MOTOR, OIL PUMP AND OIL BURNER IN COMBINATION

Filed July 29, 1963, Ser. No. 298,816
12 Claims. (Cl. 155—36.3)

This is a continuation-in-part of application Serial No. 92,219, filed February 28, 1961, now abandoned.

The present invention relates to improvements in oil burner units of the so-called gun type burner.

A general object of the invention is to make the use of fuel oil burner units more attractive from the standpoint of economy and serviceability, particularly in the case of installations where units employing other types of fuel predominate. A particular example may be found at the present time in heaters for self-contained domestic hot water supply tanks where gas fired or electric units have almost universally been in use.

Another general object of the invention is to provide an oil burner construction which is characterized both by economy of manufacture and compactness of size. While the present burner has general utility for any application, in small sizes or capacities it has particular utility in that its overall bulk is a minimum and its component parts are readily accessible.

A more specific object of the invention is to eliminate the conventional type of motor housing and to accomplish this end with a maximum of safety from possible hazardous conditions.

The above ends are attained by a burner construction which is predicated on the use of an extremely low capacity nozzle, insofar as the aspects of minimum size and cost are concerned. For standard fuel oil a return flow nozzle of known or conventional design best meets these low capacity requirements.

Employing such a nozzle, the present burner may economically compete with gas and electric heating elements in most instances not hitherto possible or practical. Examples of such uses would be on small water heaters and small space heaters.

More specifically, the structural features of the invention broadly include a housing in which a motor is mounted for driving an oil pump and the usual fan for providing the necessary combustion air. The shaft of this motor is vertically disposed with its lower end connected to the pump and its upper end connected to the fan.

The housing may be composedly formed and include an upper chamber of scroll configuration in which the fan is mounted and a lower chamber in which the pump is mounted and an intermediate chamber in which the field assembly and rotor of the motor are mounted. Oil is fed from a supply tank or the like into this motor chamber and then from the top of the motor chamber to the suction side of the pump. By this arrangement operation of the motor in a hazardous oil vapor atmosphere is prevented.

Advantageously, the portion of the housing forming the intermediate and lower chambers may be integrally formed along with the suction and discharge passages for the pump. Further, an inexpensive type of motor construction may be accurately mounted by uniquely positioned mounted locating rings, provided in accordance with another object of the invention. The structure of the present burner further may provide means for preventing accumulation of water in the motor chamber which might cause a failure of the electrical insulation. This end is attained by providing a relatively small connection between the bottom of the motor chamber and the suction side of the pump. A small amount of oil is continuously drawn from the bottom of the motor chamber and with it any water which would otherwise settle and accumulate in this chamber. In small quantities the water can be discharged from the nozzle without affecting its operation. The amount of oil drawn from the bottom of the motor chamber is not, however, sufficient to support combustion. Thus, it is necessary that the level of oil in the intermediate chamber be above the level of the motor (the electrical portions that is) and flow through the primary passageway to the suction side of the pump, if operation of the burner is to be maintained. To this end it is further preferable to provide a flame detector at the nozzle which will automatically stop operation of the motor if there is insufficient oil to maintain combustion.

Thus, operation of the motor in an oil vapor atmosphere is prevented and also continued discharge of oil from the nozzle after the flame has been extinguished.

The above and other related objects and features of the invention will be apparent from a reading of the following description of the disclosure found in the accompanying drawings and the novelty thereof pointed out in the appended claims.

In the drawings, wherein various portions are broken away and in section:

FIG. 1 is a side elevation of an oil burner unit embodying the present invention;

FIG. 2 is a section taken on line II—II in FIG. 1;

FIG. 3 is a section illustrating the attachment of locating rings to a motor used in the burner unit;

FIG. 4 is a plan view of the burner unit;

FIG. 5 is an elevation of the side thereof opposite to what is shown in FIG. 1; and

FIG. 6 is a section taken on line VI—VI in FIG. 5;

FIG. 7 is an elevation of an alternate embodiment of the invention with portions thereof taken substantially on line VII—VII in FIG. 9;

FIG. 8 is a fragmentary section taken on line VIII—VIII in FIG. 7;

FIG. 9 is a section taken substantially on line IX—IX in FIG. 7;

