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Hefling et al.

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[54] **HEAD ASSEMBLY FOR LIQUID FUEL CATALYTIC BEATER**

[75] Inventors: **Dennis Veryl Hefling; Richard Douglas Curtis; Floyd O. Cruver, Jr.,** all of Wichita, Kans.; **David J. Gladden,** Dearborn, Mich.

[73] Assignee: **The Coleman Company, Inc.,** Wichita, Kans.

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Related U.S. Application Data

[63] Continuation of Ser. No. 221,327, Jan. 27, 1972, abandoned.

[52] **U.S. Cl.** ..... **431/329;** 431/350; 126/92 R

[51] **Int. Cl.** **F23d 13/14**

[58] **Field of Search** ..... 126/92 R, 92 B; 431/350, 431/326, 328, 329

[56] **References Cited**

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Primary Examiner—Carroll B. Dority, Jr.
Attorney, Agent, or Firm—Dawson, Tilton, Fallon & Lungmus

[57] **ABSTRACT**

A liquid fuel catalytic heater has a head assembly including a catalytic element having outer wall portions which are straight and generally upright in the direction of combustion air flow over 50 to 75 percent of the combustion area to effect more efficient heating and to radiate heat laterally of the catalytic element through a guard canopy.

6 Claims, 2 Drawing Figures

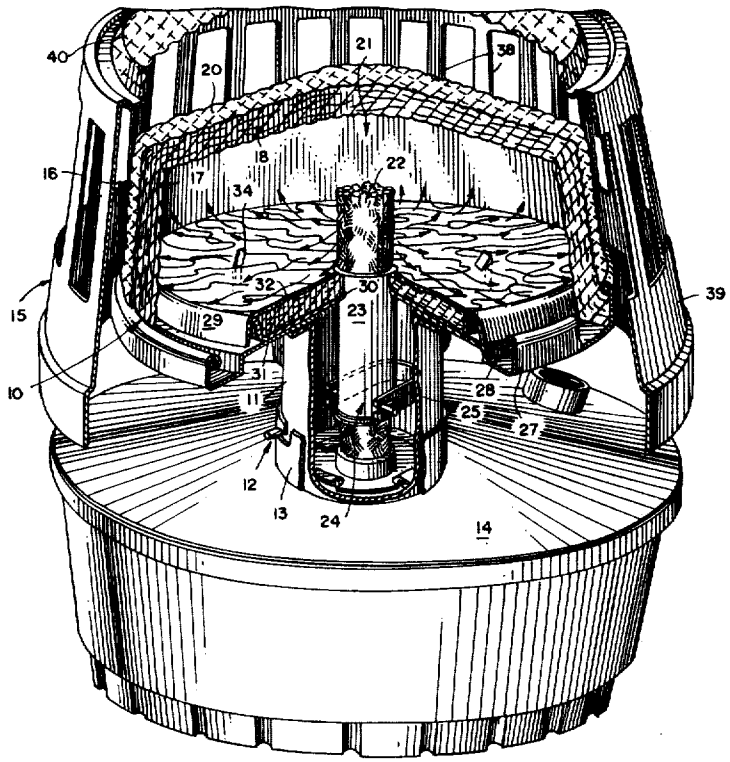


FIG. 2

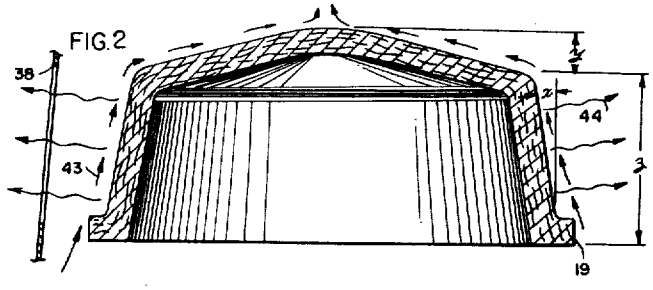


FIG. 1

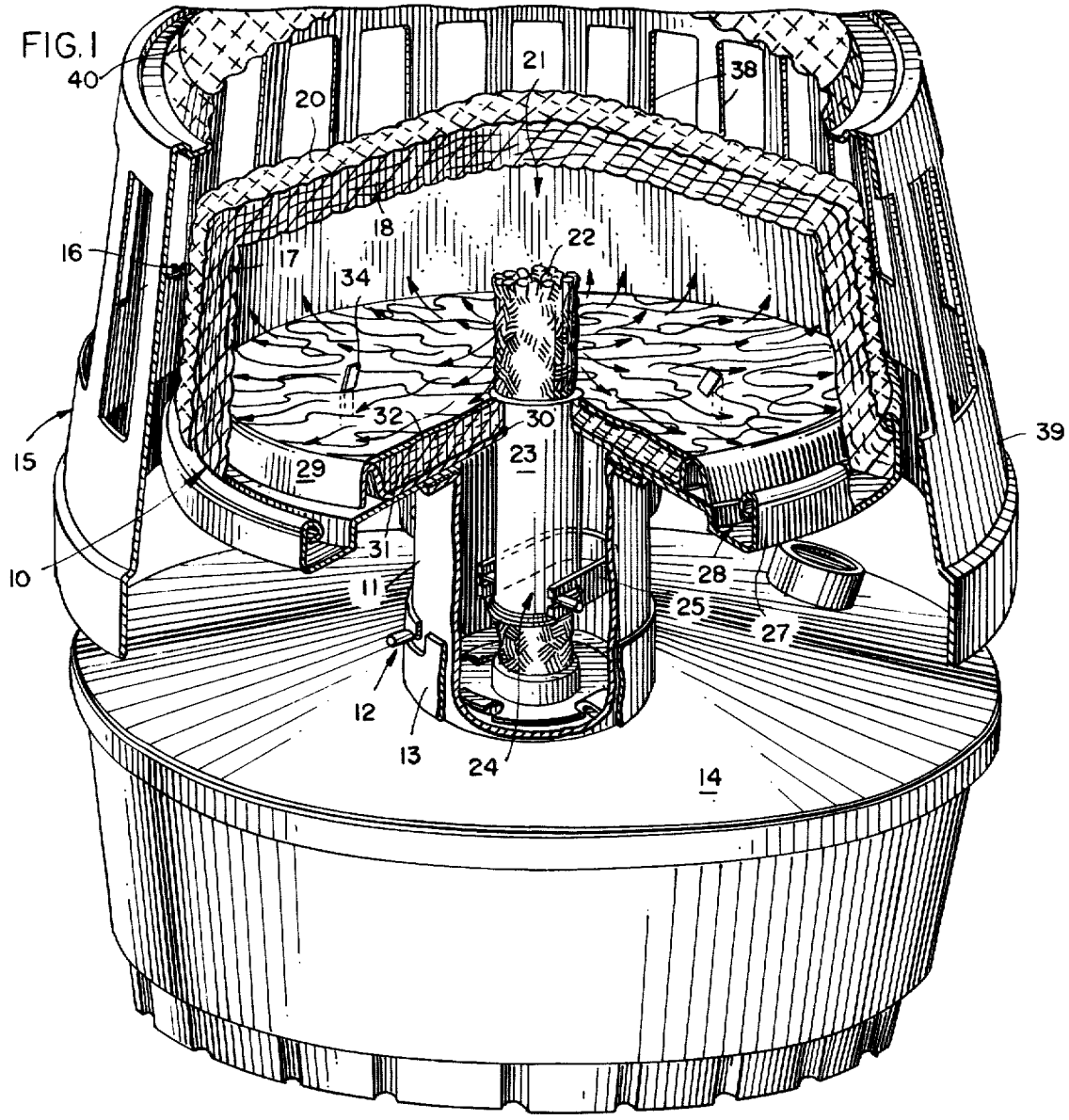
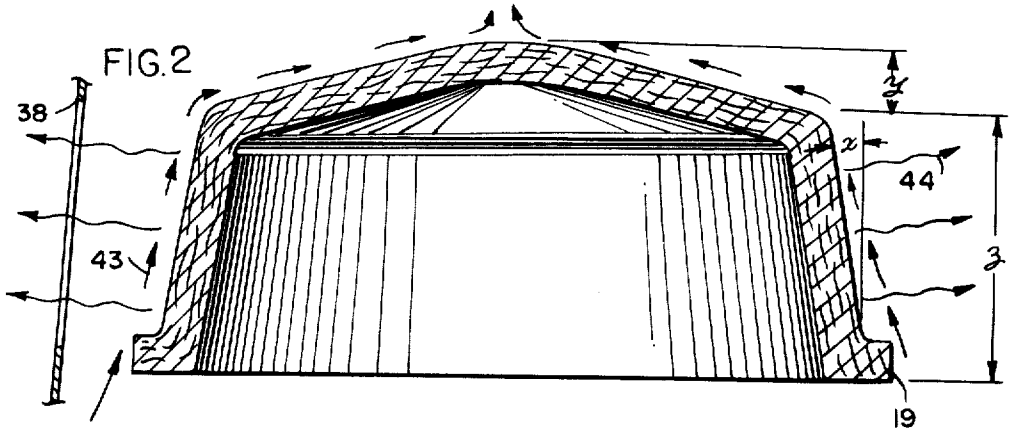

