

June 7, 1932.

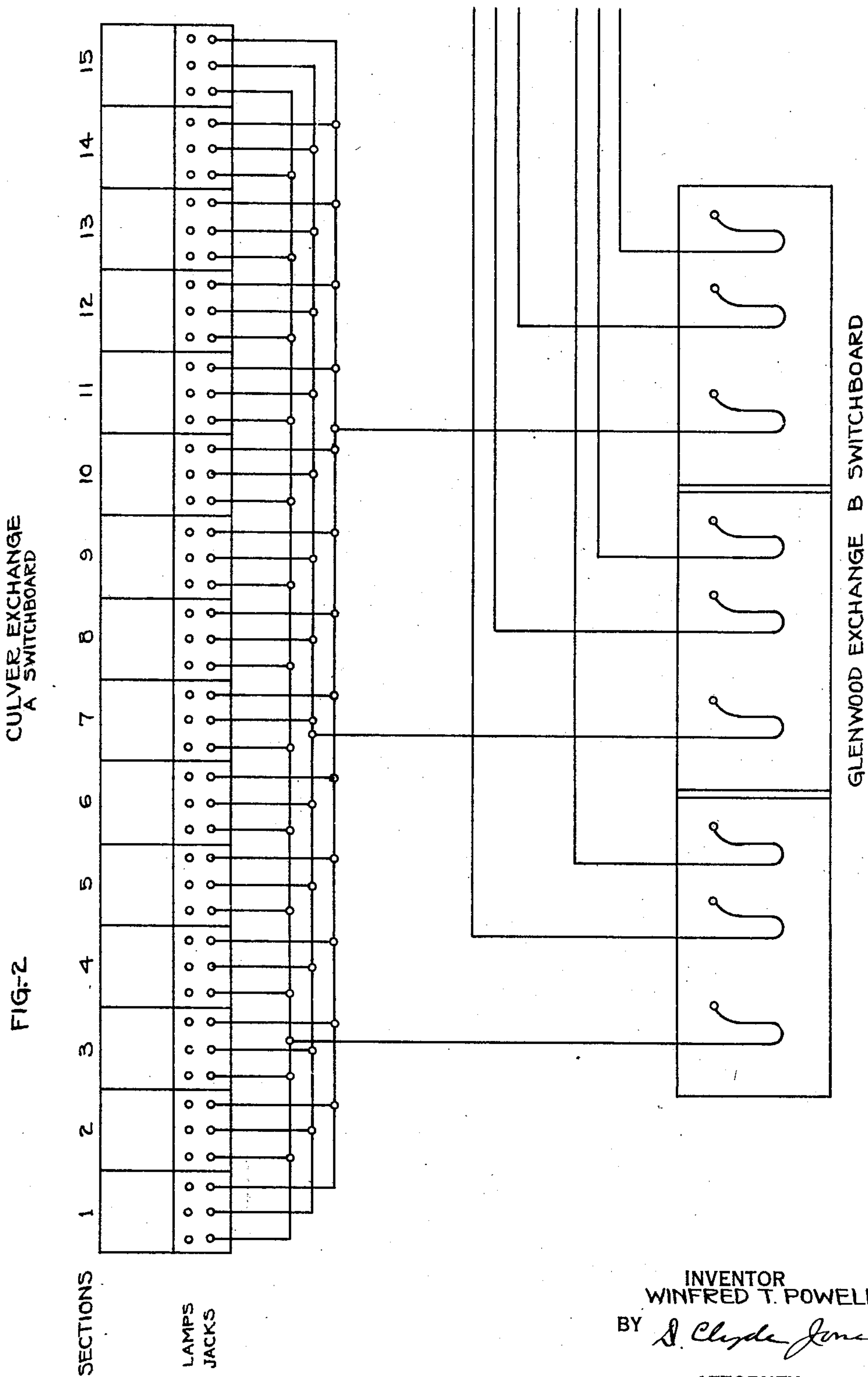
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1,861,754

CALL DISTRIBUTING TELEPHONE SYSTEM

Filed Aug. 10, 1929

9 Sheets-Sheet 2



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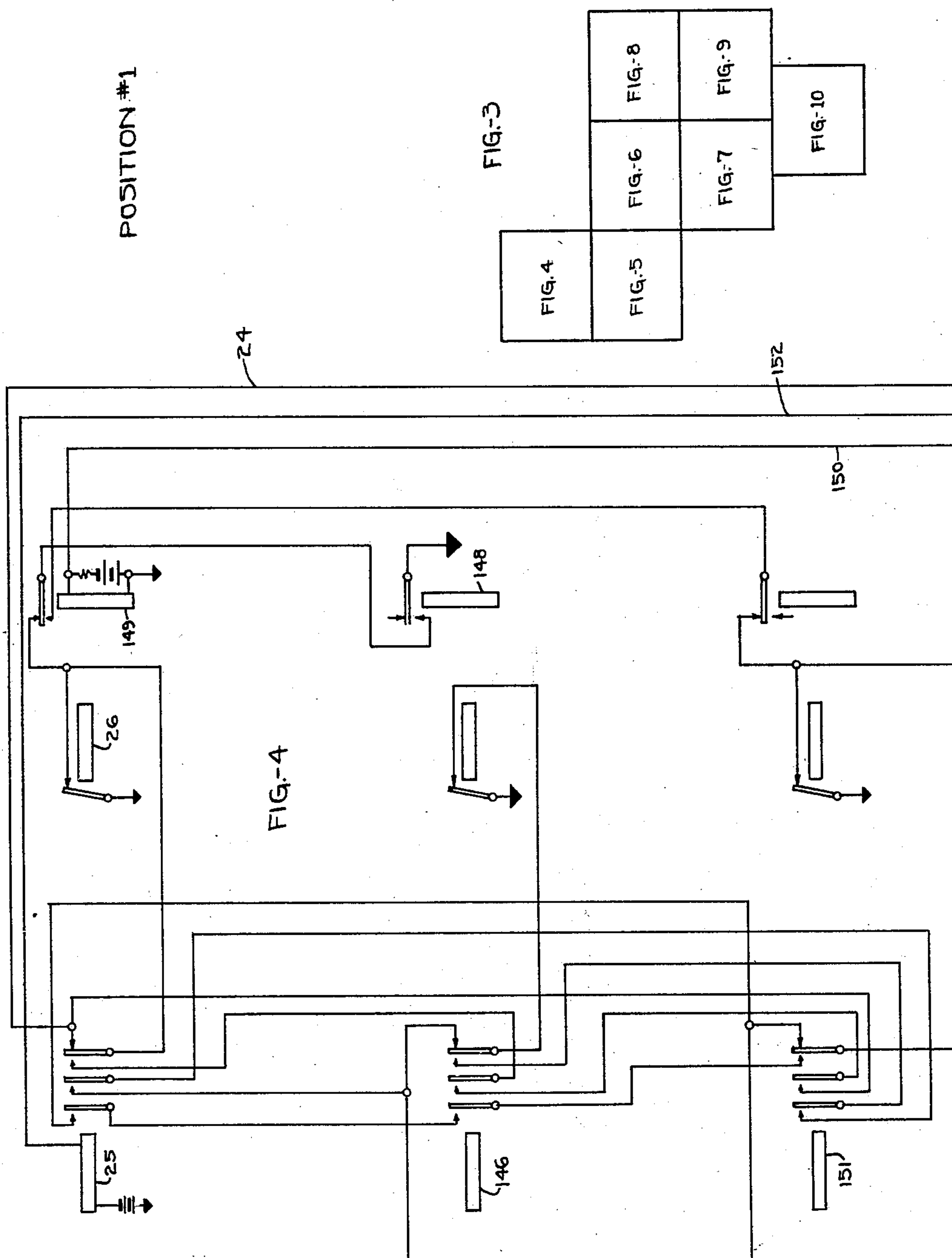
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CALL DISTRIBUTING TELEPHONE SYSTEM

