

Sept. 26, 1961

G. A. VOGT
CRYSTAL OVENS

3,002,117

Filed July 16, 1959

2 Sheets-Sheet 1

FIG. 1

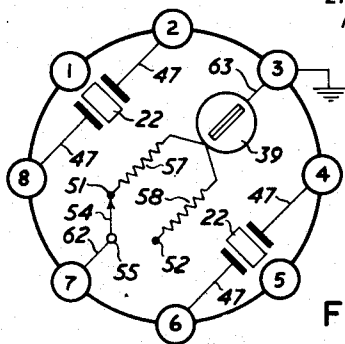
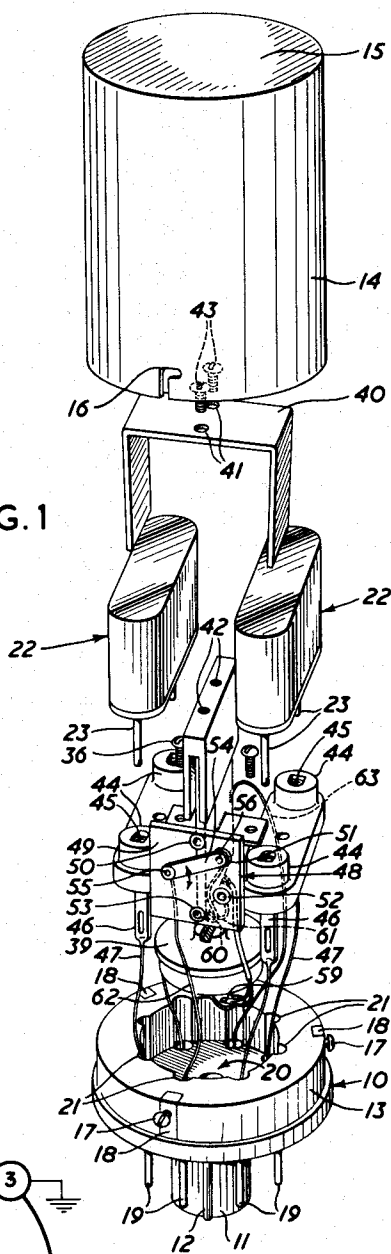


FIG. 3

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2 Sheets-Sheet 2

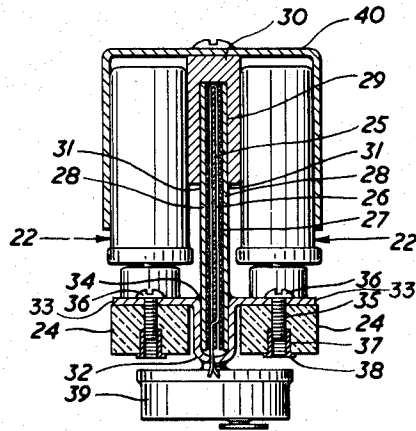


FIG. 2

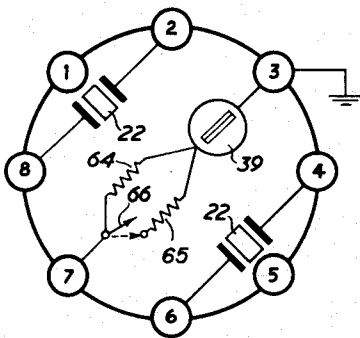


FIG. 4

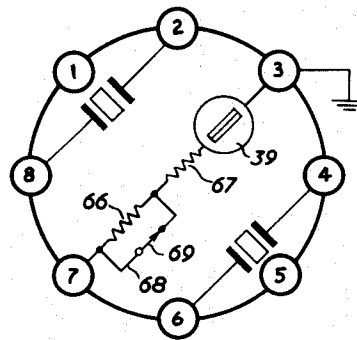


FIG. 5

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1

3,002,117

CRYSTAL OVENS

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Filed July 16, 1959, Ser. No. 827,651

14 Claims. (Cl. 310—9)

This invention relates to crystal ovens for maintaining piezo-electric crystals at a substantially constant temperature during operation.

The operating characteristics of piezo-electric crystals vary with temperature and in order to maintain their operating characteristics constant it is necessary to keep the crystals at a substantially constant temperature. Conventionally this has been done by enclosing the crystals in an enclosure known as a "crystal oven" which also contains an electrical heater controlled by a thermostat. The operation of the heater is controlled by the thermostat to maintain the crystal at a substantially constant predetermined temperature.

