

Sept. 19, 1944.

J. P. BROSIUS

2,358,302

SUBMERGED BURNER

Filed Jan. 17, 1941

2 Sheets-Sheet 1

Fig. 1

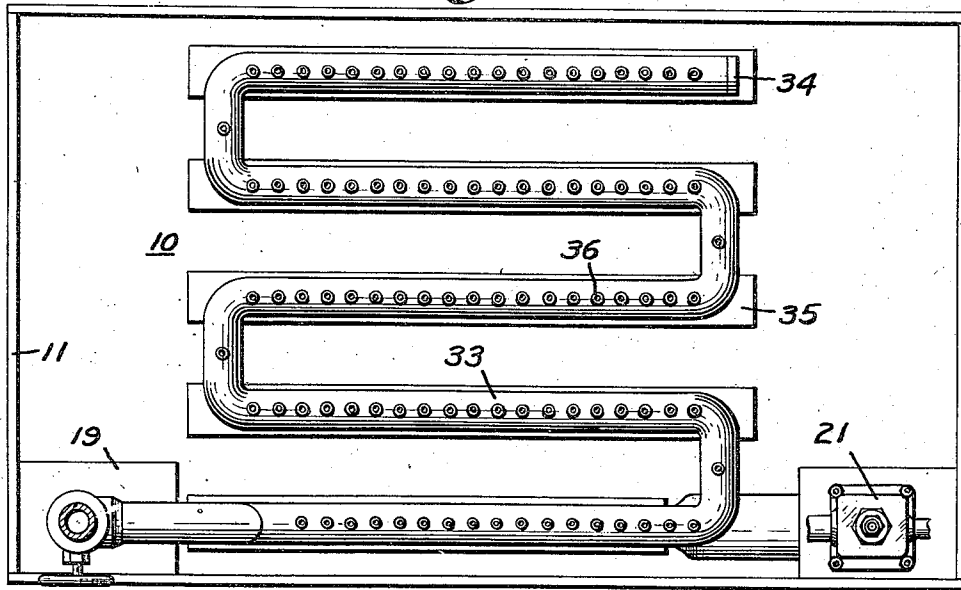
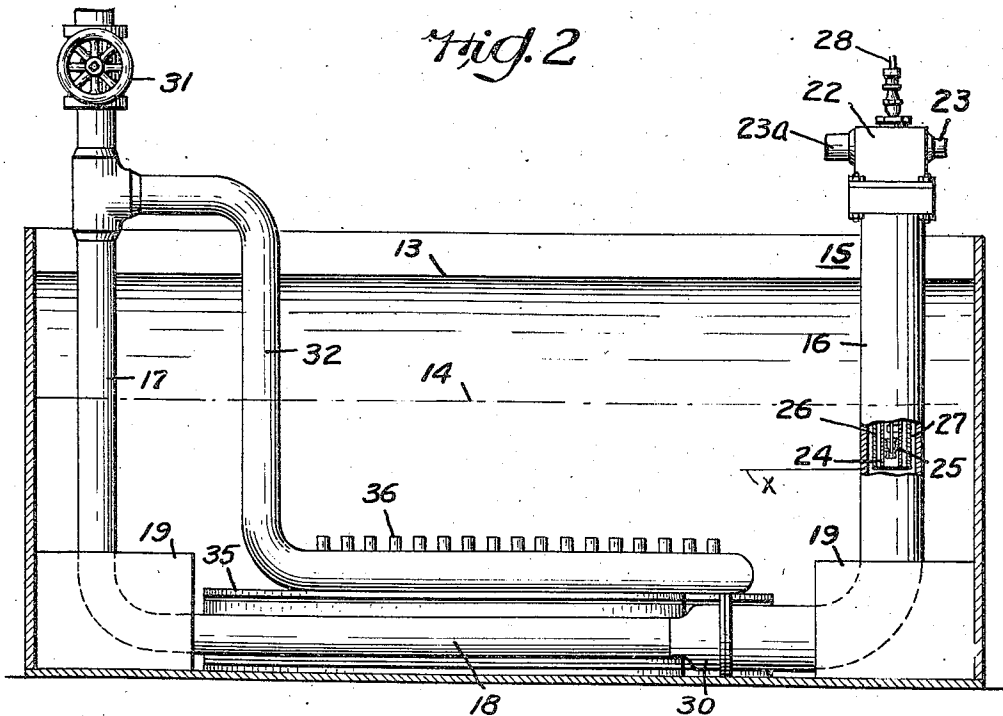


