

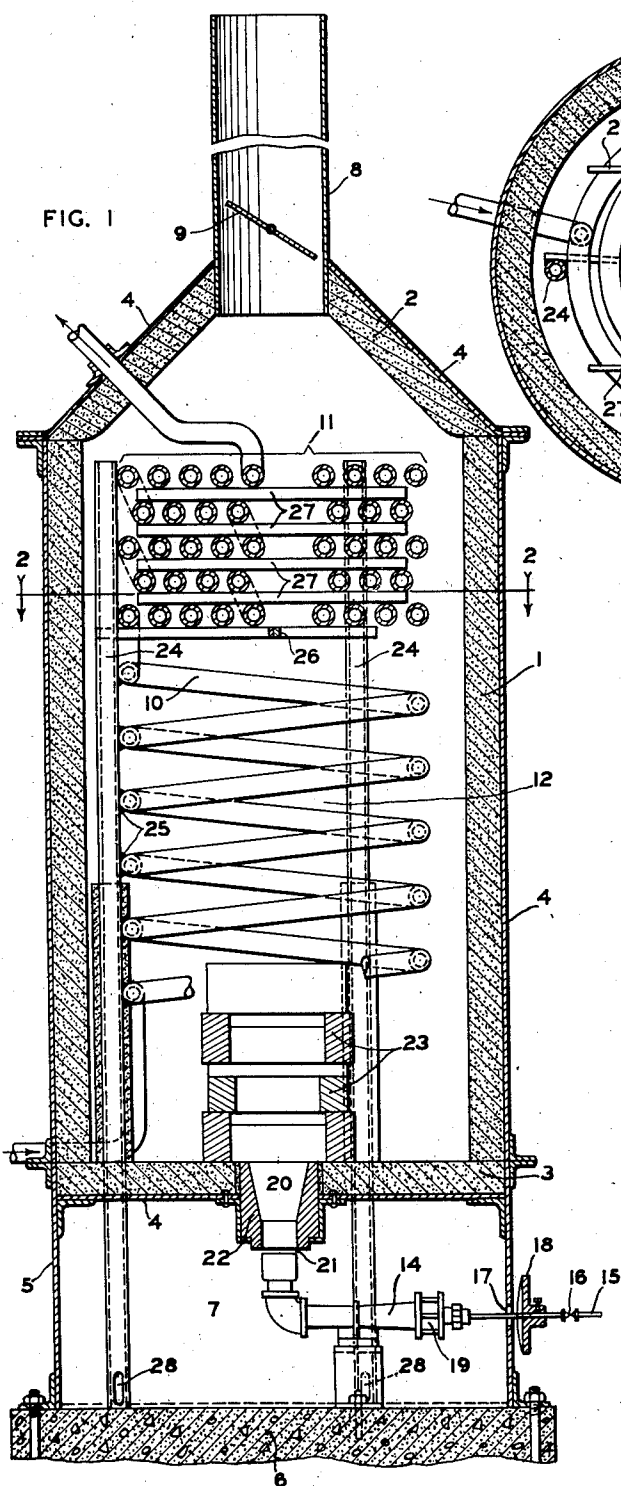
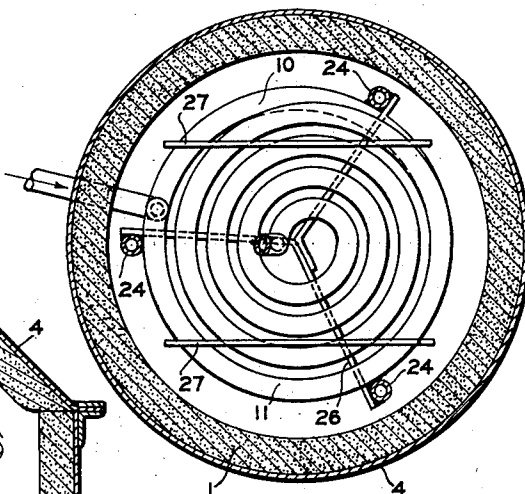
Jan. 27, 1942.

