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ELECTRIC HEATER

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Fig. 1

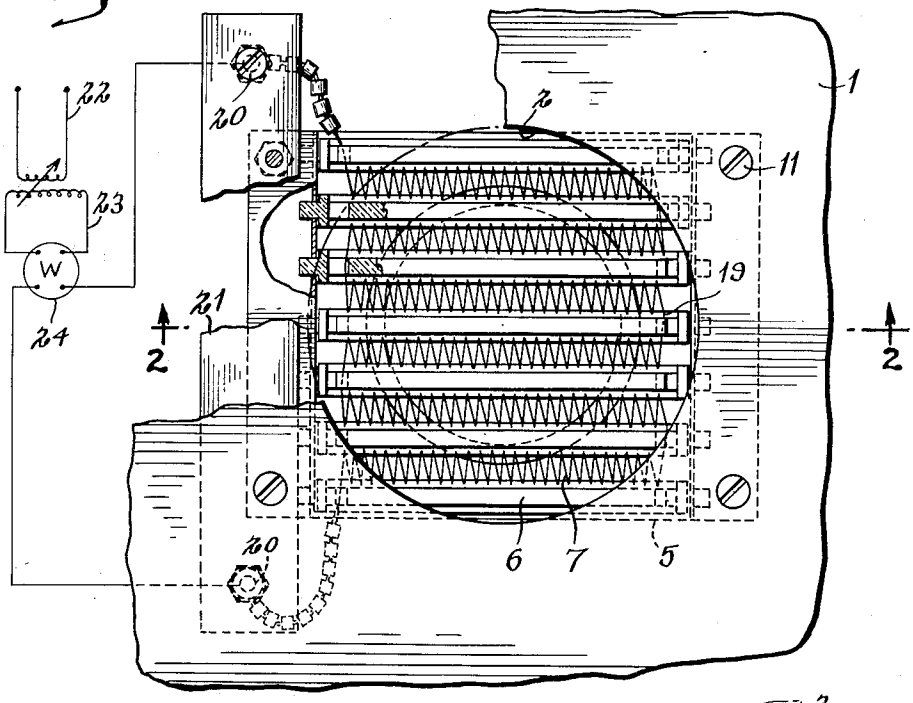


Fig. 2

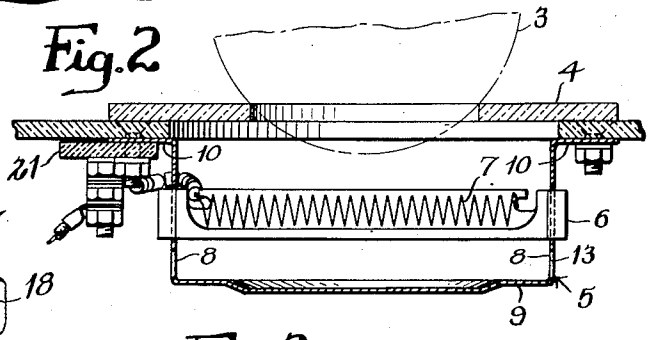


Fig. 4

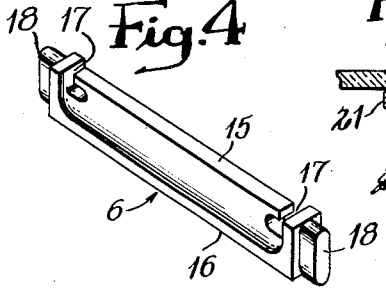
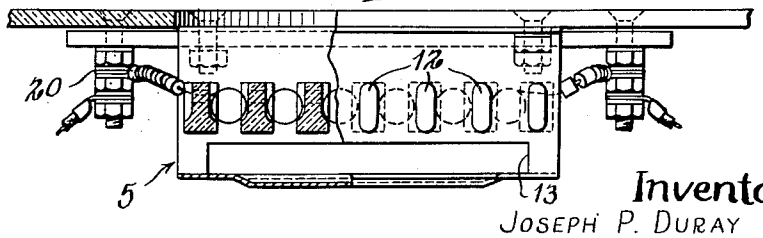


Fig. 3



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ELECTRIC HEATER

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5 Claims. (Cl. 219—19)

This invention relates to electric heaters and has particular reference to coiled wire heater assemblies employed as small stoves.

