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Smith

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[54] **FLUID HEATERS**

[75] Inventor: **Peter R. Smith,** Crawley, England

[73] Assignee: **Stone-Platt Crawley Limited,** Sussex, England

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[52] **U.S. Cl.** ..... **122/250 R;** 122/510; 122/DIG. 1
[51] **Int. Cl.** **F22b 27/08**
[58] **Field of Search** 122/248, 249, 250, 510, 122/DIG. 1

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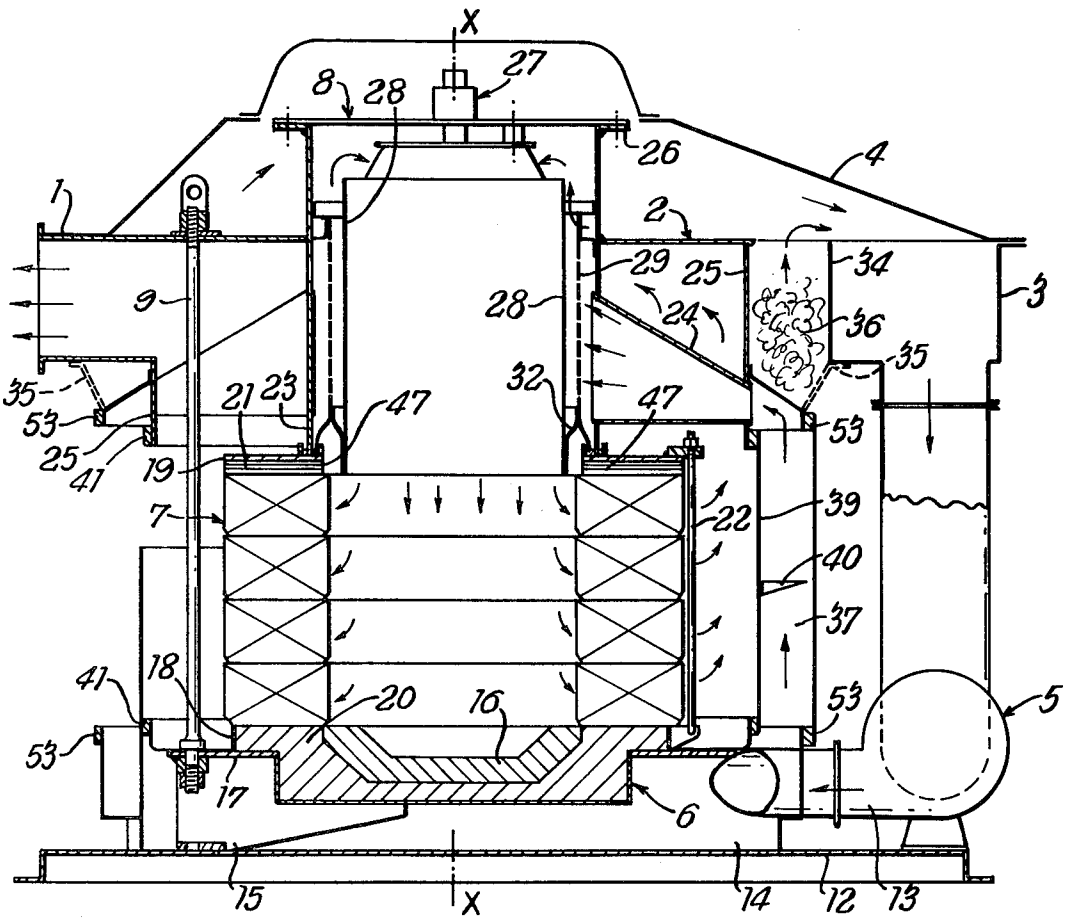
Primary Examiner—Kenneth W. Sprague
Attorney, Agent, or Firm—Fred Philpitt

[57] **ABSTRACT**

A fluid heater having a fuel-air combustor and a heat exchanger disposed below the fuel air combustor in heat exchange relationship with the exhaust gases from the combustor. To facilitate the provision of a seal between the combustor and heat-exchanger and the de-mounting of the housing for the heat exchanger, the fuel-air combustor is supported by the heat exchanger.

