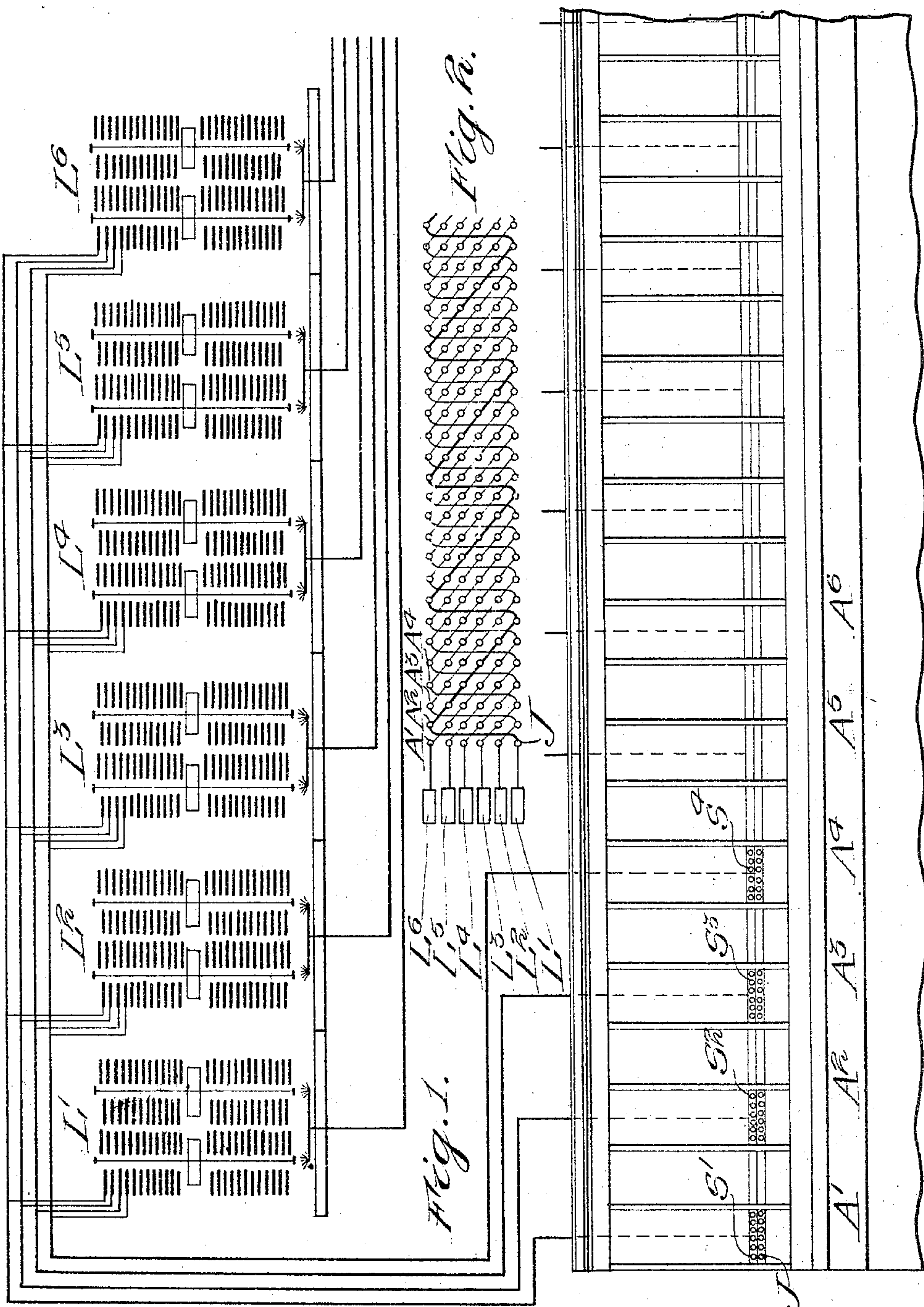


W. L. CAMPBELL.
 AUTOMATIC TELEPHONE TRUNKING SYSTEM.
 APPLICATION FILED MAY 12, 1908.

1,199,156.

Patented Sept. 26, 1916.

8 SHEETS—SHEET 1.



Witnesses.
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 S. B. S. S. S.

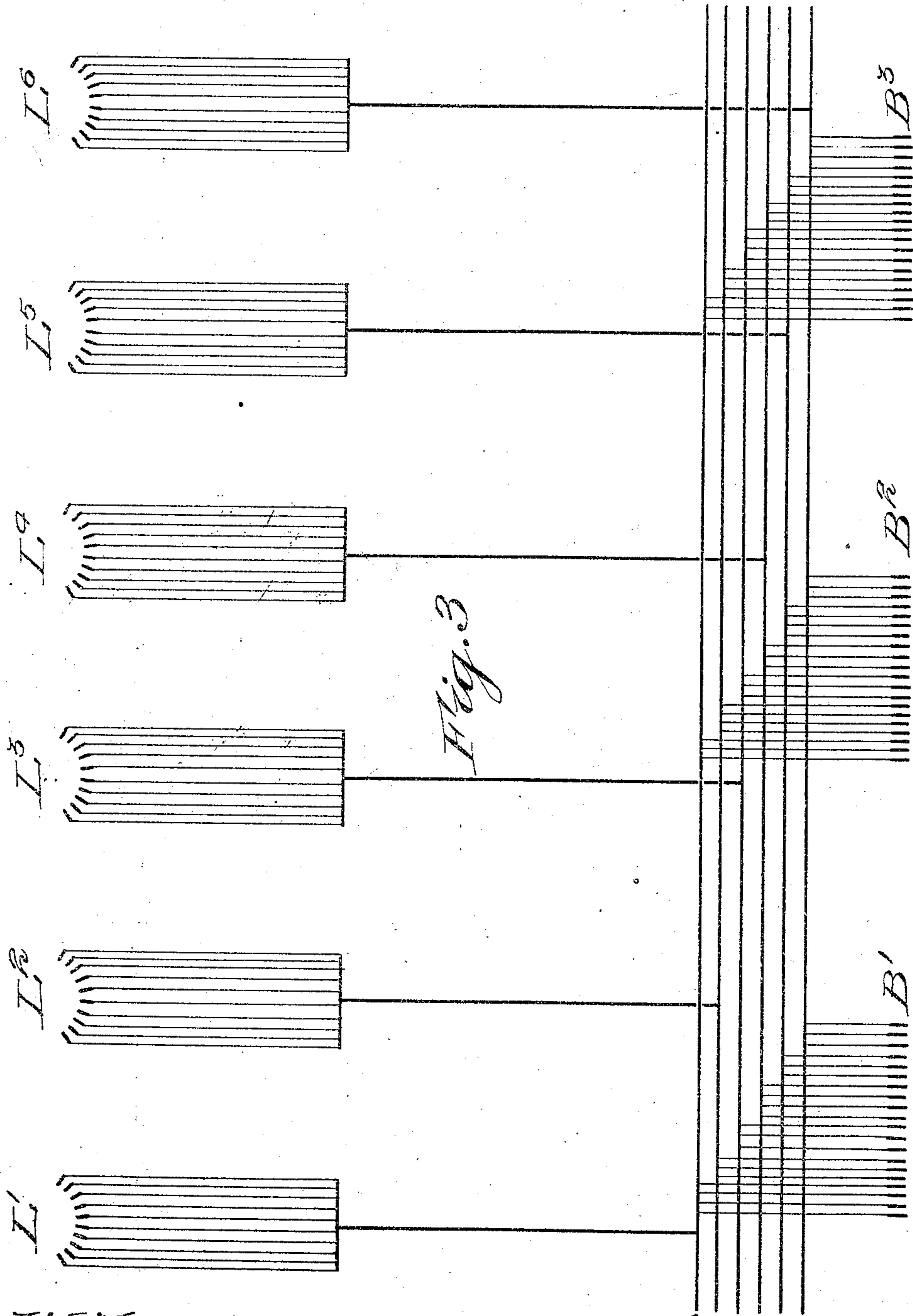
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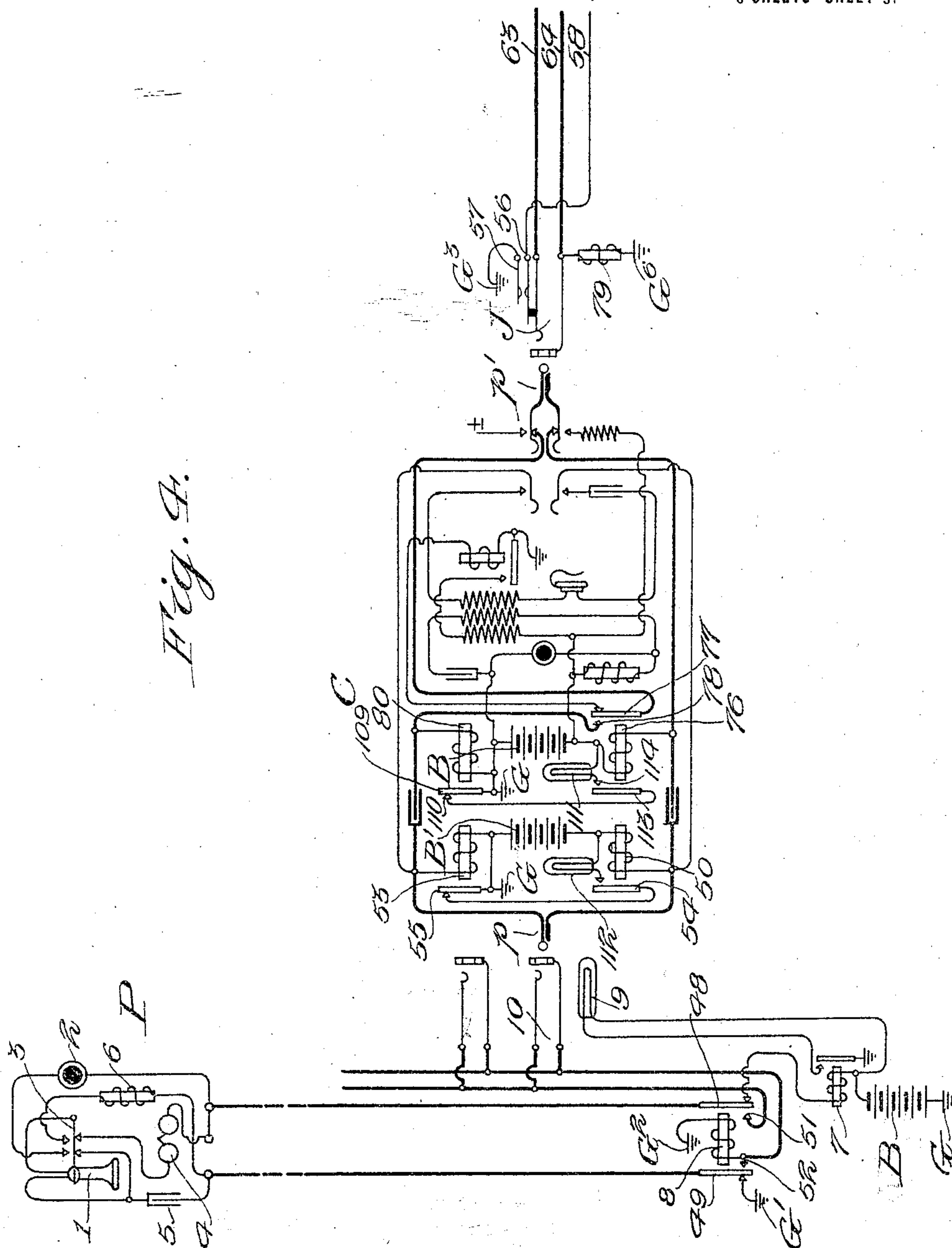


