Jan. 2, 1923. 1,440,407

H. S. OSBORNE.
DETECTING CIRCUITS.
FILED JULY 2, 1920.

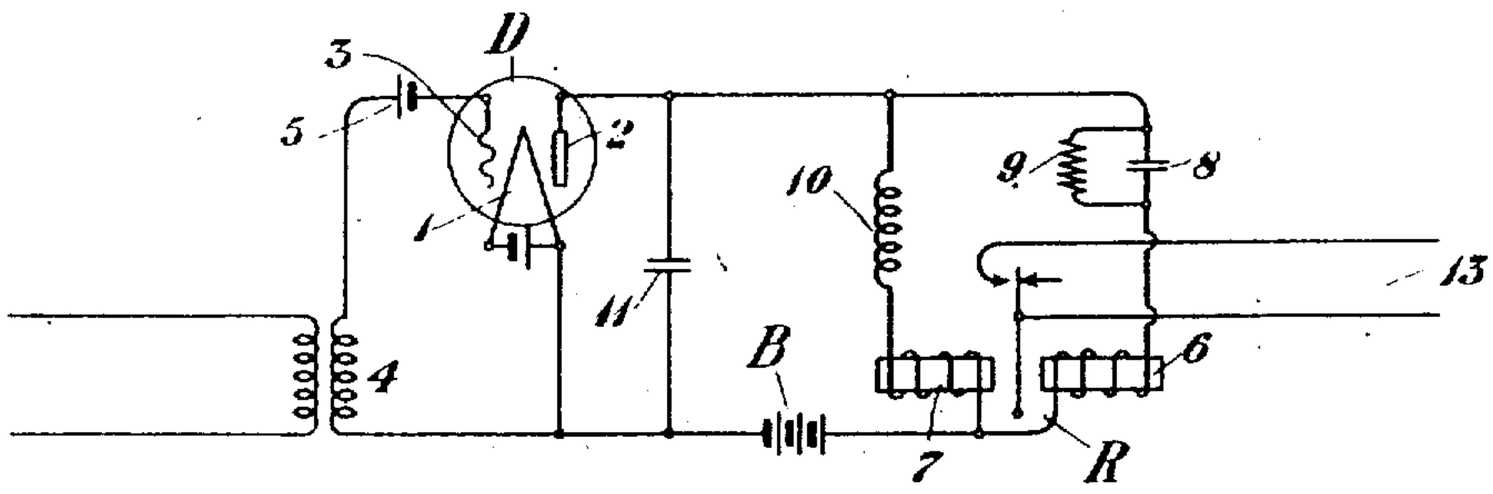

Fig. 1

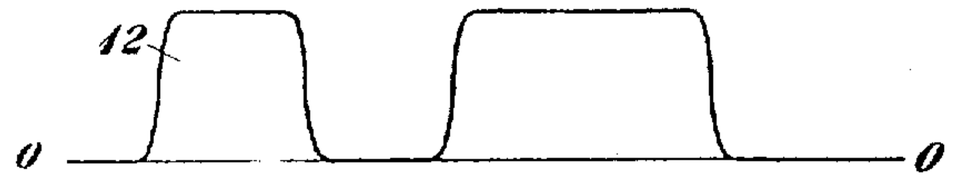

Fig 2

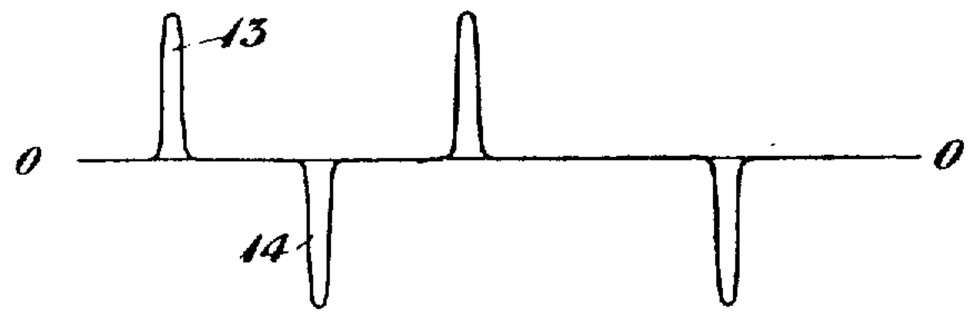

Fig 3

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Patented Jan. 2, 1923. 1,440,407

UNITED STATES PATENT OFFICE.

