

- [54] **HIGH DENSITY SPHERICAL MODULES**  
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 [22] Filed: **May 3, 1971**  
 [21] Appl. No.: **139,953**

### Related U.S. Application Data

- [63] Continuation of Ser. No. 836,543, June 25, 1969, abandoned.  
 [52] U.S. Cl. .... **219/343, 219/347, 219/354, 219/377, 219/461, 219/405, 240/47, 250/89**  
 [51] Int. Cl. .... **H05b 1/00, F21v 7/20, F21v 29/00**  
 [58] Field of Search..... 219/339, 342, 343, 219/347-358, 377, 460, 461, 405, 411; 250/88, 89; 240/47

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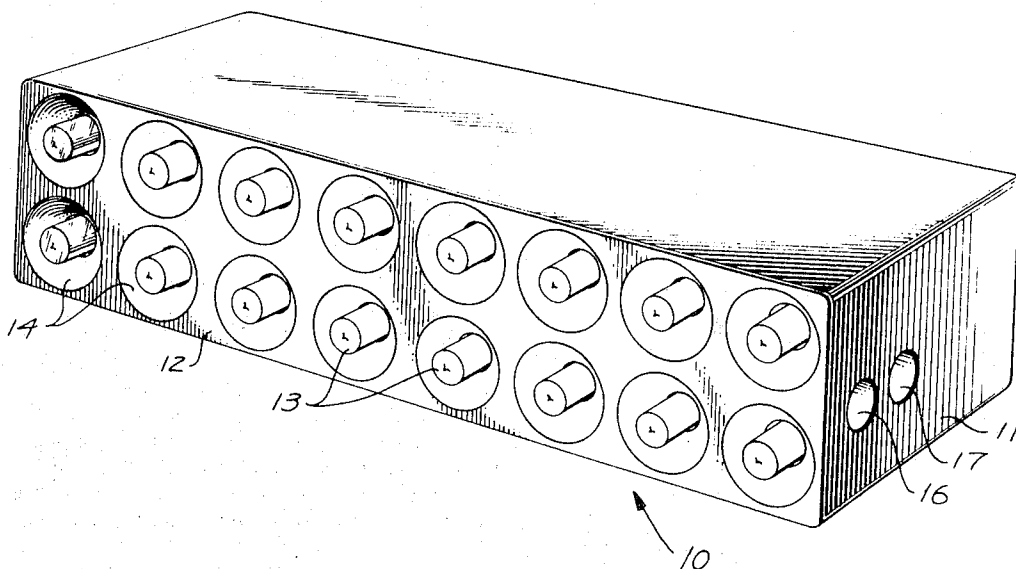
Primary Examiner—A. Bartis

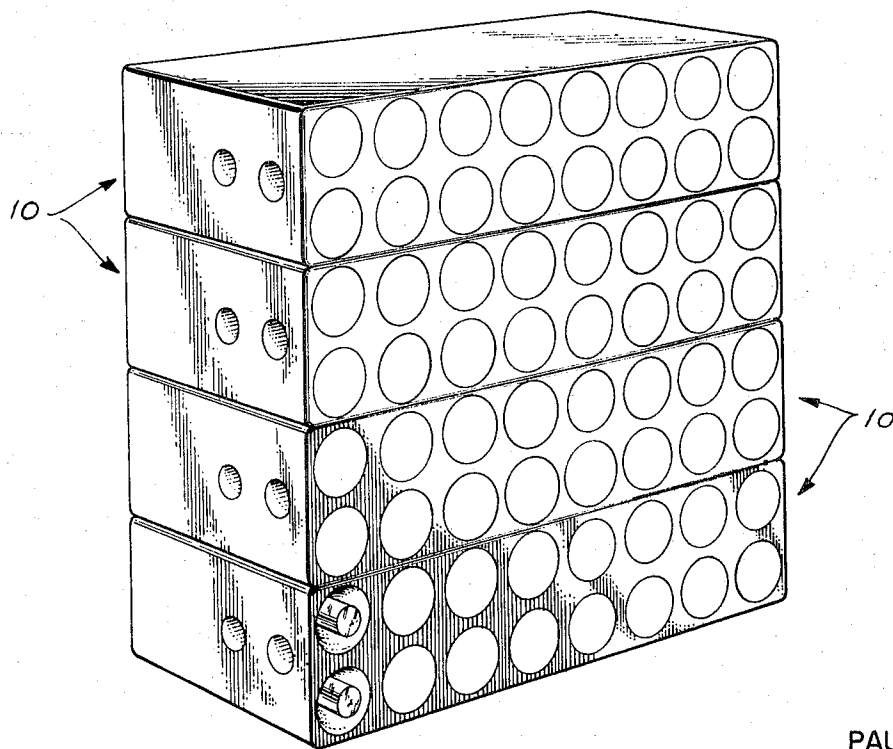
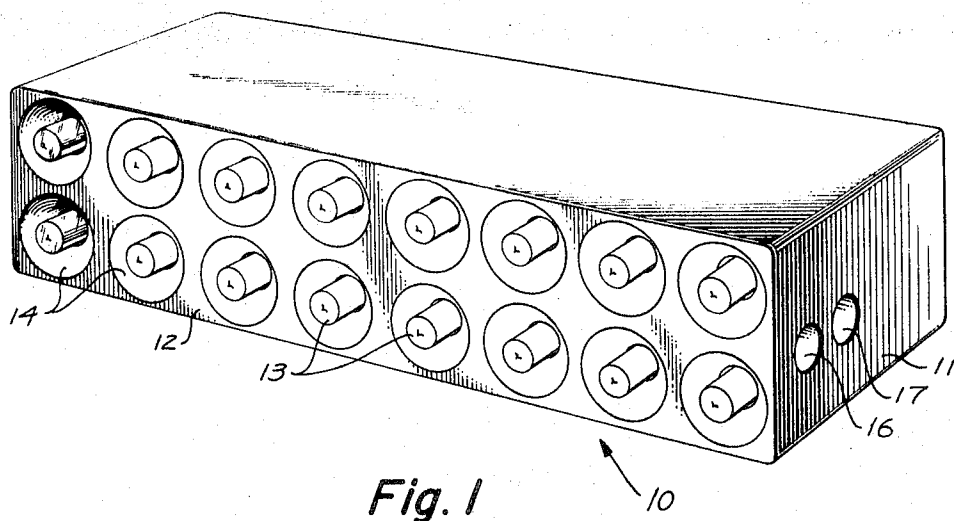
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### [57] ABSTRACT

