June 19, 1928.

1,674,299

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AUTOMATIC TRUNKING ARRANGEMENT FOR TELEPHONE SYSTEMS

Filed Feb. 23, 1927

2 Sheets-Sheet 1

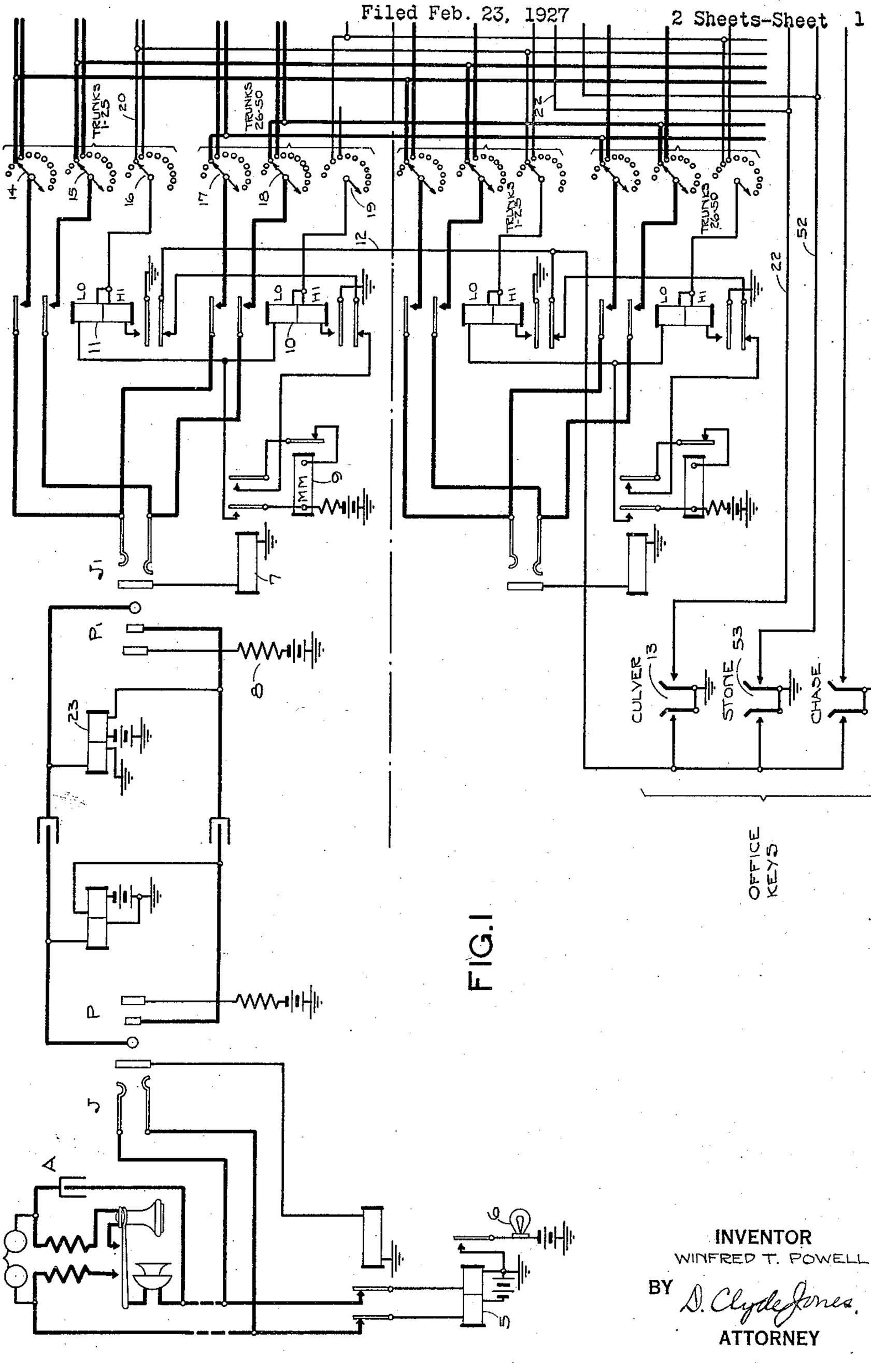

