Feb. 14, 1939. K. SCHLESINGER 2,147,556

SUPERHETERODYNE RECEIVER

Filed April 2, 1936 2 Sheets-Sheet 1

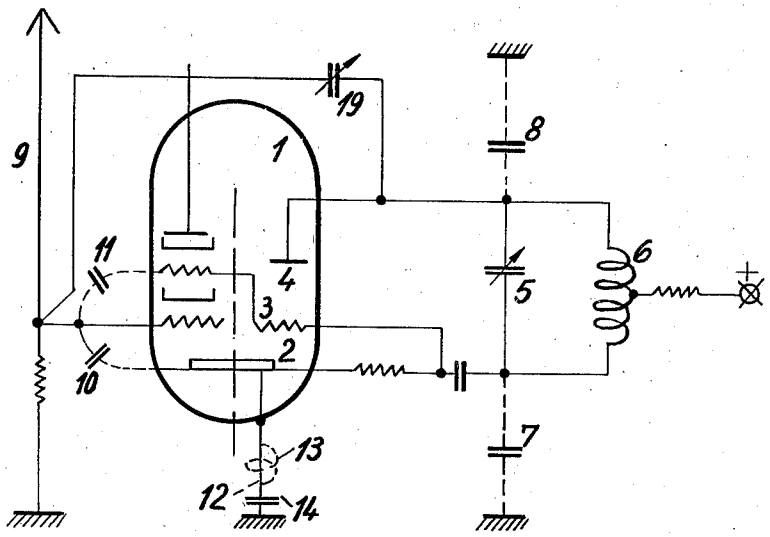


Fig. 1

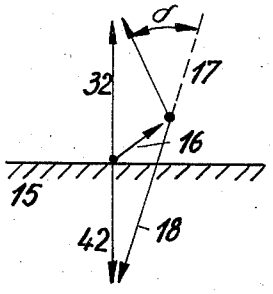


Fig. 2

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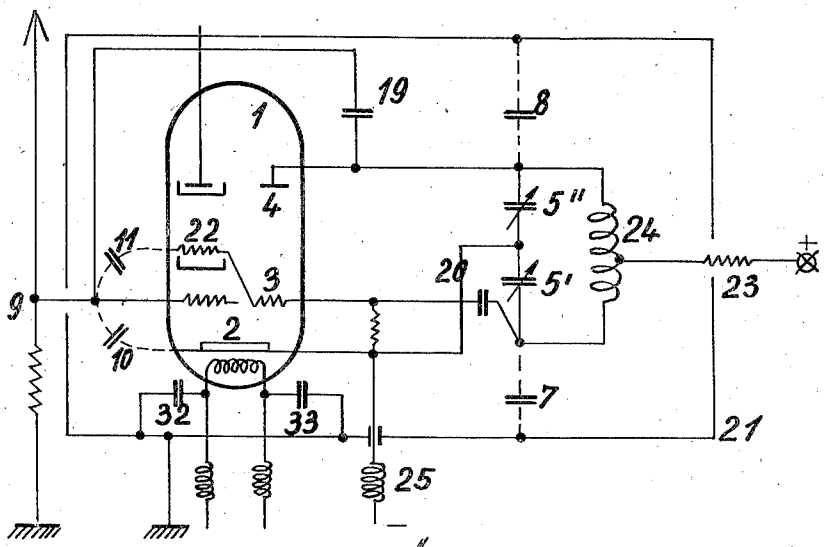


