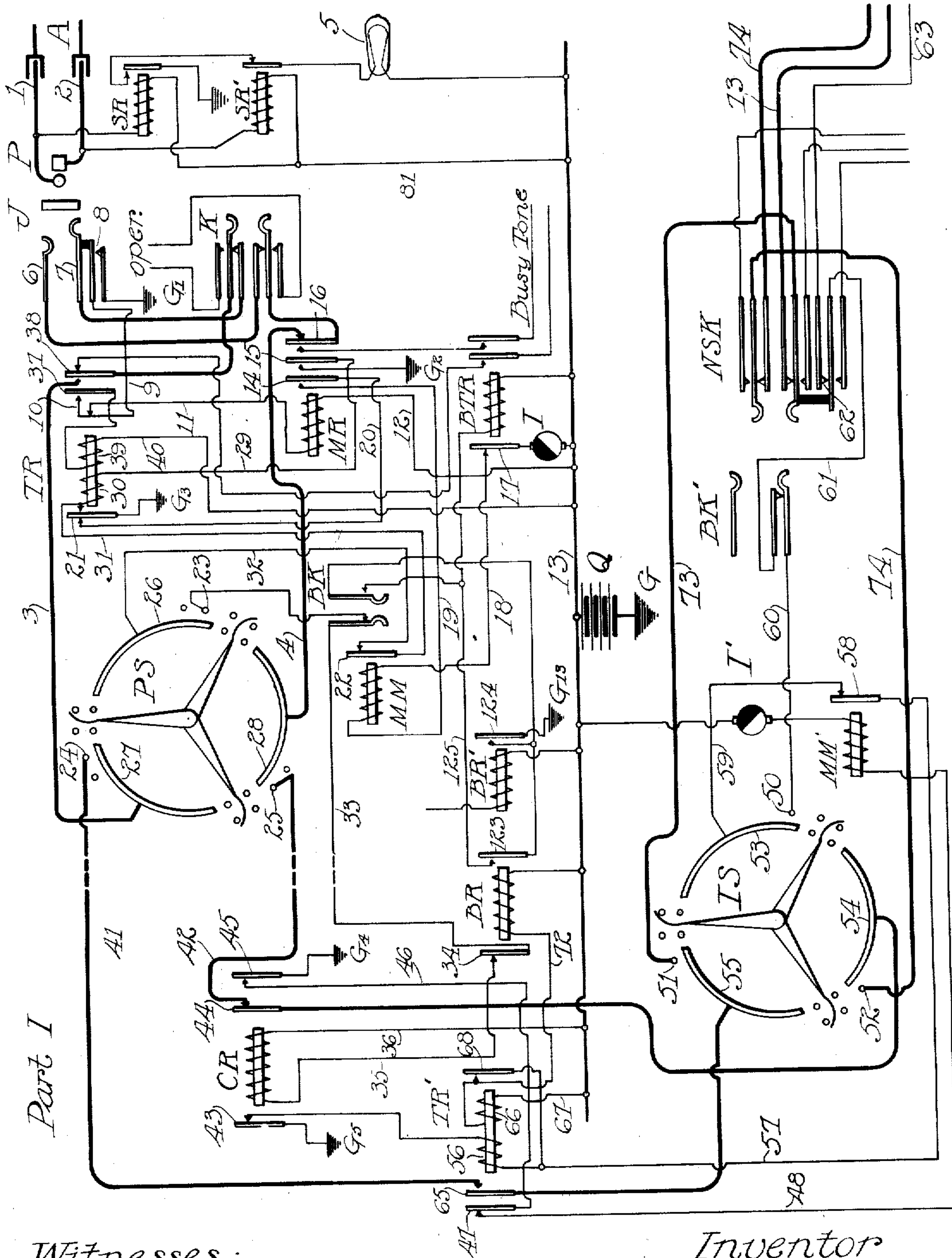


J. A. TAGGART.
TELEPHONE TRUNKING SYSTEM.
APPLICATION FILED MAY 1, 1915.

1,165,728.

Patented Dec. 28, 1915.
2 SHEETS—SHEET 1.



