Nov. 5, 1957 A. BOEKHORST 2,812,432

SELF-OSCILLATING MIXER USING TUNABLE LONG LINES

Filed Oct. 25, 1954

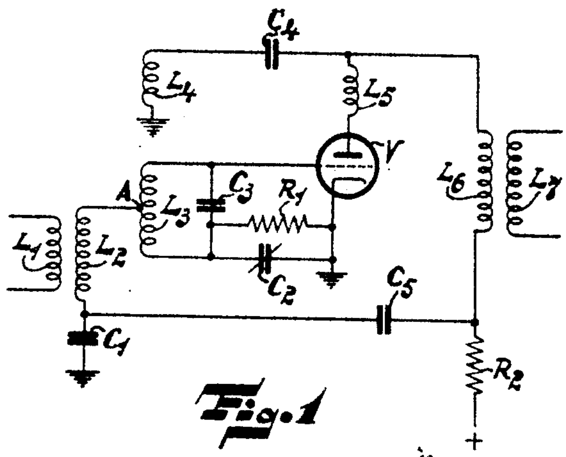

Fig. 1

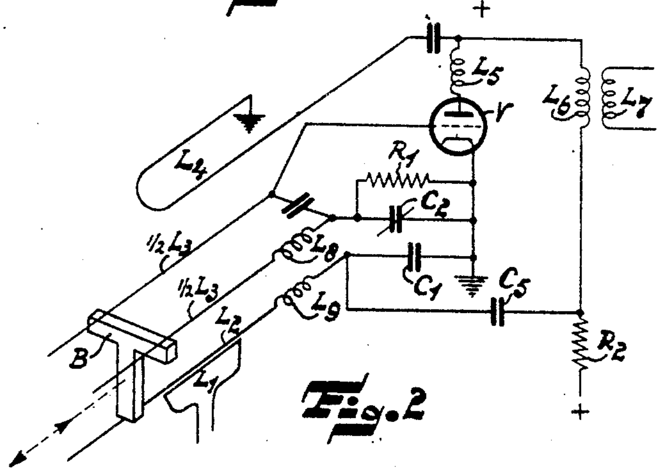

Fig. 2

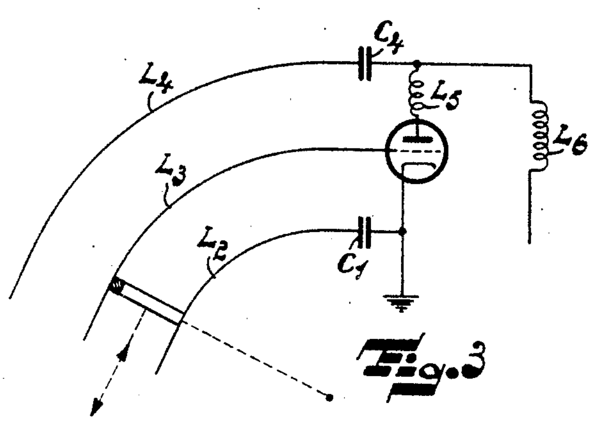

Fig. 3

INVENTOR

ANTONIUS BOEKHORST

BY Fred M. Vogel

AGENT

United States Patent Office

2,812,432

Patented Nov. 5, 1957

1

2,812,432

SELF-OSCILLATING MIXER USING TUNABLE LONG LINES

Antonius Boekhorst, Eindhoven, Netherlands, assignor, by mesne assignments, to North American Philips Company, Inc., New York, N. Y., a corporation of Delaware

Application October 25, 1954, Serial No. 464,580

Claims priority, application Netherlands December 9, 1953

3 Claims. (Cl. 250—20)

The invention relates to circuit-arrangements for changing the frequency of oscillations of very high frequencies, for example, of the order of 10^8 c./s., such as are used for television, comprising a self-oscillating mixing tube, more particularly a mixing triode, between the control-grid and cathode of which a circuit tuned to the oscillator frequency is connected. In order to counteract as such as possible the radiation of oscillations of oscillator frequency from the antenna in such circuit-arrangements, the incoming oscillations, in a known circuit arrangement, are supplied to an inductance connected between a point of the coil of the oscillatory circuit, which point does not carry any appreciable voltages of oscillator frequency relative to earth, and the cathode of the mixing tube.

It is customary to derive the intermediate frequency oscillations from a circuit, tuned to the said frequency, in the anode circuit of a mixing tube and to make provision of feedback between said circuit and the grid circuit, thus maintaining the oscillations of oscillator frequency. In general, the intermediate frequency is of the order of 10^7 c./s.

The present invention has for its object a circuit of this type which is so arranged as to be tunable in a simple manner over a comparatively wide frequency range, whilst the emission of oscillations of oscillator frequency from the antenna circuit remains low for any tuning even without the use of a preceding high-frequency amplification stage. A further object is to provide such an arrangement that the difference frequency between the incoming frequency and the oscillator frequency remains substantially constant throughout the range of tuning.

The invention consists in that not only the inductance of the oscillator circuit but also that of the receiving circuit are tunable Lecher wires.

Preferably, the inductance of the oscillator circuit is a Lecher wire system comprising two substantially parallel wires, whilst the inductance of the signal circuit is a single wire arranged symmetrically with respect to the first-mentioned wires, a single conductive sliding member being provided by which the three wires are interconnected at corresponding points.

Furthermore, in accordance with the invention, variable impedances, more particularly inductances connected in series with the Lecher wires, permit satisfactory adjustment throughout a wide frequency range.

