

Sept. 11, 1956

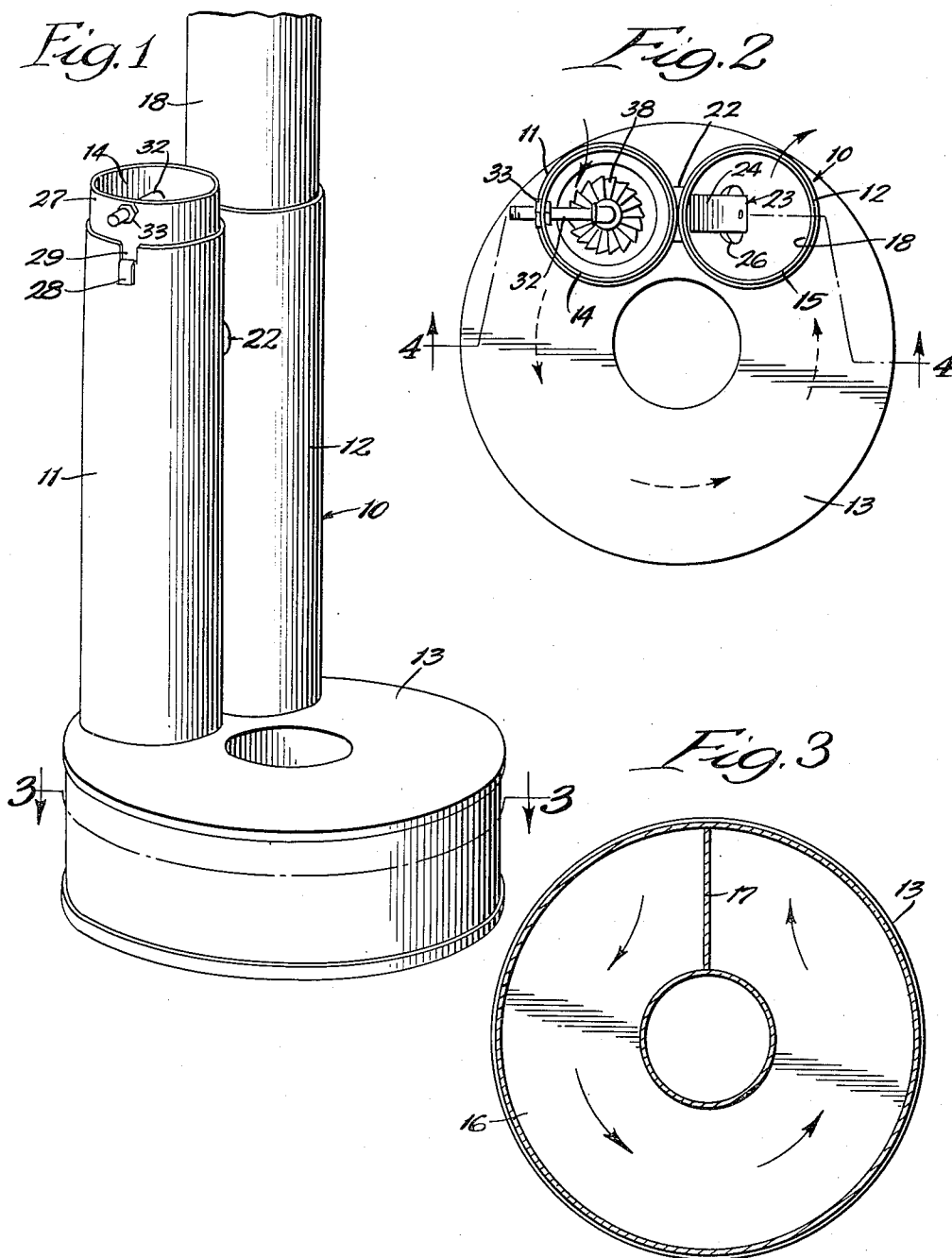
J. E. McCUTCHEN

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DRAFT STARTER STRUCTURE FOR IMMERSION HEATERS

Filed March 23, 1951

2 Sheets-Sheet 1



