

[54] **PORTABLE HEATER**

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 [58] Field of Search263/19 A; 126/116 R, 110 R,
 126/110 B, 110 C

[56] **References Cited**

UNITED STATES PATENTS

2,661,199	12/1953	Young et al.	263/19 A
3,101,193	8/1963	Varvel	263/19 A
3,256,003	6/1966	Briggs	126/110 B X
3,401,920	9/1968	Berkhoudt et al.	263/19 A

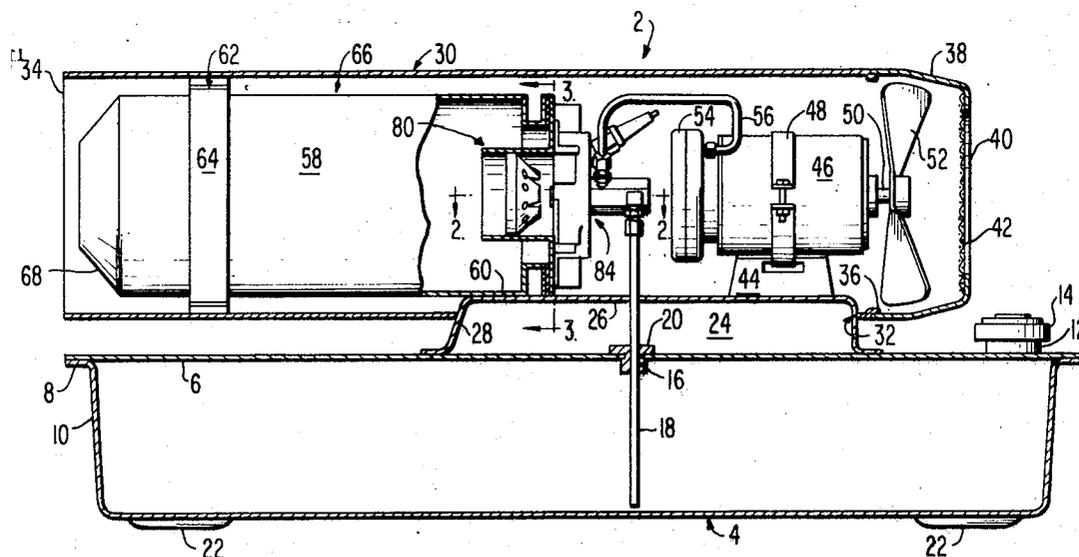
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[57] **ABSTRACT**

The elongated generally tubular shell of an oil burning

portable heater is provided with a coaxial combustion chamber at its front end portion. A motor within a rear end portion of the shell drives both a primary combustion air pump and a fan for drawing air into the rear end of the shell and forcing it longitudinally through the shell. A burner tube extends a short distance into the rear end of the combustion chamber and a burner head is mounted at the rear end of the burner tube. A fuel nozzle in the burner head is supplied with oil and primary air and projects an air-oil mixture axially of the burner tube. Auxiliary air from the fan enters openings in the circumference of the burner head and exits into the burner tube in a swirling pattern. An open ended conical flame retention head is located within the burner tube with the small end of the cone facing the nozzle to receive the air-oil mixture projected therefrom, and auxiliary air openings in the flame retention head have outwardly protruding vanes adjacent their margins for guiding auxiliary air into the flame retention head and imparting a swirl thereto in the same rotational direction as that provided when the auxiliary air enters the burner head.