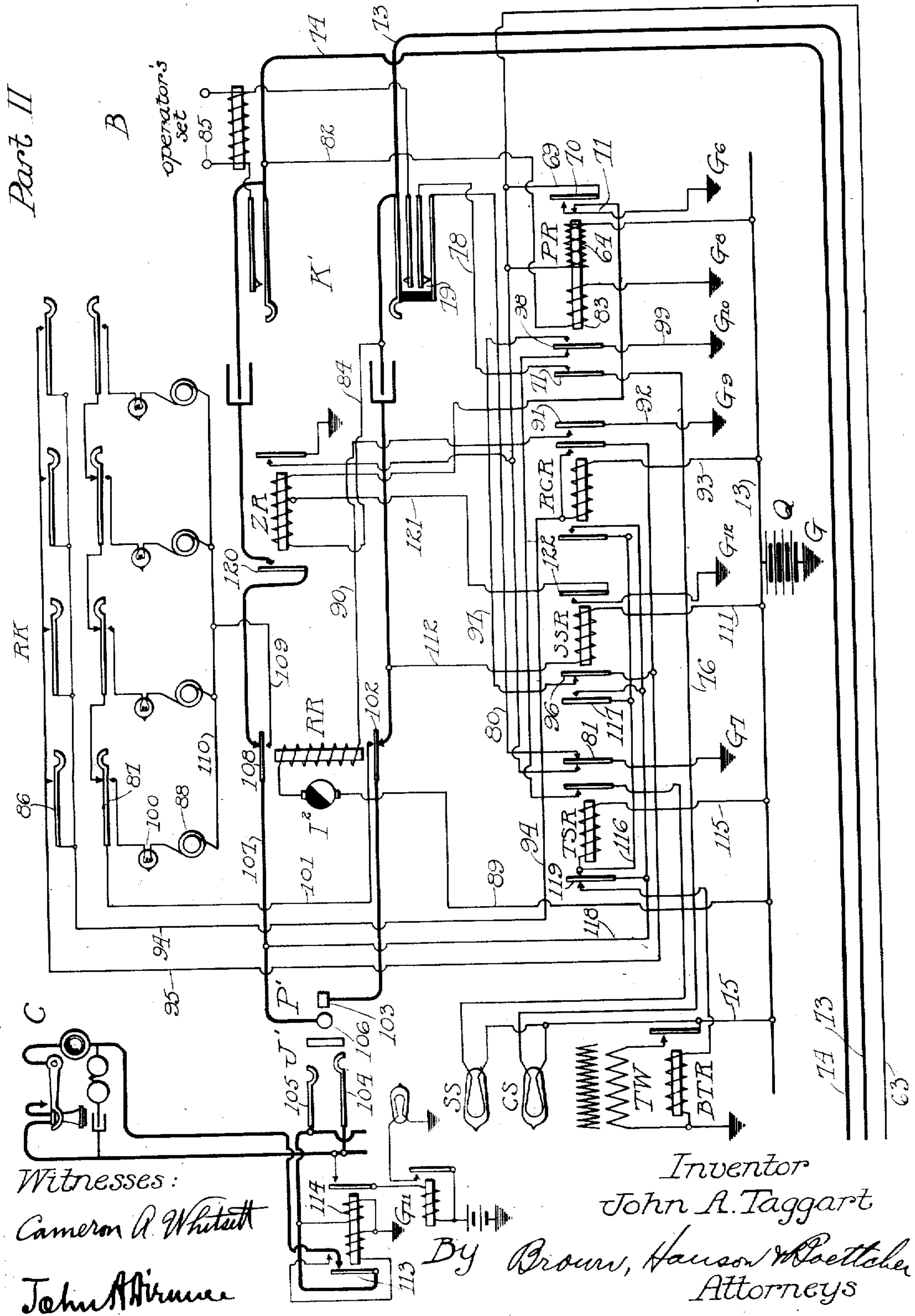
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UNITED STATES PATENT OFFICE.

JOHN A. TAGGART, OF ROCHESTER, NEW YORK, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE TRUNKING SYSTEM.

1,165,728.

Specification of Letters Patent.

Patented Dec. 28, 1915.

Application filed May 1, 1915. Serial No. 25,098.

To all whom it may concern:

Be it known that I, JOHN A. TAGGART, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented a certain new and useful Improvement in Telephone Trunking Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention provides an improved telephone trunking system.

The invention aims to effect a gain in speed of distribution of trunked calls, certainty of operation of the system, simplicity of structure of the apparatus, ease of control and minimum wear of parts.

