

June 9, 1925.

1,541,401

J. SAVIN ET AL
AUTOMATIC TELEPHONE SYSTEM

Filed Jan. 12, 1921

2 Sheets-Sheet 1

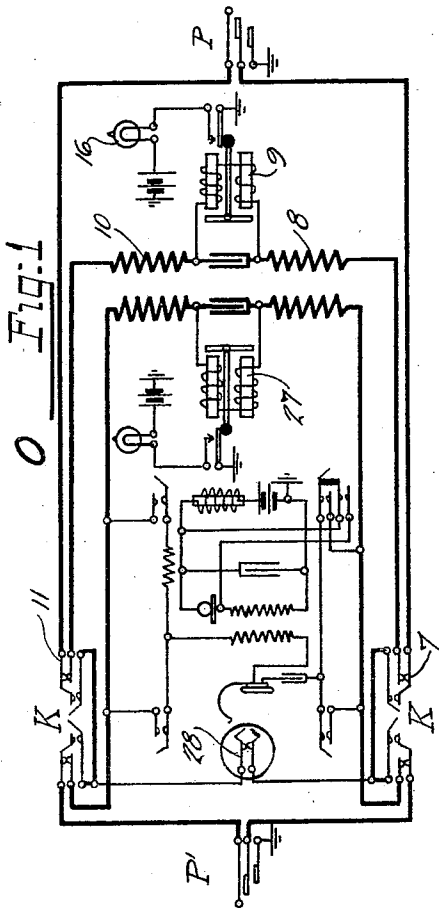


Fig: 1

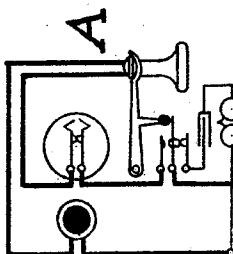
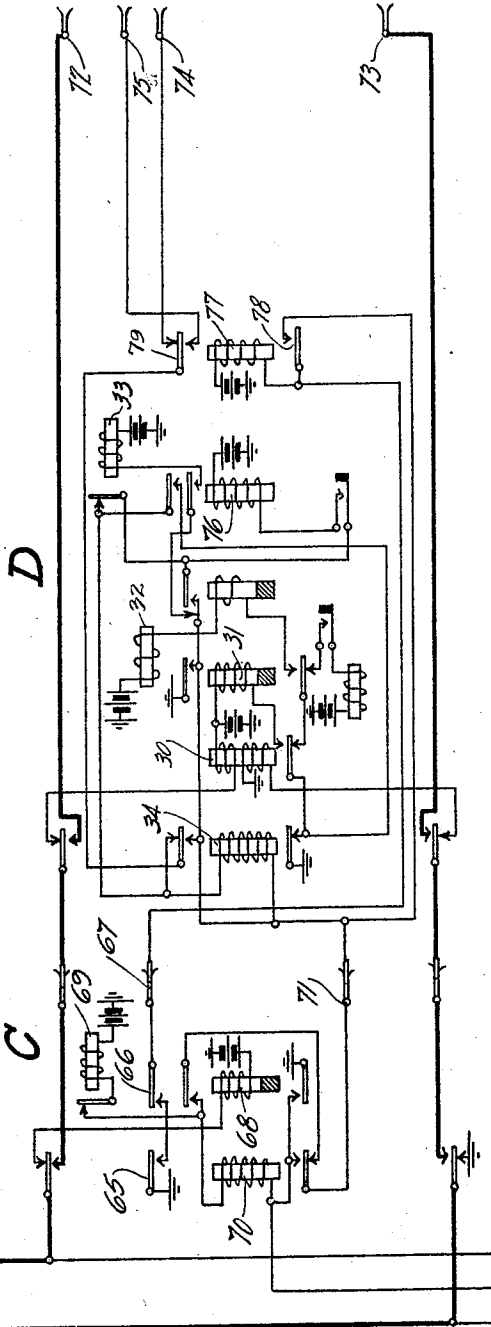


