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APPARATUS FOR HEATING GASES

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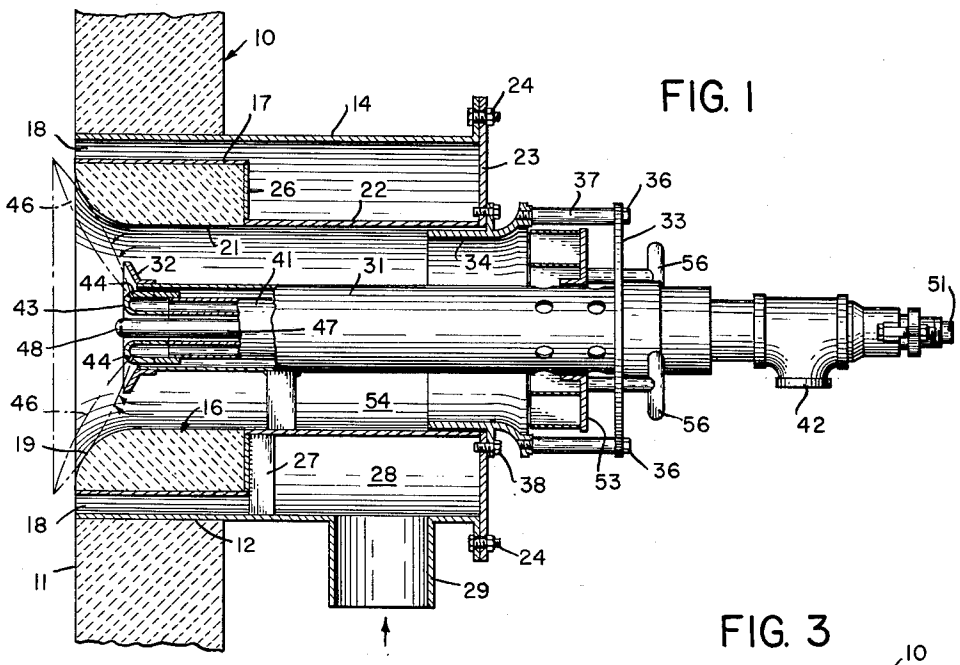


FIG. 1

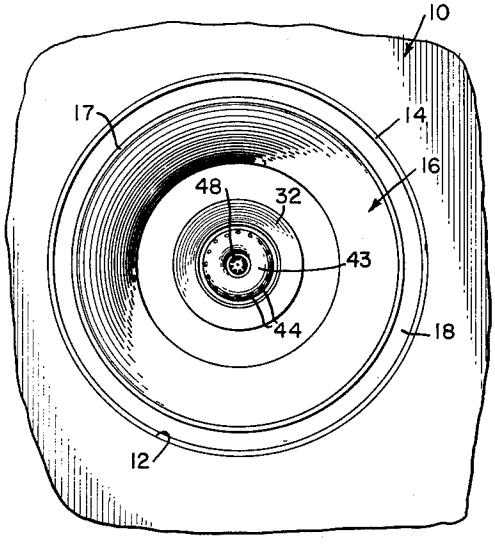
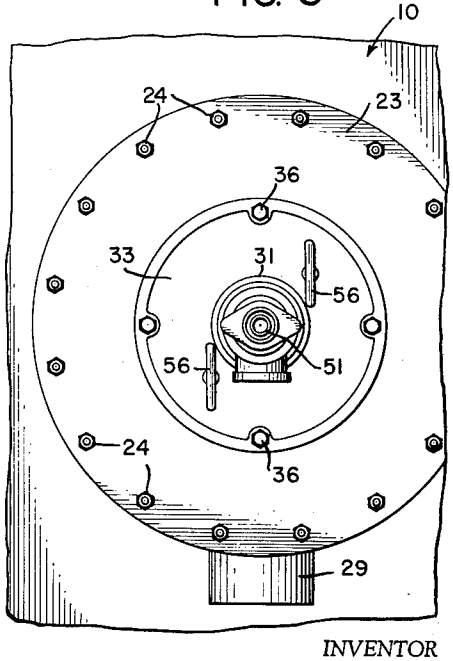


FIG. 2

FIG. 3



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APPARATUS FOR HEATING GASES

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The present invention relates to apparatus for heating gaseous fluids and more specifically pertains to means in association with a fuel burner guiding a gaseous medium into heat transfer relationship and into substantially intimate contact with the heat produced by the burning fuel.

In the chemical, petroleum and process industries it is often necessary to elevate the temperature of a gaseous medium which may be non-combustible or partially combustible in the presence of oxygen. It is often desirable that the combustible elements of the gaseous medium be heated to develop exothermic oxidation of the combustible components for the recovery of heat. In other instances it is desirable to heat a non-combustible gaseous medium which in turn serves to deliver heat to other areas. Apparatus is known which provides for the indirect heating or firing of such gaseous fluids but such equipment is complex and costly and the present invention is directed to apparatus for moving a gaseous medium to be heated into the presence of a flame produced by a fuel burner so that the heat developed by the burning fuel is transferred to the gas the instant that the fuel is burned and there is no delay in contact of the heat developed by the burning fuel with the gaseous medium.

