

March 24, 1942.

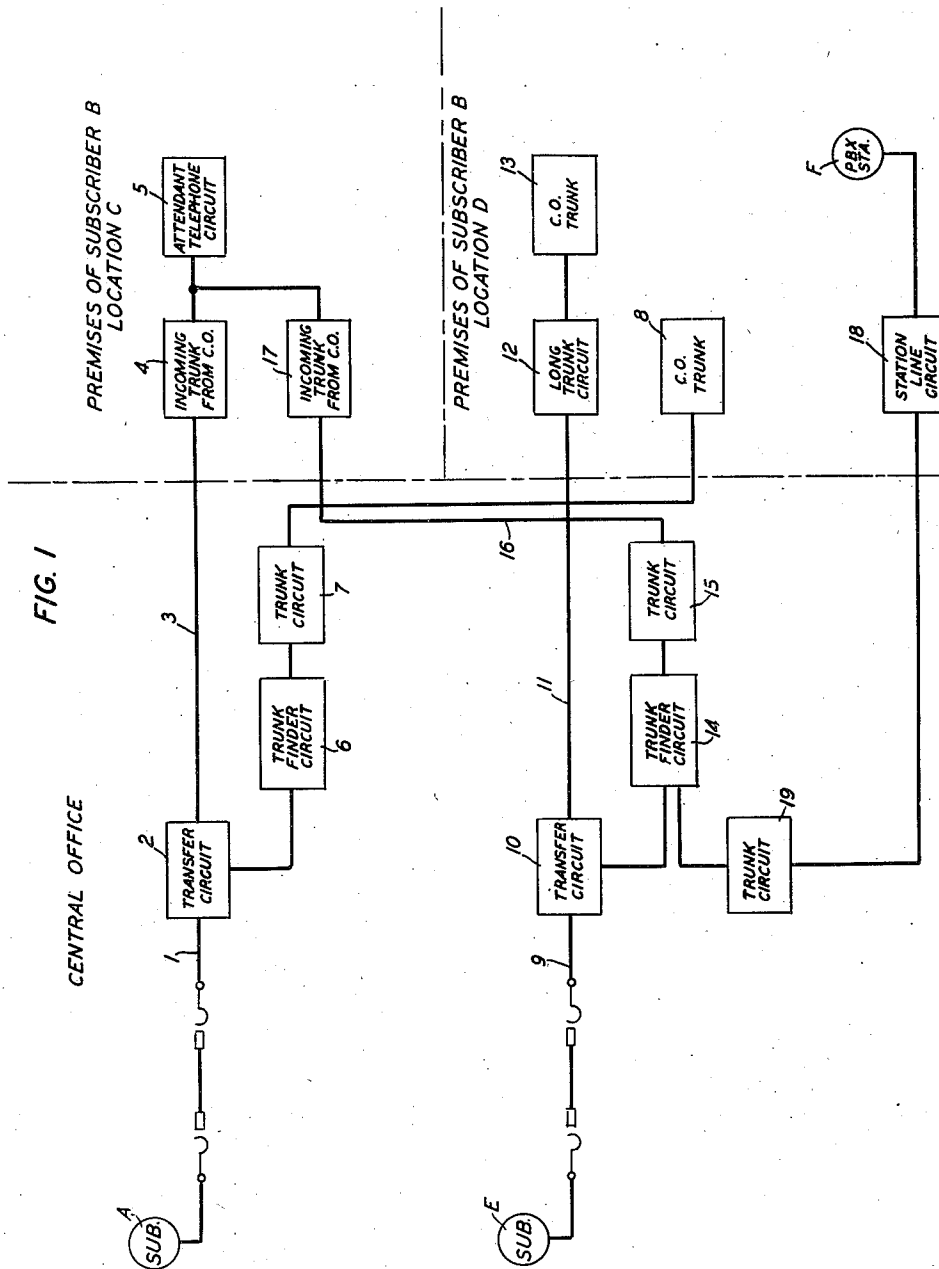
C. D. KOECHLING

2,277,441

TELEPHONE SYSTEM

Filed July 5, 1940

3 Sheets-Sheet 1



INVENTOR
C. D. KOECHLING
BY *John A. Hall*
ATTORNEY

March 24, 1942.

