Aug. 19, 1952 R. L. BERGEN ET AL 2,607,876

ELECTRIC HEATING DEVICE

Filed Oct. 31, 1949 3 Sheets-Sheet 1

Fig. 1

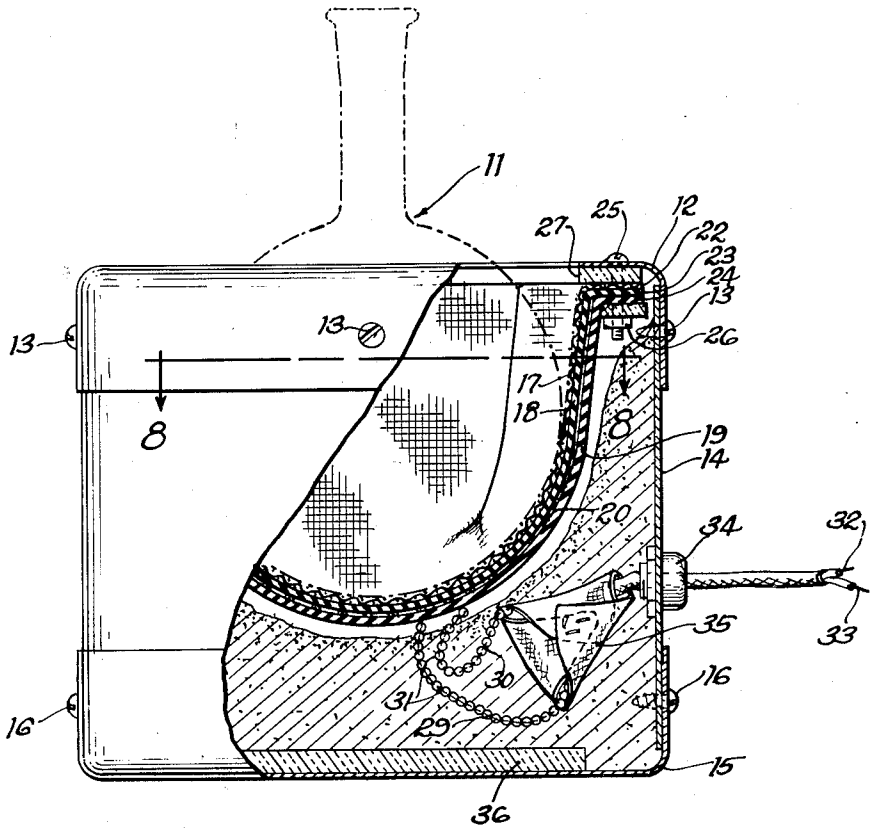


Fig. 3

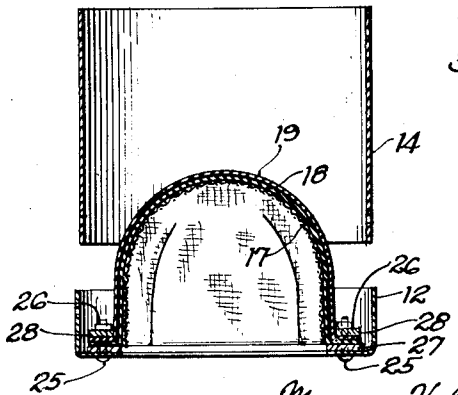
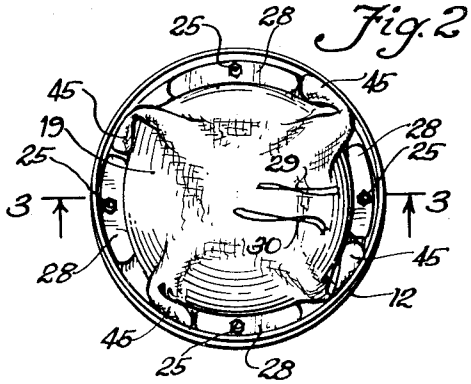


