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SIGNALING SYSTEM

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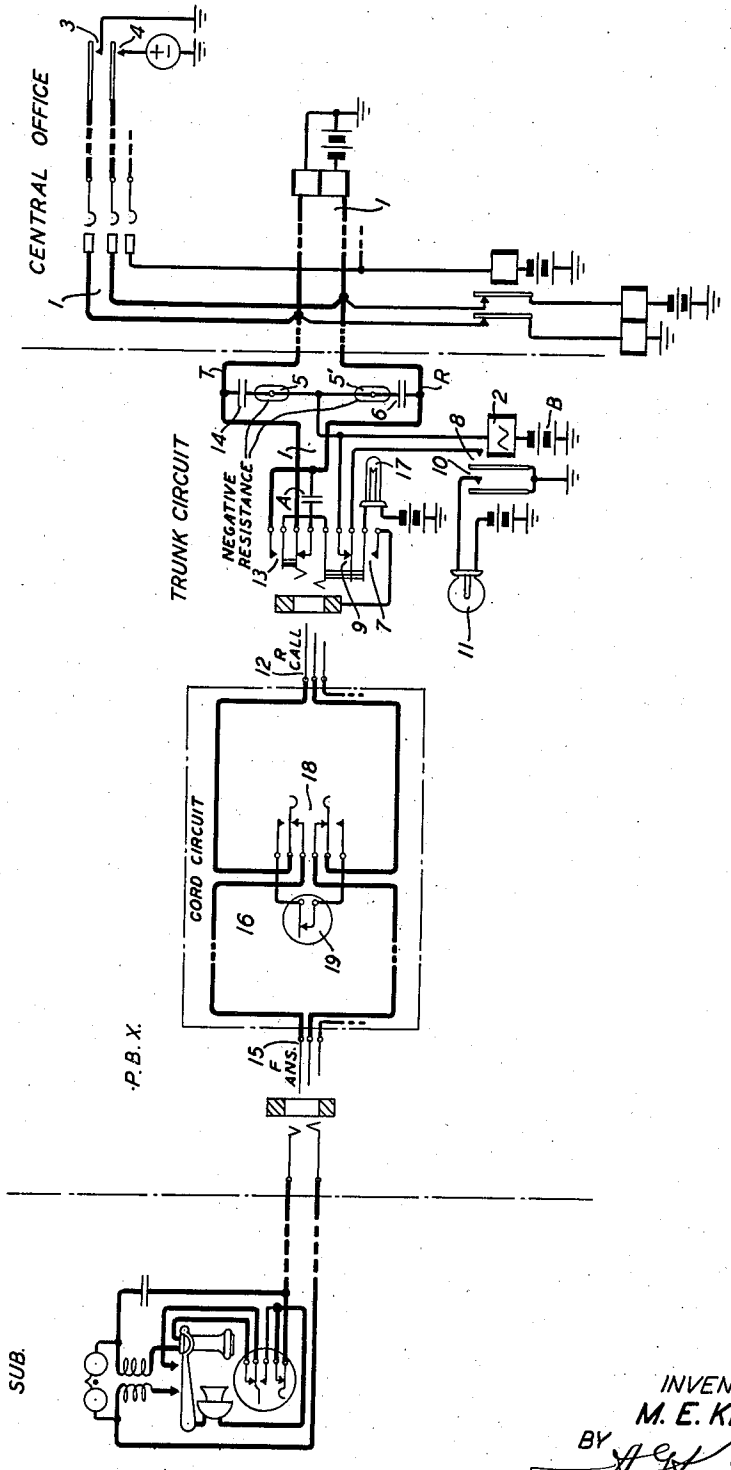

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SIGNALING SYSTEM

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This invention relates to improvements in signaling systems and more particularly to means for preventing dial impulses, or battery reversal surges, from affecting alternating current responsive signal devices associated with telephone lines.

An object of the invention is to effect economies in, and improve the efficiency of telephone trunk circuits.

