

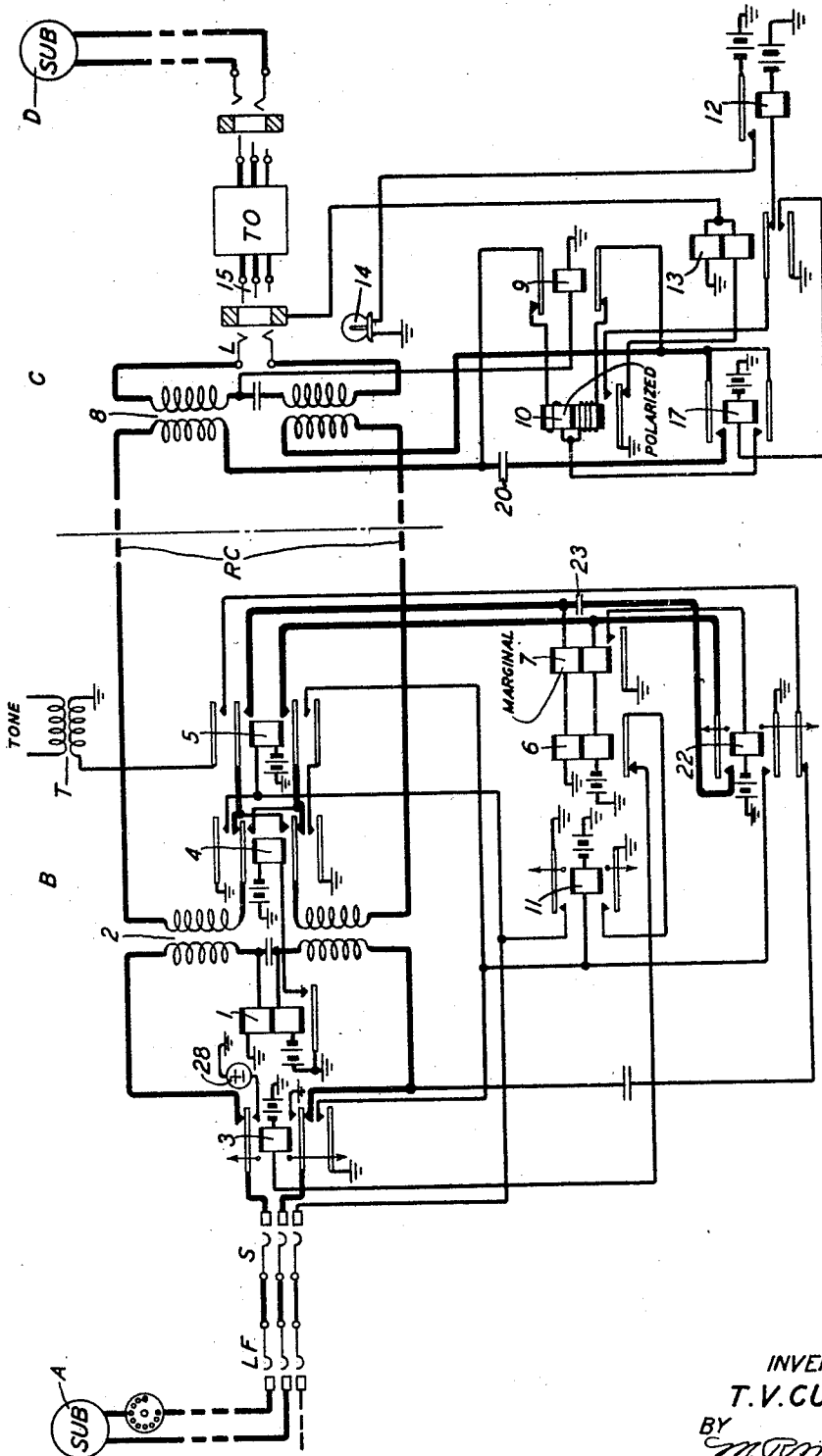
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to signaling systems.

