

May 20, 1924.

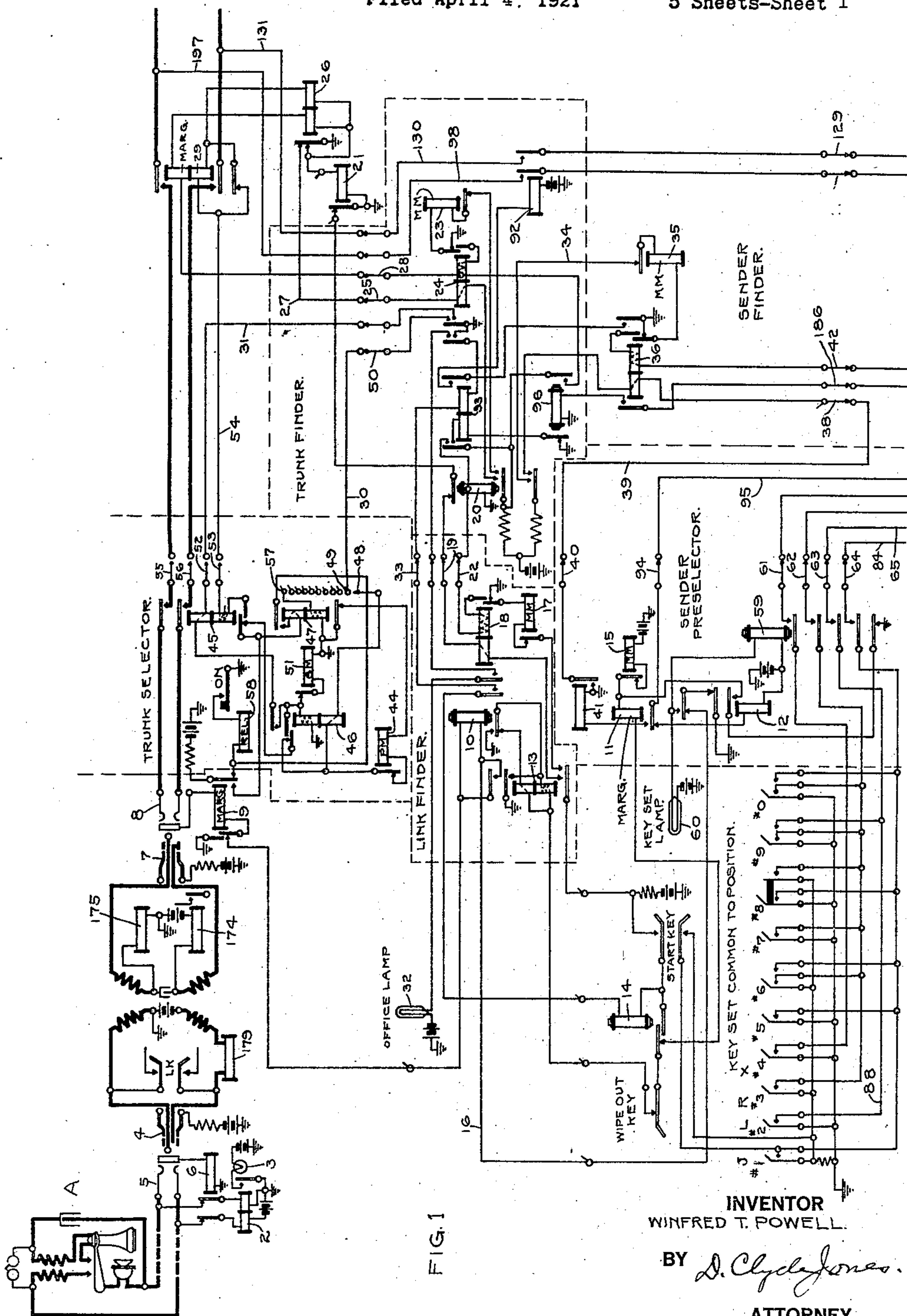
1,494,866

W. T. POWELL

INTEROFFICE TELEPHONE SYSTEM

Filed April 4, 1921

5 Sheets-Sheet 1





May 20 , 1924.

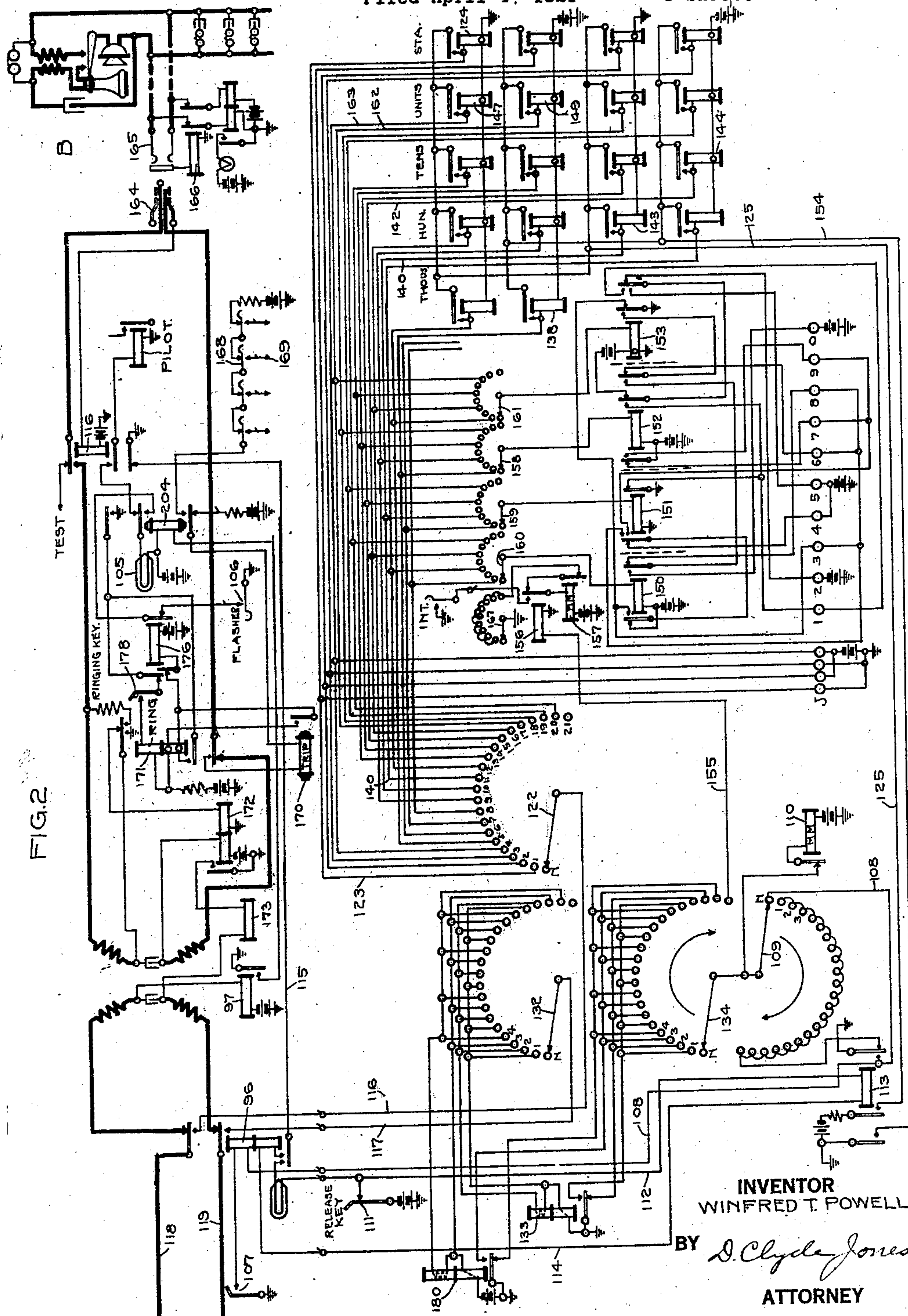
W. T. POWELL

**1,494,866**

# INTEROFFICE TELEPHONE SYSTEM

Filed April 4, 1921

5 Sheets-Sheet 2





May 20, 1924.

