

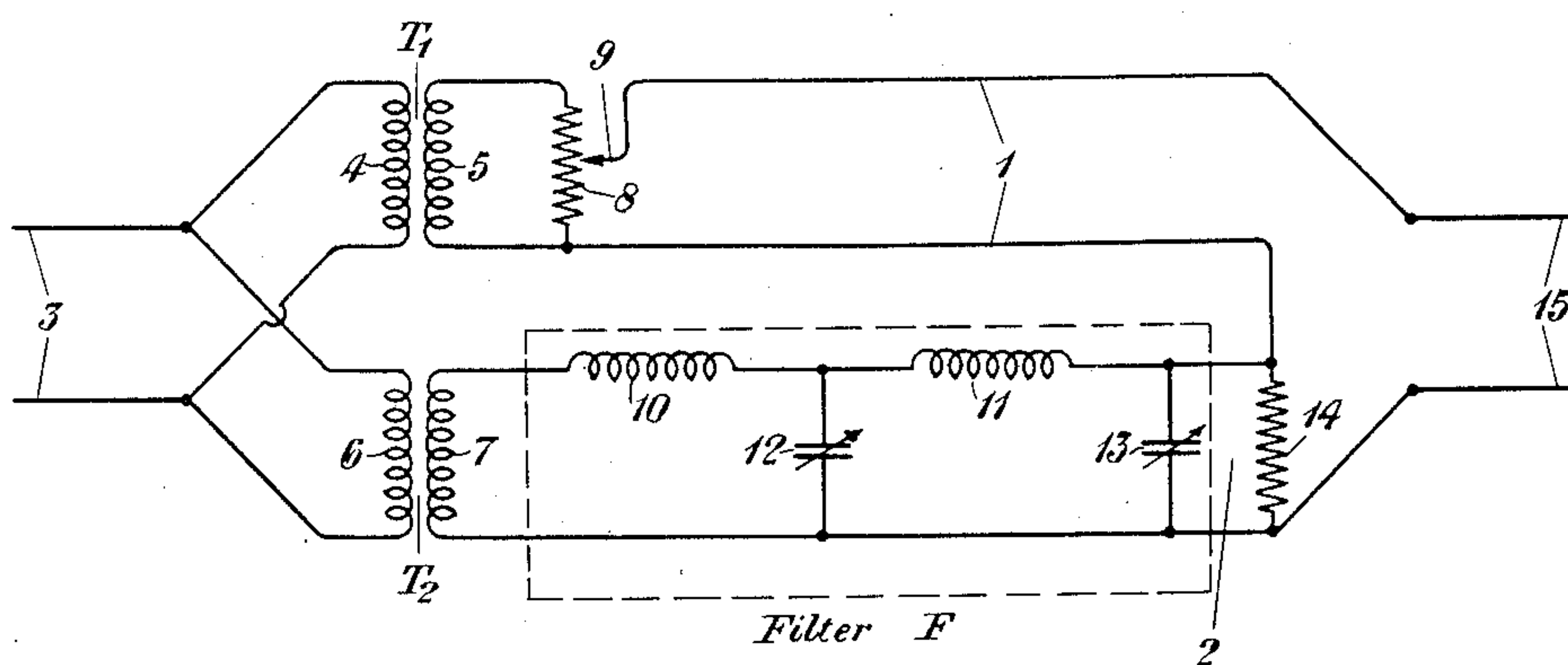
May 27, 1930.

R. G. McCURDY

1,759,952

ELECTRICAL TRANSMISSION SYSTEM

Filed March 1, 1926



INVENTOR
R. G. McCurdy
BY *gr 40-2*
ATTORNEY

UNITED STATES PATENT OFFICE

RALPH G. McCURDY, OF ENGLEWOOD, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

ELECTRICAL TRANSMISSION SYSTEM

Application filed March 1, 1926. Serial No. 91,651.

This invention relates to electrical transmission systems, and particularly to arrangements in such systems for eliminating one component of the complex wave form of the system without substantially affecting the other components.

Generally in transmission systems the fundamental component of a complex wave generates other currents. These other currents generated by the presence of the fundamental component usually distort the wave form which is to be transmitted by the system.

It is therefore an object of this invention to provide means for eliminating the fundamental component of a complex wave though freely transmitting the other components of the complex wave. It is another object of this invention to select from a complex wave having a fundamental component the harmonics of the fundamental component, and to eliminate the fundamental component so that it does not generate other currents.