HAROLD S. OSBORNE, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

DETECTING CIRCUITS.

Application filed July 2, 1920. Serial No. 393,533.

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 Detecting Circuits, of which the following is a specification.

This invention relates to receiving apparatus and more particularly to receiving apparatus to be used in connection with transmission systems in which carrier currents are employed.

Heretofore, when the carrier currents have been employed for the transmission of telegraphic signals either over wires or through the ether, it has been customary to translate the high frequency carrier currents into low frequency signals by means of a detector, such as a vacuum tube detector, in the output circuit of which a relay is included. Since detectors of this type operate by controlling the flow of a direct current, it has been necessary to use a neutral relay as the receiving instrument. One of the objects of the present invention is to provide a detector circuit of such character that a polarized relay may be used for receiving purposes. Another object of the invention is to provide a detector circuit of such character that the receiving relay will be operated by the alternating current component of the signaling current, the direct current component being effectually suppressed. These objects, as well as other objects more fully appearing hereinafter, are obtained by means of the arrangement set forth in the following description and illustrated in the appended drawings. Figure 1 of which constitutes a circuit diagram of a form of detector circuit embodying the invention, and Figures 2 and 3 of which show curves illustrating the operation of the detector.

Referring to Figure 1, D designates a detector of the vacuum tube type having a filament 1, plate 2 and controlling electrode or grid 3. The input circuit of the detector is connected between the filament 1 and the grid 3 and includes the secondary winding of a transformer 4, through the agency of which received modulated carrier currents are impressed upon the detector. A source of potential 5 is included in the grid circuit for a purpose more fully appearing hereinafter. The output circuit is connected between the filament 1 and the plate 2 and includes a source of space current B. The polarized receiving relay R having windings 6 and 7 is provided for recording the signals. The winding 6 of the polarized relay is bridged across the output circuit of the detector in parallel with the winding 7. A condenser 8 shunted by a resistance 9 is included in series with the winding 6, while an inductance 10 is included in series with the winding 7. A condenser 11 is bridged across the output circuit to form a by-pass for currents of carrier frequency, as will appear later.

The operation is as follows:

Inductance 10 and resistance 9 are so proportioned that their resistances are equal, so that a direct current flowing in the output circuit will divide equally between the windings 6 and 7 of the polar relay. The armature of the relay is therefore unbiased and will remain in whichever one of its two positions it has been moved in response to a signal, until an impulse is impressed upon the relay of such polarity as to shift it to the other position. When signals are not being received the source 5 in the grid circuit is adjusted in a well-known manner, so that no current or substantially no current flows in the output circuit.

As is well known, the modulation of a carrier frequency, in accordance with a signal wave of the character indicated by the curve 12 of Figure 2, results in a composite wave which may be resolved into a number of components, including an unmodulated wave of carrier frequency, a wave having a frequency equal to the sum of the carrier frequency and the dot frequency of the signal pulse, and a wave having a frequency corresponding to the difference between the carrier frequency and the dot frequency. Since the signal pulse is not of sine wave form but tends to be square topped, it may be resolved into a sine wave of dot frequency, and a plurality of sine waves whose frequencies are harmonics of the dot frequency. Consequently, in addition to the components above mentioned, the modulated carrier wave comprises components equal to the sums and differences between the carrier fre-

quency and the harmonics of the dot frequency.

