(12) # UK Patent Application (19) GB (11) 2 233 748 (13) A

(43) Date of A publication 16.01.1991

(21) Application No **9010450.6**

(22) Date of filing **10.05.1990**

(30) Priority data
(31) **1526** (32) **10.05.1989** (33) **IE**

(71) Applicants
Thomas Edward White
Scurlogstown, Trim, Co Meath, Ireland

Declan Robert Paul White
Scurlogstown, Trim, Co Meath, Ireland

William Bernard White
Scurlogstown, Trim, Co Meath, Ireland

(72) Inventor
Thomas Edward White

(74) Agent and/or Address for Service
Murgitroyd & Company
Mitchell House, 333 Bath Street, Glasgow,
G2 4ER, United Kingdom

(51) INT CL^5
F24B 1/183

(52) UK CL (Edition K)
F4A AKC A300 A301

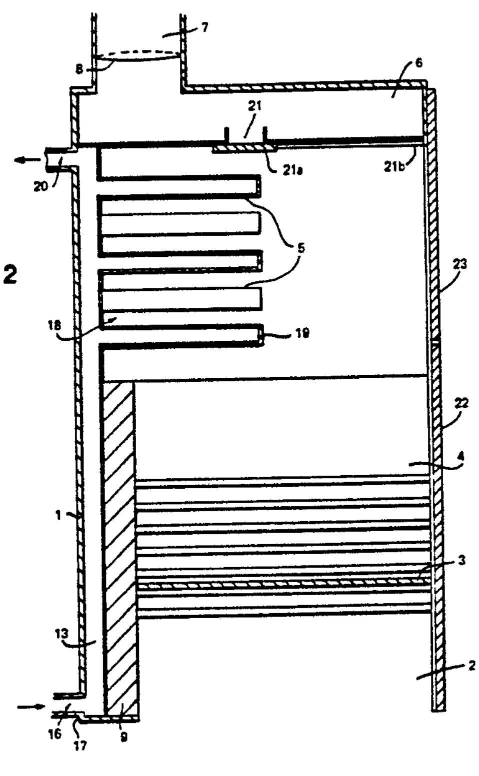
(56) Documents cited
GB 2159610 A **GB 2156954 A** **GB 2090388 A**
GB 2000861 A **GB 0891750 A** **GB 0585253 A**
GB 0310611 A

(58) Field of search
UK CL (Edition K) **F4A, F4W**
INT CL^5 **F24B 1/00 9/00, F24H 1/00**
Online database: WPI

(54) **Improvements in or relating to back boilers**

(57) The invention provides a boiler for heating a heat transfer fluid, typically water. The boiler, which may be free standing or of the back boiler type comprises a water chamber 13, an ashpit 2, a grate 3, firebox 4 and closed end pipes 5 which project from the water chamber and may therefore be easily cleaned. The water chamber is at least partially lined by a layer of refractory material such as firebrick, 9, in the region of the ashpit 2 and firebox 4. The refractory material 9 serves to insulate the firebox 4 from the water chamber to the extent that heat transfer during the initial stages of combustion is minimised and a rapid build-up of heat occurs. Combustion can also occur at a higher temperature than without the refractory material 9. Heat is transferred to the water in the water chamber via the exposed surfaces of the pipes 5 and is eventually conducted through the refractory layer 9 to the chamber.