W. T. POWELL

1,494,866

INTEROFFICE TELEPHONE SYSTEM

Filed April 4, 1921

5 Sheets-Sheet 3

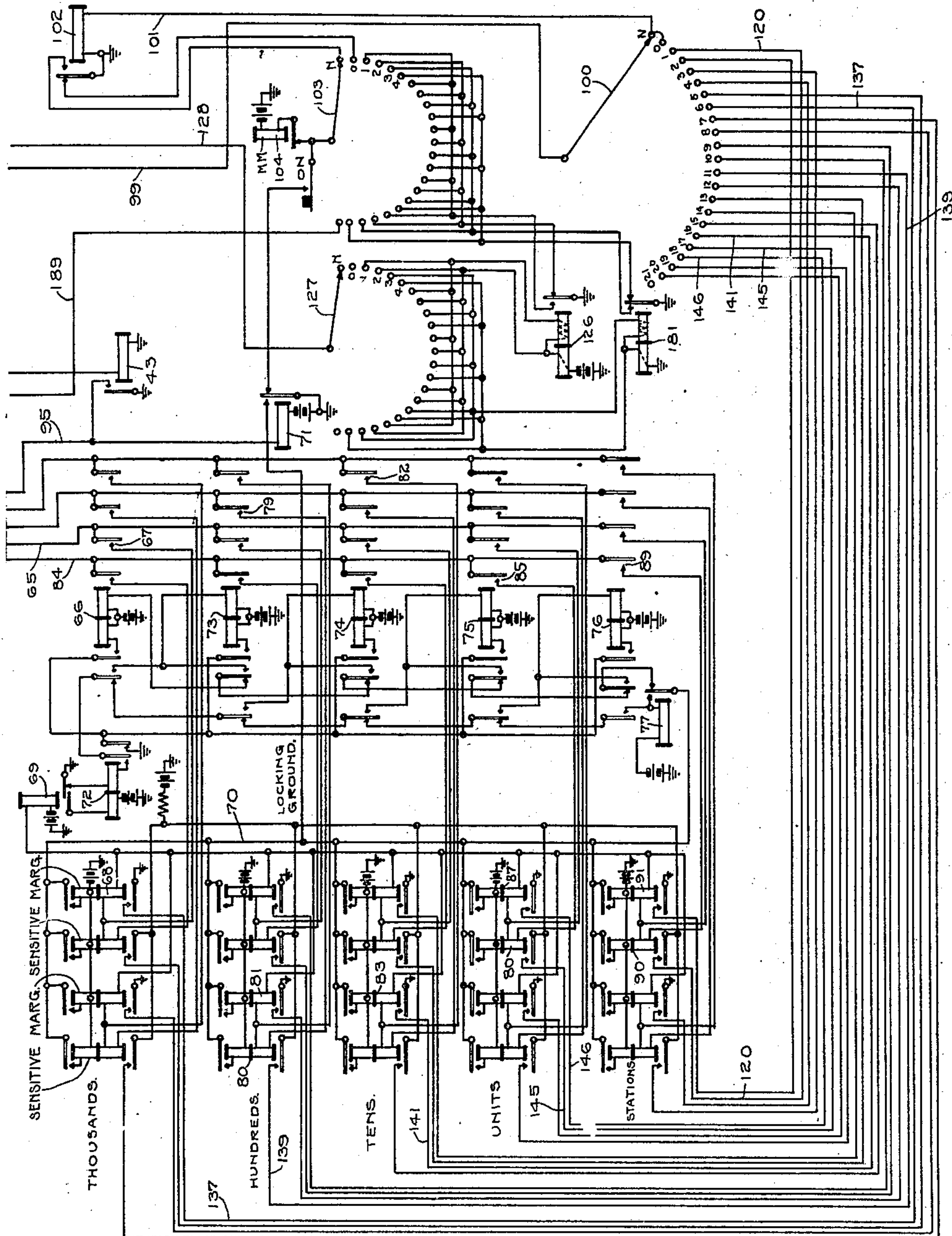


FIG. 3

INVENTOR  
WINFRED T. POWELL.

BY *D. Clyde Jones.*

ATTORNEY



May 20 , 1924

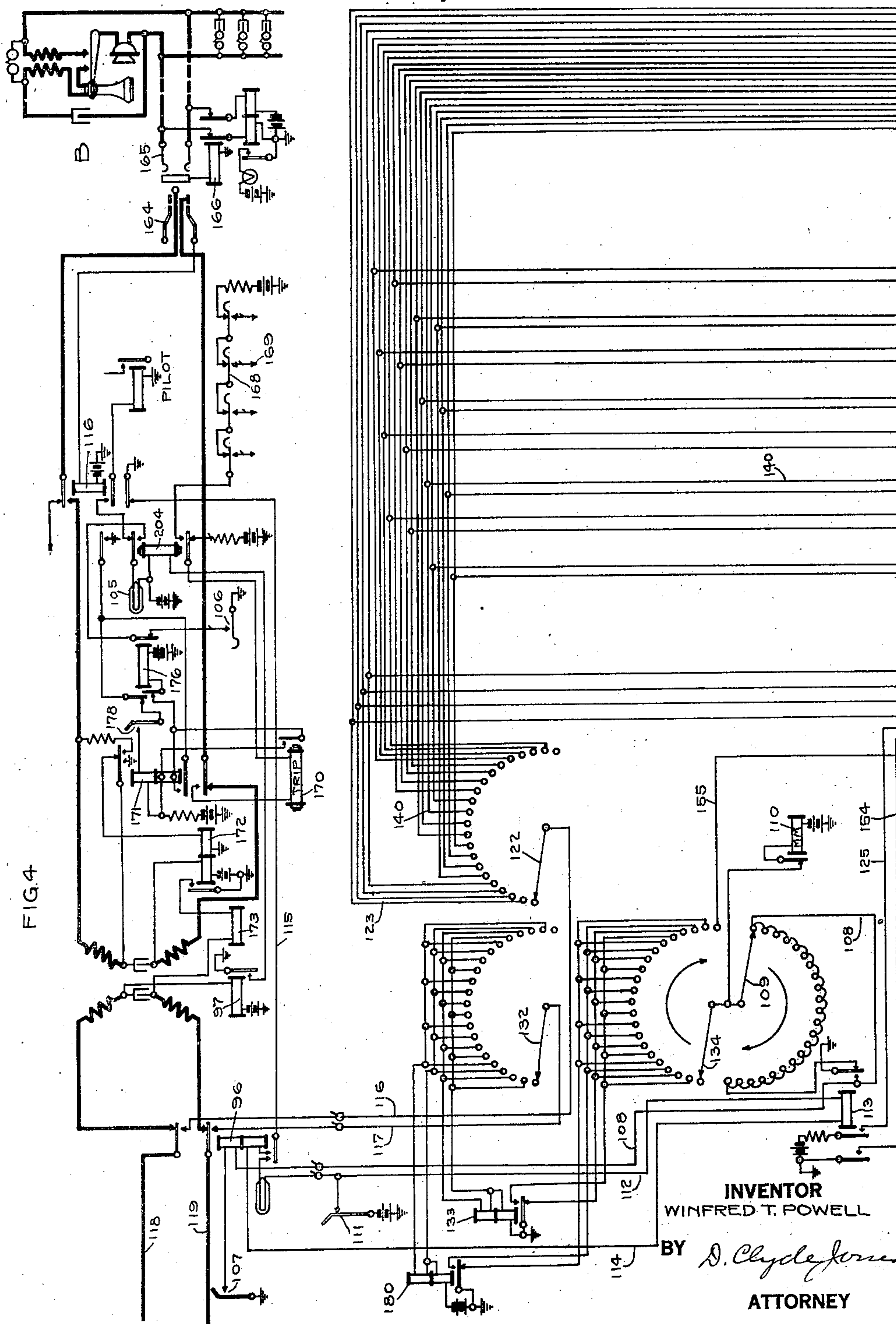
**1,494,866**

W. T. POWELL

## INTEROFFICE TELEPHONE SYSTEM

Filed April 4. 1921

5 Sheets-Sheet 4





May 20, 1924.