When a composite wave of this character is impressed upon a vacuum tube detector such as the detector D, the component frequencies of the composite wave react upon each other in a manner similar to that already described in connection with the modulating process, so that waves appear in the output circuit of the detector, whose frequencies correspond to the sums and differences of the component frequencies. These different frequencies correspond to the dot frequency and the various harmonics thereof, and combine with a direct current component caused by the change in the impedance of the output circuit in response to the received signal to form a composite wave similar to that represented by the curve 12 of Figure 2, which of course corresponds to the signal originating at the transmitting station. The frequencies in the output circuit which correspond to the component frequencies of the modulated wave and those frequencies corresponding to the sums of the component frequencies, are of no utility in recording the signal and should, therefore, be suppressed. For this purpose the condenser 11 is provided and is so adjusted as to form a path of low impedance to the high frequencies, so that these frequencies will be shunted from the receiving relay R. The composite wave indicated by the curve 12 of Figure 2 is impressed upon the receiving relay R as the condenser 11 offers a path of large impedance to the low frequencies corresponding to the dot or dash frequency and the harmonics thereof. Owing to the fact that the resistances of the path through the two windings 6 and 7 of the relay are equal, the direct current component of the signal pulse is without effect upon the polar relay. The reactances of the two paths are different, however, one being positive and one being negative. Consequently the alternating current components affect the polar relay. The armature of this relay, when no signals are being received rests upon its right-hand contact, so that the local receiving circuit 13 is open. At the beginning of the signaling pulse indicated by the curve 12 of Figure 2 the alternating current components produce a "kick" in the relay circuit, such as is indicated at 13 in Figure 3, this "kick" corresponding to the change in amplitude as the signal pulse indicated by the curve 12 rises from zero to its maximum value. The armature of the polar relay is therefore shifted to its left-hand contact and closes the local circuit 13, remaining in this position during the steady state condition in which the direct current component, as already stated, is without effect. Towards the end of the signaling pulse, as wave 12 falls again to zero, another "kick" passes through the windings of the relay R in the opposite direction as indicated at 14 in Figure 3, thereby shifting the armature of the relay to its right-hand contact. During the steady state interval corresponding to no current, the armature remains in its shifted position until the beginning of a new signaling impulse when the operation is repeated.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims:

What is claimed is:

1. A receiving circuit comprising a detector, a polar relay in the output circuit of said detector and controlled thereby and circuit connections between said detector and said polar relay including means for preventing the direct current component of a signaling pulse detected by said detector from affecting the polar relay.

2. A receiving circuit comprising a vacuum tube detector, a polar relay in the output circuit of said detector and controlled thereby and circuit connections including means for preventing the direct current component of a signaling pulse detected by said detector from affecting said polar relay.

3. A receiving circuit comprising a detector, a polar relay having two windings included in a parallel circuit with said detector, the resistances of the parallel circuits through the two windings being equal but the reactances being unequal, so that said polar relay is unaffected by the direct current component of a signal pulse but is responsive to the alternating component thereof.

4. A receiving apparatus comprising a vacuum tube detector having a plurality of electrodes, and a polar relay having two windings connected in parallel, the resistances of the parallel circuits through said windings being equal but their reactances being unequal, so that the polar relay is unresponsive to the direct current component of a signal pulse but is responsive to the alternating component thereof.

5. A receiving apparatus comprising a detector, a source of direct current for polarizing said detector, and a polar receiving relay having two windings connected in parallel circuits with said detector and said source, the resistances of said parallel circuits being equal but the reactances being unequal, so that the polar relay is unresponsive to direct current flowing from said source but is responsive to the alternating component of a signal pulse.

6. A receiving apparatus comprising a vacuum tube detector having filament and plate electrodes, a source of current connected between said electrodes, and a re-

ceiving polar relay having two windings connected in parallel with each other, and in series with said source and said filament and plate electrodes, the resistances of the path through the two windings being equal but the reactances unequal, so that said polar relay is unresponsive to direct current flowing from said source but is responsive to the alternating component of a signal pulse.

In testimony whereof I have signed my name to this specification this 30th day of June 1920.

HAROLD S. OSBORNE.