

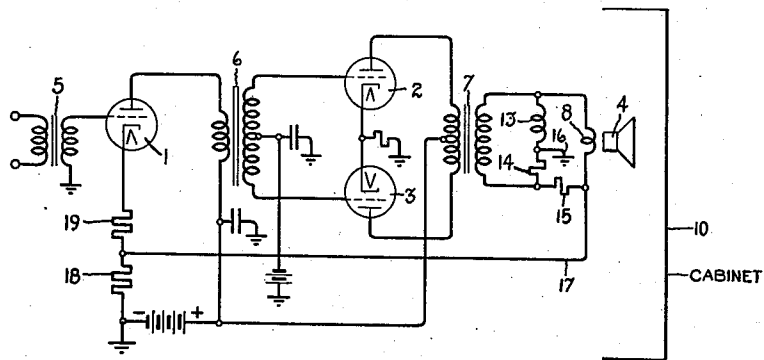
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AMPLIFICATION SYSTEM

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AMPLIFICATION SYSTEM

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5 Claims. (Cl. 179—1)

My invention relates to amplification systems and particularly to such systems used in connection with sound reproducers and recorders, such as the loudspeakers of radio receivers and recording heads.

One of the objects of my invention is to provide such an amplification system capable of maintaining constant sound output from the associated loudspeaker notwithstanding variations in impedance of the loudspeaker due to acoustic effects.

Another object of my invention is to provide such a system in which the sound wave output is maintained independent of any resonance effects which may exist in the cabinet or room in which the loudspeaker is located.

Still another object of my invention is to secure such results through control of the feedback in the amplifier in accord with variations in the impedance of the loudspeaker.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which the single figure represents an embodiment of my invention.

Referring to the drawing I have shown therein a two-stage audio frequency amplifier employing electron discharge devices 1, 2 and 3, which is utilized to supply audio frequency voltages representing voice or music waves to a loudspeaker 4, or other device, such as a recording head. Audio frequency voltages such as those reproduced in the ordinary radio receiver may be supplied to the input of electron discharge device 1 through an audio frequency transformer 5. The output circuit from this amplifier is supplied through transformer 6 to the input circuits of the discharge devices 2 and 3, which may be connected in push pull relation. The output from these discharge devices is supplied through a transformer 7 across the voice coil 8 of the loudspeaker 4.

The loudspeaker 4 may, of course, be mounted in the usual cabinet of the radio receiver which cabinet may, of course, house the remaining receiving equipment which may include the amplifier described. This cabinet is represented by the line 10 on the drawing bearing the legend "Cabinet."

Of course, in the manufacture of radio receiver

equipment, it may be desired to mount the loudspeaker 4 into a number of different cabinets. Resonance effects may occur in these cabinets which affect the impedance of the voice coil 8 of the loudspeaker and thereby affect the amount of energy supplied to the voice coil by the amplifier thereby tending to affect the volume of sound produced by the loudspeaker at the particular frequency at which the resonance effect occurs. Thus the output of the loudspeaker may vary in the different cabinets. Such effects may also result from resonance effects in the room in which the receiver is located, or in the mechanical structure of the speaker itself. These resonance effects may either increase or decrease the impedance of the loudspeaker 8. Mechanical or acoustic resonance produces an apparent increase in impedance of the voice coil and an increase in sound output. Mechanical or acoustic anti-resonance produces an apparent lowering of the voice coil impedance and reduces the sound output. These effects are particularly noticeable where the electron discharge devices employed in the output stage of the receiver are of the high-impedance, constant-current type involving electron discharge devices of the pentode type. They are less noticeable where these discharge devices are triodes such as those indicated at 2 and 3 on the drawing but still exist to an objectionable degree.

In accordance with my invention these effects are substantially eliminated by supplying a voltage from the output of the amplifiers 2 and 3 to the input of amplifier 1 which varies both in magnitude and phase in accordance with variations in the impedance of the voice coil 8.

To effect this control the voice coil 8 is connected as one arm of a Wheatstone bridge comprising the arms 8, 13, 14 and 15. The arm 13 is an inductance equal to the normal inductance of the voice coil 8 of the loudspeaker. The arms 14 and 15 are suitable resistances of small value. The point between the arms 13 and 14 is grounded as indicated at 16. The point between the arms 8 and 15 is connected through conductor 17 to a point between two cathode resistors 18 and 19, which are connected in series between the cathode of the discharge device 1 and ground.

Normally when the loudspeaker 4 is unaffected by any resonance effect which exists in the cabinet 10 or in the room in which the loudspeaker is located, the inductance of the coil 8 is equal to that of the coil 13 and the bridge is balanced.

Thus no voltage exists between ground and conductor 17. If a resonance effect occurs which increases the impedance of the coil 8, then the voltage at the frequency at which the resonance occurs appears on conductor 17 and is supplied across resistor 18 and hence between the cathode and control electrode of device 1 in series with the signal which is applied to the input of this device through transformer 5. This voltage is properly poled to render the amplifier degenerative at the frequency at which the resonance effect occurs thereby reducing the voltage supplied to the voice coil 8 and hence reducing the output from the loudspeaker to a value which would exist in the absence of such resonance effect. If the mechanical or acoustic effect be one which decreases the impedance of the voice coil, that is, is an anti-resonant effect, then the impedance of the voice coil is reduced and voltage is produced of opposite phase on the conductor 17 tending to render the discharge device regenerative at the particularly frequency of the anti-resonance. This increases the amplification of the amplifier and hence the voltage supplied to the voice coil 8 thereby increasing the volume of sound produced by the loudspeaker to the value which would be produced in the absence of the anti-resonant condition. In this way the feedback of the amplifier 1 is varied in response to impedance of the voice coil and through a range sufficient to maintain the sound output from the loudspeaker independent of any resonant or anti-resonant mechanical or acoustic condition to which the speaker may be subjected. Thus the same amplifier system and speaker may be mounted in any one of a number of different cabinets without objectionable change in the sound output due to resonance effects in the cabinets.

While I have shown a particular embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto since different modifications may be made, and I contemplate by the appended claims to cover any modifications which fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, an amplifier, a sound reproducer connected to the output of said amplifier, and means responsive to variations in impedance of said sound reproducer to vary the gain of said amplifier to maintain constant output from said sound reproducer.

2. In combination, an amplifier, a sound reproducer connected to the output of said amplifier, and means responsive to variations in impedance of said sound reproducer to vary feedback of said amplifier.

3. In combination, an amplifier, a sound reproducer connected to the output of said amplifier, means to supply feedback voltage from the output of said amplifier to the input thereof, and means automatically to vary the magnitude and phase of said feedback voltage in accord with variations in impedance of said sound reproducer.

4. In combination, an amplifier, a loudspeaker adapted for mounting in a housing having resonance effects in the range of frequencies reproduced by said loudspeaker, and means responsive to variations in impedance of said loudspeaker to control the voltage supplied by said amplifier to said loudspeaker to maintain the sound output of said speaker independent of said resonance effects.

5. In combination, an amplifier having an output circuit and an input circuit, a Wheatstone bridge having two diagonals, said output circuit being connected across one of said diagonals and said bridge being normally balanced so that substantially no voltage appears across the other of said diagonals, a loudspeaker subject to impedance variations connected in an arm of said bridge whereby voltage appears across said other diagonal having magnitude and phase varying in accordance with said variations in impedance of said loudspeaker, and means to supply said voltage across said other diagonal to the input of said amplifier.

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