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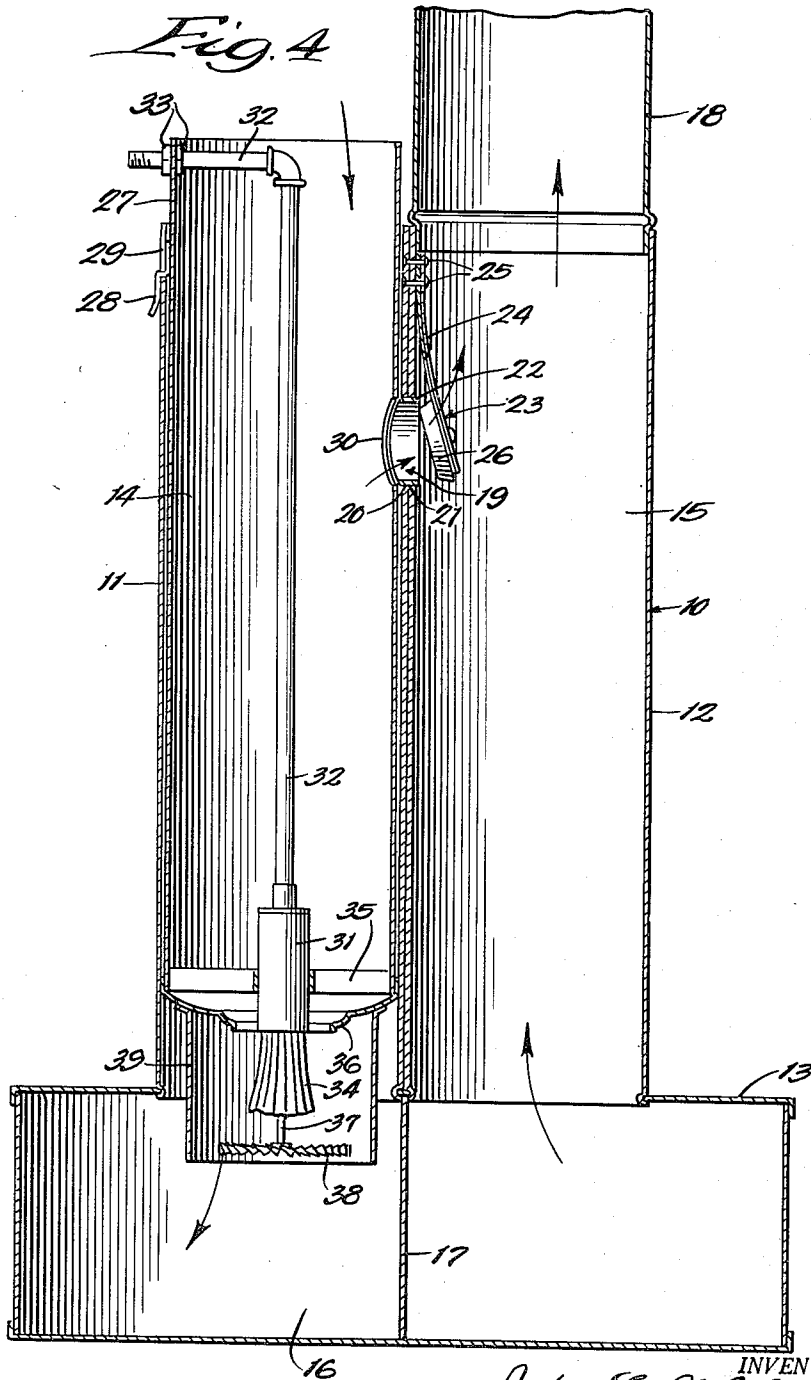
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INVENTOR:
John E. McCutchen,
BY
Dawson & Orme,
ATTORNEYS.