FIG. 10 is a section taken substantially on line X—X in FIG. 9;

FIG. 11 is a section taken substantially on line XI—XI in FIG. 9;

FIG. 12 is a section taken substantially on line XII—XII in FIG. 9;

FIG. 13 is a schematic drawing of a portion of the electrical circuit employed in the present invention;

FIG. 14 is a fragmentary section taken substantially on line XIV—XIV in FIG. 9 and illustrating a modification of the alternate embodiment of the invention;

FIG. 15 is a section taken on line XV—XV in FIG. 9 and illustrating further features of the modified alternate embodiment of the invention;

FIG. 16 is a section taken on line XVI—XVI in FIG. 15; and

FIG. 17 is a section corresponding to the section of FIG. 10 and showing further features of the modified alternate embodiment of the invention.

With reference to the drawings, the burner unit of FIGS. 1–6 comprises three main housing elements, namely a motor and pump housing 10, a fan housing 12 and a fan housing cover 14, all of which are preferably sand or die castings. These housings compositely define three chambers, viz. an upper fan chamber, an intermediate motor chamber and a lower pump chamber. For convenience, the combined motor and pump housing 10 will hereinafter be referred to as the pot housing.
The fan housing 12 is secured to the top of the pot housing 10 by screws 16, and the fan housing cover 14 is secured to the fan housing 12 by screws 18. In FIGS. 1, 4 and 5 it will be seen that the fan housing 12 and cover 14 form the upper chamber with a scroll configuration and provide a fan outlet constituting the inner end of a cylindrical air supply conduit of the unit. The lower conduit portion of the fan housing 12 is shown at 13 (FIGS. 1 and 4), and the upper conduit portion of the cover 14 is shown at 15 (FIGS. 4 and 5). Conduit portion 13 terminates in a cylindrical end having a flange 20, and the cover conduit portion 15 caps the upper half of the conduit short of the flanged end, as best shown by FIGS. 4 and 5. Flange 20 of conduit portion 13 provides means for mounting the unit directly on the side wall of a water heater or any other device, a mounting hole in the flange for this purpose being shown at 19 in FIG. 2. Alternatively the unit may be pedestal mounted.

Secured to and projecting beyond the flange 20 is a cylindrical air supply conduit or tube 22 within which the outer end of a nozzle assembly 23 is mounted with the nozzle indicated at 24.

A motor 26 is mounted within the intermediate or motor chamber of the pot housing 10. A motor shaft 27 extends from both ends with the lower end driving conically connected to a gear pump unit 28 and the upper end driving a fan 13. The motor 26 is preferably of extremely low cost and presents a special problem in that the casing of such motor units is not formed with sufficient accuracy with respect to the shaft 27 to provide any mounting surfaces which normally would serve to accurately position supports for lining up the axis of shaft 27 concentrically with the pump and fan axes. This difficulty has been overcome by welding or otherwise securing to the motor casing a positioning ring 32 around the shaft at each end of motor 26. These rings are fixed to the motor casing prior to installation of the motor in the intermediate motor chamber of the pot housing. For such purposes (FIG. 3) a fixture 34 is telescoped over the end of the shaft 27. A spherical surface 35 on the fixture 34 engages a conical seat of the ring 32 which is to be secured to the motor casing. The line of engagement between surface 35 and the seat is a circle concentric with the axis of a cone formed by the conical seat of ring 32. Such concentric relation will exist even of the angular variation of the motor casing. When the ring 32 is thus located, it is welded in place on the motor casing and thus provides an accurately locating surface although the casing of motor 26 may be inaccurately disposed relative to the shaft 27. The illustration of FIG. 5 has been exaggerated greatly to show in dramatic fashion an actual condition of the motor casing with respect to the shaft 27. The other ring 32 is similarly attached to the lower end of the motor casing also by using the fixture 34.

Thus conical ring seats are provided at opposite ends of the motor casing and it will be noted that by providing suitable locating members at the top and bottom of the motor chamber the concentricity of the motor shaft 27 may be readily maintained with respect to the axis of the fan at the top and the axis of the pump assembly at the bottom.

