Aug. 2, 1949. W. J. MISKELLA 2,478,001

INFRARED OVEN

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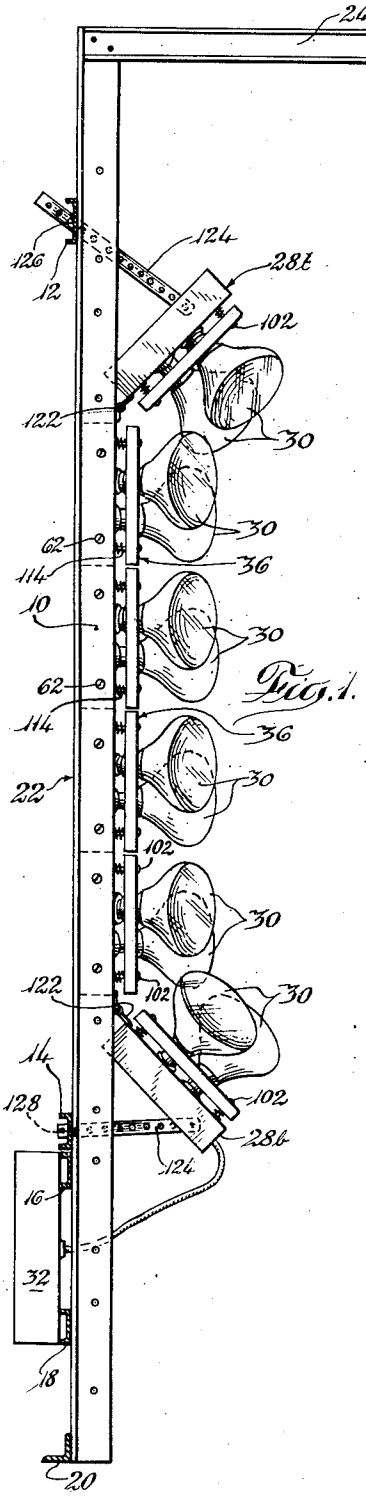


Fig. 1.

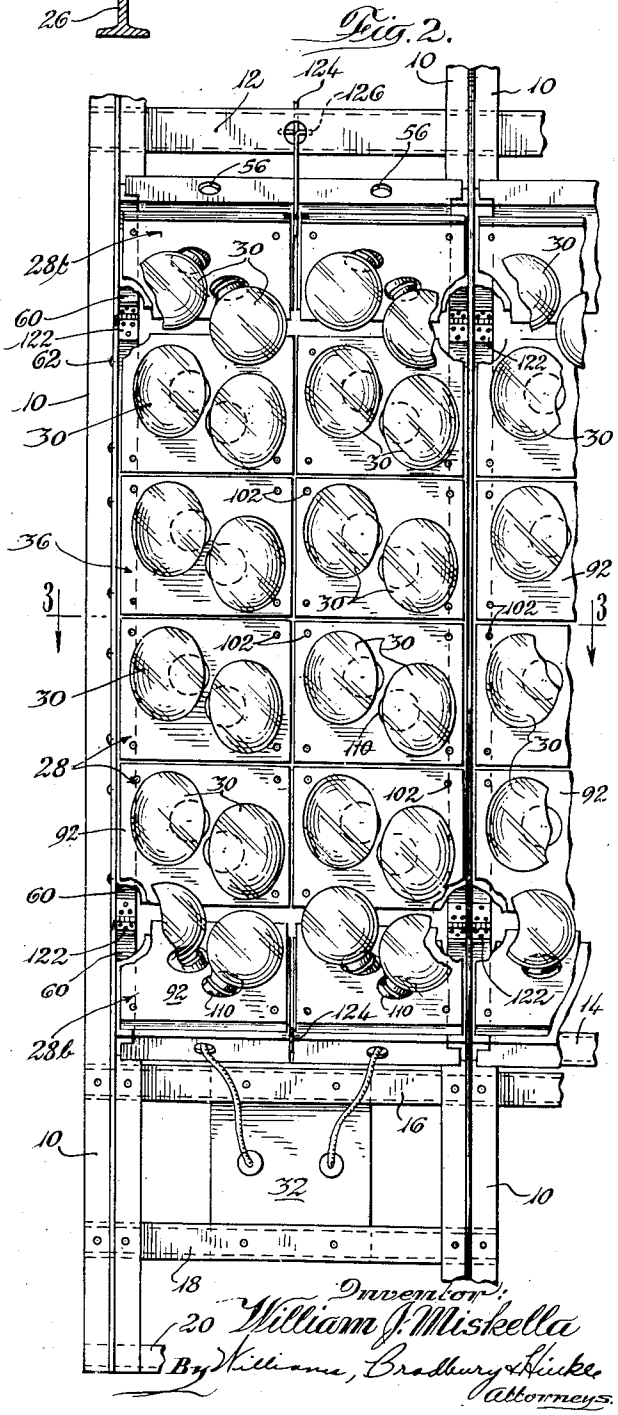


Fig. 2.

