July 8, 1958 C. E. ANDERSON 2,842,654

FLASK HEATERS

Filed Aug. 24, 1956 2 Sheets-Sheet 1

FIG. 1

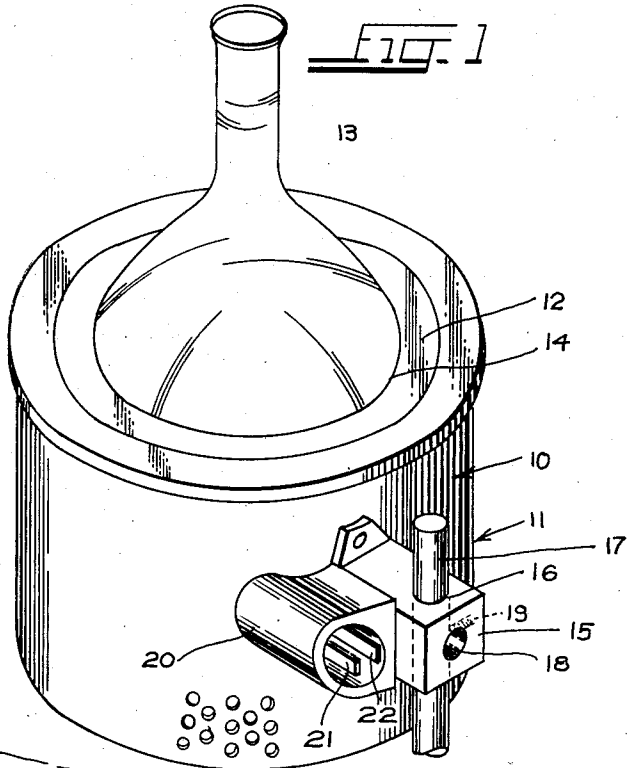
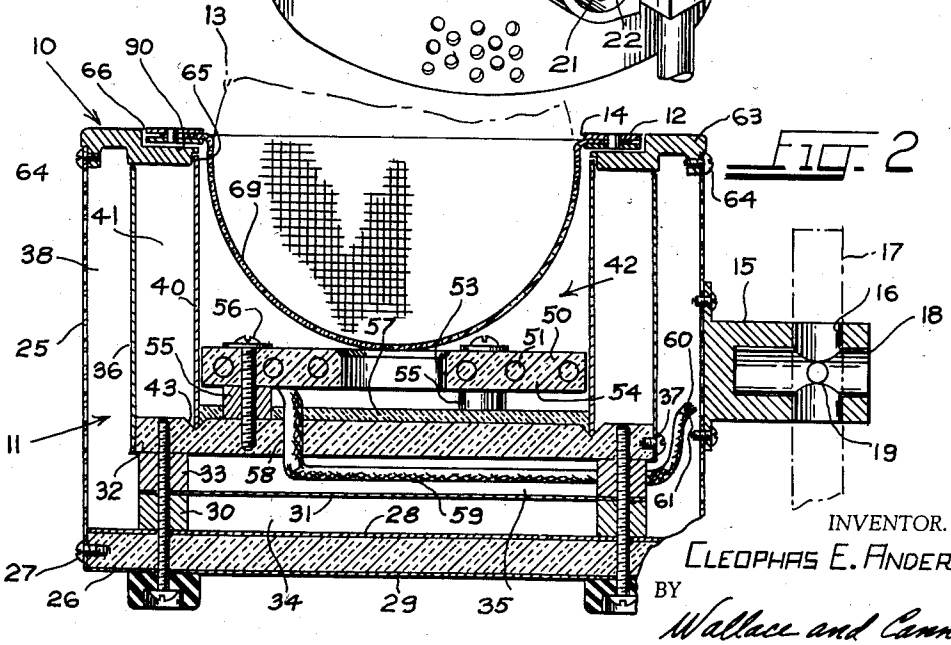


