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group in response to impulses from the calling line.

29. In a telephone exchange system divided into groups, a calling line, a plurality of subscribers' individual trunking switches, a plurality of first selectors less in number than the subscribers' individual switches, trunk lines leading to the first selectors, trunking switches at the other end of said trunk lines controlled from said calling line, trunks leading from the individual switches to said last-mentioned switches, each trunk provided with a set of multiple terminals at each end thereof, each terminal located in a different switch, and each trunk adapted for one-way trunking only, and means controlled over the selected trunk line and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group in response to impulses from said calling line.

30. In a telephone exchange system divided into groups, a plurality of first selectors, trunk lines leading to said first selectors, an automatic trunking switch at the other end of each trunk line, allotted thereto, suitable instrumentalities for automatically selecting and trunking a calling subscriber to an idle one of said automatic trunking switches, and means controlled over the selected trunk line and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group in response to impulses from the calling subscriber.

31. In a telephone exchange system divided into groups, a master switch having a shaft, a plurality of trunking switches each provided with a plunger adapted to be operated by said shaft, an actuating magnet for each trunking switch, an energizing circuit for each magnet, means for controlling said circuits by the operative engagement of said plungers with said shaft, and means accessible through any one of said switches and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group.

32. In a telephone exchange system divided into groups, a plurality of trunking switches, a master switch therefor, each trunking switch being provided with a plunger, an actuating magnet for each trunking switch, an energizing circuit for each mag-

net, each energizing circuit including a portion of one of said plungers, and means accessible through any one of said switches and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group.

33. In a telephone exchange system divided into groups, a plurality of trunking switches each provided with a plunger, a long shaft for operating said plungers, an actuating magnet for each trunking switch, contacts located on the shaft and adapted to be engaged by said plungers, each contact being connected with one terminal of one of said magnets, and means accessible through any one of said switches and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group.

34. In a telephone exchange system divided into groups, a calling line, a pair of non-numerical automatic trunking switches controlled from said calling line for seizing opposite ends of a trunk line, means for calling over said trunk line in one direction only, and means controllable over the trunk line and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group in response to impulses from said calling line.

35. In a telephone exchange trunking system divided into groups, a calling line, two non-numerical automatic trunking switches controlled from said calling line for seizing opposite ends of a trunk line in making a call, and means controllable over the trunk line and operative by vertical motion to select groups and by rotary motion to find the called line in any selected group in response to impulses from said calling line.

36. In a telephone exchange system, a calling line, a plurality of trunk lines, a plurality of automatic progressively movable switches, another switch, means for automatically selecting an idle trunk line ahead of each call, said automatic switches controlled successively from said calling line for seizing the said preselected trunk line to thereby place said other switch under the control of the calling line.

Signed by me at Chicago, Cook county, Illinois, this 7th day of August, 1907.

EDWARD D. FALES.

Witnesses:

ARTHUR B. SPERRY,

HARRIETT M. MERRIAM.