The gear pump 28 is mounted in the lower or pump chamber also formed in the pot housing 10 below the motor chamber. The pump 28 comprises a lower plate 38, in which the gears ride, and an upper plate 40. This lower pump chamber may be machined without difficulty to accurately locate the pump components. The lower plate 36 rests on a shouldered ledge and forms the upper end of a pump inlet chamber 41 below the pump. An annular locating rim 42 is formed on the upper plate 40 and has a spherical surface similar to the surface 35 of the fixture 34. The rim 42 receives the ring 32 and automatically establishes an accurately located line of contact with shaft 27. The lower end of shaft 27 is thereby accurately positioned. The upper end of the motor 26 is similarly located by a sleeve 44 which is slidingly received in a hub 46 formed centrally on the lower wall of fan housing 12 and urged into engagement with the upper rim 32 by a spring 47. Sleeve 44 is afforded free action in the hub, a vent being provided therefore in the outer end of the sleeve. 44 has a spherical surface which again is the same as the surface 35 of fixture 34. Sleeve 44 thus engages the ring 32 on an accurately located line of contact concentric with the axis of a cone formed by the conical seat of ring 32 so as accurately locate the upper end of the motor shaft. Fan housing 12 with accuratley seated on pot housing 10 by the shouldered flange 48. The described motor mounting thus concentrically locates the shaft 27 for reliable operation of pump 28 and fan 30. The rings and locating members are particularly characterized by their simplicity in utilizing motors with casings which have no dimensionally accurate relationship with respect to the shaft. As best shown by FIG. 4, the burner unit is connected to a suitable source of oil as by means of a pipe or tube 50 which is threaded into a boss 52 at the top of the fan housing 12. It is contemplated that in the usual domestic installation of the unit, oil will be stored in an adjacent supply tank at an elevation thereabove of only a few feet. Oil will then flow, preferably under gravity feed through an internal passageway 54 (FIG. 4) and thence to and through a filter mounting screw 56 at the end of the passageway 54 (see FIG. 1). From the screw the inlet flow is through a wire mesh filter 58 into the main motor chamber. The filter 58 is maintained vertically disposed in the chamber by the illustrated internal spring.

Referring now to FIG. 2, after the motor chamber is full, oil will flow over the top of a barrier or dam 60 which is integrally formed in the pot housing and together with a portion of the pot housing outer wall forms an internal vertical passageway 62. Passageway 62 at its lower end is connected by a cross conduit directing oil flow to the inlet chamber 41 beneath pump 28. Oil is discharged from the pump through an outlet in the upper pump plate 40 and thence through a passageway 64 to a pressure regulating valve 66 (FIG. 5). When the output of pump 28 reaches a relatively high pressure, on the order of 100 p.s.i., valve 66 passes oil at that pressure to and up through a vertical outlet passageway directed toward and leading to the nozzle assembly mounted in the air supply tube. Any excess oil is returned through internal passageways in the valve 66 and through a hole 98 to the pot housing. The bypassing of such excess capacity oil is in accordance with known practices.

The nozzle assembly 23 comprises a base member or support frame 72 (FIGS. 1, 4 and 5) in which outlet and return flow connecting passages are provided and from which conduit and electrode elements extend to the nozzle 24 adjacent the end of the air tube. A plate 74 (FIG. 5) rests on the top of the base plate and elevates the bottom of the base 72 above this housing. The base 72 is thus inside the air supply conduit portion 13 and the base and plate are secured to pot housing 10 by screws 76 (see FIG. 4). A tube 78 (FIG. 1) for nozzle conduit projects from the base 72, nozzle 24 being secured at the outer end thereof by the plate structure 80. Conventional electrodes 82 are also supported by the sleeve 80 and extend from their inner ends which are suitably connected (not shown) to the inner ends of a transformer indicated at 84 (FIG. 2). In normal fashion the electrodes produce the spark to ignite the oil spray from nozzle 24.

The nozzle assembly can readily be removed in its entirety. Once the fan housing cover 14 is taken off, the mounting screws 76 of the base can be loosened and the separable electrode plug connections at 83 can be pulled apart. The base may then be lifted and bodily withdrawn from the air supply tube. The nozzle assembly
is thus easily made accessible to service for repair or replacement purposes.

