H. S. OSBORNE.

COMPOSITE TRANSMISSION SYSTEM.

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1,374,219. Patented Apr. 12, 1921.

INVENTOR.

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COMPOSITE TRANSMISSION SYSTEM.

1,374,219. Specification of Letters Patent. Patented Apr. 12, 1921.

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To all whom it may concern:

Be it known that I, HAROLD S. OSBORNE, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Composite Transmission Systems, of which the following is a specification.

This invention relates to signaling systems and particularly to those employed to transmit both telephone and telegraph signals over the same conductors.

In a co-pending application, Serial No. 266,326, filed December 11, 1918, is described a system whereby telegraph signals can be transmitted over telephone lines involving the use of amplifiers and loading coils without material interference with the telephone currents by the use of telegraph currents of the same order of magnitude as telephone currents, and in which the evil effects of ground potentials and other disturbances on such currents is avoided by using complete metallic circuits. The present invention deals with improvements in the circuit arrangements for systems of this character. One object of the invention is to increase the available channels of communication in such a system. Another object is to provide for the association of the telephone and telegraph circuits of this kind without interference one with the other. Another object is to provide transmitting and receiving instruments suitable to such circuits. Other objects will be apparent from the following description.

The invention will be described more in detail in connection with the accompanying drawing in which the single figure illustrates diagrammatically a system embodying the invention.

Two standard telephone circuits are indicated at 1 and 2. A third or phantom circuit is indicated at 3 which is produced in the usual manner by tapping the neutral points of transformers 4, located in the respective side circuits 1 and 2. Branches 5 and 6 leading to telegraph apparatus are connected across the circuits 1 and 2 respectively. Each of these provides a complete metallic circuit for the telegraph currents. 7 and 8 represent telegraph relays for receiving signals transmitted from the opposite end of the line (not shown). Each of these relays has a winding connected in each side of its branch circuit and the ends of each pair, remote from the leads 5 and 6, are connected with the terminals of an artificial line N which is designed to simulate the main line. The artificial line here illustrated is of known form except that it is divided in the center to provide a neutral point 9 in each instance. A conductor leads from each of the neutral points 9 to a third receiving relay 10 which is, in all respects, like relays 7 and 8 and is similarly connected between the leads and the artificial line N'. N' however need not be arranged to provide the neutral points indicated at 9. The transmitting apparatus for each telegraph circuit is bridged across the midpoints of the relay windings as shown at 11, so that the relays may be regarded as having four windings which are in series and assisting with respect to currents received from the other end of the line, but in parallel and opposed with respect to currents transmitted from the same station, since the current emanating from 12 will in each case divide equally between the main line and the artificial line N, thus having no effect upon the receiving relay, all as is well understood in connection with duplex telegraphy.

The form of transmitting apparatus here shown includes but a single source of current 13 used for transmitting both the positive and negative impulses. The usual regulating resistance in series with the battery is indicated at 13'. Two switch arms 14, arranged to move in unison under the control of a relay magnet indicated at 14', are connected to the opposite sides of the current course and play between front and back contacts connected to the opposite sides of the circuit. Two contacts 15 are connected to one side of the circuit and arranged on opposite sides of opposite arms, while two contacts 16 are connected to the other side of the circuit and arranged on the other sides of the two arms respectively, constituting a well-known form of pole changer. These contacts, may as indicated, be spring contacts arranged to follow, to a limited extent the movement of the arms 14, so that the circuit is made on one side before it is broken on the other. When so constructed the arms 14 are preferably biased to one position by a spring in order to avoid short-circuiting the source of current when the sending apparatus is not in use. It will be obvious that if desired a polarized relay or

other equivalent of this biasing arrangement may be used.

As is well known, it is necessary in composite systems to provide means for preventing telephone currents from entering the telegraph branch of the circuit and the telegraph currents from entering the telephone branch of the circuit. To this end a high pass filter is connected in the telephone branches of the circuit, comprising condensers 17 in series in the circuit and inductances 18 in shunt thereto. In order that the inductances 18 may serve alike for the side and the phantom telephone circuits, it is necessary that each be composed of two equal and independent coils, so as to constitute an inductive resistance to currents passing through the two in series from the side circuits or in parallel from the phantom circuit. The mid-points, or the points where the two coils of each inductance 18 join, are connected by a conductor 19 as shown.

Part of the high pass filter may if desired, be individual to the side and phantom circuits as indicated at 17′ and 18′, in which case the shunt inductance for the side circuits may be provided by the transformer windings.

In the telegraph branches 5 and 6 are located low pass filters for preventing the wastage of the telephone currents in these branches. These consist of inductances 20 connected in series with the line and condensers 21 in shunt to the line and the latter are provided with midpoints which are united by the conductor 22 as in the high pass filters and for a like reason.

It is desirable to provide further filtering means in the sending branches of the individual telegraph circuits. These are indicated on the drawing at 23 and need no further description since they are in character and operation similar to the apparatus 20—21—22, except that the phantom circuit is here represented independently and there is, therefore, no need to provide the midpoints in the bridged capacities. The purpose of the filters 23 is not only to extend the filtering effect of apparatus 20—21—22 but also to prevent the higher harmonics due to the operation of the sending switch from reaching the telephone line and causing what is known as Morse thump in the telephone circuit. There is also a thump due to electromotive forces generated in the windings of the relay 7 by the operation of its armature, and the division of the low pass filter elements between the leads 5—6 and the individual sending branches should be such as to reduce both thumps to the lowest point possible.

