Dec. 27, 1949 H. BLOK ET AL 2,492,519

BAND-SPREAD TUNING CIRCUIT FOR RADIO RECEIVERS

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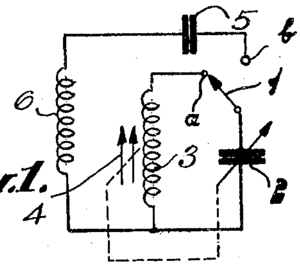
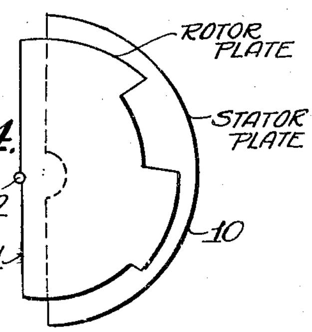


Fig.1.

Fig.4.



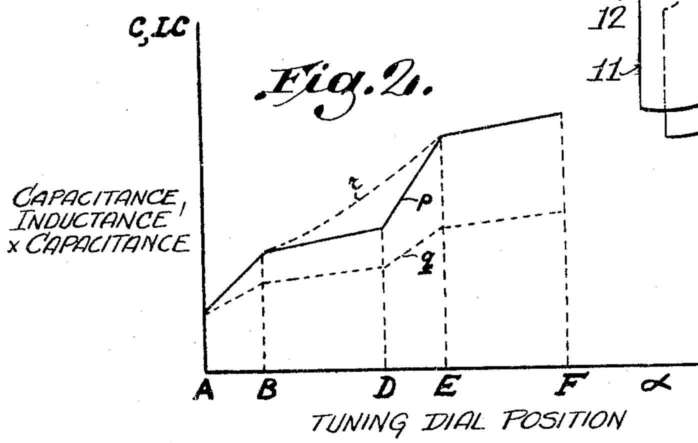
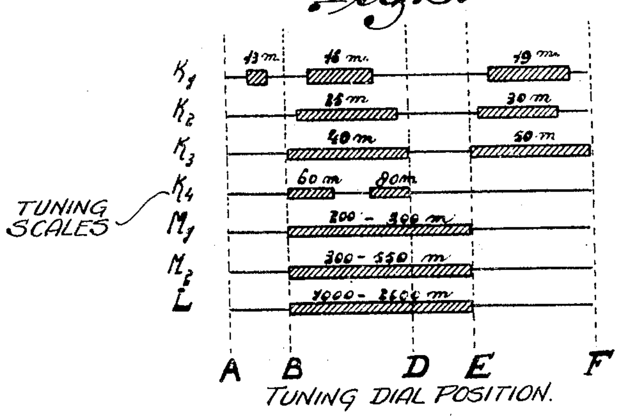


Fig.2.

Fig.3.



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BAND-SPREAD TUNING CIRCUIT FOR RADIO RECEIVERS

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This invention relates to a wireless receiver, of which one or more resonant circuits can be tuned by means of a variable tuning reactance in at least one shortwave range with bandspread and in one or more other wave ranges without bandspread.

It has been proposed to spread one or more comparatively narrow short wave bands over the dial in that the normally constructed tuning condenser of the receiver, which is used for tuning in the long and medium wave range, is combined in the short-wave range with a second variable condenser which is provided with particularly formed plates. In this case, the shape of the plates of the second condenser is chosen to be such that the capacity of the combination of the two condensers as a function of the position of the pointer relatively to the dial varies in accordance with a curve which exhibits alternately steep and less steep parts, the shortwave bands which are considered to be of particular importance and which therefore are to be spread (broadcast bands, amateur bands and the like) correspond with the flat parts of the said curve.

One disadvantage of this method is that the construction of the second variable condenser is beset with difficulty.

It has in addition been proposed before in tuning in a shortwave range to replace the normally constructed tuning condenser which serves for tuning in the long and medium wave ranges, by a condenser having particularly shaped plates, whose capacity varies as a function of the position of the pointer relatively to the dial according to a step-like curve as described hereinbefore. In this case there is the disadvantage that two different condensers must be used, and this increases considerably the consumption of material.

