

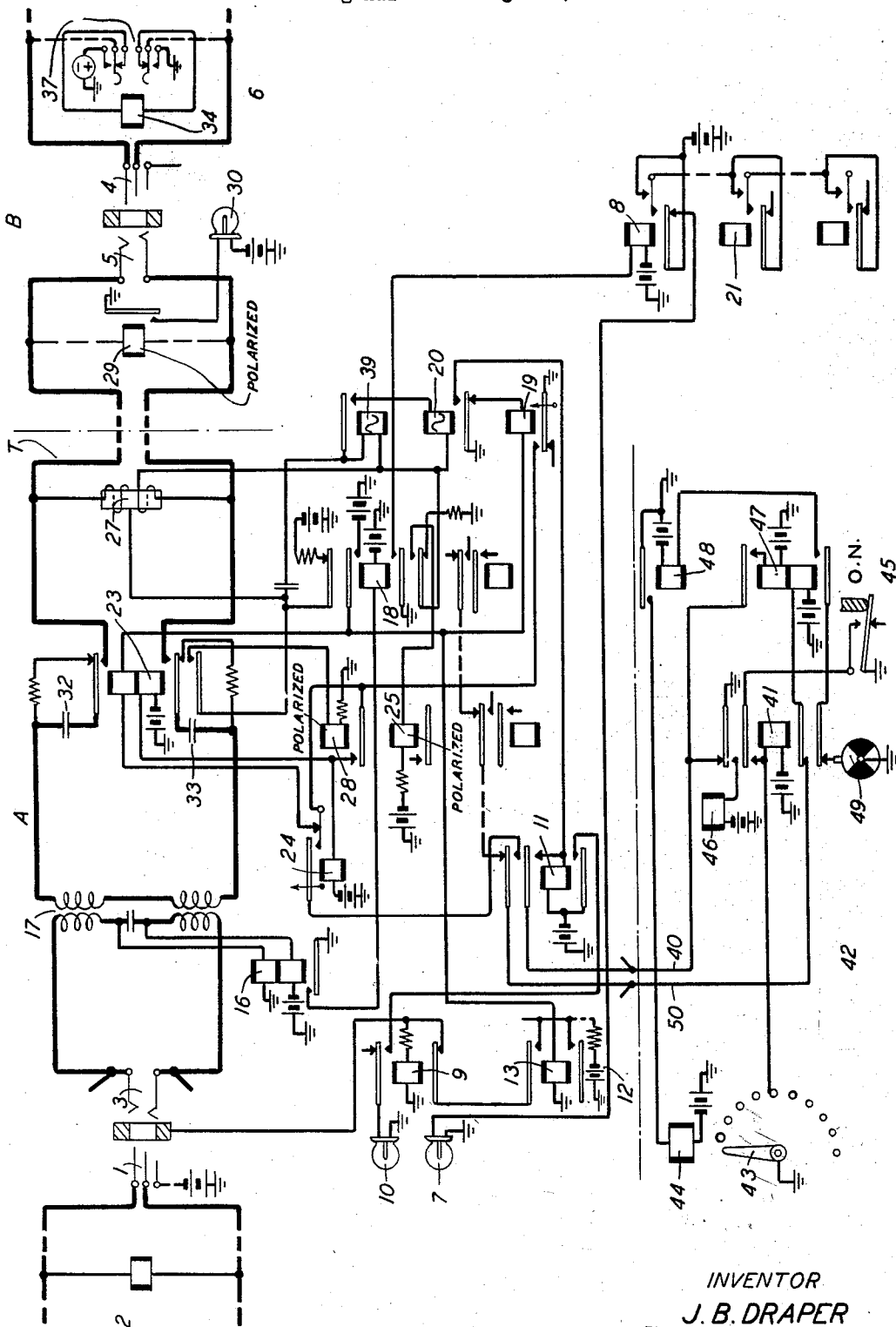
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to private branch exchange systems. Its object is to improve and simplify the service over trunks incoming to systems of this kind.

Systems have been proposed heretofore in which an operator in extending a connection from one exchange to another over a trunk applies ringing current to the trunk to cause a signal lamp to be lighted at the distant end of the trunk to call an operator thereat. Means are also employed whereby the extinguishing of this signal may be delayed a definite interval after the operator has ceased applying the ringing current should the call remain unanswered. Other systems have been used in which after a connection has been established over a trunk the call originating operator may recall the operator at the distant end by means causing the lighting of the usual supervisory signal in the cord circuit of said operator connected at the distant end of the trunk.

