June 10, 1941. L. H. PADDLE 2,244,799

ELECTRICAL FREQUENCY TRANSLATING DEVICE

Filed Nov. 15, 1938 2 Sheets-Sheet 1

FIG. 1.

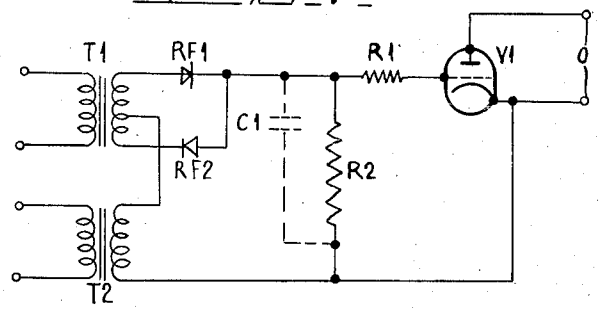
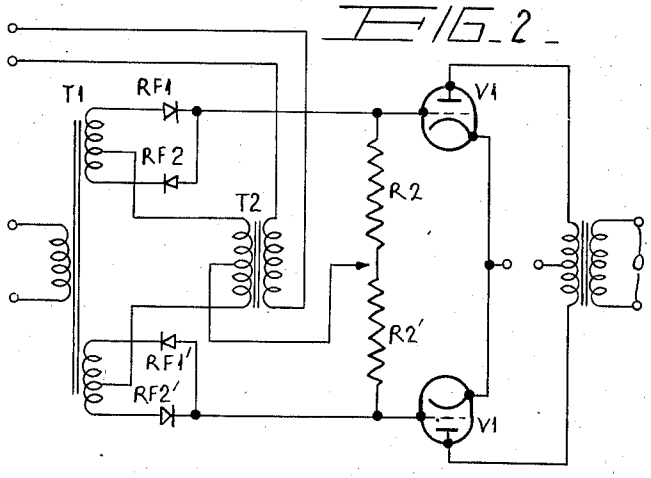


FIG. 2.



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FIG. 3

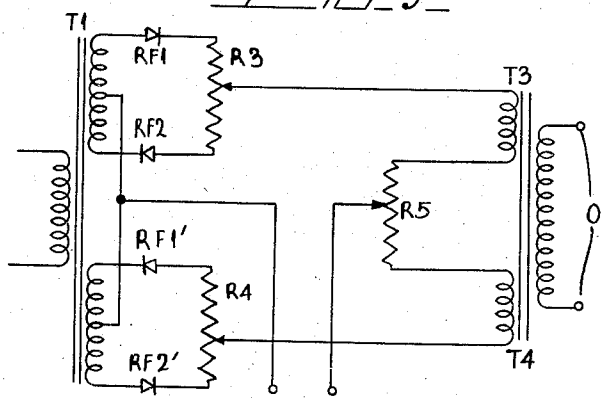


FIG. 4

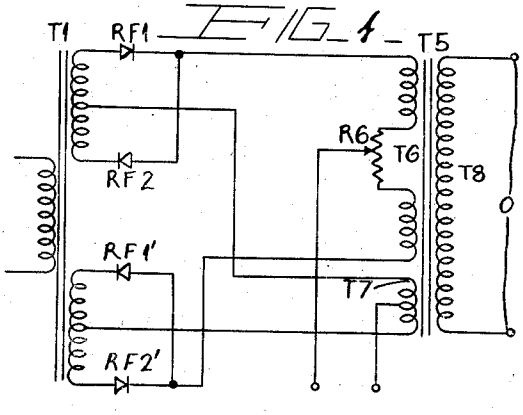
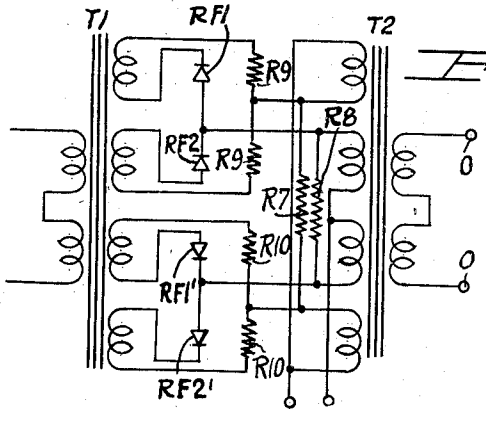


FIG. 5



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ELECTRICAL FREQUENCY TRANSLATING DEVICE

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Application November 15, 1938, Serial No. 240,583
In Great Britain December 24, 1937

2 Claims. (Cl. 179—171.5)

The present invention relates to modulating and demodulating arrangements for use with carrier wave signalling systems and is more particularly concerned with modulating and demodulating networks which are balanced with respect to at least one of the voltages applied thereto.