FIG. 2



GB 2 233 748 A

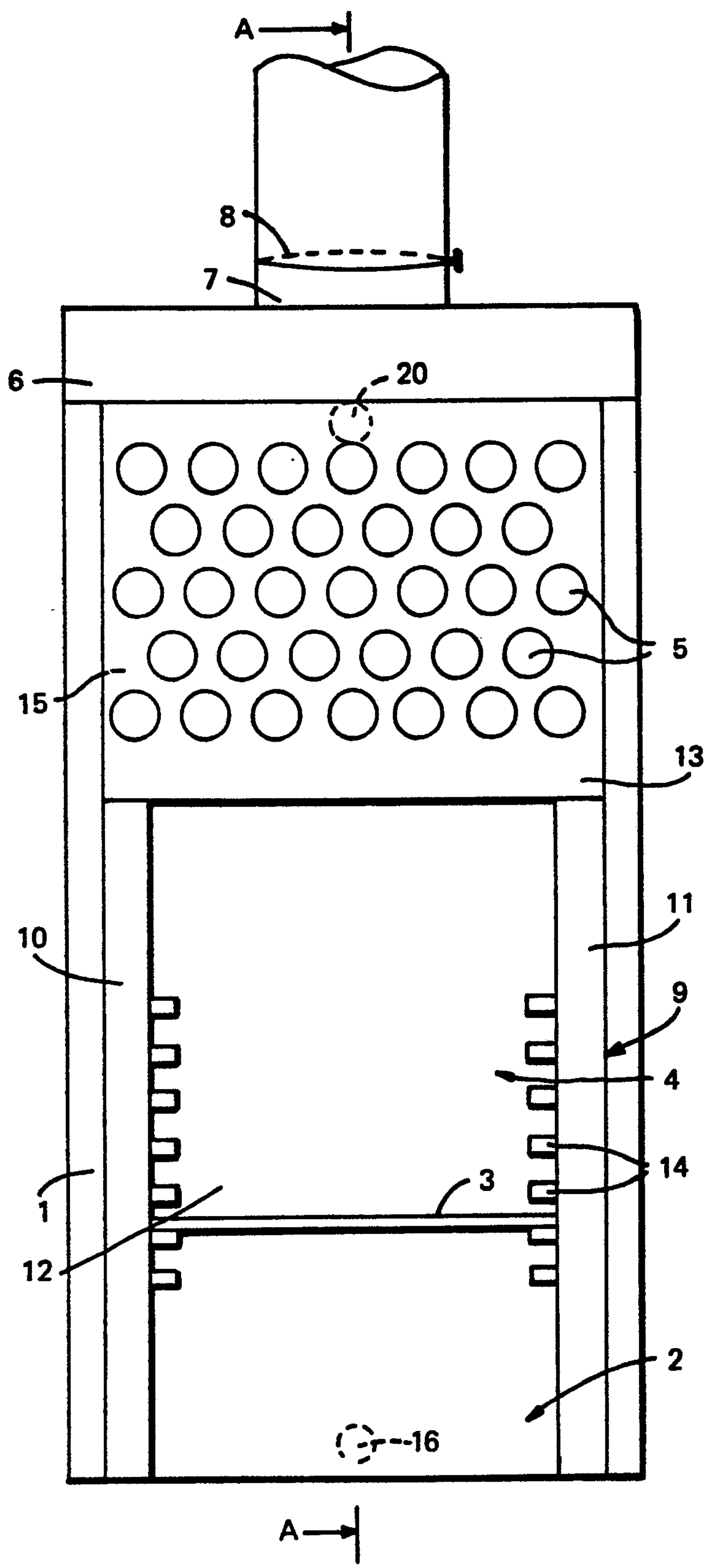


FIG. 1

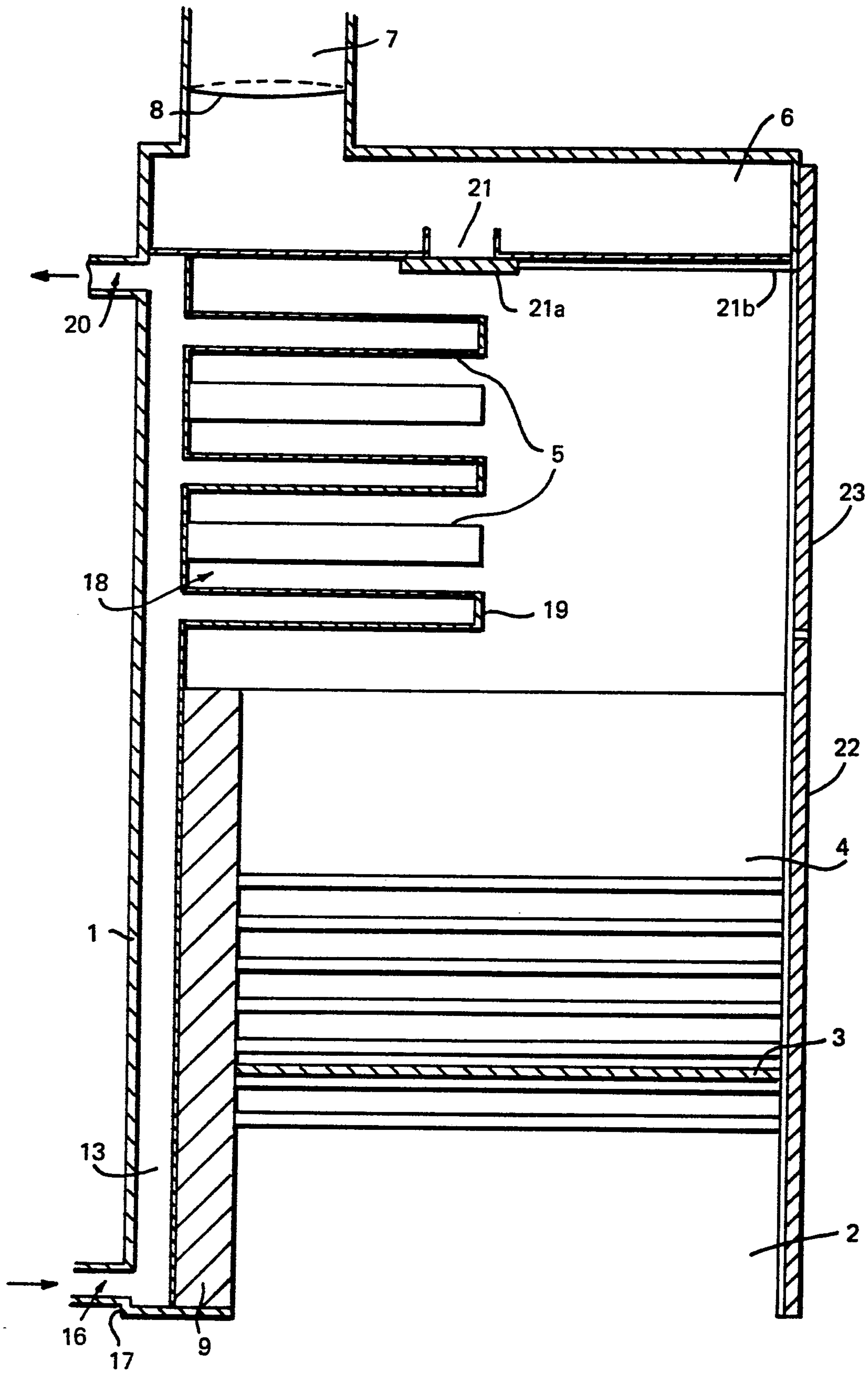


FIG. 2

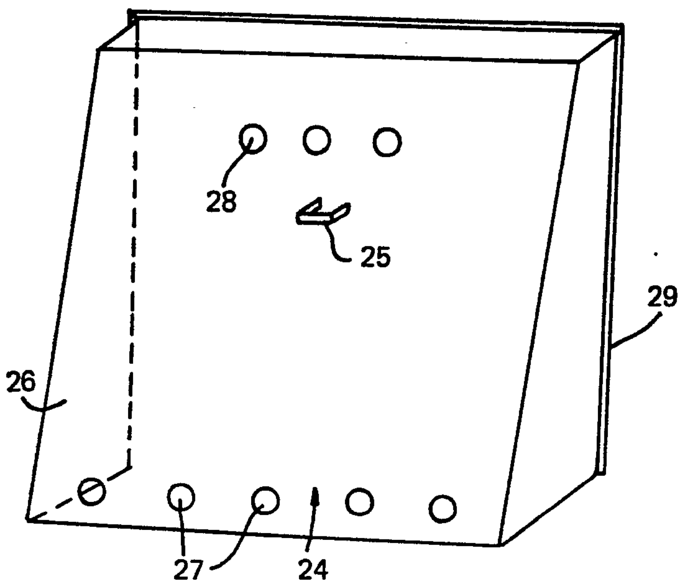


FIG. 3A

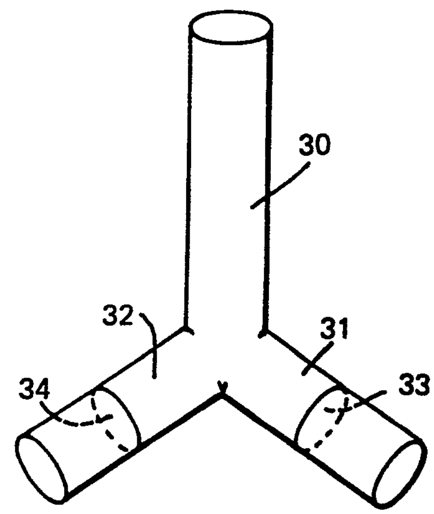


FIG. 3B

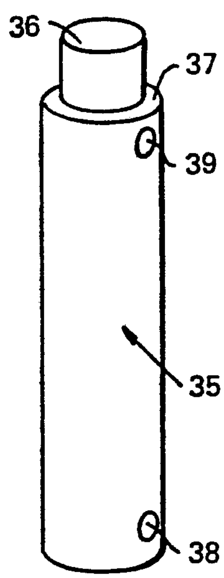


FIG. 3C

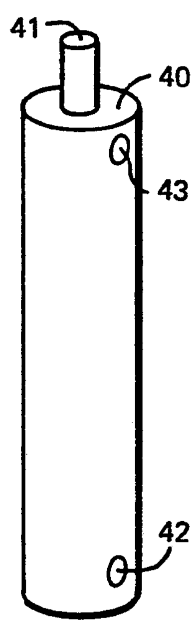


FIG. 3D

"Improvements in or relating to backboilers"

The present invention concerns a water heating unit which burns combustible materials. The heating unit may be used as a domestic back boiler with firegate, as a free standing stove or industrially as an incinerator.

Combustion of organic materials, in particular fossil fuels, is widely used on an industrial and domestic scale for heating purposes. The heat generated by fossil fuel combustion is frequently applied to the heating of water by a process of heat transfer. The hot water produced may be circulated through pipes to heat a building, heated to high temperature to generate steam and ultimately electricity or alternatively the hot water may be stored and used for a multiplicity of domestic purposes.

Domestic firegrates are frequently provided with a back boiler device by means of which hot water is generated. A back boiler as its name suggests is usually positioned to the rear and above the firebox wherein it receives the optimum amount of heat generated by the fire. Water is transported to and from the back boiler by means of an inlet and an outlet made up of tubes which transport cool water to the back boiler and remove hot water from the back boiler respectively. Upon combustion of fossil or other fuels the hot gases generated