Nov. 2, 1948. K. POSTHUMUS 2,453,078

DEVICE FOR WAVE LENGTH TRANSFORMATION OF VERY SHORT WAVES

Filed March 17, 1943

Fig. 1.

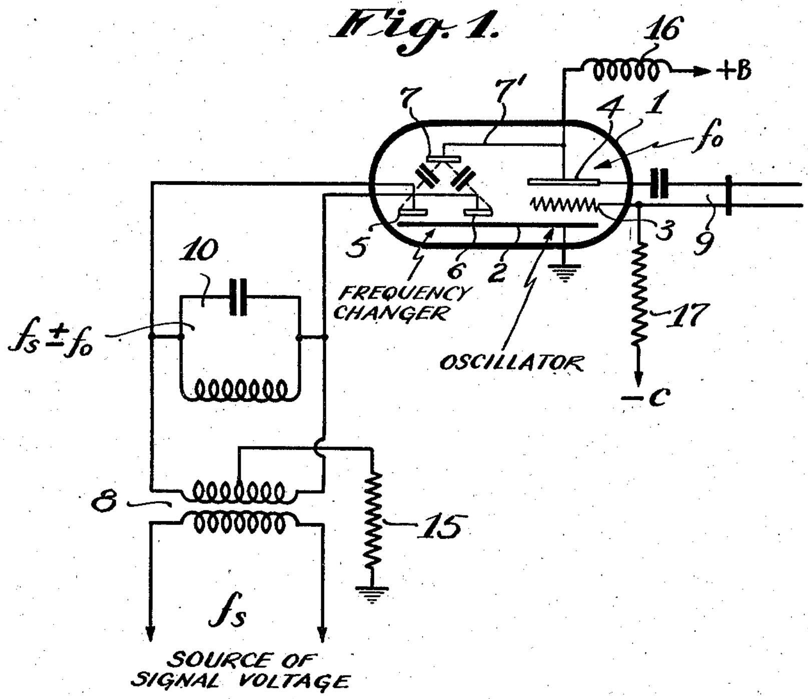
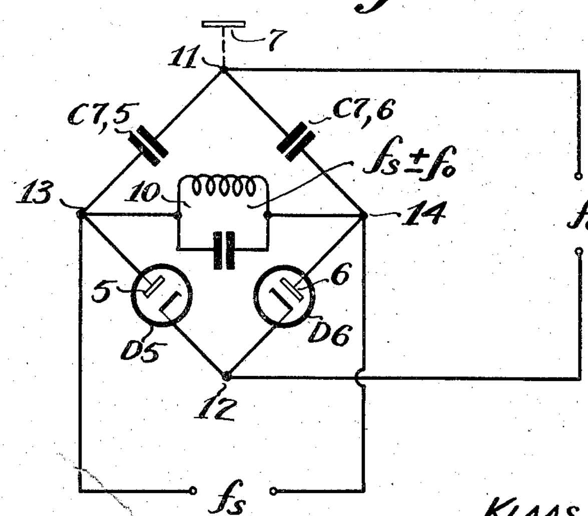


Fig. 2.



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DEVICE FOR WAVE LENGTH TRANSFORMATION OF VERY SHORT WAVES

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This invention relates to a device for wavelength transformation, more particularly of very short waves. Such devices entail the drawback that the tuning of the input circuit and that of the local generator act upon each other. With the known circuits for the above-stated purpose it was consequently necessary for the frequency of the local oscillations to be so chosen as to correspond approximately with a harmonic or a subharmonic of the signal to be received.

According to the invention, a perfect independence of the two tunings is obtained since one diagonal of a bridge connection, of which at least two branches include non-linear elements which serve for the wavelength transformation, has supplied to it the auxiliary voltages locally generated, whereas the other diagonal has applied to it the signal voltage.

According to the invention, the circuit is preferably so made that the two branches of the bridge connection which coincide in one of the corner points which has the auxiliary voltage supplied to it are each constituted by a diode and the two other branches are each constituted by a capacity.

In one embodiment of the invention the generator for the auxiliary oscillations and the two diodes are arranged in one envelope, in such manner that the anode of the generator section is coupled capacitatively to an equal degree with the anode of each of the two diodes and thus forms one corner point of the diagonal which has the auxiliary oscillation supplied to it, whereas the other corner point is formed by the cathode arranged in common to the generator section and the two diodes.

In order that the invention may be better understood and readily carried into effect, it will be explained more fully by reference to the accompanying drawing wherein Fig. 1 discloses a circuit according to one embodiment of the invention, and Fig. 2 shows the electrical equivalent of the circuit in Fig. 1.

Referring to Fig. 1 there is shown at 1 a composite discharge tube which comprises a triode section constituted by a cathode **2**, a control grid **3** and an anode **4**, as well as a double diode having anodes **5** and **6** and a common cathode **2** which constitutes an extension of the cathode of the triode section. Further, a body of conductive material in the form of a coupling plate **7** is provided which is symmetrically arranged relatively to the two anodes **5** and **6**, in such manner that the capacities of the coupling plate and of the anodes **5** and **6** are equal to each other. Further,

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the plate **7** is connected by a lead **7'** to the anode **4**.

The signal voltage is supplied in push-pull across the two diode-anodes by means of a coupling transformer **8**, the secondary of which may be center-tapped directly to ground or through a resistance **15**, in the conventional manner. The electrode system consisting of the cathode **2**, the control grid **3** and the anode **4** is connected as a triode generator for very short waves, for which purpose a tunable Lecher wire system **9** is provided between the control grid and the anode. The oscillations thus generated are supplied capacitatively and with equal phase to the two diode-anodes **5** and **6** so that frequency-changing occurs in the two diodes and the desired voltage of the sum or difference frequency may be taken from the circuit **10** tuned to this frequency.

