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MONITORING SYSTEM

Filed Aug. 9, 1944

FIG. 1

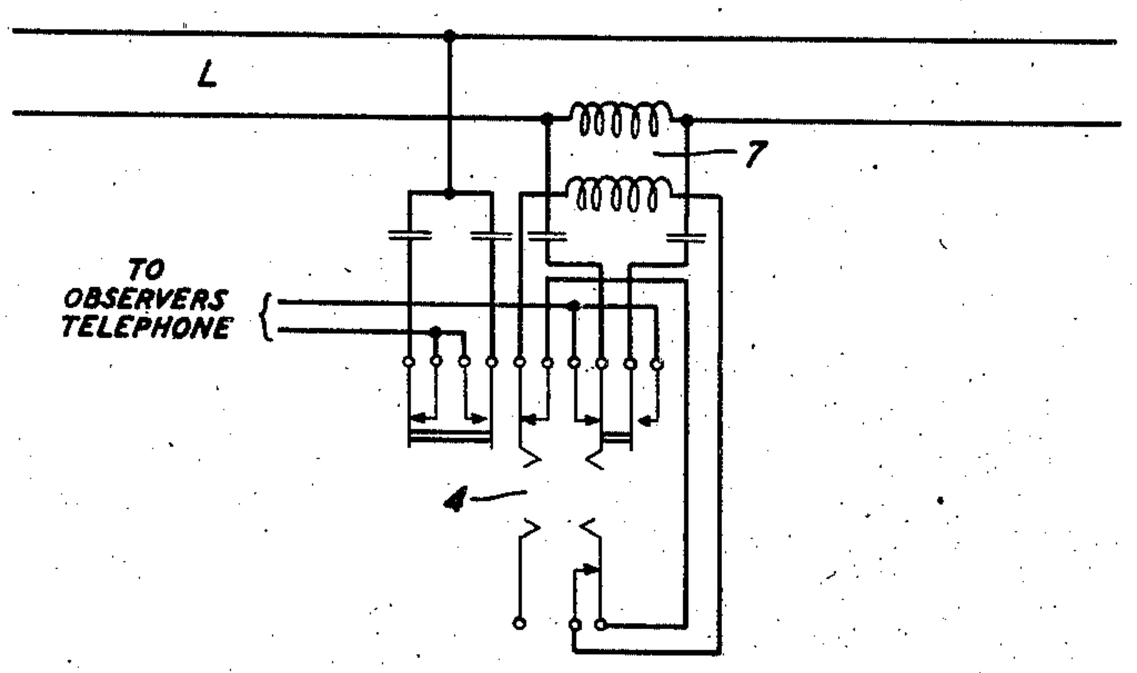
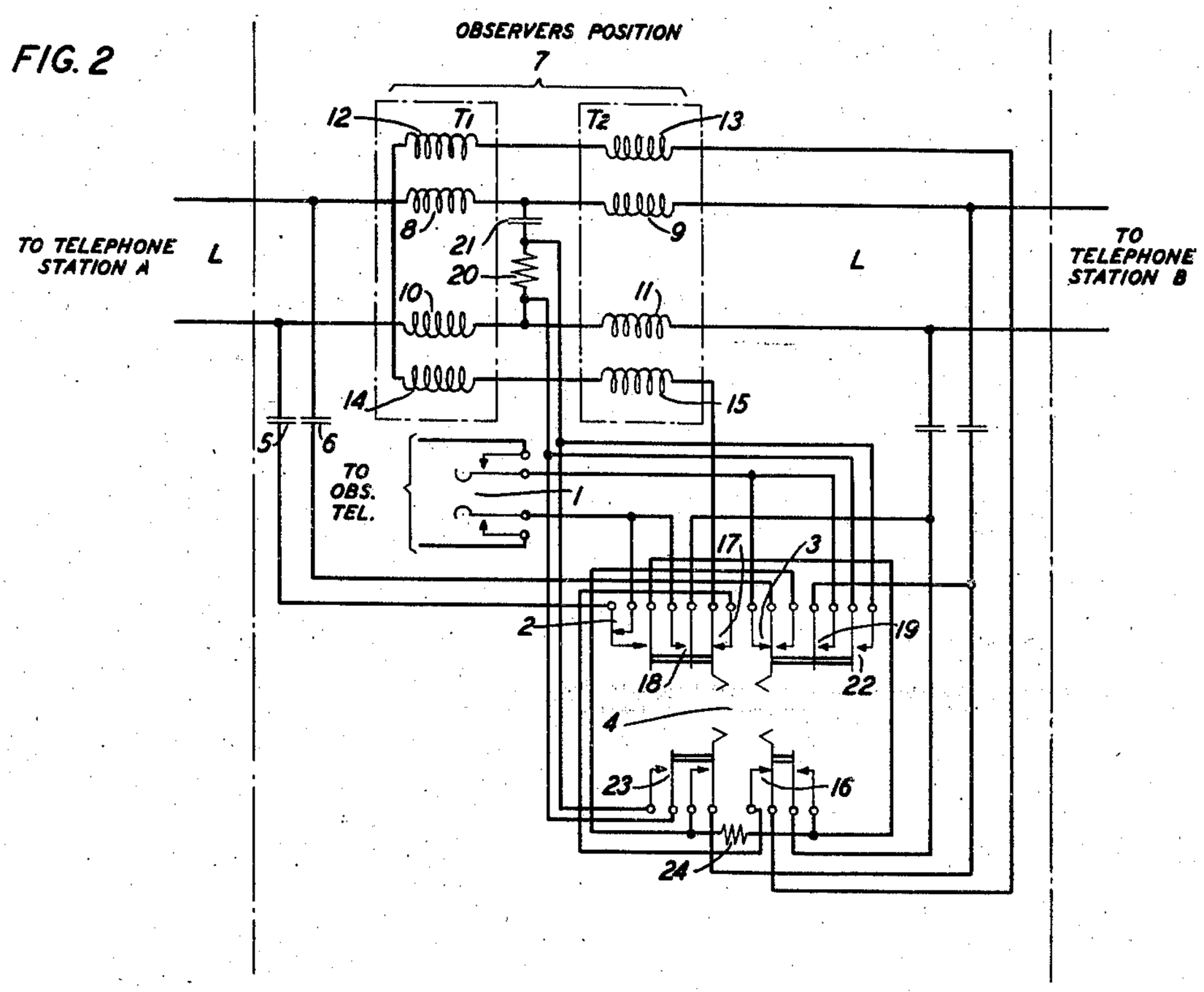


