Feb. 16, 1965 K. R. OLIVER, JR., ETAL 3,170,060

HIGH STABILITY TEST OVEN

Filed Nov. 2, 1961 5 Sheets-Sheet 1

Fig. 1.

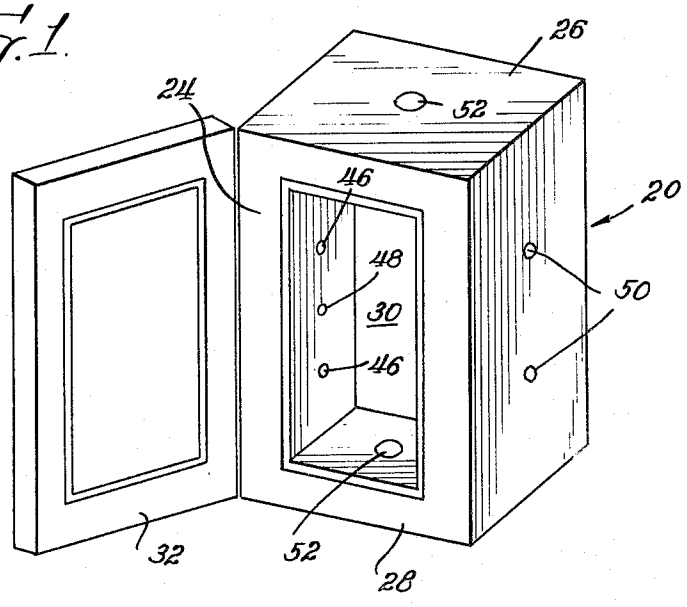
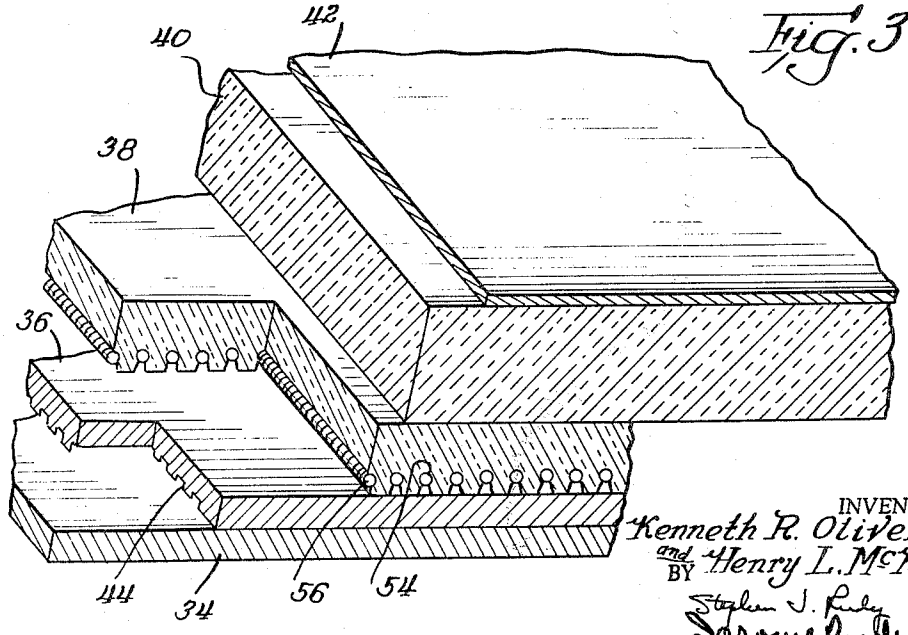


