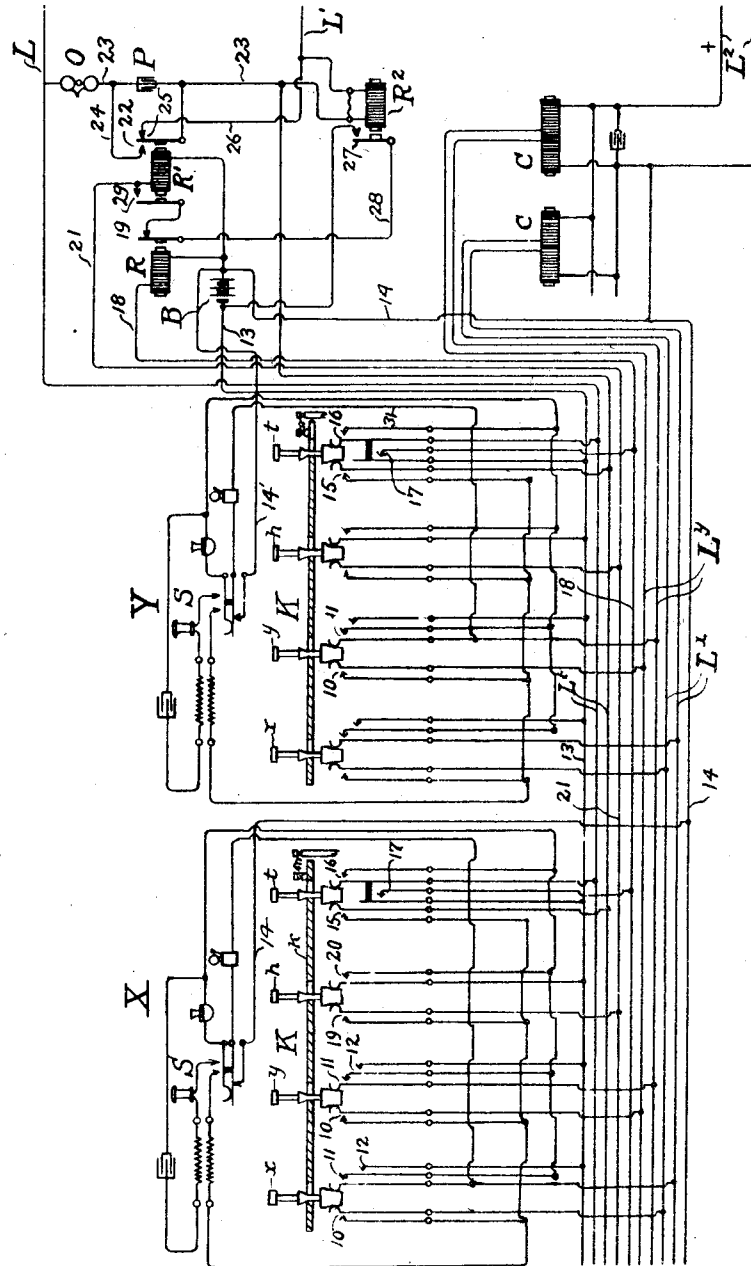


L. D. BARROWS.
INTERCOMMUNICATING TELEPHONE SYSTEM.
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Patented Apr. 29, 1913.



Witnesses.
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UNITED STATES PATENT OFFICE.

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Specification of Letters Patent,

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To all whom it may concern:

Be it known that I, LEON D. BARROWS, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Intercommunicating Telephone Systems, of which the following is a specification.

This invention relates to intercommunicating telephone systems, and especially to those which are connected through a trunk line to a central station. It looks chiefly to the provision of such a system in which calls coming over a trunk may be readily transferred from one of the intercommunicating substations to another, without danger of causing a premature disconnect signal at the central station.

The accompanying drawing illustrates diagrammatically one of the arrangements by which my invention may be effectuated.

In the present instance but two stations, X and Y, of an intercommunicating system are shown, these being joined by a trunk line L, L' to a central station (not shown). Each of the local stations has the usual telephone set S, talking current for which may be supplied from the common battery over conductors L² through suitable retardation coils C; and is further provided with a contact apparatus K consisting of a series of keys. Of the keys those designated as *w* and *y* at each station are for connecting the stations with each other, while key *t* serves to connect the local station with the trunk line, and key *h* is for temporarily holding said trunk line, as will appear later. The keys may be locked in a depressed position by a spring actuated plate, which in moving to lock any key releases that last depressed. In their locked position keys *w* and *y*, through opposite contacts 10 and 11 unite the telephone set of the substation at which they are placed with pairs of conductors L² and L² multiplied to similar contacts throughout the various substations. An extra spring 12, when the keys *w* and *y* are at the limit of their depression below that in which they are locked, joins the bell of the telephone set of the corresponding station through a contact of the switch hook to conductors 13 and 14 14' leading to a local ringing battery B. The key *t* at contacts 15 and 16, through conductors L¹, bridges the telephone set of its station across the trunk, while a third contact 17 at the limit of the key's downward movement connects the

