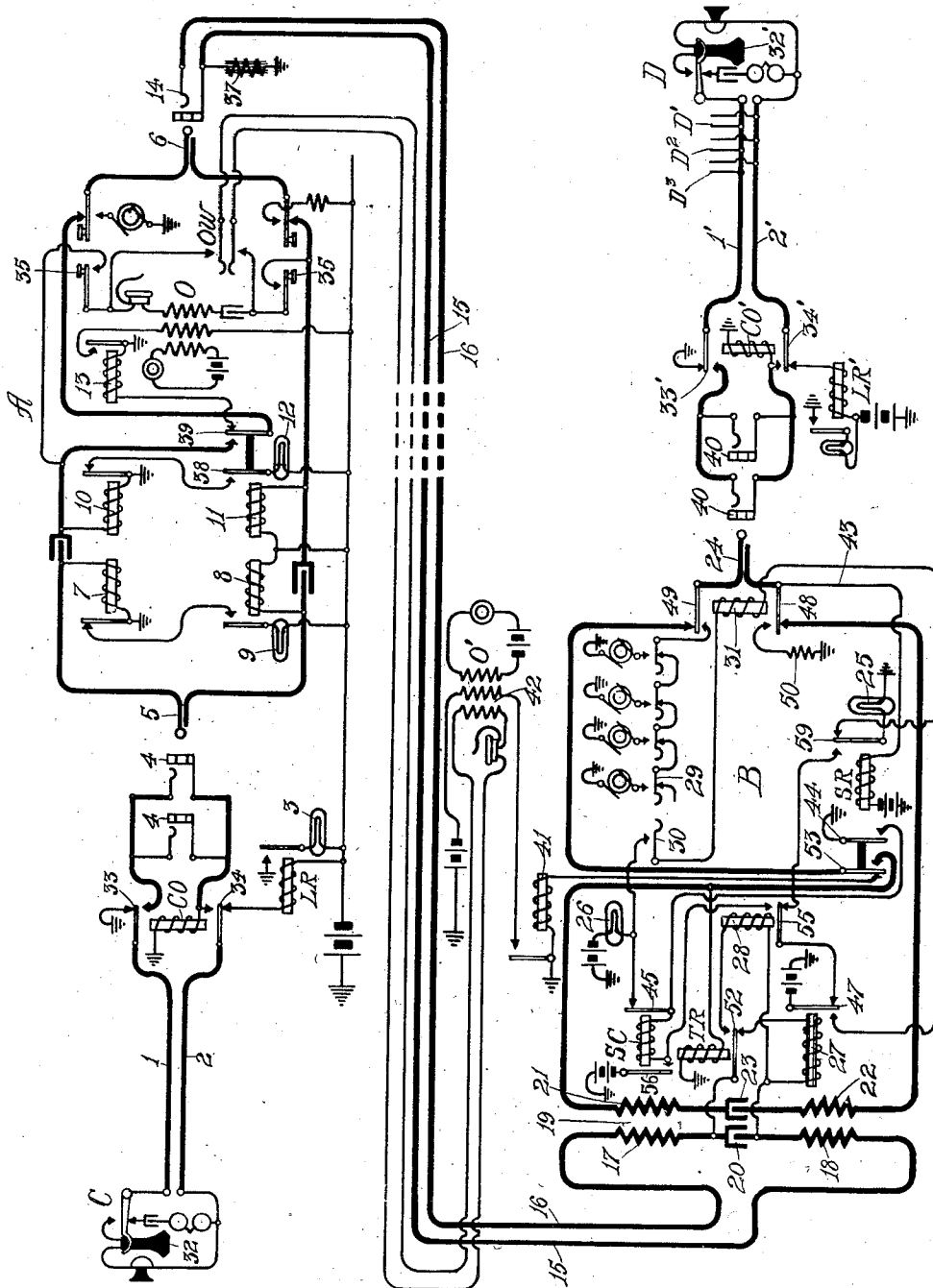


C. S. WINSTON.
TELEPHONE TRUNKING SYSTEM.
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Patented Oct. 13, 1914.



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UNITED STATES PATENT OFFICE.

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TELEPHONE TRUNKING SYSTEM.

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Specification of Letters Patent.

Patented Oct. 13, 1914.

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To all whom it may concern:

Be it known that I, CHARLES S. WINSTON, a citizen of the United States of America, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Trunking Systems, of which the following is a specification.