A heat module having a plurality of single-end heat lamps characterized by a monolithic one-piece metal block having an outer reflective face and a plurality of reflective concave cavities formed interiorally of the block and opening through reflective face. The metal block has two rows of reflective cavities with a bore passing between the two rows and adapted to carry a cooling fluid. Each reflective cavity has associated with it a lamp housing channel and means associated with each cavity and its housing channel for supporting and powering an associated heat lamp with the heating filament of each heat lamp being situated within the respective reflective cavity and with the support end of the lamp being located outside the reflective cavity.

7 Claims, 15 Drawing Figures





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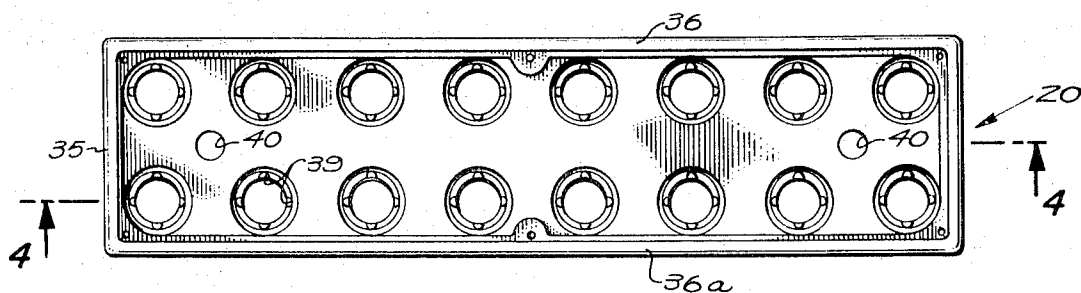


