April 22, 1952 R. W. SANDERS 2,593,490

AUDIO SIGNAL TONE CONTROL

Filed March 27, 1947

FIG. 1

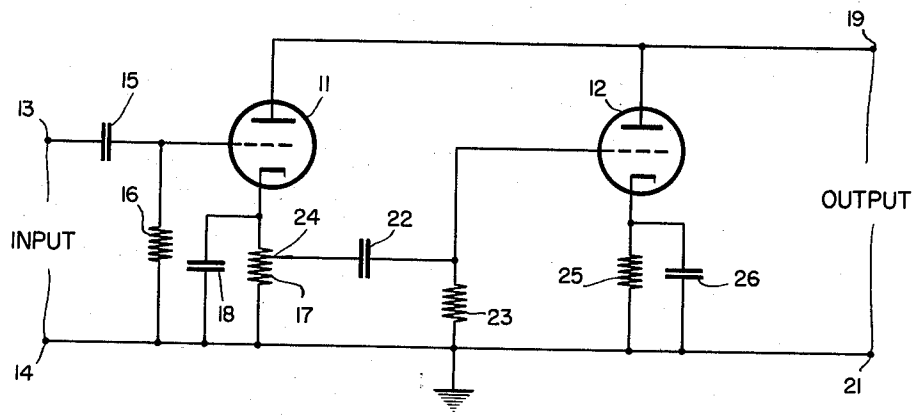
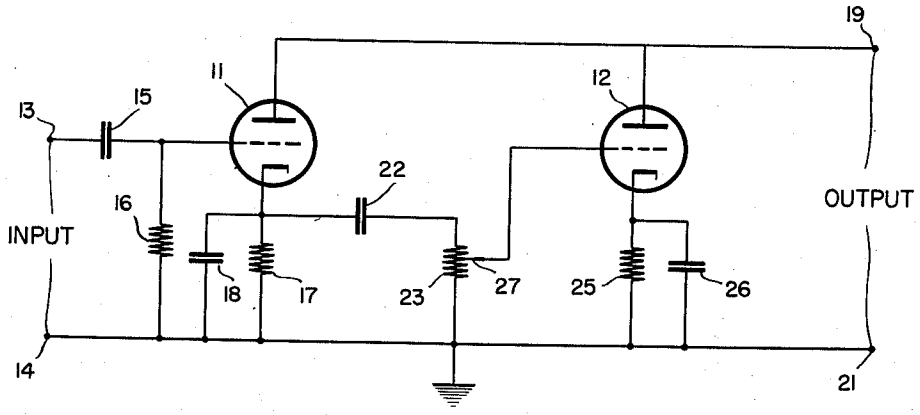


FIG. 2



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AUDIO SIGNAL TONE CONTROL

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6 Claims. (Cl. 179—171)

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This invention relates to amplifiers and particularly to tone control systems for use with audio amplifiers.

It has been the practice to equip most radio receivers with facilities for effecting a tone control of the reproduced sounds, particularly musical sounds. Most tone control systems which are commonly used operate by suppressing or attenuating certain bands of frequencies, whereby to give an apparent accentuation to other bands of frequencies. For example, when it is desired to reproduce musical sounds which have an apparent richness or mellowness, the higher frequencies in the treble range are attenuated so that the unattenuated bass frequencies are caused to have a predominant effect in the reproduced sounds. Conversely, when it is desired to accentuate the treble frequencies, the bass frequencies are suitably attenuated. The attenuation of a given band of frequencies usually is produced by means of resistive-capacitive circuits whereby the frequencies which are not to be accentuated are somewhat attenuated by the effective filtering action of these circuits.

Of course, any system which functions to attenuate a given band of frequencies will not reproduce the sounds entirely naturally. However, it is commonly desired to effect a sufficient distortion of the reproduced sounds whereby the bass frequencies are caused to dominate the treble frequencies. Ordinarily, sounds reproduced in this manner are most pleasing to the average listener than even the original sounds, wherein the treble frequencies may predominate. Nevertheless, tone control systems operating on the principle of attenuating certain frequencies only give an apparent effect of accentuating other frequencies. Actually, these other frequencies are not accentuated. Consequently, tone control systems of this character have an adverse effect upon the volume of the reproduced sounds. That is, when it is desired to effect an apparent accentuation of one band of frequencies by attenuating another band of frequencies, the volume of the reproduced sound is less by reason of the loss of the attenuated frequencies.