Fig. 3



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HIGH STABILITY TEST OVEN

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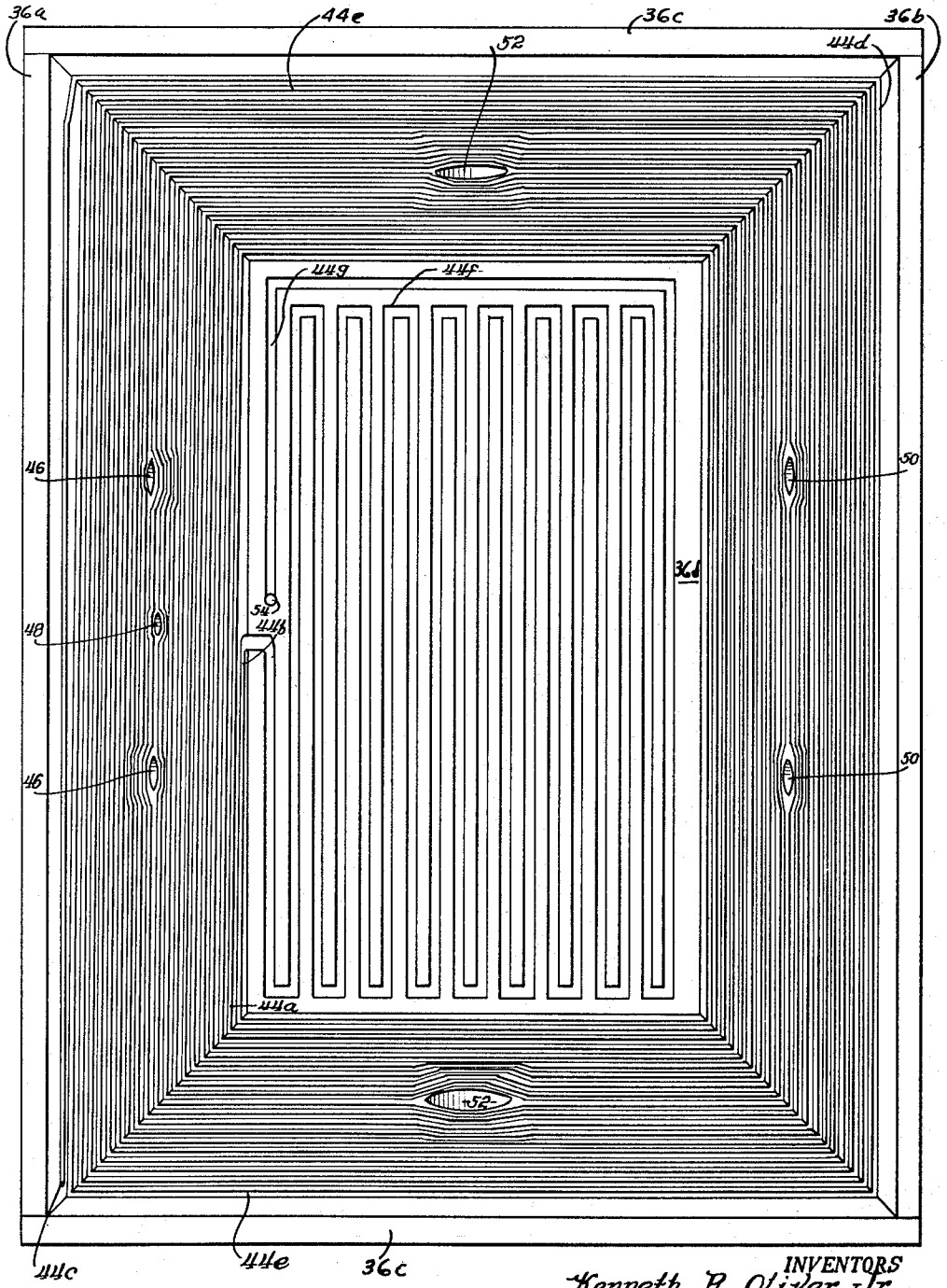


Fig. 2.

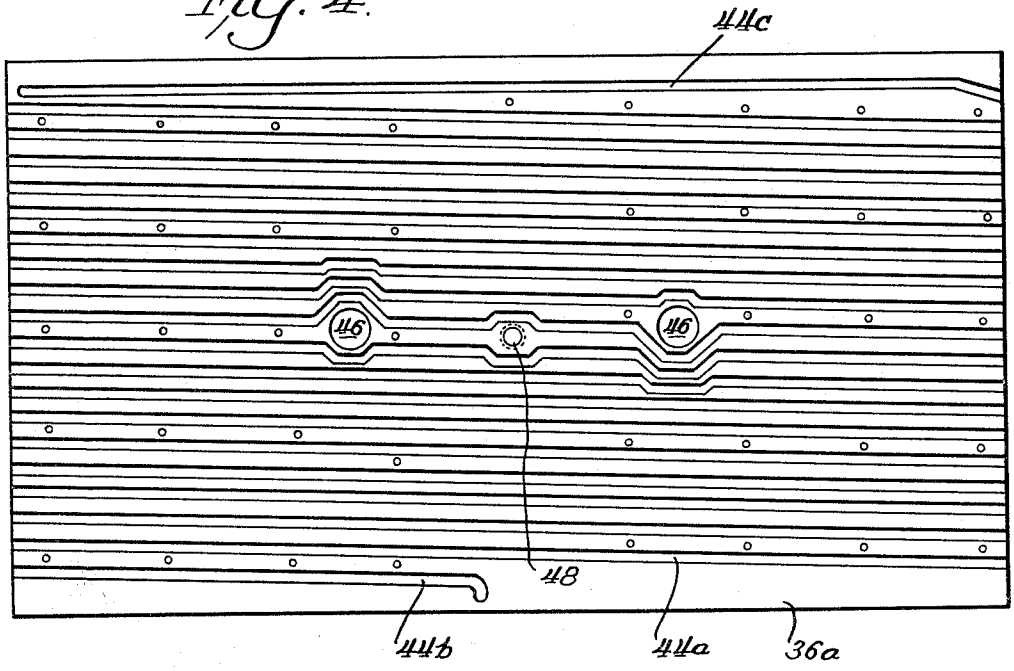
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HIGH STABILITY TEST OVEN