Fig. 2



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Fig. 4

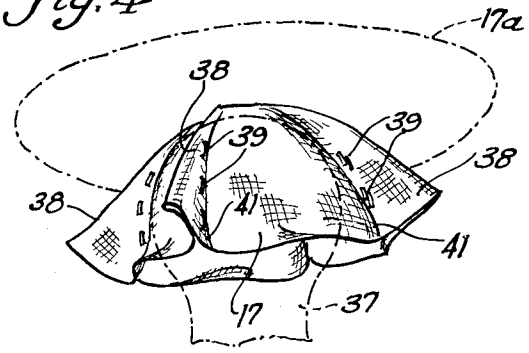


Fig. 5

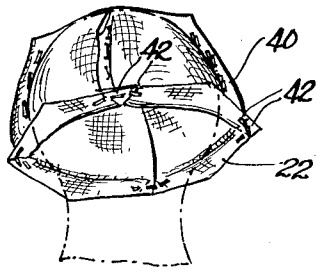


Fig. 7

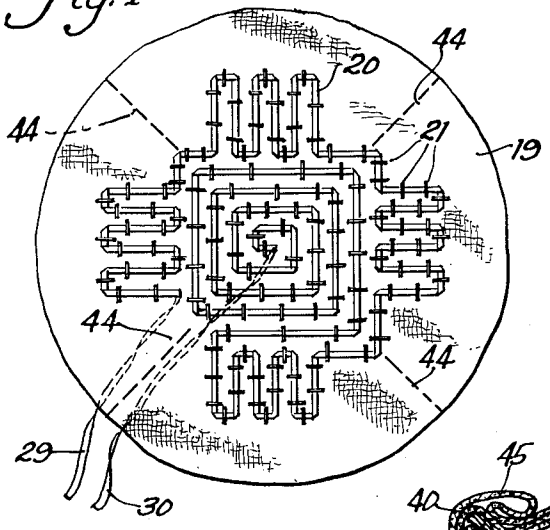


Fig. 6

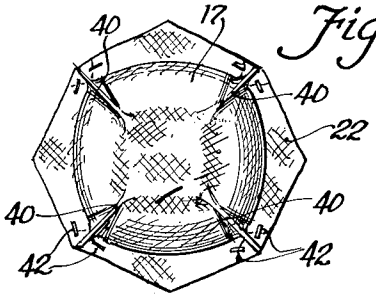
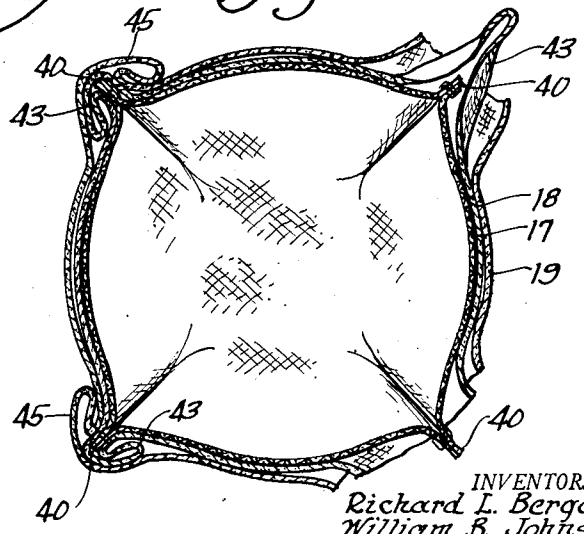


Fig. 8



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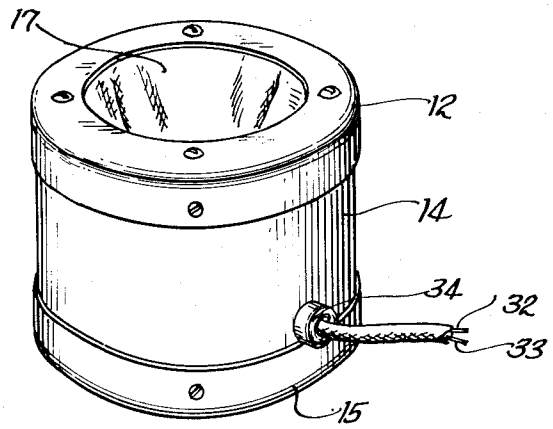
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Fig. 9