The present invention is particularly applicable to crystal ovens for use in the receiving and transmitting radio sets carried in automobiles, for example in taxicabs. Until comparatively recently most automobiles in North America operated with a six volt electrical system but a few years ago a change was made so that automobiles now being manufactured have twelve volt electrical systems. There is, however, a considerable number of automobiles with six volt electrical systems still in use and also some European manufacturers make automobiles which have six volt electrical systems. It is therefore necessary either to provide crystal ovens for use in the radio sets of automobiles and capable of operating upon either six or twelve volts or, alternatively, to make two types of crystal ovens, one type being capable of operating on six volts and the other type being capable of operating on twelve volts.

Many manufacturers and distributors of radio communications equipment have found it inconvenient and undesirable to stock an inventory of ovens for each voltage. In the attempt to circumvent this several approaches have been taken.

One approach is to design the oven and chassis so that the oven may be plugged into the chassis in either of two positions, one for six volt use and the other for twelve. The main problem here is one of versatility since the oven and chassis must be mated and cannot be used interchangeably with other chassis and ovens.

Another approach, widely used, has been to design ovens for a "compromise" voltage, e.g. for nine or ten volts in the six to twelve volt range. The difficulties here are manifold and include poor warm up at six volts, excessive current drain at twelve volts, short thermostat life, temperature shift with voltage change, and poor stability.

It is an object of the present invention to provide an improved crystal oven capable of operating upon two different voltages, normally six and twelve volts, and interchangeable with ovens designed for only a single voltage.

It is a further object of the invention to provide an oven that is highly stable and has a long life though operable at more than one voltage.

It is a further object of the invention to provide a

2

crystal oven wherein the crystal is heated substantially wholly by conduction of heat.

The invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is an exploded perspective view of one embodiment of a crystal oven according to the invention;

FIGURE 2 is a transverse section of the operative portion of the oven; and

FIGURES 3, 4 and 5 show diagrammatically alternative electrical wiring circuits for the heating elements.

Referring now to FIGURE 1, the crystal oven there shown comprises a base indicated generally at 10 and having a depending spigot 11. The base is similar to the conventional octal vacuum tube base and the depending spigot 11 has a guide ridge 12 formed thereon to mate with a guide slot in a conventional octal socket. The base has a recessed upper portion 13 arranged to be embraced by a cover 14 which is stamped from aluminum so as to be cylindrical in form with a closed end 15. Three right-angled slots 16 are spaced peripherally around the lower portion of the cover 14 and mate with screws 17 in the recessed portion of the base to form a bayonet fitting whereby the cover may be releasably attached to the base. The base is molded from insulating material and has three metal inserts 18 which are molded in position and support the screws 17.

Depending from the underside of the base 10 are eight terminal pins 19 equiangularly spaced around the periphery of the base in known manner. The pins are hollow and open into a cylindrical recess 20 in the upper portion of the base. The circumferential wall of the recess is relieved above each pin 19 as indicated at 21 to facilitate the entry of electrical connecting wires into the interior of the pins.

Mounted within the enclosure formed by the cover and the base when they are inter-connected are two plug-in crystals indicated generally at 22, each crystal being shrouded in a metal case and having a pair of depending connecting prongs 23. The prongs of each crystal are received in a ceramic socket 24 of which there are two, one for each crystal, the sockets with their associated parts now to be described forming crystal mounting means.

Referring now to FIGURE 2, disposed between the crystals 22 and sockets 24 is a heater assembly. This assembly consists of a mica sheet 25 around which are wound two separate heating coils 26 of Nichrome wire. The heating coils and mica-former are then insulated, as indicated at 27, with a strip of Permacel tape. This tape is made by Dow Corning Limited and consists of fibreglass tape coated with a thermoplastic silicone cement. The assembly of the tape 27, the former 25 and the windings 26 form the center, as it were, of a sandwich, the outside layers of which are formed by two steel plates 28. The plates are conveniently made from steel sheet and are between 12 and 15 thousandths of an inch thick. One end of the whole sandwich is then received within a slot 29 in a block of steel 30 which forms a thermal sink. It will be seen from FIGURE 1 that the block 30 is somewhat wider than the sheets 28 and overlaps the sheets at their edges. The sheets are soldered to the underside of the block 30 at 31 so that the whole forms a unitary assembly.