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9 Sheets-Sheet 3



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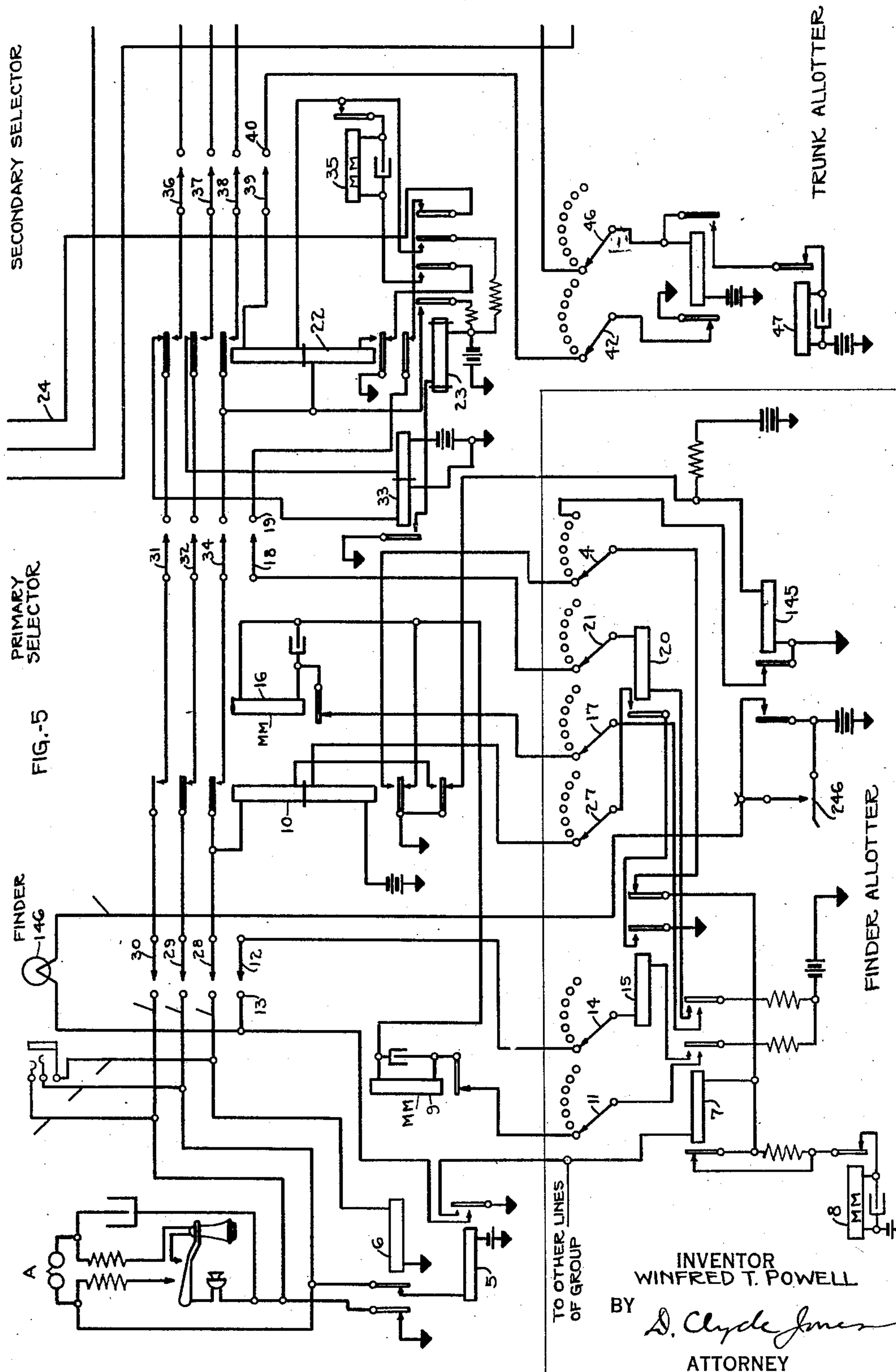
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CALL DISTRIBUTING TELEPHONE SYSTEM

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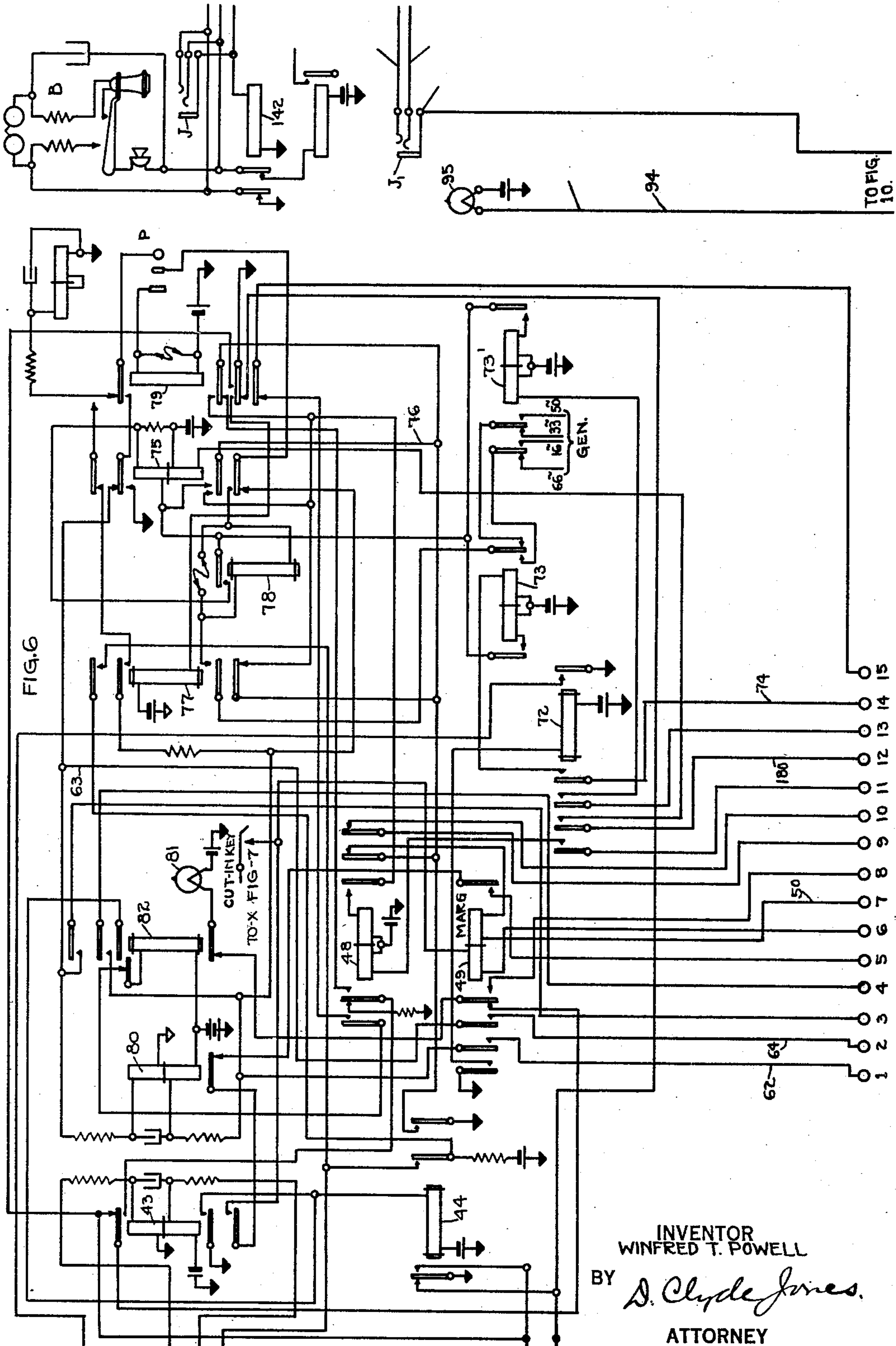
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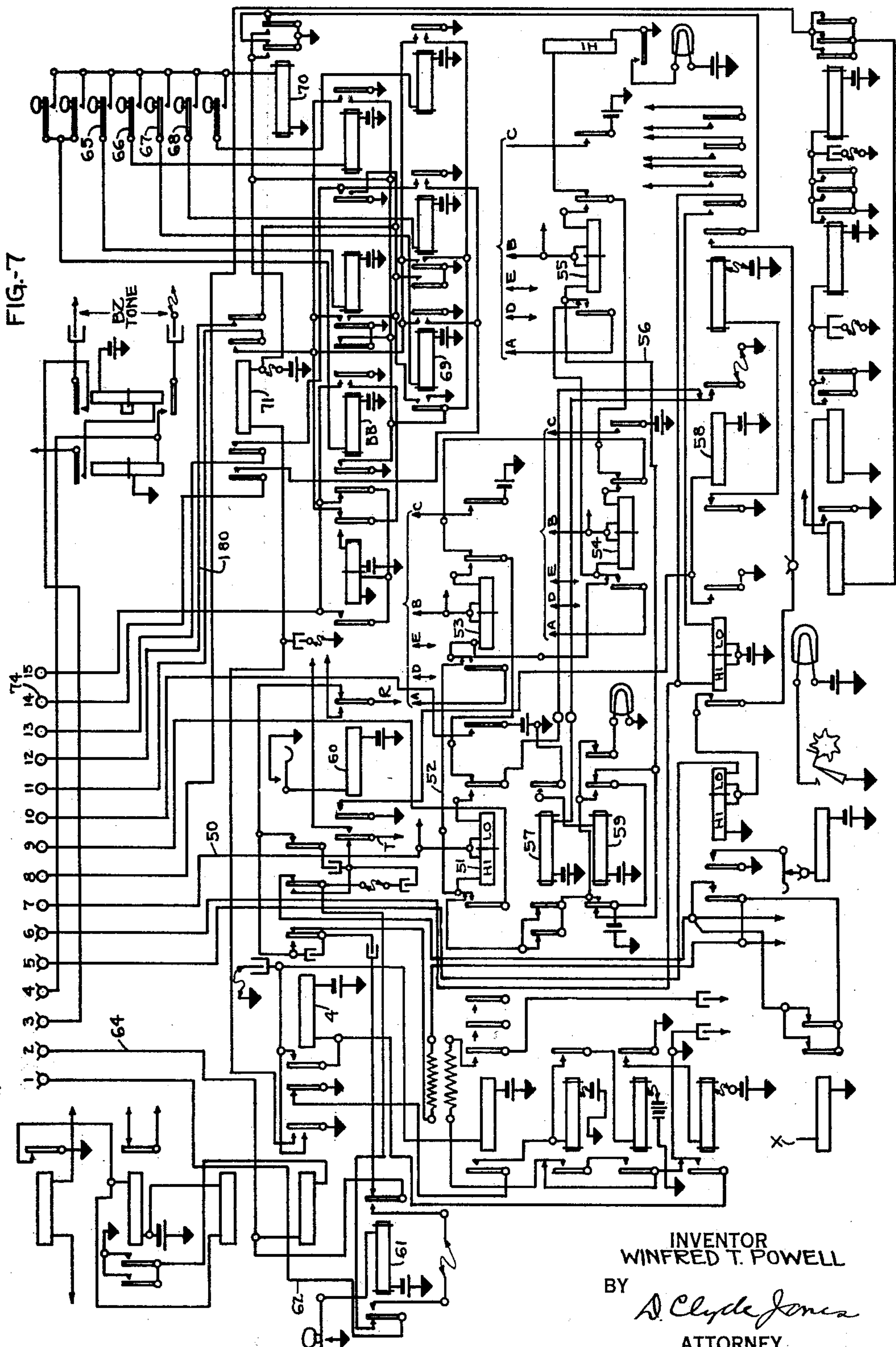
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CALL DISTRIBUTING TELEPHONE SYSTEM