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Fig. 5.

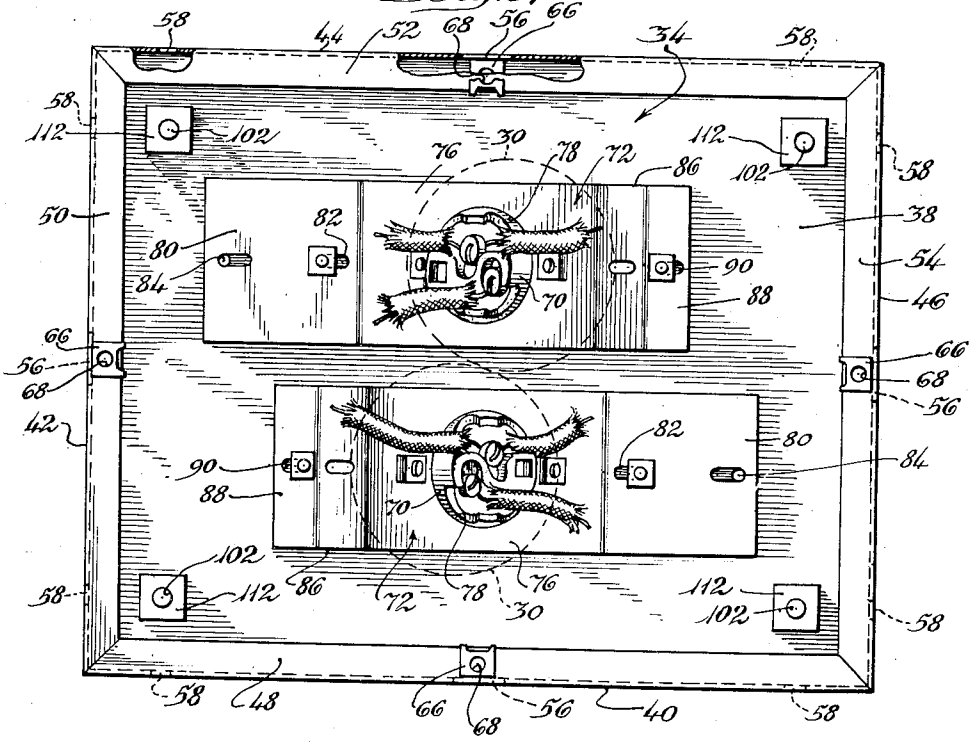


Fig. 6.

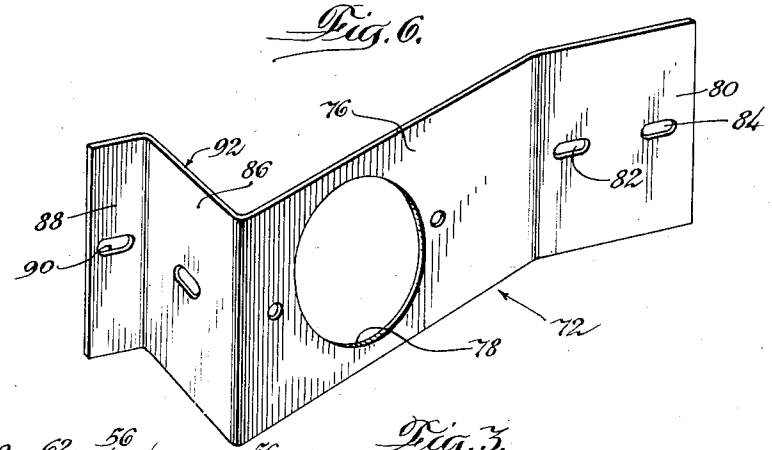
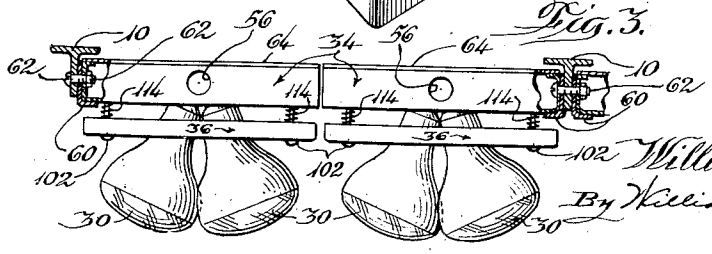


Fig. 3.