The operation of the various pieces of apparatus herein described needs no detailed explanation since it is the same as in phantom telephone and duplex telegraph apparatus now well known in the art. It will be seen, however, that I have provided for three duplex telegraph circuits for operation over four conductors, simultaneously with the operation of two side and one phantom telephone circuit over the same conductors, and all on complete metallic circuits. The employment of a transmitter in the form here shown in which a single source of current is used and in which the circuit is made in one direction before it is broken in the other, while not essential to the system as a whole, is particularly useful in a circuit of this kind since it tends to avoid sudden and irregular fluctuations. The use of a single source of sending current has the further advantage that it becomes unnecessary to maintain two separate sources at exactly the same potential and the transmitted impulses of one sign are exactly like the transmitted impulses of the opposite sign, so that the receiving apparatus is not subject to a bias due to unequal received currents. It permits moreover the use of a common battery for a number of telegraph circuits.

It will also be seen that I provide a balanced receiving relay with four equal windings, rather than two equal windings, as in the present standard differential relay, which is of special advantage in the employment of the metallic telegraph circuits here shown, because with the four windings there is less tendency to cause an unbalance in the telephone circuit due to the uneven distribution of the admittances in the telegraph branch.

The arrangement here shown is illustrative of the invention only, as it will be readily understood that various modifications may be made in details without departing from the spirit of the invention.

What is claimed is:

1. In an electrical signaling system in which side and phantom telegraph circuits are formed on conductors carrying telephone currents, means for transmitting telegraph signaling currents in both directions over the conductors of the system concurrently with the telephone currents, low pass filters connected in the branches leading to the respective side circuits each of said filters being provided with a neutral point, means joining said neutral points whereby said filters act upon both the side and phantom circuits and other low pass filters connected in and affecting only the separate side circuit and phantom circuit respectively.

2. In an electrical signaling system, two pairs of conductors, telephone apparatus connected to said conductors to provide two separate side circuits and one phantom circuit, telegraph apparatus connected to said conductors to form side and phantom tele-

graph circuits and arranged to transmit signal impulses in both directions, high pass filters arranged in the telephone branches of said pairs, low pass filters arranged in the telegraph branches of said pairs, each filter providing a neutral point in its bridged elements and conductors uniting the neutral points of the two lower limiting filters and the neutral points of the two upper limiting filters respectively, and additional filters arranged to affect each side telegraph circuit and the phantom telegraph circuit separately.

3. In an electrical signaling system, two pairs of conductors, telephone apparatus connected to said conductors to provide two separate side circuits and one phantom circuit, telegraph apparatus connected to said conductors to form side and phantom telegraph circuits and arranged to transmit signal impulses in both directions, high pass filters arranged in the telephone branches of said pairs, low pass filters arranged in the telegraph branches of said pairs, each filter providing a neutral point in its bridged elements and conductors uniting the neutral points of the two lower limiting filters and the neutral points of the two upper limiting filters respectively, and additional filters arranged to affect each of the several channels individually.

4. In an electrical signaling system, two pairs of conductors, telephone apparatus connected to said conductors to provide two side circuits and one phantom circuit, telegraph apparatus bridged across the conductors of each side circuit, means contained in the branches of said conductors leading to said telegraph apparatus for preventing the passage of currents of telephone frequencies, means contained in the branches leading to the telephone apparatus for preventing the passage of currents of telegraph frequencies, the apparatus in each telegraph branch being arranged to provide a mid or neutral point and other telegraph apparatus having its terminals connected respectively to said mid or neutral points.

5. In an electrical signaling system, two pairs of line conductors, telephone apparatus connected to said conductors to provide two side circuits and one phantom circuit, a telegraph receiving relay associated with each pair of conductors and provided with two sets of windings, each set being connected on one side to one of said conductors, an artificial line connected between the other terminals in each of said sets of windings and arranged to provide a mid or neutral point and a third telegraph receiving relay connected across said mid or neutral points.

6. In combination with a metallic telephone line, a telegraph receiving relay having four similar windings connected together in pairs and with one terminal of each pair connected to one of the conductors of the telephone line, an artificial line simulating the real line connected across the other two terminals of said pairs of relay windings and telegraph sending apparatus bridged across the points where the pairs of windings are connected together.

7. In a signaling system, a main line, a receiving relay having two sets of windings connected serially between the opposite sides of the line, an artificial line connected in circuit between the two sets of windings, and signal transmitting apparatus connected between intermediate points in the respective sets of winding such that the magnetic effect of outgoing current in the relay is negligible.

8. In a signaling system, two pairs of main line conductors, a receiving relay associated with each line, each relay having two sets of windings connected serially between the opposite sides of the line, an artificial line in the circuit between the two sets of windings of each relay and arranged to provide a mid or neutral point, and signaling apparatus connected between the neutral points provided by the two artificial lines.

9. In a signaling system, two pairs of main line conductors, a receiving relay associated with each line, each relay having two sets of windings connected serially between the opposite sides of the line, an artificial line in the circuit between the two sets of windings of each relay and arranged to provide a mid or neutral point, a third receiving relay having two sets of windings connected serially between the two neutral points so provided, a third artificial line connected between the two sets of windings of said third relay, and current transmitting circuits connected to the system at the points of balance between the main and the respective artificial lines.

10. In a signaling system, two pairs of main line conductors, a receiving relay associated with each line, each relay having two sets of windings connected serially between the opposite sides of the line, an artificial line connected in circuit between the two sets of windings of each relay and arranged to provide a mid or neutral point, a third receiving relay having two sets of windings connected serially between the two neutral points so provided, a third artificial line connected between the two sets of windings of said third relay, and signal transmitting apparatus connected between intermediate points in the respective sets of windings of each relay, such that the magnetic effect of outgoing current in the relay is negligible.

In testimony whereof, I have signed my name to this specification this tenth day of February, 1919.

HAROLD S. OSBORNE.