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9 Sheets-Sheet 6



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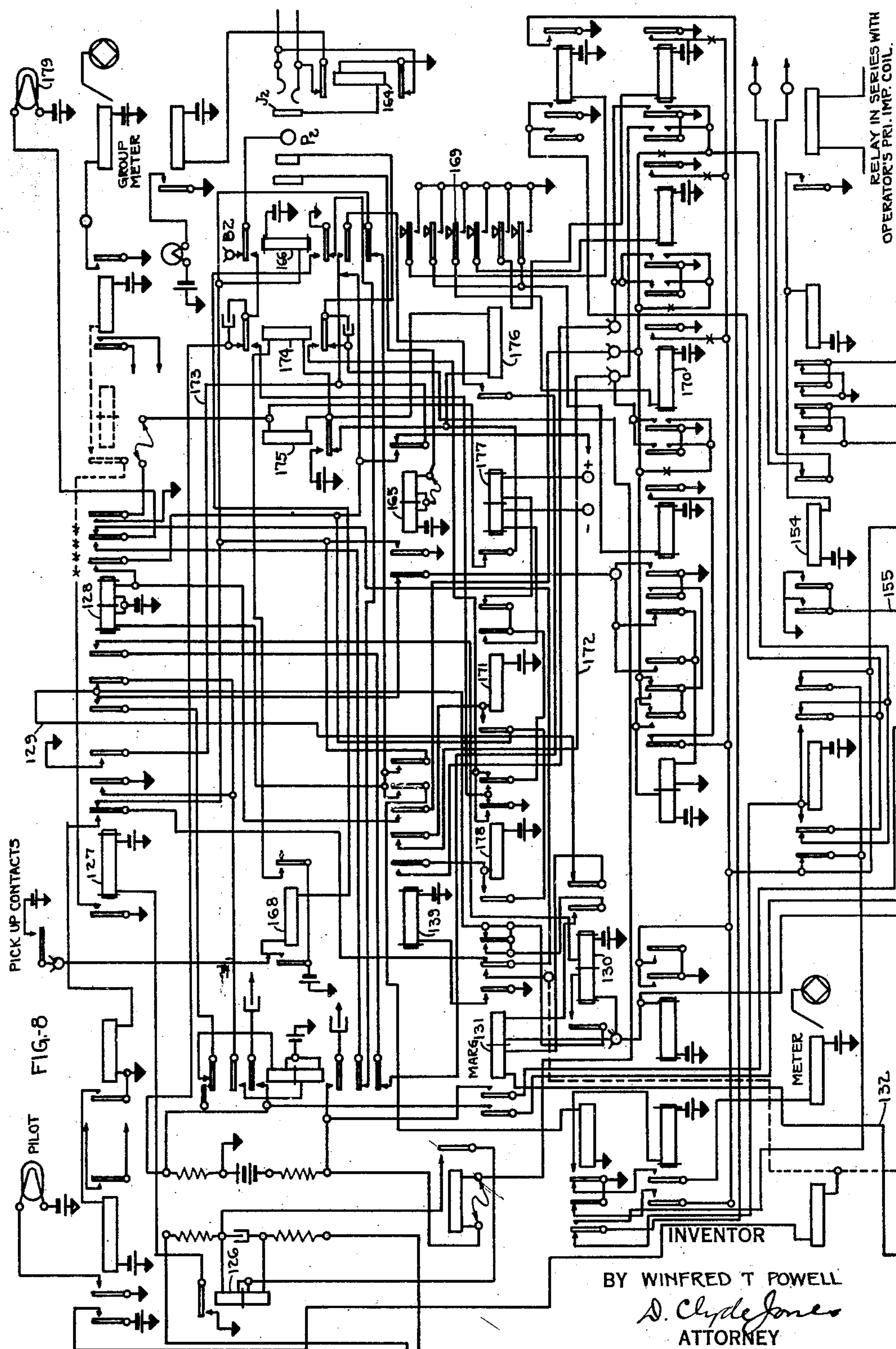
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CALL DISTRIBUTING TELEPHONE SYSTEM

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June 7, 1932.

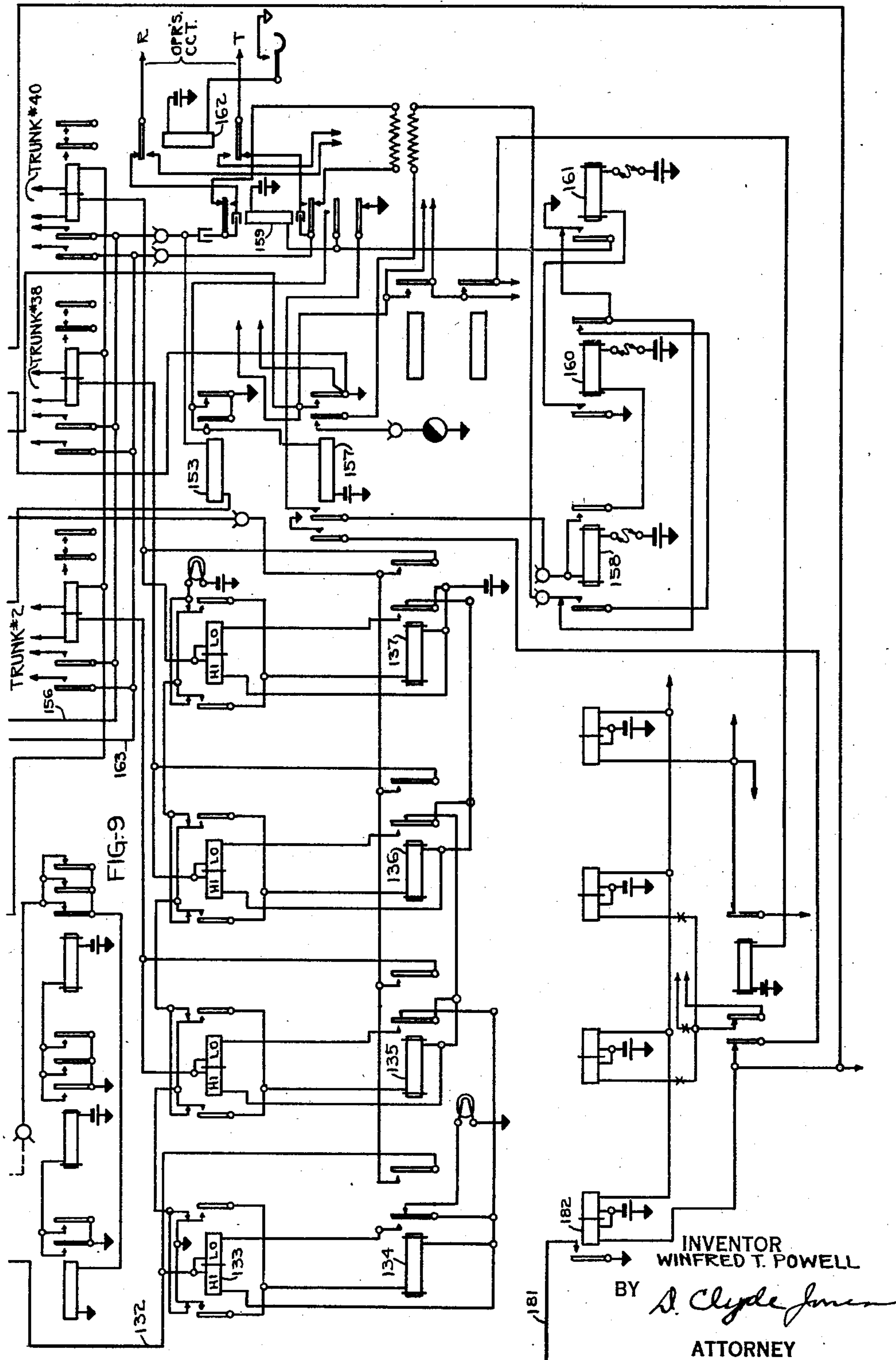
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CALL DISTRIBUTING TELEPHONE SYSTEM