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Fig. 7.

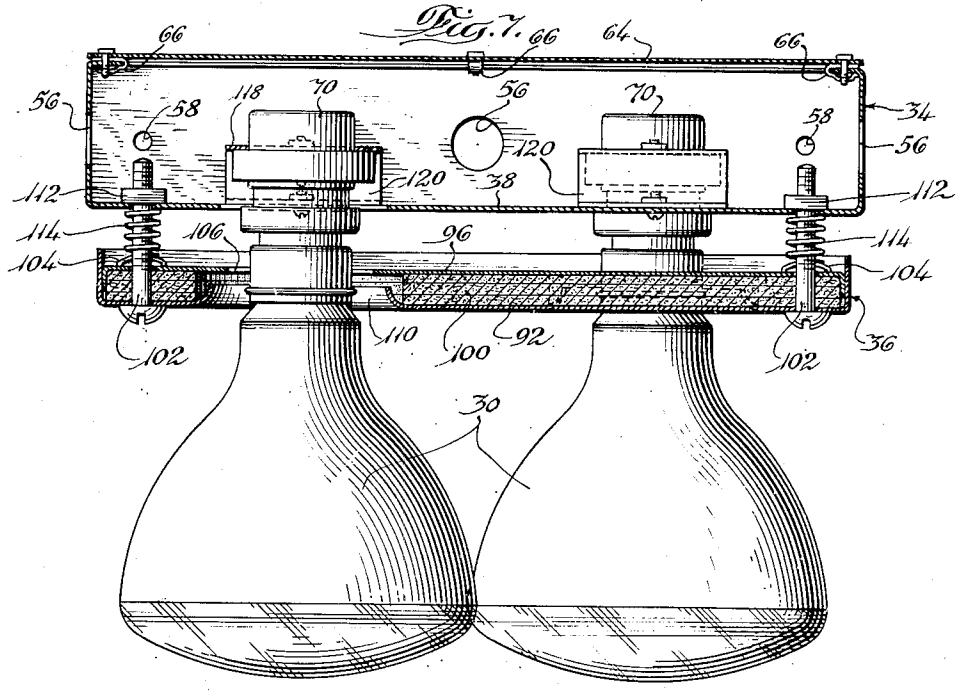
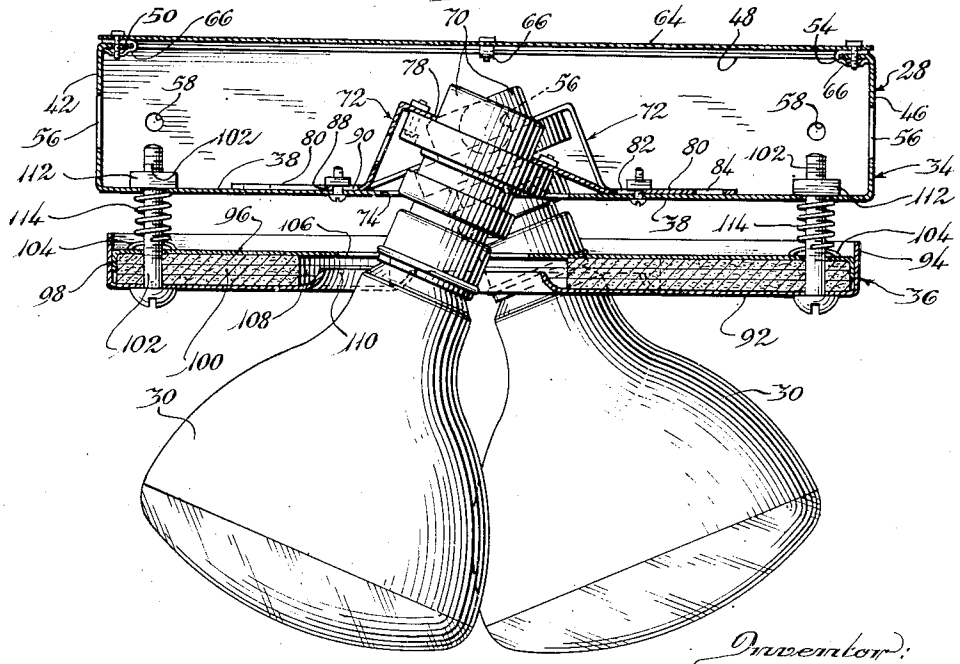


Fig. 4.



