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L. ESPENSCHIED

RECEIVING CIRCUITS FOR LOW FREQUENCY IMPULSES

Filed Sept. 26, 1919

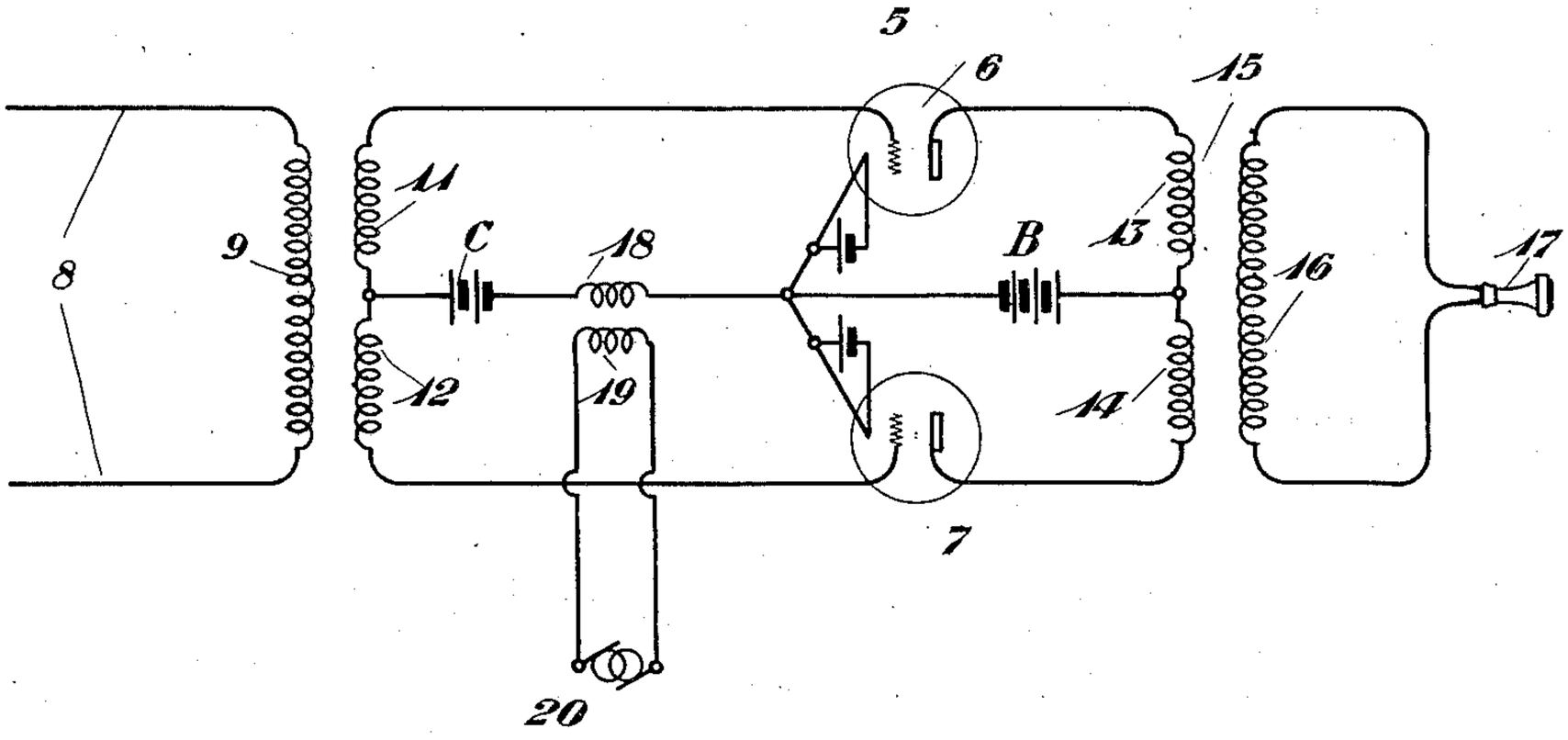

Fig. 1

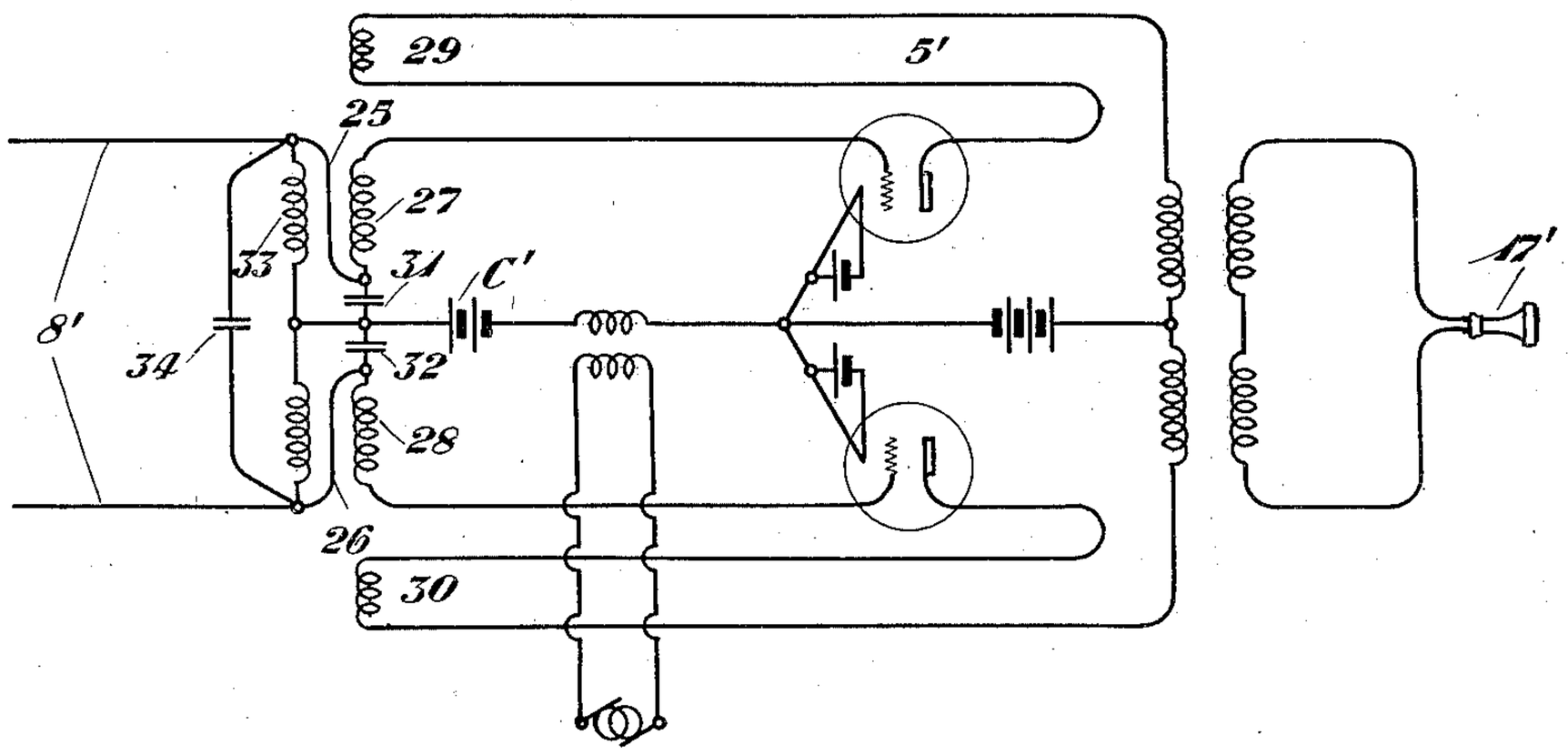

Fig. 2

INVENTOR.
Lloyd Espenschied
BY William P. Ballard
ATTORNEY.

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UNITED STATES PATENT OFFICE.

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

RECEIVING CIRCUITS FOR LOW-FREQUENCY IMPULSES.

Application filed September 26, 1919. Serial No. 326,527.

To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, residing at Hollis, in the county of Queens and State of New York, have invented certain Improvements in Receiving Circuits for Low-Frequency Impulses, of which the following is a specification.

This invention relates to signalling systems and particularly to the reception of weak low frequency signals such as are received over ocean cables or from propeller and engine noises in the detection of vessels such as submarines. It is the object of the invention to provide for the ready detection of signals of this character by means of a telephone receiver or other indicating instrument. A further and more general object of the invention is the provision of means for rendering audible, currents of sub-audible frequencies irrespective of the manner in which and the object for which such currents are generated. For instance the invention will find useful application in the detection branch of a Wheatstone bridge when used to measure impedances at low frequencies. In the accompanying drawings, Figure 1 represents diagrammatically one embodiment of the invention and Figure 2 a modification.

Referring to Figure 1, 5 represents generally a duplex thermionic amplifier of a form now well known in the art, comprising two tubes 6 and 7, each provided with the usual filament, grid and plate electrodes and having the filaments connected to a common point. The input circuits of the two tubes preferably have a portion in common, as do also the output circuits, the battery C being in the common portion of the input circuits and the battery B in the common portion of the output circuits.