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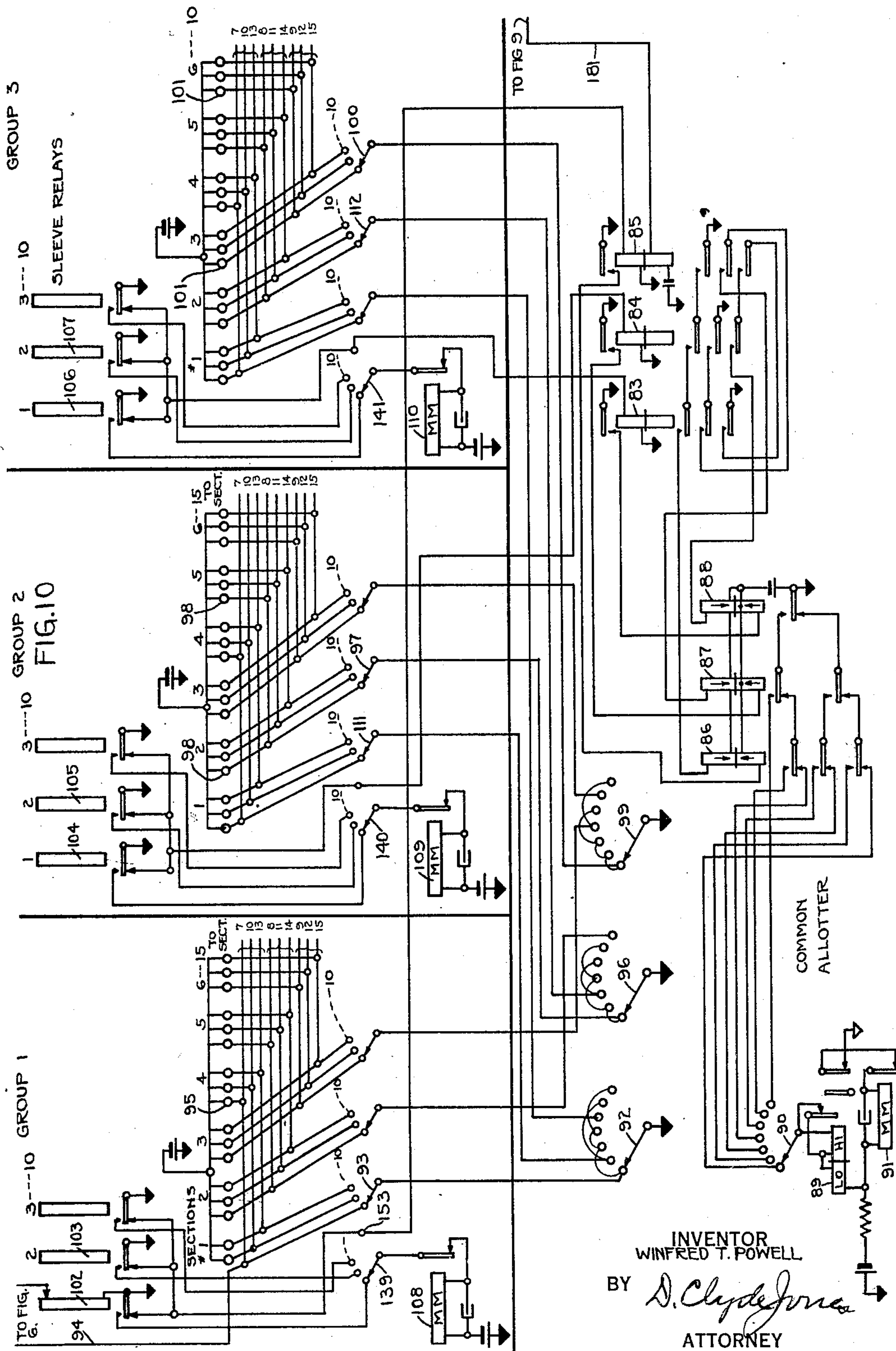
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CALL DISTRIBUTING TELEPHONE SYSTEM

Filed Aug. 10, 1929

9 Sheets-Sheet 9



UNITED STATES PATENT OFFICE

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CALL DISTRIBUTING TELEPHONE SYSTEM

Application filed August 10, 1929. Serial No. 384,943.

This invention relates to telephone systems and more particularly to interoffice telephone systems.

In earlier telephone systems it was the practice to employ a so-called order wire between offices over which an operator at the terminating office assigned a trunk for the use of the originating operator in extending a calling line at the originating office. Later such systems were improved by an arrangement known in the art as straight forward trunking wherein the operator at the originating office, known as the A operator, selected an idle trunk, leading to an idle operator at the terminating office and instructed this operator who was automatically connected to the selected trunk, as to the number of the wanted line. Such an arrangement has greatly improved the operation of interoffice telephone systems but still has not overcome all the difficulties of former systems. One of these difficulties arose from the fact that originating calls were indicated by line lamps appearing at an operator's position and since there was no means for indicating the order in which the calls were originated, it frequently happened that certain calling lines were answered out of turn with the result that certain other calling lines were unduly delayed in receiving attention. In order to overcome this disadvantage it is proposed to employ automatic switches and associated means for distributing calls to answering operators. While automatic switches have been suggested for this purpose it has been customary to provide switching equipment to take care of the maximum number of simultaneous calls, however, in accordance with the present invention a smaller number of automatic switches are used to distribute calls to operators but in addition the manual switchboard with its line lamps is retained and when a predetermined number of simultaneous calls are originated the presence of these calls are indicated by their associated line lamps and the operators answer in the multiple of the switchboard. When less than a predetermined number of calls is being extended, the line lamps are not used.

A further feature of this invention is the

combination of call distribution to the A operators of the interoffice system together with the provision for automatically connecting the B operators to extended trunks in accordance with a predetermined sequence.

In the drawings Fig. 1 indicates a schematic showing of one possible layout of automatic switches for distributing calls from a group of subscribers' lines to A operators' positions; Fig. 2 shows one possible layout of the operators' positions at an originating or A switchboard as well as the terminating or B positions of a switchboard at a distant office together with the trunk grouping between these offices; Fig. 3 is a chart showing the arrangement of the remaining figures in which Fig. 4 shows certain groups of relays each common to an operator's position which control the selection of trunks terminating at these positions; Fig. 5 shows a calling subscriber's line and a series of switches for extending such a line to an operator's position; Fig. 6 indicates a plug-ended trunk at the selected operator's position by which calls may be extended to subscribers' lines terminating at this office or by which these calls may be extended to a distant office; Fig. 7 shows some of the common equipment associated with the plug ended trunk of Fig. 6; Figs. 8 and 9 represent the B operator's equipment at the terminating office; while Fig. 10 is a schematic showing of an arrangement whereby lamps at the A switchboard associated with trunks leading to a distant office indicate a trunk designated for use whereby it is unnecessary for an operator to test the various outgoing trunks before they can be used.

For purposes of this description it is assumed, as represented in Fig. 1, that there are 630 lines such as A which have access to three A operators' positions designated O P and that there are thirty trunks T K terminating at each of these positions. For convenience the lines are divided into fifteen groups of forty-two lines each, each group being served by seven finders designated F associated with seven primary selectors P S while a single finder allotter F A is provided for each group of finders. The terminal banks of the pri-

mary selectors P S are multiplied together and are connected through trunks to ninety secondary selectors S S in three groups of thirty each. These trunks may be connected through an intermediate distributing frame I D F, if desired. The multipling is so arranged that any primary selector and any calling line may have access to any idle trunk at any A operator's position. There is associated with each A position a trunk allotter T A which functions to allot trunks leading to its associated position in rotation.

It is believed that the invention will best be understood by describing certain types of telephone connections. When a subscriber at A originates a call by removing his receiver from its switchhook, the line relay 5 is energized over the two sides of the calling line in series, through the back contacts of the cut-off relay 6. The line relay is thus actuated and closes an operating circuit for the relay 7 of the finder allotter, from ground, front contact of relay 5, winding of the relay 7, armature and back contact of relay 7, armature, back contact and winding of the motor magnet 8 to grounded battery. The operation of this relay is effective to close a driving circuit for the motor magnet 9 of the finder switch, traceable from ground at the inner armature and back contact of relay 10, winding, armature and back contact of motor magnet 9, finder allotter brush 11, inner front contact and armature of the start relay 7, resistance, to grounded battery. Under the control of this circuit the motor magnet 9 advances the brushes of the finder until its test brush 12 encounters the test terminal 13 of the calling line A, indicated by the presence of ground potential. When the calling line test terminal is thus tested, a circuit is closed from ground at the armature and front contact of line relay 5, test terminal 13, test brush 12, allotter brush 14, winding of the relay 15, inner front contact and armature of relay 7, resistance to grounded battery. It will be noted that this last described circuit is in shunt of the driving circuit of the motor magnet 9 so that this magnet no longer advances the finder brushes but the relay 15, however, is operated.

The operation of start relay 7 also closes a driving circuit for the motor magnet 16 of the primary selector, from ground, lower armature and back contact of relay 10, winding, armature and back contact of motor magnet 16, finder allotter brush 17, front contact and armature of start relay 7, resistance to grounded battery. Under control of this circuit this motor magnet advances the brushes of the primary selector until its test brush 18 finds the test terminal 19 of an idle trunk whereupon the relay 20 of the finder allotter is operated from grounded battery, resistance, outer armature and contact of relay 7, winding of relay 20, allotter brush 21, primary

selector test brush 18, test terminal 19, lower armature and back contact of relay 22, outer, back contact and armature of slow releasing relay 23, conductor 24, back contact and armature of relay 25, which relay is common to position 1, front contact and armature of relay 26 to ground.

