Jan. 20, 1953 M. W. BARNES 2,625,916

MODIFIED UP-DRAFT TYPE OF HEATERS

Filed Nov. 16, 1950

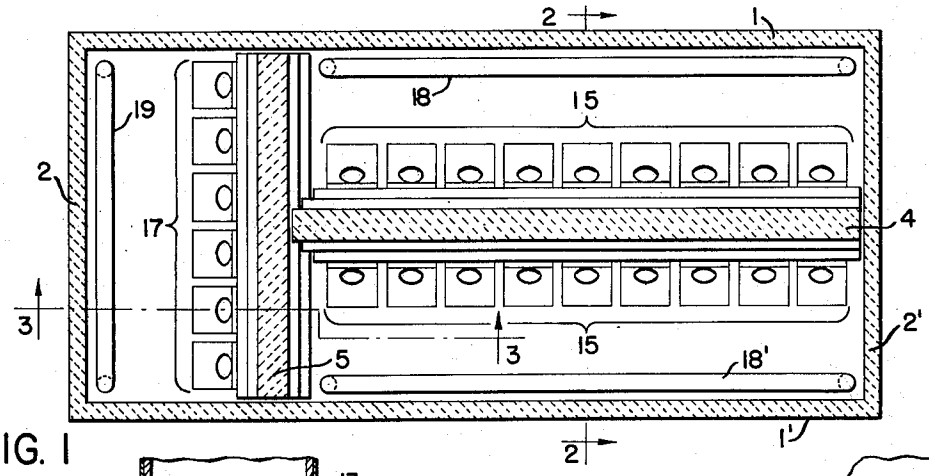


FIG. 1

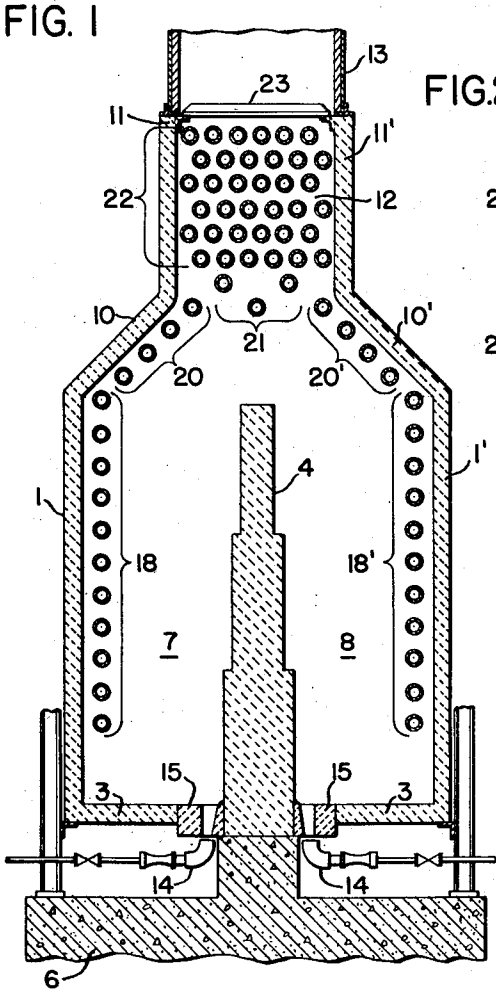


FIG. 2

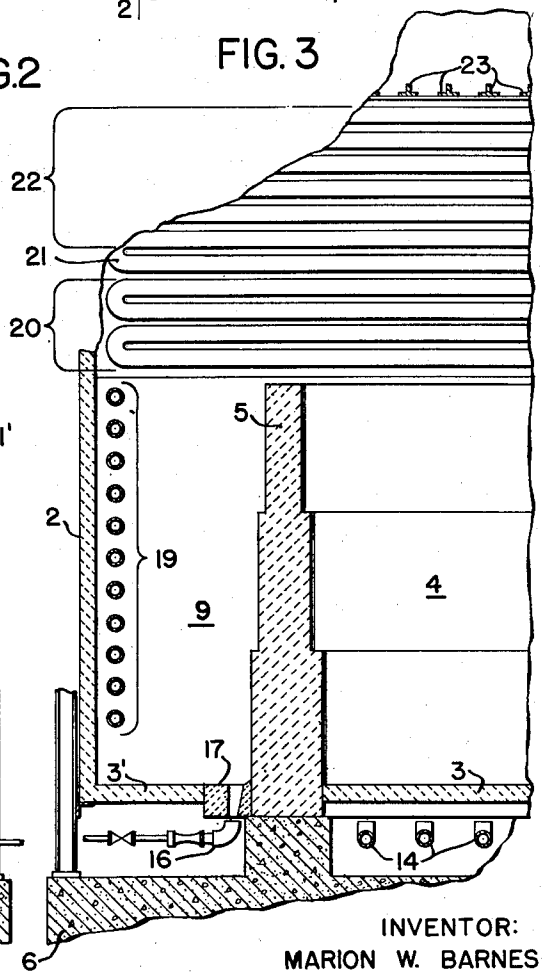


FIG. 3

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Patented Jan. 20, 1953 2,625,916

UNITED STATES PATENT OFFICE

2,625,916

MODIFIED UP-DRAFT TYPE OF HEATERS

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Application November 16, 1950, Serial No. 196,068

2 Claims. (Cl. 122—240)

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This invention relates to an improved modified up-draft type of heater suitable for high temperature heating of fluid streams, and more particularly to a modified form of up-draft heater having dividing walls provide three or more combustion and radiant heating zones, and a novel arrangement of fluid conduits therein, whereby to obtain independent and controlled heating for different fluid streams within a single heating chamber.

It is often desirable in connection with various chemical and petroleum processing operations to effect the controlled heating, or reheating, of a particular reactant stream as it progresses continuously from one reaction zone to another, or alternatively, it may be desirable to simultaneously heat more than one fluid stream within a single heating chamber and provide different temperature levels or heat absorptions for such fluid streams.

The present improved heater provides an economical and compact construction and arrangement of tubes or fluid conduits permitting high temperature radiant heating to at least three different fluid conduits. Further, the construction and arrangement is such that radiant heating may be provided for at least one fluid conduit requiring a much smaller heat absorption than other tubular or fluid conduits maintained within adjacent separated portions of the heating chamber.

The modified construction of the present heating apparatus and arrangement of tubes therein, as well as additional advantages and features, will be more apparent upon reference to the accompanying drawing and the following description thereof.

Figure 1 of the drawing is a sectional plan view of the lower portion of one embodiment of the improved heater.

Figure 2 of the drawing is a cross-sectional elevational view through the heater, as indicated by line 2—2 in Figure 1 of the drawing.

Figure 3 of the drawing is a partial sectional and elevational view through one end of the heater, as indicated by line 3—3 in Figure 1 of the drawing.