FIG. 2



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FLASK HEATERS

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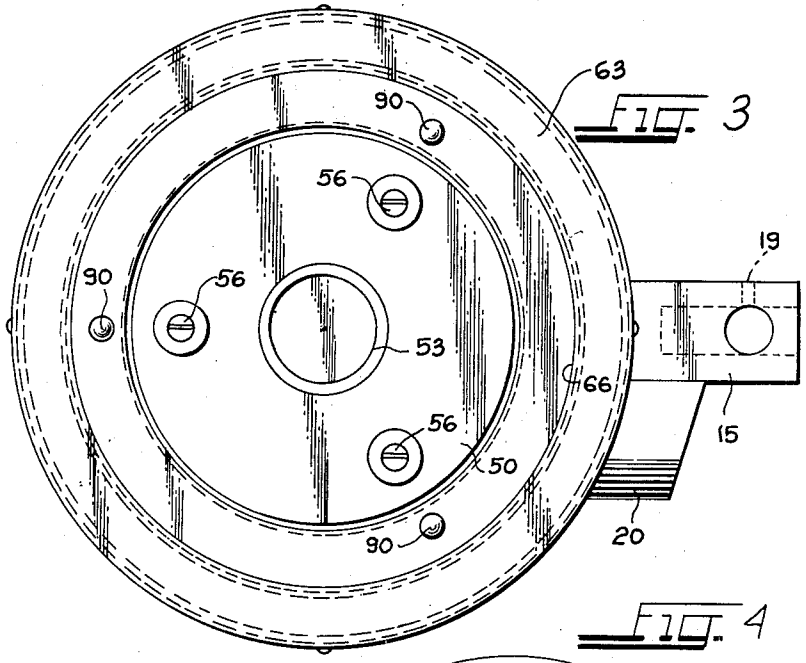


FIG. 3

FIG. 4

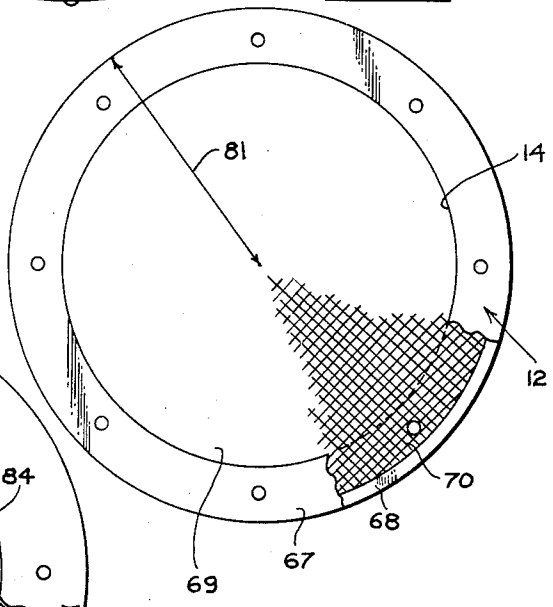
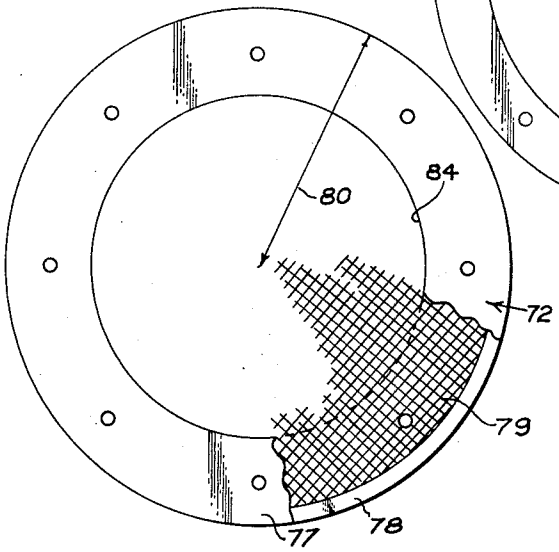


FIG. 5



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FLASK HEATERS

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Application August 24, 1956, Serial No. 606,135

7 Claims. (Cl. 219—43)

This invention relates to a heating device and is particularly concerned with a heater suitable for heating flasks and other similar vessels in chemical laboratory and like applications.

In many chemical processes, particularly when carried out in a laboratory, it is necessary to heat liquid and/or initially solid materials within a flask and to control the heat applied to the flask very closely. In many instances, it is virtually essential that the entire surface of the flask, up to the level of the material being heated therein, be uniformly heated in order to avoid undesirable chemical and/or physical effects which could otherwise disrupt the process being carried out and perhaps break the flask. Localized heating of only a portion of the bottom of the flask, as with a single gas burner, is highly undesirable in many of these applications; for example, heat applied in this manner may cause localized vaporization of the material in the flask and lead to the phenomenon generally referred to in the chemical field as "bumping," eventually fracturing the flask. In such applications, it has been common practice to heat the flask by means of a device usually referred to as a heating mantle. The conventional mantle, generally speaking, comprises a shell of insulating material such as woven glass which is shaped to fit the bottom portion of the flask. Inasmuch as the flasks employed generally have a spherical bulb portion and a tubular neck extending therefrom, these mantles have ordinarily been substantially hemispherical in configuration. An electrical heater element is interwoven with the insulating material of the mantle and is utilized to heat the entire undersurface of the flask at a relatively uniform rate.