Fig. 3

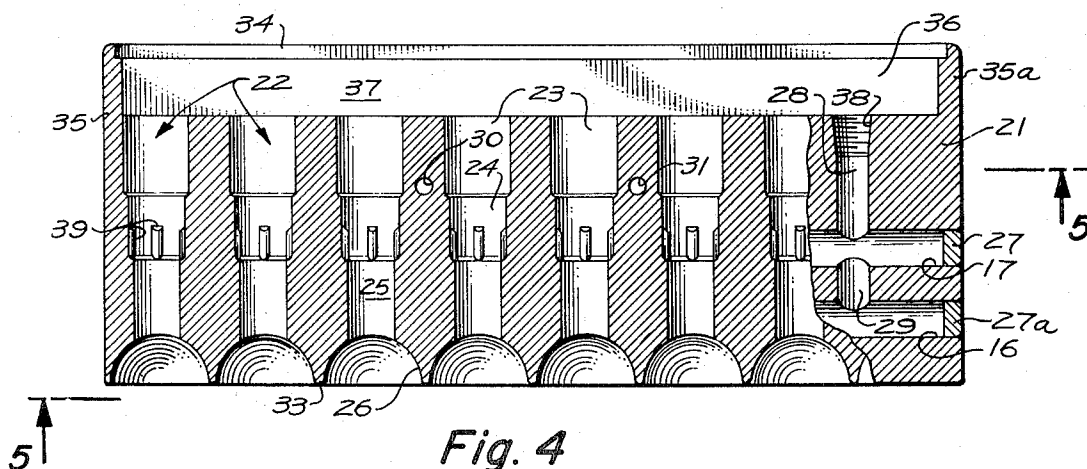


Fig. 4

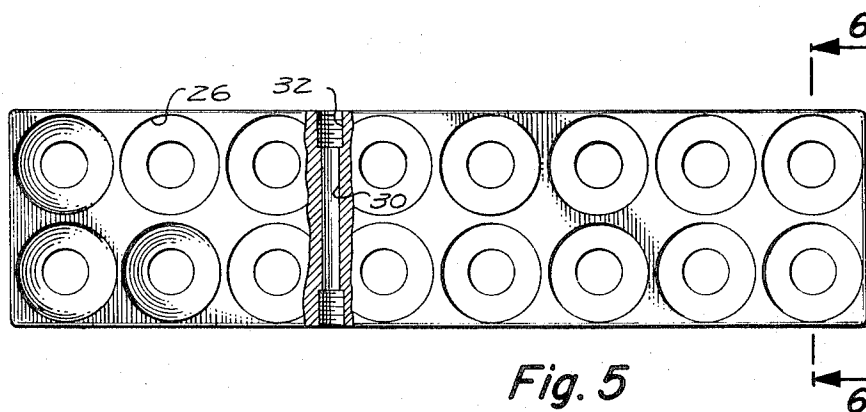


Fig. 5

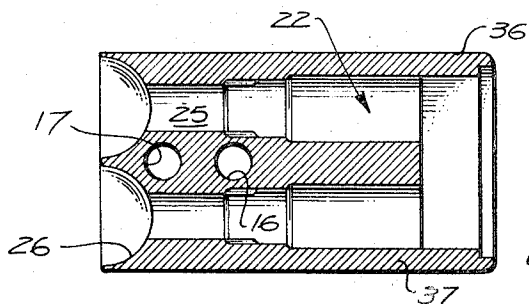


Fig. 6

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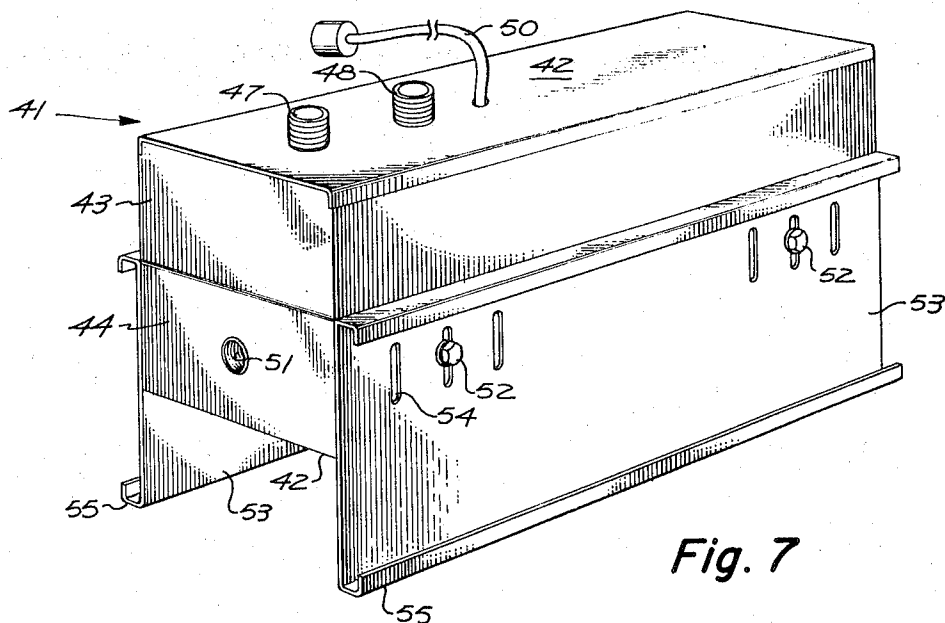


