March 11, 1930. H. C. SILENT 1,749,851

CIRCUIT CONTROLLER

Filed Feb. 18, 1928

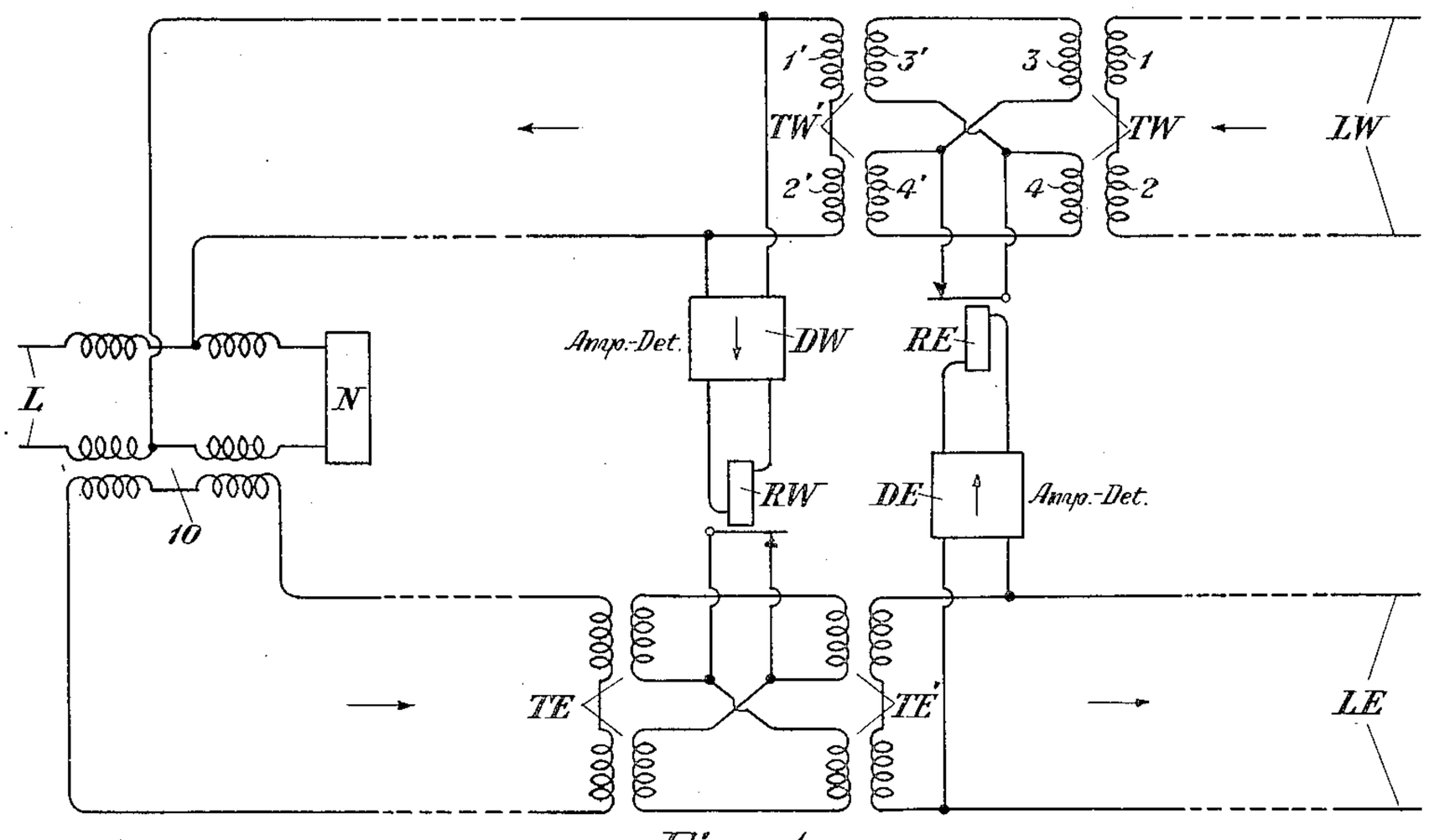

Fig. 1

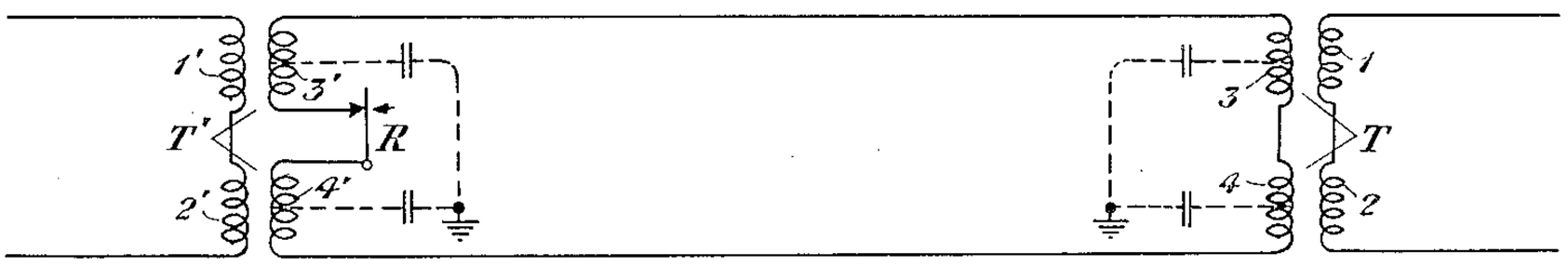

Fig. 2

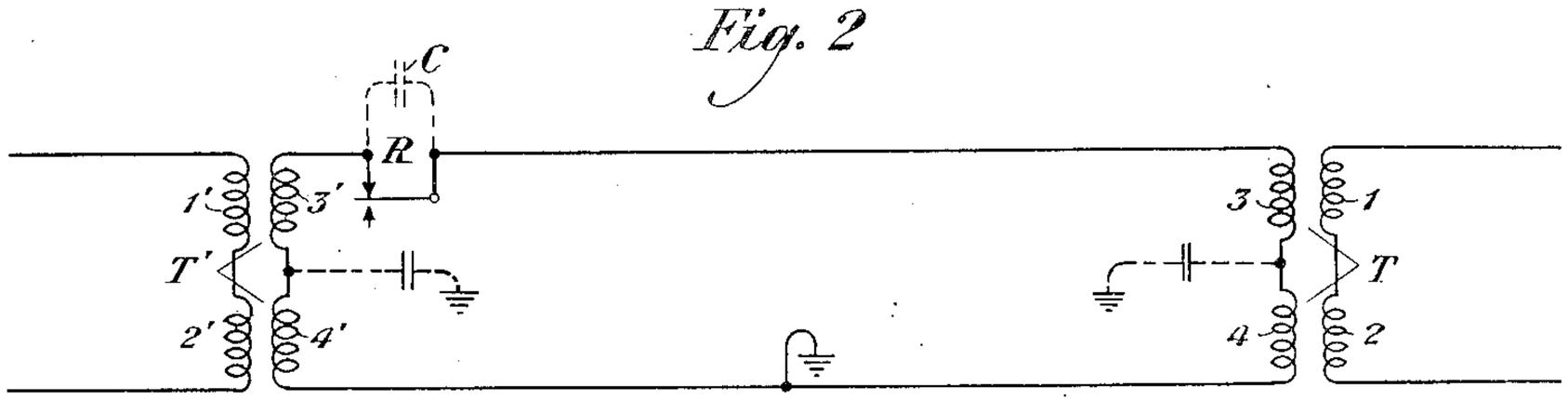

Fig. 3

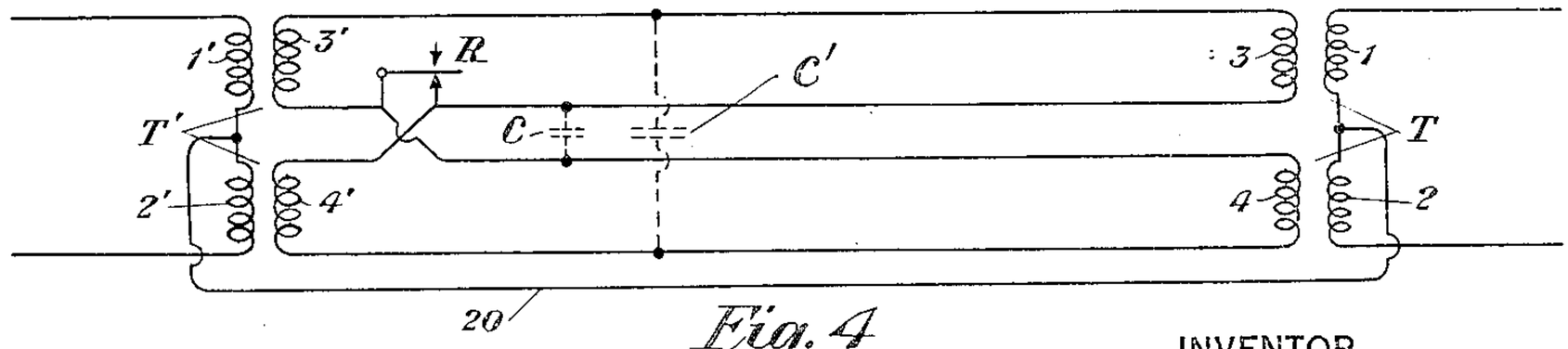

Fig. 4

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CIRCUIT CONTROLLER

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This invention relates to transmission circuit controlling arrangements, and more particularly to circuit controllers to be employed in connection with echo suppressors.

In transmission circuits employing voice operated switching devices, it is common practice to provide relay contacts at some point in the circuit where separate paths are used for transmission in opposite directions. One switching unit is there associated with each path to disable the opposite path when transmission is taking place over the first path. Heretofore, it has been the practice to arrange each switching unit in such manner that the contact of the relay associated with it disables the path controlled by it by short-circuiting the path.

Such an arrangement is subject to several objections. To apply the short-circuit, it is necessary to close a contact, which requires a certain amount of time, due to the slowness of the relay to become energized and due to the time required for the armature to shift from its back contact to its front contact. From this standpoint it is, therefore, advantageous to have a circuit controlling arrangement which disables or otherwise controls the circuit by merely opening a contact. The arrangement above described also has the disadvanatge that when the contact is closed to establish the short-circuit the path is not completely disabled, due to the contact resistance which prevents the establishment of a dead short-circuit across the path.

