

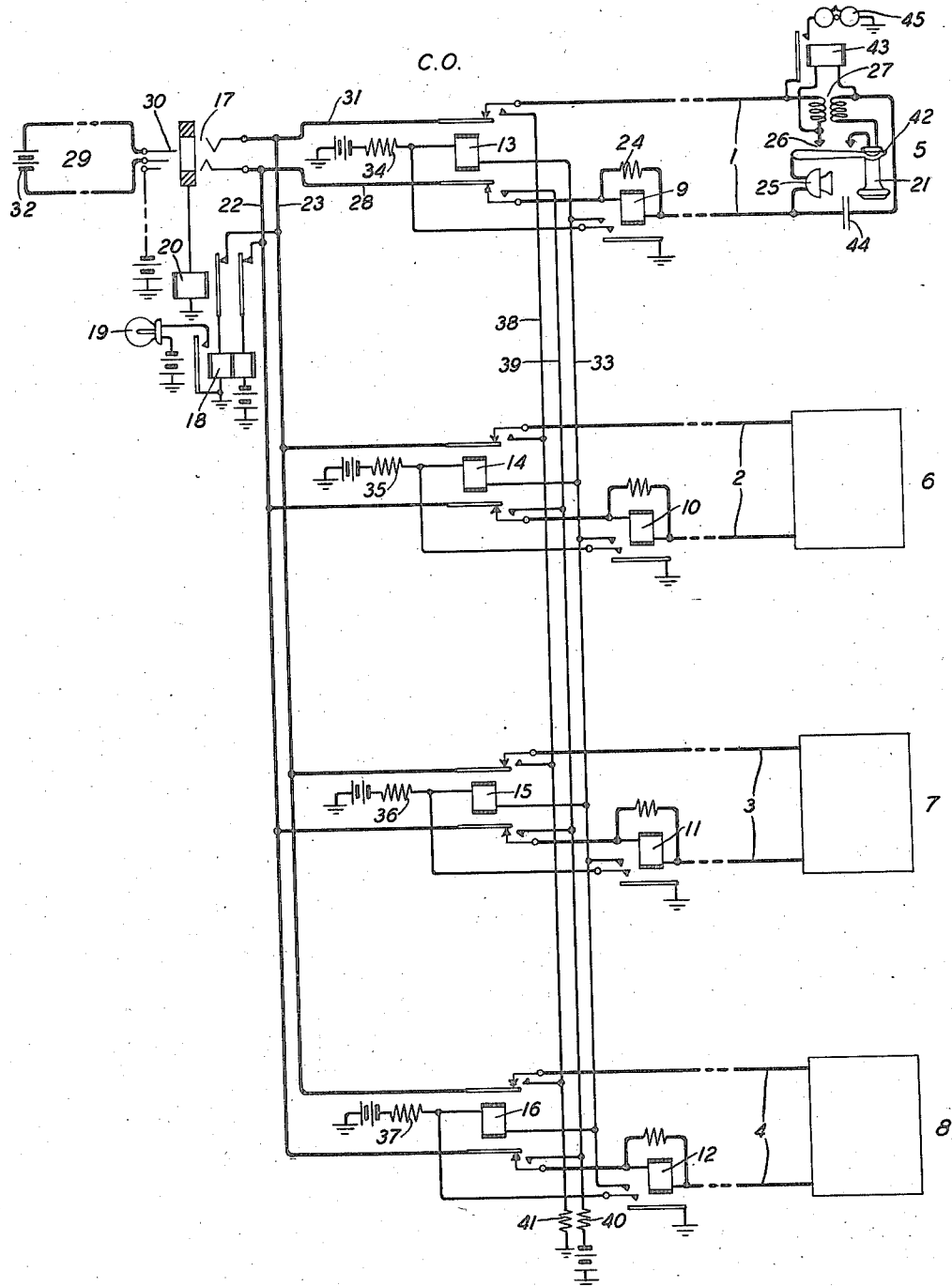
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to improvements in telephone systems and more particularly to means for eliminating bridged "tap" losses in speech transmission where two or more relatively long subscribers' loops or pair of wires are connected in multiple at some central point and terminate as a single line at the telephone exchange.

It frequently happens that it is desirable or necessary to "bunch" or "bridge" subscribers' cable pairs or "loops" at a central office main frame in order to serve subscribers' stations having the same line number but widely scattered as to location as, for example, any multiparty line such as four-party selective, two-party semi-selective or where so-called secretarial and physician call bureau service is given in the larger cities. Further, it is quite common for professional men who have business lines in their offices, to have extensions of these lines located at their residence which may be at some distance from their office and frequently in another exchange area.

