March 15, 1966 E. W. BINKLEY ETAL 3,240,256

CATALYTIC HEATER

Filed Nov. 19, 1963 3 Sheets-Sheet 1

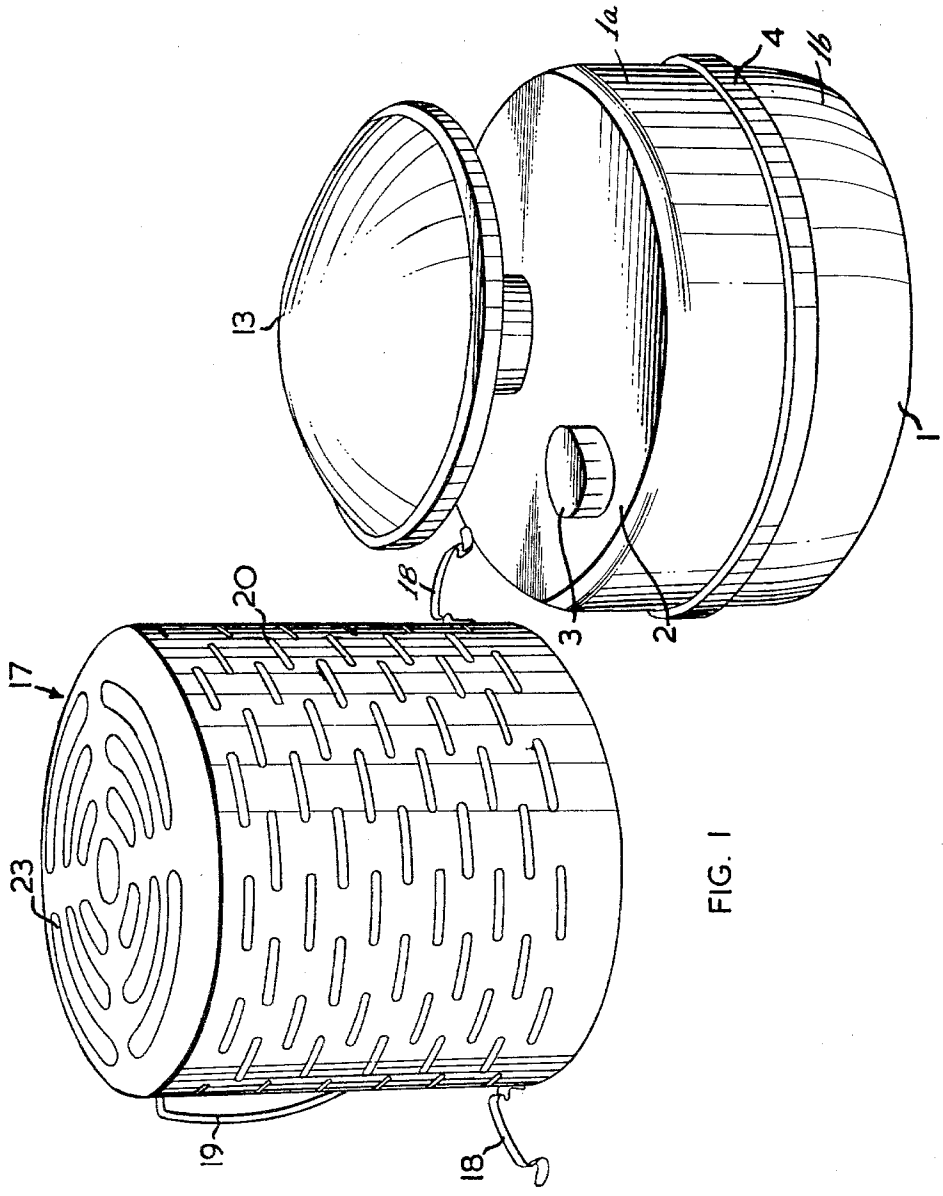


FIG. 1

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CATALYTIC HEATER

Filed Nov. 19, 1963 3 Sheets-Sheet 2

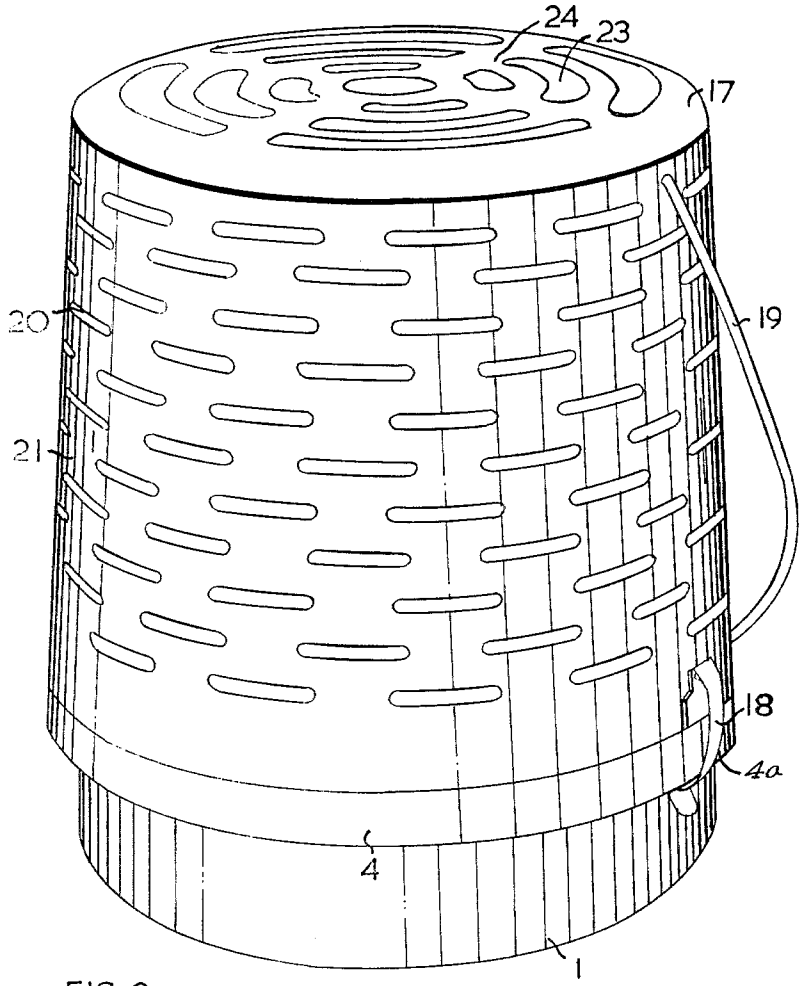


FIG. 2

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CATALYTIC HEATER

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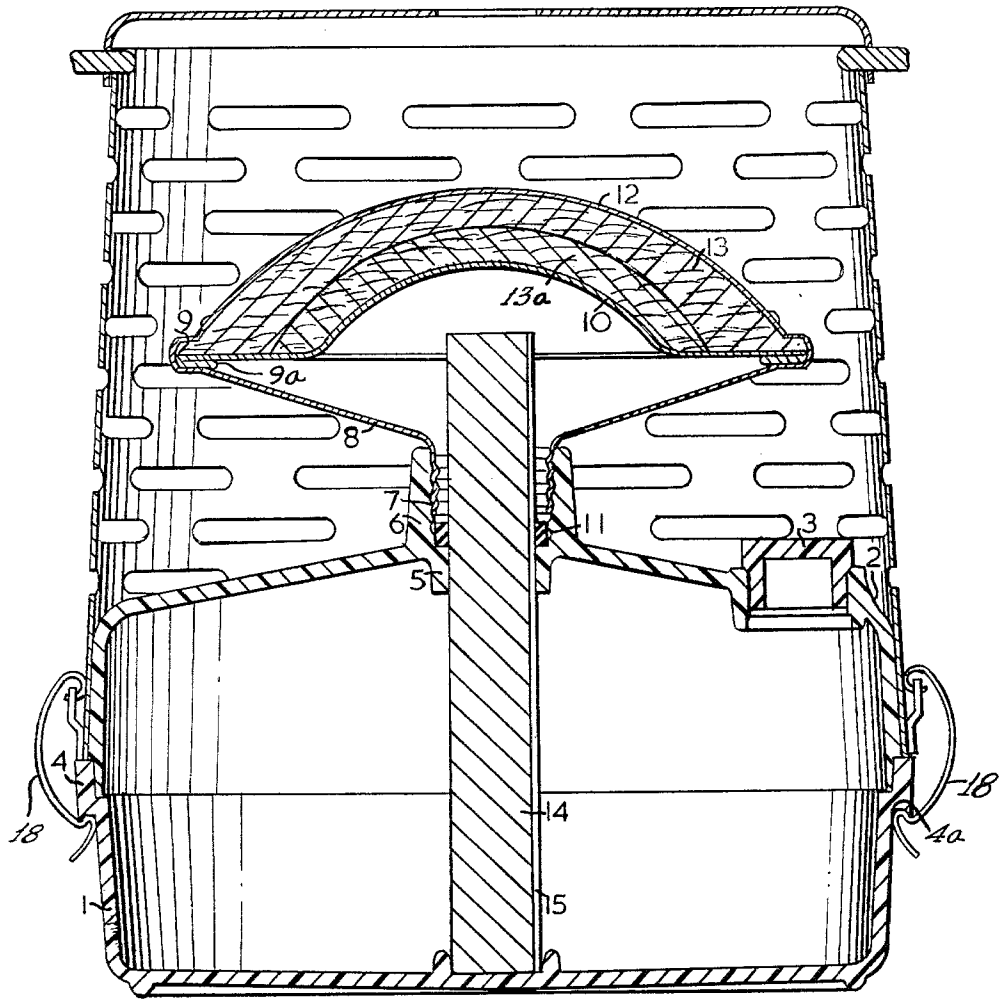


FIG. 3

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3,240,256

CATALYTIC HEATER

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7 Claims. (Cl. 158—96)

The present invention relates to catalytic heaters. Such heaters in general comprise a fuel reservoir for containing a hydrocarbon fuel and a burner housing located above this reservoir. The burner housing contains a carrier for a catalyst which is capable of effecting flameless combustion of vapours of the hydrocarbon fuel contained in the reservoir. A wick is arranged to extend between the reservoir and the burner housing; fuel is transmitted by capillary action up the wick from the fuel reservoir to the surface of the wick which is exposed within the burner housing where the fuel is vaporized for combustion on the surface of the catalyst.

