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FREQUENCY DISCRIMINATING ELECTRIC NETWORK

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Fig. 1.

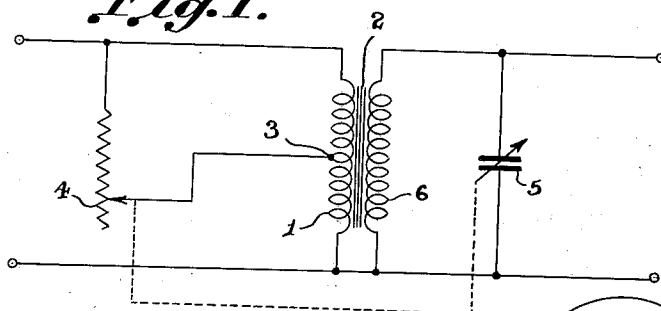


Fig. 3.

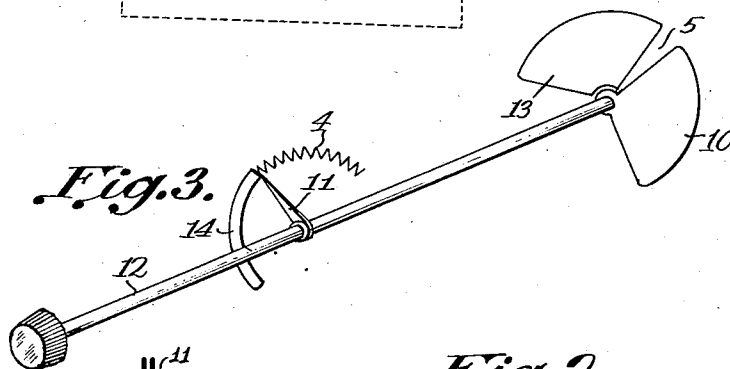
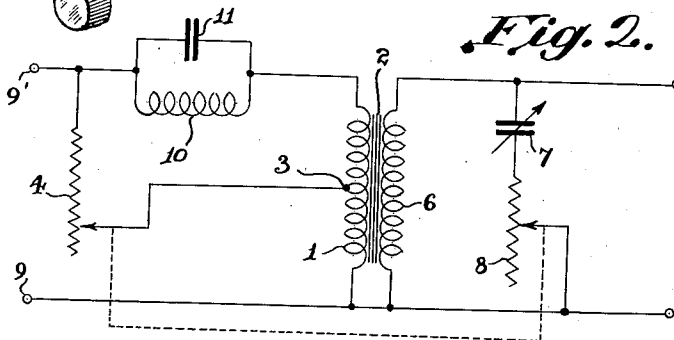


Fig. 2.



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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 arrangements 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 Figures 1 and 2 show diagrammatically two forms of network according to the present invention and Fig. 3 shows diagrammatically a form of uni-control operating means embodying the invention.

Referring to Fig. 1, the primary winding 1 of a transformer 2 is tapped at a point 3, and a variable resistance 4 is connected in parallel with one of the two portions so formed. A variable condenser 5 is connected in parallel with the secondary winding 6 of the transformer 2. The resistance 4 and the condenser 5 are preferably ganged together so that they may be operated by one control member as indicated by the dotted line shown, and the arrangement is made such that, starting from a midposition, rotation of the control member in one direction, for example, causes variation only in the value of the resistance 4, while rotation thereof in the opposite direction causes variation in the capacity of the condenser 5, but does not vary the value of the resistance 4.

This may be accomplished, for example, by suitably shaping the vanes of the condenser 5, and by arranging that when the movable contact

of the resistance 4 reaches the position in which the resistance in circuit is a maximum, the movable contact then tracks over an element of good conductivity connected in series with the resistance element, so that when the movable contact passes the position of maximum resistance, substantially no further change of resistance occurs. It is further arranged that while the movable contact tracks over the highly conducting element, the capacity of the condenser 5 is varied, the capacity remaining constant at a minimum value, which may be substantially zero, while the movable contact tracks over the resistance element itself. Such an arrangement is shown in Fig. 3 in which the movable arm 11 is shown at one end of resistor 4, the movable plate 10 of condenser 5 being secured to the same operating means, shown as a shaft 12, to which arm 11 is secured. 13 denotes the fixed condenser plate or plates. It will be seen that rotation of shaft 12 to the left causes arm 11 to slide over the conductive member 14 while the capacity of condenser 5 increases to its maximum value. Upon rotation of shaft 12 in the opposite direction, however, the capacity of the condenser remains substantially the same while the value of resistor 4 is decreased.

Alternatively, it may be arranged that when the value of the resistance 4 reaches a maximum, the resistance element itself is open-circuited; variation of the capacity of the condenser 5 then takes place only while the resistance element is open circuited, and this capacity is arranged to remain constant at a minimum value, such as substantially zero for example, while variation in the value of the resistance 4 is taking place. This arrangement may be had by simply omitting the track or conductive member 14 of Fig. 3. Methods other than those described of obtaining independent variation of the resistance 4 and the capacity of condenser 5 by means of one control member will be apparent to those skilled in the art.