The objects of this invention are to simplify signaling over trunk circuits and to economize in the use of power equipment for alternating current signals in telephone systems by employing direct current sources for signaling over trunks.

Heretofore, direct current has been used for signaling over trunks to operate signals or light lamps at the distant end of the trunks. In systems of this kind, when an operator at the distant end of the trunk answers a signal by connecting the trunk to a subscriber's line, the fact that this direct current signal is received and that the operator has established the connection causes an alternating current ringing signal to be produced to call the subscriber on the connected line.

It is a feature of this invention to provide an arrangement for signaling over trunks to recall a subscriber on a connected line by direct current means. A direct current signal produced at an operator's position is passed by a repeating coil at the toll office and caused to open the connection between the tip and the ring conductors of the trunk. At the call originating office this signal is passed by a repeating coil and translated into an alternating current signal for recalling the calling subscriber.

It is another feature of this invention to employ this signal in systems where supervisory signals are also transmitted over the trunk by the usual high-low marginal and reversed battery supervisory systems.

This invention may be applied to recording completing trunk systems in which a connection has been established over the trunk from a local office to an operator at a toll office and in which the usual supervisory signaling arrangement is employed.

The usual supervisory signaling over the trunk is accomplished from the local office by reversing the tip and ring conductors to a local battery and ground connection for the trunk and thereby cause the operation of a relay having a high and lower resistance winding bridged across tip and ring conductors at the toll office. This relay in operat-

ing lights the usual line lamp. The toll operator then inserts the plug of a toll cord into the jack of the trunk, and thereby causes the line lamp to be extinguished and also causes the high resistance winding of this relay to be short-circuited. This in turn causes the usual supervisory relay at the local office to operate to place the release of the connection from the subscriber to the toll operator under control of this operator's cord circuit. The invention is applied to this system by providing a special relay bridged across the conductors at the local office in series with the supervisory relay. This relay operates simultaneously with the operation of the supervisory relay. At the toll office the arrangement may be such that when the toll operator desires to recall the calling subscriber she will apply a direct current signal to the tip conductor on the toll office side of the usual repeating coil inserted at this end of the trunk and thus cause a relay at this end of the trunk to open the connection between the tip and ring conductors of the trunk connected through the outgoing side of the repeating coil. This in turn causes the supervisory relay and the special relay at the local office to release. The circuit arrangements at the local office are now such that a ringing relay is thereby operated to apply an alternating current signal to the calling subscriber's line to recall this subscriber.

This invention has been illustrated in the accompanying drawing in connection with a call recording and completing trunk extending between a local office and a toll office.

Referring to the drawing the line of a calling subscriber at A has been shown connected through switches LF and S, shown in diagrammatic form and representing standard line finder and selector switches in an automatic telephone exchange, or local office B, to a trunk line RC terminating at a toll office C in a jack J. From jack J the connection may be extended through a standard toll operator's cord circuit TO to a called subscriber's line at D. The cord circuit and the called subscriber's line have also been shown in diagrammatic form.

To show the application of the applicant's

invention to a system of this kind, a call will be described from the calling subscriber at A to the called subscriber at B and the recalling of the calling subscriber by the toll operator at C. If the calling subscriber at A in any manner well known in the art causes a connection to be established to the trunk RC through the line finder LF and the selector S, a circuit is completed from battery, lower winding of relay 1, lower left hand winding of repeating coil 2, lower inner armature and back contact of relay 3 over a loop established through the calling subscriber's telephone set, back over the upper armature and back contact of relay 3, upper left hand winding of repeating coil 2 and upper winding of relay 1 to ground. This causes the operation of relay 1, which in turn closes an obvious circuit for the operation of relay 4 and this latter relay in turn closes an obvious circuit for the operation of relay 5. Relay 5 in operating closes a signaling path from the tone source T to the ring conductor back to the calling subscriber's set to notify him that the toll operator is being called.