FIG. 1

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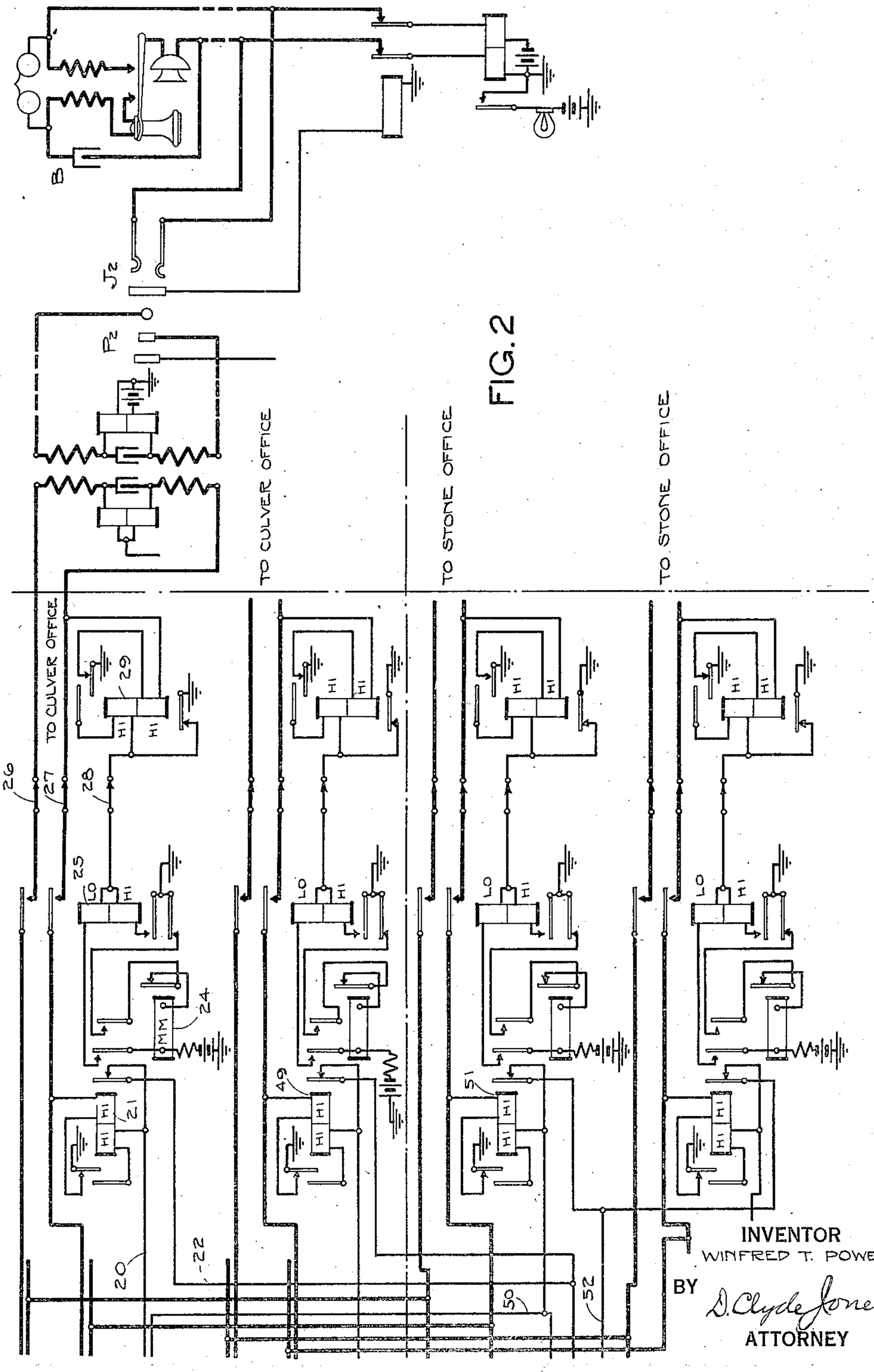

FIG. 2

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UNITED STATES PATENT OFFICE.