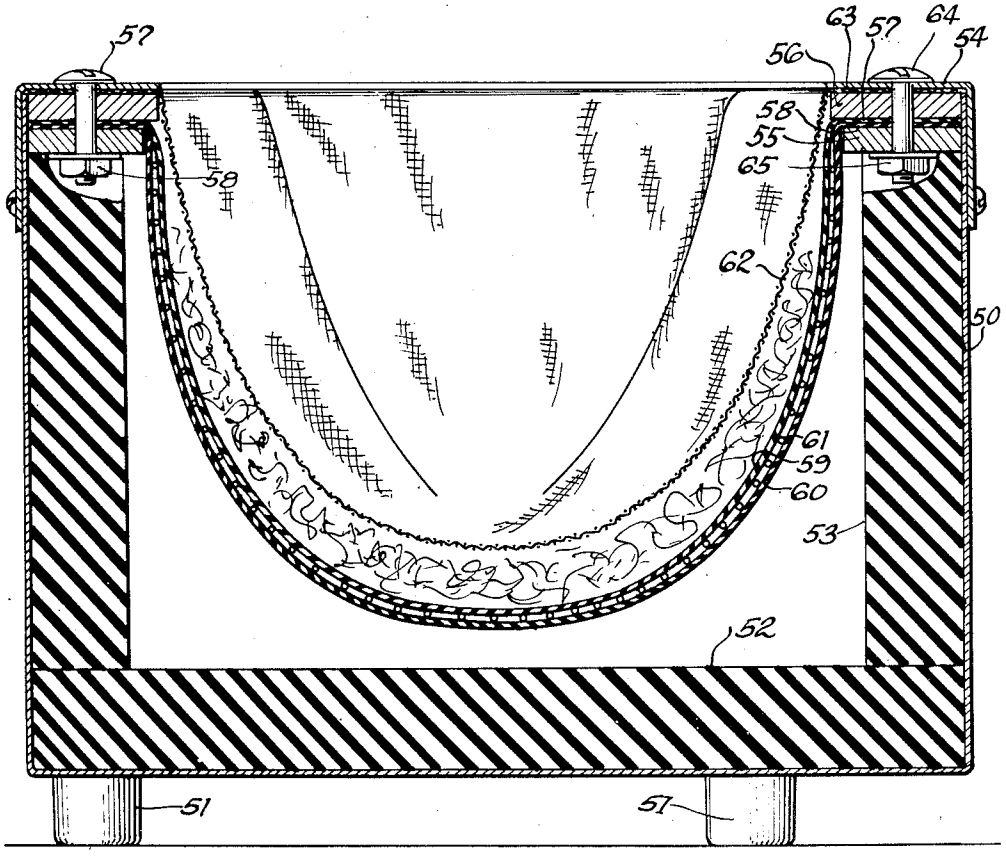


Fig. 10

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ELECTRIC HEATING DEVICE

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Application October 31, 1949, Serial No. 124,642

18 Claims. (Cl. 219—38)

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This invention relates to electric heating devices and methods of constructing the same. More particularly, the invention relates to devices for supporting and heating glass vessels such as flasks and the like, and the invention has for an object the provision of improved reliable and inexpensive devices of this character.

Electric heating devices of the above character have heretofore been proposed in which the vessels to be heated are supported in a suitably shaped receptacle of flexible resilient and non-heat-conducting fabric formed of glass fibers or the like, having a helical electric resistance element stitched or otherwise secured to the rear surface thereof, the heating element and the flexible fabric being surrounded and supported by a mass of resilient heat insulating material such as glass wool which has been packed or matted into a resilient cushion. Such prior devices are subject to definite limitations in that the glass fabric which is non-heat-conducting tends to cause hot spots unless the electric heating element is very carefully positioned on the surface thereof, and in that glass cloth of this character is incapable of withstanding temperatures above 450 degrees. The use of quartz cloth, which has likewise been proposed, is objectionable from the standpoint of expense. Accordingly it is a further object of this invention to provide improved heating devices of this character which may be operated at relatively high temperatures and which insure uniform heating of the flasks.

Another object of the invention is the provision of heating devices of this character employing a vessel supporting member formed of heat conducting material such as steel cloth or similar metal mesh.

Still another object of the invention is to provide a simple and rugged construction which may be readily and economically assembled and which operates reliably and safely over wide ranges of temperature.

Still another object of the invention is the provision of improved methods of manufacturing heating devices of the above character.

In carrying out the invention in one form, a heating device is provided comprising an outer casing having an upper open end in which is supported a reentrant vessel-receiving member formed of relatively flexible but shape retaining heat conducting material such as steel cloth. An electric heating element is supported within the outer casing closely adjacent the rear surface of the steel cloth in electrically insulated relation

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thereto, and heat insulating material is provided within the casing substantially coextensive with the side and bottom walls thereof and in spaced relation to the heating element and the vessel-receiving member. More particularly, the electric heating element is in the form of a flexible ribbon type heater and is mounted between a pair of flexible sheets of electrical insulating material which substantially conform to the shape of the vessel-receiving member and are supported in loosely nested relation thereto. Preferably the heat insulating material which is contained in the casing between the casing walls and the heater supporting members constitutes a mass of loose powdered heat insulating material which substantially fills the remainder of the space in the casing. As will be pointed out in detail in the following description, the invention also contemplates improved methods of forming heating devices of the above indicated character.