Electric stoves or plates of the type employing an inexpensive heater element in the form of a coil of an electrical resistance wire have been characterized by relatively large thermal inertia. The slow rate of change of the heater or stove temperature works to a disadvantage in many instances. Thus in installations where a hydrocarbon or other liquid may be heated in distillation equipment for fractionating, it is important that the heater have a fast thermal response to change in the electrical input energy in order that the liquid boiling point can be readily controlled. However, despite the ease with which electrical input energy itself can be controlled, the requirements for supporting and spacing the heater coil in order that the heating capacity over a given area can be made sufficiently large has also resulted in heating a large mass of insulating material. The time of thermal response, as well as the efficiency of the unit in terms of electrical energy converted to usefully directed heat, are adversely affected.

It is therefore an object of the invention to provide an improved electric heater or stove having low thermal inertia.

It is also an object of the invention to provide a more efficient stove or heater, advantageously providing both radiant heat energy and the convection of heated air.

It is another object of the invention to provide an inexpensive small electric stove of the type having a coiled wire heater unit which is both inexpensive in construction and relatively free of maintenance requirements.

It is still another object of the invention to provide a coiled wire heating unit having an improved support means facilitating low thermal inertia and high effective efficiency.

It is a further object of the invention to provide in a coiled wire electrical heater an improved insulating support means which minimizes the danger of damage or shorting of the heater coil due to either extended use, abuse, or spilling of materials on the heater.

It is a still further object of the invention to provide an inexpensive small stove capable of long life and having easily maintained or replaced parts.

The objects of the invention thus generally set forth together with other objects and ancillary advantages are attained by the construction and arrangement shown by way of illustration in the accompanying drawings in which:

Figure 1 is a top view, partly in section, of an electric stove unit incorporating the invention together with a schematic representation of a controlled electrical energy source therefor.

Fig. 2 is a sectional view along line 2—2 of Fig. 1 and also showing in dotted outline the position of a flask and flask holder on the stove.

Fig. 3 is an end view partly in section of the stove of Fig. 1; and

Fig. 4 is a perspective view of one of the insulating spacers suitably employed in the stove of Fig. 1.

While the invention is susceptible of various modifications and alternative constructions, there is shown in the drawing and will herein be described in detail as a preferred embodiment a flask heater having a small capacity, being rated in the order of a few hundred watts, but it is to be understood that it is not thereby intended to limit the invention to the form disclosed, but it is intended to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention as expressed in the appended claims.

Referring to the drawings, the heater shown includes a top plate or panel 1 of asbestos board or other suitable material preferably having small thermal storage capacity and conductivity so that the panel itself will not be heated unduly. This panel may be suitably supported in a horizontal position by legs (not shown) either as a single unit or in combination with other heaters. A circular opening 2 in the panel is designed to expose the bottom of a flask 3 which is exposed to radiation and heated air from the heater unit below the panel. As particularly indicated in Fig. 2, the flask 3 may have a curved bottom surface, in which case it is suitably supported by an auxiliary support pad 4 which rests over the aperture 2 in the panel 1 and is itself apertured to support a particular size of flask and expose its bottom surface to the heater. Obviously many types of stove tops and holder arrangements may be employed for supporting the object to be heated on or above the heater unit without departing from the spirit of the invention. Likewise, the heater unit may be variously supported or enclosed as may be desired for the appearance, thermo-insulation, or other requirements of particular types of installations.

In accordance with the invention, the heater unit itself comprises a generally U-shaped support base or channel 5 which holds a plurality of spaced insulating bars 6 which in turn between them continuously support lengths of a heating coil 7. As may be seen from the drawings, the base member 5 suitably takes the form of a rectangular metal sheet having vertical side members 8 bent up from the substantially flat bottom surface 9. Support flanges 10 are suitably bent over from the upper portions of the side walls 8 and form a convenient means for attaching the base to the underside of the stove top panel 1, flush flat-head machine screws 11 being suitably used for that purpose. A plurality of vertically elongated slots 12 are punched or otherwise formed in a horizontal array in each side wall 8 of the base, the slots being uniformly spaced and oppositely alined in the facing side walls to accommodate the ends of the spacer bars 6.

The base or channel member 5 also additionally serves to increase the heater effectiveness. Toward this end a horizontally elongated slot 13 running almost the entire width of the base member is provided in the lower portion of each side wall 8 below the holding slots 12. These slots 13 together with the passages provided by the pair of open sides of the channel 5 help give rise to the convection air currents, the air entering under the heater element rising through it to the flask 3 above. The bottom surface 9 of the base is not itself apertured or perforated since it serves as a reflecting shield for radiant energy from the heater element. Thus a portion of any downwardly radiated heat energy is reflected upwardly again toward the flask 3. For this purpose, the base member is preferably made of polished aluminum, or, where the heater has a higher temperature rating as may be required for particular installations, of polished stainless steel. As shown in the drawings, the bottom surface 9 of the base member 5 may also be formed with a circular boss or depression 14, principally for the purpose of increasing the rigidity of

that member, although such a feature may be omitted if desired.