1,494,866

W. T. POWELL

INTEROFFICE TELEPHONE SYSTEM

Filed April 4, 1921

5 Sheets-Sheet 5

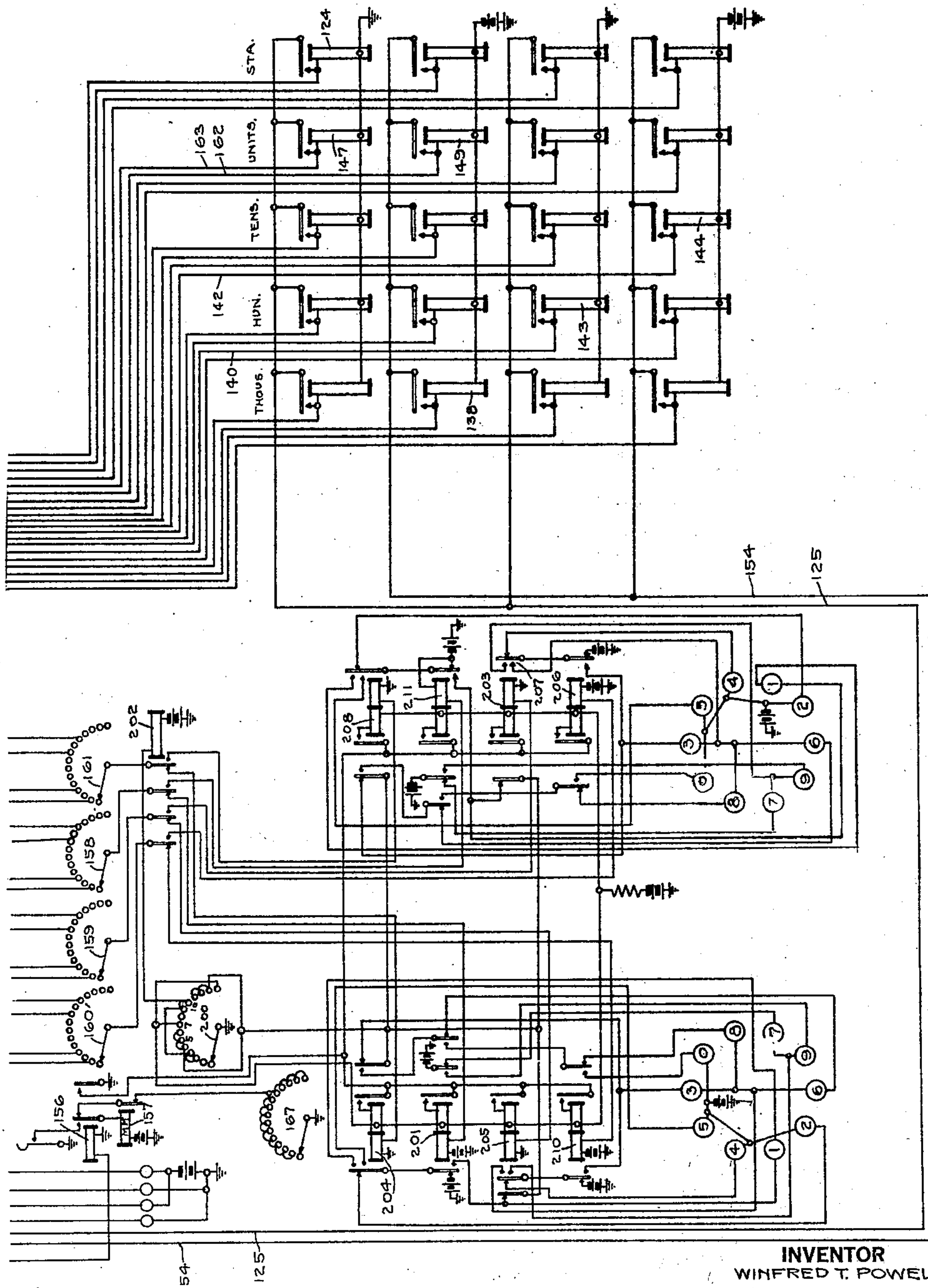


FIG. 5

INVENTOR  
WINFRED T. POWELL

BY *D. Clyde Jones*  
ATTORNEY



# UNITED STATES PATENT OFFICE.

WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

## INTEROFFICE TELEPHONE SYSTEM.

Application filed April 4, 1921. Serial No. 458,318.

*To all whom it may concern:*

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Interoffice Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly the systems employing automatic switches to establish some part of a telephone connection.

In inter-office telephone systems, it has formerly been necessary to provide an instruction circuit between operators at the exchanges through which a telephone connection is to be extended. This instruction circuit commonly known as an order wire is employed to convey instructions between the operators as to the lines and trunks to be used in the connection. As a result of the use of this instruction or order wire, the service is rendered less rapid by reason of the fact that the wanted number must be repeated to the operator at the exchange where the wanted line terminates, and this operation, in addition to the slowing down of the service, is a source of numerous errors due to the fact that the numbers are not repeated distinctly.

The present invention has for its purpose the elimination of the mentioned instruction or order wire, as well as to provide novel means for facilitating the establishment of a telephone connection. These various features will appear from the following detailed description and claims:

The drawings with Figures 1 and 2 arranged in the order named, and with Figure 3 placed below Figure 1, diagrammatically represent a portion of a telephone system employing the present invention. At the upper left-hand corner of Figure 1 there is represented the line and sub-station circuits of a subscriber and multiple jack of this line. There is also represented an abbreviated cord circuit terminating at each end in a well-known connecting plug. This cord circuit may be of any well known type employed for extending inter-office telephone connections. In this figure there also

appears the operating circuits of a trunk selector switch of the two-motion type which functions to first select a group of trunks leading to the wanted office and thereupon selects an idle trunk in the selected group. A trunk finder switch for locating the trunk to be seized by the trunk selector and a sender finder for selecting a pre-selected register sender are linked together and are arranged to be set in operation by a so-called link finder switch. This link finder switch is set into operation as a result of the insertion of the calling plug of the cord circuit into a multiple jack of any one of a group of trunks leading to the wanted office. A sender pre-selector switch also appears in this figure and functions to pre-select an idle sender for use ahead of the calls. These various switches and the operating circuits for the same are enclosed by dotted lines and by the confines of the drawing. At the lower left-hand portion of Fig. 1 there appears a single strip of ten numerical keys which is common to a single position at the switchboard. In Fig. 3, there is represented a register sender including a control or sender switch individual to this sender. It will be understood that the arrangements appearing in Figs. 1 and 3 are located in the same office. In Figure 2 there is diagrammatically shown a portion of the trunk circuit at the second or distant office, and the controlling circuits for the same. In this figure there also appear groups of relays for receiving the designation from the registers of the originating office and a receiver switch for co-operating in the transfer of this designation to the groups of receiving relays.

Figures 4 and 5 represent the trunk and controlling circuits associated therewith at the distant office as well as the modified receiving registers and lamp indicating devices associated therewith. It will be understood that the circuits of Figures 4 and 5 may be substituted for those of Figure 2, in which case the circuits of Figures 4 and 5 operate with those in Figures 1 and 3.

The switches employed in this system, with the exception of the trunk selector switches, may be substantially similar in structure to those disclosed in the patent to



Clement No. 1,107,153 patented August 11, 1914. The trunk selector switch may be similar to that disclosed in the patent to Keith et al No. 815,321 patented March 13, 1906.

The various portions of the equipment of the system may be arranged in the following manner, although the invention is not limited to the exact number of pieces of apparatus or to the exact arrangement of the circuits herein disclosed.

Each operator's position is provided with a single set of ten numerical keys herein referred to as a key-set, a key-set lamp for indicating that the registers of the pre-selected sender are in readiness to be adjusted under control of the key-set, and a start key for releasing the key-set from the operated register sender. A wipe-out key is also provided for each position to release registers that are inaccurately adjusted. Before each operator there are placed groups of multiple trunk jacks connected to trunks, each group of which is assigned for calls destined to a particular exchange or office. These multiple trunk jacks are connected to primary trunks each of which terminates at its other end in a two-motion selector switch operating to seize the secondary trunk circuit indicated by a trunk finder switch. The number of trunks and the number of two-motion selector switches of course will depend upon the amount of traffic. To the terminals of these two-motion switches and multiplied to other similar switches at other operator's positions is a secondary group of trunks leading to distant offices. In this system there are provided a plurality of register senders each comprising a group of relay registers and a rotary control switch or sender switch. These register senders are common to all the positions at the originating office and will be sufficient in number to care for the maximum number of calls that are in process of completion at the same time. A sender pre-selector switch is provided for the individual use of each operator's position and functions to preselect an idle register sender for its individual position ahead of the call. In order to associate an idle register sender with an idle secondary trunk circuit to the wanted office, a series of link circuits common to a plurality of operators are provided. Each of these link circuits terminates at one end in a trunk finder switch having multiple terminals of the various secondary trunk circuits and serving to select an idle secondary trunk circuit, and at its other end in a sender finder switch functioning to locate a pre-selected register sender. In order to select one of these link circuits and to start a trunk finder and a sender finder switch into operation, link finder switches are provided of which there

is one of these switches associated with each operator's position for each of the offices that is reached from this position.

At the distant office there is provided a receiver switch and a group of receiving relays for each operator's position, and this receiver switch and group of relays are so multiplied that they may be associated with any trunk on which the receiving operator may receive a call.

It is believed that the invention will best be understood by describing the method of completing a telephone connection from a subscriber's sub-station indicated at "A" to a wanted subscriber's station indicated at "B." When the calling subscriber at "A" removes his receiver from its switchhook, the line relay 2 is operated in the well-known manner and actuates the line signal 3. The operator thereupon inserts the plug 4 into multiple jack 5 of the calling line. This operation is effective to actuate the cut-off relay 6 which functions to disconnect the line relay 2 from the calling line and to extinguish the line signal 3. The operator thereupon depresses the listening key LK to connect her telephone set (not shown) to the calling line and thereby receives the designation of the wanted line from the calling subscriber. All of this takes place in the well known manner.

Let it be assumed that the designation of the wanted line is Main 2345—J: The operator then inserts the calling plug 7 into any one of a group of jacks, such as 8 assigned to the exclusive use of calls completed through the Main exchange. As soon as this operation is complete, a circuit is closed from grounded battery through the sleeve of plug 7 and sleeve of jack 8, winding of the marginal relay 9, its armature and back contact, winding of the slow-releasing relay 10, conductor 16, lower back contact and armature of relay 11, uppermost back contact and armature of relay 12 to ground. Marginal relay 9 is not actuated in this circuit, but the relay 10 is operated to close other circuits which will be described. One of these circuits extends from ground, front contact and armature of relay 10, lower high-resistance winding of the relay 13, the normally-closed contacts of the wipe-out key, continuity spring and back contact of the slow-releasing relay 14, winding of the marginal relay 11, armature, back contact and winding of the motor magnet 15 to grounded battery. The motor magnet 15 and the marginal relay 11 are not operated in this circuit but the relay 13 is actuated to close a locking circuit for itself at its inner armature and front contact, while at its uppermost armature and front contact it short-circuits the slow-releasing relay 10, which relay shortly afterwards retracts its armature. At this time the marginal relay 9 is now op-



erated in a circuit traceable from grounded battery, resistance through the sleeves of the plug 7 and jack 8, winding of relay 9, its continuity spring and back contact, uppermost armature and front contact of relay 13, conductor 16, lowermost back contact and armature of relay 11, uppermost back contact and armature of relay 12 to ground. Relay 9 on operation closes a locking circuit for itself through its continuity spring and armature to ground. The relay 13 when operated also closes a locking circuit for itself and an operating circuiting for relay 11 through its low resistance winding, this circuit being traced from ground, inner armature and front contact of relay 13, armature and back contact of the relay 10 low resistance winding of relay 13 through the contacts of the wipe-out key and through the windings of relay 11 and motor magnet 15 to grounded battery.

