

Jan. 3, 1961

E. S. DOWNS

2,966,944

LIQUID FUEL BURNING HEATER

Filed Jan. 2, 1959

3 Sheets-Sheet 1

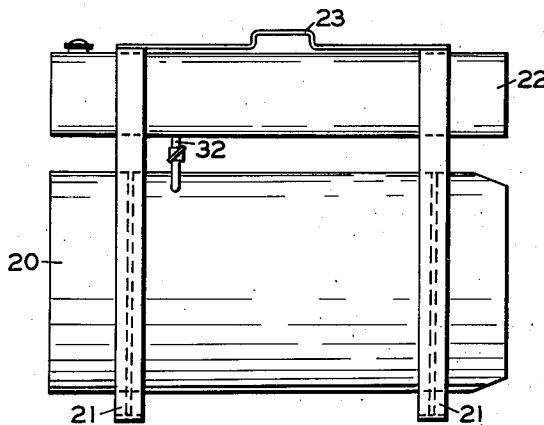


FIG. 1

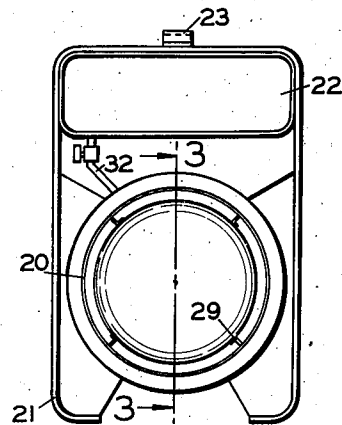


FIG. 2

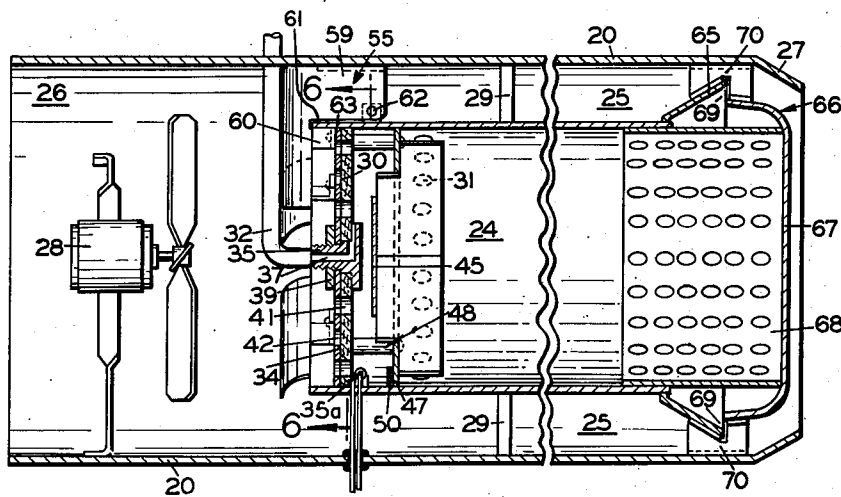


FIG. 3

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3 Sheets-Sheet 2

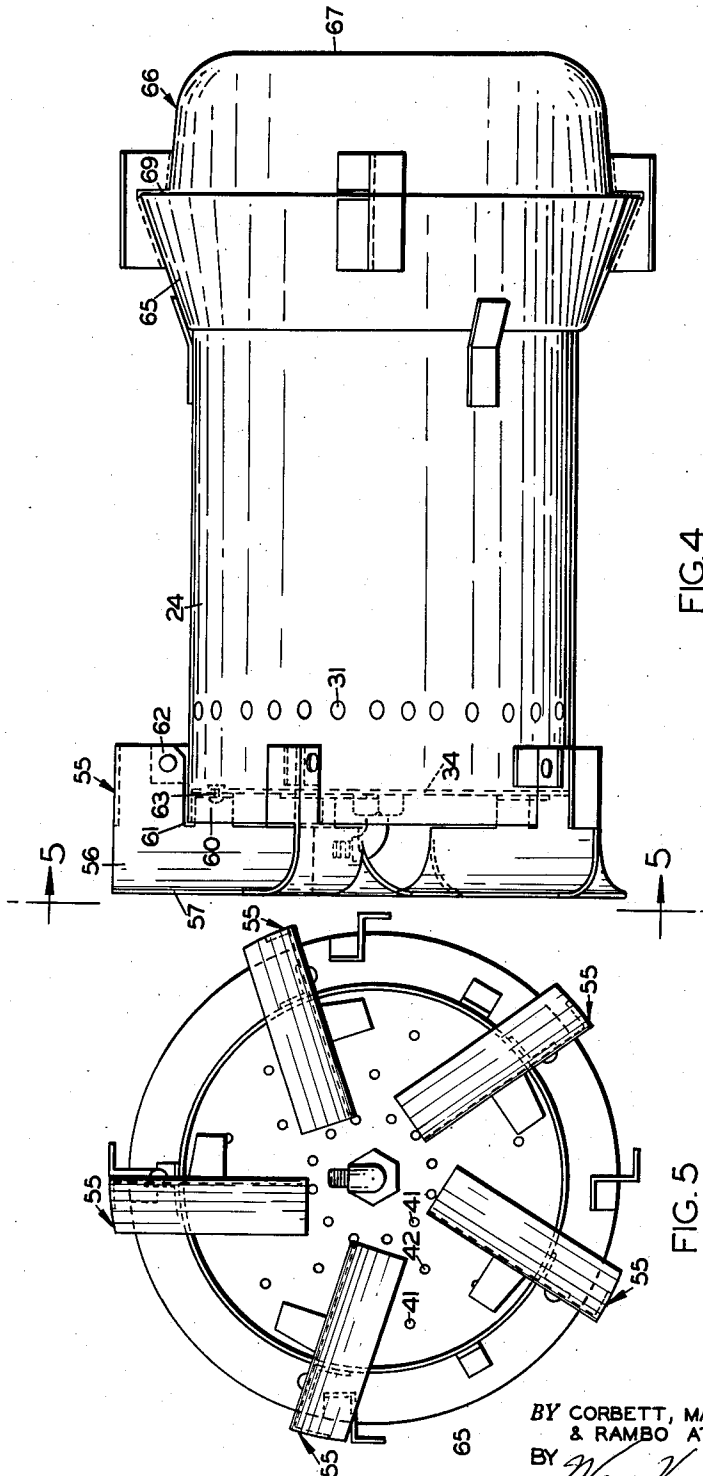


FIG. 4

FIG. 5

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3 Sheets-Sheet 3

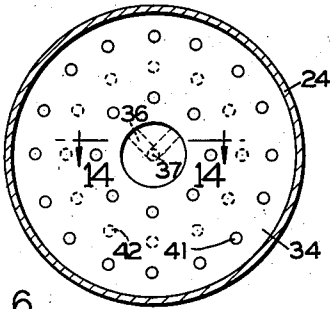


FIG. 6

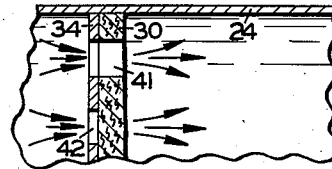


FIG. 8

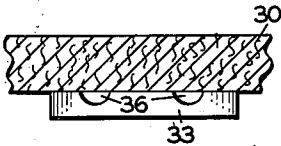


FIG. 14