Accordingly, it is proposed, in accordance with the present invention, to provide a circuit controller for the transmission path which will disable the path by merely opening a contact. It is further proposed to accomplish this result without opening any of the conductors of the transmission path. These results are accomplished by a transformer arrangement having a plurality of windings so connected that when the contact is open the windings will be series opposing, but when the contact is closed the windings effectively form two circuits in aiding relation with the contact common to both circuits. By such an arrangement it is possible, if the windings are well constructed and accurately balanced, to produce a much more complete disablement of a transmission path than is possible by the use of a short-circuiting contact.

The invention will now be more fully understood from the following description when read in connection with the accompanying drawing, in which Figure 1 shows in schematic form a circuit employing echo suppressors equipped with the circuit controlling arrangements of the invention; while Figs. 2, 3 and 4 are diagrams illustrating the advantages of the invention.

Referring to Fig. 1, a four-wire circuit comprising paths LE and LW is shown, the two paths being connected together at one end and associated with a terminal two-wire line L through the usual form of hybrid coil 10 and balancing network N. Each of the paths may include a radio link, in which case the path LE would be connected to a radio transmitter and the path LW to a radio receiver. An echo suppressor equipment comprising an amplifier-detector arrangement DE of known type is bridged across the circuit LE, and the amplifier-detector arrangement is connected to operate a relay RE whose contact is arranged to disable the path LW. Similarly, an echo suppressor equipment comprising an amplifier-detector unit DW is bridged across the path LW, and a relay RW associated with the amplifier-detector is connected to disable the path LE.

The disabling arrangement associated with the path LW comprises transformers TW and TW′. The transformer TW has two secondary windings 3 and 4, and the transformer TW′ has two primary windings 3′ and 4′. The upper terminals of windings 3 and 3′ are connected together, and likewise the lower terminals of windings 4 and 4′ are connected together. The lower terminal of winding 3 is, however, connected to the upper terminal of winding 4′, while the upper terminal of winding 4 is connected to the lower terminal of winding 3′. This connection is such that, taken by itself, the windings would be opposed so as to prevent transmission through the path LW. The contact of the relay RE is so connected, however, that when closed

it cross-connects and thereby ties together the lower terminals of windings 3 and 3′ and the upper terminals of windings 4 and 4′ so that, in effect, two series aiding circuits are established through the transformer to permit transmission to take place. The opening of the contact, of course, restores the circuit to its condition above described, whereby the windings are balanced and transmission is prevented.

