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A. BAILEY

VOLUME INDICATOR

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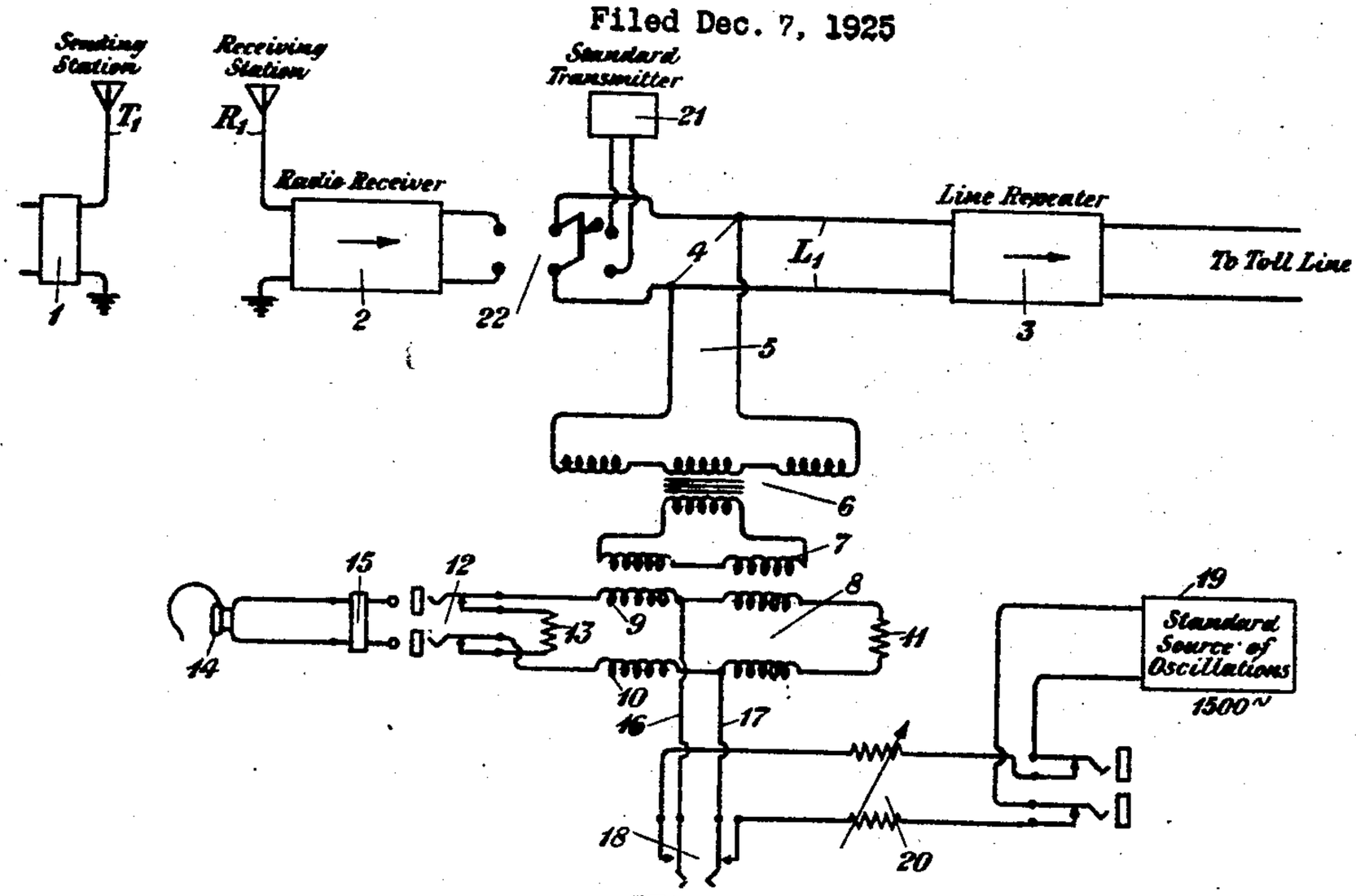

