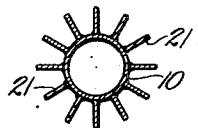
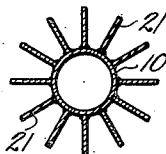
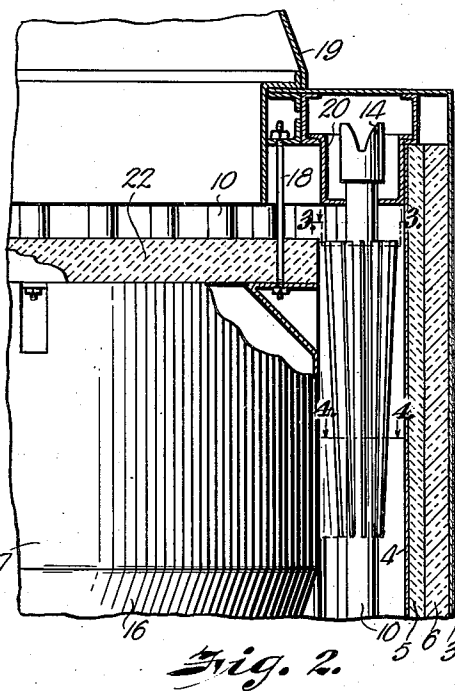
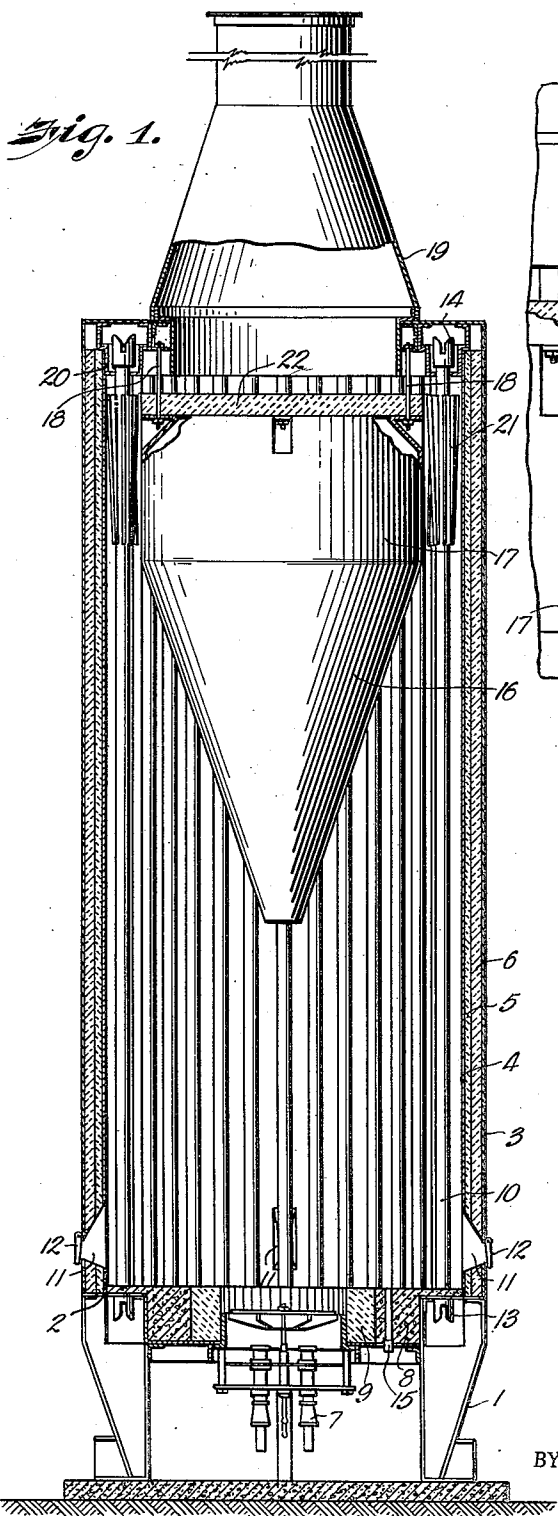


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2,276,527

APPARATUS FOR HEATING FLUIDS

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APPARATUS FOR HEATING FLUIDS

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5 Claims. (Cl. 122—333)

Our invention relates to apparatus for heating fluids and more particularly for tubular furnaces for use in petroleum and chemical industries for distillation, cracking and thermal processing of various fluids. Our furnace is particularly adapted for use in the petroleum industry.