For a more complete understanding of the invention reference should now be had to the drawings, in which:

Fig. 1 is an elevational view, partly in section, of a heating device for flasks embodying the present invention, a typical flask being shown in broken lines;

Fig. 2 is an inverted plan view showing a partial assembly of some of the elements embodied in the structure of Fig. 1;

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 2 showing an additional step in the assembly of the device;

Figs. 4 to 7, inclusive, are detail views showing various elements and the manner in which these elements are formed and assembled to complete the structure of Fig. 1;

Fig. 8 is a sectional view taken substantially along the line 8—8 of Fig. 1;

Fig. 9 is a perspective view; and

Fig. 10 is an elevational sectional view illustrating another form of heating device embodying the present invention.

Referring now to the drawings, the invention is shown as embodied in a device for supporting and heating glass vessels such, for example, as the flask 11 shown in broken lines in Fig. 1, which heating device comprises an annular top member 12 which is substantially L-shaped in cross section and is adapted to be secured by suitable fastening means, such, for example, as the self-threading screws 13, to a body member 14, which may take the form of a metal cylinder formed of aluminum or similar material, the cylinder 14 being secured at its lower end to a

cup-shaped bottom closure member 15, as, for example, by self-threading screws 16.

The improved supporting and heating means embodying the present invention are suspended in loosely nested relation from the horizontal flange portion of the top member 12 and preferably comprise a suitably shaped vessel-supporting member 17, which is formed of relatively flexible but shape retaining heat conducting material such, for example, as steel cloth of 40 to 60 mesh. Disposed rearwardly of the vessel-supporting member 17 is a pair of electric insulating members 18 and 19 which may be formed of any suitable flexible non-shape-retaining but electric insulating material, such, for example, as asbestos fiber cloth, and a heating element 20 which, as shown best in Fig. 7, preferably constitutes a ribbon type flexible resistor element which is formed to a desired pattern and secured to the inner surface of the insulating member 19 as, for example, by metal staples 21. The members 17, 18 and 19, the detailed construction of which will be more fully described hereinafter, are provided, as shown in Fig. 1, with flanges 22, 23 and 24, respectively, and all of these flanges are supported from the annular top member 12 by means of suitable bolts 25 and nuts 26, a heat insulating ring 27 formed of Transite or other suitable heat insulation being disposed between the flange 22 on the heat conducting member 17 and the top member 12, and suitable supporting blocks 28, which are preferably formed of the same material as the ring 27, are disposed at intervals around the periphery of the assembled members so as to receive the bolts 25, whereby all of the flanges 22, 23 and 24 are clamped and tightly secured in position, thereby supporting the members 17, 18 and 19 within the casing formed by the members 12, 14 and 15.

As shown in Fig. 4, the inner and outer ends of the heating element 20 extend through suitable apertures in the member 19 so as to form flexible leads 29 and 30, which are provided, as shown in Fig. 1, with a plurality of insulating beads 31, and the leads 29 and 30 are electrically connected by means of a suitable terminal block, not shown, to the conductors 32 and 33 which extend through an insulating bushing 34 in one wall of the body member 14 and are provided with a suitable external connector plug, not shown. The cord or cable which includes the conductors 32 and 33 extends loosely through the bushing 34 and, in order to protect the leads 29 and 30 against strain, the terminal block is wrapped, as shown in Fig. 1, in a sheet of asbestos 35, which wrapped asbestos will take up any strain exerted on the external cord by engaging the inner wall of the casing 14. The space within the outer casing and the outer nested member 19 is substantially filled, as shown in Fig. 1, with a loose mass of powdered insulating material, such, for example, as powdered magnesia cement, so as suitably to insulate the casing against heat from the element 20, the leads 29 and 30 and the connection enclosed within the asbestos wrapping 35 being substantially surrounded by the mass of powdered material, and, if desired, a supplemental insulating block or plate 36, which constitutes the portion of the insulating material that remains when the insulating ring 27 is cut from a sheet of material, may be placed within the casing resting on the bottom wall thereof, as shown in Fig. 1.