The invention has for its object to obviate the said disadvantages. According to the invention, for this purpose, the variation of the tuning reactance as a function of the position of the pointer relatively to the dial is chosen to be such that the slope of the tuning curve is reduced for part of the variation range, due to which at least one shortwave band is spread and, when tuning in one or more other wave ranges, the tuning reactance is combined with at least one other variable reactance (correction reactance) which is mechanically coupled with the tuning reactance and whose variation is brought about in such manner that, when tuning in these wave ranges, a tuning curve having an at least

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approximately constant or at least continuously variable slope is ensured at least for part of the dial.

When tuning in a shortwave range a similar fixed reactance is preferably connected in series and/or in parallel with the tuning reactance in order to reduce the variation range of the tuning reactance. It is advisable to construct the tuning reactance in such manner that for each shortwave range at least two shortwave bands are spread.

The tuning reactance is preferably constituted by a variable condenser, whereas the correction reactance is constituted by a variable inductance, for example a coil whose inductance can be varied by means of a slidable core of ferromagnetic or conductive material.

The tuning reactance and the correction reactance being mechanically coupled with one another, they are capable of being varied by means of a common tuning device. In this case the two reactances need, however, not be varied at the same time. If desired the variation of the reactances may be effected in succession or alternately.

In order that the invention may be clearly understood and readily carried into effect, it will now be set out more fully with reference to the accompanying drawing, on which one form of construction is shown, by way of example.

Fig. 1 shows a circuit embodying the invention;

Fig. 2 illustrates graphically the operation of the circuit shown in Fig. 1, showing tuning position as a function of C and LC;

Fig. 3 shows a ratio dial scale calibrated in accordance with the frequency response curve shown in Fig. 2; and

Fig. 4 illustrates an embodiment of the variable capacitor shown as **2** in Fig. 1.

Fig. 1 shows a resonant circuit which may, for example, constitute the oscillator circuit of a wireless receiver according to the invention. A waveband switch **1** permits of changing over the circuit to a number of differing wave ranges. For the sake of simplicity the figure shows a waveband switch having two positions, that is to say a position *a*, in which the receiver is tunable in a range of long or medium waves and a position *b*, in which the receiver can be tuned with bandspread in a range of short waves. In the position *a* of the switch **1** the resonant circuit is formed by a tuning condenser **2** and an inductance coil **3** whose inductance is variable by means of a slidable core **4** of ferro-magnetic or conductive material. In practice satisfactory results are obtained by the use of a core 4 made of copper. The condenser 2 and the core 4 are mechanically coupled with one another and are controlled by a common tuning device.

In the position b of the switch 1 the resonant circuit is formed by the condenser 2 with which a fixed condenser 5 is connected in series as well as by an inductance coil 6. The short waves to be received are distributed in such manner about several short wave ranges that each of these ranges comprises two short wave bands to which bandspread is applied.

Referring to Fig. 2, the curve p indicates the variation of the capacity C of the condenser 2 as a function of the position of the pointer relatively to the dial. The curve q shows the variation of the capacity of the series combination of the condensers 2 and 5. In the parts AB and DE the capacity varies comparatively fast, whereas in the parts BD and EF which correspond with the shortwave bands to be spread a comparatively slow variation of the capacity is ensured. The short wave bands are thus spread about a comparatively large part of the dial, whereas in the parts of the shortwave range lying external to the shortwave bands and corresponding to the parts AB and DE of the dial the slope of the tuning curve is approximately equally large as in the case of the wave range from 13 to 30 m being covered without changing-over and without use of bandspread.

In order to secure the capacity variation shown by the curve p, the fixed and/or movable plates of the condenser 2 are shaped in a particular manner, for example in such manner that these plates are constituted by alternating parts having a small and a large diameter. Fig. 4 illustrates a suitable configuration of condenser plates by means of which the relationship between dial setting and capacitance indicated by curve p of Fig. 2 may be achieved. In this figure, plate 10 is a stator plate while plate 11 is a rotor plate rotatable on a shaft 12. Rotor 11 comprises alternate sections having large and small diameters to produce a non-linear capacity variation as the rotor is rotated.

In the receiver according to the invention this condenser 2 having particularly shaped plates is also used as a tuning condenser in the long and medium wave range. In order that in these wave ranges normally varying tuning may be secured, it is essential that the divergences which the tuning curve p shows relatively to a normally varying tuning curve having an at least approximately constant slope should be corrected. According to the invention, this correction takes place by means of a variation of one of the other reactances of the resonant circuit, for example by providing the inductance coil 3 with a slidable core 4.