6 Claims, 7 Drawing Figures



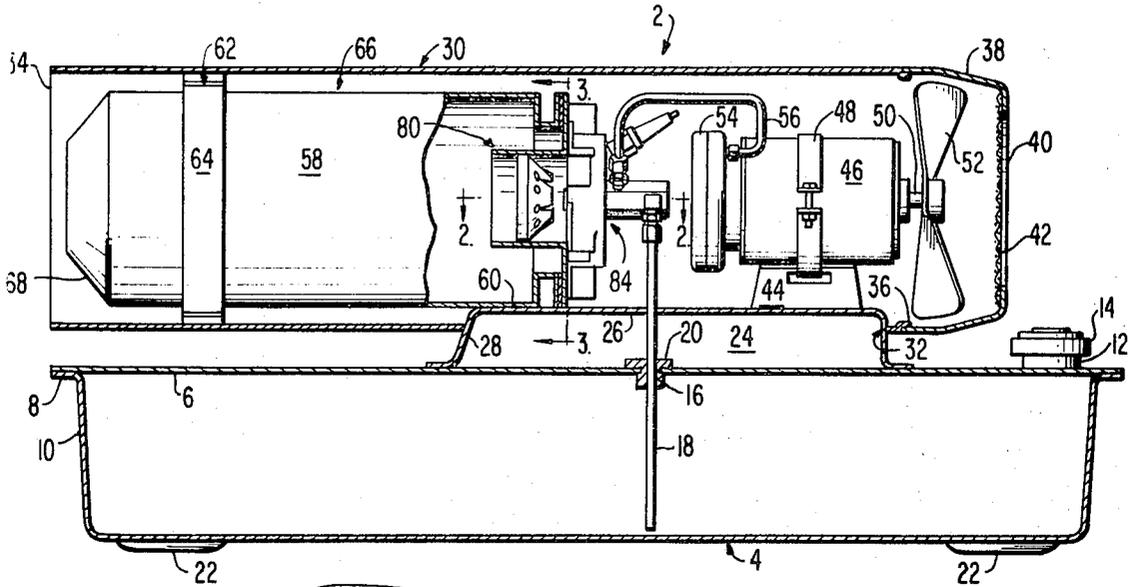


FIG. 1

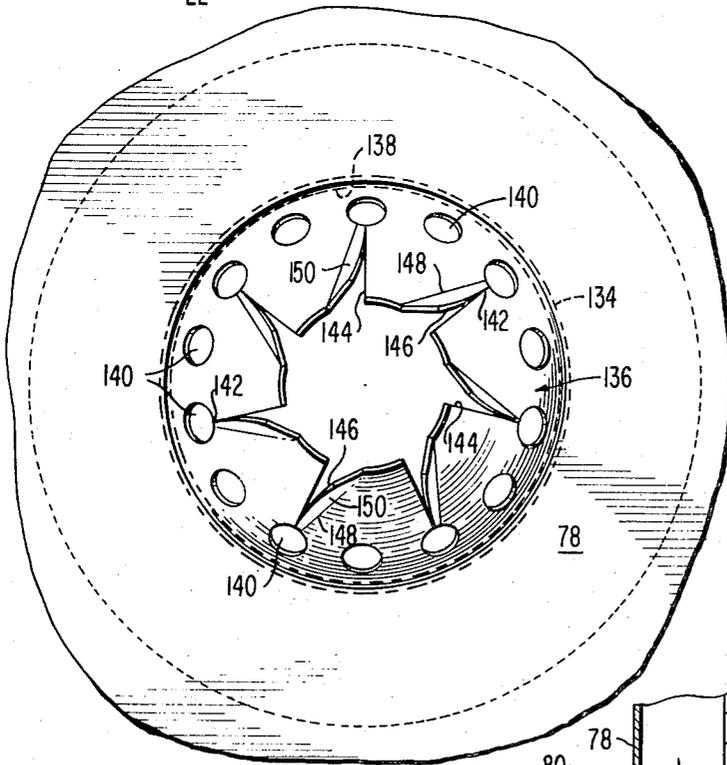
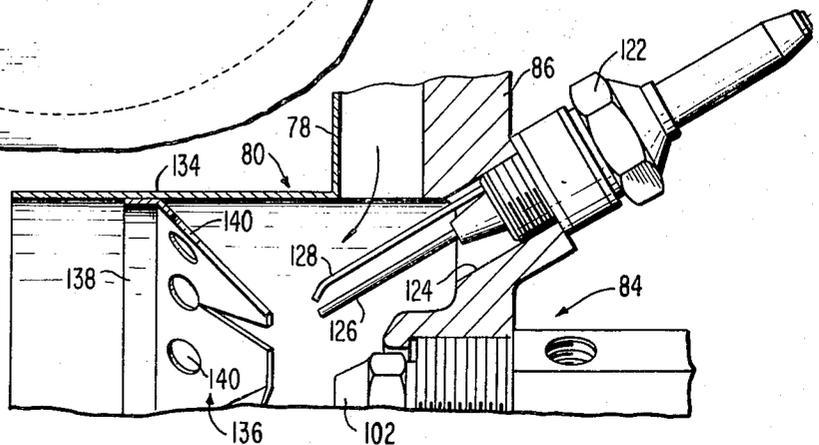
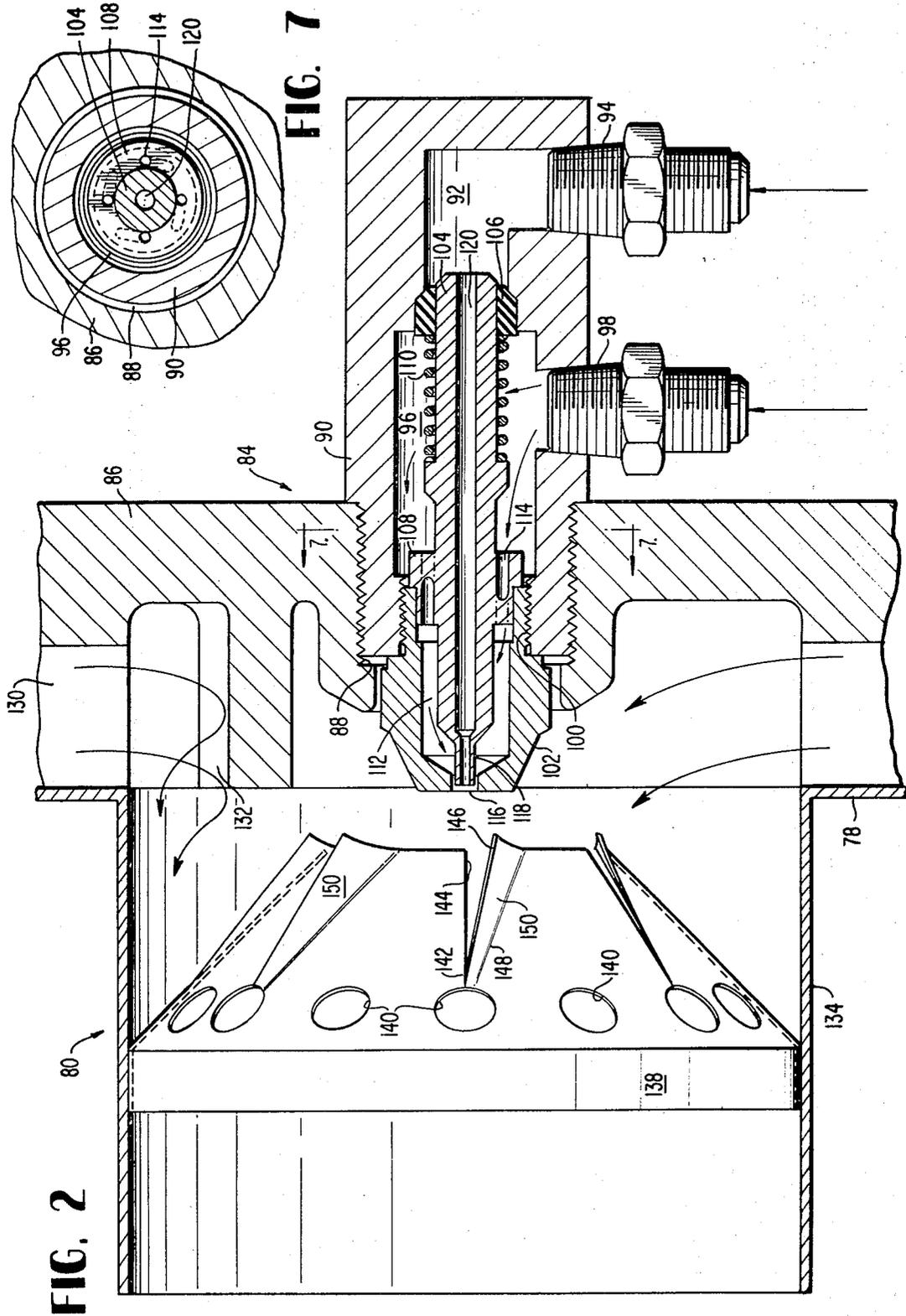


