March 1, 1955 J. W. THROCKMORTON ET AL 2,703,072

INDIRECT HEATER

Filed July 12, 1950

FIG. 1

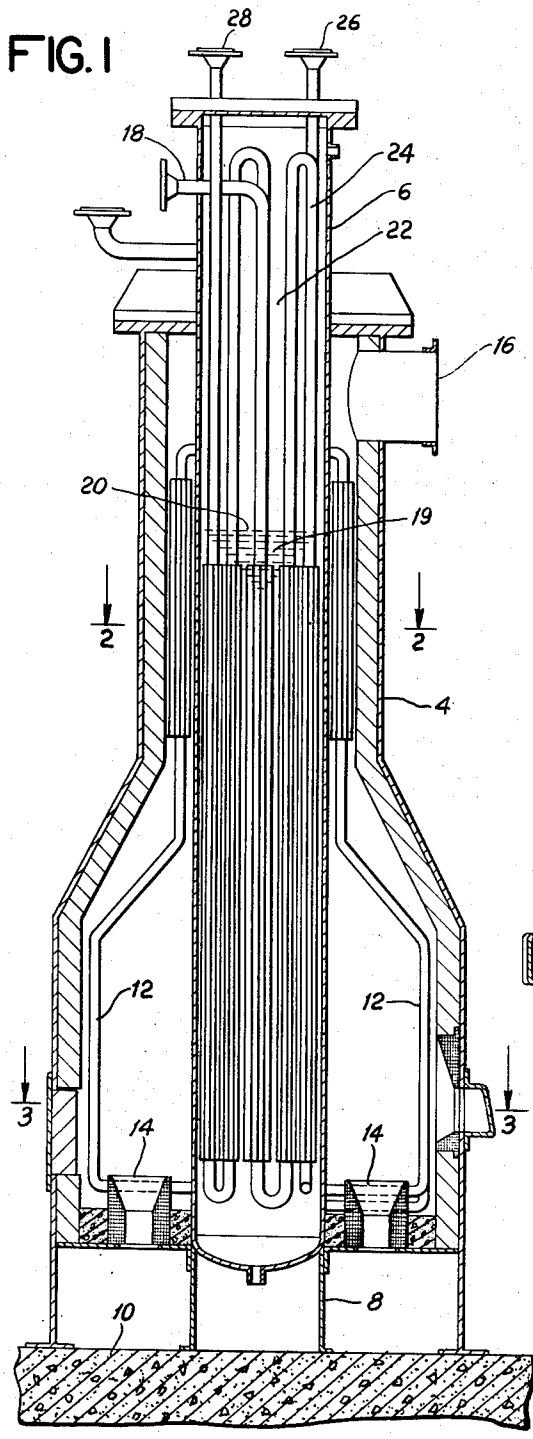


FIG. 2

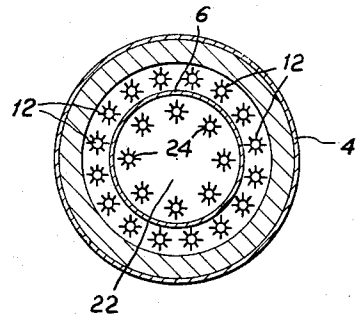
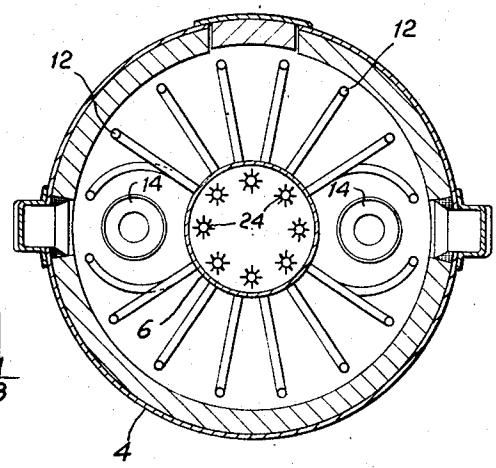


