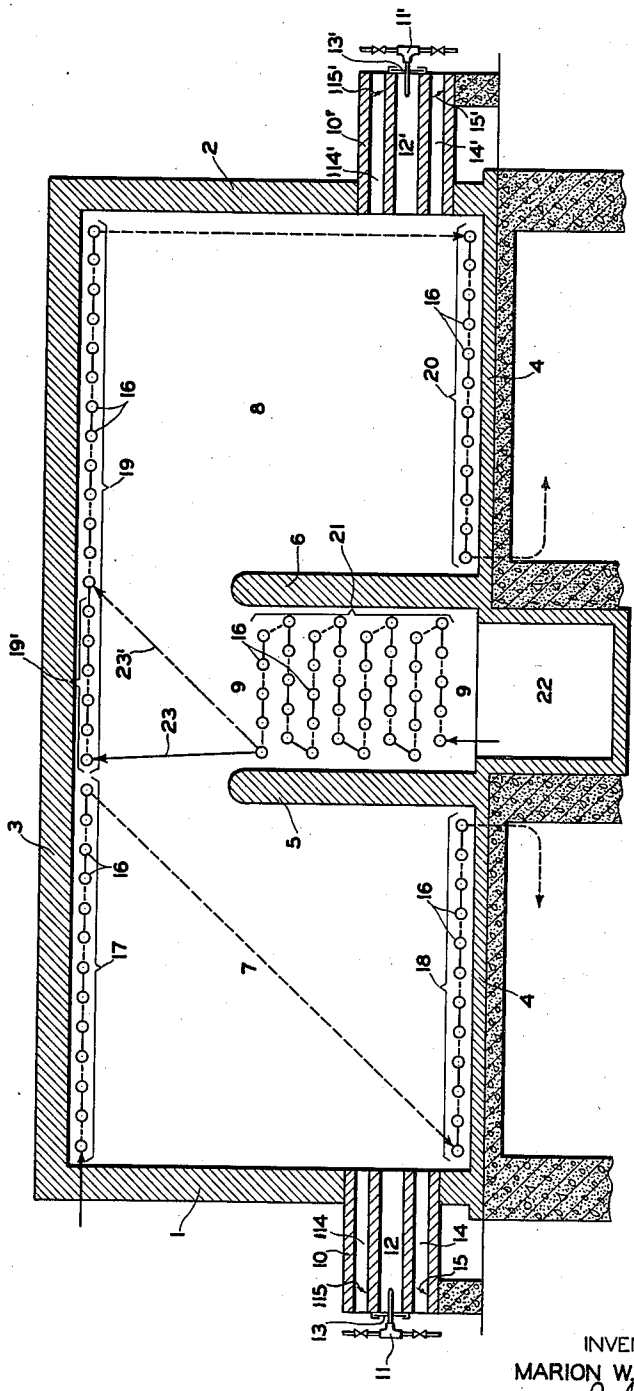
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HEATING OF FLUIDS

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HEATING OF FLUIDS

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This invention is more particularly directed to the heating of hydrocarbon oils to the high temperatures required for their pyrolytic conversion. It embodies improvements to the form of heater now generally known as the "double-end-fired" type of furnace, which improvements make the furnace particularly adaptable to the simultaneous treatment of two separate streams of different hydrocarbon oils whereby each oil is subjected to independently controlled heating conditions regulated to suit its particular requirements and whereby each oil is subjected to substantially progressively increasing rates of heating during its flow through the heating coil.

One specific embodiment of the improved furnace structure provided by the present invention comprises two separate combustion and heating zones, means for independently supplying combustible materials in regulated amounts to each combustion zone, means for independently controlling the characteristics of the flame in each combustion zone, a convection heating zone located between said combustion and heating zones, means for passing hot combustion gases from both combustion and heating zones through said convection heating zone, a fluid conduit located adjacent the roof of each combustion zone, a fluid conduit located adjacent the floor of each combustion zone, a fluid conduit located within said convection heating zone, means for passing a stream of hydrocarbon oil first through the fluid conduit adjacent the roof of one combustion zone, then through the fluid conduit adjacent the floor of the same combustion zone and means for simultaneously passing a stream of different hydrocarbon oil first through the fluid conduit in said convection heating zone, then through the fluid conduit adjacent the roof of the other combustion zone and finally through the fluid conduit adjacent the floor of the last mentioned combustion zone.

The process of the present invention comprises, in its specific embodiment, simultaneously heating two separate streams of different hydrocarbon oils each under independently controlled heating conditions in the same furnace structure, subjecting each stream to substantially progressively increasing rates of heating during its entire heat treatment and subjecting each oil to independently controlled conversion conditions.

The accompanying diagrammatic drawing is a cross-sectional elevation of one specific form of furnace structure embodying the features of the present invention. The following description of the drawing includes a description of the operation of the furnace and will serve to more clearly illustrate the methods of heating provided by the process of the invention.