The lower end of the sandwich is embraced by a U-shaped clip 32 having laterally projecting arms 33, the clip 32 being soldered to the plates 28 at 34. Each lateral arm 33 is provided with an aperture which is adapted to line up with an aperture 35 in one of the ceramic sockets 24. A screw 36 passes through the hole in each arm and into the hole 35 of a socket 24 and is retained in position by an internally screw-threaded collar 37 mounted in the aperture 35. Each collar 37 has a flange 38 which bears against the bottom of the ceramic socket.

Soldered to the lower portion of the U-shaped clip 32 is a thermostat indicated generally at 39. Preferably the thermostat is of the snap-acting type, having a bi-metallic disc which "oil-cans" with temperature change and thus has very positive opening and closing of the electrical contacts. It will be seen from FIGURE 1 that the thermostat is substantially circular and is of a convenient size to fit within the recess 20 of the base 10.

The crystals 22 are embraced by a U-shaped bracket 40 having apertures 41 in its upper surface. Apertures 42 are formed in the upper surface of the block 30 and are internally screw threaded to receive screws 43 whereby the U-shaped bracket 40 may be maintained in place. The depending legs of the U-shaped bracket when free are arranged to converge slightly towards one another and when the bracket is mounted to embrace the crystals 22, as shown in FIGURE 2, the metal shrouds of the crystals are forced into contact with the block 30 forming the thermal sink. The shrouds are also in contact with the U-shaped bracket 40 which is itself in contact with the top of the thermal sink so that heat may pass by conduction from the thermal sink to both sides of the crystal shrouds.

Turning now to the electrical connections, each ceramic socket is provided with a pair of up-standing bosses 44 within each of which is mounted a metallic sleeve 45 having a depending lug 46; the sleeves are adapted to receive the prongs 23 of the crystal. Soldered to each lug 46 is an electrical connecting wire 47 which passes downwardly and into the interior of a terminal pin 19. It will be seen that there are four such sockets and lugs and therefore four wires pass from the crystals downwardly to the terminal pins. The wires are soldered to the pins and serve to connect the crystal assembly to the base.

Switch means, generally indicated at 48 is soldered to the edges of the steel plates 28. The switch means comprises a thin plate 49 of insulating material having four eyelets 50, 51, 52 and 53 passing therethrough. The eyelets 50 and 53 are soldered to the edges of the plates 28 thereby securing the plate 49 to the plates 28. A switch arm 54 is pivotally mounted at 55 onto the plate 49 and has at its free end a pip or depression 56 which is capable of entering and making contact with either of the eyelets 51 or 52 as desired.

Referring now to FIGURE 3, the crystals are indicated diagrammatically at 22 and it will be seen that one crystal is connected by its wires 47 between terminals 2 and 8 on the base whereas the other crystal is connected between terminals 4 and 6 of the base. The heating means, consisting of the switching means 48, the heating coils and the thermostat 39, is connected between terminals 3 and 7. The heating coil for twelve volt operation is indicated at 57 whereas the heating coil for six volt operation is indicated at 58. It will be seen that one end of each heating coil is connected to the thermostat and the wires making this connection are indicated in FIGURE 1 at 59. The other ends of the heating coils are connected to eyelets 51 and 52 respectively as indicated, thus in FIGURE 1 the wire joining the eyelet 51 to the twelve volt heating coil is indicated at 60 whereas the wire connecting the eyelet 52 to the six volt heating coil 58 is indicated at 61. A wire 62 connects the pivot point 55 of the arm 54 to the terminal 7 and

the other side of the thermostat is grounded and connected to the plates 28 by the soldering of the thermostat to the plates 28; a wire 63 connects the plates 28 to the grounded terminal 3.

