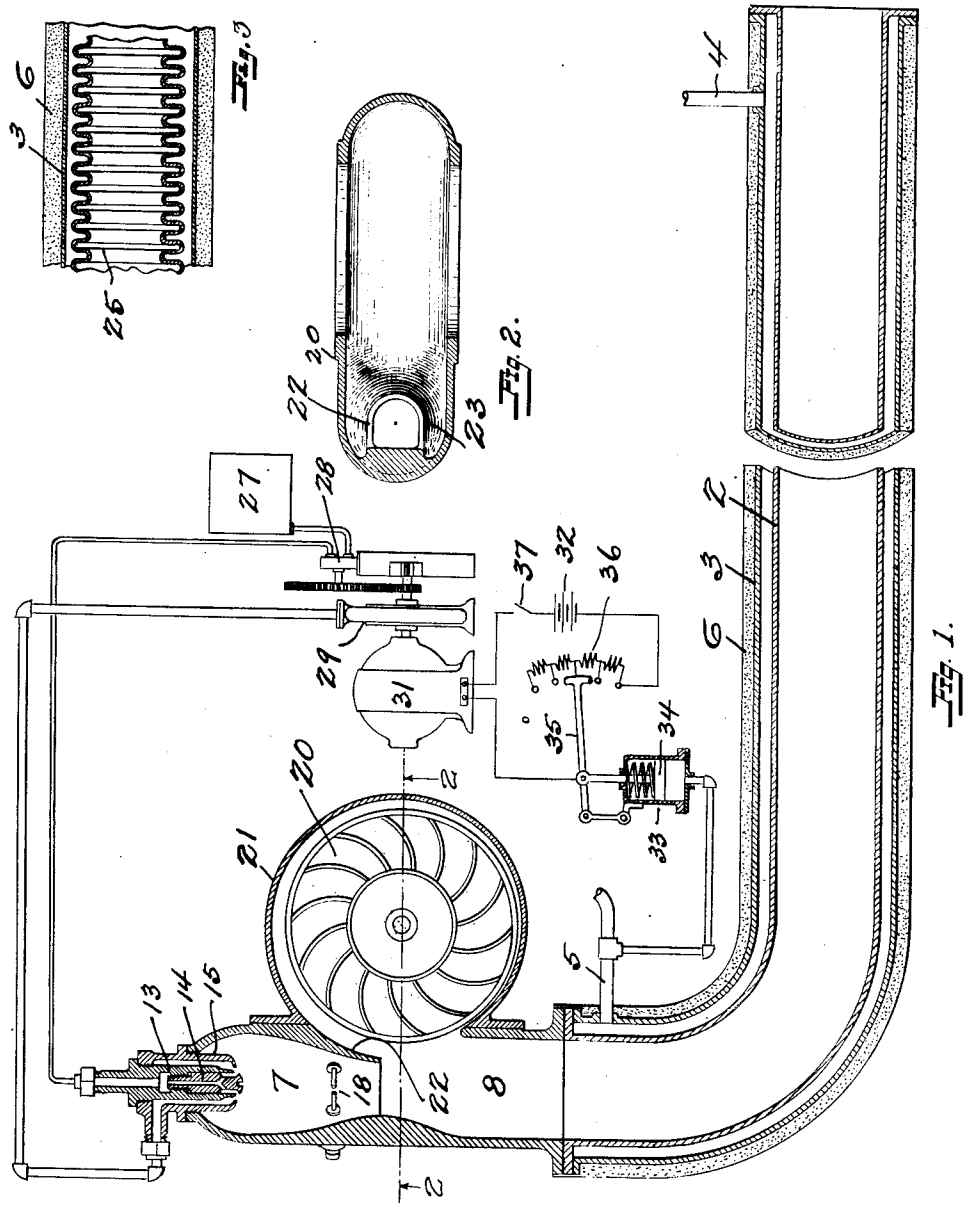
W. A. AND J. A. DOBLE.

FLUID HEATER.

APPLICATION FILED MAR. 2, 1917.

1,395,399.

Patented Nov. 1, 1921.



WITNESSES:

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FLUID-HEATER.

1,395,399. Specification of Letters Patent. Patented Nov. 1, 1921.

Application filed March 2, 1917. Serial No. 151,927.

To all whom it may concern:

Be it known that we, WILLIAM A. DOBLE and JOHN A. DOBLE, citizens of the United States, and residents of the city and county of San Francisco and State of California, have invented a certain new and useful Fluid-Heater, of which the following is a specification.

The invention relates to fluid heaters and particularly to fluid heaters such as steam generators, water heaters and air heaters, employing liquid or gaseous fuel as the heating medium.

An object of the invention is to provide a fluid heater in which the actual combustion of the fuel occurs in thermal contact with the heat-absorbing medium.

Another object of the invention is to provide a steam generator which is particularly applicable for use in automobiles, aeroplanes, submarines and other vehicles.

Another object of the invention is to eliminate the fire box in a fluid heater burning liquid fuel.

The invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description where we shall outline in full that form of the invention which we have selected for illustration in the drawings accompanying and forming part of the following specification. In said drawings we have shown one specific form of our generic invention and several modifications thereof, but it is to be understood that we do not limit ourselves to such form, since the invention as expressed in the succeeding claims may be embodied in a plurality of forms.

Referring to the drawings:

Figure 1 is a vertical section of one form of fluid heater of our invention, the fuel and air-feeding means being shown diagrammatically.

Fig. 2 is a cross section taken on the line 2—2 Fig. 1, the blower fan being omitted.

Fig. 3 is a section of a fragment of a modified form of heater.

In the drawings we have shown the invention embodied in a steam generator and shall so describe it in the specification, but it is to be understood that the invention is not limited to steam generators.

The generator of our invention comprises a steam generating unit and means for producing a flame in said unit so that the combustion of the fuel occurs within the steam generating unit. Heretofore, steam generators have been provided with fire boxes in which combustion of the fuel is substantially complete and the hot products of combustion have passed into thermal contact with the heat-absorbing medium. In the present construction, the fire box is eliminated and the actual combustion of the fuel occurs in direct thermal contact with the heat-absorbing medium. This not only eliminates the fire box, which on account of its weight is an objectionable feature in steam generating plants for vehicles, but produces a more efficient generator and one in which steam can be initially generated extremely quickly. Fire boxes are usually lined with refractory brick, which when the fire is first started, absorb a large amount of heat retarding the initial generation of steam. Further, when the brick becomes hot, it gives off its heat when the feed of fuel is reduced and thereby prevents an accurate control of the fire due to steam conditions within the boiler. In accordance with our invention, we eliminate the fire box and introduce the combustible mixture directly into the device containing the heat-absorbing medium.

The heat absorbing unit or steam generating unit, as the case may be, consists in one embodiment of the invention, of a long tube 2 of sufficient strength to withstand the pressure to which it is exposed. The diameter and length of the tube will be determined by the amount of power it is desired to generate and by the conditions of installation. In automobile use it is evident that the length of the tube, if disposed in a straight line, should be less than the length of the vehicle. Surrounding the tube 2, preferably for its entire length, and spaced apart therefrom, is an outer tube or jacket 3, which is sealed at its ends to the inner tube 2, thereby forming a long, annular chamber surrounding the inner tube. This chamber is provided at its end adjacent the outlet of the inner tube 2, with a water inlet pipe 4, through which the feed water is forced in any desirable manner. At the end of the chamber adjacent the inlet of the tube 2, is a

steam discharge pipe 5. The outer tube 3 is entirely surrounded by a jacket 6 of heat-insulating material.

Means are provided for blowing a combustible mixture directly into the inner tube. Connected to the end of the tube is a device for producing and igniting a fuel spray and for blowing the resultant mixture into the tube wherein it is burned. This device may assume a plurality of forms and in the present embodiment comprises a casing including a fuel atomizing and ignition chamber 7 and an air-mixing chamber 8, which is connected directly to the steam generator. The fuel atomizing chamber 7 is provided with a liquid fuel nozzle, which in the present instance comprises a shell 13 into which the nipple 14 is screwed, the nipple being provided with a fuel passage opening on the side therein within the shell and adjacent the end thereof. The nipple is narrowed adjacent its outer end to form an annular chamber within the shell, and a head on the nipple forms, with the end of the shell, an annular nozzle, the area of which is adjustable by screwing the nipple in the shell. Liquid fuel in measured quantity is fed under pressure from the supply tank 27 to the liquid fuel nozzle by the measuring pump 28, which is preferably of the gear type. Surrounding the shell and spaced thereform whereby an annular chamber is formed, is a sleeve 15 which terminates in an inturned lip adjacent the end of the shell, and forms an annular nozzle surrounding the fuel nozzle and in atomizing relation therewith. Air under pressure is forced into the sleeve, whence it discharges, blowing the fuel into a spray. The spray-producing air is obtained from the high pressure blower 29. Arranged in the path of the fuel spray produced by the air and fuel nozzles is an electric ignition device 18 comprising two insulated electrodes connecting to the terminals of a transformer or induction coil having a make-and-break device in the primary circuit. A spark between the electrodes ignites the fuel spray. Supplementary air is supplied to the resultant flame to form a combustible mixture at a point in front of the ignition device, so that the spray is not diluted until after it is ignited. The supplementary air is supplied to the mixing chamber 8 by the low pressure blower 20 which is preferably arranged immediately adjacent the mixing chamber. In the present construction we have shown the blower housing 21 secured directly to the mixing chamber housing and the blower is arranged to blow air into the mixing chamber in the direction of the steam generator. Means are provided for causing the supplementary air supplied by the blower to contact with the flame on all sides without materially distorting the flame or blowing it toward one side of the mixing chamber. The outlet of the spraying and ignition chamber is constricted somewhat by a hood 22, which divides the blower chamber from the ignition chamber and directs the air in a smooth curve into the mixing chamber. The hood is spaced from the wall of the mixing chamber at the top and sides and forms a horseshoe shaped passage 23 through which the air is blown into the mixing chamber. The ignited spray issues from under the hood and the auxiliary air contacts with the flame on all sides, thereby producing complete combustion without materially distorting the flame. Means are provided for synchronously driving the low pressure blower 20, the high pressure blower 29 and the fuel-measuring pump 28, so that the speeds of these three devices always correspond and so that the relative proportions of fuel and air always remain constant, and these proportions are originally adjusted to produce a fuel mixture which burns with perfect combustion. In the present instance the two blowers and the fuel pump are driven by a motor 31 which is furnished with current from a suitable source of supply, such as a storage battery 32.