FIG. 3



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INDIRECT HEATER

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Application July 12, 1950, Serial No. 173,302

3 Claims. (Cl. 122—33)

This invention pertains to an indirect fluid heater in which a bundle of heat exchanger tubes has been inserted in the vapor space of a boiler drum and the steam is condensed by the fluid passing through the heat exchanger bundle, and more particularly to such a heater in which the heat exchanger bundle extends into the liquid zone of the boiler drum, the tubes being bare in the vapor space or zone and being provided with extended surfaces in the liquid zone, by finning, for example.

Where the heating of certain fluids is very critical, i. e., where close temperature control must be maintained, it is common practice to heat one fluid by direct firing and use this first heated fluid to heat a second fluid. For instance, a heat exchanger bundle has been inserted in the vapor space of a boiler drum and the steam condensed by the fluid passing through the heat exchanger bundle, and close temperature control of the fluid passing through the bundle is maintained. Similarly, steam or Dowtherm has been heated in a boiler and the vapors in turn transmitted to a reboiler in the base of a tower and the condensate from the reboiler (condensed steam or Dowtherm) returned to the generator.

A main feature of the invention lies in extending the tubes of the heat exchanger bundle downwardly from the vapor zone in the drum into the liquid zone and in extending the surface of the portions of the tubes in the liquid zone. This change substantially increases the heat transfer rate to the fluid. The transfer rate from saturated vapor is high; therefore, bare tubes are desirable in the vapor zone, and fins would have very little effect on increasing the rate of heat transfer in the vapor zone. On the other hand, the transfer rate in the liquid zone, based on thermal circulation below the liquid level in the drum, is relatively much lower; therefore, submerged fin tubes below the liquid level are very desirable to increase the rate of heat transfer in the liquid zone. This is because the surface area of the tubes is materially increased by the fins.

Accordingly, it is a principal object of the invention to provide an indirect heater with greatly increased rate of heat transfer to the fluid being heated indirectly.

Other and further objects and advantages of the invention will appear from the following description.

In the accompanying drawings which form part of the instant specification and are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

Fig. 1 is a sectional view of a furnace showing an embodiment of the invention;

Fig. 2 is a transverse sectional view taken on line 2—2 of Fig. 1; and

Fig. 3 is a transverse sectional view taken on line 3—3 of Fig. 1.

Referring to the drawings, the illustrated unit consists in general of the boiler design illustrated and described in our copending application for U. S. patent, Ser. No. 173,301, filed July 12, 1950; now continued in application Ser. No. 419,342, filed March 29, 1954.

Briefly, the illustrated boiler consists of a vertical combustion chamber 4 which has a greater diameter in the lower, radiant zone than in the upper, convection zone. A vertical, cylindrical drum 6 is coaxial with the chamber 4 and is supported by a skirt 8 resting on the boiler's foundation 10. A bank of vertical heating tubes 12 surrounds the drum 6 and is coaxial therewith. The lower ends of the tubes 12 are connected to the drum 6 in the lower portion of the chamber 4 in the radiant zone and

the upper ends are connected to the drum 6 in the upper portion of the chamber 4 in the convection zone. Some of the tubes 12 are bent so as to get around burners 14 which are installed in the floor of the chamber 6. The space between the surface of the drum 6 and the inner wall of the chamber 4 forms an annulus to maintain proper velocity of the combustion gases through the convection zone on their way to a flue gas outlet 16. The tubes 12 are finned in the convection zone.

Water, Dowtherm, or some similar liquid 19 is introduced into the drum 6 by means of a feed pipe 18 and the drum 6 is filled to a desired liquid level, shown at 20, leaving a vapor space 22 above the level 20. The unit then operates in a manner similar to a conventional steam or Dowtherm boiler, liberating hot vapor in the vapor space 22.

