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F. C. BISBEE

RECORDING SYSTEM

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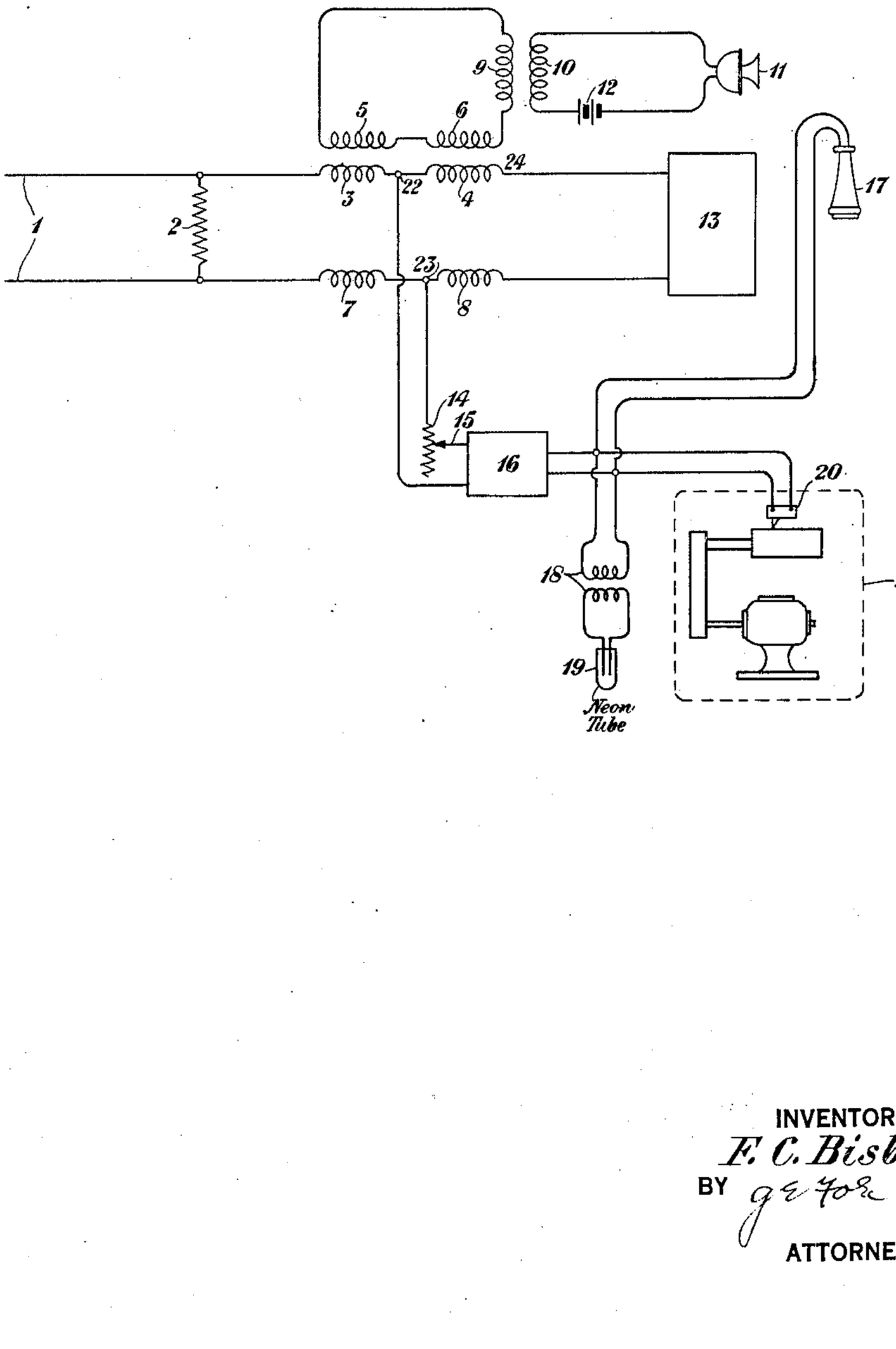

INVENTOR

F. C. Bisbee

BY g e Yoe

ATTORNEY

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FREDERICK CARLETON BISBEE, OF CRANFORD, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

RECORDING SYSTEM.

Application filed January 30, 1925. Serial No. 5,850.

This invention relates to systems for recording voice currents and particularly to arrangements in such systems for controlling the voice currents for satisfactory recording.

In telephone practice it is found that the ordinary speech levels in the telephone circuits vary considerably. In other words, if the amplitude of the current be measured for different telephone conversations it will be found to vary through wide limits. This is due in most part to the distances between the speakers and the instruments at the opposite ends of a telephone circuit. It is also due in part to the different lengths and gauges of the conductors interposed between the two speakers. The result is that the speech levels are not all the same at a recording instrument where conversations over different telephone circuits are to be recorded. One of the objects of this invention is therefore to obtain a satisfactory level for recording regardless of the varying speech levels encountered in actual service.