As shown best in Figs. 4 to 6, inclusive, the vessel engaging member 17 is preferably formed in accordance with the present invention from a circular sheet of steel cloth represented by the broken line 17a in Fig. 4 by forming the sheet 17a about a suitable form 37, which forming operation is carried out by folding the sheet 17a along substantially radial lines to provide a plurality of wedge shaped double thickness folds 38, which are thereupon secured together along the inner edges thereof by suitable means, such, for example, as staples 39. The wedge shaped folds 38 may thereupon be trimmed to provide substantially uniform width flanges 40, as shown best in Fig. 5, and the shaped element is thereupon slit along opposite edges of the radial flanges as indicated by the reference numeral 41 in Fig. 4, so as to permit the outer edges of the member 17 and the lower edges of the flanges 40 to be turned outwardly and secured together by suitable staples 42, thereby to form the peripheral flange 22 which is employed, as heretofore described in connection with Fig. 1, to support the member 17 in inverted relation from the member 12. After the vessel-supporting member 17 has thus been formed, a similar circular sheet of asbestos fiber cloth which is employed to form the member 18 may be placed over the shaped member 17 and similarly folded to provide a plurality of double thickness wedge shaped ears 43 (Fig. 8) which are positioned to receive the radial flanges 40 on the member 17 and which may be thereafter folded over the flanges as indicated at the left hand side of Fig. 8.

Preliminary to the forming of the outer member 19, a circular sheet of asbestos cloth is provided, as shown in Fig. 7, with a ribbon type electric resistor 20 arranged to permit folding of the circular sheet along the radial lines indicated by the broken lines 44. While the arrangement of the resistor 20 on the circular sheet from which the member 19 is formed is not critical due to the fact that the heat conducting characteristic of the member 17 insures uniform heat distribution, assembly of the ribbon type resistor on the asbestos sheet may be facilitated by first stencilling the desired pattern on the circular sheet and then securing the resistor along the stencilled lines by means of the stapes 21. After the resistor element has been secured to the circular sheet of asbestos cloth, the outer member 19 may be formed over the previously formed member 18 by folding the circular sheet along the lines 44 to provide the double thickness folded portions 45 shown in Fig. 8, which folded portions encompass the folded portions 43 on the member 18 and are preferably folded thereover in a direction opposite from the direction in which the folds 43 were formed. Thus any possibility of the resistor member 44 contacting the flanges 43 on the metallic member 17 is eliminated.

In order to assemble the heating device, the top member 12 is placed in inverted position, as shown in Fig. 3, the insulating ring 27 is positioned within the member 12, and the sub-assembly comprising the members 17, 18 and 19 is then located as shown in inverted position on the ring 27, whereupon the insulating blocks 28 may be positioned, as shown in Figs. 2 and 3, and the sub-assembly completed by means of the bolts 25 and the nuts 26. Thereafter the cylindrical body member 14 may be telescoped into the top member 12 and secured by the screws 13, whereupon the connection of the leads 29 and 30 to the outgoing conductors 32 and 33 may be completed as hereinbefore described and the powdered insulating material poured into the member 14 so as substantially to fill the same.

The insulating plate **36** may then be placed on top of the powdered insulating material and, after securing the bottom member **15** to the open end of the body member **14**, the unit may be inverted to provide the finished device shown in Fig. 1.

It will thus be seen that, in accordance with the present invention, a heating device has been provided which may be inexpensively and readily manufactured with a minimum of effort, which may be quickly assembled without recourse to skilled labor, and which provides an efficient heating device that is properly insulated both from the electrical and thermal standpoints.

In Fig. 10 a further embodiment of the invention is shown wherein an open topped outer casing **50** having suitable supporting legs **51** secured thereto is provided with a heat insulating lining which may be integrally formed but which is shown as comprising a block **52** and a cylindrical liner **53** shaped to fit within the casing **50**, the upper end of the casing **50** being provided with an annular top member **54** which is substantially L-shaped in cross section. Secured to the inwardly extending flange of the top member **54** are a pair of heat insulating rings **55** and **56**, between which are disposed the annular flanges **57** and **58** of a pair of reentrant members **59** and **60** formed of suitable electrical insulation and having disposed therebetween an electrical resistor element or heater **61**. The members **59** and **60** and the resistor unit **61** may be formed in the same manner as the members **18**, **19** and **20** heretofore described in connection with Fig. 1, and disposed within the member **59** in spaced relation thereto is a vessel engaging and supporting member **62** which may be formed of any suitable flexible fabric and which is provided at its open upper end with a flange **63** adapted to be clamped between the insulating member **56** and the top member **54** by suitable bolts **64** and nuts **65** which likewise serve to clamp the flanges **57** and **58** between the members **55** and **56**. If the vessel supporting member **62** is formed of heat conducting material, similar to the member **17** of the embodiment shown in Fig. 1, an additional ring of heat insulating material similar, for example, to the ring **56** may be interposed between the flange **63** and the annular top member **54**. In this embodiment of the invention it will be understood that the heater element **61** is connected through suitable leads to an outgoing pair of conductors similar to the conductors **32** and **33** of the embodiment shown in Fig. 1. If desired, the space between the outer asbestos cloth member **60** and the insulating members **52** and **53** may be filled with powdered insulating material similar to that employed in the embodiment of Fig. 1, although in most cases such additional heat insulation will not be required.