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Patented Aug. 2, 1949

2,478,001

UNITED STATES PATENT OFFICE

2,478,001

INFRARED OVEN

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Application November 30, 1945, Serial No. 632,058

8 Claims. (Cl. 219—35)

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My invention relates to novel heating and drying apparatus and more particularly to an infrared oven which may be constructed of a number of standard units.

This invention represents an improvement over the invention described in my prior Patent #2.387,804, dated October 30, 1945.

The principal object of the present invention is to provide an improved infrared oven which may be quickly and easily assembled from a number of standard units.

Another object of the invention is to provide a novel infrared oven assembled from standard units which can be made in a variety of shapes and sizes so as readily to be adapted for different installations.

Another object is to provide an infrared oven which is ventilated at the bases of the infrared lamps to extend the effective life of such lamps.

Another object is to provide a novel oven wherein the infrared lamps are angularly positioned, and in which the amount of angularity can be adjusted.

Another object is to provide an improved oven which is easily and rapidly assembled and which is inexpensive in construction.

Another object is to provide a novel oven which is light-weight in construction and yet has low heat loss characteristics.

Another object is to provide improved standard units for the construction of an infrared oven which are economical to manufacture and easily packaged for shipment.

Other objects and advantages will become apparent from the following description taken in conjunction with the following drawings, in which:

Fig. 1 is an end view of the left-hand side of an oven at the inlet end;

Fig. 2 is a fragmentary plan view of one wall of the oven illustrated in Fig. 1;

Fig. 3 is a sectional view taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a sectional view on an enlarged scale through one of the units of which the oven is constructed;

Fig. 5 is a back plan view with parts broken away in section of the unit shown in Fig. 4;

Fig. 6 is a perspective view of the bracket which mounts the infrared lamps; and

Fig. 7 is a view similar to Fig. 4 showing a modification of the invention.

Referring to Figs. 1, 2 and 3, it is seen that the oven framework comprises a plurality of vertical standards 10 of T cross-section connected by horizontally extending channels 12, 14, 16 and 18 and an angle 20. The side frame indicated generally by the reference character 22 is connected to a similar side frame on the opposite side of the oven by I-sections 24 which support a rail 26 for the conveyor system. Adjacent standards 10 support a plurality of units 28 in which are mounted infrared lamps 30.

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It will be seen from Fig. 2 that the units 28 are arranged in vertical rows and the lamps in each row are wired so as to be used with one of the standard line voltages of 110 v., 220 v., 440 v. and so on, the connections in each installation being arranged to fit the line voltage in the establishment in which the oven is to be used. Each row of units 28 is connected to a switch box 32 mounted on the channels 16 and 18, and each vertical row may be separately energized so as to give variable oven temperatures.

Each of the units 28 comprises a box 34 which supports sockets for the infrared lamps 30 and a heat insulated reflective panel 36. The box 34 is generally rectangular in shape, having a front face 38 and side walls 40, 42, 44, and 46 provided with turned-in flanges 48, 50, 52, and 54, respectively. Each of the side walls is provided with an opening 56 at approximately the mid-point thereof for the passage of the wires constituting the electrical connections between adjacent units 28 and between the row of units and the switch box 32. Adjacent the corners of each box smaller holes 58 are drilled or punched in the side walls for the purpose of bolting units 28 together and to the vertical standards 10. The means for securing the units to the standards 10 is shown clearly in Fig. 3, and comprises angle sections 60 bolted to the outer edges of each adjacent pair of rows of units 28 so that the units will be connected together.