It will be noted that this stopping ground which is supplied to the secondary selector for stopping the primary selector is connected as shown in Fig. 4 where the circuit is so arranged that when all A operators' positions are idle there is a stopping ground for the selectors of all three groups so that the primary selector will select a secondary selector in any group. When position 1 becomes busy, that is when the operator's telephone set is connected to a telephone line, relay 25 is energized and the stopping ground for the secondary selectors reaching this position, is removed and transferred to position 2. If position 2 is likewise in use, the stopping ground for the secondary selectors is removed by the operation of relay 146'. While, if position 3 is engaged, the relay 151 is likewise operated to remove the stopping ground so when any operator removes her telephone set from her position, the induction coil relay 26 deenergizes and makes that position unselectable. When all three positions are busy, stopping ground is again extended to all positions so calls will come in to all of them. The control circuits of Fig. 4 are so arranged that during light traffic periods, when one operator is handling calls for all three positions and is stationed at position 2, for example, calls normally come to that position. Under this condition when all trunks at position 2 are in use, relay 148 energizes and extends the stopping ground to the trunk of position 1 even though the induction coil relay 26 is deenergized. This allows calls to reach position 1. When all the trunks at positions 1 and 2 are busy, the stopping ground is extended to position 3 and calls are thereupon routed to this position. Referring to Fig. 6 it will be seen how relay 149 is operated when all trunks are busy. As long as there is an idle trunk there will be ground on common conductor 150, applied either at the left hand armature and back contact of relay 44 or at the lower back contact and armature of sleeve relay 79, and this ground keeps the relay 149 short circuited but when all the trunks at this position are busy, current will flow through relay 149 and the resistance coil causing it to energize. It will be understood that the relay 25, common to an operator's position and corresponding to relays 146 and 151 at other positions, is operated whenever the A operator is engaged in answering a call. It will be seen that relay 25 is energized over conductor 152 to ground at the right hand front contact and armature of relay 72.

As soon as both relays 15 and 20 are operated the switching relay 10 of the finder switch is actuated from grounded battery, through its lower winding, allotter brush 27, inner, front contact and armature of relay 20, inner front contact and armature of relay 15, to ground. The allotter shown in the lower left hand corner of Fig. 5 is normally standing with its brushes in a position to allot an idle finder for use and as soon as the allotted finder is taken for use, the allotter advances to an idle position. In the case of the finder used in connection with a call just described, as soon as the switching relay 10 is operated and when the cut-off relay 6 has operated to release the line relay 5, which in turn deenergizes the start relay 7, the motor magnet 8 has its operating circuit closed so that it proceeds to hunt for an idle finder. This circuit is traceable from grounded battery, winding, back contact and armature of the motor magnet 8, armature and back contact of relay 7, armature and back contact of relay 15, allotter brush 4, inner front contact and armature of relay 10, to ground. The allotter is thus advanced until its brush 4 encounters a terminal not connected to ground indicating an idle finder, at which time the allotter ceases to operate. In the event that all the finders of a group are busy, relay 145 is operated since it is no longer short circuited by ground at a lowermost back contact and armature of some one of the switching relay 10 of the group. With the relay 145 operated, the allotter will come to rest with its brushes in engagement with the last set of terminals of the sets engaged by the allotter brushes and a break point in the circuits for the multiple switchboard lamps 146 is closed. Thus when a line relay such as 5 is energized, the associated lamp 146 is lighted as a signal to the operator to complete the connection in the multiple. A switch 246 is provided so that the calls can be made to appear in the multiple even when all of the finders are not engaged.

When the switching relay 10 is operated, as previously described earlier in this description, the calling subscriber's line is extended through the finder brushes 29 and 30, upper armature and front contacts of relay 10, primary selector brushes 31 and 32, uppermost armature and back contacts of relay 22, through both windings in series of the relay 33, to ground and grounded battery. The relay 33 is thus energized and at its armature and front contact completes an operating circuit for the slow releasing relay 23. This relay closes a holding circuit for the cut-off relay 6 and the switching relay 10 traceable from grounded battery, resistance, armature and front contact of relay 23, primary selector brush 34, innermost, upper front contact, armature and upper winding of relay 10, its lower front contact and armature to ground.

A circuit, in multiple of that just described, is extended through the finder brush 28 and the cut-off relay 6, to ground.

The relay 23 also closes an operating circuit for the motor magnet 35 of the secondary selector, traceable from grounded battery, resistance, middle armature and contact of relay 23, back contact, armature and winding of motor magnet 35, front contact and armature of the relay 23, inner back contact and armature of relay 22 to ground. Under the control of this circuit and motor magnet 35 advances the secondary selector brushes 36 to 39 inclusive until the test brush 39 engages the test terminal 40 of an idle trunk leading to an A operator's position. As soon as this test brush encounters the test terminal 40, the motor magnet 35 is shunted and the switching relay 22 operated in a circuit completed from grounded battery, resistance, middle armature and front contact of relay 23, upper winding of the relay 22, test brush 39, test terminal 40, brush 42 of the trunk allotter to ground.

The operation of the switching relay 22 connects the extended conductors of the calling line to the brushes 36 and 37 and thence through the upper and lower windings of the repeating coil and both windings in series of the relay 43, to ground and grounded battery respectively. This circuit operates the relay 43 which in turn completes an energizing circuit for the slow releasing relay 44. The holding circuit for the switching relay 22 is then extended from ground, lower armature, front contact and winding of this relay, its upper armature and front contact, selector brush 38, inner front contact and armature of relay 44, resistance to grounded battery. The holding circuit for the finder and primary switches is also extended at this time through the innermost upper armature and front contact of relay 22.

Also when the relay 44 is operated, it advances the trunk allotter to a position to allot an idle trunk by closing a circuit for the relay 42 from grounded battery, winding of this relay, allotter brush 46, left hand front contact and armature of relay 44 to ground. The relay 42 energizes and disconnects the stopping ground from the test terminal such as 40 characterizing an idle trunk and at its right hand armature it extends an operating circuit for the motor magnet 47 of the allotter which is in multiple with the energizing circuit of the relay. Under the control of this circuit the motor magnet 47 advances the trunk allotter brushes until the brush 46 encounters a terminal characterized by the absence of potential which indicates that its related trunk is idle.

If no other call is in the process of being extended at this operator's position, at the time when relay 44 is energized, this relay completes a circuit from ground, its outer

armature and front contact, middle armature and back contact of relay 48, right hand winding of the marginal relay 49, conductor 50, left hand winding of the relay 51, conductor 52, back contacts and continuity springs of relays 53, 54, and 55, conductor 56, left hand back contact and armature of slow releasing relay 59 to grounded battery. The chain circuit just described includes relays 53, 54, 55, etc., each of which is individual to one trunk of this group and this circuit is so arranged that if the relay of any trunk in this group is operated the corresponding relays of other trunks thereof appearing in the chain are disabled. By such an arrangement the calls are distributed in sequence to an idle operator.

The relay 51 is energized in this last described circuit but the marginal relay 49 is not operated owing to the high resistance of the left hand winding of relay 51. However, as soon as the relay 51 is operated it actuates the low resistance, slow releasing relay 57 from grounded battery, winding of this relay, continuity spring and back contact of the relay 58, innermost right hand armature and contact of relay 51, the low resistance winding of this relay and thence to ground over conductor 50 and the remainder of the circuit previously described. The operation of the relay 57 causes the energization of the slow releasing relay 59 from grounded battery, winding of this relay, right hand front contact and armature of relay 57 to ground. The operation of the relay 59 at its left hand contact and armature opens the sequence circuit previously described to prevent any other trunks from operating until the present trunk connection is extended.

The actuation of marginal relay 49 closes a break point in the operating circuits of the ringing frequency selecting relays 73 and 73' by energizing slow releasing relay 72. Relay 49 is also effective to connect the operator's telephone set and the common key equipment shown in Fig. 7 to the trunk that is now being extended. The operator's telephone set (not shown) is extended over the conductors T and R to the trunk connected to the calling telephone line, conductor T being extended from the outer armature and back contact of relay 60, middle armature and front contact of relay 4, left hand, back contact and armature of slow releasing relay 61, conductor 62, front contact and armature of relay 49, and thence to the lower right hand winding of the repeating coil. Conductor R is extended from the right hand back contact and armature of relay 60, inner front contact and armature of relay 4, through the condenser, right hand back contact and armature of relay 61, conductor 64, front contact and armature of relay 49, upper right hand winding of the repeating coil. As soon as the operator's telephone set is thus

connected to the trunk taken for use, and thereover to the calling subscriber's line, the operator inquires the number of the wanted subscriber's line.

The ringing equipment associated with the trunks at this operator's position is arranged so that the selected ringing key may be operated prior to or subsequent to the insertion of the plug P into the jack of a subscriber's line which terminates at the originating office or in the jack of a trunk leading to a distant office. Let it be assumed that the wanted line is the one whose substation is indicated as B in the upper right hand corner of Fig. 6. The operator thereupon tests this line by touching the tip of the plug P to the sleeve of the jack J and in the absence of a busy condition, indicated by the sound of a click in the operator's head set, she inserts this plug into the jack J. This operation causes the energization of sleeve relay 79 in series with cut-off relay 142 and relay 79 in turn completes a circuit for energizing slow releasing relay 77. If the proper ringing frequency has not previously been selected, the operator depresses some one of the keys 65 to 68 inclusive, such as key 67 of Fig. 7. This operates the slow releasing relays 69 and 70 in series through the contacts of key 67, which effects the operation of the ringing frequency relay 73 (Fig. 6) from grounded battery, its right hand winding, innermost front contact and armature of relay 72, conductor 74, outer armature and front contact of relay 71, right hand front contact and armature of relay 69 to ground. The relay 73 on operation closes a locking circuit for itself through its left hand winding, its left hand front contact and armature, inner front contact and armature of relay 75, conductor 76, to ground at the right hand front contact and armature of relay 44. Ringing relay 75 is operated at this time from grounded battery, its lower winding, front contact and armature of relay 72, conductor 180, outer right hand, front contact and armature of relay 71, left hand front contact and armature of relay 69 to ground.