While particular embodiments of the invention have been shown, it will be understood, of course, that the invention is not limited thereto since many modifications may be made and it is therefore contemplated by the appended claims to cover any such modifications as fall within the true spirit and scope of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A heating device for supporting and heating glass vessels and the like comprising an outer casing having an upper open end, a reentrant vessel-receiving member formed of meshlike relatively flexible but shape retaining heat-conducting material, means for supporting said member from said upper end of said casing, heat insulating means interposed between said member and the upper end of said casing thereby maintaining them in heat insulated relationship, an electric heating element supported in said casing closely adjacent the rear surface of said member in electrically insulated relation thereto, and heat-insulating material in said casing substantially coextensive with the side and bottom walls thereof and in spaced relation to said vessel-receiving member.

2. A heating device for supporting and heating glass vessels and the like comprising an outer casing having an upper open end, a reentrant vessel-receiving member formed of metal mesh, means for supporting said member from said upper end of said casing, heat insulating means interposed between said member and the upper end of said casing thereby maintaining them in heat insulated relationship, an electric heating element supported in said casing closely adjacent the rear surface of said member in electrically insulated relation thereto, and heat-insulating material in said casing substantially coextensive with the side and bottom walls thereof and in spaced relation to said vessel-receiving member.

3. A heating device for supporting and heating glass vessels and the like comprising an outer casing having an upper open end, a reentrant vessel-receiving member formed of relatively flexible steel cloth, means for supporting said member from said upper end of said casing, heat insulating means interposed between said member and the upper end of said casing thereby maintaining them in heat insulated relationship, an electric heating element supported in said casing closely adjacent the rear surface of said member in electrically insulated relation thereto, and heat-insulating material in said casing substantially coextensive with the side and bottom walls thereof and in spaced relation to said vessel-receiving member.

4. A heating device for supporting and heating glass vessels and the like comprising an outer casing having an upper open end, a reentrant vessel-receiving member formed of meshlike relatively flexible but shape retaining metal heat-conducting material, means for supporting said member from said upper end of said casing, heat insulating means interposed between said member and the upper end of said casing thereby maintaining them in heat insulated relationship, an electric heating element supported in said casing closely adjacent the rear surface of said member in electrically insulated relation thereto, a substantially imperforate flexible member disposed rearwardly of said meshlike member in loosely nested relation thereto, and a mass of loose powdered heat-insulating material at least partially filling the space between said imperforate member and the side and bottom walls of said casing thereby substantially to surround said heating element.

5. A heating device for supporting and heating glass vessels and the like comprising an outer casing having an upper open end, a reentrant vessel-receiving member formed of relatively flexible steel cloth, means for supporting said member from said upper end of said casing, heat insulating means interposed between said member and the upper end of said casing thereby maintaining them in heat insulated relationship, an electric heating element supported in said casing

closely adjacent the rear surface of said member in electrically insulated relation thereto, a substantially imperforate flexible member disposed rearwardly of said steel cloth member in loosely nested relation thereto, and a mass of loose powdered heat-insulating material at least partially filling the space between said imperforate member and the side and bottom walls of said casing thereby substantially to surround said heating element.

6. A heating device for supporting and heating glass vessels and the like comprising, an outer casing having an annular inwardly extending flange at the upper edge thereof, a meshlike flexible but relatively shape retaining vessel-receiving member formed of heat-conducting material, heat insulating means interposed between said flange and said member to support said member in heat insulated relation from said flange, means for supporting an electrical heating element in said casing closely adjacent said heat conducting member in electrically insulated relation thereto, and heat insulating material disposed in said casing between the side and bottom walls thereof and said heating element.