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FIG. 2


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HEAD ASSEMBLY FOR LIQUID FUEL CATALYTIC BEATER

RELATED APPLICATION

This is a continuation application of copending application Ser. No. 221,327, filed Jan. 27, 1972 and now abandoned.

BACKGROUND AND SUMMARY

This invention relates to catalytic heaters; and more particularly, it relates to an improved head assembly for a portable catalytic heater which operates on a refillable liquid fuel charge.

Portable liquid fuel catalytic heaters have been known in the art for some time. Typically, a porous catalytic element having a catalyst impregnated on its outer surface partially defines a fuel vapor chamber wherein fuel is vaporized. The fuel is fed to the chamber by a wick which conducts liquid fuel from a tank located beneath the head assembly. Such portable liquid fuel catalytic heaters characteristically have a catalytic element in the form of a hemisphere or dome which is surrounded by a guard canopy having a cylindrical side skirt of metal which directs room air for combustion onto the catalytic element. The primary heat transfer mechanism in this type of catalytic heater is through convention currents. One such heater is disclosed in the Berchtold, et al., re-issue U.S. Pat. No. 26,976.

In the present invention, a portable liquid fuel catalytic heater has a head assembly wherein the catalytic element is formed, preferably by molding, into a shape having a generally upright side wall of frusto-conical shape and a slightly domed top. Preferably, the inclination of the side wall forms an angle in the range of 3°–15° with the vertical, and the height of the slightly domed top is less than about one-fourth the height of the side wall portion. A canopy is provided in the heater which covers the head assembly and it includes a generally cylindrical skirt portion; however, the skirt portion of the canopy contains large windows laterally of the side wall of the catalytic element.

It has been found with the improved head construction of the present invention, that most of the combustion takes place at the side wall of the catalytic element and that a relatively minor portion of combustion occurs at the top. Because of the straight shape of the side wall parallel to its axis, combustion air traveling upwardly along the side wall tends to have a reduced velocity, and this has been found to significantly enhance the efficiency of combustion of the vapor passing through the side wall of the porous catalytic element. Further, lateral heating by radiation is greatly enhanced with the present construction because most of the combustion takes place at the side wall and there is a relatively unimpeded radiation path laterally of the side wall. This is of particular advantage in a tent, for example, wherein persons gathered around the heater can be warmed through radiation. As has already been mentioned, lateral radiation heating with previous catalytic heaters has been minimal.

It is also preferable to have a slight dome shape at the center of the top portion of the catalytic element in order to facilitate lighting of the heater in a wind.

Normally, portable liquid fuel catalytic heaters having a domed catalytic element exhibit an area at the very top where combustion is reduced. This is caused by the upward flow of combustion air at this point, away from the surface of the catalytic elements. This is sometimes referred to as the "dead area." It has been found that with the shape of the catalytic element of the present invention, the dead area at the top center of the catalytic element is greatly reduced.

Other features and advantages of the present invention will be apparent to persons skilled in the art from the following detailed description of a preferred embodiment accompanied by the attached drawing.

THE DRAWING

FIG. **1** is an upper perspective view of a liquid fuel catalytic heater constructed according to the present invention with a portion of the head assembly and its support tube cut away; and

FIG. **2** is a vertical cross sectional view of the catalytic element of the heater of FIG. **1.**

DETAILED DESCRIPTION

Referring then to the drawing, FIG. **1** shows a portable liquid fuel catalytic heater including an upper head assembly generally designated by reference numeral **10** supported on a tube **11** which, in turn, is secured by means of a bayonet lock generally designated **12** to a collar **13** mounted to the top of a fuel tank or reservoir **14** wherein liquid fuel is stored. The fuel tank **14** is, of course, refillable.