Ringing current is then applied from the 66 cycle source through the back contact and armature of relay 73', the right hand front contact and armature of relay 73, inner lower armature and front contact of relay 77, winding of the trip relay 78, lowermost front contact and armature of relay 75, ring contacts of the plug and jack, over the side of the subscriber's line and substation equipment including the ringer, over the other side of the subscriber's line, tip contacts of the jack and plug, upper armature and front contact of the sleeve relay 79, inner, upper armature and front contact of relay 75 to ground. When the subscriber at B removes his receiver from the switchhook in response to the ringing signal, the trip relay 78 attracts its

armature which shunts the relay 75 causing its deenergization whereby the talking circuit is completed through its back contacts and armatures.

5 Talking battery is supplied to the calling subscriber through the winding of the supervisory relay 43 while talking battery is supplied to the called subscriber through the winding of the relay 80.

10 At the close of the conversation when the subscriber at A replaces his receiver on its switchhook, the supervisory relay 43 deenergizes thereby lighting the disconnect lamp 81 in a circuit traceable from grounded battery, lamp 81, armature and back contact of the relay 82, innermost armature and back contact of relay 49, upper armature and back contact of relay 43, front contact and armature of sleeve relay 79 to ground. On noting
20 that the lamp 81 is steadily lighted, the operator removes the plug P from the jack J thereby permitting the equipment to be restored to normal. The deenergization of the relay 43 thereupon causes the deenergization
25 of the slow releasing relay 44 which in turn at its inner armature and front contact, removes holding battery from the circuit which has been holding the finder and primary and secondary switches operated. These switches
30 thereupon are released.

Let it now be assumed that the subscriber at A had desired to call a subscriber at the distant office. In previous systems it has been necessary either for the operator at the
35 originating office to have a trunk assignment transmitted from the terminating office over an order wire or else it was necessary for the originating operator to test all the outgoing trunks leading to the terminating office by
40 touching the tip of the plug P to the sleeves of jacks such as J' leading to this office. In accordance with the present invention provision is made so that an idle trunk to the wanted office is indicated by the presence of
45 a lighted lamp associated with the jack of such idle trunk.

For purposes of this description it is assumed that there are fifteen sections or operators' positions in the originating office
50 (Culver) and that there are three positions in which trunks from this office terminate at the terminating office (Glenwood). It is also assumed that there are thirty trunks extending between the originating and terminating offices. It will be understood of course
55 that these numbers are merely for purposes of illustration and may be varied as traffic requirements demand. In the following description it will be seen that the trunk indication given to the originating operator is
60 such that there is an even distribution of calls to the positions at the terminating office. In addition there is provided means whereby the idle trunks in each group are indicated to
65 the originating operator in consecutive order,

that is, they are assigned in rotation by means of a rotary stepping switch which makes a progressive trip over all of the trunks in the group and then starts at the beginning again. This arrangement provides even wear on the
70 trunk jacks and permits a more uniform answering time so that the possibility of delay at the terminating end, due to calls being answered out of turn, is greatly reduced.

In Fig. 10 there is disclosed a schematic
75 showing of this arrangement in which one rotary switch is provided for each group of trunks at the terminating office and since it is assumed that there are only three groups of trunks, there are three of these switches. In
80 addition there is provided one rotary stepping switch which is common to all of the sections in the originating office so that a total of four rotary switches are provided. The switches associated with the groups have
85 eleven terminals each since it is assumed that there are ten trunks in each group, while the common switch has seven terminals. For purposes of this description it is assumed that
90 all of the terminating operators are idle, that all trunks are idle, and further, that the group switches are standing in the positions shown in Fig. 10. Since all positions at the terminating office are idle, relays 83, 84, and 85
95 are in their normal condition. It will be understood that these relays are the remote control relays which are operated whenever their corresponding terminating positions become busy. With these relays in normal
100 condition all of the differential relays 86, 87, and 88 will likewise be in their normal condition so that the relay 89 will be energized from grounded battery, resistance, its left
105 hand winding, continuity spring and back contact, brush 90 in position 1, back contacts and armatures of relays 86 to 88 inclusive to ground. The energization of relay 89 is held
110 operated over the previously described circuit now including both of its windings in series. At this time a circuit is effective from ground, brush 92 in position 1, brush 93 of the
115 switch associated with group 1, conductor 94, lamps 95 in sections 1, 4, 7, 10 and 13 associated with the jacks J' of the idle trunk to grounded battery. The lighting of the
120 lamps 95 indicates that the trunk terminating in the jacks J' is idle. A circuit is also effective from ground at brush 96 in position 1, brush 97 and the first lamp 98 of group 2 at positions 2, 5, 8, 11 and 14. This indi-
125 cates the idle trunk in the second group. Likewise a circuit is effective from ground, brush 99, in position 1, brush 100 in position 1, and lamps 101 associated with the first trunk in group 3 at positions 3, 6, 9, 12 and 15. When
130 these trunks are taken by the originating operators, their corresponding relays such as 102, 103, 104, 105, 106, 107, etc. will be operated and as each such relay is energized, a circuit is closed from ground either by way

of one of the brushes such as 139, 140 or 141, back contact, armature and winding of the motor magnets such as 108, 109 or 110 to grounded battery. In this way the switch
 5 associated with each group of trunks is progressively advanced to idle trunks. If a trunk in group 1, for example trunk #1 is chosen, its sleeve relay 102 is operated to cause the motor magnet 108 to advance its
 10 switch brushes to trunk #2. It will be noted later in this description that the relay 85 is energized at relay 182 (Fig. 9) over conductor 181 when the operator's telephone set at terminating position 1 is connected to a
 15 trunk and this relay closes a circuit through the lower winding of the differential relay 86 to battery. This relay energizes and thereby extends a circuit from ground through the lowermost armatures and back
 20 contacts of relays 87 and 88, its lowermost contact and armature to position 2 of brush 90. Since the locking ground is removed from the windings of relay 89 by the operation of relay 86, relay 89 deenergizes and
 25 thereby permits the motor magnet 91 to advance the brushes of its switch to position 2 where the ground applied by the energization of relay 86 to the position 2 of brush 90 is effective to shunt the motor magnet 91 and
 30 stop the switch in this position, moving brush 92 to position 2. Relay 89 is operated in this position of the switch and is locked operated as previously described. With the brushes 96 and 99 also moved into position 2 their
 35 circuits in position 2 are not changed since terminals 1 and 2 at brushes 96 and 99 are multipled together. Brush 92 however disconnects ground from brush 93 of the switch associated with position 1, which brush controls the lamps in group 1 in sections 1, 4,
 40 7, 10, and 13, and connects ground to brush 111 which ground extends by way of position 1 of this brush and the first lamp of group 2, at sections 1, 4, 7, 10 and 13. If the operator at position 2 is busy, relay 84 is operated and
 45 at its upper armature and front contact closes a circuit including the lower winding of relay 87 to grounded battery. Relay 87 operates and extends ground through the lower armature and back contact of relay
 50 88, the lower armature and contact of relay 87, armature and back contact of relay 86, to position 3 of brush 90. Relay 89 deenergizes, as before described, whereupon the motor magnet 91 advances the brushes of its
 55 switch into position 3 where relay 89 is then operated. Brushes 92 and 99 are wired the same as in position 1. Therefore the idle trunk in groups 1 and 3 will be indicated at the same sections as when all B positions are
 60 idle. Brush 96 at position 3 connects ground by way of brush 112 to the idle lamps at group 3 in sections 2, 5, 8, 11 and 14. This removes the idle trunk indication in group 3 at
 65 2 and extends it to idle lamps in group 3 at

sections 2, 5, 8, 11 and 14. When the operator at position 3 is busy, relays 83 and 88 will be energized and the latter will extend ground to position 4 of brush 90 which will
 70 cause the common switch to advance to position 4 where brush 99 will shift the idle lamp indication from group 3 at sections 3, 6, 9, 12 and 15 to group 1 at these sections. From the above, it will be seen that as each
 75 group of trunks, that is, each terminating position becomes busy, the idle trunk indication is shifted from this group at those sections where the terminating position is given preference to the next idle group or terminating
 80 operator's position.

When B positions 1 and 2 are busy, relays 85 and 84, 86 and 87 are energized causing the common switch to go to position 5. In
 85 position 5, brushes 92, 96 and 99 are effective to shift the idle indication of groups 1 and 2 to group 3 at sections 1, 2, 4, 5, 7, 8, 10, 11, 13, and 14.

When B positions 1 and 3 are busy, relays 85 and 83, 86 and 88 are operated to advance
 90 the common switch to position 6. In this position, brushes 92, 96, and 99 are effective to give the indication in group 2 at sections 1, 3, 4, 6, 7, 9, 10, 12, 13 and 15.

When B positions 2 and 3 are busy, relays 84, 83, 87 and 88 energize to advance the
 95 common switch to position 7. In this position, brushes 92, 96, and 99 are effective to shift the idle lamp indication of groups 2 and 3 to group 1 at sections 2, 3, 5, 6, 8, 9, 11, 12, 14 and 15.

When all three of the B positions are busy, relays 83, 84, and 85 are operated. The lower
 100 windings of 86, 87 and 88 are energized from contacts of corresponding relays 83, 84 and 85. With these last mentioned relays energized chain circuits are closed for energizing the upper windings of relays 86, 87, and 88. Since these latter relays are differential, they will all deenergize and being in their normal
 105 positions, a circuit is effective to advance the common switch to position 1. Under this condition, the lamp indication is the same as when all B positions were idle, but there is, of course, a delayed cut-in at the B end.

As B positions now become idle, the com-
 110 mon switch will be advanced to the proper position for indicating at all sections at the A end by means of the lamp, just which B position is idle.

