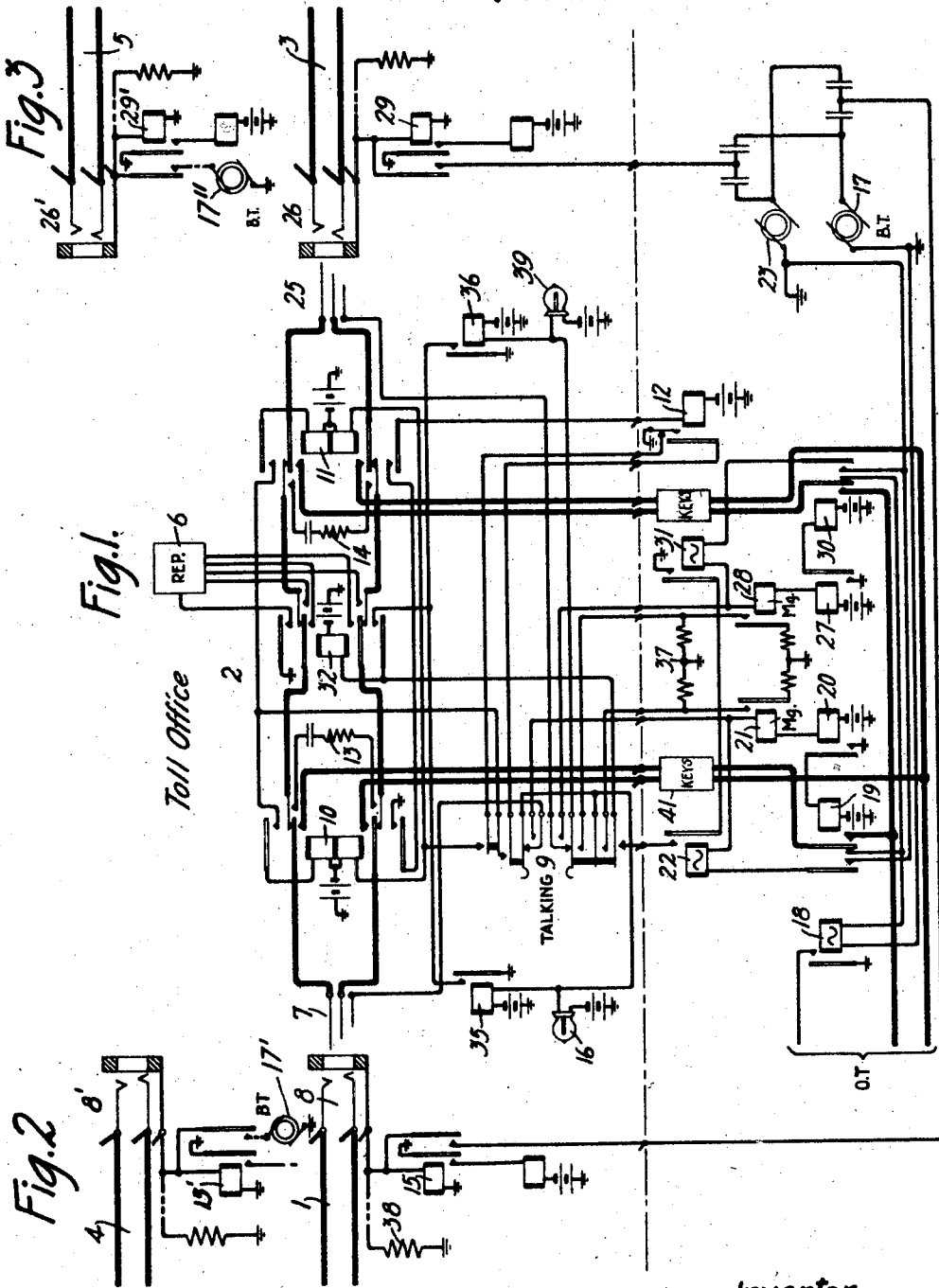


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TELEPHONE SYSTEM

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TELEPHONE SYSTEM.

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This invention relates to telephone systems, and more particularly to improvements in the connecting circuits used in toll switching systems whereby operators at toll switching centers establish connections between switching trunks or toll lines.