Fig. 2



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Fig. 3

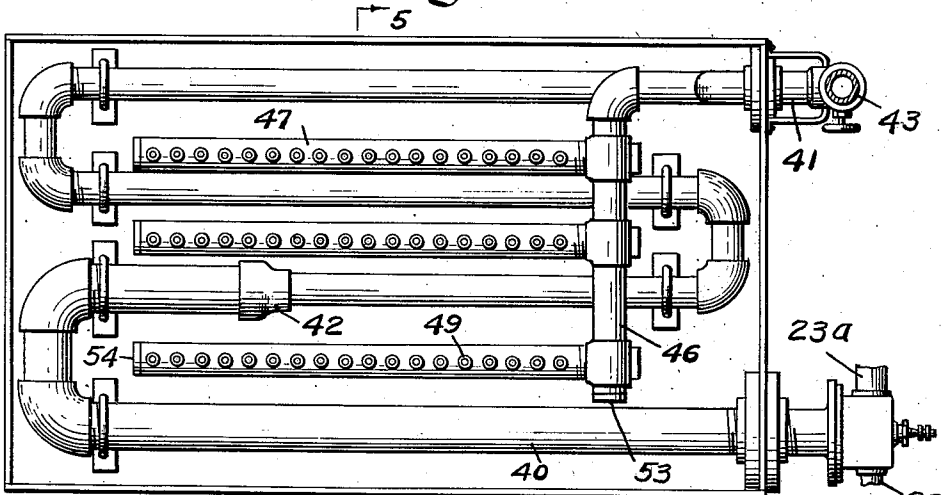


Fig. 4

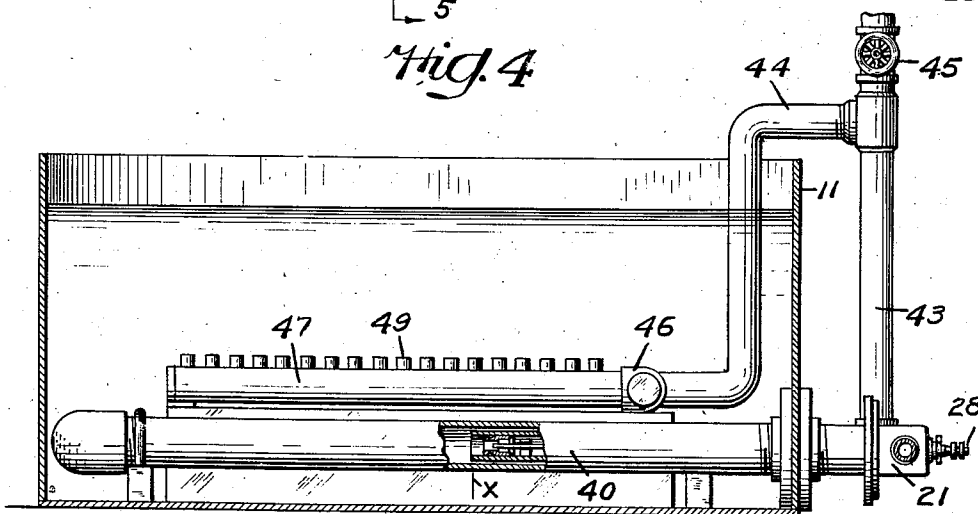


Fig. 5

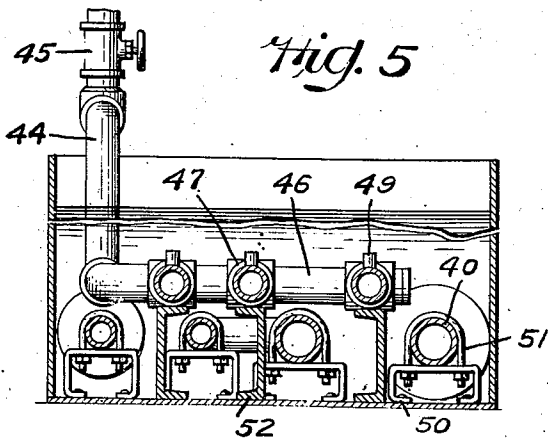
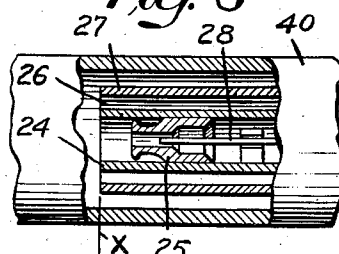