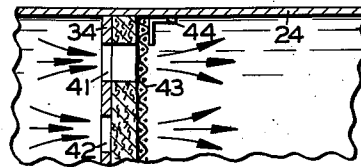


FIG. 9

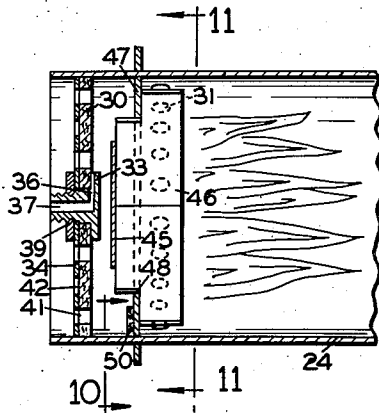


FIG. 7

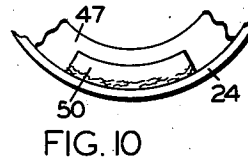


FIG. 10

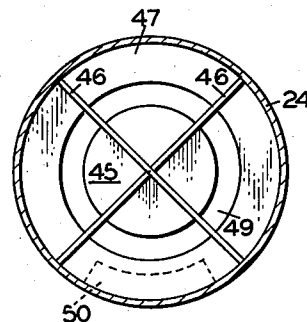


FIG. 11

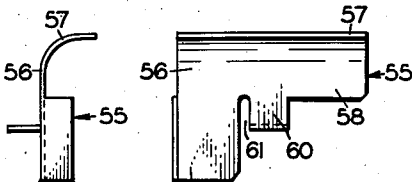


FIG. 12

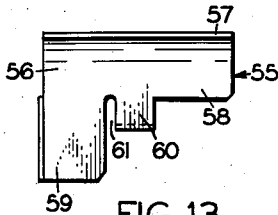


FIG. 13

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2,966,944

LIQUID FUEL BURNING HEATER

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Filed Jan. 2, 1959, Ser. No. 784,723

6 Claims. (Cl. 158—96)

My invention relates to a liquid fuel burning heater. It has to do, more particularly, with a heater of the oil-burning type.

