Nov. 10, 1936. A. W. MULLER 2,060,237

ELECTRIC HEATING DEVICE

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Fig. 1,

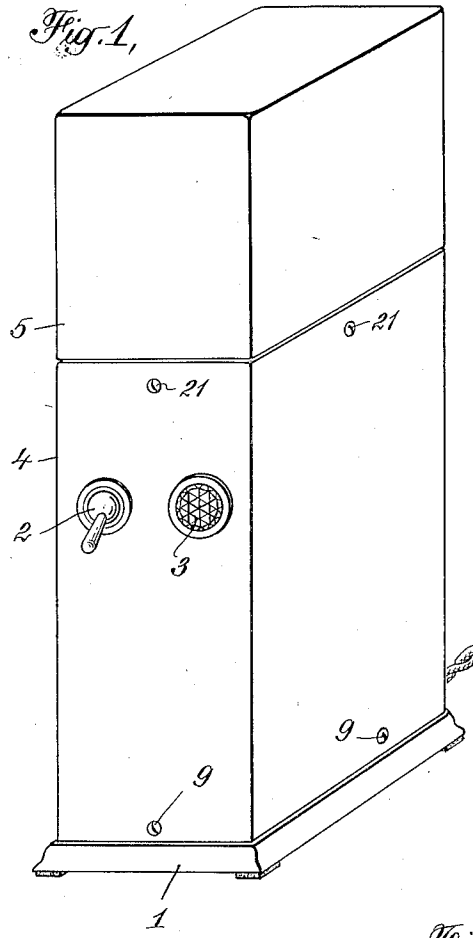


Fig. 2,

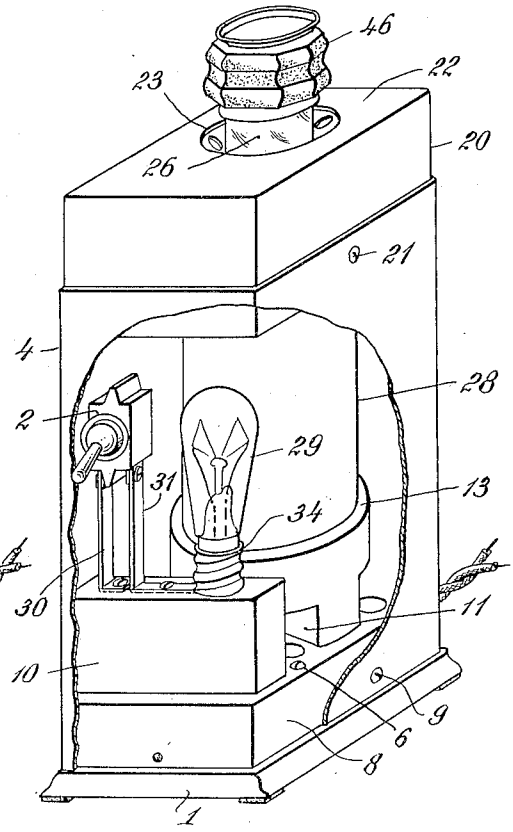
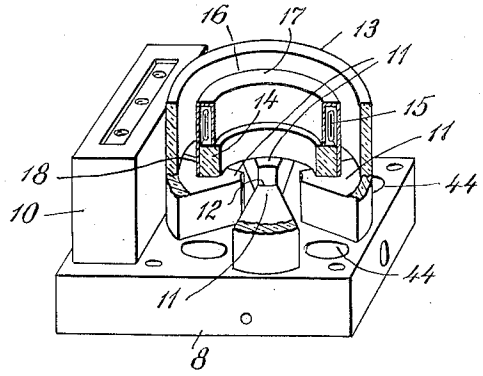