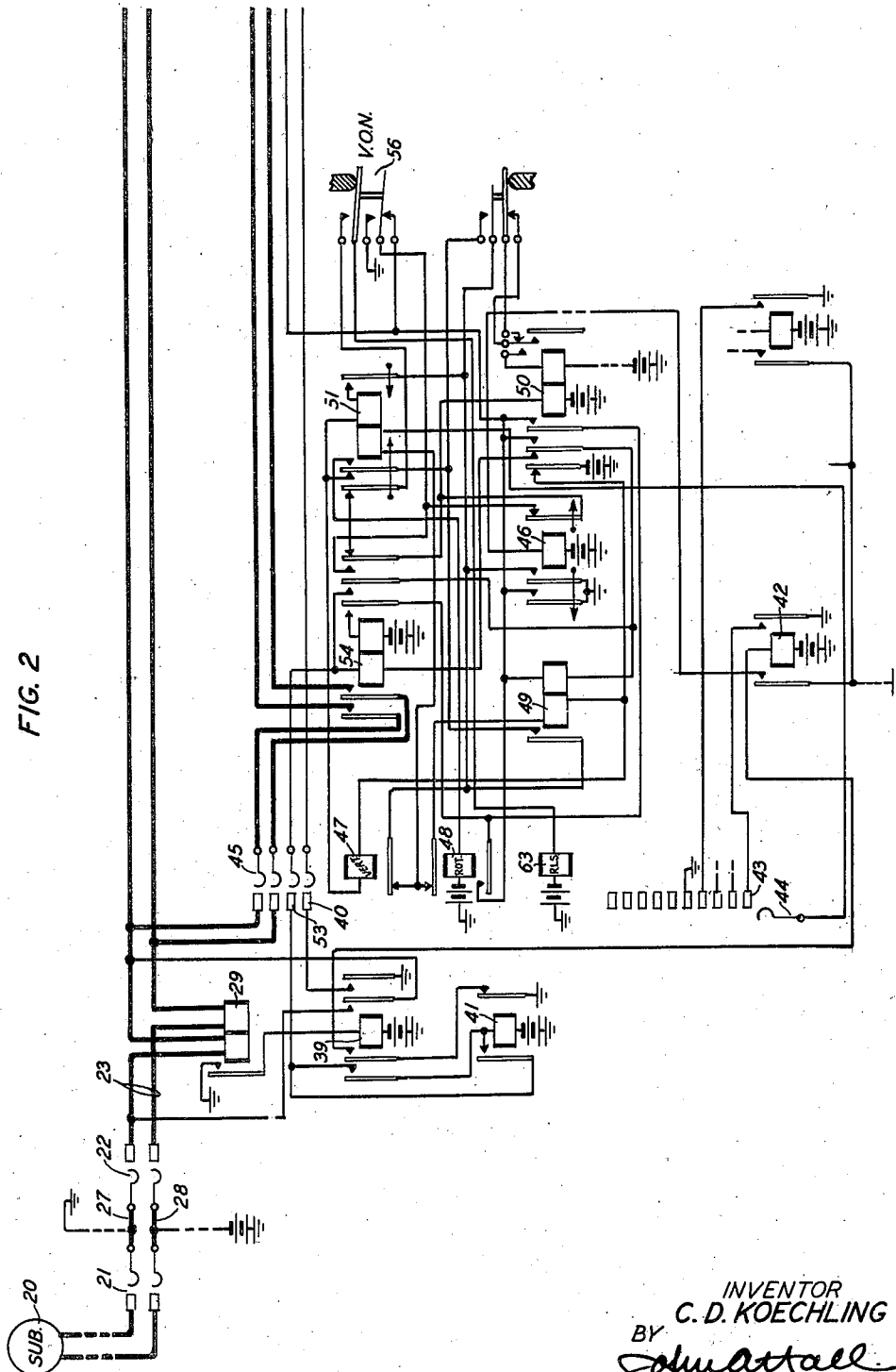
C. D. KOECHLING

2,277,441

TELEPHONE SYSTEM

Filed July 5, 1940

3 Sheets-Sheet 2



INVENTOR
C. D. KOECHLING
BY *John A. Hall*
ATTORNEY

March 24, 1942.