Relay 11 is thus energized and effects the operation of relay 59 in a circuit closed from grounded battery, its winding, lowermost armature and front contact of relay 11, uppermost back contact and armature of relay 12 to ground. The lamp 60 is lighted in multiple with relay 59 to indicate that the operator's key set has been connected to an idle register sender. Relay 11 also completes operating circuits for relays 41 and 71 traceable from ground, winding of relay 41, inner front contact and armature of relay 11, brush 94, conductor 95, winding of relay 71 to grounded battery. Relay 71 when operated opens the release circuit of the sender switch of Figure 3 and connects the locking ground to conductor 70. With the locking ground connected to conductor 70 an operating circuit is closed for the thousand's switching relay 66, completed from grounded battery, right-hand winding of this relay, middle armatures and back contacts of relays 73, 74, 75 and 76 back contact and armature of relay 77 to ground over conductor 70. The switching relay when thus operated connects the operator's key set to the thousand's relay register. Also when the relay 13 is operated, it closes a circuit from grounded battery, resistance, lower armature and front contact of relay 13, armature, back contact and winding of the motor magnet 17, continuity spring and back contact of relay 18 to ground. Under the control of this circuit the motor magnet 17 advances the brushes of the link finder switch until the test brush 19 engages the test terminal of an idle link circuit, which link circuit terminates at one end in a trunk finder switch and at the other end in a sender finder switch. As soon as the idle link is located, a circuit is closed for short-circuiting motor magnet 17 and thereby stopping the link finder switch, this circuit being completed from grounded bat-

tery, resistance, armature and front contact of relay 13, left-hand winding of relay 18, test brush 19, back contact and armature of the slow-releasing relay 20, back contact and armature of the group relay 21 to ground. It may be stated at this point that when all of the trunks of a group accessible through a particular group of trunk finders are engaged, the group relay 21 will be operated and thereby remove the stopping ground from all the terminals associated with trunk finder switches whose outgoing trunks are busy. The relay 18 when operated closes a locking circuit for itself from grounded battery, resistance, armature and front contact of relay 13, armature, back contact and winding of the motor magnet 17, continuity spring, armature and right hand winding of relay 18, holding brush 22, winding of the slow-releasing relay 20 to ground. Relay 18 is maintained operated in this circuit, but the motor magnet 17 is not actuated in series with the high resistance winding of the relay 18. The relay 20 at its upper armature removes the stopping ground potential from all the test terminals of this link at other link finder switches so that it will be rendered busy. The operation of the relay 20 completes circuits for setting the trunk finder switch and the sender finder switch of the selected link circuit into operation. The actuation of the first of these mentioned switches will now be described.

As soon as the relay 20 actuates its armatures it closes a circuit from grounded battery through the resistance inner armature and front contact of relay 20, back contact, armature and winding of the motor magnet 23, continuity spring and back contact of relay 24 to ground. The motor magnet 23 is actuated in this circuit and advances the brushes of the trunk finder switch until the test brush 25 engages a test terminal of an idle trunk, at which time a circuit is closed to ground at the armature and back contact of relay 26, conductor 27, test brush 25, left-hand low resistance winding of the relay 24, front contact and armature of relay 20 through the resistance to grounded battery. This circuit is effective to short-circuit the motor magnet 23 and to actuate the relay 24. This last-named relay when operated closes a locking circuit for itself from grounded battery, resistance, armature and front contact of relay 20, back contact, armature and winding of the motor magnet 23, continuity spring armature and right-hand high resistance winding of the relay 24, holding brush 28, upper winding of the marginal relay 29, left-hand winding of relay 26 through the back contact and armature to ground at some other relay similar to 26 associated with an idle trunk leading to the Main exchange. As soon as all the relays similar to 26 are actuated the last-de-



scribed circuit will extend through the winding of the group relay 21 which operates to remove the stopping ground from the terminals of all link finders assigned for use with trunks leading to the Main exchange. Since relay 29 is marginal it will not operate in the last described circuit but holds open the tip and ring conductors of the selected trunk to prevent interference with the impulse circuit including conductors 197 and 131. The relay 24 at its inner left-hand armature and front contacts applies ground over conductor 30 to the group terminal of the trunk selector switch to indicate the group of trunks to be selected by this switch, whereas ground is applied over conductor 31 to indicate the trunk that is to be seized in this selected group. At the outer left-hand armature of relay 24 a circuit is closed from grounded battery through the lamp 32, inner armature and front contact of relay 18 through the brush of the link finder, outer front contact and armature of relay 24 to ground. Lamp 32 when lighted informs the operator that an idle trunk circuit to the distant office, as well as an idle register sender have been selected, also at the outer armature and front contact of relay 24, a break-point is closed in the operating circuit of the relay 14, but this circuit is still incomplete at the starting key. The purpose of this last-mentioned circuit will be described in the course of the following descriptions.

The operation of the sender finder switch will now be described: It will of course be understood that the sender finder and the trunk finder switches operate simultaneously, the sender finder switch being operated by the closure of the circuit from grounded battery through the resistance, lowermost armature and front contact of relay 20, conductor 34, back contact, armature and winding of the motor magnet 35, continuity spring and back contact of relay 36 to ground. The sender finder switch advances its brushes until its test brush 38 encounters a test terminal of the pre-selected sender, at which time a circuit is closed from grounded battery resistance, lowermost armature and front contact of relay 20, left-hand low resistance, winding of relay 36, test brush 38, conductor 39, sender pre-selector brush 40, armature and front contact of relay 41 to ground. This circuit is effective to operate the relay 36 and introduce resistance in the circuit of the motor magnet 35 of the sender finder to stop the same with its brushes in engagement with the terminals of the pre-selected sender. The relay 36 when operated closes a locking circuit for itself from grounded battery resistance, lowermost armature and front contact of relay 20, conductor 34, back contact, armature and winding of the motor magnet

35, continuity spring, armature and high-resistance winding of relay 36, sender finder brush 42, winding of relay 43 to ground. Relay 36 is locked operated and the relay 43 is actuated in this last described circuit to indicate that the register sender of Fig. 3 is busy.

As soon as the marginal relay 9 is operated it closes an operating circuit for advancing the trunk selector switch. Here it should be noted that the trunk selector operates practically simultaneously with the trunk finder and sender finder, the operation of which has been previously described. The mentioned operating circuit extends from grounded battery, resistance, right hand armature and front contact of relay 9, continuity spring and back contact of relay 45, continuity spring and back contact of relay 46, armature, back contact and winding of the primary motor magnet 44, lower contact and armature of relay 47 to ground. Under the control of this circuit the primary motor magnet advances the brushes of the trunk selector until the group brush 48 encounters the group terminal 49 to which ground potential has been applied by the operation of the trunk finder switch. As soon as this terminal is located the primary magnet 44 is short-circuited by a circuit which may be traced from grounded battery resistance, armature and front contact of relay 9, continuity spring and back contact of relay 45, continuity spring, back contact, lower winding of relay 46, group brush 48, group terminal 49, trunk finder brush 50, inner front contact and armature of relay 24 to ground. This circuit is effective to stop the operation of the primary motor magnet and also actuates the relay 46 which immediately closes a locking circuit for itself from ground through its upper high resistance winding, its inner armature and continuity spring, back contact and continuity spring of relay 45, front contact and armature of relay 9 resistance to grounded battery. With the relay 46 operated an actuating circuit is closed for the secondary motor magnet from ground, the winding, armature and back contact of this magnet, innermost armature and continuity spring of relay 46, back contact and continuity spring of relay 45, front contact and armature of relay 9 through the resistance to grounded battery. This circuit is effective to advance the brushes of the trunk selector switch in its secondary movements to hunt for the pre-selected trunk circuit in the selected group of trunks. As soon as the pre-selected trunk is located, a circuit is closed from grounded battery, resistance armature and front contact of relay 9, continuity spring and contact of relay 45, uppermost front contact and armature of relay 46, low resistance winding of relay 45, test brush



52 of the trunk selector, conductor 31, front contact and armature of relay 24 to ground. The secondary motor magnet is shunted, but the relay 45 is actuated and closes a locking  
 5 circuit for itself from grounded battery, resistance, armature and front contact of relay 9, continuity spring, armature and high resistance winding of relay 45, holding brush 53 of the trunk selector, conductor 54, lower  
 10 back contact and armature of relay 29, right-hand winding contact and armature of relay 26 to ground. Relay 45 when operated also is effective to connect the talking conductors of the selected trunk to the brushes 55 and 56  
 15 of the trunk selector. In the event that the trunk selector reached the group terminal before the trunk has been selected by the trunk finder switch, the primary motor magnet will continue to advance the brushes of  
 20 the trunk selector until the group brush 48 encounters the overflow terminal 57 to close an operating circuit for the relay 47. This effects the release of the trunk selector switch by reason of a circuit closed from  
 25 grounded battery, resistance, armature and front contact of relay 9, upper winding, front contact and armature of relay 47, winding of the release magnet 58 and off-normal contacts to ground. This will re-  
 30 lease the trunk selector switch and it will immediately repeat the operation of hunting for the preselected group of trunks and as soon as this group of trunks is located the primary operation of the trunk selector  
 35 switch will be stopped in the manner already described.

As soon as the relay 59 is operated the operator's set of keys is connected to the brushes 61, 62, 63 and 64 of the sender pre-  
 40 selector and since this pre-selector is assumed to be standing with its brushes in engagement with the terminals of an idle sender the operator's key set is thus connected to an idle register sender. It has  
 45 been assumed earlier in the description that the designation of the wanted line is Main 2345—J. The operation of plugging in to a connecting jack assigned to the Main office completes the first part of the selection.  
 50 It therefore remains for the operator to set up the remainder of the designation 2345—J which is done by pressing the respective keys in the order named.