1

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DRAFT STARTER STRUCTURE FOR IMMERSION HEATERS

John E. McCutchen, Wichita, Kans., assignor to The Coleman Company, Inc., Wichita, Kans., a corporation of Kansas

Application March 23, 1951, Serial No. 217,191

6 Claims. (Cl. 126—360)

My invention relates to an improved draft starter structure for immersion heaters. More particularly my invention relates to the incorporation of an automatic draft starter in the pipe structure of immersion heaters.

Immersion heaters of the type to which this invention relates are widely used by the military services for outdoor heating of cans of water. Heaters of this type also have utility as stock tank heaters, and similar applications. These heaters are characterized by a distinctive pipe structure whose purpose is to allow the burner to be positioned below the water or other liquid in which the pipe structure is submerged, and to facilitate the transfer of heat from the burner flame and combustion gases to the liquid surrounding the pipe structure. The pipe structure which has been found satisfactory for this purpose is characterized by having a generally vertical burner tube and a generally vertical stack tube arranged in side by side relation and communicating with each other at their lower ends.

In operation the immersion heater pipe structure is mounted in a generally vertical position within a container filled with the liquid to be heated so that the open upper ends of the burner tube and stack tube project above the surface of the liquid. Within the burner tube generally at about midway there is positioned a burner designed to burn downwardly in the burner tube. A stack is attached to the top of the stack tube for exhausting the combustion gases. During normal operation, the combustion air enters through the top of the burner tube and mixes with the fuel at the burner level to produce a downwardly projecting flame. This flame and the resulting combustion gases are sucked downwardly to the bottom of the burner tube and through the communicating passage into the stack tube, and then move upwardly through the stack tube and are exhausted through the stack.

One problem which has arisen in connection with immersion heaters of this type is that of establishing a down draft in the burner tube and an up draft in the stack tube. When the burner is first ignited the initial tendency of the flame is to burn upwardly in the burner tube, and to draw air downwardly through the stack tube. Since this is exactly opposite to the desired direction of the draft in both tubes, it is necessary to induce the proper draft by auxiliary means. This is ordinarily done by inserting a torch within the stack tube to start the gases moving upwardly in the stack tube and thus induce the desired draft in both tubes. Because of the greater height of the stack tube a relatively small torch can be used for this purpose, and once the proper direction of flow of combustion gases is begun the flow will rapidly accelerate until the maximum draft is achieved. Heretofore, however, no better means of inducing the correct draft in immersion heaters has been known.

It is therefore an object of my invention to modify the conventional pipe structure of immersion heaters so that upon ignition of the burner the correct draft will automatically be induced. More specifically, it is

2

an object of my invention to provide a by-pass between the burner tube and the stack tube above the level at which the burner flame originates so that the initial tendency of the burner flame to burn upwardly in the burner tube will cause heated gases to pass into the stack tube through the by-pass and thereby create a suction in the stack tube to automatically establish the desired draft. Also, it is an object of my invention to equip the by-pass of my invention between the burner and stack tube with a thermostatic valve to control the flow of gases through said by-pass, and more particularly to employ a thermostatic valve adapted to close the by-pass after a down draft has been established in the burner tube and an up draft established in the stack tube by responding to the temperature of the stack gases. Further objects and advantages will appear as the specification proceeds.

My invention is shown in an illustrative embodiment in the accompanying drawings in which—

Figure 1 is a perspective view of an immersion heater pipe structure equipped with my invention and having a burner mounted within the burner tube and a stack attached to the stack tube; Fig. 2, a plan view of the pipe structure, burner and stack of Fig. 1 showing the thermostatic valve mounted within the stack tube; Fig. 3, a plan cross-sectional view taken on line 3—3 of Fig. 1 showing the structure of the connecting tube between the lower ends of the burner tube and the stack tube; and Fig. 4, a front elevational view taken in section on line 4—4 of Fig. 2 showing the location of the burner within the burner tube, the by-pass, and the thermostatic valve.

In the illustration given, a conventional immersion heater pipe structure 10 is shown. Pipe structure 10 is composed of a generally vertical burner or intake tube 11 arranged in side by side relation with generally vertical stack or exhaust tube 12 communicating with each other at their lower ends through a laterally extending tube 13.