Fig. 3

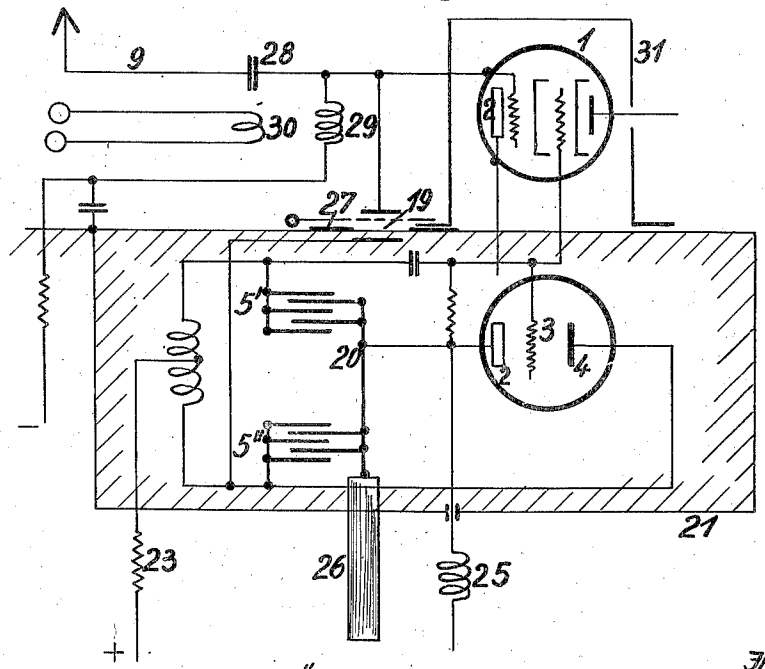


Fig. 4

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SUPERHETERODYNE RECEIVER

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Application April 2, 1936, Serial No. 72,314
In Germany April 6, 1935

5 Claims. (Cl. 250—20)

In the application Ser. No. 67,343, filed March 5, 1936, there is described the behaviour of a heterodyne mixing valve, for example a mixing hexode, upon the reception more particularly of ultra-short waves in the case of a circuit in which this valve is connected in direct fashion with the aerial. There then occurs, as set forth in that application, an interfering radiation of the local oscillation by the receiving aerial. This radiation takes place by reason of detrimental capacities within the valve. The subject matter of the application mentioned above is a method of eliminating the interfering radiation by a compensating means. For this purpose a potential of opposite phase with respect to the oscillatory potential at the oscillatory grid is impressed on the aerial and the oscillatory grid respectively by way of a capacitative coupling of adjustable value. The subject matter of the present invention is a modification of the arrangement used in the application Ser. No. 67,343, filed March 5, 1936, and consists in the means of obtaining energy with a phase displacement of exactly 180°, which is performed by dividing the oscillatory circuit condenser into two single capacities.

To enable the invention to be clearly understood it will now be described with reference to the accompanying drawings.

Fig. 1 shows a circuit setting forth the principle of the elimination of the radiation.

Fig. 2 shows a vector diagram of the single potentials in question and

Fig. 3 shows by way of example an embodiment of the arrangement according to the invention and

Fig. 4 shows a more constructional embodiment employing a similar circuit to that of Fig. 3.

Fig. 1 shows a combined mixing and oscillator valve 1 with its oscillator system consisting of the cathode 2, the oscillator grid 3 and the oscillator anode 4, which is connected to an oscillator circuit comprising condenser 5 and inductance 6. In this oscillator circuit the oscillator system commences to oscillate as soon as a capacitative potential division of sufficiently high conductivity is produced by the inherent capacities 7/8. Since generaly speaking the capacities 7 and 8 are merely small (order of magnitude 10 cm.) the circuit is able to oscillate only in the case of high operating frequency (ultra-short wave circuit). Due to self-capacities 7 and 8 self oscillation is set up in circuit 5, 6 and the aerial 9 commences to radiate. The same itself, after all external lines have been balanced out against the aerial by earthed screening means, is still coupled by the inner capacities 10 and 11 with the electrodes 2 and 3 of the oscillator system within the valve 1. 11 represents its capacitative coupling with the grid 3, and 10 represents its capacitative coupling with the cathode 2. In the prior application it has been assumed that it is possible to earth the cathode 2 effectively. Practice, however, has shown, that this is not fully successful, particularly in the case of short waves. The self-inductance 13 of the earthing conductor 12 or also the internal resistance of the earthing condenser 14 prevents the connection of the cathode 2 to earth from being of zero impedance. The spatial extension of the chassis may be sufficient to cause a phase shift in the case of short waves if the circuit 5/6 is mounted on a point of the chassis other than the earthing point of the cathode 2. In this case the impedance of 12 is no longer negligibly small, the potentials between electrodes 3 and 2 and betwen 4 and 2 are no longer at reverse phase. This is illustrated by the vector diagram of Fig. 2 in which 32 representing the potential of grid 3 with reference to earth is displaced by precisely 180° relatively to 42 which represents the potential of anode 4 with reference to earth. This is ensured by the self-capacities 8 and 7. Theoretically the cathode 2 should not have potential with reference to earth. On account of impedances 12, 13, 14, however, it does in practice have a potential for example the potential represented by 16 in Fig. 2, with respect to earth. Between the cathode 2 and the grid 3 there is accordingly produced the potential represented by 17, and between the cathode and the anode the potential represented by 18. These two potentials, however, are no longer of opposite phase, but deviate from this condition by an angle δ. Owing to this angle of error, however, the neutralization which is attempted in Fig. 1 by a condenser 19 from the anode 4 to the aerial point 9 fails.