Heaters of this type have been known for many years but have been subject to various disadvantages. Some of these disadvantages have been associated with the nature of the material used for the wick. This material has commonly been cotton or other textile material and has therefore had a tendency to char. The wicks of the prior art have also often had a somewhat limited capacity for supplying fuel vapour to the burner housing. Other disadvantages have resulted from the use of an inefficient means for generating an air stack about the burner housing. Also, in some cases the structure of the heater has been such as to allow an excessive flow of heat back to the fuel reservoir and this has constituted a fire hazard.

It is one object of the present invention to provide a catalytic heater having a wick which is more durable than the wicks of the prior art while at the same time permitting an adequate flow of fuel vapour to the burner housing.

It is another object of the present invention to provide a catalytic heater having means to promote an efficient air stack about the burner housing while minimizing flow of heat back to the fuel reservoir.

Accordingly, the invention provides a catalytic heater comprising a fuel reservoir, a burner housing located above said reservoir and supporting a catalyst adapted to effect flameless combustion of a hydrocarbon fuel, and a wick extending between said reservoir and said burner housing for supplying fuel vapour from said reservoir to said fuel housing, said wick being formed of an absorbent ceramic material.

The invention further provides a catalytic heater comprising a fuel reservoir, a burner housing located above said reservoir and supporting a catalyst adapted to effect flameless combustion of a hydrocarbon fuel, a wick extending between said reservoir and said burner housing for supplying fuel vapour from said reservoir to said housing, and a shroud enclosing said burner housing, said shroud having a peripheral wall extending upwardly from said reservoir to a level above that of the burner housing, said peripheral wall having a plurality of apertures therein to afford access of air to the interior of said shroud both above and below said burner housing.

