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FREQUENCY DISCRIMINATOR CIRCUITS

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Fig. 1.

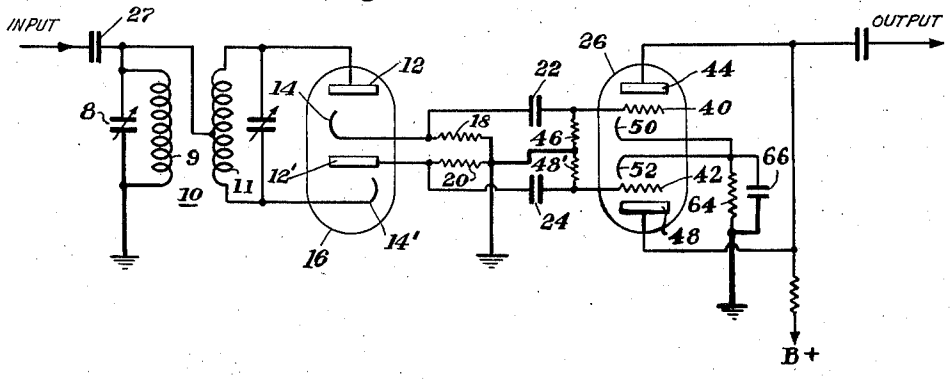
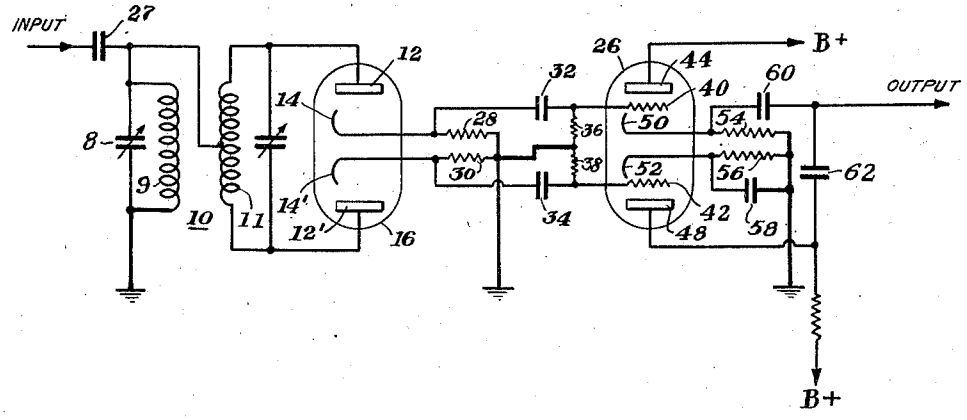


Fig. 2.



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FREQUENCY DISCRIMINATOR CIRCUITS

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5 Claims. (Cl. 250—27)

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This invention relates to improvements in frequency discriminator circuits, and more particularly to such circuits as are adapted to be used with frequency modulation receivers.

An object of this invention is to provide a frequency discriminator circuit which is satisfactory at very high frequencies as well as at the more usual, lower frequencies.

More specifically, the invention provides a frequency discriminator circuit in which the diode load resistors are not shunted by any discriminator or input circuit condensers, and which will remain completely balanced.

These and other features of the invention will be best understood and appreciated from the following description of a preferred embodiment and a modification thereof, described for purposes of illustration and shown in the accompanying drawings, in which:

Fig. 1 is a circuit diagram of a preferred form of frequency discriminator in accordance with the present invention;

Fig. 2 is a circuit diagram of a modified form of frequency discriminator.

While the use of frequency discriminator circuits embodying a pair of diodes or a double diode is common practice in frequency modulation receivers, such circuits as heretofore proposed are unsuitable for the recovery of high frequency modulation frequencies from frequency modulated waves. All frequency discriminator circuits as heretofore proposed, embody in the frequency discriminator input coupling circuit, a condenser which will be in shunt with at least one of the diode resistors through the common connection between the midpoint of the secondary winding of the input coupling and the common ends of the diode resistors. If this condenser is made of low capacity, loss of efficiency occurs due to the reactance of the condenser becoming large at the carrier frequency. A radio frequency choke serially connected with this condenser is unsuitable at higher frequencies, while if a large resistor is used instead of this choke, loss of efficiency occurs due to the fact that the value of this resistor becomes comparable in value to that of the diode resistors.

The frequency discriminator circuit according to the present invention, and a preferred example of which is illustrated in Fig. 1, overcomes the aforementioned difficulties. As there illustrated, the frequency discriminator input coupling or transformer 10 has its primary and secondary windings coupled and one end of its secondary winding connected to the anode 12 of one diode

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and the cathode 14' of a second diode, both diodes preferably being embodied in a double diode tube 16 of any suitable well-known type. The cathode 14 of the one diode is connected to ground through a resistor 18 while the anode 12' of the other diode section is connected to ground through the resistor 20. The voltage drop across the two resistors may be compared by connecting the cathode 14 through a condenser 22 to one grid of a double triode 26, while the anode 12' is connected to the other grid through a condenser 24, the cathodes of the double triode 26 being grounded. As indicated, output will be taken from the anodes of the double triode 26.

