June 2, 1925.

1,540,421

W. T. POWELL

TELEPHONE CIRCUITS

Filed June 5, 1924

FIG.-1

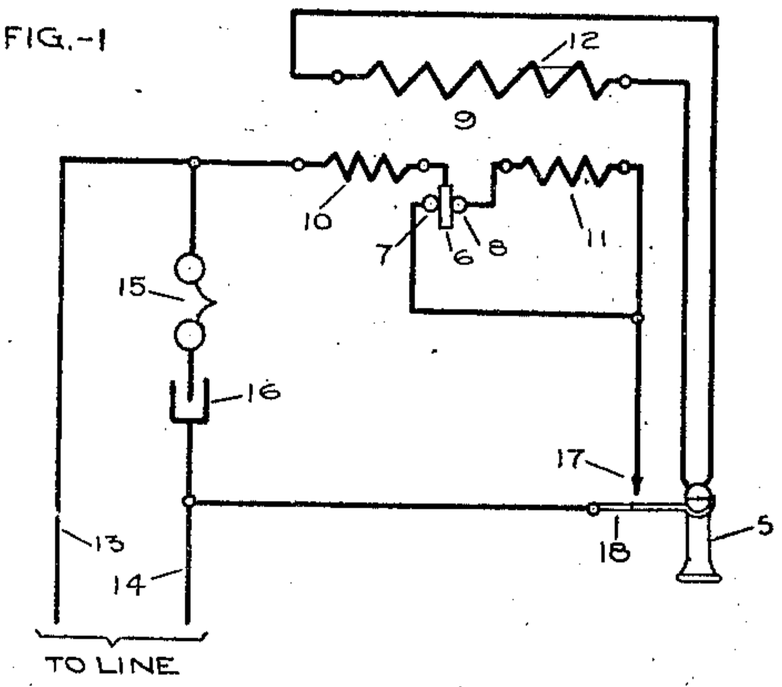
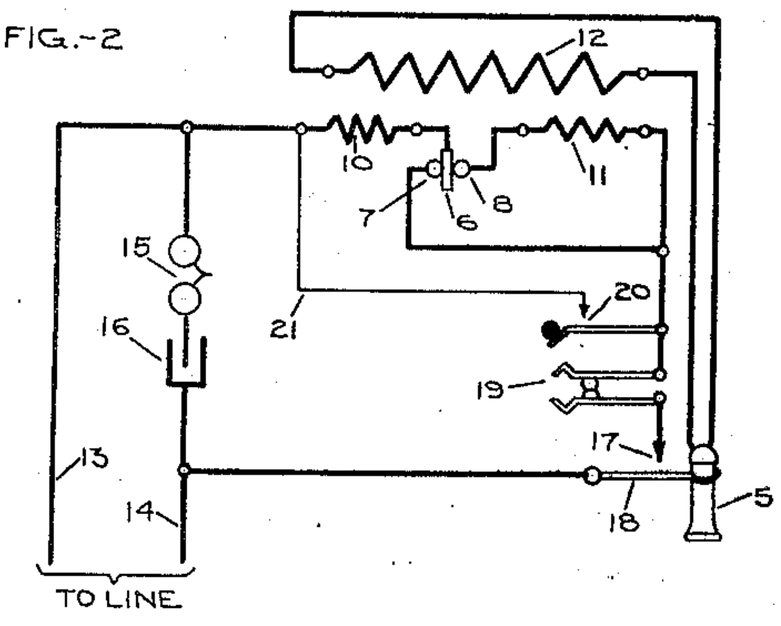


FIG.-2



INVENTOR
Winfred T. Powell
BY D. Clyde Jones.
ATTORNEY

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UNITED STATES PATENT OFFICE.

WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE CIRCUITS.

Application filed June 5, 1924. Serial No. 718,141.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Telephone Circuits, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone circuits and more particularly to the circuits of a telephone set including a receiver and a telephone transmitter.