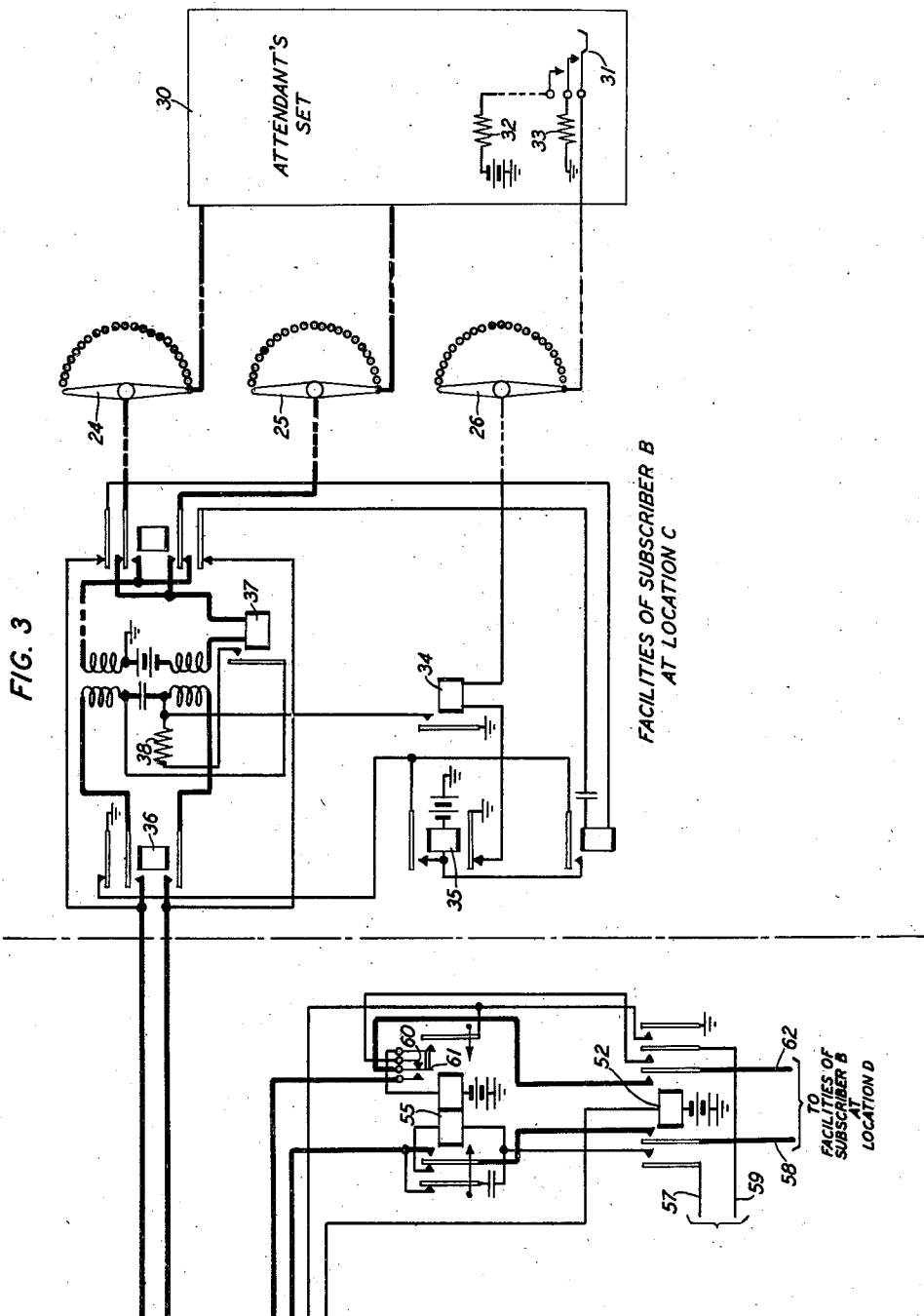
C. D. KOECHLING

2,277,441

TELEPHONE SYSTEM

Filed July 5, 1940

3 Sheets-Sheet 3



INVENTOR

C. D. KOECHLING

BY

John A. Hall

ATTORNEY

UNITED STATES PATENT OFFICE

2,277,441

TELEPHONE SYSTEM

Charles D. Koechling, Floral Park, N. Y., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application July 5, 1940, Serial No. 344,039

