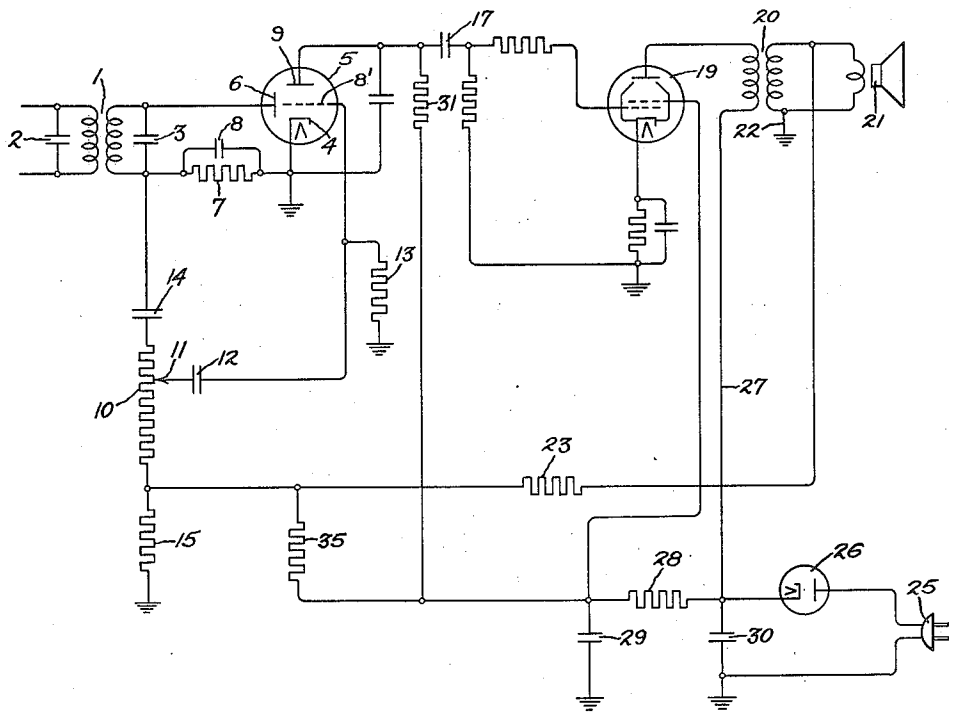
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HUM REDUCING SYSTEM

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HUM REDUCING SYSTEM

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3 Claims. (Cl. 179—171)

My invention relates to hum reducing systems for amplifiers and particularly for amplifiers employed in radio receivers.

My present application is a continuation-in-part of my United States patent application Serial No. 166,292, which is assigned to the same assignee as my present application. In that application is disclosed an amplifier for use in radio receivers and in which degeneration is employed in a novel and improved way to effect the reduction of hum arising from the power source, as well as to reduce distortion and to improve the frequency response characteristic. My present invention has for its object to effect certain further improvements with respect to the reduction of hum.

Another object of my invention is to combine certain hum reducing expedients with the degeneration means of my prior patent thereby to improve the operation of the amplifier with respect to hum while avoiding any material increase in cost of the receiver.

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 indicated at 1 a transformer, which may be the last intermediate frequency transformer of a superheterodyne radio receiver. Preferably the windings of this transformer are tuned to the intermediate frequency by condensers 2 and 3 respectively. The radio frequency voltage across the tuned secondary of this transformer is rectified by means of a diode comprising the cathode 4 of an electron discharge device 5 and an anode 6 arranged thereon, the tuned secondary being connected between this cathode 4 and diode 6 through a load resistor 7 shunted by a condenser 8. This resistor 7 may be the usual diode detector load resistance, and the condenser 8 the usual radio frequency bypass therefor, these elements being proportioned to have a time constant such that audio frequency voltages are produced across the resistance in response to audio frequency modulation of the rectified carrier wave.

The cathode 4 is grounded and comprises also the cathode of an audio frequency amplifier having an input electrode 8' and an anode 9 in the discharge device 5. Audio voltage from the resistance 7 is supplied to the input electrode 8' by means of a potentiometer 10 having a variable contact 11, which is connected through a coupling capacitance 12 to the control electrode 8', the latter being also connected to ground through the usual grid resistance 13. The potentiometer 10 is connected between the negative terminal of the resistance 7 and ground through a blocking condenser 14 and a small resistance 15, the latter being of the order of 1,000 ohms whereas the former, i. e., the volume control potentiometer 10, is of the order of two megohms.

The audio frequency amplifier comprises also an electron discharge device 19 having a pair of output terminals. The output voltage on the anode 9 of amplifier 5 is supplied through coupling condenser 17 to the input electrode of the subsequent amplifier 19 whereby it is amplified and supplied through an output transformer 20 to a loud speaker 21. One side of the secondary winding of the transformer 20 is grounded as indicated at 22 and its other terminal is connected through resistance 23 to a point between resistances 10 and 15. The secondary winding of transformer 20 is so poled that the voltage supplied therefrom across resistance 15 is supplied to the input electrode 8' of amplifier 5 in degenerative phase.