Fig. 6



INVENTOR

JOHN P. BROSIUS

BY

W. L. Sullivan

ATTORNEY

UNITED STATES PATENT OFFICE

2,358,302

SUBMERGED BURNER

John P. Brosius, Pittsburgh, Pa.

Application January 17, 1941, Serial No. 374,832

7 Claims. (Cl. 126—360)

This invention relates to a novel submerged combustion burner.

Submerged combustion burners of the type herein described are used for heating liquids of various kinds. In certain uses such as for heating pickling baths controlled agitation is desired since it is well known that such agitation materially assists the pickling operation. Also, a burner of this type should be of rugged construction to withstand severe usage and simple in design while being efficient and economical in operation. Further, it should require a minimum of service and be operable by ordinary plant personnel.

Another object of the invention is to provide an improved submerged type combustion burner.

A further object of the invention is to provide a submerged combustion burner for heating liquids wherein the escape of combustion gases beneath the liquid surface can be accurately controlled to effect a controlled agitation of the liquid.

According to the invention the burner disposed in a tank of liquid comprises a tube adapted to have pre-mixed gaseous or vapor fuel admitted at one end and the fuel is ignited at a point below the normal liquid level. The opposite end of the tube extends above the liquid level and is provided with an exhaust valve. Beneath the exhaust valve a second tube communicates with the first tube, the second tube having a portion extending preferably horizontally in the bottom portion of the liquid. This portion has a closed end and is provided with spaced discharge ports whereby combustion gases can be discharged directly into the liquid. The exhaust valve is employed to control the amount of combustion gases passing to the second tube and since the gases escaping into the liquid from the discharge ports causes agitation of the liquid the exhaust valve affords a means of accurately controlling the liquid agitation.

The burner is designed to operate under high back pressure which permits the use of long combustion chambers and heating coils, of relatively small cross-sectional area.

The invention will be readily understood from the following description and drawings wherein:

Fig. 1 is a plan view of a liquid receiving tank having my improved burner mounted therein.

Fig. 2 is an elevational view of the apparatus of Fig. 1 with the front wall of the tank removed for clearness of illustration.

Fig. 3 is a plan view showing a modified form of burner.

Fig. 4 is an elevational view of the apparatus of Fig. 3 with the front wall removed.

Fig. 5 is a section along line 5—5 of Fig. 3, and

Fig. 6 is an enlarged fragmentary view, partially in section, showing the flame retention and igniting means.

Referring now to the drawings, the burner generally indicated at 10 is mounted within a tank 11 adapted to contain a liquid to be heated. The normal level of the liquid is indicated at 13 and the minimum liquid level at 14. The liquid may be water, a pickling solution or the like and for convenience I will describe the invention in connection with a pickling solution.

A generally U shaped tube 15 comprises vertical legs 16 and 17 and a horizontally extending portion 18. The burner may be supported in any suitable manner as by blocks 19 secured to the tank base and the legs 16 and 17.

A burner unit generally indicated at 21 is adapted to supply pre-mixed gaseous or vapor fuel to leg 16. Any suitable burner unit may be used but I preferably employ a burner unit as more fully shown and described in United States Patent 2,138,998 issued to me December 8, 1938. The burner unit comprises a housing 22 having a plurality of non-communicating chambers therein. Pre-mixed fuel under variably controllable pressure is fed to one of said chambers from a supply line 23 and from said chamber to a central tube 24. Tube 24 preferably has a flame retention nozzle 25 disposed adjacent the lower end thereof. Pre-mixed fuel from a second source 23a is supplied to another chamber of housing 22 and thence to a passage 26 formed intermediate central tube 24 and an encircling spaced tube 27. As described in the above mentioned patent a burner unit of this type provides a flame of maximum heating value over a wide thermal output and temperature range.