Another and more specific object of the invention is to prevent, in a more economical manner than heretofore, false operation of alternating current ringing relays connected to telephone lines when successive direct current dial impulses are transmitted thereover, on a so-called loop basis.

A further object is to transmit successive pulses of the order of twenty per second over such lines without distortion of the current pulses.

A feature of the invention whereby the foregoing objects are attained resides in a high resistance negative temperature coefficient bridge across the line between the mid-point of which and ground the alternating current responsive device or ringing relay is connected. By this arrangement direct current flowing in opposite directions in the two sides of line does not affect the ringing relay but when alternating current is projected over either side of the line, or both sides simultaneously, from a grounded source, it will, after a fraction of a second delay, find a low resistance path to ground through the ringing relay or other responsive device.

More specifically the bridge consists of two serially connected resistance units of boron, silver sulphide or other negative temperature coefficient substance, each resistance having a cold or normal resistance of the order of 100,000 ohms and so arranged that the application of ringing current thereto will cause the resistance of each unit to drop to approximately 1,000 ohms in approximately one-half second. This characteristic, i. e., the time interval before the resistance drops to a current conducting value prevents false operation of the ringing relay on line surges which persist for only a few milliseconds. Further, the normally high resistance of the bridge does not introduce any inductive disturbance in the circuit which will distort rapid direct current dial pulses flowing in opposite directions in the two sides of the line.

In practice the bridge also includes a pair of condensers one in series with each resistance thereby completely eliminating any steady direct current leakage across the line.

Another feature of the invention resides in the employment of a single wound ringing relay arranged when operated to lock itself in the operated condition over its operating winding, under control of the answering jack, without affecting the other normal functions of the line.

The invention will be understood from the following description when read in connection with the accompanying drawing which represents a local subscriber's station and line, a trunk circuit from a machine switching central office which trunk is arranged in accordance with the present invention, and a private branch exchange cord circuit for interconnecting said subscriber's line and trunk.

Incoming call

Let it be assumed that the line terminals of trunk circuit 1 have been seized at the central office CO by brushes of an automatic switch and ringing current has been applied over relay contacts 3 and 4 to signal the operator at the private branch exchange. Under this condition a source of grounded alternating current, of ringing frequency, is transmitted over the ring conductor R of the trunk thereby causing operation of the ring-up relay 2 in a circuit which can be traced from the grounded source of ringing current, contacts 4, the ring conductor R of the line, condenser 14, negative temperature coefficient resistance element 5' and winding of relay 2 to ground through the locking battery B.

Resistance unit 5' is composed of some material such as boron, silver sulphide or their equivalent and of such dimensions as to have a very high resistance, i. e., of the order of 100,000 ohms, under normal conditions, but having the characteristic of decreasing its resistance very rapidly to a comparatively low value when subjected to ringing current of the voltage commonly used in telephone systems, i. e., of the order of 90 volts.

In the present case an element of boron, whose dimensions are such as to have a normal (cold) resistance of 100,000 ohms will, when subjected to 90 volt ringing current for a period of one-half second, lower its resistance to about 100 ohms. Therefore, when ringing current has been applied to the resistance element 5' for approximately one-half second, its resistance will be sufficiently low to permit the required current to flow through the winding of relay 2 to cause its operation.

Due to the fact that direct ground is connected to the tip conductor T of the trunk over contacts 3, no voltage will be impressed on resistance ele-

ment 5, which is substantially identical to element 5'. If, however, under certain conditions the connection of the ringing source to the line should be reversed, the resistance element 5 would decrease its resistance and allow sufficient current to operate relay 2 in the same manner as previously described.

Further, should conditions be such that the ringing source is connected to both the tip and the ring of the trunk in parallel, the resistance of both elements 5 and 5' would decrease to a low value within the specified interval of time.

Relay 2 in operating closes its outer left contacts thereby lighting line lamp 11 in an obvious circuit.

Closure of the inner left contacts of relay 2 completes an obvious locking circuit for itself, which includes battery B.