Although generally satisfactory in many instances, conventional heating mantles in chemical flasks exhibit certain distinctive disadvantages. The mantles are relatively expensive, since it is necessary to provide an individual one for each different flask size to be employed in the laboratory and, of course, as many mantles of a given size as may be required for simultaneous heating of a number of similar flasks must be provided. Moreover, the mantle structures heretofore known in the art have generally been too hot in operation to permit manual handling of the mantle in the event of an emergency. In other words, the exterior surface of the heating mantle reaches a temperature high enough to burn the chemist's hands seriously in the event that the flask breaks and it becomes necessary to dispose of the flask contents in a hurry.

The co-pending application of Cleophas E. Anderson and David C. Stratton, Serial No. 612,079, filed August 24, 1956, now Patent No. 2,793,278, discloses and claims a flask heater which represents a very substantial improvement over conventional heating mantles and which substantially eliminates or minimizes the above noted disadvantages of known flask heaters. The device of the aforesaid application despite its great advantage with respect to prior art heaters, embodies in some respects

structure that may prove to be bulkier and heavier than is desirable for some laboratory uses, and although when operating at maximum temperature presents an exterior temperature low enough to permit unprotected manual handling, may still exhibit discomfort to extended unprotected handling.

A principal object of the invention, therefore, is a new and improved flask heater of the general type disclosed in the aforesaid application which affords an even lower external surface temperature than achieved by that device.

Another principal object of the invention is the provision of a new and improved flask heater which is relatively compact in size and easy to handle, and which is relatively light in weight.

A corollary object of the invention is a new and improved flask heater construction which permits heating of a plurality of different size flasks with a single basic heater unit and which requires a minimum of expenditure for adapting the basic unit to different flasks.

An additional object of the invention is a new and improved heater suitable for use with chemical flasks and other similar vessels which is inherently highly economical to manufacture and which provides for maximum operational life with a minimum of maintenance.

A flask heater constructed in accordance with the inventive concept comprises an external shell of metal mesh, usually perforated sheet metal, having a relatively highly reflective inner surface. An insulator plate, preferably of ceramic material, is mounted within the external metal shell in spaced relation thereto. An intermediate metal shell having a relatively highly reflective inner surface is mounted within the external shell adjacent the insulator plate; this intermediate shell includes side walls that extend upwardly from the insulator plate and which are separated from opposed walls of the external shell by a substantially continuous air space which is open to the atmosphere through the perforations in the external shell. An inner and substantially imperforate metal shell having a highly reflective internal surface is mounted within the intermediate shell above the insulated plate and includes side walls separated from the aforesaid side walls of the intermediate shell by a second air space; this inner shell defines a heating chamber substantially larger than the largest flask to be heated. An electrical heating element is supported within the heating chamber in space-heating relation with respect to the inner metal shell and preferably is also spaced from the insulator plate which forms the base of the heating chamber. A metal mesh basket is removably supported upon one of the metal shells, usually the external shell; this mesh basket has a configuration and size corresponding to that of the base portion of a particular size flask to be heated. The mesh basket is utilized to suspend a flask within the heating chamber in spaced relation with respect to the heating element and to the sides of the chamber to receive heat radiated upwardly from the heating element and further to receive heat radiated outwardly from the heater element and reflected inwardly by the metal shells.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principle thereof and what I now consider to be the best mode in which I have contemplated applying that principle. Other embodiments of the invention embodying the same or equivalent principle may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a perspective view of a flask heater constructed in accordance with one embodiment of the invention and showing a flask supported within the heater in operational position;

Fig. 2 is a sectional view of the flask heater of Fig. 1;

Fig. 3 is a plan view of the base portion of the flask heater of Fig. 1;

Fig. 4 illustrates one form of the top or lid portion of the heater of Fig. 1; and

Fig. 5 illustrates another lid or top structure which may be employed in the heater of Fig. 1.

The perspective view of Fig. 1 illustrates one embodiment of a flask heater constructed in accordance with the inventive concept; the flask heater 10 shown therein includes a base 11 upon which is supported a top or lid 12. As indicated in this figure, a flask 13 of the usual spherical-base type may be supported in a central aperture 14 in lid 12 in order to heat the contents of the flask. Flask heater 10 is also equipped with suitable means for mounting the heater upon a ring stand or other similar supporting device. In the illustrated embodiment, this mounting arrangement comprises a bracket 15 having a vertical opening 16 extending therethrough into which the support rod 17 of a ring stand may be inserted. In addition, bracket 15 is provided with a horizontal opening 18 into which a support rod may be inserted if mounting of the flask heater is desired. A set screw, thumb screw, or the like may be threaded into an opening 19 in bracket 15 to clamp the bracket to a support rod inserted in either of openings 16 or 18 in the usual manner. Preferably, bracket 15 is formed as an aluminum casting and includes an extension 20 which serves as a housing for an electrical connector having a pair of terminals 21 and 22 of conventional form.