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AUTOMATIC TRUNKING ARRANGEMENT FOR TELEPHONE SYSTEMS.

Application filed February 23, 1927. Serial No. 170,214.

This invention relates to telephone systems and more particularly to multi-office trunking arrangements between the several offices of such systems.

In prior telephone systems it was customary to employ a so-called order-wire over which an A operator at the office where the call originated, could converse with the B operator at the office where the wanted line terminated. Over such an order-wire the A operator notified the B operator of the number of the wanted line and the B operator employed this order-wire to instruct the A operator as to the idle trunk assigned for use. Such order-wires caused much confusion and resulted in wrong connections so that it has been proposed to employ, what is known in this art, as straightforward trunking, in which the A operator selects an idle trunk of a group of trunks allotted to a wanted office, and then repeats the wanted line designation over the selected trunk to a B operator at this distant office. For efficiency in trunking, it has been suggested that automatic switches be employed in straightforward trunking systems to extend the calling line from the A operator's position to a B operator's position at the wanted office, but in such former systems, it was customary to provide a trunking switch for each outgoing trunk jack at each A operator's position and if it be assumed that there were twenty cord circuits at each of these positions by which connections could be made to these outgoing jacks, and if it further be assumed that there were five offices in the system it would be necessary to provide four times twenty trunk jacks or a total of eighty jacks at each position together with eighty rotary switches for each position.

In accordance with the present invention it is proposed to employ non-numerical selection of a desired group of trunks and thereby reduce the number of trunk jacks and the number of outgoing trunks connected thereto at each A position to a number sufficient to accommodate the maximum number of cord circuits in use at any one time in each position and it is therefore necessary to provide only one automatic trunk hunting switch for each trunk jack so that in this system it also results that the number of primary trunking switches are also greatly reduced. It is also proposed in the present arrangement to provide primary trunking switches having but twenty-five points or sets of terminals, but each set of terminals has connected thereto two primary trunks with their associated testing circuits. In this way it is possible to establish twice the number of primary trunk connections through a switch and at the same time use a small type, commercial rotary trunking switch.

Other features of the invention reside in the detailed circuit arrangements which will be more particularly pointed out in the following description and appended claims.

For a more complete understanding of the present invention, reference is made to Figs. 1 and 2 which, when placed in the order named, diagrammatically represent a multi-office telephone system, showing in Fig. 1 and that portion of the drawing at the left of the broken line of Fig. 2, an originating office and at the right of the broken line of Fig. 2 trunks leading to various terminating offices. A trunk circuit and a terminating subscriber's line at one of these last-mentioned offices only is shown. At the left of Fig. 1 there is indicated a calling subscriber's line leading to an A operator's position of which only a single cord circuit is partially represented. At the right of Fig. 1 there are shown two outgoing trunk jacks but it will be understood that as many cord circuits and outgoing trunk jacks are provided at each A operators' position as are necessary to take care of simultaneous connections. The A operators' positions are also equipped with office keys, one office key being provided for each office accessible through those positions. It will also be noted that the trunk terminating in each outgoing jack is provided with two branches, each branch terminating in a set of brushes of a rotary trunking switch provided with sets of fixed contacts or terminals in which two primary trunks and their associated test conductors terminate so that the brushes of a rotary trunking switch can be advanced to engage the terminals of two trunks

simultaneously. The pairs of trunks terminating in the primary trunking switches are arranged in groups, the trunks of each group leading to a different office and the number of trunks in each group being determined by the amount of traffic to the various offices. The secondary trunking switches of each group select idle trunks to the office into which they operate. At this office there are provided B operators' positions in one of which the selected plug-ended trunk terminates. The B operator's telephone set, ringing equipment and the supervisory apparatus associated with the B operator's position is omitted for purposes of this description, but it will be understood that it may be of any well-known type or may be similar to that disclosed in the application of John H. Levis, Jr., SN. 77,197 Dec. 23, 1925.