This application relates to improvements on the heater disclosed in my copending application Serial No. 711,691 filed January 28, 1958 which issued as Patent No. 2,879,837 on March 31, 1959.

Up to the time of development of the burner disclosed in my said copending application, oil burners commonly in use were divided into two main types. One was the atomizing gun type which, though very efficient, is quite costly and if not cared for properly is dangerous in use. The other main type commonly in use was the pot-type which is less costly but which tends to become clogged with carbon and soot and which, therefore, must be cleaned often to insure proper operation. This type is also dangerous if not cared for properly.

According to the invention disclosed in my copending application, I provided a heater which included a burner for liquid fuel that was inexpensive, provided for efficient vaporizing and burning of the fuel with the formation of little carbon or soot, and required little or no maintenance and yet was completely safe in operation. This burner has met with considerable commercial success and has gone into wide use, especially where it is necessary to provide a portable burner under conditions where a stack or flue is not available.

According to the invention disclosed in my copending application, I provided a burner in which liquid fuel, such as kerosene, fuel oil, or gasoline, was vaporized for combustion by a thin pad of indiscriminately disposed thin ceramic fibers made into a felt or paper. The material used in forming the pad has an extremely high degree of capillarity which permits it to move the fuel rapidly from the fuel inlet evenly over the face of the pad. This causes extremely rapid evaporation of fuel from all parts of the pad. The heat to accomplish this evaporation is that radiated from the flame which establishes a flame-front a fraction of an inch away from the fuel-wet ceramic pad. The high rate of evaporation tends to cool the liquid fuel in the pad and prevent formation of carbon on the pad through "cracking" of the liquid fuel. The fact that the pad is thin also permits cooling by contact with the metal rear combustion chamber wall which supports it and is, in turn, cooled by air forced over it. Beside having high capillarity the pad also is able to withstand indefinitely the temperatures to which it is exposed and not be attacked by the chemical constituents of the fuel or products produced by oxidation or cracking of the fuel. The ceramic pad forms one wall of a combustion chamber and air is passed into the combustion chamber under forced draft through holes in the ceramic pad. The purpose of this air, designated as primary air, is to permit a very rapid and even mixing of air and oil vapor evaporated from the pad. This rapid mixing establishes the flame front in close proximity to the wet ceramic pad which provides heat by radiation to continue the rapid evaporation of the fuel. To aid com-

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bustion, secondary air is supplied at the face of the pad through openings in the wall of the combustion chamber.

The present invention deals with mechanical or structural improvements in a burner of the general type referred to above and described in detail in my said copending application. It relates specifically to improvements in the pad and its supporting structure, in means behind the pad for supplying and directing the forced draft for primary and secondary air to the pad, in means for improving the supply of air to the pad to insure carbon-free operation, in means adjacent to the face of the pad for accelerating the mixing of air and oil vapor, in means for preventing an excessive amount of oil from moving toward the exit end of the combustion chamber, in means at the exit end of the combustion chamber to aspirate air from the interior of the combustion chamber and thereby promote better combustion therein, and in other structural arrangements associated with those specifically mentioned.

In the accompanying drawings, I have illustrated one example of a heater made according to my invention but it is to be understood that it can take other specific forms without departing from the basic principles of my invention.

In these drawings:

Figure 1 is a side elevational view of an oil-burning heater in which my invention is embodied.

Figure 2 is an end view of the heater.

Figure 3 is a vertical sectional view taken along line 3—3 of Figure 2 through the fan chamber and combustion chamber of the heater.

Figure 4 is a plan view of the combustion chamber.

Figure 5 is an end view of the combustion chamber taken at the inlet end thereof substantially along line 5—5.

Figure 6 is a transverse sectional view taken along line 6—6 of Figure 3 showing the oil-vaporizing pad.

Figure 7 is a vertical sectional view through the combustion chamber showing the pad and associated structure therein.

Figure 8 is an enlarged detail of a portion of the pad and associated support.