The internal construction of flask heater 10 is in many respects best shown in Fig. 2. As indicated in this figure, the base 11 comprises a first or external shell 25 of metal mesh material. Shell 25 is preferably fabricated from perforated sheet metal having a relatively highly reflective surface, particularly upon the internal surface thereof. For example, the exterior shell may be formed of perforated twenty gauge mild steel which is chromium plated to afford the desired high degree of reflectivity and to afford a surface which is substantially resistive to corrosion. Preferably, however, the exterior shell is fabricated from perforated stainless steel of approximately twenty gauge or heavier with a relatively smooth surface to afford the desired reflectivity; the stainless steel in general affords maximum resistance to corrosion from direct contact with chemical agents and/or from the corrosive atmosphere sometimes present in chemical laboratories. The external shell could also be fabricated from aluminum, which would be desirable from the standpoint of weight reduction but since the rigidity and strength of the heater base are to a substantial extent determined by the external shell construction, stainless steel is preferred.

As indicated in Fig. 2, the external shell 25 is open at the bottom thereof, although the perforated metal may be extended across the complete lower surface of the shell, if desired. In the illustrated embodiment, however, an insulator plate or disc 26, is mounted within external shell 25 as by a plurality of screws or similar mounting members 27 to complete the external structure of the heater base. Insulator plate 26 may be formed from any relatively rigid heat-insulating material; one satisfactory material for this purpose comprises a mixture of asbestos and fire clay compressed and fired to form a refractory insulating slab. Preferably, the upper and lower surfaces of insulator plate 26 are coated with aluminum or silver paint or similar material, as indicated by coatings 28 and 29 to afford reflective surfaces on the insulator material.

A plurality of individual spacers 30 are supported upon insulator plate 26 and are utilized to support a metal reflector 31 above the insulator plate in spaced relation thereto. Spacers 30 may be formed by relatively small porcelain cylinders or may be fabricated from any suitable heat-insulating material so that the reflector 31 is to a substantial extent insulated from plate 26. A second heat-insulating plate or disc 32 is supported within the heater base above reflector 31 by means comprising a plurality of individual spacers 33 which may be essentially similar in construction to spacers 30. Thus, the reflector 31 is supported intermediate the two insulator plates in space relation with respect thereto and is respectively isolated from the insulators by a pair of air spacers 34 and 35.

A second or intermediate metal shell 36 is mounted within the external shell 25 in spaced relation with respect to the external shell; in the illustrated embodiment, shell 36 is supported upon the peripheral edge of insulator disc 32 and may be affixed thereto by any suitable means such as a plurality of individual mounting screws 37. Intermediate shell 36 is fabricated from metal having a relatively highly reflective surface, particularly on the inner surface of the shell and is separated from external shell 25 by a substantially continuous air space 38 which communicates with both of the air spacers 34 and 35 in the base of the heater. Consequently, because of the mesh or perforated construction utilized for external shell 25, air is permitted to circulate freely through all of the air spaces 34, 35 and 38. Intermediate shell 36 may be fabricated from ordinary sheet steel and plated to obtain the desired reflectivity or may be formed from sheet stainless steel having a relatively smooth surface. Preferably, however, since intermediate shell 36 performs no load bearing function and does not determine the rigidity or strength of the base structure, it is fabricated from relatively thin sheet aluminum having a relatively smooth surface to obtain the desired reflective properties. In this respect, it should be noted that none of the reflector surfaces in the flask heater needs to be extremely highly polished; an ordinary "bright" metal surface provides the requisite degree of reflectivity. As indicated in Fig. 2, intermediate shell 36 is preferably imperforate in nature.

