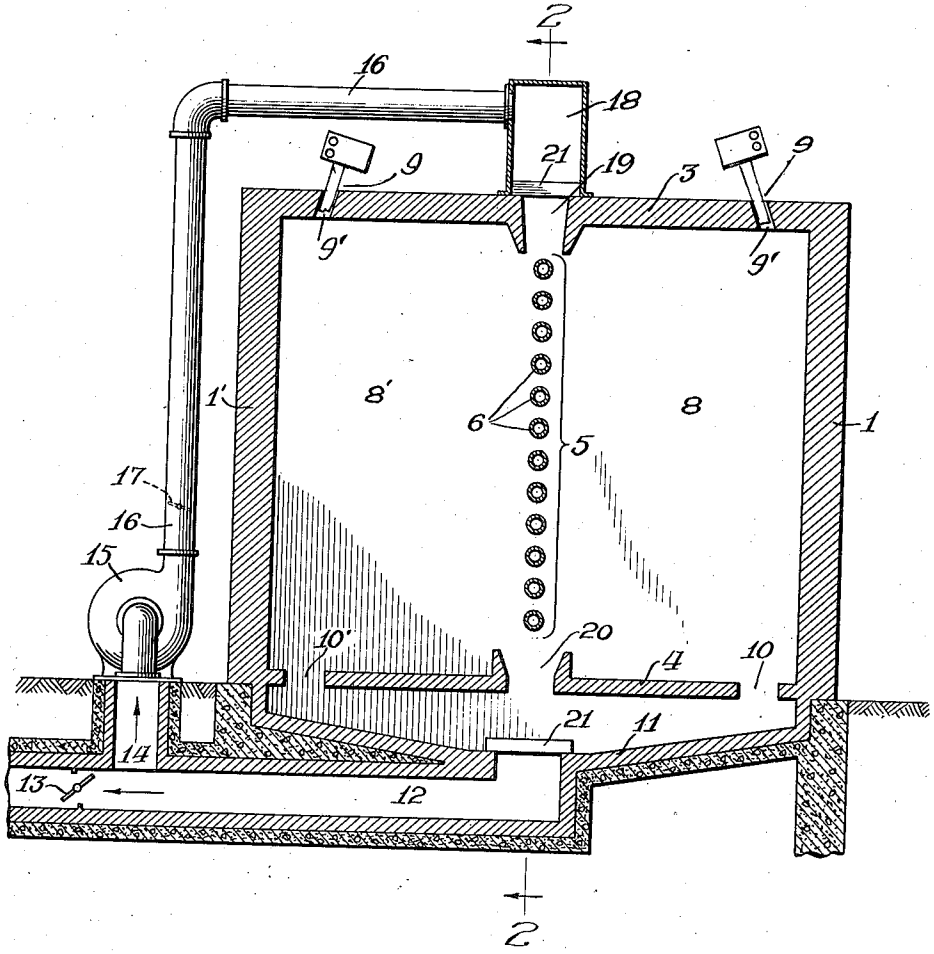
Aug. 4, 1936. J. D. SEGUY 2,049,473

HEATING OF FLUIDS

Filed March 17, 1933 2 Sheets-Sheet 1

Fig. 1.



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Filed March 17, 1933 2 Sheets-Sheet 2