7 Claims. (Cl. 179-27)

This invention relates to telephone systems and particularly to automatic working, being especially directed to transferring means whereby connections extended to one point may be rerouted to another point.

The object of the invention is to provide facilities whereby flexible operation by a subscriber having a plurality of terminating stations in different localities may be had.

The prior art affords a number of disclosures of telephone systems wherein calls may be transferred from one called subscriber to another called subscriber. Generally speaking such facilities are provided in special private branch exchange arrangements. The present invention, however, contemplates a plurality of private branch exchange installations and the object is to transfer a call incoming to one such private branch exchange operator to another and particularly where the different private branch exchange switchboards are in different localities. The present invention therefore differs from previously known arrangements in several essential aspects.

In accordance with one feature of the invention the transfer arrangements while still controlled by a called subscriber are nevertheless located at the distant end of the line. Specifically, the transfer is made at the central office end of a trunk rather than locally in the private branch exchange circuits.

In accordance with another feature the transfer is more in the nature of a rerouting since the new connection is not directly extended to a particular called subscriber's line but rather to another group of lines leading in the desired direction.

A further feature of the invention is a simple key controlled means for initiating the transfer or rerouting operation at the distant end of the trunk line. In the specific embodiment of the invention herein employed a differential relay at the central office end of a trunk is made to respond to a manual key controlled operation at the private branch exchange end of the trunk.

In accordance with another feature each of a group of central office lines terminating in a distributing means for allotting incoming calls to individual attendants of a group has in it a transfer means operated by a common key at each attendant's position to affect transfer means at the central office end of the line for there transferring or rerouting the call over one of another group of lines extending to a different location. Where a subscriber has premises at

two widely separated locations and where cable conductors are at a premium the present invention becomes a means toward economy especially since additional tie line facilities need not be provided for transferring calls directed to one location which are to be handled at another location.

In accordance with a further feature of the invention such transferred connections may be used for conference purposes since the original connection to the subscriber's premises to the first location is not destroyed after being transferred or rerouted though it may be abandoned.

Other features will be set forth in detail in the following description.

The drawings consist of three sheets.

Fig. 1 is a schematic diagram showing the general plan of operation; and

Figs. 2 and 3 with Fig. 3 placed to the right of Fig. 2 provide a circuit diagram for explaining the present invention.

In Fig. 1 the diagram is divided into three portions by a dot-and-dash line. The portion to the left of the vertical dot-and-dash line represents central office circuits. The two portions to the right of the dot-and-dash line represent the premises of a subscriber, the upper portion representing premises at one location and the lower portion representing premises at another location. A subscriber A wishing to call subscriber B and selecting the telephone number of subscriber B leading to his premises at location C will set up a connection to a line 1 leading to subscriber B at location C. This line 1 passes through a transfer circuit 2 over line 3 to an incoming circuit arrangement 4 which may be attended by an attendant having a circuit 5. The attendant finding that the subscriber A in reality wished to talk to an employee of subscriber B at location D thereupon performs a manual operation within the attendant's telephone circuit 5 which causes a relay operation in the incoming trunk circuit 4 and which in turn causes an operation in the transfer circuit 2; thereupon a finder switch 6 will operate and extend the line over an idle trunk circuit 7 leading to the premises of subscriber B at location D where the call will be answered by an attendant having supervision over the central office trunk circuit 8. In a similar manner a subscriber E may set up a connection to the line 9 leading to the premises of subscriber B at location D. This line passes through a transfer circuit 10 similar to the transfer circuit 2, thence over a central office line 11 to a trunk termina-

tion circuit 12 on the premises of subscriber B at location D, and thence to a termination 13 in a private branch exchange switchboard. The attendant here, finding that the subscriber E actually wished to talk to an employee of subscriber B at location C, performs the same sort of manual operation as the attendant at location C whereupon a differential relay in the transfer circuit 10 causes the trunk finder circuit 14 to operate and extend the connection over an idle trunk 15 leading to the premises of subscriber B at location C. The line 16 terminates at that point in an incoming trunk circuit 17 which may be attended by the attendant having charge of the attendant's telephone circuit 5.