The framework comprising the standards 10, channels 12, 14, 16, 18, angle 20 and cross members 24, is first bolted or riveted together, and then pairs of rows of units 28 are bolted in place between adjacent vertical standards 10 by means of bolts 62 which are passed through suitable holes in the standards 10 and angle 60, and the holes 58 in the boxes 34. After the units 28 have been bolted in place, back plates 64 may be bolted or screwed to the boxes 34 by means of screws driven through "Speed-nuts" 66 which are locked in place over holes 68 provided at approximately the mid-point of each of the in-turned flanges 48, 50, 52 and 54. If desired, of course, conventional sheet metal screws or other fastening means may be used instead of the "Speed-nuts."

Each infrared lamp 30 is screwed into a standard electrical socket 70 which is bolted to a bracket 72. Bracket 72 is bolted to the inner surface of face 38 of the box 34 in such a manner that the infrared lamp 30 protrudes through a large opening 74 formed in the face 38 of the box 34.

The bracket 72 is illustrated in Fig. 6 and comprises a central portion 76 having formed therein a large opening 78 in which is placed the base of the socket 70. At one end the bracket 72 is provided with an attaching flange 80 having slots 82 and 84 cut therein. At the opposite end the bracket 78 is formed with an angular flange 86 which is integral with an attaching flange 88 having a slot 90 formed therein. The flanges 80 and 88 lie in the same plane, and the spacing flange 86 permits mounting the socket in the box 34 in an angular position. The degree of angularity may be varied by bending the brackets to change the angles between the center portion 76 and the flanges 80, 86 and 88. The provision of two slots in flange 80 makes mounting of the bracket 72 in the box more flexible with only one set of holes drilled in the box itself. As seen in Figs. 4 and 5, a pair of brackets 72 is mounted in each box in such manner that the lamps 30 are pointed oppositely from a line drawn perpendicular to the face 38; thus, the two openings 74 must be slightly offset relative to each other and to the center line of the box.

Each of the heat insulated panels 36 includes a front plate 92 which has a reflective surface of porcelain or chromium or cadmium plating, and is provided with rearwardly extending flanges 94 to form an open shallow box-like structure. The box is closed by a back plate 96 which has forwardly extending flanges 98 around the periphery thereof, and suitable heat insulating material such as sheet asbestos 100 is positioned between the plates 92 and 96. The sheets 92 and 96 and the insulation 100 are held in sandwich form by bolts 102 and "Speed-nuts" 104. The lamps 30 extend through openings 106 in the plate 96, 108 in the insulation 100, and 110 in the plate 92. The opening 110 is formed in part by bending the reflective plate 92 back toward the back plate 96, but preferably not sufficiently far so that it touches this plate, so as to minimize the amount of heat transfer between the front plate and the back plate, particularly around the lamps where there is the greatest concentration of heat. Because the lamps 30 are set at an angle relative to the panels 36 and the boxes 34, the openings in the panel 36 are offset relative to the openings 74 in the box 34, and the amount of offsetting depends upon the degree of angularity of the lamp mounting.

The panel 36 is bolted to the box 34 by the bolts 102 and nuts 112, and is spaced therefrom by coil springs 114 surrounding the shanks of the bolts 102, thus providing a firm mounting and adjustable spacing between the box 34 and the insulated panel 36. The air gap thus formed is desirable to promote circulation of air upwardly through the row of units 28 so as to cool the bases of the lamps which lie substantially in the space between the box 34 and the insulated panel 36. By keeping the bases of the lamps cool, it is possible substantially to prevent deterioration of the cement which holds the glass envelope in the metal base and appreciably to extend the effective life of each infrared lamp. This becomes very important as the oven may be constructed to give a very high wattage per unit of area of oven surface. By making the face of the heat insulated panel of reflective material, and by making the opening 110 of such size and shape as closely to encircle the lamp adjacent the neck thereof, it is possible to prevent any appreciable amount of radiated rays from passing beyond the surface of the panel 36. This means, particularly since the front panel is insulated, that the rear of the panel 36 and the box 34 will be at a much lower temperature than the interior of the oven and the air which circulates through the space between the panel 36 and the box 34 will be of a temperature which will promote cooling of the lamp bases.

The plate 96 may be formed of Bakelite or similar electrical insulating material, and since the opening 106 has a smaller diameter than the opening 110, the base of the lamp 30 is prevented from contacting any metal in the panel 36. When lamps with brass caps are used, this electrical insulating feature prevents short circuits because the turned back edge of the opening 110 is spaced from the plate 96. As Bakelite is also a heat insulating material, the heat insulating characteristics of the panel 36 are improved over those constructed with a metal plate 96.