This difficulty is overcome by dispensing altogether with the separate earth connection for the cathode and secondly by producing the capacitative potential division which serves to produce the oscillation by means of the oscillator circuit capacity 5 itself, instead of by means of the small stray capacities to earth 7 and 8 of the structure. The capacity 5 is much larger than the stray capacities 7 and 8. The internal resistance of the potential divider in accordance with Fig. 3 is considerably smaller than according to Fig. 1. The capacity of the oscillatory circuit is formed of two equal condensers 5′ and 5″, which are connected in series. Each of these

condensers, therefore, has twice the capacity of the condenser 5 of Fig. 1. The cathode has no separate earth connection but is connected through lead 20 to the junction point of the condensers 5' and 5''. In this way it is ensured that a phase displacement of precisely 180 degrees exists between the electrodes 3 and 4 of the oscillator system 2, 3, 4. It is no longer necessary for the cathode 2 to be exactly at earth potential, the position of the earthing point of the oscillator circuit is determined by the two stray capacities 7 and 8 and need not coincide with the potential midpoint between grid 3 and anode 4 produced by the condensers 5', 5''. An earthed metallic covering 21 is placed over the entire arrangement and also in particular over the metallic coating of the valve 1 connected with the cathode 2 for the purpose of eliminating any radiation caused by cathode potential.

In the arrangement according to Fig. 3, it is possible to eliminate the radiation of disturbing local oscillation from the aerial 9, because the control grid is coupled to the cathode 2 and the mixing grid 22 in a purely capacitative manner through capacities 10 and 11 respectively and because these electrodes 2 and 22 are free from angle with the aerial and both oscillate in phase and reverse phase respectively and can therefore be completely neutralized by oscillations supplied by the condenser coupling 19. The anode 4 is fed through a resistance 23 or a choke of such impedance that the resistance of 7 and 8 is smaller than the resistance of 23; the lead from resistance 23 is taken to the midpoint (or near to the midpoint) of the oscillatory coil 24, so that no earthing effect is introduced into the oscillator system by this conductor. The connection with the negative pole of the anode battery is performed through the medium of a choke or a resistance 25 likewise of large impedance, so that the phase of the potential of the cathode 2 is determined exclusively by the condensers 5', 5'', and is not disturbed by the battery conductors.

Fig. 4 shows a more constructional arrangement of a heterodyne local oscillator of this kind in which for the sake of simplicity the oscillator system 2, 3, 4 and the mixing system 1 are shown separately. The rotary plate condenser 5', 5'' consists of two stators with their rotors mounted on a common shaft 20. These condensers are arranged for inside the earthed casing 21 and are driven by an insulated spindle 26 which projects through the housing. Their capacities as compared with its environments should be smaller than their capacities in relation to their accompanying stators. The feed resistance 23 in the positive line and choke 25 in the negative line are the same as in Fig. 3. Condenser 19 is constructed as a shielded condenser, as it is only possible by means of such a construction having an earthed displaceable intermediate layer 27 always to adjust the required extremely small capacities down to zero. The aerial 9 is coupled either with the grid choke 29 capacitatively through the medium of a small coupling condenser 28, or inductively through the medium of a primary coil 30. The latter coupling is suitable particularly for use with feeder conductors when the aerial is a long way from the receiver. An important part is the screening hood 31, which is mounted in earthed fashion over the mixing valve 1 and is required to prevent the metallic coating of this valve connecterd with the cathode 2 from radiating oscillations, the cathode 2 not being at zero potential with reference to earth. For the same reason the oscillatory system is also closed on all sides by means of a closed earthed metallic casing 21.

A special screening means 31 may be dispensed with if in place of a screening coating within the valve in mirror form connected with the cathode a coating is employed which is passed out separately and is connected with earth. Particular attention is directed to the heating lines feeding the indirect cathode. These are connected to the casing preferably through the medium of condensers 32/33, which are shown in Fig. 3, and include chokes near their exit from the casing.

I claim:

1. In a short wave superheterodyne receiver means for preventing radiation of the locally generated oscillation by the receiving aerial, a mixing tube including a mixing electrode-system consisting of at least an anode, a grid supplied with said local oscillations, a control grid and a cathode, and an oscillatory electrode-system consisting of an anode, a grid and a cathode, an oscillatory circuit connected to the oscillatory electrode system, a neutralizing circuit between said oscillatory circuit and said mixing electrode system, said oscillatory circuit consisting of a combination of two condensers and an inductance and being connected between the anode and the grid of said oscillatory electrode system, which grid is also connected to the said grid of the mixing system supplied with local oscillations, the cathode of said oscillatory system being connected to the junction point of said two condensers arranged in the oscillatory circuit, said anode and said cathode of the oscillatory system being fed through an impedance which has such a value that the value of the effective resistance of the stray capacity of said oscillatory circuit being the foundation for producing the oscillation is negligibly small in comparison to said impedances in the feed line connection.