Heater base 11 further includes a third or inner metal shell 40, similar to intermediate shell 36, which is mounted within the intermediate shell above insulator plate 32 and which is separated from the intermediate shell by an additional air space 41. Inner shell 40 may, as in the case of intermediate shell 36, be fabricated from sheet aluminum in order to maintain the weight of the heater base at the minimum and to afford maximum resistance to the corrosive action of regions and/or atmosphere with which the shell may come in contact when employed in a chemical laboratory. Inner shell 40 is supported upon insulator disc 32, in the illustrated embodiment, and serves to define a heating chamber 42 above the insulator disc which is substantially larger than the largest flask which the heater is intended to accept. Preferably, the shell 40 has the lower edge thereof disposed in an annular groove 43 in insulator disc 32 to maintain the inner shell in the desired position with respect to intermediate shell 36 and to aid in sealing heating chamber 42 to make the chamber substantially liquid-tight, as will be described more completely hereinafter.

An electrical heating element 50 is supported within heating chamber 42, the heating coil 51 of the heating element being mounted in spaced heat-insulating relation with respect to inner metal shell 40. The heating coil 51 may comprise a conventional nickel-chromium heater wire disposed in spiral configuration within the heating element to cover most of the lower surface of heating chamber 42. As indicated in Fig. 3, heating element 50 is preferably of substantially annular configuration and is provided with a central aperture 53 for a purpose set forth in detail hereinafter in conjunction with the operational description of the flask heater. Preferably, the heater coil 51 is embedded in a refractory cement body 54 and is supported above insulator disc 32 in spaced relation with respect to the insulator disc. The heating element may, for example, be supported upon a plurality

of porcelain spacers 55 and may be maintained in position by a plurality of screws or bolts 56 extending through the spacers as indicated in Fig. 2. Moreover, the lower or base portion of heating chamber 42 is preferably sealed by a layer 57 of refractory cement. In the preferred embodiment shown in the drawings, the electrical leads for heater coil 51 are brought out of the heating chamber through an aperture 58 in disc 32, the electrical leads being indicated at 59, and the refractory sealing layer 57 is formed after electrical leads 59 are in their final position in order that the heating chamber may be made substantially liquid-tight. The sealing function of the refractory cement layer 57 is materially improved in the illustrated embodiment by virtue of the fact that the cement layer extends at least partially into the groove 43 in which inner metal shell 40 is supported, thereby assuring an effective seal at the lower peripheral edge of the heating chamber. The two leads 60 and 61 included within cable 59 are individually connected to the terminals 21 and 22 (shown in Fig. 1) in the usual manner, the terminal connections not being shown in the drawings.

A metal rim 63 is mounted upon external shell 25 of the heater base, as by means of a plurality of screws 64 or other suitable means; the rim 63 extends from the external shell into alignment with inner shell 40 of the heater base; preferably, however, the rim is not in direct contact with the inner shell but is rather separated by a relatively small space as indicated at 65. Rim 63 is provided with a central groove 66 within which the rim of lid 12 is seated when the lid is in operating position upon the heater base.

Lid 12, which is shown in detail in Fig. 4, comprises three principal elements. A first annular ring 67 is positioned opposite a second annular ring 68 of corresponding configuration, the inner surface of the two rings determining the diameter of lid opening 14. A metal mesh basket 69 is supported by the two rings 67 and 68 which are riveted or otherwise secured to each other with a flange portion 70 of the metal basket interposed therebetween. Metal basket 69 is formed with a size and configuration corresponding to that of the base portion of a particular sized flask to be heated. In the illustrated embodiment, lid 12 and basket 69 are intended for use with a conventional spherical-base glass flask; accordingly, basket 69 is made approximately hemispherical in configuration. The mesh basket may be fabricated from any suitable metal mesh material which exhibits a substantial degree of resistance to corrosion, including such materials as bronze and/or brass wire mesh. Preferably, however, the mesh is fabricated from stainless steel wire to afford maximum strength and resistance to corrosion. The particular wire size and mesh spacing are not critical and may be varied to suit the requirements of the designer and the fabricating material.

Fig. 5 shows an alternative lid structure 72 which is in most respects essentially similar to the lid 12 described above in connection with Fig. 4. Thus, the lid structure 72 includes a pair of annular members 77 and 78 and mesh basket 79 which are essentially similar in configuration with the corresponding elements 67, 68 and 69 of the previously described construction. Moreover, the external radius 80 of rings 77 and 78 is made approximately equal to the external radius 81 of lid 12 in order that lid 72 may be associated with the seating groove 66 of heater base 11 (see Fig. 2) interchangeably with lid 12. The central opening 84 in lid 72, however, is made substantially smaller than the opening 14 in lid 12, and basket 79 is similarly smaller; consequently, lid 72 may be utilized to support a much smaller flask in the heater base than that suspended therein by lid 72. Consequently, by providing a family of the individual and extremely expensive lids such as lids 12 and 72, a single heater base as 11 may be employed effectively to heat a plurality of different flasks of varying sizes and shapes, affording a much greater versatility in the flask heater than would be obtainable with conventional devices.