Fig. 4.

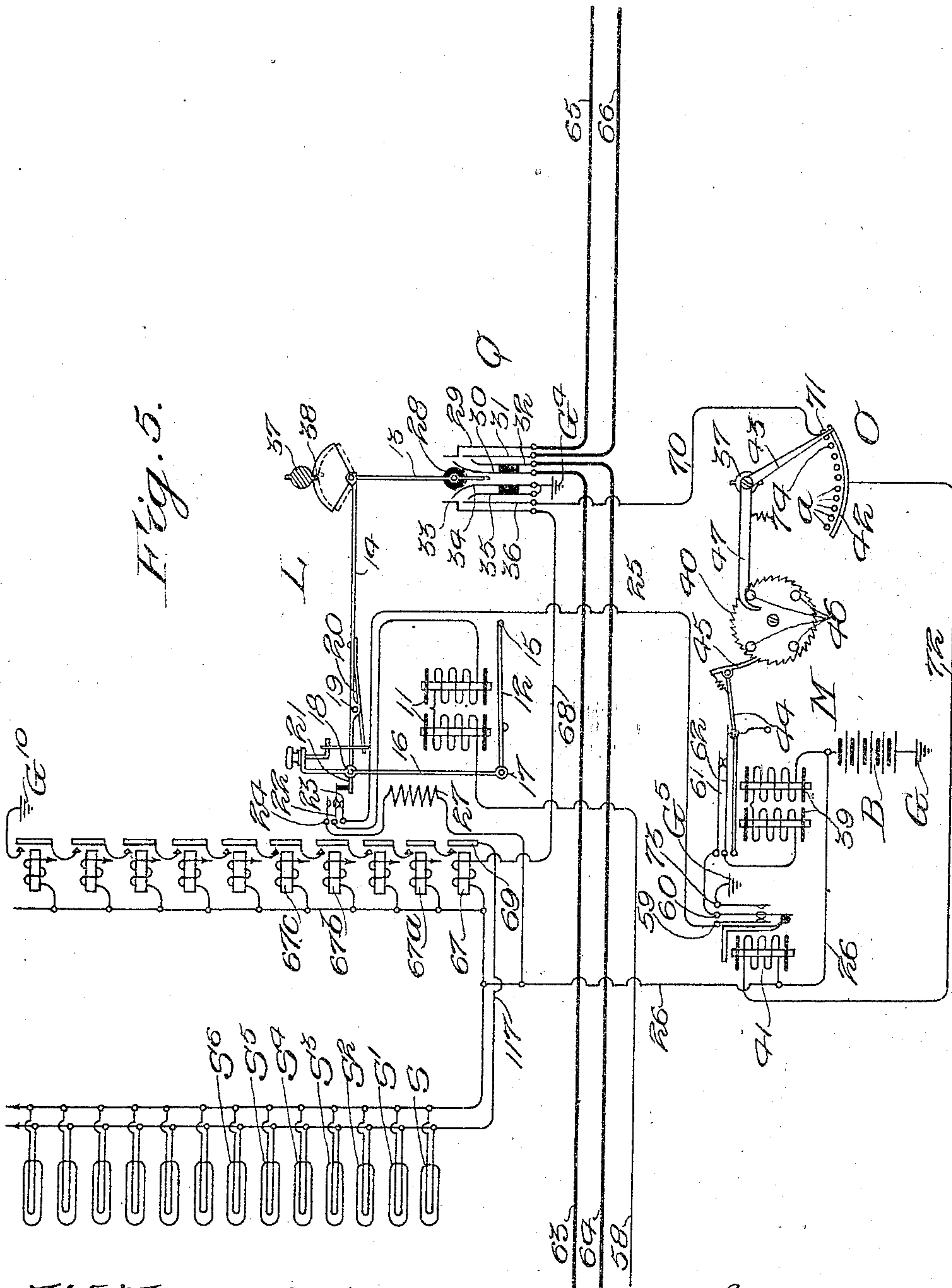
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8 SHEETS—SHEET 4.



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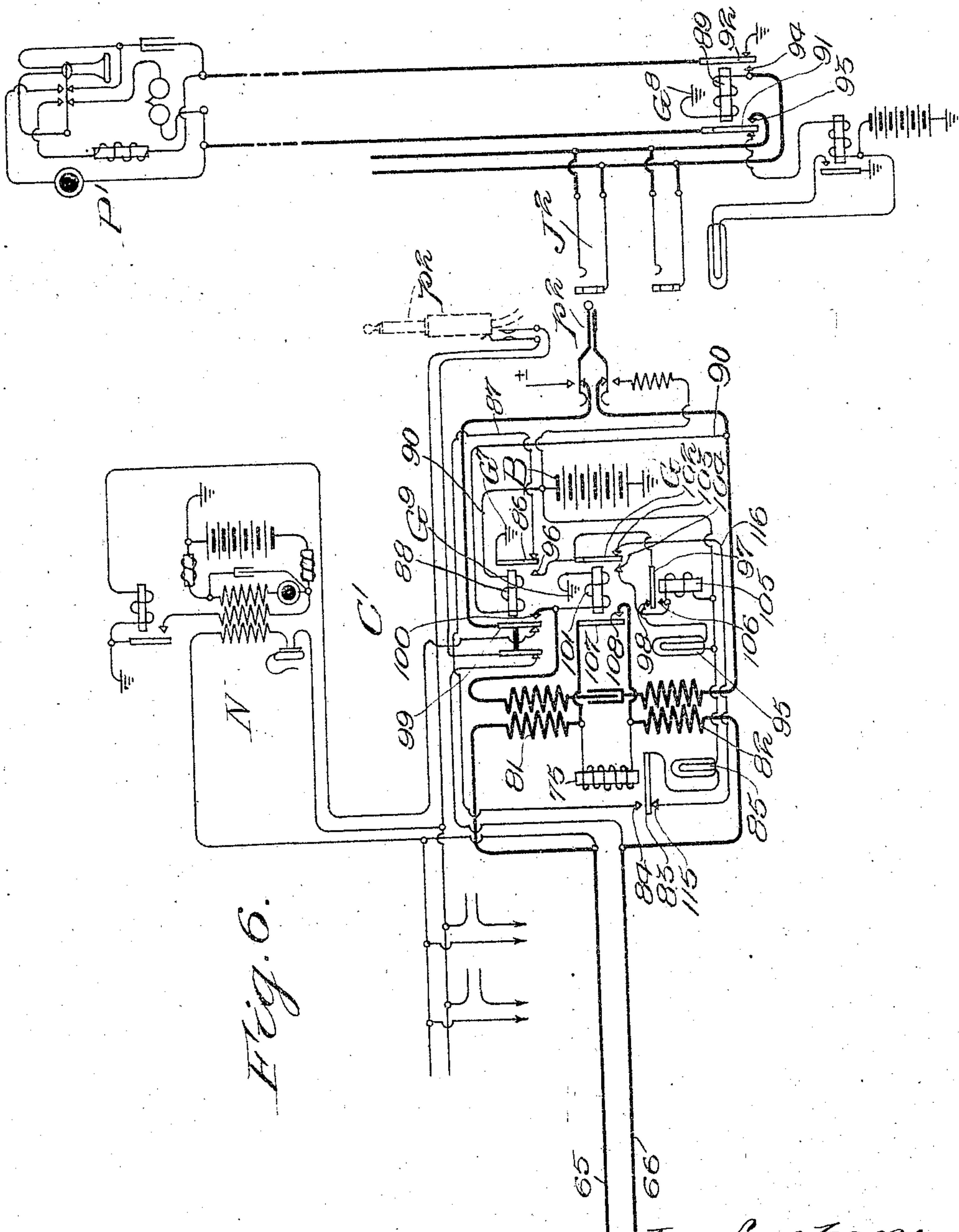


Fig. 6.