When the operator presses key No. 2, a  
 55 circuit is closed from ground through the contacts of this key, conductor 88, armature and front contact of relay 59, brush 63, conductor 65, armature and contact 67 of relay 66, lower winding of the marginal relay 68,  
 60 winding of relay 69 to grounded battery to operate relay 69. Relay 68 is actuated in this circuit and completes a locking circuit for itself from grounded battery, its upper winding front contact and armature,  
 65 front contact and armature of relay 71 to

ground. The operation of relay 69 actuates relay 72. When, however, the No. 2 key is released, relay 69 deenergizes and retracts its armature, but an operating circuit is closed  
 70 from ground, its continuity spring and back contact, right-hand winding of relay 72, its inner front contact and armature, outer armature and front contact of relay 66, right-  
 75 hand winding of relay 73 to grounded battery. The relay 73 is actuated in this circuit and is locked operated, first in a circuit from grounded battery, its left-hand winding, inner front contact and armature, outer armature and front  
 80 contact of relay 72 to ground. A second locking circuit for relay 73 extends from grounded battery, right-hand winding of this relay, its middle front contact and ar-  
 85 mature through the middle back contacts and armatures of relays 74, 75 and 76, back contact and armature of relay 77, conductor  
 90 70 to the holding ground. The operation just described is effective to selectively actuate the thousands relay register and has extended the control of the operator's key-  
 95 set to the hundreds relay register. The operator now depresses key No. 3 and thereby completes a circuit from ground through the resistance, contacts of the No. 3 key, armature and front contact of relay 59, brush  
 100 62, armature and front contact 79 of relay 73, lower winding of sensitive relay 80, lower winding of the marginal relay 81, winding of relay 69 to grounded battery. The relays  
 105 80 and 69 are actuated in this circuit, but marginal relay 81 remains inert. Relay 80 on operation closes a locking circuit for itself from grounded battery, its front con-  
 110 tact and armature to ground over conductor 70. The relay 69 when operated again, actuates 72 to effect the deenergization of the switching relay 73 and the actuation of the  
 115 tens switching relay 74 in the manner just described for the relays 66 and 73. The tens register is now in readiness to be operated and the operator depresses No. 4 key, of her  
 120 key-set to close a circuit from ground, contacts of the No. 4 key, armature and front contact of relay 59, brush 61, armature and contact 82 of relay 74, lower winding of the  
 125 marginal relay 83, winding of relay 69 to grounded battery. Relay 83 when operated is locked operated over a circuit including conductor 70 to the locking ground. Switch-  
 130 ing relay 74 then deenergizes and the units switching relay 75 is actuated in the same manner as has been described in connection with relay 73. The operator now depresses numeral key No. 5 and extends the circuit  
 135 from ground through the contacts of No. 5 key, armature and front contact of relay 59, brush 64, conductor 84, armature and con-  
 140 tacts 85 of relay 75, lower winding of sensitive relay 80 lower winding of marginal relay 87, winding of relay 69 to grounded



battery. Here also the sensitive relay 80 and the relay 69 are energized, together with relay 87. Relays 80 and 87 on operation are locked in this condition over conductor 70 to the locking ground. Switching relay 75 deenergizes and relay 76 is operated in a manner similar to the operation of relay 73. The operator now depresses the party key "J" which extends a circuit from ground, resistance, contacts of key "J", armature and front contact of relay 59, brush 64, conductor 84, armature and contact 89 of relay 76, lower winding of relays 90 and 91 and winding of relay 69 to grounded battery. Relays 90 and 69 are actuated in this circuit, the former of these relays being held operated over conductor 70 to the locking ground. Relay 69 effects the operation of relay 72 to control in turn the actuation of the relay 77 which is locked operated over the locking ground conductor to remove this register sender from the further control of the operator's key-set. The relays of the register sender remain in this actuated condition until the operator at the distant office has signified that she is in readiness to receive the indication of the wanted party.

The operator after setting up the wanted number depresses the start key and completes a circuit from grounded battery, resistance, upper contact of the start key, winding of the relay 14, outer armature and front contact of relay 18, brush 33, right-hand winding of relay 93, outer front contact and armature of relay 24 to ground. Relay 14 is operated in this circuit and opens the operating circuit of the relay 11 which permits the sender pre-selector to be advanced to select an idle sender. This is effected by reason of the fact that the relay 12 is now operated in a circuit traceable from grounded battery, its winding, lower back contact and armature of relay 11, test brush 94 of the sender pre-selector, conductor 95 and front contact and armature to ground, of relays similar to 43 at engaged register senders. While relay 12 is held operated, motor magnet 15 is actuated in a circuit extending through its winding, back contact and armature, the inner front contact and armature of relay 12, lowermost armature and back contact of relay 59. Under the control of this last described circuit the sender pre-selector advances its brushes until the test brush 94 engages a test terminal characterized by the absence of potential. Also the relay 93 is energized in series with the relay 14 and locks itself operated from ground, back contact and armature of relay 96, left-hand winding of relay 93, its front contact and armature through the resistance to grounded battery. With the relays 36 and 93 actuated, relay 92 is energized from grounded battery, its winding, right-hand front contact and armature of relay

93, outer front contact and armature of relay 36, to ground. Relay 92 when operated, extends the impulse circuit from the register sender to the conductors of the selected trunk.

It will be remembered that the relay 13 is locked in series with relay 11 and when relay 14 opens the circuit of relay 11 it effects the deenergization of the relay 13 whereupon the locking circuit including right-hand winding of relay 18 is opened and this relay retracts its armatures. The link finder is of that type which remains in engagement with the trunk last used so that this last described operation is all that is necessary to effect its release. The link circuit in use is, however, guarded by the energization of relay 20, circuit of which extends from ground, its winding, left-hand front contact and armature of relay 93, resistance to grounded battery.

As soon as the trunk circuit of this description has been extended to the distant office, the relay 97 of Figure 2 is energized from grounded battery, its winding, through the upper winding of the repeating coil, back contact and uppermost armature of relay 96, conductor 118 of the trunk, conductor 197 through the brush of the trunk finder, conductor 98, inner front contact and armature of relay 92, sender finder brush 121, conductor 99, register controller brush 100 in its normal position, conductor 101, winding of relay 102 to ground. Relays 97 and 102 are both energized in these circuits, the operation of relay 102 closes a circuit from ground, its armature and front contact, controller brush 103 in its normal position, back contact, armature and winding of the motor magnet 104 to grounded battery. The motor magnet thus causes the advance of the controller brushes into their zero position. The relay 97 of Fig. 2, however, when operated closes a circuit from ground, armature and contact of this relay winding of slow-releasing relay 204 to grounded battery. Relay 204 is thus actuated and connects the lamp 105 in series with a flasher 106. Lamp 105 is thereby intermittently lighted to call the operator's attention to the fact that a call is awaiting attention on the trunk to which this lamp is individual.

As soon as the operator at the distant office is in readiness to attend to this call, she depresses the assignment key 107 which extends a circuit from ground through the contact of this key, upper winding of relay 96, conductor 108, the receiver brush 109 in its normal position, back contact, armature and winding of the motor magnet 110 of the receiver switch to grounded battery.

Relay 96 is also energized in this circuit and closes a locking circuit for itself from grounded battery, contacts of release key 111, conductor 112, winding of relay 113,



conductor 114, lower winding of relay 96, its front contact and armature, conductor 115, lowermost back contact and armature of relay 116 to ground. Relay 113 is thereby actuated and closes a circuit by which the motor magnet 110 is operated to advance the receiver brushes into their first position. Relay 96 when operated also extends the conductors 116 and 117 leading to the numerical receiver, to conductors 118 and 119 of the trunk circuit. Relay 96 when operated also opens the previously described circuit of 102 so that this relay deenergizes and advances the sender switch into position 1.

With sender and receiver switches in position 1, the registration stored up on the register sender of Fig. 3 is communicated to the number-receiving device of Fig. 2. This is effected in the following manner. It will be remembered that the station's relay 90 is actuated in response to the depression of the party key J, therefore, with relay 90 operated a circuit is closed from grounded battery resistance, through the armature and front contact of relay 90, conductor 120, brush 100, conductor 99, brush 121, inner armature and front contact of relay 92, conductors 98, 197 and 118, upper armature and front contact of relay 96, conductor 116, receiver brush 122, conductor 123, winding of relay 124 to ground. Relay 124 is operated in this circuit and is locked actuated over conductor 125, front contact of relay 113 through the resistance to grounded battery. Also with the sender and receiver switches in position 1, relay 126 (Fig. 3) is operated in a circuit traceable from grounded battery through both windings in series of this relay, sender brush 127 in its first position, conductor 128, brush 129, outer armature and front contact of relay 92, conductors 130, 131, and 119, inner armature and front contact of relay 96, conductor 117, receiver brush 132 in its first position, lower winding of relay 133 to ground; relay 133 remains inactive. In response to the energization of relay 126, the motor magnet 104 of the sender switch has an operating circuit closed from grounded battery, winding of this magnet, its armature and back contact, sender brush 103 in position 1, front contact and armature of relay 126 to ground. Under the control of this circuit the motor magnet advances the brushes of the sender switch into their second position. At this time a circuit is extended from grounded battery, resistance, left-hand winding of relay 126, brush 127 in its second position, conductor 128, brush 129, conductors 130, 131 and 119, armature and front contact of relay 96, conductor 117, brush 132 in its first position, low resistance winding of relay 133 to ground. Relay 126 remains operated and relay 133 attracts its armature and thereby closes an operating