Pre-mixed fuel will be delivered either from tube 24, passage 26, or both and combustion will initiate when the fuel is ignited at a zone indicated by the line X. I preferably employ electrically operable ignition means wherein a central electrode 28 terminating at its lower end within the flame retention nozzle 25 will have high voltage current applied thereto causing a fuel igniting spark to occur between electrode 28 and the flame retention nozzle which is suitably grounded. The ignition means illustrated is more fully described in my co-pending application Serial Number 277,527 filed June 5, 1939. It is understood that the particular burner unit and ignition

means constitutes no essential part of my invention and any desired apparatus may be used.

The combustion gases are led from leg 16 to portion 18 which is preferably reduced in cross-section by a reducing nipple or the like 30. The gases then traverse upstanding leg 17 and a portion of the gases may be vented to atmosphere through an exhaust valve 31. The un-vented gases will be carried downwardly into the solution through a tube 32. Tube 32 may be of any desired shape to provide efficient distribution of gases through the liquid and discharge of same beneath the liquid level. In the present instance, the tube 32 extends downwardly to a generally serpentine horizontal portion 33 closed at the end 34 thereof. The portion 33 may be supported in any suitable manner as by I sections 35 resting on the tank base. Horizontal portion 33 is provided with a plurality of exhaust or discharge tips 36 therealong, the number and spacing of said tips being dependent upon the distribution of gases desired. Also, it is understood that the horizontal portion 33 may be altered in shape as best suited for operating conditions with a particular tank.

The gases discharged into the liquid or solution through tips 36 will cause agitation of the liquid. The degree of agitation will be dependent upon the pressure of the gases issuing from tips 36 or upon the relative amount of gases passing to tube 32. The unit is designed to operate under high back pressure and with valve 31 closed the entire amount of combustion gases will be discharged into the liquid and by further regulation of valve 31 a desired proportion of the gases will be vented directly to atmosphere. The control of the gases in this manner is an important feature of the invention and provides a very sensitive regulation of the amount or degree of liquid agitation.

Due to the fact that high back pressures are used the combustion chambers and heating coils may be relatively long and of relatively small cross-sectional area.

Although I have shown round tubes it is understood that the tubes may be of any desired cross-section such as oval, square, or rectangular. I have shown tubes 15 and 32 as lying in a common vertical plane but it is understood that tube 32 may be rotated angularly relative to tube 15 to dispose the horizontal portion 33 thereof in a desired position as best determined by operating conditions.

The operation of the unit will now be described. Premixed fuel such as gas and air under a desired pressure will be delivered from burner unit 21 to central tube 24 and passed through flame retention nozzle 25. The fuel will be ignited by applying high voltage current to electrode 28 and resultant causing a spark at the flame retention nozzle and in the path of the fuel stream. If a greater thermal output is desired than that effected by fuel supplied to central tube 24, additional fuel is supplied to passage 26. Combustion will initiate substantially at the lower end of the tube 24 and hot combustion gases will be forced through the lower end of leg 16, portion 18, and upwardly through leg 17. Due to the length of the tubing described considerable heat exchange is effected during passage of the gases. If valve 31 is closed all the gases will be directed downwardly through tube 32 and then discharged into the liquid or solution through exhaust tips 36. Thus, considerable travel is imparted to the gases insuring efficient heating

of the liquid and this is supplemented by the heating effect of the hot discharged gases passing upwardly through the liquid to atmosphere.

Referring now to Figs. 3 to 6 inclusive, I have shown a modification of my invention wherein the pre-mixed gaseous or vapor fuel is fed horizontally into the tank rather than vertically. In this modification a horizontal pipe 40 is sealingly projected through a side wall of the tank and adjacent the tank base. Burner unit 21 is secured to pipe 40 externally of the tank and in a manner previously described pre-mixed fuel supplied to pipe 40 will be ignited whereby combustion will start substantially at X. Pipe 40 continues horizontally in generally serpentine form and is sealed to the tank and projected therethrough the tank as indicated at 41. A reducing nipple 42 is preferably provided to reduce the cross-sectional area of a portion of the pipe to compensate for pressure drop.

A vertically extending pipe 43 connects with pipe 40 and also with a pipe 44 formed to extend over the tank edge and downwardly into the tank.

