April 19, 1932. G. WIRTH 1,854,916

TELEPHONE EXCHANGE SYSTEM

Filed Aug. 15, 1931

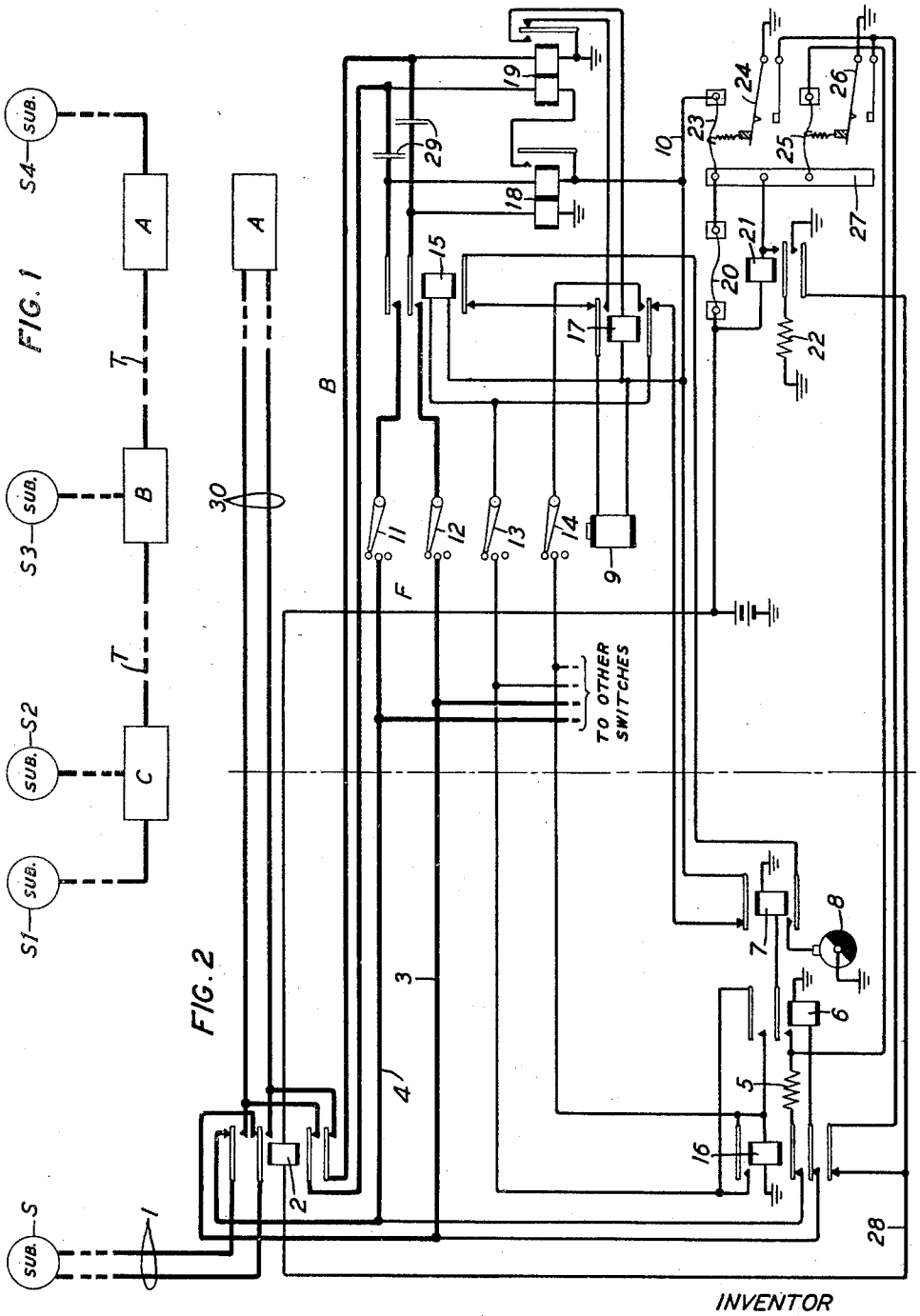

FIG. 1

FIG. 2

INVENTOR
G. WIRTH
BY
ATTORNEY

Patented Apr. 19, 1932 1,854,916

UNITED STATES PATENT OFFICE

GUSTAV WIRTH, OF NUREMBURG, GERMANY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TELEPHONE EXCHANGE SYSTEM

Application filed August 15, 1931, Serial No. 557,237, and in Germany April 2, 1930.

This invention relates to telephone systems and particularly to systems which include automatic or semi-automatic branch exchanges.

The object of this invention is to insure continuous telephone service to a subscriber whose line terminates in an automatic or semi-automatic branch exchange.

According to this invention switching means becomes effective, whenever the automatic equipment of a branch exchange becomes disabled, to connect a subscriber's line to an outgoing trunk leading to the main office in order that the subscriber will continue to have telephone service during the time the branch office equipment is out of service.