Between the A operators and the B operators, I provide a series of trunks. Each of the A operators has at her position a plurality of jacks with which she may make connection by means of the usual plug and cord circuit. Each of the B operators has at her position a plurality of special link circuits, preferably single ended cord circuits selectively connectible with the jacks of the A operator's position. Automatic selecting switches connect any jack which is selected by an A operator with an idle link circuit at any one of the B operators' positions and as soon as the connection is completed to that position, a call signal corresponding to the link circuit selected is displayed before the corresponding B operator. The B operator completes the telephone connection by connecting the link circuit selected with the called line. I employ, preferably, non-normaling switches, that is, switches which remain stationary indifferently at any position instead of returning to a definite normal position after each selecting operation. This allows greater speed of operation and provides a structure of great simplicity. Each link circuit is provided with a switch which will throw the selection of a given link circuit upon another board or operator's position. This allows a reduction of the number of operators when the load upon the system grows less and also arranges a very convenient solution of the problem of taking care of the night load, as all the selections may be thrown to a special position or positions. In addition I provide

means for barring each link circuit and each selecting switch. This prevents calls being distributed to apparatus which may be out of order or under repair or the like. In order to take care of the situation arising when all the trunks are busy, I provide means for returning a busy tone to the calling subscriber.

The manner in which the above is accomplished will be observed from the following description of an illustrative embodiment of my invention shown diagrammatically in the accompanying two sheets of drawings, which form a part of the present specification. The diagram shown in Part 1 is joined to the diagram shown in Part 2.

In the drawing the A operator's position is shown at the upper right hand corner of Sheet 1, this position being illustrated diagrammatically by the end of the cord circuit having the plug P and the cord strands 1 and 2, to which the operator's set may be connected. The cord strands 1, 2, are illustrative of any cord circuit at the operator's position which may be employed in making connections between calling and called subscribers. The operator's position at A is provided with a number of jacks, one of which is shown at J. Each jack J has an individual primary switch PS connected thereto, each of said primary switches being operable to select an intermediate switch IS which in turn has contacts leading to single ended cord circuits distributed at the various B operators' positions, shown in diagram in Part 2 of the drawing.

The jack J has the usual tip and sleeve springs 6 and 7 respectively, for making connections to the cord strands 1 and 2. Insertion of a plug P in the jack J also closes the control contact 8 which governs the starting of the primary switch in making a selection of an idle intermediate switch. Closing of the contact 8 completes a circuit for the motor relay MR over the following circuit: ground through contact pair 8, wire 9, make before break contact 10, wire 11, relay MR to grounded battery Q by way of the wire 12 and the battery bus 13. The relay MR is energized and closes its armatures, 14, 15 and 16 against their front contacts. The armature 14 completes a circuit through the interrupter I and the motor magnet MM which steps the switch PS for-

ward until the switch is connected to an idle contact leading to an idle intermediate switch. This circuit is completed over the following path: grounded battery Q, bus 13, interrupter I, back contact of armature 17 of the busy test relay BTR, wire 18, motor magnets MM, wire 19, front contact of the armature 14, wire 20, back contact of the armature 21 of the relay TR at the ground at G³. The interruptions of the circuit of the motor magnet MM cause through suitable pawl and ratchet mechanism advancing steps of the switch PS until the switch is placed in connection with an idle set of contacts leading to an intermediate switch as at IS. It will be noted that upon each energization of the motor magnet its armature 22 which controls the circuit of the testing relay TR is opened. This is to allow the test of each contact as the same is reached, the switch being advanced upon the deenergization of the magnet MM. Assuming that the contact set 23, 24 and 25 is idle, the moving arms of the switch will come to rest upon these contacts when the same are reached. Stopping of the switch arm is caused by an opening of the circuit of the motor magnet by the armature 21 of the testing relay, the testing relay TR being energized over the circuit which is closed between the idle contact 23 and the switch segment 26 in the private wire. This circuit may be traced over the following: ground G², back contact of the armature 15 of the motor relay MR, wire 29 winding 30 of the test relay TR, wire 31, armature 22 of the motor magnet MM, back contact, wire 32, switch segment 26, contact 23, through the barring key, BK, over the wire 33 to the armature 34 of the private relay BR, back contact wire 35, winding of the starting relay CR to grounded battery Q over the wires 36 and the bus-bar 13. This circuit energizes the testing relay TR of the switch PS and energizes the winding of the relay CR of the switch IS to start the switch IS in search of an idle trunk line leading to a single ended cord circuit before a B operator's position. Energization of the relay TR attracts the armatures 21, 37 and 38, breaking the circuit of the motor magnet at the armature 21, closing a locking circuit for the winding 39 upon the relay TR at the make before break contact 10 and closing the tip strands 3 of the trunk at the armature 38. The circuit for the holding winding 39 may be traced as follows: ground G¹, jack contact 8, wire 9, contact 10, armature 37, winding 39 of the testing relay, wire 40 to battery Q by way of the bus-bar 13. Attraction of the armature 37 breaks the circuit of the motor control relay MR, causing the same to be deenergized and closing the tip strand 4 of the trunk at the armature 16. In case the trunks 41, 42 had been busy,