For the purposes of this invention, it is preferable that burner tube 11 and stack tube 12 be arranged contiguously so that at least at one point their walls are close together or touching. If desired, burner tube 11 and stack tube 12 can be formed with a common wall. The reason for desiring the tubes to be close together will subsequently be explained in detail.

Although for purpose of facilitating heat transfer from the combustion gases to the surrounding liquid it is desirable to connect burner tube 11 and stack tube 12 by a laterally extending connecting tube such as doughnut-shaped tube 13, this is not essential to the present invention. In fact, any connecting passage between the lower ends of the burner and stack tubes is satisfactory from the standpoint of automatically establishing the correct draft. It is true, however, that when a laterally extending connecting tube is employed to facilitate heat transfer that the problem of starting the correct draft is complicated because of the difficulty of inserting a lighted torch at the bottom of the burner tube, or even sufficiently far into the connecting passage.

As seen more clearly in Figs. 3 and 4, burner tube 11 provides interiorly a down draft passage 14, and stack tube 12 provides interiorly an up draft passage 15. Down draft passage 14 communicates with up draft passage 15 through circular passage 16 provided within doughnut casing 13 by means of partition member 17. Thus, as indicated by the arrows in the drawing the air flows into the top of burner tube 11 and passes downwardly through passage 14 to supply oxygen to the burner, and thereafter together with the combustion gases passes around passage 16 and up through passage 15 in stack tube 12. A stack 18 is detachably secured to the open upper end of stack tube 12 to exhaust the combustion

gases and to lengthen stack tube 12 to create suction for the desired draft.

The pipe structure thus far described is of the conventional type with which the difficulties of starting the draft have been experienced. In order to overcome these difficulties, I have now provided a by-pass 19 between burner tube 11 and stack tube 12. By-pass 19 can be located at any point above the lower ends of the tubes, so long as provision is made for mounting the burner within the burner tube so that the flame originates below by-pass 19. I prefer, however, to locate by-pass 19 above the middle or in the upper portion of the tubes so that the burner is positioned above the lower end of the burner tube. It will be understood that if it is desired to have by-pass 19 below the surface of the liquid being heated that the by-pass will have to be made liquid-tight by any suitable means.

In the illustration given, by-pass 19 is formed by cutting a port 20 in the wall of burner tube 11 adjacent stack tube 12. Another port 21 is cut in the side of stack tube 12 in alignment with port 20. A connecting ring 22 is mounted with its ends extending through ports 20 and 21 and soldered to the sides of burner tube 11 and stack tube 12 to produce a water-tight connection. It will be understood that any suitable connecting passage structure can be utilized, which may take the form of a single port if a common wall is employed between the burner tube and stack tube. The purpose of by-pass 19 will subsequently be explained in detail.

In order to fully accomplish the objects of my invention it is necessary to equip by-pass 19 with a thermostatic valve 23 to control the flow of gases through by-pass 19. Thermostatic valve 23 can be of any construction which permits valve 23 to close by-pass 19 after a down draft has been established in burner tube 11 and an up draft established in stack tube 12 by responding to the temperature of the stack gases. I have found that an unusually simple and effective means for operating thermostatic valve 23 is to employ a bimetallic strip 24. In the illustration given, bimetallic strip 24 has its upper end riveted at 25 to the inner wall of stack tube 12 so that its lower end is in alignment with by-pass 19, or more precisely port 21. A plug 26 is secured to the lower end of strip 24 so that when strip 24 straightens upon being heated plug 26 will seat within connecting ring 22 and thereby close by-pass 19. Bimetallic strip 24 can be composed of any of a number of well-known metals whose expansion and contraction characteristics are such that at normal temperatures strip 24 is arcuate but straightens to seat plug 26 within by-pass 19 upon being heated by the stack gases after the establishment of an up draft in stack tube 12.