rise and pass over the tubes whereby heat is transferred across the pipes to the water contained within the pipes. Preferably, the pipes are arranged to form baffles wherein the flow of hot gases is obstructed sufficiently to optimise contact between the hot gases and the pipes, thereby maximising heat transfer.

The hot water generated by heat transfer may be transported via the tubes to heating radiators throughout the building and/or to a hot water storage unit. Industrial boilers function in an analogous manner to domestic back boilers. However, industrial boilers are commonly used to generate steam due to the greater capacity of the industrial furnace or incinerator, the steam being used to heat radiators or generate power etc.

In the generation of heat by combustion of fossil fuel the oxygen or air supply to the fire proper is important. The air supply in industrial boilers and domestic back boilers is controlled by draft systems, which determine the flow of air across the firebox and into the chimney flue.

Boilers which are capable of combusting solid organic materials such as fossil fuels and refuse at the same time generate significant amounts of heat and hot water are clearly economical. However, a number of problems have been associated with existing back boilers.

Existing solid fuel boilers require a considerably longer time than their oil or gas fired equivalents to generate sufficient heat to produce hot water. Furthermore, solid fuel heating methods are regarded as being messy wherein frequent cleaning of the firegrate, firebox, chimney, pipes and the environs of the fire is required.

In particular, the heat transfer system of existing back boilers usually comprises a series of pipes parallel to the plane of the rear wall of the firegrate, whereby displacement of condensed gases and smoke, usually in the form of soot, from said pipes is difficult.

A considerable disadvantage associated with the existing solid fuel burners is the limited range of solid fuels, which may be used. Particular types of solid fuel only are recommended for use with the burners used to heat water e.g. smokeless fossil fuels. Furthermore, existing fireplaces and many industrial boilers are not suitable for the combustion of a multiplicity of refuse types, e.g. plastics, due to the residue which remains, the residue being difficult to dispose of. In the combustion of plastics and the like, the carbonaceous residues remain due to the inability of the boiler or firebox to reach sufficiently high temperatures to vaporize the residue. Clearly, the resulting residues would only serve to exacerbate the 'messy' image of solid fuel burners. Nevertheless, even when the recommended fuels are used, existing firegrates invariably require frequent and sometimes daily cleaning.

A further disadvantage associated with solid fuel burners - both domestic and industrial - is the considerable amount of carbonaceous smoke produced. Carbonaceous smoke emissions are recognised as being highly undesirable due to their detrimental effect on the atmosphere and buildings. Furthermore, in consequence of these damaging effects a number of regions have been declared "smokeless zones" wherein the combustion of smoke producing solid fuels is prohibited.