According to a further feature of the invention switching means is provided in an automatic branch exchange for automatically disconnecting a subscriber's line from the branch office equipment and connecting the line to a trunk leading to the main office in case the branch office equipment becomes disabled, the transfer of said line being effected, in case the line is in use at the time the trouble occurs and the trouble does not interfere with the connection, after the connection is released.

The invention is applicable to branch exchange telephone systems including systems in which several exchanges are serially connected to one or more trunks to the main exchange. The drawing represents such a system in which the invention is embodied but the invention is not limited in its application to the system disclosed in the drawings.

Referring to the drawings:

Fig. 1 shows schematically a main exchange A, two branch exchanges B and C serially connected by a trunk T to the manual main exchange A, and subscribers' stations S1, S2, S3 and S4.

Fig. 2 shows a preferred subscriber's station S and line 1 terminating in the branch exchange B, an automatic switch F, a switching relay 2, the main exchange A, and a trunk line 30 extending between the branch exchange and the main exchange.

The system illustrated in the drawings is one in which calling lines are normally extended by automatic finder switches to the manual main exchange at which the calls are answered. In case the branch exchange equipment becomes inoperative due to the operation of a fuse or due to some other trouble, the switching relay 2 is actuated to connect the preferred subscriber's station S and line 1 directly to the trunk 30 leading to the main exchange A. There may, of course, be as many preferred subscribers in the branch exchange B as there are trunks between exchanges A and B.

Assuming that the subscriber at station S removes the receiver to originate a call, a circuit is closed for operating relay 6; this circuit may be traced from battery through the main fuse 20, bus bar 27, fuse 25, resistance 5, inner lower contact of relay 16, conductor 4, outer upper back contact of relay 2, over line 1 and through the telephone at station S, inner upper back contact of relay 2, conductor 3, middle lower contact of relay 16, winding of relay 6, to ground. Relay 6 closes a circuit for operating the starting relay 7; this circuit may be traced from battery through fuses 20 and 25, front contact of relay 6, winding of relay 7, to ground. With relay 7 operated, interrupter 8 is connected through the front contact of relay 7, and back contacts of relays 15 and 17, through the winding of driving magnet 9 of the switch F, and through fuses 23 and 20 to battery. The magnet 9 is thus operated under control of interrupter 8 to advance the brushes 11, 12, 13 and 14. When test brush 13 makes contact with the terminal which is associated with line 1, a circuit for operating test relay 15 may be traced from battery through fuses 20 and 23, conductor 10, winding of relay 15, brush 13 and terminal 2, front contact of relay 6, winding of relay 16, to ground; test relay 15 and cut-off relay 16 both operate in this circuit. Relay 16 locks through its front contact and disconnects relay 6 from line 1 so that relay 6 and relay 7 both release. Relay 15 opens the circuit for operating the driving magnet 9 so that the brushes are not advanced further; relay 15 also extends line 1 over conductors 3 and 4, through brushes 11 and 12 and the upper contacts of relay 15, and

through the windings of relay 18 to ground and battery. Relay 18 is thus operated to connect battery over conductor 10 through the front contact of relay 18 through the left-hand winding of relay 19 and the inner lower contact of relay 2 to the tip conductor of trunk 30, the ring conductor of trunk 30 being connected through the outer lower contact of relay 2 and the right-hand winding of relay 19 to ground. With the windings of relay 19 connected from battery and ground to trunk 30, a calling signal is operated in the main exchange. Relay 19 operates to cause the operation of relay 17 but the operation of this relay performs no useful function until the connection is released. The talking circuit from line 1 to the main exchange includes condensers 29.

On an incoming call over trunk 30 relay 19 is operated by current through its right-hand winding. Relay 19 closes a circuit from battery over conductor 10, winding of relay 17, to ground at the front contact of relay 19. Relay 17 connects the winding of driving magnet 9 to the back contact of relay 19 and connects the winding of test relay 15 to brush 14. When relay 19 responds to impulses over the ring conductor of trunk 30, magnet 9 operates each time relay 19 releases to advance brushes 11, 12, 13 and 14 to the desired line terminals. Relay 17 does not release during the receipt of impulses. Assuming the called line to be the line 1, relays 15 and 16 operate when brush 14 engages the terminal to which relay 16 is connected, providing this line is idle. Relay 15 connects the windings of relay 18 through brushes 11 and 12 to the line 1 and relay 16 disconnects the line from relay 6. Relay 16 locks through its upper contact and brush 13 in series with relay 15. The signaling current is transmitted from the main exchange over the trunk 30, through condensers 29 to the called station and when the called subscriber answers relay 18 operates thereby connecting battery from lead 10 through the left-hand winding of relay 19 to operate a supervisory signal at the main exchange.

When the receiver is replaced at station S relay 18 releases and when the connection is released at the main exchange relay 19 releases. The release of relay 19 causes the release of relay 17 but before relay 17 releases magnet 9 is reoperated to advance the brushes 11, 12, 13 and 14 to the next set of terminals thereby causing the release of relays 15 and 16. The switch F is now normal ready for use on another call.