Other electrical components shown are a junction box 85 to which a power supply line (not shown) is connected. From box 85, connections are made with transformer 84, motor 26 and a flame detector (not shown) normally adjacent nozzle 24. Flame detector connections are shown at 87 (FIG. 5) while connections are shown to motor 26 at 89. Line 89 (FIG. 2) passes through the illustrated liquid-tight seal in the side wall of the pot housing 10. Motor 26 is preferably a shaded pole motor and other types of motors having no sparking producing elements may also be employed.

The return flow nozzle system receives oil at the upper right side from passage 68, through a port in plate 74 (FIG. 5) leading into an angled passage 86 of the base 72 (see FIG. 1). As previously mentioned, a tube 78 extends from the base terminating at the nozzle sleeve section 80. Tube 78 encloses a return flow tube 88 from the nozzle section, the oil flowing from passage 86 being directed into the annular passage of tube 88 to said nozzle section. A return flow type system as is well known delivers an excess of pressurized oil to the nozzle section and from this section the excess is withdrawn and returned for recirculation to the suction side of the pump. In the present instance the return oil passes forwardly through the pipe 89 (FIG. 1) past the inlet end of tube 78, into a passageway 90 of the base 72 (see also FIG. 5), through a check valve 93, through a port of plate 74 and into a right angled passageway 92 formed integrally in pot housing 10. Passage 92 (FIG. 6) leads to a pressure regulating valve 94 which is preset to maintain a desired pressure in the return flow oil line. Preferably this is on the order of 35 lbs. p.s.i. so as to control the rate of fuel consumption and also to obtain optimum combustion characteristics. An outlet port at 96, returns oil from the valve 94 back into the motor chamber and inlet system of the pump 26.

The fan 30 rotates within the chamber provided by housing 12 and cover 14 which, as mentioned, takes the usual scroll configuration for the discharge of air through the supply tube to nozzle 24. A web 104 is formed across an opening 106 (FIGS. 2 and 4) in the cover 14, distantly from the fan 30. A cap 108 has a stem 110 threadably received by the web 104 whereby the cap 108 may be adjusted in a heightwise fashion to regulate and control the intake of air to the fan 30. A slotted annular flange 112 surrounds the opening 106 and extends upwardly of the edges of the cap.

It will also be noted in connection with pressure regulating valves 66 and 94 that free movement of these valves is assured by the openings 98 and 100 provided adjacent the rear ends thereof. The openings communicate with the motor chamber so that the valve pistons may be freely displaced by the pressurized oil from the pump 28 or the return flow oil from the nozzle 24, as the case may be. In other words the openings 98 and 100 prevent any trapped oil from hindering proper valve operation. It will also be noted that the check valve 93 prevents flow of oil back through the return flow passageway to the nozzle in the event an excessive pressure builds up in the main chamber 10, or in the event the spring of the regulating valve 94 should fail. Thus means are provided for preventing an accidental spillage of oil from nozzle 24 and the resultant hazard which would be created.

The disclosed oil burner unit is particularly compact as is evident from examination of the drawings. Further, it will be noted that installation of the entire unit is extremely simple in that only the usual electrical connections need be made to junction box 85 and a single pipe or tube 50 connected to the inlet from a fuel supply tank. These few connections and the necessary physical mounting of the burner unit by flange 20 or pedestal mount complete the requirements for installation.

In addition to savings which may be realized by eliminating the usual cast iron housing for the motor 26, additional reliability and length of service is obtained by mounting the motor 26 directly in an oil bath. The usual motor fan is eliminated since the oil serves as the cooling medium for the motor. The motor is cooled by oil from the pot housing 10, and fins as illustrated may be provided to further facilitate such cooling.

The disclosed arrangement has a further advantage in that there is no need for any high pressure seals. The pressure in the motor chamber is relatively low so that conventional inexpensive packing rings at the upper end of the motor shaft 27 and a low pressure seal may be employed where line 89 passes into the motor chamber. The thrust of gear pump 28 is in a downward direction and is easily taken up by the integral construction.

Additionally, the high pressure discharge of oil from pump 28 flows through an integrally formed passage. All of these features combine to provide a high degree of reliability with a minimum need for servicing.