An object of the invention is to provide casing means in association with a fuel burner for delivering a gaseous medium into the presence of the burning fuel in a zone where the combustion of the fuel is virtually complete with the gaseous medium delivered into a zone at the downstream end of the flame produced by the burning fuel thereby providing apparatus for heating large volumes of gases and with the heat delivered uniformly throughout the mass of the gaseous medium and without the necessity of accessory devices for recycling the gaseous medium into the presence of the heat source.

Another object of the invention is to provide apparatus for continuously heating a moving gaseous medium and to uniformly heat the gaseous material without the necessity of providing supplemental means for forcing contact of the hot gases produced by burning fuel with the gaseous medium to be heated.

A further object of the invention is to provide a fuel burner wherein the flame and the heat pattern of the burning fuel has an annular shape and with casing means forming an annular passageway delivering the gaseous fluid as an annular stream transversely of the perimeter of the burning fuel and into intimate contact with the heat at the perimeter of the heat pattern.

Other objects and features of the invention will be appreciated by those skilled in the art to which the invention pertains as the present disclosure proceeds and upon consideration of the annexed drawing and the following detailed description wherein one embodiment of the invention is disclosed.

In the drawing:

FIG. 1 is an axial sectional view of apparatus exhibiting the invention.

FIG. 2 is an elevational view of the downstream end of the apparatus and showing a fragmentary portion of a wall supporting the apparatus.

FIG. 3 is an elevational view of the rear end of the apparatus.

The invention is directed to means in association with a fuel burner for heating a gaseous medium and in a continuous manner as the gaseous fluid flows in the presence of the burner head. In the embodiment illustrated

in the drawing the assembly is supported on a wall 10 of a refractory type which also serves the purpose of providing a barrier so that a pressure differential may be maintained on opposite sides of the wall. A pressure below atmospheric may thus be established beyond the downstream face 11 of the wall 10. A relatively large cylindrical opening 12 is provided in the wall 10 for accommodating a generally cylindrical shaped casing 14. The free end of the casing 14 may terminate flush with the downstream face 11 of the wall 10 and may be anchored to the wall in any suitable manner.

A ring-shaped tile member 16 formed of refractory material is arranged within the opening 12. The tile member is partially encased by a sleeve 17 of cylindrical shape having a smaller diameter than the interior of the casing 14. An annular passage 18 is thereby provided between the perimeter of the sleeve 17 and the interior of the casing 14. The downstream end of the tile member 16 is arcuate shaped as indicated at 19 to provide an outwardly flaring profile in section at the exit end of the tile member 16. The remaining inner portion of the tile member 16 has a cylindrical interior surface 21.

A tubular element 22 having an internal diameter substantially equal to the diameter of the surface portion 21 of the tile member 16 carries a flange 23 at the upstream end thereof which is joined to the upstream end of the casing 14 in any suitable manner such as by means of a bolt and nut assemblies 24. The sleeve 17 encasing the tile member is joined to the tubular element 22 by means of a flange 26. The structure may be reinforced to provide additional support for the tile member 16 by means of a plurality of lugs one of which is shown at 27 in FIG. 1. The lugs 27 are circumferentially spaced about the perimeter of the assembly. The free end of each lug 27 is in abutting relationship with the interior of the casing 14 and the inner end of the lugs may be welded to the tubular element 22 and to the flange 26 as indicated in FIG. 1.

The casing 14 and the tubular element 22 and the parts associated therewith provide a chamber 28 which is in communication with the annular passage 18. The casing 14 carries a radially disposed conduit 29 for connection to a source of the gaseous medium which is to undergo heat treatment. The gaseous medium enters the annular space 28 and moves through the passage 18 by reason of the fact that the pressure downstream of the wall 10 is lower than atmospheric. If necessary means may be provided for forcing the gaseous medium through the annular passage 18. It is desirable that the gaseous medium move through the annular passage 18 at fifty feet or more per second.

The open area provided interiorly of the tubular element 22 provides space for accommodating a burner head and for the flow of secondary air. The burner may be of any suitable type but desirably produces a flame having an annular shape or pattern. In the embodiment illustrated in the drawing a guide tube 31 extends coaxially of the tubular element 22. The downstream end of the guide tube 31 carries a frusto-conical shield 32. The guide tube 31 is supported by a disc-shaped member 33 which is secured to the flange 23 in a conventional manner by means of a thimble 34. Cap screws 36 and spacer elements 37 serve to support the disc-shaped member in spaced relationship with respect to the upstream end of the thimble 34. The thimble 34 is secured to the flange 23 by means of cap screws 38. An annular conduit 41 for the gaseous fuel is mounted within the guide tube 31 and it is supplied with gaseous fuel through the fitting 42. The annular burner head 43 for the gaseous fuel is provided with a plurality of discharge ports 44 which have their axes so disposed as to provide an annular

flame of substantially frusto-conical shape as represented at **46**.