FIG. 3

FIG. 6





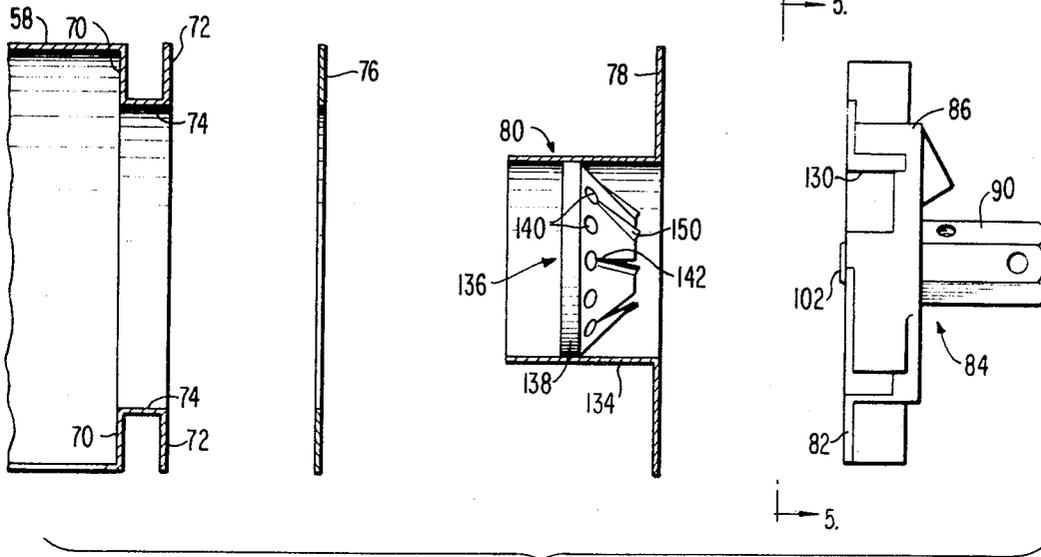


FIG. 4

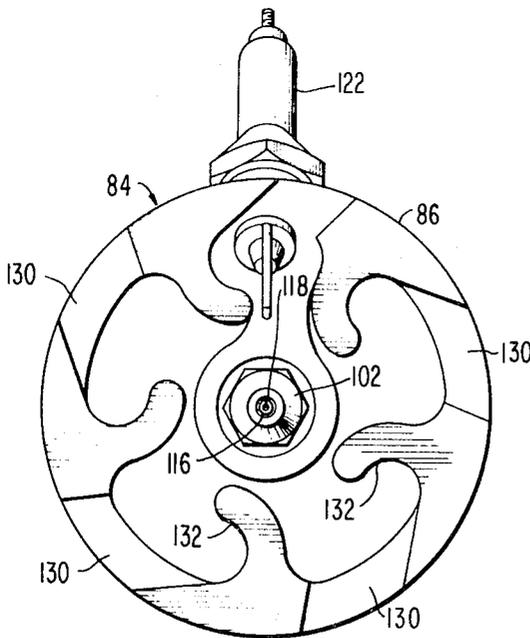


FIG. 5

PORTABLE HEATER**CROSS REFERENCE TO RELATED APPLICATIONS**

The disclosure of this application is related to the disclosures of an application Ser. No. 128,734 of Eugene C. Briggs entitled "Fuel Burner" and a joint application Ser. No. 128,726 of Eugene C. Briggs and William C. Wellbaum entitled "Combustion Apparatus", now U.S. Pat. No. 3,666,396, both filed in the U.S. Patent Office on Mar. 29, 1971.

BACKGROUND OF THE INVENTION

This invention relates to a portable space heater suitable for use in home workshops, on farms and at construction jobs.

Both gas and oil fired portable heaters of the general type with which the present invention is concerned have been used with considerable success in recent years. As indicated, for example, in U.S. Pat. No. 3,338,287 to Loris D. Clark and in U.S. Pat. No. 3,256,003 to Eugene C. Briggs, such portable heaters may include both a fuel supply and appropriate combustion apparatus mounted on a stand, and the stand may, if desired, include one or more wheels for facilitating movement of the heater from one place to another.

The combustion apparatus for these portable heaters usually includes an elongated shroud supported on the fuel tank. The shroud is tubular and is provided with openings at both of its ends. Motor driven fan means within the shroud draws air through an opening in the rear end and forces it along the shroud and out of the front end. A combustion chamber and a burner head for supplying air and fuel to the combustion chamber also are located within the shroud so that the air forced through the shroud by the fan is heated. The combustion gases exiting from the combustion chamber ordinarily pass out the same opening at the front end of the shell.