My invention relates to trunking cord circuits for telephone systems, and more particularly to such systems in which supervisory relays are controlled over the line conductors of connected sub-stations. In certain trunk systems in which supervisory relays are adapted to be energized upon response of the called subscriber, and are connected directly to the line conductors of a called telephone line, there is a tendency for such relays to momentarily attract or kick up their armatures when a sub-station is called, due to a discharge from the line conductors and bridged condensers, through such relays after each application of ringing current to the line. Especially in trunk circuits, where a relay is locked up responsive to energization of such supervisory relays, this kick or momentary attraction, causes a premature effacement of the associated signal.

One of the objects of my invention is to provide a system in which the supervisory features are free of these objections, other features of my invention being more particularly pointed out in the accompanying specification and in the appended claims.

Referring to the accompanying drawing, the system there illustrated includes two sub-stations, "C" and "D", which terminate in line circuits at different exchanges. The cord circuit "A", which is in the same exchange with the line circuit of sub-station "C", is a well known four-relay cord circuit adapted for connecting to the lines terminating in its exchange. The trunk circuit "B", of which the outgoing end is located in the same exchange with the line of sub-station "D", is connected to the spring jack 14 in the exchange of sub-station "C" by means of the heavily marked conductors 15 and 16.

The sub-station "C" is connected to its exchange by means of line conductors 1 and 2 which terminate at contacts of cutoff relay CO. The line relay LR is associated with the line of sub-station "C" and is adapted

upon energization to display the line lamp 3. The multiple jacks 4, in practice, would appear in different positions of the switchboard and are adapted to be connected to by the answering plug 5 of cord circuit "A". The said cord circuit "A" also includes a calling plug 6 which is adapted for connection to spring jacks of other telephone lines in the same exchange, or spring jacks leading to trunk circuits as B in distant exchanges. The said cord circuit "A" also includes a tip answering supervisory relay 7, and a sleeve answering supervisory relay 8, which through their cooperation control the answering supervisory lamp 9. The calling supervisory relays 10 and 11, are adapted by their cooperation to control the calling supervisory lamp 12. The test relay 13 is connected through normal contacts of relay 11 to the tip contact of the calling plug 6. The operator's telephone O is adapted for use with cord circuit "A" and other such circuits which may be used by the same operator. The order wire switch contacts OW are adapted to connect the operator's telephone O with the operator's telephone O' in a distant exchange.

Spring jack 14 is connected to trunk circuit "B" at a distant exchange by means of the heavily marked conductors 15 and 16 which terminate at the incoming end of the said trunk circuit "B" in the windings 17 and 18 of repeating coil 19, the said windings having condenser 20 interposed between their terminals. The other windings 21 and 22 of the said repeating coil 19, have the condenser 23 interposed between the inner terminals, the said windings being connected by means of the heavily marked conductors to the plug 24. The said trunk circuit "B" also includes a sleeve supervisory relay SR and a tip supervisory relay TR, a supervisory signal lamp 25 and a ringing lamp 26. Normally in bridge of the incoming end of trunk circuit "B" is the high resistance, slow acting relay 27.

The relay 28, which is of comparatively low resistance to relay 27 is adapted upon operation of tip relay TR, to be connected in bridge of the incoming end of trunk circuit "B" in place of the high resistance relay 27. The signal controlling relay SC is adapted, upon response of a called subscriber, to efface ringing lamp 26 and is locked in its en-

ergized position to prevent a further display of said lamp until the plug 24 has been withdrawn from a connected spring jack. The ringing key of the trunk circuit "B" includes four sets of springs 29, each one being adapted to connect a different frequency of ringing current to the terminals of a called party line, for the purpose of ringing selectively any one of the sub-stations connected thereto. The plungers which operate the springs 29, are so arranged that the contact springs 30 and the selected springs 29, are closed only when any of the ringing plungers are in a fully depressed position, the said springs 30 being common to the actuating plungers for the four contact sets 29. The ringing relay 31 is adapted to be energized when the contact springs 30 are closed, so as to connect ringing current to the terminals of the called line and open the talking conductors of the trunk circuit.

The telephone line of sub-station "D" is equipped similar to that of sub-station "C" except that it has four telephones, one being connected to each of the terminals D', D² and D³.

