

Feb. 10, 1942.

J. STEINMETZ

2,272,589

REGENERATIVE WAVE BAND FILTER

Filed April 11, 1939

2 Sheets-Sheet 1

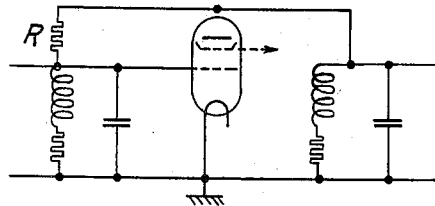


Fig. 1

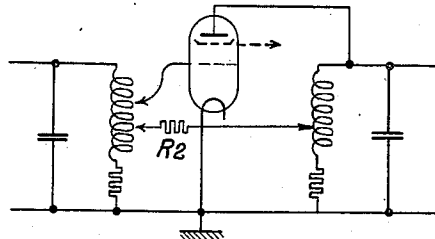


Fig. 2

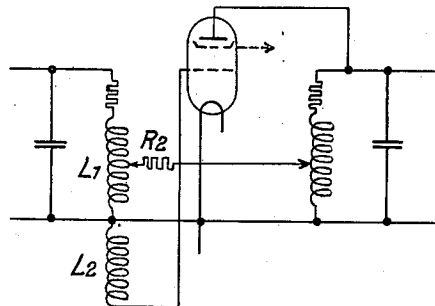


Fig. 3

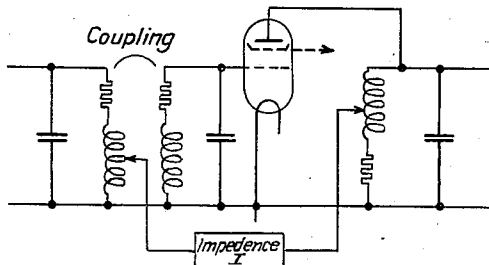


Fig. 4

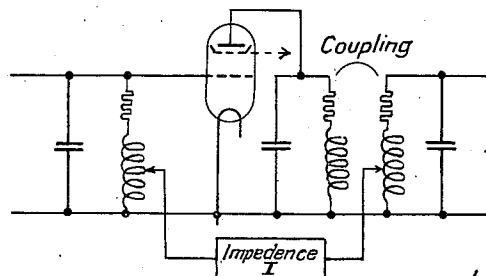


Fig. 5

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2 Sheets-Sheet 2

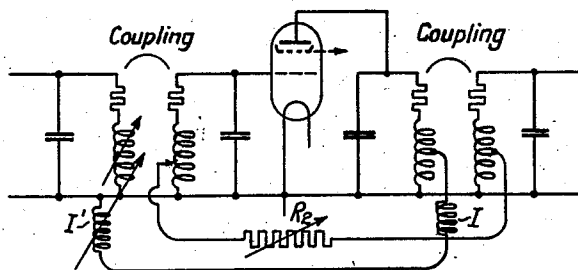


Fig. 6

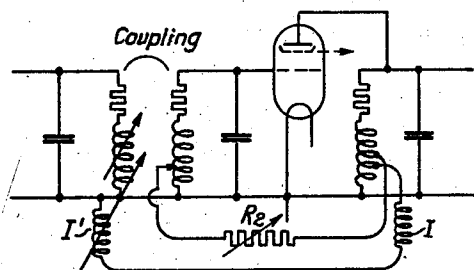


Fig. 7

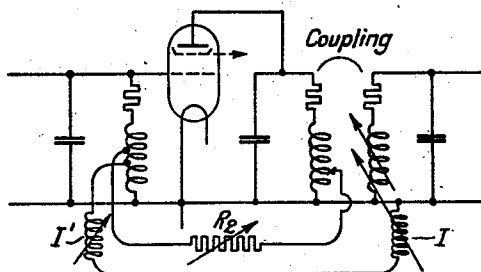


Fig. 8

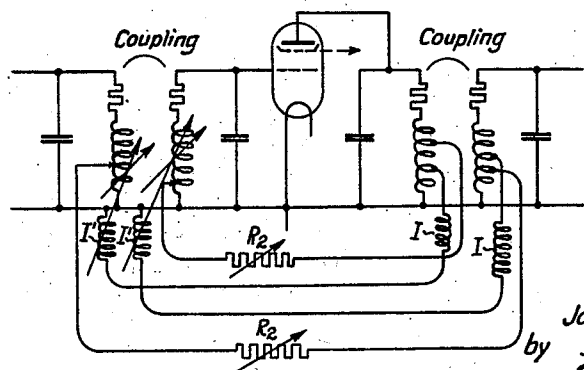


Fig. 9

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UNITED STATES PATENT OFFICE

2,272,589

REGENERATIVE WAVE BAND FILTER

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Application April 11, 1939, Serial No. 267,219
In Germany April 7, 1938

1 Claim. (Cl. 178—44)

This invention relates to regenerative wave-band filters, the band-width of which may be varied by changing the feedback.