Figure 9 is a similar view showing an addition to the structure of Figure 8.

Figure 10 is an enlarged detail in section taken along line 10—10 of Figure 7.

Figure 11 is a transverse sectional view taken along line 11—11 of Figure 7.

Figure 12 is an edge view of one of the turning vanes used at the inlet end of the combustion chamber.

Figure 13 is a view of one of the turning vanes taken at a right angle to that of Figure 12.

Figure 14 is an enlarged transverse sectional view taken along line 14—14 of Figure 6 showing the oil inlet at the face of the pad.

With reference to the drawings, in Figures 1 and 2 I have illustrated the general arrangement of a heater in which my invention may be embodied and which general arrangement is similar to that disclosed in my said copending application. This heater is shown as being of the small portable type although it is to be understood that my invention may be embodied in various other types of heaters. However, with my heater it is possible to obtain efficient combustion without the use of a stack or chimney and, therefore, it is particularly useful as a portable heater.

The heater shown comprises a tubular outer casing 20 carried on the supports 21, which serve as legs upon which the entire heater rests, and which extend upwardly above the housing to support an oil tank 22. A handle 23 is provided above the tank 22 and is connected to

the supports 21 and can be used in carrying the heater.

Within the tubular casing 20 and in concentric relationship therewith is a tubular combustion chamber 24. As shown in Figure 3, this chamber 24 is of smaller diameter than the casing 20 so that an annular air passageway 25 is provided therebetween. Also, the chamber 24 is of less length than the casing 20 to form the fan chamber 26 at the open inlet end of the heater and the discharge throat 27 at the outlet end, the throat being flared inwardly as indicated. The chamber 26 has the electric fan or blower 28 concentrically disposed therewithin and associated with the rear or inlet end of the combustion chamber 24 to force air thereinto. The chamber 24 is supported centrally within the casing 10 by means of spacer clips 29 which will not interfere with air flow through the annular space 25 which will be produced by the fan 28.

As shown in Figures 3 and 7, the rear wall of the combustion chamber 24 at the inlet end thereof is formed by the ceramic pad 30 in the form of a disc which fits within the rear end of the chamber 24 and extends through the cross-sectional area thereof. Spaced slightly ahead of the pad 30 in the direction of flow of air produced by the fan 28 are the secondary air holes 31 formed at spaced intervals around and in the wall of the chamber 24.

Oil is supplied from the tank 22 to the front side of the pad 30 by means of a line 32. An inlet fitting 33 (Figure 3) for this line 32 is provided at the center of the pad 30. The inlet fitting 33 forms part of a clamp for clamping the pad 30 to the metal backing plate 34 which serves as the rear wall of the chamber 24. The fitting 33 is provided with a rearwardly extending threaded boss 35, which extends through aligning central openings in the pad 30 and the plate 34, and which receives a clamp nut 39. The front or disc-like part of the fitting 33 is provided with channels 36 arranged in a V and communicating at their lower ends with the central bore 37. These channels 36 are preferably semi-circular in cross-section and open rearwardly against the face of the pad 30, as indicated in Figure 14.

As explained in my copending application, the two face channels 25 formed by the half circular cross-section, prevent clogging of the oil inlet by providing openings through which solids may float up and out. If such face channels 37 are not present, experience has shown that dirt and waxes in the oil will form a continuous film on the upstream side of the ceramic fiber pad 30, thereby stopping oil flow. This inlet 33 also has the advantage of putting the oil on the forward face or flame, side of the ceramic pad 30 thereby preventing clogging and giving a more even pattern of oil on the ceramic fiber pad. The oil is introduced to the pad 30 slightly above the center of the pad thereby compensating for the slight effect of gravity on the normal movement out on the pad by capillary action. By pointing the channels 36 upwardly at 45 degrees left and right from the vertical, direct spillage of oil out of the open channels is prevented, even though the heater may be tipped considerably to the right or left.

For the initial ignition of the oil, an electric spark igniting device 35a may be provided just ahead of the pad 30 adjacent the front or exposed face thereof.

The pad 30 is shown best in Figures 3 and 5. It is made in the form of a paper, or a loose felt or mat which is composed of ceramic fibers that are resistant to high temperatures. The important characteristics of this pad are disclosed in my copending application and are set forth below.

