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TIE LINE

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FIG. 1

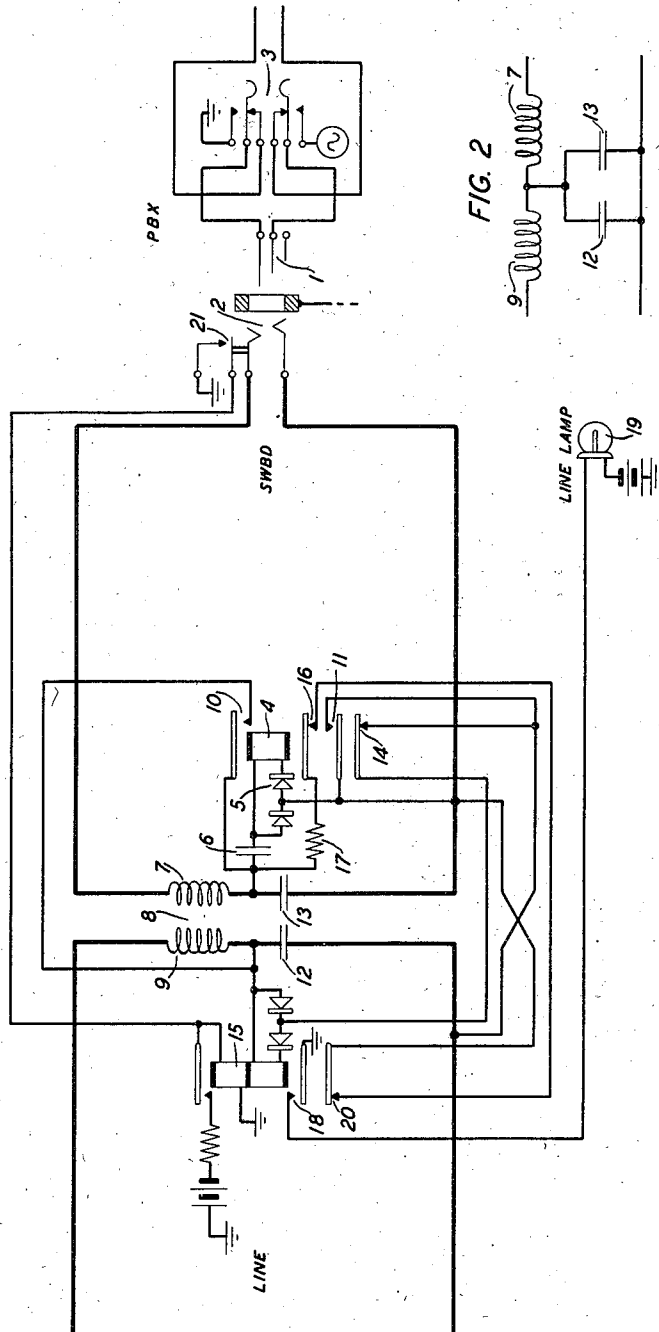
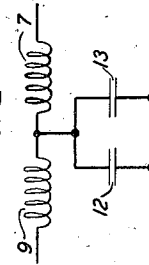


FIG. 2



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TIE LINE

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6 Claims. (Cl. 179—42)

This invention relates to what are called private branch exchange tie-line systems, that is, lines interconnecting two private branch exchanges and more particularly to an improved and simplified ring-down circuit of this character.

In circuit arrangements for this type of service which have been heretofore used, means have been provided for automatically removing a repeating coil normally connected in the line, when ringing current is connected to the line on outgoing calls, which removal has been accomplished by means of an alternating current relay actuated by the ringing current which in turn controls another relay to open a connection for the repeating coil and establish through connections for the line conductors to permit the ringing current to pass directly out over the line. In such an arrangement when the ringing key is operated, and ringing current flows over the line, a substantial charge is built up between the line conductors, due to the normal distributed capacity of the line, and when the ringing key is released and ringing ceases a relatively high potential surge from the charged line flows back into the switchboard and may cause objectionable clicks in any connected receiver.

An object of the present invention is to guard against objectionable clicks when outgoing ringing current is disconnected from the line.

A feature of the invention whereby the foregoing object is obtained resides in providing means, controlled by an outgoing ring, from either end of the line, for translating a repeating coil, normally included in the line thereat, to constitute a low-pass filter for preventing undesirable clicks caused by a line discharge when the ringing current is removed.

Another feature of the invention resides in such an arrangement of circuits at each end of the line that reliable and satisfactory operation is obtained with less and cheaper apparatus than heretofore employed in circuit arrangements of this character.

The invention will be understood from the following description when read in connection with the accompanying drawing,

Fig. 1 of which shows one end of a tie-line arranged in accordance with the invention and extending between two private branch exchanges; and

Fig. 2 is a schematic showing of the connection of the repeating coil during an outgoing ring.

Assuming an outgoing call from the private branch exchange, the operator, after inserting the plug 1 in jack 2 of the line, operates the ringing

key 3 to connect alternating ringing current to the line, whereupon relay 4 operates in a circuit including the lower or ring conductor of the line, unilaterally conducting device 5, winding of the relay 4, condenser 6 and the right-hand winding 7 of repeating coil 8 to the upper or tip conductor of the line.

Relay 4, in operating, closes its upper contacts 10, thereby joining the lower terminals of windings 7 and 9 of the repeating coil and at contacts 11 connects the lower or ring conductor of the line through to the ring spring of the jack 2. With contacts 10 and 11 closed windings 7 and 9 of the repeating coil are connected in series with the upper or tip conductor of the line and the lower or ring conductor is connected through to the jack thus forming a T-section of a low-pass filter as shown in Fig. 2 in which the windings 7 and 9 form the series inductance element and condensers 12 and 13, in parallel, the shunt capacity.