17 Claims, 6 Drawing Figures



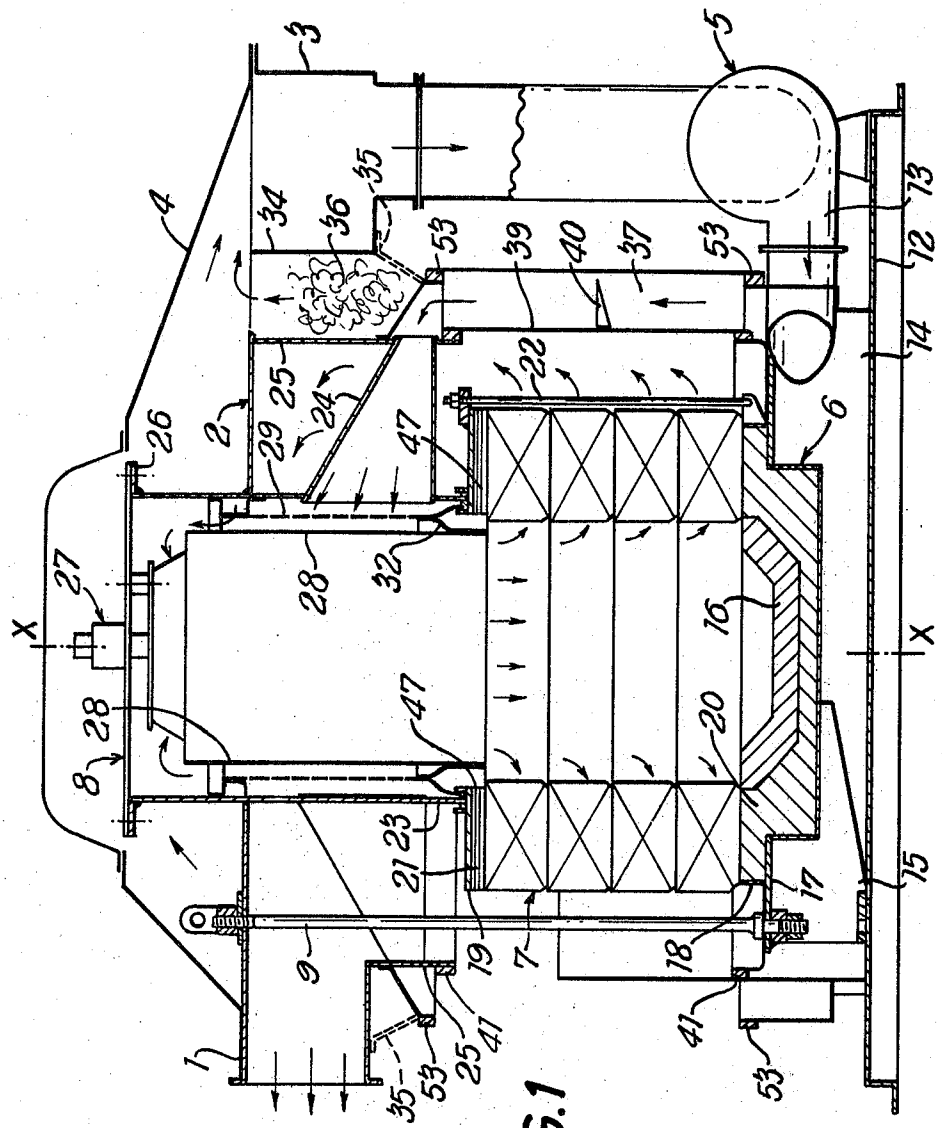

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FIG.1

FIG. 3

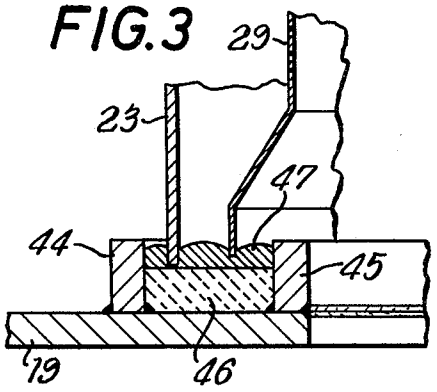
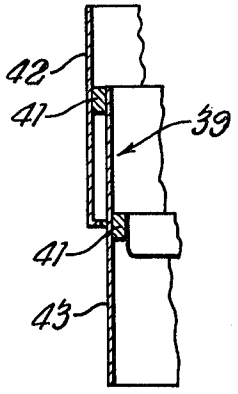


FIG. 2



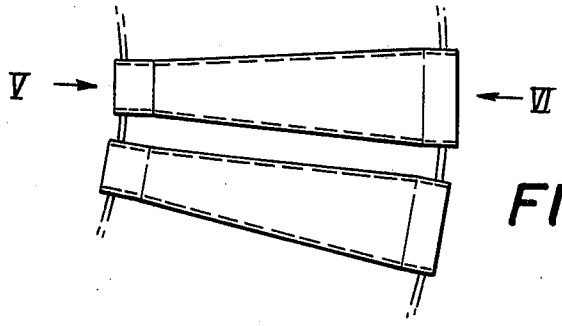


FIG. 4

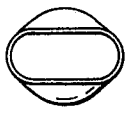


FIG. 5

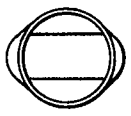


FIG. 6

FLUID HEATERS

This invention relates to fluid heaters. By the term "fluid heater" as used in this specification it is intended to embrace boilers in which a change of state from liquid to vapour takes place, and heaters in which there is no change in fluid state, for example water heaters.