Operation of the crystal oven is as follows: the crystals 22 are plugged into the sockets in the ceramic holders 24 and are retained in position by the U-shaped bracket 40 and screws 43. With the arm 54 in the position shown in FIGURES 1 and 3, the heating coil or element 57 for operation on twelve volts is connected in circuit between terminals 3 and 7. When the oven is therefore plugged into an appropriate socket in a radio set, filament current will flow along the wire 62, along the arm 54, through the heating coil 57, the thermostat 39, and the wire 63 to ground. The heating coil will heat up and will heat the plates 28, and the thermal sink 30. Heat will pass by conduction directly from the thermal sink 30 to the metal shrouds of the crystals 22 and also along the arms of the U-shaped bracket 40 to the outer surfaces of the metal shrouds. Heat will also pass by conduction from the thermal sink down the plates 28 to the thermostat 39. When the thermostat reaches a pre-set temperature it will open, thus interrupting the circuit through the heating coil 57 which will then cease to operate. When the temperature of the thermostat falls below its predetermined level, the thermostat will close and the heating coil will again be brought into circuit.

There will be a temperature gradient along the plates 28 and therefore the temperature at which the thermostat is to operate will be chosen so that the crystals will be at the desired temperature when the thermostat opens.

Normal temperatures at which it is desired to maintain crystals are 75° C., 85° C. or 87½° C. The amount of heat conducted to the thermostat can be altered by changing the dimensions of the plates and/or the material from which they are made. Thus if the plates are made thicker more heat will reach the thermostat or, if the plates are made of a material having a greater conductivity than steel, for example copper or brass, the thermostat will receive more heat than it would were the plates of the same dimensions and made of steel. It is thus possible to correlate the temperature at which the thermostat will operate with the temperature of the crystals to obtain the desired results.

If the crystals are to be used in a circuit having a six volt filament current then the arm 54 is moved from the position shown in FIGURE 1 until the pip or depression 55 is in contact with the eyelet 52. In this case the heating coil or element 58 will be in circuit instead of the heating coil 57 but otherwise the operation of the oven would be identical to that above described.

In FIGURES 1 and 3 have been shown two heating coils 57, 58 which may be selected to work off the desired voltage. Other arrangements of heating coils are shown in FIGURES 4 and 5. Referring to FIGURE 4, two heating coils 64 and 65 are shown. The heating coil 64 is always in circuit between the terminals 3 and 7 of the base through the thermostat 39. Heating coil 65 may be brought into circuit by movement of a switch 66 from the position shown in full lines to the position shown in dotted lines. When the switch 66 is closed the heating coils 64 and 65 will be in parallel. The heating coil 64 will be used for twelve volts and the combined heating coils 64, 65 will be used for six volts. It will be appreciated that the heating element for twelve volts is the coil 64 whereas the combined coils 64, 65 may be considered to be the heating element for six volts.

A further arrangement of heating coils is shown in FIGURE 5 in which two heating coils 66 and 67 are connected in series with each other and with the thermostat between the terminal pins 7 and 3 of the base. A short-circuit line 68 is connected around the coil 66 and is provided with a switch 69. When switch 69 is closed, as shown in FIGURE 5, only the heating coil 67 is in

5

operation and this is used for a six volt supply. If the switch 69 is open, then the heating coils 66 and 67 act in series for a twelve volt system. The heating element for six volts is the coil 67 and the heating element for twelve volts can be considered as a combination of the coils 66 and 67.

The switching means for either of the arrangements shown in FIGURES 4 and 5 would be similar to that shown in FIGURE 1, i.e. a plate of insulating material would be attached to the plates 28 and would have eyelets thereon and a switch arm. Operation of the oven would be the same as heretofore described.

It will be seen that the invention provides a crystal oven which may be inserted into a conventional octal socket in a radio set in only one position whereby incorrect insertion by inexperienced persons is avoided. Moreover inexperienced persons are unlikely to remove the cover of the oven and change the switch so that the oven of the present invention is less liable to misconnection than ovens previously proposed. Furthermore, although the oven has been described as having two crystals, it is within the scope of the invention to provide crystal ovens which mount only a single crystal or which mount multiple miniature crystals for example six, eight or ten miniature crystals. The oven might well be sold as an article of commerce without the crystals actually inserted therein, the purchaser supplying and mounting crystals of his choice.

It will be understood that the form of the invention herewith shown and described is a preferred example and various modifications can be carried out without departing from the spirit of the invention or the scope of the appended claims.