Incoming signals from the line 8 are received in the primary winding 9 of the transformer 10, the secondary of the transformer being composed of two equal windings 11 and 12, one in the input circuit of each of the tubes 6 and 7 and so arranged as to oppositely affect the grid potentials of the two tubes for a given signal impulse. The output circuits of the two tubes are provided with similar windings 13 and 14 which constitute the primary of a transformer 15, whose secondary 16 is connected to the receiving device, here shown as a telephone receiver 17.

In the conductor constituting the common portion of the input circuits of the tubes is a source of alternating current here shown as a transformer winding 18 inductively related to a winding 19 which is supplied from the alternating current generator 20. This generator may be of any desired form suitable for providing an audible frequency, say one thousand cycles.

When no signal impulse is present in the winding 9, the current from the generator 20 will equally and oppositely affect the tubes 6 and 7 and their output currents will likewise equally and oppositely affect the transformer 15, so that no tone will be produced in the receiver 17. When a signal impulse appears in the winding 9, the potentials set up in the windings 11 and 12 will, as above stated, oppositely affect the tubes 6 and 7, thereby increasing in one tube, at any given instant, the resultant potential due to the superposition of the signal and the source of audible frequency 20 and correspondingly decreasing the resultant potential due to the superposition in the other tube. This produces an unbalance in the current flowing through the windings 13 and 14 of the transformer 15, and there will, therefore, be generated a current in the secondary 16 and a tone will be produced in the receiver 17 corresponding to the character of the impulse received from the line.

In this way it will be seen that telegraph signals or other signals of a frequency below the audible limit and which may be too weak to affect recording devices of an efficient and economical character, may be readily read in an ordinary telephone receiver.

Figure 2 shows an arrangement differing from Figure 1 in providing a metallic connection between the line and the duplex amplifier and in employing a feed-back connection for the amplifier for increasing the amplification without the use of additional stages. The metallic connections between the line 8′ and the duplex amplifier 5′ are indicated at 25 and 26, each running to the grid of one of the tubes of the amplifier. Each of these connections includes a winding, 27—28, which is inductively related to a winding, 29—30, in the output circuit of the corresponding tube. Each of the connections 25 and 26 is separated from the common portion of the input circuit of the

two tubes by a condenser, 31—32, to prevent short-circuiting of the amplifier for the low frequency impulses of the line 8′.

An attenuation equalizer composed of a parallel arrangement of inductance 33 and capacity 34 may, if desired, be connected across the line 8′. The inductance 33, if it has its central point connected to the common part of the input circuits as shown will also permit the use of a common battery C′ for the input circuits.

In the operation of the system shown in Figure 2, both the alternating and direct current components of the received signals will be amplified and reproduced in the receiver 17′, the tone therein continuing for the full length of any direct current impulse in the line 8′. The feed-back connection shown will increase the amplification in accordance with well known principles by re-amplifying through the same tube variations produced by the impulses received over the line.

Various modifications of the circuit arrangements here shown may obviously be made without departing from the spirit of the invention.

What I claim is:

1. The method of receiving signals transmitted by currents of a frequency not affecting the receiving device, which consists in continuously generating two currents of a frequency suitable for affecting the receiver, opposing these currents in the circuit of the receiving device so as to normally produce no effect thereon and oppositely affecting the amplitude of the two generated currents by and in accordance with received signals, whereby the generated current is effective in the receiving device in a form corresponding to the signals.

2. The method of receiving signals transmitted by currents of a frequency not affecting the receiving device, which consists in continuously generating current of a frequency suitable for affecting the receiving device reproducing the last named current in amplified form in two circuits arranged to equally and oppositely affect the receiving device and oppositely affecting the amplitude of the amplified currents in the two circuits by and in accordance with received signals whereby said generated current becomes effective in the receiving device in a form corresponding to the signals.

3. The method of receiving signals transmitted by currents of a frequency not affecting the receiving device, which consists in generating two currents of audible frequency, opposing these currents in the circuit of the receiving device so as to normally produce no effect therein, amplifying the received signals and oppositely affecting the amplitude of the two generated currents by and in accordance with the amplified signals, whereby the generated currents become effective in the receiving device in a form corresponding to the signals.

4. A receiving device for a signaling system comprising two three-electrode thermionic tubes, means for causing the tubes to produce similar pulsating currents in their output circuits, a circuit for applying said similar pulsating currents oppositely to the receiving device and connections for applying the received signals to the controlling electrodes of said tubes in opposite senses, whereby the amplitude of the pulsating current in the output circuit of one tube is increased, while that of the output circuit of the other tube is decreased and a feed-back circuit connecting the output circuits in said tubes with the input circuits of said tubes.

In testimony whereof, I have signed my named to this specification this 25th day of September 1919.

LLOYD ESPENSCHIED.