FIG. 2



INVENTOR
H. M. BASCOM
BY H. O. Kingsman
ATTORNEY

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MONITORING SYSTEM

Henry M. Bascom, New York, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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6 Claims. (Cl. 179—51)

1

This invention relates to telephone monitoring or observing systems whereby an attendant located at some intermediate point on a telephone line is able to listen in and talk on the line over which an established telephone conversation is in progress and more particularly relates to means whereby the attendant is able to listen on the line and talk to both parties simultaneously or to interrupt the transmission of voice frequency currents between the connected stations without opening any direct current paths which may be established over the line and to talk to either party to the exclusion of the other party.

It has been established practice for many years to provide telephone operator's cord circuits with what are known as splitting keys whereby an operator is enabled to open the cord, intermediate its two ends and to selectively talk over either of the connected lines to the exclusion of the other line. Such an arrangement, however, merely provides for severing the cord conductors at some point intermediate the two connected terminals and connecting the operator in either direction to either of the connected lines. In such an arrangement, for the reason that the cord conductors are actually severed, no electrical path exists between the lines connected to the two ends of the cord.

In the present arrangement, a line transmitting voice frequency currents and also providing one or more paths for direct current supervision or other purposes, can be "split" to the extent that voice frequency current transmission is interrupted without appreciably interfering with the flow of direct current.

An object of the invention is to provide so-called "splitting" at an observer's position on a line whereby voice frequency transmission is prevented without interfering with the transmission of direct current thereover.

A feature of the invention whereby the foregoing object is obtained, resides in the inclusion in a line at an observer's position, of an inductive device having a low direct current resistance, and also having a low impedance alternating current within the voice range, and by the provision of means controlled by an observer for changing the impedance of the device to voice frequency currents to a high value without changing its direct current resistance in the line.

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

Fig. 1 of which shows the fundamental concept

2

of the invention applied to an observer's "splitting" circuit; and

Fig. 2 shows a practical application of the invention to a line arranged for voice frequency transmission and direct current supervisory signaling.