The pad 30 is of densely packed random direction ceramic fibers preferably of short lengths ranging from about 1/4" to 1/2" and in actual practice I have used lengths of about 3/8". Density and fiber diameter are such as to assure high capillarity with respect to normally used liquid fuels, such as kerosene, fuel oil #1, fuel

oil #2, and gasoline. Density and fiber diameter are even over the face of the pad. The fiber diameter is from submicron to 10 microns, preferably 2 microns. The bulk density of the ceramic pad ranges from 2 to 25 pounds per cubic foot but is preferably 15 pounds per cubic foot.

An example of a suitable material which I have used is Fiberfrax paper produced from Fiberfrax fibers by the Carborundum Company with the following chemical composition:

Al_2O_3 —51.2%; SiO_2 —47.1%; B_2O_3 —0.6%; Na_2O —0.6%

Approximate fiber diameter:

Submicron to 10 microns (mean 2 1/2 microns).

Another example of a suitable material which I have used is Micro-Quartz felted insulation made by LOF Glass Fibers Co. This material is 98% pure quartz.

Approximate fiber diameter:

.1 micron

A high degree of capillarity is present in the pad 30 to provide lateral flow over the face of the pad in sufficient quantity to keep the pad well saturated with fuel. The high rate of evaporation from this wet pad provides a strong cooling action due to the latent heat of evaporation of the fuel. This cooling action tends strongly to prevent cracking of the fuel in the liquid state by lowering the temperature of the pad.

In this type of vaporizing pad 30 virtually all the heat for evaporating the oil is supplied by radiant heat transfer from the flame front formed immediately in front of the pad to the fuel filled pad.

The pad is composed of fibers that will result in a white surface so that reflectivity of radiant energy from the flame front will be at a maximum and absorptivity from the same source at a minimum so that the temperature of the pad will remain low. Experiments have shown that if the pad has a gray or black surface, pad temperature will rise, causing cracking of fuel on the pad and consequent formation of carbon and coke thereon. If the pad is white a satisfactory heat balance is established between heat radiated from the fire to the pad on the one hand and heat transferred to the rear surface of the pad by conduction to the cool metal surface forming its rear wall and conversion of sensible to latent heat during the evaporation of oil from the pad surface on the other hand.

The ceramic fiber pad is composed of fibers that will withstand approximately 2000° F. for long periods of time without noticeable deterioration. These fibers must also withstand the effects of hot fuel and the products formed by chemical reaction of the fuel, either by oxidation or "thermal cracking" for long periods without noticeable deterioration.

For effective and carbon free operation the pad 30 is thin—not less than .020" and not more than .200" in thickness, and a thickness which I have found very satisfactory is .070". This thin section permits further cooling action by conduction of the radiant heat received through the pad to the air cooled metal plate 34 backing it up.

As previously indicated, the pad 30 is backed up by a metal plate over which air flows, such as the wall 34. This plate acts as a barrier to prevent tearing and distortion of the thin, mechanically weak ceramic fiber pad, from pressure of the air behind it. To provide flow through the primary air holes, the air pressure must be higher on the rear of the pad than on its front face.

Suitable air inlet openings are provided in the ceramic fiber pad 30 and in the metal plate 34 immediately behind it as shown best in Figures 6, 7 and 8. Due to a higher air pressure outside or behind the metal plate 34 than at the inside surface or front exposed face of the ceramic fiber pad, a carefully measured amount of air, called primary air, forming 1/4 to 1/2 total air sup-

plied for combustion and not sufficient to wholly complete combustion, is admitted into the combustion chamber 24 formed by the metal plate-ceramic fiber pad in the rear and the metal walls on the side. By admitting this air through the saturated pad 30 at carefully spaced intervals, intimate and rapid mixing of air and fuel vapor is permitted. This causes a flame front to be established immediately in front of the exposed face of the ceramic fiber pad 30, which in turn radiates heat back to the saturated pad for the continuing evaporation of liquid fuel.

As previously indicated, to furnish additional air to completely and cleanly burn the fuel, secondary air is admitted through the carefully spaced holes 31 in the sides of the combustion chamber 24.

