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D. E. BRANSON ET AL

COMPOSITE SET

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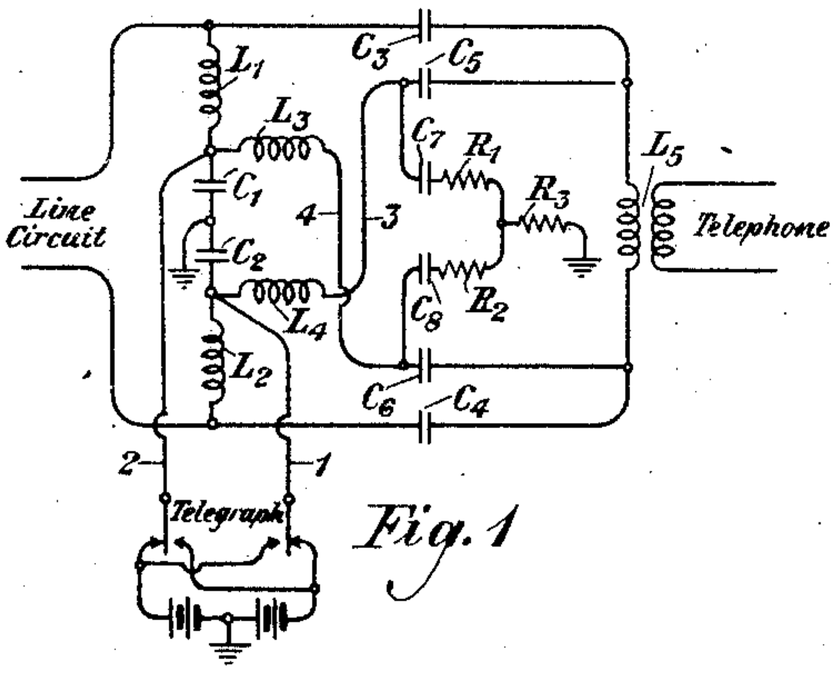