Fig. 7

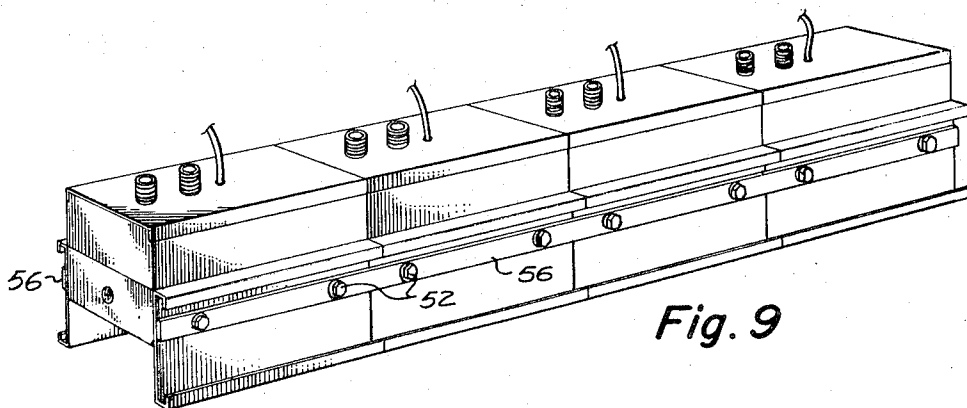


Fig. 9

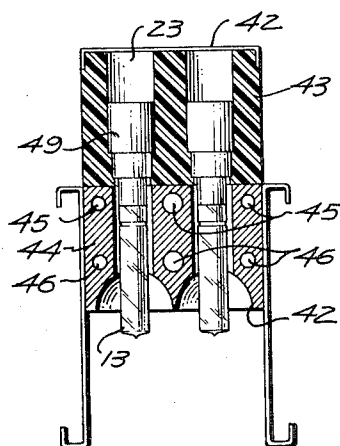


Fig. 8

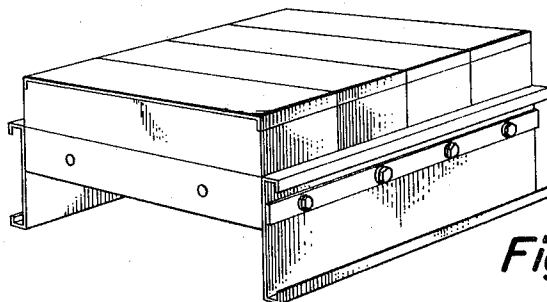


Fig. 11

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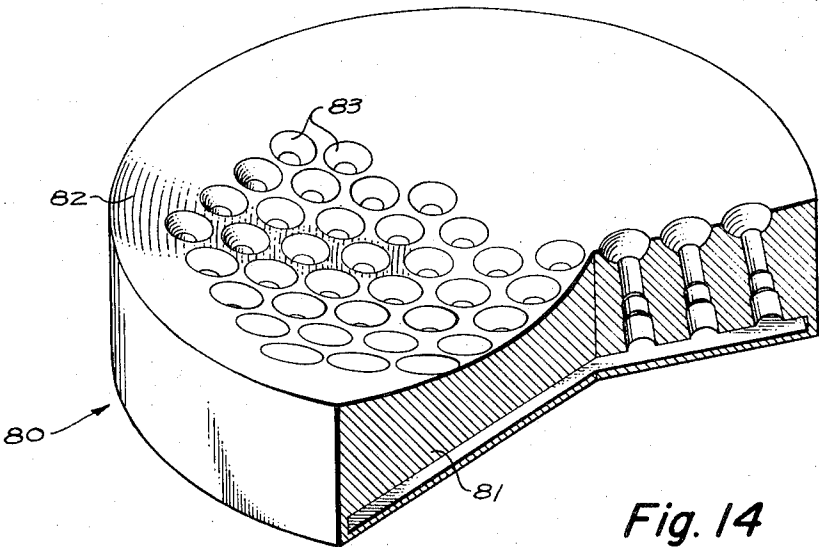


Fig. 14

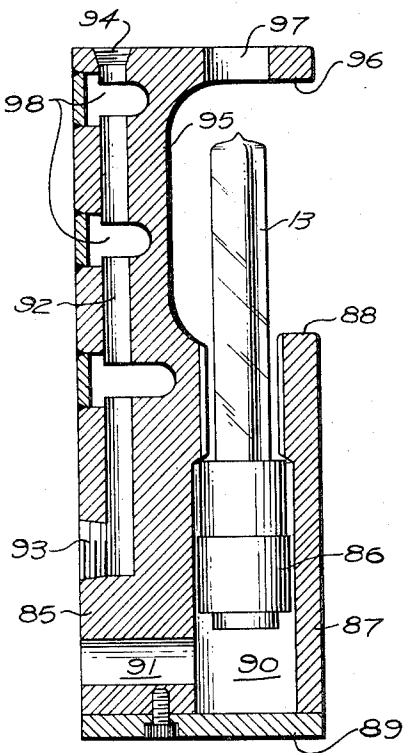


Fig. 15

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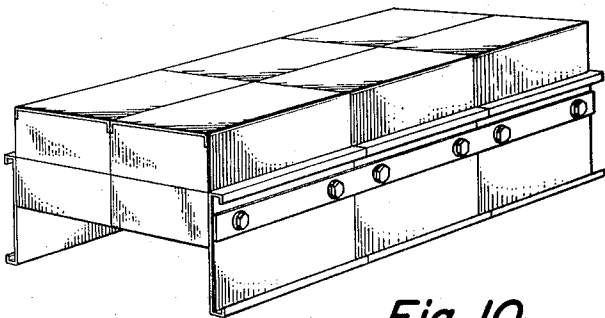


Fig. 10

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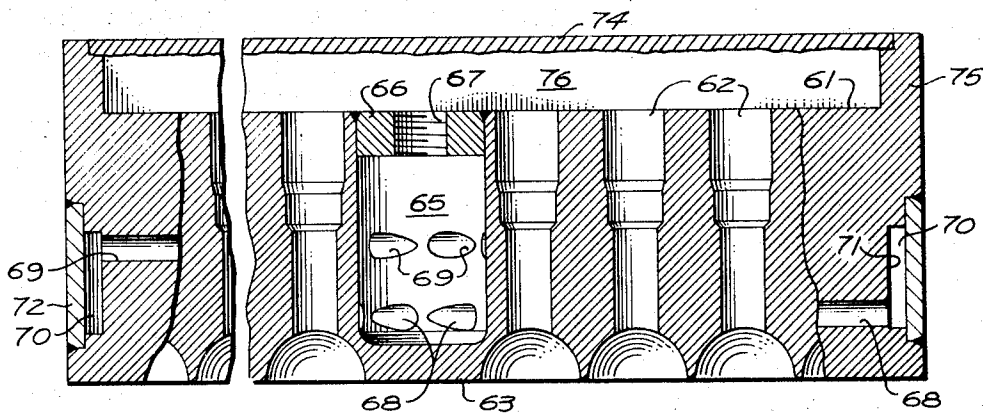