Referring to the drawing, the main furnace structure comprises end walls 1 and 2, a roof 3, a floor 4 and side walls which are not indicated in the particular view of the furnace here illustrated. The interior of the furnace is divided by means of bridge walls 5 and 6 into two separate combustion and heating zones 7 and 8 and a centrally located convection heating zone 9.

One or, preferably, a plurality of firing tunnels, designated in the drawing as 10 and 10', communicate through the respective end walls 1 and 2 with the respective combustion and heating zones 7 and 8. Combustible fuel of any desired form together with any air or steam required for atomization, is supplied by means of burners 11 and 11' through respective firing compartments 12 and 12' of the respective firing tunnels 10 and 10' to the respective combustion and heating zones 7 and 8. A regulated portion or all of the air required for combustion may be supplied to firing compartments 12 and 12', respectively, by means of suitable regulating shutters or dampers 13 and 13' and is thereby transmitted with the fuel to the respective combustion and heating zones. Additional air for combustion and/or any desired quantity of excess air may be supplied direct to combustion and heating zones 7 and 8 by means of the respective air ducts 14, 114, 14' and 114' controlled by dampers 15, 115, 15' and 115' respectively, said air ducts being located both above and beneath firing compartments 12 and 12'.

By independently controlling the quantity of fuel supplied to the two combustion and heating zones the temperatures of each may be independently controlled and further control over the heating conditions in each zone is obtained by independently regulating the relative proportions of fuel and air supplied to each combustion zone. The characteristics of the flames in each combustion zone are independently controlled by regulating the amount of excess air supplied to each combustion zone and by the provisions for controlling the method of introducing the air to each combustion zone. By varying the relative quantities of air supplied to the combustion zones above and beneath the firing compartments more or less heat may be concentrated, as desired, along the roof or along the floor of each combustion zone. The length and luminosity of the flame in each combustion zone may be controlled, without varying the fuel air ratio, by regulating

the proportion of the total air supplied to each combustion zone through firing compartments 12 and 12' respectively as compared with that supplied through the upper and lower air ducts.

A fluid conduit 17 comprising, in the case illustrated, a single horizontal row of horizontally disposed tubes 16, extending between the side walls of the furnace parallel to end wall 1, is located adjacent the roof of combustion and heating zone 7 and a similar fluid conduit 18 is located adjacent the floor of the same combustion zone. Another similar fluid conduit 19 is located adjacent the roof of combustion and heating zone 8, which also contains another similar fluid conduit 20 located adjacent its floor. Although each of the tube banks or fluid conduits 17, 18, 19 and 20 comprise, in the case here illustrated, a single horizontal row of tubes it is, of course, within the scope of the invention to employ more than a single row of tubes in any or all of the banks and it is also within the scope of the invention to employ tubes of either the same or different size in the various banks, although the tubes are all indicated in the drawing by the reference number 16. Another fluid conduit 21 comprising, in the case here illustrated, a plurality of super-imposed horizontally parallel rows of horizontally disposed tubes 16 of any desired size extending between the side walls of the furnace is located within convection heating zone 9.

Heat is transmitted from the materials undergoing combustion in combustion zones 7 and 8 and from the hot refractory walls of the furnace to the tubes of banks 17, 18, 19 and 20 predominantly by radiation. The hot combustion gases from combustion zones 7 and 8 pass over the respective bridge walls 5 and 6 and commingle above convection heating zone 9, through which the commingled combustion gases pass, over the tubes of bank 21, transmitting convection heat thereto, and enter flue 22 from which they pass to a suitable stack, not shown.

In the case here illustrated adjacent tubes in each of the banks 17, 18, 19, 20 and 21 are connected at their ends in series by means of suitable return bends located outside the heating zone. The return bends are not illustrated in the drawing but the connections between the tubes on the near side of the furnace are indicated by full single lines while those on the far side are indicated by dotted lines. The solid and dotted lines connecting the various tube banks indicate outside cross-over connections on the near and far side of the furnace, respectively. The arrows on these lines indicate the general direction of flow of the oil and the sequence of flow through the various tube banks.

In accordance with the features of the present invention one stream of hydrocarbon oil, comprising, for example, reflux condensate from within the cracking system or gas oil or other distillate suitable for conversion is supplied to the end tube of bank 17 adjacent wall 1 of the furnace flowing in series through adjacent tubes in this bank to its opposite end, in a general direction concurrent to the direction of firing in combustion and heating zone 7, and is then directed to the end tube of bank 18 adjacent wall 1 of the furnace, flowing in series through adjacent tubes in this bank in a general direction concurrent to the direction of firing, to be discharged from the end tube of bank 18 adjacent bridge wall 5 to subsequent portions of the cracking system not pertinent to the present invention. Simultaneously a separate stream of different hydrocarbon oil of any desired nature, such as, for example, crude petroleum, topped crude, fuel oil or the like is supplied to an end tube in the lower most row of tube bank 21, flowing in series through adjacent tubes and adjacent rows of tubes in this bank, in a general direction countercurrent to the direction of flow of the combustion gases passing through zone 9 of the furnace, to the end tube of the uppermost row of this bank, wherefrom it passes to the end tube of bank 19 adjacent bank 17, flowing in series through adjacent tubes of this bank, in a general direction countercurrent to the direction of firing in combustion and heating zone 8, to the end tube of this bank adjacent wall 2, from which it passes to the end tube of bank 20 adjacent wall 2, flowing in series through adjacent tubes of this bank, in a general direction concurrent to the direction of firing, to be discharged from the end tube of bank 20 adjacent bridge wall 6 to subsequent portions of the cracking system not pertinent to the present invention.