This invention is an improvement over the furnace shown in our copending application Serial No. 343,272, filed June 29, 1940.

One object of our invention is to provide a furnace in which uniform heat intensity is delivered throughout the full length of all the tubes.

Another object of our invention is to provide a furnace of high efficiency having a convection section comprising an extension of the radiant tubes without resorting to excessive tube lengths.

Another object of the invention is to provide a nonrefractory furnace setting wherein a non-oxidizing, reflective, alloy retaining plate surrounds the heat absorbing elements or tubes and is itself encompassed by suitable insulating material positioned between the retaining plate and the outer metallic casing or shell.

Another object of our invention is to provide a prefabricated furnace of low cost and low weight.

Another object of our invention is to provide an oil heating furnace in which the path of oil travel is reduced to the minimum, making for a low pressure drop.

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

In the accompanying drawing which forms part of the instant specification and is to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views;

Figure 1 is a sectional view of a furnace showing one embodiment of our invention.

Figure 2 is an enlarged sectional view of the upper portion of the convection section of our furnace.

Figure 3 is a sectional view taken on the line 3—3 of Figure 2.

Figure 4 is a sectional view taken on the line 4—4 of Figure 2.

Referring now to the drawing, a pedestal 1 supports a tube support casting 2 and a prefabricated metal sheathing 3. Internal alloy sheathing 4 is spaced from the sheathing 3 and positions the insulating material. The insulating material 5 is mono-block, high temperature insulation, while the insulation 6 is rock wool blanket or the like. A plurality of oil burners 7

are supported at the bottom of the furnace. These burners are directional, that is, the type in which the burner tips may be turned to give a swirling or tangential velocity to the flue gas.

Insulating concrete 8 and fire brick 9 form the floor of the combustion chamber around which the tubes 10 are positioned along the circumference of a circle. Observation openings 11, closed by doors 12 are provided near the base of the combustion chamber. The tubes 10 are joined at the bottom by headers 13 and at the tops by headers 14. A steam snuffing pipe 15 may be provided, if desired. Adjacent the upper end of the furnace, we provide an alloy cone 16 having a cylindrical base portion 17, secured or suspended from the top of the furnace by means of bolts 18. The alloy cone serves the same function in the instant application as that in our copending application, Serial No. 343,272. The cylindrical base portion 17 forms an extended convection section through which the flue gases pass on their way to a stack 19. An annular channel member 20 forms a guide tube sheet, permitting the tubes to expand and contract.

It will be observed that the portions of the tubes 10 within the annular convection passageway are provided with contact fins 21. These fins are welded to the tubes in heat exchange contact therewith. The combustion gases pass upwardly and progressively give their heat to the fins as they pass over the tubes. The fins are increased in area toward the tip to compensate for the lower temperatures involved, thus maintaining the uniform heat exchange gradient on this portion of the tubes. The ratio of fin surface to bare tube surface is such that the entire tube operates at substantially uniform heat. For example, if the maximum permissible transfer rate is 9,000 B. t. u. per square foot, the radiant surface is designed for these conditions and in the convection zone the fins are increased as the flue gas temperature decreases so that a rate of 9,000 B. t. u. is maintained through the entire convection section.

It will be observed that the burner tips of the burner 7 are arranged to give the gas a whirling motion, due to their tangential discharge. This brings the burning gases into contact with the tubes throughout their entire length. The radiant cone 16 will be heated so that its radiant heat compensates for the drop in temperature of the combustion gases due to the giving up of some of their heat to the fluid being heated. The radiating area, however, increases to compensate for the lowered sensible temperature of the combus-

tion gases. That is, the radiation and increased velocity due to reducing the cross sectional area makes up progressively for the drop in the temperature of the combustion gases. This principle is carried on in the convection section, and the whole design is such that a uniform heat transfer exists throughout the entire length of the tubes 10.