Although these compact portable heaters have proved highly useful, the constructions known prior to the present invention were subject to some disadvantages. Since these heaters are so readily movable, it is important that they be designed in such a way that, should they be used in a somewhat restricted environment such as a garage or farm shed, there will be minimum danger of injury from the exhaust gas products. That is to say, these portable heaters must be designed so as to achieve complete combustion of the fuel. Moreover, since the volume of the combustion chamber is necessarily limited in these portable heaters, the provision of sufficient excess air for assuring complete combustion has led to the use of somewhat complex and expensive structures.

Additionally it has been noted that the heating efficiencies of these previously known portable heaters have not been as high as might be desired. This has been especially true in connection with oil fired units in which carbon formation caused by flame impingement on cold sheet metal surfaces has been a problem.

SUMMARY OF THE INVENTION

This invention has as its principal object the provision of a compact heater in which highly efficient com-

bustion is achieved by improved air flow control into and within the combustion area.

A more particular object of the invention is to provide an oil fired heater in which the oil is thoroughly atomized and burned completely in a small intense flame confined by air currents which prevent the impingement of the flame and incompletely burned oil particles against the parts of the apparatus.

Yet another object of the invention is to provide a low cost heater construction in which the main heater fan or blower drives air along the exterior of the combustion chamber to be heated thereby and also supplies auxiliary mixing air to and around the flame area.

In its general configuration, the heater of this invention is similar to the heater illustrated in the aforesaid Briggs U.S. Pat. No. 3,256,003. It includes an elongated tank and a generally cylindrical elongated shell supported above the oil tank. The rear end portion of the shell contains a small electrical motor having outputs at both of its ends generally coaxial with the shell. A fan or blower on the rear motor output draws air through an inlet at the rear end of the shell and forces the air forwardly along the length of the shell. A vane type pump is driven by the front motor output and serves to draw air from the interior of the shell and deliver it at an increased pressure to a burner nozzle.

The combustion chamber for the heater extends rearwardly from a location near the open front end of the shell to a location at or somewhat to the rear of the middle of the shell. It is cylindrical over much of its length and has a diameter less than the diameter of the shell. The combustion chamber is mounted so that a substantial portion of the air supplied by the blower may pass forwardly between the combustion chamber and the shell to receive heat from the exterior wall of the shell and be discharged through the open front end of the shell.

The rear end of the combustion chamber has attached thereto a burner tube and a burner head unit. These are generally coaxial with the combustion chamber and neither protrudes radially beyond the combustion chamber far enough to materially obstruct the flow of air into the space between the combustion chamber and the shell.

The burner tube unit includes a radial flange by which the unit may be attached to the rear end of the combustion chamber, and a short, small diameter, tube projects forwardly into the interior of the combustion chamber. A flame retention head having the general configuration of a frustum of a cone is mounted within the interior of this tube with its small end facing rearwardly. The large end of the coned flame retention head is of the same diameter as the tube and its exterior seals against the interior wall of the tube.

The burner head unit includes a nozzle provided with fuel and primary air passages leading to an orifice in the forwardly facing tip of the nozzle. An air line transmits primary air from the vane type pump driven by the motor within the rear end portion of the heater shell to the air passage in the nozzle, and an oil line transmits oil from the oil tank to the oil passage in the nozzle. The primary air issues at high velocity from the orifice in the nozzle tip and serves to atomize the oil and project the oil particles forwardly into the small end of the flame retention head.

The burner head also includes a plurality of auxiliary air inlets spaced about its circumference and internal guide surfaces which impart swirling motions to the auxiliary air entering these openings. The volume of air so supplied is substantial and it swirls forwardly into the burner tube to further break down the oil particles and supply excess oxygen for assuring complete combustion.

The flame retention head is shaped to control the auxiliary air flow and maximize its effectiveness. Longitudinal slots are located at regularly spaced intervals about the axis of the flame retention head and each of these slots is open to the small end of the head. The material of the head is bent outwardly at an angle along one margin of each of the slots to provide a series of vanes skewed relative to the axis of the head. The vane inclinations are correlated with the direction of auxiliary air swirl provided by the burner head so that the swirling air continues its swirling pattern as it enters the interior of the flame retention head along the vane surface. This auxiliary air swirling about the axis serves to inhibit lateral flame expansion, to bring about an efficient air-fuel mixture in the flame zone and to scour the interior surfaces of the flame retention head.

The flame retention head preferably includes additional air passages located near but spaced from its larger end. These additional air passages may be simple holes the axes of which intersect the longitudinal axis of the flame retention head. The holes preferably are spaced regularly about the circumference of the head and at least some of them may intersect the ends of the longitudinal slots remote from the small end of the head. The additional air passing through the holes is driven directly into the flame area and minimizes flame expansion so that the flame is held in close proximity to the conical head. This additional air also provides a shield for preventing impingement of raw or incompletely burned fuel against the walls of the downstream portions of the head and burner tube so as to minimize carbon deposits thereon.

With this construction the actual burning zone is very small. The flame produced is a small, bright yellow flame having the appearance of a vortex oriented along the burner tube axis. The oil is completely burned here, and there is little or no tendency toward the formation of carbon deposits on the interiors of the burner tube and combustion chamber.

It is noteworthy also that the substantial improvements in performance achieved by the new heater construction have resulted not from complex and expensive components but rather from a structurally simplified design. The components are adapted for mass production operations and they may be assembled readily in completing the portable heater.

A more complete understanding of these and other features and advantages of the invention will be gained from a consideration of the following detailed description of an embodiment illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross sectional view through a portable heater constructed in accordance with the present invention.

