

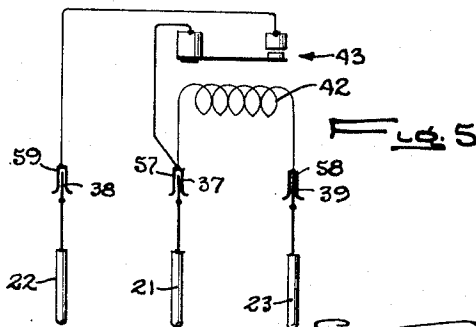
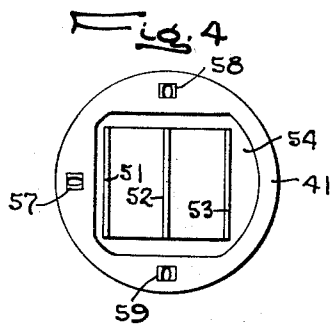
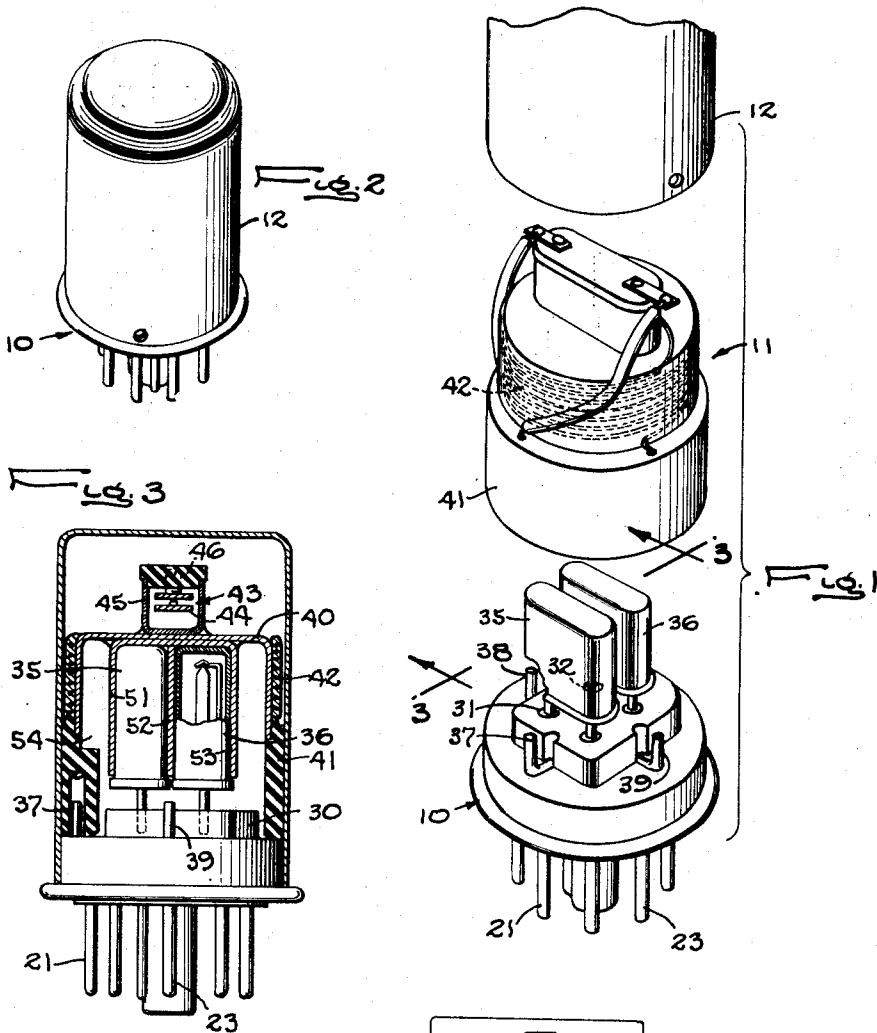
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TEMPERATURE CONTROL UNIT FOR PIEZOELECTRIC CRYSTAL

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TEMPERATURE CONTROL UNIT FOR
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4 Claims. (Cl. 310—9)

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The present invention relates to a thermostatically controlled oven for maintaining a piezoelectric crystal at a predetermined temperature.

It is an object of the invention to provide an improved crystal oven for maintaining a piezoelectric crystal at a predetermined temperature with a high degree of precision in spite of large and sudden changes in the ambient conditions. It is another object to provide an improved crystal oven for use with the standard, commonly employed can type of crystal holder, in which a plurality of such holders, preferably two, may be accommodated.