Fig: 2



D

C

— INVENTORS —
John Savin and Richard Mercer
Chas. W. Condy. Atty:

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2 Sheets-Sheet 2

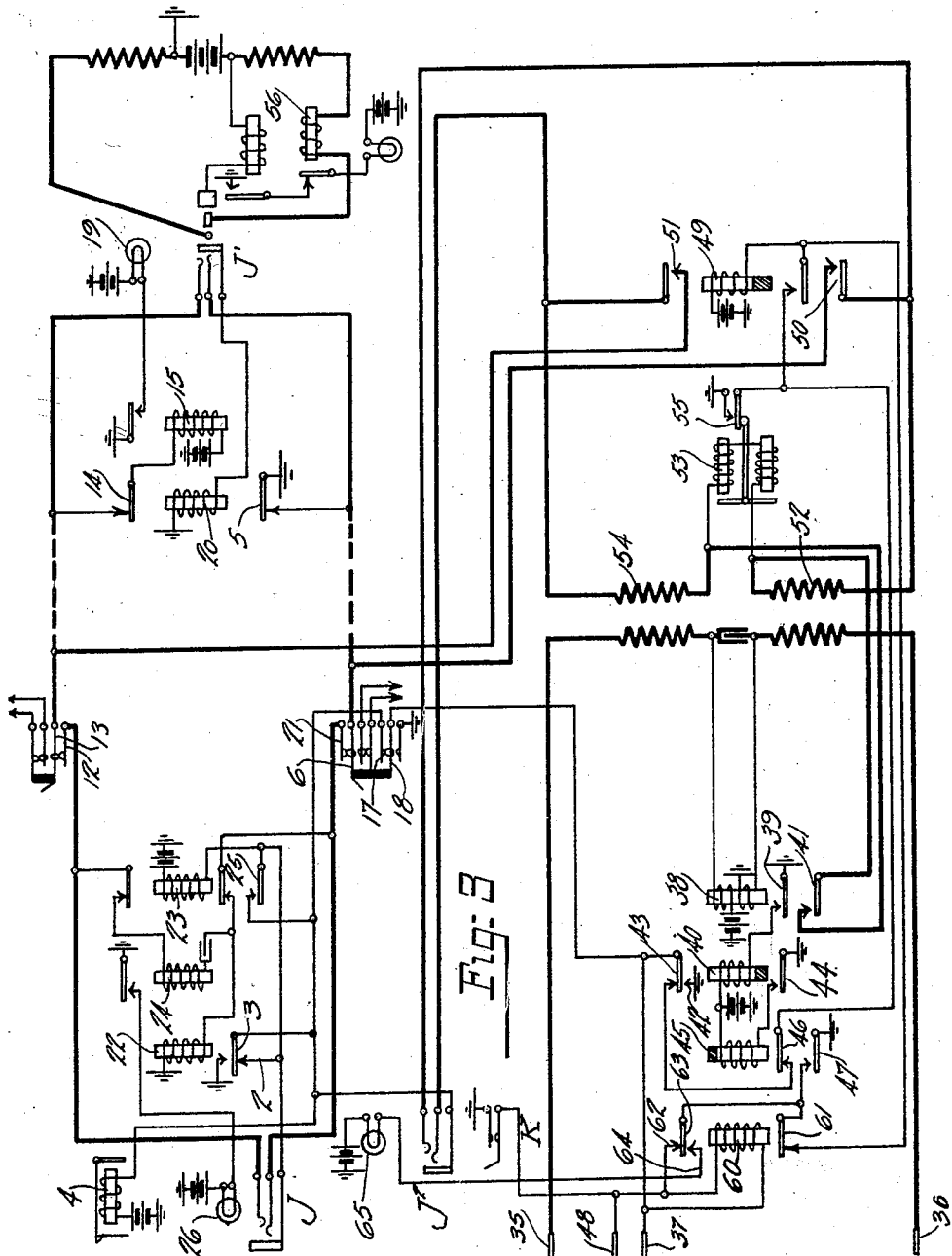


Fig. 3

Inventors
John Savin & Richard Mercer
Chas. W. Candy, Atty.