Referring now to FIGS. 7-13, and FIG. 7 in particular, a further embodiment of the invention will be described.

This burner unit again comprises a plurality of components defining an upper fan motor chamber, an intermediate motor chamber and a lower pump chamber.

These elements comprise a pump housing member 200, a motor housing 202 and a fan housing 204, with a removable fan housing cover 206 to provide access for maintenance and repair. Each of these may be advantageously formed as sand or die castings. These elements correspond to the housing elements previously described, except that what was previously referred to as a pot housing now comprises the two members 202 and 200, rather than one.

The pump housing member 200 is secured to the lower end of the motor housing 202 by screws 208 and forms in combination therewith the lower pump chamber. The fan housing 204 is secured to the upper end of the motor housing 202 by screws 210 and forms in combination therewith the sealed intermediate motor chamber. The fan housing cover 206 is secured to the fan housing by screws 212 and these two members have a scroll configuration of known design and further provide a fan outlet providing the inner end of a cylindrical air supply conduit designated at 214 and terminating in a flange 216 to provide means for mounting the burner unit directly on the side wall of a water heater or the like, in much the same fashion as the previous embodiment. Secured to and projecting beyond the flange 216 is a cylindrical air supply conduit or tube 218 within which the outer end of a nozzle assembly 220 projects. The construction of the outer end of the tube 218 and the outer end of the nozzle may be the same as in the previous embodiment.

A motor 222 is mounted in the motor housing 202 with its shaft 224 vertically disposed. The lower end of the shaft 224 projects through a bore in the bottom wall of the motor housing 202 and is drivingly coupled to a gear pump 226 mounted within the pump housing member 200. The field wind lamination core 228 of this motor are accurately formed relative to its armature, permitting the lamination to be received by a machined bore 230 in the motor housing 202 and rest on a machined ledge 232. The armature is positioned by the journal formed for the lower end of the shaft 224 in the motor housing 202 and by a journal formed at 234 which is mounted on the fan housing 204 to receive the upper end of the motor shaft. An oil seal is provided at 236 to prevent passage of oil from the motor housing 202 into the fan housing 204.

The bore 230 is provided with an opening at 237 (FIGS. 7 and 9) to provide communication with the remainder of the intermediate motor chamber and permit circulation of oil around the motor 222. The motor is
further positioned by a circular flange 239 depending from the fan housing 204 into contiguous relation with the upper end of the laminations 228. An opening 230 is provided in this flange to facilitate the electrical connections to the motor 222 which are made by a cable 243 extending from an electrical junction box 245 which is formed integrally with the motor housing 202. The opening 241 also provides for complete immersion of the passage through the oil and prevents entrainment of air which might otherwise cause a hazardous atmosphere. The opposite sides of the laminations 228 are cut away, as indicated in FIG. 9 and a finger 247 projects downwardly from the flange 239 along side these laminations to prevent their rotation.

A squirrel cage fan 238 is mounted on the upper end of the shaft 224 within the scroll configuration of the fan housing 204 and fan housing cover 206. The air inlet for the fan is provided by an opening 240 in the cover 206. A web 242 spans this opening and threadedly receives a cap 244 which is arranged to be telescoped over an upstanding flange 246 having V-shaped slots 248. The heightwise position of the cap 244 controls the effective opening between the lower end of the cap and the slots 248, thus providing means for regulating the amount of air drawn by the fans 238, and thus the amount of air supplied to the motor housing. The oil pressure reaches a predetermined limit, the valve 272 is opened permitting oil to flow into the passageway 274 towards the nozzle assembly 220. Oil then flows laterally along a channel 276 (FIGS. 9 and 11) which is sealed by the fan housing 204. The oil then passes through a hollow pin 278 (see also FIG. 8) projecting beyond opposite sides of a mounting pad 280. The use of the hollow pin 278 permits removal and relocating the nozzle assembly so that the nozzle is in accurate relation to the entrance of the intermediate chamber. Oil then enters a passageway 282 (FIGS. 7 and 11) in the nozzle assembly. The construction of the nozzle assembly 220 is essentially the same as in the previous embodiment and includes a return flow type nozzle which burns only a portion of the oil actually delivered, with the excess oil being returned through a passageway 292 (FIG. 7).

