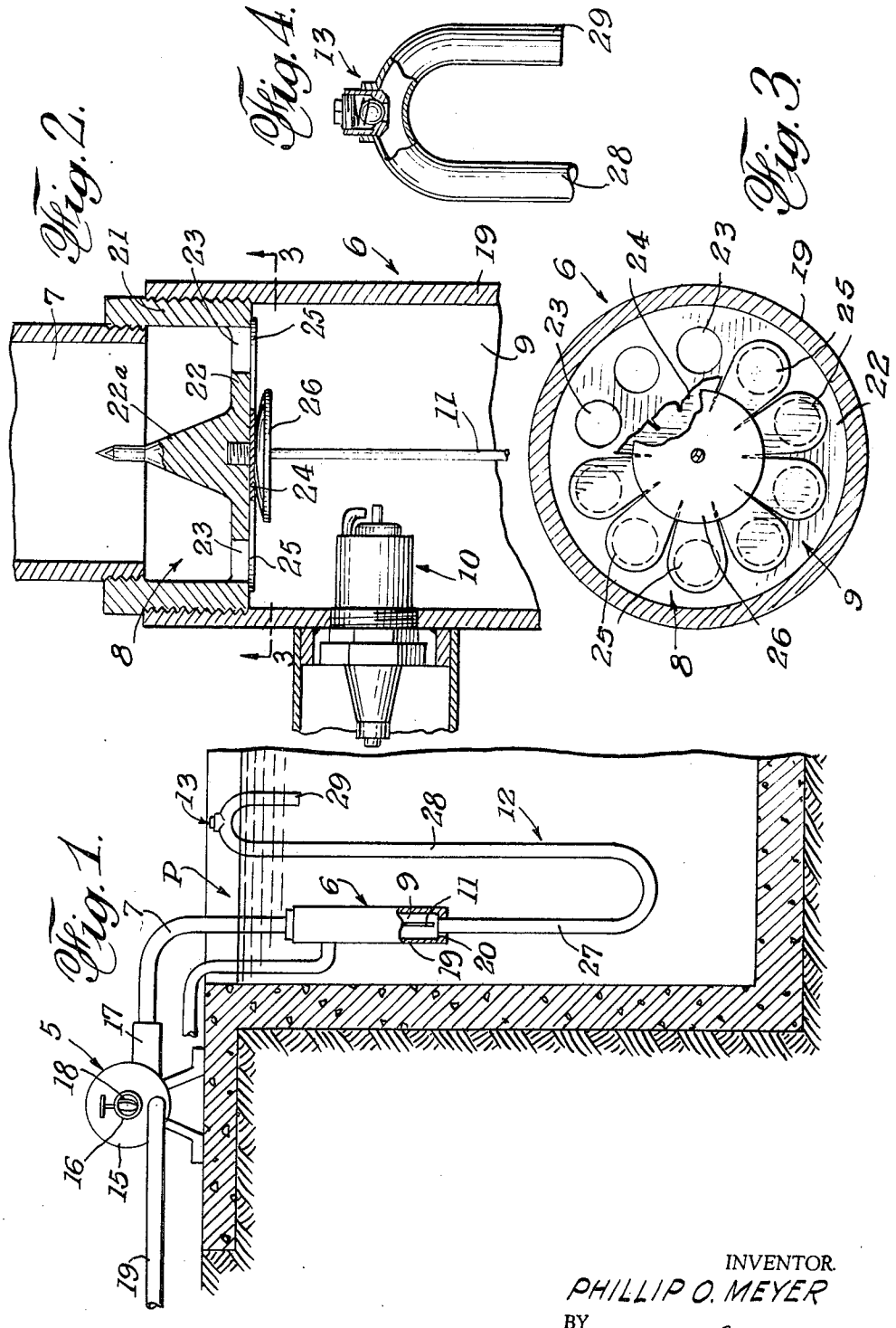
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MEANS FOR HEATING A BODY OF LIQUID

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MEANS FOR HEATING A BODY OF LIQUID

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ABSTRACT OF THE DISCLOSURE

A blower to conduct a regulated flow of gaseous fuel to a combustion unit submerged in a body of fluid, a reed-type check valve interposed in said flow at the inlet to a combustion chamber in said unit, an igniter in the outlet side of the check valve which, by igniting the fuel in said chamber beyond said valve, explodes the same to produce a closing pressure on the valve followed instantly by sudden expansion of the gases which, thereby, are propelled along a conduit extending first downwardly in the body of liquid, then upwardly therein and terminating at the surface in a vacuum breaker, and an instantaneous condition of vacuity in the chamber being caused by reaction at the inner side of the reed valve, opening the same, such actions and reactions being repeated two to three hundred times per second.

