

Sept. 22, 1925.

1,554,266

L. ESPENSCHIED

DETECTING CIRCUITS

Filed July 1, 1920

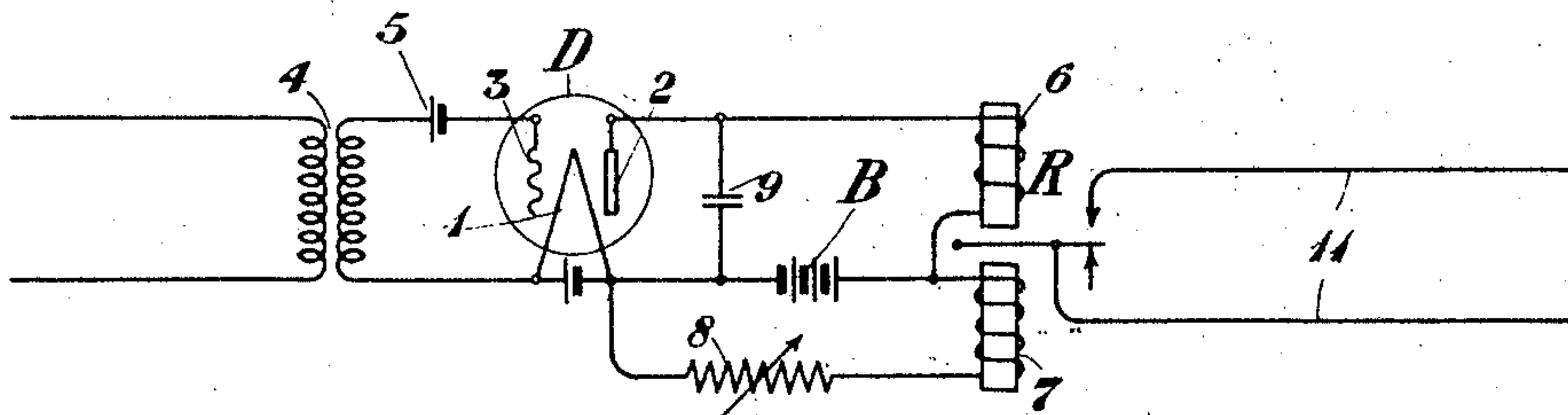


Fig. 1

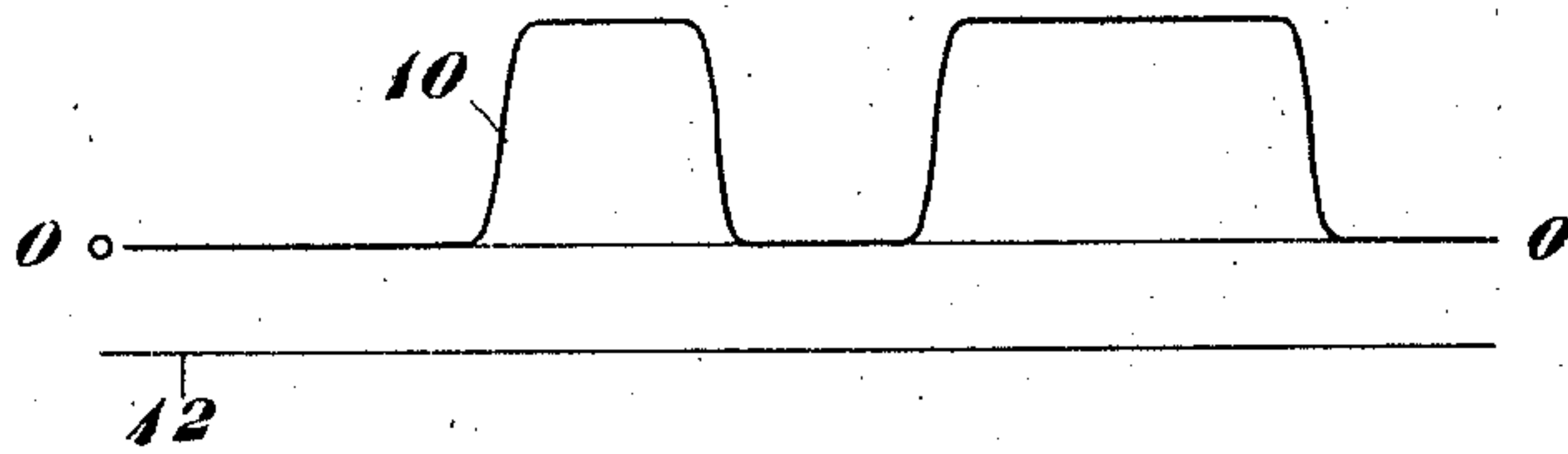


Fig. 2

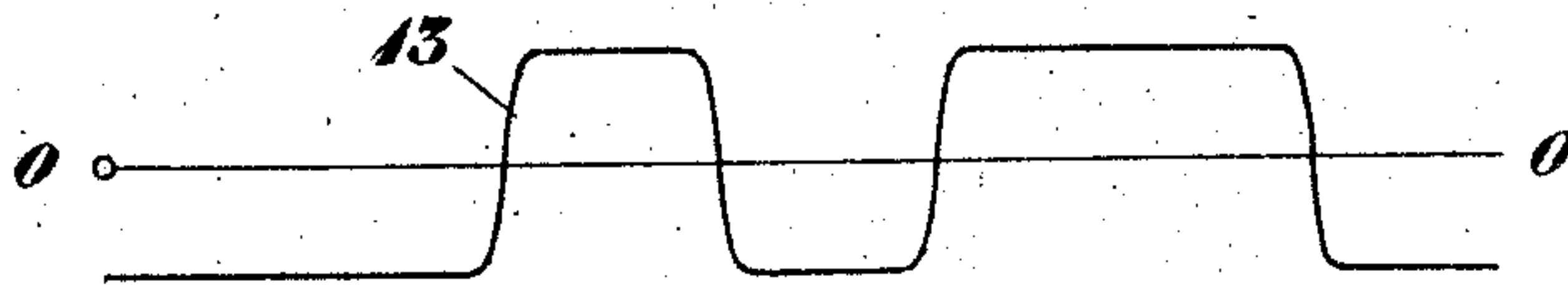


Fig. 3

INVENTOR
L. Espenschied
BY *John*
ATTORNEY

Patented Sept. 22, 1925.

1,554,266

UNITED STATES PATENT OFFICE.

LLOYD ESPENSCHIED, OF QUEENS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

DETECTING CIRCUITS.

Application filed July 1, 1920. Serial No. 393,352.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Queens, in the county of Queens 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 a signaling system in which high frequency currents are employed for the transmission of telegraph signals.

Heretofore, in the transmission of telegraph signals, by means of carrier currents, whether transmitted over wires or through the ether it has been customary to translate carrier currents at the receiving station into low frequency signals by means of a detecting apparatus, such as a vacuum tube detector. Since detectors of this character operate by changing the amplitude of a direct current, it has heretofore been necessary to use a neutral relay in the output circuit of the detector, as the receiving instrument. One of the objects of this invention is to provide a detector circuit in which a polarized relay may be used for receiving the signals, although other and further objects of the invention will more fully appear hereinafter.