M. W. BARNES

2,270,863

HEATING OF FLUIDS

Filed Oct. 24, 1938



INVENTOR
MARION W. BARNES

BY *Lee Gary*
ATTORNEY

UNITED STATES PATENT OFFICE

2,270,863

HEATING OF FLUIDS

Marion W. Barnes, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill., a corporation of Delaware

Application October 24, 1938, Serial No. 236,681

8 Claims. (Cl. 122—510)

The invention relates to an improved apparatus for heating fluids and refers more particularly to an improved form of heater having air-cooled supports for the fluid conduit, the passage of air through said supports for cooling the same being induced by the stack draft.

The invention is particularly applicable to heaters of the type wherein one portion of the fluid conduit is exposed to direct radiation from flames and hot combustion gases, while another portion thereof is heated by direct contact with combustion gases which have given up a substantial portion of their radiant heat to the first mentioned portion of the fluid conduit, both portions of the fluid conduit (i. e., that heated predominantly by radiation and that heated substantially by convection) being supported by the same air-cooled tubular members through which a flow of air is induced by the draft action of the furnace stack. However, the invention is not limited to this specific embodiment since its features are, in their broader sense, applicable to many different types of fluid heaters including those employing heating predominantly by radiation and those employing heating predominantly by direct contact between combustion gases and the fluid conduit, as well as the preferred type, previously mentioned, which employs heating by both radiation and convection.

By passing air through tubular members which support the heating coil or fluid conduit, in the manner provided by the invention, overheating of the tube supports, which would result in their distortion or failure, is prevented. This is particularly important as applied to supporting members for a fluid conduit located in a relatively hot zone. The trend in modern furnace design, particularly as applied to the oil refining industry, is to employ exceptionally high rates of heating in at least a portion of the fluid conduit by locating that portion in a combustion zone wherein it is subjected to direct radiation from flames and hot combustion gases generated therein. The problem of properly supporting a fluid conduit so located is difficult and a satisfactory solution is offered in the present invention.

The method and means provided by the invention for inducing the flow of air through the air-cooled supporting members of the fluid conduit is simple and effective and avoids the use of fans or blowers by employing the natural draft action of the stack.

The accompanying diagrammatic drawing illustrates one specific form of apparatus embodying

the features of the invention and in which the improved method of heating provided by the invention may be conducted. The form of heater shown in the drawing is a simple and inexpensive type and it is chosen to illustrate the invention for this reason. It will, of course, be understood, as previously stated, that the features of the invention may be employed to advantage in many other specific forms and types of heaters and, since other adaptations will be readily apparent to those familiar with the art, they are entirely within the scope of the invention.

Figure 1 of the drawing is an elevational view, partially in cross-section, of a heater embodying the features of the invention and Figure 2 is a cross-sectional view of the same heater taken along a plane indicated by line 2—2 in Figure 1.

The main furnace structure comprises an outer wall 1, a roof 2 and a floor 3. The walls, roof and floor are of suitable refractory material which may, for example, be fire-brick shapes or one of the several types of materials which are placed in semi-solid or plastic form and upon hardening or setting possess good refractory characteristics. A suitable metallic shell or housing 4 incases the refractory walls, roof and floor of the furnace and this housing extends, as indicated at 5, beneath floor 3 and is anchored to a suitable foundation 6, a space 7 being provided between floor 3 and the foundation. The upper portion of housing 4 supports a stack 8 in which a suitable damper 9 is provided.

The heater here illustrated was designed for heating fluid hydrocarbons to relatively high temperatures and the fluid conduit through which they are passed comprises a tubular coil 10 having several helical turns and a series of flat spiral coils 11 disposed above and connected with coil 10 in series, the several flat spiral coils also being connected with each other for series flow therethrough. Coil 10 is disposed within the central portion of the heater which comprises combustion and heating zone 12 and the tubular turns of this coil are located relatively close to the circular walls 4 of the heater, leaving an unobstructed space within the coil for the combustion of fuel and for the upward passage of flames and hot combustion gases resulting from such combustion. The spiral coils 11 are located within the upper portion of the heater directly above combustion and heating zone 12 and the tubular member, comprising these coils, is disposed within the direct path of travel of the hot combustion gases passing from combustion and heating zone 12 to stack 8.