What I claim as my invention is:

1. A crystal oven comprising a base of insulating material, a cover to fit over the base and form therewith an enclosure, cooperating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to support a crystal within the enclosure, electrical connections between the crystal supporting means and some of the terminals, and electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure; the heating means including: two electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to maintain a crystal mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, switch means operable to selectively connect one of said heater elements into circuit between said pair of terminals, and a thermostat to control the operation of the heater element which is in circuit to maintain the crystal substantially at said predetermined temperature.

2. A crystal oven comprising a base of insulating material, a cover to fit over the base and form therewith an enclosure, cooperating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to support a crystal within the enclosure, electrical connections between the crystal supporting means and some of the terminals, and electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure; the heating means including: two electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to maintain a crystal mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, the heater elements each having a common end and a free end, switch means associated with the free ends of the elements and operable to selectively

6

connect either of said heater elements, one at a time, into circuit between said pair of terminals, and a thermostat to control the operation of the heater element which is in circuit to maintain the crystal substantially at said predetermined temperature.

3. A crystal oven comprising a base of insulating material, a cover to fit over the base and form therewith an enclosure, cooperating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to support a crystal within the enclosure, electrical connections between the crystal supporting means and some of the terminals, and electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure; the heating means including: first and second electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to maintain a crystal mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, a thermostat, first and second heating coils connected in series with each other and with the thermostat between said pair of terminals, the first heating element consisting of the first heating coil and the second heating element consisting of the series combination of the first and second heating coils, and switch means operable to selectively short out the second heating coil, the thermostat controlling the operation of the heater element which is in circuit between said pair of terminals to maintain the crystal substantially at said predetermined temperature.

4. A crystal oven comprising a base of insulating material, a cover to fit over the base and form therewith an enclosure, cooperating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to support a crystal within the enclosure, electrical connections between the crystal supporting means and some of the terminals, and electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure; the heating means including: first and second electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to maintain a crystal mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, a thermostat, first and second heating coils connected in parallel with one another, and in series with the thermostat, between said pair of terminals, one heating element consisting of the first heating coil alone and the second heating element consisting of the parallel combination of the first and second heating coils, and switch means operable to selectively break the parallel connection of the heating coils to isolate the second heating coil, the thermostat controlling the operation of the heater element which is in circuit between said pair of terminals to maintain the crystal substantially at said predetermined temperature.

5. A crystal oven comprising a base of insulating material, a cover to fit over the base and form therewith an enclosure, cooperating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to support two crystals in spaced apart relation within the enclosure, electrical connections between the crystal supporting means and some of the terminals, and electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure; the heating means including: two electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to main-

7

tain crystals mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, the heater elements being so dimensioned and located as to be between such crystals, switch means operable manually to selectively connect one of said heater elements into circuit between said pair of terminals, and a thermostat to control the operation of the heater element which is in circuit to maintain the crystals substantially at said predetermined temperature.

6. A crystal oven comprising a base of insulating material, a cover to fit over the base and form therewith an enclosure, cooperating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to support two crystals within the enclosure with a space between them, electrical connections between the crystal supporting means and some of the terminals, electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure, a pair of parallel vertical metal plates located in said space between crystals, and a block of metal in contact with the plates at their upper ends to provide a thermal sink; the heating means including: two electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to maintain crystals mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, the heater elements being sandwiched between the metal plates, switch means operable manually to selectively connect one of said heater elements into circuit between said pair of terminals, and a thermostat in thermal contact with the lower ends of the plates to control the operation of the heater element which is in circuit to maintain the crystals substantially at said predetermined temperature.

7. A crystal oven comprising a base of insulating material, a cover to fit over the base and form therewith an enclosure, cooperating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to support two crystals within the enclosure with a space between them, electrical connections between the crystal supporting means and some of the terminals, electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure, a pair of parallel vertical metal plates located in said space between crystals, a block of metal secured to the plates at their upper ends to provide a thermal sink, and a U-shaped bracket releasably secured to an upper portion of the block, crystals mounted in the supporting means being interposed between the block and the U-shaped bracket; the heating means including: two electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to maintain crystals mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, the heater elements being sandwiched between the metal plates, switch means manually operable to selectively connect one of said heater elements into circuit between said pair of terminals, and a thermostat in thermal contact with the lower ends of the plates to control the operation of the heater element which is in circuit to maintain the crystals substantially at said predetermined temperature.

