Nov. 3, 1936. H. L. OURA 2,059,389

FREQUENCY DISCRIMINATING ELECTRIC NETWORK

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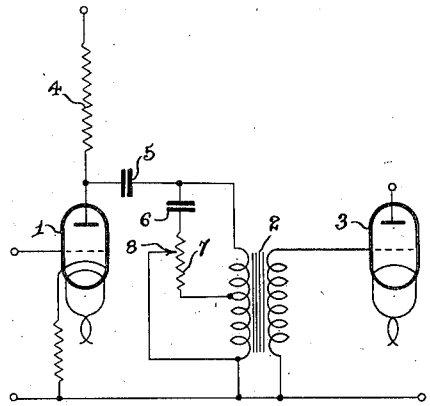


Fig. 1.

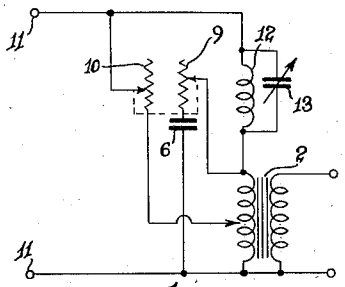


Fig. 2.

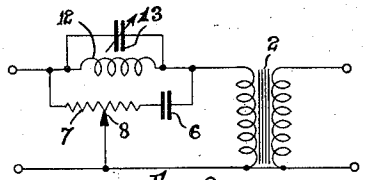


Fig. 3.

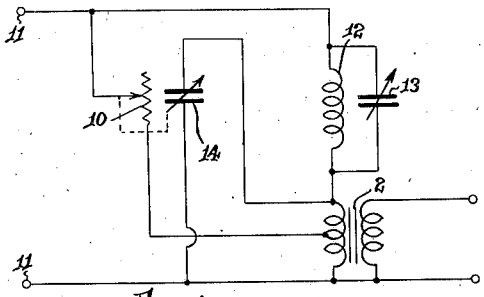


Fig. 4.

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FREQUENCY DISCRIMINATING ELECTRIC NETWORK

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8 Claims. (Cl. 178—44)

The present invention relates to frequency discriminating electrical networks, and more particularly but not exclusively to networks of the type employed in audio-frequency amplifying arrangement and the like for purposes of tone control. Networks of this type usually comprise one or more variable elements, whereby the frequency discriminating property of the network may be adjusted.

Audio-frequency tone controls have numerous applications in modern wireless receivers; they are employed, for example, for correcting for side band attenuation taking place in the radio-frequency circuits of the receiver, for compensating for imperfections in the frequency response of the loudspeaker, and for other purposes.

It is an object of the present invention to provide frequency discriminating electrical networks of the type referred to which are simple to construct, and can readily be embodied in an audio-frequency amplifying arrangement.

It is a further object of the invention to provide a frequency discriminating electrical network which may be adjusted to have any one of a number of frequency characteristics within limits at which low frequencies are favoured at the expense of high frequencies, or high frequencies are favoured at the expense of low frequencies.

The invention will be described by way of example with reference to the accompanying drawing, in which

Fig. 1 shows diagrammatically a part of a low frequency amplifier embodying a frequency discriminating network according to the present invention, and

Figs. 2, 3 and 4 show further forms of network suitable for use for tone control purposes in low frequency amplifiers. Like parts in the several figures are designated by the same references.

Referring to Fig. 1, an amplifying valve 1 is coupled by means of a transformer 2 to a further valve 3 which may, for example, be a power output valve. The primary winding of the transformer 2 is coupled to the valve 1 by means of a circuit comprising an anode resistance 4 and a coupling condenser 5.

The transformer 2, which has its primary winding tapped at a suitable point such as the centre point thereof, has shunted across one of the two portions of the winding a circuit comprising a condenser 6 and a potentiometer resistance 7 in series. The end of the unshunted portion of the primary winding is connected to a contact point 8 which is adjustable along the potentiometer resistance. The arrangement is such that when the adjustable contact 8 is at the end of the potentiometer resistance 7 closest to the condenser 6, the latter is connected in parallel with the whole of the primary winding of the transformer 2, and when the adjustable contact 8 is at the other end of the potentiometer 7, the portion of the primary winding referred to above as the unshunted portion is short-circuited, and the whole of the potentiometer resistance 7, in series with the condenser 6, lies in parallel with the shunted portion of the primary winding.

In the first of the above-mentioned positions of the adjustable potentiometer contact 8, the condenser 6 tends to by-pass the high audio frequencies, and is given such a value that the desired amount of high frequency control is obtained.

In the second position of the contact 8, the amount of inductance in the primary winding of the transformer is effectively reduced, and the transformer 2 becomes less efficient in the transmission of low audio frequencies, which thus tend to be suppressed.

It will be seen that, by varying the position of the adjustable potentiometer contact 8, the frequency response of the whole network may be varied progressively from a response which falls from a maximum at low audio frequencies, to one which rises to a maximum at high audio frequencies. Efficient tone control is thus simply obtained by the operation of one manual adjustment.

In Fig. 2 there is illustrated a further form of frequency discriminating network in which the potentiometer resistance 7 of Fig. 1 is replaced by two variable resistances 9 and 10. Resistance 9 is connected in series with the condenser 6 across the whole of the primary winding of the transformer 2, while resistance 10 is shunted across a part of the primary winding. The arrangement is such that as the value of the resistance 9 is decreased, the high frequency response of the network falls, due to the by-passing action of the condenser 6, while as the value of the resistance 10 is decreased, the low-frequency response of the network falls, as a part of the primary winding tends to become short-circuited. Preferably the control members of the variable resistances 9 and 10 are ganged together, as indicated by the broken line in Fig. 2, the arrangement being such that as the value of

the resistance 9 is increased, the value of resistance 10 is decreased, and vice versa.