A heat exchanger bundle 24, having a fluid inlet 26 and a fluid outlet 28 atop the drum 6, is inserted into the drum 6, and extends substantially from the top to the bottom thereof. Above the level 20, the tubes of the heat exchanger bundle 24 are bare and below the level 20 they are finned. As the fluid within the drum 6 and its tubes 12 is vaporized by direct firing, it is condensed on the bare tube sections of the heat exchanger bundle 24, above the liquid level 20. At the same time, some heat is transmitted to the finned tube portion of the heat exchanger bundle 24, below the liquid level 20, where the heat transfer rate is based upon thermal circulation and is relatively much lower than it is in the vapor zone. Submerged fin tubes below the level 20 are very desirable to increase the heat transfer rate in that zone.

From the foregoing, it will be seen that the invention is one well adapted to attain all of the ends and objects hereinbefore set forth.

Since many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. An indirect heater in which a first fluid is directly heated and a second fluid is indirectly heated by said first fluid, said heater comprising: a vertical cylindrical shell; means for heating said first fluid directly, said means including a cylindrical boiler drum in said shell and coaxial therewith, a chamber defined laterally on the outside by said shell and on the inside by said drum and having a radiant section and a convection section in the bottom and top thereof, respectively, burners in said radiant section, means for filling said drum to a predetermined level with said first fluid in the liquid phase, a vapor space within said drum above said level, and a bank of vertical boiler tubes within said chamber and connected thereto above and below said level, said means being adapted to discharge said first fluid in the vapor phase into said vapor space; and a bundle of heat exchanger tubes through which said second fluid circulates, within said drum and having a bare portion above said level and an extended-surface portion below said level.

2. An indirect heater in which a first fluid is directly heated and a second fluid is indirectly heated by said first fluid, said heater comprising: a vertical cylindrical shell; means for heating said first fluid directly, said means including a cylindrical boiler drum in said shell and coaxial therewith, a combustion chamber having a radiant section and a convection section in the bottom and top thereof, respectively, burners in said radiant section, means for filling said drum to a predetermined level with said first fluid in the liquid phase, a vapor space within said drum above said level, and a bank of vertical boiler tubes within said combustion chamber and connected to the drum above and below said level, said heating means being adapted to discharge said first fluid in the vapor phase into said vapor space; and a bundle of heat exchanger tubes through which said second fluid circulates, within said drum and having a bare portion above said level and an extended-surface portion below said level.

3. An indirect heater in which a first fluid is directly heated and a second fluid is indirectly heated by said first fluid, said heater comprising: a vertical cylindrical shell;

means for heating said first fluid directly, said means including a cylindrical boiler drum in said shell and coaxial therewith, a chamber defined laterally on the outside by said shell and on the inside by said drum and having a radiant section and a convection section in the bottom and top thereof, respectively, burners in said radiant section, means for filling said drum to a predetermined level with said first fluid in the liquid phase, a vapor space within said drum above said level, and a bank of vertical boiler tubes within said chamber and connected thereto above and below said level, said heating means being adapted to discharge said first fluid in the vapor phase into said vapor space; and a bundle of heat exchanger tubes within said drum and through which said second fluid circulates, said bundle being partially within said first, liquid phase zone and partly within said second, vapor phase zone, substantially all of that portion of said tubes within said first, liquid phase zone having

extended surfaces and substantially all of that portion of said tubes within said second, vapor phase zone being bare.

References Cited in the file of this patent

UNITED STATES PATENTS

1,866,367	Nerad	July 5, 1932
1,883,733	Hahn	Oct. 18, 1932
2,102,424	Larrecq	Dec. 14, 1937
2,130,894	Muir	Sept. 20, 1938
2,244,567	Ohlsson	June 3, 1941
2,540,055	Mohn	Jan. 30, 1951
2,592,980	Van Wert	Apr. 15, 1952

FOREIGN PATENTS

517,641	Great Britain	Feb. 5, 1940