At this point it will be noted that the capacity of the pump 226 is substantially greater than the rate at which oil is burned by the nozzle. Thus, there is a greater amount of oil delivered through the passageway 270 (FIG. 11) than can enter the passageway 274. In order to prevent straining the pump, this excess oil is conveyed through internal passageways in the valve 272 to a passageway 284 adjacent the rear thereof. Oil then flows through the passageway 284 and is discharged through an opening 286 back into the intermediate motor housing cover 206. Oil then flows into the opening 286, to close it off, and a pipe connected to the opposite end of the passageway 284 which extends to the exterior of the motor housing 202 (see FIG. 9). This pipe would then return the excess oil to the supply tank and would serve to minimize the entrainment of air in the intermediate chamber. In the illustrated embodiment, however, the opening of the passageway 284 to the exterior of the motor housing 202 is sealed off by a plug 287 (FIGS. 9 and 12).

Referring now to the nozzle assembly 220 (FIG. 7), it will be seen that the pad 280 is secured by screws 288 to the bottom wall of the fan housing 204, the screws being preferably threaded into the motor housing 202. The nozzle assembly itself is secured to the pad 280 by screws 290 which are threaded into this pad. This manner of mounting facilitates removal of the nozzle assembly for repair or replacement.

The oil which is returned from the nozzle flows from the passageway 292 (FIG. 7), through an opening 294 (FIG. 8) formed in the mounting pad 280, and then along a channel 296 formed in its lower surface. This return oil then passes through a short channel 298 (FIG. 9) formed in the lower surface of the motor housing 202. From this point it flows downwardly through a vertical hole 300 (see also FIG. 12) to a horizontal passageway 302, both of which are formed in integral portions of the motor housing 202. A combined pressure relief check valve 304 is seated in the passageway 302. The return oil unseats the check valve 304 and is then free to pass along the plunger of this check valve to an opening 306 which directs the return oil to the interior of the intermediate motor chamber (FIG. 10). The valve 304 serves the function of a pressure relief valve to control the return flow oil pressure for most effective combustion by the nozzle assembly, which serves a check valve function to prevent reverse flow of oil through the return flow passageways and thus prevent escape of oil from the nozzle when the burner unit is not in operation. It will also be seen that means are provided for adjusting the operating pressures of this valve, as well as the valve 226 on the high pressure side of the pump (see FIG. 12).

One further feature to be noted with reference to FIG. 7 is that the provision of a small passageway 308, in the bottom wall of the motor housing 202. This passageway connects with the suction side of the pump 226 so that a small amount of liquid will be continuously drawn from the bottom of the intermediate chamber.

There is always the possibility that water resulting
from condensation will be mixed with oil. If water is present, it could collect in the bottom of the intermediate motor chamber and eventually could rise to the level of the upper end of the components of the motor 222. The combined effect of corrosion and the fact that water is an electrolyte, could therefore result in a hazardous condition. The provision of the passageway 308 prevents this situation from arising, usually without any harmful effects on the operation of the burners. That is, the amount of water which would be found in the oil would be very small and be continuously drawn from the bottom of the intermediate motor chamber will pass through the nozzle without materially affecting its operation. Any large amounts of water, of course, will result in the fire being extinguished and would not create any hazards as far as the motor itself is concerned.

The passageway 308 is predetermined to be small enough so that the amount of oil which may be drawn therethrough is not sufficient to support combustion at the nozzle. It is further contemplated in this combination that a flame detector 309 (conventional design) can be connected effectively in series with the motor 222, as indicated in the highly simplified showing of FIG. 13. Thus, if the level of oil in the intermediate motor chamber falls below the level of the entrance to the hole 262 (FIG. 7) oil will continue to be drawn through the passageway 308 to the pump 320. If this oil is not sufficient to support combustion, the flame detector having sensed the flame failure, will automatically stop operation of the motor 222. In this fashion, operation of the motor 222 in a possibly hazardous oil vapor atmosphere, is prevented . . . while at the same time preventing possible operation of the motor in water.