FIG. 2 is a horizontal cross sectional view of a central portion of the heater of FIG. 1, the view being taken along the line 2—2 in FIG. 1 and illustrating on an enlarged scale the burner tube and burner head units of the heater.

FIG. 3 is a detailed view taken along the line 3—3 in FIG. 1 and illustrating the burner tube unit from its rear end.

FIG. 4 is an exploded view of a combustion chamber rear end portion and the burner tube and burner head units of the heater of FIG. 1.

FIG. 5 is an elevational view of the front end of the burner head as this head appears from the plane 5—5 in FIG. 4.

FIG. 6 is a partial cross sectional view through the burner tube and head assemblies, illustrating an igniter component in its proper relationship to the other constructional features of the assembly.

FIG. 7 is a detailed cross sectional view, taken along the line 7—7 in FIG. 2 and illustrating certain features of the nozzle employed in the heater of FIG. 1.

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENT

The portable heater 2 of FIG. 1 includes an oil tank 4 having a substantial internal volume providing a reservoir for a supply of fuel oil. This tank 4 may be generally rectangular as viewed from the bottom thereof, and its top is closed by a plate 6 permanently secured and sealed to flanges 8 on the upper ends of the side walls 10 of the tank.

A filler tube 12 enters an opening in the top plate 6 of the tank 4 and is provided with a conventional closure 14 which may be removed when it is desired to introduce oil into the tank through the tube 12. The top plate 6 also is provided with an opening 16 for an oil outlet tube 18 the inlet end of which is located near the bottom of the tank 4. A resilient seal 20 fills the space between the exterior of the oil tube 18 and the margins of the opening 16 in the top plate 6 to prevent the escape of vapors.

The illustrated fuel tank 4 also is provided with foot elements 22 at each of the corners of the bottom wall thereof. These foot portions permit a heater to be placed directly on the ground or on the floor of a building structure where the heater is to be operated. However, it will be understood that the illustrated heater also may be provided with a supporting frame structure and that the frame structure may include wheel means for facilitating movement of the heater between different locations. Suitable frame structures are illustrated, for example, in the Clark U.S. Pat. No. 3,338,287 and the Briggs U.S. Pat. No. 3,256,003 mentioned above.

An elongated support 24 having the general configuration of an inverted rectangular pan is secured to a mid portion of the top plate 6 of the oil tank 4. This configuration provides the support with good rigidity characteristics while at the same time minimizing its weight. The upper wall 26 of the support 24 is provided with an opening for the oil tube 18, and it is not necessary that this opening be sealed.

The front wall 28, and preferably also one of the side walls, of the support 24 is inclined so that the top of the support 24 is somewhat smaller than the bottom. A

main heater shell 30 of generally cylindrical configuration is provided with an opening 32 on one of its sides and fitting over the upper end of the support 24. The opening 32 corresponds in shape to the shape of the exterior of the support 24 and the margins of the opening 32 may be welded or otherwise secured to the side and end walls of the support 24.

The front end 34 of the shell 30 is completely open and unobstructed. At its rear end the shell 30 is provided with an internal lip 36, and a removable end cap 38 is held in frictional engagement with the lip 36. This end cap has a large opening at its rear end 40, and suitable filter means 42 extend across the opening 40 to minimize the amount of particulate matter entering the shell 30 through the opening 40.

The support 24 also carries a motor bracket 44 on which a small electric motor 46 is mounted and secured by strap means 48. This motor 46 has output shaft means at both its rear and its front end, these being generally coaxial with the shell 30. The rear motor output 50 has secured thereto a fan or blower 52 which serves as the main air circulation fan for the system. This fan 52 draws large quantities of air through the opening 40 and forces the air longitudinally along the interior of the shell 30.

The front output of the motor 46 drives a pump or air compressor 54 of a vane type described more fully in U.S. Pat. No. 3,256,003, granted to Eugene Briggs. The disclosure of such patent is incorporated herein by reference and the patent may be examined in order to gain a detailed understanding of the interior construction of the pump 54. It will suffice here to point out that the pump 54 receives air from the interior of the shell 30 and delivers the air at a higher pressure to an output line 56.

A stainless steel combustion chamber 58 also is supported, at least in part, by the top 26 of the support 24. This combustion chamber 58 is generally cylindrical and coaxial with the shell 30, and its rear end portion 60 rests upon the support 24. Suitable fastening means, such as a weld or a screw type connector, may be provided to attach this rear end portion of the combustion chamber to the top wall 26 of the support. Additional support means 62 may be provided for the front end portion of the combustion chamber 58 in order to assure the maintenance of a proper alignment of the combustion chamber within the shell 30. The front support may take the form of strap means 64 attached to fittings disposed at various locations about the circumference of the shell 30.

Although the forward support means 62 may take various forms, such means should not be of a nature to prevent flow of air from the fan 52 along the space 66 between the exterior of the combustion chamber 58 and the interior of the shell 30. It is desirable that substantial quantities of air be directed along this generally annular space 66 to receive heat from the wall of the combustion chamber 58 and be discharged in its heated condition from the open front end 34 of the burner shell 30.

The front end of the combustion chamber 58 is provided with a conventional nose cone 68 which may be integral with the main body of the combustion chamber or which may be a separate component attached to the front end of the cylindrical portion of the combustion

chamber 58. At its rear end the combustion chamber 58 is given a special configuration which adapts this end portion of the combustion chamber for use as a support for other components of the apparatus. This special configuration includes front and rear radial wall sections 70 and 72 connected rigidly together by a short cylindrical wall section 74 having a diameter less than the diameter of the main body portion of the combustion chamber 58.