It is an object of the present invention to provide circuit arrangements which will deliver the maximum amount of energy in the form of an outgoing signal to a telephone line and which will receive the maximum amount of energy in the form of an incoming signal from said telephone line without the disturbance of the receiving circuit by the transmission circuit, which disturbance is commonly known as "side-tone" in the receiver. In other words it is the object of the invention to provide a circuit arrangement for preventing talking currents in the talking net-work from interfering seriously with the receiving net-work.

In the embodiment of the invention herein disclosed well-known substation equipment such as a receiver, fixed condenser and a signal or ringer, are associated in a circuit net-work with a two-element transmitter and an induction coil having leads from its mid-point, to which certain elements of the transmitter are connected.

In the drawings Fig. 1 diagrammatically represents the invention applied to the substation circuits of a manual telephone line. Fig. 2 shows a similar substation circuit arrangement in which a well-known impulse transmitter with a shunt spring combination are provided for use when the substation circuit is incorporated in an automatic telephone system.

The transmitter herein referred to as a "two-element transmitter", may consist of a diaphragm, on each side of which a carbon button impinges. Other types of transmitters such as electromagnetic or electrostatic transmitters may be employed.

The impulse transmitter herein referred to, may be similar in construction to that disclosed on pages 34 and 35 of Automatic Telephony, by Smith and Campbell, first edition, but in which a different shunt spring combination is provided.

Referring to Fig. 1, 5 designates the well known receiver associated with a two-element transmitter, which consists of the diaphragm 6 mounted to be engaged by the carbon buttons 7 and 8. An induction coil generally indicated as 9, includes the primary windings referred to as 10 and 11 and the secondary winding 12. The primary windings 10 and 11 are inductively related to the secondary winding 12. The line conductors 13 and 14 are normally bridged by a circuit including the ringer 15 and the fixed condenser 16, 17 indicates a contact which is closed by the switchhook 18 when the receiver 5 is removed therefrom.

When the net-work is used to transmit outgoing currents, such currents do not produce serious side-tone noises in the receiver 5. To explain this result, let it be assumed that the carbon button 7 is being compressed and button 8 is being disengaged from the diaphragm 6. The resistance of the first mentioned button will be decreasing, while the resistance of the last mentioned button is increasing. This causes an increased flow of current through the winding 10 and a decreased flow of current through winding 11. The values of the primary windings 10 and 11 are such that the induced voltage across the secondary winding 12, due to the current rise in the primary winding 10, is equal to the voltage across the mentioned secondary winding 12, due to the decreased current flow in winding 11. Therefore, no current will flow in the receiver circuit and there will be no side-tone. If at this instant the carbon button 8 is being compressed and the carbon button 7 expanded, the same result will be accomplished because the current will rise in the winding 11 when it is decreasing in winding 10.

The present circuit arrangement is designed to give an amplified signal which is commonly referred to as the "booster effect". This is attained as will now be

described. Assume that the current is decreasing through primary winding 10 due to the expansion of carbon button 7. At this time the current through primary winding 11 will be increasing, due to the compression of carbon button 8. This increase of current flow through winding 11 is effective to induce a current flow in primary winding 10, which is in opposition to the line current normally included in conductors 13 and 14, when the hookswitch contacts 17 and 18 are closed. The opposition of the induced current flow in the net-work to the line current results in the further reduction in the line current below the values, which would be due to the expansion of button 7.

When the current through winding 10 is increasing and that through the winding 11 is decreasing, due to the alternate condition of the transmitter buttons 7 and 8, a decrease of current flow through winding 11 will induce a flow of current in winding 10, which is in the same direction as the line current, with the result that the current flow in the line conductors 13 and 14 will be increased over that caused by the compression of carbon button 7.

When this net-work is employed in receiving signals, the incoming currents pass through the primary windings 10 and 11 of the induction coil and transmitter button 8 in series. Part of the current after passing through the primary winding 10 flows through the transmitter button 7. These currents are always in the same direction in both windings and are effective to produce an induced current in the closed circuit including the receiver 5.