Having described in general the apparatus used in the system illustrated, the operation of the said system in connecting two subscribers in different exchanges will now be described. Assuming subscriber at sub-station "C" desires connection with a subscriber at sub-station "D", he would remove receiver 32 from its switch hook, thereby establishing a circuit through line relay LR from ground, normal contact 33, line conductors and sub-station "C", normal contact 34, the winding of relay LR to battery, energizing said relay LR and lighting line lamp 3. The operator in response to said signal inserts answering plug 5 into a jack 4, thereby establishing an energizing circuit for relays 8 and CO traced from battery through the winding of relay 8, the sleeve contacts of plug 5 and jack 4, and through the winding of relay CO to ground. The said relays are thereupon energized, the cut-off relay CO interrupting the circuit through line relay LR, thereby effacing line lamp 3. A circuit for relay 7 is also established from battery over the previously described path to alternate contact 34 of relay CO, then over the line conductors and through sub-station "C", tip contact of jack 4 and plug 5 and through the winding of relay 7 to ground, energizing the said relay. The operator then actuates listening key 35 to ascertain the wants of the calling subscriber.

Assuming, as previously stated, that the calling subscriber at sub-station "C" desires connection with sub-station "D" which is in a distant exchange, the operator presses the order wire button OW leading to the exchange in which the line of sub-station "D"

terminates and inquires of the distant operator which trunk is to be used for the connection. The operator at the first exchange now inserts the calling plug 6 into a jack 14 of the assigned trunk circuit. Responsive to the said connection a circuit for relay 11 is established from battery through the winding of said relay 11, tip contact of plug 6 and jack 14, through impedance coil 37 to ground, energizing the said relay 11 and lighting the supervisory lamp 12 over a circuit established from ground, through the normal contact of relay 10, alternate contact 38 of relay 11 and lamp 12 to battery. Responsive to the energization of relay 11 the alternate contact 39 is closed, thereby establishing a circuit through relay 27 of trunk circuit "B" traced from ground through relay 10, over conductor 16 through winding of relay 27 and back through conductor 15 and relay 11 to battery, energizing relay 27. The said relay 27 being of a comparatively high resistance, sufficient current does not flow through its winding to energize relay 10 so the lamp 12 remains lighted.

If the trunk operator has not plugged into the jack of called substation as yet, upon energization of relay 27, lamp 25 will light, indicating to the trunk operator that the first operator has connected with the proper trunk, or if the trunk operator plugs into a jack 40, and lamp 25 lights, the trunk operator will know the first operator has not plugged into jack 14, due to relay 27 failing to energize.

The operator at trunk circuit B having ascertained from the operator at cord circuit "A" the number of the called subscriber, now tests the jack 40 of the called subscriber by touching the tip of the plug 24 to the sleeve of jack 40. If the called line is busy, the test relay 41 is energized in a well known manner by battery flowing from the sleeve contact of jack 40, and the operator receives a click in her receiver due to the closing of a circuit through the middle winding of induction coil 42. If the line of the called subscriber is idle there will be no potential above ground on the sleeve contact of jack 40 and test relay 41 will therefore not energize, and the operator not receiving a busy click inserts the plug 24 into a jack 40 of the called line. Responsive to the said connection an energizing circuit is established through cutoff relay CO' and the supervisory relay SR, traced from ground through the winding of said relay CO', sleeve contacts of jack 40 and plug 24, conductor 43, through the winding of relay SR to battery. The energization of the relay CO' removes the sub-station control of line relay LR' and also establishes a continuity of the talking conductors of the trunk circuit "B" to the terminals of said

sub-station "D". Responsive to the energization of relay SR, a circuit through ringing lamp 26 is established from ground through alternate contact 44, normal contact 45, through said lamp 26 to battery, lighting the said lamp. The trunk operator now actuates a ringing button to connect the proper ringing generator to the line of the called substation. The actuation of said key closes the proper ringing springs 29 and the contact springs 30; and responsive to the closing of contact springs 30, a circuit through relay 31 is established, from ground through alternate contact 44, normal contact 45, contact 30 to winding of relay 31 to battery at alternate contact 47, energizing said relay 31 and closing alternate contacts 48 and 49. A path for ringing current is thereby established, from generator through the closed alternate contact 29, alternate contact 49, tip contacts of plug 24 and jack 40, alternate contact 33' over the line conductors 1', 2', and through the condenser and call bell of sub-station D, alternate contact 34', sleeve contacts of jack 40 and plug 24, through alternate contacts 48 and resistance 50 to ground. The operator actuates the selected key several times to ring the bell of the sub-station "D" and upon each restoration of the actuated key the contact 30 and contact 29 are restored to normal. Upon each actuation of the said ringing key, the line conductors and condensers in bridge thereof are charged from the applied ringing current, and upon each restoration of the said ringing key, contacts 30 and 29 are opened and the said line conductor and condensers will discharge to ground through the winding of the tip relay TR causing a tendency of the said relay TR to kick up its armature, opening the circuit through the slow relay 27 and establishing a circuit through the relay 28 through alternate contact 52. This momentary attraction of the armature of relay TR is not of sufficient duration to allow the relay 27 to release its armature, it being slow acting, so that even should relay 28 be energized by current from cord circuit "A", the relay 27 not having released its armature, a premature energizing circuit for relay SC is not closed. It will thus be seen, that due to the circuit arrangement just described the relay SC will not be energized to prematurely efface the ringing lamp 26.