More particularly the invention is concerned with fluid heaters comprising a fuel-air combustor, a heat exchanger assembly, for example a coil pack assembly, for carrying fluid to be heated, the heat exchanger assembly being disposed below the fuel-air combustor and being arranged so that it is in heat exchange relationship with the combustion exhaust gases and a heat exchanger box housing the heat exchanger assembly.

According to this invention the heat exchanger assembly supports the fuel-air combustor.

By having the heat exchanger assembly as a weight-supporting structural part of the heater, the surrounding wall assembly of the heat exchanger box can be substantially non-load supporting so that its removal is facilitated for inspection and cleaning of the heat exchanger assembly. Also the arrangement minimises relative movement between the heat exchanger assembly and the combustor enabling a substantially rigid gas seal construction to be fitted between them.

In a preferred construction of the heater, a flue box, to which the combustion exhaust gases pass from the heat exchanger box, is of annular form and carries a support plate for the combustor which passes down through the centre hole of the annular flue box and projects into the heat exchanger box and the flue box is supported on the heat exchanger assembly which is also of annular form substantially co-axial with the flue box.

The flue box preferably has an inner wall which abuts against the heat exchanger assembly through a seal and an outer wall which aligns with the wall of the heat exchanger box so that combustion exhaust gases after passing through the heat exchanger assembly pass upwardly into the flue box between its inner and outer walls.

The seal advantageously comprises an upwardly facing channel located on a top plate of the heat exchanger assembly and extending around the inner periphery of the assembly, the channel being at least partially filled with asbestos or the like deformable and cuttable sealing material and the lower edge of the inner wall of the flue box cutting into the sealing material. Alternatively the channel can be mounted downwardly facing on the inner wall of the flue box with the upper edge of an upstanding lip on the heat exchanger assembly cutting into the seal assembly. To further advantage the channel may have bars extending across it at intervals around the channel, to ensure that the lower edge of the inner wall of the flue box is spaced from the base of the channel.

In order to further explain the invention and to describe further advantageous constructional features one boiler construction in accordance with the invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 shows a vertical section through the boiler,

FIG. 2 shows a fragmentary sectional view of a modification of FIG. 1,

FIG. 3 shows a seal arrangement used in the boiler,

FIG. 4 shows a detail of an air transfer duct which can be used in the boiler, and

FIGS. 5 and 6 show views looking in the directions of arrows V and VI respectively of FIG. 4.

The boiler is radially symmetrical about vertical axis X—X with the exception of two features usually placed at front and rear (i.e., right and left hand sides respectively of the drawing). At the rear is the flue exit duct 1 which branches off the annular flue box 2 whilst at the front is the air collecting box 3 which collects air from under the hood 4 and conveys it to the intake of the fan 5.

The main structural items of the boiler, i.e., the items which are load bearing are, proceeding vertically upwards, base assembly 6, coil pack assembly 7, the annular flue box 2 and combuster head mounting plate 8. The whole structure is bolted to a base plate 12 on which is mounted the fan 5 and other auxiliaries not shown in the drawing.

The base assembly 6 consists essentially of a heavy section metal dish having a top flange 17 and provided with feet 15 which lift the dish clear of the base plate 12. The dish is filled with cast or brick refractory 16 and 20 contained at the outer side by wall 18.

The coil pack assembly 7 consists of a number of nesting coil packs (four are illustrated in the drawing). The coil packs are clamped between the base assembly 6 and a top plate 19, the upper end being sealed by sheets of asbestos or like flexible material 21 sandwiched between the coil packs and the top plate 19. There is normally a minimum of two clamping tie bolts, one such bolt 22 is shown on the right hand side of FIG. 1. It should be noted that the tie bolts are only required during assembly of the boiler. Once the main boiler ties 9 are tensioned up and the coil pack snadwiched between the base 6 and the top plate 19 via the flue box 2 the coil ties 22 can be removed if desired.

An alternative to the coil pack assembly is a pack consisting of a battery of straight vertical tubes passing into top and bottom header plates, the header plates forming one side of top and bottom annular header tanks.