It is a further object of the invention to provide a novel crystal oven which is simple and inexpensive to construct, which is extremely compact and which, nevertheless, may be easily and quickly disassembled and serviced.

Other objects and advantages of the present construction will be apparent upon reference to the detailed description and the accompanying drawing in which:

Figure 1 is an exploded perspective of the crystal oven constructed in accordance with the present invention.

Fig. 2 shows the appearance of the crystal oven assembled and including a protective cover.

Fig. 3 is a cross section of the crystal oven taken along the line 3—3 in Figure 1.

Fig. 4 is a bottom view of the heater assembly.

Fig. 5 is a schematic diagram of the electrical connections.

While the invention is susceptible of various modifications and alternative constructions and uses, we have shown in the drawings and will herein describe in detail the embodiment of the invention; it is to be understood, however, that we do not intend to limit the invention by such disclosure, but aim to cover all modifications and alternative constructions and uses falling within the scope of the invention as expressed in the appended claims.

Referring to Figure 1, it will be seen that the oven comprises a base assembly 10, a heater assembly 11 and a cover 12. The base assembly is preferably designed to fit in a standard octal tube socket and includes prongs 21—23. The base assembly is preferably formed of moulded phenolic or the like and includes an upraised portion or island 30 having pin sockets 31—34 inclusive. These pin sockets are adapted to receive the contact pins of two crystal holders 35—36 of the well known rectangular can type. Appropriate connections are made from the pin sockets 31—34 to the octal prongs although such connections have been omitted in the drawing for the sake of simplicity. The base assembly

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further includes upwardly projecting posts 37, 38, 39 which are electrically connected to prongs 21, 22, 23 for the purpose of establishing electrical contact with the heater assembly 11.

The heater assembly 11, which is dimensioned to telescope over the crystal holders 35, 36, includes an inverted cup 40 which may be of copper, aluminum or other metal having high thermal conduction. The cup is mounted on an insulating base or rim 41. Wound about the outside of the cup 40 is a heating element 42 preferably insulated and bonded to the cup 40 by a thin layer of thermoplastic material which is stable at normal operating temperatures.

For the purpose of controlling the temperature of the crystal holders 35, 36, a thermostat is mounted in intimate conducting relation to the end surface of the cup 40 and means are provided within the cup for establishing a path of direct heat flow from the thermostat to the crystal holders. As shown in Fig. 3, the thermostat indicated as 43 includes a bimetallic element 44 mounted in a metal enclosure 45 which is soldered or otherwise bonded to the end surface of the cup 40. While an adjustment 46 may be included if desired, the thermostats of the type shown are commercially available and are normally supplied, sealed and calibrated for a desired operating temperature.

Extending downwardly within the cup and intimately fastened to the end surface thereof for example by soldering, are fins 51, 52, 53. Fins 51, 52 are spaced in inverted U-formation so as to closely embrace the crystal holder 35 while fins 52, 53 embrace the crystal holder 36. Preferably fins 51—53 are laterally spaced from the wall of the cup 40 defining an air space 54. Furthermore the fins are made of highly conductive metal and are substantially coextensive with the sides of the crystal holders so that they constitute the primary thermal path between the heating element 42 and the crystal holders.

The connections from the heating coil and the thermostat are brought out to clips 57, 58, 59 (Fig. 4) which engage the contact posts 37, 38, 39 projecting upwardly from the base assembly. The clips have sufficient friction so that the heater assembly 11 is firmly retained on the base assembly 10 in spite of shock or vibration which may be encountered in use.

The crystal ovens of the type disclosed herein have been found to control the temperature and, therefore, frequency drift to a higher degree of precision than comparable ovens commercially available. For example, in tests on the present oven and with the thermostat adjusted to maintain a temperature 20° C. above normal ambient,

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the ambient temperature has been suddenly varied by as much as 150° C. with less than 1° C. change in crystal temperature. Resistance of the unit to thermal shock of this sort has been made the subject of investigation but is still not fully understood. It is believed to be due to a combination of structural features. In the first place, it will be noted that the crystal holders are surrounded almost completely by the coil 42, and the cup 40 upon which it is wound serves as an effective buffer against thermal shock. Thus any change in ambient temperature cannot act directly on the crystals but can only be conducted to the crystals along the same thermal path, namely the cup 40 and the fins attached thereto, which conducts the heat from the coil. Furthermore, it will be noted that substantially all of the heat conducted to the crystals from the fins flows from the region of the thermostat. As a result any change in ambient conditions must first act directly on the thermostat which responds to correct the situation by the opening or closing of the contacts. The thermostat thus anticipates any tendency toward change in the crystal temperature before any actual change occurs so that the crystals are subject to much less temperature fluctuation than the thermostat.