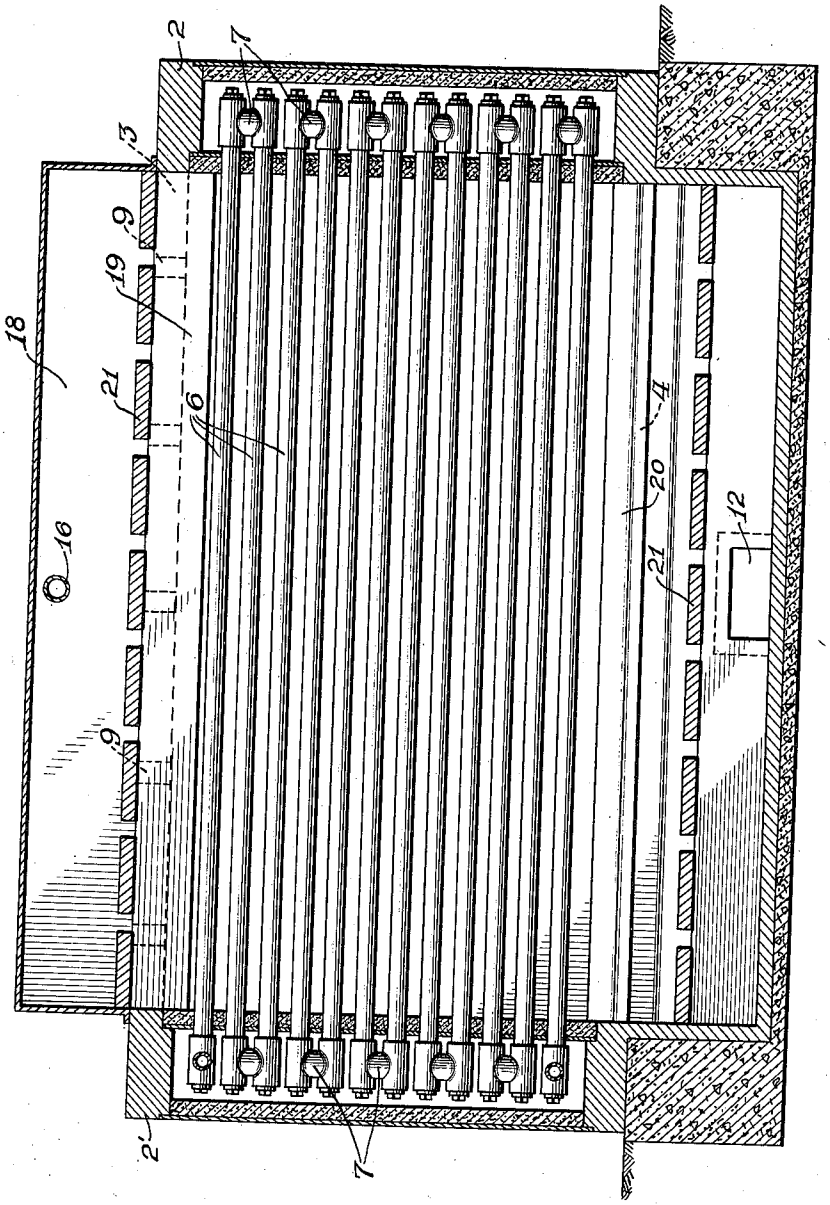


Fig. 2.

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HEATING OF FLUIDS

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8 Claims. (Cl. 122—356)

This invention relates to an improved form of furnace and method of heating, particularly adapted to the heating of hydrocarbon oils to conversion temperatures, of the type wherein the fluid conduit is subjected to substantially uniform heating on opposite sides substantially only by direct radiation from sources of heat, the improvements of the present invention comprising the controlled recirculation of combustion gases over the fluid conduit in such a manner as to effect a positive control over the fluid heat input to the tubes from the combustion gases and to modify the radiant heating effect from the flames and hot refractory surfaces of the furnace.

In the preferred embodiment of the invention combustion products withdrawn from the furnace are passed, by means of a suitable recirculating fan or blower, over the fluid conduit, preferably in a direction concurrent to the general direction of the flame in the combustion zones, said recirculating combustion gases forming a channel or enveloping layer of gases on both sides of the fluid conduit. In the case of a furnace enclosing a fluid conduit comprising a vertical bank of horizontally disposed tubes with combustion zones located on opposite sides of the fluid conduit, combustibles supplied thereto in a downward direction and flue gases removed from the lower portion of the furnace, constituting what may be termed a top-fired down-draft furnace, combustion products are removed from the combustion zones and are forced from a point above the fluid conduit over the tubes in a downward direction to an exit beneath the fluid conduit, thus setting up a cycle of enveloping gases around the tubes. Since the enveloping combustion gases are substantially the only fluid heating medium coming into direct contact with the tubes, their controlled recirculation serves as a means of controlling the fluid component of the total heat input to the tubes, thereby constituting an additional and positive means of regulating, within suitable limits, the rate of total heat input to the tubes. Obviously the enveloping layer of circulating combustion gases around the fluid conduit serves to modify the radiant heat component supplied to opposite sides of the tubes by direct radiation from the flames and from the hot refractory surfaces of the combustion zone. Also by surrounding the tubes with an enveloping layer of combustion gases they are protected from direct impingement of the flames and any consequent localized overheating.