Condensers 14 and 6 prevent any direct current leakage through the bridge.

When the private branch exchange operator notices the lighted lamp 11, she inserts plug 12 of her cord circuit into the trunk jack which opens the locking circuit for relay 2 which releases thereby extinguishing the line lamp. Insertion of the plug also closes contacts 13 thereby completing the ring talking conductor of the cord through to the trunk and removes condenser A from its normally bridged connection across the tip and ring of the trunk. The function of this condenser is to normally provide an instantaneous alternating current path of low impedance in bridge of the trunk which is required for certain test purposes in connection with so-called cross-bar switching systems, which path is not provided by condensers 14 and 6 and resistance elements 5 and 5', due to the normally high resistance of elements 5 and 5'.

Re-ring by central office

If for any reason the central office re-rings on the trunk before the plug 12 is removed from the jack, relay 2 again operates approximately one half second after ringing starts, which time is required for the unit 5' to reduce its resistance sufficiently for the relay to operate.

When relay 2 operates, it remains operated, and lights lamp 11, only as long as the ringing current is applied to the trunk.

Outgoing call

In case subscriber S requests a connection with a central office subscriber, the operator will insert plug 12 in the trunk jack and as the ring spring is disconnected from the ring conductor of the trunk, at contacts 13, until the tip of the plug fully engages the tip spring of the jack, the possibility of a false impulse of current over the trunk to the central office is almost negligible.

Insertion of the plug opens the locking path of relay 2 and connects battery through resistance lamp 17 over contacts 7 of the jack to the sleeve of the plug to operate the sleeve relay of the cord (not shown).

If the operator is to dial the wanted number, she operates the talk and dial key 18 and actuates the dial 19 to transmit the requisite code of impulses.

Due to the normal high resistance and non-inductive characteristic of the resistance units 5 and 5', the ringing bridge will have no distorting effect on the current impulses in the trunk caused by the rapid interruption (20 per second) of the circuit at the contacts of dial 19.

What is claimed is:

1. In a signaling system a line, a grounded source of alternating ringing current adapted to be connected to said line, a negative temperature coefficient resistance in bridge of said line, and an alternating current responsive device connected between the mid-point of said bridge and ground.

2. In a signaling system a line, a grounded source of alternating ringing current adapted to be connected to said line, a bridge comprising a pair of boron resistances connected in series across said line, and a ringing current responsive device connected between the junction of said units and ground.

3. In a signaling system a line, a grounded source of alternating current adapted to be connected to said line, a device responsive to said ringing current, a pair of boron resistors, a pair of condensers and a connection between each side of the line and ground including one of said resistors, one of said condensers and said responsive device.

4. In a telephone system, a trunk line terminating at one end in an automatic exchange and in a dial at the other end, a grounded source of alternating ringing current adapted to be connected to the line at the automatic exchange, a bridge across the line intermediate the ends thereof, serially comprising a pair of boron resistors and a pair of condensers and a ringing relay connected between ground and the electrical mid-point of said bridge.

5. In a signaling system a line, a grounded source of alternating ringing current adapted to be connected to said line, a negative temperature coefficient resistance in bridge of said line and a single wound alternating current relay connected between the mid-point of said bridge and a grounded battery, said relay being so arranged that when operated it closes a locking circuit for itself including its operating winding and said grounded battery.

6. In a telephone system, a trunk line and a single wound ringing relay connected thereto, said relay being so arranged and connected that when operated, it closes a locking circuit for itself including its operating winding without affecting any of the normal functions of the trunk circuit.

7. In a telephone system, a trunk line terminating at one end in an automatic exchange and in a dial at the other end, a grounded source of alternating ringing current adapted to be connected to the line at the automatic exchange, a bridge across the line intermediate the ends thereof serially comprising a pair of boron resistors and a pair of condensers and a single winding relay connected between grounded battery and the electrical mid-point of said bridge, said relay being so arranged that when operated it closes a locking circuit for itself including its operating winding.

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