Operating voltage for the amplifiers is derived by rectification of a commercial source of alternating current, which may be obtained by means of a plug 25, which may be inserted in a conventional household wall outlet, for example. The alternating-current voltage supplied therefrom is rectified by means of the diode 26 and is supplied through conductor 27 and the primary of the output transformer 20 to the anode of the amplifier 19. It is also supplied to the filter comprising resistance 28 and condensers 29 and 30, the latter comprising the usual filter for the reduction of the hum or ripple voltages resulting from rectification of the alternating-current voltage. Since the discharge device 19 requires higher operating voltage than does device 5 its anode voltage is derived from the input to the filter 28, 29, 30. The voltage at the output of the filter is supplied to the screen electrode of amplifier 19 and through resistance 31 to the anode 9 for operation of the amplifier 5.

Of course, owing to the current of hum frequency, i. e., sixty cycles, and harmonics thereof, which flows through resistance 31 and through the internal anode resistance of the discharge device 5 a hum voltage is developed on resistance

31, which is supplied through condenser 17 to the input of discharge device 19. Similarly, hum voltage due to the current of the hum frequency flowing in conductor 27, the primary winding of transformer 20 and the anode resistance of discharge device 19 is also developed. The hum voltage supplied to the grid of this discharge device is so phased as to neutralize the effect of the latter in the transformer 20 thereby to minimize the production of hum currents in the circuit of the loud speaker 21.

Of course, the constants of the system may be so proportioned that the hum voltage is materially reduced by the means thus described. A residuum of hum is, however, present. It has been found in accordance with my invention that this residuum of hum may be reduced in the system described and without any material additional cost of the system by connecting the resistance 35 between the output of the filter and the point between resistances 10 and 15 thereby to supply additional hum voltage to the degeneration resistance 15. This hum voltage is, of course, supplied to the input of the discharge device 5 just as is the feedback degenerative voltage from the output of the amplifier supplied to the input of discharge device 5 and it is poled so that its effect in the output of amplifier 19 is to reduce the residuum of hum previously referred to.

Of course, the amount of undesired hum voltage and degenerative voltage on resistance 15, which is supplied to the input of amplifier 5 is maximum when the contact 11 is at the terminal of resistance 10 adjacent the upper terminal of resistance 15 and it is reduced as the contact 11 is moved upward. The resistance 10, capacitance 14 and resistance 7 constitute a voltage dividing path across resistance 15. Thus, as contact 11 is moved upward to increase the amount of signal voltage derived from resistance 7, which is supplied to the amplifier, the amount of degenerative voltage and hum voltage on resistance 15, which is supplied to the amplifier is reduced. Resistances 15 and 35 are proportioned in such a ratio as to produce the minimum of hum when the contact 11 is at its lower position to which it is adjusted for minimum volume of sound reproduced by the loud speaker. As the contact 11 moves upward the hum, of course, increases. This, however, is not objectionable because the volume likewise increases and in an amount sufficient to mask the effect of the hum. In this way the increased undesired hum sound reproduced by the loud speaker becomes unnoticeable.

It has been found that by the use of my invention a very material reduction in hum is possible. In one equipment, by the connection of resistances 15 and 35, as described the hum was reduced from a level of −44 decibels to a level of −58 decibels or in a ratio of 5:1 reduction in voltage.

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, both in the circuit arrangement and in the instrumentalities employed may be made and I contemplate by the appended claims to cover any such modifications as 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, a source of audio voltage to be amplified, a resistance connected across said source, an electron discharge amplifier, having output terminals connected across a portion of said resistance and input terminals connected across said portion and a variable portion of the remainder of said resistance, said output terminals being poled to supply voltage to said resistance in degenerative phase, means to supply operating voltage subject to undesired variations to said amplifier, and means to supply said undesired variations across said portion of said resistance in phase to neutralize undesired variations in said output produced by said operating voltage whereby as said variable portion of said resistance is increased said degeneration and neutralization effects are reduced and the volume of output is increased sufficiently to render unobjectionable any resultant undesired variations in said output.

2. In combination, a source of voltage to be amplified, a pair of resistances connected in series across said source, an electron discharge amplifier having input and output terminals, one input terminal being variably connected along one of said resistors for volume control and the other input terminal being connected to the electrically remote terminal of the other resistor, means to supply voltage from said output terminals across said other resistor in degenerative phase, means to supply operating voltage subject to undesired variations to said amplifier and to supply said undesired variations across said other resistor in phase to neutralize said undesired variations produced between said output terminals by reason of said operating voltage, said resistances being proportioned to reduce said undesired variations in said output both by said neutralization and by degeneration when said one input terminal is in position for minimum volume, whereby when said variations are increased by movement of said terminal to increase volume the increased volume masks the undesired increase in said undesired variations.

3. In combination, a pair of cascade connected electron discharge amplifiers having an output circuit, a power supply rectifier having an output hum filter, means to supply operating voltage from the input of said filter to the anode of the last of said amplifiers and from the output of said filter to the anode of the first of said amplifiers, whereby hum voltage supplied to said first of said amplifiers tends to neutralize in said output circuit the effect of hum voltage supplied to the last of said amplifiers, a source of voltage to be amplified having a point connected to one input terminal of the first of said amplifiers, said point being variable on said source for volume control, and a resistance in series with said source, said resistance being connected across the output of the last of said amplifiers to have degenerative voltage applied thereto and being connected across the output of said filter to have hum voltage impressed thereon, said voltage being poled to neutralize any residuum of hum in the output of said last amplifier, said hum voltage and degenerative voltage being supplied through said source and variable input terminal to the first of said amplifiers in amounts variable with variation of said terminal on said source and being maximum when said terminal is positioned for minimum volume.

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