It will be understood that various modifications of the specific flow above described may be employed without departing from the spirit and scope of the present invention. For example, the direction of flow through any of the various banks may be reversed, when desired, and, when desired, all or a portion of the tubes in any bank may be connected in parallel instead of in series.

It is also specifically within the scope of the present invention to omit the tubes of bank 19 which are directly above convection heating zone 9 of the furnace. This section of bank 19 is indicated in the drawing at 19'. In such cases line 23' instead of line 23 connects tube bank 21 with the remaining portion of bank 19. When this method of flow is employed the temperature of the combustion gases entering convection heating zone 9 is ordinarily somewhat higher than when bank 19' is employed, due to the absence of the cooling effect of the tubes of bank 19', and consequently a somewhat higher rate of heating may be obtained in tube bank 21, particularly in the upper two or three rows of this bank.

I claim as my invention:

1. A furnace for the heating of fluids which comprises, in combination, two separate combustion and heating zones, means for independently supplying combustible fuel in regulated amounts to each combustion and heating zone, means for independently controlling the characteristics of the flame and the heating conditions in each combustion and heating zone, a convection heating zone located between said separate combustion and heating zones, means for passing combustion gases from each combustion and heating zone through said convection heating zone, a fluid conduit located adjacent the roof of each combustion and heating zone, a fluid conduit located adjacent the floor of each combustion and heating zone, a fluid conduit located within the convection heating zone, means for passing hydrocarbon oil in a continuous stream through the fluid conduit adjacent the roof of one combustion and heating zone and then through the fluid conduit adjacent the floor of the same zone, means for simultaneously passing a different hydrocarbon oil in a continuous stream through the fluid conduit in the convection heating zone, then through the fluid conduit adjacent the roof of the other com-

bustion and heating zone and then through the fluid conduit adjacent the floor of the last mentioned combustion and heating zone.

2. A furnace for the heating of fluids which comprises, in combination, two separate combustion and heating zones, means for independently supplying combustible fuel in regulated amounts to each combustion and heating zone, means for independently controlling the characteristics of the flame and the heating conditions in each combustion and heating zone, a convection heating zone located between said separate combustion and heating zones, means for passing combustion gases from each combustion and heating zone through said convection heating zone, a fluid conduit located adjacent the roof of each combustion and heating zone, a fluid conduit located adjacent the floor of each combustion and heating zone, a fluid conduit located within the convection heating zone, means for passing hydrocarbon oil in a continuous stream through the fluid conduits adjacent the roof and floor of one combustion zone in series and in a general direction concurrent to the direction of firing in said zone and means for simultaneously passing a different hydrocarbon oil in a continuous stream through the fluid conduit in the convection heating zone and through the fluid conduits adjacent the roof and floor of the other combustion and heating zone in series.

3. In the heating of hydrocarbon oils to conversion temperatures in furnaces of the character having a pair of independently fired combustion zones and a convection zone supplied with combustion gases from both said combustion zones, the method which comprises passing a stream of oil first adjacent the roof and then adjacent the floor of one of said combustion zones, and simultaneously passing a second stream of oil first through the convection zone and then adjacent the roof and finally adjacent the floor of the other of said combustion zones, and subjecting both said streams to progressively increasing rates of heating during their flow through the furnace.

4. In the heating of hydrocarbon oils to conversion temperatures in furnaces of the character having a pair of independently fired combustion zones and a convection zone supplied with combustion gases from both said combustion zones, the method which comprises passing a hydrocarbon oil in a continuous uninterrupted stream through one of said combustion zones adjacent the roof and adjacent the floor thereof, simultaneously passing a second hydrocarbon oil in a continuous uninterrupted stream through the convection zone and through the other of said combustion zones adjacent the roof and adjacent the floor thereof, and subjecting both said streams to progressively increasing rates of heating during their flow through the furnace, the streams being most strongly heated while adjacent the floor of each combustion zone.

5. In the heating of hydrocarbon oils to conversion temperatures in furnaces of the character having a pair of independently fired combustion zones and a convection zone supplied with combustion gases from both said combustion zones, the method which comprises passing a hydrocarbon oil in a continuous uninterrupted stream through one of said combustion zones adjacent the roof and adjacent the floor thereof, simultaneously passing a heavier hydrocarbon oil in a continuous uninterrupted stream through the convection zone and through the other of said combustion zones adjacent the roof and adjacent the floor thereof, and subjecting both said streams to progressively increasing rates of heating during their flow through the furnace, the streams being most strongly heated while adjacent the floor of each combustion zone.

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