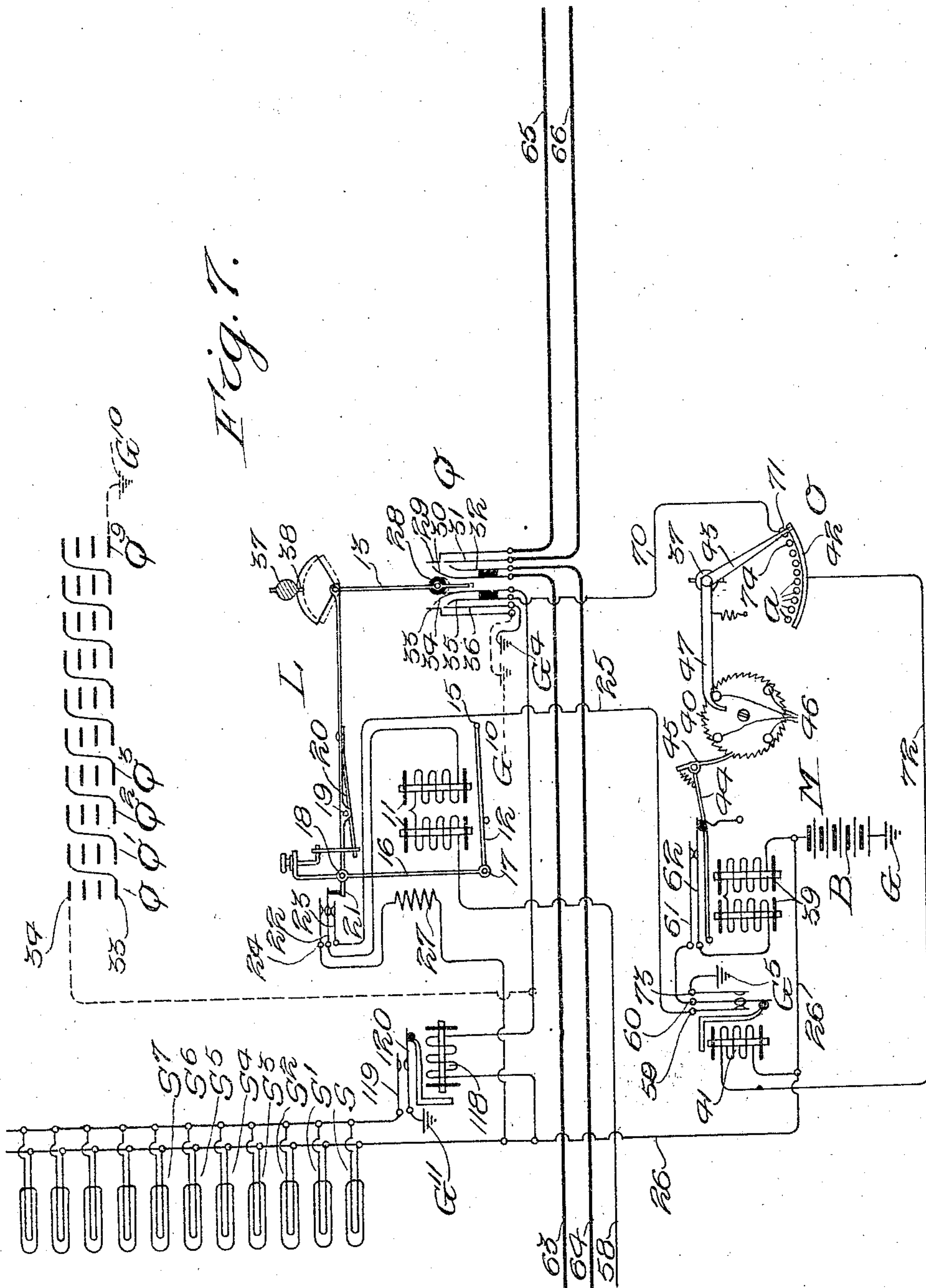
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8 SHEETS—SHEET 6.

1,199,156.



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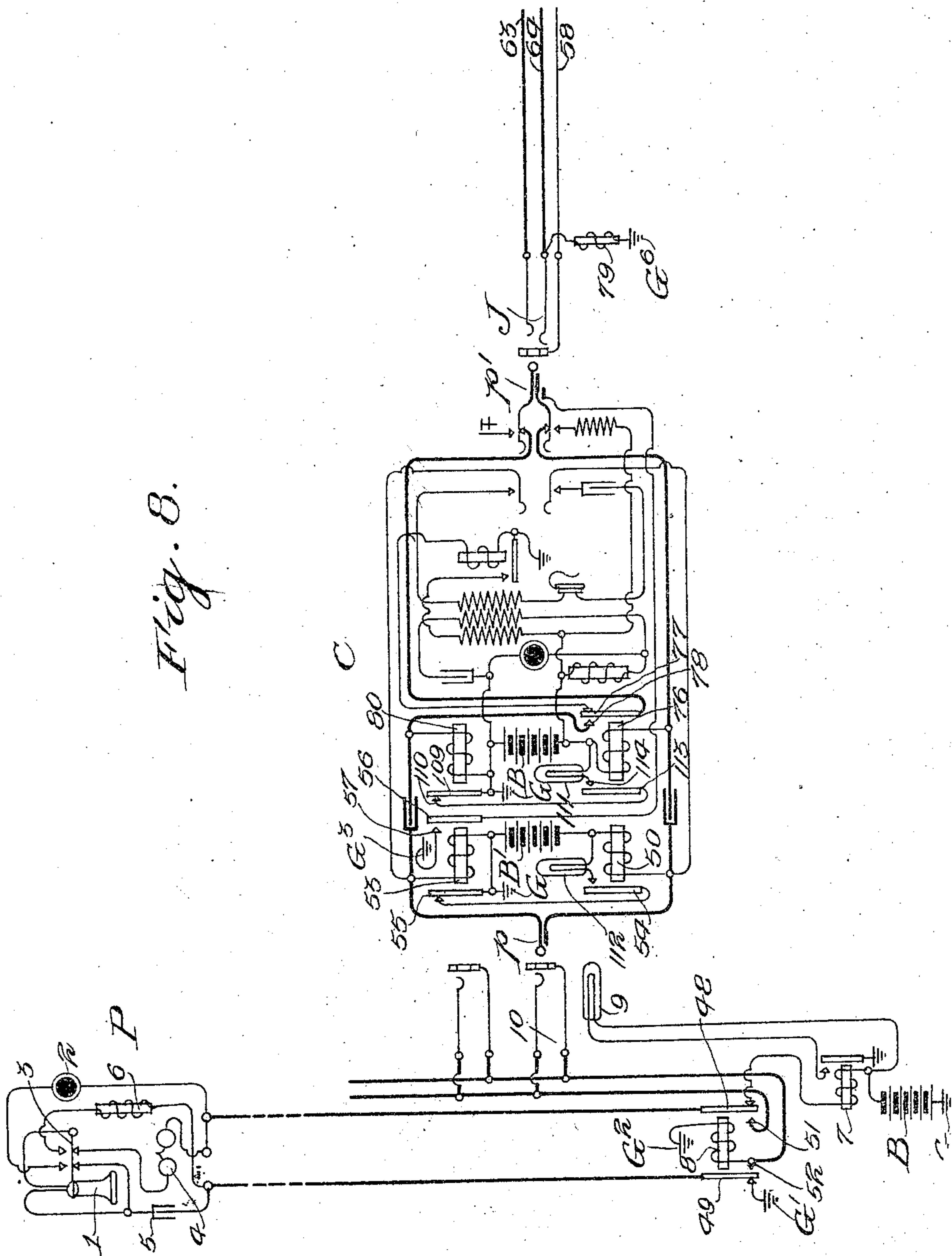
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8 SHEETS—SHEET 7.