As shown in Figures 6 and 8, the primary air inlet openings for the pad 30 include some openings which extend through both the pad 30 and its back-up plate 34 and some openings which extend only through the back-up plate. Thus, I have shown the openings 41 arranged concentrically in an inner and outer circle, the openings of each row being angularly spaced, and the openings extending through both the back-up plate 34 and the ceramic pad 30. The openings 42, which extend only through the back-up plate 34, are arranged in an intermediate circle of angularly spaced openings. By actual experiment I have found that by forcing part of the primary air through the ceramic fiber pad 30 itself by means of openings 42, in addition to that entering through the holes 41 in the pad, the pad remains completely white and free of any tendency to stain or form carbon in the area through which the air is passing. This is probably due to the fact that air passing through the material of the pad tends to cool it, and hence the oil in the pad, and keep the oil below the cracking temperature. It may also keep the oil moving toward the front face or flame side of the pad and hence keep oil vapor from coming backward away from the fire and condensing and cracking out in the rear of the pad and on the back-up plate 34. It also mixes the air with the oil and oil vapor in the pad 30 thus keeping cracking from taking place as it is well known the fuel oils will not crack in the presence of adequate oxygen. Thus, passing air through the pad 30 permits vaporization of the fuel without danger of cracking it through raising it above the boiling range of its hydrocarbons while keeping it below the cracking temperature, approximately 700° F., and at the same time mixing it with some oxygen. Bleeding air through the ceramic fiber pad such as through the openings 42 may tend to distort it due to higher pressure behind it than in front of it. This distortion may cause the pad to crack and eventually tear unless some means of reinforcement is provided for it. The pad 30 is low in tensile strength due to the fact that the short fibers are held together only by the friction of one fiber on another. I have devised two methods of increasing the tensile strength of the ceramic pad. One is to soak the pad in a silica solution such as the sodium silicate known as "waterglass," or a colloidal silica solution such as "Ludox" made by The Dupont Company. Another method is to place a screen 43 of temperature-resistant metal on the front face or fire side of the ceramic pad 30 as shown in Figure 9. The screen 43 may be fastened to the combustion chamber wall by the clips 44 which will hold it in place against the pad to prevent outward bulging thereof.

As indicated best in Figures 3, 7 and 11, directly downstream of the pad 30 and of the oil-inlet fitting 33 associated therewith, is a coaxially disposed disc member 45. Although it is preferred that this member 45 is disc-shaped, it need not necessarily be of circular outline. It is carried on the rear edges of the transverse braces 46. Beyond the disc 45 and concentric therewith is a ring or annulus 47 which has its outer periphery

adjacent to the wall of the combustion chamber 24. This ring in turn carries the transverse braces 46 and is attached to the back-up plate 34 by the spacers 48. The braces 46 not only serve to support the disc 45 but also serve as vanes extending toward the outlet end of the combustion chamber 24 to aid in the prevention of twisting or rotation of the flame which would tend to produce smoke. They also prevent the flame from licking back on the disc 45 which would cause coking of the disc on its forward side. As indicated in Figure 11, there is an annular space 49 between the ring 47 and disc 45, and, therefore, the burning mixture of primary air and oil mixture does not reach out directly to the secondary air holes 31 but must flow upwardly and outwardly through the space 49.

At the lower side of the combustion chamber 24 and on the upstream or rear side of the ring 47 is a segmental gasket 50. This gasket is preferably formed of ceramic fiber material and extends a suitable distance along the bottom and upwardly of the sides of the combustion chamber. This gasket 50 may be secured to the ring 47 in a suitable manner such as by cementing or bolting.

The ceramic fiber gasket 50 is of material which will withstand the heat to which it is subjected and serves to provide a seal which prevents excess oil from running along the bottom of the combustion chamber 24 toward the exit end thereof. During the time that the burner is being ignited, excess oil often drains down into the bottom rear of the combustion chamber 24. If this oil is permitted to flow forwardly along the bottom of the combustion chamber, its ignition is delayed and smoke and a spurt of flame may occur later when it suddenly vaporizes and ignites as it moves towards the outlet end of the chamber. The segmental sealing gasket 50 prevents forward flow of any accumulation of oil and insures that it is vaporized and consumed directly adjacent the face of the pad 30.

The centrally disposed metal disc 45 provided over the oil inlet fitting 33 and extending over the innermost circle of primary air inlet openings 41 serves to perform two functions. It promotes turbulence adjacent the face of the pad 30 which improves and greatly accelerates the mixing of primary air and oil vapor. It also shields the oil inlet 33 from excessive heat radiated by the fire, thereby preventing cracking of the oil inside the oil inlet and the consequent plugging of the oil inlet with carbon and the heavier hydrocarbons.

The use of the flat metal ring or annulus 47, between the secondary air inlets 31 and the pad 30, also performs two important functions. This ring also promotes turbulence adjacent the face of the pad 30 which improves and accelerates the mixing of the primary air and the oil vapor. It also prevents the premature mixing of the rich mixture of oil vapor and primary air with secondary air supplied through the secondary air inlets 31 and thereby prevents carbon formation which might otherwise occur because of the excessive and sudden chilling of the rich primary air-oil vapor mixture by the incoming secondary air.