The arrangement of tubes around the combustion chamber offers a maximum of heat exchange surface within the radiant zone to the heat of the combustion gases. The construction of the furnace is such that a portion of the tubes is positioned in the radiant zone and a portion in the convection zone. That portion in the radiant zone exposes a bare tube surface to the radiant heat of the combustion gases, while fins or extended surfaces of any suitable type are affixed to that portion of the tubes in the convection section. The amount of the extended or fin tube surface in the convection section is proportioned so as to compensate for the decrease in flue gas temperature, assuring a uniform heat absorption to the heating elements in both the radiant and convection zones and throughout the full length of the tubes. In order to obtain this uniform heat absorption, care is taken to fire the furnace properly, direct the burners at a proper angle and shape the fins or extended surfaces in the convection zone so that a greater amount of heat is absorbed at the discharge end where the flue gases are at their lowest temperature than at the entrance to the convection section where the flue gases contain a greater amount of heat.

It is appreciated also that, although it has been indicated that radiant heat is more or less the sole source of heat supplied to the tubes in the radiant zone, there is inevitably a certain amount of convection heat transmitted to the tubes, due to swirling and spiral circulation of the combustion gases occasioned by the arrangement of the burners and the manner of firing the furnace.

It will be observed that the cylindrical base section 17 of the radiant cone 16 is such that it is unnecessary to use any brickwork at the top of the furnace, because the flue gas is sufficiently low in temperature to be introduced directly into the stack. Thus, it is only necessary to insulate the roof of the base member by insulating the material 22, which prevents radiation losses at the top of the furnace.

The invention as suggested heretofore, is adaptable as well to the heating of fluids such as water heaters, steam generating units and evaporators as well as for use in the petroleum and chemical industries.

It will be seen that we have accomplished the objects of our invention. We have provided a furnace in which high efficiency use of fuel is made with the full length of all tubes operating at the maximum possible transfer rate. A minimum path of oil travel is provided due to the short, straight tubes resulting in a low pressure drop. The furnace is of low cost and of low weight.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is,

therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, we claim:

1. A furnace including in combination a combustion chamber having radiant and convection zones through which combustion gases pass, a plurality of heat exchange elements positioned in said combustion chamber and having a portion thereof in the radiant zone and a portion thereof in the convection zone, said portion in the radiant zone exposing a plane surface to the combustion gases and the portion in the convection section exposing to the combustion gases a heat conducting extended surface bonded to the tubes to form an integral structure, the amount of extended surface increasing with decreasing combustion gas temperature passing thereover.

2. A furnace including in combination a combustion chamber having radiant convection zones through which combustion gases pass, a plurality of substantially vertical heat exchange tubes positioned in said combustion chamber and having a portion thereof in the radiant zone and a portion thereof in the convection zone, the portion in the radiant zone exposing a plane surface to the combustion gases and the portion in the convection zone exposing a heat conducting extended surface bonded to the tubes to form an integral structure.

3. A furnace including in combination a combustion chamber having radiant convection zones through which combustion gases pass, a plurality of substantially vertical heat exchange tubes positioned in said combustion chamber and having a portion thereof in the radiant zone and a portion thereof in the convection zone, the portion in the radiant zone exposing a plane surface to the combustion gases and the portion in the convection zone exposing a heat conducting extended surface bonded to the tubes to form an integral structure, said extended surface being in axial alignment with the tubes.

4. A furnace including in combination a combustion chamber having radiant and convection zones through which combustion gases pass, a depending conical member located in the upper part of the combustion chamber partly within the convection and partly within the radiant zones, a plurality of substantially vertical heat exchange tubes positioned in said combustion chamber and having a portion thereof in the radiant zone and a portion thereof in the convection zone, the portion in the radiant zone exposing a plane surface to the combustion gases and the portion in the convection zone exposing a heat conducting extended surface bonded to the tubes to form an integral structure.

5. A furnace including in combination a combustion chamber having radiant convection zones through which combustion gases pass, a plurality of substantially vertical heat exchange tubes positioned in said combustion chamber and having a portion thereof in the radiant zone and a portion thereof in the convection zone, the portion in the radiant zone exposing a plane surface to the combustion gases and the portion in the convection zone exposing a heat conducting extended surface in the form of radial fins bonded to the tubes to form an integral structure.

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