The flue box 2 is of annular form having inner and outer circumferential walls 23 and 25 and is clamped on to the top of the coil pack assembly by the main ties 9, the inner wall 23 of the annulus pressing into a circular channel packed with asbestos sealing material 47 on the plate 19 as will be described in detail with reference to FIG. 3. This junction between wall 23 and plate 19, forms a gas tight seal and also transmits clamping force from the ties 9 to the coil pack assembly 7. Spanning the space between the inner and outer walls 23 and 25 of the flue box are a number of radially disposed air transfer ducts 24. These can take the form of straight tubes but a preferred arrangement is for the variable section straight sided duct to be used as shown in FIG. 1.

FIGS. 4 to 6 illustrate a further construction of cross air duct formed from an initially circular-sectioned tube which is progressively flattened as it passed from the outside to the inside wall of the flue box with the resulting longer dimension of the cross-section extending vertically. The degree of flattening can be controlled so that there is a constant gap width between adjacent tubes for the passage of flue gases, whilst the cross-sectional area remains substantially constant. This ensures that the flue gas flow over the outside of

the tubes is roughly constant over the length of the tubes and so giving the best heat transfer situation.

The inner wall **23** of the flue box **2**, is extended upwards and terminates in a flange **26** to which is bolted the burner head mounting plate **8**. This plate carries on its top side the burner head consisting of fuel nozzle **27**, igniter and flame detector, etc. the last two items not being shown in FIG. **1**. On the underside of plate **8** is carried a cylindrical sleeve **28** and between this sleeve and the flue box inner wall **23** is placed an outer sleeve **29** the two sleeves together defining a combustion chamber with a hollow side wall structure. The sleeve **29** is suitably secured to the flue box **2**. The lower end of the sleeve **29** is flared and tucks into the annular seal having asbestos **47** which forms the seal between items **23** and **19**. At its lower end the sleeve **28** carries a sealing member **32** which forms a sliding metal to metal seal with the inside surface of the sleeve **29**.

Surrounding the flue box **2** and attached to it by brackets is an outer annular wall **34** which is "closed" at its lower end by a ring of perforated sheet metal **35** or expanded metal mesh through which the air supply to the boiler passes. In the annulus so formed between the flue box and wall **34** can be placed an air filter material **36** or acoustic baffles to reduce the noise from the fan intake. From this annulus, air is drawn across the top and round the sides of the combustion chamber mounting wall and into the air collecting box **3**.

Air from the fan **5** enters the air space **14** below the coil packs **7** tangentially via the duct **13** and passes up the air annulus **37** formed by the hollow wall structure of the coil pack box. The outer wall of the air annulus is made up of a thin metal shell **38** such as of aluminium in order to obtain a heat reflecting surface on the inside. This shell is split vertically at two or more places to provide a number of sections which can be unclipped and removed easily from the boiler to reveal the inner coil box wall **39**. The boiler is shown with one of the sections of the shell **38** removed at the left-hand side of FIG. **1**. To provide an effective seal, the sections locate against asbestos sealing strips **53**. Spanning the space between the two walls **38, 39** is an air deflector strip **40** which guides the air space into an upward helical path and to ensure an evenly distributed entry into the air transfer ducts **24**. This deflector strip can be attached to either the inner or the outer wall or sandwiched between them by appropriately placed locating strips or pegs.

The inner coil box wall **39** can be made in two or more sections with means for detaching them to examine the coils but a preferred arrangement shown in FIG. **1** is to have the wall in the form of a complete ring or cylinder which in its operative position locates against upper and lower seals **41**. By unclipping or unbolting the upper end, the wall **39** can slide downwards over its lower seal **41** as shown at the left-hand side of Fig. **1** so that it comes to rest on that part of the base **12** forming the floor of the lower air space **14**. This will expose the upper coil sections and give access for coil washing and inspection. Thus the left hand side of FIG. **1** shows the condition for a coil examination with the outer aluminium wall section **38** removed and the inner wall **39** lowered. If desired and in order to expose a greater length of coil pack, the inner wall **39** can be made in two telescoping sections **42** and **43** as illustrated in FIG. **2**.

FIG. **3** illustrates an enlarged view of the top plate seal assembly. The seal is formed by welding two upright sections **44** and **45** to form a channel on the top plate **19** of the coil assembly. In the base of this channel are welded a number of radially disposed bars **46**. On assembly the space above and between these strips is filled with asbestos **47** as previously mentioned or other heat resisting material. The flue box **2** is then placed over the coil assembly and the inner wall **23** of the box **2** cuts through the sealing material **47** and comes to rest on the bars **46**. This ensures that the coil and flue assemblies are square one with another and that there is a seal between the exhaust gas and air side of the boiler.