UNITED STATES PATENT OFFICE.

JOHN SAVIN AND RICHARD MERCER, OF LIVERPOOL, ENGLAND, ASSIGNORS TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

Application filed January 12, 1921. Serial No. 436,665.

To all whom it may concern:

Be it known that we, JOHN SAVIN and RICHARD MERCER, both subjects of the King of Great Britain and Ireland, and both residents of Liverpool, England, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

The present invention relates in general to automatic telephone systems, but is more particularly concerned with such systems as include automatic branch exchanges, and as shown herein the invention provides improved trunking facilities for connecting an automatic branch exchange with a main exchange. The invention may be considered as being an improvement on or modification of the system disclosed in the United States Patent Number 1,455,951, granted May 22, 1923, to B. D. Willis.

Among the objects of the invention are the provision of means for extending connections either manually or automatically in one direction over a trunk line of the character described, together with the provision of means whereby certain calls may be extended over the trunk automatically to the main exchange without calling in the attendant or operator at the branch exchange, and whereby other calls, which may require a charge or other control by the operator, will always be held up to bring the attendant in on the connection before it can be extended to the main exchange. In this manner the attendant at the branch exchange will be informed as to all calls which go to the main exchange in which she is interested. In order to accomplish this result, means have been provided whereby if the trunk is called by one set of subscribers, then the call may proceed without the operator's attention. While if the trunk is called by another set of subscribers means are operated to signal the operator and to prevent further extension of the connection until the operator allows such extension.

The preferred embodiment of the invention is illustrated in the accompanying drawings.

In Fig. 1 a cord circuit O of well known type is shown having means for supervising calls received from the main exchange and for controlling any automatic switches in the branch exchange. In Figure 2, is shown a substation A, a line switch C, and a selec-

tor D of standard two wire side switchless type which is well known in the art. The line switch C as shown is of a special type as used in connection with those subscribers who are only allowed to make outgoing calls through the medium of an operator. The line switches of subscribers who can make outgoing calls direct, are identical except that the contacts springs 65 and 66 and wiper 67 would be omitted or possibly just the earth connection to contact 65 so that a subscriber may be transferred from one class to another as desired.

In Fig. 3 a trunk line between two exchanges is shown, terminating in a jack J before the attendant operator at the branch exchange, in a jack J' in the main exchange and in the banks of the selector D (Fig. 2).

The method by which the attendant at the branch exchange calls the operator at the main exchange will be first described. When the attendant receives an order for a call to the main exchange the plug P of the cord circuit O is inserted into the jack J (Fig. 3). The insertion of plug P closes a circuit from ground through the sleeve of plug P, sleeve of jack J, springs 2 and 3 and visual signal 4 to battery. A branch of this circuit extends to the sleeve of the jack J² and another branch through the springs 17 and 18 to the test contacts of the trunk in the banks of the selector D (Fig. 2), and another branch extends through relay 23 to battery. Relay 23 energizes to disconnect the relay 24 and relay 22 from the trunk circuit and closes springs 25. A further result of the insertion of the plug is the closure of a circuit from ground through springs 5, springs 6 and 21, ring of jack J, plug P, springs 7, winding 8, relay 9, winding 10, springs 11, tip of plug P and jack J, springs 12 and 13, springs 14, and relay 15 to battery. The current in this circuit is of the proper direction to cause relay 9 to attract its armature to light the lamp 16 in the cord circuit, and relay 15 energizes to light the lamp 19 before the main exchange operator. The operator at the main exchange, upon seeing the lamp 19 lighted, inserts the plug of her cord circuit into the jack J' thereby energizing the sleeve relay 20 to disconnect the relay 15 and ground from the trunk circuit at springs 14 and 5, respectively. A further result of the insertion of this plug in the jack J' is the