It is the object of the invention to provide improved circuits of this type and according to one feature thereof a modulator or demodulator comprises a closed network in which the output and one input circuit are so connected to the network that currents in the input circuit by itself will produce no effect on the output circuit characterised in that the closed network includes two rectifiers arranged in the same sense in series with two impedance elements.

According to another feature of the invention the input current is fed through two secondary windings of an input transformer or transformers and two rectifiers, the output current being derived from points in the network such that there is one of said windings and a rectifier in each branch between said points.

According to a further feature the modulator or demodulator comprises at least three closed networks an inclusive closed network having two equal branches with respect to junction points to which one input current is fed each branch including a primary winding of an output transformer or transformers arranged on each side of an included closed network also having two equal branches with respect to the points where the included closed networks are connected in the branch of the inclusive closed network each of the branches of the included networks including a secondary winding of an input transformer by which the second input current is fed into the networks, and a rectifier, the rectifiers being arranged in the same sense around the included closed networks.

The invention will be better understood from the following description of five embodiments taken in conjunction with the accompanying drawings comprising Figures 1–5. In the drawings like references designate similar circuit components.

Fig. 1 is a schematic diagrammatic view of a circuit illustrating one feature of applicant's invention.

Fig. 2 is a similar view illustrating a modified form of applicant's invention.

Fig. 3 is another diagrammatic schematic view of a circuit illustrating a further modification of the present invention.

Fig. 4 is a view similar to Fig. 3 illustrating a further modified form of invention.

Fig. 5 is still another diagrammatic schematic view of a circuit illustrating still another modification of the present invention.

Referring first to Figure 1 this circuit is more particularly applicable to demodulation of carrier wave signals. The circuit includes two transformers T1 and T2 to the primaries of which the locally generated carrier and the incoming side bands are applied. The secondary winding to transformer T1 has connected in parallel therewith two rectifiers RF1 and RF2 preferably of the dry plate contact type. These two rectifiers are arranged in the same sense passing round the network. The junction point of the rectifiers is connected over a resistance R1 to the grid of a valve V1. The centre point of the secondary winding of transformer T1 is connected to one end of the secondary winding of transformer T2 the other end of which is connected to the cathode of the valve V1 to complete the grid circuit. The output from the valve is taken across the terminals O between the cathode and the plate of the valve. This circuit is so arranged that the current flowing over the primary winding of transformer T1 is suppressed from the output when no voltage is applied across the transformer T2. Thus, for instance, if the locally generated carrier is applied across the transformer T1 there will in the absence of side band current in T2 be no current flow in the output circuit of the valve V1, the rectifiers RF1 and RF2 forming a shunt across the secondary winding of the transformer T1. When, however, side band currents are applied across the transformer T2 the balance of the circuit is upset and demodulation occurs with the result that the audio frequency currents appear in the output circuit O. It will also be understood that in addition to the audio currents other high frequency currents will also normally be present as a result of demodulation and in order to reduce the intensity of these currents a high resistance R2 of the order of 100,000 ohms is connected across the grid circuits to the valve V1. In addition a by-pass condenser C1 may also be connected in parallel with the resistance R2 if desired in order to form a by-pass circuit for the locally generated carrier.

Figure 2 comprises two circuits precisely similar to that shown in Figure 1 and arranged back to back. This circuit can be employed either as a modulator or as a demodulator and is balanced as regards both voltages applied to the network so that side band frequencies or audio frequencies only, as the case may be, appear in the output. It is pointed out that the secondary winding of transformer T2 is wound in such a manner that similar potentials are developed at both terminals of the winding in order to balance out the voltage concerned. This of course may be easily done, for instance, by winding two halves in opposition. It will also be noted that the resistances R2, and R2' in Figure 2 which

correspond to the resistance R2 in Figure 1 are variable in order that the balance of the network may be easily adjusted.