Fig. 12

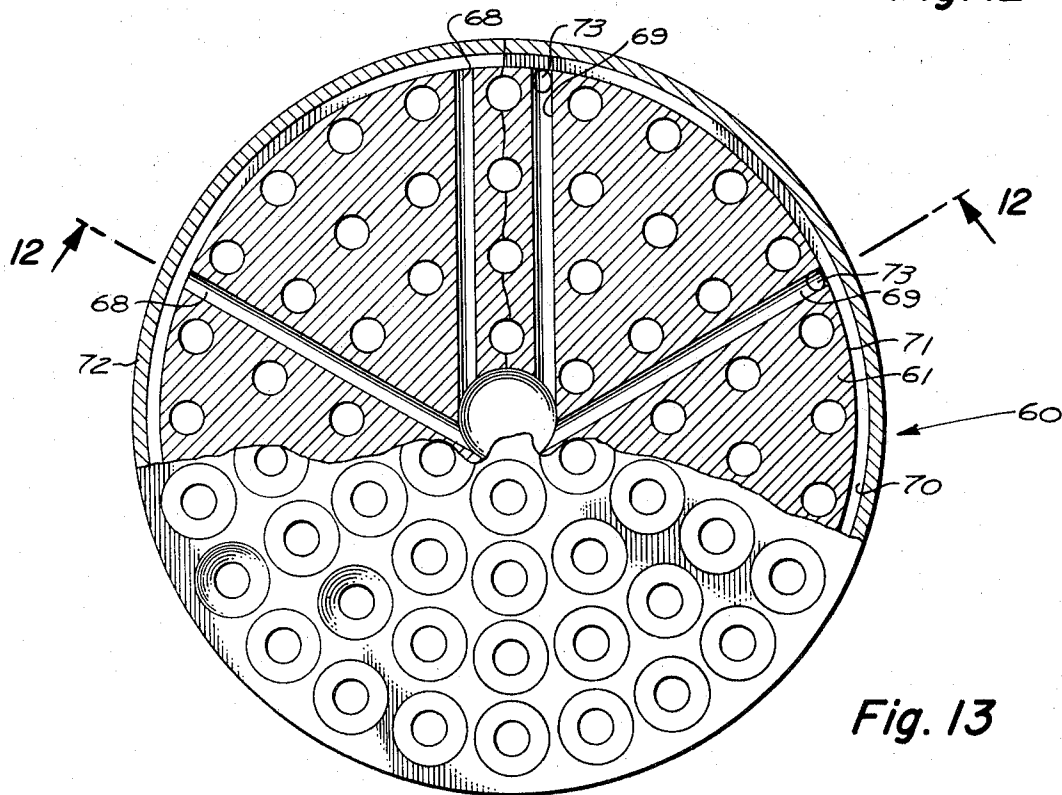


Fig. 13

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**HIGH DENSITY SPHERICAL MODULES**

This application is a continuation of co-pending U.S. Pat. application Ser. No. 836,543, filed June 25, 1969, now abandoned.

This invention relates to the application of localized heating and has for an object to apply intense heating to a selected localized area. A related object is to provide a heating facility capable of performing operations such as heating or brazing on devices over a considerable range of physical size.

Furnaces heretofore in use have been designed to a size, usually for some special operation and accordingly have not generally been useful for heating or brazing a great variety of sizes of devices.

By use of the present invention it is possible to set up a heater or furnace useful for heating or brazing or the like which will apply intense heat over such area as to be heated even though a small or a large size.

The heat module of the invention houses a plurality of single-end heat lamps in a monolithic one-piece metal block. The metal block has an outer reflective face and a plurality of reflective concave cavities formed interiorly of the block opening through the reflective face. Each reflective cavity has associated with it a lamp housing channel extending from the respective cavity through the metal block. The monolithic metal block is further characterized by a bore adapted to carry a cooling fluid. The bore is out of fluid flow communication with the reflective cavities. The block has at least two rows of reflective cavities with the bore passing between the two rows. Means are associated with the respective reflective cavities and their associated lamp housing channels for supporting and powering the associated heat lamp. The foregoing means are designed to support the respective lamps with their heating elements situated within the associated reflective cavities and with the support end of each lamp being located outside the cavity.

A feature resides in the use of a number of heat lamps in a module which constitutes a complete controllable heating unit. Each lamp is arranged with a reflector preferably a spherical reflector placed side by side in the module and directing the heat in approximately the same direction. By this arrangement no substantial part of the radiant heat from any of the lamps is directed to any other lamp and it is all directed at the workpiece.

Preferred features reside in the provision of cooling by air or liquid coolant, or both, in the module.

The geometry of the module is such that any module can readily be fitted or associated with any number of other modules.

The foregoing and other features will be better understood from the following detailed description and the accompanying drawings of which:

FIG. 1 is an isometric view of a heat module in accordance with this invention;

FIG. 2 shows a stack of the modules of FIG. 1;

FIG. 3 shows a rear view of a heat module in the general form shown in FIG. 1;

FIG. 4 is a cross-section view taken at line 4—4 of FIG. 3;

FIG. 5 is a front view of the module of FIGS. 3 and 4, showing a partial section taken at line 5—5 of FIG. 4;

FIG. 6 is a cross-section view taken at line 6—6 of FIG. 5;

FIG. 7 is an isometric view of a heat module according to the invention, provided with side supports;

FIG. 8 is an end view in cross section of the module of FIG. 7;

FIG. 9 shows a tandem arrangement of several modules according to FIG. 7;

FIGS. 10 and 11 show other arrangements of several modules like that of FIG. 7;

FIG. 12 is a cross-section view taken at line 12—12 of FIG. 13, showing a flat type of heat module according to this invention;

FIG. 13 is a bottom view partially in section of the module of FIG. 12;

FIG. 14 is a partial view partially in cross-section of a parabollic form of heat module according to this invention; and

FIG. 15 is a cross-section view of a portion of another form of heat module according to this invention.