The circuit controlling arrangement associated with the relay RW for disabling the circuit LE comprises transformers TE and TE′ having windings connected in the manner similar to that just described. It will further be understood that the paths LE and LW may include amplifying devices and other circuit elements commonly employed in practice which are not illustrated as they are not concerned with the present invention.

When voice currents arrive from the line L they are transmitted through the hybrid coil 10 and through the transformers TE and TE′ (whose control circuits are connected in series aiding relation) to the path LE. Some of the energy applied to the path LE enters the amplifier-detector unit DE and thereby cause operation of the relay RE. The opening of the contact of the relay RE opens the connection normally tying together the four inner terminals of the windings of the transformers TW and TW′. The windings are now balanced so that transmission cannot take place from the path LW to the line L. This also prevents transmission from entering the amplifier-detector unit DW and causing false operation. When the voice currents from the line L cease, the relay RE is deenergized and restores the controlling circuit comprising transformers TW and TW′ to normal, so that both paths LW and LE are in their normal operative condition. Voice currents transmitted over the line LW from east to west pass through the transformers TW and TW′ (whose connections are in series aiding relation) to the line L. Some of the energy also enters the amplifier-detector unit DW to cause the relay RW to be energized and open its contact, thus changing the connections of the transformers TE and TE′ so that the windings oppose each other and prevent transmission from the hybrid coil 10 to the line LE, at the same time preventing any current from entering the amplifier-detector unit DE.

A circuit controller of the type above described has a number of advantages. For example, if a single contact R is connected to break the circuit between the transformers T and T′, as shown in Fig. 2, the capacities to ground of the transformer windings are such as to partially overcome the effect of opening the contact. The effective capacities to ground of the transformer windings 3′ and 4′ are shown in dotted lines in Fig. 2, and it is obvious that even when the contact R is open a transmission path exists from ground through the capacity of the winding 3′, through turns of the winding 3′, over the upper conductor of the transmission path, through turns of the winding 3, and through the capacity of said winding to ground. Likewise, another transmission path exists from ground through the capacity of the winding 4′, over the lower conductor of the transmission path, and through the capacity of the winding 4 to ground. Each of these paths permits transmission through transformers T and T′ in either direction, so that while the opening of the contact R has the effect of reducing the transmission it does not completely disable the path.

Likewise, difficulty is encountered when the contact is connected to open one of the wires of the transmission path between the transformers T and T′, as shown in Fig. 3. If we assume that the capacities to ground of the windings 3′ and 4′ are concentrated in a capacity connected to the junction point of the windings, as shown in dotted lines, and that the capacities to the windings 3 and 4 are similarly represented by an equivalent capacity connected to the junction point of the windings, it will be evident that the opening of the contact R will prevent any transmission from ground through the winding 3′, over the upper conductor, through the winding 3 and the capacity to ground. A path would still exist, however, through the capacity to ground and the turns of the winding 4′ over the lower conductor of the path and through the turns of the winding 4′ and the capacity to ground. Transmission over this path may be prevented, however, by grounding the lower conductor, as shown. Such an arrangement is open to the objection that the system is necessarily unbalanced to ground, due to the ground connection last referred to, and the contact R is not at ground potential. If, as is often the case, it is necessary to ground the contact R to establish a circuit over its alternate contact, the ground must be omitted from the lower conductor. There remains, also, the capacity between the conductors from windings 3 and 3′ leading to the relay contacts. This capacity effectively prevents the complete elimination of transmission, since it has the effect of a capacity shunting the relay contact, as shown in dotted lines at C.

Where, however, the windings of the transformer are connected in accordance with the present invention, as shown in Fig. 4, with the contact R arranged when closed to tie together the inner terminals of the windings 3, 3′, 4 and 4′, the circuit is completely balanced so that the capacities to ground of the coils are without effect upon its operation. Furthermore, the capacity of the leads from the coils to the relay contact, (which is equiva-

