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CRYSTAL FILTER

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FIG. 1

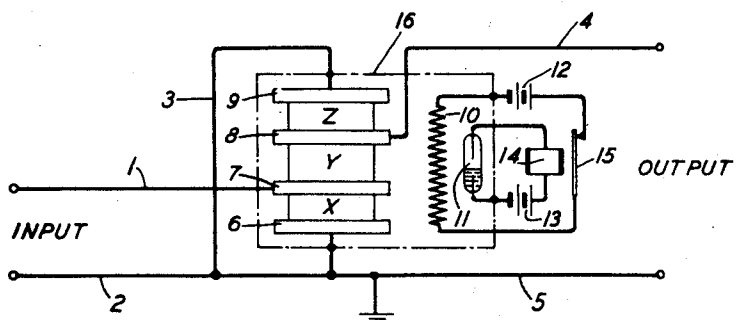
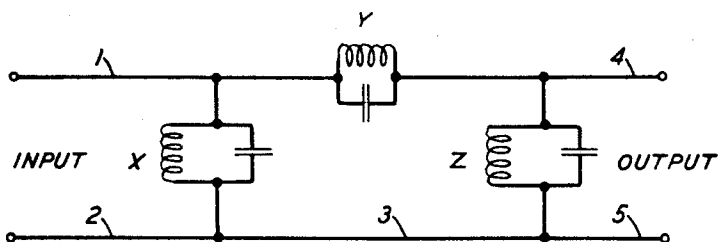


FIG. 2



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CRYSTAL FILTER

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4 Claims. (Cl. 178—44)

This invention relates to crystal filters although it may find use in any place where a multiple crystal assembly is desired.

The object of the invention is to provide a simple crystal assembly which by proper electrical connection may be used as a multi-section electrical network.

This is accomplished by interconnecting various electrodes in a crystal stack, and connecting the leads from the input and output circuits to suitable electrodes in order to provide the electrical characteristics desired.

A feature of the invention is the simplicity which such an assembly offers for temperature control of the crystals used.

Other objects and features of the invention will be apparent from the detailed description when read in connection with the attached drawing in which:

Fig. 1 illustrates a physical and electrical embodiment of the invention; and

Fig. 2 illustrates diagrammatically the equivalent electrical circuit of the crystal stack of Fig. 1.

In Fig. 1 is shown a stack of crystals X, Y, and Z connected between electrodes 6, 7, 8 and 9. The input conductors to the crystal stack are connected to electrodes 6 and 7, and the output conductors 4 and 5 are connected to electrodes 8 and 9. Conductor 3 connects electrode 9 to electrode 6. A constant temperature oven 16 is represented diagrammatically by broken lines. Within this oven is a heating coil 10 in series with a battery 12 and the armature 15 of a relay 14. A temperature responding element 11, such as a mercury-in-glass device, is also mounted within the oven, and is in series with a battery 13 and relay 14. As shown, current is flowing through the heating coil 10. This will cause the mercury in the temperature responding element 11 to rise and make contact with the upper contact point, completing a circuit through the relay 14. The relay 14 will operate its armature 15 to break the heating circuit through the heating coil 10. The walls of the constant temperature oven may be grounded, as shown, and the electrodes 6 and 9 may also be connected to ground. This will eliminate the necessity for the conductor 3, which is shown only for the purpose of more clearly disclosing the electrical relations of these electrodes 6 and 9. One side of the heating coil, and one side of the temperature responding element, may also be grounded, as shown.

The electrical characteristics of a crystal are approximately those of a parallel resonant elec-

trical circuit. In illustrating in Fig. 2 the equivalent electrical circuit of the crystal stack shown in Fig. 1, parallel resonant circuits X, Y and Z have been used in place of the electrically equivalent crystals. It will be seen from this figure that input conductors 1 and 2 are connected across the crystal X. Input conductor 1 is also connected to the lower electrode of the crystal Y and the other side of the crystal Y is connected to the output conductor 4. Crystal Z is connected across the output conductors 4 and 5 crystals X and Z being connected together by the conductor 3.

By the arrangement shown all the crystals may be mounted in a single unit and maintained at constant temperature in a single constant temperature oven. Since the upper and lower electrodes are connected together, the arrangement shown makes it possible to operate such a device with both of these electrodes at ground potential, eliminating the necessity of insulating these electrodes from the casing of the oven, reducing the number of insulated leads to the device, and lessening the danger of short circuits within the apparatus.

What is claimed is:

1. A plurality of piezo-electric crystals arranged so as to have a common axis normal to their electrode faces, electrodes interposed between adjacent crystals, and electrical connections to said crystals, whereby two of said crystals are in shunt and one in series.

2. An electrical circuit comprising a plurality of piezo-electric crystals superposed in stack-like conformation with interposed and end electrodes, and means for interconnecting said electrodes whereby the crystals taken together constitute an electrical filter.

3. An electrical circuit comprising a plurality of piezo-electric crystals superposed in stack-like conformation with interposed and end electrodes, and means interconnecting said electrodes whereby the crystals are in shunt and series relationship in said electrical circuit.

4. An electrical system comprising three piezo-electric crystals in a stack, electrodes interposed between adjacent crystals and outside of the outer crystals, an input circuit connected to the electrodes of the bottom crystal, an output circuit connected to the lower electrode of the bottom crystal and to the lower electrode of the upper crystals, and an electrical conductor connecting the upper electrode of the upper crystal to the lower electrode of the bottom crystal.

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