A canopy generally designated by reference numeral **15** encompasses the head assembly **10,** and a snuffer (not shown) is also provided for covering a catalytic element **16** in the head assembly **10** when it is desired to stop combustion.

The catalytic element **16** includes a frusto-conical side wall **17** and a domed top **18** integral with the side wall **17.** An outwardly extending foot flange **19** is formed at the bottom of the side wall **17.**

The catalytic element **16** is preferably formed from non-combustible fibers such as ceramic fibers which are vacuum formed into the shape that has been illustrated. A slurry of the fibers together with a binder such as a starch adhesive or colloidal silicone is drawn into a die of the desired shape by means of a vacuum. This forms a porous, felt-like base through which fuel vapor is transmitted. The surface of the base is then impregnated with a catalyst, such as platinum, according to conventional means. The present invention is not limited, however, to any particular base material nor to a specific catalyst; but, rather, this invention relates to improvements in the shape of the catalytic element and the advantages resulting therefrom.

The catalytic element **16** may also be provided with an exterior wire mesh screen designated **20** in FIG. **1.** The catalytic element **16** partially defines a fuel vapor chamber generally designated **21** at the center of which there is a wick **22.** The wick **22** is surrounded at its intermediate section with a vertically slidable tube **23** to which there is attached a wick-adjustment mechanism generally designated by reference numeral **24** and including a yoke **25** which is adjustable upwardly and downwardly from a position outside of the support tube **11** to move the adjustment tube **23** to cover more or less of the portion of the wick **22** within the fuel vapor chamber **21.** The bottom portion of the wick **22** extends downwardly into the reservoir **14** and conducts liquid fuel upwardly into the fuel vapor chamber **21.** The fuel then vaporizes from the exposed portion of the

wick **22** and passes through the catalytic element **16,** combustion occurring at the outer surface thereof.

A head bottom **27** is attached to the top of and supported by the support tube **11.** The bottom **27** includes a peripheral recess **28** for receiving the outwardly extending foot portion **19** of the catalytic element **16.** As best seen in FIG. **1,** the catalytic element and the screen **20** are held in place by crimping the outer portion of the head bottom **27** over the top of the foot flange **19.**

Resting on top of the head bottom **27** and secured to it as with spot welding is a head support **29** which extends inwardly to form a central aperture **30** through which the adjustment tube **23** is raised and lowered. The head support **29** forms a pan which is filled with Fiberglas insulation material **31** which, in turn, is covered with a sheet of tin foil **32.** The tin foil **32** and insulation material **31** are held in place by means of tabs **34** which are formed in the head bottom and extend upwardly through the insulation material and tin foil and then crimped over to hold them in place.

The canopy **15** is secured to the top of the reservoir **14** in a suitable manner permitting it to be pivotally moved to uncover the catalytic element **18** for starting. The canopy **15** includes a plurality of upwardly extending windows **38** which extend upwardly from a lower skirt **39** to provide at least 50 percent free space laterally of the side wall **17** of the catalytic element **16.** Since most of the combustion takes place at the side wall **17** in this construction, as will be explained more fully below, the placement of the windows **38** and the large openings provided thereby greatly facilitate the radiation of heat from the surface of the side wall **17** so that persons gathered around the heater may be warmed by radiation. The top of the canopy **15** includes a screen **40** through which heated room air and combustion products move.

Turning now to FIG. **2,** the frusto-conical shape of the side wall **17** of the catalytic element **16** can be better appreciated. An angle, indicated as x, is formed between the outer surface of the side wall **17** and a vertical line. This inclination is primarily to facilitate removal of the vacuum-formed catalytic element from its mold; the primary function of the upright shape of the side wall is to promote lateral heating through radiation. Thus, the angle x may be varied within the range 0°–15°, although for the reason mentioned, it is preferably greater than about 3°.

Combustion air is drawn in beneath the lower skirt **39** of the canopy **15,** in the direction of the arrows **43,** and combustion takes place primarily at the outer surface of the upright side wall **17.** Because the combustion surface is straight in the direction of flow of combustion air and it is generally parallel to the flow lines, the moving combustion air tends to cling to the outer surface and reduce its velocity. This promotes a more complete combustion, and significantly contributes to the improved burning efficiency of the heater. Tests run on heaters constructed according to the present invention demonstrate that fuel vaporizing from the wick **22** flows primarily outwardly in a radial direction, thereby indicating that most of the combustion takes place at the side wall **17** of the catalytic element. Further, after the heater has heated sufficiently, the outer surface of the side wall **17** glows with a much brighter light than does the top **16.** Thus, heating by lateral radiation, as diagrammatically illustrated by the sinusoidal arrows **44** is significant and can be felt by persons located beside the heater.