The spacer bars **6** are designed to be locked or anchored in placed in an open parallel array between the side walls **8** of the base member **5**. As shown in Fig. 4, each of the bars is made of a refractory insulating material which may be readily molded to the desired form. Porcelain or other ceramic material is suitable, such materials having both electrical and thermal insulating properties. Each of the spacer bars has a basic rectangular form with a reduced thickness portion or rib **15** defined between its end portions and above a wider bottom surface or ledge **16**. A smooth curved transition or fillet is preferably provided from the ledge to the rib to accommodate the lower side portions of the heater coil and to prevent accumulation of dirt or spilled materials. The effect is thus generally to provide a rib having a bottom portion which is wider than the top portion so that when the ribs are arranged in uniformly spaced parallel array, their top portions or ribs are more widely spaced than the bottom portions. At the end of each narrowed rib portion **15** is a notch **17** extending downwardly from the top surface and inwardly for the purpose of accommodating a heater wire and holding it in place. Beyond each full diameter end portion of each spacer bar is a reduced diameter noncircular end projection **18**, this projection taking the form in Fig. 4 of a vertically elongated oval cross section dimensioned to fit within the slot **12** in a base side wall **8**.

The spacer bars are inserted in position in the base **5** with each end portion **18** extending through one of the slots **12** before the base member is bolted in place under the top panel **1**, the sheet metal channel base being easily bent or sprung outwardly to admit the spacer bars. A small amount of end play for the spacer bars is preferably provided, the distance between the full diameter end portions of each bar being somewhat less than the distance between the base side walls, thus allowing the bars to expand and contract with changes in temperature and to prevent binding or stresses due to variations of dimension within manufacturing tolerances. At the same time, however, the bars are locked or anchored in place once the base has been fastened in place and held against rotation. The number of spacer bars and their length depends upon the desired size of the heater area, since it is the space between adjacent bars that provides or defines a position for each length of the heater coil **7**.

The heater coil **7** itself is suitably made of conventional heater wire such as a nickel-chromium alloy helically wound with spaced turns. Such heater elements conveniently provide a relatively large heat dissipation rating and a practical resistance range for commonly available electrical power supplies. Successive straight lengths of the heater coil are defined between stretched turns **19** and positioned between each adjacent pair of facing spacer sides. The coil is anchored in a zig-zag or folded form, the wire of the stretched or pulled apart turns **19** being fitted within a slot **16** of the spacer bar between adjacent coil sections. The coil assembly is held firmly in place since the notches **17** are undercut. While for this simple self-connected series of coil lengths only alternate spacer notches **16** are employed, the spacer bars **6** are in this case shown with notches **16** at each end since it is generally more economical to provide both notches than to require end-for-end alternation of single-notch bars in assembly. The ledge **16** formed by the broadened base portion of the spacer bar prevents the coil from dropping down through the open space between the base surfaces of adjacent bars which is slightly less than the coil diameter but still provides continuous support along each coil length. Effective retention of the coil in proper position is thus assured since in an open support frame the coil would otherwise tend to sag or droop due to its annealing with use.

Suitable terminals **20** are provided for the ends of the coil, a terminal board **21**, also suitably made of asbestos board, being conveniently provided for this purpose and attached to the underside of the top panel **1** through the same screws that hold one of the base flanges in place.

In operation, since the heater assembly described has a quick thermal response, it may be advantageously employed with graduated or continuous current control means. Thus, as shown in Fig. 1, the heater element is energized from a convenient electrical energy source **22** such as the usually available 115-volt, 60-cycle supply through a variable transformer **23**, although of course other means of varying the current such as an adjustable resistor may be employed. A wattmeter **24** may also be additionally connected in circuit so that an instantaneous reading of the energy supplied to the heater element is available as an accurate temperature reference. With the particular apparatus shown, which is very advantageously employed in heating a hydrocarbon liquid in the flask **3** for distillation tests, the boiling point of the liquid may be readily controlled by varying the transformer ratio and thus controlling the distillation of the various fractions.