connection of negative battery to the ring side of the jack J' and ground to the tip side of the jack J'. This it will be seen causes a reversal of battery through the windings of the relay 9 in the cord circuit O (Fig. 1) and therefore causes the signal 16 to be retired. The attendant at O, therefore, knows that the main exchange operator has answered and gives the desired number. The connection is then extended to the desired subscriber in the regular manner and when completed, and the main exchange operator removes the plug from the jack J', then relay 9 in the cord O will operate to give a disconnect signal to the attendant operator.

In case of a call in the opposite direction from the main to the branch exchange, the main exchange operator after testing the jack J' inserts her plug into said jack and by a ringing key (not shown) projects generator current out over the conductors of the trunk line to operate the bridged relay 24. Relay 24 closes the circuit of the call signal lamp 26 before the attendant who then inserts the answering plug P' into the jack J to answer the call. In this case it will be seen that the relay 27 is in bridge of the trunk circuit as was the relay 9 in the preceding call and operates in a similar manner to give the proper supervision. The attendant operator's cord O is provided with a calling device 28 and a two way key K which may be operated to connect said calling device to either the answering or to the calling end of her cord circuit, and she may, therefore, operate the automatic switches of the branch exchange to extend the connection to a desired automatic subscriber.

It will be assumed that there are certain subscribers at the branch exchange who are entitled to a free use of the trunk lines while others have to pay and must, therefore, only obtain access through an operator. The free subscribers are provided with line switches such as C (Figure 2) but with the earth connection removed from spring 65 while the subscribers who have to pay are provided with switches identical with those shown in Figure 2.

The operation by which a free subscriber obtains the use of the trunk line will first be described.

On the subscriber such as A lifting his receiver, the line relay 68 will energize as usual and connect the magnet 69 and switching relay 70 in series between battery and earth, with the test wiper 71 connected to an intermediate point. The operation is such that if the line wipers are in contact with a busy line the test wiper finds earth and the magnet 69 operates to move the wipers on one step, which operation repeats until an idle line is found when the relay 70 operates in the usual way to switch

the line conductors through to the selector D. The line relay 30 is then energized through the subscriber's loop followed by the energization of release relay 31, and the connection of earth thereby to the release trunk and thence to wiper 71, back to the line switch to hold relay 70 energized. Relay 70 is of high resistance so that magnet 69 cannot operate in this circuit. The subsequent operation of the selector is well known and need not be described. The transmission of impulses energizes the vertical magnet 32 to step the selector up to the desired level, in this case the tenth, after which the rotary magnet 33 is energized to bring the wipers 72, 73, 74 and 75 into engagement with the first set of contacts 35, 36, 37 and 48. The relay 77 is a discriminating relay which is not operated in this case so that the wiper 75 is disconnected.

If the first set of contacts are free the relay 34 is energized in the usual way to switch the line conductors through to the wipers 72 and 73 but if busy the wiper 74 finds earth and the relay 34 is short circuited. The rotary magnet interrupter relay 76 is then energized to again energize the rotary magnet as is well known. This operation repeats until an idle set of contacts is found when the relay 34 energizes and connects the line conductors through to wipers 72 and 73, contacts 35 and 36 and thence through windings of repeating coil to the windings of line relay 38, the other side of which windings are connected to battery and earth respectively. Relay 38 energizes over the subscriber's loop and at contacts 39, closes the circuit of release relay 40 which operates and connects earth to the release trunk at springs 42 and 43 and at spring 44 closes the energizing circuit of relay 45. Relay 45 on energizing at springs 47 closes a circuit for switching relay 49 through contact 61 of relay 60. Relay 49 energizes and connects the repeater windings 54 and 52 by means of contacts 51 and 50 direct to the main exchange trunk. As the windings 54 and 52 are connected together by the contacts 41 on relay 38 an energizing circuit is formed for relay 15 as before described through contacts 14 and 5 and the closed circuit. Relay 15 operates and by illuminating the lamp 19 calls the attention of the main exchange operator who attends to the call as before described.

