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TELEPHONE SUPERVISORY SYSTEM

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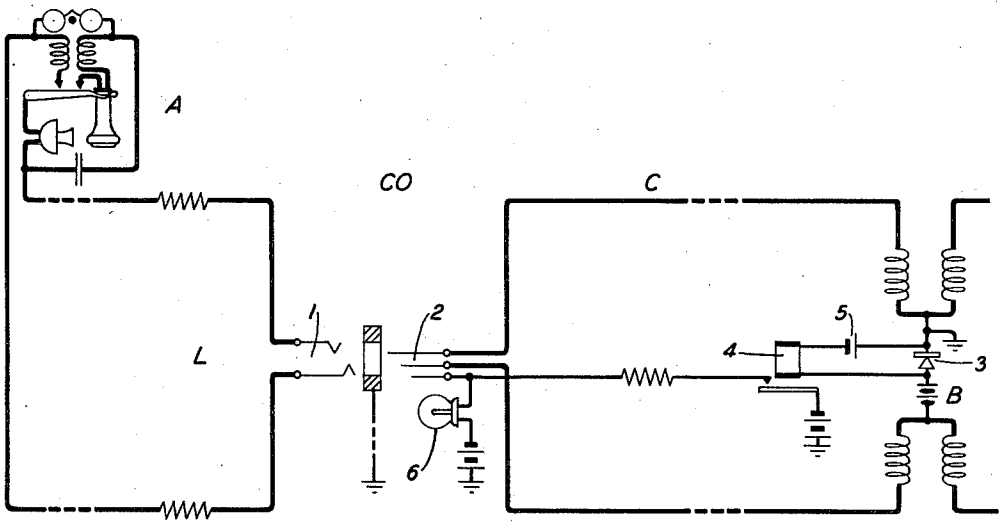


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## TELEPHONE SUPERVISORY SYSTEM

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3 Claims. (Cl. 179—70)

This invention relates to signaling systems and more particularly to telephone supervisory systems whereby a supervisory relay may be controlled over long or high resistance lines without seriously increasing the impedance of the line circuit.

An object of the invention, therefore, is to retain satisfactory supervisory relay operation over unusually high resistance lines without seriously impairing the transmission of voice currents thereover.

A feature of the invention whereby the foregoing object is attained resides in connecting a metal oxide rectifier of the proper characteristic in series with the line and exchange battery in such a manner that it will conduct currents when the line is closed and in connecting the cord supervisory relay, and an auxiliary battery, in series therewith, in shunt to the rectifier, the auxiliary battery being so poled that when the line is open and no current is flowing in the rectifier there will be no appreciable current flow from the auxiliary battery through the relay.

Under the above condition when the line is closed and current flows through the rectifier the resistance thereof is said to collapse or is reduced to a very low value as is well known, thereby permitting current from the auxiliary battery to flow therethrough and through the relay to cause its operation.

In such an arrangement the current flowing through the relay winding when the line is closed is substantially independent of the value of the current flowing in the line and, by choosing a rectifier having the proper characteristic the impedance added to the line impedance thereby may be quite low thus removing certain of the difficulties experienced in providing proper supervision over long or high resistance lines which heretofore have necessitated that the cord supervisory relay, which is usually in series with one of the talking conductors, must be of rather high impedance which frequently seriously impairs the transmission of speech current.

The invention will be understood from the following description when read in connection with the accompanying drawing which shows, schematically, a subscriber's telephone line and a conventional repeating coil type common battery cord circuit arranged as above described.

Referring to the drawing, A is a subscriber's station connected to a line L terminating at the central office CO in jack 1. C is one end of an operator's cord circuit of the well known repeating coil type which is adapted to be connected to the line L by means of plug 2.

Serially connected at the center of the repeating coil bridge in the cord circuit is a dry or metal oxide type rectifier element 3 poled in a conductive direction with respect to the central office battery B. Connected in shunt to the rectifier 3 is a circuit serially including an auxiliary source of direct current 5 and the usual cord supervisory relay 4 which, when operated, shunts the supervisory lamp 6 thereby extinguishing it. Source 5 is connected in the circuit so that its current will tend to flow through the rectifier 3 in the non-conducting direction.