In all these cases and particularly where the wires are contained in cables, speech transmission over the line is frequently impaired due to the combined capacity of the bridged pairs of wires.

An object of the present invention is to eliminate such "bridged tap" losses in cases where two or more pairs of wires are connected together in multiple.

A feature of the invention whereby the foregoing object is attained resides in disconnecting all the bridged pairs from the main line except the pairs connected to stations at which receivers have been removed from the hook.

In this connection it may be observed that in a great majority of calls only one station on the line will have its receiver off the hook and, therefore, a circuit free of bridged impedance will extend from the switchboard to the station in use. However, as referred to above, in case of a revertive call, that is, a call from one station to another station connected to the same line, but on a different bridged pair, the removal of the receiver at the second, or called station, will be effective to connect its loop or pair across the line in parallel with the calling station pair.

The arrangement of the present invention differs from the arrangement disclosed in the patent to Barrows, et al., 1,227,735, dated May 29, 1917, in this feature, i. e. means for permitting a second station to connect to the main line merely by the removal of its receiver, which was not possible in the Barrows arrangement.

The invention will be understood from the fol-

lowing description when read in connection with the accompanying drawing which shows a plurality of bridged pairs connected to a common line circuit terminating in a telephone switchboard and arranged in accordance with the present invention.

Referring to the drawing, there are shown four subscribers' lines or loops arranged according to this invention for four-party selective ringing. Lines 1, 2, 3 and 4 terminate at the outward end, respectively in substations 5, 6, 7 and 8, at only one of which has the usual circuit arrangement been shown in detail. These lines are terminated at their inward end at a central office CO. One of the conductors of each line passes through the windings of respective relays 9, 10, 11 and 12, and then through the normally closed lower contacts, of relays 13, 14, 15 and 16, respectively. Each of the other conductors of said lines passes through the upper normally closed contacts of relays 13, 14, 15 and 16, respectively. After passing through said relay contacts all four lines are multiplied together and connected to jack 17, with which is associated the usual line relay 18, line lamp 19, and cut-off relay 20. A detailed description of the operation of the circuit arrangement of the drawing will now be given.

Let it be assumed that the subscriber 5 of line 1 desires to initiate a call to some line other than one of the associated lines 2, 3 and 4. On removing the receiver 21 from the associated switch-hook 42 a circuit is closed through the windings of line relay 18, which may be traced from battery through the right-hand winding of relay 18, outer contacts of relay 20, over conductors 22 and 28, lower normally closed contacts of relay 13, winding of relay 9, including non-inductive resistance 24, over ring conductor of line 1, through transmitter 25 of subscriber's station 5, switch-hook contacts 26, left-hand winding of induction coil 27, over tip conductor of line 1, through upper normally closed contacts of relay 13 over conductors 31 and 23, inner contacts of relay 20, to ground through the left-hand winding of relay 18. Relay 18 operates and closes an obvious circuit through line lamp 19, which lights. In response to the lighted lamp, the answering operator inserts plug 30 of cord circuit 29 into jack 17. Cord circuit 29 is of the usual common battery type and is shown only in abbreviated form. The insertion of plug 30 closes a circuit for operating cut-off relay 20, which may be traced from ground through the winding of relay 20, sleeve contacts of jack 17 and plug 30 to battery. Relay 20 in operating disconnects from conductors

22 and 23, the windings of relay 18, which releases and opens the circuit of lamp 19, which is extinguished. When the plug 30 of cord circuit 29 was inserted in jack 17, battery 32 was connected over the tip and ring contacts to conductors 31 and 28, respectively, and thence was extended over the circuit previously traced in describing the operation of relay 18. Relay 9 now operates and connects ground to both winding terminals of relay 13 and to conductor 33 over obvious circuit paths. Relay 13 is therefore short-circuited and does not operate, thereby maintaining the continuity of the conversational circuit between the answering operator and the calling subscriber at station 5. The ground on conductor 33 connected thereto by the operation of relay 9, however, causes the operation of relays 14, 15 and 16, through circuits including resistances 35, 36 and 37, respectively, thereby disconnecting lines 2, 3 and 4 from their connection with conductors 22 and 23. According to a feature of this invention this disconnection of lines 2, 3 and 4 removes the bridged transmission loss which would result due to the electrostatic capacity of said lines 2, 3 and 4. After receiving the number of the desired line the operator now completes, in the usual manner, with the calling end (not shown) of cord circuit 29, the connection to the desired line, which, as hereinbefore assumed is not one of the associated four-party line branches.