Fig. 1

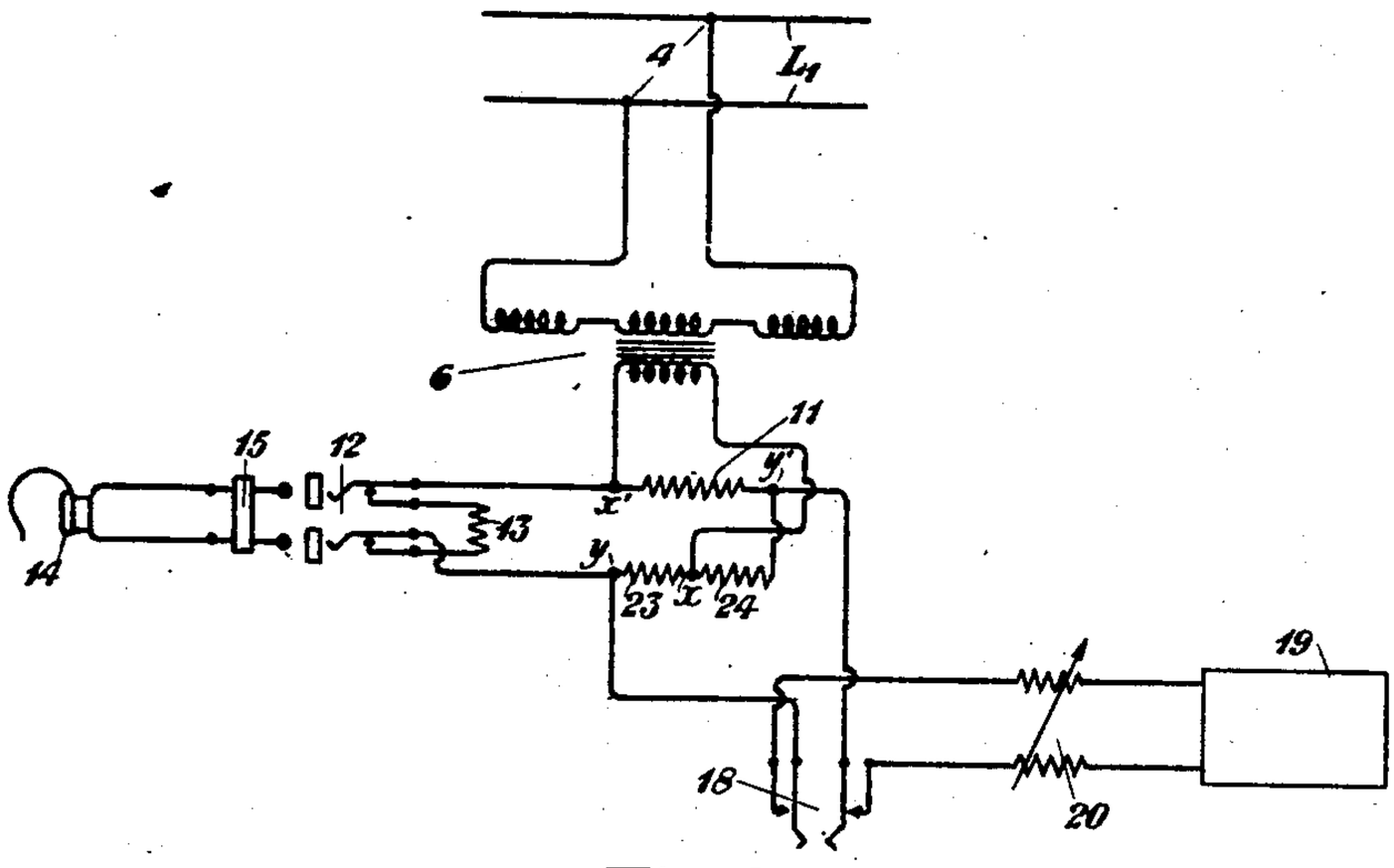

Fig. 2

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UNITED STATES PATENT OFFICE.

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VOLUME INDICATOR.

Application filed December 7, 1925. Serial No. 73,811.

This invention relates to volume indicators, and particularly to a device of that type adapted for use upon radio signaling systems.