For the purposes of this invention, any suitable burner can be mounted within burner tube 11. In the illustration given, a liquid fuel burner is employed. This burner consists of an adaptor tube 27 removably positioned within burner tube 11 by means of bracket 28 engaging notch 29 at the top of burner tube 11. The purpose of adaptor tube 27 is to permit the easy removal and insertion of the burner and to assure that the burner is correctly positioned. Adaptor tube 27 is provided with a port 30 which aligns with by-pass 19 when adaptor tube 27 is positioned within burner tube 11 as shown.

Within adaptor tube 27 there is suspended a wick housing or tube 31 by means of fuel supply pipe 32 which is locked to the upper end of adaptor tube 27 at 33. Wick housing 31 is filled with wick filaments 34 which extend below wick housing 31. Wick filaments 34 can be conveniently made from woven strands of fibrous glass. To assist in maintaining burner tube 31 in a centered position there is provided a support bracket 35 connected to the side walls of adaptor tube 27. To increase the velocity of air past wick elements 34 there is provided a baffle member 36 secured to the lower end of adaptor tube 27 and providing an annular opening of

reduced size above wick members 34. On a rod 37 secured within housing 31 and extending downwardly below wick members 34 there is mounted a flame spreader 38 consisting of a wheel with overlapping inclined blades, as seen best in Fig. 2. There is also provided an adaptor extension 39 forming an inclosure of smaller diameter about wick members 34 and flame spreader 38.

Operation

In the operation of the improved immersion pipe structure of my invention, the pipe structure is immersed in the liquid to be heated with the burner mounted in the burner tube and the stack attached to the stack tube. Fuel is then supplied to the burner, and the burner ignited. In the illustration given, liquid fuel would be passed downwardly through fuel supply pipe 32 upon wick elements 34. Wick elements 34 could then be ignited by means of a torch. However, if desired the burner can be adapted for lighting with a match, etc.

Prior to the ignition of the burner, the air flow pattern through the heater is downwardly through the burner tube 11 and upwardly directed through the stack tube 12. The reason for this is that the stack has a substantially greater height than the burner tube and the pressure differential afforded thereby will tend to cause a circulation of air in the stated manner. Shortly after the burner is ignited, the initial tendency of the flame is to burn upwardly in a conventional manner. But instantaneously upon ignition of the burner, a down draft through the stack tube 12 and a corresponding up flow of air and combustion gases through the tube 11 will not occur. The reason for this is that the air within the burner tube 11 must first be heated to some value that will overcome the natural tendency of the air to flow downwardly through the burner tube that is caused by the greater height of the stack tube 12. In conventional immersion heater apparatus, it would only be a matter of time until the flow of air and combustion gases would be upwardly through the burner tube 11. That condition, however, does not occur in my heater apparatus.

However, shortly after ignition of the burner (and for all practical purposes, almost immediately thereafter) the tendency of the flame is to burn upwardly within burner tube 11, and to draw at least part of its combustion air supply downwardly through stack 18 and stack tube 12. Thus, in the illustration given, flames and combustion gases would initially move upwardly from wick elements 34 and out of the top of burner tube 11. This direction of the burner flame and movement of the combustion gases would cause a portion of the combustion gases to flow through by-pass 19 into stack tube 12 for immediately after ignition of the burner, the dominant air flow pattern is still upwardly through the stack 18. By-pass 19 would be open at this time since thermostatic valve 23 opens by-pass 19 at normal temperatures.

Passage of even small amounts of heated gases through by-pass 19 into stack tube 12 will amplify the dominant flow pattern and cause some gases to rise into stack 18 and pass outwardly at the top thereof. Because of the combined height of stack tube 12 and stack 18 a magnified draft will be introduced in stack tube 15 as the result of the heated gases passing through by-pass 15 and out through stack 18. Thus, in a very few minutes the suction becomes sufficiently strong within stack tube 12 to draw the combustion gases through connecting tube 13. This causes the burner flame to burn downwardly and also causes the combustion air to enter at the top of burner tube 11. The net result of this process is to quickly and automatically establish a down draft in burner tube 11 and an up draft in stack tube 12.