The rotary trunking switches employed in this system may be similar in structure to that disclosed in the patent to Clement 1,107,153, granted August 11, 1914, and they are preferably of the 25-point type, that is, they are provided with 25 sets of terminals. However, in case of the primary trunking switches, the sets of brushes are duplicated and the seats of fixed trunk terminals are also duplicated so that although the switch is of the twenty-five point type, fifty trunks terminate in its fixed terminals. A test terminal is provided for each set of trunk terminals, but the test brushes instead of extending in opposite directions from the brush shaft, as in the case of the other brushes thereof, extend in only one direction from the brush shaft, and the two test brushes of each switch are positioned 180 degrees apart. This is indicated diagrammatically in Fig. 1 as shown by the brushes 16 and 19 of the uppermost primary trunking switch. By this arrangement during one-half revolution of the switch, the test brush 16 engages its associated arc of test contacts and during the other half of the revolution of the switch brushes the test brush 19 engages its arc of test contacts while at this time the test brush 16 is out of engagement with its associated test terminals. In this way by a complete revolution of the test brushes fifty trunks may be tested instead of twenty-five when a commercial twenty-five point switch of the mentioned type is employed.

It is believed that this invention will be best understood by describing the method of establishing a telephone connection from a telephone line such as A of Fig. 1 to a telephone line such as B of Fig. 2 terminating at a distant office. When the subscriber at A removes his receiver from its switch-hook, the line relay 5 is energized in a circuit completed over the two sides of the calling line in series and attracts its armature whereby the line lamp 6 is lighted. The A operator, upon noting the lighting of lamp 6, inserts the answering plug P of an idle cord circuit into the jack of the calling line. The A operator's telephone set (not shown) is then manually or automatically connected to the cord circuit taken for use, and she inquires for the wanted number. It is assumed that the designation of the wanted number indicates that it terminates at the distant office herein referred to as Culver and the A operator then inserts the calling plug P^1 of this cord circuit into the jack J^1 of an idle trunk and also depresses the office key individual to the Culver office. The connection of the plug P^1 with the jack J^1 energizes the sleeve relay 7 of the outgoing trunk through the sleeve contacts of this mentioned plug and jack, in a circuit extending from the sleeve relay through the resistance 8 to grounded battery. The relay 7, when energized, completes an actuating circuit for the motor magnet 9 of the primary rotary switch, individual to the outgoing trunk connected to the trunk jack J^1. It will be noted that this outgoing trunk is provided with two branches, each branch terminating in a set of switch brushes and each branch is provided with a test circuit also terminating in a separate test brush at the primary rotary switch.

The operating circuit of the motor magnet 9 is traceable from grounded battery, resistance, winding, back contact and armature of the magnet 9, outer armature and front contact of sleeve relay 7, lowermost back contacts and armatures of relays 10 and 11, conductor 12, spring contacts of the key 13, assigned to the Culver office, to ground. Under the control of this circuit the motor magnet 9 advances the two sets of brushes 14, 15, 16 and 17, 18, 19 until one or the other of the test brushes 16 or 19 encounters the test terminal of an idle trunk. Idle trunks are characterized by the presence of ground potential on their test terminals, whereas the test terminals of busy trunks are characterized by the absence of potential. Let it be assumed that the first idle primary trunk tested by the sets of brushes 14 to 19 of the switch is that shown at the top of Figs. 1 and 2. When the test brush 16 encounters the idle test terminal of this trunk, a circuit is completed to stop the operation of this rotary switch by shunting its motor magnet 9. This circuit may be described as extending from grounded battery, resistance, inner armature and front contact of relay 7, upper winding of the relay 11, test brush 16, test conductor 20, inner right-hand back contact and armature of relay 21, conductor 22, spring contacts of the key 13 of the Culver office key, to ground. The relay 11 is energized in this circuit and at its upper front contacts and

