

UNITED STATES PATENT OFFICE

2,139,232

TRANSMISSION SYSTEM

John L. Hysko, Brooklyn, N. Y., assignor to Bell Telephone Laboratories Incorporated, New York, N. Y., a corporation of New York

Application June 1, 1936, Serial No. 82,883

4 Claims. (Cl. 178-66)

This invention relates to transmission systems and more particularly to carrier telegraph transmission systems.

In carrier telegraph systems the signals are usually sent by impressing the carrier on a transmission line in accordance with a code. During transmission the periods when the carrier is not impressed on the line are of as much importance as those periods when the carrier is impressed on the line. Arrangements are known in which the impedance of a shunt across the line is varied to change from the condition of transmitting the carrier to the condition of not transmitting, that is, from marking to spacing or vice versa.

Heretofore such arrangements have commonly involved contacts in the carrier circuit which are opened and closed. Due to the low power of the carrier at the point of control small particles of dust or other foreign matter on the contacts greatly increase the impedance presented to the carrier with resultant false signals.

This invention has as a general object the improvement of carrier telegraph systems.

Another object is the elimination of false signals from such systems.

A further object is the elimination of contacts from the carrier source in carrier telegraph systems.

The term "carrier telegraph system" as used herein includes radio as well as wire systems or a combination of them.

The objects noted are achieved according to this invention by the use of a direct current to change the impedance to the carrier of impedance devices inserted in the carrier path.

The invention, its objects and various features will be better understood from the following description in connection with the attached drawing, in which:

Fig. 1 illustrates one form which the invention may take involving shunt and series impedances;

Fig. 2 illustrates a modification of Fig. 1 in which the direct current paths are individually controlled to afford a better balance; and

Fig. 3 illustrates another arrangement of impedances according to the invention.

Referring now to Fig. 1 there is illustrated an oscillator 1 which forms the carrier current source. In series with this source is a resistance 2 to control the output level of the source. Also in series are transformer windings 3 and 4 of transformers 35 and 36 respectively. The other windings of these transformers are shown at 5 and 6. In shunt to the source are transformer windings

7 and 8 of transformers 37 and 38, respectively, having corresponding windings 9 and 10.

Sources of direct current 11 and 12 are associated with the subscriber's loop SL in which there is a key 39 and resistances R_1 , R_2 and R_3 whose functions will appear hereinafter.

Inserted in one of the leads to windings 5 and 6 are surface type rectifiers or one-way devices 14 while in one of the leads to windings 9 and 10 are similar devices 15.

Block 16 represents a filter to eliminate harmonics and other undesirable currents from the line which extends beyond the filter.

Windings 5 and 6 are so connected that current passes through winding 5 in the opposite direction to that of the current in winding 6. The currents induced in windings 3 and 4 when current is impressed on or removed from windings 5 and 6 are therefore opposed and hence no current flows to the line due to the change of current in windings 5 and 6, that is, no direct current "kicks" are impressed on the line.

This condition exists also in transformers 37 and 38 and no direct current "kicks" from these transformers reach the line.

The cores of the transformers are of such material and the value of direct current impressed upon them from the subscriber's loop circuit is such that the cores become saturated from such current. When the cores are saturated, alternating current impressed on windings 3 and 4 or 7 and 8 meets only the direct current resistance of the windings since there is substantially no inductive reactance.

Signals are sent by impressing oscillating current from source 1 on to the line beyond filter 16 in accordance with a code. The embodiment of the invention illustrated in Fig. 1 makes use of key 39 to form the code.

When key 39 is open as illustrated no current flows from direct current source 11. Current from battery 12 flows through parallel circuits, one including its own ground, ground 40, resistances R_3 and R_2 to the negative terminal of the battery. The other circuit includes the battery 45 ground, ground 40, resistance R_1 , conductor 41, conductor 42, windings 9 and 10, one-way devices 15, conductor 43, resistance R_4 to the negative terminal of battery 12. No current can flow in windings 5 and 6 since one-way devices 14 are poled to oppose it.