It will be understood that windings 7 and 9 are so connected that when they are in series with the line, they are inductively aiding with respect to each other.

With relay 4 operated, i. e., when ringing current is connected to the line the filter arrangement, above described, has a negligible attenuating effect on the outgoing ringing current, but when the ringing key is released, thus disconnecting ringing current from the line, this arrangement prior to the release of relay 4, offers a high series impedance and a low impedance bridge to surges due to a capacity discharge from the line which, otherwise, might cause objectionable clicks in the operator's receiver.

During the ringing interval, operation of relay 4 also closes its contact 14 to disconnect the ring-up line relay 15, and its associated unilaterally conducting devices, from their normal connection across condenser 12,

Further, operation of relay 4 on an outgoing ring, removes at its contacts 16 a resistance 17, which is normally connected across condenser 13, for the purpose of reducing the load on the ringing current supply.

On an incoming ring, relay 15 operates and locks over its upper contacts and, by closing its contacts 18, lights the line lamp 19 in the switchboard. Relay 15, in operating, also opens its normally closed contacts 20 thus opening at another point the circuit across condenser 13 which includes resistance 17, which, however, performs no useful function at this time.

In the case of a rering while the cord circuit is connected to the jack 2, relay 15 operates but

does not lock due to the fact that its locking winding is short-circuited at local contacts 21 of the jack 2. Contacts 20 are also opened at this time which disconnect the resistance 17 from its normal connection across condenser 13 to cause a supervisory relay in the cord circuit (not shown) to light a supervisory lamp in the cord as a signal to the operator. The line lamp 19 also lights on a rering but in this case its value is negligible.

What is claimed is:

1. In a telephone system, in combination, a private branch exchange, a switchboard thereat, an inductive device at said exchange comprising a two-winding transformer and a pair of condensers, a two-way ring-down tie-line terminating in series with one of said windings and one of said condensers, the other winding and condenser being serially connected to line terminals of said switchboard, a pair of relays each adapted to respond to ringing current, a third condenser, a first one of said relays being serially connected with the third condenser in shunt to the condenser in the switchboard side of said inductive device and the second relay being normally connected in shunt to the condenser in the line side of said inductive device under control of said first relay, a resistance normally connected, under joint control of both relays, in a circuit in shunt to the condenser in the switchboard side of the inductive device, and means responsive to operation of said first relay, for connecting the line through to the switchboard with the two coil windings in series with one side thereof and the said pair of condensers in a parallel bridge between the mid-point of said connected windings and the other side of the line.

2. In a telephone system, a switchboard, a tie-line, a two-winding repeating coil for inductively connecting said tie-line to said switchboard, a condenser in series with each of said windings, a ringing responsive relay connected to said line, means at said switchboard for applying ringing current to said line to operate said relay, and means responsive to operation of said relay for connecting one side of the line through to the switchboard in series with said two coil windings, directly connecting the other side of the line through to the switchboard and for connecting said two condensers in parallel between said other side of the line and a point intermediate said two windings.

3. In a telephone system, a switchboard, a tie-line, a two-winding repeating coil for inductively connecting said tie-line to said switchboard, a condenser in series with each of said windings, a resistance shunting the condenser in the switchboard side of said repeating coil, a ringing responsive relay connected to said line, means at said switchboard for applying ringing current to said line to operate said relay, and means responsive to operation of said relay for connecting one side of the line through to the switchboard in series with said two coil windings, directly con-

necting the other side of the line through the switchboard and for connecting said two condensers in parallel between said other side of the line and a point intermediate said two windings, and other means responsive to operation of said relay for disconnecting said resistance from its shunt connection to said condenser.

4. In a telephone system, a switchboard, a tie-line, a two-winding repeating coil inductively connecting said tie-line to said switchboard, a condenser in series with each of said coil windings, a first relay connected in parallel with the condenser in the switchboard side of said repeating coil, means at said switchboard for applying ringing current to the line to operate said first relay, means responsive to operation of said first relay for connecting one side of the line through to the switchboard in series with said two coil windings, directly connecting the other side of the line through to the switchboard, and for connecting said two condensers in parallel between said other side of the line and a point intermediate said two windings, a second relay connected in parallel with the condenser in the line side of said repeating coil and responsive to ringing current incoming over said line and other means also responsive to operation of said first relay for disabling said second relay.

5. In a telephone system, a switchboard, a line, a two-winding repeating coil inductively coupling said line to said switchboard, a condenser in series with each of said coil windings, a relay connected in shunt to the condenser in the switchboard side of said repeating coil and responsive to ringing current applied to the line at the switchboard for effectively translating said repeating coil and associated condensers to constitute a T-section of a low-pass filter in said line.

6. In a telephone system, a switchboard, a tie-line, a two-winding repeating coil inductively connecting said line to the switchboard, a condenser in series with each of said coil windings, a first relay connected in parallel with the condenser in the switchboard side of said repeating coil, means for applying ringing current to the line at the switchboard to operate said relay, means responsive to operation of said first relay for connecting one side of the line through to the switchboard in series with said two coil windings, directly connecting the other side of the line through to the switchboard and for connecting said two condensers in parallel between said other side of the line and a point intermediate the two windings, a second relay responsive to ringing current connected in parallel with the condenser in the line side of said repeating coil, a resistance also shunting the condenser in the switchboard side of said repeating coil, means responsive to operation of said first relay for disabling said second relay, and means responsive to operation of either one of said relays for disconnecting said resistance.

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