As indicated best in Figures 3 and 5, the upstream or inlet end of the combustion chamber 24 is equipped with turning vanes 55 which take the twisting air delivered by the propeller fan 28 and straighten it out so that it flows in streams parallel to the main axis of the combustion chamber. These vanes straighten out both the air flowing towards the pad 30 and the air flowing into the annular space 25 between the wall of the combustion chamber 24 and the casing 20. This action of straightening the air tends to change velocity pressure to static pressure and hence to build up the static pressure on the outside of the primary air holes 41 and 42 and the secondary air holes 31.

To be most effective, these vanes 55 should be the shape illustrated in Figures 12 and 13 and supported in the manner shown in Figures 3 and 5. Each vane is provided with

a body portion 56 which is radially disposed and which extends from a point close to the center of the fan chamber 26 outwardly to the wall of the casing 20. Each body portion 56 is provided with a curved leading edge 57 and a straight trailing edge 58. For mounting each turning vane, the body has a larger outer lug 59 and a smaller inner lug 60 with a slot 61 therebetween. The slot 61 slips over the rear edge of the wall of the combustion chamber 24 as shown in Figure 3. The lug 59 will extend forwardly between the wall of the combustion chamber 24 and the wall of the casing 20. It may be fastened at 62 to a lug on the outer surface of the wall of the combustion chamber 24. The smaller lug 60 contacts the back-up plate 34 and may be fastened thereto as indicated at 63. Thus, each vane will be effectively supported in the position shown in Figures 3 and 5. The twisting air from the fan 28 will first contact the curved leading edge 57 of each turning vane and the curvature thereof will tend to direct the air forwardly in a straight path towards the primary air openings in the pad 30 and the secondary air openings 31 in the wall of the combustion chamber.

The exit or downstream end of the combustion chamber 24 is equipped with a larger cone or outwardly flared skirt 65 which may be termed the approach cone and a smaller reversely directed skirt or cone 66 which may be termed the exit cone. The inner or rear edge of the skirt or cone 65 is secured to the outer end of the chamber 24 while the cone member 66 at its outer side is provided with a central closure disc 67. This disc 67 is attached to a perforated screen or metal sleeve 68 which telescopes within the outer end of the chamber 24 and is suitably secured thereto. It will be noted that the cones 65 and 66 are so arranged relatively that there is an annular outlet 69 therebetween. Also, there is an annular outlet 70 for the chamber 25 between the outermost edge of the skirt or cone 65 and the adjacent wall of the casing 20 which flares inwardly, as previously indicated at 27, just beyond the outlet 69.

The purpose of the indicated arrangement of the concentric reverse cones 65 and 66 is to aspirate combustion gas from the interior of the combustion chamber 24 through the annular outlet 69, thereby resulting in a lower combustion chamber pressure and thus promoting good combustion by allowing the combustion air to flow into the relatively low pressure combustion chamber 24 through the primary openings 41 and 42 and the secondary openings 31 at a high velocity. This is enhanced by having the outer cone 65 approach the inside diameter of the casing 20 so that the annular outlet 70 is relatively narrow. As the air propelled by the fan 28 at the rear of the combustion chamber moves outwardly or downstream through the chamber 25 and over the surface of the combustion chamber 24, it is compressed against the interior of the casing 20 and hence its velocity is increased thereby increasing its aspirating action relative to the combustion gases passing out through the annular exit 69 between the approach and exit cones 65 and 66. The sleeve 68 will screen out any large particles of carbon that might form for any reason in the heater. This sleeve should be of metal resistant to heat since it reaches a high temperature which is fairly even over its entire surface and thereby assists in completing combustion by warming up those areas of the flue gas which reach that point and are not sufficiently hot to complete combustion.