Referring to Fig. 1, a line L over which speech currents are being transmitted and which also provides for direct current supervisory signaling between its terminals, is provided with a transformer or retardation coil 7 having at least two windings, one of which windings (upper) is serially included in the line and the other winding is included in a normally closed local circuit including two contacts of a splitting key 4. The device 7 is of such design and construction and its windings of such proportion that the line winding has a low direct current resistance and when the lower winding is in the closed circuit condition shown on the drawing, i. e., when the contact springs of the key 7 are in their normal or unoperated position, the upper or line winding also offers a relatively low impedance to voice frequency currents flowing in the line, but when the circuit including the lower winding is opened by operation of the splitting key to either of its two positions, the impedance offered by the line winding to alternating current is increased to such a high value that through transmission of speech is effectively prevented. Further, when the upper unit of the key 4 is actuated, which opens the normally closed circuit for the lower winding of the device 7, to increase its impedance, the observer's telephone set is connected in bridge of the section of the line to the right of the observer, when the upper unit of the key is restored to normal, the observer's telephone is connected to the opposite section of the line to the left of the observer and the circuit of the lower windings of the coil is again closed and when the lower unit of the key is actuated, the circuit of the lower winding of the coil 7 is again open-circuited at another point to again increase the impedance of the device 7.

When both upper and lower units of the key 4 are in their normal position, the observer's telephone is connected in bridge of the line and the lower winding is connected in a closed circuit thereby permitting through speech transmission over the line and enabling the observer to monitor on the conversation if desired.

Referring to Fig. 2 of the drawing, which shows a practical arrangement of the invention, an observer's position is shown located on a line L intermediate the ends thereof, which line, as

referred to in connection with Fig. 1, is adapted for the transmission of speech and direct current supervisory signals. Included in the line at the observer's position is shown a network 7 comprising two multiwound transformers or retardation coils T1 and T2, each having two of its windings 8, 10 and 9, 11, respectively, connected in series with the line, one in the upper or tip side and one in the lower or ring side. The remaining two windings of each transformer 12, 14 and 13, 15, respectively, are connected in series in a circuit closed at contacts 16 and 17 of splitting key 4. Windings 8 and 10 of transformer T1 and windings 9 and 11 of transformer T2 are connected in the line in such a manner that when the circuit including windings 12, 14 and 13, 15 are in a closed circuit, i. e., when the contacts 16 and 17 of key 4 are in their normal or closed conditions the effective impedance to voice frequency currents offered by windings 8, 10 of transformer T1 and 9, 11 of T2 is of a relatively low order.

Further, due to the low ohmic resistance of windings 8, 10 and 9, 11, which in practice are equal, the passage of direct current through the network is not effected to any appreciable extent. For a purpose to be later referred to, a large capacity condenser 21 and a high resistance 20 are serially connected across the line at a point in the network intermediate the two transformers T1 and T2, but due to the high value of resistance 20, the shunting effect of this arrangement to both direct current and speech frequencies is negligible.

At the observer's position, a telephone, not shown, is adapted to be connected to the line by means of a talk key 1 over a circuit which normally includes contacts 3 and 2 of the splitting key 4 and condensers 6 and 5.

In describing the operation of the invention, Fig. 2, it will be assumed that a telephone connection has been established over line L between stations A and B and that when the connection was established the observer was notified of the fact, by means not shown, and therefore put on notice to listen in on the conversation, if considered necessary or desirable, which operation is accomplished in a well-known manner by operation of the talk key 1 which connects the observer's telephone in bridge of the line as before referred to.

In case the observer desires to interrupt the conversation and speak to station A, to the exclusion of station B, the splitting key 4 is operated to its lower position thereby opening at its contacts 16, the normally closed circuit including windings 12, 13 and 15, 14 of transformers T1 and T2 whereupon windings 8 and 10 of transformer T1 and windings 9 and 11 of transformer T2, due to the absence of the opposing inductive effects of windings 12, 14 and 13, 15, respectively, assume a high impedance to voice currents and tend to isolate stations A and B from each other.

When splitting key 4 was operated to its lower position, it also closed its contacts 23 thereby short-circuiting high resistance 20 and leaving condenser 21 alone in shunt to the line thereby further increasing the impedance of network 7 to a very high value and effectively preventing through transmission between the connected stations. In this position of the key 4, i. e., when the closed circuit for windings 12, 13, 15 and 14 is open and the resistance 20 is short-circuited a circuit arrangement for network 7 is established which constitutes a single T section of what

is known as a constant K two-element low-pass filter, i. e., one having two inductances in series with the line and a capacity in shunt to the line which filter will transmit all frequencies between zero and the cut-off frequency which can be established, by proper design, as the low side of the voice frequency band.

Also in this lower position of key 4, the operator's telephone remains connected over contacts 2 and 3 of key 4 to the left-hand section of the line and hence the observer can talk with station A without being overheard by station B.

In case the observer desires to talk with station B to the exclusion of station A, the talk key 4 is operated to its upper position thereby transferring the operator's telephone circuit from the left-hand tc the right-hand section of the line which involves opening contacts 2 and 3 and closing contacts 18 and 19. Contacts 17 are also opened in this position of key 4, thus opening the circuit of windings 12, 13, 14 and 15 at another point to increase the impedance effect of network 7 in the line, as before.