Witnesses:
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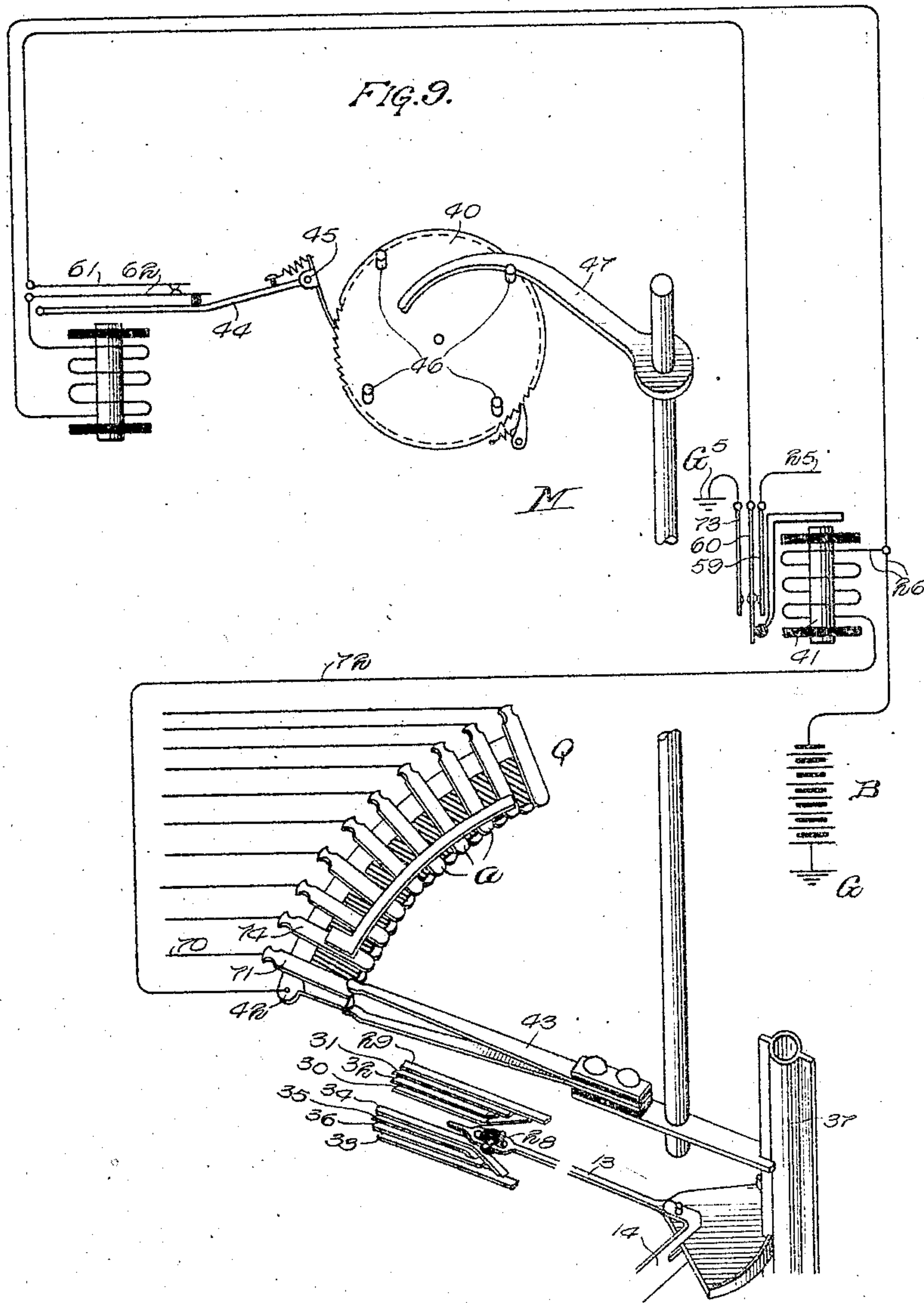
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1,199,156.

Patented Sept. 26, 1916.

8 SHEETS—SHEET 8.



WITNESSES

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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE TRUNKING SYSTEM.

1,199,156.

Specification of Letters Patent.

Patented Sept. 26, 1916.

Application filed May 12, 1908. Serial No. 432,551.

To all whom it may concern:

Be it known that I, WILSON L. CAMPBELL, 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 Automatic Telephone Trunking Systems, of which the following is a specification.

My invention relates to telephone systems in general, but more particularly to systems having a divided central, or in which more than one exchange is employed, thus necessitating trunking between the boards of the same or different exchanges. In systems of this kind the calling subscriber's line terminates at one board, or at one exchange, and the called subscriber's line terminates at another board, or at a different exchange, when a subscriber of one division or exchange calls a subscriber of another division of the same system. In such case it is usual for the operator to trunk the calling subscriber into connection with the board of the called subscriber, or into connection with the more or less distant exchange of the called subscriber, and then another operator completes the connection with the called subscriber's line. In exchanges of this kind the different switchboards are sometimes-referred to as A and B boards, and the operators thereof as A and B operators, and it is the trunking between the A and B boards, or the A and B operators, to which my invention more particularly relates. Ordinarily this trunking is purely manual, and is only accomplished after the originating operator—that is to say, the operator who receives the call from the calling subscriber—has ascertained which of the different trunks is idle and in condition to be used for trunking the call to the other board, or to the other exchange. Such an arrangement requires what are ordinarily known as order wires between the different operators, over which one operator gives the other instructions as to which trunk is to be used, etc., which arrangement and mode of operation are more or less inefficient, as considerable time is wasted.

The principal object of my invention is, therefore, the provision of means whereby the selection of trunks between the A and B boards, or between the different exchanges, is purely automatic, and preferably of such character that an idle trunk is automati-

cally found as a result of the simple act on the part of the originating operator of plugging into a trunking jack—that is to say, of such character that the operator who receives the call from the calling subscriber need not endeavor to ascertain which of the different trunks can be used for extending the call to the other board, or to the other exchange, but may simply plug into a jack and thereby automatically connect with an idle trunk.

It is also an object of my invention to provide means whereby the said jacks may have signals for indicating when they are busy—that is to say, of such character that the operator may instantly determine which jacks are in condition for extending connection to a trunk, it being understood that when all of the trunks which are accessible through the medium of any particular jack are busy, a signal is then displayed at such jack, and the operator understands instantly that in order to obtain an idle trunk she must plug into some other jack at which no signal is displayed.

In the preferred form of my invention, as herein disclosed, the automatic selection of trunks precedes the calls, so that when an operator plugs into a trunking jack, connection is immediately made with a trunk that has been selected beforehand, whereby the plugging into a trunking jack is followed only by an automatic connection with the preselected idle trunk leading to the other board, or to the other exchange, and the automatic selection of another trunk for the next call.

My invention also consists in certain improvements in the automatic trunking switches, more especially with reference to the operating circuits for the combined trip and release magnets of said switches, as well as the locking circuits therefor, as will hereinafter more fully appear.

It is also an object of my invention to provide certain details and features of improvement and combination tending to increase the general efficiency and serviceability of a telephone exchange system of this particular character.

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

In the accompanying drawings, Figure 1 represents diagrammatically a manual

switchboard, showing the A operators' positions A^1, A^2, A^3, A^4 , etc. From each operator's position trunk lines are shown leading to the line switch groups L^1, L^2, L^3, L^4 , etc., and from the line switch groups are trunk-lines leading to the B operators' positions. Fig. 2 shows diagrammatically the manner in which the trunk-lines to the line switch groups are assigned to the different A operators' positions. Fig. 3 shows diagrammatically the method of distributing the trunks among the B operators' positions B^1, B^2, B^3 , etc. Fig. 4 represents diagrammatically a subscriber's substation P and an A operator's cord-circuit C. Fig. 5 shows a trunk-line switch L and its master switch M. Fig. 6 shows a B operator's cord-circuit C^1 and a subscriber's substation P^1 . Fig. 7 is a modification of the apparatus shown in Fig. 5, as will be explained. Fig. 8 is a modification of the cord-circuit C shown in Fig. 4. Fig. 9 is a diagrammatic representation of the essential features of the so called master switch M shown in Fig. 5.

In the various figures the means for supplying current consists of several batteries. There may be, however, but one battery, or there may be one battery for each exchange. The subscriber's substation P as shown in Fig. 4, is of the usual common battery type, and comprises a receiver 1, transmitter 2, switch-hook 3, ringer 4, condenser 5 and impedance coil 6. Allotted to the line of the substation P at the central office are the line and cut-off relays 7 and 8, line lamp 9 and answering jack 10.

The A operator's cord-circuit may be any suitable cord-circuit. The one shown at C is similar to that disclosed in United States Letters Patent No. 12,090, reissued March 3, 1903, to W. W. Dean, and may be readily understood upon referring to the aforesaid patent.