The modified embodiment of FIGS. 14–17 illustrates a so-called two-stage, two-pipe system wherein the oil pump is provided with two gear units, one of which pressurizes oil for delivery to the nozzle, and the other of which functions primarily to provide a suction for drawing oil from a supply tank. This arrangement would be particularly desirable where oil is drawn from an underground supply tank requiring a relatively high suction. The construction of the embodiment of this invention is essentially the same as just described, except for the provision of a two-stage pump 310 in the lower chamber and the addition of certain passageways for the second pump stage thereof. The same pump housing member 200 and motor housing 202 may be employed for this embodiment and like reference characters are employed to designate corresponding components of the previously described embodiment.

From the intermediate motor chamber through the passageway, which includes the hole 262 to the bottom chamber. The pump 310 comprises a nest of five plates 312 which are secured to the underside of the motor housing 202. A pair of gears rotate in openings in the second and fourth plates 312, with the shoveling of the pump itself being simplified to illustrate primarily oil flow. The upper set of gears which is referred to as the second stage (FIG. 17), functions essentially in the same fashion as the pump 226. Thus aligned openings 314 in the plates 312 form the inlet to this suction side of the second stage pump. Pressurized oil delivered therefrom passes through the passageway 270 and to the nozzle assembly 220 in the manner previously described. Oil is drawn to the first pump stage through a lateral passageway 316 formed in the middle plate 312 (FIG. 14). Oil is delivered from the first pump stage through aligned openings 318 in the upper plates 312. A passageway 320 is formed in the motor housing 202 and leads to a small chamber 322 formed between the pump housing 200 and motor housing 202. A hole 324 is formed in the motor housing 202 and connects the small chamber 322 with the passageway 284.

A passageway 284 is sealed at its inner end by a plug 326 to prevent flow of oil back into the intermediate motor chamber through the opening 286. A pipe 328 is threaded into the passageway 284 and extends back to the oil tank. Oil flows from the first pump stage back to the intermediate motor chamber through the opening 330 (FIG. 15) rather than through the passageway 284 and opening 286. As noted above, the advantages of the two stage pump system are found in the fact that the second stage pump provides a substantially greater suction force for drawing oil from the supply tank. It will also be appreciated that the returning oil drawn by the first pump stage back to the supply tank will tend to minimize the amount of air which will collect in the intermediate motor chamber. Thus it will be noted that the inlet to the suction side of the first stage pump (passageway 316) is disposed within the bottom pump chamber at a point spaced above the inlet to the second pump stage. Any air entering the bottom chamber will tend to be drawn into the first pump stage and returned to the supply tank without affecting the second pump.

Having thus described the invention, what is claimed as novel and desired to be secured by Letters Patent of the United States is:

1. An oil burner unit comprising an electric motor, first housing means open at the upper end thereof and forming a first chamber in which the motor is mounted with its shaft vertically disposed, and a second chamber below said motor chamber, a pump mounted in said second chamber and drivingly connected to the lower end of the motor shaft, second housing means closing off the upper end of said first housing means and having means extending therethrough for connecting the first chamber to a source of oil and for filling the first chamber with oil and immersing the motor, a single pump inlet passageway means formed integrally in said first housing means and communicating with said second chamber on the suction side of the pump from a point in said first chamber above said motor, high pressure passageway means also formed integrally in said first housing means and communicating with the outlet side of the pump, and a burner nozzle assembly mounted on said second housing means with the high pressure passageway means connected therewith.

2. An oil burner unit as in claim 1 wherein said second housing means forms a third chamber above said first chamber and a fan is mounted therein being drivingly connected to the upper end of said motor shaft.

3. An oil burner unit comprising an electric motor, first housing means open at the upper end thereof and forming a chamber in which the motor is mounted with its shaft vertically disposed, a pump in the lower portion of said housing means drivingly connected to the lower end of the motor shaft, passageway means leading from a point adjacent the top of said chamber and above said motor to the inlet side of said pump, second housing means sealing the upper end of said first housing means, inlet means extending through said second housing means into said chamber for connecting a source of oil supply to the chamber and for filling the chamber with oil to immerse the motor as the oil rises in said first chamber and reaches said pump inlet passageway means, and high pressure passageway means in said first housing means leading from the outlet side of the pump to the motor therein for carrying first housing means and a burner nozzle assembly unit mounted at the top of said first housing means and having conduit means connected between said high pressure passageway means and said nozzle unit.