An exhaust valve 45 disposed in pipe 43 above the point of connection with pipe 44 is adapted to control the amount of combustion gases passing to pipe 44. Pipe 44 at its lower end connects with a transverse header 46 and a plurality of longitudinally extending pipes 47 connect with header 46. Spaced discharge tips 49 are disposed along pipes 47.

Pipe 40 may be mounted on channel members 50 secured to the tank base and maintained by straps 51. Pipes 47 may be supported by channels 52 secured to the tank base. Of course, the end of header 46 is sealed as indicated at 53 as is also the ends of pipes 47 as indicated at 54.

It will be noted that in both forms of the invention that the point of connection of the pipes 32 and 44 adapted to carry the gases to a submerged discharge zone is above the maximum liquid level in the tank. Thus, when the burner is not operating any liquid entering pipes 32 and 44 through the discharge tips will not be carried back into other portions of the burner and upon start-up it is not necessary to blow liquid from such portions.

Although I have shown and described preferred forms of my invention I contemplate that numerous and extensive departures may be made therefrom without departing from the spirit of my invention and the scope of the appended claims.

What I claim is:

1. A submerged combustion burner for liquids comprising means for delivering pre-mixed gaseous or vapor fuel to a zone beneath the liquid level, means for igniting the fuel at said zone, means for conducting all combustion gases along a closed and unimpeded path beneath the liquid level and subsequently to a point above the liquid level, and means for re-conducting at least a portion of said gases from said point beneath the liquid level and discharging same directly into the liquid.

2. The combustion burner as described in claim 1 and wherein valve means are provided above said point for venting a portion of said gases directly to atmosphere.

3. The combination with a tank adapted to receive liquid of a submerged type combustion burner adapted to heat and agitate the liquid, said burner comprising means extending within the tank adapted to deliver premixed gaseous or

vapor fuel to a zone beneath the liquid level, means for igniting the fuel at said zone, means for conducting all combustion gases along a closed and unimpeded path beneath the liquid level in heat exchange relation with the liquid and subsequently to a point above the liquid level, and means for reconducting at least a portion of said gases beneath the liquid level and discharging same directly into the liquid.

4. The combination as described in claim 3 and wherein the discharge means comprises a plurality of spaced horizontally disposed discharge tips.

5. A submerged combustion burner for heating liquids comprising a generally U shaped tube having its end portions projected above the liquid level and sealed against liquid entry, means for supplying pre-mixed gaseous or vapor fuel under high pressure to one leg of said tube, means for delivering the fuel to a point beneath the liquid level, means for igniting the fuel at said point, a second generally L shaped distributing tube connected to the opposite leg of the first tube above the liquid level, said L tube having a horizontally extending portion adapted to be disposed in the bottom portion of the liquid, said L tube having a closed end and plurality of ports therealong for discharging combustion gases directly into the liquid, and an exhaust valve in the U tube beyond the point of connection with the L tube for venting combustion gases directly to atmosphere.

6. The combination with a tank adapted to receive liquid of a submerged type burner for heating and agitating the liquid, said burner comprising a closed conduit extending beneath the liquid level in serpentine form and terminating at

one end above the liquid level, a second conduit having an unimpeded passage therethrough connected to the first conduit at said end above the liquid level and extending in serpentine form beneath the liquid level, said second conduit having a plurality of discharge ports therealong, means for supplying pre-mixed gaseous fuel to the first conduit, means for igniting said fuel, and valve means for controlling the amount of combustion gases passing from the first conduit to the second conduit.

7. The combination with a tank adapted to receive liquid to a pre-determined level of a submerged type burner for heating and agitating the liquid, said burner comprising a first closed conduit means extending beneath the tank liquid level and with the end portions thereof extending above the tank liquid level whereby said first conduit means is continuously sealed against the entry of liquid thereto, means for supplying pre-mixed gaseous or vapor fuel to the first conduit means at one end portion thereof, means for igniting said fuel beneath the liquid level whereby combustion gases may be conducted through the first conduit means without impedence and in heat exchange relation with the liquid to the other end portion, a second conduit means communicating with said other end portion of the first conduit means above the tank liquid level, the second conduit means extending beneath the liquid level and having ports therein for discharging combustion gases directly into the liquid, and valve means for controlling the relative amount of combustion gases passing to the second conduit means from the first conduit means.

JOHN P. BROSIUS.