It is a further object of this invention to eliminate a component of a complex wave by transmitting the complex wave through one transmitting circuit, then transmitting the particular component to be eliminated through another transmitting circuit, and then bringing the phases of the particular component to be eliminated to opposition in the respective transmitting circuits so that the particular component is neutralized and eliminated.

While the nature of the invention will be pointed out with particularity in the appended claims the invention itself, both as to its further objects and features, will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention.

Referring to the drawing, there are shown two branch or transmitting circuits, 1 and 2, which are associated with a source of complex current connected to the leads 3. The transmitting circuit 1 is connected with the source of complex current 3 through a transformer T_1 having a primary winding 4 and a secondary winding 5. The transmitting circuit 2 is also connected with the source of

complex current 3 through a transformer T_2 having a primary winding 6 and a secondary winding 7. The secondary winding 5 of the transformer T_1 is connected across the terminals of a potentiometer 8. A movable arm 9 is associated with the potentiometer 8 for adjusting the potential of the complex wave impressed across the secondary winding 5 of the transformer T_1 to be transmitted to the transmitting circuit 1. A low-pass filter F having series inductances 10 and 11 and shunt capacities 12 and 13 is connected across the secondary winding 7 of the transformer T_2 . A fixed resistance 14 is connected across the output of the filter F . An output or common transmitting circuit 15 unites the transmitting circuits 1 and 2, the potentiometer 8 and the fixed resistance 14 being in series with the common transmitting circuit 15.

The arrangement of this invention is suitable for eliminating the fundamental component of the complex wave in the source 3 before the complex wave is transmitted to the common transmitting circuit 15. The complex wave is transmitted through transformers T_1 and T_2 to the potentiometer 8 and the filter F , respectively. The wave shape of the complex wave is faithfully reproduced across the terminals of the potentiometer 8. The complex wave is also transmitted to the filter F which is set up so as to eliminate all of the harmonics of the fundamental component and to freely transmit the fundamental component. Consequently there will appear across the output of the filter F an undistorted sinusoidal wave of the fundamental frequency free from harmonics. The filter is known in the art as a low-pass filter of the type described in the patent to G. A. Campbell, No. 1,227,113, filed May 22, 1917, but it will be understood that any other arrangement suitable for transmitting one component of a complex wave and for suppressing all other components of the complex wave will be equally suitable for the invention.

The phase of the fundamental component transmitted by the transformer T_1 is normally the same as the phase of the fundamental component transmitted by the transformer T_2 ; but by choosing the proper connections

to the secondary winding 7 of the transformer T_2 and by choosing the proper filter constants, the phase of the fundamental component transmitted by the transformer T_2 and the filter F to the transmitting circuit 2 may be brought in opposition to the phase of the fundamental component transmitted by the transformer T_1 to the transmitting circuit 1. If the fundamental component transmitted by the respective transmitting circuits 1 and 2 are made equal in magnitude, since they are opposite in phase, the effect of the fundamental component on the common transmitting circuit 15 will be made negligible. The movable arm 9 associated with the potentiometer 8 is employed for bringing the magnitude of the fundamental component transmitted by the transformer T_1 equal to the magnitude of the fundamental component transmitted by the transformer T_2 and the filter F associated with the secondary winding thereof. Furthermore, the phase relationship may be brought more nearly to opposition by the adjustment of the capacity of either condenser 12 or condenser 13 in the filter F . The impedance 14 is connected in series with the potentiometer 8 and the common transmitting circuit 15 so that the common transmitting circuit 15 receives all of the components of the complex wave in the source 3 except the one eliminated by the apparatus shown in the drawing.

By employment of the apparatus of this invention a very nearly perfect elimination of the fundamental component of a complex wave form can be accomplished. This arrangement has a distinct advantage over any involving the use of a high pass filter because in this arrangement the position of the inductance with respect to the rest of the circuit does not render it as susceptible to the effects of pickup from stray magnetic fields.

It will be understood that while the arrangement of this invention has been described for the elimination of the fundamental component of a complex wave, any other component may be eliminated by employing another filter which will pass that component to the exclusion of all other components.