Referring now to the drawing, there is shown diagrammatically one modified embodiment of the up-draft type of heater providing three radiant heating zones, the lower portion of the heating chamber being formed by refractory side walls 1 and 1', end walls 2 and 2', refractory floors 3 and 3'. The latter being across one end of the heating chamber. A longitudinal center wall 4

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extends upwardly within the lower portion of the heating chamber, spaced midway between the side walls and from the end wall 2' of the heating chamber to a cross wall or partitioning wall 5. The latter extends across one end of the lower portion heating chamber, between side walls 1 and 1' and at right angles to the center wall 4, at a spaced distance from the other end wall of the heating chamber. Both of the partitioning walls and the entire furnace or heating chamber are supported on a suitable foundation 6 with the partitioning walls 4 and 5 preferably of a gravity well construction supported directly by the foundation 6.

In accordance with the present improved form of this up-draft heater, the center wall 4 and cross wall 5 extend upwardly from the bottom of the heating chamber to a height substantially equivalent to that of the side walls 1 so that the lower portion of the heater is divided into separated heating sections or zones. In the present embodiment, three radiant heating zones 7, 8 and 9 are formed within the lower portion of the heating chamber by the partitioning walls. However, while it is a feature of the present invention to provide at least 3 independently controlled heating zones with at least one lateral or cross zone such as radiant heating section 9, additional zones may be formed within the heating chamber.

Each of the partitioned radiant heating zones are in open communication with each other at the upper end of the partitioning walls, i. e. above walls 4 and 5. A tapering or narrowing heating zone is formed between sloping walls 10 and 10', while a still narrower or small cross-sectional area heating zone is formed in the upper portion of the chamber between the more closely spaced walls 11 and 11'. This narrower upper portion of the heating chamber provides a convection heating zone 12. Above the convection heating zone 12, and resting on walls 11 and 11', is a breaching or flue gas collecting duct 13, which in turn commmunicates with a suitable stack, not shown, so that combustion gases may be discharged from the upper portion of the heating chamber.