Since no direct current flows in windings 5 and 6, the inductive reactance to alternating current impressed on windings 3 and 4 will be large. At the same time since direct current flows in

windings 9 and 10, the cores of transformers 37 and 38 are saturated and the inductive reactance of windings 7 and 8 to alternating current is very small. Under these circumstances windings 7 and 8 constitute a low impedance shunt and hence any current from oscillator 1 which may pass windings 3 and 4 is shunted away from the filter 16 and the line beyond, by windings 7 and 8.

When key 39 is closed batteries 11 and 12 are effectively connected in series. The potential at the point where conductor 43 is connected to the loop is positive with respect to the potential at the point where conductor 41 is connected to the loop between resistances R₂ and R₃, and therefore current flows from the positive terminal of battery 11 through key 39, conductor 43, one-way devices 14, windings 6 and 5, conductor 41, resistance R₃, ground 40, and negative terminal of battery 11. Some current also flows through key 39, resistance R₁, battery 12 to ground and negative terminal of battery 11. There is also local current from ground 40, resistance R₃, resistance R₂, battery 12 to ground. The voltage drops in resistances R₁, R₂ and R₃ due to the currents in these last-mentioned circuits will determine the potentials in the loop circuit which cause current to flow through the transformer windings as described.

Direct current in windings 5 and 6 saturates the cores of transformers 35 and 36 and windings 3 and 4 present only a small direct current resistance to the current from oscillator 1. At the same time since no current flows in windings 9 and 10 due to one-way devices 15, windings 7 and 8 present a high inductive reactance to the current from oscillator 1 and this branch becomes essentially an open circuit. Hence, current from oscillator 1 is impressed on filter 16 and the line beyond and a marking signal is sent.

It will be noted that no relay contacts are present in either the loop circuit or the signaling circuit. Since the only contacts that are present in the entire arrangement are those at key 39, false signals due to dirty contacts are practically eliminated.

Fig. 2 illustrates a slight modification of the arrangement of Fig. 1 to insure better balance of the direct current through windings 5 and 6, and 9 and 10. Like parts are given the same indices in this figure as in Fig. 1.

The improved balance is obtained by inserting between windings 5 and 6 a resistance 18 and between windings 9 and 10 a resistance 19. Sliding contacts 20 and 21 for windings 5 and 6 and sliding contacts 22 and 23 for windings 9 and 10 may be so adjusted that equal direct currents flow through the opposing windings. Due to slight inaccuracies in winding during manufacture of the transformers the windings may have unequal direct current resistances and hence unequal voltage drops resulting in incomplete opposition or neutralization of the induced voltages caused by the change in direct current. Upon making or breaking of the direct current circuits this unbalance is evidenced in the transmission line by pulses which may cause false signals. The operation of the arrangement of this figure is the same as that of Fig. 1.

Fig. 3 illustrates a modification of the invention in which two three-winding transformers 24 and 25 are used. Transformer 24 is composed of input winding 26, direct current winding 27 and output winding 28 all mounted on a common core. Transformer 25 is composed of input winding 29, direct current winding 30 and output

winding 31 mounted on a common core. Direct current windings 27 and 30 are connected in opposing relation to avoid direct current kicks as described above.

As in Figs. 1 and 2 the carrier current is generated in oscillation generator 1 the output level of which is controlled by resistance 2. Windings 26 and 29 in series complete the local carrier circuit. Windings 28 and 31 are connected in series and inductively to windings 26 and 29 respectively. The filter 16 associated with output windings 28 and 31 performs the same function as with the arrangements of Figs. 1 and 2.

One-way devices 32 are included in the circuit of windings 27 and 30 as is also the armature 13 of the sending relay. Direct current sources 11 and 12 are associated with armature 13. In this case, however, direct current source 11 is associated with the marking contact M while source 12 is associated with spacing contact S. Also associated with spacing contact S and armature 13 is a resistance 33 in series with a condenser 34 to insure spacing and marking signals of equal length as will be described later.

