

[54] **COMBUSTION CHAMBERS**
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[51] Int. Cl..... **F23d 15/00**
[58] Field of Search 431/351, 352; 60/39.65,
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[57] **ABSTRACT**

In a combustion chamber of the flame tube type in which air is intimately mixed with a fuel spray, the air being split into primary and secondary flow paths which enter the combustion chamber at different points along its length, the flame tube is formed of two independently supported tube lengths which define between them the inlet for the secondary air flow.

4 Claims, 5 Drawing Figures

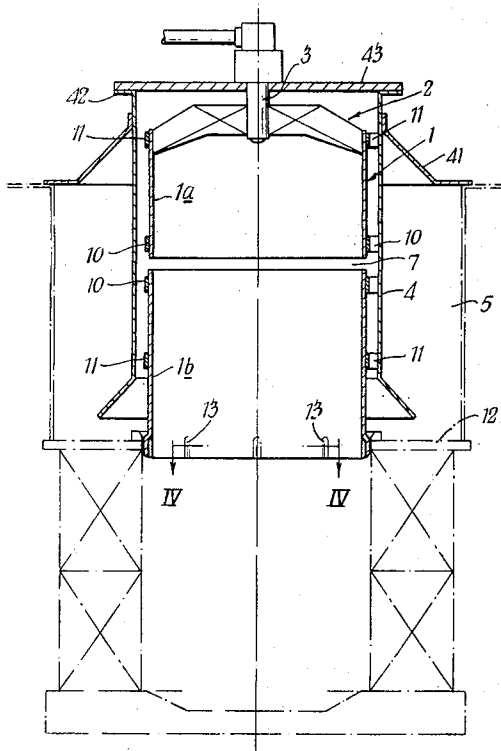


FIG. 1

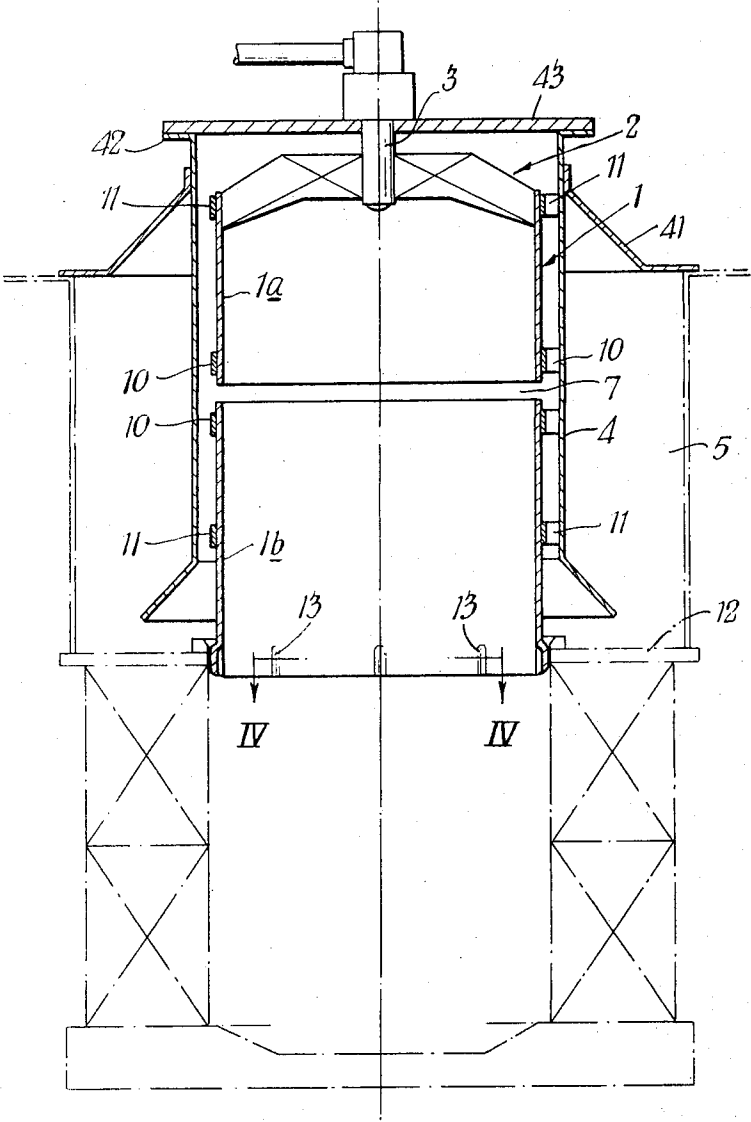


FIG. 2

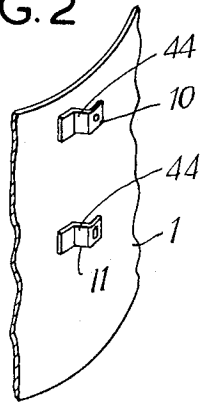


FIG. 3

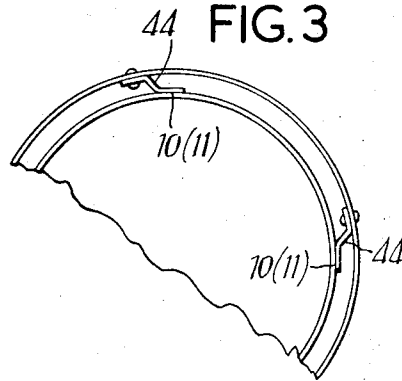


FIG. 4

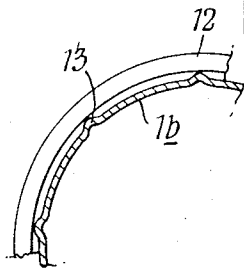
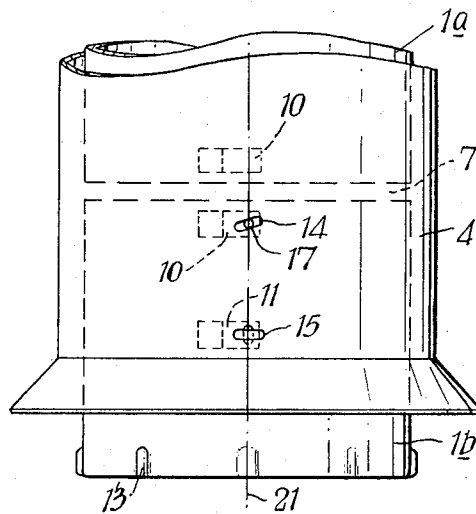


FIG. 5



COMBUSTION CHAMBERS

This invention relates to combustion chambers for heaters or boilers of the flame tube type in which air is intimately mixed with a fuel spray, the air being split into primary and secondary flow paths which enter the combustion chamber at different points along its length.

A combustion chamber of the type with which the invention is concerned will comprise a flame tube with an inlet arrangement part-way along its length for the introduction of the secondary air. The effect of this secondary air flow into the flame tube is to cause the combustion gases passing along the tube to turn inwards and back thereby describing a toroidal path. This promotes further mixing of the fuel spray and air and ensures that combustion is substantially complete by the time the gases leave the flame tube.

The main problem with which the present invention is concerned is to provide an efficient but relatively inexpensive arrangement for introducing the secondary air and which does not so weaken the flame tube that there is a tendency for it to buckle.

This problem is solved according to the present invention by forming the flame tube in two independently supported tube lengths which define between them the inlet for the secondary air flow. Thus the inlet for the secondary air flow can be formed as a continuous slot around the periphery of the flame tube. Further, separate replacement of each length of the flame tube is facilitated, and by independently supporting the two lengths of the flame tube, structural weakness at the inlet for the secondary air flow is eliminated.