Fig. 3,



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Fig. 4,

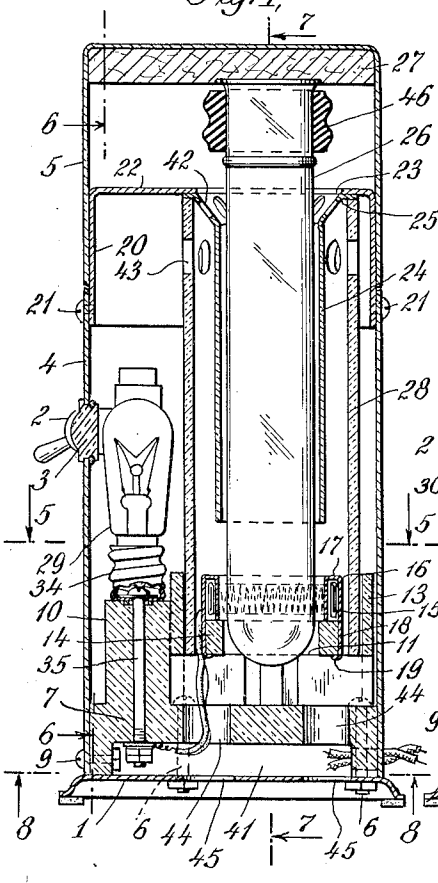


Fig. 6,

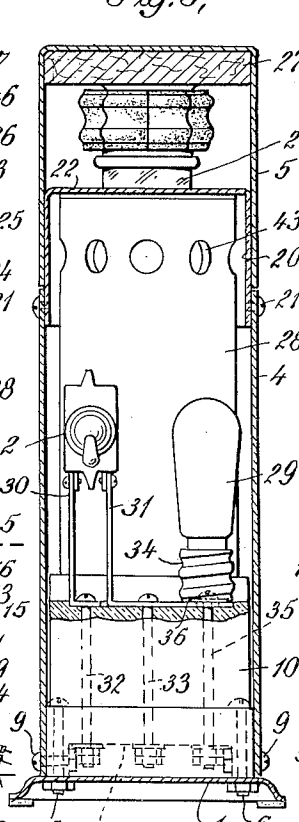


Fig. 7,

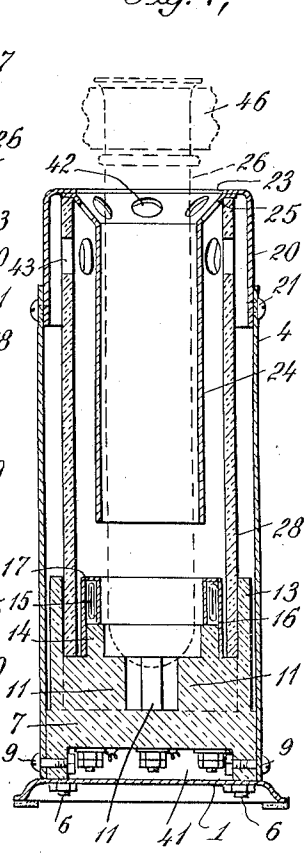


Fig. 5,

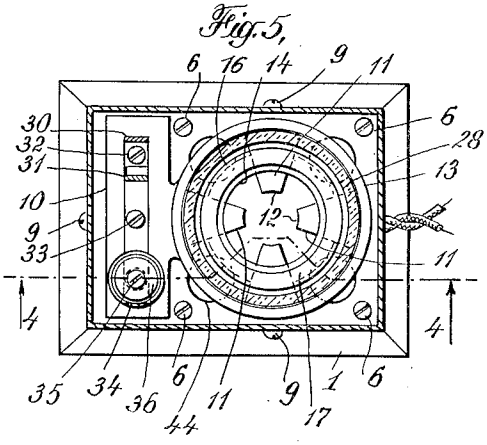
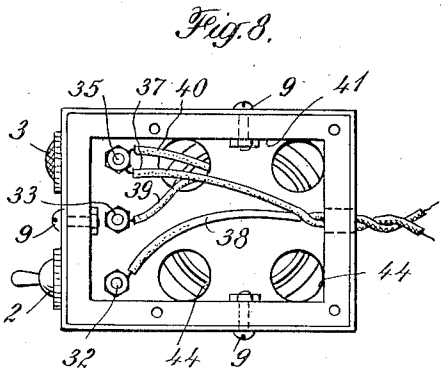


Fig. 8.



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Patented Nov. 10, 1936 2,060,237

UNITED STATES PATENT OFFICE

2,060,237

ELECTRIC HEATING DEVICE

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Application February 27, 1935, Serial No. 8,438

8 Claims. (Cl. 219—19)

This invention relates to portable electric heating devices such as are used for heating a small quantity of liquid in a test tube.