It has previously been assumed that the
 115 lamp 95 associated with trunk jack J' is lighted, which is an indication to the operator at the originating office that this trunk is idle. This operator therefor inserts the plug P into the jack J' which is effective to cause the energization of the supervisory relay 126. This relay at its upper armature and front contact closes an energizing circuit for the slow releasing relay 127. Relay 127 when operated is effective to set into operation the

common equipment which connects an operator's telephone set to the trunk just seized and associates the common ringing equipment with this trunk. This is accomplished in a circuit traceable from ground, middle armature and front contact of relay 127, armature and back contact of relay 128, back contact and armature of relay 130, left hand winding of marginal relay 131, conductor 132, left hand winding of relay 133, armature and back contacts of chain relays 135, 136, 137 to grounded battery. Relay 133 is energized in this circuit but the marginal relay 131 is not operated at this time. The operation of relay 133 effects the energization of the slow releasing relay 134 from ground, continuity spring and front contact of relay 133, winding of relay 134 and thence through the contacts and armatures of relays 135, 136 and 137 to grounded battery. Relay 134, when operated, substitutes the right hand low resistance winding of relay 133 for the left hand high resistance winding of this relay which was previously connected in circuit with the marginal relay 131. Relay 131 therefore operates at this time. The slow releasing relay 139 is then actuated in a circuit completed at the inner right hand armature and contact of relay 131, to associate the common ringing equipment with the trunk circuit taken for use. At the left hand armatures and contacts of relay 131 the operator's telephone set is connected in series with the right hand windings of the repeating coil.

At this time relay 153 of Fig. 9 is energized from ground at the armature and front contact of relay 154 which relay is normally energized during the period that the operator's telephone set is connected to the circuits of her position, conductor 155, winding of relay 153, conductor 156, inner left hand contact of relay 131 through the winding of the repeating coil to grounded battery. Relay 153 effects the energization of the relay 157 which in turn operates the relay 158 from grounded battery, its winding, armature and front contact of relay 157, lower armature and back contact of relay 159 to ground. Relay 158 then causes the operation of relay 160 and this relay in turn energizes the relay 161. These last named relays are effective to apply a call passing tone which indicates to the A operator that the B operator is in readiness to receive the call. As soon as relay 161 is energized it operates the relay 159 which locks itself operated through its middle armature and front contact to ground at the front contact and armature of relay 153. With the relay 159 operated, the operator's telephone set is connected over conductors T and R through the armatures and back contacts of relay 162, front contacts and armatures of relay 159 and thence over conductors 156 and 163, left hand armatures and front

contacts of relay 131 to the right hand windings of the repeating coil.

On receiving the call passing tone the A operator informs the B operator of the designation of the wanted telephone line which is assumed to be the line whose multiple jack is indicated at J^2 . The operator then touches the tip of the plug P^2 to the jack J^2 and in the absence of a distinctive click, known as a busy signal, the operator inserts the plug into the jack J^2 . This is effective to energize the sleeve relay of the operator's circuit and the cut-off relay in a circuit extending from ground, winding of the cut-off relay 164, sleeve contacts of the jack and plug, winding of the sleeve relay 165 to grounded battery.

As soon as the marginal relay 131 is operated it effects the energization of the slow releasing relay 139 which associates the common key equipment of the operator's position with the trunk circuit of Fig. 8. With the sleeve relay 165 energized, a circuit is closed for operating the slow releasing relay 166 to close a break point in the tip conductor. The relay 166 also closes a circuit to actuate the relay 168 from grounded battery, through the intermittently closed contacts of the pick-up device, continuity contact and spring of relay 168, winding of this relay, inner front contact and armature of relay 166 to ground. Relay 168 when operated closes a locking circuit for itself from grounded battery, its armature and continuity spring and thence over the remainder of the circuit to ground at the front contact of relay 166. The operator then depresses some one of the ringing keys shown at the right of Fig. 8. Let it be assumed that ringing key 169 is depressed whereupon the slow releasing ring current selector relay 170 is energized. When the relay 170 is energized, it closes an operating circuit from grounded battery, right hand winding of the relay 128, right hand winding and armature of relay 139, inner front contact and armature of relay 170, to ground. This energizes relay 128 to open a break point in the circuit of the incoming disconnect lamp 179. Relay 128 when operated closes a locking circuit for itself from grounded battery, through its right hand winding, its front contact and armature, front contact and armature of sleeve relay 165, outer armature and front contact of relay 127 to ground. The energization of the relay 128 opens the operating circuit of the marginal relay 131 to permit the release of the common operator's sequence cut-in equipment of Fig. 9. With the release of the relay 131 the common equipment including the operator's listening circuit is restored to normal.

As soon as the relay 170 is operated, the ringing frequency selecting relay 171 is energized from grounded battery, its winding, armature and front contact of relay 139, conductor 172, left hand front contact and arma-

ture of relay 170 to ground. When thus energized, relay 171 closes a locking circuit for itself, from grounded battery, its winding, left hand front contact and armature, right hand front contact and armature of sleeve relay 165 and thence over conductor 173 to ground at the right hand armature and front contact of relay 127.

Prior to this time the ringing relay 174 has been energized from grounded battery, right hand armature and contact of relay 168, winding of relay 174, armature and back contact of relay 175, armature and back contact of relay 177, outermost armature and contact of relay 128 to ground. Ringing current of the proper character to signal the called subscriber is now applied from the negative source, left hand winding of relay 177, right hand front contact and armature of relay 171, armature and back contact of relay 178, inner, lower contact and armature of relay 174, ring contacts of plug P^2 and jack J^2 , the lower side of the subscriber's line and substation circuits in series, over the upper side of the subscriber's line, tip contacts of the plug and jack, armatures and front contacts of relays 166 and 174, inner, back contact and armature of relay 178, to ground. When the subscriber answers the call by removing his receiver from its switchhook, the relay 177 is energized and removes the short circuit about the relay 175 which is now operated from grounded battery at the armature and front contact of relay 168, windings of the relays 174 and 175 in series, armature and front contact of relay 128, to ground. This short circuits the ringing relay 174 causing it to deenergize so that there will be no further application of the ringing current during this call. Talking battery is supplied to the called subscriber through the right hand windings of the repeating coil.

At the close of the conversation, when the calling subscriber replaces his receiver on the switchhook, the A operator receives the disconnect signal in the manner already indicated whereupon she removes the plug P from the jack J^1 resulting in the release of the relay 126 which whereupon effects the release of the slow releasing relay 127. The disconnect lamp 179 is then lighted from grounded battery, lamp 179, armature and back contact of relay 128, armature and back contact of relay 131, inner armature and back contact of relay 127, left hand front contact and armature of relay 165 to ground. The lighting of this lamp is the signal to the B operator to remove the plug P^2 from the jack J^2 whereupon this operator's equipment is restored to normal.

Chart of operation of common allotter (Fig. 10)

The common allotter is in position 1 when all B positions are idle—also when all B posi-

tions are busy and no group has all trunks busy.

The common allotter is in position 2 when B position 1 is busy—also when all B positions are busy and all trunks in group 1 are busy.

The common allotter is in position 3 when B position 2 is busy—also when all B positions are busy and all trunks in group 2 are busy.

The common allotter is in position 4 when B position 3 is busy—also when all B positions are busy and all trunks in group 3 are busy.

The common allotter is in position 5 when B positions 1 and 2 are busy—also when all B positions are busy and all trunks in groups 1 and 2 are busy.

The common allotter is in position 6 when all positions 1 and 3 are busy—also when all B positions are busy and all trunks in groups 1 and 3 are busy.

The common allotter is in position 7 when B positions 2 and 3 are busy—also when all B positions are busy and all trunks in groups 2 and 3 are busy.

The common allotter is in position 1 when all trunks in all groups are busy.

What I claim is:

1. The method of handling telephone calls which consists in automatically distributing each of a predetermined number of simultaneous calls individually to certain operators and extending each call exceeding said predetermined number to a plurality of operators.

2. In a telephone system, a plurality of telephone lines, operators' positions provided with jacks in which said telephone lines terminate, a lamp associated with each jack, operators' answering equipment, means responsive to the initiation of a predetermined number of calls on said lines for extending lines to idle operators' equipment, means for operating the lamps of call originating lines at said positions for all calls exceeding said predetermined number.

3. The method of handling telephone calls which consists in automatically distributing each of a predetermined number of simultaneous calls individually to a different operator, and extending each call exceeding said predetermined number to all of said different operators.

4. In a telephone system, a plurality of telephone lines, operators' positions provided with jacks in which said telephone lines terminate, a lamp associated with each jack, operator's answering equipment at each position including sources of ringing current of different character and a single ringing key common to each position for each source of ringing current, means responsive to the initiation of a predetermined number of calls on said lines for extending each line to dif-

ferent idle operators' equipment, means for operating the lamps of lines at said positions for all calls exceeding said predetermined number, outgoing lines, and means including operators' answering equipment for extending a calling telephone line to a desired outgoing line.

5. In a telephone system, a plurality of telephone lines, operators' positions provided with jacks in which said telephone lines terminate, a lamp associated with each jack, operators' answering equipment, means including automatic switches and trunks responsive to the initiation of a predetermined number of calls on said lines for extending each of said calling lines to different idle operators' equipment, means including an allotter for assigning idle trunks for use, and means responsive to the operation of said allotter through a predetermined cycle for rendering said lamps operative when their associated lines originate calls.