Should the calling man hang his receiver up first on the termination of the call, the line relay 38 will deenergize and at springs 41 remove the short circuit about the polarized relay 53. This relay is so arranged that it is adapted to operate with current supplied when the main exchange plug is in the jack, to close the contacts 55, which in turn connect earth to hold up the relay 49 and further to connect earth by means of

the contact 46 and 43 to contact 37 to maintain the multiples of the trunk line engaged when relay 45 is deenergized which naturally follows on the deenergization of line relay 38 and the consequent deenergization of release relay 40.

During the release of relay 45 subsequent to the release of relay 40 earth is removed from the release trunk for a short interval to permit of the release of the selector D and the cut off relay of line switch C. On breaking the short circuit across the relay 53 at springs 41, the current in the line circuit including relay 56 is reduced to permit of the release of the latter relay which accordingly gives the operator the disconnect signal she then removes the plug, the relay 20 deenergizes to restore battery conditions to normal when the relay 53 retracts its armature and opens the contact 55. Earth is accordingly removed so that relay 49 deenergizes and earth is removed from the private bank multiples of the trunk line.

If a subscriber having restricted service should desire to make a call, although he makes identically the same operations as the free subscriber, he is switched on to an operator who can assess the charge and take the necessary particulars before putting him through. This is effected as follows:

When the line switch C comes to rest on an idle trunk leading to a first selector such as D, a short interval exists during which the switching relay 70 and the slow acting line relay 68 are simultaneously operated. Consequently, a circuit may be traced as follows:—Earth, contacts 65, contacts 66, wiper 67, relay 77 to battery, relay 77 energizes and locks itself to the release trunk through contact 78 while at contact 79 the wiper 75 is substituted in the test circuit in place of the wiper 74.

The consequence is that contacts such as 48 are tested in place of contacts such as 37 so that if the line is busy due to the relay 45 being energized earth will be found on contact 48 through springs 47. Between the contact 48 and contact 37 is a low resistance relay 60 which is energized in the release trunk circuit at contacts 43 as soon as relay 40 of an idle trunk line is found and the circuit may be traced as follows, earth, contact springs 42 and 43, relay 60, contact 48, wiper 75, springs 79 in operated position, working contact of relay 34 and both relay 34, rotary magnet interrupter springs, off normal springs, relay 76 to battery and wiper 71, relay 70 and magnet 69 to battery.

The total current is sufficient to energize relay 60, which breaks at springs 61, the energizing circuit of relay 49 while at springs 63 and 64 connects earth, through springs 47 to lamp 65 at local exchange operator's position. The operator then inserts

her answering plug in jack J², and ascertains the requirements and particulars of the calling party, and having ascertained that everything is in order she presses the key K connecting earth direct to contact 48 so that relay 60 is short circuited and falls away; earth is then maintained on contact 48 from spring 47 and resting contact 62 of spring 63; also the energizing circuit of relay 49 is closed at springs 61, so that the operator at the main exchange is called as before described.

It will be appreciated that the relay 45 is arranged to close springs 47 only after relay 60 has energized to break springs 61 and 62 from their resting contacts.

An alternative arrangement might be used for carrying the invention into effect as a temporary or like measure by instructing the different classes of subscribers to dial to different levels when calling the main exchange. That is, the pay subscribers would dial to say the 10th level of the selector while the free subscribers would dial to the 9th level. The bank contacts of the trunk lines of the two levels would be multiplied together while the private bank contact of the tenth level would be connected similarly to contact 48 and the private bank contact on the 9th level similarly to contact 37. Then obviously the line switch C and selector D may be of standard construction, that is to say, the contacts 65, 66, wiper 67, relay 77, and wiper 75 may be eliminated and the same result may be obtained provided, of course, the instruction was followed.