The mass of the heater assembly which is subject to increase or decrease of temperature along with the change in temperature of the heater wire itself is minimized, but the space between the heater elements minimizes conductive heating of the stove or heater assembly itself. Instead, a portion of the radiant energy of the coil which is directed downwardly from the bottom side of the heater coil is reflected upwardly upon incidence with the polished reflective bottom surface **9** of the heater base so that it may be directed upwardly between the spacer bars to directly heat the flask. Not all of the heating is by radiation, of course, and again the spacing between the heater bars facilitates the flow of convection air currents, the heated air rising to also heat the flask. Thus it may be seen that not only is the thermal response time made very fast, but the thermal efficiency of the unit so far as its application of the heat generated to the flask is also increased. In this way, the wattmeter reading is made more significant as to accuracy as well as to time, further facilitating manual control of the heater for particular control or test requirements.

At the same time, the structure of the unit itself is seen to be so simple as to permit it to be inexpensively manufactured and maintained. The heater coils are assured of long life by their protection against shorting through adequate and continuous support so that the annealing of the heater with age does not result in sagging and dislocation of the heater. Accidental spilling of the liquid being heated causes minimum damage to the coil in so far as the liquid is free to pass through the spaces between the insulating bars. Replacement of the heater coils when necessary is immediately effected by reason of the fact that the base assembly is easily removed and sprung or bent to permit replacement of the individual spacers.

We claim as our invention:

1. A quick response electric heater comprising a channel-shaped support base, each channel side being provided with a horizontal array of spaced apertures, a plurality of separate insulating spacer bars positioned within said channel with their opposite ends anchored in said channel side apertures, said spacer bars being formed to provide a lesser spacing between their bottom portions than between their top portions, and a coiled wire heater element having lengths thereof positioned between adjacent pairs of said spacer element sides, said element having a coil diameter greater than said lesser spacing whereby said heater coil lengths are supported between said spacer bars.

2. A quick response electric heater comprising a channel-shaped sheet metal support base having a heat reflect-

ing inner bottom surface, each channel side being provided with a horizontal array of uniformly spaced apertures, a plurality of separate spaced insulating bars positioned within said channel with their opposite ends supported in said channel side apertures, said spacer bars being formed to provide a lesser spacing between their bottom portions than between their top portions, and a coiled wire heater element having a coil diameter greater than said lesser spacing with successive self-connected lengths thereof positioned between adjacent pairs of said spacer element sides whereby said heater coil lengths are supported between said spacer bars, each of said spacer bars being notched near an end thereof to retain a connecting wire between adjacent heater coil lengths.

3. A quick response electric stove comprising a top panel having an aperture therein, a channel-shaped sheet metal support base under said panel with the inner bottom surface of the channel disposed under said aperture, said surface being highly reflective of radiant heat energy, each channel side being provided with a horizontal array of uniformly spaced apertures, a plurality of separate insulating spacer bars positioned within said channel with their opposite ends supported in said channel side apertures, said spacer bars being formed to provide a spacing between their bottom portions smaller than between their top portions, and a coiled wire heater element having a coil diameter greater than said smaller spacing with successive self-connected lengths thereof positioned between adjacent pairs of said spacer element sides, each of said spacer bars being notched near an end thereof to retain a connecting wire between adjacent heater coil lengths.

4. A quick response electric heater comprising a top panel having an aperture therein, a channel-shaped polished sheet metal support base fastened to the under side thereof with the inner bottom surface of the channel disposed under said aperture for reflecting heat energy thereto, each channel side being provided with a horizontal array of uniformly spaced apertures, a plurality of separate uniformly spaced refractory insulating bars positioned within said channel with their opposite ends supported in said channel side apertures, each of said spacer bars having a lower edge on each side along its intermediate length, and a coiled wire heater element having successive self-connected lengths thereof retained between adjacent pairs of said spacer element sides on said ledges, each of said spacer bars being transversely notched near one end thereof to anchor a connecting wire between adjacent heater coil lengths.

5. A quick response flask heater comprising a top panel having an aperture therein, a channel-shaped polished sheet metal support base fastened to the under side thereof with the inner bottom surface of the channel disposed under said aperture for reflecting heat energy thereto, each channel side being provided with a horizontal row of uniformly spaced apertures, a plurality of separate uniformly spaced refractory insulating bars spaced within said channel above said bottom surface with their opposite ends supported in said channel side apertures, each of said spacer bars having a lower ledge on each side along its intermediate length and being transversely notched near one end, and a coiled electric resistance wire heater element having successive self-connected lengths thereof retained between adjacent pairs of said spacer element sides on said ledges with connecting wires between adjacent heater coil lengths secured in said notches, said channel side being additionally apertured below said row of apertures.

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