winding of a release relay R, common to all the substations of the intercommunicating system, to the battery B by way of conductors 13 and 18. The holding key *h* connects, through contacts 19 and 20, the telephone set of its substation and conductors 13 and 21, the winding of a holding relay R' to battery B. At its front contact 22 relay R' controls the introduction, in place of a substation set, of a bridge across the trunk for maintaining against operation the usual disconnect signals at the central station. This bridge consists of a conductor 23, containing the trunk line ringer O of the intercommunicating system, a condenser P and a short circuit 24 about the condenser closed by relay contact 22. At its back contact 25 relay R', when energized, opens a short circuit 26 about a locking and release relay R², the winding of which is included in the trunk conductor L' between the extremity of the holding bridge and the central station. The front contact 27 of relay R² closes a gap in a locking circuit 28 of holding relay R', through back contact 19 of the release relay R and a front contact 29 of the holding relay, this locking circuit being independent of the original energizing circuit through holding key *h*. It will be seen that the relays R' and R² together furnish an electromagnetic apparatus upon the energization of which the maintenance of the holding path depends.

When a call comes into the intercommunicating system over the trunk line, we will assume that it is answered at substation X, and that a subscriber at substation Y is wanted. The subscriber at X pushes down the key *t*, which locks and at contacts 15 and 16 bridges the telephone set across the trunk, and talks with the calling party. Upon learning that the call is for Y the holding key *h* is depressed, freeing the trunk key *t*, and current flows from battery B through the winding of relay R', conductor 21, contact 19 of key *h*, the telephone set of substation X (the receiver being off its hook), contact 20 of key *h* and conductor 13 to battery. Relay R' operates, opening contact 25 and the short circuit of relay R² which is at once energized by current over the trunk. When the front contacts 22 and 29 of relay R' close, condenser P is short circuited through the former by conductor 24, making effective the holding bridge of the trunk through ringer O; and the contact 29 completes the

locking circuit 28 for the holding relay, contact 19 of the release relay R being normally closed and contact 27 of relay R² having been made as described. The maintenance
 5 of the disconnect signal at the central station is now independent of the connection of the substation sets. The subscriber at station X next depresses the key *y*, releasing the holding key *h*. In the extreme position
 10 of key *y* the closing of contact 12 rings the bell at substation Y, from battery B through conductor 14', hook switch of station Y, conductors 31 and L', contacts 11 and 12 of key *y* and conductor 13. The
 15 subscriber at Y, responding, locks down his key *y*, and upon removing the receiver from its hook is connected for conversation with the subscriber at X through contacts 10 and 11 of the two keys *y* and conductors L'.
 20 Upon informing substation Y of the call, the subscriber at X may hang up his receiver. The subscriber at Y depresses the trunk key *t*, and contacts 15, 16 bridge his telephone set across the trunk. The momentary closing of contact 17 operates the
 25 release relay R from battery B by way of conductors 13 and 18, and this drawing up its armature opens the locking circuit 28 of the holding relay R'. The latter at contact 22 severs the direct current bridge of the trunk, and at contact 25 restores the short
 30 circuit of the winding of relay R² deenergizing it. Said trunk is thus cleared for transmission between the calling and called subscribers. Since the relay R² governing the locking circuit of the holding relay is in series with the trunk, it is under the control of the central station operator, who, if the inter-
 35 communicating subscribers fail to depress the trunk keys sufficiently to make contact 17, and thus actuate the release relay R, can cut off the central station battery by withdrawing the trunk plug and thus deenergize relay R², opening the locking circuit of the
 40 holding relay at contact 27. Relay R² may therefore be considered both as a locking and a secondary release relay.

Circumstances may arise which render my arrangement of the relay R² with relation to the other elements of the system of great advantage. For example, suppose in a connection as generally outlined above, the trunk key at Y being locked down as a
 50 result of the previous use of the apparatus, that when the subscriber at Y answered, he removed the receiver from its hook before depressing the local answering key *y*. This would cause the telephone set to be connected across the trunk through the contacts
 55 of key *t*, and were the relay R² in the holding bridge of the trunk, would shunt it by a low resistance path, causing its release. This would unlock the holding relay, opening the bridge 23, 24 and leaving the disconnect signal at the central station de-
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pendent upon the connection of the substation set. When the subscriber at Y continued the operation of answering the subscriber at X by actuating key *y*, thus releasing key *t*, he would shift the telephone set
 70 from the trunk to the local circuit, and the disconnect signal would be actuated as a result of the complete removal of the holding means, leading the central station operator to withdraw the trunk plug. But with
 75 the system arranged in accordance with my invention, although such a procedure shunts the holding bridge, it does not deenergize the locking and secondary release relay R². This shunt circuit may be traced from the
 80 juncture of the holding bridge circuit with the trunk line L' or one extremity of the holding bridge to contact 15 of trunk key *t* by way of one of the conductors L', thence through Y's telephone set to contact 16 of trunk key *t*, thence along the return conductor L', to the other extremity of the
 85 bridge where it joins trunk line L. The current in the trunk is increased by the decrease of resistance due to the connection of the low resistance loop, and this flowing through the relay winding directly in the trunk insures against release. A similar advantage is gained by removing the release
 90 relay R from the trunk, where it is sometimes placed. For assuming the same sequence of acts on the part of the subscriber at Y, the increase of current due to the connection of the telephone set across the trunk through the contacts of key *t*, flowing
 95 through the winding of relay R in series with the trunk would energize it, breaking the locking circuit of the holding relay at contact 19, and, as before, giving the disconnect signal at the central station. I have so disposed the release relay that it
 100 it independent of variations in the trunk current and the holding means will be effective regardless of the manner in which the subscriber responds.
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I claim as my invention:

1. The combination with the local stations of an intercommunicating system and their telephone sets, of a trunk line for connecting the intercommunicating system with a
 115 central station, means at each local station for connecting its telephone set across the trunk, a path for current which may be substituted for the telephone set to hold the trunk, and electromagnetic apparatus upon
 120 the energization of which the maintenance of the holding path depends, said electromagnetic apparatus having an energizing winding in the trunk line in the path of operating currents between the central station and intercommunicating stations.
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2. In a telephone system, a central station, intercommunicating trunk conductors extending between the central station and intercommunicating stations, a telephone
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set at the intercommunicating stations and means for joining its terminals to the trunk conductors, a trunk holding path connected at its extremities to the trunk conductors and which may be substituted for the telephone set, and electromagnetic apparatus upon the energization of which the maintenance of the holding path depends, said electromagnetic apparatus having an energizing winding in a trunk conductor between the connection of the holding path and the central station.

3. The combination with the local stations of an intercommunicating system and their telephone sets, of a trunk line for connecting the intercommunicating system with a central station, means at each local station for connecting its telephone set across the trunk, a path for current which may be substituted for the telephone set to hold the trunk, and electromagnetic apparatus having independently energized windings upon the energization of which the maintenance of the holding path depends.

4. The combination with the local stations of an intercommunicating system and their telephone sets, of a trunk line for connecting the intercommunicating system with a central station, means at each local station for connecting its telephone set across the trunk, a path for current which may be substituted for the telephone set to hold the trunk, and electromagnetic apparatus having independently energized windings upon the energization of which the maintenance of the holding path depends, one of the windings being in series with the trunk line.

5. The combination with the local stations of an intercommunicating system and their telephone sets, of a trunk line for connecting the intercommunicating system with a central station, key apparatus at each local station for connecting its telephone set across the trunk, a path for current which may be substituted for the telephone set to hold the trunk, and relay apparatus having a plurality of windings upon the energization of each of which the holding path depends, the circuit of one of which windings is governed by the key apparatus, the circuit of another of the windings being in series with the trunk line.

6. The combination with the local stations of an intercommunicating system, of a trunk line connected therewith, a holding bridge for the trunk line, means for closing the bridge, and electromagnetic means for opening the bridge, said electromagnetic means having an energizing winding in series with the trunk line between the bridge and central station.

7. The combination with the local stations

of an intercommunicating system, of a trunk line connected therewith, a holding bridge for the trunk line, a holding relay for closing the bridge, and a relay controlled by the holding relay and serving when energized to complete a locking circuit for said holding relay.

8. The combination with the local stations of an intercommunicating system, of a trunk line connected therewith, a holding bridge for the trunk line, a holding relay for closing the bridge, and a locking relay controlled by the holding relay and serving when energized to complete a locking circuit for said holding relay, the locking relay being energized by current over the trunk line.

9. The combination with the local stations of an intercommunicating system, of a trunk line connected therewith, a holding bridge for the trunk line, a holding relay for closing the bridge, and a locking relay controlled by the holding relay and serving when energized to complete a locking circuit for said holding relay, the holding relay being energized by local current and the locking relay by current over the trunk line.

10. The combination with the local stations of an intercommunicating system, of a trunk line connected therewith, a holding bridge for the trunk line, a relay controlling in its contacts the holding bridge, a release relay for the holding relay, and an energizing circuit for the release relay, said circuit being independent of the trunk line.

11. The combination with the stations of an intercommunicating system and their local battery, of a trunk line connected with said stations, a holding bridge for the trunk line, a relay controlling in its contacts the holding bridge, and a release relay for the holding relay, said release relay being energized from the local battery.

12. The combination with the stations of an intercommunicating system and their local battery, of a trunk line connected with said stations, a holding bridge for the trunk line, a relay controlling in its contacts the holding bridge, and a plurality of release relays for the holding relay, one of said release relays being energized from the local battery and another of said relays being energized over the trunk line.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this sixteenth day of March, 1912.

LEON D. BARROWS.

Witnesses:

HARRY P. CHARTSWORTH,

R. S. SUTLIFFE.