Volume indicators, which essentially are vacuum tube volt meters, are well-known devices having been employed heretofore in various types of circuits for the measurement of the voltage levels at various points thereon. Such devices usually comprise a vacuum tube rectifier and a volt meter connected with the output side thereof whereby the alternating wave is rectified and measured. While experience has shown that such devices are satisfactory when employed upon wire transmission circuits, they are not satisfactory when used upon radio circuits because of the nature and the magnitude of static interference produced in the path of radio transmission.

This invention resides in a volume indicating device in which the measurement of the volume of the tone produced by the signaling current will be substantially independent of interference produced by static or other sources.

Other objects of this invention will be apparent from the following description when read in connection with the attached drawing of which Figure 1 shows schematically a form of embodiment of the invention employing a hybrid coil; and Fig. 2 shows the use of a bridge network in place of the hybrid coil.

In the drawing, T_1 represents the transmitting antenna at a sending station, and R_1 represents the receiving antenna at a receiving station. The device 1 at the sending station represents a transmitter which is adapted to send out a signal of known magnitude and frequency for the purpose of making measurements, which will be more fully described hereinafter. The antenna R_1 is connected with a radio receiver 2, which may be of any type adapted to detect the signal transmitted from T_1 to R_1, and to vary the amplitude of the signal either before or after detection, or in both instances. The output side of the receiver 2 is connection with the line L_1 which has therein a repeater 3, which is intended to amplify the line currents in the course of their transmission from the radio receiving station to the subscriber connected with the distant end of the line L_1. Bridged across the line L_1 at the point 4, is a branch circuit connected with the volume indicator. This branch circuit, designated 5, is connected with the primary winding of the transformer 6, which has its secondary winding connected with the winding 7 of the hybrid coil 8. This coil, sometimes called a triple winding transformer, is well-known in the art, and therefore needs no detailed description here. Bridged across the right-hand terminals of the windings 9 and 10, is a network 11, and similarly bridged across the terminals of the same windings, through the contacts of the double jack 12, is a similar network 13 which together with 11 keeps the hybrid coil balanced when the receiver 14 is disconnected from the left-hand terminals of the windings 9 and 10. The insertion of the plug 15 in the jack 12 connects the receiver effectively across the terminals of the said windings and also balances the network 11. Bridged across the midpoints of the windings 9 and 10 are the conductors 16 and 17, which are connected with the movable elements of the switch 18 whose contact points are connected with a source of oscillations 19, the said connection including the variable resistances 20, which control the magnitude of the current flowing from the source 19 to the circuits connected with the conductors 16 and 17. The source 19 is the standard for the measurement of the volume of the signal. It is normally adjusted to produce a definite frequency within the limits of audibility such as 1500 cycles. It will be seen that the source 19 is effectively disconnected from the receiver 14 when the switch 18 is in the unoperated position shown in the drawing. A standard source for calibrating the volume indicator is represented by the device 21. This may be a standard transmitter having suitable measuring devices connected with it, which will show the volume of the output of the transmitter in any suitable units such as "watts". This transmitter may be connected with the measuring circuit and with the line by a right hand movement of the switch 22, which disconnects the radio receiver from these circuits during the time of calibration.

The manner in which this volume indicator functions to facilitate the adjustment of the volume of the signal in the output circuit of the radio receiving system is as follows: Assuming that in a signaling system comprising a radio link and wire lines connecting