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Fig. 4.



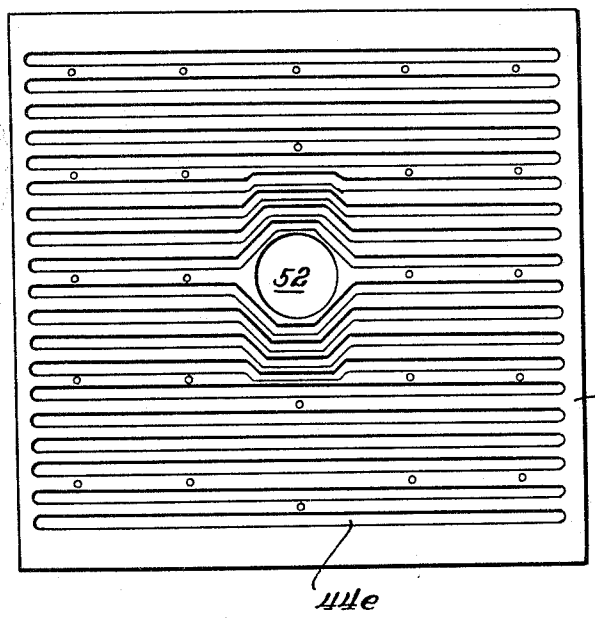


Fig. 5.

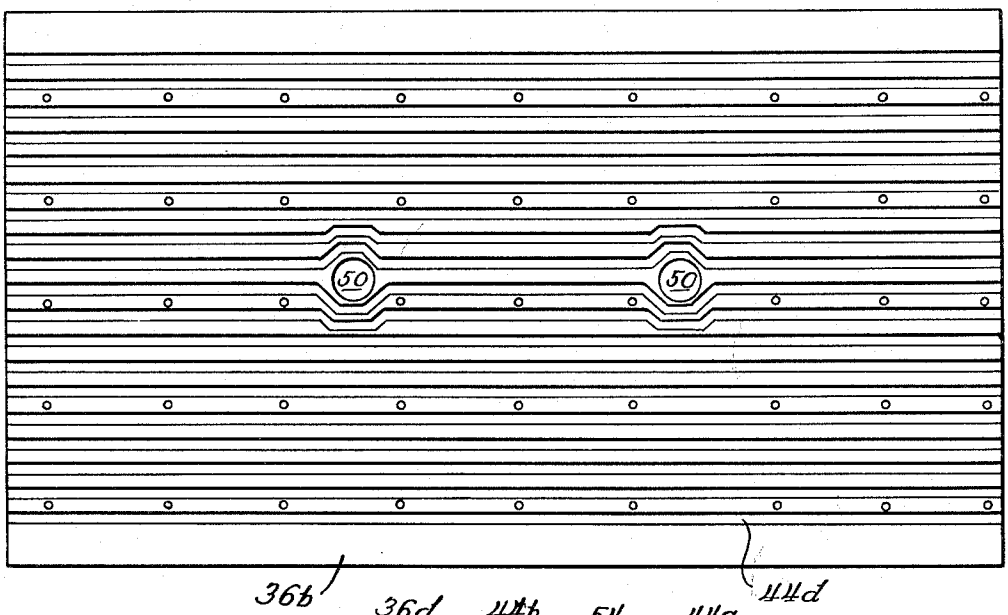
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HIGH STABILITY TEST OVEN

