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LOCAL OSCILLATOR CIRCUIT IN SUPERHETERODYNE RECEIVER

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The diagram shows a radio receiver circuit. It starts with a power source (battery) on the left. A network of resistors W_3 and W_4 is connected to the positive terminal. A capacitor C_1 is connected in series with the main signal path. The circuit then branches into several parallel paths. One path contains a switch S_1 and a capacitor C_4 . Another path contains a switch S_2 and a resistor W_2 . A central path contains a series combination of inductor K , capacitor a , inductor M , capacitor b , inductor L , capacitor c , and a series combination of capacitors C_2 and C_3 . The output is taken from a terminal labeled $+B$.

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LOCAL OSCILLATOR CIRCUIT IN SUPER-
HETERODYNE RECEIVERS

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1 Claim. (Cl. 250—36)

For the production of oscillations by means of vacuum tubes it is known to employ the capacitive three-point circuit which is termed also capacitive voltage divider circuit or the Colpitts oscillator circuit. This basic circuit can be employed without additional circuit elements in superheterodyne receivers, wherein for the purpose of obtaining tracking or synchronous operation of the local oscillator circuit and the input circuit a padding or tracking condenser is placed in series to the oscillatory coil of the local oscillator. The variable condenser and the padding condenser are then employed as a capacitive voltage divider. In this case, therefore, a special feed back coil can be dispensed with. The degree of feed back is regulated by the voltage division between the variable tuning condenser and the padding condenser. Now, since in the case of short wave reception the padding condenser is to be higher than in the case of medium waves and long waves, because in the former the percentage frequency difference of the local oscillator frequencies and input frequencies is smaller, the potential appearing at the padding condenser becomes too low. Therefore, this circuit with capacitive voltage division cannot be used for short wave reception.

In order to obtain a better understanding of the invention reference will be had to the accompanying drawing wherein Figure 1 shows an oscillator circuit according to the invention, Figure 2 shows the circuit of Figure 1 when conditioned, by switch means, to operate at short waves, and Figure 3 shows the circuit according to Figure 1 which is effective in the case of reception with intermediate waves.

In general, according to the invention it is proposed in the medium and/or long wave ranges to employ the variable condenser (C) of the local oscillator and the padding condenser (C₃) or a part of the latter as a capacitive voltage divider for a feed back three-point circuit, while for the short wave range there is provided a feed back coil (R_k) placed in the plate circuit. For the short wave reception there is then required solely a feed back coil while for the medium wave range and long wave range the feed back coil can be dispensed with.

Now, in this circuit the difficulty may be encountered that at the reception of medium waves the oscillator may be excited at a frequency in the short wave range. Hence, the short wave feed back coil is then to be rendered inactive for instance by short circuiting it. In accordance with a further feature of the invention in order

to avoid a special switch the capacitively bridged additional long wave coil (L) placed in series to the grid coils (K and M) for short waves and intermediate waves is adapted to short circuit the short wave feed back coil (R_k) remaining in the anode line, and this is done also eventually with the additional padding condenser (C₂) for the long wave reception which is placed in series.

If at long wave reception the danger of a short wave excitation likewise exists, this condition can be eliminated through a particular connection of the parallel capacitance with the additional long wave coil as will be explained below.

Referring now more particularly to Figure 1 there is shown solely the local oscillator circuit of a superheterodyne receiver which can be placed at the mixer stage in any desired manner. The resistance W₄ and the condenser C₁ serve in a manner known as such for the excitation of the grid biasing potential which adjusts itself automatically to the amplitude of the local oscillator. In order to obtain a sufficient oscillation potential when employing the said capacitive voltage division, it was found necessary to increase the hitherto customary value of the resistance W₄ from about 50,000 ohms to about 150,000 ohms. In order to maintain the time constant of the W₄-C₁ combination within admissible limits whereby any contribution to the appearance of relaxation oscillation in the short wave operation is avoided the capacity of C₁ should be reduced from about 100 mmfd. down to 25 mmfd. The resistance W₃ serves in a manner known as such for preventing an increase of the oscillation potential at the lower end of the short wave range; in this case there appears a reduction of the alternating grid potential through voltage division between the grid-cathode capacity and the resistance W₃.

At short wave reception only the switch S₁ is closed so that the lower end of the short wave coil K is directly at ground. Between this switch and ground a padding condenser may be inserted which can however be dispensed with at short wave reception since the percentage frequency difference between the oscillator frequency and the receiving frequency is very small and a sufficiently synchronous operation is already obtained without this condenser.