The invention will be described by way of illustration and without limitation with reference to the accompanying drawings wherein:

FIG. 1 is an isometric view of a catalytic heater with the shroud thereof removed,

FIG. 2 is an isometric view of the heater of FIG. 1 with its shroud in position, and

FIG. 3 is a sectional view of the heater of FIGS. 1 and 2.

The catalytic heater shown in the drawings comprises a fuel container 1 formed of a molded synthetic resin. The container 1 is made up of an upper portion 1*a* and a lower portion 1*b* cemented together by means of an epoxy resin. The fuel container 1 is formed with a threaded inlet 2 for introduction of fuel, the inlet 2 being normally closed by a threaded plug 3. An annular boss 4 extending all the way round the container 1 is formed as a shoulder on the upper exterior surface of the container portion 1*b*.

Centrally of its upper surface the fuel container 1 is formed with an inwardly directed annular flange 5 and an outwardly directed, internally threaded neck 6. Into the neck 6 is screwed externally threaded base 7 of a burner housing 8 formed of nickel plated mild steel.

The burner housing 8 has a turned over rim 9 which serves to grip and secure thereto a dome-shaped stainless steel wire screen 10 which together defines a vaporization chamber. Disposed above the wire and clamped thereto by the rim is a woven asbestos or glass fibre cloth 12 impregnated with a platinum catalyst, a felt pad 13 of refractory ceramic fibers and a second felt pad 13*a* also of refractory ceramic fibers; the pads 13 and 13*a* lying between the screen 10 and the asbestos cloth 12. An annular ring 9*a* of asbestos wick is interposed between the screen 10 and the housing 8. This serves to reduce conduction of heat from the screen 10 to the housing 8. The asbestos cloth 12 has been impregnated with a platinum catalyst in a conventional manner by soaking the cloth in a solution of a platinum salt and then heating it to a temperature high enough to decompose the platinum salt and deposit platinum on the fibers of the cloth. The felt pads 13 and 13*a* are of the order of about ½ inch thick and may consist of any type of mineral fibers such as asbestos fibers. Unlike the pad 13, the pad 13*a* does not extend to the periphery of the burner housing 8. Fuel vapour therefore can, pass more readily from the interior of the housing 8 to the asbestos cloth 12 at the periphery of the burner than at the center thereof. At the center of the burner the fuel vapour must pass through the combined thickness of the pads 13 and 13*a* whereas at the periphery of the burner it has to pass only through the peripheral portion of the pad 13. In this way fuel vapour is preferentially directed to the periphery of the burner which is desirable since there is more oxygen available at this location.

A cylindrical ceramic wick 14 extends from the interior of the fuel container 1 to the interior or vaporization chamber of the burner housing. The wick 14 is held in place by a ring 11 formed of synthetic rubber or other resilient material which is resistant to attack by hydrocarbon fuels. The ring 11 is fitted on the wick 14 to grip the cylindrical surface thereof and is held within the base of the neck 6 by the threaded base 7 of the burner housing 8. A groove 15 is formed on the outer surface of the wick 14 and extends along the length of the wick. The groove 15 permits easy return into the fuel container 1 of any liquid fuel which has found its way into the burner housing 8 by spillage or otherwise. The groove 15 also provides a vent between the fuel container and the burner housing to equalize the fuel vapour pressure resulting from temperature changes during operation.

The heater is provided with a shroud 17 of generally cylindrical shape which is adapted to seat on the upper face of the annular boss 4 and is retained in position thereon by means of two spring clips 18 engageable with the lower surface of the annular boss 4; this lower surface being undercut at 4*a* to ensure firm engagement. A handle 19 is secured to the radiator housing 18 to facilitate carrying the assembled heater from place to place.

A large number of horizontally extending slots **20** are formed in the cylindrical wall **21** of the shroud **17**. These slots are arranged in circumferentially extending rows with the slots in adjacent rows being in staggered relationship to one another so that any downward conduction of heat through the wall **21** of the shroud **17** necessarily takes a circuitous path. In this manner conduction of heat downwardly towards the fuel container **1** is minimized.