While the arrangement of this invention is disclosed in one particular embodiment which is deemed desirable, it is to be understood that it is capable of embodiment in other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The method of eliminating the fundamental component of a complex wave, which consists in transmitting the complex wave through one branch circuit, transmitting only the fundamental component of the complex wave through a paralleled branch circuit, and shifting the phase of the funda-

mental component transmitted through one of the branch circuits so as to be in opposition to the phase of the fundamental component transmitted through the other of the branch circuits, and combining the branch circuits so as to eliminate the fundamental wave. 70

2. The method of eliminating the fundamental component of a complex wave, which consists in transmitting the complex wave through one branch circuit, transmitting the fundamental component of the complex wave through another branch circuit, shifting the phase of the fundamental component transmitted through one of the branch circuits to opposition with respect to the phase of the fundamental component transmitted through the other of the branch circuits, equalizing the amplitudes of the fundamental component transmitted through the respective branch circuits, and combining the components transmitted through the respective branch circuits. 75 80 85

3. The method of eliminating a component of a complex wave, which consists in freely transmitting the complex wave through a transmitting circuit, freely transmitting through a paralleled transmitting circuit the particular component to be eliminated and substantially suppressing all other components, bringing the phases of the particular component to be eliminated in the respective transmitting circuits to opposition and the amplitudes to equality, and freely transmitting through a common transmitting circuit all the components of the complex wave except the particular component eliminated by phase opposition. 90 95 100 105

4. The method of suppressing the fundamental frequency of a source of current and transmitting the harmonics of the fundamental frequency, which consists in transmitting the fundamental frequency to the exclusion of all other frequencies through one circuit, transmitting the fundamental frequency and its harmonics through another circuit, adjusting the phases of the fundamental frequency in the respective circuits to opposition, and combining the currents in the respective circuits. 110 115 120 125

5. In combination, a source of current having a fundamental frequency and its harmonics, two transformers, a filter capable of transmitting the fundamental frequency to the exclusion of all other frequencies, an output circuit, one transformer transmitting the fundamental frequency and its harmonics, the other transformer and the filter transmitting the fundamental frequency and suppressing the harmonics of the fundamental frequency, and means for adjusting the phases of the fundamental frequency transmitted by the respective transformers to opposition, the output circuit receiving the harmonics of the fundamental frequency free from the fundamental frequency. 130

6. In a system for transmitting the harmonics of a fundamental frequency and suppressing the fundamental frequency, comprising a source of current having a fundamental frequency and its harmonics, two transformers, a filter designed to freely transmit the fundamental frequency to the exclusion of all other frequencies, one transformer transmitting the fundamental frequency and its harmonics, the other transformer and the filter transmitting the fundamental frequency and suppressing the harmonics of the fundamental frequency, and means for adjusting the phases of the fundamental frequency transmitted by the respective transformers to opposition.

means associated with the second of said transmitting circuits for bringing the phase of the component to be suppressed into opposition with respect to the phase of the same component transmitted through the first of said transmitting circuits, and a common transmitting circuit for freely transmitting all the unsuppressed components of the complex wave, the particular component being eliminated by its presence in the common transmitting circuit in opposite phases.

In testimony whereof, I have signed my name to this specification this 26th day of February 1926.

RALPH G. McCURDY.

7. In combination, a source of current of fundamental frequency and its harmonic components, a filter capable of transmitting the fundamental frequency while suppressing all other frequencies, a potentiometer, two transformers, one transformer and the potentiometer being so related to the source of current as to transmit the fundamental frequency and its harmonic components, the other transformer and the filter being so related to the source of current as to transmit the fundamental frequency and to suppress the harmonic components of the fundamental frequency, and means for bringing the phase of the fundamental frequency transmitted by the transformer and the potentiometer in opposition to the phase of the fundamental frequency transmitted by the other transformer and the filter so as to nullify the effect of the fundamental frequency.

8. In combination, a complex source of current, two branch circuits, means for transmitting through one branch circuit the fundamental component of the complex current, means for transmitting through another branch circuit the fundamental component of the complex current and its harmonics, means for equalizing the magnitudes of the fundamental component flowing through the respective circuits, means for shifting the phases of the fundamental component flowing through the respective branch circuits to opposition, and circuit arrangements for combining the branch circuits so as to transmit the harmonics of the fundamental component free from the fundamental component.

9. A system for eliminating a component of a complex wave, comprising a transmitting circuit for freely transmitting the complex wave, a parallel transmitting circuit including an electrical wave filter for freely transmitting only the particular component to be eliminated and substantially suppressing all other components, means associated with the first of said transmitting circuits for bringing the amplitude of the current to be suppressed into equality with respect to the amplitude of the same component transmitted by the second of said transmitting circuits,

85

90

95

100

105

110

115

120

125

130