When it is desired to place flask heater 10 in operation, heater base 11 may first be mounted upon a ring stand or other device as indicated by rod 17, and the terminals 21 and 22 may be connected to a suitable source of electrical energy by means of a conventional female plug connector (not shown). Preferably the electrical connection is completed through a thermostatic or other control device to afford a means for regulating the temperature within the heater chamber 42 of the flask heater. In this connection it should be noted that any one of a wide variety of different temperature-control devices may be associated with the flask heater to control its operating temperature; inasmuch as operation of the heater is in no way dependent upon use of any particular control apparatus, this apparatus has not been illustrated or described herein.

Setting up of the flask heater for operation further requires that a suitable lid and basket structure such as one of the devices 12 or 72 be placed in the operating position indicated in Fig. 2, the lid being supported within groove 66 upon a plurality of relatively small bosses or other projections 90 formed in the lower surface of the seating groove. These bosses are provided to separate the lid from the rim 63 and reduce heat transfer between the lid and the rim to a minimum. With a suitable electrical energy source connected to the heater coil 51, as indicated above, the heater coil radiates heat in the usual manner to heat chamber 42 and the flask 13 suspended therein. A substantial portion of the heat from coil 51 is radiated upwardly and is intercepted directly by flask 13. A further substantial portion of the heat is radiated downwardly but is reflected back toward the heating chamber by reflector 31 and the two reflector surfaces 28 and 29 on insulator plate 26. In addition, a portion of the heat is radiated outwardly and is reflected back toward the heating chamber by the three concentric shells 25, 36 and 40. Consequently, a relatively high proportion of the heat developed by heating element 50 impinges upon and is utilized to raise the temperature of the flask 13.

The insulating structure of heater base 11, comprising air spaces 34, 35, 38 and 41, along with insulator plates 26 and 32, maintains the external shell 25 at an extremely low temperature with respect to the temperature developed within heating chamber 42. Thus, even when chamber 42 is maintained at an operating temperature of over 1200° F., the external shell temperature does not exceed a value substantially greater than approximately 20° above ambient. Consequently, in the event that flask 13 breaks during the heating operation, it may easily be removed from its supporting stand and dumped into a sink or other receptacle to protect the heater and other laboratory equipment without requiring that the laboratory worker wear insulated gloves or utilize any other cumbersome, interfering protection measures. In this respect, it is important to note that the multiple-air chamber construction described herein is substantially more effective than any comparable arrangement utilizing solid insulators as the principal means of isolating exterior shell 25 from the extremely high temperatures developed from the heating chamber 42. Moreover, in addition to reducing the weight of the heater as compared with devices which rely primarily upon solid heat insulators, the multiple air chamber construction of the invention substantially reduces the weight of the flask heater, thereby materially adding to its convenience insofar as its laboratory use is concerned. The annular shape for the heater is also highly advantageous in reducing the weight and size of the heater to a minimum, a desirable attribute particularly in laboratory work.

The central opening 53 provided in heating element 50 is extremely important to operation of the flask heater in that it avoids excessive localized or "hot spot" heating effects at the base of the flask being heated and conse-

quently precludes breakage due to "bumping." In this respect, the central aperture serves the same function as the corresponding structural feature of the aforementioned copending application. In the illustrated apparatus, this reduction of localized heating is further assisted by separating the heater element from the base of heating chamber 42, permitting better equalization within the heating chamber. The central aperture also affords a means for introducing the refractory layer into the chamber after the heating element has been mounted therein in its operating position.

The flask heater of the invention is extremely economical in construction and affords marked advantages in comparison with prior art devices. In particular, the heater may be manually handled without required protection of the worker's hands despite the fact that the operating temperature may be extremely high. The extremely inexpensive lid structures such as those described in connection with Figs. 4 and 5 make it possible to heat flasks of a wide variety of sizes and shapes in a single heater at a minimum of cost. The flask heater is light, compact, and rugged and is eminently well suited to laboratory use.