Advantageously the two flame tube lengths are rigidly secured to supporting structure adjacent the inlet for the secondary air in order to maintain the width of this inlet substantially constant, but have a freedom of movement longitudinally away from this rigid securement to allow for thermal expansion of the flame tube.

In further development of the invention at least one of the flame tube lengths is mounted on the supporting structure in such manner that it can be adjusted to vary the width of the inlet for the secondary air.

This facility to adjust the width of the inlet enables accurate setting of the inlet during assembly while allowing relatively wide manufacturing tolerances. It also enables the width of the inlet to be adjusted to suit different firing conditions in the combustion chamber and its air supply.

Conveniently the adjustment can be provided by slots in the supporting structure in which are located securing bolts for the flame tube length, the slots extending circumferentially of the combustion chamber and being inclined to the combustion chamber axis so that they are for example helical to the combustion chamber axis. Thus rotation of the flame tube length about the combustion chamber axis will cause the flame tube length to move along its axis to adjust the width of the inlet for the secondary air.

Constructions of combustion chamber in accordance with the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a sectional elevation of a heater or boiler incorporating a combustion chamber in accordance with the invention,

FIG. 2 is a perspective view of a detail,

FIG. 3 is a plan view of a detail,

FIG. 4 is a part section on the line IV—IV of FIG. 1, and

FIG. 5 is an elevational view showing a modified form of support for the combustion chamber.

In FIG. 1 the chained dotted lines illustrate the features of the boiler or heater which are not directly concerned with the present invention.

The combustion chamber consists of a flame tube 1 made of a heat resisting metal alloy. Inserted into the top of the flame tube is an air swirler assembly 2 including swirl vanes and through which fuel spray device 3 projects. The primary air flows into the chamber via the swirl vanes which impart a swirling movement to the air. The secondary air flow passes into the chamber via slot 7 part way along the flame tube 1.

Air for combustion is fed by a fan into the air box 5 and passes up the annular space formed between the outer sleeve 4 and the flame tube 1. If additional air is needed, holes can be provided in the sleeve 4. The outer sleeve 4 is made in a medium temperature alloy to withstand the temperature caused by radiation from the flame tube and the incandescent gas in the region of the slot 7 and is supported on the boiler through structure 41. It carries a flange 42 on its upper end to which the plate 43 carrying the fuel spray device 3 and associated component equipment is bolted.

The flame tube 1 is split into upper and lower sections 1a and 1b so that it is effectively formed of two tube lengths each independently supported by the outer sleeve 4, and defining between them the continuous inlet slot 7 for the secondary air flow around the whole periphery of the flame tube.

In order to mount the flame tube sections 1a and 1b on the sleeve 4 in such a manner that the slot width stays substantially constant when the temperature rises brackets 10 and 11 are used. Brackets 10 adjacent the slot 7 are made to locate the flame tube sections 1a and 1b axially as well as radially, whereas the brackets 11 adjacent the upper and lower ends of the flame tube are designed to allow some axial movement so that the differential expansion lengthwise between the flame tube and outer sleeve 4 can be allowed for. It is important that the brackets 10 are located as near to the slot 7 as possible so that each section of the flame tube expands away from the slot region, the slot 7 staying at constant gap width. In the example shown in FIG. 3, four of the brackets 10 and 11 are arranged on each circumference, but three or even two brackets could be used. This expansion of the flame tube necessitates that it be free to expand downwise through the hole in the plate 12. In order to hold the flame tube central in the hole leaving a small cooling air gap surrounding the tube, it may be necessary to press out some local raised bosses in the lower region of the tube as indicated at 13 in FIG. 4.

In FIG. 2 a vertical slot is shown in the bracket 11 to allow for axial expansion but, of course, the slot could equally be in the outer sleeve 4. The flame tube sections 1a and 1b also expand radially more than the outer sleeve 4 due to the higher temperature of their inner wall. Because of this it is important that the brackets 10 and 11 allow for the differential radial expansion; this is achieved by cranking the brackets as shown in FIG. 3 so that the part 44 of the brackets 10 and 11 spanning the annulus is at an angle to the radial

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direction. A reduction in the annular gap will then be permitted by variation of the angle, the flame tube in the view shown in FIG. 3, turning slightly clockwise relative to the outer sleeve 4.