The operation of certain parts of the heater have been discussed above but in summarizing the general operation of the entire heater, it will be understood that oil is supplied to the pad 30 and will spread therethrough. The fan 28 is started and the oil is ignited by means of the igniter 35. The oil will vaporize as it is supplied to the pad and the pad will burn clean. Primary air, under forced draft, will be supplied to and through the pad 30 at various locations throughout its area by the primary air openings 41 and 42. While the quantity of primary air so introduced is not sufficient to complete combustion,

it is sufficient to support combustion and establish a flame front in close proximity to the exposed face of the pad. This primary air at numerous places mixes rapidly with vaporized fuel which it entrains and carries toward the exit end of the combustion chamber 24. Secondary air is supplied, under forced draft, in front of the pad 30 and the baffle member or ring 47 in sufficient amounts to complete combustion through the openings 31. Radiant heat produced by the actual flame front in close proximity to the saturated pad 30 furnishes heat to continue evaporation of the fuel at a high rate. In fact, an active and vigorous flame may be maintained with the temperature of the incoming air as low as -40° F., which is important with a heater of this portable type since it may be used under very low temperature conditions and it is very important that it burn clean without providing a stack or flue. The air blown into the combustion chamber 24 by the fan 28 at its inlet end is straightened out by the vanes 55 with the advantage of building up the static pressure outside the combustion chamber 24 so that it will more positively be forced through the primary air holes 41 and 42 and the secondary air holes 31. The provisions of the metal disc or baffle member 45 ahead of the pad 30 promotes turbulence adjacent the face of the pad to accelerate the mixing of primary air and oil vapor and to protect the oil inlet 33 from excessive heat thereby preventing cracking of the oil in the oil inlet and consequent plugging with carbon and the heavier hydrocarbons. The use of the flat metal ring 47 also promotes turbulence at the face of the pad 30 and prevents premature mixing of the rich oil and vapor mixture with secondary air supplied through the air inlets 31. The approach cone 65 and the exit cone 66 at the outlet end of the combustion chamber 24 provide means for aspirating combustion gas from the interior of the combustion chamber 24, thereby resulting in lowering combustion chamber pressure and aiding the forced flow of air into the combustion chamber through the primary and secondary openings. Furthermore, to prevent an excess amount of oil from flowing forwardly along the bottom of the combustion chamber 24 with resultant smoke formation when suddenly ignited, the segmental sealing gasket 50 is provided at the bottom of the ring 47.

It will be apparent from the above that I have provided a heater which has all of the advantages of the unit disclosed in my copending application Serial No. 711,691 but which is improved in many structural arrangements to function even better than the heater disclosed in said application.

Having thus described my invention, what I claim is:

1. A burner for burning liquid fuel comprising a combustion chamber, a ceramic pad having an exposed face at the inner surface of a wall of said combustion chamber, means for supplying the liquid fuel to said pad so that it will be absorbed thereby and distributed throughout the pad by the capillary attraction of the material of the pad, said wall of said combustion chamber including a rigid plate backing up said pad, said rigid plate and said pad having aligning primary air openings extending through both the rigid plate and the pad to the exposed face of the pad, said plate also having other primary air openings extending therethrough only, to the back surface of the pad, means for positively forcing primary air through said openings into said combustion chamber to vaporize the oil so it will be burned adjacent to the exposed face of said pad, the heat for vaporizing the oil in the pad being received from the flame which forms in front of the exposed face of the pad, the wall of the combustion chamber just beyond the face of the pad in the direction of flow of the primary air therethrough being provided with air inlet openings for supplying secondary air to said combustion chamber to aid in complete and clean burning of the fuel in the combustion chamber.

2. A burner according to claim 1 including a baffle member between said secondary openings and said face of the pad, said baffle member being spaced outwardly of the exposed face of the pad and having an exit opening through which the flame forming adjacent the face of the pad will extend.

3. A burner according to claim 2 in which the means for supplying the fuel to the pad has an inlet within the area of the pad at the face thereof, and a second baffle member spaced outwardly of the face of the pad in the said direction of flow and extending over a portion of the area thereof to protect said inlet from the flame, said second baffle member having a flat face facing said pad face and being spaced inwardly of said first baffle member to provide said exit opening for the flame therebetween.

4. A burner according to claim 2 in which the combustion chamber is horizontal and the pad is vertically disposed at the inlet end thereof, and sealing means between said baffle member and the adjacent wall of the combustion chamber at the bottom thereof to prevent flow of oil outwardly past said baffle member.

5. Structure according to claim 1 in which said fiber pad is treated with a reinforcing substance.

6. Structure according to claim 1 including a reinforcing screen at the face of the pad opposite said back-up plate.

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2,541,332	Campbell	Feb. 13, 1951
2,558,493	Melot	June 26, 1951
2,699,648	Berkey	Jan. 18, 1955
2,775,293	Raymond et al.	Dec. 25, 1956
2,879,837	Downs	Mar. 31, 1959