BACKGROUND OF THE INVENTION

The primary object of the invention is to rapidly and with high caloric efficiency heat large bodies of water as, for instance, swimming pools.

Another object of the invention is to provide a heater, as characterized, that operates with a hydrogen-containing fuel which yields water as a product of combustion and in which, at atmospheric pressure, the lower pressure of the water vapor of said fuel in combustion ordinarily forms a condensate when the temperature is allowed to fall below 120° to 140° F., thereby causing liberation of the heat of vaporization of the condensate.

Corollary to the foregoing, it is a further object of the invention to heat large bodies of water or other liquids at a high caloric efficiency, i.e., above 90% of the high heat value of the fuel.

The invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description, which is based on the accompanying drawing. However, said drawing merely shows, and the following description merely describes, one embodiment of the present invention, which is given by way of illustration or example only.

SUMMARY OF THE INVENTION

The invention comprises, generally, fuel-feeding means **5**, a burner or combustion unit **6** connected by a conduit **7** with the outlet of said means **5** and submerged in a swimming pool P, a reed-type check valve **8** controlling flow from said conduit to the combustion chamber **9** of said unit, an igniter **10** in the chamber **9** downstream of the valve **8**, a combustion-maintaining member **11**, a submerged outlet conduit **12** for the combustion gases generated in the chamber **9**, and a vacuum breaker **13** provided in said conduit.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing, like reference characters designate similar parts in the several views.

FIG. 1 is a fragmentary vertical sectional view of a swimming pool showing the present means for heating the water therein.

FIG. 2 is an enlarged fragmentary longitudinal sectional view of the fuel inlet and firing portion of the combustion unit of said means.

FIG. 3 is a cross-sectional view as taken on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary and partial sectional view of the outlet end of the gases of combustion of the means shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The fuel-feeding means **5** is presently shown as a blower **15** with a regulated air inlet **16** and an outlet **17** to the conduit **7**. The regulation of the inlet **16** may be effected, as by a damper **18**. A source of gaseous fuel is represented by the conduit **19** that enters the blower **15** for admixture with the air drawn thereinto through the inlet **16**. Natural gas, i.e., a mixture of the low molecular weight paraffin series hydrocarbons, of which methane, propane and butane are prime examples, may be used as a fuel. Since the exact composition of natural gas varies with locality, the same will be understood to be the type that is ordinarily used directly as a fuel.

The fuel combustion unit **6** is shown as comprising a tubular housing **19** which encloses the sides of the chamber **9**, the mentioned check valve **8** closing said chamber at its upper end, and the chamber being open at its lower end **20**.

The valve **8** is connected to the lower end of the conduit **7** and is shown as comprising a tubular wall **21**, a bottom wall **22** provided with a plurality of ports **23** preferably circularly arranged about the axial center of the wall **21**, and on which is provided a diverter **22***a* that directs the flow of fuel to the ports **23**, a reed unit **24** applied to the under face of said wall and formed to have flexible reed flaps **25** in register with each port **23**, and a backup plate **26** to hold the reed unit **24** in operative position and limit the fluctuations or vibrations of the reed flaps **25** relative to said under face of wall **21**. The elasticity of the reed flaps **25** is such that the same will normally flex downwardly under whatever regulated pressure is provided in the flow of fuel in the conduit **7**. Also, the blower size should be large enough to enable the setting of the theoretically correct amount of air for complete combustion of the fuel which passes through the valve ports **23** into the combustion chamber **9**, as above explained.

The igniter **10** is shown as a spark plug, which is preferred, but may comprise a glow plug or other high heat device that generates heat suitable to cause explosive combustion of the fuel entering said chamber **9**, thereby causing sudden expansion of the fuel charge due to its instant change to a heated state. As a result, the pressure of said burning charge being equal in all directions, instant closing of the ports **10** will be caused due to pressure from below on the reed flaps **25**. The resultant movement of the burning charge is downward in the leg **27** of the outlet conduit **12**. This combustion may be maintained by the metallic rod or wire **11** as the charge travels downwardly in the combustion chamber **9**. These heated gases, under their high impetus downwardly, cause a lowering of pressure in said chamber below that of the pressure in the feed conduit **7**. Such reactive vacuum is instantaneous and causes a downward inhalation through the ports **23** due to the downward flutter movement of the reed flaps

25. The principle of operation of the present burner **6** is similar to that of a supercharged pulse-jet engine with the combustion chamber submerged in the liquid to be heated and the discharging of its burnt gases under the surface of said liquid. The intermittent or pulsatng thrust of the reed valve flaps **25** has a per-second rate approximately between 200 to 300 times.