In systems of this kind where connections between subscribers located at widely distant points are desired, a number of various types of connections may be made at the toll switching centers or offices. For example, a connection may be established from a calling subscriber at a local office over a switching trunk to the toll office and from there over a long distance toll line to another local office from which the called subscriber may be reached. In this type of connections it is not ordinarily necessary to include the usual repeater networks in the transmission line at the toll office. However, in some other types of connections, it is essential that repeater networks should be included at the toll office for the well known purpose of maintaining the proper transmission line efficiency. This inclusion is usually essential for connections where the switching trunk incoming from a local office is unusually long or where the connections will extend through other toll offices over long distance toll lines in either or both directions. The toll operator's cord circuits, switching trunks and toll lines are usually so designed that in cases where no repeaters are required, automatic changes will take place on the establishing of a connection to exclude the repeater therefrom. On the other hand, in connections where repeaters are required these circuits will automatically act on the establishing of such connections to include the repeater.

It is an object of this invention to provide improved circuit arrangements in switching trunks, toll lines and universal toll operators' cord circuits used in establishing connections of the above mentioned types.

Another object of the invention is to utilize alternating current in the supervisory control over such types of connections. To attain these and other objects of the invention, as will hereinafter appear, there is provided in accordance with one feature thereof means whereby the inclusion or omission of the usual repeaters in connections of the above type and the performing

of the usual busy test may be under control of alternating current signals of different character. Such control is independent of other supervisory functions performed during the establishing of such connections.

Another feature resides in the provision of means whereby when a connection is established, between a switching trunk or a toll line and another toll line requiring a repeater, the cord circuit used in the connection is automatically controlled by alternating current signals to include a repeater in said cord circuits. On the other hand if the connection is extended between a switching trunk and a toll line that do not require the inclusion of a repeater, a condition suitable for such a connection is automatically established or maintained in the cord circuit.

Another feature of the invention is the provision of means whereby the alternating current signals used for changing the conditions of the cord circuit as mentioned above are effective over the sleeve terminals of the jacks and plugs in which the switching trunks, toll lines and cord circuits terminate.

Another feature of the invention resides in means whereby alternating current signals are used for actuating the usual busy test signals such alternating current signals being effective over the sleeve terminals of the switching trunk or toll line tested and over the tip conductors of the cord circuit employed.

Another feature of the invention resides in the provision of means whereby the insertion of both the answering and calling plugs of a cord circuit into the jacks of the lines connected thereby is required before the change in or maintenance of the condition in the cord circuit is effected.

Another feature of the invention resides in the provision of alternating current responsive relays for changing the conditions of the cord circuits which are common to a plurality of cord circuits.

The invention has been illustrated in the accompanying drawings in which Fig. 1 shows the incoming end of a switching trunk or toll line equipped to cause the inclusion of a repeater, the outgoing end of a toll line similarly equipped and a cord circuit for the establishment of connections between these two lines, all arranged in accordance with

this invention. Fig. 2 shows the incoming end of a switching trunk not arranged for the inclusion of a repeater when connected to the cord circuits shown in Fig. 1. Fig. 3 shows the outgoing end of a switching trunk or toll line that does not require the service of a repeater. All of these lines are also shown in accordance with this invention with means for performing the usual busy test employing alternating current signals.

The drawings show means whereby a connection may be established from a calling subscriber, connected through the opposite end of the switching trunk or toll line 1 at a distant exchange, over the cord circuit 2 at a toll office to the toll line 3 outgoing to a distant exchange and from there to the called subscriber through the usual channels. A connection may also extend from the switching trunk 4 over the cord circuit 2 and the switching trunk or toll line 5; or from switching trunk 4 over the cord circuit 2 and the toll line 3 or switching trunk or toll line 5; or from toll line 3, or switching trunk or toll line 5 in the opposite direction to switching trunk or toll line 1, or switching trunk 4.

In the type of connections mentioned above a switching trunk or toll line 1 and toll line 3 are assumed to be of such length as to require the inclusion of repeaters, and consequently are so arranged that when they are connected through cord circuit 2, the repeater indicated by a box 6 is included in the transmission circuit between the two lines. On the other hand, if a connection is desired between switching trunk 4 and switching trunk or toll line 5, which are assumed to be of such length as not to require the inclusion of repeaters, the cord circuit conditions will be such as to prevent the repeater 6 from being included in the transmission line between the two lines. This latter effect will also be produced in the cord circuit if a connection is made between a short line at one end, such as switching trunk 4 and a long line at the opposite end, such as toll line 3.