In order that the invention may be readily carried into effect, it will now be described, by way of example, with reference to the accompanying drawing in which

Fig. 1 shows a known circuit arrangement,

Fig. 2 shows a circuit arrangement according to the invention, and

Fig. 3 is a variation of the arrangement shown in Fig. 2.

In Fig. 1, V stands for a triode mixing tube. A coil L_1 is included in the antenna circuit and coupled with a coil L_2 which may be a high-frequency tuning coil. L_3 stands for the tuning coil of the oscillator, which is inductively coupled to coil L_4 which, in series with a fixed capacitor C_4 and an inductance L_5, is connected between the anode and earth. This coil serves for regenerative feedback, thus producing oscillations in the tube. The cathode of the tube is earthed. The inductance L_5 has for its purpose to make the anode circuit inductive with regard to incoming high-frequency oscillations so as to reduce, in combination with the capacitance between anode and grid, the damping of the high-frequency tuning circuit. L_6 is the coil of the first intermediate frequency tuning circuit, which is coupled to L_7. L_6 is tuned to the intermediate frequency by means of a capacitor C_4 and the available parasitic capacities. The coil L_7, which may also be tuned to the intermedaite frequency, is connected to the intermediate frequency amplifier.

The upper end of coil L_3 is connected to the control grid of tube V, its lower end being connected to the earthed cathode through a capacitor C_2.

The upper end of coil L_2 is connected to a tapping point A of coil L_3, its lower end being earthed through the capacitor C_1. The lower end of coil L_2 is moreover connected, through a capacitor C_5, to the common point of a coil L_6 and a resistor R_2. The static direct current is supplied to the anode of tube V through the said resistor R_2. Across the latter and the capacitor C_1 an intermediate frequency voltage is set up and applied via L_2 and L_3 to the control grid of the triode so as to reduce the damping of the intermediate frequency circuit, whilst a low frequency inverse feedback, suppressing over-excitation, is produced by the same way. The capacitor C_2 is a trimmer by means of which the lowest possible oscillator emission is adjusted at point A. The capacitor C_3 is the oscillator-circuit capacitor. The capacitors C_4 and C_5 act at the same time as blocking capacitors with regard to direct voltage. The resistor R_1 serves to obtain the correct bias of the control grid of tube V.

In accordance with the invention, the arrangement is tunable over a frequency range of a given width, for example, the television band of from 174 to 216 m. c./s., since the inductances L_2 and L_3 are variable and constituted by Lecher wires.

A circuit-arrangement as described is shown in Fig. 2, corresponding parts bearing the same reference numerals as in Fig. 1.

In the arrangement shown in Fig. 2, the inductance L_3 is constituted by two parallel conductors along which a short-circuiting bridge B is movable. The conductor L_2 provides the self-induction of the high-frequency receiving circuit and is arranged symmetrically with regard to the first-mentioned conductors. As shown in this figure, the first-mentioned conductors each provide one half of the self-induction required for the oscillator circuit. The conductor L_2 is also conductively connected to the short-circuiting bridge B and to this end the latter is T-shaped. If the short-circuiting bridge is displaced, both the inductance L_3 and the inductance L_2 will be changed in value, whilst the upper end of the high-frequency coil L_2 remains invariably connected to the centre of the oscillator coil L_3.

By connecting one half of coil L_3 to an additional variable inductance L_8 an oscillator voltage equal to zero is obtainable for two frequencies of the tuning range at point A. At the lowest value of L_3 adjustment is effected by means of L_8 and at the highest value by means of C_2, so that the total deviation from correct adjustment is very small throughout the tuning range.

In order to reduce the padding deviation recourse may be had to a similar step in respect of the high frequency coil L_2. By means of an additional inductance L_9 the tuning frequency is adjustable on the higher frequency side, whereas adjustment on the lower frequency side of the range is effected by means of the capacitor C_1.

As shown in Fig. 2, the coils L_1 and L_4 are loops located substantially symmetrically with regard to the circuits with which they are associated.

Another solution of the problem involved in obtaining a constant frequency difference between the receiving circuit and the oscillator circuit is to curve the conductors into parts of circles so that L_2 has a smaller radius than the two halves of L_3. An arrangement of this type is shown in Fig. 3, the spacing between L_2 and L_3, and the radius of the circle segments determining satisfactory padding.

What is claimed is:

1. A tunable self-oscillating mixer circuit comprising a triode tube containing cathode, grid and anode electrodes, first and second conductors positioned substantially side-by-side and mutually parallel and respectively connected electrically at corresponding ends thereof to said grid and said cathode, a third conductor positioned symmetrically and parallel to said first and second conductors and connected electrically to said cathode at the end thereof corresponding to said ends of the first and second conductors, a single electrically conductive slider member positioned to contact said three conductors and adapted to slide along the length of said conductors, a feedback circuit connected to said anode and coupled electrically to at least one of said first and second conductors to cause a local oscillation to occur at the frequency to which said first and second conductors are tuned by means of said slider member, and a source of input oscillations coupled to said third conductor.

2. A circuit as claimed in claim 1, including a padding inductance interposed in series with at least one of said conductors at said end thereof.

3. A circuit as claimed in claim 1, in which said conductors are curved to form circular segments about a common point, the radii of said first and second conductors about said common point being equal to each other and larger than the radius of said third conductor about said common point.

References Cited in the file of this patent

UNITED STATES PATENTS

2,126,541	De Forest	Aug. 9, 1938
2,665,339	Leng	Jan. 5, 1954

FOREIGN PATENTS

698,397	Great Britain	Oct. 14, 1953