Jan. 24, 1939. F. PFLEIDERER 2,145,095

TELEPHONE SYSTEM

Filed Jan. 22, 1936

FIG. 1

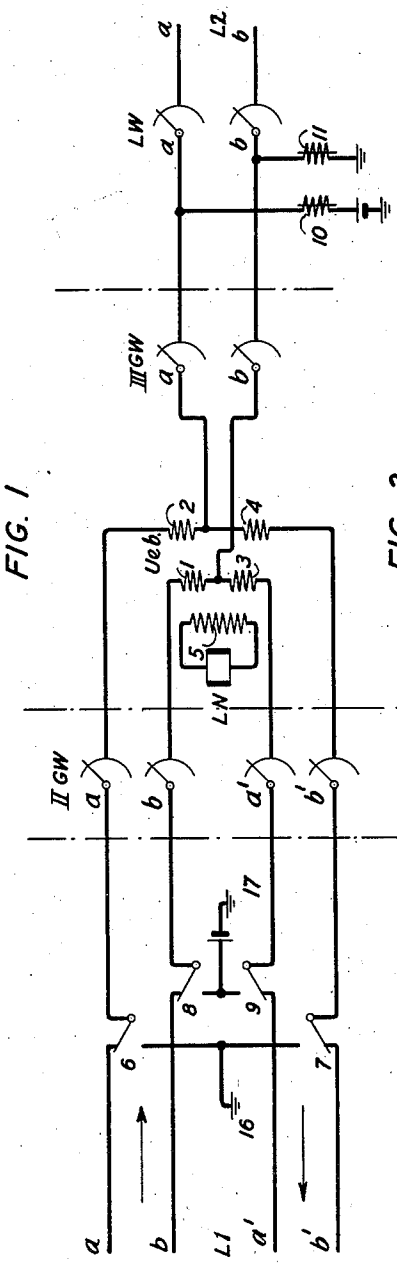
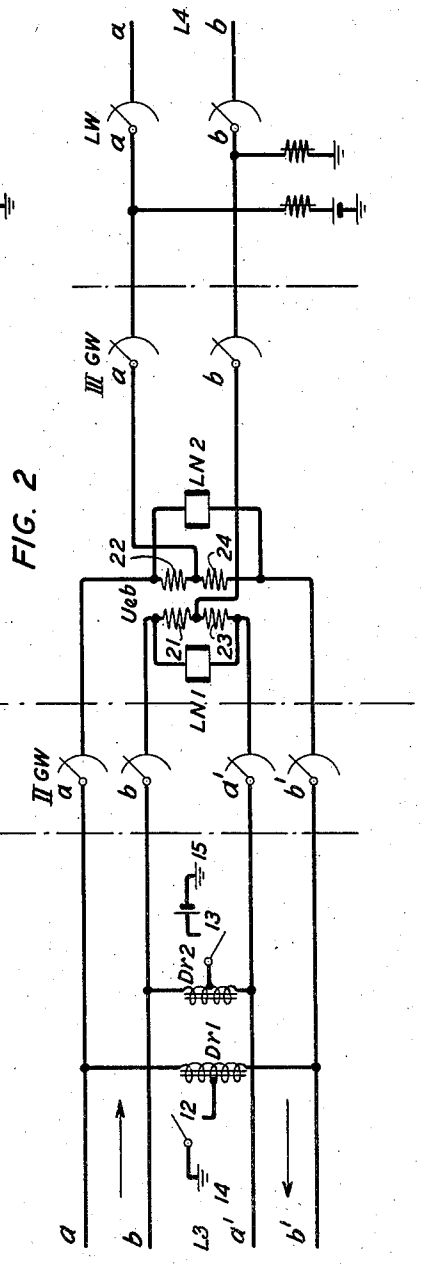


FIG. 2



INVENTOR
F. PFLEIDERER
BY
ATTORNEY

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TELEPHONE SYSTEM

Fritz Pfleiderer, Berlin-Wilmersdorf, Germany, assignor to Siemens and Halske Aktiengesellschaft, Siemensstadt, near Berlin, Germany, a company of Germany

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12 Claims. (Cl. 179—16)

This invention relates to signaling systems and particularly to telephone systems which include both four-wire and two-wire lines.

It is the object of this invention to provide a more satisfactory, simple and efficient circuit arrangement for interconnecting two-wire and four-wire lines.