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Fig. 6



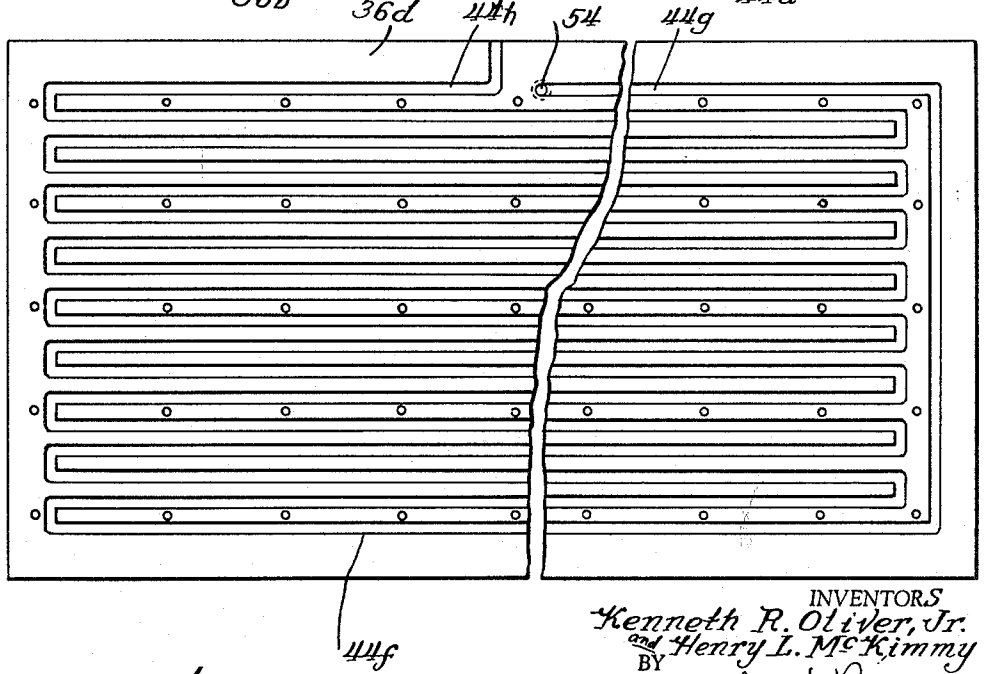


Fig. 7

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Fig. 8.