Relays 4 and 5 in operating close a connection from battery and ground over the trunk RC to the toll office C as follows: From battery through the lower windings of relays 6 and 7 in series, lower inner armature and front contact of relay 5, upper inner armature and front contact of relay 4, upper right hand winding of repeating coil 2, tip conductor of trunk RC, upper left hand winding of repeating coil 8, upper armature and back contact of relay 9, upper and lower windings of relay 10 in series aiding, lower armature and back contact of relay 9, lower left hand winding of repeating coil 8, ring conductor of trunk RC, lower right hand winding of repeating coil 2, lower inner armature and front contact of relay 4, upper inner armature and front contact of relay 5, and upper windings of relays 7 and 6 in series to ground. The operation of relays 4 and 5 also completes another circuit for the operation of relay 11 from battery, winding of this relay, lower outer armatures and front contacts of relays 5 and 4 to ground. Relay 11 closes at its upper armature and front contact a connection to ground for the sleeve circuit through the selector S to maintain the connection in the usual manner through the selector S and the line finder LF for the calling subscriber's line. The connection established over the trunk RC causes the operation of relay 6 at the local office B and relay 10 at the toll office C. Relay 6 opens at its armature and back contact the circuit established by relay 11 for relay 3. The purpose of the operation of relays 11 and 6 will become apparent hereinafter. Relay 10 in operating closes a circuit for the operation of relay 12 from battery, winding of this relay, lower inner armature and back contact of relay 13, armature

and front contact of relay 10 to ground. Relay 12 in operating closes an obvious circuit for the lighting of lamp 14 to indicate to the toll operator that a call is waiting on this trunk.

When the operator answers this call by inserting plug 15 into jack J, a connection is established from battery at the cord, not shown, through the sleeve connection the upper winding of relay 13 to ground to cause the operation of this relay. Relay 13 in operating opens the circuit for relay 12 to extinguish the lamp 14. Relay 13 also in operating closes an obvious circuit for the operation of relay 17. Relay 17 closes at its lower armature and front contact a shunt circuit for the lower high resistance winding of relay 10 and at its upper armature and front contact establishes a connection between the left hand windings of repeating coil 8 through condenser 20 to establish a talking path through the repeating coil. The reducing of the resistance trunk RC causes the marginal relay 7 to operate. This relay in operating closes an obvious circuit for the operation of relay 22 and this latter relay in operating closes at its upper armature and front contact a connection between a tip and ring conductor of the truck through the right hand windings of repeating coil 2 and condenser 23 to establish the talking connections through this repeating coil. Relay 22 in operating opens the hereinbefore mentioned signaling path from the tone source T established on the operation of relay 5 to the calling subscriber's telephone. This indicates to the calling subscriber that the toll operator has answered. The calling subscriber may now converse with the toll operator and inform her of the connection desired. The toll operator may then complete the connection to the desired subscriber's line at D whereupon conversation between the two subscribers may take place.

In the foregoing description it has been shown how supervisory signals may be transmitted over the trunk TC from the local office B to the toll office C and from the toll office to the local office. A description will now be made showing how the operator may recall the calling subscriber without interfering with supervisory signals of the above description. In case the toll operator desires to recall the calling subscriber she completes a circuit to battery, not shown, in the cord over the tip conductor to cause the operation of relay 9. Relay 9 in operating opens the connection over the tip and ring conductors of the trunk RC and thereby causes the release of relays 6 and 7. Relay 6 in releasing closes the circuit for the operation of relay 3 from battery, through the winding of relay 3, lower armature and back contact of relay 6, lower armature and front contact of relay 11. Relay 3 in operating applies ringing cur-