The trunk operator having signaled the subscriber at sub-station "D" as described, upon response of the said subscriber by the removal of receiver 32' from its switch hook, a circuit for the tip relay TR is established, from ground through the winding of said relay TR, alternate contact 53 of relay SR, normal contact 49, tip contacts of plug 24 and jack 40, over the line conductors and through the called substation, back through

sleeve contacts of the jack 40 and plug 24, conductor 43, and the windings of relay SR to battery. Relay TR is thereupon energized, interrupting the circuit through relay 27, allowing said relay to deenergize, and establishing a circuit through the lower resistance relay 28, by the closing of alternate contact 52 of relay TR. The closing of this low resistance path through the winding of relay 28, allows relay 10 of the cord circuit "A" to energize, effacing the supervisory lamp 12 and notifying the operator of cord circuit "A" that the called subscriber has responded.

Returning now to relay 28, upon its said energization, a circuit through the relay SC is established, from battery through normal contact 47 of relay 27, alternate contact 55, through the winding of relay SC to ground at alternate contact 44 of relay SR. Responsive to the energization of relay SC the circuit through ringing lamp 26 is interrupted at contact 45, and the said lamp is effaced, notifying the trunk operator that the called subscriber has responded. Also, responsive to energization of relay SC, a locking circuit therefor is established from battery through alternate contact 56 and the winding of said relay SC to ground at alternate contact 44. It will be seen from this, that the relay SC being locked up through contacts of the sleeve supervisory relay SR, that the ringing lamp 26 cannot again be lighted until the plug 24 is withdrawn from the jack. The subscribers are now connected in a conversational circuit traced over the heavily marked conductors, talking current for the calling subscriber being supplied through the relays 7 and 8 of cord circuit "A", and talking current for the called subscriber being supplied through the relays TR and SR of the trunk circuit "B". While I have shown several batteries at each exchange, it is to be understood that they may be one and the same, that is, each exchange to have but a single battery.

After the subscribers have finished conversation they replace their receivers upon their respective switch hooks. The restoration of the calling subscriber's receiver, opens the circuit through relay 7 of the cord circuit "A" allowing the said relay to deenergize and close a circuit through supervisory lamp 9.

Upon the called subscriber replacing his receiver upon its switch-hook, the previously traced circuit through relays TR and SR is interrupted, allowing the said relay TR to deenergize, but the relay SR remains energized due to the circuit through the cutoff relay CO'. Upon deenergization of tip relay TR, the circuit through the low resistance relay 28 is interrupted at contact 52, and a circuit through the high resistance relay 27 is again established over the pre-

viously described path from battery through relays 10 and 11 of cord circuit "A". The high resistance relay 27 having been included in the energizing path for relays 10 and 11 in place of the low resistance relay 28, the relay 10 does not receive sufficient current to retain its armature and it therefore retracts, closing a circuit through the supervisory lamp 12, as the relay 11 is still maintained energized from ground through impedance coil 37 at jack 14, and over conductors 15, 16. The operator of cord circuit "A" in response to the signal received from the lighted lamps 9 and 12, withdraws the plugs 5 and 6 from their respective spring jacks, restoring the apparatus of cord circuit "A" to normal and also restoring cutoff relay CO of the calling line. Upon withdrawal of plug 6 of cord circuit "A" from spring jack 14, the circuit through relay 27 of trunk circuit "B" is interrupted and the said relay is deenergized, and a circuit through disconnect signal lamp 25 is established from battery, through normal contact 47 of relay 27, normal contact 55, alternate contact 59, through the lamp 25 to ground, lighting the said lamp. The trunk operator in response to this signal withdraws plug 24 from jack 40, thus opening the circuit through supervisory relay SR and the cutoff relay CO', allowing the said relays to deenergize. Upon deenergization of relay SR the circuit through signal lamp 25 is interrupted effacing the said lamp. Also, upon deenergization of relay SR, the locking circuit for relay SC is interrupted at contact 44, allowing said relay SC to deenergize and retract its armature. The apparatus of trunk circuit "B" having now been restored, and being in an idle condition is available for further use.