Referring now to FIGS. 1 and 4, it will be seen that a gasket 76, a radial flange portion 78 of a burner tube unit 80, and a radial flange portion 82 of a burner head unit 84 are designed to cooperate with the special configuration at the rear end of the combustion chamber 58. The gasket 76 and the flange portions 78 and 82 are brought together and abutted against the radial rear wall 72 of the combustion chamber 58. Fastenings such as bolts (not illustrated) then are passed through circumferentially spaced and aligned openings through the assembled parts to secure the burner tube unit 80 and the burner head unit 84 in place on the rear end of the combustion chamber 58.

The nozzle assembly just described is exceedingly simple and effective. The special configuration at the rear end of the combustion chamber 58 is sufficiently rigid to assure that the rear wall 72 will be located at right angles to the axis of the combustion chamber, and this in turn assures proper alignment of the burner tube and burner head with respect to the combustion chamber. It should be noted also that the space between the radial walls 70 and 72 at the rear end portion of the combustion chamber 58 is located at the exterior of the combustion chamber so that the ends of the fasteners for securing the components in place need not be exposed at the interior of the combustion chamber where special materials would be required in order to guard against degradation effects.

The central portion of the burner head 84 is best illustrated in FIG. 2. The body 86 of the burner head 84 is provided with an axial opening which is threaded at 88 for receiving an externally threaded front end portion of a nozzle housing 90. The nozzle housing 90 is hollow and includes both a chamber 92 communicating with an oil inlet fitting 94 and a chamber 96 communicating with a primary air inlet fitting 98.

Although the fittings 94 and 98 have, in the interests of clarity, been illustrated in FIG. 2 as being located in the same plane, it will be understood that these may be located at any convenient locations about the axis of the housing 90, and the arrangement shown in FIG. 1 is a particularly desirable one. The oil inlet fitting 94 is of course connected to the oil line 18 leading from the tank 4, and the primary air inlet fitting 98 is connected to the line 56 leading from the vane type pump 54 at the front end of the motor 46.

The front end of the nozzle housing 90 is open and is threaded internally at 100 for receiving an externally threaded rear end portion of a nozzle tip 102. A nozzle core 104 is disposed centrally of the nozzle housing and tip and fits closely within an opening at the rear end of the nozzle tip and within a seal 106 separating the oil chamber 92 from the air chamber 96. The longitudinal position of the core 104 within the housing 90 and the attached tip 102 is established by a radial collar 108 on the core, and a compression spring 110 is arranged to

press the core forwardly until the front face of the collar 108 abuts against the rear end of the nozzle tip 102.

The front end portion of the nozzle core 104 has an external diameter less than the diameter of the opening in the corresponding portion of the tip 102 to provide therebetween another air chamber 112. Air flows from the chamber 96 to the chamber 112 through inclined passageways 114 (FIGS. 2 and 7) in the collar 108. These inclined passageways serve to produce a high velocity air flow in a swirling pattern through the chamber 112 and through an orifice 116 at the outlet end of the nozzle tip 102.

The core 104 additionally includes at its front end a tip portion 118, and an oil passage 120 leads through the center of the core from the chamber 92 to the orifice 116. The swirling air flow from the chamber 112 out of the orifice 116 in the nozzle tip produces an aspiration effect which causes oil to flow through the passage 120, and a mixture of air and atomized oil is projected forwardly from the nozzle tip.

In order that this mixture may be ignited, the burner head unit 84 also is provided with an igniter component 122 best illustrated in FIG. 6 of the drawings. This igniter component is threaded into an opening 124 through the rear of the burner head body 86 and it includes a pair of electrodes 126 and 128 projecting to a location near the nozzle tip 102. Suitable electric control means (not illustrated) provide current for energizing the igniter 122 at the beginning of a burning cycle. When the igniter is energized, an arc is struck between the tips of the electrodes 126 and 128 to initiate combustion of the oil-air mixture issuing from the nozzle tip.

The burner head body 86 also is provided with means defining auxiliary air passageways through which substantial portions of the air forced along the interior of the heater shell 30 may flow into the rear end portion of the burner tube unit 80. Referring particularly to FIG. 5, it will be seen that the circumference of the burner head body 86 is provided with a number of spaced openings 130 directed toward curved guide surfaces 132 spaced about the axis of the burner head. The guide surfaces 132 are contacted by the inrushing auxiliary air and serve to deflect this air into a swirling pattern. This swirling air then issues from the open front face of the burner head body 86 into the rear end of the burner tube as indicated in FIG. 2. Although five of the openings 130 have been illustrated in the drawings, it will be understood that this number is not critical. It is desirable, however, that the burner head passageways accommodate a relatively large volume of auxiliary air flow, and that the overall arrangement be such as to assure thorough mixing of portions of this air with the spray issuing from the nozzle tip 102.

The cylindrical portion 134 of the burner tube unit 80 is relatively short as compared with the length of the combustion chamber 58 and its diameter also is small as compared with that of the combustion chamber. This cylindrical portion 134 is completely open at both its front and rear ends, and a flame retention head 136 is mounted within the interior thereof.

The flame retention head 136 is disposed a short distance in front of the outlet end of the nozzle tip 102 as illustrated in FIG. 1. This head 136 is formed of heat resistant thin wall material such for example as thirty

gauge stainless steel. Its shape is basically that of a frustum of a cone and it is preferred that the cone angle (i.e. inclination relative to axis) be on the order of about 45°. The small end of the coned flame retention head 136 faces toward the nozzle tip 102, while the larger end faces toward the front outlet end of the burner tube 134. The diameter of the larger end of the head 136 corresponds to the diameter of the burner tube 134, and an attachment ring 138 of cylindrical configuration seals this end of the head 136 against the wall of the tube 134.

