

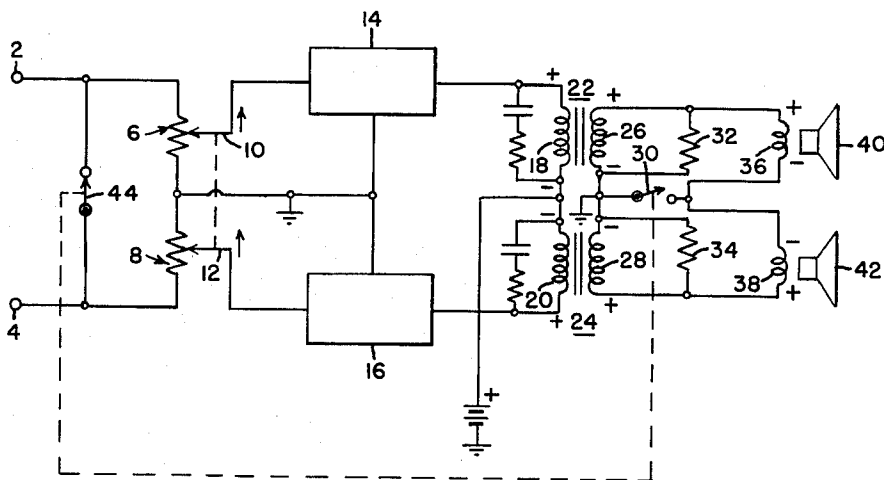
Dec. 7, 1965

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3,222,455

AURAL STEREOPHONIC BALANCE INDICATOR

Filed May 31, 1962



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AURAL STEREOPHONIC BALANCE INDICATOR
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Filed May 31, 1962, Ser. No. 198,834
4 Claims. (Cl. 179—1)

This invention relates to means for balancing the gain of two audio channels.

In a stereophonic-audio system, two separate amplifying channels, each energizing an acoustic transducer, are provided. In order to insure optimum performance in such a system it is necessary that the gains of the channels be equalized. The achievement of this goal has been effected in most prior art systems by expensive balance indicators.

It is an object of this invention to provide means whereby the gains of two channels can be equalized by the addition of a minimum number of components.

Briefly, this objective is achieved by the provision of a switch that connects the outputs of the two channels in a series circuit in such relative polarities that the voltages in the outputs tend to cancel. When the channel gains are adjusted so as to be equal, the output voltages of the channels cancel, and an aural null is produced in the sounding emanating from the acoustic transducers for each channel.

It has been discovered that with some amplifier designs, the balancing circuit set up by the switch may cause the amplifier to oscillate as the desired aural null is approached, thus making it difficult to secure the desired balanced condition.

Accordingly it is another object of this invention to provide a balancing circuit of the type described wherein the tendency for oscillation to occur is greatly reduced.

Reference is now made to the drawing for a detailed explanation of one form of this invention. Input terminals 2 and 4 are respectively connected to ungrounded ends of balancing potentiometers 6 and 8. The movable contact arms 10 and 12 are ganged together in such a manner that one moves farther from ground as the other moves toward it and vice versa, as indicated by the arrows. Amplifiers 14 and 16 have their inputs respectively connected to primary windings 18 and 20 of output transformers 22 and 24. Positive direct current operating potential is supplied to the amplifiers 14 and 16 by connection of a suitable source between ground and the ends of the secondary windings 26 and 28 that are remote from the amplifiers. Secondary windings 26 and 28 of the transformers 22 and 24 have ends of like polarity connected to a point of reference potential such as ground. When a switch 30 is closed, load impedances, herein shown as voice coils 36 and 38 for loudspeakers 40 and 42, are connected in parallel with the secondary windings 18 and 20.

When the switch 30 is closed, the electrical connections are conventional, but the provision of a switch which enables the ground connection to the junction of the voice coils 36 and 38 to be broken is novel and is a part of this invention and operates in the following manner. To balance the relative gains of the two channels, the switch 30 is opened, as shown, and if the signals applied to the input terminals 2 and 4 are not known to be identical a switch 44 is closed so as to connect the terminals 2 and 4 together and thus apply identical signals to the potentiometers 6 and 8. For ease in operation, the switches 44 and 30 can be mechanically connected so that closing one

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opens the other. With the switch 30 in an open position, the secondary windings 26 and 28 and the voice coils 36 and 38 form a closed loop in which the audio voltages induced in the secondary windings 18 and 20 oppose each other. When the gains of the channels are unequal, one of these induced audio voltages will be greater than the other with the result that sound will emanate from both of the loudspeakers 40 and 42. The volume of the sound increases with the degree of imbalance. Equating the gains of the two channels with a means such as the balance control potentiometers 6 and 8, causes the audio voltages induced in the secondary windings 26 and 28 to be substantially identical. In this condition substantially no current flows in the loop 26, 28, 36 and 38, and hence the loudspeakers receive no energy. Thus, when the gains are balanced, an aural null is produced in the sound emanating from the loudspeakers 40 and 42.

Upon identical balance being achieved, and with switch 30 in the open position, the load impedance looking into the output secondary windings 26 and 28 from their respective primary windings appears to be infinite, thus creating the possibility that the amplifiers 14 and 16 will become unstable. Insertion of load resistors 32 and 34 sustains a simulated load impedance for the secondary windings 26 and 28 and reduces the tendency of the amplifiers 14 and 16 to become unstable and oscillate.

It will be understood by those skilled in the art that the polarities of the secondary windings 26 and 28 indicate the polarities of the audio signal voltages produced across the secondary windings where the same signal is applied to each of the terminals 2 and 4. If the channels are identical, the polarities are the same as the windings sense of the secondary windings 26 and 28 with respect to the primary windings 18 and 20.

What I claim is:

1. A circuit for aiding in indicating where the gains of two separate audio signal channels are in balance comprising a first channel having a first output transformer, a second channel having a second output transformer, each of said transformers having a secondary winding with a predetermined polarity, means electrically connecting an end of one of said secondary windings to an end of like polarity of the other of said secondary windings, first and second load impedances, and a single pole single throw switch connected so that said first and second load impedances are respectively connected in parallel with said secondary windings when said switch is closed and said secondary windings and said load impedances are connected in series when said switch is open.

2. A circuit as set forth in claim 1 wherein load resistors are connected in shunt with each of said secondary windings.

3. The combination of a first signal amplifying channel having a pair of output terminals, a second signal amplifying channel having a pair of output terminals, first and second load impedances, switching means for alternatively connecting said first and second load impedances respectively in parallel with said output terminals or connecting said output terminals and said first and second load impedances in a series loop, and a resistor connected across each of said pairs of output terminals.

4. The combination of a first amplifier having an input and an output, a second amplifier having an input and an output, a first output transformer having a primary and a secondary winding connections placing said primary winding of said first output transformer across said output of said first amplifier, a second output transformer

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having a primary and a secondary winding, connections for placing said primary winding of said second output transformer across said output of said second amplifier, a point of reference potential, connection between said point and one end of each of said secondary windings having signals of like polarity, a first loudspeaker having a first voice coil, a second loudspeaker having a second voice coil, a connection between one end of said first voice coil and the other end of said secondary winding of said first output transformer, a connection between one end of said second voice coil and the other end of said secondary winding of said second output transformer, a connection between the other ends of said first and second voice coils, and a single pole single throw switch connected between said point of reference potential and said other ends of said first and second voice coils.

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