7. A heating device for supporting and heating glass vessels and the like comprising, an outer casing having an annular inwardly extending flange at the upper edge thereof, a meshlike flexible but relatively shape retaining vessel-receiving member formed of heat-conducting material, heat insulating means interposed between said flange and said member to support said member in heat insulated relation from said flange, a pair of flexible members formed of electric-insulating material supported from said flange rearwardly of said vessel-receiving member in loosely nested relation thereto, an electrical heating element secured to the inner surface of the outer one of said nested members, and heat-insulating material in said casing substantially coextensive with the side and bottom walls thereof and in spaced relation to said outer one of said nested members.

8. A heating device for supporting and heating glass vessels and the like comprising, an outer casing having an annular inwardly extending flange at the upper edge thereof, a flexible but relatively shape retaining vessel-receiving member formed of steel cloth, heat insulating means interposed between said flange and said member to support said member in heat insulated relation from said flange, a pair of flexible members formed of asbestos fiber cloth supported from said flange rearwardly of said vessel-receiving member in loosely nested relation thereto, an electrical heating element secured to the inner surface of the outer one of said asbestos members, and heat insulating material in said casing substantially coextensive with the side and bottom walls thereof and in spaced relation to said outer one of said asbestos members.

9. A heating device for supporting and heating glass vessels and the like comprising, an outer casing having an annular inwardly extending flange at the upper edge thereof, a flexible but relatively shape retaining vessel-receiving member formed of steel cloth, heat insulating means interposed between said flange and said member to support said member in heat insulated relation from said flange, a pair of flexible members formed of asbestos fiber cloth supported from said flange rearwardly of said vessel-receiving member in loosely nested relation thereto, an electrical heating element secured to the inner surface of the outer one of said asbestos members, and a mass of loose powdered heat-insulating material substantially filling said casing rearwardly of said outer asbestos member.

10. In a flask heater, the combination of a flask engaging member formed of heat-conducting flexible meshlike material shaped to conform substantially to the lower portion of a flask and having outwardly extending flange means at the upper edge thereof, a first layer of flexible heat-resistant electric insulation shaped to receive said flask engaging member loosely therein and having outwardly extending flange means, a second layer of flexible heat-resistant electric insulating material shaped to receive said first layer loosely therein and having flange means extending outwardly thereof, an electric heating element secured to the inner surface of said second layer and extending over a substantial portion of said surface, and means for securing said flanges together to form a unitary assembly of said flask engaging member and first and second layers and to support said flask engaging member and said layers in individually suspended nested relation.

11. In a flask heater, the combination of a flask engaging member formed of heat conducting flexible meshlike material shaped to conform substantially to the lower portion of a flask and having outwardly extending flange means at the upper edge thereof, a first layer of flexible heat-resistant electric insulation shaped to receive said flask engaging member loosely therein and having outwardly extending flange means, a second layer of flexible heat-resistant electric insulating material shaped to receive said first layer loosely therein and having flange means extending outwardly thereof, a ribbon type flexible electric heating element extending in a predetermined heat distribution pattern over a substantial portion of the inner surface of said second layer and stapled thereto, said element including spaced apart lead-in portions extending through said second layer, and means for supporting all of said flanges as a unitary assembly and to suspend said flask engaging member and said layers in individually supported nested relation.

12. In a flask heater, the combination of a flask engaging member formed of heat-resistant flexible metal cloth shaped to conform substantially to the lower portion of a flask and having outwardly extending flange means at the upper edge thereof, a first layer of flexible heat-resistant electric insulation shaped to receive said flask engaging member loosely therein and having outwardly extending flange means, a second layer of flexible heat-resistant electric insulating material shaped to receive said first layer loosely therein and having flange means extending outwardly thereof, an electric heating element secured to the inner surface of said second layer and extending over a substantial portion of said surface, and means for securing said flanges together as a unitary assembly and to support said flask engaging member and said layers in individually suspended nested relation.

13. The method of forming devices for supporting and heating glass vessels and the like, which method comprises sequentially forming a plurality of substantially circular sheets of flexible material about a substantially hemispherical form in overlying relation by folding each of said sheets along substantially radial lines to form a plurality of double thickness ears extending outwardly from the hemispherically formed por-

tion of each sheet, the first of said sheets constituting a heat-conducting substantially shape-retaining material and the second and third sheets constituting non-shape-retaining electric insulating material, securing the double thicknesses of each of said ears on said first sheet together prior to forming said second sheet thereover, securing a flexible electrical resistance element to the inner surface of said third sheet prior to formation thereof over said second sheet, and supporting all of said formed sheets from the upper edges thereof in independently suspended loosely nested relation.