a circuit of the private wire 33 would have been broken at the contact 34 and it would have been impossible for the testing relay TR to be energized to stop the motor magnet.

Energization of the starting relay SR which occurs when the primary switch is placed in connection with an idle trunk line such as 41, 42, closes a contact at the armature 45 for the motor magnet MM' of the intermediate switch. This circuit may be traced as follows: ground G⁴, armature 45, front contact, wire 46, armature 47, back contact, wire 48, motor magnet MM', interrupter I' and to battery Q over the busbar 13. The intermediate switch IS moves its wipers into contact with an idle set of contacts 50, 51 and 52, leading to an idle trunk ending in a plug at a B operator's position. As soon as the private contact 50 is connected to the switch segment 53, a circuit is closed for the testing relay TR' over the following path: ground G⁵, armature 43 and front contact of the starting relay CR, winding 56 of the testing relay TR', wire 57, armature 58 of the motor magnet, back contact, wire 59, to segment 53, idle contact 50, wire 60 through the barring key BK', wire 61, contact 62 in the night switch key NSK, wire 63 which is continued on the second sheet, Part 2 of the diagram, through the higher resistance winding 64 of the private relay PR to the battery, bus 13, and to the grounded battery Q. The high resistance winding 64 gives a non-inductive resistance disposed upon the core of the relay TR merely for the sake of convenience. This resistance prevents excessive flow of current and serves to regulate the battery feed for the test wire 63. The switch IS is constructed like the switch PS, having the moving contact advanced upon deenergization of the motor magnet. This allows the testing circuit to be closed at the time when the moving switch member is stationary. This circuit energizes the winding 56 of the testing relay TR', breaking the circuit for the motor magnet at the armature 47, closing the tip strand 41 of the trunk at the armature 65 and at the same time closing a locking window 66 for the test relay TR' over the following circuit: grounded battery Q, bus 13, wire 67, winding 66, armature 68, wire 57, armature 58 of the motor magnet, wire 59, private segment 53, private contact 50, private wire 60, wire 61 and contact 62, private wire 63, wire 69, armature 70 of the private relay PR, make before break contact 71 and ground at G⁶. It is to be noted at this time that the energization of the winding 64 of the private relay PR has attracted the armature 70 to close a locking circuit for this winding as follows: ground G⁶, contact 71, armature 70, wire 69, winding 64, battery bus 13 to the battery Q. It is also to be noted that at

traction of the armature 68 of the testing relay TR' closed a circuit for the barring relay BR (see Sheet 1) breaking the circuit of the starting relay at the contact 34 of the barring relay, a circuit being traced as follows: grounded battery Q, bus 13, winding of the barring relay BR, wire 72, armature 68, wire 57 and over the circuits previously traced, to ground at G⁶. The connection has now been extended through the strands 41 and 42, the latter being closed at the armature 44 by the deenergization of the relay SR through the intermediate switch IS to the strands 73 and 74 of the trunk leading to the idle cord circuit in front of the B operator. The call signal CS, which preferably is a small incandescent lamp, is now displayed in front of the B operator to indicate that a call has come in on this particular circuit. The circuit for the call signal CS may be traced over the following circuit: grounded battery Q, bus 13, wire 75, wire 76, armature 77 of the relay PR, which is now energized, wire 78, through the contact 79 on the operator's key K', wire 80, armature 81 of the tip supervisory relay TSR and to ground at G⁷.