Fig. 1

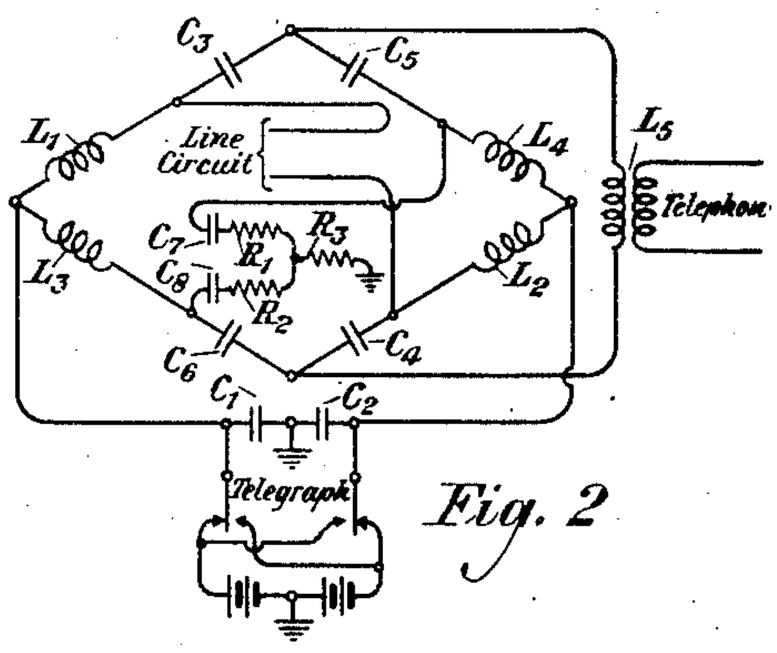

Fig. 2

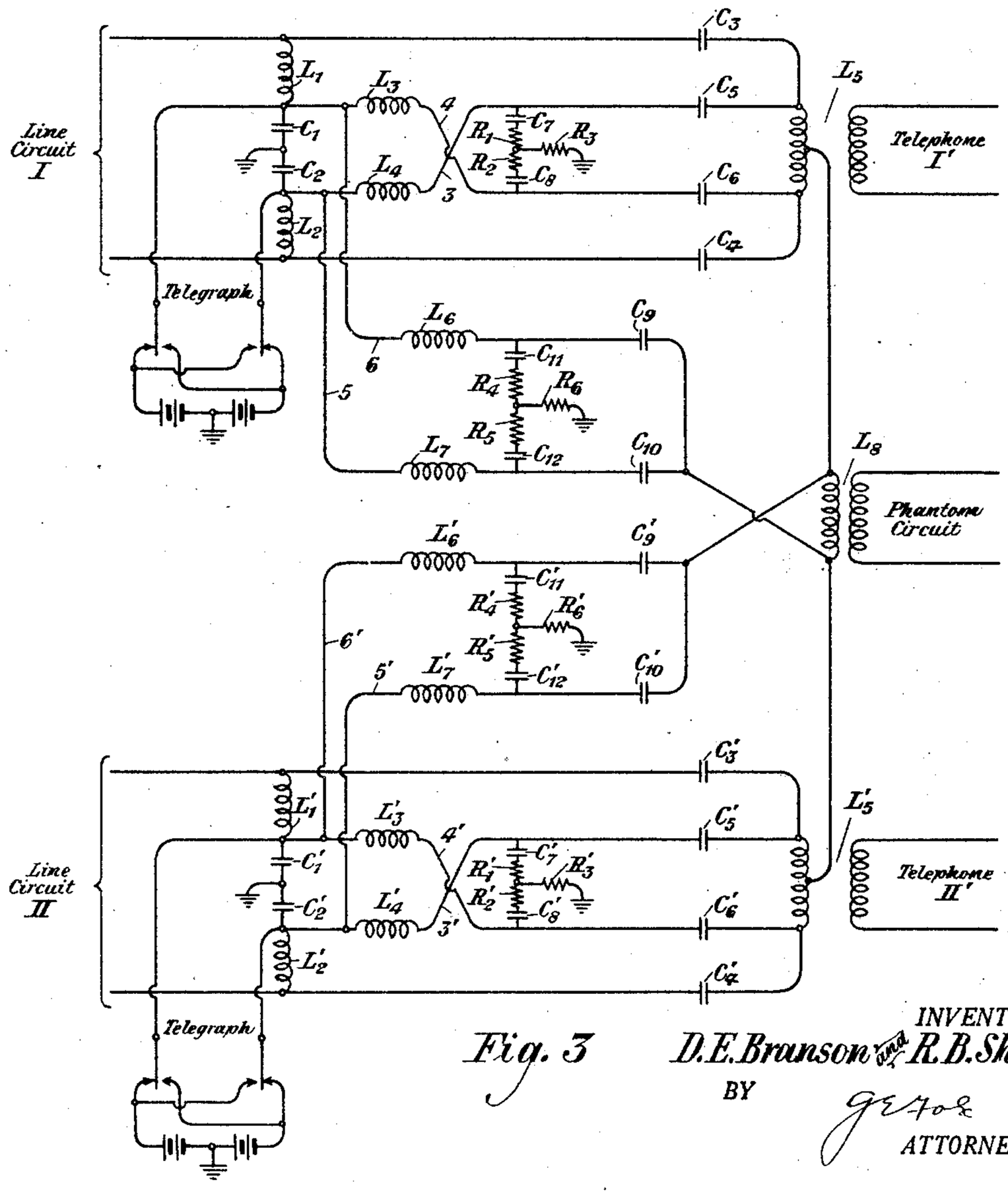

Fig. 3

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COMPOSITE SET.

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This invention relates to multiplex signaling systems and more particularly to improvements in arrangements, such as composite sets, usually associated with the terminal facilities of the lines of such systems to prevent the different currents utilized from interfering with each other.