As is usual in frequency discriminator circuits the input, as from the prior intermediate frequency or limiter stage, will be connected to the center tap of the secondary winding 11 of the coupling 10 as well as to the tuned primary circuit comprising condenser 8 and primary winding 9. In this case, however, this input may be connected through a blocking condenser 27 prior to the interconnection to the coupling 10. By grounding the common center terminal between the resistors 18 and 20, it will thus be seen that neither the condenser 27 nor any other condenser in the input coupling discriminator circuit will be in shunt with either of these diode resistors. The connection back to the center tap of the secondary winding 11 of the coupling transformer 10 will take place through the common ground connection, as through the primary winding 9 of the coupling. Thus, the only capacitance across the diode resistors will be that resulting from the inherent capacity of the tube and possible wiring capacities. All external capacitors have been eliminated. The inverter type of circuit shown in Fig. 1 will result in voltage drops across the resistor 18 and 20 whose sum is measured by the balanced output circuit consisting of condensers 22 and 24 and resistors 46 and 48', this output being applied to the grids 40 and 42 of the double triode 26 having their cathodes 50 and 52 connected together and to ground through resistor 64 and condenser 66 and anodes 44 and 48 supplied by a source of anode potential, from whose output this sum is translated into suitable audio frequency signals.

The modified form of invention shown in Fig. 2 is identical with the principles of the invention illustrated in Fig. 1, but in this case the secondary winding 11 of the input coupling 10 is connected across the anodes 12 and 12' of the double diode 16, while the cathodes 14 and 14' are connected to ground through resistors 28 and 30 re-

spectively. The blocking condenser 27 is still so positioned that it, or any other discriminator circuit condenser, will not be in shunt with the resistors 28 and 30, the lower end of the primary winding 9 of the coupling 10 being also grounded, as heretofore described. In the form of system illustrated in Fig. 2 the difference between the voltage drops across resistors 28 and 30 is measured by the balanced output circuit consisting of condensers 32 and 34 and resistors 36 and 38, this output being applied to the grids 40 and 42 of the double triode 26 having anodes 44 and 48 connected to a source of anode potential and, connected for equal amplitude amplifications but for 180° phase shift in one section, and 0° phase shift in the other. This arrangement comprises connecting cathodes 50 and 52 serially through resistors 54 and 56, their midpoint being connected to ground, a bypass condenser being connected across resistor 58, and will result in a completely balanced output taken from cathode 50 through condenser 60 and anode 48 through condenser 62, while at the same time the only capacity in shunt with the diode resistors 28 and 30 will be the inter-tube capacities and the external wire capacity, if any.

While we have described above the principles of our invention in connection with a specific circuit and a modification thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of our invention as set forth in the objects and the accompanying claims.

We claim:

1. Frequency discriminator circuit including, in combination, input coupling means comprising an input transformer having primary and secondary windings, means galvanically connecting one end of said primary winding to the substantial midpoint of said secondary winding, a condenser in shunt with each winding and forming with each a tuned circuit, a first resistor, first rectifier means serially connecting one end of the secondary winding to one end of said resistor, a second resistor, second rectifier means serially connecting the other end of said secondary winding to one end of said second resistor, means having negligibly low loss interconnecting the other end of the primary winding with the other end of the two resistors, and means deriving and comparing the potentials across said two resistors.

2. Frequency discriminator circuit including, in combination, input coupling means comprising an input transformer having primary and secondary windings, means galvanically connecting one end of said primary winding to the substantial midpoint of said secondary winding, a condenser in shunt with each winding and forming with each a tuned circuit, a first resistor, first rectifier means serially connecting one end of the secondary winding to one end of said resistor, a second resistor, second rectifier means serially connecting the other end of said secondary winding to one end of said second resistor, means galvanically interconnecting the other end of the primary winding with the other end of the two resistors, and means deriving and comparing the potentials across said two resistors including a pair of electron discharge devices each having an anode, a cathode and a grid with their grids coupled respectively to one end of each of said resistors and their anodes directly connected with each other and a combining output circuit.

3. The combination according to claim 2, in which the means interconnecting the other end of the primary winding with the other ends of the two resistors comprises a common ground.

4. Frequency discriminator circuit including, in combination, input coupling means comprising an input transformer having primary and secondary windings, means galvanically connecting one end of said primary winding to the substantial midpoint of said secondary winding, a condenser in shunt with each winding and forming with each a tuned circuit, a first resistor, first rectifier means having an anode and a cathode, means connecting said anode to one end of said secondary winding and said cathode to one end of said resistor, a second resistor, second rectifier means having an anode and a cathode, means respectively connecting the cathode of the second rectifier means to the other end of said secondary winding and the anode to one end of the second resistor, means grounding the other end of said primary winding and the other ends of said two resistors, and translating means responsive to the sum of the voltages across the two resistors including a pair of electron discharge devices each having an anode, a cathode and a grid with their grids coupled respectively to the one end of each of said resistors, their cathodes directly connected with each other and their anodes directly connected with each other and to the output.

5. Frequency discriminator circuit including, in combination, input coupling means comprising an input transformer having primary and secondary windings, means galvanically connecting one end of said primary winding to the substantial midpoint of said secondary winding, and a condenser in shunt with each winding and forming with each a tuned circuit, a first resistor, first and second rectifier means each having an anode and a cathode, a pair of resistors, means respectively connecting the anodes of said two rectifier means to opposite ends of said secondary winding, means respectively connecting the cathodes of said two rectifier means to one end of said resistors, means grounding the other end of said primary winding and the other ends of said resistors, and translating means responsive to the difference between the voltage across the resistors including a pair of electron discharge devices each having an anode, a cathode and a grid with their grids coupled respectively to the one end of each of said resistors, a third and fourth resistor having one end of each connected respectively to the cathodes of said devices and the other end of each connected to each other and to ground, and means coupling the anode of one of said devices to the cathode of the other of said devices and to the output.

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