The supervisory signal 5 at the A operator's position is displayed when the plug P is inserted in the jack J and is extinguished as soon as the connection is extended to the trunks 73, 74, the supervisory relay SR being energized as follows: battery Q, bus 13, wire 81, relay SR, plug P, jack J, tip strand 4 through the switch PS, wire 42, through the switch IS to the trunk strand 74, wire 82, winding 83 of the relay TR and to ground at G⁸. The B operator perceiving the calling signal CS connects her telephone set, which is connected to the terminals 85, to the trunk wires 73 and 74, and being informed of the number of the desired subscriber, she raises the plug P' to test the thimble of the jack of the called subscriber in the usual manner. Assuming that the line is not busy, she inserts plug P' and depresses one of the ringing keys in the set RK to project ringing current of the proper frequency over the called line. Assuming that the first key shown to the left of Sheet 2 is connected to a generator 88, giving the proper frequency for ringing a bell at the called subscriber's station C, the springs 86 and 87 are pressed outwardly, closing a circuit for the ringing relay RR and for the ringing generator 88. The circuit of the ringing relay may be traced as follows: grounded battery Q, bus 13, wire 89, interrupter I², winding of relay RR, wire 90, front contact of armature 91 of the ringing control relay RCR to ground at G⁹ over the wire 92. The ringing control relay RCR has its circuit closed at the contact 86 over the following circuit: grounded battery Q, bus 13, wire 93, winding of the relay RCR, wire 94, key

spring 86, front contact thereof, wire 95, back contact of the armature 96 of the sleeve supervisor relay SSR, wire 97, armature 98 of the relay TR which is then energized, to ground at G¹⁰ over the wire 99.

The interruptions of the circuit of the relay RR cause ringing current to be applied to the called line at regular intervals, over the following circuit: generator 88, through the lamp 100, key spring 87, wire 101, back contact of the armature 102 of the ringing relay, over the sleeve side of the cord, sleeve contact 103 of the plug, sleeve spring 104 of the jacks J' over the called line back to the tip spring 105 of the jack J', tip contact 106 of the plug P', tip strand 107, armature 108 of the ringing relay RR back to generator 88 over the wire 109 and the bus 110. As soon as the called subscriber responds the conducting bridge at the sub-station C is closed and battery is fed over both strands of the cord in parallel, as follows: grounded battery Q, bus 13, wire 111, through the winding of the sleeve supervisory relay SSR, wire 112, over the sleeve strand of the cord, through the plug and jack connection, through the conducting bridge and the sub-station, to the armature contact 113 of the cut-off relay 114, to ground G¹¹ through the left hand winding of the relay 114.

Battery is fed over the tip strand of the cord as follows: grounded battery Q, bus 13, wire 115, winding of the tip supervisory relay TSR, wire 116, armature contact 117, wire 118 over the tip strand of the cord through the plug and jack to ground at G¹¹ through the right hand winding of the relay 114. The tip supervisory relay also closes a locking circuit for itself through its armature 119 and the front contact to the wire 118 and to ground at G¹¹ as above described. The tip strand of the cord circuit is closed at the armature contact 120 which contact was previously open to allow the operator to test the busy or idle condition of the called line. The tip relay TR which controls the armature 120 is energized over a circuit traced as follows: grounded battery Q, Sheet 1, bus 13, wire 81, supervisory relay SR', strand 2 of the cord circuit at the A operator's position, plug P, jack J, sleeve strand 3 to the switch PS, wire 41, switch IS, sleeve strand 73 of the trunk, wire 84, winding of the tip relay TR, wire 121, armature 122 of the sleeve supervisor relay SSR, to ground at G¹². The subscribers are now placed in communication and they carry on a conversation; at the conclusion thereof the A operator receives the usual disconnect signal from the calling subscriber and withdraws the plug P from the jack J, releasing the trunk circuit which was set up. Withdrawal of the plug P opens the springs 8 at the jack J, deenergizing the relay TR, thereby removing the grounded potential from

the private segment 26 of the primary switch PS. As the plug P has been withdrawn there is no supply of battery to the talking strand of the circuit and as a consequence the tip relay ZR (see Sheet 2) and the private relay PR are deenergized. Deenergization of the relay PR closes the circuit for the supervisory signal SS at the B operator's position, thus advising the B operator that the connection should be taken down. Deenergization of the relay PR also removes the ground from the segment 53 of the intermediate switch IS. It is to be noted, however, that the ground from the private wire 63 is not removed until the tip supervisory relay TSR is also deenergized which occurs when the plug P' is withdrawn from the jack J', hence it can be seen that the intermediate switch will remain busy so long as the plug P' is connected to a subscriber's jack.