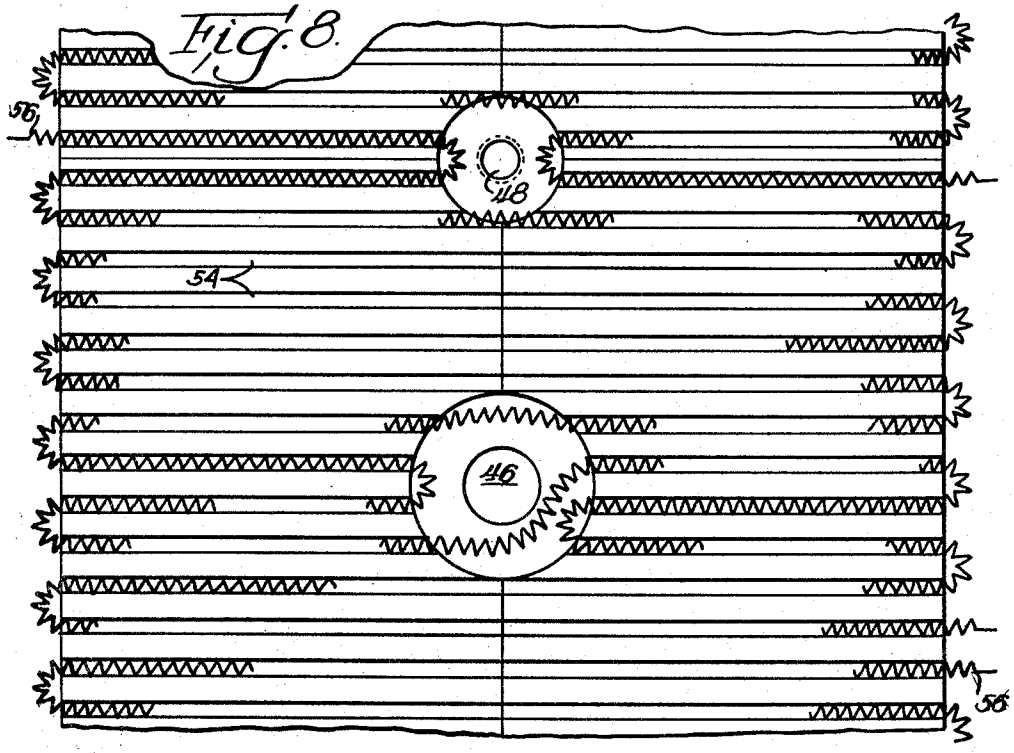
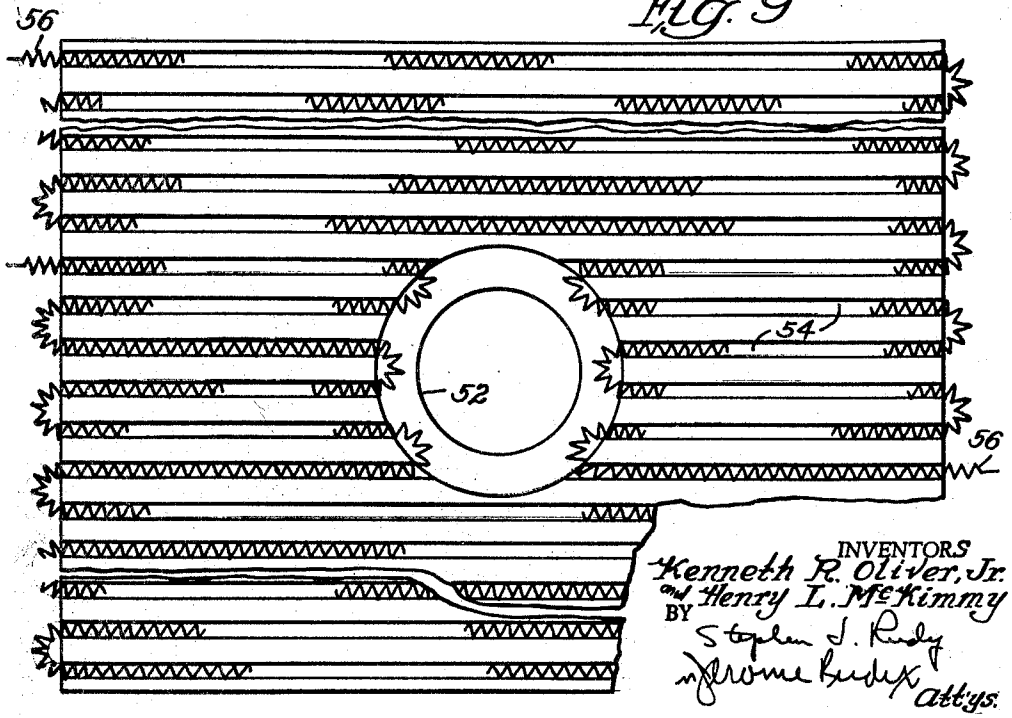


Fig. 9



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HIGH STABILITY TEST OVEN

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Filed Nov. 2, 1961, Ser. No. 149,634
9 Claims. (Cl. 219—390)

This invention relates to ovens, and more particularly to a high stability oven for thermal degradation studies.

The usual arrangement for laboratory ovens employed for the stated purpose, includes the use of a high temperature heat source for heating air, which in turn, heats the walls of the oven. The walls used are either thermal insulating material, or thin aluminum sheeting. Such arrangements do not give uniform wall temperatures, nor are stable wall and air temperatures achieved.

The oven of the invention not only maintains the oven air, or atmosphere, at control temperature, but also maintains all radiant surfaces at control temperature. Briefly, the oven includes an air labyrinth formed on the under surface of sheeting comprising the inner oven walls, which walls are relatively thick to assure uniform temperature distribution. The walls are heated by a uniform and closely spaced array of resistance coils operated at about 2% normal input power. The ends of the coils are separately arranged so that a number of possible levels are available.

The main object of this invention is to provide a high stability oven which may be used for thermal degradation studies.

A more specific object is to provide an oven which will not only maintain oven air, or atmosphere, at control temperature, but will also maintain radiant oven surfaces at control temperature.

Still another object of the invention is to provide an electrically powered oven which may be operated at different power levels.