In telephone systems comprising four-wire lines, balancing transformers may be employed for coupling two-wire lines to the four-wire lines. Such an arrangement enables the transmission of voice-frequency currents from a two-wire to a four-wire circuit but does not permit the direct transmission of supervisory and directive signals between the coupled lines. This invention is a circuit arrangement in which a metallic connection is provided for transmitting signals through the windings of a balancing transformer which couples a four-wire line to a two-wire line for the transmission of speech. The two wires of one branch of the four-wire circuit are separately connected through different windings of the transformer to the two wires of the other branch of this circuit, each of these windings having middle taps to which the wires of the two-wire circuit are separately connected. Line balancing networks may be connected to the same or other windings of the transformer.

The drawing which forms a part of this specification represents schematically two circuit arrangements embodying the invention as applied to telephone systems in which directively controlled switches are employed in completing desired connections. The invention is not limited in its application to these specific embodiments but is in general applicable to any signaling system in which a two-wire line is coupled to a four-wire line.

In the drawing,

Fig. 1 shows schematically a four-wire line L1, an incoming group selector IIGW, a balancing transformer Ueb, a line balancing network LN, an intermediate group selector IIIGW, a final selector LW, and a two-wire line L2;

Fig. 2 shows schematically a four-wire line L3, retardation coils DR1 and DR2, an incoming group selector IIGW, a balancing transformer Ueb, line balancing networks LN1 and LN2, an intermediate group selector IIIGW, a final selector LW, and a two-wire line L4.

In the arrangement shown in Fig. 1, the four-wire line L1 is connected through four brushes of the incoming group selector IIGW, to the windings 1, 2, 3 and 4 of the balancing transformer Ueb. Conductors a, b of the four-wire line are used in transmitting voice currents in one direction and conductors a', b' are used in transmitting voice currents in the other direction. The balancing transformer Ueb connects the two branches a, b and a', b' of the four-wire line L1 with the two-wire line L2 so that voice currents incoming to the transformer Ueb over branch a, b are transmitted into the two-wire line L2, and voice currents incoming to the transformer Ueb over line L2 are transmitted over branch a', b' of the four-wire line. To establish the connection between the line L1 and transformer Ueb, the selector IIGW may be directly controlled by impulses received from the four-wire line L1. In other arrangements embodying this invention, the four-wire line might be connected directly to the windings of the transformer. The windings 1 and 3 of transformer Ueb are alike, as are also the windings 2 and 4, the midpoints between windings 1 and 3 and between windings 2 and 4 being connected through brushes of the intermediate group selector IIIGW to the windings of the line relays 10 and 11 of the final selector LW and also through brushes of the selector LW to the a and b wires of the two-wire line L2. The selectors IIIGW and LW may be similar to those shown in Figs. 110 and 111 and described on pages 139 to 144 inclusive, of the first edition of "Automatic Telephony" by Smith and Campbell, published in 1914. The artificial line comprising network LN is inductively coupled to the lines by winding 5 of the balancing transformer Ueb. To establish the connection between the transformer Ueb and the selector LW, the intermediate group selector IIIGW is directively controlled by a train of impulses from the four-wire line. The relay contacts 6 and 7 repeat the incoming impulses through brushes a and b' of selector IIGW and windings 2 and 4 of transformer Ueb to the A relay (not shown) of selector IIIGW while the relay contacts 8 and 9 repeat the incoming control impulse through brushes a' and b of selector IIGW and windings 1 and 3 of transformer Ueb to the B relay (not shown) of selector IIIGW, the control impulse continuing during the receipt of the entire train of impulses as is usual in selectors of this type. The windings of the relays to which contacts 6 and 7 and contacts 8 and 9 belong are not shown in the drawing but are connected to the conductors of line L1 to respond to the dial and control impulses incoming over line L1. The succeeding trains of dial impulses received over line L1 are repeated by contacts 6 and 7 to the line relay 10 of connector LW while the corresponding control impulses are repeated by contacts 8 and 9 to the line relay 11 of connector LW, the brushes of connector LW being thereby advanced into engagement with the set of terminals to which the two-wire line L2 is connected. The circuit for operating line relay 10 may be traced from ground 16, through contacts 6 and 7, the a and b' wipers of selector IIGW, the windings 2 and 4 of transformer Ueb, the a wiper of selector IIIGW

and the winding of relay 10 to battery. The circuit for operating relay 11 may be traced from battery 17, through contacts 8 and 9, the *b* and *a'* wipers of selector IIGW, windings 1 and 2 of transformer U*eb*, the *b* wiper of selector IIIGW, and the winding of relay 11 to ground.