Or if desired, the plate 96 may be omitted from the heat insulated panel 36, provided the insulation 100 has sufficient body to permit it to support itself. If this modified construction is used, the "Speed-nuts" 104 are driven against the insulation 100 to hold it to the plate 92, or small washers may be interposed between the nuts 104 and the insulation.

In Fig. 7 there is illustrated a modification of the invention which shows the lamps 30 placed perpendicularly to the surface of the insulated panel. The construction of this unit is substantially the same as that described with reference to Fig. 4 in that it has the box 34 in which are supported the lamps 30 and has the heat insulated panel 36 which is formed of the reflective front plate 92 and back plate 96, enclosing heat insulated material 100, the whole being held together by bolts 102 and nuts 104. Similarly also, the panel is bolted to the box 34 by the nuts 112 and bolt 102 and spaced therefrom by the coil spring 114. The principal difference in the construction is the positioning of the openings in the insulated panel 36 and base 38 of the box 34 so that the openings are in alignment. The lamp sockets 70 are mounted in U-shaped straps 118 which are bolted to the bottom 38 of the box 34. The U-shaped strap 118 may be made of the same stock as the bracket 72 but bent so as to give a pair of parallel spacer flanges 120 of equal height so as to hold the lamp with its base in the space between the insulated panel 36 and the box 34 for the purpose of cooling the lamp, as has been more fully discussed hereinbefore.

I provide both angular and perpendicular mounting for the lamps so as to permit greater flexibility in oven design, and units with both angular and perpendicular lamp mounting may be used in the same oven if desired. In general the angular mounting of the lamps is to be preferred since it directs the infrared rays so as to give better coverage of all surfaces of an object being treated as it is passed through the oven.

It may be desirable to construct an oven wherein the banks of infrared lamps are not all placed in flat panels but where some, usually the top and/or bottom units, are placed at an angle to others of the units. Such an arrangement is shown in Figs. 1 and 2 wherein the top and bottom units of each vertical row are inclined in-

wardly so as to direct the infrared rays toward the top and bottom of the object which is being passed through the oven.

I provide a very simple mechanical arrangement for permitting angular positioning of one or more of the units in the oven which includes hinges 122 which connect the appropriate units to the adjacent angles 60. Such hinges permit angular movement between adjacent units, but yet in no way interfere with the rigidity of the connection between the units in any row or pair of rows. In order to hold the unit 28 in the angular position, a strap 124 is bolted between the boxes 34 of horizontally adjacent movable units and extends rearwardly toward the supporting framework 22. This strap is perforated throughout its entire length so as to give a considerable number of adjustment points and passes through a hole or slot in the channel 12 or 14. At the top of the oven where the inclination is down toward the center of the oven, the top unit 28t is prevented from further movement by a pin 126 which is inserted through one of the perforations in the strap 124 and rests against the inner face of channel 12. At the bottom of the oven where it is desired to hold the unit 28b facing upwardly, a pin 128 is passed through one of the perforations in strap 124 and rests against the outer face of channel 14. By providing any number of hinged units 28 and straps 124 of suitable length, virtually any number of angular positions may be obtained even to the extent of having an interior which is substantially closed.

The lamps are positioned in the units 28 in such a manner that when one unit is inclined toward another, the overlapping lamps 30 will nest and will not interfere with one another. In fact they are so positioned that with the hinge arrangement shown in Figs. 1 and 2, one unit 28 can be placed at right angles to another unit 28 which is the minimum angle customarily considered desirable in oven design.

The heat insulated panels 36 are slightly smaller in size than the boxes 34 to which they are mounted so as to permit ease in mounting the units 28 and to permit the user to remove and replace any insulated panel 36 without the necessity of disturbing any of the adjacent panels or units and without the necessity of removing the box 34 to which the panel 36 is secured.

It will be seen from the foregoing description that I have invented an infrared oven which is composed of a number of standard units 28 of similar size and shape which are, in turn, mounted in an exceedingly simple framework built up of standard structural sections, and that the possibilities of constructing an oven having an interior of any size and shape are practically limitless. By providing individual controls for each vertical row of units 28, I can vary the temperature of the interior of the oven to adapt it for baking and drying various coating materials having a wide range of baking temperatures and at a considerable range of conveyor speeds. If it is desired to build an oven which does not require the maximum temperature which a completely lamped oven gives, then any number of the rows of lamps or any number of the units 28 can be replaced by a blank unit which comprises a box 34 without the mounting brackets for the infrared lamps and a perfectly plain surfaced heat insulated reflective panel constructed in a manner similar to the panels 36 but without the openings for the insertion of the infrared lamps. By the use of these blank insulated reflective

panels heat loss from the ovens is kept to a minimum, since the radiant energy as well as the hot air is kept under control.