A burner 14 is provided within space 7 with the floor 3 of the furnace and foundation 6. In the particular case here illustrated, this burner is supplied with gaseous fuel through line 15 and valve 16, although fluid fuel may be employed, when desired. Air is admitted to space 7 through opening 17 in shell 5, the quantity of air, thus admitted, being controlled by suitable sliding damper arrangements such as indicated, for example, at 18. A portion of the air for combustion is admitted to the burner through a suitable mixing device 19 and the combustible mixture is discharged from the mouth of the burner through burner port 20 to the combustion zone wherein it is burned. Additional air for combustion is mixed with the materials discharged from the mouth of the burner as they pass through burner port 20 by admitting the same from space 7 through space 21 provided between the mouth of the burner and the tuyère or burner block 22. A checker-work 23 of fire-brick or the like is provided within the furnace immediately above burner port 20. The purpose of this checker-work is to diffuse the flame and give more uniform distribution of the radiant heat.

The flames and hot combustion gases are directed upwardly from the burner port and checker-work through heating zone 12 and the tubular coil 10 is heated by both direct radiant and convection heat. The combustion gases which have given up a substantial portion of their heat to coil 10 pass upwardly from combustion zone 12 into direct and intimate contact with the tubular element of coils 11, which they serve to heat, and pass thence upwardly through stack 8 to the atmosphere.

Coils 10 and 11 are both supported, in the case here illustrated, on three vertically disposed tubular elements 24 which, as indicated in Figure 2, are spaced approximately 120° apart on a circle somewhat larger in diameter than that about which coil 10 is wound. In this particular case, coil 10 is attached to tube supports 24 by welding, as indicated at 25 in Figure 1, and radial members 26 welded to tubes 24 support the tube bank comprising coils 11, each of the flat spiral coils 11 being spaced from and supported on the next adjacent lower coil by members 27. Each of the tubular supporting members 24 extends through the floor and metal shell of the heater and rests upon foundation 6 to which the weight of the heating coil assembly is thereby transmitted. That portion of each of tubes 24 which extends through space 7 is slotted, as indicated at 28, to admit air from space 7 to the interior of the tube and each of the tubular supporting members is open at its upper end to permit the discharge of heated air therefrom. The flow of air through members 24 is induced by the draft action of stack 8 and, in passing through the tubes, the air is heated by radiation of the flames and hot combustion gases in zone 12 of the heater and its flow thereby augmented. Preferably, as here illustrated, the lower portion of members 24 are insulated with any suitable insulating material capable of withstanding the high temperatures encountered. This insulation preferably extends from floor 3 to a point somewhat above checker-work 23 and protects tubes 24 against overheating in the hottest zone of the furnace. The air leaving the upper ends of members 24 commingles with the combustion gases passing to the stack and serves to reduce the temperature of the stack gases and thereby reduce the sever-

ity of conditions to which the flue and stack are subjected.

Other means of supporting either or both of the coils 10 and 11 from members 24 will be apparent and may be employed within the scope of the invention.

I claim:

1. A heater for fluids comprising, in combination, a combustion zone, a heating zone, a stack, an air chamber, means for generating combustion gases in said combustion zone, means for passing combustion gases from said combustion zone through said heating zone to the stack, a fluid conduit disposed in said heating zone to receive heat from said combustion gases passing therethrough, supporting means for said fluid conduit having fluid passageways therethrough, said passageways being open to the air chamber and to the heating zone at opposite ends thereof whereby the draft action of the stack induces the flow of air through said fluid passageways to cool said supporting means and the stack gases.

2. A furnace for the heating of fluids comprising, in combination, a combustion zone, a heating zone, an air chamber and a stack disposed in superimposed relation, means for generating combustion gases in the combustion zone, a fluid conduit in said heating zone disposed to receive heat from combustion gases passing from the combustion zone through the heating zone to the stack, supporting means for said fluid conduit comprising substantially vertical tubular members, the lower ends of said tubular members being provided with openings for admitting air thereto from said air chamber and the upper ends of said tubular members being provided with openings for discharging air therefrom into the stream of combustion gases passing to the stack.