The cores of transformers 24 and 25 and the value of the current from source 12 is such that when the direct current flows through windings 27 and 30 the cores are overloaded and no induction occurs as between windings 26 and 28 and between windings 29 and 31.

Signals are transmitted by causing sending relay armature 13 to move in accordance with a code. When armature 13 is on spacing contact S, direct current flows from ground 17 through windings 27 and 30 in series, one-way devices 32, armature 13, contact S, source 12 to ground. Under this condition the transformer cores are saturated and windings 26 and 29 induce no currents in windings 28 and 31. Hence no current is impressed on the transmission line.

When armature 13 is on marking contact M no current flows through windings 27 and 30 because one-way devices 32 are poled against passage of current from the positive terminal of source 11. Therefore, the currents from generator 1 will flow through windings 26 and 29 and corresponding currents will be induced in windings 28 and 31 and after passing through filter 16 will be impressed upon the transmission line.

The function of resistance 33 and condenser 34 may be best explained by assuming armature 13 on the spacing contact S and current flowing from ground 17 through the circuit previously traced through armature 13, contact S to source 12. When armature 13 leaves contact S this current will continue to flow through resistance 33 until condenser 34 is charged. The value of resistance 33 and the capacity of condenser 34 are such that the time to charge the condenser is greater than the time for armature 13 to move from contact S to contact M. When armature 13 contacts with contact M the positive potential of source 11 is impressed on the armature and current flow through the windings ceases.

Very little, if any, current will flow through windings 27 and 30 while armature 13 is on contact M and none will flow during the armature travel from M to S. Current will flow only when armature 13 contacts with contact S and upon leaving S until it contacts with contact M. It will, therefore, be seen that if the armature travel time from S to M is the same as from M to S the marking signals will be the same length as the spacing signals.

It is understood that many modifications may be made in the circuits described which will be within the scope of this invention. The invention, however, is to be limited only by the appended claims.

What is claimed is:

1. In combination, a source of alternating current, a circuit therefor, multiwinding impedance devices in series with said alternating current source, multiwinding impedance devices in shunt to said alternating current source, a direct current source, circuits separately connecting certain of the windings of said series and certain of the windings of said shunt multiwinding devices to said direct current source through respectively oppositely poled one-way devices, means to vary the polarity of the direct current impressed on said circuits whereby direct current of one polarity is impressed on certain of the windings of said series devices and direct current of the opposite polarity is impressed on certain of the windings of said shunt devices.

2. A combination in accordance with claim 1, characterized in this that relatively opposing magnetic fields are set up by said direct current when it is impressed on certain of the windings of said multiwinding devices.

3. In a telegraph transmission system, an alternating-current carrier source, a transmission device, a circuit connecting the carrier source and the transmission device, an inductive impedance in the alternating-current circuit in series with the carrier source, an inductive impedance in the alternating-current circuit in shunt of the car-

rier source, a direct-current source, a circuit including unidirectional devices for connecting the direct-current source to the impedances, and a switch in the direct-current circuit, the switch when in a spacing position causing direct current of one polarity to flow in the shunt impedance and when in a marking position causing direct current of an opposite polarity to flow in the series impedance so that the carrier source is effectively blocked from the transmission device when the switch is in the spacing position and is applied to the transmission device when the switch is in the marking position.

4. In a telegraph transmission system, an alternating-current carrier source, a transmission device, a circuit connecting the carrier source and the transmission device, multiwinding inductive impedances connected in the alternating-current circuit, a direct-current source, a circuit including unidirectional devices for connecting the direct-current source to certain windings of the inductive impedances, and a switch in the direct-current circuit, the switch when in a spacing position causing direct current to flow in said certain windings of the impedances and when in a marking position effectively blocking the direct current from said certain windings of the impedances so that the carrier source is effectively blocked from the transmission device when the switch is in the spacing position and is applied to the transmission device when the switch is in the marking position.

JOHN L. HYSKO.