When relays 14, 15 and 16 operated they also connected the tip conductors of lines 2, 3 and 4 directly to conductor 38, and the ring conductors of said lines to conductor 39, through the windings of relays 10, 11 and 12, respectively. Let it be assumed now that while subscriber 5 is conversing over the connection hereinbefore described, one of the other subscribers, subscriber 6 for example, desires also to call the central office. On removing his receiver from the switchhook, a circuit is closed for operating the associated relay 10, through a circuit that may be traced from battery through resistance 40, over conductor 39, through lower operated contacts of relay 14, winding of relay 10, over ring conductor of line 2, through substation 6, over tip conductor of line 2, upper operated contacts of relay 14, over conductor 38, through resistance 41 to ground. Relay 10 operates and connects ground to both winding terminals of relay 14, thereby short-circuiting said relay 14 and causing its release. When relay 14 releases, it reestablishes the normal connection of line 2 to conductors 22 and 23, and relay 10 holds on the battery of cord circuit 29, connected through the contacts of plug 30 and jack 17 to conductors 22 and 23. Relay 14 is provided with so-called "continuity" contacts in order that the transfer of the conductors of line 2 from connection with conductors 38 and 39 to connection with the conductors 22 and 23 may be made without interrupting the operating circuit of relay 10. In the case of subscribers 7 and 8 there would be a similar circuit action if either of these should attempt to call when line 1 is busy. After line 2, is thus reconnected to conductors 22 and 23, the subscriber 6 is enabled to determine that the line is busy and accordingly restores his receiver to the switchhook causing the release of associated relay 10, and the reoperation of relay 14, from ground on conductor 33, connected by the contacts of relay 9 of line 1, which by previous assumption, is busy. The reoperation of relay 14, accordingly disconnects line 2, and again removes the bridged

transmission loss due to the connection of this line. After the subscriber 5 hangs up receiver 21, relay 9 releases, releasing also relays 14, 15 and 16. After the operator receives the usual disconnect signal (not shown), plug 29 is removed from jack 17, releasing cut-off relay 20. All apparatus is now restored to normal, ready for another call.

Another operating condition of the invention will now be described. Let it be assumed that one of the stations 6, 7 or 8 desires to call station 5. For purpose of description assume that the calling station is station 6. When the receiver at station 6 is removed from the switchhook the relays of associated line 2 function in the same manner as the corresponding relays of line 1, as hereinbefore described in connection with the call originated at station 5. After line relay 18 operates, lighting line lamp 19, the operator inserts the plug 30 of cord circuit 29 into jack 17, causing the operation of cut-off relay 20, and the disconnection of the windings of line relay 18, all as hereinbefore described. The operator now ascertaining that the call is for station 5, a so-called "revertive" connection, i. e., for a station with the same line number, will request station 6 to hang up for a moment while station 5 is being called. The operator now connects grounded ringing current by a ringing key (not shown) to the conductors of cord circuit 29. This causes the operation of relay 43 and ringer 45, as will be evident from the hereinafter given description. Assuming that the non-grounded terminal of the ringing current source (not shown) which is of the proper polarity to ring ringer 45 is connected to the tip conductor of cord circuit 39, the circuit proceeds through the tip contacts of plug 30 and jack 17, over conductor 31, through upper normally closed contacts of relay 13, over tip conductor of line 1, through left-hand winding of induction coil 27, winding of relay 43, condenser 44, over ring conductor of line 1, through winding of relay 9, including resistance 24, lower normally closed contacts of relay 13, over conductor 28, through ring contacts of jack 17 and plug 30, and ring conductor of cord circuit 29 to the other or grounded terminal of said source of ringing current. Relay 43 in operating connects the winding of ringer 45 to the tip conductor of line 1. The ringing current potential on said tip conductor causes a flow of ringing current through the winding of ringer 45 to ground and thence by ground to the grounded terminal of said ringing current source at the central office CO. Ringer 45 is now actuated, as it is poled to respond to the polarity of the ringing current which is now being applied, and only to said polarity. In response to the ring of ringer 45, subscriber 5 removes his receiver from the switchhook. When calling subscriber 6 also again removes his receiver from the switchhook, after having waited for the operator to ring, the conversational connection is completed due to operation of series relay 10 which short-circuits relay 14, which relay is now operated due to the ground connected to conductor 33 at the lower contacts of relay 9. When relay 14 is short-circuited it releases, as previously explained, and reconnects the line 2 to the common line conductors 22, 23. Transmitter current for both stations is now supplied by cord circuit battery 32. During the ringing interval, although ringing current passes through the windings of relays 9, 10, 11 and 12, these relays,

however, do not operate at this time, since they are designed not to operate on the alternating ringing current that passes over their associated lines 1, 2, 3 and 4, respectively.