The accompanying diagrammatic drawings (Figures 1 and 2) illustrate one specific form of furnace structure embodying the features and advantages of the present invention. Figure 1 is a sectional elevation of the furnace and Figure 2 is another sectional elevation of the same structure taken at right angles to Figure 1 along a plane indicated by the line 2—2 in Figure 1.

Referring to the drawings, the main furnace structure comprises side walls 1 and 1', end walls 2 and 2', a roof 3 and a floor 4. A single vertical row 5 of horizontally disposed tubes 6 connected, in the case illustrated, in series, by means of suitable return bends or headers 7 located outside the heating zone, comprises the fluid conduit through which the hydrocarbon oil or other material to be heated is passed. The tube bank or fluid conduit 5 is centrally located between the side walls 1 and 1', similar combustion zones 8 and 8' being provided on opposite sides of the fluid conduit.

Any suitable combustible fuel such as oil, gas or pulverized solid fuel is supplied by means of suitable burners 9 through firing ports 9' located, in the case illustrated, in the roof of the furnace to combustion zones 8 and 8'. Preferably, as indicated by burners 9 and firing ports 9', the combustibles are directed in a general downward direction and at a slight angle toward the side walls 1 and 1'. This serves to assist combustion and uniform distribution of the combustibles, causing the refractory walls 1 and 1' to be heated to a radiant condition and assists in preventing flame impingement of the tubes 6. Direct radiation from the flames in combustion zones 8 and 8' on opposite sides of the fluid conduit as well as radiation from the highly heated refractory walls of the furnace imparts heat to oppositely sides of each of the tubes 6 of the fluid conduit whereby a high average rate of heating around the entire circumference of each tube is secured. The combustion gases leave combustion zones 8 and 8' through the openings 10 and 10' respectively in the floor 4 of the furnace and pass through the space provided between the floor 4 and the sub-floor 11 to flue 12 from which a regulated portion of the combustion gases cooled and diluted by recirculated gases, as will be later more fully described, pass through regulating damper 13 to a stack, not shown.

In accordance with the provisions of the present invention, a portion of the combustion gases from combustion zones 8 and 8' are withdrawn from flue 12 through duct 14 to a suitable flue gas recirculating fan 15, driven by an electric motor or any other suitable motivating means, not shown in the drawings, by means of which

the combustion gases are directed through duct 16 controlled by damper 17 to a distributing header 18 wherefrom they are directed through port 19 in the roof of the furnace downward along opposite sides of the tubes 6 of the fluid conduit, forming a stream or channel of combustion gases enveloping the tubes and flowing downward through the furnace in a direction concurrent to the general direction of firing and the flow of hot combustion gases passing through ports 10 and 10'. The recirculated combustion gases having passed over the tube bank 5 flow through port 20 in floor 4 of the furnace to flue 12. Refractory blocks 21 placed above port 19 and above the opening in sub-floor 11 to flue 12 and spaced at the desired intervals serve as a means of evenly distributing the recirculated combustion gases along the entire length of the tubes 6 in the heating zone. Although not illustrated in the drawings, duct 16 and the distributing header 18 as well as the recirculating fan 15 preferably are well insulated in order to avoid excessive cooling of the recirculated combustion gases. By control of damper 17 and/or the speed of fan 15 the velocity of the recirculated gases and the volume of such gases flowing over tube bank 5 in a given time is controlled, thereby positively and effectively controlling the fluid heat input to the tubes and modifying the radiant heat effect from the flames and hot refractory walls of the furnace to any desired degree.

In a furnace of the type such as illustrated and above described but without means for recirculating flue gases in an enveloping stream or channel and in controlled quantities over the fluid conduit only a minor quantity of fluid heat is imparted to the tubes and the only means of controlling the heat input to the tubes is by controlling the firing conditions such as the volume of fuel supplied to the combustion zones, the volume of air relative to the volume of fuel and the draft. With the flue gas recirculating features of the present invention an additional and positive means of controlling the heating conditions is afforded, the recirculated gases serving to modify the intense heat imparted to the tubes by radiation from the flame and hot refractory walls of the furnace.