In a signaling system in which both telephone and telegraph currents are transmitted over the line circuits thereof it has been the practice to associate with the terminal facilities of such line circuits a device known as a composite set whereby the incoming telegraph and telephone currents may be separated and diverted to their respective circuits without interference with each other. The composite set, furthermore, functions to prevent the outgoing telegraph currents from entering the telephone path at the terminal facilities and vice versa. It is one of the primary objects of the composite set of this invention to provide a novel means for preventing the telegraph currents originating at the terminal of the line from entering the telephone circuits, or phantom circuits, thereat and thereby obviating the disturbances caused thereby, which disturbances are commonly called telegraph thump. The composite set of the invention makes use of the balance principle to minimize the amount of telegraph current which may get into the telephone circuits. This involves the use of auxiliary neutralizing or balancing circuits connected to each telegraph leg and to the transformer winding of the telephone circuit to neutralize in said transformer any telegraph current transmitted thereto. Further objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1, 2, and 3 of which the invention is illustrated. Fig. 1 shows a circuit diagram embodying a preferred form of the invention. Fig. 2 shows a schematic arrangement which is the equivalent of Fig. 1. In Fig. 3 the arrangements of the invention are shown as applied to a system utilizing a phantom telephone line. Like reference characters have been utilized to denote like parts in all of the figures of the invention.

In Fig. 1 is shown a line circuit which includes the winding of a transformer L_5. To the other winding of this transformer is connected a telephone circuit. In each of the conductors of the line circuit, there would be provided condensers, such as C_3 and C_4, to prevent the telegraph currents coming in over the line from entering the telephone circuit. Bridged across the conductors of the line circuit is a tetegraph branch comprising the inductances L_1 and L_2 and the condensers C_1 and C_2. This arrangement of inductances and capacities would tend to prevent the telephone currents from entering the telegraph branch. Connected to this bridge would be the telegraph legs 1 and 2 leading to the usual sending apparatus comprising batteries and switching means. The above described arrangements comprise substantially a composite set of the prior art. In accordance with this invention there is connected to each of the telegraph legs 1 and 2, respectively, the auxiliary balancing circuits 3 and 4. Circuit 3 includes an inductance L_4 and a capacity C_5 and is connected to the opposite side of winging L_5 than leg 1. Circuit 4 includes an inductance L_3, and condenser C_6 and is connected to the opposite side of coil L_5 than leg 2. Under these conditions when voltages are applied to either or both of the telegraph legs, which voltages might be set up in coil L_5, neutralizing voltages will be set up by these auxiliary circuits 3 and 4 in the coil L_5 in such a way that with the proper constants for each of the elements little or no interference or thumb current will result and the telephone circuit will not be affected. A network, consisting of condensers C_7 and C_8 and resistances R_1, R_2 and R_3, is connected to the neutralizing circuits 3 and 4 so as to give the same admittance between the two neutralizing circuits and also to ground that is given by the line circuit itself. The condensers C_7 and C_8 are a part of this network for preventing any unnecessary current flow from the telegraph battery.

The method of neutralization of any interfering telegraph currents may be more clearly understood from the arrangements

of Fig. 2, which shows the circuit arrangement of Fig. 1 drawn up in slightly different form to show the bridged arrangement between the telegraph transmitter branch and the telephone drop circuit. If the impedances of the various bridge elements are given, the proper values of the network consisting of condensers C_7 and C_8 and resistances R_1, R_2 and R_3 may be omitted. The two conditions when this may be done and at which time a close balance of the bridge is obtained are when:

(1) Impedances of coils L_1, L_2, L_3 and L_4 are all equal and large. Impedances of condensers C_1, C_2, C_3 and C_4 are all equal and small.

(2) Impedances of coils L_1, L_2, L_3 and L_4 are all equal and small. Impedances of condensers C_1, C_2, C_3 and C_4 are all equal and large. It is pointed out that in order to preserve the proper telephone frequency characteristic and to prevent the shunting effect of the telegraph bridge on the telephone circuit, condition (1), above, would be the more practicable.

Another condition exists similar to cases (1) and (2) above, in which the balancing network may be omitted when the impedances of coils L_1, L_2, L_3 and L_4 are equal and small and the impedances of condensers C_1, C_2, C_3 and C_4 are equal and small. For this condition, the line impedance will be large in comparison to the impedances of the individual parts of the bridge and the balance will not be materially affected by the connection to the line. For this condition, the telegraph transmitter branch will shunt to some extent the telephone branch and the telephone branch will also shunt to some effect the telegraph branch.