circuit for the motor magnet 110 of the receiver switch from grounded battery, winding armature and back contact of this magnet, receiver brush 134 in its first position, front contact and armature of relay 133 to ground. The motor magnet is thus operated to advance the brushes of the receiver switch into their second position. In position 2 a circuit is closed from grounded battery, low resistance winding of relay 126, brush 127 in its second position, conductor 128, brush 129, armature and front contact of relay 92, conductors 130, 131 and 119, inner armature and front contact of relay 96, conductor 117, brush 132 in its second position through both the high resistance and low resistance windings in series of relay 133 to ground. Relay 126 will not remain operated in series with both windings of relay 133 and deenergizes to complete a circuit from ground, its armature and back contact, brush 103 in its second position, back contact, armature and winding of the motor magnet 104 to grounded battery. Under the control of this circuit the brushes of the sender switch are advanced into position 3. The circuit of relay 133 is opened and it deenergizes to advance the receiver switch into position 3. With the sender and receiver switches both in position 3, the relay 181 is energized in a circuit traceable from ground through both windings in series of this relay, brush 127, conductor 128, brush 129, conductors 130, 131 and 119, armature and front contact of relay 96, conductor 117, brush 132 through the low resistance winding of relay 180 to grounded battery. Relay 180 does not operate in this circuit but relay 181 is actuated and thereby closes a circuit for causing the motor magnet 104 to advance the sender switch into position 4. This operation is effective to remove high resistance winding of relay 181 from the control circuit just described so that relay 180 is operated to close the operating circuit for the motor magnet 110 by which the receiver switch is advanced into position 4. When the receiver switch brush 132 goes to 4, the high resistance winding of 180 is cut into circuit and allows relay 181 to release to move the sender to position 5. With the sender in position 5, the circuit to 180 is opened and it releases to move the receiver to position 5.

From the foregoing described operation of relays 126, 133, 181 and 180 it will be noted that first one of the relays of these pairs is operated and subsequently the other relay of the same pair is operated to advance the receiver switch into a succeeding position. It will thus be seen that the sender switch is first advanced one step to complete a circuit for advancing the receiver switch a single step and this operation completes a circuit for advancing the sender switch into



its next succeeding position. This alternate advancing of first the sender switch and then the receiver switch, each under the control of the other, insures that both switches  
5 will be in synchronism, so that the designation stored up on the relay registers may be transferred to relays at the distant office.

When the sender and receiver switches are passing through position 6, a circuit is closed  
10 from ground at the lower armature and front contact of relay 68, conductor 137, brush 100, conductor 99, sender finder brush 121, inner armature and front contact of relay 92, conductors 98, 197 and 118, upper  
15 armature and front contact of relay 96, conductor 116, brush 122, winding of relay 138 to grounded battery. Relay 138 is thus operated and is locked in this condition to ground over conductor 154. When the  
20 sender and receiver switches are passing through position 11 the registration stored up on the hundreds relay register is transferred to the hundreds group of relays at the distant office over a circuit completed  
25 from grounded battery, resistance, armature and front contact of relay 80, conductor 139, brush 100 and through the circuit previously described including the tip conductor 118 of the trunk to the distant office, to brush 122  
30 of the receiver, conductor 140, winding of relay 143 to ground. Relay 143 is thus operated and is locked actuated over the conductor 125 to grounded battery at the armature and front contact of relay 113. As the  
35 sender and receiver switches are advanced through position 16, the registration stored up on the tens register is transmitted to the distant office over conductor 141 and the tip side of the signalling circuit previously described, brush 122 of the receiver switch,  
40 conductor 142, winding of relay 144 to grounded battery. Relay 144 is thus energized and is locked operated to ground over conductor 154. The registration stored up  
45 on the units register is transmitted to the distant office over conductors 145 and 146 while the sender and receiver switches are passing through positions 17 and 18, and these mentioned conductors are included in  
50 circuits for actuating relays 147 and 149 at the distant office. Relay 147 when actuated is locked in this condition to grounded battery over conductor 125, while relay 149 when operated, is locked in this condition to  
55 ground over conductor 154. It will thus be seen that the registration stored up at the originating office is repeated to the distant office and is there recorded on the groups of relays designated thousands, hundreds, tens,  
60 units and stations.

At this time the release of the trunk finder, the sender finder and the sender switch is accomplished as will be described. When the brush 103 of the sender switch  
65 reaches position 21 it closes a circuit for op-

erating the release relay 96 appearing at the middle of Figure 1. This circuit may be traced as extending from ground, winding of relay 96, front contact and armature of relay 36, sender brush 186, conductor 189,  
70 brush 103 back contact, armature and winding of motor magnet 104 to grounded battery. This circuit in addition to actuating the relay 96 advances the sender switch into its normal position. At the time when relay  
75 96 is operated it opens the holding circuit for the relay 93 and this relay deenergizes to open the holding circuit for relay 20 and operating circuit of the relay 92. The last named of these relays opens the previously  
80 described impulse circuit while the relay 20 removes the guarding condition from the link circuit rendering it selectable for use on a succeeding call, also the operation of the relay 96 completes a circuit which will  
85 now operate marginal relay 29 which connects the trunk circuit between the two offices in question. This operating circuit of the relay 29 extends from grounded battery  
90 through the resistance armature and front contact of relay 96, brush 28, upper winding of relay 29, left-hand winding of relay 26 to ground at the armature and back contact of a relay similar to 26 associated with an idle  
95 trunk or if all of the trunks are busy, through the winding of relay 21 to ground.

In accordance with the present invention it is proposed to have one set of ten numerical lamps and four station lamps. The stations designation of the wanted subscriber  
100 first appears on one of the stations lamps and thereafter the digits of this designation appear one at a time on the ten numerical lamps appearing at the lower part of Fig. 2. This is effected as will now be described.  
105

When the receiver switch is advanced into position 21 it closes a circuit from grounded battery, winding of the motor magnet 110, its armature and back contact, brush 134, conductor 155, winding of relay  
110 156 to ground. Relay 156 when thus operated closes a circuit for the motor magnet 157 of a small distributor switch provided with five sets of brushes disclosed adjacent to each other, near the center of Fig. 2. The  
115 operating circuit for this motor magnet extends from grounded battery, its winding, armature and front contact of relay 156 and through the intermittently closed brush of the interrupter to ground. Under the control of this circuit the motor magnet 157  
120 advances the brushes of the distributor switch to connect in succession the group of relays 150 and 153 inclusive to the actuated relay or relays as the case may be, first of the  
125 thousands group, then of the hundreds and subsequently to the groups of tens and units relays that have been actuated. It has been assumed that the first digit of the wanted number is 2, and it will be observed by  
130



tracing out the circuit for actuating lamp No. 2 that relay 152 must be operated. This is effected when the brush 158 of the distributor switch is passing through its second position, at which time the relay 152 is connected to ground in multiple with actuated thousands relay 138, over conductor 154. Since the next digit is 3, it is necessary to light the No. 3 lamp which is effected by actuating relay 151. Relay 151 is operated when the brush 159 of the distributor is advanced to position 4 where a circuit is completed over conductor 140 to the front contact and armature of actuated hundreds relay 143, to grounded battery over conductor 125. In order to light the No. 4 lamp it is necessary to actuate relay 150 and this is effected when the brush 160 of the distributor switch is advanced to its sixth position where a circuit is completed over conductor 142 and the front contact and armature of the actuated tens relay 144, to ground over conductor 154. In order to light the No. 5 lamp it is necessary to operate both the relays 152 and 153. This is effected when the distributor brushes 158 and 161 are advanced into their eighth position at which time relay 152 is operated in a circuit closed from grounded battery, winding of this relay, distributor brush 158, armature and front contact of actuated units relay 149 to ground over conductor 154. Relay 153 is operated in a circuit traceable from ground, its winding, distributor brush 161, conductor 163, front contact and armature of a second actuated units relay 147, to grounded battery over conductor 125.

It will of course be understood that the speed of operation of the distributor switch can be varied at will so that the various lamps will remain lighted long enough so that the operator can ascertain the designation of the wanted number. In the event that the operator did not observe the designation indicated by the lamps on the first rotation of the distributor switch, it will continue to rotate until the operator receives the designation and inserts the calling plug 164 in the multiple jack 165 of the called line.

When the operator effects this connection, relay 116 associated with the connecting cord circuit is operated from grounded battery, its winding, the sleeves of the plug 164 and jack 165 in series with the winding of cut-off relay 166 to ground. Relay 116 attracts its armatures and at its upper armature, closes a break point in the tip side of the cord circuit. At the inner armature and front contact of relay 116 a break-point is closed in the circuit of the supervisory lamp 105 in series with the pilot relay, but this circuit is ineffective at this time since the relay 204 is operated. At the lower armature and back contact of relay 116,

ground is removed from conductor 115 which allows relay 96 to release to cause the deenergization of relay 113. Relay 113 at its left-hand armatures, removes grounded battery from the holding conductor 125 and holding ground from conductor 154. At the right-hand armature and back contact of relay 113, a restoring circuit is closed for the receiver switch which extends from ground, armature and back contact of relay 113 through brush 109 of the receiver in any one of its off-normal positions, back contact, armature and winding of the motor magnet 110 to grounded battery. Under the control of this last described circuit the brushes 109, 122, 134 and 132 of the receiver switch are advanced into their normal position. As soon as brush 134 of the receiver switch leaves position twenty one, relay 156 deenergizes and a restoring circuit is closed for the motor magnet 157 of the distributor switch, which circuit is completed from grounded battery, winding of this magnet, armature and back contact of relay 156, armature and back contact of the motor magnet, brush 167 of the distributor switch in any one of its off-normal positions, to ground.