It will be understood that the features of the present invention may be incorporated in many furnace structures other than the specific form here illustrated and in its broad aspect the invention is limited only to the controlled recirculation of combustion gases in an enveloping stream or channel around a fluid conduit which is simultaneously subjected to heating substantially only by radiation.

I claim as my invention:

1. In a process for the heating of fluids wherein the fluid is passed through a conduit, within a furnace, heated on opposite sides by radiation, the improvement which comprises continuously withdrawing a stream of combustion gases from the furnace and recirculating said stream through the furnace in a layer enveloping the fluid conduit for the purpose of modifying the effect of such radiation on both sides of the conduit.

2. In a process for the heating of fluids wherein the fluid is passed through a conduit, within a furnace, subjected to heating on opposite sides by direct radiation from flames resulting from the combustion of fuel, the improvement which comprises continuously withdrawing from the furnace a stream of the gases resulting from such combustion and recirculating said stream through the furnace in a layer enveloping the fluid conduit to serve as a gaseous protecting medium on both sides of the conduit and modify the effect of such radiation.

3. In a process for the heating of fluids wherein the fluid is passed in a continuous stream through a fluid conduit comprising tubular elements located within a furnace, the opposite sides of each tubular element being subjected to heating by radiation from sources of heat, the improvement which comprises continuously withdrawing a stream of combustion gases from the furnace and recirculating said stream through the furnace over the fluid conduit in such a manner as to modify the effect of such radiant heating on both sides of the conduit.

4. In a process for the heating of fluids wherein the fluid is passed in a continuous stream through a fluid conduit comprising tubular elements located within a furnace, opposite sides of each element being heated by direct radiation from flames resulting from the combustion of fuel, the improvement which comprises continuously withdrawing a stream of gases resulting from such combustion from the furnace and recirculating said stream over the fluid conduit in such a manner as to modify the effect of such heating by radiation on both sides of the conduit.

5. In a furnace for the heating of fluids having a fluid conduit comprising a plurality of tubular elements located in a common vertical plane within a furnace structure, combustion zones located on opposite sides of the fluid conduit, means for supplying combustible fuel thereto and effecting its combustion in such a manner that opposite sides of each tubular element of the fluid conduit are heated by direct radiation from flames resulting from such combustion and means for continuously removing combustion gases from the combustion zones, the improved method of operation which comprises continuously withdrawing from the furnace a stream of the combustion gases and recirculating said stream through the furnace and over the fluid conduit in an enveloping layer which serves to protect both sides of the fluid conduit from overheating by modifying the effects of such radiant heating.

6. In a furnace for the heating of fluids having a fluid conduit comprising a plurality of tubular elements located in a common vertical plane within a furnace structure, combustion zones located on opposite sides of the fluid conduit, means for supplying combustible fuel thereto and effecting its combustion in such a manner that opposite sides of each tubular element of the fluid conduit are equally heated by direct radiation from flames resulting from such combustion and means for continuously removing combustion gases from the combustion zones, the improved method of operation which comprises continuously withdrawing from the furnace a stream of the combustion gases and recirculating said stream through the furnace and over the fluid conduit in an enveloping layer which serves to protect both sides of the fluid conduit from overheating by modifying the effects of such radiant heating.

7. A heating apparatus comprising a furnace having a pair of heat radiant walls, a fluid heating conduit between and spaced from said walls, means for impinging flame angularly against each of said walls on the side thereof facing said conduit to heat opposite sides of the conduit by direct radiation from the flames and by radiation from the walls, means for withdrawing combustion

gases from the furnace, and means for recirculating a portion of the withdrawn gases through the furnace in an enveloping layer over said conduit.

8. A heating apparatus comprising a furnace having a pair of heat radiant walls, a plurality of horizontal heating tubes disposed in a vertical plane between and spaced from said walls, means for impinging flame downwardly and angularly against each of said walls on the side thereof facing the tubes, means for withdrawing combustion gases from the furnace, and means for recirculating a portion of the withdrawn gases downwardly through the furnace in an enveloping layer over the tubes.

JEAN DELATTRE SEGUY.