FIG. 1 shows a heat module 10 according to this invention. It comprises a housing 11 in the form of a rectangular prism or box having a front or face 12 which is the heat-reflecting face. Within the housing there are fitted a number of heat lamps 13 threaded into suitable sockets for receiving electrical power from a source (not shown). The heat lamps are arranged in two parallel rows, there being eight lamps in each row in the embodiment shown. It will be understood, of course, that some other number of lamps may, if desired, be used in the module. The forward ends of the lamps 13 protrude through respective spherical reflectors 14 which should be polished for high heat reflectance when aluminum is used for the block containing the reflectors, which is the usual case. In case stainless steel is used instead of aluminum, the steel of the reflectors will ordinarily have applied to it a coating of porcelain of a fusing temperature of about 1,800° F which will then be fired with gold having a fusing temperature of about 1,400° F. Heat from the respective lamps radiates forwardly from the face 12 in the direction in which the lamps extend. Since the forward ends of the lamps do not protrude far forwardly of the reflectors, the principal radiation from the reflectors is in the forward direction from the face 12. The heat lamps are preferably of the tungsten filament type having quartz envelopes so that a large amount of infrared radiation is developed. The hot filaments are located within the forward portion of the envelope so as to be situated within the spherical part of the reflectors.

The module 10 is capable of radiating intense heat suitable for heating or brazing in an area limited by the area of the heat-radiating face 12.

Substantial heat is also created within the module itself, and for the purpose of cooling the module there is provided a conduit system extending between the two horizontal rows of lamps through which coolant fluid, ordinarily water, can be sent comprising bores 16 and 17. The terminations of these bores can be in the form of threads to which exterior piping for the fluid can be connected, and one of these terminations will be the entrance of the fluid and the other the exit from the module. The cooling will extend substantially the full length of the module so as to be in proximity with all of the heat lamps.

When it is desired to heat an area of greater size than that which the single module can adequately supply, two or more modules may be arranged together, for example in the stacked arrangement shown in FIG. 2,

wherein there are shown four modules like that of FIG. 1, one stacked above the other. Suitable means may be used to hold the stack of modules in place, such as the means 30, 31 and 32 shown in FIGS. 4 and 5.

FIGS. 3 to 6 inclusive, show in detail the construction of a heat module of a form which is basically shown in FIG. 1. The module 20 is similar to that of module 10 in FIG. 1 in that there is a similar arrangement of two rows of eight heat lamps each, one above the other, each lamp arranged with a spherical reflector in the manner of FIG. 1. The body 21 of the module, which can be of metal or other suitable material, serves as a block for supporting the heat lamps. It has formed through it generally tubular passageways 22 equal in number to the number of heat lamps in the module and properly spaced to provide substantially equal lamp spacing. The rearmost cylindrical portions 23 of each of these openings is dimensioned to have fastened into it a threaded socket for the heat lamp so that the base of the lamp forward of the threaded lamp member which enters the socket will occupy the area 24 and the lamp protrudes through cylindrical portion 25 and out into the spherical reflector 26.

A pair of ducts 16 and 17, spaced somewhat apart and parallel to each other, extend for almost the full length of the module through the body portion between the two rows of heat lamps, and in the region of the lamps, through which coolant fluid can flow to carry away heat. When a number of the modules are stacked in the general manner shown in FIG. 2 the bore holes 16 and 17 will be closed at their ends by plugs 27 and 27a which can be welded in place to the block. The entrance to these ducts is furnished by a duct or bore 28 entering at the rear of the body 21 to meet duct 17, and an extension 29 thereof enables bore 28 to communicate with duct 16. There is a duct or bore similar to bores 28 and 29, communicating with the rear of the module and with ducts 17 and 16 at the opposite end of the module, this not being shown. Cooling fluid can be sent into one of these bores 28 so that it will flow in the same direction in the two ducts 17 and 16 and be emitted at the other of the bores at the other end of the module.

For the purpose of securing a plurality of the modules together, there are provided a pair of bores 30 and 31 extending through the module from top to bottom and provided with suitable internal threads 32 at their ends. When a number of the modules are stacked as shown in FIG. 2, long bolts or studs can be passed through the respective holes 30 and 31 of all the modules and secured by nuts at the ends of the bolts. When only a single module is used, reflector plates can be attached to its opposite sides by individual bolts which thread into thread 32, in the general manner shown in FIG. 7.

The reflecting face 33 of the module is made mainly of the spherical reflectors 26, the peripheries of which are placed close to each other. The back of the body 21 is provided with a rearwardly extending extension the end portions of which are indicated as 35 and 35a, and the long portions as 36 and 36a to which there can if desired be attached a back plate (not shown), which when present forms an enclosed space 37 between the block 21 and such back plate. The region 37, either with or without the back plate, can accommodate the electrical wiring necessary to connect with the several lamp sockets and also the coolant fluid conduits to connect with the threaded inlets and outlets 38 of the cool-

ant fluid system. The back plate can be held securely to the module body, for example, by bolts.