In accordance with the present invention arrangements are provided whereby approximately the same recording levels are established at a recorder for speeches in both directions. It is also an object of this invention to provide such arrangements with a minimum amount of apparatus, and so far as possible, without the use of any special equipment other than that ordinarily provided at a recorder.

A further object of this invention is to provide means for indicating when the proper amount of energy is being supplied to the recorder.

This invention will be more fully understood from the following description when read in connection with the accompanying drawing.

Referring to the drawing which represents the main parts of the subscriber's loop, line 1 connects the subscriber at the recorder with the subscriber at the distant end of the telephone circuit. Windings 3, 4, 5, 6, 7 and 8 form what is commonly termed a "three-winding transformer" or "hybrid coil", all of said windings being arranged on the same core. Each pair of the windings, such as 3 and 4, 5 and 6, and 7 and 8, are wound so as to be series aiding, windings 3, 5 and 7 having the same number of turns as windings 4, 6 and 8, respectively. 21 is a recorder of the magnetic type familiar to those skilled in the art. 16 represents an amplifier, the gain of which is controlled by the movable arm 15. A balancing network 13 is connected to the terminals of windings 4 and 8 designed to have as far as practicable the same impedance as the line itself. An indicator is provided, the operation of which will be explained hereinafter.

For the purposes of explanation let it be assumed that a source of electromotive force is connected to line 1, arranged in place of resistance 2, and that the voltage of this source is the same as that part of the line extending from the subscriber to the central office. Let it be assumed that windings 7 and 8 are moved beside windings 3 and 4, respectively. Assume, also, that the balancing network 13 is temporarily disconnected, leaving the terminals of windings 4 and 8 open. The current supplied by this assumed source of electromotive force flows through winding 3, through the input of amplifier 16 and back through winding 7. If the ratio of windings 9 and 10 is such that the impedance between the terminals of winding 3 equals the impedance between terminals 22 and 23, the input of the amplifier 16—considering the impedance presented by winding 3 for currents from the source of electromotive force as assumed—then the difference in voltage between the terminals of winding 3 will equal that between the terminals 22 and 23, the input of amplifier 16. And the difference in voltage between the terminals of winding 3 will equal the voltage induced in winding 4 by reason of the fact that the latter winding interlinks the same flux as winding 3, having the same number of turns. The difference in voltage between the terminals 23 and 24 is therefore zero and no current flows through the balancing network 13 when it is again connected to the terminals of windings 4 and 8. Hence the transmission loss is infinitely large between the assumed source of electromotive force and the balancing network 13. While this last statement is rigidly true for an ideal transformer, yet it is very nearly true for a practical transformer. The exciting current required by the practical transformer slightly unbalances the arrangement and results in a small flow of current through the balancing network 13. This can be overcome, however, by inserting a suitable inductive shunt arranged in parallel with the

input of the amplifier 16. It therefore follows that no current flows through the balancing network 13 by reason of the insertion of a source of electromotive forces as assumed. Thus the impedance of the input of the amplifier 16 balances the impedance of the transmitter even though these may be of different magnitudes depending upon the impedance ratio of windings 9 and 10.

The arrangement illustrated shows windings 7 and 8 forming part of the three-winding transformer. However, the arrangement illustrated is merely a modification of the one assumed above for the purposes of explanation.

For receiving, voice currents that come in over the subscriber's loop therefore divide equally between the transmitter and the amplifier circuit. That part of the energy which enters the transmitter circuit serves no useful purpose. That part of the energy which enters the amplifier circuit divides between the receiver 17, the inscribing element 20 of the recorder 21 and the indicator 19.

The tube indicator 19 and transformer 18 may be so chosen that the tube will glow when the proper amount of energy is being delivered by the amplifier 16 for satisfactory recording. Such an indicator may have a rare gas or mixture of rare gases such as neon, helium, argon, krypton, etc., to form the light-giving medium. The electrodes of such an indicator may be formed of the alkali metals or their alloys. The metal of such electrodes will evaporate slowly during the operation of the indicator and form a deposit on the wall of the tube.

Then if the tube indicator 19 and the transformer 18 are chosen so that the tube will glow when the proper amount of energy is being delivered by the amplifier 16 for satisfactory recording the subscriber can keep the tube at the same brilliance by adjusting the gain of the amplifier 16 by means of potentiometer 14 and thus realize that the energy entering the recorder 21 is sufficient for satisfactory recording.