therewith, it is desired to maintain constant the over-all equivalent between the sending and the receiving stations of that system, it is necessary to have a standard representing the desired volume, to which standard may be compared the volume existing in the portion of the circuit to be tested, so that adjustments may be made until the volume of the signal is substantially equal to the standard. In order to carry out this process, the switch 22 is operated so as to connect the standard transmitter 21 across the conductors of the line L_1 and of the branch circuit 5. This standard transmitter would be adjusted to send out the desired volume of energy which would be indicated by the instruments connected with the transmitter. This volume would be impressed upon the receiver 14 which would be connected across the proper terminals of the hybrid coil by inserting the plug 15 in the jack 12. After listening to the tone produced in the receiver by the source 21, the switch 22 would be opened and the switch 18 operated to connect the source 19 with the receiver. By alternate operation of the switches 22 and 18, and by suitable adjustment of the resistances 20, the tone produced by the receiver 14 when the source 19 is connected therewith may be made equal to the tone produced by energy from the source 21. When this condition exists, the source 19 and the resistances 20, as adjusted for the condition of equality of tone just mentioned, represent the standard of comparison for subsequent measurement and adjustment of the volume of the signal transmitted by the receiver 2 to the line L_1. The switch 22 is then operated to the left so as to disconnect the source 21 and to connect the output side of the radio receiver 2 to the line L_1 and the branch circuit 5. A tone of given intensity is applied to the transmitter 1 at the sending station, which transmits a signal of predetermined level, which signal is received by the receiving antenna R_1 and demodulated by the radio receiver 2. This detected signal, which would be of the same frequency as the standard, is impressed upon the line L_1 and the circuit 5, and the energy in the latter circuit actuates the receiver 14. In making this test, the signal is sent out intermittently from the sending station. During the intervals of no signal transmission, the key 18 is operated so as to impress upon the receiver energy from the standard source 19, by means of which the relative strength of the signal and the standard source may be determined. Assuming that the signal is lower in volume, the amplifiers connected with the radio receiver 2 would be adjusted to raise the volume level of the signal in the output circuit. By alternately listening to the signal and to the standard source of oscillations and adjusting the amplification of the radio receiver, the level in the output circuit may be brought up to that point at which it must be maintained in order that the over-all equivalent of the circuit may be maintained constant.

It will be apparent that the effect of static and other interference upon the measurements made by this circuit is substantially eliminated. When the sending station is sending a signal, the signaling current, together with interfering currents created by static and otherwise, will together be impressed upon the branch circuit 5, and will produce a combined effect upon the receiver 14. However, the interfering current continues to be received during the interval in which the signal is not transmitted from the sending station, that is, during the interval in which the standard current from the source 19 is impressed upon the receiver 14 by the operation of the key 18. By having the interfering current present in the receiver circuit, not only while the signal current is coming in to the receiver circuit, but also while the current from the reference standard is coming in, the effect of such interference upon the accuracy of the measurement is substantially eliminated, error only arising from slight difference between the magnitude of the interfering current at different instants.

Other ways of using this volume indicator will suggest themselves to persons skilled in the art. Thus, for example, the resistances 20 may be calibrated and marked so as to indicate directly the energy level represented by different settings of the dial of the said resistance produced by current from the standard source flowing through the said resistances and the windings of the hybrid coil and thence through the receiver 14. With the resistances 20 thus calibrated, a switch similar to 22 could be closed so as to connect the output side of the radio receiver or other circuit whose volume output is to be measured, across the sides of the line L_1 and of the branch circuit 5. A tone having an intensity corresponding to this output energy would be produced by the receiver 14. Then the said switch would be opened, and the standard source 19 would be connected with the receiver, and a comparison of tones would be made. By alternate connections of the unknown source and of the standard source, and by suitable adjustment of the resistances 20, the output level of the radio receiver 2 would be indicated directly by the setting of the dial of the resistances 20.

It is desirable to point out that by the employment of any form of balanced network, such as a hybrid coil, the standard current from the source 19 will pass to the receiver 14 and will also flow through the network 11, but will not pass to the branch circuit 5 because of the well-known characteristic of hybrid coils. This prevents the

transmission of the testing current over the line L_1, and thus avoids interference with the signal being transmitted over the said line.

The arrangement shown in Fig. 2 employs a bridge network for performing the function of the hybrid coil of Fig. 1. The same numbers indicated in both figures indicate similar parts. The network comprises the ratio arms 23 and 24, the artificial line 11 and either the artificial line 13 or the receiver 14, depending upon whether the plug is disconnected from or connected with the jack 12. The transmission circuit is bridged across the points x and x' of the network and the standard source 19 is bridged across the points y and y'. With a balanced bridge the testing current from the source 19 will not pass out onto the line L_1.