In order to prevent connection with the trunks when all of the same are busy, I employ mechanism for returning a busy tone to the calling subscriber or to the A operator. Inasmuch as each jack J has a primary switch individual thereto, it is unnecessary to test the condition of the jacks; the plug P being inserted in any jack J which is unoccupied. Each intermediate switch IS has a relay individual thereto, indicating its busy or idle condition. The relay for the switch I have shown in the drawings is indicated at BR and is maintained in the energized condition as long as the ground potential is placed on the segment 53. The relay BR controls by means of its armature 123, one of the breaks in a chain circuit passing through the busy tone relay BTR. This circuit is completed from the ground G¹³ through the armatures 124, 123, etc., of the series of relays BR, BR' to the common wire 125, through the winding of the busy tone relay to battery. Energization of a busy tone relay opens the circuit of the motor magnet, preventing stepping of any of the switches PS and applying the busy tone to any line which is seeking the selection of an idle trunk. In such case the supervisory signal 5 at the A operator's position will remain lighted and the operator may ascertain the reason for non-selection by opening the key K, whereupon a busy tone will be applied to the terminals of her telephone set. In case the line of the called subscriber C is found busy this fact may be made known to the calling subscriber by the B operator who connects her telephone set to the trunk by means of the key K'.

A barring key BK' individual to a trunking circuit is provided, that is, the circuit terminating in the plug at the B operator's position may be barred from selection by operation of the key BK'. The night switch key NSK provides means for switching all

of the calls to a special position so that instead of having the calls distributed to all of the B operators, all the calls may be caused to appear at one or more positions so that several operators can take care of all calls, as is found advisable during the night hours.

What I claim as new and desire to secure by Letters Patent is the following:

1. In a system of the class described, a plurality of telephone lines grouped at operators' switching stations, operator controlled means to interconnect the lines at each station, a plurality of jacks at said first station, primary selecting switches individual to said jacks, said switches being rendered active by connection with said operator controlled connecting means, secondary selecting switches selectable by said primary switches, a plurality of operator controlled link circuits terminating at said second station, a call signal for each of said link circuits, said link circuits being selectable by said secondary switch to display said call signal.

2. In a system of the class described, a plurality of telephone lines grouped at operators' switching stations, means to interconnect the lines at each of said stations, a plurality of jacks at said first station, selecting switches individual to said jacks, secondary selecting switches selectable by said first switches, a plurality of operator controlled link circuits terminating at said second station, a call signal for each of said link circuits, said link circuits being selectable by said secondary switches to display said call signal and means for returning a busy signal to a calling subscriber when all of said secondary selecting switches are busy.

3. In a system of the class described a plurality of telephone lines grouped at operators' switching stations, operator controlled means to interconnect the lines at each station, a plurality of jacks at said first station, selecting switches individual to said jacks, said switches being rendered active by connection with said operator controlled connecting means, secondary selecting switches selectable by said first switches, a plurality of operator controlled link circuits, terminating at said second station, a call signal for each of said link circuits, said link circuits being selectable by said secondary switches to display said call signal, and means for barring from selection each of said link circuits.

4. In a system, of the class described, a plurality of telephone lines grouped at a plurality of operators' switching stations, means to interconnect the lines at each station, a plurality of jacks at said first station, selecting switches to connect to said jacks, secondary selecting switches to connect to

said primary switches, a plurality of operator controlled link circuits terminating at said second station, a call signal for each of said link circuits, said link circuits being selectable through said secondary switches to display said call signal, and means for interchanging said link circuits to cause said calls to appear at a predetermined operator's position.

5. In a system, of the class described, a plurality of telephone lines terminating at an exchange, other telephone lines terminating in switch jacks in said first exchange and terminating in operator controlled switching means in said second exchange, a plurality of jacks at said first station, non-normalizing selecting switches, individual to said jacks, a motor circuit for each switch, said circuit closed by the act of connecting to the corresponding jack, said circuit being interrupted by connection of a switch with an idle trunk extension and means to place a busy potential upon one of the terminals of said trunk extension to render the same non-selectable.