For transmitting voice currents to the subscriber at the distant end of the telephone circuit the energy originating in the transmitter circuit divides equally between the line 1 and the balancing network 13 by reason of the fact that the three-winding transformer is symmetrically arranged. If the network 13 exactly balances the line 1 no current can enter the amplifier 16. But it is impossible to obtain an exact balance and on that account there will always be current entering the amplifier 16, the amount depending upon the degree of balance between the network 13 and the line 1. As there does not appear to be any means for telling what the subscriber's loop will terminate in, it is advisable to connect a resistance 2 across the subscriber's loop in order to have a fairly constant condition to balance against. By predetermining the degree of balance the amount of energy entering the amplifier may be reduced to an amount comparable to that received from the distant subscriber.

While this invention has been disclosed in a certain specific arrangement which is deemed desirable it is to be understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a recording system, in combination an electrical circuit upon which voice currents may be superposed, means for transmitting and receiving voice currents in said electrical circuit, a balancing network, a three-winding transformer, an amplifier, the input of said amplifier being associated with the midpoints of two windings of said transformer and the third winding being associated with the transmitter of said electrical circuit, recording means, and means for indicating when the amplifier is delivering sufficient energy to said recording means for proper recording.

2. A recording system comprising an electrical circuit upon which voice currents may be superposed, means for transmitting and receiving voice currents in said electrical circuit, an artificial line for balancing said electrical circuit, a three-winding transformer, an amplifier, a recorder, a potentiometer for adjusting the gain of said amplifier for proper recording, and means for indicating whether the current entering said recorder is sufficient for proper recording, two windings of the transformer being serially arranged in said electrical circuit and the third winding being inductively arranged with said two windings of the transformer, the input circuit of said amplifier being associated with the mid-points of said two windings of the transformer, the output circuit of said amplifier being associated with the inscribing element of the recorder.

3. In a recording system, the combination of a telephone line, an amplifier, a recorder of currents flowing in said telephone line after amplification, a telephone receiver and visual means for indicating the level at said recorder, said recorder, said visual means and said telephone receiver being coupled in parallel relationship.

4. In a recording system, the combination with a telephone line, a recorder of currents flowing in said telephone line, an amplifier for amplifying the currents flowing in said telephone line, and a lamp in parallel relationship with said recorder for indicating the level at said recorder.

5. A recording system comprising an electrical circuit upon which voice currents may be superposed, a three-winding transformer, a balancing network connected to the electrical circuit through two of the windings of said transformer, a telephone transmitter coupled to the third winding of said transformer, means for amplifying the voice currents superposed on the electrical circuit, said amplifying means being connected to the midpoints of the two windings connected to the electrical circuit, means for varying the gain of said amplifying means, means for recording the amplified voice currents, and means for indicating the level of the energy entering said recording means.

6. A recording system comprising a telephone line, a three-winding transformer, a balancing net work connected to the telephone line through two of the windings of said transformer, a recorder, and means consisting of an amplifier for varying the amount of energy flowing from the telephone line to said recorder so as to be sufficient for proper recording.

7. A recording system comprising a telephone line, means associated with said telephone line to develop fluctuating currents therein in accordance with voice currents, two windings, a balancing network connected to the telephone line through said windings, recording means, means including an amplifier connected to the midpoints of said windings for increasing the energy flowing to said recording means from the telephone line so as to be sufficient for proper recording, and means for indicating whether the level of energy entering the recording means need be varied.

8. A recording system comprising a telephone loop circuit over which telephonic currents may be transmitted and received, a balanced three-winding transformer, a network connected to the telephone loop circuit through two of the windings of said transformer, a transmitter coupled to the third winding of said transformer, recording means, means extending from the midpoints of the two windings connected to the telephone loop circuit to the recording means for obtaining the proper recording level, and means for indicating the level of the energy entering said recording means.

9. A recording system comprising an electrical circuit in which fluctuations in the current of said circuit may be established in accordance with voice currents to be transmitted and received, recording means, an amplifier interposed between said electrical circuit and said recording means so that the current entering said recording means may be controlled and varied for proper recording, a telephone receiver and a neon tube, said recording means, said telephone receiver and said neon tube being intercoupled in parallel relationship.

10. A recording system comprising an electrical circuit in which fluctuations in the current of said circuit may be established in accordance with the voice currents to be transmitted and received, two substantially equal windings, a balancing network connected to said electrical circuit through said windings, recording means, amplifying means interconnecting said electrical circuit and said recording means in order that the proper recording level under varying conditions in said electrical circuit may be obtained, and means for indicating whether the recording level at said recording means is sufficient for proper recording.

In testimony whereof, I have signed my name to this specification this 28th day of January, 1925.

FREDERICK CARLETON BISBEE.