rent from the source 28 over the tip and ring conductors to the calling subscriber's line to recall this subscriber. It will be noted that relay 22 will release on the release of relay 7, but being slow in releasing, it will prevent the tone circuit from being completed at its lower armature and back contact before the operation of relay 3 so that no tone will be transmitted to the calling subscriber's line during recall signaling. When relay 3 operates, relays 1 and 4 may release, but relay 11 is maintained operated by the connection to ground for this relay is closed by the operation of relay 3 at its lower outer armature and front contact. The purpose of the slow releasing feature of relay 22 is also to maintain relay 11 operated after relay 4 is released and until relay 3 is operated, thus serving to maintain relay 11 operated during this recall signaling period. When the operator ceases to signal the calling subscriber, relay 9 is released and the circuit is again completed over the trunk for the reoperation of relays 6 and 7. Relay 6 in operating opens the circuit for relay 3 to discontinue the recall signaling of the calling subscriber. It should be noted that when relay 3 releases, the circuit for relays 1 and 4 are reestablished. The operation of relay 7 causes the operation of relay 22 to maintain relay 11 operated after relay 3 is released and until relay 4 is reoperated. Relays 3 and 11 have been shown slow to release in order to further insure the proper sequence of operations as described above. Thus it will be seen that in recalling the calling subscriber, the consequent circuit changes at the local office do not disturb the maintaining of the connection from the calling subscriber through the trunk as maintained by the operation of relay 11 over the upper armature and front contact.

While the invention has been illustrated and described in connection with but one disclosure, it should be understood that it could readily be applied to other systems without departing from the spirit thereof and that the present disclosure should only be taken as illustrative of one application of the invention.

What is claimed is:

1. In a telephone system, a local office, a toll office, a subscriber's line terminating in said local office, a trunk between said offices, means for connecting the subscriber's line to the trunk at said local office, means responsive to said connection for signaling the toll office and means for signaling the calling subscriber from the toll office by opening the connection between the tip and ring conductors of the trunk without releasing the connection between the calling subscriber and the trunk.

2. In a telephone system, a trunk, a repeating coil inserted in said trunk near each end thereof, means responsive to the application

of a direct current signal to one conductor at one end of the trunk for opening the connection over the tip and ring conductors of the trunk between the repeating coils, a source of ringing current and means responsive to said opening for connecting said source of ringing current to the trunk at the opposite end thereof.

3. In a telephone system, a local office, a toll office, a trunk between said offices, a repeating coil inserted in said trunk near each end thereof, means for signaling from the local office to the toll office including the reversal of current over the trunk between the repeating coils, means for signaling from the toll office to the local office including the decreasing of the resistance of the trunk between the repeating coils and means for signaling from the toll office to the local office over said trunk past the repeating coils including the opening of the connection over the tip and ring conductors of the trunk between the repeating coils.

4. In a telephone system, a subscriber's line, an operator's position, a trunk terminating at said position, a cord at said position, means for establishing a connection from the subscriber's line to said trunk, a signal at the terminating end of the trunk, means responsive to said connection for actuating said signal, means responsive to the connection of the cord to the terminating end of the trunk for disabling said signal and for transferring control over said first mentioned connecting means to said cord to maintain it established, means responsive to the replacing of the receiver on the switchhook by the subscriber of said line for reoperating said signal, means for opening the connection between the tip and ring conductors of the trunk, and means responsive to said opening for signaling the subscriber on said line.

5. In a telephone system, a subscriber's line, an operator's position, a trunk terminating at said position, a cord at said position, means for establishing a connection from the subscriber's line to said trunk, a signal at the terminating end of the trunk, means responsive to said connection for actuating said signal, means responsive to the connection of the cord to the terminating end of the trunk for disabling said signal and for transferring control over said first mentioned connecting means to said cord to maintain it established, means responsive to the replacing of the receiver on the switchhook by the subscriber of said line for reoperating said signal, means for opening the connection between the tip and ring conductors of the trunk, and means responsive to said opening for transmitting an alternating current signal over the subscriber's line.