In making a so-called "Benedict test" of the urine of a diabetic person, a small quantity of the urine is placed in a test tube containing Benedict solution and the test tube is then heated. The heating is usually accomplished by immersing the test tube in boiling water or holding it over an open flame. So far as I am aware there is no satisfactory electrical heating device available for this purpose. Heating devices heretofore proposed for heating the contents of a test tube have been so designed that, if used for the Benedict test, the heat would not be applied where needed, or else the heat would be so intensively applied to, and concentrated at, the small quantity of liquid in the lower part of the test tube as to eject it by what is known as "geyser action". Physicians and surgeons usually employ a gas burner to heat the test tube in making the Benedict test. This is a laboratory instrument and lacks the appearance of a finished product and is reluctantly used for want of a better article. If the patient is making the test in his own home it must be made where the open flame or the boiling water is available and he is therefore usually prevented from making the test with the desired amount of privacy.

Among the objects of the invention are:

To provide an electric heating device which is especially suitable for use in making a urine Benedict test;

To provide an electric heating device for heating a small quantity of liquid in a test tube, or the like, in which the source of heat is so located with respect to the test tube and its contents, and the heat is so controlled by certain provisions for insuring a proper circulation of air, that the liquid will be properly heated without causing "geyser action" in the liquid;

To provide a heating device which will constitute a neat and presentable finished instrument for use in physicians' offices;

To benefit diabetic patients by making available to them a satisfactory electric heating device which will eliminate the burdensome procedure in making Benedict tests, and which, due to its convenience and the privacy allowed, will cause the patient to check his condition oftener;

To provide a heating device which is compact and all of whose parts are enclosable in a casing to form a small unit capable of being easily carried and transported in a suit case, or the like, so that Benedict tests may be made outside of one's home, and so that physicians may carry it with them in making visits to patients;

To enclose all of the working parts in an insulated casing to prevent burning of the hands.

Other objects will hereinafter appear.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

Fig. 1 is a perspective view of the device as it appears when the cover is in position;

Fig. 2 is a similar perspective view with the cover removed and a part of the side wall of the casing broken away to expose the interior parts;

Fig. 3 is a detailed perspective view of the dielectric base which supports the heating element, the test tube, and other parts of the device, certain parts being shown in section to better illustrate its construction;

Fig. 4 is a transverse vertical section through the complete device taken on the line 4—4 of Fig. 5;

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 4;

Fig. 6 is a vertical transverse section of the complete device taken on the line 6—6 of Fig. 4;

Fig. 7 is a vertical transverse section of the device with the cover removed, the section being taken on the line 7—7 of Fig. 4; and

Fig. 8 is a horizontal section taken on the line 8—8 of Fig. 4.

When the cover of the heating device is in position, as shown in Fig. 1, the exterior shape is that of a rectangular parallelepiped all of whose faces are smooth and unbroken, except for a base 1, an electric switch 2 and a small lens or crystal 3 whose functions will be hereinafter described. The casing which receives the interior parts is shown at 4 and the removable cover at 5. Secured to the metal base 1 by bolts 6 is a dielectric base 7, shown in its entirety in Fig. 3. The lowermost part 8 of the dielectric base is rectangular in horizontal cross section and fits snugly within the lower portion of the casing 4, to which it is secured by horizontally positioned bolts 9. At one side of the lower portion 8 of the base and rising vertically therefrom is a block 10 to support certain elements hereinafter described. To one side of the block 10 and rising vertically from the lower portion 8 are four projections 11, each of which, in horizontal cross section, has the shape of a segment of a circle. The projections 11 are spaced apart circumferentially. The innermost ends of the projections 11 do not meet but are shaped so that the inner vertical faces form a central vertical opening

as shown at 12 (Figs. 3 and 5). A cylindrical sleeve 13 rises vertically for a short distance from the outer edges of the segmental projections 11. A dielectric ring 14 mounted on or preferably integral with the segmental projections 11 supports the heating element. The heating element comprises a resistor preferably formed by a conductor wound on a mica strip, the entire resistor being designated by the numeral 15. The resistor is enclosed in a hollow sheet metal ring 16 closed at its top edge as shown at 17. The outer vertical wall of the sheet metal ring 16 extends vertically downward below the inner wall as shown at 18 and is designed to telescope snugly over the dielectric ring 14. The lower edge of the outer wall of the metal ring is crimped under the dielectric ring 14 at the spaces between the segmental projections 11 as shown at 19 (Fig. 4). In this way, the heating element is firmly attached to the dielectric ring 14 and the resistor is completely enclosed at the sides and at the top by the metal of the ring and at the bottom by the upper surface of the dielectric ring 14.