While this invention has been disclosed as embodied in a particular form, it is obviously capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A device for measuring the volume of transmission of a signaling circuit comprising a triple winding transformer having one of its windings connected with the signaling circuit, a telephone receiver bridged across two corresponding ends of the second and third windings of said transformer, a network simulating said receiver bridged across the other corresponding ends of said second and third windings, a standard source of energy of known frequency effectively bridged across the midpoints of the said second and third windings, the connection including calibrated means to vary the magnitude of energy from said source, and switching means to effectively connect and disconnect said standard source of energy.

2. A device for measuring the volume of transmission of a signaling circuit comprising a triple winding transformer having one of its windings connected with the signaling circuit, two similar networks, one of which is bridged across two corresponding ends of the second and third windings of said transformer, and the other network across the other corresponding ends of said windings of said transformer, an indicating device simulating each network, means to effectively bridge said indicating device across two of said ends and to disconnect therefrom the network normally connected thereto, a standard source of energy of known frequency, a calibrated device connected with the output side of said source to control the magnitude of the output energy, and switching means to effectively connect and disconnect the said source to and from the midpoints of the said second and third windings of said transformer.

3. In a signaling system, the combination with a signaling circuit having signal transmitting means connected therewith, of an amplifier connected with said circuit to adjust the energy level thereof, and a volume indicator connected with said signaling circuit at or near the output of said amplifier, the said indicator including a telephone receiver, a standard source of energy capable of producing in said receiver a tone of the same magnitude as the signal energy of the desired transmission level, and switching means to connect and disconnect said source to and from said receiver.

4. In a signaling system, the combination with a radio system having a transmitting station and a receiving station, the said receiving station having means to detect and to controllably amplify the detected signal, a wire circuit upon which said detected signal is impressed, and a volume indicator connected with said wire circuit having a triple winding transformer one winding of which is connected across the said wire circuit, a telephone receiver and a balancing network connected with said other windings of said transformer, a standard source of energy having switching means to alternately connect and disconnect said source to and from the midpoints of said other of the transformer windings.

5. In a signaling system, the combination with a transmission circuit having controllable means therein to vary the energy level in the said circuit, of a standard measuring circuit, the said measuring circuit including a hybrid coil, one winding of which is connected with the said transmission circuit, a controllable source of energy of known frequency connected with the other windings of the said coil, a telephone receiver and a network simulating said receiver connected symmetrically across the opposite ends of the said other windings of said coil, the said transmission circuit and the said controllable source of energy being conjugately connected with the windings of the said hybrid coil so that each will be balanced with respect to the other.

6. In an electrical measuring system, the combination with a line circuit exposed to interference and also transmitting signals, the transmission level of which is to be measured, a source of current constituting a standard for level measurement, a hybrid coil having one winding connected with the said line circuit, a telephone receiver and its balancing network connected symmetrically with opposite ends of the other windings of said hybrid coil, the said source of current being bridged across the midpoints of the said other windings so as to be conjugate to the said line circuit whereby the said source produces no effect on the said line circuit.

7. In a signaling system, the combination with a signaling circuit having signal trans-

mitting means connected therewith, of an amplifier connected with the said circuit to adjust the energy level thereof, and a volume indicator connected with the said signaling circuit at or near the output of the said amplifier, the said indicator comprising a balanced network, having connected therewith an indicating device, means to balance the said device, and a source of energy having means to vary at will the magnitude thereof, the said source being connected across the said balanced network conjugately to the connection of the said signaling circuit with the said balanced network whereby current from the said source will be prevented from passing to the said signaling circuit.

8. In a signaling system, the combination with a signaling circuit over which signals of a predetermined frequency are transmitted, of an amplifier connected with the said circuit by which the energy level thereof may be varied at will, and a volume indicator connected with the said signaling circuit, the said indicator comprising a balanced network having connected therewith an indicating device, means to balance the said device, and a source of energy of the same frequency as the transmitted signal, the said source having means to vary its magnitude and means to connect it across the said balanced network conjugately to the connection of the said signaling circuit with the said network whereby current from the said source will be prevented from passing to the said signaling circuit.

In testimony whereof, I have signed my name to this specification this fourth day of December, 1925.

AUSTIN BAILEY.