In order to make the application of the invention to these disclosures more clear, a detailed description will be made; first, a connection between switching trunk or toll line 1 and the toll line 3 which require the usual repeater, and second, a connection requiring no repeater such as between switching trunk 4 and switching trunk or toll line 5.

Assuming then that the toll operator equipped with cord circuit 2 has been assigned or has selected, in the usual manner in toll line service, the switching trunk or toll line 1 for the establishment of a connection from a distant office, the usual busy test may be performed or not depending on the manner in which the line 1 is appro-

priated. If the busy test is to be performed, the operator first actuates her talking key 9 and then touches the sleeve of jack 8 with the tip of plug 7. On the operation of key 9, circuits for relays 10 and 11 are completed as follows: battery, lower windings of relays 10 and 11 in parallel, closed upper outer contacts of relay 9, make-before-break contacts of relay 12 to ground. This circuit is however only completed if relay 12 is in a released condition and the arrangement is such that it will be released as soon as the equipment below the dash-dotted line in the drawing, which is common to a plurality of cord circuits, is released from use with another cord circuit. This common equipment includes an operator's telephone set, a busy test relay arrangement, alternating current responsive relays required for the inclusion of the repeater 6 with cord circuits and alternating current sources employed in this system. Relays 10 and 11 in operating open the tip and ring leads of the cord and include the balancing networks 13 and 14 in the opposite sides respectively of the repeater 6 so that when it is subsequently connected to the cord circuit, singing is prevented as is well known in the art. The operation of relays 10 and 11 also closes a circuit for relay 12 as follows: battery, winding of relay 12, lower outer armature and front contacts of relays 11 and 10 in series to ground. Relay 12 in operating opens the operating circuit for relays 10 and 11 at its make-before-break contact, but at the same time closes at its armature and front contact an obvious locking circuit for these two relays through their upper windings.

If it is found that the switching trunk 1 is engaged through a multiple jack at another position in a connection of the same type, relay 15 will be operated over a circuit as follows: battery, the supervisory lamp of the employed cord circuit at the other position corresponding to lamp 16 of cord circuit 2, normally closed contacts of a talking key corresponding to key 9, sleeve of the plug corresponding to plug 7, sleeve of a multiple jack of switching trunk 1, winding of relay 15 to ground. Consequently, when the tip of plug 7 comes in contact with the sleeve of jack 8 when the busy test is performed, a circuit as follows will be completed. From one side of the alternating current sources 17 and 23 outer armature and front contact of relay 15, sleeve of jack 8 tip of plug 7, upper inner armature and front contact of relay 10, through various common keys, such as a ringing and a splitting key, well known in the art and therefore merely indicated by a box 41, inner armature and back contact of relay 19, alternating current responsive relay 18 to ground. Relay 18 responds to the particu-

lar alternating current from source 17 and closes a circuit to the usual busy test circuit at the operator's telephone set connected at O. T. so that the operator will now receive the usual indication that the jack tested is busy.

On the other hand, if the switching trunk 1 is idle, the operator may after having operated the talking key 9 insert plug 7 in jack 8 and the following circuit is thereby completed: battery, windings of relay 20, winding of marginal relay 21, inner upper closed contacts of key 9, sleeve terminals of plug 7 and jack 8, winding of relay 15 to ground. This circuit causes the operation of relays 20 and 15. The operation of relay 20 closes an obvious circuit for relay 19, so that relay 19 in operating opens the connection for the busy test relay 18 and closes a connection for the alternating current responsive relay 22 to the alternating current sources 17 and 23. On the operation of relay 15, this circuit from the sources 17 and 23 through the relay 22 is completed as follows: one side of the alternating current sources 17 and 23, outer armature and front contact of relay 15, sleeve terminals of jack 8 and plug 7 inner upper closed contacts of key 9, winding of alternating current responsive relay 22, outer armature and front contact of relay 19, to ground. Relay 22 operates in response to the current from the particular alternating current source 23 and closes at its armature and front contact a circuit for the inclusion of repeater 6 in the transmission circuit of cord circuit 2, as will be hereinafter described.