A row of burners 14 is disposed beneath the floor 3 on each side of the center wall 4 so that resulting flame and hot combustion gas may be directed upwardly along each face of the center wall 4 to provide high temperature radiant heat into the longitudinal zones 7 and 8. Suitable firing ports or burner blocks 15 are provided in the floor 3 on each side of the center wall in

order to properly direct the flames into substantially a continuous sheet on the opposite faces of the wall 4 as is desirable for uniform radiant heating of tubes adjacent the opposing side walls. In the small lateral radiant heating zone 9, and below the floor 3' are a plurality of burners 16 which in turn fire through a plurality of spaced ports or burner blocks 17 to also direct a continuous sheet of flame and hot combustion gases against the face of wall 5, and in turn provide a desired high temperature radiant heating within the zone 9. Resulting hot combustion and flue gases from the lower radiant heating zones pass upwardly through the chamber to the narrowing zone between sloping walls and into the small restricted convection heating zone 12, between walls 11 and 11', prior to being discharged from the heating chamber itself.

In the present embodiment, a plurality of spaced and horizontally disposed tubular conduits 18 are positioned in a vertical row adjacent the side wall 1, and similarly a plurality of tubes 18' are adjacent the side walls 1', with each of the tubular members extending for substantially the full length of the longitudinal heating zones 7 and 8, as best illustrated in Figure 1 of the drawing. These tubes may be connected by suitable U bends or return bend fittings to form one or more continuous fluid conduits, however, it is not intended to limit the present invention to any particular flow through the heating zones or through the heating chamber. The tubular members may be connected in a series flow, or alternatively by means providing parallel flows, if it is so desired.

Within the small lateral heating zone 9 a plurality or spaced and horizontally positioned tubular members 19 are placed in a row adjacent the end wall 2. The individual tubular members may be connected as desired by suitable U fittings or return bends to form one or more continuous conduits.

By individually controlling the various burners of the different rows thereof in the separated radiant heating zones, the improved construction and arrangement permits heating of the separate tubular or pipe coils. The cross wall 5 prevents a higher or lower temperature from the adjacent longitudinal zones effecting the substantially independent heating of the tubes in bank 19, and conversely prevents the independently controlled heating in the end zone 9 from affecting the heating of the tubular members 18 and 18' adjacent the side walls. The present arrangement is of course particularly adapted to the heating of independent fluid streams where it is desired to provide a substantially equivalent heat absorption or heat input to the fluid streams which pass through the longitudinal heating zones 7 and 8 and in the banks of tubes provided by members 18 and 18', while at the same time effecting the simultaneous heating of a third fluid stream which requires a relatively low heat absorption or heat input. The latter stream being accommodated in the tubes 19 within the smaller laterally positioned heating zone 9.

Within the tapering portion of the heating chamber above the radiant heating zones, a plurality of spaced and horizontally positioned tubular fluid conduits 20 and 20' extend adjacent respectively the sloping walls 10 and 10'. These tubes receive some radiant heat from the longitudinal center wall and from the cross wall 5, as well as a considerable quantity of high temperature convection heat from the hot combustion gases flowing upwardly from each of the combustion and radiant heating zones. In a preferable arrangement, each of the tubular members 20 and 20' extend for substantially the full length of the heating chamber between the end walls thereof. Also, these tubes may be connected as desired by suitable U bend or return-bend fittings to effect the heating of separate fluid streams, or alternatively, to connect with the upper and lower positioned tubes as part of a continuous fluid conduit. The diagrammatic tube arrangement in Figure 2 of the drawing indicates a plurality of tubes 21 which extend longitudinally and horizontally the full length of the heating chamber just below the convection heating zone 12. Such tubes normally serve as shock tubes and receiving a small amount of radiant heat from the lower high temperature radiant heating zones, together with convection heating from the converging flue gas streams.

Immediately above the shock tubes 21 and within the smaller cross-sectional area convection heating zone 12 is a larger bank of longitudinally positioned tubes 22 which receive primarily convection heating from the resulting hot combustion gases flowing upwardly from the lower portion of the heater and to the outlet breaching 13. The tubes 22 preferably extend substantially the full length of the heating chamber between end walls 2 and 2' and are relatively closely spaced in a plurality of staggered rows so that a major portion of heat remaining in the hot combustion gases may be taken out by the fluid medium passing through the bank of tubes. It is of course not intended to limit the apparatus to any particular number of tubes, or rows of tubes, in the convection heating bank, or utilize any one flow in connecting the plurality of tubes forming the convection heating bank.