Energizing potential for the anode **4** of the oscillator section is applied in the conventional manner from a source of direct current potential, represented by +B, through an R. F. choke **16**. Biasing potential for the grid **3** is obtained from a source represented by —C through a grid resistance **17**, a blocking condenser **18** serving to isolate the grid from the source of anode voltage in the conventional manner.

From the equivalent bridge circuit of Fig. 2 it is seen that the oscillatory circuit tuned to the signal frequency and the Lecher wire system tuned to the frequency of the auxiliary oscillations cannot act upon each other. In this circuit the capacity between the coupling plate **7** and the diode-anode **5** is indicated by $C_{7,5}$ and the capacity between the coupling plate **7** and the diode-anode **6** by $C_{7,6}$. The two diodes are indicated by D_5 and D_6 respectively. As it appears from the diagram, the elements $C_{7,5}$, $C_{7,6}$, D_5 and D_6 constitute a bridge connection in which the corner points **11**, **12** of one diagonal have supplied to them the locally generated oscillations of frequency f_0 and the corner points **13**, **14** of the other diagonal have supplied to them the received oscillations of frequency f_s. If the bridge connection is balanced, which may be effected in known manner by giving the capacities $C_{7,5}$ and $C_{7,6}$ equal values and providing for the diodes D_5 and D_6 exhibiting identical characteristics, the voltage between the points **13** and **14** will not vary with a voltage set up between the points **11** and **12**, and inversely, so that interaction of the circuits connected between the points **11** and **12**, and **13** and **14** is also avoided.

In devices according to the invention the intermediate-frequency voltages may be taken in push-pull from the mixing stage, which, especially if the intermediate frequency is comparatively high, is advantageous in view of the next following amplifying stages.

The further advantages of the device according to the invention which can be mentioned are the possibility of greatly reducing the length of the connecting leads between the generator section and the frequency-changing section, since the electrode systems concerned may be arranged in one envelope, and the possibility of connecting the cathode of the system to earth. Besides, it is in this case very well possible for the generator oscillations to be generated with a frequency equal, for example, to that of the input signal increased by the intermediate frequency, instead of a harmonic or a subharmonic of this frequency.

What I claim is:

1. A frequency-changing network adapted to mix a voltage of locally generated oscillations with a signal voltage particularly for use in signalling by means of short waves, comprising a bridge connection constituted by a diode in each of two branches of the bridge connection and a capacity in each of the two remaining branches, characterized in that the voltage of locally-generated oscillations is supplied across that diagonal of the bridge across which the dissimilar branches are in series and the signal voltage is applied across the other diagonal across which the similar branches are in series.

2. A frequency-changing network particularly for use in signalling by means of short waves, comprising a bridge connection constituted by a diode in each of two branches of the bridge connection and a capacity in each of the two remaining branches, said diodes having a common cathode which forms one corner point of the bridge, the opposite corner point of said bridge being formed by the common terminal connection of said capacities, a voltage source of locally-generated oscillations connected across said corner points which constitute one diagonal of the bridge, and a signal voltage source connected across the other diagonal of the bridge.

3. In a frequency converter circuit utilizing an electron discharge tube provided with a pair of diodes and a plurality of additional electrodes, an input circuit tuned to the signal frequency coupled to the diode-anodes, external circuit elements connected to said additional electrodes constituting an oscillator of a predetermined frequency, coupling means within said discharge tube between the oscillator output and each of the diodes, and a circuit tuned to a frequency resulting from the inter-action between the signal and oscillator frequencies connected between the diode-anodes.

4. In a frequency converter circuit utilizing an electron discharge tube provided with a common cathode, a pair of diode-plates and a plurality of additional electrodes including an anode, an input circuit tuned to the signal frequency coupled to the diode-plates, external circuit elements connected to said additional electrodes constituting an oscillator of a predetermined frequency, capacitive coupling means within said discharge tube between the anode of the oscillator and each of the diode-plates, and a circuit tuned to a frequency resulting from the inter-action between the signal and oscillator frequencies connected between the diode-plates.

5. A frequency converter system for high frequencies comprising an electron discharge device provided with a pair of diodes and a plurality of additional electrodes, external circuit elements connected to said electrodes constituting an oscillator, said additional electrodes constituting an oscillator section, said diodes and oscillator section having a common cathode, a signal input circuit connected to the diode-anodes, means within said discharge device for coupling the oscillator section to each of the diode-anodes, and a circuit connected between the diode-anodes for deriving the sum or difference frequency resulting from the inter-action between the signal and oscillator frequencies.

6. A frequency converter system for high frequencies, comprising, in combination, a generator of local oscillations, a pair of diodes, a signal input circuit connected in push-pull to the diodes, a circuit connected between the diode-anodes for deriving the sum or difference frequency resulting from the inter-action between the signal and oscillator frequencies, and the improvement which consists in providing capacitive coupling means from the local oscillator generator to each of the diode-anodes.

7. A frequency converter system as defined in claim 6 wherein the improvement consists in providing the pair of diodes and the electrodes of the oscillation generator in a common envelope, and the output electrode of the generator has connected to it within the envelope a conductive member which is symmetrically arranged with respect to the diode-anodes to provide equal capacitive coupling between the oscillator generator and each of the diodes.

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