A feature of the present invention is an arrangement in a trunk circuit incoming to a private branch exchange for recalling the private branch exchange operator by the lighting of the trunk lamp at the private branch exchange in response to the application of ringing current by the operator at the distant end of the trunk and for delaying the extinguishing of said lamp a certain interval after said recalling ringing current has been disconnected from the trunk.

Another feature is the provision whereby the means for delaying the extinguishing of a trunk lamp after the ringing ceases is made common to a plurality of trunks.

This invention has been illustrated in the accompanying drawing in connection with a trunk line T connecting a private branch exchange A and a central office B.

To illustrate the application of the invention in a circuit of this kind, descriptions will be made of a call outgoing from the private branch exchange A and originating by the insertion of the plug 1 of an ordinary private branch exchange operator's cord, illustrated in diagrammatic form at 2, into a jack 3 of the trunk T. This will be followed

by a description of the operations when a toll operator at the main exchange answers the call by inserting the plug 4 into a jack 5 of the trunk T. The plug 4 is the answering plug of a standard toll operator's cord shown in diagrammatic form at 6. A description will then be made of the operations of the circuits when the operator at the private branch exchange is rerung by the toll operator and when the toll operator is recalled by the private branch exchange operator.

The private branch exchange operator may originate the outgoing call by inserting plug 1 into jack 3 of an idle trunk. The idle condition is indicated by the lighted lamp 7 and all other corresponding lamps in multiple therewith are associated with the multiple jacks of this trunk at other operators' positions as will be explained hereinafter. The circuit for these lamps extends from battery through the armature and back contact of relay 8 through lamp 7 and the other lamps to ground. Relay 9 is now operated over the sleeve circuits from battery in the cord circuit 2 through the sleeve terminals of plug 1 and jack 3 and winding of relay 9 to ground. Relay 9 in operating establishes a partial connection for lamp 10 to the front contact of the lower armature of relay 11, the purpose of which will be explained hereinafter.

Jacks, relays and lamps, such as 3, 9, 7 and 10, may be multiplied to appear at other operators' positions and by the operation of relay 9 the sleeve circuit of this jack is separated from the common circuit to battery 12 for all of the multiple jacks connected through armatures and front contacts of relay 13. Said multiple jacks, relays and lamps are connected to their respective circuits in the same manner, that is, tip and ring of the jacks are multiplied and so are the connections for lamp 7 while the sleeve circuits terminate at the individual relays such as 9 to the upper armatures of which the individual lamps such as 10 are connected. The lower armatures are connected to armatures of relay 13, the front contacts of which are connected in multiple to battery 12. It will be explained hereinafter how relay 13 is operated. This relay, when operating, connects

the common battery 12 to the sleeve circuits of all other jacks through the corresponding lower armatures and back contacts of relays such as 9 to make these jacks busy.

5 Relay 16 is also operated over the loop through the cord 2, tip and ring conductors of plug 1 and jack 3, the left-hand windings of repeating coil 17, windings of relay 16 to battery and ground. The operation of relay 10 16 closes an obvious circuit for the operation of relay 18. Relay 18 in operating closes a circuit for the operation of relay 19 from battery through the upper inner armature and front contact of relay 18, winding of 15 relay 19 to ground at the armature and back contact of relay 20. Relay 13 was also operated by the operation of relay 18 from battery at the upper, inner armature and front contact of relay 18, winding of relay 13 to 20 ground. Relay 13 in operating makes as hereinbefore stated the multiple jacks of this trunk busy by applying current from battery 12 to the various sleeve circuits of 25 these jacks. It should be noted that the operation of relay 18 closes an obvious circuit for relay 8 of this trunk and thereby disconnects battery at its lower armature and front contact from the circuit for lamp 7 to extinguish it and connects this battery through 30 this armature and its corresponding front contact to the armature and back contact to relay 21 which relay is associated with the next idle trunk line and thereby causing the lamp corresponding to lamp 7 in this trunk 35 to be lighted to indicate to the operator the next trunk to select. If this trunk is then taken for use, the lamp of the succeeding trunk is lighted and so forth until all trunks are taken for use.