It, therefore, is an object of the present invention to provide a tone control system for an audio amplifier which does not adversely affect the volume of the reproduced sounds.

Another object of the invention is to provide a tone control system for an audio amplifier which effects added amplification of the band of frequencies which it is desired to accentuate.

In accordance with the present invention,

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there is provided tone control apparatus for a radio receiver which consists of two amplifying stages. The first of these stages functions to amplify all frequencies of an audio signal without substantial discrimination between frequencies. The apparatus, in addition, is provided with means for segregating that portion of the audio signal having a predetermined frequency range which it is desired to accentuate. The second of said amplifying stages functions to additionally amplify the segregated audio signal. The amplifier is provided with means for recombining the additionally amplified signal with the entire audio signal.

More specifically, in accordance with the illustrative embodiments of the invention disclosed herein, the tone control apparatus comprises a pair of vacuum tubes, each of which includes an anode, a cathode and a control grid. The cathode circuit of a first one of these tubes is provided with a load circuit of a character to develop a voltage representative of only the predetermined band of audio frequencies which it is desired to accentuate. The load circuit of the first vacuum tube is coupled to the control grid of the second vacuum tube so that this latter tube functions to amplify additionally only the band of audio frequency signals reproduced in the load circuit of the first tube. The anode circuits of the two tubes are coupled together to a common output circuit so as to recombine the additionally amplified portion of the audio signal with the entire audio signal.

Preferably, the coupling between the two vacuum tubes is of such a character that the voltage impressed upon the control grid of the second tube may be varied in order to effect a corresponding control of the degree of additional amplification given the selected band of audio frequency signals. In accordance with another feature of the invention, the coupling facilities provided between the two vacuum tubes may be altered simply by changing the value of some of the components so as to select the particular band of audio frequency signals desired to be accentuated.

For a better understanding of the invention, together with other and further objects thereof, reference is made to the following description, taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing:

Fig. 1 is a schematic circuit diagram of a por-

tion of an audio signal amplifier embodying one form of the present invention; and,

Fig. 2 is a schematic circuit diagram of a portion of an audio signal amplifier embodying another form of the invention.

Referring now to Fig. 1 of the drawing, the tone control system comprises a two stage audio amplifier including vacuum tubes 11 and 12. The audio signals are impressed upon a pair of input terminals 13 and 14. The input terminal 13 is coupled by means of a condenser 15 to the control grid of the first stage tube 11. A resistor 16 provides a leak to ground for the coupling condenser. A load resistor 17 is connected in the cathode circuit of the first stage tube and it is bypassed for relatively high audio frequencies by a condenser 18. The anode and cathode circuits of the first stage are coupled to a pair of output terminals 19 and 21.

The load resistor 17 for the first stage tube is coupled by means of a condenser 22 and a leak resistor 23 therefor to the control grid of the second stage tube 12. This coupling circuit is connected to the load resistor by a sliding contact 24. The cathode circuit of the second stage tube is provided with a load resistor 25 which is bypassed for relatively high audio frequencies by a condenser 26. The anode circuit of the second stage tube is coupled to the output terminals 19 and 21.

Having reference now to the operation of the embodiment of the invention shown in Fig. 1, it will be understood that there are impressed upon the input terminals 13 and 14 audio signals which are substantially undistorted. That is, all of the frequencies which it is desired to reproduce, are present in their proper relative magnitudes. These signals are amplified by the first stage tube 11. The relatively high frequencies are shunted to ground by the condenser 18. Consequently, the signal voltages which are developed in the load resistor 17 are representative of the low audio frequency tones. Consequently, the signal voltage which is derived from this resistor for impression upon the second stage tube 12 is representative only of the low audio frequencies. Accordingly, the tube 12 functions to amplify only the low frequency signals. These separately amplified low frequency signals are then recombined with the complete audio signal by the coupling of the anodes of both amplifier tubes 11 and 12 to the output terminal 19.