The trunk line switch L (Fig. 5) is of the same general form as that disclosed in United States application for Letters Patent Serial No. 311,327, filed April 12, 1906, by A. E. Keith. The switch L is provided with a magnet 11 that performs not only the functions of a release magnet, but also an additional function which the release magnet in the said application does not perform. The magnet 11 of the switch L is designed to also remain energized while the switch is in operation. This magnet 11 serves both as a trip magnet and as a release magnet, and when the said magnet is energized the armature 12 is attracted, moving the plunger arm 14 about its pivot point. The plunger 13 is in turn thrust into the switch bank Q. Now, when the magnet de-energizes, the armature 12 then returns to normal position, thereby returning the plunger 13 to normal position. Thus, through

the medium of the magnet 11 the plunger is thrust into the bank and then withdrawn. The armature 12 is pivotally secured to the switch frame (not shown) at the point 15, and at the other end the arm 16 is pivotally secured to the pin 17. The connecting link 16 is in turn pivotally secured at the point 18 to the plunger arm 14, which rotates about the pin 19. By means of the spring 20 the plunger arm mechanism is restored to normal position upon the deenergization of the magnet 11. The plunger arm 14 is provided with a finger 21 which, when the plunger is operated, shifts the spring 22 out of engagement with the spring 23 and into engagement with the spring 24. By this operation the magnet 11 is disconnected from the conductor 25 which leads to the motor magnet, and is connected to the battery lead 26 through the resistance coil 27. Said line switch is provided with a bank of terminals, usually ten in number but only one of which is shown at Q. As shown, the said terminal Q is displaced from its true position relative to the plunger 13, and the bushing 28 is correspondingly turned around, all for the purpose of making the diagrammatic illustration clearer. The terminal Q comprises the springs 29 and 30, 31 and 32, 33 and 34, and 35 and 36. Said springs are normally disconnected from each other, but are driven into contact in pairs, as above indicated, when the plunger 13 operates. When the plunger 13 is in locked engagement with the plunger shaft 37, the notch 38 is in engagement with the flange or web of the shaft 37, and when in sliding engagement the fan-like tailpiece of the plunger 13 rests upon the edge of the flange or web, as shown by the dotted lines—that is, when the plunger shaft is operated the plunger 13 is not carried along with the locked plungers, but remains in the dotted position, the plunger shaft sliding upon the end.

The general operation of the switch is as follows: The magnet 11 is energized when an A operator inserts a plug in the jack J and the armature 12 is attracted against the magnet cores. The armature 12, upon thus operating, moves the plunger arm 14 about the pivot point 19, and thrusts the plunger 13 into the bank terminal Q. The switch is restored when the operator withdraws the plug from the jack J (Fig. 4), thus breaking the energizing circuit for the magnet 11. Accordingly, the magnet 11 deenergizes, permitting its armature 12 to return to normal position, thus withdrawing the plunger 13 from the bank terminal Q. Also, since the plunger shaft 37 has advanced one step, the tail-piece of the plunger 13 comes to rest in the position shown by the dotted line—that is, in sliding engagement with the plunger shaft 37; and as the said plunger

shaft advances each time an idle trunk is seized, the plunger 13 is not advanced, but remains in this position opposite the trunk terminal from which it has just disengaged, since the slot 38 is not in engagement with the plunger shaft. After all of the trunk-lines have been successively seized and the shaft 37 is released from this last position, the said shaft then starts toward starting point, or normal position, and picks up the plunger 13 when the web or flange of the said shaft over which the slot 38 normally rides arrives at the position at which the plunger 13 was originally released—that is, the plunger passes into locked engagement with the shaft. From thence on the plunger 13 is carried by the shaft 37 until it is again released when another call is made; but if, after the plunger is released and before the shaft 37 returns to pick up the said plunger, the switch C is again operated, the plunger 13 again engages the same terminal Q.

The master switch M, which may be of any suitable or approved type, is provided for operating the plunger shaft 37, and for controlling certain circuits that will be disclosed hereinafter. It comprises the following details: the motor magnet 39 for operating the ratchet wheel 40, which latter is designed for operating the plunger shaft 37, and a relay 41 for controlling the energizing circuit of the motor magnet 39. The master switch also has a bank O comprising a set of contacts *a* and a common metallic segment 42. The wiper 43 is adapted to remain in constant engagement with the bank O and to maintain one of the segments *a* in electrical connection with the common segment 42. The motor magnet 39 is provided with an armature 44 upon the end of which is mounted a pawl 45. When the magnet 39 energizes, the pawl 45 operates the ratchet wheel 40, thereby turning the pin 46 one notch. The pin 46, upon turning, bears against the cam-arm 47, which in turn moves the plunger shaft 37.

The operator's cord-circuit C¹ (Fig. 6) may be any suitable cord-circuit, and the one shown is similar to that disclosed in United States Letters Patent No. 841,747, granted January 22, 1907, to H. G. Webster.

A clearer understanding of my invention may be had from an explanation of its operation when one subscriber calls another. Suppose, for example, that the subscriber at substation P desires to speak with the subscriber at substation P¹, the line of which terminates in a second exchange. When the subscriber at substation P removes his receiver from the switch-hook an energizing circuit is established through the line relay 7, said circuit extending from battery B through the line relay 7, armature 48 to the line conductor, then through the substation

P, over the line and through the armature 49 to ground G¹. The line relay 7 energizes and closes the circuit through the line lamp 9. The operator then inserts the plug *p* into the answering jack 10, whereupon a circuit is closed through the cut-off relay 8, said circuit extending from ground G² through the cut-off relay 8, through the sleeve of the jack 10 and the sleeve of the plug *p*, relay 50, thence through battery B¹ and to ground G. The cut-off relay 8 thereupon energizes and attracts its armatures 48 and 49 into engagement with the contact points 51 and 52. The subscribers' lines are then extended to the jack 10, and the substation transmitter is provided with talking battery current from ground G through the relay 53, through the tip of the plug and jack to the contact point 51, armature 48, transmitter 2, through the switch-hook 3, impedance coil 6, armature 49, contact point 52, through the sleeve of the jack and plug, relay 50 and to battery B¹. The relays 50 and 53 thereupon energize and attract their respective armatures 54 and 55.

The operator, upon learning that a subscriber of a distant exchange is wanted, inserts the plug *p*¹ into the trunk jack J. When the plug *p*¹ enters the jack the springs 56 and 57 are pressed into contact, thereby closing an energizing circuit through the magnet 11 of the line switch L (Fig. 5). This circuit extends from ground G³ through the springs 57 and 56, conductor 58 (Fig. 5), through the magnet 11, springs 22 and 23, motor magnet relay springs 59 and 60, motor magnet springs 61 and 62, through the winding of the motor magnet 39 to the battery B, and thence to ground G. The magnet 11 thereupon energizes and operates to thrust the plunger 13 into the bank Q, but on account of the comparatively high resistance of the magnet 11, sufficient current does not flow to energize the magnet 39. When the plunger enters the bank the springs 29 and 30, 31 and 32, 33 and 34, and 35 and 36 are pressed into contact. The engagement of the springs 29 and 30 and 31 and 32 extends the trunk conductors 63 and 64 to the trunk conductors 65 and 66 (Fig. 5), which terminate in the B operator's cord-circuit C¹ (Fig. 6). Also, when the plunger 13 engages the bank Q and presses the springs 33 and 34 into contact an energizing circuit is closed through the signal relay 67. This circuit extends from ground G⁴ through the springs 34 and 33, conductor 68, through the winding of the relay 67 to battery lead 26, thence through battery B and to ground G. The relay 67, upon energizing, attracts its armature 69, which operation is without effect at this time. When the plunger 13 engages the bank terminal Q and presses the springs 35 and 36 into contact an energizing circuit

is established through the motor magnet relay 41, which in turn operates to close an energizing circuit through the motor magnet 39. The motor magnet then operates to advance all idle plungers which are in locking engagement with the shaft 37 to a position opposite the next idle bank terminal similar to the terminal Q. The circuit through the relay 41 extends from ground G^4 through the springs 35 and 36, conductor 70, contact point 71, common segment 42, conductor 72, through the winding of the relay 41 to the battery lead 26, thence through battery B to ground G. The relay 41, upon energizing, operates to shift the spring 60 out of engagement with the spring 59 and into contact with the spring 73, thereby closing an energizing circuit through the motor magnet 39 extending from ground G^5 through the springs 73 and 60, motor magnet springs 61 and 62, through the motor magnet 39 to the battery B, thence to ground G. The motor magnet 39 operates to advance the plunger shaft 37 and all engaging or locked plungers one step to a position opposite another trunk terminal similar to the trunk terminal Q, assuming that the next trunk-line is idle. Consequently, the wiper 43 is carried from the contact point 71 to the contact point 74. Furthermore, when the line switch L operates, as explained, the spring 22 is carried out of contact with the spring 23 and into contact with the spring 24, whereby a new energizing circuit is established for the magnet 11. This circuit extends from ground G^3 at the jack J (Fig. 4) over the conductor 58, through the magnet 11 (Fig. 5), springs 22 and 24, through the resistance coil 27 to the battery lead 26, thence through battery B to ground G. When the line switch L thus operates, the A operator (Fig. 4) selects a trunk-line leading to the B operator in the distant exchange (Fig. 6). When the trunk conductors 63 and 64 (Fig. 4) are thus extended to the trunk conductors 65 and 66 (Fig. 6), an energizing circuit is closed through the supervisory relay 75. First, however, it will be shown how the relay 76 of the cord-circuit C (Fig. 4) operates to close the armature 77 and the contact point 78 in contact, whereby the tip line conductor is extended from the answering plug p to the calling plug p^1 .