armatures closes break points in the conductors connecting the tip and ring conductors of the jack J^1 to the brushes 14 and 15 of the primary trunking switch. The relay 21 of Fig. 2 is thereupon operated from ground, its continuity spring, contact and right hand winding, lower side of the primary trunk switch, brush 15, inner front contact and armature of relay 11, ring contacts of the jack J^1 and plug P^1, right hand winding of supervisory relay 23 to grounded battery. Relay 21, when thus energized, closes a locking circuit for itself from ground, its continuity spring, armature and left hand winding, conductor 20, test brush 16, upper winding of the relay 11, inner front contact and armature of relay 7 and through the resistance, to grounded battery. The relay 11, when energized as previously described, also closes a locking circuit in multiple with that just described, including its lower inner armature, front contact and lower winding.

As soon as the relay 21 of Fig. 2 is operated it also closes a driving circuit for the motor magnet 24 of the secondary trunking switch which is completed from grounded battery, resistance, winding, back contact and armature of the motor magnet 24, outer armature and front contact of relay 21, back contact and armature of the relay 25 to ground. Under the control of this circuit the motor magnet 24 advances its brushes 26, 27 and 28 until the test brush 28 encounters an idle test terminal characterized by the presence of ground potential thereon. Let it be assumed that the first idle trunk tested by this switch is that shown in the upper right hand corner of Fig. 2. Under this assumption the brushes of the secondary trunking switch are stopped in engagement with the terminals of this idle trunk since the motor magnet 24 is shunted by the following circuit, from ground, lower armature and back contact of relay 29, test brush 28, upper winding of switching relay 25, middle contact and armature of relay 21, resistance, to grounded battery. Relay 25 is energized in this circuit and closes a locking circuit for itself, from ground, its lower armature, front contact and lower winding, and thence in series with the upper winding to grounded battery through the middle front contact and armature of relay 21. Also when the relay 25 attracts its armatures it extends the calling line through the brushes 26 and 27 to the plug-ended trunk terminating at the B operator's position in the wanted office. As a result of the completion of this portion of the connection, the relay 29 is energized from ground, its continuity spring, back contact and lower winding, and thence over the lower side of the trunk sections previously selected through the right hand winding of the relay 23 of the supervisory relay in the A operator's cord circuit of Fig. 1 to grounded battery. The relay 29, when thus energized, closes a locking circuit for itself from ground, its continuity spring, armature and upper winding, and thence through brush 28 to grounded battery in multiple with the locking circuit previously described for the relay 25. The selected plug-ended trunk terminating at the B position at the Culver office is provided with various equipment and circuits, not shown, for effecting automatic listening, signaling of the called line, and supervision by which the A and B operators may be informed as to the condition of the call, that is, whether or not the called party has answered or to indicate whether either of the parties have terminated the connection.

When the calling line has been extended in the manner already described to the B operator's position at the Culver office indicated in the upper right hand corner of Fig. 2 indicating means (not shown) indicates to the B operator that a call is awaiting her attention. Her telephone set at this time is connected to the plug-ended trunk referred to so that she can inquire of the A operator the number of the wanted subscriber. Upon receiving this information the B operator inserts the plug P^2 of this trunk into the jack J^2 of the wanted subscriber's line. Thereafter the wanted subscriber at B may be signaled by means of the mentioned signaling equipment (not shown).

At the close of the conversation, supervisory equipment (not shown) at the A operator's position, indicates to her that the connection should be disestablished. She then removes the plug P from jack J and the plug P^1 from the jack J^1, thereby interrupting the circuit of the sleeve relay 7 and this last relay on deenergization opens the holding circuit of the switching relay 11 of Fig. 1 and the holding relay 21 of Fig. 2. It will be remembered that holding relay 21 has maintained the second switching relay 25 operated to retain the secondary switch operated, so that when relay 21 deenergizes it effects the release of relays 25 and 29. The release of these relays restores for common use the trunks and the switches last used. Also supervisory equipment at the B operator's position indicates to this operator that the connection should be terminated and she thereupon removes the plug P^2 from the jack J^2 so that the equipment is again in readiness for use on a succeeding call.