Assume now that station A is engaged in conversation on some connection involving a switch other than the switch F, cut-off relay 16 being operated; and assume that fuse 23 or fuse 25 operates during the conversation. Since these fuses do not supply current for the connection in which the subscriber at station S is engaged there is no occasion for immediately switching line 1 to trunk 30. Accordingly the contact 24, closed by the operation of fuse 23, only partially closes a circuit for operating switching relay 2. When the connection is released and cut-off relay 16 releases, relay 2 operates in a circuit which may be traced from battery through the winding of relay 2, lowermost contact of relay 16, contact 24, to ground. With relay 2 operated the line 1 is connected directly to trunk 30, so that the operation of either or both of fuses 23 and 25 does not interefere with further service to the preferred subscriber at station S.

If the main fuse 20 operates, the transfer of line 1 to trunk 30 is immediate since such a trouble condition interrupts all connections through the automatic equipment at the branch exchange. In this case relay 21, which is normally short-circuited by the main fuse 20, operates to directly close the circuit through the winding of relay 2. Relay 2 is thus immediately operated to connect line 1 to trunk 30.

It is of course understood that other troubles, such, for instance, as the failure of the interrupter 8, may be arranged to cause the operation of relay 2 to transfer line 1 to trunk 30. It is also to be understood that the switching means for effecting the transfer may differ from the specific arrangement disclosed in the drawing. To illustrate,—the switching relay may be a normally operated relay which releases when the fuse is actuated, the release of the relay being effective to transfer the line of the preferred subscriber directly to the trunk leading to the main office.

What is claimed is:

1. In a telephone system, an automatic branch office, a main office, a trunk from said branch office to said main office, a subscriber's line terminating in said branch office, and switching means effective in case the equipment of said branch office becomes disabled for connecting said line directly to said trunk.

2. In a telephone system, an automatic branch office, a main office, a trunk from said branch office to said main office, a subscriber's line terminating in said branch office, another subscriber's line, said lines being connected for conversation, and switching means for connecting the first mentioned line directly to said trunk in case part of the equipment of said branch office becomes disabled, the operation of said switching means being effected upon the release of said connection.

3. In a telephone system, a main office, a trunk connected to said main office, automatic branch offices serially connected to said trunk, a subscriber's line terminating in one of said branch offices, and switching means effective in case the equipment at said one of

the branch offices becomes disabled for connecting said line directly to said trunk.

4. In a telephone system, a main exchange, a branch exchange, a trunk leading from said main exchange to said branch exchange, a subscriber's line terminating in said branch exchange, an automatic switch in said branch exchange for use in connecting said line to said trunk, and means independent of said switch for connecting said line directly to said trunk.

5. In a telephone system, a main exchange, a branch exchange, a trunk leading from said main exchange to said branch exchange, a subscriber's line terminating in said branch exchange, an automatic switch in said branch exchange for use in connecting said line to said trunk, and means independent of said switch for connecting said line directly to said trunk in case said automatic switch becomes disabled.

6. In a telephone system, a main exchange, a sub-exchange, trunks connecting said exchanges, subscribers' lines terminating in said sub-exchange, automatic switches for establishing connections between said subscriber's lines and said trunks, and switching means individual to a preferred subscriber's line and to one of said trunks for connecting said line directly to said trunk.

7. In a telephone system, a main office, a branch office, automatic switches in said branch office, subscribers' lines terminating in said branch office, a trunk leading from said branch office to said main office, a switching relay for connecting the line of a preferred subscriber directly to said trunk, and means for immediately operating said relay in case the equipment of said branch exchange becomes disabled.

8. In a telephone system, a main office, a branch office, subscribers' lines terminating in said branch office, trunks leading from said branch to said main office, automatic switches in said branch office for establishing connections between said lines and said trunks, switching means individual to one of said lines and one of said trunks for connecting said line directly to said trunk, and means effective upon said line becoming idle for operating said switching means.

9. In a telephone system, a main office, a branch office, subscribers' lines terminating in said branch office, trunks leading from said branch to said main office, automatic switches in said branch office for establishing connections between said lines and said trunks, switching means individual to one of said lines and one of said trunks for connecting said line directly to said trunk, means effective upon said line becoming idle for operating said switching means, and means for opating said switching means irrespective of the idle or busy condition of said one of said lines.

10. In a telephone system, a main office, a branch office, subscribers' lines terminating in said branch office, trunks leading from said branch to said main office, automatic switches in said branch office for establishing connections between said lines and said trunks, switching means individual to one of said lines and to one of said trunks for connecting said line directly to said trunk in case all or part of the equipment of said branch office becomes disabled, means effective upon a part of the equipment of said branch office becoming disabled for operating said switching means providing said one of said lines is idle, and means effective upon all of the equipment of said branch office becoming disabled for immediately operating said switching means irrespective of the idle or busy condition of said one of said lines.

In witness whereof, I hereunto subscribe my name this 16th day of July 1931.

GUSTAV WIRTH.