The operation of the circuit is as follows: If it is assumed that station A is the called station, when the operator inserts plug 2 in jack 1 no current will flow in the line as long as the subscriber's receiver is on the switchhook and hence the normal resistance of rectifier element 3 remains undisturbed due to the fact that no current is flowing therein.

If the resistance of rectifier element 3, relay 4 and voltage of source 5 are properly chosen insufficient current will flow from source 5 through relay 4 to cause its operation and hence supervisory lamp 2 will be lighted in the obvious sleeve circuit.

When the subscriber at station A removes his receiver from the hook the line circuit is closed at that point and current immediately flows from the central office battery B through the rectifier 3, which is poled in a conducting direction with respect to the battery B, to the line. This flow of current through the rectifier causes its resistance to collapse, i. e., to decrease to a very low value and hence it offers little opposition to the flow of current from source 5 through relay 4 which relay thereupon operates and extinguishes lamp 6 by shunting it in an obvious manner.

When the subscriber replaces his receiver on the hook the line circuit is opened and current ceases to flow through rectifier 3 whereupon its resistance increases to a relatively high value thereby reducing the current flowing in the circuit including relay 4 to a negligible value and permitting relay 4 to release which thereupon removes the shunt from lamp 2 permitting it to light as a disconnect signal.

The operation of the circuit is the same in case station A is the calling station, i. e., when the line is closed at the station and the plug of the cord circuit inserted in the line jack current flows through the rectifier 3 and causes its

resistance to be lowered to a point which will permit sufficient current to flow from source 5 through the rectifier and relay 4 to cause that relay to operate and when the line is opened the rectifier resistance is increased thereby reducing the current through relay 4 and permitting it to release.

The manner in which values of the various elements in the circuit are chosen in order that it will operate in the desired manner can be explained as follows:

Let:

E=voltage of battery B
L=length of line L in ohms
R=resistance of relay 4
$e$=voltage of auxiliary source or battery 5
$r$=resistance of rectifier element 3
$\epsilon$=voltage drop across rectifier 3
$I_1$=current in line L
$I_2$=current through relay 4.

Then:

$$r(I_1-I_2)+e-RI_2=0 \quad (1)$$

$$E-r(I_1-I_2)-LI_1=0 \quad (2)$$

$$\epsilon=r(I_1-I_2)=E-LI_1 \quad (3)$$

From (1) $$I_2=\frac{e+rI_1}{R+r} \quad (4)$$

Substituting (3) and (4) in (2) and solving,

$$e=RI_1-\frac{\epsilon}{r}(R+r) \quad (5)$$

If the value of the current in relay 4 is to change materially when the subscriber's receiver is removed from the switchhook the resistance of relay 4 will have to be a small fraction of the resistance of the rectifier element 3 to the flow of current in the non-conducting direction. This is indicated by Equation (4). If the resistance of the rectifier 3 to the flow of current in the conducting direction is considerably smaller than the resistance of relay 4, and it is desired that the rectifier 3 operate at a certain point on the resistance-voltage characteristic curve of the rectifier unit when a particular value of current flows in the line loop, then the necessary voltage of the auxiliary battery 5 is expressed from Equation (5) as:

$$e=R\left(I_1-\frac{\epsilon}{r}\right)$$

What is claimed is:

1. In a common battery telephone system, a line, a cord circuit adapted to be connected to said line, a source of direct current in said cord circuit, a metal oxide rectifier in series with said source of current, a supervisory relay connected in shunt to said rectifier and a second source of current in series with said relay.

2. In a signaling system, a line circuit serially including a source of direct current and a metal oxide rectifier, means for closing the circuit, a relay connected in shunt to said rectifier, and a second source of direct current in series with said relay, said rectifier and current sources being so connected with respect to each other that when the line is open there will be substantially no flow of current from either source and when the line is closed current from the first source will flow in the line and current from the second source will flow through the relay to cause its operation.

3. In a telephone supervisory signal system a line, a link circuit adapted to be connected to said line, a source of direct current in bridge of said link circuit, a metal oxide rectifier in series with said source of current, a supervisory relay connected in shunt to said rectifier and a second source of direct current in series with said relay, said second source being so poled in said shunt circuit that no appreciable current will flow therefrom through said rectifier.

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