6. In a telephone system, a trunk, means for signaling from one end of the trunk to the other including a direct current signal

applied to the tip and ring conductor of said trunk, means for signaling from the opposite end of the trunk including the decreasing of the resistance of the tip and ring conductors of the trunk, and means for signaling from said opposite end of the trunk including the opening of the connection between the tip and ring conductors of said trunk.

7. In a telephone system, a local office, a toll office, a trunk between said offices, a repeating coil inserted in said trunk near each end thereof, means for signaling from the local office to the toll office past the repeating coil at this end of the trunk including the application of a direct current signal over the tip and ring conductors of said trunk, means for thereafter signaling from the toll office to the local office including the decreasing of the resistance of the tip and ring conductors of said trunk between said repeating coils and means for thereafter signaling from the toll office to the local office past the repeating coils including the opening of the connection between the tip and ring conductor between the repeating coils.

8. In a telephone system, a local office, a toll office, a trunk between said offices, a repeating coil inserted in said trunk near each end thereof, a subscriber's line at the local office, means for establishing a connection between said subscriber's line and said trunk at said local office, means responsive to said connection for signaling over the trunk, a signal at the toll office, means responsive at the toll office to said signaling for actuating the signal at the toll office, an operator's cord at said toll office, means for connecting said cord to the trunk, means responsive to said last mentioned connection for disabling the signal at the toll office and for signaling the local office over said trunk, means responsive to said signaling from the toll office for holding the connection between the calling subscriber's line and the trunk under control of the cord, means for signaling past the repeating coil at the toll office over the trunk and past the repeating coil at the local office including the opening of the connection between the tip and ring conductors of the trunk between the repeating coils, and means responsive to the last mentioned signaling for transmitting an alternating current signal over the subscriber's line to call the subscriber.

9. In a telephone system, a trunk, a repeating coil inserted in said trunk near each end thereof, means responsive to the application of a direct current signal at one end of said trunk for opening the connection between the tip and ring conductors of said trunk between said repeating coils, a relay controlled by the opening of said connection and means controlled by said relay for establishing a signal condition at the opposite end of said trunk.

10. In a telephone system, a local office, a toll office, a trunk between said offices, a repeating coil inserted in said trunk near each end thereof, means for signaling from the local office to the toll office including the closing of the tip and ring conductors of said trunk through a current source between said repeating coils, two relays at the local office one of said relays operative in response to the closing of the connection between the tip and ring conductors of said trunk, a relay at the toll office operative in response to the closing of the connection between the tip and ring conductors, a signal at said toll office, means responsive to the operation of said relay at the toll office for actuating said signal, means at said toll office for closing a connection between said tip and ring conductors past a portion of the winding of said relay at said toll office, means responsive to the closing of said last mentioned connection for operating the other relay at the local office for signaling at said local office, means for opening the connection between the tip and ring conductors between said repeating coils at the toll office to cause the release of said relays at the local office, and means responsive to the release of the first mentioned relay at the local office for signaling beyond the repeating coil at said local office towards the end of said trunk.

11. In a telephone system, a local office, a toll office, a subscriber's line terminating at said local office, a trunk between said offices, automatic means for connecting the subscriber's line to the trunk at said local office, means responsive to said connection for closing the tip and ring conductors of said trunk, two relays at the local office, a relay at the toll office, means responsive to the closing of the tip and ring conductors for operating one of the relays at the local office and the relay at the toll office, means responsive to the operation of the relay at the toll office for signaling the toll office, means at said toll office for closing a connection between the tip and ring conductors of the trunk between the repeating coils past a portion of the winding of said relay at the toll office, means responsive to said last mentioned connection for operating the other relay at said local office, means responsive to the operation of said other relay for maintaining the connection between a calling subscriber and the trunk circuit at said local office and for signaling the subscriber, means at said toll office for opening the connection between the tip and ring conductors to release said two relays at the local office, and means responsive to the release of said first mentioned relay at the local office for signaling the subscriber.

In witness whereof, I hereunto subscribe my name this 31 day of August, 1931.

THOMAS V. CURLEY.