The invention may now be understood from the following description, when read in connection with the accompanying drawing, Figure 1 of which is a circuit diagram of a detector circuit embodying the principles of the invention and Figs. 2 and 3 of which are curves, illustrating the operation of the receiving apparatus.

Referring to Fig. 1, D designates a vacuum tube detector of well-known type, comprising a filament 1, a plate 2, and a 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 of a transformer 4 and a source of potential 5.

The output circuit of the detector is connected between the filament 1 and the plate 2 and includes the usual plate battery B and one winding 6, of a polarized relay R. The other winding 7 of the polarized relay is connected in a parallel circuit with the battery B through a variable resistance 8, whereby the current flowing through the winding 7 may be regulated. A condenser

9 is shunted across the output circuit as shown, to form a path of low impedance for currents of carrier frequency.

The operation is as follows: Normally, the source of potential 5 in the grid circuit is adjusted in a manner well understood, so that when no signals are being received, no current flows from the battery B across the gap between the filament 1 and the plate 2 and through the upper winding 6 of the polarized relay. When high frequency carrier currents modulated in accordance with telegraph signals are impressed upon the grid circuit, changes in the grid potential are produced, so that pulses of direct current flow through the winding 6 of the polarized relay, said pulses corresponding to the signals, in accordance with which the carrier currents were modulated.