These and further objects and features of the invention will become more apparent from the following description and accompanying drawings wherein:

FIG. 1 is a perspective-like view of an oven embodying the principles of the invention;

FIG. 2 is a view illustrating an air labyrinth circuit employed in the oven of FIG. 1;

FIG. 3 is a fragmentary perspective-like view of a wall portion of the oven of FIG. 1;

FIG. 4 is a plan view of a side sheet used in the oven of FIG. 1, illustrating an air labyrinth pattern;

FIG. 5 is a plan view of an end sheet used in the oven of FIG. 1, illustrating an air labyrinth pattern;

FIG. 6 is a plan view of another side sheet used in the oven of FIG. 1, illustrating an air labyrinth pattern;

FIG. 7 is a plan view of a back sheet used in the oven of FIG. 1 illustrating an air labyrinth pattern;

FIG. 8 is a plan view of a side sheet used in the oven of FIG. 1 illustrating a heater pattern; and

FIG. 9 is a plan view of an end sheet used in the oven of FIG. 1 illustrating a heater pattern.

Referring now to the drawings and more particularly to FIGS. 1 and 3, numeral 20 identifies an oven illustrative of an embodiment of the invention which includes a pair of side walls 22 and 24, a top wall 26, a bottom wall 28, a back wall 30, and a door 32 which is hinged to the side wall 24. Means (not shown) are provided to maintain the oven door in closed position during operation.

The walls, as best seen in FIG. 3, are formed of a plurality of elements including in sequential order (starting from inside of oven), an inner plate means comprising a pair of aluminum sheets or plates 34 and 36, a ceramic slab or block 38, a section composed of foamed glass 40, and an outer plate means comprising an aluminum plate 42. The relative thickness of these various elements are preferably as illustrated, the plates 34 and 36 being approximately one-half inch thick.

The inside surface of the sheets 36 are formed to provide an air labyrinth consisting of a plurality of grooves 44, which are approximately one-quarter inch wide by one-eighth inch deep. Such arrangement of the grooves 44 provides a continuous passageway, or circuit when the sheets are assembled to form the oven walls. Such an air labyrinth circuit is illustrated in skeletal form in FIG. 2.

Details of the groove arrangement of each sheet is illustrated in FIGS. 4 to 7 inclusive. FIG. 4 illustrates the groove pattern formed in a sheet 36*a* which is inside wall assembly 24. It will be noted that generally parallel grooves 44*a* extend the full length of the sheet and are arranged to pass around a pair of access holes 46, and a smaller diameter threaded hole 48, the latter of which may be used for accommodation of temperature measurements means (not shown). It will be noted that a groove 44*b* located nearest one edge of the sheet, is terminated at mid-region of the sheet. As will be seen later, the groove 44*b* is arranged to connect with another groove formed on the sheet in the back wall 30, to form a connection point between the grooves of these walls.

FIG. 6 illustrates the groove pattern formed in a sheet 36*b* which is in the opposite side wall assembly 22. It will be noted that generally parallel grooves 44*d* extend the full length of the sheet and are arranged to pass around a pair of access holes 50.

It will also be noted that the grooves 44*a* and grooves 44*b* are arranged at a slight angle to the longitudinal edges of the sheet, with the exception of one groove 44*c* which is parallel with an edge except at an end portion thereof.

FIG. 5 illustrates the groove pattern formed in each of the sheets 36*c* one each of which are in the top and bottom walls 26 and 28 respectively. It will be noted that parallel grooves 44*e* are arranged to extend substantially the full length of the sheet 36*c* and pass around an access hole 52. The lateral spacing of the grooves 44*e* is such as to match the lateral spacing of the grooves 44*a*, 44*b* ,44*c* and 44*d*, or more specifically, the end regions thereof, of the plates 36*a* and 36*b*. In such manner, the grooves will provide a continuous passageway, or circuit when the sheets are assembled to form the oven walls.

FIG. 7 illustrates the groove pattern found in a sheet 36*d* which is in the back wall assembly 30. It will be noted that parallel grooves 44*f* extend substantially the full length of the sheet and are connected at each end to form a continuous path. One groove 44*g*, which begins at mid-region of the sheet and has a threaded entry hole 54 at the terminal point, extends around the groove arrangement for connection with the groove furthest removed therefrom. Another groove 44*h* terminates at mid-region of the sheet and is arranged for connection with the groove 44*b* of the sheet 36*a*. In such manner, the air labyrinth formed includes a continuous circuit passing in sequential order through the grooves 44*g*, 44*f*, 44*h*, 44*b*, 44*a*, 44*a*, 44*d*, 44*e*, and finally 44*c*. The circuit may be traced in the FIG. 2 illustration.