2. In a short wave superheterodyne receiver means for preventing radiation of the locally generated oscillation by the receiving aerial, a mixing tube including a mixing electrode system consisting of at least an anode, a grid supplied with said local oscillations, a control grid and a cathode, and an oscillatory electrode system consisting of an anode, a grid and a cathode, an oscillatory circuit connected to the oscillatory electrode system, a neutralizing circuit between said oscillatory circuit and said mixing electrode system, said oscillatory circuit consisting of a combination of two condensers and an inductance and being connected between the anode and the grid of said oscillatory electrode system, which grid is also connected to the said grid of the mixing system supplied with local oscillations, the cathode of said oscillatory system being connected to the junction point of said two condensers arranged in the oscillatory circuit, said anode and said cathode of the oscillatory system being fed through an impedance which has such a value that the value of the effective resistance of the stray capacity of said oscillatory circuit being the foundation for producing the oscillation is negligibly small in comparison to said impedances in the feed line connection, one single cathode being used for both said electrode systems.

3. In a short wave superheterodyne receiver means for preventing radiation of the locally generated oscillation by the receiving aerial, a mixing tube including a mixing electrode system consisting of at least an anode, a grid supplied

with said local oscillations, a control grid and a cathode, and an oscillatory system consisting of a tube having at least an anode, a grid and a cathode and an oscillatory circuit connected thereto, a neutralizing circuit between said oscillatory circuit and said mixing electrode system, and separate shielding compartments, said oscillatory circuit consisting of a combination of two condensers and in inductance and being connected between the anode and the grid of said oscillatory electrode system, which grid is also connected to the said grid of the mixing system supplied with local oscillations, the cathode of said oscillatory system being connected to the junction point of said two condensers arranged in the oscillatory circuit, said anode and said cathode of the oscillatory system being fed through an impedance which has such a value that the value of the effective resistance of the stray capacity of said oscillatory circuit being the foundation for producing the oscillation is negligibly small in comparison to said impedances in the feed line connection, said oscillatory electrode system and said mixing electrode system being located within said separate shielding compartments.

4. In a short wave superheterodyne receiver means for preventing radiation of the locally generated oscillation by the receiving aerial, a mixing tube including a mixing electrode system consisting of at least an anode, a grid supplied with said local oscillations, a control grid and a cathode, and an oscillatory electrode system consisting of an anode, a grid and a cathode, an oscillatory circuit connected to the oscillatory electrode system, a neutralizing circuit between said oscillatory circuit and said mixing electrode system, and a spacious shielding casing said oscillatory circuit consisting of a combination of two condensers and an inductance and being connected between the anode and the grid of said oscillatory electrode system, which grid is also connected to the said grid of the mixing system supplied with local oscillations, the cathode of said oscillatory system being connected to the junction point of said two condensers arranged in the oscillatory circuit, said anode and said cathode of the oscillatory system being fed through an impedance which has such a value that the value of the effective resistance of the stray capacity of said oscillatory circuit being the foundation for producing the oscillation is negligibly small in comparison to said impedances in the feed line connection, said two condensers of the oscillatory circuit being located inside said spacious shielding casing and spaced well away from the other circuit elements inside the casing and being operated from outside the casing by means of a common insulated shaft.

5. In a short wave superheterodyne receiver means for preventing radiation of the locally generated oscillation by the receiving aerial, a mixing tube including a mixing electrode-system consisting of at least an anode, a grid supplied with said local oscillations, a control grid and a cathode, and an oscillatory electrode system consisting of an anode, a grid and a cathode, an oscillatory circuit connected to the oscillatory electrode system, a neutralizing circuit between said oscillatory circuit and said mixing electrode system, said oscillatory circuit consisting of a combination of two condensers and an inductance and being connected between the anode and the grid of said oscillatory electrode system, which grid is also connected to the said grid of the mixing system supplied with local oscillations, the cathode of said oscillatory system being connected to the junction point of said two condensers arranged in the oscillatory circuit, said anode and said cathode of the oscillatory system being fed through an impedance which has such a value that the value of the effective resistance of the stray capacity of said oscillatory circuit being the foundation for producing the oscillation is negligibly small in comparison to said impedances in the feed line connection, said neutralizing circuit containing a variable condenser, said condenser being constructed as a shielded condenser with an earthed intermediate layer by which the coupling effect is made variable.

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