It will be understood that in accordance with standard toll practice, the operator at this office has acquired through the usual means, the numbers of both the calling and called subscribers and while the calling subscriber's line is being connected to the switching trunk 1 through the usual B operator's position at the distant office, this toll operator now connects her calling plug 25 to jack 26 of the toll line 3 leading to the office through which the wanted subscriber may be reached. It should be understood also that a busy test of this toll line 3 may be performed in the same manner as was the busy test of switching trunk 1. That is, on touching the tip of plug 25 to sleeve of jack 26 if the toll line 3 is busy, relay 18 will operate and a busy test signal given to the operator. The insertion of plug 25 in jack 26 closes a circuit as follows: battery, relay 27, marginal relay 28, closed contacts of key 9, sleeve terminals of plug 25 and jack 26, relay 29 to ground. This causes the operation of relays 27 and 29. The operation of relay 27 closes an obvious energizing circuit for relay 30 which in operating removes the busy test relay 18 from connection with the tip of the plug

25 and closes a circuit to the alternating current sources 17 and 23 so that a circuit is now completed from ground, through the outer armature and front contact of relay 30, alternating current responsive relay 31, closed contacts of key 9, sleeve terminals of plug 25 and jack 26, outer armature and front contact of relay 29, to the opposite side of the alternating current sources 17 and 23. This circuit causes the operation of relay 31 in response to the current from source 23 and a circuit is thereby closed for the operation of relay 32 as follows: battery, winding of relay 32, closed contacts of key 9, armature and front contact of alternating current responsive relay 22 and armature and front contact of alternating current responsive relay 31 to ground. The operation of relay 32 causes the leads from the repeater 6 to be connected to both sides of the cord circuit talking conductors, that is, a circuit will be completed from the inner upper and lower armatures and front contacts of the relay 32, through the repeater to the upper and lower make before break contacts of relay 32. A circuit will also be closed at the upper outer armature and front contact of relay 32 to ground for the repeater 6 to start it to function as is well known in the art. It should be understood that any well-known type of repeater circuit may be used and therefore no details of such a circuit has been shown, but merely represented by the box 6.

It should be noted that when the key 9 was operated a circuit was completed for relay 35 and relay 36 as follows: battery, windings of these relays to closed contacts of key 9, respectively, to the ground at 37 so that these relays were operated immediately after the actuation of key 9. The operation of these relays therefore provides a locking circuit for relay 32 over an obvious circuit to the lower outer armature and front contact of relay 32. As is well known in standard toll practice when the calling subscriber's line has been connected through the B operator's position at the distant office to the switching trunk 1, the condition of the sleeve circuit of jack 8 will change. That is, a low resistance path to ground will be provided for the sleeve through a resistance 38 so that now the electrical character of the circuit through relays 20 and 21 will be such as to cause the marginal relay 21 to operate. The operation of this marginal relay 21 closes a circuit through a low resistance to ground for the lamp 16. This lamp is now lighted to indicate to the operator at the cord circuit 2 that the switching trunk is connected through to the calling subscriber's line. In a similar manner the toll operator at cord circuit 2 may be notified, by the operator at the opposite end of the toll line 3 causing the lamp 39 to be lighted, that the

called subscriber's line has been connected through to the toll line 3, although the usual practice is that the operator at the distant office transmits this information verbally to the toll operator and the information that the wanted subscriber has been called and is ready to receive the call. When these indications have been received by the toll operator, she proceeds to ring the calling subscriber by operating the usual ringing key, not shown, but as stated may be included in the talking leads at the place indicated by the numeral 41. When the calling subscriber removes his receiver from the hook in answer to the ringing the condition of the sleeve of switching trunk 1 is changed so as to remove therefrom the resistance 38 to ground and thus cause relay 21 to release and thereby extinguish lamp 16 as an indication to the toll operator that the calling subscriber has answered the call.

The calling and called subscriber are now therefore connected respectively to the switching trunk 1 and the toll line 3 and it now merely remains for the toll operator to complete the connection between these two lines. She accomplishes this by releasing the talking key 9 and the effect of this operation is that the talking leads are connected through from plug 7 to plug 25 through the repeater 6 by the release of relays 10 and 11. It will be noted that the sleeve connection from jack 8 and plug 7 is now extended directly to the lamp 16 and relay 35. Lamp 16, however, is not lighted at this time due to the resistance conditions on the sleeve circuit, but relay 35 is maintained operated so that the locking circuits closed at the armature and front contacts of relays 35 and 36 for relay 32 are maintained and therefore relay 32 is held operated to maintain the repeater 6 in the circuit. Relays 20, 19, 27 and 30 are also released on the return of key 9 to normal. Upon the release of relays 10 and 11, the circuit for relay 12 is broken, so that the common equipment will now be in position to be used by any other cord circuit.