The arrangement in Fig. 2 is similar to that of Fig. 1. Two balancing networks LN1 and LN2 are provided, one being directly connected across transformer windings 21, 23 and the other across windings 22, 24. The line relays of final selector LW are controlled by contacts 12 and 13; the closure of contact 12 being effective to complete a circuit from ground 14, through the windings of retardation coil DR1, brushes *a* and *b'* of selector IIGW, windings 22, 24 of transformer U*eb*, brush *a* of selector IIIGW, and the winding of one of the line relays to battery; and the closure of contact 13 being effective to complete a circuit from ground at 15, through the battery and contact 13, windings of retardation coil DR2, brushes *b* and *a'* of selector IIGW, windings 21, 23 of transformer U*eb*, brush *b* of selector IIIGW, and the winding of the other of the line relays to ground. The winding of the impulse repeating relay to which contact 12 belongs and the winding of the control relay to which contact 13 belongs are not shown in the drawing but are connected to the conductors of line L3 to respond to the dial and control impulses incoming over line L3.

While the source of current for repeating the impulses to the relays of selectors IIIGW and LW are shown as direct current sources, the arrangements are also suitable for the metallic transmission of current impulses from low frequency sources of alternating current.

What is claimed is:

1. In a telephone system, a two-wire line, a four-wire line, and a balancing transformer interconnecting said lines for the transmission of voice currents and the metallic transmission of signaling current.

2. In a telephone system, a two-wire line, a four-wire line, a line balancing network, and a balancing transformer interconnecting said lines and network for the transmission of voice currents and interconnecting said lines for the metallic transmission of signaling current.

3. In a telephone system, a two-wire line, a four-wire line, line balancing networks, and a balancing transformer interconnecting said lines and networks for the transmission of voice currents and interconnecting said lines for the metallic transmission of signaling current.

4. In a telephone system, a four-wire line, a two-wire line, signal receiving means connected to said two-wire line, signal transmitting means connected to said four-wire line, and a balancing transformer interconnecting said lines for the transmission of voice currents and for the metallic transmission of signals from said four-wire line to said two-wire line.

5. In a telephone system, a four-wire line, a two-wire line, and a balancing transformer comprising two windings, the ends of one of said windings being connected to one conductor of each of the two branches of the four-wire line, the ends of the other of said windings being connected to the other conductors of each of the two branches of the four-wire line, and the midpoints of the said windings being connected to the conductors of said two-wire line.

6. In a telephone system, a four-wire line, a two-wire line, signal transmitting means for said four-wire line, signal receiving means for said two-wire line, and a balancing transformer comprising two windings, the ends of one of said windings being connected to one conductor of each of the two branches of the four-wire line, the ends of the other of said windings being connected to the other conductors of each of the two branches of the four-wire line, and the midpoints of the said windings being connected to the conductors of said two-wire line.

7. In a telephone system, a four-wire line, a two-wire line, a line balancing network, and a balancing transformer comprising three windings, the ends of a first of said windings being connected to one conductor of each of the two branches of the four-wire line, the ends of a second of said windings being connected to the other conductor of each of the two branches of the four-wire line, the midpoints of said first and second windings being connected to the conductors of said two-wire line, and the third of said windings being connected to said network.

8. In a telephone system, a four-wire line, a two-wire line, two line balancing networks, and a balancing transformer comprising two windings, the ends of one of said windings being connected to one conductor of each of the two branches of the four-wire line and to one of said networks, the ends of the other of said windings being connected to the other conductor of each of the two branches of the four-wire line and to the other of said networks, and the midpoints of said windings being connected to the conductors of said two-wire line.

9. In a telephone system, a four-wire line, a two-wire line, a balancing transformer interconnecting both branches of said four-wire line with said two-wire line, and contact means for sending direct current signals over one conductor of each of the branches of the four-wire line and one conductor of the two-wire line.

10. In a telephone system, a four-wire line, a two-wire line, a balancing transformer interconnecting both two-wire branches of the four-wire line with said two-wire line, and contact means for transmitting direct current signals over one conductor of each of the branches of the four-wire line and one conductor of the two-wire line and for transmitting direct current signals over the other conductor of each of the branches of the four-wire line and the other conductor of the two-wire line.

11. In a telephone system, a two-wire line, a four-wire line, and a balancing transformer interconnecting said lines for the transmission of voice currents and the transmission of direct current signals between said lines.

12. In a telephone system, a four-wire line, a two-wire line, signal receiving means connected to said two-wire line, signal transmitting means connected to said four-wire line, and a balancing transformer interconnecting said lines for the transmission of voice currents and for the metallic transmission of direct current signals from said four-wire line to said two-wire line.

FRITZ PFLEIDERER.