The observer can now talk with the person at station B without being overheard by station A.

Further, operation of key 4 to its upper position closes at its contact 22 another short-circuit around high resistance 20 to remove this resistance from the shunt connection across the line to again increase the impedance of the network to a high value.

It will be noted that when the splitting key 4 is operated in either direction to connect the observer's telephone to one station to the exclusion of the other, and to effectively split the two line sections from each other a resistance 24 (of the order of 600 ohms) is connected across the section of the line which is not connected to the observer's telephone for the purpose of maintaining a predetermined impedance termination across that section of the line which may be required in case a repeater, or other transmission apparatus is included in that section of the line.

What is claimed is:

1. In a monitoring system, a line, telephone stations at each end thereof for transmitting voice frequency currents thereover in either direction, a monitoring position intermediate said stations, a telephone set at said position, and splitting means including a pair of selective switches controlled at said position for simultaneously preventing transmission of voice currents between said stations and for selectively connecting said telephone set to said line for communicating with either of said stations to the exclusion of the other, said splitting means also comprising a multiwound inductance coil having at least one winding in series with said line and one winding normally short-circuited and adapted to be open-circuited in response to operation of either of said switches.

2. In a monitoring system, a line, telephone stations at each end thereof for transmitting voice frequency currents thereover in either direction, a monitoring position intermediate said stations, a telephone set at said position and splitting means including a pair of selective switches at said position for simultaneously preventing transmission of voice currents between said stations and for selectively connecting said telephone set to said line for communicating with either of said stations to the exclusion of the other, said splitting means also comprising a pair of

multiwound transformers each having two windings connected in series-aiding relation in each side of the line and also having a plurality of other windings, serially-connected in an aiding direction in a closed loop, a high resistance and a large capacity condenser connected in series across the line between the transformer, and means responsive to operation of either of said switches for opening said closed loop and for short-circuiting said high resistance.

3. In a monitoring system, a line, telephone stations at each end thereof for transmitting voice frequency currents thereover, means at each end of the line for transmitting direct current signals over said line, a monitoring position intermediate two sections of the line, and splitting means at said position and controlled thereat for preventing transmission of said voice frequency currents between said line sections without interfering with the transmission of said direct current signals, said splitting means including a device in said line comprising inductive, capacitative and non-inductive resistance elements so arranged and normally connected that said device offers a negligible impedance to the transmission therethrough of both direct and voice frequency currents, said splitting means also comprising switching means for changing the effective arrangement and connection of said elements to constitute a T-section of a constant K two-element low-pass filter having the property of highly attenuating voice frequency transmission therethrough and having a substantially negligible attenuating effect on direct current transmission therethrough.

4. In a monitoring system, a line, telephone stations at each end thereof, for transmitting voice frequency currents thereover, means at each end of the line for transmitting direct current signals thereover, a monitoring position intermediate the two ends of the line and splitting means controlled at said position for preventing transmission of voice frequency currents between said stations without interfering with the transmission of said direct current signals, said splitting means

including a device in said line comprising a pair of inductance coils each having at least two windings one winding of each coil being serially connected in one side of the line and another winding of each coil being normally short-circuited, a condenser and a high resistance serially connected across said line between said inductance coils, said splitting means also including a switching device for simultaneously opening said short-circuited windings and effectively reducing said high resistance to a negligible low value.

5. In a monitoring system, a line, telephone stations at each end thereof for transmitting voice frequency currents thereover in either direction, a monitoring position intermediate said stations, a telephone set at said position, and splitting means including a switching device controlled at said position for simultaneously preventing transmission of voice current between said stations and for selectively connecting said telephone set to said line, for communicating with either of said stations, said means also comprising a pair of multiwound inductance coils, each coil having one of its windings connected in series with the line and another winding normally short-circuited, and a large capacity condenser and a high resistance serially connected in bridge of said line between said two line windings, said switch being adapted, when operated, to simultaneously open said short-circuited windings, short-circuit said high resistance and selectively connect said telephone set to said line on either side of said pair of inductance coils.

6. In a telephone system, a line adapted to transmit both direct current and speech frequency alternating current, means intermediate the ends of said line for effectively preventing the through transmission of said alternating current without interfering with the transmission of said direct current, said means comprising an inductance device having one winding in series with the line and a second winding normally short-circuited, and a switching device for opening said short-circuited winding.

HENRY M. BASCOM.