Figure 3 shows an arrangement which is very similar to that shown in Figure 2 except that the currents resulting from the modulation or demodulation action are applied not to a pair of valves V1 and V1' in Figure 2 but to two primary windings T3 and T4 having a common secondary winding from which the modulation or demodulation products may be obtained. It should also be pointed out that the primary windings T3 and T4 are separated by a resistance R5 to a tapping point on which a connection is made to one pole of one of the sources of potential, the other pole being connected to the centre points of the secondary windings of T1. Further the two networks which include the rectifiers have the addition of variable resistances R3 and R4, again for the purpose of adjusting the balance of the network.

Referring now to Figure 4 the circuit arrangement shown in the drawings again comprises a pair of rectifier networks similar to those shown in Figures 1 and 2. The output transformer in this embodiment comprises three primary windings T5, T6, and T7 with a single common secondary winding T8. The primary windings T5 and T6 have a variable resistance R6 interposed between two of their ends while the other ends are each connected to the rectifier networks. The third winding is connected across the centre points of the secondary windings of T1 and the second input voltage is applied across the centre point of the primary winding T7 and the variable resistance R6.

In Figure 5 the circuit arrangement shown is somewhat similar in principle to that of Figure 4. There are two rectifier networks each comprising two rectifiers in the same sense connected in series between two secondary windings of an input transformer T1, the opposite ends of the two secondary windings being connected together by means of a centre-tapped resistance (R9, R10). The output transformer T2 includes four primary windings arranged in pairs, each pair forming a closed network completed by means of a resistance (R7, R8) provided for the purpose of ensuring that the output load is substantially constant at all the derived or generated frequencies the junction point of the two windings in each closed network forming an input terminal for a second input current while the resistance of the closed network is connected in the case of one network between the centre-tapped points of the resistances of the rectifier networks and in the case of the other network between the connecting point of the two rectifiers in the same sense.

It should be understood that in Figures 2, 3, 4 and 5 the output and the input are interchangeable if the transformer windings are suitably designed for the frequencies which are required to be induced into their secondary windings from their primary windings.

I claim:

1. An electrical frequency translating device comprising a transformer having a winding, an external circuit including said winding, four other windings inductively coupled to said first-mentioned winding, on said transformer, two closed networks, each network including two of said four windings and two rectifiers, each network having its two windings connected together at one end, the other end of one winding being connected to one terminal of one rectifier and the other end of the other winding being connected to one terminal of the other rectifier, means connecting the other terminals of the two rectifiers together, said windings and rectifiers of each network being thus connected in series with each other with the rectifiers connected in the same sense, each network having only two external connections, one at the junction between the two rectifiers and one at the junction between the two windings, a second transformer having a winding included in a second external circuit, a pair of windings connected together at one end and inductively coupled to the first winding of said second transformer, one of the pair of windings of the second transformer having its other end connected to one external connection of one network and the other of said pair of windings of the second transformer having its other end connected to a corresponding external connection of the other network, variable resistance means connected between the other external connections of the two networks and junction point of the pair of windings of the second transformer, a thermionic valve having a cathode and a grid associated with each network and having its grid connected to said other external connection of its respective network, and means connecting the cathodes of the two valves of the respective networks together.

2. An electrical frequency translating device comprising a transformer having at least five windings, a second transformer having at least five windings, each of two pairs of said windings of said first transformer being connected together, two pairs of rectifiers, one pair of rectifiers and one pair of windings of said first transformer being connected in series in a closed circuit having only two external connections which extend from the junction point between the rectifiers and the junction point between the windings, respectively, with the rectifiers arranged in the same sense around the circuit, and another pair of rectifiers and another pair of windings of said first transformer being connected in a second closed circuit having only two external connections extending from the junction point between the rectifiers and the junction point between the windings, respectively, with the rectifiers arranged in the same sense around the circuit, and six terminals for connecting to external circuits, one pair of said six terminals being connected to the fifth winding of said first transformer, the second pair of six terminals having one terminal connected to the junction of a pair of windings of said second transformer and the other terminal of said pair connected to the junction of another pair of windings of said second transformer, the other ends of said first pair of windings of said second transformer being connected with corresponding external connections of said closed networks and the other ends of the windings of said second pair of windings of said second transformer being connected with the other corresponding external connections, respectively, of said closed networks and the third pair of terminals being connected to the fifth winding of said second transformer.

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