8. A crystal oven comprising a base of insulating material, the base having a recess in the upper surface thereof, a cover to fit over the base and form, with the recess, an enclosure, co-operating means on the cover and the base to releasably attach the cover to the base, a plurality of terminals carried by the base to project from the enclosure, crystal supporting means on the base to

8

support a plurality of crystals in spaced apart relation within the enclosure, electrical connections between the crystal supporting means and some of the terminals, electrical heating means connected between a pair of the terminals and mounted on the base to be within the enclosure, a pair of parallel vertical metal plates located to be between such crystals, a block of metal secured to the plates at their upper ends to provide a thermal sink, and a U-shaped bracket having depending legs parallel to, and spaced from, the plates, the bracket being releasably secured to an upper portion of the block and crystals mounted in the supporting means being interposed between the block and said legs; the heating means including: two electrically operable heater elements each of which is capable of operating separately, upon a voltage different from the other element, to maintain a crystal mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, the heater elements being sandwiched between the metal plates, switch means manually operable when the cover is removed from the base to selectively connect one of said heater elements into circuit between said pair of terminals, and a thermostat located in said recess in thermal contact with the lower ends of the plates, the thermostat controlling the operation of the heater element which is in circuit to maintain crystals substantially at said predetermined temperature.

9. A crystal oven as claimed in claim 5 wherein the switch means, within the enclosure, are located at one side of the enclosure.

10. A crystal oven as claimed in claim 9 wherein the switch means include, adjacent the base, a plate of insulating material disposed vertically and a switch mounted on the plate of insulating material.

11. A crystal oven as claimed in claim 10 and having within the enclosure a pair of parallel metal plates vertically interposed between crystals mounted in the crystal supporting means, the heater elements being sandwiched between the plates, and the plate of insulating material being secured to edges of the pair of metal plates.

12. A crystal oven as claimed in claim 11 wherein the crystal supporting means include a U-shaped metal clip which embraces the lower ends of the metal plates, the clip having laterally projecting arms to support the crystals, the thermostat being fastened to the underside of the clip and thus in thermal contact with the metal plates through the clip.

13. A crystal oven as claimed in claim 12 including a metal block having a vertical slot which receives the upper ends of the metal plates, the thermostat thus being in thermal contact with the metal block through the clip and metal plates, the metal block providing a thermal sink.

14. A crystal oven comprising an insulating base having a recess in the upper surface thereof, a cover releasably attached to the base and forming, with the recess, an enclosure, a plurality of terminals carried by the base, crystal supporting means on the base to support two crystals in spaced apart relation within the enclosure, the crystal supporting means including two crystal receiving sockets and a U-shaped metal clip having two laterally projecting arms, one socket being supported on each arm and each socket being connected to a pair of the terminals, a thermostat in said recess and fastened to the underside of the U-shaped metal clip, a pair of metal plates vertically interposed between the crystal receiving sockets and extending upwards between such crystals, the lower ends of the metal plates being embraced by the U-shaped metal clip, a metal block having a vertical slot which receives the upper ends of the metal plates between such crystals, the metal block providing a thermal sink, the thermostat being in thermal contact with the metal block through the clip and metal plates, first and second electrically operable heater elements sandwiched between the metal plates, each heater element being capable of oper-

ating separately, upon a voltage different from the other, to maintain crystals mounted in the crystal supporting means at substantially a predetermined temperature within a predetermined range of ambient conditions, switch means within the enclosure and including a vertically disposed plate of insulating material adjacent the base and secured to edges of the said pair of metal plates, a manually movable switch mounted on the plate of insulating material, the switch in one position connecting one of the heating elements across a pair of the terminals and in another position connecting the other heating element across the last mentioned pair of terminals,

5

10

the thermostat controlling the operation of the heater element which is connected across the last mentioned pair of terminals to maintain the crystals substantially at said predetermined temperature.

References Cited in the file of this patent**UNITED STATES PATENTS**

2,438,345	Miller	Mar. 23, 1948
2,613,306	Waltersdorf et al.	Oct. 7, 1952
2,651,731	Overbey et al.	Sept. 8, 1953
2,791,706	Font	May 7, 1957
2,915,612	Font	Dec. 1, 1959