A plurality of spaced baffle members 23 are placed across the top of the heating section 12 at the upper extremities of closely spaced walls 11 and 11', providing means for controlling the flow of the hot combustion gases upwardly through the heating chamber and into the outlet breaching 13. By suitably spacing the members 23, the flow of hot combustion gases through the convection bank of tubes 22 as well as through the upper portion of the heater itself, may be distributed in a manner to uniformly heat the fluid conduits throughout subtantially the full length of the heating zone. The spacing of the baffles 23 may also be regulated to aid in controlling the draft and flow of hot combustion gases upwardly through each of the independent and separated radiant heating zones within the lower portion of the heater.

I claim as my invention:

1. A heater for fluids, comprising in combination, refractory side and end walls defining the lower portion of a confined heating chamber, a center wall extending longitudinally between said side walls for a major portion of the length thereof, a cross wall spaced from an end wall of said heating chamber and extending between said side walls abutting said center wall at right angles thereto, said center wall and said cross wall extending upwardly from the bottom of the chamber to a height substantially equivalent to that of said side walls, said center wall forming with said side walls two longitudinal radiant heating zones, said cross wall and adjacent end wall forming a small lateral radiant heating zone at right angles to said longitudinal heating zones, means for directing flames and hot combustion gases

upwardly against each face of said center wall, independent burner means for directing flames and hot combustion gases against the face of said cross wall within said lateral heating zone, a fluid heating zone of smaller cross-sectional area than said lower portion of said heating chamber disposed between upper portions of said side walls and said end walls, with the latter heating zone being in open communication with each of said separated radiant heating zones, breaching positioned above the upper portion of said smaller fluid heating zone suitable for collecting and discharging flue gases from said chamber, a plurality of tubular fluid conduits disposed adjacent the side walls of said heating chamber in each of said longitudinal radiant heating zones, a plurality of tubular fluid conduits disposed adjacent the end wall of said heating chamber in said laterally positioned radiant heating zone, a plurality of tubular fluid conduits disposed horizontally in a tube bank within said smaller heating zone between the upper portions of the side walls of said heating chamber, inlet means for introducing fluid to be heated to said tubular fluid conduits within said heating chamber, and outlet means for withdrawing resulting heated fluid streams therefrom.

2. A heater for fluids, comprising in combination, refractory side and end walls defining the lower portion of a confined heating chamber, a center wall spaced from and extending longitudinally between said side walls for a major portion of the length thereof, a cross wall spaced from an end wall of said chamber and extending between said side walls abutting said center wall at right angles thereto, said center wall and said cross wall extending upwardly from the bottom of the chamber to a height substantially equivalent to that of said side walls, said center wall forming with said side walls two longitudinal radiant heating zones, said cross wall and the spaced adjacent end wall forming a small laterally positioned radiant heating zone at right angles to and separated from said longitudinal heating zones, means for directing flames and hot combustion gases upwardly against the faces of said longitudinal center wall in said longitudinal heating zones, independent burner means for directing flames and hot combustion gases against the face of said cross wall within said lateral heating zone, a plurality of tubular fluid conduits disposed adjacent the side walls of said chamber in each of the longitudinal radiant heating zones and a plurality of tubular conduits adjacent the end wall in said laterally positioned radiant heating zone at the end of said heating chamber, whereby said fluid conduits are subjected to radiant heating from said heated walls, closely spaced upper portions of said side walls and said end walls defining a convection heating zone of smaller cross-sectional area than said lower portion of said heating chamber and disposed longitudinally therein above said center wall, sloping walls connecting the upper side portions of said side walls with the lower portion of said side walls of said heating chamber, a plurality of tubular fluid conduits disposed horizontally in said convection heating zone, with said fluid conduits disposed in a tube tank extending longitudinally for substantially the entire length of said heating chamber between said end walls thereof, a plurality of tubular fluid conduits disposed horizontally and adjacent said sloping walls over said longitudinal radiant heating zones and said lateral radiant heating zone for substantially the full length of said heating chamber, inlet and outlet means for introducing and withdrawing fluid streams to be heated to said tubular fluid conduits of said chamber, breaching means above said smaller convection heating zone for collecting and discharging resulting combustion gases passing upwardly from said heating chamber.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,219,860	Zimmerman	Oct. 29, 1940
2,275,412	Becker	Mar. 10, 1942
2,330,188	Barnes	Sept. 28, 1943
2,330,189	Barnes	Sept. 28, 1943