The slots **20** also serve for admission of air in a controlled manner to the interior of the shroud **17** so as to promote a stack of air within the shroud. Holes **23** are provided in the upper surface **24** of the shroud **17** to permit discharge of heated air and combustion products from the shroud. In the embodiment shown in the drawings the total area of the slots **20** is approximately 40% of the cylindrical surface **21** of the shroud **17**. This has been found to be a suitable proportion for the embodiment described but it will be appreciated that a different proportion might be more suitable in a modified construction.

The arrangement of the slots **20** in the wall **21** is such that they afford as much inflow of air below the rim **9** of the burner housing **8** as above it. This provides a vigorous flow of air upwardly about the burner housing **8** which serves to cool the lower portions of the burner housing **8** and of the wall **21** of the shroud **17** while maintaining an adequate supply of air for combustion purposes.

The shroud **17** not only serves to create an air stack around the burner housing **8** but also acts as a radiator since the top **24** and the upper portion of the wall **21** become quite hot during operation of the heater. Some of the radiant heat emitted from these parts of the shroud **17** is directed into the interior of the shroud and serves the useful purpose of maintaining an elevated temperature around the burner housing **8** thereby ensuring that combustion continues.

The ceramic wick **14** offers considerable advantages over the wicks of the prior art which commonly tended to char during operation of the heater. No such tendency is displayed by the ceramic wick **14**.. At the same time it is capable of supplying fuel vapour by capillary action to the interior of the burner housing **8** with high efficiency. The ceramic of which the wick **14** is composed, has an absorptivity for hydrocarbon fuels which is preferably greater than 20% by volume, for example about 25% by volume, by comparison with an absorptivity of 1% for a normal porcelain.

A suitable wick may be prepared by incorporating a combustible organic material, such as sawdust, in a formulation of a type used for the production of a typical porcelain and then firing the mix. During the firing the sawdust or other carbonaceous material is burnt out to leave a highly porous ceramic material.

The nature of the catalyst with which the asbestos cloth **12** is impregnated is not critical. Normally it will be a platinum catalyst although another type may be preferable depending on the type of fuel used. A platinum catalyst has been found to be eminently suitable when using naphtha as a fuel. It is however, not suitable for use with leaded fuels since it tends to become poisoned by such fuels. In generally it may be said that the catalyst carried on the asbestos cloth **12** is one of the class generally known for supporting flameless combustion of hydrocarbon fuels and is selected in accordance with the nature of the fuel to be used.

When it is desired to use the heater shown in the drawings the shroud **17** is removed. A small amount of alcohol is poured over the surface of the asbestos cloth **12** and is ignited. The shroud **17** is then replaced. The heat generated by the combustion of the alcohol raises the temperature of the platinum catalyst carried by the woven asbestos cloth **12** to a point where catalytic combustion of the fuel vapour rising from within the burner

housing **8** is initiated. From then on the heat generated by combustion fuel maintains the platinum catalyst at the operating temperature which is about 400° F. to 800° F. Air within the shroud **17** is heated by such combustion and the heat is transmitted to the surrounding environment both by radiation from the housing **17** and by passage of hot air and combustion products upwardly and out of the housing by way of the holes **23**. The capacity of the fuel reservoir **1** is sufficient to maintain the burner in operation for from about 22 to about 24 hours.

If too much alcohol is used when starting the heater there is a tendency for the burner housing **8** to be raised to too high a temperature. This causes fuel to be vaporized too quickly into the burner housing **8** saturating the pad **13**. The fuel then condenses within the burner housing. However, in the present heater rapid return of such condensed fuel to the reservoir **1** takes place because of the provision of the groove **15** in the ceramic wick **14**.