4. Oil burner unit construction comprising a composite motor and pump housing open at the upper end thereof and forming a chamber, a motor mounted in said
3,220,461

the exit end of said pump outlet conduit having a nozzle return flow conduit communicating with said motor chamber and including a second pressure regulating valve in said return flow conduit, a fan fixed on the upper end of the motor shaft above said motor chamber and a fan housing fixed on said composite housing at the top of the motor chamber and through which said motor shaft projects, said fan housing having an oil supply inlet conduit communicating with said motor chamber and the said fan housing being formed with a lower wall structure defining a scroll form of fan chamber and air supply tube portion, the latter portion terminating in a cylindrical flanged end, a cover mounted on said fan housing enclosing the upper section of said fan chamber and air supply tube portion and having means for regulating air flow to the fan housing, a burner nozzle assembly of the return flow type extending outwardly from the flanged end of said air tube portion and the inner end of said assembly having a base mounting frame member detachably carried on said composite motor housing, said base member having a nozzle outlet conduit and a return flow conduit including a check valve, said latter conduits communicating with the corresponding conduits of said motor housing, said base member being detachable for removal of said nozzle assembly in its entirety from said air supply tube plenum inwardly engaging the cylindrical flanged end on removal of said fan housing cover.

10. An oil burner unit comprising a closed composite housing having upper and lower chambers, an electric motor mounted in the upper chamber, a pump mounted in the lower chamber and driven by said motor, means for introducing fuel into said upper chamber and immersing the motor therein, a single passageway leading from the upper chamber to the suction side of said pump, a burner nozzle element mounted on said composite housing and passageway means connecting the discharge of said pump with said nozzle element, the inlet of said single passageway to the suction side of the pump being disposed above the level of the motor to thereby prevent operation of the motor in a fuel vapor atmosphere, and a relatively small drain passageway leading from the bottom of the upper chamber to the suction side of said pump so that a small amount of liquid will be continuously drawn from the bottom of the upper chamber to prevent a buildup of water therein which might create a hazardous condition with respect to the electrical components of the motor, the size of said drain passageway being insufficient to pass the amount of fuel required to maintain combustion at said nozzle element for stopping operation of said motor in the event there is insufficient fuel to maintain combustion to further prevent operation of the motor in a fuel vapor atmosphere.

11. An oil burner unit comprising a compositely formed housing unit which includes an upper fan chamber, an intermediate motor chamber and a lower pump chamber, said housing unit including three integrally formed members, a first member defining the sides and bottom of said intermediate chamber, the second member being sealingly secured to the top of the first member to define the upper portion of the intermediate chamber and having a scroll configuration leading to a discharge passageway, a third member removably secured to the bottom of the first member to define the remainder of the bottom chamber, means for connecting the intermediate chamber to a source of oil, an electrically operated motor mounted in the intermediate chamber with its shaft vertically disposed and projecting from opposite ends thereof into said upper and lower chambers, a fan secured to the upper end of said shaft and a pump connected to the lower end of said shaft, a burner nozzle assembly mounted on said housing unit in said discharge outlet, said first member having an integrally formed passageway leading from a point in said intermediate chamber above the electrical elements of said motor to said bottom chamber and to the inlet to said pump, passageway means integrally formed in said first
member for connecting the discharge of said pump with said burner nozzle assembly and a relatively small drain passageway leading from the bottom of said intermediate chamber to said bottom chamber and to said inlet so that a small amount of liquid will be continuously drawn from the bottom of the intermediate chamber to prevent a buildup of water therein which might create a hazardous condition with respect to the electrical components of the motor, the size of said drain passageway being insufficient to pass the amount of fuel required to maintain combustion at said burner element and means for stopping operation of said motor in the event there is insufficient fuel to maintain combustion to further prevent operation of the motor in a fuel vapor atmosphere.

12. A burner unit as in claim 11 wherein the pump is provided with a first and a second stage and the inlet to the first stage is disposed in said bottom chamber at a point spaced above the inlet to the second stage thereof, and further wherein passageway means are formed through said first member which connects with the discharge of said first pump stage and extends to the exterior of said member for connection with a conduit leading to the oil source.

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