14. The method of forming devices for supporting and heating glass vessels and the like, which method comprises sequentially forming a plurality of substantially circular sheets of flexible material about a substantially hemispherical form in overlying relation by folding each of said sheets along substantially radial lines to form a plurality of double thickness ears extending outwardly from the hemispherically formed portion of each sheet, the first of said sheets constituting a substantially shape-retaining steel cloth and the second and third sheets constituting non-shape-retaining asbestos fiber cloth, stapling the double thicknesses of each of said ears on said steel cloth sheet together prior to the forming of the second sheet thereover, stapling a flexible ribbon type resistor element to the inner surface of said third sheet prior to formation thereof over said second sheet, and supporting the upper edge portions of all of said sheets intermediate said ears to suspend said formed sheets in independent loosely nested relation.

15. The method of forming devices for supporting and heating glass vessels, which method comprises forming a substantially circular sheet of flexible but form retaining meshlike material about a substantially hemispherical form by folding said sheet along a plurality of radial lines to provide outwardly extending wedge shaped ears of double thickness, securing the layers of said double thickness ears together at spaced points along the inner edges thereof, trimming said ears along lines outwardly of the securement points to produce radial flanges of substantially uniform width, slitting said formed sheet inwardly adjacent the opposite sides of each of said flanges, bending the edge portions of said sheet between said flanges and the ends of said flanges between said slits outwardly to form a peripheral flange extending around the hemispherically formed portion of said sheet, forming a first substantially circular sheet of non-form-retaining electric insulating material loosely about said formed meshlike material to provide double thickness wedge shaped ears positioned to receive said radial flanges and an annular flange adjacent said peripheral flange, folding said double thickness wedge shaped ears on said formed insulating sheet over the edges of said radial flanges, securing an electrical heating element to one surface of a second substantially circular sheet of non-form-retaining electric insulating material, forming said second sheet about said first sheet with said heating element facing inwardly to provide double thickness wedge shaped ear portions encompassing said folded ears on said first sheet, and suspending all of said formed sheets in loosely nested relation.

16. The method of forming devices for supporting and heating glass vessels, which method comprises forming a substantially circular sheet of substantially shape retaining steel cloth into a substantially hemispherical form by folding said sheet along a plurality of radial lines to form outwardly extending wedge shaped ears of double thickness, stapling the thicknesses of said ears together at spaced points along the inner edges thereof, trimming said ears along lines outwardly of the staples to produce radial flanges of substantially uniform width, slitting said formed sheet inwardly on opposite sides of each radial flange, bending the edge portions of said sheet between said flanges and the ends of said flanges outwardly to form a peripheral flange about the hemispherically formed portion of said sheet, forming a first substantially circular non-shape-retaining sheet of asbestos fiber cloth loosely about said formed steel cloth sheet to provide double thickness wedge shaped ears positioned to receive said radial flanges and to provide a peripheral flange thereon, folding said wedge shaped flanges on said formed asbestos cloth sheet over said radial flanges, stapling a flexible ribbon type resistor in a predetermined pattern on the inner surface of a second substantially circular sheet of said asbestos fiber cloth, forming said second asbestos cloth sheet about said formed first asbestos cloth sheet to provide a peripheral flange and double thickness wedge shaped ears encompassing said folded ears with said resistor between said formed asbestos cloth sheets, and suspending all of said formed sheets from said flanges in loosely nested relation.

17. The method of forming flask heating devices which comprises assembling in inverted nested relation a plurality of flanged hemispherical members of sheet material with an electrical heating element disposed between two of said members, securing the flanges of all of said assembled members to the horizontal leg of an inverted annular top member of L-shaped cross section, securing a tubular body member to the other leg of said annular member in surrounding relation to said assembled members, extending an electrical conductor from said heating element through an aperture in a wall of said tubular body member, at least partially filling the space between the outermost of said assembled members and said body member with light powdered heat-insulating material, and securing a bottom closure member to the open end of said body member.

18. The method of forming flask heating devices which comprises assembling in inverted nested relation a flanged hemispherical member formed of heat-conducting shape-retaining material and a pair of overlying similarly shaped members of flexible non-shape-retaining electric insulating material having an electric heating element disposed therebetween, securing the flanges of all of said assembled members to the horizontal leg of an inverted annular top member of L-shaped cross section, securing a tubular body member to the other leg of said annular member in surrounding relation to said assembled members, extending an electrical conductor from said heating element through an aperture in a wall of said tubular body member, at least partially filling the space between the outermost of said assembled members and said body member with light powdered heat-insulating material, and securing a bottom closure member to the open end of said body member.

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