The ceramic block 38 is formed to provide a plurality of parallel arranged grooves, or slots 54 which are adapted to receive heating elements 56. As best seen in FIG. 3, the slots 54 are disposed to generally extend at a right angle to the grooves 44 provided in the plate 36 forming the respective wall assemblage. In such manner, a more uniform distribution of wall temperature is achieved in the oven walls. Typical heater element patterns are

illustrated in FIGS. 8 and 9, the former illustrating that utilized in a side wall 24, while the latter illustrates the pattern utilized in a top or bottom wall 26 or 28 respectively. The heater elements are not necessarily connected in series, rather, a plurality of end portions, or leads, are provided so that a number of possible maximum power levels are available. One connection used, included 10 series elements with two parallel groups across a 115 volt supply, which gave a low level heat source with a maximum power input of 400 watts, and provided a safe limit on upper temperatures in case of controller failure. The average power input to maintain a 350° F. temperature in the oven, was in the order of 300 watts.

When operating the oven at a temperature of 350° F. a stability of ±0.09° F. was achieved. An array of twenty-two thermocouples arranged in a plane was placed at twelve levels, two inches apart in the oven to obtain the temperature distribution. No measurable differences were found with a sensitivity of ±0.5° F.

It will be apparent that an oven made in accordance with the foregoing disclosure will satisfy the objectives as set forth hereinbefore.

The foregoing description has been given in detail without thought of limitation since the inventive principles involved are capable of assuming other forms without departing from the spirit of the invention or the scope of the following claims.

What is claimed is:

1. In an oven, a wall assembly comprising an inner and an outer plate means, said inner plate means being formed to provide a plurality of generally parallel arranged grooves forming an air labyrinth on an interior surface thereof, a block means arranged between the inner and outer plate means, said block means being formed to provide a plurality of generally parallel arranged grooves which extend at a right angle to the grooves in said inner plate means, and electric heating elements arranged in said block groove means.

2. In an oven, a wall assembly comprising an inner and an outer plate means, said inner plate means being formed to provide a plurality of generally parallel arranged grooves forming an air labyrinth on an interior surface thereof, a ceramic block means arranged between the inner and outer plate means, said block means being formed to provide a plurality of generally parallel arranged grooves which extend at a right angle to the inner plate grooves, a plurality of electric heating elements arranged in said block grooves, and a heat insulating material positioned between the ceramic block and the outer plate means.

3. In an oven, a wall assembly according to claim 2, wherein said inner plate means includes two juxtaposed plates, said air labyrinth grooves being formed on a surface of one of said plates, which surface is in engagement with a surface of the other of said plates.

4. In an oven, a wall assembly according to claim 3, wherein the grooves in the ceramic block are arranged to open on a surface thereof, said surface being in engagement with a surface of said inner plate means.

5. An oven comprising a plurality of walls and a door all arranged to form an enclosure, said walls each including an inner and an outer plate means, said inner plate means being formed to provide a plurality of generally parallel arranged grooves forming an air labyrinth on an interior surface thereof, said air labyrinth extending in continuous manner through said walls, a ceramic block arranged between the inner and outer plate means, said block means being formed to provide a plurality of generally parallel arranged grooves which extend at a right angle to the inner plate grooves, and a plurality of heating elements arranged in said block grooves.

6. An oven according to claim 5, wherein said inner plate means includes two juxtaposed plates, said air labyrinth grooves being formed on a surface of one of said plates which surface is in engagement with a surface of the other of said plates.

7. An oven according to claim 5, wherein a heat insulating material is positioned between the block and the outer plate means.

8. In an oven, a wall assembly comprising an inner and an outer plate means, said inner plate means being formed to provide a continuous generally parallel-groove passageway on one interior surface thereof, a block means arranged between the inner and outer plate means, said block means being formed to provide a plurality of generally parallel-groove means which extend transversely of said continuous generally parallel-groove passageways in said inner plate means at an angle not less than ten degrees, and electric heating elements arranged in said block groove means.

9. In an oven, a wall assembly comprising an inner and an outer plate means, said inner plate means being formed to provide a plurality of generally parallel arranged grooves forming an air labyrinth on an interior surface thereof, a block means arranged between the inner and outer plate means, said block means being formed to provide a plurality of generally parallel arranged groove means which extend transversely of said grooves in said inner plate means at an angle not less than ten degrees, and electric heating elements arranged in said block groove means.

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