In the embodiment shown in the drawings, the fuel reservoir **1** contains only fuel. It might, however, be desirable to provide an absorbent filler for the purpose of minimizing spillage if the heater is accidentally inverted. The filler could be made of a formed resin which is resistant to aromatic hydrocarbons. A polyurethane resin would be suitable although in this connection it may be mentioned that account should be taken of the fact that a polyurethane foam expands when soaked in gasoline. It follows that the volume of filler introduced into the reservoir **1** should be sufficiently smaller than the volume of the reservoir **1** to allow for expansion.

If desired, the heater shown in the drawings may be modified by providing within the fuel reservoir **1** a separate compartment within which alcohol may be stored to be used when starting the burner. An inlet similar to the inlet **2** would then be provided for the alcohol compartment and this additional inlet could be closed by a stopper carrying a medicine dropper or the like to facilitate withdrawal of a suitably small amount of alcohol from the compartment.

A further modification of the heater shown in the drawings would make it possible to dispense with the need for alcohol to initiate combustion. This modification involves providing a heating element formed of nichrome wire and inserted immediately beneath the woven asbestos cloth **12**. By passing an electric current through such a resistance element the temperature of the platinum catalyst carried by the cloth **12** can be raised to the temperature which is necessary to initiate flameless combustion of the fuel arising from the burner housing **8** through the felt pad **13**.

We claim:

1. A catalytic heater comprising a fuel reservoir, a burner housing having a porous laminate impregnated with a platinum catalyst supported thereon by a dome-shaped stainless steel wire and defining a vaporization chamber and a wick extending from said reservoir into said chamber for supplying fuel vapor to the latter, said wick comprising an absorbent ceramic material substantially cylindrical in cross-section and having a groove in the surface thereof extending from said reservoir to said vaporization chamber to provide a return path to the reservoir for excess fuel in the vaporization chamber and to vent said reservoir.

2. A catalytic heater comprising a fuel reservoir, a burner housing located above said reservoir and supporting a catalyst thereon adapted to effect flameless combustion of a hydrocarbon fuel, said burner housing having a vaporization chamber therein interconnected with said reservoir by a wick extending from within said reservoir into said chamber for supplying fuel vapor to the latter, said wick being rigid and self-supporting and comprising an absorbent ceramic material having a groove in the

surface thereof extending from said reservoir to said vaporization chamber to provide a return path to the reservoir for excess fuel in the vaporization chamber and to vent said reservoir.

3. A catalytic heater comprising a fuel reservoir, a burner housing having a vaporization chamber located above said reservoir and supporting a catalyst adapted to effect flameless combustion of a hydrocarbon fuel, an absorbent ceramic wick extending between said reservoir and the vaporization chamber of said burner housing for supplying fuel vapor from said reservoir to said vaporization chamber and a shroud enclosing said burner housing, said shroud having a peripheral wall extending upwardly from said reservoir to a level above that of the burner housing, said peripheral wall having a plurality of apertures therein to afford access of air to the interior of said shroud both above and below said burner housing, said apertures comprising a plurality of slots elongated in a substantially horizontal direction and arranged in a plurality of rows, the slots in adjacent rows being staggered with respect to one another and overlapping whereby to minimize downward conduction of heat in said shroud, said plurality of apertures occupying approximately 45% of the area of said peripheral wall and providing as much inflow of air into the interior of the shroud above the level of the burner housing as below the level of the burner housing.

4. In a catalytic heater having a fuel reservoir, a burner housing located above said reservoir and supporting a catalyst adapted to effect flameless combustion of a hydrocarbon fuel and a wick extending between said reservoir and a vaporization chamber in said burner housing for supplying fuel vapor from said reservoir to said chamber, the improvement comprising a wick formed of an absorbent ceramic material and having on the surface thereof a groove extending between said burner housing and said fuel reservoir.

5. A catalytic heater according to claim 4 wherein said ceramic material has an absorptivity for hydrocarbon fuels of greater than 20% by volume.

6. A catalytic heater according to claim 4 wherein said ceramic has been formed by firing a porcelain-forming mix to which has been added a combustible organic material.

7. A catalytic heater according to claim 4 wherein said burner housing supports cloth formed of mineral fibers and impregnated with said catalyst and also supports a felt formed of refractory fibers, said felt being located beneath said cloth and in contact therewith.

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