The outlet conduit **12**, at the lower end of the downward leg **27** thereof, is extended as an upward leg **28** which has a downwardly turned discharge end **29** that is immersed in the pool water.

The vacuum breaker **13** is provided in a portion of the conduit **12** that is above the level of the water, so the same may discharge to atmosphere. Such a device is here shown as a spring check valve in the mentioned end **29**. This valve, because it discharges above the water level, keeps water from reaching the combustion chamber when the heater is out of operation. The same also serves as a diverter to insure discharge of the hot gases from the end **29** of the conduit **12** below the water level.

The burner is preferably adjusted to discharge its pulsations of the gases of combustion into the water when the same have cooled to about 130° F. when reaching the atmosphere, whereby the water vapor in the products of combustion is cooled sufficiently to condense to a liquid state to gain the high heat value of combustion as set forth in the objects above.

It will be understood that the operation of the burner does not require the pressure of a blower, as the blower **5**, since the pulsating characteristics of the burner provide for an inhalation of fuel into the combustion area from the conduit **7**. Use of such a blower serves to increase fuel burn rate and makes for easy starting, fuel control, and ease of operation.

While the foregoing has illustrated and described what is now contemplated to be the best mode of carrying out the invention, the construction is, of course, subject to modification without departing from the spirit and scope of the invention. Therefore, it is not desired to restrict the invention to the particular form of construction illustrated and described, but to cover all modifications that may fall within the scope of the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. Means for heating a body of liquid comprising:
   (a) a burner submerged in said body of liquid and having a combustion chamber,
   (b) a fuel line for conducting a gaseous fuel chosen from the group consisting of natural gas, methane, propane and butane, from above the level of the liquid to the upper submerged end of the burner,
   (c) a plurality of ports communicating said fuel line and the combustion chamber,
   (d) flexible reed flaps operatively associated with said ports on the combustion chamber side of the ports,
   (e) an igniter in the combustion chamber to explode and, thereby, expand a charge of fuel in the combustion chamber to create port-closing pressure on the reed flaps and simultaneous propulsion of the gases of combustion downwardly in the combustion chamber, followed by creation of a condition of lowered pressure in the combustion chamber causing reactive movement of the reed flaps and opening of the ports to such lowered pressure and an inhalation flow of a subsequent charge of fuel into said chamber, and
   (f) a conduit to conduct the gases of combustion first downwardly in said body of water, and then upwardly to discharge into said water below and adjacent the level thereof, to heat the same,
   (g) said conduit being provided with
      (1) a downwardly directed leg,
      (2) an upwardly directed extension on said leg,
      (3) a downwardly turned discharge end on the extension,
      (4) the connection between the extension and the discharge end being disposed above the level of the liquid, and
      (5) a vacuum breaker in said connection.

2. A burner adapted for submergence in a body of liquid, provided with an igniter, connected at one end to a line for feeding gaseous fuel to the burner for ignition thereof by said igniter and connected at the other end to a conduit to conduct the gases of combustion outwardly of the burner into said body of liquid, said burner comprising:
   (a) a combustion chamber in which said igniter is disposed, and
   (b) a check valve interposed between the mentioned fuel and the upper end of the combustion chamber above the igniter, said valve comprising:
      (1) a transverse wall having a plurality of ports through which the fuel from said line enters the combustion chamber, and
      (2) a plurality of flexible reed flaps operatively and independently associated with each of said ports on the combustion chamber side thereof.
   (c) the igniter being adapted to explode and, thereby, expand a charge of fuel that enters the combustion chamber through said ports, such expansion creating port-closing pressure on the reed flaps and simultaneous propulsion of the gases of combustion downwardly in the combustion chamber, followed by creation of a condition of lowered pressure in the combustion chamber causing reactive movement of the reed flaps and opening of the ports to such lowered pressure and an inhalation flow of a subsequent charge of fuel in the combustion chamber,
   (d) the gases of combustion of the exploded fuel entering the above-mentioned conduit.

3. A burner according to claim **2**, in which a combustion-sustaining member is provided within the combustion chamber to promote continued combustion of the fuel during its progress downwardly therein.

4. A burner according to claim **3**, in which the combustion-sustaining member extends from the mentioned wall of the check valve downwardly to and terminating above the lower end of the burner.

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