Means are provided for varying the speed of the blowers and pump in accordance with variations in conditions of the heat-absorbing medium, in the present instance in accordance with variations in steam pressure in the steam generator. Connected to the steam discharge pipe 5 is a cylinder 33 having a spring-loaded piston 34 therein, which is connected to the rheostat arms 35. The rheostat 36 is in the motor circuit and is so arranged that a movement of the rheostat arm due to an increase in steam pressure in the boiler, produces a reduction in the speed of the motor, and vice versa. A switch 37 in the battery circuit serves to start or stop the motor when desired. By this arrangement, a perfect combustible mixture is always produced, which is blown into and burned in direct thermal contact with the heat-absorbing medium and the amount of mixture introduced in a given time is dependent upon conditions of the heat-absorbing medium.

The combustible mixture-producing device is preferably arranged vertically and the main portion of the generating unit horizontally, the forward end thereof being turned upwardly to meet the mixture-producing device. This arrangement is particularly adapted to automobiles, wherein the mixture-producing device may be arranged under the hood and the steam generating unit may extend under the car in the direction of its length. For this use the tubes may be of small diameter, so that the generating unit will occupy a small space. By

turning the forward or hottest end of the generating unit upward, a steam chamber is provided within the unit.

In Fig. 3 we have shown a modified form of generator in which the inner tube is formed of a longitudinally corrugated tube 25 which, on account of its deep corrugations, presents an increased area to the flame and to the heat-absorbing medium, thereby producing a generator of increased capacity in proportion to its length. The fluid spaces between the successive corrugations are small, so that a small amount of fluid is contained therein and the area of this small amount of fluid in contact with the tube is great, so that the fluid is rapidly heated. The corrugations also serve to produce swirls and eddies of flame and hot gases within the tube, thereby retarding the discharge of the gases therefrom. The cold fluid is introduced into the generator at the discharge end of the tube and progresses toward the hot end, so that the flame and gases come successively in contact with colder surfaces, resulting in very efficient thermal conditions. While we have described the combustible mixture producing device in connection with liquid fuel, it is to be understood that it may be used with gaseous fuel.

Subject matter disclosed, but not claimed, in this application, is claimed in applicant's co-pending application Serial No. 151,928, filed simultaneously herewith, and it is understood that such subject matter is not disclaimed, abandoned or dedicated to the public.

We claim:

1. A fluid heater comprising a long tube, a jacket surrounding and spaced from said tube and forming with said tube a fluid containing and heating chamber, means for producing a fuel flame and directing it into one end of said tube whereby the products of combustion pass through said tube longitudinally and discharge from the opposite end thereof, a housing connecting the tube and said fuel flame producing means, a fluid inlet pipe connected to the chamber adjacent the gas discharge end of the tube and a heated fluid outlet pipe connected to the chamber at the flame inlet end of the tube.

2. A fluid heater, comprising a long horizontally disposed tube having an upturned inlet end, a jacket surrounding and spaced from said tube and forming therewith a fluid heating chamber, a fluid outlet connected to the upturned portion of said chamber and means for producing a fuel flame in said tube.

3. A fluid heater, comprising a long tube having an upturned inlet end, a jacket surrounding and spaced from said tube and forming with said tube a fluid heating chamber having an upturned end, a heated fluid outlet pipe connected to the upturned end of said chamber, a cold fluid inlet pipe connected to the other end of said chamber, and means for introducing a fuel flame downwardly into the upturned end of said tube.

4. The combination with means adapted to receive a heat-absorbing medium, of means for measuring and feeding fuel and atomizing said fuel, means for feeding air to the atomized fuel and blowing the mixture directly into said heat-absorbing medium containing means wherein it is burned, and means for synchronously driving said fuel-measuring means and said air-feeding means.

5. The combination with a steam generator, of a liquid fuel spray nozzle, a pump for forcing fuel through said nozzle, means for igniting the fuel spray, a blower for adding air to the ignited spray to produce complete combustion and blow the ignited mixture into the steam generator wherein the mixture is burned, and mechanism responsive to changes in steam pressure in the generator for simultaneously varying the speed of the pump and the blower.

6. The combination with means adapted to receive a heat-absorbing medium, of a fuel-mixing device attached thereto, means for measuring and feeding the measured quantity of fuel to said device, means for atomizing said fuel, and means driven synchronously with said fuel-measuring means for adding air to the atomized fuel and blowing the mixture directly into said heat-absorbing medium containing means wherein combustion of the mixture occurs.

In testimony whereof, we have hereunto set our hands at San Francisco, California, this 21st day of February, 1917.

WILLIAM A. DOBLE.
JOHN A. DOBLE.

In presence of—
T. H. MORGAN,
WILLIAM A. DOBLE, JR.