40 Another circuit closed by the operation of relay 18 is that for relay 23 as follows: From battery, upper inner armature and front contact of relay 18, upper winding of relay 23, make-before-break contact of relay 24 to 45 ground at the armature and front contact of relay 19. Relay 18 also removes battery and ground from the tip and ring conductors of trunk T at the upper outer and lower outer armatures and corresponding back contacts and also connects battery through the winding of relay 25, lower outer armature and front contact of relay 18, one winding of retardation coil 27 to the ring conductor of the 50 trunk. Relay 23 in operating connects ground to the tip conductor through the winding of relay 28, lower outer armature and front contact of relay 23 and the other winding of retardation coil 27. With ground 55 connected to the tip conductor and batteries to the ring conductor the polarized relay 29 at the central office B is operated to close an obvious circuit for the lighting of lamp 30 to indicate to the toll operator that a call is 60 waiting on this trunk. The relays 25 and 28 are now operated and the operation of

relay 23 closes at its upper and lower inner armatures and front contacts a talking circuit through the condensers 32 and 33 from the operator at 2 through the repeating coil 17 over the trunk T to the central office. 70

The toll operator at 6 now answers this call by inserting plug 4 into jack 5. This causes the polarized relay 29 by any means well known in the art to be disconnected 75 from the tip and ring conductors to extinguish the lamp 30 and the tip and ring connections are extended through jack 5 and plug 4 and a bridge in the cord circuit at 6 to maintain relays 28 and 25 operated. The operation of relay 28 closes a circuit for relay 24 from battery; winding of this relay, armature and front contact of relay 28 to ground 80 at the armature and front contact of relay 19. Relay 28 in operating closes an obvious locking circuit for relay 23 through its lower winding, while the operation of relay 24 opens the original energizing circuit for relay 23 and extends the connection from ground at relay 19 to the front contact of the upper 85 outer armature of relay 11 the purpose of which will be explained hereinafter in connection with the reringing of the operator at the private branch exchange A. 90

To rering or recall the private branch exchange operator the toll operator at 6 will 95 operate the ringing key 37 to apply ringing current over the trunk T to the private branch exchange. This causes the relays 25 and 28 to release immediately due to the opening 100 of the bridge in the cord circuit by the operation of the ringing key. The release of relay 28 causes the release of relay 23 to open the talking circuit over the trunk, the purpose of this being to prevent clicks or ringing induction from being heard at the 105 calling station or by the operator at the private branch exchange. The ringing current applied by key 37 causes the operation of relay 39 and this relay in turn causes the operation of relay 20 from the ringing current 110 in parallel with relay 39. Relay 20 in operating opens the circuit for relay 19 to cause it to release. All of these operations take place before relay 24 releases due to the release of relay 28 as relay 24 is slow in releasing to prevent ground from the lower 115 armature and front contact of relay 19 from being connected through the upper winding of relay 23 and cause this latter relay to reoperate at this time. Relay 20 in operating causes the operation of relay 11 over an obvious circuit. Relay 11 now locks temporarily over a circuit from battery through its winding and upper inner armature and front 120 contact over conductor 40 to ground at the upper outer armature and back contact of relay 41 of the common timing device 42. 125

This common timing device consists of a step-by-step switch 43 including a circular terminal bank and a brush therefor, a step- 130

ping magnet 44, of normal contacts 45 and release magnet 46. This switch may be of any design well known in the art. This device also includes the relays 41, 47 and 48 and interrupter 49 and may be as stated
 5 common to a plurality of trunks such as T by having the leads 40 and 50 multiplied to these trunks. Relay 11 in operating closes a circuit for the lighting of lamp 10 from
 10 battery through the lower armature and front contact of relay 11 to lamp 10 to ground. This lamp, as stated, is associated with jack 3 and indicates to the operator at this private branch exchange that the toll operator is
 15 recalling.

When the toll operator releases the ringing key the relays 20 and 39 release. Relay 20 in releasing causes the operation of relay 19 and relay 19 in operating causes the operation of relay 23. As relay 19 is slow in operating the operation of relay 23 is delayed to permit the bridge to be closed across the tip and ring conductors at the cord 6 when the key 37 is released, before the talking circuit is established. Relay 28 in reoperating after the operation of relay 23 locks relay 23 as hereinbefore described and causes the reoperation of relay 24. Relay 24 in operating establishes a connection to ground from the armature and front contact of relay 19 through its armature and front contact, upper outer armature and front contact of relay 11, start conductor 50, lower inner armature and back contact of relay 41, lower winding of relay 47 to battery. This circuit causes the operation of relay 47 to start the timing device 42 to function to cause lamp 10 to remain lighted for a definite period after the toll operator has stopped ringing. Relay 47 in operating closes a locking circuit for itself from battery through its upper winding, upper armature and front contact to ground at the upper armature and back contact of relay 41. Relay 47 also closes an obvious interrupting circuit for relay 48 from the interrupter 49. This circuit causes relay 48 to be alternately operated and released to alternately open and close the obvious pulsing circuit for the stepping magnet 44. This alternate operation of the stepping magnet will advance the brush of switch 43 until a connection is made from ground through the brush and a terminal of switch 43 through the winding of relay 41 to battery. When this connection is made relay 41 operates and closes a locking circuit for itself through the off normal contacts 45 to ground to maintain itself operated until the switch has returned to normal. Relay 41 in operating opens the locking circuit for relays 47 and 11 and opens the interrupting circuit for relay 48 and stepping magnet 44. Relay 41 also closes a circuit for the release magnet 46 to cause this
 65 magnet to return the switch to normal. Re-

lay 11 releasing at the end of this period extinguishes lamp 10, which has now been maintained lighted, a certain period after the toll operator released the key 37.