The facilities provided by the trunk finder circuits such as 14 may be utilized by employees of subscriber B for setting up connections to fellow employees at the other location; thus a subscriber F may set up a connection through the station line circuit 18 to a trunk circuit 19 which will cause the operation of the trunk circuit 14 in the same manner as the transfer circuit 10 causes this operation, whereupon the subscriber F, employee of subscriber B, may be connected to a fellow employee at the location C.

The essential parts of the circuit are shown in Figs. 2 and 3. For a more complete disclosure of the circuits of this nature, reference may be had to Patent 1,841,093 to Dahl, January 12, 1932. The circuits shown in Figs. 2 and 3 are modifications of the circuit shown in great detail in the above-noted Dahl patent. A subscriber at station 20 may establish a connection, by way of example, through automatic switches 21 and 22 to a line 23 leading to a line termination circuit shown to the right of the dot-and-dash line in Fig. 3. This line termination circuit in turn leads to an automatic switch here designated by wipers 24, 25 and 26 leading to an attendant's telephone set. The manner in which such a call distributing switch is operated is well known so that here only the parts of the circuit external to the present invention are indicated. It will be noted that between switches 21 and 22 a source of talking battery is furnished to the line in the form of a ground connection to the tip conductor 27 and a battery connection to the ring conductor 28. Battery and ground then cause a current flow in a loop circuit so that this flow of current is equal and opposite in the two conductors. Since these two conductors lead through windings of relay 29, this current flow will not cause relay 29 to operate. Thus relay 29 is not operated during the normal use of the line from subscriber 20 to the attendant having charge of the attendant's telephone set 30.

If the attendant finds that the call should have gone to some other employee at another location, she will operate transfer key 31. This key will set up a potentiometer connection including the resistances 32 and 33 and a middle point leading through wiper 26 and thence through the winding of transfer relay 34 to ground on the back contact and lower armature of relay 35. If relay 35 is non-operated, as it would be during the normal use of the line since at that time relay 36 would be operated, then relay 34 will respond. Since the supervisory relay 37 will be operated while the attendant's telephone set 30 is connected to the line, the operation of relay 34 will place a ground on the ring conductor of the line and through the resistance 38 also on the tip conductor. This will result in a great decrease

of current through the left-hand winding of relay 29 and a great increase in the current through the right-hand winding of relay 29. Relay 29 thereupon operates and causes the consequent operation of start relay 39.

Relay 39 through its outer right-hand armature and front contact places a ground on terminal 40 individual to the line 23. Through its inner right-hand armature and front contact relay 39 short-circuits the left-hand winding of relay 29 so that relay 29 will remain operated thereafter even though the attendant at the distant end releases the transfer key 31. Through its inner left-hand armature and front contact start relay 39 establishes a circuit from ground to the right-hand armature of back contact of cut-off relay 41 through the inner left-hand armature and front contact of relay 39, winding of relay 42 to battery. Relay 42 places a ground on group contact 43 of the finder switch here designated by its group contact wiper 44 and the four upper wipers of which No. 45 is one. Relay 42 also extends a ground from its left-hand armature and front contact to the winding of relay 46 which, becoming operated, closes a circuit from ground, inner left-hand armature and front contact of relay 46, armature and back contact of vertical magnet 47, back contact and upper armature of rotary magnet 48, left-hand winding of relay 49, back contact and outermost left-hand armature of relay 50 to battery. Relay 49, becoming operated, establishes a circuit from ground, the inner left-hand armature and front contact of relay 46, the armature and front contact of relay 49, the inner left-hand armature and back contact of relay 51, winding of vertical magnet 47, to battery at the back contact and outer left-hand armature of relay 50. Vertical magnet 47 moves the brushes of this switch on step in a vertical direction and by opening the circuit of relay 49 thereby breaks its own circuit. Thus the vertical magnet will automatically step until it is stopped by brush 44 reaching terminal 43. At this time a circuit will be established from ground, right-hand armature and front contact of relay 42, group terminals 43, brush 44, left-hand winding of relay 51, back contact and upper armature of rotary magnet 48 through the left-hand winding of relay 49 to battery on the back contact and outer left-hand armature of relay 50. As this circuit is completed while the vertical magnet 47 has opened the circuit through its armature and back contact, relay 49 will not release at this time and thus vertical magnet 47 will not be allowed to close this circuit. Relay 51 responds and closes through a substitute circuit for holding the vertical magnet 47 as well as the relay 51 energized through its right-hand winding, front contact and right-hand armature.

