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SUPERHETERODYNE RECEIVER
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Fig. 1

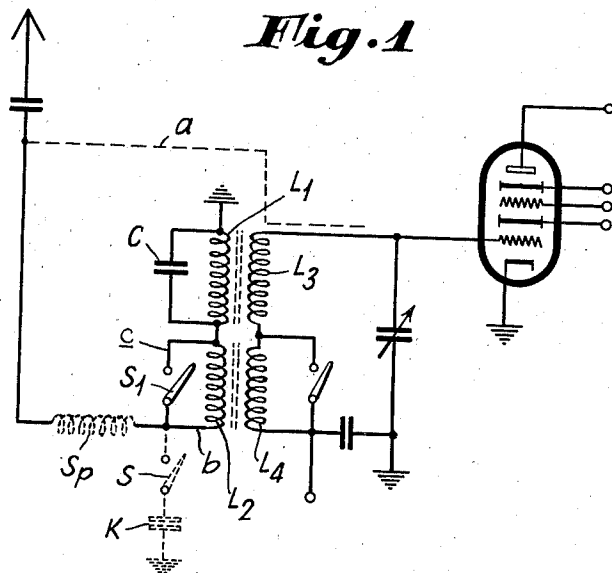


Fig. 2

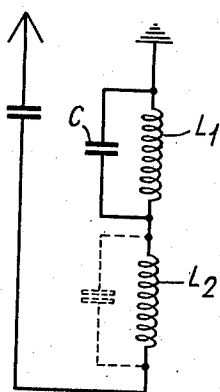
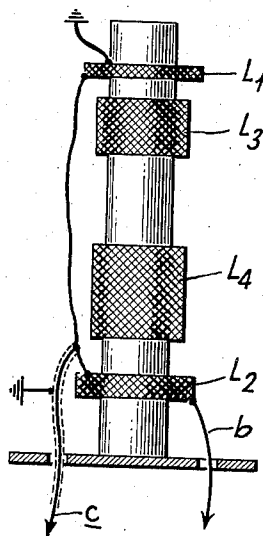


Fig. 3



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SUPERHETERODYNE RECEIVER

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3 Claims. (Cl. 250—20)

The invention is concerned with input circuit organizations for superheterodyne receiver apparatus, and its chief object is to eliminate disturbing actions due to image frequencies inside the long-wave range or band. Other objects of the invention will be apparent from the following detailed specification when read in conjunction with the appended drawing. In the drawing, Fig. 1 illustrates a coupling arrangement in a superheterodyne circuit wherein a prior art image suppression scheme is shown in dotted lines and the arrangement according to the invention shown in heavy lines; Fig. 2 illustrates a simplified form of the invention; and, Fig. 3 illustrates one preferred assembly of the coils. It will be seen that inside the long-wave band the frequencies of the medium-wave band act as image frequencies if the I. F. (and this is usually the case) is positioned between the two receiving bands. According to the earlier art it has been customary to connect simultaneously with the change to the long-wave band, a stopper or rejector between the antenna and the receiver consisting of the coil S_p and the condenser K indicated by the dash-lines in Fig. 1. In case of medium-wave reception, switch S was opened so that the coil S_p then acted merely as a loading (lengthening) coil. However, the said stopper, as a general rule, does not yet suffice so that it was necessary to resort to a compensating circuit scheme by placing the lead a shown in Fig. 1 and connected with the antenna circuit in the neighborhood of the control grid lead. In this manner, by virtue of capacitive coupling, the image frequency voltages reaching the grid circuit by way of inductive coupling were neutralized. However, such a balanced state was difficult to realize in practice because the adjustment to this condition is rather delicate and critical.

Now, by the ways and means disclosed in the invention, the problem of elimination of the image frequencies is substantially simplified. The invention may be used in connection with superheterodyne receivers comprising inductive antenna coupling means, and a plurality of receiving bands or ranges obtainable by short-circuiting or disconnecting additional coils, and the same consists in so dimensioning the antenna circuit, especially in the presence of high inductance antenna coupling in the receiving band in which the image frequencies are troublesome, by raising the self-capacitance of the other antenna coupling coil or coils (which inside this band do not act as additional coils), or by paral-

leling a capacity to the other coupling coil or coils, that no rise of resonance of the image frequencies as a result of series resonance in the antenna circuit will be occasioned.

In the circuit scheme Fig. 1, the capacity thus added is indicated by heavy lines at C . In the absence of the said capacity, as shall be explained by reference to Fig. 2, a state of series resonance arises which lies inside, or close to the outside of the image-frequency range. The result is that at this resonance frequency and the adjacent frequencies there arises a very strong short-circuit current in the antenna circuit, at these frequencies, and the result is that the latter, by inductive ways and means, are liable to become transferred to the grid circuit, and this causes disturbances by the image frequencies. The coupling coil L_2 in Fig. 2, as will be understood, acts capacitively for high frequencies and thus also for the image frequency, especially when it is proportioned for high-inductance coupling (for instance, 8 millihenries) so that conjointly with its self-capacitance (say, 5 micro-microfarads) it has a comparatively low natural period (say, 800 kc. corresponding to a wave of 380 meters). When the antenna coupling is of low inductance, this case arises when the self-capacitance of the coupling coil is high. But the coil L_1 , in the absence of the added condenser C , exercises an inductive action for the image frequency, even if dimensioned for a high-inductance antenna coupling, for in the case of long-wave reception the antenna capacity is no longer in parallel relation to the coil L_1 , with the result that the natural resonance point of the coil L_1 together with its self-capacitance comes to lie above the signal frequency band, whereas, in the presence of a short-circuited coil L_2 , in other words, when the medium-wave band is received, the natural resonance lies below the signal frequency or receiving band (where there exists a high-inductance coupling), because of the antenna capacity being then connected in parallel.