Hence, while I have illustrated and described the preferred embodiments of my invention, it is to be understood that these are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. A flask heater for heating a flask to a relatively high temperature yet permitting manual handling of the heater comprising: an external shell of metal mesh having a relatively highly reflective inner surface; an insulator plate mounted within said external shell in spaced relation thereto; an intermediate metal shell having a relatively highly reflective inner surface, mounted within said external shell adjacent said insulator plate and extending upwardly therefrom, said intermediate shell being separated from said external shell to afford a substantially continuous air space between said shells; an inner substantially imperforate metal shell having a relatively highly reflective inner surface mounted within said intermediate shell above said insulator plate and separated from said intermediate shell to afford another air space between the inner and intermediate shells, said inner shell defining a heating chamber substantially larger than a given size flask to be heated; an electrical heating element, supported within said heating chamber in spaced heat-insulating relation with respect to said inner metal shell; and a metal mesh basket, removably supported upon one of said shells and including a part having a configuration and size corresponding to that of the base portion of a particular size flask to be heated, for suspending a flask within said heating chamber in spaced relation with respect to said heating element and the portions of said inner shell defining said chamber to enable heat radiated from said heater element and reflected inwardly through the metal basket by said metal shells to heat such a flask.

2. A flask heater for heating a flask to a relatively high temperature yet permitting manual handling of the heater comprising: an external shell of metal mesh having a relatively highly reflective inner surface; a metal reflector plate supported within the lower portion of said external shell in spaced relation thereto; an insulator plate mounted within said external shell in spaced relation thereto above said reflector plate and separated from said reflector plate by a first air space; an intermediate metal shell having a relatively highly reflective inner surface, mounted within said external shell adjacent said insulator plate and extending upwardly therefrom, said intermediate shell being separated from said external shell to afford a substantially continuous second air space between said shells communicating with said first air space; an inner substantially imperforate metal shell having a relatively highly reflective inner surface mounted within said intermediate shell above said insulator plate and separated from said intermediate shell to afford a third air space between said inner and intermediate shells, said inner shell defining a heating chamber substantially larger than a given size flask to be heated; an electrical heating element, supported within said heating chamber in spaced heat-insulating relation with respect to said inner shell; and a metal mesh basket, removably supported upon one of said shells and including a part having a configuration and size corresponding to that of the base portion of a particular size flask to be heated, for suspending a flask within said heating chamber in spaced relation with respect to said heating element and the portions of said inner shell defining said chamber to enable heat radiated from said heater element and reflected inwardly through the metal basket by said metal shells and said metal reflector to heat such a flask.

3. A flask heater for heating a flask to a relatively high temperature yet permitting manual handling of the heater comprising: an external shell of metal mesh having a relatively highly reflective inner surface; a first insulator plate mounted within the base of said external shell; a second insulator plate mounted within said external shell in spaced relation with respect to said first insulator plate and said shell; an intermediate metal shell having a relatively highly reflective inner surface, mounted within said external shell adjacent said second insulator plate and extending upwardly therefrom, said intermediate shell being separated from said external shell to afford a substantially continuous air space between said shells; an inner metal shell having a relatively highly reflective surface mounted within said intermediate shell above said second insulator plate and separated from said intermediate shell to afford another air space between said inner and intermediate shells, said inner shell defining a heating chamber substantially larger than the base of a given size flask to be heated; an electrical heating element, supported within said heating chamber in spaced heat-insulating relation with respect to said inner metal shell; and a metal mesh basket, removably supported upon one of said shells and including a part having a configuration and size corresponding to that of the base portion of a particular size flask to be heated, for suspending a flask within said heating chamber in spaced relation with respect to said heating element and the portions of said inner shell defining said chamber to enable heat radiated from said heater element and reflected inwardly through the metal basket by said metal shells to heat such a flask.

4. A flask heater for heating a flask to a relatively high temperature yet permitting manual handling of the heater comprising: an external shell of perforated sheet metal having a relatively highly reflective inner surface; a first insulator plate, having a reflective coating on the opposed faces thereof, mounted within the base of said external shell; a second insulator plate mounted within said external shell in spaced relation with respect to said first insulator plate and said shell; a metal reflector plate supported between said insulator plates in heat-insulating mutual spaced relation with respect to said insulator plates and said shell; an intermediate metal shell having a relatively highly reflective inner surface, mounted within said external shell adjacent said second insulator plate and extending upwardly therefrom, said intermediate shell being separated from said external shell to afford a substantially continuous air space between said shells communicating with the air spaces separating said insulator plates and said reflector; an inner metal shell having a relatively highly reflective surface mounted within said intermediate shell above said second insulator plate and separated from said intermediate shell to afford another air space between said inner and intermediate shells, said inner shell defining a heating chamber substantially larger than the base of a given size flask to be heated; an electrical heating element,

supported within said heating chamber in spaced heat-insulating relation with respect to said inner metal shell and said second insulator plate; and a metal mesh basket, removably supported upon one of said shells and including a part having a configuration and size corresponding to that of the base portion of a particular size flask to be heated, for suspending a flask within said heating chamber in spaced relation with respect to said heating element and the portions of said inner shell defining said chamber to enable heat radiated from said heater element and reflected inwardly through the metal basket by said metal shells to heat such a flask.