Conversation between the calling and called subscriber may therefore now begin and when the conversation ceases and the calling subscriber, for example, hangs up his receiver, lamp 16 will again become lighted as release indication to the operator at cord circuit 2. The toll operator may then break down the connection by removing her plugs 7 and 25, and relays 35, 36 and 32 are all returned to normal as well as the relays 15 and 29 at the incoming ends of switching trunk 1 and toll line 3.

It will be seen that in connection with the above type the fact that an alternating current source, such as 23, is connected to the sleeve circuits of jack 8 and jack 26 causes the operation of the common equipment and

the operation of relay 32 to include the repeater 6 in the transmission circuit between the two lines.

If a connection is desired between a switching trunk, such as 4, and a switching trunk or toll line, such as 5, requiring no repeater, the busy test may be performed, in the same manner as described in the previous case, that is a busy test of switching trunk 4 may be performed through the outer armature and front contact of relay 15' which is operated when this switching trunk is busy and the busy tone from alternating current source 17' is connected with the sleeve of jack 8'. The same operation will take place when a busy test is performed to ascertain the busy or idle condition of switching trunk or toll line 5 where the busy tone alternating current source 17'' will be connected to the sleeve of jack 26' through the operation of relay 29'.

If switching trunk 4 and switching trunk or toll line 5 are idle, the toll operator will first insert plug 7 into the jack 8' thus causing the operation of relays 15' and 20, which in turn, cause the operation of relay 19 to complete the tip lead through to the operator's telephone set O. T. As an alternating current source such as 23 is not connected to the sleeve circuit of the switching trunk 4, relay 22 will not operate at this time nor will relay 31 operate when plug 25 is inserted in jack 26' as no alternating current source such as 23 is connected to the sleeve circuit of this jack. Consequently, the circuit for relay 32 will not be closed and the continuity of the talking leads between the plugs 7 and 25 will therefore not be disturbed except, of course, at the armature and contacts of relays 10 and 11 which relays will be maintained operated until the release of key 9 when the connection will be cut through from the calling and called subscriber by the release of these relays. It is evident then that in this case, due to the fact that an alternating current source such as 23 is not connected to the sleeve circuits of the jacks 8' and 26' of these two lines, the cord circuit 2 will function so as not to include the repeater 6.

On the other hand, if a connection is desired between the switching trunk 4 and the toll line 3 it will be seen that the result of functioning of the cord circuit 2 will be the same, that is the repeater 6 will not be included as in this case relay 22 will not operate so that the circuit for relay 32 will not be completed.

In connections extending from the opposite direction the functions of the cord circuit will be the same for the three types of connections mentioned above. It may also be pointed out that the arrangement of the cord circuit 2 is such that it is immaterial how the plugs 7 and 25 are used in a con-

nection of this sort. That is, plug 25 may be used for answering a call, while plug 7 may be used for completing a through connection and vice versa.

5 What is claimed is:

1. In a telephone system, lines, cord circuits for interconnecting said lines, a plurality of alternating current sources associated with said lines, a busy signaling device common to said cord circuits, means responsive to current from one alternating current source for actuating said device when an engaged line is tested by a cord circuit, and means responsive to current from another alternating current source for changing the condition of a cord circuit connected to a line.

2. In a telephone system, lines, a cord circuit for interconnecting said lines, a source of alternating current associated with each line, means responsive to said alternating

current associated with one end of the cord circuit for preparing it for a change in condition, and means associated with the other end of the cord circuit for completing the change in condition of said cord circuit.

3. In a telephone system, lines, a cord circuit for interconnecting said lines, a source of alternating current associated with each line, means individual to the calling end of the cord circuit responsive to alternating current from a connected line, means individual to the called end of the cord circuit responsive to alternating current from a connected line, and means jointly responsive to said last mentioned two means for changing the condition of said cord circuit.

In witness whereof, I hereunto subscribe my name this 25th day of July A. D., 1925.

LESLIE F. PORTER.