The arrangement illustrated in Fig. 2 is a modification of that shown in Fig. 1. The variable condenser 5 which in Fig. 1 is connected in parallel with the secondary winding 6 of the transformer 2 is replaced in Fig. 2 by a fixed condenser 7 in series with a variable resistance 8. Adjusting means associated with resistance 4 are preferably ganged to similar means associated with resistance 8, one control member being provided as indicated by the dotted line shown whereby simultaneous variation of both resistances may be obtained. The arrangement is

preferably such that as the resistance 4 is increased, the resistance 8 is decreased, and vice versa.

The network illustrated in Fig. 2 is provided with two input terminals 9 and 9'. Connected in series between the terminal 9' and the upper end of the winding 1 is a resonant filter circuit comprising an inductance coil 10 in parallel with a condenser 11, this circuit being tuned to a frequency against which it is desired that the network should discriminate. When the network is associated with a low frequency amplifier, the circuit 10, 11 may serve to provide a sharp high-frequency cut-off, the amplifier and other apparatus with which it is associated being arranged to have little response above the required cut-off frequency. The condenser 11 may be made variable for the purpose of adjusting the cut-off frequency.

The method by which networks such as that shown in Fig. 2 function to provide tone control will now be discussed by way of explanation. Assume, firstly, the resistance 4 to be a maximum, and resistance 8 to be a minimum. The capacitative reactance of the circuit 7, 8 is then a maximum, and high frequency voltages set up across the secondary winding 6 of the transformer 2 tend to be reduced in intensity on account of the by-passing action of the condenser 7. As the value of resistance 8 is increased, this action is reduced, and the value of the resistance 4 is also reduced. The latter resistance and a portion of the winding 1 constitute an inductive circuit. As the resistance 4 is decreased, the impedance of this inductive circuit is decreased, and the effective inductance of the primary winding 1 is also decreased. The transformer accordingly becomes less efficient in the transmission of the lower frequencies, which thus tend to be suppressed.

It will be seen that by varying simultaneously the resistances 4 and 8, the frequency response of the whole network may be varied progressively from a response which falls from a maximum at the lower frequencies, to one which rises to a maximum at the higher frequencies.

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-acoustic field.

I claim:

1. An electrical network for transmitting a wide band of audio frequency currents comprising the combination of a transformer having a primary winding and a secondary winding, a variable resistor connected between an intermediate point and one end of one of said windings, a circuit having a capacitative reactance connected in shunt across the other of said windings, a direct connection between the low potential ends of said windings whereby said ends are maintained at the same potential, and a single adjusting means arranged to vary the impedance of said circuit and the value of said resistor.

2. Apparatus constituting a frequency discrim-

inating electrical network, comprising an audio frequency transformer having a primary winding and a secondary winding, one of said windings being divided into two portions, a variable resistor having its ends conductively connected to the ends of one of said portions and constituting therewith a circuit having an inductive reactance, a variable condenser connected in parallel with the other of said windings, and a single adjusting means for varying both the value of said resistor, and the capacity of said condenser.

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 means of a tapping into two portions, a variable resistance element connected in parallel with one of said portions and constituting therewith a circuit having an inductive reactance, a circuit having a capacitative reactance and comprising a condenser in series with a variable resistance element connected in parallel with the other of said windings, and a uni-control adjusting means for varying the resistance of both said elements.

4. Apparatus constituting an audio frequency discriminating electrical network, comprising an input terminal and an output terminal, an iron core transformer having a primary winding and a secondary winding, a circuit having an inductive reactance and comprising a variable resistance element connected with one of said windings, a circuit having a capacitative reactance connected in parallel with the other of said windings, and a filter circuit tuned to cut off high audio frequency currents connected effectively in series between said input terminal and said primary winding.

5. Apparatus constituting an audio frequency discriminating electrical network, comprising an audio frequency transformer having a primary winding and a secondary winding, a circuit having an inductive reactance and comprising a variable resistance element associated with one of said windings, a circuit including a variable resistance and having a capacitative reactance connected in parallel with the other of said windings, and adjusting means ganged together for simultaneous actuation for varying both said resistances.

6. Apparatus constituting a frequency discriminating electrical network, comprising a transformer having a primary winding and a secondary winding, one of said windings being divided into two portions, a variable resistance element connected in parallel with one of said portions and constituting therewith a circuit having an inductive reactance, a variable condenser connected in parallel with the other of said windings, adjusting means for varying the resistance of said element and the capacity of said condenser, and coupled to said adjusting means an operating member for varying, over a part of its range of movement, the resistance of said element and, over another part of said range, the capacity of said condenser.

7. 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, one of said windings being divided by means of a tapping into two portions, a variable resistance element connected in parallel with one of said portions and constituting there-

with a circuit having an inductive reactance, a circuit having a capacitative reactance connected in parallel with the other of said windings, an inductance coil in parallel with a condenser connected effectively in series between said input terminal and said output terminal, and a single adjusting means for varying the impedance of both said reactive circuits consecutively.

8. Apparatus constituting a frequency discriminating electrical network, comprising an audio frequency transformer having a primary

winding and a secondary winding, one of said windings being divided into two portions, a variable resistance element having its ends conductively connected in parallel with one of said portions and constituting therewith a circuit having an inductive reactance, a variable condenser connected in parallel with the other of said windings, and a uni-control adjusting means for varying both the value of said resistance and the capacity of said condenser.

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