It has been found that significant radiant heating to the side of the heater is best achieved if the total surface area of the side wall **17** is in the range 50–75 percent of the total exposed area of the catalytic element **16,** and preferably within the range 60 to 65 percent. Another design parameter that has been found important is the ratio of the height of the side wall **17** (as indicated by the arrow z in FIG. **2**) to the height of the slightly domed top **18.** The dead area at the center of the top **18** surprisingly has been found to be minimized when the ratio z/y is maximized; however, if the top **18** were perfectly flat even though the dead area would be at a minimum, a difficulty arises in lighting the heater. Normally, lighting is accomplished by swinging the canopy **15** to uncover the catalytic element **16** and placing a small amount of fuel on the center portion of the top **18** and lighting it. It has been found that if the top **18** is perfectly flat, lighting of the heater in the wind becomes difficult because the wind tends to blow the flame out. However, by a slight doming of the type shown in FIG. **2,** lighting is facilitated while keeping the dead area to a minimum. Preferably, the ratio of the height of the side wall to the height of the top z/y, is less than about 4/1.

Another advantage of the present invention is that the time between starting and attaining normal operating temperature for the catalytic element is reduced, and this is due at least in part to the reduced mass of the element. The need for an interior wire screen, as prior elements required, has been eliminated because the inventive element is molded into its shape and retains it without such screen.

Thus, with the present invention, a portable liquid fuel catalytic heater has been found to exhibit a more efficient burning of fuel than occurs in heaters with conventional hemispherical catalytic elements. Further, by maintaining a major portion of the combustion area in a generally upright side wall wherein the shape of the side wall is straight along the direction of flow of combustion air, most of the combustion takes place at the side wall and may be radiated through a protective canopy provided with large openings to heat persons gathered around the heater by radiation.

Having thus described in detail the preferred embodiment of the invention, persons skilled in the art will be able to modify certain of the structure which has been illustrated and to substitute equivalent elements for those which have been disclosed, while continuing to practice the principle of the invention; and it is, therefore, intended that all such modifications and substitutions be covered as they are embraced within the spirit and scope of the appended claims.

We claim:

1. In a portable liquid fuel catalytic heater, the improvement comprising: a catalytic element having an upright frusto-conical side wall defining a vertical axis of symmetry and a top integral therewith for partially defining said fuel vapor chamber, the outer surface of said side wall being substantially straight along upright paths defining the direction of combustion air flow and comprising between 50 and 75 percent of the total combustion surface of said catalytic element and lines on the outer surface of said side wall extending parallel to said axis defining an included angle with the vertical in the range between 0° and 15°, the combustion per

unit area being appreciably greater on said side wall than on said top; a protective canopy over said catalytic element and spaced outwardly therefrom to provide a space for the flow of combustion air, said canopy defining a plurality of apertures extending along substantially the entire height of and spaced about the circumference of the side wall portion of said catalytic element, the total area of said apertures comprising at least 50 percent of the area of said canopy adjacent said side wall element to facilitate lateral heating by radiation; and means including a wick for supplying liquid fuel to said chamber where said fuel is vaporized.

2. The heater of claim **1**, wherein said included angle is approximately 3° with the vertical.

3. The heater of claim **1**, wherein said apertures in said canopy comprise a plurality of vertically elongated apertures spaced about the periphery of said canopy and each extending from a point above the sidewall portion of said catalytic element to a point below said sidewall portion.

4. The system of claim **1**, wherein the top of said catalytic element is slightly domed to facilitate lighting of said element in a wind, the height of said side wall being at least four times greater than the height of said domed top.

5. The heater of claim **1**, wherein said catalytic element includes non-combustible fibers molded to form a porous element impregnated at its surface with a catalyst.

6. The heater of claim **1** further comprising a wire mesh on the exterior of said catalytic element for covering the same, said element being free of any interior support to thereby reduce the mass thereof and facilitate rapid starting.

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