A circuit for the rotary magnet 48 may now be traced from battery to winding of rotary magnet 48, front contact and inner left-hand armature of relay 51, front contact and armature of relay 49, front contact and inner left-hand armature of relay 46 to battery. Magnet 48 operates to move the brushes represented by 45 in a rotary direction and by moving its armatures breaks the circuit of relay 49. Relay 49 becomes deenergized and thus opens the circuit for the rotary magnet 48. By this means the rotary magnet 48 automatically steps the brushes 45 around until the grounded terminal 40 is reached. At this time ground will be extended to the winding of relay 52. Relay 52 operates. At the same time a connection is set up from battery, the

winding of cut-off relay 41 through the outer left-hand armature and front contact of relay 39, the terminal 53 and its associated brush, left-hand winding of relay 54, back contact and middle left-hand armature of relay 50, right-hand winding of relay 49 to ground on the front contact and outer left-hand armature of relay 46. The cut-off relay 41 will operate in this circuit and lock through its left-hand armature and front contact to the condition found on terminal 53. Relay 49 will remain operated to prevent further stepping of rotary magnet 43 so that the brushes now having found the proper line will remain stationary. Relay 41 removes ground from the winding of relay 42 and this relay allows relay 46 to become deenergized. Relay 54 is also operated and serves to cut through the line to the contacts of relay 55. Relay 54 locks in a circuit from battery through its right-hand winding, front contact and inner right-hand armature, through the lower armature and front contact of rotary stepping magnet 48 to ground on the front contact of relay 46, which is slow to release and which holds ground until relay 50 becomes operated. Upon the operation of relay 54, ground is extended from the lower contacts of the vertical off-normal set of contacts 56 through the front contact and outer right-hand armature of relay 54, left-hand winding of relay 50 to battery. Relay 50 now becomes operated and removes the battery connection for the operation of the vertical and rotary magnets, but establishes a connection for the holding of relay 54 which may be traced from battery to right-hand winding of relay 54, front contact and inner right-hand armature thereof, inner left-hand armature and front contact of relay 50 to ground at the front contact of outer right-hand armature of relay 52. Relay 51 becomes deenergized.

When relay 52 is operated, ringing current from a source connected to conductor 57 is connected through the outer left-hand armature and front contact of relay 52 through the left-hand winding of tripping relay 55, back contact and inner left-hand armature of relay 55, front contact and left-hand armature of relay 52 to line conductor 58, and ground is connected from conductor 59 through the inner right-hand armature and front contact of relay 52, the contacts 60 and 61 controlled by the right-hand armature of relay 55 through the front contact and inner right-hand armature of relay 52 to line conductor 62. When the subscriber at the end of the line comprising conductors 58 and 62 responds, the current flowing through the left-hand winding of relay 55 may be increased and this relay will become operated, its right-hand winding thereupon being included in a circuit to ground at the outer right-hand armature of relay 52. The operation of relay 55 also cuts through the line from the line 23 to the line comprising conductors 58 and 62 and cuts off all connections through the source of ringing current on conductors 57 and 59.