All that is necessary to make the circuit shown in Figure 3 operative is that a different test contact should be engaged by a pay subscriber to that engaged by a free subscriber.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In a telephone system, two classes of subscribers' lines, a selector switch accessible to lines of both classes, a trunk line accessible to said selector and having two branches at the other end thereof, two test wipers in said selector and corresponding test contacts associated with said trunk line, means whereby a calling subscriber can operate said selector to extend a connection over said trunk line via one of said branches, the branch used depending on which of said test wipers is used, and means whereby if the calling subscriber is in one of said classes one of said test wipers will be used, and whereby if he is in the other of said classes the other of said test wipers will be used.

2. In a telephone system, a trunk line having two branches at one end, a selector switch controlled by a calling subscriber to

connect with said trunk line at the undivided end thereof, discriminating conductors individual to the calling line and said selector, respectively, and means controlled over said conductors automatically in response to the completion of said connection for routing the call over a particular one of said branches.

3. In a telephone system, a trunk line having two branches at one end, one branch being normally disconnected, two serially related switches for extending a calling line to said trunk line, the second switch having wipers for engaging the trunk line at the end opposite said branches, a conductor extending between said switches, a switching device in the second switch operated over said conductor in case the calling line is not entitled to service over the disconnected branch, a second switching device responsive when the trunk line is connected with for connecting said normally disconnected branch, and means for causing said second device to respond only in case said first device is not in operated position.

4. In a telephone system, a trunk line having two branches at one end, a selector switch having two test wipers corresponding to said branches, respectively, for testing said circuit, means controlled by any calling party for operating said selector to connect with said trunk line at the end opposite said branches, only one of said test wipers being connected to test the trunk during any given call, and means automatically responsive to the completion of a connection with said trunk for routing the call away from the trunk over the particular branch which corresponds to the test wiper in use.

5. In a telephone system, a trunk line having two branches at one end, a selector switch having two test wipers corresponding to said branches, respectively, two successively calling lines, each calling subscriber operating said selector to connect with said trunk line at the end opposite said branches, circuit connections and switching means such that one test wiper is caused to test the trunk when one line is calling while the other test wiper tests the trunk when the other line is calling; and means automati-

cally responsive whenever the trunk is connected with for routing the call away from the trunk over the particular branch which corresponds to the test wiper in use.

6. In a telephone system, a trunk line having two branches at one end, a selector switch, a set of bank contacts in said selector connected to the said trunk line at the end opposite said branches, means whereby said selector is controlled over calling lines to extend connections to said trunk line by way of said contact set, and means automatically responsive whenever a connection is made with the trunk for determining over which branch the call will be routed away from the trunk.

7. In a telephone system, a trunk line having two branches at one end, a selector switch, a set of bank contacts in said selector connected to the said trunk line at the end opposite said branches, means whereby said selector is controlled over calling lines to extend connections to said trunk line by way of said contact set, and means operative automatically and independent of the subscribers to route calls from some of said lines over one of said branches and calls from the rest of said lines over the other of said branches.

8. In a telephone system, two automatic switches, a trunk line accessible to both said switches and extending to a third switch, a non-talking conductor included in said trunk line and connected to a relay in said third switch, a pair of line wipers in said third switch, two test wipers in said third switch either of which may be used in testing for a line to be connected with by said line wipers, means controlled by said relay for determining which of said test wipers is to be used, means in only one of said two first mentioned switches for momentarily closing an energizing circuit for said relay over said conductor when said trunk line is connected with, so that the energization of said relay will occur only if a particular one of said first two switches is used, and a circuit for locking said relay energized.

Signed by us at Liverpool, England, this 8th day of December, 1920.

JOHN SAVIN.
RICHARD MERCER.