The energizing circuit for the relay 76 extends from ground G^6 at the jack J through the impedance coil 79, sleeve of the jack J and sleeve of the plug p^1 , through the relay 76, thence through battery B to ground G. The relay 76 thereupon energizes and moves its armature 77 into engagement with the contact point 78. When this is done the energizing circuit through the supervisory relay 75 of the cord circuit C^1 (Fig. 6) is completed. This circuit extends from

ground G through the relay 80 of the cord-circuit C, contact point 78, armature 77, through the ringing key, tip of the plug p^1 and tip of the jack J, trunk conductor 63, through the trunk-line switch springs 30 and 29 to the trunk conductor 65 (Fig. 6), thence through the winding 81 of the repeating coil, relay 75, winding 82 of the repeating coil, trunk conductor 66, line switch bank springs 31 and 32, conductor 64, through the sleeve of the jack and plug p^1 , ringing key springs, through the relay 76 to battery B, thence to ground G. Of the relays included in this circuit the relays 76 and 75 energize, the relay 75 being of such high resistance relative to the relay 80 that sufficient current does not flow to operate the latter. The relay 75, however, upon energizing, moves the armature 83 into engagement with the contact point 84, whereby a circuit is completed through the signal lamp 85. This circuit extends from ground G^7 through the armature 86, conductor 87, contact point 84, armature 83, through the lamp 85, thence through battery B to ground G. The B operator, upon observing the signal, removes the plug p^2 from its seat, thereby connecting the operator's set N with the trunk conductors 65 and 66, and upon learning that the subscriber at substation P^1 is wanted the B operator inserts the plug p^2 into the jack J^2 . When the plug p^2 enters the jack J^2 an energizing circuit is established through the signal relay 88 extending from ground G^8 through the cut-off relay 89, sleeve of the jack J^2 and plug p^2 , through the conductor 90, winding of the relay 88, thence through battery B to ground G. The relay 88 and the cut-off relay 89 thereupon energize. When the relay 89 energizes, its armatures 91 and 92 are placed in engagement with the contact points 93 and 94, whereby the subscribers' line conductors are extended to the jack J. When the relay 88 energizes, the circuit previously traced through the signal lamp 85 is destroyed and a new circuit is established through the lamp 95 instead. Also, the armature 99 is placed in engagement with the contact point 100, thereby completing the connection of the tip conductor. This circuit extends from ground G^7 through the armature 86 and contact point 96, armature 97, contact point 98, through the signal lamp 95, thence to battery B and to ground G. The operator then presses the ringing key to signal the subscriber at substation P^1 . The subscriber at substation P^1 , in response to the signal, removes the receiver from the switch-hook, thereby bridging the transmitter across the line conductors and completing the circuit which provides the called substation with talking battery current. This circuit extends from ground G^9 through the relay 101, 120

contact point 100, armature 99, through the tip of the plug p^2 and jack J^2 , contact point 93, armature 91, through the substation P^1 , armature 92, contact point 94, sleeve of the jack J^2 and plug p^2 , conductor 90, relay 88, thence through battery B to ground G. The relay 101 thereupon energizes and attracts its armature 102 from engagement with the contact point 103 to the contact point 104. The engagement of the armature 102 and the contact point 104 provides an energizing circuit for the relay 105 extending from ground G^7 through the armature 86, contact point 96, armature 102, contact point 104, relay 105, thence through battery B to ground G. The relay 105 thereby energizes and attracts its armature 97 from the contact point 98 to the contact point 106. The disengagement of the armature and the contact point 98 breaks the circuit through the supervisory lamp 95, whereupon the operator knows that the called subscriber has answered. The engagement of the contact point 106 by the armature 97 provides a locking circuit for the relay 105. Furthermore, when the relay 101 energizes, the armature 107 engages the contact point 108, whereby a shunt is closed around the high resistance coil 75. The relay 80 of the cord circuit C now energizes and attracts its armature 109 from the contact point 110, thereby breaking a circuit through the supervisory lamp 111, thus indicating to the A operator that the subscriber at substation P^1 has answered. The two substations being thus connected, communication may be carried on over the conductors shown by the heavy lines in Figs. 4, 5 and 6.

When the calling subscriber at substation P hangs up his receiver the relay 53 de-energizes, permitting its armature 55 to fall back. The relay 50, however, remains energized through the circuit extending from ground G^2 at the cut-off relay, as previously stated. When the armature 55 falls back a circuit is provided for the supervisory lamp 112, giving the operator the disconnect signal so far as the subscriber P is concerned. Now, when the subscriber at substation P^1 restores his receiver the energizing circuit through the relay 101 of the cord-circuit C^1 is broken, permitting the armatures 107 and 102 to return to normal position. When the armature 107 disengages from the contact point 108 the high resistance relay 75 is placed in a series circuit with the relays 80 and 76 of the cord circuit C. As previously explained, when the relay 80 is in series with the high resistance coil 75 it permits its armature 109 to fall back to normal position, whereby an energizing circuit is established through the lamp 111. This circuit extends from ground through the armature 109, contact point 110, armature 113, contact point 114 and lamp 111 to the battery B, thence

to ground G, the relay 76 in the meantime remaining energized, as above explained. The A operator of the cord circuit C is thus given the disconnect signal by both subscribers P and P^1 , and she withdraws the plugs p and p^1 from their respective contacts. When the plug p^1 is withdrawn from the jack J the springs 56 and 57 disengage, thereby breaking the energizing circuit through the magnet 11 of the line switch L (Fig. 5). The armature 12 returns to normal position, thereby withdrawing the plunger 13 from the bank terminal Q. Also, when the plug p^1 is withdrawn from the jack J the energizing circuit through the supervisory relay 75 of the cord circuit C^1 (Fig. 6) is broken, and this relay permits its armature 83 to return to normal position in engagement with the contact point 115, thereby providing a circuit for the lamp 85, said circuit extending from ground G^7 through the armature 86, contact point 96, armature 102, contact point 103, conductor 116, contact point 115, armature 83, supervisory lamp 85 to the battery B, thence to ground G. The glowing of the lamp at this time indicates to the B operator that the trunk-line conductors 65 and 66 have been vacated, and she then accordingly withdraws the plug p^2 from the jack J^2 , thus restoring all the central office equipment to normal position.

In the foregoing it has been explained how the central office equipment is operated to establish connection between a subscriber of one exchange and a subscriber of another exchange by means of the trunk line switch L. It will now be pointed out from Figs. 1, 2 and 3 how the trunk-lines are grouped or multiplied. As shown in Fig. 1, the different A operators' positions are indicated at A^1 , A^2 , A^3 , A^4 , etc. From each operator's position there are trunk-lines leading to the groups of line switches L^1 , L^2 , L^3 , L^4 , etc., and from the line switch groups trunk-lines lead to the B operators. The A^1 position will be considered. From the jack J a trunk-line leads to a line switch in the group L^1 ; from the second jack J a trunk-line leads to a line switch in the group L^2 ; and from the third jack J a third trunk-line leads to a line switch in the group L^3 , etc. From the remaining positions A^2 , A^3 , A^4 , etc., there is a trunk-line to a line switch in each one of the groups L^1 , L^2 , L^3 , etc., there being as many trunk-lines from each position as there are groups L^1 , L^2 , L^3 , etc. This is one arrangement. Sometimes it may be advantageous to provide a plurality of trunk lines leading from one operator's position to a plurality of line switches. The line switches may be distributed into one or more groups, such as groups L^1 , L^2 , etc. By means of the slip multiple arrangement shown in Fig. 2 the remaining operators' positions of the

manual board may be connected with any line switch which is accessible to any other position.

In Fig. 2 there is shown how the slipping between the positions A^1 , A^2 , A^3 occurs—that is, the first jack J in the A^1 position leads to the group L^1 , while the first jack in the A^2 position leads to the line switch in the group L^2 , and the first jack in the A^3 position leads to a line switch in the group L^3 , etc. The last jack, however, in the A^2 position leads to a line switch in the L^1 group, and the last jack in the A^3 position leads to a line switch in the L^2 group. From each group L^1 , L^2 , L^3 , etc., there may be ten trunk-lines leading to the B operators. Thus, in either of the above arrangements, since each A operator has access to all of the groups L^1 , L^2 , L^3 , etc., all of the trunks to the B operators are accessible from any A operator's position.

In Fig. 3 is shown how the trunks from the different groups L^1 , L^2 , L^3 , etc., are distributed among the B operators. For instance, the ten trunks from the group L^1 are distributed as follows: four to the B^1 position, three to the B^2 position and three to the B^3 position. The trunks from the group L^2 are divided among the three positions in a similar manner. Another arrangement, however, may be resorted to.

Referring to Fig. 5, it was shown how, when the line switch L operated to seize a trunk-line, an energizing circuit was established through the relay 67. Suppose, now, that a second line switch in the same group operates to seize a second trunk, and so on through the third, fourth and fifth, until all the trunk-lines in the L^1 group are seized, all the relays 67, 67^a, 67^b, 67^c, etc., become energized, attracting their respective armatures. When all these relays are thus energized a circuit is established extending from ground G^{10} through each successive contact point and armature of the ten relays allotted to the ten trunk-lines, through the conductor 117, then through the lamps S^1 , S^2 , S^3 , S^4 , etc., one of which is allotted to each A operator's position A^1 , A^2 , A^3 , A^4 , etc., in front of the jack of the trunk-line which leads to this group L^1 , thereby indicating to the operators that all of the trunk-lines of this group are busy.