The fins 51, 52 and 53, by closely embracing the walls of the crystal holders and covering almost their entire area, provide extremely intimate coupling between the thermostat and the crystals. While it is true that a certain amount of the heat from the coil 42 will pass to the crystals through the air space 54 as a result of radiation and conduction, the proportion of the heat transferred in this manner appears small as compared to the amount of heat flowing up through the cup 40 and downwardly through the fins.

The oven is protected by the cover 12 which protects the thermostat from drafts and serves as a buffer against thermal shock. It has been found unnecessary to employ the thick layers of insulating material conventionally used in the more accurate types of crystal ovens.

One of the advantages of the arrangement shown is that the heater assembly 11 may be readily pulled off and replaced by a similar unit when servicing becomes necessary. Similarly, the crystal holders 35, 36 may be removed and holders having crystals of different frequency quickly substituted. It will be apparent that the holder is simple and compact, yet capable of being operated under conditions of shock, vibration, and wide temperature swing encountered, for example, in the use of aircraft and military radio apparatus.

We claim:

1. In an oven for a piezoelectric crystal the combination comprising a base having provision for mounting a crystal holder thereon with the crystal holder extending upwardly away from the base, an inverted cup of thermally conductive metal mounted on said base for enclosing said crystal holder, a thermostat thermally bonded to the upper end of said cup, a heating coil wound on said cup and connected for control by said thermostat, and heat conducting fins fastened within said cup in the region of said thermostat and extending downwardly therein for embracing the crystal holder, said fins being spaced from the wall of said cup so that heat is conducted to said crystal holder primarily from the region of said thermostat.

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2. In an oven for a piezoelectric crystal the combination comprising a base having provision for mounting a crystal holder thereon with the crystal holder extending upwardly away from the base, an inverted cup mounted on said base for enclosing said crystal holder, said cup being of thin walled construction and made of metal having good conducting properties, a thermostat thermally bonded to the upper end of said cup, a heating coil wound on said cup and connected for control by said thermostat, and a heat conducting fin fastened within said cup in the region of said thermostat and extending downwardly therein in heat conducting relation to the crystal holder, the cup being so dimensioned as to provide an insulating space between the cup wall and the crystal holder so that heat is conducted to said holder primarily from the region of said thermostat.

3. In an oven for a piezoelectric crystal the combination comprising a base having provision for mounting two crystal holders of the rectangular can type thereon with the holders extending upwardly away from the base and separated slightly from one another, an inverted cup mounted on said base for enclosing said crystal holder, said cup being of thin walled construction and made of metal having good conducting properties, a thermostat thermally bonded to the end of said cup, a heating coil wound on said cup and connected for control by said thermostat, and three heat conducting fins fastened within said cup in the region of said thermostat and extending downwardly therein for straddling the crystal holders, said fins being as dimensioned as to be substantially coextensive with the wall of the adjacent holder and said cup being so dimensioned as to provide an insulating space between the cup wall and the crystal holders.

4. In an oven for a piezoelectric crystal the combination comprising a base assembly and a heater assembly, said base assembly having a socket for the reception of a crystal holder to maintain the same in upright position on the base assembly and having electrical connectors spaced about the periphery thereof, said heater assembly comprising an inverted cup having a heating coil wound about the wall of the cup and a thermostat mounted on the upper end of the cup, said cup being of thin walled construction and made of metal having good conducting properties, a rim of insulating material continuously engaging the lower edge of the cup for reinforcing the same and having separable electrical connectors and connected to said coil and said thermostat and spaced to engage the connectors on said base when said heater assembly is positioned thereon, and heat conducting fins thermally bonded to the end of said cup and extending downwardly therein for embracing said crystal holder and supplying heat thereto.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,940,599	Morrison	Dec. 19, 1933
1,967,184	Clapp	July 17, 1934
2,438,345	Miller	Mar. 23, 1948
2,470,134	Bitner	May 17, 1949