It belongs to common technical knowledge that wave-band filters may be produced by introducing a counter-coupling, such as a negative feedback, in high frequency double circuit amplifiers. As a matter of fact, the higher the amount of feedback is made in this type of amplifier, the wider is the amplified wave-band and, moreover, on exceeding the critical amount of coupling, the larger is the break-in attained in the band filter characteristic.

My invention consists of certain features of novelty which will be readily understood from the following description and be pointed out in the appended claim, reference being had to the accompanying drawings, in which—

Figs. 1 and 2 diagrammatically show two circuit arrangements known in the art, while the Figs. 3 to 9 show a number of circuit diagrams for putting my invention into effect.

In the known circuit arrangement embodied in Fig. 1, the amount of coupling is adjusted either by varying a resistance R interposed between the grid circuit and the plate circuit of a thermionic tube, or by varying the slope of the tube characteristic. The last mentioned possibility is realized by changing the grid bias of the tube and involves the advantage that the width of the band filter may be varied by means of a direct voltage regulation. However, the circuit arrangement shown in Fig. 1 suffers under the disadvantage that the inherent capacity of the resistance R considerably increases the anode-to-grid capacity of the tube, which increase in turn renders the filter characteristic curve strongly asymmetric. The deleterious effect involved by the anode-to-grid capacity might be slightly reduced by means of a secondary coupling through a resistance R_2 shown in Fig. 2, but even this expedient has failed to provide the desired satisfactory results.

It is proposed according to my invention to overcome the heretofore mentioned disadvantages by employing a circuit arrangement as shown in Fig. 3. This arrangement is distinguished from that shown in Fig. 2 by an additional coupling coil L_2 being closely coupled to an inductance coil forming part of the grid circuit of the tube. The effect thus obtained is that the feedback instead of introducing attenuation acts in a gain involving sense with the result that the width of the wave band decreases with higher feedback. The sense of regulation is thus op-

posite to that described in connection with Fig. 1 so that an increased selectivity is obtained.

The deleterious effect of the additional inherent capacity of the coupling resistance may be completely eliminated according to a further feature of my invention by circuit arrangements as illustrated in the Figs. 4 and 5, in which the regulation is effected by changing the feedback in the same manner as heretofore described, that is, either by varying the coupling resistance, or by changing the slope of the tube characteristic in response to a variable biasing potential applied to the grid of this tube. Due to the fact that a phase displacement of ± 90 degrees takes place in the wave-band filter, the impedance element I shown in these figures must be purely capacitive or purely inductive in order to attain a symmetric filter characteristic. Dependent upon the polarity of the inductance coils and whether the impedance element I is an inductance or a capacity, the feedback acts in an attenuating or in a gain involving sense.

The Figs. 6 to 9 show further circuit arrangements representing further developments of my invention. The various couplings, whether ohmic or inductive, are indicated by arrows. In the arrangement of Fig. 6 positive feedback may be obtained through resistance R_2 , and negative feedback may be obtained through impedances I and I' or both feedbacks may be positive. Fig. 7 shows an arrangement utilizing negative feedback through both R_2 and the impedances I and I' . The feedback through I and I' may, however, be positive. In Fig. 8 I have shown an arrangement for producing negative feedback through R_2 and positive feedback through impedances I and I' . Fig. 9 illustrates a combination of the types of feedback shown in Figs. 6–8 and in this case has negative feedback through resistances R_2 and positive feedback through impedances I and I' . By simultaneously varying both feedback paths the band width may be maintained constant while the filter characteristic is varied. It is by no means necessary to concurrently use the entire number of coupling possibilities shown since the desired result will be obtained by employing any of the couplings indicated. Also in these embodiments of my invention feedback may act in an attenuating or in a gain introducing sense, and the width of the wave-band may be increased or decreased dependent upon the phase adjustment of the feedback. Moreover, both kinds of feedback may simultaneously be used in each of the circuit arrangements referred to in the last paragraph,

in which case a filter device is obtained in which the wave-band characteristic may be varied while maintaining constant the width of the band.

What is claimed is:

In a one stage wave band filter having symmetric characteristics, comprising a vacuum tube having an anode, a grid and a cathode, an input circuit having one terminal connected to said cathode, an inductance having one terminal connected to said cathode and the opposite terminal connected through a resistance to the opposite side of said input circuit, a second inductance

5 closely coupled to the first mentioned inductance having one terminal connected to said grid and the opposite terminal to said cathode, an anode circuit comprising an inductance connected through a resistance to said anode and a feed-back circuit including a resistance adjustably connected to the first mentioned inductance, and the output inductance, the arrangement being such that the amount of feedback is adjustable and the width of the wave band decreases as the feedback is increased.

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