A further optional feature resides in provision for introducing cooling air to the heat lamps. This can be done by utilizing the back plate as described above and introducing the air under pressure into the enclosed space 37. For this purpose, an air tube (not shown) will be led through the back plate to communicate with space 37 from whence air flows through spaces around the lamp sockets and the quartz envelopes of the lamps and out through the reflectors, inasmuch as the diameters of the lamps are not as great as the respective parts of the body which surround the lamp, such as the internal diameter of areas 25 and the openings through the spherical reflectors. To facilitate cooling of the lamp base, there are provided a number of spaced slots 39 (four of these slots being shown for each lamp) communicating with spaces 25 and extending rearwardly adjacent the lamp socket.

It will be recognized that a plurality of the modules according to FIGS. 3 to 6 may be stacked in the manner shown in FIG. 2.

FIGS. 7 and 8 show a heat module mounted for application of radiant heating to an area. The module 41 is similar to those of FIGS. 1 and 3 in having two rows of heat lamps. In this case, the module is turned so that the heat lamps and the reflecting surface 42 are horizontal and face downward to heat an area beneath it. The arrangement differs from that of FIGS. 3 and 4 in that there is no space such as 37 between any back cover and the heat lamps such as in FIG. 4. Instead, the cover 42 is placed directly on the lamp base block 43, which can be made of a suitable heat-resisting insulating material such as Bakelite. The portion 44 of the module body carrying the spherical reflectors through which the lamps 13 protrude, will ordinarily be of metal and securely fastened to the block 43. The body (see FIG. 8) is provided with upper fluid conduits 45 and lower fluid conduits 46 such that coolant fluid can be sent into the upper conduits 45 to flow in one direction while returning by way of the lower conduits 46. Fluid connection to the inlet end of conduit 45 and the exit end of conduit 46 are provided by pipe elements 47 and 48, respectively. Lamp sockets 49 are fitted into the openings 23 in the block 43 and the bases of the lamps 13 are threaded into the sockets as has been previously described. The form of lamp 13 shown in FIG. 8 can be used in all embodiments of this invention. Electrical connection to the several lamp sockets is made by electric cable 50 passing through the cover plate 42.

The member 44 is provided with threaded holes 51 at its ends and also its sides through which bolts 52 can be threaded. The purpose of this is for attachment of reflector members 53 suitably apertured or slotted at 54 to permit passage of the bolts. Use of two of these reflector plates 53, one on either side as shown in FIG. 7, provides support for the module at some distance above a table or floor on which the module is placed by resting it on footings 55 formed at the edges of the reflectors. The inner surfaces of the reflectors are preferably made to have a polished reflecting surface, preferably being gold fired like the spherical surfaces for the lamp reflectors, to provide good heat radiation.

It will be recognized that a number of the modules according to FIG. 7 can be placed end-to-end in tandem as shown in FIG. 9, in which case suitable lock bars 56 can be used to hold them in position by passing



the bolts 52 through the lock bars. Such an arrangement will provide heating over elongated areas.

Where it is desired to make the elongated area somewhat broader than in the arrangement of FIG. 9, an arrangement like that of FIG. 10 can be used. This utilizes rows of the modules with the reflectors bolted at the outsides of the arrangement. In this case the abutting sides of the rows will be fastened together in a suitable manner.

Another possible module arrangement is that shown in FIG. 11 wherein a tandem arrangement of modules is made up by placing them side by side, and bolting the ends by the lock bars and the reflectors.

In the arrangement of FIGS. 7 through 11, no specific arrangement for injecting air is shown. It will be understood, however, that air injection may, if desired be introduced behind the lamp base to send air alongside the lamps and out through the spherical reflectors.

FIGS. 12 and 13 show a flat circular form of unit embodying an array of heat lamps with spherical reflectors operable in a manner somewhat similar to the modules previously described, which is suitable for heating areas commensurate with the circular reflecting surface of the unit. In this construction, the unit 60 comprises a circular body 61, provided with a number of openings 62 through it, corresponding to the number of heat lamps to be used, which in the case of FIGS. 12 and 13 is about sixty. The reflecting face 63 contains a spherical reflector 64 for each lamp, and lamp bases for the lamps can be fitted into the respective openings in the manner described in connection with previous figures so that lamps fitted into the lamp sockets will protrude forwardly from the reflectors.

Fluid cooling for this embodiment is provided by provision of a central cavity 65 into the top of which there is welded a circular collar 66 which is centrally drilled and threaded at 67, into which there can be threaded a coolant fluid inlet conduit. There radiate from the sides of this cavity 65 a number of forward level channels 68 and a similar number of rearward level channels 69. These channels radiate radially outward through the block to an annular passageway or space 70 formed by a re-entrant part 71 of the block and a ring member 72 welded to the outer circumference of the block as shown, leaving the annular space 70 in communication with both sets of channels 68 and 69, so that there is communication through the channels from the reservoir 65 to the annular space 70. In the arrangement shown there are six upper channels 69 and six lower channels 68. At the junction of each upper channel with the annular space 70 there is provided an outlet 73 through the block to the side of the block opposite the reflector surface. Thus, water injected into inlet 67 will be ejected from the six outlets 73 which can be all connected together for cooling and recirculation.

A back cover plate 74 attached to a circular rim 75 protruding from the block provides a space through which the necessary electric power wiring can be carried, and also the tubing for the coolant fluid. Likewise when it is desired to inject air in addition to liquid coolant, this may be injected into space 76 for flow past the lamps in the manner previously described.