Fig. 7, as previously stated, is a modification of Fig. 5 in which the work done by the relays 67, 67^a, 67^b, 67^c, etc., is done in the bank terminals Q , Q^1 , Q^2 , Q^3 , etc., when the plunger is operated—that is, when the plunger 13 is thrust into the terminal bank Q the springs 33 and 34 are pressed into contact. When the next terminal is seized the outside springs of the terminal Q^1 are pressed into contact, and so on when Q^2 , Q^3 , etc., are seized. The final connection with ground G^{10} not being established until the

last terminal Q^9 is seized, then the ground G^{10} is transmitted through all of the terminals Q^1 , Q^2 , Q^3 , etc., back to the relay 118, thence to the battery lead 26, and through battery B to ground G. The relay 118 then operates to press the springs 119 and 120 into contact, whereby a circuit is closed through the signal lamps S^1 , S^2 , S^3 , etc., said circuit extending from ground G^{11} through the springs 120 and 119, lamps S^1 , S^2 , S^3 , etc., in multiple to the battery lead 26, thence through battery B to ground G.

In Fig. 8 the cord-circuit C is a modified form of the cord-circuit C shown in Fig. 4. The trunk line switch L (Fig. 5) is controlled from the jack J (Figs. 4 and 8) over the conductor 58. Referring to Fig. 4 it will be seen that the trunk line switch is tripped in as soon as the plug p^1 enters the jack J and presses the springs 56 and 57 into contact, thereby transmitting a ground to the conductor 58 and energizing the trip magnet 11. The trunk line switch L remains in an operated position as long as the plug p^1 remains in the jack and maintains the ground connection to the conductor 58. In Fig. 8 the ground connection to the conductor 58 is controlled from one of the supervisory relays of the cord-circuit. This is so arranged that when the plug p^1 enters the jack J, ground for operating the line switch L is transmitted from ground G^3 through the contact point 57, armature 56 of the calling subscriber's supervisory relay to the conductor 58 which leads to the line switch L (Fig. 5). Furthermore, when the calling subscriber restores his receiver to the switch-hook, the relay 53 deenergizes, and the armature 56 falls away from the ground contact point 57, thereby removing ground from the conductor 58 and permitting the trunk line switch L to restore itself to normal position even before the operator removes the plug from the jack. The calling subscriber therefore controls the clearing out and makes the trunk to the B-board idle as soon as he restores his receiver. In drawings, as shown in Fig. 4, the trunk to the B-board is not made idle until the A operator removes the plug from the line switch jack.

From the foregoing it will be seen that the trunking between the A and B boards of the same exchange, or between the A and B operators of different exchanges in the same system, is entirely automatic, and that the operators are not required to ascertain which trunks are idle and in condition for use, as the mere act of plugging into an idle trunk jack is sufficient to automatically connect the calling subscriber's line to the other board, or to the other exchange. If the A-board, for example, has several sections, then there may be as many trunk jacks in

each section as there are trunks leading to the B-board, and the trunks may be multiplied between the different operators in the manner shown in Fig. 2, or any other well known manner. In this way the trunks between the A and B boards, or between the different exchanges, in the same system, are all common to each and every section into which such boards may be divided, although if it requires more than one operator to a section, then the trunks are not all common to each and every operator—that is to say, the different operators of any one section of the board will each have access to a different set of trunks. The signals provided and associated with the trunk jacks indicate to the operators the condition of such jacks, showing whether the same are available for obtaining access to an idle trunk. If a signal is displayed at a trunk jack, then the operator understands that all of the trunks to which access is afforded through this jack are busy, and that some other or idle jack must be used in extending the call over an idle trunk to the other board. The idle trunks are preselected, so that when an operator plugs into a trunk jack the only result that follows therefrom is the automatic connection of the jack with a preselected idle trunk, and the automatic selection of another trunk for the next call. Thus, each time that an operator plugs into a jack two things happen, namely the automatic connection of that jack with the preselected idle trunk, and the automatic selection of the next idle trunk, which newly selected idle trunk will be given the next operator who has occasion to make a trunk connection. Furthermore, it will be seen that with the system of slipping or cross-multiplying employed, such as shown in Fig. 2, the multiple jacks allotted to any particular trunk leading to an automatic trunking switch do not occupy like or similar positions in the different operators' positions, whereby different operators each have their multiple jacks differently arranged. In this way the different operators can all plug into the first jack and obtain connection with as many different trunking switches, thus distributing the load or traffic more evenly between the different trunks, and preventing more wear and tear on one switch than others. In other words, and without such arrangement, it will be seen that the natural inclination of the operators to always plug into the first jack, if the same be idle, would tend to impose a great deal of work on one particular automatic switching machine, leaving the others, or at least some of them, more or less idle a good share of the time.

What I claim as my invention is:

1. In a telephone system, a set of trunks each terminating at one end in a plug, an automatic trunk selector, a jack connected

with said trunk selector, a second plug, and means operated by the insertion of said second plug into said jack for causing said selector to seize an idle trunk, and to select another trunk for the next call.

2. In a telephone system, a set of trunks, a trunk jack, a cord-circuit plug, means for preselecting an idle trunk, and means common to a plurality of said trunks responsive to the insertion of said plug into said jack for automatically connecting the latter with an idle preselected trunk.

3. In a telephone system, a set of trunks, means for automatically selecting idle trunks ahead of the calls, a trunk jack, and means common to a plurality of said trunks responsive to the insertion of a plug in said jack for automatically connecting the latter with the preselected idle trunk.

4. In a telephone system, a trunk jack, an automatic switch individual thereto, a set of trunks leading from said automatic switch, means for preselecting an idle trunk, and a cord-circuit plug, said switch comprising means responsive to the insertion of said plug into said jack for automatically connecting the latter with an idle preselected trunk.

5. In a telephone system, a set of trunk jacks, a plurality of trunks, means responsive to the insertion of a plug in said jacks for automatically connecting the latter with idle trunks, only a portion of said trunks being accessible through the medium of any one jack, signals associated with said jacks, and means for automatically displaying the signal of a jack when all of the trunks accessible therefrom are in use.

6. In a telephone exchange system, an A-board, a B-board, manual equipment on said boards, trunks between the two boards, means for automatically selecting idle trunks between said boards ahead of the call, and a line switch common to and adapted to connect with a plurality of said trunks.

7. In a telephone exchange system, a manual exchange, another exchange, trunk lines extending from one exchange to the other, electrically-operated means for automatically selecting idle trunk lines ahead of the call, and a line switch common to and adapted to connect with a plurality of said trunks.

8. In a telephone system, a set of trunks each terminating in a plug, means for preselecting an idle trunk, an automatic switch for connecting with idle preselected trunks, said switch provided with an operating magnet, a trunk jack connected with said switch, a second plug, and means whereby the said magnet is energized when said second plug is inserted in said jack, and de-energized when the said plug is withdrawn therefrom.

9. In a telephone system, a set of trunks,

an automatic trunking switch therefor, an operating magnet for said switch, a battery having one pole grounded, a circuit extending through said magnet to the non-grounded pole of the battery, a resistance, and a locking circuit for said magnet extending through said resistance before reaching the non-grounded pole of said battery, as set forth.

10. In a telephone system, a set of trunks, an automatic trunking switch, an operating magnet therefor for controlling the selecting movement, a locking circuit to maintain said magnet energized, and a high resistance included in said locking circuit.

11. In a telephone system, originating and trunking operators' cord circuits, a set of primary trunks and a set of secondary trunks extending between the two, means operated upon the connection of a cord circuit with a primary trunk line to automatically select an idle secondary trunk for the next call, and a line switch adapted to connect with any one of a plurality of said secondary trunks.

12. In a telephone system, a plurality of groups of switches, a signal associated with each group, trunk lines leading out of said switches, trunk lines leading into said switches, and means including the closing of a ground connection to operate the corresponding signal when all of the trunk lines leading out of a particular group are in use.

13. In a telephone system including manual automatic means for establishing a connection between a calling and a called subscriber's line, a plurality of operators' boards, a plurality of groups of trunk-selecting switches, trunk lines extending from said operators' boards to said switches, trunk lines leading out of said switches, a signal on each operator's position corresponding to each group of trunk-selecting switches, and means including the closing of a ground connection to operate the corresponding signal when all of the trunks leading out of a particular group of switches are in use.

14. In a telephone system, a plurality of operators' boards, a plurality of groups of non-numerical trunking switches, a master switch for controlling each group, trunk lines extending from said operators' boards into said switches, trunk lines extending out of said switches, said outgoing trunk lines being less in number than the incoming trunk lines, a signal at each operator's position corresponding to each group of switches, and means including the closing of a ground connection to operate said signal when all of the trunk lines leading out of a particular group of switches are in use.

15. In a telephone system, an A-board, a B-board, trunk lines extending from the A-

board to the B-board, automatic means for selecting idle trunks ahead of the call, means common to a plurality of said trunks for connecting with the selected trunk, an operator's talking set, and means responsive to the closure of a circuit for automatically connecting the set with the selected trunk.