When the connection is to be released through well-known means, the battery and ground connection to conductors 27 and 28 will be released, resulting in the deenergization of relay 29. This allows relay 39 to become deenergized which removing ground from the terminal 49 will allow relay 52 to release. This relay removes the ground connection from the conductor connected to its front contact associated with its outer right-hand armature and this breaks the hold-

ing circuit for relay 54. This relay in deenergizing establishes a circuit for the release magnet 63 from battery, the winding of release magnet 63, the upper pair of contacts of the vertical off-normal contacts 56, outer left-hand armature and back contact of relay 51, outer right-hand armature and back contact of relay 54, right-hand armature and back contact of relay 46 through the lower set of vertical off-normal contacts 56 to ground. Release magnet 63 causes the switch 45 to return to normal.

It should be noted that the connection from subscriber's station 20 thus set up to the attendant having charge of the attendant's telephone set 30 and thus transferred to the line conductors 58 and 62 leading to the same subscriber's premises at a different location, may be made the subject of a conference connection, since the original connection to the attendant's telephone set 30 is not destroyed when the connection to the line wires 58 and 62 is established. By the same token, the connection in the new direction may be used and the attendant at the right of Fig. 3 may abandon the connection without disturbing it.

What is claimed is:

1. In a telephone system, a central office, a plurality of groups of lines extending from said central office to subscribers' premises, each said group extending to a subscriber's premises at a different location, means individual to each of said lines at said central office responsive to manual control at the said subscriber's premises for automatically extending said line from said central office to an idle one of said lines in a predetermined one of said groups of lines.

2. In a telephone system, a central office, a group of lines extending from said central office to a first subscriber's premises, another group of lines extending from said central office to a second subscriber's premises, means at said central office individual to each of said lines of said first group responsive to control from said first subscriber's premises for causing said lines to be automatically extended to an idle one of said lines of said second group.

3. In a telephone system, a central office, a group of lines extending from said central office to a first subscriber's premises, automatic line finders at said central office for extending each of said lines, a second group of lines extending from said central office to a second subscriber's premises, said second group of lines each terminating in one of said line finders and means at said central office individual to each of said lines of said first group under manual control from said first subscriber's premises for automatically causing the operation of said line finders.

4. In a telephone system, a central office, a group of lines extending from said central office to a subscriber's premises at a first location, another group of lines extending from said central office to said subscriber's premises at a second location, means individual to each of said lines of said first group at said central office responsive to means individual to each of said lines of said first group at said subscriber's premises at said first location for extending each of said lines of said first group to an idle one of said lines of said second group extending to said subscriber's premises at said second location.

5. In a telephone system, a central office, a group of lines extending from said central office to a subscriber's premises at a first location, another group of lines extending from said central

office to said subscriber's premises at a second location, a differential relay in each of said lines of said first group at said central office unresponsive to normal use of said lines, means individual to each of said lines of said first group at said subscriber's premises for operating said differential relays, a switch for extending each of said lines of said first group to one of said lines of said second group, said switches being under control of said differential relays.

6. In a telephone system, a central office, a group of lines extending from said central office to a subscriber's premises at a first location, another group of lines extending from said central office to said subscriber's premises at a second location, an attendant's position at said first location accessible to said lines of said first group, means in each of said lines of said first group at said first location for placing a distinctive condition on said lines, means in said attendant's position common to said lines for operating said distinctive conditioning means, means in

each of said lines of said first group at said central office responsive to a said last-named means for extending said lines to one of said lines of said second group.

5 7. In a telephone system, a central office, a group of lines extending from said central office to a subscriber's premises at a first location, another group of lines extending from said central office to said subscriber's premises at a second location, a plurality of attendants' positions at
10 said first location accessible to said lines of said first group, a transfer relay in each of said lines of said first group at said first location, a transfer key in each of said attendant's positions for controlling said transfer relays, a second transfer
15 relay in each of said lines of said first group responsive to said first transfer relays and means under control of said second transfer relays for transferring a call on one of said lines
20 of said first group to one of said lines of said second group.

CHARLES D. KOECHLING.