Thus, inasmuch as the coil L_2 conjointly with the self-capacitance acts capacitively and the coil L_1 inductively so far as the image frequencies are concerned, conditions for series resonance are present. While it is true that this condition could be diminished or shifted either by coming, or by altering the values or data of the coupling coils, it will be understood that other undesirable effects will then arise and be put up with, such as loss of signal strength.

Now, in practicing the idea underlying the invention, the self-capacitance of the coil L_1 is

artificially raised, or else a capacity is connected in parallel relation thereto being of a dimension such that the paralleling of L_1 and C has a capacitive effect so far as the image frequencies are concerned.

5 The fact that the shunt capacity of the coil L_1 is raised as a result of the addition of capacity C will not prove troublesome for reception inside the medium-wave band, for the reason that this capacity, since the switch S_1 is then closed, is
10 connected in shunt to the antenna capacity. Hence, capacity C may be provided in such a way that the lead c , Fig. 1 is shielded, with the shield being grounded as shown in Fig. 3. To be sure,
15 this is feasible only in the case where the blocking filter shown by the dash-line, Fig. 1, is absent for the reason that the capacity C , in medium-wave reception, would replace the capacity K . In other words, if a stopping filter is provided,
20 means must be provided to disconnect the capacity C .

Practical research has shown that where the object of the invention is carried into practice, the conditions and chances for compensation of
25 the image frequencies have become more favorable. In the presence of proper polarity of the antenna coupling coil, the transfer of image frequencies, which will always arise by virtue of inevitable capacitive coupling between the coils,
30 can be obviated by an oppositely acting inductive coupling. In addition to proper polarity, what is also important is to choose the size of the condenser C in such a way (say, around 20 to 50 micro-microfarads) that a compensatory action
35 is produced. It is expedient to choose the capacity C of such size that the active capacity of the parallel scheme C , L_1 will be higher than the active capacity of L_2 (say, around 5 micro-microfarads), with the result that the major part of
40 the potential stays at the coil L_2 , and that the capacitive transfer to the grid lead by virtue of voltage division is lessened.

In a trial construction as shown in Fig. 3, for the same sense of winding of the antenna and
45 the grid coils, it is found that the beginning of the medium-wave antenna coil must be connected to ground, and the end of the corresponding grid circuit coil must be connected with the grid.

50 In the practical construction of the coil assembly, attention must be paid so that lead b in Figs. 1 and 3 at which the full image frequency potential becomes active is made as short as feasible and is laid inside the canned coil lest spurious
55 couplings might arise to the other coils.

The practical adoption of the invention offers this further merit that the entrance of oscillator

waves into the antenna circuit is prevented seeing that the oscillator potential which reaches the receiving circuit through the control grid and thence the coupling coil L_1 is grounded through the added capacity C ; in other words, the chances of its reaching the antenna by way of the coil L_2 and thus the risk of its disturbing other receivers by antenna radiation will be lessened.

Actual tests have demonstrated that in a circuit organization as here disclosed the suppression of image frequency waves is perfectly equivalent to what is secured by circuit schemes known in the prior art, although the amount of circuit means is far less.

I claim:

1. In a superheterodyne receiver arranged for operation over a first band of frequencies the images of which lie within a second band of frequencies, an antenna circuit for said receiver including means for providing said antenna circuit with a principal resonance frequency which is below said first band of frequencies, said last named means having inherent capacity which gives the antenna circuit a secondary resonance frequency which is higher than said first band of frequencies, means for insuring that said secondary resonance frequency falls below said second band of frequencies comprising additional capacity shunted across said inherent capacity in said antenna circuit, said additional capacity being sufficiently large so that together with said inherent capacity the secondary resonant frequency is reduced below the lower limit of said second band.

2. In an arrangement as described in claim 1 a tuned secondary circuit for coupling the antenna circuit to the receiver and direct capacity coupling from the antenna to the tuned circuit, said last named coupling acting to oppose in said tuned circuit image frequency voltage transferred to the tuned circuit through the first named coupling between the antenna and the tuned circuit.

3. In an arrangement as described in claim 1 an input circuit for said receiver including a tuned secondary circuit inductively coupled to the antenna circuit, a direct capacity coupling from the antenna circuit to said tuned circuit said last named coupling being arranged to transfer image frequency voltage from the antenna circuit to the tuned circuit in opposition to the image frequency voltage transferred to the tuned circuit through the inductive coupling between the antenna and the tuned circuit.

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