5 The descriptions hereinbefore given were for calls originating at one of the four stations, first, for a non-associated station, that is for a non-revertive call; secondly for an associated four-party station, that is for a revertive call. The
10 operation of the invention will now be described for an incoming call from a non-associated station directed to one of the stations 5, 6, 7 or 8. For descriptive purposes let it be assumed that 5
15 is the called station. On receiving a call for station 5 of line 1 the operator having access to jack 17 will plug into jack 17 with either the calling plug of a cord circuit or of a trunk circuit, each not shown. With the proper polarity
20 of grounded ringing current applied to the tip conductor and ground to the ring conductor of line 1, ringing current is transmitted over line 1 so as to operate ringer 45 of station 5, in the manner described hereinbefore in connection
25 with a revertive call. When the receiver 21 is removed from the switchhook all apparatus functions as hereinbefore described in connection with an originating call.

The invention has been described in connection with its application to a four-party selective
30 line system. It is to be understood, however, that it is also applicable to other party line systems; for example, it can be applied to a four-party semi-selective system, or to a multiparty non-selective arrangement of lines, where the
35 individual subscribers are called by a system of code ringing. It may also be used for call bureau service. In this case the line to the subscriber, and the line to the call bureau may be widely separated and may be arranged according
40 to this invention so that when either line is busy, this causes the disconnection of the other line, if idle, thereby avoiding the bridged transmission loss due to the idle line. Still other arrangements of a similar nature will readily occur to
45 those skilled in the art.

What is claimed is:

1. In a common battery telephone system, a plurality of subscribers' stations, a line for each station, a common line normally connected to
50 all said station lines in multiple, cut-off means individual to each station line for disconnecting its station line from the common line, other individual means in each station line responsive to currents flowing therein to disable its companion
55 cut-off means and actuate all others, an auxiliary circuit including a source of direct current, and means for connecting said auxiliary circuit to all station lines whose cut-off relays are operated.

2. In a telephone system, a subscriber's line, a plurality of subscribers' stations, a branch line
60 for each sub-station, an individual cut-off relay for connecting and disconnecting each branch line to and from the subscriber's line, a relay in each branch line and controlled by the associated subscriber's station equipment, a common energizing circuit for all cut-off relays closed by the
65 operation of any one branch line relay, circuit

means controlled by each branch line relay for short-circuiting its associated cut-off relay, and an auxiliary circuit including a source of current adapted to be connected to each branch line in substitution for the subscriber's line when the individual cut-off relay operates. 5

3. In a telephone system, a central station, a subscriber's line, a plurality of subscribers' stations, a branch line for each subscriber's station, a cut-off relay for connecting and disconnecting
10 each branch line to and from the subscriber's line, an individual relay for each branch line having an energizing winding in series therewith, a common energizing circuit for all cut-off relays including the front contact of any one of the
15 branch line relays, individual circuit connections for short-circuiting each cut-off relay, said circuit connections including a front contact of its corresponding branch line relay, and a source of direct current adapted to be connected to each
20 branch line by the operation of the corresponding cut-off relay.

4. In a telephone system, a central station, a common battery subscriber's line extending therefrom to a connecting point, a plurality of
25 subscribers' stations, a branch line extending from each subscriber's station to said connecting point, a cut-off relay for each branch line located at the connecting point and adapted to normally connect the branch line to the subscriber's line
30 in multiple and when operated to disconnect said branch line therefrom, a series relay in each branch line adapted to be operated when its associated substation receiver is removed from the hook and an energizing circuit for all of said cut-
35 off relays adapted to be closed by the operation of any one of said series relays, circuit means controlled by the operation of each series relay for short-circuiting its corresponding cut-off relay, and an auxiliary circuit including a source of
40 current adapted to be connected to each branch line in response to the operation of its cut-off relay.

5. In a common battery telephone system, a plurality of lines, a common line normally connected to all of said station lines in multiple, cut-
45 off means individual to each station line for disconnecting its respective line from the common line, other individual means in each station line responsive to current flowing therein to disable
50 the companion cut-off means and actuate all other, an auxiliary circuit including a source of direct current, and means for connecting said auxiliary circuit to all station lines whose cut-off relays are operated. 55

6. In a telephone system, a plurality of branch subscribers' station lines, a common line normally connected to all said branch lines in multiple, means responsive to the closure of any branch
60 line at a subscriber's station for disconnecting all the other branch lines from the common line to the exclusion of the closed branch line, and other means thereafter automatically responsive to closure of any one of said disconnected branch
65 lines for reconnecting it to the common line to the exclusion of the other disconnected lines.

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