It is well-known that when a carrier current of a given frequency is modulated by a telegraphic signaling current, such as is indicated by the curve 10 of Fig. 2, the resultant modulated current may be resolved into a number of components, including an unmodulated component of the carrier frequency, a component having a frequency equal to the carrier frequency plus the dot frequency of the signal and another component having a frequency equal to the carrier frequency minus the dot frequency of the signal. Since the signal pulse itself is not of simple sine form but assumes the form of an approximately square topped wave, it may be resolved into a sine wave of dot frequency, upon which are superposed a plurality of waves whose frequencies are various harmonics of the dot frequency. Consequently, in addition to the frequencies above referred to, as components of the modulated carrier, other frequencies appear, corresponding to the sums and differences of the carrier frequency and the various harmonics of the dot frequency.

When the composite wave made up of these various frequencies is impressed upon the grid circuit of the detector D, a reaction takes place between the various component frequencies similar to that taking place during modulation. In other words, frequencies corresponding to the component frequencies of the modulated carrier, together with frequencies corresponding to the sums and differences of these components, appear in the output circuit of the detector.

The difference frequencies will consist of the fundamental dot frequency together with the various harmonics thereof, so that the composite wave resulting in the output circuit from these difference frequencies again assumes the form indicated by the curve 10 of Fig. 2. In the receiving operation, only the composite pulse made up of the fundamental dot frequency and its harmonics is desirable and some means should be provided for eliminating the several components of carrier frequencies, as well as the components corresponding to the sums of the component frequencies of the modulated carrier wave. For this purpose, the condenser 9, previously referred to, is provided, the condenser being of such capacity as to form a path of low impedance to the high frequency components, so that they are substantially prevented from flowing through the winding 6 of the polarized relay R. The condenser 9, on the other hand, offers a large impedance to the dot frequency and its harmonics, so that the composite pulse corresponding to the wave 10 flows through the winding 6 of the polarized relay R.

As previously stated, the potential of the grid 3 is normally adjusted so that no current flows through the winding 6 of the polarized relay R. The resistance 8, however, is so adjusted that a current from the battery B flows through the winding 7 of the relay R of such value as to bias the armature of the relay, so that it rests upon its lower contact, thereby holding open the local receiving circuit 11. The resistance 8 is adjusted so that the value of this biasing current is about one-half of the amplitude of the direct current pulse flowing through the winding 6, in response to a signal. This is indicated in Fig. 2, where the curve 12 represents the steady current flowing through the winding 7 to bias the armature of the polarized relay R to its lower position. Curve 13 in Fig. 3 is the resultant of the biasing current 12 and the detected signal pulse indicated by the curve 10 of Fig. 2. The signal pulse such as 10 is of sufficient strength to overcome the pull on the armature of the relay, due to the biasing current, and draw the armature to its upper position, closing the local circuit 11. It will be seen from the curve 13 that the resultant forces acting on the armature correspond to a current of alternating potential and hence the operation of the relay R is that of a polar relay.

It will be obvious that the general prin-

ciples 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 having an armature, one winding of said relay being controlled by pulses of detected current supplied through said detector and the other winding being energized by a continuous and substantially invariable biasing current, and circuits for said relay and detector whereby pulses of detected current in the one winding of said relay shift said armature against the pull exerted by the biasing current in the other winding.

2. A receiving circuit comprising a vacuum tube detector, a polar relay having an armature, one winding of said relay being controlled by pulses of detected current supplied through said detector and the other winding being energized by a continuous and substantially invariable biasing current, and circuits for said relay and detector whereby pulses of detected current in the one winding of said relay shift said armature against the pull exerted by the biasing current in the other winding.

3. A receiving circuit comprising a vacuum tube detector and a polar relay, a source of space current for said detector and circuit connections such that one winding of said relay is energized by current supplied from said source through said detector and the other winding is supplied by current from said source, independent of the detector.

4. A receiving circuit comprising a vacuum tube detector having a filament, grid and plate, a source of space current connected between the filament and plate, a polarized receiving relay, having one winding in circuit with said source, and said filament and plate, and having another winding in circuit with said source independent of said filament and plate, a source of potential in circuit with said grid and filament, the potential of said source being such that normally no current flows through the winding of said polarized relay which is in circuit with the filament and plate.

In testimony whereof, I have signed my name to this specification this 28th day of June, 1920.

LLOYD ESPENSCHIED.