After the operator has inserted the plug 164 into the multiple jack 165, she depresses one of the ringing keys to supply ringing current of the proper character to signal station "J" on the wanted line. Let it be assumed that the key No. 168 is the key for signalling party "J". When the key 168 is depressed it closes its contacts 178 to actuate the ringing relay 171 in a circuit extending from grounded battery, resistance, upper winding of this relay, contacts 178, back contact and armature of relay 176 to ground at the uppermost armature and front contact of relay 204. The ringing relay when operated closes a locking circuit for itself through its lower winding, inner front contact and armature to ground at the uppermost armature and front contact of relay 204. With the ringing key 168 depressed and with the ringing relay 171 locked operated, a source of ringing current is connected over conductor 169, contacts of the ringing key 168 and normal contacts of the other keys preceding it in series, lower front contact and armature of relay 204, winding of the trip relay 170, lowermost front contact and armature of the ringing relay 171, ring conductor of the cord, ring contacts of the plug 164 and jack 165, over the lower side of the wanted line through the bell circuit of station J, over the upper side of the wanted line through the tip contacts of the jack 165 and plug 164, over the tip conductor of the cord, armature and front contact of relay 116 and through the resistance to ground, at the front contacts and upper armature of ringing relay 171. Under



the control of this circuit the bell at station J is actuated until the subscriber thereat responds, at which time the trip relay 170 will receive sufficient current to be actuated and attracts its armature. This short-circuits the ringing relay 171 and thereby causes it to retract its armatures to disconnect ringing current from the wanted line and to close a break-point in the ring conductor of the cord circuit.

Talking battery is supplied to the called party through the windings of supervisory relay 172 and when the called party responds, this relay is actuated to complete a circuit for relay 173 in series with the supervisory relay 174 of the cord circuit at the originating office. To provide supervision at the originating office, relay 173 is operated in series with the relay 174 of the cord circuit at the originating office, while to give supervision to the terminating operator, the tip side of the circuit is connected through the windings of relays 175 and 97. Talking battery is supplied to the calling party through the left-hand windings of the repeating coil in the A operator's cord circuit.

When the calling subscriber A terminates the call, a supervisory relay such as 179 is released in the operator's cord circuit at the originating office indicating that plugs 4 and 7 of her cord circuit are to be removed from the jacks with which they have been in engagement, thereby disestablishing the connection. As soon as this operation has been effected the energizing circuit of relay 97 of Fig. 2 is interrupted, and this relay retracts its armature to effect the deenergization of relay 204. With relay 204 in its inoperative condition, a circuit is closed for lighting the disconnect lamp 105. This circuit extends from grounded battery through this lamp, inner armature and back contact of relay 204, inner front contact and armature of relay 116, winding of the pilot relay to ground.

In the event that the called party terminates the connection by replacing his receiver on its switch-hook before the calling party hangs up, then the relay 172 deenergizes and opens the circuit including relays 173 and 174. Relay 174 will then deenergize to light a disconnect lamp (not shown) at the A operator's position. This operator will then proceed to remove the plugs 4 and 7 of the jacks 5 and 8.

In Figs. 4 and 5 there are shown modified circuits for the wanted office to replace those of Fig. 2. It will be understood of course that the circuits of Fig. 4 are to be connected to those of Fig. 1 and operate in a manner identical with the circuits controlling the receiver switch and the talking circuit of Fig. 2. In Fig. 5, however, there is a somewhat modified arrangement for con-

trolling the lighting of the various lamps. In certain cases it might be found desirable to light two of the lamps simultaneously such as the lamps corresponding to the thousands and hundreds digits and subsequently light the tens and units lamps corresponding to the tens and units digits of the wanted station. In this modification it will be understood of course that the number is stored up in the same manner as previously described on the relay registers of Fig. 3. It will also be understood that the sender switch of Fig. 3 will operate in connection with a receiver switch at Fig. 4 in the same manner as previously described. Also in this operation some of the relays of the thousands, hundreds, tens and units relays will be actuated and locked operated in the manner previously described.

It will now be assumed that the modified circuits of Figs. 4 and 5 are to be used instead of the circuits of Fig. 2. It will also be assumed that the designation of the wanted party is Main 2345—J as in the previous case. It will be noted in Figs. 4 and 5 that the same reference characters have been applied to the portions of Figs. 4 and 5 that are identical with Fig. 2, which will render it unnecessary to describe the operation of the receiver switch or the receipt and storing of the designation on the thousands, hundreds, tens, units and stations groups of relays of Figure 5. The description may therefore be taken up at the point where the thousands relay 138 and the hundreds relay 143, tens relay 144, the units relays 147 and 149, and the stations relay 124 have been locked actuated. It will also be assumed that the receiver switch has been advanced to position 21, in which position a circuit is completed over conductor 155 to actuate the relay 156. As in the previous case this effects the operation of the motor magnet 157 which advances the brushes of the small distributor switch in the same manner as in the first described circuits.

It will be remembered that in the first modification the numeral lamps were lighted one at a time to indicate the desired number, but in the modification now under consideration, two numeral lamps are lighted simultaneously. This is effected in the following manner: While the brush 158 of the distributor switch is passing through position 2, the left-hand winding of relay 201 is connected in a circuit in multiple with the relay 138 of the thousands groups of relays. This circuit may be traced from grounded battery, left-hand winding of relay 201, armature and back contact of relay 202, distributor brush 158, front contact and armature of relay 138 to ground over the holding conductor 154. Relay 201 is thus operated and is locked in this condition in a circuit extending from grounded battery,



resistance, right-hand winding of relay 201, its innermost front contact and armature to ground at the outer front contact and armature of relay 156. When the distributor brush 200 is advanced to position 3, the switching relay 202 is operated in a circuit closed to ground through the brush 200 and when the distributor switch reaches position 4, relay 203 has an operating circuit closed from ground, its right-hand winding, front contact and armature of relay 202, brush 159, conductor 140, front contact and armature of relay 143, to the holding battery over conductor 125. Relay 203 when operated is locked in this condition through its left-hand front contact and armature to ground at the front contact and armature of relay 156, and while the distributor brush 200 is passing through positions 5, 6 and 7, a lamp in each of the two groups is actuated. It will be noted that relay 202 deenergized when the distributor brush 200 left position 2. Lamp No. 2 corresponding to the thousands digit is lighted in a circuit extending from grounded battery through lamp No. 2, left-hand, back contact and armature of relay 304, left hand, armature and front contact of relay 201, outer back contact and armature of relay 205, distributor brush 200 to ground. The lamp No. 3 corresponding to the hundreds digit of the wanted number is lighted in a circuit traceable from grounded battery, right-hand back contact and armature of relay 206, right-hand armature and contact 207 of relay 203 through the No. 3 lamp, outer back contact and armature of relay 208, distributor brush 200 to ground. The No. 2 and No. 3 lamps will remain lighted in the circuits just described until the distributor brush reaches position 8, at which time the relays 201 and 203 are short-circuited and they deenergize. While the distributor switch is passing through position 9, the relay 210 is operated in multiple with the relay 144 and when thus operated, is locked to ground at the outer front contact and armature of relay 156, as the distributor brush is passing through position 11 the relays 208 and 211 are actuated in multiple with the relays 147 and 149 of the units group. Relays 208 and 211 when operated are locked to ground at the armature and front contact of relay 156. When the distributor brush is passing through positions 12, 13 and 14, the lamps corresponding to the tens and units digit of the wanted number are lighted, and when the distributor brush 200 reaches position 15, relays 210, 208 and 211 are short-circuited and released. As in the case of the modification shown in Fig. 2 the distributor switch will operate to cause the repeating of the number on the numerical lamps until the operator plugs into a multiple jack of the wanted line, at

which time relay 113 of Fig. 4 will deenergize to remove the holding ground and battery from conductors 125 and 154 so that the actuated relays of the thousands, hundreds, tens and units groups are released. The deenergization of relay 113 also causes the motor magnet of the receiver switch to advance the brushes of this switch out of position 21. This opens the circuit including conductor 155 permitting relay 156 to deenergize and to cause the distributor switch to be advanced into its normal position. The operations of ringing and release take place in the manner already described.

I claim:—

1. In a telephone system, an originating office having an "A" operator's position, a terminating office having a "B" operator's position, telephone lines terminating in each operator's position, a trunk circuit terminating at said "A" operator's position, means for connecting said trunk circuit to said "B" operator's position, a cord circuit at said "A" operator's position for connecting a calling line to said trunk circuit, a plurality of register senders, means responsive to the connection of said cord circuit to said trunk for seizing a register sender for use, means for variably adjusting said seized register sender, an indicating device at said "B" operator's position arranged to be variably operated in accordance with the adjustment of said register sender, means for synchronizing a seized sender and an associated indicating device and means controlled at said "B" operator's position for connecting said trunk circuit to a wanted telephone line.

2. In a telephone system, an originating office having an "A" operator's position, a terminating office having a "B" operator's position, telephone lines terminating at each operator's position, a trunk circuit terminating at said "A" operator's position, means for connecting said trunk circuit to said "B" operator's position, a cord circuit at said "A" operator's position for connecting a calling line to said trunk circuit, a key-set at said "A" operator's position, comprising a single set of numerical keys, a plurality of register senders, means responsive to the connection of said cord circuit to said trunk for seizing a register sender for use and for placing it under the control of said key-set, means including said key-set for variably adjusting said seized register sender, an indicating device at said "B" operator's position arranged to be variably operated in accordance with the adjustment of said register sender, and means controlled at said "B" operator's position for connecting said trunk circuit to a wanted telephone line.