3. A heater for fluids comprising, in combination, a combustion and heating zone, means for generating combustion gases therein, an air chamber, a fluid conduit in said combustion and heating zone disposed to receive heat by radiation from said combustion gases, a stack adapted to draw combustion gases through and from said combustion and heating zone, supporting means for said fluid conduit having fluid passageways therethrough and exposed to heating by radiation from said combustion gases, said passageways being open to the air chamber and to the heating zone at opposite ends thereof whereby the draft action of said stack induces the flow of air through said fluid passageways to cool said supporting means and the stack gases.

4. A heater for fluids comprising, in combination, a combustion and heating zone, means for generating flames and hot combustion gases therein, an air chamber, a fluid conduit disposed adjacent walls of said combustion and heating zone out of the main path of flow of said flames and hot combustion gases, a fluid heating zone disposed above and in direct communication with said combustion and heating zone, a fluid conduit in said fluid heating zone disposed in the direct path of travel of combustion gases passing therethrough from said combustion and heating zone, a flue disposed above said fluid heating zone and leading to a stack, supporting means for said fluid conduits having fluid passageways therethrough and exposed to heating from said combustion gases, one end of each of said fluid passageways communicating with said air chamber and the opposite ends thereof communicating with the stream of com-

bustion gases passing from said fluid heating zone to the stack, whereby the draft action of the stack induces the flow of air through said fluid passageways to cool said supporting means and the stack gases.

5. A heater for fluids comprising, in combination, a combustion and heating zone, means for generating flames and hot combustion gases therein, an air chamber, a fluid conduit disposed adjacent walls of said combustion and heating zone out of the main path of flow of said flames and hot combustion gases, a fluid heating zone disposed above and in direct communication with said combustion and heating zone, a fluid conduit in said fluid heating zone disposed in the direct path of travel of combustion gases passing therethrough from said combustion and heating zone, a flue disposed above said fluid heating zone and leading to a stack, supporting means common to both of said fluid conduits having fluid passageways therethrough and exposed to heating from said combustion gases, one end of each of said fluid passageways communicating with said air chamber and the opposite ends thereof communicating with the stream of combustion gases passing from said fluid heating zone to the stack, whereby the draft action of the stack induces the flow of air through said fluid passageways to cool said supporting means and the stack gases.

6. A furnace for heating fluids comprising, in combination, substantially cylindrical outer walls defining an air chamber, a combustion and radiant heating zone and a superimposed fluid heating zone, a flue disposed above said fluid heating zone leading to a stack, means for protecting flames and hot combustion gases upwardly into said combustion and radiant heating zone, means for passing combustion gases from said combustion and radiant heating zone through said fluid heating zone to the stack, fluid conduits disposed adjacent said outer walls of the combustion and

radiant heating zone out of the main path of flow of said flames and hot combustion gases, fluid conduits in said fluid heating zone disposed in the direct path of flow of the combustion gases passing therethrough, substantially vertical tubular members extending through said combustion and radiant heating zone adjacent the outer walls thereof and supporting the fluid conduits in both of said zones, the lower ends of said tubular members being provided with openings communicating with said air chamber and the upper ends of said tubular members having openings communicating with the stream of combustion gases passing from the fluid heating zone to the stack.

7. A heating apparatus comprising a furnace having a stack, means for passing combustion gases through the furnace to the stack, heat absorbing elements within the furnace, supporting means for said elements having an air passage therethrough, one end of said passage being open to the atmosphere and the other end thereof being open to the interior of the furnace whereby the draft action of the stack induces air flow through said passage to cool the supporting means and to commingle the air with the combustion gases.

8. A heating apparatus comprising a furnace having an exit combustion gas passageway leading to a stack, means for passing combustion gases through the furnace to the stack, heat absorbing elements within the furnace, supporting means for said elements having an air passage therethrough which communicates adjacent one end thereof with the atmosphere and communicates adjacent its opposite end with said exit passageway for the combustion gases, whereby the draft action of the stack induces air flow through said passage to cool the supporting means and to commingle the air with the outgoing combustion gases.

MARION W. BARNES.