In the modification shown in Fig. 2 the same reference characters are used to designate corresponding parts of Fig. 1. The net-work of Fig. 2 differs from that of Fig. 1 by the inclusion of the impulse springs 19 of the well-known dial impulse sender and by the addition of the shunt springs 20 and conductor 21. The operation of this modification is identical with that of Fig. 1, except that during the period of sending impulses, that is, when the impulse springs 19 are intermittently closed by dial mechanism (not shown), the shunt springs 20 are closed and conductor 21 thereby causes a shunt about the receiver 5, to eliminate dial noises therefrom. This shunt also extends about the transmitter so that the impedance thereof is not included in the impulse circuit.

What I claim is:

1. In a telephone net-work, two line conductors, a signal normally bridged across said line conductors, an induction coil having a secondary winding and a primary winding, said primary winding being separated into two portions, a transmitter connected between said portions of the primary winding and in series therewith, a second bridge across said line conductors including said transmitter and the portions of said primary winding, and a closed circuit including a receiver and said secondary winding, said closed circuit being conductively separated from said line conductors.

2. In a telephone net-work, two line conductors, a signal normally bridged across said line conductors, an induction coil having a secondary winding and a primary winding, said primary winding being electrically divided into two portions, a transmitter having a diaphragm and a variable resistance unit at each side of said diaphragm, two of the ends of said primary winding being connected to said line conductors, said transmitter diaphragm being connected to a third end of said primary winding, the fourth end of said primary winding being connected to one of said variable resistance units, a conductor connected at one end to the other variable resistance unit and to one of said first mentioned ends of said primary winding, and a circuit including said secondary winding and a receiver electrically related to said primary winding.

3. In a telephone net-work, two line conductors, a net-work electrically connected to said line conductors, a two-element transmitter in said net-work, means in addition to said two-element transmitter for amplifying the current effects produced thereby, a receiver conductively separated from but inductively connected to said net-work so that incoming telephone currents over said line conductors may actuate said telephone receiver.

4. In a telephone net-work, line conductors, an induction coil having a secondary winding and a primary winding electrically divided into two portions, a two-element transmitter connected in series with said portions of the primary winding at the point of division, said primary winding being arranged for connection across said line conductors, a shunt circuit about one portion of said primary winding and terminating at one end in said telephone transmitter, and a receiver electrically connected to the ends of said secondary winding.

5. In a telephone net-work, two line conductors, a bridge across said line conductors including a condenser and a ringer, an induction coil having a secondary winding and a primary winding, said primary winding being composed of two portions, a transmitter connected between the two portions of said primary winding and in series therewith, a shunt circuit about one portion of said primary winding controlled by said transmitter, a second bridge across said line conductors including both portions of said

primary winding and said transmitter, and a receiver connected to the ends of said secondary winding.

6. In a telephone net-work, two line conductors, a bridge across said line conductors including a condenser and a ringer, an induction coil having a secondary winding and a primary winding, said primary winding being composed of two portions, a transmitter connected between the two portions of said primary winding and in series therewith, a shunt circuit about one portion of said primary winding controlled by said transmitter, a second bridge across said line conductors including both portions of said primary winding and said transmitter, and a closed circuit including a receiver connected to said secondary winding, said closed circuit being conductively separated from but inductively connected to said primary winding.

7. In a telephone net-work, a pair of line conductors, a bridge circuit across said line conductors, a two-element transmitter having its elements connected in multiple in said bridge circuit, a telephone receiver, and a circuit therefor inductively connected to but conductively separated from said line conductors.

8. In a telephone net-work, a pair of line conductors, a bridge circuit across said conductors, a transmitter comprising a diaphragm and a button engaging each side of said diaphragm, the buttons of said transmitter being connected in multiple in said bridge circuit, a telephone receiver, and a closed circuit therefor inductively connected to but conductively separated from said line conductors.

9. In a telephone net-work, a pair of line conductors, a normally open bridge including a two-element transmitter connected across said line conductors, a second bridge including a ringer and a condenser connected across said line conductors, a hookswitch for opening said first mentioned bridge, a telephone receiver, and a closed circuit for said receiver conductively separated from but inductively connected to said first bridge.

In witness whereof, I hereunto subscribe my name this 4th day of June A. D. 1924.

WINFRED T. POWELL.