3. In a telephone system, an originating office having a plurality of "A" operators' 130



positions, a terminating office having a "B" operator's position, telephone lines terminating in each operator's position, trunk circuits terminating at said "A" operators' positions, means for connecting said trunk circuits to said "B" operator's position, a cord circuit at each of said "A" operators' positions for connecting a calling line to a trunk circuit, a plurality of register senders common to said "A" operators' positions, means responsive to the connection of a cord circuit to a trunk circuit for seizing a register sender for use, means for variably adjusting said seized register sender, an indicating device at said "B" operator's position arranged to be variably operated in accordance with the adjustment of said register sender, means for synchronizing said sender and indicating device and means controlled at said "B" operator's position for connecting said trunk circuit to a wanted line.

4. In a telephone system, an "A" operator's position, a "B" operator's position, a trunk circuit for connecting said positions, telephone lines terminating at each of said positions, means for connecting a calling line at the "A" operator's position to said trunk circuit, a variably operable sender at said "A" operator's position arranged to be adjusted in accordance with the designation of the wanted line, a single set of ten numerical keys at said "A" operator's position for adjusting said sender a receiver at said "B" operator's position comprising receiving mechanism for each digit of the wanted number, said receiver being adjusted from said sender, lamps associated therewith less in number than the number of said mechanisms and means for connecting said trunk circuit to a wanted telephone line as indicated.

5. In a telephone system, an "A" operator's position, a "B" operator's position, a trunk circuit for connecting said positions, telephone lines terminating at each of said positions, means for connecting a calling line at the "A" operator's position to said trunk circuit, a variably operable sender at said "A" operator's position arranged to be adjusted in accordance with the designation of the wanted line, a receiver at said "B" operator's position comprising receiving mechanisms for each digit of the wanted number, sets of lamps associated therewith less in number than the number of said mechanisms, means for synchronizing the operation of said sender and adjusted receiver, and means for connecting said trunk circuit to a wanted telephone line as indicated.

6. In a telephone system, an "A" operator's position, a "B" operator's position, a trunk circuit for connecting said positions, telephone lines terminating in each position, means for connecting a calling telephone

line at said "A" operator's position to said trunk circuit, a variably operable sending device connectible to said trunk circuit, a receiving device at said "B" operator's position comprising a set of receiving mechanisms, one for each digit of the wanted number, said mechanisms being arranged to be variably operated under the control of said sender, a single set of keys at the "A" operator's position for controlling the operation of said sender, means for locking the mechanisms in their actuated condition, a single set of indicating lamps arranged to be operated under the control of the actuated receiving mechanisms, means for connecting said trunk circuit to a wanted telephone line as indicated, and means responsive to such connection for releasing the actuated mechanisms.

7. In a telephone system, an "A" operator's position, a "B" operator's position, a trunk circuit for connecting said positions, telephone lines terminating at said positions, means for connecting a calling line at said "A" operator's position to said trunk circuit, a sender at said "A" operator's position arranged to be variably adjusted in accordance with the designation of the wanted line, means for connecting said sender to said trunk, a group of receiving relays at said "B" operator's position arranged to be variably operated under the control of said sender over said trunk, a set of indicating lamps repeatedly operated under the control of two different groups of relays, and means for connecting said trunk circuit to a wanted line as indicated.

8. In a telephone system, an originating office, a plurality of other offices, telephone lines terminating at each of said offices, an individual group of secondary trunks leading to each of said offices from the said originating office, a group of primary trunks at the originating office for each office reached therefrom, each primary trunk terminating at one end in a manual switch, automatic means for connecting the other end of each primary trunk to an idle secondary trunk, means responsive to the manual connection of a calling line to a primary trunk to effect the selection of an idle secondary trunk, means responsive to such selection to cause said automatic means to seize the selected secondary trunk, a plurality of register senders for common use at said originating office, means for associating an idle register sender with the selected secondary trunk, means for variably adjusting said selected sender in accordance with the designation of the wanted line, means associated with the selected trunk at the distant office and operated over said selected trunk under the control of the adjusted register sender for indicating thereat the designation of the wanted line, and means at the wanted office



for completing the connection in accordance with such designation.

9. In a telephone system, an originating office, a distant office, a plurality of operators' positions at each of said offices, telephone lines terminating at each of said offices, trunk circuits for connecting said offices, certain of which terminate at the originating office in jacks, operators' cord circuits at the originating office for connecting a calling line through a jack to a trunk leading to said distant office, a key-set at each operator's position, a plurality of register senders common to a plurality of positions at said originating office, means responsive to the connection of a calling line to a trunk for associating an idle register sender with said trunk and for connecting the same to the key-set of the operator that has completed the connection of the calling line to the trunk, said register sender being variably operated in accordance with the designation of the wanted line under the control of said operator's key-set, means associated with the operators' positions at the distant office and operated under the control of the adjusted register sender for indicating the designation of the wanted telephone line at one of said last-mentioned operators' positions, and means at this last-mentioned operator's position for completing the extended connection.

10. In a telephone system, an originating office, a distant office, telephone lines terminating at each of said offices, trunk circuits for connecting said offices, a plurality of operators' positions at the originating office in each of which telephone lines terminate, a plurality of trunk circuits and means at the originating office for connecting the same to calling telephone lines, a plurality of register senders common to said operators' positions, means for associating a register sender with one trunk circuit leading to the distant office, means at each of said positions for variably adjusting a register sender in accordance with the designation of a wanted telephone line at the distant office, an operator's position at the distant office in which said trunk circuit terminates, a set of numerical lamps at the distant office, means at this office operating under the control of a single adjustment of said register sender for operating said lamps a plurality of times to give the designation of the wanted line, and means for connecting the extended trunk circuit to said wanted line.

11. In a telephone system, an A operator's position, a B operator's position, a trunk circuit connecting said positions, telephone lines terminating at said positions, means for connecting a calling line at the A operator's position to said trunk circuit, a

ator's position to be adjusted in accordance with the designation of the wanted telephone line, a receiver at said B operator's position comprising a mechanism for each digit of the wanted number, said receiver being adjusted under the control of said sender, one or more sets of lamps associated with said receiver switch less in number than the number of said mechanisms, means for connecting said mechanisms in succession to said lamps, and means for connecting said trunk circuit to a wanted telephone line.

12. In a telephone system, an A operator's position, a B operator's position, a trunk circuit for connecting said positions, telephone lines terminating at said positions, means for connecting a calling telephone line at the A operator's position to said trunk circuit, a variably operable sender at said A operator's position arranged to be adjusted in accordance with the designation of the wanted telephone line, a receiver at said B operator's position comprising a receiving mechanism for each digit of the wanted number, said receiver being adjusted under the control of said sender, one or more sets of lamps associated with said receiver switch less in number than the number of said mechanisms, a progressively movable switch for connecting said sets of lamps to said mechanisms in succession, and means for connecting said trunk circuit to a wanted telephone line.

13. In a telephone system, an originating office having an A operator's position, a terminating office having a B operator's position, telephone lines terminating at each operator's position, a primary trunk circuit terminating at said A operator's position, a plurality of secondary trunks terminating at said B operator's position, an automatic switch for extending said primary trunk to a selected secondary trunk, a plurality of register senders at said A operator's position, a link circuit terminating at each end in a progressively movable switch for connecting an idle register sender to a secondary trunk, means responsive to the connection of said link circuit to said secondary trunk for causing said automatic switch to extend the primary trunk to the selected secondary trunk, means actuated by said A operator for variably operating the register sender in accordance with the designation of the wanted telephone line, an indicating device associated with said B operator's position operated under the control of the adjusted register sender for indicating the designation of the wanted telephone line, and manual means at said B operator's position for extending the selected secondary trunk to the wanted telephone line.

14. In a telephone system, an A operator's



position, a B operator's position, telephone lines terminating in each of said positions, a primary trunk terminating in said A operator's position, manual means for connecting a calling telephone line at an A operator's position to said primary trunk, a plurality of secondary trunks extending to said B operator's position, a plurality of register senders, link circuits each terminating at its ends in progressively movable switches, a link finder switch, means operating responsive to the connection of said calling telephone line to said primary trunk for causing said link finder to seize an idle link circuit whereby an idle register sender is connected to an idle secondary trunk, means responsive to said last mentioned connection for connecting the primary trunk to said selected secondary trunk, a single set of keys arranged to be operated several times in each adjustment of said register sender, an indicating device at said B operator's position, means including said adjusted register sender for variably operating said indicating device to variably indi-

cate the designation of the wanted telephone line, and manual means at said B operator's position for extending the selected secondary trunk to said wanted telephone line.

15. In a telephone system, an originating office, a distant office, telephone lines terminating at each of said offices, trunk circuits interconnecting said offices, means at the originating office for connecting a calling telephone line through a trunk to said distant office, a sender at the originating office variably operable in accordance with the designation of the wanted telephone line, an indicating device at said second office arranged to be controlled by said sender, manual means for connecting the extended telephone line to the wanted telephone line, and means for causing said indicating device to repeat its designation until the operation of said manual means.

In witness whereof, I hereunto subscribe my name this 31st day of March A. D. 1921.

WINFRED T. POWELL.