An object to be heated can sometimes conveniently be taken care of by a parabollic form of heating unit. Such a unit is shown in a basic form in FIG. 14 in which the heating unit 80 is provided with a block 81 shaped to provide a parabollic heat-reflecting surface 82. The

spherical reflectors 13 with their heat lamps are fitted to this parabollic surface and into the block in the general manner illustrated in the case of the flat circular reflecting surface of FIG. 13. Likewise, a liquid coolant system, as well as an air-cooling system, can be provided in a manner similar to that illustrated in FIG. 13. Except for the parabollic shape of the reflecting surface, the structure can be built as shown in FIG. 13.

FIG. 15 shows a form of heat module somewhat different from those previously described. In this arrangement, the block 85 is in the form of an annulus and FIG. 15 is a cross-section view through only one side of this annulus, the center line of the annulus being represented by the line C-L.

In this arrangement, the block 85 is at one side that is, above the lamps 13 so that the lamps lie along the block. It will be understood that a plurality of such lamps, located in the same place, will be used around the annulus. The base of each lamp is threaded into its lamp socket 86 by holding the socket between the base 85 and a front wall 87, spaced from and extending parallel to the block 85 from a position below the base to a position 88 which is short of the position of the tungsten filament in the quartz lamp. Circular plate 89, forming the inner wall of the annulus, serves to provide a space 90 to which access is had by a channel 91 through which the electrical power lead to the lamp sockets can be brought and also through which air can be blown into annular space 90 to pass out through spaces left between the lamp sockets and the lamps and the walls which surround the lamps.

Liquid cooling is provided by a channel 92, the ends of which are reached by a threaded inlet and outlet 93 and 94, respectively. Channel 92 communicates with annular channels 98 formed in the ring so that the coolant fluid can pass all around the ring in the vicinity of the lamps.

A polished reflecting portion 95 is formed in the block behind the lamps to reflect heat out through the opening between position 88 and position 96 at the end of the block near the forward end of the lamp. Holes 97 at the peripheral portion of the annular ring enable the lamps to be removed and replaced.

It is contemplated that the electric heat lamps which will be used in the several embodiments will be the tungsten filament type encased in quartz, and of about 750 watts power capacity.

The embodiments illustrated herein are given by way of example rather than of limitation, and it will be understood that other arrangements within the scope of the invention may suggest themselves. The invention is not limited except in accordance with the scope of the appended claims.

What is claimed is:

1. In a heat module having a plurality of single-end heat lamps, the improvement comprising:

a monolithic one-piece metal block having an outer reflective face with a plurality of reflective cavities formed interiorally of the block and opening through said reflective face, said reflective cavities each comprising a curvilinear concave surface and having a lamp housing channel extending from the respective cavity through the metal block, said metal block being further characterized by a bore to promote cooling of the metal block and out of fluid flow communication with the reflective cavities and adapted to carry a cooling fluid, said block

having at least two rows of reflective cavities with the bore passing between the two rows; and means associated with each reflective cavity and the respective lamp housing channel for supporting and powering the associated heat lamp, said means 5 designed to support the associated lamp with the heating filament of said heat lamp being situated within the respective heat reflective cavity and with the support end of said lamp being located outside said reflective cavity. 10

2. A module according to claim 1 in which each of the reflective cavities is substantially hemispherical.

3. A module according to claim 1 in which means is provided for supplying pressurized cooling air into the block, and opening means formed in said block in communication with said air supply means along the surface of each lamp and out through said reflective cavity for the lamp. 15

4. A heat module according to claim 1 in which the heating elements of the heat lamps are tungsten filaments and the lamps have envelopes of quartz containing the tungsten filaments. 20

5. A heating system comprising a plurality of modules according to claim 1 fastened side by side.

6. In a heat module having a plurality of single-end heat lamps, the improvement comprising: 25

a monolithic one-piece rectangular metal block having an outer reflective face with a plurality of reflective cavities formed interiorally of the block and opening through said reflective face, said reflective cavities each comprising a curvilinear concave surface and having a lamp housing channel extending from the respective cavity through the metal block, said metal block being further characterized by a bore to promote cooling of the metal block and out of fluid flow communication with the reflective cavities and adapted to carry a cooling fluid, said block having at least two rows of reflec-

tive cavities with the bore extending lengthwise between the two rows; and

means associated with each reflective cavity and the respective lamp housing channel for supporting and powering the associated heat lamp, said means designed to support the associated lamp with the heating filament of said heat lamp being situated within the respective heat reflective cavity and with the support end of said lamp being located outside said reflective cavity.

7. In a heat module having a plurality of single-end heat lamps, the improvement comprising:

a monolithic one-piece metal block having an outer reflective face with a plurality of reflective cavities formed interiorally of the block and opening through said reflective face, said reflective cavities each comprising a curvilinear concave surface and having a lamp housing channel extending from the respective cavity through the metal block, said metal block being further characterized by a bore to promote cooling of the metal block and out of fluid flow communication with the reflective cavities and adapted to carry a cooling fluid, said block having at least two rows of reflective cavities with the bore extending lengthwise between the two rows; 30

means associated with each reflective cavity and the respective lamp housing channel for supporting and powering the associated heat lamp, said means designed to support the associated lamp with the heating filament of said heat lamp being situated within the respective heat reflective cavity and with the support end of said lamp being located outside said reflective cavity; and

means for supporting the module above a underlying surface with its reflective face spaced therefrom and directed downwardly.

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