I have found that by-pass 19 is effective in accomplishing this result although it is of very small size. For example, when employing burner tubes and stack tubes of around six inches in diameter, I have found it sufficient if by-pass 19 is about one inch in diameter. If burner

5

tube 11 and stack tube 12 are positioned closely together, and preferably so that their walls are contiguous, at least around by-pass 19, the passage of combustion gases through by-pass 19 will be facilitated. In fact, when the walls of burner tube 11 and stack tube 12 are brought closely together at by-pass 19 a considerably smaller diameter by-pass can be employed.

Upon the establishment of the correct draft the combustion gases pass upwardly through stack tube 12 and over bimetallic strip 24. The combustion gases are thus effective in heating bimetallic strip 24 which causes strip 24 to straighten and seat plug 26 within by-pass 19 to effect the closure of the by-pass for normal operations. If thermostatic valve means were not provided for closing by-pass 19 in response to the temperature of the stack gases, cold air entering at the top of burner tube 11 would be by-passed through passage 19 and cause a cooling of the gases within stack 18 and thereby reduce the draft.

While in the foregoing specification, for purpose of illustration I have set forth specific details of an embodiment of my invention, it will be apparent to those skilled in the art that many of the details set forth can be varied widely without departing from the spirit of my invention.

I claim:

1. In a heater having a generally vertical burner tube and a generally vertical stack tube of substantially greater height than the burner tube and arranged in substantially side-by-side relation therewith, said tubes communicating with each other at their lower ends, said burner tube having a fuel burner therein adapted to provide a downwardly directed flame when combustion air is drawn downwardly through said burner tube, means for automatically overcoming the tendency of a flame to burn upwardly in said burner tube upon ignition of said fuel burner by providing a down draft in said burner tube, comprising a by-pass extending between the adjacent sides of said tubes at an elevation above said fuel burner, and a thermostatically controlled valve for controlling the flow of gases through said by-pass, said valve being normally open at atmospheric temperatures to provide free communication between said tubes through said by-pass and being arranged to close said by-pass after a down draft has been established in said stack tube by response to the temperature of the heated combustion gases flowing through said stack tube.

2. The structure of claim 1 in which said thermostatically controlled valve is actuated by a bimetallic strip.

3. The structure of claim 1 in which said by-pass has a small cross-sectional area relative to the cross-sectional area of said burner and stack tubes.

4. The structure of claim 1 in which said burner and stack tubes communicate at their lower ends through a heat exchanger tube.

6

5. In an immersion heater characterized by having a generally vertical burner tube and a generally vertical stack tube arranged in contiguous side-by-side relation and communicating at their lower ends through a heat exchanger tube adapted to be submerged in a liquid, said burner tube having a fuel burner mounted therein adjacent the lower end thereof and adapted to provide a downwardly directed flame when air for combustion is drawn downwardly through said burner tube and said stack tube having a substantially greater height than the burner tube, the improvement of means for automatically providing a down draft in said burner tube upon lighting of said burner by overcoming the tendency of the flame to burn upwardly, comprising the provision by said burner and stack tubes of communicating ports between the contiguous surfaces thereof at an elevation above said burner, said ports having a small cross-sectional area relative to the cross-sectional area of said burner and stack tubes, a normally arcuate bimetallic thermostat strip mounted inside of said stack tube adjacent the port provided thereby, and a plug carried on an end of said strip and adapted to close said ports when seated therein, said strip being operative to space said plug from said ports under atmospheric temperatures and to straighten and seat said plug in closing relation with the stack port in response to the elevated temperature of the stack gases after a downflow of air has been established in said burner tube and an upflow of combustion gases in said stack tube, whereby when said burner is lighted the initial tendency of the flame to burn upwardly in the burner tube will cause heated gases to pass into said stack tube through said ports and thereby create a suction in said stack tube operative to automatically establish the desired draft after which said bimetallic strip, after the heating thereof, moves said plug to close said ports for normal operation.

6. The structure of claim 5 in which said fuel burner comprises a wick housing communicating at its upper end with a source of liquid fuel and having a plurality of wicks extending downwardly therefrom, and an air baffle extending across said burner tube and providing a perimetric opening about said wicks for the flow of air thereto.

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