16. In a telephone system, an A operator, a B operator, talking lines running between the A and B operators, automatic means for selecting an idle one of said talking lines ahead of the call, means common to a plurality of said talking lines for connecting with the selected line, and automatic means responsive upon the closure of a circuit to connect an A operator with a selected talking line.

17. In a telephone system, an A-board, a plurality of operators' positions on said board, a B-board, a plurality of operators' positions on said B-board, a talking circuit terminating on each operator's position on said B-board, automatic selective devices controllable by the operators at the A-board to automatically select an idle circuit leading to the B-board, and means common to a plurality of said talking circuits for connecting with the selected circuit.

18. In a telephone system, an A-board, a B-board, trunks extending between said boards, and means by which the A-operator automatically selects the trunks leading to the B-board, said means including a master switch and a line switch controlled thereby, said line switch having terminals of the trunks in a bank and having a circuit closer for connecting the A-operator with a trunk to the B-board, said master switch comprising means for moving said circuit closer from trunk position to trunk position until the position of an idle trunk is reached, and means in said line switch for then operating said circuit closer to connect the A-operator with the trunk to the B-board.

19. In a telephone system, an A-board, a B-board, trunks extending between said boards, and means by which the A-operator automatically selects the trunks leading to the B-board, said means including a line switch adapted to connect with an idle trunk extending to the B-operator's board, said line switch having terminals of the said trunks in a bank and having a circuit closer for performing the connecting operation, means for moving the said circuit closer from trunk position to trunk position until the position of the idle trunk is reached, and means in said switch for then operating said circuit closer to close the connection.

20. In a telephone system, an A-board, a B-board, trunks extending between said boards, and means comprising a bank of terminals of said trunks by which the A-operator automatically selects the trunks

leading to the B-board, said means including a line switch adapted to connect with an idle trunk extending to the B-operator's board, said means comprising a circuit closer for performing the connecting operation, an electromagnetic release mechanism controlled over the established connection for withdrawing the circuit closer from the bank, and means for thereafter further moving the circuit closer, and being adapted when released to disengage from said trunk without passing over other trunks to reach a released position.

21. In a telephone system, a pair of subscribers' lines, an A-board and a B-board for connecting said lines, trunk lines extending between said boards, automatic switches for selecting an idle trunk, trunks extending from the A-board to said automatic switches, said last-mentioned trunks including a pair of talking conductors and a third conductor, means for controlling the operation of said switches from the A-board, and means controlled over one of said lines for releasing said switches over said third conductor.

22. In a telephone system, a pair of subscribers' lines, an A-board and a B-board for connecting said lines, trunk lines extending between said boards, automatic switches for selecting an idle trunk, trunks extending from the A-board to said automatic switches, said last-mentioned trunks including a pair of talking conductors and a third conductor, and means for controlling the operation and release of said switches over said last-mentioned trunks, said means controlled over one of said lines.

23. In a telephone system, a subscriber's line, an A-operator's cord circuit adapted to be connected with said line, a B-operator's cord circuit, automatic switches controlled from the A-operator's cord circuit for selecting an idle B-operator's cord circuit, and means controlled by the calling subscriber for releasing said automatic switches.

24. In a telephone system, a subscriber's line, an A-operator's cord circuit adapted to be connected with said line, a B-operator's cord circuit, automatic switches controlled from the A-operator's cord circuit for selecting an idle B-operator's cord circuit, and means controlled by the calling subscriber for closing a ground connection to control the release of said automatic switches.

25. In a telephone system, an A-operator's board, a B-operator's board, a calling subscriber's line terminating in said A-operator's board, trunks extending to the B-operator's board, an automatic switch, for selecting an idle trunk, an auxiliary conductor associated with said trunk and extending from said A-operator's board to said automatic switch, a circuit for connecting the

line and the trunk, and means controlled by the calling subscriber for closing a ground connection over said auxiliary conductor to control the release of said switch.

26. In a telephone system, an A-operator's board, a B-operator's board, trunks terminating each in a jack in the A-operator's board, a progressively movable switch for each trunk, other trunks terminating in contacts in said switches and each terminating in a plug in the B-operator's board, said switches controlled by master switch mechanism, each switch responsive to the insertion of a plug in its corresponding jack in the A board to connect the trunk terminating in said jack with one of the said other trunks terminating in the B board.

27. In a telephone system, an A-operator's board, a B-operator's board, a calling subscriber's line terminating in said A-operator's board, trunks extending to the B-operator's board, an automatic switch for selecting an idle trunk, another trunk extending from the A-operator's board to said automatic switch, an auxiliary conductor associated with said other trunk and extending from said A-operator's board to said automatic switch, a circuit for connecting the line and the said other trunk, and means controlled by the calling subscriber for closing a circuit over said auxiliary conductor to control the release of said switch.

28. In a telephone system, an A-operator's board, a B-operator's board, a plurality of lines extending to said A-board, other lines extending from said board, automatic switches for said other lines, circuits for connecting any one of said first lines with any one of said other lines, automatic electromagnetically controlled apparatus for controlling one of said automatic switches to extend a connection from one of said other lines to the B-operator, an auxiliary conductor associated with said connection, a relay controlled over the first line in the connection for closing a circuit over said conductor to control the release of said switch, and a release magnet for releasing said switch.

29. In a telephone system, an A-board, a B-board, a plurality of lines extending to said A-board, other lines extending from said board, an automatic switch for each one of said other lines, a circuit for connecting any one of said first lines with any one of said other lines and with the automatic switch associated therewith, an operating magnet for said automatic switch controlled over the said connecting circuit for extending a connection from one of said other lines to the B-operator's board, an auxiliary conductor associated with said established circuit, a relay controlled over the first line in the connection for closing a circuit over said conductor to control the release of said

switch by breaking the circuit of said operating magnet.

30. In a telephone system, a set of trunks each terminating at one end in a plug, an automatic trunk selector, a jack connected with said trunk selector, a second plug, means operated by the insertion of said second plug into said jack for causing said selector to seize an idle trunk and to select another trunk for the next call, said means also responsive to the withdrawal of said plug for releasing purposes.

31. In a telephone system, a set of trunks, a trunk jack, a cord-circuit plug, means for preselecting an idle trunk, and means common to a plurality of said trunks responsive to the insertion of said plug into said jack for automatically connecting the latter with an idle preselected trunk, said means also responsive to the withdrawal of said plug for releasing purposes.

32. In a telephone system, a set of trunks, means for automatically selecting idle trunks ahead of the calls, a trunk jack, and means common to a plurality of said trunks responsive to the insertion of a plug in said jack for automatically connecting the latter with the preselected idle trunk, said means also responsive to the withdrawal of said plug for releasing purposes.

33. In a telephone system, a trunk jack, an automatic switch individual thereto, a set of trunks leading from said automatic switch, means for preselecting an idle trunk, a cord-circuit plug, said switch comprising means responsive to the insertion of said plug into said jack for automatically connecting the latter with an idle preselected trunk, said switch means also responsive to the withdrawal of said plug for releasing purposes.

34. In a telephone exchange system, an A-board, a B-board, manual equipment on said boards comprising plugs and jacks on the A-board, trunks between the two boards, means for automatically selecting idle trunks between said boards ahead of the call, and a line switch common to said trunks having automatic means controlled by said plugs and jacks to establish a connection with any one of said trunks, said means also controlled by said plugs and jacks to release the connection.

35. In a telephone exchange system, a manual exchange comprising plugs and

jacks, another exchange, trunk lines extending from one exchange to the other, electrically-operated means for automatically selecting idle trunk lines ahead of the call, and a line switch common to said trunks having automatic means controlled by said plugs and jacks to establish a connection with any one of said trunk lines, said means also controlled by said plugs and jacks to release the connection.

36. In a telephone system, originating and trunking operators' cord circuits, a set of primary trunks and a set of secondary trunks extending between the two, means operated upon the connection of a cord circuit with a primary trunk line to automatically select an idle secondary trunk for the next call said means also responsive to the withdrawal of said plug for releasing purposes.

37. In a telephone system, a calling subscriber's line and a called subscriber's line, means for connecting said lines, said means comprising an A-board and a B-board, trunk lines extending between said boards, automatic switches for selecting an idle trunk, trunks extending from the A-board to said automatic switches, said last mentioned trunks including a pair of talking conductors and a third conductor, means for controlling the operation of said switches at the A-board, and means controlled over the calling line for releasing said switches over said third conductor.

38. In a telephone system, a calling subscriber's line and a called subscriber's line, means for connecting said lines, said means comprising an A-board and a B-board, trunk lines extending between said board, automatic switches for selecting an idle trunk, trunks extending from the A-board to said automatic switches, said last mentioned trunks including a pair of talking conductors and a third conductor, and means for controlling the operation and release of said switches over said last mentioned trunks, said last means controlled over the calling subscriber's line.

Signed by me at Chicago, Cook county, Illinois, this 30 day of April, 1908.

WILSON L. CAMPBELL.

Witnesses:

HARRIETT M. MERRIAM,
EDWARD D. FALES.