5. A flask heater for heating a flask to a relatively high temperature yet permitting manual handling of the heater comprising: an external shell of metal mesh having a relatively highly reflective inner surface; an insulator plate mounted within said external shell in spaced relation thereto; an intermediate metal shell having a relatively highly reflective inner surface, mounted within said external shell adjacent said insulator plate and extending upwardly therefrom, said intermediate shell being separated from said external shell to afford a substantially continuous air space between said shells; an inner metal shell having a relatively highly reflective surface mounted within said intermediate shell above said insulator plate and separated from said intermediate shell to afford another air space between said inner and intermediate shells, said inner shell defining a heating chamber substantially larger than the base of a given size flask to be heated; an electrical heating element, supported within said heating chamber in spaced heat-insulating relation with respect to said inner metal shell; a metal rim, having a substantially reflective lower surface, supported upon said external shell, said rim affording a central aperture having a configuration corresponding to the base of a particular size flask but substantially larger than said flask base and further affording a seating groove encompassing said aperture; and a lid comprising a metal mesh basket affixed to a support member adapted to rest in said seating groove, removably supported upon said rim, said basket including a part having a configuration and size corresponding to that of the base portion of said particular flask size, for suspending a flask within said heating chamber in spaced relation with respect to said heating element and the portions of said inner shell defining said chamber to enable heat radiated from said heater element and reflected inwardly through the metal basket by said metal shells to heat such a flask.

6. A flask heater for heating a flask to a relatively high temperature yet permitting manual handling of the heater comprising: an external shell of perforated sheet metal having a relatively highly reflective inner surface; an insulator plate mounted within said external shell in spaced relation thereto; an intermediate metal shell having a relatively highly reflective inner surface, mounted within said external shell adjacent said insulator plate and extending upwardly therefrom, said intermediate shell being separated from said external shell to afford a substantially continuous air space between said shells; an inner imperforate metal shell having a relatively highly reflective surface mounted within said intermediate shell upon said insulator plate and separated from said intermediate shell to afford another air space between said inner and intermediate shells, said inner shell defining a heating chamber substantially larger than the base of a given size flask to be heated; an annular electrical heating element, supported within said heating chamber in spaced heat-insulating relation with respect to said inner metal shell and said insulator plate, the electrical leads for said heating element extending out through an aperture in said plate; a layer of heat-insulating sealing material within the base of said heating chamber, for sealing said electrical lead aperture and the junction between said inner shell and said plate to render said chamber substantially liquid tight; and a metal mesh basket, removably supported upon one of said shells and having a configuration and size corresponding to that of the base portion of a particular size flask to be heated, for suspending a flask within said heating chamber in spaced relation with respect to said heating element and the portions of said inner shell defining said chamber to enable heat radiated from said heater element and reflected inwardly through the metal basket by said shells to heat such a flask.

7. A flask heater for heating a flask to a relatively high temperature yet permitting manual handling of the heater comprising a frame including an external metal mesh having a relatively highly reflective inner surface; an insulator plate mounted within said external shell in spaced relation thereto; an intermediate metal shell having a highly reflective inner surface, mounted within said external shell adjacent said insulator plate and extending upwardly therefrom, said intermediate shell being separated from said external shell to afford a substantially continuous air space between said shells; an inner shell of substantially imperforate metal having a relatively highly reflective surface, mounted within said intermediate shell above said insulator plate and having side walls separated from opposed side walls, said intermediate shell to afford an interposed air space of substantial thickness, said inner shell encompassing a heating chamber substantially larger than the base portion of a given size flask to be heated; and electrical heating element, supported within said heating chamber in spaced heat-insulating relation with respect to said second shell; and means removably supported on said frame and including a part having a configuration and size corresponding to that of the base portion of a particular size flask to be heated, for suspending a flask within said heating chamber in spaced relation with respect to said heating element and the portions of said inner shell defining said chamber to enable heat radiated from said heater element and reflected inwardly through the metal basket by said metal shells to heat such a flask.

References Cited in the file of this patent

UNITED STATES PATENTS

2,282,078	Morey	May 5, 1942
2,450,981	Newman	Oct. 12, 1948

FOREIGN PATENTS

52,054	Sweden	June 28, 1922
47,601	Norway	Mar. 3, 1930
704,788	Germany	Apr. 7, 1941