lent to the capacity C in dotted lines), may be balanced and its effect cancelled by similar capacity C′ existing between the conductors which connect windings 3 to 3′ and 4 to 4′. With the terminals of the windings tied together, as shown, through the closed contact R, two parallel paths exist from the secondary of transformer T to the primary of transformer T′. When the contact is open, however, the windings 3 and 4 oppose each other, and likewise the windings 3′ and 4′ oppose each other. Furthermore, the paths established by the capacities to ground of the coils will also oppose each other, due to the cross-connecting of the terminals of the windings 3—4′ and 4—3′. If it is necessary to ground the armature of the switch R to complete a circuit over its alternate contact, the system will still operate due to the balanced condition of the circuit.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. In a transmission circuit, a circuit controller therefor, said circuit controller including a plurality of transformer windings in said transmission circuit and a contact adapted to assume either an open or closed condition, and circuit connections for said transformer windings and said contact to establish mutually aiding transmission paths through said windings with the contact in one condition and to establish said windings in opposing relation with the contact in its other condition.

2. In a transmission circuit, a circuit controller therefor, said circuit controller including a plurality of transformer windings in said transmission circuit and a contact adapted to assume either an open or closed condition, and circuit connections for said transformer windings and said contact to establish mutually aiding transmission paths through said windings with said contact closed and to establish said windings in opposing relation when the contact is open.

3. In a transmission circuit, a circuit controller therefor, said circuit controller including a plurality of transformer windings in said transmission circuit and a contact adapted to assume either an open or closed condition, cross connections independent of said contact between certain terminals of said windings to establish them in opposing relation, and a connection through said contact for tying said cross connections together to establish aiding parallel transmission paths through said windings.

4. In a transmission system involving tandem links, a circuit controller for interconnecting said links, said circuit controller including two transformers and a controlling contact, each transformer having a main winding and auxiliary windings, a main winding of one transformer being connected to one link and a main winding of the other transformer being connected to another link, two auxiliary windings of each transformer being inductively associated with said main windings, connections between said auxiliary windings independent of said contact such that one terminal of each auxiliary winding is connected to one of the auxiliary windings of the other transformer and its other terminal is connected to the other auxiliary winding of the other transformer, and connections whereby said contact may tie together certain terminals of all of said auxiliary windings.

5. In a transmission system involving tandem links, a circuit controller for interconnecting said links, said circuit controller including two transformers and a controlling contact, each transformer having a main winding and auxiliary windings, a main winding of one transformer being connected to one link and a main winding of the other transformer being connected to another link, two auxiliary windings of each transformer being inductively associated with said main windings, connections between said auxiliary windings and independent of said contact to establish the two auxiliary windings of each transformer in opposing relation, and connections whereby said contact may tie together certain terminals of all of said auxiliary windings.

6. In a transmission system involving tandem links, a circuit controller for interconnecting said links, said circuit controller including two transformers and a controlling contact, each transformer having a main winding and auxiliary windings, a main winding of one transformer being connected to one link and a main winding of the other transformer being connected to another link, two auxiliary windings of each transformer being inductively associated with said main windings, connections independent of said contact from one terminal of each auxiliary winding of one transformer to the corresponding terminal of the corresponding auxiliary winding of the other transformer, connections from the other terminal of each auxiliary winding of said first transformer to the remaining terminal of the other auxiliary winding of the second transformer, and a connection through said contact for tying together two of said conections.

7. In a transmission system involving tandem links, a circuit controller for interconnecting said links, said circuit controller including two transformers and a controlling contact, each transformer having a main winding and auxiliary windings, a main winding of one transformer being connected

to one link and a main winding of the other transformer being connected to another link, two auxiliary windings of each transformer being inductively associated with said main windings, connections independent of said contact from one terminal of each auxiliary winding of one transformer to the corresponding terminal of the corresponding auxiliary winding of the other transformer, connections from the other terminal of each auxiliary winding of said first transformer to the remaining terminal of the other auxiliary winding of the second transformer, and a connection through said contact for tying together said last mentioned connections.

8. In a transmission circuit, a circuit controller therefor, said circuit controller including a plurality of transformer windings in said transmission circuit and a contact adapted to assume either an open or closed condition, cross connections independent of said contact between certain terminals of said windings to establish them in opposing relation, a connection through said contact for tying said cross connections together to establish aiding parallel transmission paths through said windings, and a capacity connected across certain of the connections between terminals of said windings to balance the capacity tending to shunt said contact due to the capacity between the elements of the connection through said contact.

In testimony whereof I have signed my name to this specification this 17th day of February, 1928.

HAROLD C. SILENT.