The inductance variation of the coil 3 may be effected in such manner that the said divergences are obviated throughout the variation range of the tuning condenser or else these divergences may be neutralized only in part of the variation range, using solely these parts for tuning in the long and medium wave ranges. A correction throughout the variation range of the tuning condenser can only be achieved with considerably greater difficulty than a correction over an adequately chosen part of the variation range, since in the first-mentioned case at some points of the variation range a correction may be required which is about 200% of the initial value of the inductance, whereas in the second case a correction of 50% may generally be sufficent. Therefore in the embodiment shown by way of example on the drawing solely the part BE of the dial is used for tuning in the long and medium wave ranges, when the correction is a minimum. In this case the tuning in the long wave range is not beset with particular difficulty. However, the medium waves to be received must be distributed about two approximately equally sized medium wave ranges (for example from 1500 to 1000 kc./s. and from 1000 to 550 kc./s.).

In Fig. 2, the dotted curve r shows the product LC of the inductance of the coil 3 and the capacity of the condenser 2 as a function of the position of the pointer relatively to the dial. In the part BE of the dial this curve has an at least approximately constant slope, so that the medium and long wave ranges are tunable in the normal manner.

Fig. 3 shows how the tuning dial of a receiver according to the invention may be constructed. As is apparent from this figure, the receiver may be provided with seven scales K_1, K_1, K_3, K_4, M_1, M_2 and L placed below one another. The wave range on the scale K_1 comprises the broadcast bands of 13, 16 and 19 m., the latter two of which are spread. The wave ranges corresponding to the scales K_2 and K_3 comprise the short-wave bands of 25 and 30 m. and of 45 and 50 m. respectively which are spread all of them. The range corresponding with the scale K_4 comprises the broadcast bands of 60 and 80 m., which are spread jointly in the part BD of the dial. Each of the scales M_1 and M_2 comprises one of the medium wave ranges, whilst the long wave range is found on the scale L.

The invention brings about the additional advantage that tracking of the various circuits is more easily obtainable, since this can be taken into account when designing the correction reactance. In addition, it is advantageous that with the receiver according to the invention the slope of the tuning curve is greater for the long waves and smaller for the medium waves than with the well-known receivers, since in the well-known receivers this slope is generally too small for the long waves and too large for the medium waves.

What we claim is:

1. A resonant circuit arrangement to provide band-spreading over selected ranges of wave length in a radio receiver, comprising a fixed inductance element and a fixed capacitative element in series therewith, a variable inductance element, a variable capacitative element having a reactance curve the slope of which is reduced over given ranges of capacitative reactance values, switch means for selectively connecting said variable capacitative element in series with said fixed inductive and fixed capacitative elements and with said variable inductance element, and means to simultaneously adjust the variable inductance element and the said variable capacitative element.

2. A resonant circuit arrangement to provide band-spreading over selected ranges of wave length in a radio receiver comprising a fixed inductance element and a fixed capacitative element in series therewith, a variable capacitative element having a reactance curve the slope of which is reduced over given ranges of capacitative reactance values, a variable inductance element, switch means for selectively connecting said variable capacitative element in series with said fixed inductance and fixed capacitative ele-

ment and with said variable inductance element, and means to simultaneously adjust the variable inductance element and the said variable capacitative element whereby the reactance curve of said variable inductance element and said variable capacitative element has a substantially constant slope.

3. A resonant circuit arrangement to provide band-spreading over selected ranges of wave length in a radio receiver comprising a fixed inductance element and a fixed capacitative element in series therewith, a variable capacitative element having a reactance curve the slope of which is reduced over given ranges of capacitative reactance values, a variable inductance element the inductance of which is varied by means of a slidable core of ferromagnetic material, switch means for selectively connecting said variable capacitative element in series with said fixed inductance and fixed capacitative element and with said variable inductance element, and means to simultaneously adjust the variable inductance element and the said variable capacitative element.

4. A resonant circuit arrangement to provide band-spreading over selected ranges of wave length in a radio receiver comprising a fixed inductance element and a fixed capacitative ele-

ment in series therewith, a variable capacitative element having a reactance curve the slope of which is reduced over given ranges of capacitative reactance values, a variable inductance element the inductance of which is varied by means of a slidable core of conductive material, switch means for selectively connecting said variable capacitative element in series with said fixed inductance and fixed capacitative elements and with said variable inductance element, and means to simultaneously adjust the variable inductance element and the said variable capacitative element.

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