Referring now to FIG. 5, for identification purposes the same reference numerals have been used as in FIGS. 1 to 4. Thus the flame tube 1 is split into upper and lower sections 1a and 1b each independently supported from the outer sleeve or muff 4 and defining between them a continuous inlet slot 7 for the secondary air flow.

In order to mount the flame tube sections 1a and 1b on the outer sleeve 4 the brackets 10 and 11 are used. Brackets 10 adjacent the slot 7 are made to locate the flame tube sections 1a and 1b axially as well as radially so that the slot 7 is maintained at constant width, whereas the brackets 11 adjacent the upper and lower ends of the flame tube are designed to allow some axial movement so that the differential expansion lengthwise between the flame tube and outer sleeves 4 can be allowed for. Thus the brackets 11 are provided with slots elongated in the axial direction of the combustion chamber for receiving fixing bolts for securing the flame tube sections 1a and 1b to the sleeve 4 precisely as shown in FIG. 2.

In order to enable adjustment of the width of the slot 7 the fixing bolts passing through the brackets 10 of the lower flame tube section 1b are located in helically extending slots 14 in the supporting sleeve 4 so that rotation of the flame tube section 1b about the combustion chamber axis 21 will cause the section 1b to move along the axis 21 relatively to the sleeve 4. After adjustment the bolts are tightened. In order that the bolts passing through the elongated slots in the brackets 11 do not interfere with the adjustment they locate in slots 15 in the sleeve 4 elongated at right angles to the slots in the brackets 11.

As so far described the arrangement provides for an initial adjustment of the width of gap 7 after which the fixing bolts are tightened. In order to enable the slot width to be adjusted during operation of the combustion chamber to suit different air and fuel flow conditions a lever or other means of movement would be provided for the locating bolts 17 passing through the brackets 10 so that they can be moved from one end of the slot 14 to the other. The lever or the like would be operated by the system which is controlling the air and

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fuel flow to the chamber. The bolts passing through the slots of bracket 11 and the slots 15 would be left slack or omitted.

I claim:

1. A combustion chamber of the flame tube type in which air is intimately mixed with a fuel spray, the air being split into primary and secondary flow paths which enter the combustion chamber at different points along its length, the combustion chamber comprising two tube lengths disposed in alignment with one another and having their adjacent ends longitudinally spaced from each other to define between said adjacent ends a slot constituting the inlet for the secondary air flow, a supporting structure including a casing surrounding said tube lengths for supplying air to said combustion chamber, a mounting structure for independently supporting said tube lengths on said supporting structure, said mounting structure including means for holding said adjacent ends of said aligned tube lengths against longitudinal movement relative to one another to maintain constant the longitudinal width of said slot, said mounting structure further including means for permitting the remote ends of said tube lengths to move longitudinally relative to one another upon occurrence of thermal expansion of said tube lengths.

2. A combustion chamber as claimed in claim 1, wherein said mounting structure comprises first mounting brackets disposed closely adjacent the slot and constructed to hold the flame tube lengths against longitudinal movement, said mounting structure further including second mounting brackets spaced longitudinally from said slot and constructed to permit longitudinal movement of the flame tube lengths relatively to the supporting structure.

3. A combustion chamber as claimed in claim 2, wherein said first and second mounting brackets are each constructed to permit thermal expansion of the flame tube lengths in radial directions relative to the supporting structure.

4. A combustion chamber as claimed in claim 1 wherein said mounting structure includes means for selectively varying the longitudinal position of at least one of the flame tube lengths relative to said supporting structure to adjust the longitudinal width of said slot.

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