In the event that all the trunks to the Culver office tested by the test brush 16 were found to be busy, the switch would continue to advance its brushes until its test brush 19 encountered an idle trunk to the wanted office in the second group of 25

trunks at this switch. When this idle trunk is found the switching relay 10 and the relay 49 associated with the idle trunk are operated in the same manner and over circuits similar to those described for relays 11 and 21.

If the operator desired to extend the call to the Stone office she would connect the plug P^1 to the jack of an idle trunk which in the case assumed, is that designated J^1. The switch represented in the upper right hand corner of Fig. 1 would operate in this instance to select an idle trunk to the Stone office. The operating circuit for this switch, as in the case previously described, would be over conductor 12, but instead of being completed at the Culver office key 13, it would be completed at the left-hand contact of the Stone office key designated 53. Also in this case the test circuit for an idle trunk to this wanted office such as that shown fourth from the top in Fig. 2 would be over conductor 50, inner back contact and armature of relay 51 individual to this trunk, conductor 52, and right-hand contacts of key 53 to ground. Otherwise the step of selecting a trunk is similar to that described in detail in connection with the extension of the first call.

In the lower right hand corner of Fig. 1 there is shown a second trunk back with its outgoing trunk terminating in the brushes of a second switch. The primary trunks terminating in this switch are multipled to contacts corresponding to contacts in the switch shown in the upper right hand corner. The operation of this separate switch is similar to that of the switch previously described and need not be further referred to.

What is claimed, is:

1. In a telephone system, an incoming line, two groups of outgoing lines arranged in pairs, a group of test circuits associated with each group of outgoing lines, an automatic switch for interconnecting said incoming line with any of said outgoing lines and means effective by the operation of said switch for alternately rendering first one group of test circuits and then a second-group of test circuits effective.

2. In a telephone system, an incoming line provided with two branches, an automatic switch having two sets of brushes and two sets of fixed contacts, each incoming line branch terminating in one only of said sets of brushes, trunks terminating in said fixed contacts, said sets of brushes being always in position to engage two sets of said fixed contacts, and means rendered effective by the movement of said switch for placing said branches in sequence in effective condition whereby said incoming line is extended through an effective branch to an idle trunk.

3. In a telephone system, an incoming line provided with two branches, an automatic switch having two sets of brushes and two sets of fixed contacts, each incoming line branch terminating in one only of said sets of brushes, trunks terminating in said fixed contacts, said sets of brushes being always in position to engage two sets of said fixed contacts, a switching relay individual to each branch of said incoming line, and means rendered effective in sequence by the movement of said switch for operating one of said switching relays to seize an idle outgoing line and to extend its individual branch thereto.

4. In a telephone system, an incoming line having two branches, two groups of outgoing lines, a unidirectional automatic switch for connecting said incoming line to an idle outgoing line in either of said groups, and means rendered effective by the operation of said switch for alternately placing first one branch and then the other branch of said incoming line in succession in condition to be extended to its associated group of outgoing lines.

5. In a telephone system, an incoming line provided with branches, pairs of outgoing lines arranged in groups, the outgoing lines of each group terminating in a different area, an automatic switch for extending said incoming line, one manual switch being provided for each of said areas, means rendered effective in the operation of said automatic switch for placing one of said incoming line branches in condition to select an associated idle outgoing line, and an operating circuit for said automatic switch completed at the manual switch of a predetermined area for operating said automatic switch to select an idle outgoing line in the group leading to the predetermined area.

6. In a telephone system, an incoming line provided with branches, pairs of outgoing lines arranged in groups, the outgoing lines of each group terminating in a different area, an automatic switch for extending said incoming line to any outgoing line of said pairs, a manual switch at said incoming line provided for each of said areas, means rendered effective in the operation of said automatic switch for placing one of said incoming line branches in condition to select an associated idle outgoing line, an operating circuit for said automatic switch completed at the manual switch of a predetermined area, and a test circuit completed at said predetermined manual switch for stopping said automatic switch in position to extend one of the branches of said incoming line to an idle outgoing line leading to the predetermined area.