When the flue box is in position the sleeve **29** can be forced down into the inner portion of the seal **47** forming a seal between the inner and outer air annuli formed by the sleeve wall **29**.

In alternative seal assemblies the groove could be formed integral with the plate **19** of items **44, 45** could be replaced by a rolled channel section mounted on top of the plate **19** or welded to the inner circular edge of this plate. The whole assembly could also be turned upside down so that the plate **19** carries a single vertical lip which enters an inverted channel section formed on the end of the flue wall **23**. Further, and in order to improve sealing quality in the arrangement shown in FIG. **6** the wall **23** could terminate in a small inverted U-section which cuts twice into the sealing strip forming a double labrynth path for any gas escaping past the foot of the wall **23**.

I claim:

1. A fluid heater comprising in combination

a. a base assembly,

b. a heat exchange assembly supported above said base assembly,

c. a fuel combustor assembly positioned so that substantially its entire weight is supported upon the upper portion of said heat exchange assembly,

d. said heat exchange assembly being

1. adapted to carry the fluid to be heated, and

2. being positioned to receive the hot combustion gases from said fuel combustor,

e. a wall member surrounding at least part of said heat exchange assembly, which wall member serves to confine and channel the hot combustion gases after the hot combustion gases have passed through said heat exchange assembly, said wall member being substantially non-load bearing with respect to said fuel combustor in the sense that the wall member can be removed for purposes of cleaning or inspection of the heat exchange assembly without the need to move either the heat exchange assembly or the fuel combustor assembly.

2. A fluid heater as set forth in claim **1**, wherein a flue box, to which the combustion exhaust gases pass from said surrounding wall member, surrounds the fuel-air combustor, the flue box being supported on the heat exchanger assembly and supporting the fuel-air combustor.

3. A fluid heater as set forth in claim **2**, wherein said flue box has an inner wall which at its lower end abuts against the heat exchanger assembly through a gas-tight seal.

4. A fluid heater as set forth in claim **3**, wherein the seal comprises a channel containing deformable and cuttable sealing material, and a cooperating sealing member having an edge which cuts into the sealing material.

5. A fluid heater as claimed in claim 4, wherein the channel has bars extending across it at intervals to ensure that the edge of the cooperating sealing member is spaced from the base of the channel.

6. A fluid heater as set forth in claim 4 wherein the channel is located on a top plate of the heat exchanger assembly and the cooperating sealing member is constituted by the lower edge of the inner wall of said flue box.

7. A fluid heater as set forth in claim 1, wherein the fuel air combustor has a chamber open at its lower end, and a gas tight seal is provided between the lower end of the chamber and the heat exchanger assembly.

8. A fluid heater as set forth in claim 7 wherein the seal comprises a channel containing deformable and cuttable sealing material, and a cooperating sealing member having an edge which cuts into the sealing material.

9. A fluid heater as claimed 8, wherein the channel is located on a top plate of the heat exchanger assembly and the cooperating sealing member is constituted by the lower end of the chamber.

10. A fluid heater as claimed in claim 6, wherein the fuel air combustor has a chamber open at its lower end and wherein said channel also receives the lower end of the combustion chamber which cuts into the sealing material to form a gas-tight seal between the fuel air combustor and the heat exchanger assembly.

11. A fluid heater as set forth in claim 2, wherein said surrounding wall member has a wall structure of sheet metal surrounding the heat exchanger assembly and releasably secured in position so that it can be moved to expose the heat exchanger assembly.

12. A fluid heater as set forth in claim 11, wherein said surrounding wall member is composed of inner and outer walls defining a space between them through which air is supplied to the fuel-air combustor.

13. A fluid heater as set forth in claim 12, including a base plate and feet which are supported on the base plate and which support the heat exchanger assembly at a distance above the base plate, whereby when said inner wall is released it can be dropped downwards to rest on the base plate and expose the heat exchanger assembly.

14. A fluid heater as set forth in claim 13, wherein said inner wall is composed of telescopicable sections.

15. A fluid heater as set forth in claim 12, wherein the outer annular wall of the heat exchanger box is in individually releasable sections.

16. A fluid heater as set forth in claim 12, wherein a hood is positioned over the flue box and fuel-air combustor and provides a part of the ducting leading to the intake of a fan arranged to supply air to the fuel-air combustor via the space enclosed by said outer wall.

17. A fluid heater as set forth in claim 12, wherein air ducts extend radially across the flue box from the space between said inner and outer walls, the air ducts comprising tubes which, adjacent said space, are of generally circular cross section and which become progressively flattened as they approach the fuel air combustor, the longer dimension of the flattened cross-section extending vertically.

* * * * *