Telescoping within the upper end of the casing 4 is a sheet metal member 20 which is secured to the walls of the casing by screws 21. The vertical walls of the member 20 form a neck portion over which the cover 5 telescopes. The member 20 is closed at its top by a horizontal wall 22, provided with a circular opening 23. A sheet metal sleeve 24, whose upper end is flared outwardly as shown at 25, is secured to the top wall 22 of the member 20 at the opening 23 and projects downwardly into the interior of the device. This sleeve 24 constitutes a guide and lateral support for the test tube 26 (Figs. 4 and 7). When the test tube is inserted in the sleeve 24 its lower end rests on the inner circular edges at the top of the segmental projections 11. The upper end of the test tube projects beyond the top wall 22 of the member 20. When the cover 5 is in place a body of soft material, such as sponge rubber 27 within the cover presses against the upper edge of the test tube and holds it firmly in position. An insulating sleeve 28 is supported within the upstanding ring 13 of the dielectric base and surrounds the test tube, the sheet metal sleeve 24, and the heating element so as to prevent the outside casing from getting too warm and to lessen the danger of burning the hands when handling the device.

The supply of current to the heating element is controlled by the switch 2. A pilot lamp 29 whose light is visible through the lens 3 (Fig. 1) indicates when the device is functioning as it is illuminated when current is being supplied to the heating element and is out when no current is being supplied to the heating element. The switch 2 and the lamp 29 are supported on the upstanding block 10 of dielectric base. Metal strips 30 and 31 serving as supports and also as conductors for the switch are secured to the dielectric base by bolts 32 and 33. The innermost metal strip 31 is bent at its lower portion to extend under and make contact with the lamp socket 34. A third bolt 35 passes upwardly through the dielectric base and its head clamps the lamp socket 34 to the block 10. The head of this bolt also serves as the central contact for the lamp socket. For this purpose the head of the bolt is insulated from the lamp socket and from the metal strip 31 by an insulating washer 36. One of the incoming leads, for instance, that shown at 37 (Fig. 8) is connected to the lower end of the bolt 35 and the other incoming lead 38 is connected to the lower end of the bolt 32. One of the leads 39 from the resistor is connected to the lower end of the middle bolt 33 and the other lead 40 from the resistor is connected to the lower end of the bolt 35. In this way the resistor and the pilot lamp are connected in parallel and both of them are controlled by the switch 2. The bottom of the dielectric base may be recessed as shown at 41 to accommodate the electric wires and to provide space for the nuts at the lower end of the bolts.

When the device is functioning heat passes upwardly from the resistor and is confined within the insulating sleeve 28 until it reaches the top of the sleeve where it is discharged to the outside atmosphere through openings 42 provided in the flaring upper end of the guide sleeve 24. Any heat developed by the lamp 29 is discharged through openings 43 in the insulating sleeve 28 near its upper end and then through the openings 42 to the outside atmosphere.

The test tube, the guide tube 24, the heating element, the ring 14 on which it is mounted and the segmental projections 11 are all so correlated as to size and relative positions that when the test tube is resting on the seat formed by the inner circular edges at the top of the segmental projections 11, no part of the heating element will make direct contact with the test tube. The walls of the heating element and the test tube are spaced radially apart as clearly shown in Fig. 4. Likewise, the ring 14 which supports the heating element is spaced radially away from the walls of the test tube. The amount of surface contact between the support and the test tube is very small because the test tube rests on the circular line—contact seat formed by the edges of the projections 11. This circular seat causes the test tube always to rest exactly in the center so that it does not contact with the ring 14 or the heating element or any metal part heated thereby.

Air is permitted to flow upwardly through the ring 14 and through the space between the test tube and the inner wall of the heating element. Free access of air for this purpose is permitted by openings 44 in the lower portion 8 of the dielectric base. Each of these openings is located between two of the segmental projections 11 as clearly shown in Fig. 3. The sheet metal base 1 is likewise provided with openings 45 to allow outside air to enter the recess 41 in the bottom of the dielectric base and then to pass upwardly through the openings 44, then between the segmental projections 11 and then upwardly around the heating element.

It will be noted that the heating element is located near the bottom of the test tube, and as it surrounds the test tube the heat is concentrated on the sides of the test tube for a limited distance. While the heating element does not make contact with the test tube, it is placed in close enough proximity to permit a full application of heat to the test tube contents. No heat whatever is focused to the bottom of the test tube. In fact the bottom of the test tube is cooled by a constant stream of air flowing upwardly to the heating element between the projections 11 and through the central opening formed by the inner ends of these projections. By placing the heating element near the lower portion of the test tube, but not under it, by eliminating direct contact between the heating element and the test tube, and by admitting outside air to the device and allowing it to impinge against the bottom of the test tube and to flow upwardly around the heat-

ing element and the test tube it is possible to apply the right amount of heat to a small quantity of liquid in the test tube without danger of ejecting the contents of the test tube by "geyser action". The device is therefore particularly useful in making a "Benedict test".