In series with the input terminals 11 of the network shown in Fig. 2, and the primary winding of the transformer 2, there is connected a filter circuit comprising an inductance coil 12 in parallel with a condenser 13. This circuit is sharply tuned to a frequency against which it is required that the network shall discriminate; for example, when the network is associated with the low-frequency amplifier of a wireless receiver, the circuit 12, 13 may be tuned to a frequency of 5,000 cycles per second. It may then be arranged that the receiver as a whole shall have little response to oscillations at frequencies substantially above 5,000 cycles per second, and the effect of the sharply tuned circuit 12, 13 is thus to produce a sharp cut-off at the frequency to which it is tuned. The condenser 13 may be made variable for the purpose of varying this cut-off frequency.

The arrangement shown in Fig. 3 is similar to that shown in Fig. 1, with the exception of the fact that as the contact 8 on the potentiometer resistance 7 approaches the left-hand position, the whole of the primary winding of the transformer 2 tends to be short-circuited. The network shown in Fig. 3 incorporates a filter circuit 12, 13, the function of which is the same as that of the circuit 12, 13 of Fig. 2.

The network illustrated in Fig. 4 is a modified form of that shown in Fig. 2, the fixed condenser 6 and variable resistance 9 of Fig. 3 being replaced in Fig. 4 by a variable condenser 14. Preferably the operating members of the variable resistance element 10 and the variable condenser 14 are ganged together for simultaneous actuation, as indicated by the broken line, the arrangement being that as the value of the resistance 10 is increased, the capacity of the condenser 14 is also increased, and vice versa.

It is to be noted that the frequency discriminating networks described above are given by way of illustration only, and many variations within the scope of this invention, as defined in the appended claims, will readily occur to those skilled in the art; for example, in place of the transformer employed in the arrangements described above, an auto-transformer or like device may be employed. Furthermore, the networks according to this invention are not limited in their application to providing tone-control in broadcast receivers, but may find many other uses in the electro-accoustic field.

I claim:

1. A tone control device comprising the combination of an audio frequency transformer having a primary winding and a secondary winding, one of said windings being divided by a tapping into two portions, a circuit having an inductive reactance and comprising an impedance element connected to said tapping point and in series with one of said portions, a circuit constituting a capacitative path in parallel with said divided winding, and adjusting means for varying both the impedance of said inductive circuit and the impedance of said capacitative path.

2. Apparatus constituting a frequency discriminating electrical network, comprising a transformer having a primary winding and a secondary winding, one of said windings being divided by a tapping into two portions, a variable resistance element in shunt with one of said portions, a variable resistance element in series with a condenser connected in parallel with the whole of said divided winding, and adjusting means for varying the resistance of both said variable resistance elements.

3. Apparatus constituting a frequency discriminating electrical network, comprising a transformer having a primary winding and a secondary winding, one of said windings being divided by a tapping into two portions, a variable resistance element in shunt with one of said portions, a variable resistance element in series with a condenser connected in parallel with the whole of said divided winding, adjusting means for varying the resistance of both said variable resistance elements, an operating member, and a coupling between said adjusting means and said member such that actuation of said member causes changes in opposite senses in the resistance of said elements.

4. Apparatus constituting a frequency discriminating electrical network comprising an input terminal and an output terminal, a transformer having a primary winding and a secondary winding, a circuit comprising an impedance element connected in series with at least a portion of one of said windings, said circuit having an inductive reactance, a capacitative shunt path connected across one of said windings, and a filter circuit resonant at an audio frequency effectively in series with said input and output terminals.

5. A tone control device comprising an input terminal and an output terminal, a transformer having a primary winding and a secondary winding, a circuit comprising an impedance element connected to one of said windings, said circuit having an inductive reactance, a capacitative shunt path connected across one of said windings, and an inductance coil in parallel with a condenser constituting a filter circuit resonant at a high audio frequency effectively in series with said input and output terminals.

6. Apparatus constituting a frequency discriminating electrical network comprising an input terminal and an output terminal, a transformer having a primary winding connected to said input terminal and a secondary winding connected to said output terminal, one of said windings being divided by a tapping into two portions, a variable resistance element in shunt with one of said portions, a variable resistance element in series with a condenser connected in parallel with the whole of said divided winding, an inductance coil in parallel with a condenser constituting a filter circuit effectively in series with one of said windings, adjusting means for varying the resistance of both said variable resistance elements, an operating member, and a coupling between said adjusting means and said member such that actuation of said member causes changes in opposite senses in the resistance of said elements.

7. A tone control device comprising the combination of an audio frequency transformer having primary and secondary windings, a tap intermediate the ends of said primary winding, a pair of input terminals, a direct connection between one of said terminals and one end of said primary winding, a circuit connecting the other end of said primary winding to the other input terminal, an adjustable resistor connected in series between said tap and the other of said input terminals, a circuit having capacitive reactance shunted across the terminals of said primary winding and a unicontrol operating means arranged to vary the impedance of said circuit and the value of said resistor.

8. A tone control device comprising the com-

bination of an audio frequency transformer having primary and secondary windings, a tap intermediate the ends of said primary winding, a pair of input terminals, a direct connection between one of said terminals and one end of said primary winding, a circuit connecting the other end of said primary winding to the other input terminal, an adjustable resistor connected in series between said tap and the other of said input terminals, a variable condenser having its opposite sides directly connected to the ends of said primary winding and a single operating means connected to adjust said resistor and said condenser simultaneously.

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