One set of auxiliary air openings 140 through the coned flame retention head 136 is located near but spaced from the large end of the coned section. These openings 140 are circular holes regularly spaced about the circumference of the head. The exact number and the sizes of the holes 140 may be chosen on the basis of the air requirements for efficient combustion of fuel at the rate appropriate for the heating task to be accomplished by the heater. The conical section of the flame retention head 136 also is provided with another set of auxiliary air passages or slots by slitting the head longitudinally from alternate ones of the holes 140 to the small rear end of the head. Viewing the coned head 136 from its rear (FIG. 3), it will be seen with respect to each of the slits 142 that the edge 144 thereof which trails in a counterclockwise sense lies in a longitudinal plane containing the axis of the flame retention head and is not deflected from the coned shape. However, the material adjacent the opposite marginal edge 146 is bent outwardly along a bend line 148 to provide an inclined vane 150.

With this construction the opposite edges 144 and 146 of the slits 142 cooperate to define forwardly converging longitudinal slots or air passage mouths for receiving auxiliary air from the zone at the rear and about the flame retention head. The inclined inner faces of the vanes 150 impart to the air flowing thereover a swirling pattern of motion about and along the axis of the burner tube 134. Since the slits extend all the way to the completely open small end of the coned flame retention head 86 air may move to the inner flow-controlling surfaces of the vanes 150 not only from the periphery of the head but also from the zone immediately behind the head.

It will be noted that the directions of swirl induced by the flame retention head vanes 150 and by the burner head guide surfaces 132 are the same. In both instances the flow is counterclockwise when viewed from the rear. Thus, the mouths of the slots formed by the edges of the slits 142 in the flame retention head 136 open toward the direction of flow established by the guide surfaces 132 in the burner head body, and large volumes of auxiliary air flow smoothly into the interior of the flame retention head. The interior of the flame retention head is uninterrupted by inward projections and the spiral auxiliary air flow proceeds longitudinally within the head without abrupt direction changes.

It will be understood, of course, that the illustrated components of the heater 2 are subject to variations and modifications. For example, the illustrated burner nozzle is particularly suitable for heaters which need not have extremely high burning rates. Other applications requiring higher burning rates may be served by embodiments of the invention incorporating nozzles

and pressurized fuel oil supply systems appropriate for higher rates of fuel delivery.

SUMMARY OF BURNER OPERATION AND ADVANTAGES

When it is desired to initiate a burning cycle within the heater 2, the motor 46 is energized to drive the main air circulation fan 52 and the vane type primary air pump 54. The primary air from the pump 54 is delivered through the nozzle in the burner head 84 to produce a suction in the oil passage of the nozzle, and oil is drawn from the tank 4 through the tube 18 into the nozzle to be sprayed in atomized form from the orifice 116 in the nozzle tip and into the completely open small end of the flame retention head 136 in the burner tube 134. The size of the opening at the small end of the flame retention head 136 is sufficient to permit entry of the air-oil stream from the nozzle orifice without impingement of the material against the walls of the flame retention head.

As flow is being established, the igniter 122 is energized to strike an arc between the tips of the electrodes 126 and 128. This initiates combustion of the air-oil mixture, and then the igniter is de-energized until it becomes necessary to initiate another burning cycle.

The auxiliary air entering the burner head 84 through the circumferential openings 130 swirls forwardly into the burner tube 134. Some of the auxiliary air passes directly into the open rear end of the flame retention head along with the stream issuing from the nozzle. Additional increments of air enter the mouths of the slots in the flame retention head and are acted upon by the vanes 150 to enhance the swirling action. This spiral flow exerts a confining effect upon the flame in a radial sense, scours the interior surface portions of the flame retention head 136 and further improves the air-oil mixture in the flame area.

Still other increments of auxiliary air are driven through the holes 140 toward and along the central axis of the burner tube 134 to further confine the flame and carry the combustion of the fuel to completion. This air flow through the holes 140 also provides a shield for the metal surfaces located downstream thereof so that these surfaces are protected against carbon deposits.

The flame produced is a small, intense, bright yellow flame of a shape indicative of a vortex. The flame does not impinge upon the surfaces of the flame retention head 136, the burner tube 134 or the combustion chamber 58, and carbon deposits upon the apparatus walls are avoided. Moreover, the large supply of effectively controlled auxiliary air assures complete combustion of the oil so that the exhaust gases from the opening in the nose cone of the combustion chamber 58 are clean and free of sometimes dangerous carbon monoxide components.

Heating efficiency of the unit 2 is further enhanced by the substantial volume of air flowing through the space 66 between the exterior of the combustion chamber 58 and the interior of the shell 30. This air is heated within the unit and becomes available as a part of the exhaust flow. At the same time, the shell 30 itself remains relatively cool so that there is little likelihood of someone being burned accidentally by contacting the shell.

Moreover, the structural simplicity of the heater 2 contributes materially to cost reductions. The mounting system for the burner head and burner tube units assures proper orientation of the parts with a minimum of installation expense, and the support 24 on the top of the oil tank 4 cooperates with the opening 32 in the burner shell 30 and with other components within the shell to simplify the assembly operations.

Although the invention has been illustrated and described with particular reference to one embodiment, a number of modifications and variations will readily suggest themselves to persons skilled in the art. It is intended, therefore, that the foregoing detailed description of the illustrated embodiment be considered as exemplary only and that the scope of the invention be ascertained from the following claims.