6. In a telephone system, a plurality of telephone lines, a plurality of operators' positions provided with jacks in which said telephone lines terminate, a lamp associated with each jack, finder switches having fixed terminals in which said lines terminate, each finder switch being provided with a set of brushes, a selector having its brushes linked by a trunk to the brushes of said finder, an allotter for assigning idle finder switches for use, means including an allotted finder an associated selector for extending a calling line to an idle operators' position, means responsive to the allotting of a predetermined number of finders for use, for rendering the lamps associated with the remaining telephone lines operative on the initiation of a call thereover.

7. In a telephone system, a plurality of telephone lines, operators' positions provided with jacks in which said lines terminate, a lamp associated with each jack, finder switches in which said lines terminate, a primary selector individual to each finder and linked thereto, a plurality of secondary selectors accessible from said primary selectors, a plurality of trunks terminating in said secondary selectors and said operators' positions, an allotter for assigning idle finders for use, a second allotter for assigning idle operators' positions for use, and means operative in response to the assignment of a predetermined number of finders for use for rendering the lamps associated with the remaining telephone lines operative on the initiation of a call thereover.

8. In a telephone system, a plurality of telephone lines, a plurality of primary operators' positions, a plurality of secondary operators' positions, trunks interconnecting said primary and said secondary positions, means for visually assigning different trunks in a predetermined sequence at different primary

operators' positions, and means for interconnecting a calling telephone line with an assigned trunk.

9. In a telephone system, a plurality of telephone lines, operators' positions provided with jacks in which said lines terminate, a lamp associated with each jack, trunks terminating at said operators' positions and leading to a distant office, means for visually assigning idle trunks for use in sequence, means for automatically trunking a predetermined number of simultaneous calls to said operators' positions, and means responsive to such extension of a predetermined number of calls for rendering the lamps of the remaining telephone lines operative on the initiation of a call thereover.

10. In a telephone system, a plurality of telephone lines, A operators' positions provided with jacks in which said lines terminate, a lamp associated with each jack, trunks terminating at said A operators' positions and leading to a distant office, B operators' positions at said distant office in which said trunks terminate, a plurality of sources of ringing current of different character and a single ringing key for each source of current common to all trunks terminating at said B operators' positions, means for visually assigning at A operators' positions idle trunks for use in sequence, means for mechanically extending calling telephone lines to idle A operators' positions, and means responsive to such extension of a predetermined number of calls for rendering the lamps of the remaining telephone lines operative on the initiation of a call thereover.

11. In a telephone system, a plurality of telephone lines, A operators' positions provided with jacks in which said lines terminate, a lamp associated with each jack, B operators' positions at a distant office, trunks interconnecting said A operators' positions and said B operators' positions, means for visually assigning at said A operators' positions idle trunks for use in sequence, means for automatically extending a predetermined number of simultaneous calls to said A operators' positions and means responsive to such extension of a predetermined number of calls for rendering the lamps of the remaining telephone lines operative on the initiation of calls thereover, operator's listening equipment at the B operators' positions and automatic means responsive to the extension of a call over one of said trunks to a B operator's position at the distant office for automatically connecting said operators' listening equipment thereto.

12. In an automatic telephone system, a plurality of telephone lines, a plurality of A operators' positions provided with jacks in which said telephone lines terminate, a lamp associated with each of said jacks, means including automatic switching devices for ex-

tending a predetermined number of simultaneous calls to said A operators' positions, means responsive to the extension of a predetermined number of calls for rendering the
 5 associate lamps of the remaining telephone lines operative in response to the initiation of calls thereat, a plurality of B operators' positions, called telephone lines terminating thereat, a plurality of sources of ringing current of different character common to said B
 10 operators' positions for signalling said telephone lines, means including a single ringing key common to a B operator's position for controlling the application of its associated source of signalling current to a called tele-
 15 phone line, trunks interconnecting said A and said B operators' positions, means for assigning said trunks in sequence for the use of said A operators, other telephone lines terminating at said B operators' positions, and
 20 means for connecting the trunk of an extended call to a called one of said last mentioned lines.

13. In a telephone system, a plurality of
 25 telephone lines, a plurality of operators' positions, means including non-numerical switches and incoming trunks for automatically distributing calls from said telephone lines to idle operators' positions, an opera-
 30 tor's telephone set at each position, automatic means for connecting said telephone set to a trunk over which a call is extended to said operator's position, outgoing lines and out-
 35 going trunks terminating at said positions, means at said positions for connecting an extended trunk to an outgoing line, a plural-
 40 ity of sources of ringing current, and means including a single ringing key common to the trunks of an operator's position for connect-
 ing each source of ringing current to any selected incoming trunk, and means for assign-
 ing outgoing trunks for use.

14. In a telephone system, a plurality of
 45 incoming lines, a plurality of primary operators' positions, means including automatic switches and primary trunks for distributing calls from said telephone lines to said opera-
 50 tors' positions, secondary trunks terminating in jacks in said operators' positions and indicating lamps associated with said jacks, and
 means for controlling said lamps in a predetermined sequence in accordance with the busy or idle condition of said secondary opera-
 55 tors' positions for indicating an idle secondary trunk terminating therein, means for connecting a primary trunk to the jack of an indicated trunk, and means at said secondary
 60 positions for completing the extension of calls.

15. In a telephone system, a plurality of
 telephone lines, primary operators' positions provided with jacks and associated lamps, lines terminating in said jacks, means includ-
 65 ing automatic switches and trunks for ex-

tending calling telephone lines to said pri-
 mary operators' positions, means operative when more than a predetermined number of calls are extended to said primary operators' positions for lighting the lamps at said posi-
 70 tions corresponding to additional calling lines, outgoing lines terminating in the jacks at said primary operators' positions, lamps associated with said jacks, secondary opera-
 75 tors' positions in which said outgoing lines terminate, means controlled in accordance with the busy or idle condition of said secondary operators' positions for lighting said
 80 lamps to indicate idle outgoing lines leading to said positions, other telephone lines terminating at said secondary operators' positions, and means at said last mentioned posi-
 tions for completing connections to said last mentioned lines.

16. In a telephone system, a plurality of A
 85 operators' positions, a plurality of telephone lines terminating thereat, a plurality of B operators' positions, trunks each terminating in a plurality of A operators' positions and in
 a B operator's position, means at the A op-
 90 erators' positions for assigning trunks in a prearranged order in accordance with the busy or idle condition of the B operators' positions, means for extending a calling tele-
 95 phone line to an assigned trunk, a plurality of telephone lines terminating at said B operators' positions, and means for extending an assigned trunk to a wanted one of said
 last mentioned telephone lines.

17. In a telephone system, a plurality of A
 100 operators' positions, a plurality of telephone lines terminating thereat, a plurality of B operators' positions, trunks each terminating in a plurality of A operators' positions and
 in a B operator's position, an indicator asso-
 105 ciated with each trunk at each A operator's position, said trunks at said A operators' positions being arbitrarily arranged in groups, means for operating the indicators of each
 group of A operators' positions in a definite
 110 sequence in accordance with the busy or idle condition of the B operators' positions in which said trunks terminate, means for ex-
 tending calling telephone lines to assigned
 115 trunks, a plurality of telephone lines terminating at said B operators' positions, and means for extending assigned trunks to said
 last mentioned telephone lines.

18. The method of trunking calls between A
 operators' positions and B operators' posi-
 120 tions, which comprises assigning trunks of groups in sequence to said A operators, while any B operator's position is idle, and then as-
 signing trunks in sequence to said A opera-
 125 tors so that there is uniform distribution of calls to the B operators, while all of the B operators remain busy.

19. In a telephone system, a plurality of A
 operators' positions, a plurality of telephone
 lines terminating thereat, a plurality of B 130

operators' positions, trunks each terminating in a plurality of A operators' positions and in a B operator's position, indicators associated with each trunk at each A operator's position, said trunks at said A operators' positions being arbitrarily arranged in groups, means for operating the indicators of each group of trunks of the A operators' positions in a definite sequence to assign said trunks in accordance with the busy or idle condition of the B operators' positions in which said trunks terminate, the operating means for said indicators functioning to uniformly assign trunks to said B operators' positions when all of said B operators' positions are busy, means for extending calling telephone lines to said assigned trunks, a plurality of telephone lines terminating at said B operators' positions and means for extending assigned trunks to said last mentioned telephone lines.

20. In a telephone system, a plurality of telephone lines, a plurality of primary operators' positions, each provided with answering equipment, trunks interconnecting said primary and said secondary positions, means for assigning different trunks in a predetermined sequence at different primary operators' positions, means for transmitting a signal over an assigned trunk when a secondary operator's answering equipment is connected thereto, and means for extending a calling telephone line to an assigned trunk.

35 21. In a telephone system, a plurality of telephone lines, A operators' positions, trunks terminating at said A operators' positions and leading to a distant office, B operators' positions at said distant office in which said trunks terminate, a plurality of sources of ringing current of different character and a single ringing key for each source of current common to all trunks terminating at said B operators' positions, means for visually assigning at A operators' positions idle trunks for use in sequence, means for mechanically extending calling telephone lines to idle A operators' positions, and means for connecting an extended telephone line to an assigned trunk.

50 22. In a telephone system, a plurality of telephone lines, A operators' positions, B operators' positions at a distant office, trunks interconnecting said A operators' positions and said B operators' positions, means for visually assigning at said A operators' positions idle trunks for use in sequence, means for automatically extending calling telephone lines to said A operators' positions, means for connecting an extended telephone line to an assigned trunk, operator's listening equipment at each B operator's position, and automatic means responsive to the extension of a call over one of said trunks to a B operator's

position at a distant office for automatically connecting said operator's listening equipment thereto.

In witness whereof, I hereunto subscribe my name this 9th day of August A. D. 1929.

WINFRED T. POWELL.

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