The private branch exchange operator may recall the toll operator by withdrawing and reinserting the plug 1 into jack 3. This causes relays 9, 16, 18, 13, 19, 23, 25, 28 and 24 to release and reoperate. The release and reoperation of relays 18 and 23 cause the usual supervisory lamp in the trunk cord 6 to flash signifying to the toll operator that the private branch exchange operator is recalling.

When the private branch exchange operator releases the connection by removing plug 1 from jack 3, relays 9, 16, 18, 13, 19, 23, 25, 28 and 24 are released. The release of relay 18 causes the toll cord supervisory lamp to light as a disconnect signal and when the toll operator disconnects, the circuits are restored to normal.

While this invention has only been illustrated in connection with one type of circuit, it should be understood that it may readily be applied to other trunk systems without departing from the spirit thereof and that the present disclosure should merely be considered as illustrative of one application of the invention.

What is claimed is:

1. In a telephone system, a trunk circuit, a cord circuit for connection to the trunk circuit, a signal in said trunk circuit, a source of ringing current, means responsive to the connection of the cord circuit to the trunk circuit and to the application of ringing current from said source to the trunk circuit for actuating said signal, and means operative on the cessation of the ringing current for maintaining said signal actuated a short interval thereafter.

2. In a telephone system, a trunk line, a cord circuit, means for establishing connection between said cord circuit and said trunk line, a signal in said trunk line, a source of ringing current, means in said trunk line responsive to ringing current from said source for actuating said signal, and means for maintaining said signal actuated for a short interval after the ringing current is disconnected.

3. In a telephone system, a trunk circuit, a cord circuit, a signal in said trunk circuit, a circuit for said signal, means responsive to the connection of the cord circuit to the trunk circuit for partially preparing the circuit for the signal, a source of ringing current, means responsive to the application of ringing current from said source to the trunk circuit for completing the circuit for the signal, and means for maintaining said signal actuated a short interval after the ringing

current has been removed from said trunk circuit.

4. In a telephone system, a trunk circuit, a cord circuit, a signal in said trunk circuit, an alternating current source, a relay in said trunk circuit responsive to alternating current, means responsive to the connection of the cord circuit to the trunk circuit and to the actuation of said relay in response to alternating current from said source for actuating said signal, and means responsive on the release of said alternating current responsive relay for maintaining said signal actuated for a short interval thereafter.

5. In a telephone system, trunk circuits, a cord circuit, a signal for each trunk circuit, a source of ringing current for each trunk circuit, means responsive to the connection of the cord circuit to a trunk circuit and to the application of ringing current to said trunk circuit from the associated source for actuating the corresponding signal, a timing device common to said trunk circuits, and means responsive on the cessation of the ringing current for maintaining said signal actuated a short interval thereafter under control of said common timing device.

6. In a telephone system, a trunk circuit, a cord circuit for connection to the trunk circuit, a signal in said trunk circuit, means operative after the cord circuit is connected

to the trunk circuit for actuating said signal, and means operative after said first-mentioned means has ceased to function for maintaining said signal actuated for a short interval thereafter.

7. In a telephone system, a trunk circuit, a cord circuit for connection to the trunk circuit, a signal in said trunk circuit, means operative after the cord circuit is connected to the trunk circuit for actuating said signal, said means including a relay actuated when said means is operating and a circuit closed by the operation of said relay for controlling the signal, and means for maintaining said relay operated a short interval after said first-mentioned means has ceased to function to maintain said signal actuated for said interval under control of said circuit.

8. In a telephone system, trunk circuits, a cord circuit, a signal for each trunk circuit, means operative after the cord circuit is connected to a trunk circuit for actuating the associated signal, a timing device common to said trunk circuits, and means responsive when said first-mentioned means ceases to control a signal for maintaining said signal actuated a short interval thereafter under control of said common timing device.

In witness whereof, I hereunto subscribe my name this 21st day of August, 1931.

JOHN B. DRAPER.