What is claimed is:

1. A heater comprising:

- a elongated shell having an outlet for heated gas at its front end and an air inlet at its rear end;
- fan means for forcing air through said inlet and forwardly along the interior of said shell;
- a combustion chamber disposed within a front end portion of said shell with the exterior of said combustion chamber being spaced from the interior of said shell to permit the passage of air to be heated along the exterior of said combustion chamber and out of said outlet opening in said shell, said combustion chamber being provided with an outlet opening at the front end thereof for exhausting hot gas along with the heated air from the space between the interior of said shell and the exterior of said combustion chamber;
- a burner tube extending centrally into a rear end portion of said combustion chamber and having an open outlet end in communication with the interior of said combustion chamber, said burner tube being provided with a transversely extending flange member cooperating with said combustion chamber to compel fluid entering the rear end of said combustion chamber to flow through said burner tube;
- a burner head at the rear end of said burner tube provided with a fuel nozzle coaxial with said burner tube and being shaped to permit the entry of air from the interior of said shell into a zone surrounding the outlet end of said nozzle and in communication with the interior of said burner tube;
- means for supplying fuel to said nozzle to be projected forwardly from the outlet end thereof; and
- a flame retention head of thin material disposed between said nozzle and the outlet end of said burner tube and being formed into a generally conical section coaxial with said burner tube, said conical section having a large end the diameter of which corresponds to the diameter of the interior of said burner tube and a small end defining an unobstructed opening facing said nozzle for receiving flow from the outlet end of said nozzle, said conical section also being provided with slots extending longitudinally from the small end thereof and outwardly inclined vane portions adjacent said slots for receiving portions of the air from said burner head zone and guiding such air into a swirling pattern of motion about and along the axis of the flame retention head.

2. A heater according to claim 1,
 wherein said conical section of said flame retention
 head has a concave interior surface unobstructed
 by radial protrusions therefrom, and
 wherein said conical section is additionally provided 5
 with a ring of holes therethrough near but spaced
 from its large end with one of said holes being
 disposed in intersecting relation to the forward end
 of each of said slots.

3. A heater according to claim 2, 10
 wherein said nozzle is an aspirator nozzle;
 wherein means are provided for supplying primary
 air under pressure to said nozzle; and
 wherein said burner head shape for permitting the
 entry of air from the interior of said shell into a 15
 zone surrounding the outlet end of said nozzle and
 in communication with the interior of said burner
 tube includes auxiliary air inlets and interior guide
 surfaces for swirling the auxiliary air passing
 through such inlets and moving forwardly from the 20
 burner head into the rear of said burner tube.

4. A heater according to claim 3, wherein said guide
 surfaces in said burner head and said vane portions of
 said flame retention head are so arranged that the rota-
 tional direction of air swirling motion imparted by each 25
 is the same.

5. A portable oil fired space heater comprising:
 an oil tank provided with means for contacting the
 base surface of the area to be heated so as to sup-
 port the heater on such surface; 30
 a support fixed to and extending upwardly from said
 oil tank;

an elongated, generally cylindrical, open ended, shell
 overlying said oil tank and being secured to said
 support, said shell being provided with an opening 35
 for receiving an upper portion of said support;

a motor generally coaxial with said shell mounted on
 said upper portion of said support and having a ro-
 tary output at each of its front and rear ends;

fan means secured to the rotary output at the rear 40
 end of said motor for forcing air into the rear end
 of said shell and forwardly along said shell;

primary air pump means connected to the rotary out-
 put at the front end of said motor for receiving air
 from the interior of said shell and delivering such 45
 air at an elevated pressure;

a generally cylindrical combustion chamber disposed
 within a front end portion of said shell with the ex-
 terior of said combustion chamber being spaced
 from the interior of said shell to permit the passage 50
 of air to be heated along the exterior of said com-
 bustion chamber and out of the opening at the
 front end of said shell, said combustion chamber
 being provided with an outlet opening at the front
 end thereof for exhausting hot gas along with the 55
 heated air from the space between the interior of

said shell and the exterior of said combustion
 chamber;

a burner tube extending centrally into a rear end por-
 tion of said combustion chamber and having an
 open outlet end in communication with the interi-
 or of said combustion chamber, said burner tube
 being provided with a transversely extending
 flange member secured to the rear end of said
 combustion chamber for compelling fluid entering
 the rear end of said combustion chamber to flow
 through said burner tube and for supporting said
 burner tube on said combustion chamber;

a burner head secured to the rear end of said burner
 tube and being provided with an aspirator nozzle
 coaxial with said burner tube, said nozzle having a
 primary air passage for receiving primary air from
 said pump and projecting such air from an orifice
 at the front end of the nozzle at high velocity, said
 nozzle also having an oil passage for receiving oil
 from said tank and delivering such oil to said ori-
 fice to be projected therefrom as an atomized
 spray, said burner head being additionally pro-
 vided with auxiliary air inlets adjacent its
 periphery and interior guide surfaces for swirling
 the auxiliary air passing through such inlets and
 moving forwardly from the burner head into the
 rear of said burner tube; and

a flame retention head of thin material mounted in
 said burner tube, said material being formed into a
 generally conical section coaxial with said burner
 tube and having a large end the diameter of which
 corresponds to the inner diameter of said cylindri-
 cal member and a small end defining an unob-
 structed opening facing the outlet end of said noz-
 zle, said flame retention head having a ring of
 regularly spaced holes therethrough at a location
 close to but spaced from the large end of said con-
 ical section and the material of said conical section
 being slit longitudinally from at least some of said
 holes to the small end of the conical section, por-
 tions of the material of said conical section each
 bound by an edge of one of said slits and by an
 inclined bend line converging toward such edge
 from the small end of the conical section being
 bent outwardly along said bend lines to form
 vanes, all of said vanes having inner surfaces
 inclined in the same direction about the axis of the
 head for imparting a swirling motion to auxiliary
 air passing along said surfaces and into the interior
 of the flame retention head.

6. A heater according to claim 5 wherein said guide
 surfaces in said burner head and said vanes of said
 flame retention head are so arranged that the rota-
 tional direction of auxiliary air swirling motion imparted by
 each is the same.

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