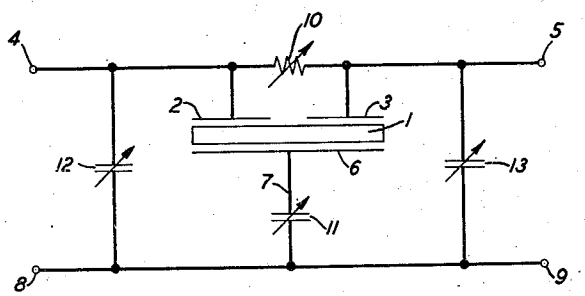
Jan. 11, 1949. A. R. D'HEEDENE 2,459,019

PIEZOELECTRIC CRYSTAL FILTER

Filed Dec. 27, 1946



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Patented Jan. 11, 1949 2,459,019

UNITED STATES PATENT OFFICE

2,459,019

PIEZOELECTRIC CRYSTAL FILTER

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Application December 27, 1946, Serial No. 718,687

5 Claims. (Cl. 178—44)

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This invention relates to wave transmission networks and more particularly to wave filters which use piezoelectric crystals as impedance elements.

The object of the invention is to increase the height and sharpness of an attenuation peak in a wave filter.

The wave filter in accordance with the present invention is of the band-elimination type, that is, one having an attenuation band on each side of which is a transmission band. The filter comprises a piezoelectric crystal and a resistor. The crystal is dimensioned to be resonant at a frequency within the attenuation band and has two electrodes associated with one major face and a third electrode associated with the opposite face. One of the two electrodes is connected to an input terminal of the filter and the other to an output terminal. The third electrode is connected through a common shunt path to the remaining input and output terminals. The resistor is connected between the electrodes on the one side and given an ohmic value such as to balance the effective resistance of the crystal at the resonant frequency. There is thus provided a comparatively narrow, sharply peaked attenuation band centered approximately at that frequency. A capacitor, preferably variable, may be connected in the shunt path to adjust the location of the attenuation peak. Additional capacitors may be connected in shunt at the ends of the filter to lower the image impedances, if desired.

The nature of the invention will be more fully understood from the following detailed description and by reference to the accompanying drawing, the single figure of which is a schematic circuit showing one embodiment of a band-elimination wave filter in accordance with the invention.

In the embodiment shown, the filter comprises a piezoelectric crystal 1 dimensioned to be resonant at a frequency f within the band to be attenuated. Associated with one major face of the crystal 1 are two electrodes 2 and 3 which are connected, respectively, to an input terminal 4 and an output terminal 5. An electrode 6 associated with the opposite face of the crystal 1 is connected through a common shunt path 7 to the remaining input terminal 8 and output terminal 9.

A resistor 10, which may be variable, is connected between the electrodes 2 and 3 and given a value approximately equal to four times the effective resistance of the crystal 1 at the frequency f with full plating on each side. In this way the resistance of the crystal 1 is balanced out in the filter circuit and there is provided a comparatively narrow, sharply peaked attenuation band centered approximately at the frequency f, with adjacent transmission bands on each side thereof.

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It may be found that the attenuation peak is slightly displaced from the frequency f due to the presence of stray capacitance, such as that between the electrodes 2 and 3. However, a capacitor 11, preferably variable, may be added in the common shunt path 7 to provide a precise adjustment of the frequency of this peak.

If the image impedances of the filter are too high for proper operation between the desired load impedances they may be lowered by adding the shunt capacitors 12 and 13 at the ends of the filter. For an impedance match with the filter the load impedance should have a value approximately equal in magnitude to the reactance of the end capacitor 12 or 13 at the frequency f.

What is claimed is:

1. A band-elimination wave filter comprising a pair of input terminals, a pair of output terminals, a piezoelectric crystal which is resonant at a frequency within the attenuation band, and a resistor, said crystal having two electrodes associated with one face and a third electrode associated with the opposite face, said two electrodes being connected, respectively, to one of said input terminals and one of said output terminals, said third electrode being connected through a common shunt path to the remaining terminals, and said resistor being connected between said two electrodes associated with said one face and having a value to balance the resistance of said crystal in the neighboring of said resonant frequency.

2. A wave filter in accordance with claim 1 which includes a capacitor connected between said input terminals and a second capacitor connected between said output terminals.

3. A wave filter in accordance with claim 1 in which said resistor has a value approximately equal to four times the effective resistance of said crystal at said resonant frequency.

4. A wave filter in accordance with claim 1 which includes a capacitor in said common shunt path.

5. A wave filter in accordance with claim 1 which includes a capacitor connected between said input terminals, a second capacitor connected between said output terminals, and a third capacitor in said common shunt path.

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