The foregoing description is of a preferred form of my invention, but it will be apparent to those skilled in the art that numerous changes may be made therein without departing from the spirit and scope of my invention, and, therefore, I desire to be limited only by the appended claims.

I claim:

1. An infrared oven comprising in combination a frame including a plurality of horizontally braced vertical standards, a plurality of similar oven units, each of said units comprising a rectangular box-like element having a front face provided with at least one lamp opening, a lamp socket, bracket means securing said socket within said element and aligned with said opening, a heat insulated reflective panel, said panel having a front face shaped similarly to said front face of said box-like element and substantially coextensive therewith, means securing said panel to said element in spaced relation thereto, said panel having a lamp opening therethrough in alignment with said socket and said lamp opening in said box-like element, means connecting two or more oven units together to form a row of units so that the spaces between said elements and said panels are aligned to form a duct through which cooling air may circulate, and means securing said row of units to said vertical standards.

2. An infrared oven as claimed in claim 1 wherein said bracket means has a portion to which said lamp socket is secured and a spacing flange portion holding said first mentioned portion at an angle to said front face of said box-like element so that an infrared lamp held by said socket will have its major axis disposed at an acute angle to the reflective surface of the panel secured to said box-like element.

3. An infrared oven as claimed in claim 1 wherein said means for connecting two or more oven units together comprises an angle member secured to the box-like element of each of the units comprising the row of units.

4. An infrared oven as claimed in claim 1 wherein said means for connecting two or more oven units together includes a hinge means so that one of said units in said row may be disposed at an angle to the other units in said row.

5. An infrared oven as claimed in claim 1 wherein said means for connecting two or more oven units together comprises an angle member secured to the box-like element of each of the units comprising the row of units, said angle member including a hinge means so that one of said units in said row of units may be disposed at an angle to the other units in said row, the combination including a strap connected to the box-like element of said angularly disposed unit and to the frame to hold said angularly disposed unit in position.

6. A heat insulated reflective panel for use in constructing an infrared oven comprising a generally plane surfaced element of substantial thickness having an opening therethrough of such size and shape as closely to encompass the neck of an infrared lamp which has the major portion of the glass envelope thereof protruding beyond the surface of said element, said element comprising a back plate, a front plate spaced from said back plate and having a heat and light reflective outer surface, heat insulating material confined in the space between said plates, and

means securing said front plate, said back plate, and said heat insulating material together in sandwich-like style to form said element, said front plate being so formed that it is bent toward said back plate at said opening but is spaced from said back plate to minimize heat transfer thereto and to provide a reflective surface about said opening.

7. A heat insulated reflective panel for use in constructing an infrared oven comprising a generally plane surfaced element of substantal thickness comprising a back plate, a front plate spaced from the back plate, heat insulating material confined in the space between said plates, means securing said front plate, said back plate, and said heat insulating material together in sandwich-like style to form said element, said front plate, said back plate, and said heat insulating material having coincident openings formed therein of such size and shape as closely to encompass the neck of an infrared lamp which has the major portion of the glass envelope thereof protruding beyond the surface of the element, said opening in said back plate being slightly smaller than said opening in said front plate, and said front plate being bent back toward said back plate around said opening but being spaced therefrom to minimize heat transfer thereto.

8. A unit for use in constructing an infrared oven of the type composed of a plurality of such units comprising in combination a rectangular box-like element having a front face provided with at least one lamp opening, a lamp socket, bracket means securing said socket within said

element and aligned with said opening, said bracket means comprising a strap secured to said front face of said box-like element, said strap having a portion to which said lamp socket is secured and a spacing flange portion holding said first mentioned portion at an angle to said front face of said box-like element, a heat insulated reflective panel, said panel having a front face shaped similarly to said front face of said box-like element and substantially coextensive therewith, and means securing said panel to said element in a generally parallel spaced relation thereto, said panel having a lamp opening therethrough in alignment with said socket and said lamp opening in said box-like element, whereby an infrared lamp held by said socket will have its major axis disposed at an acute angle to the reflective surface of said panel.

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