7. In a telephone system, an incoming line provided with two branches, each provided with a break-point, a switching relay for each branch for closing a breaking-point therein, pairs of outgoing lines arranged in

groups, each group of outgoing lines leading to a different area, a manual switch for each area, an automatic switch for extending either of said branches to an idle outgoing line of a wanted area, an operating circuit for said automatic switch controlled by said switching relays and by the manual switch of the desired area, and means including said manual switch for operating one of said switching relays to cause said automatic switch to seize an idle outgoing line to the wanted area.

8. In a telephone system, an incoming line provided with two branches, a switching relay for each branch for closing a breaking-point therein, pairs of outgoing lines arranged in groups and provided with test conductors, each group of outgoing lines leading to a different area, a manual switch individual to each group, an automatic switch for extending either of said branches to an idle outgoing line, an operating circuit for said automatic switch controlled by said switching relays and by the manual switch of the desired area, and a test circuit including a test conductor of an idle outgoing line and said manual switch for operating one of said switching relays to cause said automatic switch to seize an idle outgoing line in the desired group.

9. In a telephone system, an A operator's position, a B operator's position, telephone lines terminating at each of said positions, means including trunks and automatic switches for interconnecting said positions, said automatic switches having access to two groups of trunks, two groups of test circuits associated with said trunks, and means rendered effective in the rotation of said switches for alternately rendering first one group of test circuits and then a second group of test circuits effective.

10. In a telephone system, an operator's position, outgoing trunks terminating at said position, primary trunks arranged in groups, automatic switches in which said primary trunks terminate, a non-numerical key at said operator's position individual to each group of trunks, and an operating circuit for the motor magnet for each of said automatic switches completed at one or another of said keys whereby said automatic switches operate to select idle primary trunks in desired groups.

11. In a telephone system, an operator's position, outgoing trunks terminating in said operator's position, a primary trunking switch for each outgoing trunk, primary trunks terminating in said primary switches, said primary trunks being arranged in groups, an operator's key individual to each group of primary trunks, an operating circuit for the motor magnet of said primary switch completed at a predetermined one of said keys, and a test circuit for stopping a selected primary switch in engagement with an idle trunk in the desired group, said test circuit being controlled at a predetermined one of said keys.

12. In a telephone system, telephone lines, an operator's position, outgoing trunks terminating in said position, each outgoing trunk being provided with two branches over either of which a telephone connection may be extended, manual means at said operator's position for connecting any telephone line to any idle outgoing trunk, a primary trunking switch in which the branches of each outgoing trunk terminate, groups of primary trunks terminating in said primary switches, a group key at the operator's position for each group of primary trunks, an operating circuit for each primary switch completed at the contacts of a predetermined one of said group keys depending on which group of primary trunks is desired, and test circuits for said trunks completed at contacts of said predetermined group key.

13. In a telephone system, an automatic switch provided with duplicate sets of contacts arranged in the arc of a semi-circle, each set of contacts including trunk contacts and a test contact, two sets of brushes engaging with the sets of contacts during the progressive movement of said sets of brushes, each set of brushes including a test brush, said test brushes being positioned so that only one test brush is in position to engage its group of test contacts at any one time, incoming telephone circuits terminating in said test brushes, trunks terminating in said contacts and means for operating said automatic switch.

14. In a telephone system, an automatic switch provided with two groups of contacts arranged in pairs, each set of contacts including a test contact, a brush shaft, two sets of brushes extending in opposite directions from said brush shaft, each set of brushes including a test brush, said sets of test brushes being so arranged that only one test brush, engages its associated set of test contacts at any one time, trunks terminating in said sets of contacts, incoming line branches terminating in said brushes and means for operating said automatic switch when a telephone connection is originated over either of said telephone line branches.

In witness whereof, I hereunto subscribe my name this 21st day of February A. D. 1927.

WINFRED T. POWELL.