In Fig. 3, the arrangements of the invention are shown as applied for the purpose of neutralizing interference or telegraph thump in a system including a phantom telephone circuit. Two line circuits I and II are illustrated connected to the telephone lines I′ and II′. Line circuit I and its associated apparatus is identical with the arrangements shown in Fig. 1, like reference characters being used to denote like parts. Line circuit II is identical with line circuit I, like reference characters with the added designation prime being used to denote like parts. Connected between the midpoints of coils L_5 and L'_5 is a circuit including the coil L_8 which is one of the windings of a transformer to which the phantom circuit is connected. Bridged across the conductors 3 and 4 associated with line circuit I is a phantom neutralizing circuit 5, 6. A connection is made from this circuit to the side of the phantom coil L_8 opposite to that which is connected to line circuit I. Coil L_6 and condenser C_9 have the same impedance characteristics as the combined effect of coils L_1 and L_3 and condensers C_3 and C_6, the coil L_5 being of little effect since its coils are connected parallel opposed as far as the phantom circuit is concerned. Also coil L_7 and condenser C_{10} have the same impedance characteristics as the combined effect of coils L_2 and L_4 and condensers C_4 and C_5. In case it becomes necessary to add the balancing network to the phantom neutralizing circuit similar to that described for the side circuit, the bridged network consisting of condensers C_{11} and C_{12} and resistances R_4, R_5 and R_6 may be connected across this neutralizing circuit as shown. With such an arrangement any disturbing voltages set up in coil L_8 by telegraph currents from the set of line I would be neutralized by opposing voltages set up in said coil by the neutralizing circuit 5, 6. Associated with the line circuit II is a similar phantom neutralizing circuit 5′, 6′. This circuit is connected to the side of phantom coil L_8 opposite to that connected to coil L'_5. In a manner similar to that heretofore described interfering voltages from telegraph currents from the set of line II set up in coil L_8 will be neutralized by opposing voltages set up in said coil by the operation of circuit 5′, 6′.

The method of neutralization, as illustrated by this invention, may be applied to any type of battery, arrangements for the various telegraph systems since it makes no difference whether the circuits operate on a ground return or as a metallic circuit. This would apply to both the metallic telegraph system whether single or full commutation and a duplex system having a ground return. Accordingly, while the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A transmission line, a connecting means serially included in said line, a telephone circuit associated with said line through said connecting means, a composite set including a telegraph bridge across said line circuit, telegraph legs associated with each side of said line circuit through said bridge, and auxiliary balancing circuits connecting each of said telegraph legs to sides of said connecting means opposite to those to which said telegraph legs are connected through said bridge.

2. A transmission line, a connecting means included serially therein, a telegraph circuit connected to one of the sides of said line, and an auxiliary balancing circuit connecting said telegraph circuit to a side of said connecting means opposite to that connected to said side of said line to which said telegraph circuit is connected.

3. A transmission line, a winding included

serially therein, telegraph circuits connected to each of the sides of said line, auxiliary balancing circuits connecting each of said telegraph circuits to sides of said winding opposite to those to which each telegraph circuit is connected, and a balancing network connected across said auxiliary balancing circuits.

4. A transmission line, a coil included serially therein, telegraph circuits connected to each of the sides of said line, auxiliary balancing circuits connecting each of said telegraph circuits to sides of said coil opposite to those to which each telegraph circuit is connected, a second transmission line having the same elements in combination as said first mentioned line, a circuit including a phantom coil and being connected to the mid-points of the coils serially included in each of said transmission lines, a phantom balancing circuit bridged across the auxiliary balancing circuits associated with said first transmission line, a phantom balancing circuit bridged across the auxiliary balancing circuits associated with said second transmission line, and means to connect each of said phantom balancing circuits with sides of said phantom coil opposite to those connected to the lines each of said phantom balancing circuits are associated with.

In testimony whereof, we have signed our names to this specification this 24th day of February, 1927.

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