The upper end of the test tube is preferably provided with a rubber ring **46** which enables it to be handled while it is hot. This ring is preferably made hexagonal or octagonal in shape so that the test tube will not roll when lying in a horizontal position. The rubber ring also prevents breakage of the tube in case it should fall from a vertical position upon its side.

In using the device it is only necessary to remove the cover **5**, place the test tube with its liquid contents in the guide tube **24** until the bottom of the test tube rests upon the upper inner edges of the segmental projections **11**. The switch **2** is then operated to supply current to the heating element **16**. When the heating element is functioning the pilot lamp **29** will be illuminated and its light will be visible through the crystal or lens **3**. Heat from the heating element will be sufficiently, but not too severely, applied to the contents of the tube by radiation. The incoming air will cool the bottom of the test tube and will then pass upwardly around the heating element and through the space between the heating element and the test tube. It thus acts as a ventilating medium to prevent such an intense application of the heat as might result in "geyser action". The air heated by the heating element continues to flow upwardly to heat the upper portion of the test tube and is then discharged through the openings **42**.

It will now be seen that the device is compact and neat in appearance and is the kind of an instrument which a physician does not object to use in his office. When the cover is in place all parts are enclosed and the test tube is held firmly in position and the device may be readily transported. It may be used any place where electric current is available.

While my improved heating device was especially designed for use in making a "Benedict test", and while its advantages for this particular use have been emphasized, it may, of course, be used for other purposes.

The foregoing description has been made specific because of its reference to the preferred form of the invention, but that fact should not be construed as an intention to limit the invention to the particular form of the device described. On the contrary, many changes can be made, including variations in materials, dimensions, location of the parts, etc. without departing from the scope of the invention as defined by the accompanying claims.

I claim:—

1. A heating device for heating the contents of test tubes, and the like, comprising a base provided with circumferentially spaced vertical projections upon which the test tube is adapted to rest, the base having openings located between said projections to permit air to flow upwardly around the test tube, and an annular electric heating element supported by said projections and adapted to surround the test tube and having an inner diameter greater than the outside diameter of the test tube whereby air may flow upwardly through said openings then between the projections and through the space between the heating element and the walls of the test tube.

2. A heating device in accordance with claim 1 in which a sleeve supported by the outer ends of the projections surrounds the heating element and is spaced radially therefrom, and an insulating sleeve telescoping within the first named sleeve and surrounding the test tube and the heating element.

3. A heating device comprising an outer casing, means in the lower part of the casing for supporting a receptacle, a guide for holding the receptacle in an upright position, electric heating means surrounding the receptacle, and a single cover for the casing adapted to enclose the top of the casing and to seal the top of the receptacle.

4. A heating device comprising an outer casing, a receptacle support in the lower part of the casing, an electric heating element surrounding the receptacle, a member telescoping partly within the upper portion of the casing and having a top wall provided with an opening, said member constituting a neck portion for the casing, a receptacle guide secured to the top wall of said member at said opening and extending downwardly into the casing, and a cover for the casing adapted to be applied to said neck portion.

5. A heating device in accordance with claim 4 in which the receptacle when resting on the support projects above the top wall of said member through its opening whereby it may be engaged by the end of the cover to steady it when the member is in place.

6. An electric heating device comprising a casing having a top wall provided with an opening, a receptacle guide extending into the casing and having a flared upper end joining the top wall of the casing at said opening, a receptacle support below said guide, and an electric heating element adapted to surround the receptacle, the flared portion of said guide having openings to permit the escape of heat from the casing.

7. An electric heating device comprising a casing, a receptacle support therein, an electric heating element within the casing to heat a receptacle and its contents, a cover for the casing and a body of soft material located at the inner side of the top wall of said cover for engaging the upper end of a receptacle when the latter is resting upon the said support.

8. A heating device comprising a base having vertical projections which are arranged to support a receptacle and spaced apart circumferentially, in circular arrangement, to provide air passages, said base having openings to admit air to the passages between said projections, whereby air may flow through said passages upwardly around the receptacle, an electrical heating means for heating said receptacle, said heating means comprising an annular heating element which surrounds a portion of the receptacle but is spaced radially therefrom.

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