The parts of the circuit according to Figure 1 which are effective in the case of short wave reception are shown in Figure 2 in which however the circuit elements W₃, W₄ and C₁ are omitted for the sake of simplification. It is seen that an inductive return coupling takes place between

the feed back coil R_k and the grid circuit coil K . The circuit elements M , W_1 , L and C_2 of Figure 1 are in parallel to the condenser C_3 in the switch position for short wave reception and therefore, they are practically ineffective and not shown in Figure 2.

At reception on intermediate waves the switch S_1 in Figure 1 is open and the switch S_2 is closed. The part of the circuit according to Figure 1 which is effective for the intermediate wave reception is separately shown in Figure 3. In contrast to Figure 2 the return coupling takes place by means of a capacitive three-point circuit.

The short wave feed back coil R_k acts in the case of intermediate waves practically as a line connection. For this reason, for the intermediate waves, the long wave additional coil L in Figure 1 and the additional padding condenser C_2 are practically short-circuited by the switch S_2 . The parallel capacity c which serves to increase the initial capacitance in the case of long wave reception, is for the same reason in parallel to the capacitance C_3 . By closing the switch S_2 there is avoided at the same time the danger of excitation on a short wave without the use of a special switch since the alternating plate current for short waves is by-passed across the switch S_2 and the capacity c as regards the feed back coil R_k . This would also be the case if the capacity c were only in parallel to the coil L . As padding condenser and feed back condenser only the capacities C_3 and c are effective. A short-circuiting of these capacities through the plate current lead-in is avoided through the insertion of the resistance W_2 or of a high-frequency choke.

The resistance W_1 in the Figures 1 and 3 serves to avoid an increase of the amplitude of the local oscillator at the end of the wave range. The resistance W_1 of about 200 ohms causes a damping action primarily only at the upper end of the wave range since then the wattless current in the oscillatory circuit owing to the higher tuning capacity is larger than at the lower end of the range and therefore the loss power increases. The same resistance W_1 fulfills the same task at long wave reception.

If both switches S_1 and S_2 are open as shown in Figure 1 the circuit is adapted for the long wave reception. In comparison with the intermediate wave reception, in addition to the coil L , the condenser C_2 is provided to render the padding capacity lower than in the case of the reception on intermediate waves. Then the series connection of C_2 and C_3 is effective as the padding capacity. However, for the feed back by means of capacitive voltage division only the condenser C_3 is employed because otherwise the feed back would be too intense. Thus the circuit is further simplified because a special switch contact for reversing the upper end of W_2 to have it at the upper end of C_2 becomes superfluous.

The danger of excitation on a short wave can,

if necessary, be eliminated if, instead of placing the parallel capacity c directly in parallel to the coil L , it is grounded at its lower end as shown in Figure 1. In the position of the switches for long wave reception it is not only the feed back coil R_k which produces a feed back action for a short wave but in addition also the feed back potential appearing at the condenser C_3 is to be considered since without employing the said connection of the capacity c the low potential point of the coil K would for a short wave be connected with the connection point of C_2 and C_3 across the capacity b and the capacity c . In view of the particular connection of the capacity c the fact is that for the short wave the low potential point of the coil K is placed at ground across the capacities b and c while omitting C_3 . The capacity c (about 70 mmfd.) should be high in comparison with the natural capacity.

The connection of the capacity c has no effect upon the production of oscillations of the long waves since for the long waves the oscillatory circuit which is effective consists substantially of the capacity C having in parallel thereto the series connection of condensers a , b and c , and also the series connection of the coils K , M and L , and the padding condensers C_2 and C_3 . It should furthermore be pointed out that the capacities a , b and c need not necessarily be adjustable.

What we claim is:

In a superheterodyne receiver for the reception of short, medium and long waves, a local oscillator circuit utilizing a tube having at least a cathode, grid and anode, a tunable oscillation circuit connected between grid and cathode comprising short, medium and long wave coils and a pair of padding condensers connected in series and a variable tuning condenser in shunt across said coils and padding condensers, a feed-back coil in coupling relation to only the short wave coil connected at one end to the anode and at the other end to the common terminal of the padding condensers, a source of potential having positive and negative terminals, the positive terminal being connected to said common terminal of the padding condensers and the negative terminal being connected to the cathode of the oscillator, a first switch connected from cathode to the junction between the short and medium wave coils, and a second switch connected from the anode side of the feed-back coil to the junction between the medium and long wave coils, the arrangement being such that with both switches open the circuit will oscillate in the long wave band, with only the first mentioned switch closed the circuit will oscillate in the short wave band, and with only the second mentioned switch closed the circuit will oscillate in the medium wave band.

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