Should a called subscriber, after having responded to a call, desire to converse with one of the operators, by operating his switch hook, the circuit through the supervisory relay TR will be opened, allowing the said relay to retract its armature, thereby opening the low resistance path through relay 28 and substituting therefor a high resistance path through relay 27, thereby again deenergizing the supervisory relay 10 of cord circuit "A" and flashing the supervisory lamp 12. The operator at cord circuit "A" observing this signal, may connect the operator's telephone O with cord circuit "A" and converse with the called subscriber at substation "D".

It will be noted that due to the circuit arrangement as heretofore described, that any premature, incidental, momentary energization of the supervisory relay TR will not affect the signal controlling relay SC, and therefore it will require an energization of relay TR of some duration to effect an energization of the signal controlling relay SC.

What I claim as new and desire to secure by Letters Patent is:

1. In a telephone system, a trunk circuit for connecting calling and called sub-stations, comprising a trunk supervisory relay adapted to be operatively energized upon response from a called substation when connected thereto, a signal controlling relay for said trunk circuit adapted to be energized responsive to a responsive energization of the supervisory relay, a signal operated responsive to such energization of the signal relay, and means to prevent said signal relay from being energized responsive to an incidental momentary operation of said supervisory relay.

2. In a telephone system, the combination with a trunk circuit of a cord circuit connected to the incoming end thereof, a called subscriber's sub-station connected to the outgoing end thereof, a trunk supervisory relay connected to a talking strand of the called sub-station, adapted to be operatively energized upon response of the called subscriber, a signal controlling relay for said trunk circuit adapted to be energized responsive to a responsive energization of said supervisory relay, a trunk signal controlled by said signal relay, means for connecting calling current to said strand, and means to prevent any energization of said signal relay responsive to an incidental momentary operation of said supervisory relay.

3. A telephone system including a trunk circuit, a link circuit connected to the incoming end thereof, a called subscriber's line connected to the outgoing end thereof, a relay in bridge of said incoming end, energized by current from said link circuit, a supervisory relay for said trunk adapted to be energized upon response of the called subscriber, and having normally closed contacts controlling said bridged relay, a signal controlling relay, adapted to be energized responsive to energization of said supervisory relay and deenergization of said bridged relay, and means for momentarily holding the armature of said bridged relay attracted and said contacts open, after an energization of said supervisory relay.

4. In a telephone system, a trunk circuit, a relay in bridge of the incoming end thereof, an energizing circuit for said relay, a supervisory relay for said trunk adapted to be energized upon response of a connected called subscriber, a second relay, switch contacts on said supervisory relay adapted upon energization of said supervisory relay to interrupt the energizing circuit of the said bridged relay and include said second relay in said energizing circuit, means for momentarily holding the armature of said bridged relay attracted after its energizing circuit is opened, a signal controlling relay, and an energizing circuit therefor adapted to be

closed upon energization of said second relay and deenergization of the bridged relay.

5 A telephone system, comprising a trunk circuit for connecting telephone lines, a cord
10 circuit for connecting to the incoming end thereof, a slow relay in bridge of said incoming end, energized by current from said
15 cord when connected to said trunk, a second relay, switch contacts for disconnecting said slow relay to deenergize it and substituting
20 said second relay to be energized, a supervisory relay, adapted to be energized upon response of a called subscriber when connected to, for controlling said switch con-
25 tacts, a signal controlling relay, and an energizing circuit therefor, adapted to be closed upon deenergization of said slow relay and energization of said second relay.

6. A telephone system comprising an operator controlled link circuit, a called telephone line and substation connected thereto, a response supervisory relay individual to said link circuit, a signal control relay for said link circuit adapted to be operatively
25 energized by a responsive operation of the supervisory relay, a locking circuit for said signal control relay effective upon its ener-

gization, a supervisory signal for said link circuit operated when said signal control relay is operatively energized, and means 30 whereby a premature momentary operation of said response relay does not effect any energization of the signal control relay.

7. A telephone system comprising a link circuit, a slow relay energized by current 35 over the answering end of said circuit, a supervisory relay connected to the calling end of said link circuit and adapted to be energized upon response from a connected called substation, a third relay, said supervisory 40 relay being adapted when energized to disconnect said slow relay and substitute said third relay to be energized, a signal control relay, and an energizing circuit therefor adapted to be closed when said slow relay 45 is deenergized and said third relay energized.

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

CHARLES S. WINSTON.

Witnesses:

GEORGE E. MUELLER,
WM. BERGHAHN.