If desired the burner may be of the type for the combustion of liquid fuel and such a burner includes a pipe **47** arranged inside the conduit **41** and provided with a nozzle **48**. The liquid is supplied through an inlet fitting **51** on the tube **47**. The nozzle **48** is provided with ports which function to discharge the atomized liquid to provide a flame having an annular shape or frusto-conical pattern somewhat like that represented at **46**. If desired both burners may be operated simultaneously.

An air control door structure **53** is provided for controlling the volume of air admitted into an annular space **54** provided around the guide tube **31**. The door structure **53** is adapted to slide on the guide tube **31** and may be moved by means of handles **56**. It is desirable that the air move at a velocity of at least fifty feet per second so as to provide for extremely rapid burning of the fuel. The fuels are delivered to the respective burner heads at a velocity between six hundred and three thousand feet per second. The fuel streams accordingly move at very high velocity and carry huge quantities of energy. The air moving in the annular space **54** is at low velocity and accordingly carries very little energy. The high velocity fuel streams issuing from the respective burner ports set up low pressure zones at the points of discharge. Thus there is extremely rapid mixing of the fuel with the air and extremely rapid burning of the fuel. The fuel is virtually burned by the time it arrives adjacent of the drownstream end of the annular passage **18**.

There is no mixing of the gaseous medium moving in the annular passage **18** with either type of fuel nor is there any mixture of the gaseous medium flowing through the annular passage **18** with the air for the fuel burners prior to the arrival of the gaseous medium at the exit end of the annular passage **18**. The gaseous medium escaping through the exit end of the passage **18** and moving at a velocity of at least fifty feet per second is instantly and evenly mixed with the hot gases produced by the burning fuel. It is this even and instant mixture of the heat with the gaseous fluid which produces an even temperature throughout the gaseous mass. Such an assembly contributes to a reduction of the space for accommodating a large volume of the gaseous material undergoing heat treatment. The high velocities of the fuel streams provides rapid mixture of the fuel and air and high inertia for the fuel mixture which supplies energy for mixture with the gaseous fluid.

In the event that the gaseous medium is an inert gas the quantity of air admitted to the presence of the burning fuel is limited by moving the air door structure **53** towards the closed position so that the air admitted is limited to that required for burning the fuel. If the gaseous medium flowing through the passage **18** carries combustible elements the quantity of air admitted to the presence of the burner head is increased by shifting the door structure **53** towards a more open position so that the air entering the annular space **54** is then sufficient for burning the fuel plus that required for burning the combustible elements of the gaseous medium. As a consequence of the high energy of the fuel streams the air is entrained with the fuel streams for instant delivery to the combustible elements if they are carried by the gaseous medium flowing through the annular passage **18**. The temperature of the gaseous medium is elevated to a point above the kindling temperature of the combustibles.

While the invention has been described with reference to one general organization including burner heads of a particular type it will be appreciated that changes may be made in the overall assembly along with changes in the various elements. Such modifications and others may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. Apparatus for heating a gaseous fluid comprising, a wall having a downstream face and an exterior face, said wall having a circular opening therethrough, a cylindrical shaped casing fitting within said opening and extending from the exterior face of said wall, a tubular element of smaller diameter than said casing arranged substantially concentrically therewithin, a sleeve carried by said tubular element within said casing having an end within said opening and forming an annular passage between the casing and the sleeve, a ring shaped tile member fitting within said sleeve and having an inner annular surface substantially flush with an inner annular surface of said tubular element, means spaced from said exterior face joining the casing with the tubular element providing a close annular chamber, means for guiding a gaseous fluid into said annular chamber for movement through said annular passage for discharge as an annular stream from the downstream face of said wall, a tube of smaller diameter than said tubular element arranged substantially concentrically therein, a fuel burner head supported by said tube within the opening in said wall, means for supplying fuel to said burner head, said tubular element and said tube forming an annular passage therebetween for movement of air into the presence of the burner head, and said burner head having discharge ports providing an annular pattern of burning fuel extending generally radially from the burner head to heat the gaseous fluid as it is discharged from said annular passage.

2. Apparatus for heating a gaseous fluid according to claim 1 wherein, an annular flange extends from the sleeve to the tubular element and covers an inner end of the tile member.

3. Apparatus for heating gaseous fluid according to claim 1 wherein, the downstream end of the tile member flares outwardly in proceeding from its inner annular surface.

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