It is seen, therefore, that all audio frequencies are amplified in the first stage tube 11 substantially without discrimination between frequencies. However, the low frequency signals only are additionally amplified by the tube 12. As a result, the audio signals produced at the output terminals 19 and 21 have the low frequencies amplified to a greater extent than all other frequencies.

The degree of additional bass frequency amplification effected by the tube 12 may be varied at will by suitably positioning the sliding contact 24 on the resistor 17. The closer this contact is moved toward the cathode-connected end of this resistor, the greater will be the base frequency amplification effected. For the purpose described, the coupling condenser 22 is quite large and serves only to prevent the development of direct current effects in the resistor 23. If it is desired to effect additional amplification to the treble frequencies it merely is necessary to reduce the size of the condenser 22.

For a description of another embodiment of the invention, reference now will be made to Fig. 2. This circuit is substantially similar to that illustrated in Fig. 1. In some respects it comprises a preferred form of the invention inasmuch as it affords a control of the magnitude of the signals to be accentuated which is less noisy than in the apparatus of Fig. 1. In this connection the coupling condenser 22 is connected directly to the cathode of the first stage tube 11. In addition, the control grid of the tube 12 is connected by a sliding contact 27 to the resistor 23.

The apparatus functions substantially in the same manner as that shown in Fig. 1. However, in order to selectively control the amount of the additional frequency amplification, the sliding contact 27 is differently positioned on the resistor 23. In order to increase the amount of additional amplification by the tube 12, the contact 27 is moved to a higher point on the resistor 23 so as to include a greater portion of this resistor in the input circuit of the second stage tube.

It may be seen from the foregoing description of two illustrative embodiments of the invention that there is provided by the instant invention a tone control system which is not subject to the drawback of reducing the volume of the reproduced sounds when it is desired to accentuate certain signal frequencies. On the contrary, if anything, there is an increase in the total volume of the reproduced sound. This is effected by reason of the additional amplification given to some of the signal frequencies. It is to be noted that the tone control system, in accordance with this invention, operates entirely free of any signal frequency attenuation.

While there has been described what, at present, is considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it, therefore, is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A tone control apparatus for an amplifier comprising a pair of electron discharge tubes each having an anode, a cathode and a control grid, said anodes having a common connection, each of said tubes having a common point of potential, means for impressing a band of signals between the control grid of the first of said tubes and said common point, means coupled between the cathode of said first tube and said common point for developing signal voltages representing a predetermined portion of said band, means coupled between said voltage developing means and the control grid of the second of said tubes for impressing said developed signal voltages between said last named control grid and said common point, said second tube adapted to amplify said developed signal voltages, means coupled between the cathode of said first tube and said common point for providing a low impedance path for another portion of said band, and means coupled to said common anode connection and said common point to provide a combined output of both portions of said band between said common anode connection and said common point.

2. A tone control apparatus as claimed in claim 1, wherein said means coupled between

the cathode of said first tube and said common point comprises a resistance.

3. A tone control apparatus as claimed in claim 1, wherein said means coupled between said voltage developing means and the control grid of the second of said tubes comprises an impedance element having a low reactance to the signal voltages representing a predetermined portion of said band.

4. A tone control apparatus as claimed in claim 1, wherein said means coupled between the cathode of said first tube and said common point for providing a low impedance path comprises a condenser having a low reactance to the signal voltages of the other portion of said band.

5. A tone control apparatus as claimed in claim 1 wherein said means coupled between said voltage developing means and the control grid of the second of said tubes further comprises a condenser having a low reactance to the signal voltages representing a predetermined portion of said band and a resistor in series connection between said condenser and said common point.

6. A tone control apparatus as claimed in claim 5, wherein said resistor includes a variable connection between the control grid of said second tube and said resistor.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,700,393	Winther	Jan. 29, 1929
2,072,708	Case	Mar. 2, 1937
2,101,688	Rechnitzer	Dec. 7, 1937
2,230,996	Barcus	Feb. 11, 1941
2,313,098	Shepard, Jr.	Mar. 9, 1943
2,350,869	Bliss	June 6, 1944
2,384,263	Schlesinger	Sept. 4, 1945
2,408,242	Toomim	Sept. 24, 1946
2,429,755	Hallmark	Oct. 28, 1947

FOREIGN PATENTS

Number	Country	Date
216,062	Switzerland	Nov. 17, 1941