6. In a system of the class described, a plurality of telephone lines grouped at an operator's switching station, a second group of telephone lines terminating at a second operator's switching station, operator's cord circuit for interconnecting the telephone line at each operator's switching station, trunk lines interconnecting said operators' stations, selecting switches in said trunk lines, said trunk lines having a pair of talking strands and means for feeding battery in parallel over said talking strands, when said trunk line is employed to connect said operators' stations by connection of an operator's cord circuit with one end thereof.

7. In a system of the class described, a plurality of telephone lines grouped at a plurality of operators' switching stations, means to interconnect the lines at said stations, a plurality of jacks at said first station, selecting switches individual to said jacks, secondary selecting switches selectable by said primary switches, a plurality of operator controlled link circuits, terminating at said second station, a call signal for each of said link circuits, said link circuits being selectable by said secondary switches to display said call signal and means controlled by the operator at the first station for feeding battery in parallel over the talking strands of the selected trunk.

8. In a system of the class described, a plurality of telephone lines, grouped at a plurality of operators' switching stations, operator controlled means to interconnect the lines at each of said stations, a plurality of jacks at said first station, automatic selecting switches individual to said jacks, said switches being rendered active by the connec-

tion of the operator controlled interconnecting means with the corresponding jack, secondary selecting switches for connecting with said first selecting switches, a plurality of operator controlled link circuits, terminating at said second station, said link circuits connected to said secondary selecting switches, a call signal for each of said link circuits, said link circuits being selectable through said secondary switches to display said call signal and means under the control of one of said operators for releasing said first selecting switches and means under the control of an operator at another switching station for releasing the secondary selecting switches.

9. In a system of the class described, a plurality of telephone lines terminating at operators' switching stations, other telephone lines terminating at other operators' switching stations, link circuits terminating at said second operators' switching stations in operator controlled switching means, said link circuits terminating at said first operators' switching stations in switch jacks, primary selecting switching means and secondary selecting switching means for connecting said operator controlled switching means with said jacks, means to transmit a busy signal through said jacks at the first operators' switching station and means controlled by the busy condition of all of said secondary selecting switches to cause said busy signal to be transmitted through said jacks.

10. In a system of the class described, a plurality of telephone lines grouped at a plurality of operators' switching stations, other telephone lines terminating at other operators' switching stations, link circuits terminating in contact plugs at said second operators' switching station, a plurality of jacks greater in number than said connecting circuits at said first operators' switching station, primary selecting switches for extending connection from one of said jacks toward said connecting circuit, secondary selecting switches for connecting said primary switches with idle ones of said connecting circuit, and means controlled by the busy condition of all of said secondary selecting switches for projecting a busy tone signal through said switching jacks at the first operators' switching station.

11. In combination a plurality of telephone lines terminating at an A operator's position, a plurality of cord circuits for interconnecting said telephone lines, a plurality of telephone lines terminating at a B operator's position, switching jacks at said A operator's position, single plug ended cord circuits at said B operator's position, primary switches and intermediate switches for connecting said switching jacks with an idle one of said cord circuits, said primary switches being rendered active by the con-

nection of a cord circuit with one of said
jacks to select an idle intermediate switch, a
supervisory signal for said single plug end-
ed cord circuit, said signal controlled jointly
5 by disconnection of said jacks at the A op-
erator's position and connection of the plug
corresponding thereto at the B operator's
position, and means controlled by disconnec-
tion of the jacks at the A operator's position
10 and disconnection of the plugs at the B op-
erator's position for rendering said switches
idle for further connection.

12. In combination a plurality of lines
terminating at A operators' positions, other
15 telephone lines terminating at B operators'

positions, switching jacks at each of said A
operators' positions, switching plugs at each
of said B operators' positions, primary and
secondary selecting switches for selecting
said jacks with an idle one of said plugs at 20
the B operator's positions and manual switch
means for rendering any one of said plugs
nonselectable.

In witness whereof, I hereunto subscribe
my name this twenty-third day of April, 25
A. D. 1915.

JOHN A. TAGGART.

Witnesses:

WILLIAM W. DEAN,
M. F. VAN FLEET.

It is hereby certified that in Letters Patent No. 1,165,728, granted December 28, 1915, upon the application of John A. Taggart, of Rochester, New York, for an improvement in "Telephone Trunking Systems," an error appears in the printed specification requiring correction as follows: Page 2, line 115, for the word "window" read *winding*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of January, A. D., 1916.

[SEAL.]

R. F. WHITEHEAD,

Acting Commissioner of Patents.

Cl. 179—27.