Clearly, a need exists for a device which can combust a wide range of materials to generate heat whilst preventing significant carbonaceous smoke emissions.

With regard to the thermal aspects, an efficient heating system has two objectives: maximization of heat transfer per unit area of surface and to effect maximum heat generation from the fuel i.e. to effect efficient use of fuel.

Existing heating methods which utilise the combustion of solid materials have frequently been observed to be inefficient. Significant amounts of heat or hot gases are known to escape through the chimney without transferring heat to the cool water bearing pipes.

An object of the present invention is to provide an efficient boiler system whereby rapid and efficient heat generation may be obtained.

According to the present invention there is provided a boiler for heating a heat transfer fluid contained therein comprising a fluid reservoir defined by a chamber adapted to at least partially surround a heat source and a layer of refractory material of sufficient thickness and disposed in such a manner adjacent to the chamber as to conduct heat to the chamber from the heat source.

Preferably, an arrangement of heat exchange pipes communicating with and extending forwardly from the chamber above the heat source is provided.

Preferably the forwardly-extending heat exchange pipes are closed off at their outermost extremities. Suitably, a length of piping is provided for cleaning soot/residues from the heat exchange pipes, comprising a length of pipe of slightly larger diameter with a sliding fit and a sharpened edge.

A boiler in accordance with the present invention is capable of generating a high heat output in a short time whereby water bearing pipes may be heated rapidly. The construction of the boiler provides for rapid and efficient ignition of the fuel in the firegrate by means of the arrangement of the refractory or heat insulating materials and draft system incorporated into the unit. The speed of heat generation facilitates an output which is comparable to that of other gas or oil fired heating units.

Furthermore, the boiler is preferably of an enclosed construction wherein doors are present to the front of the firegate and box to minimise the escape of smoke particles, dust etc. The boiler also comprises a substantial ash pit in which residues may be stored thereby reducing the frequency with which said residues should be removed.

The boiler further minimises the residues usually remaining following the combustion of solid fuel whereby the high temperatures which may be achieved minimise soot formation and the like. A wide range of solid fuels may be used e.g. refuse, due to said high temperatures thereby providing a versatile heat source.

A further advantage of the present invention, which may be attributed to the potentially high temperatures, is the essentially smokeless nature of the exit gases. The high temperatures prevent condensation of the exit gases on the water bearing pipes and also ensure complete vaporization or combustion of the majority of organic fuels which may be employed. A boiler according to the invention, therefore may be of use in designated smokeless zones for the burning of a wide range of fuels.

The construction of water-bearing pipes in the boiler facilitates easy cleaning as these pipes project outwardly from the rear panel of a water jacket in contrast to the transverse arrangement of water-bearing pipes which is common in the prior art. The pipes are easily cleaned by means of a slightly larger pipe with a sliding fit which may be provided with a cutting edge at one end, to act as a reamer. Access to the pipes may be had by means of a removable panel to the front of the pipes.

Embodiments of a boiler according to the invention will now be described having regard to the accompanying drawings, in which

Figure 1 is a front view of a boiler of the present invention with panels cut away in order to show the pipes and firebox,

Figure 2 is a longitudinal cross-section viewed along the line AA of the embodiment shown in Figure 1,

Figure 3 shows a number of devices, which may be used in the construction of the invention, comprising a firebox front (A) and chimney type (B), and chimney-pipe types (C) and (D).

Referring to the drawings, a boiler of the present invention comprises an outerwall or skin 1 which may be constructed from a metal such as iron, a ceramic or other suitable material, said skin enclosing an ashpit 2, a grate 3, a firebox 4, and a multiplicity of pipes 5. The outer skin 1 forms a cavity space 6 above the pipes 5 from which a chimney or flue 7 complete with damper mechanism 8 projects, and defines a water jacket. The outer skin 1 abuts at the sides against a refractory heat insulating layer 9 which extends from the base of the ashpit 2 to the top of the firebox 4 wherein it terminates below the pipes 5. The heat insulating layer 9 forms a continuous layer comprising two side cheeks 10, 11 and the rear wall 12 of the ashpit 2 and firebox 4.

The heat insulating layer 9 is usually constructed of a firebrick or ceramics material and serves to insulate the firebox 4 and ashpit 5 whereby heat transfer between the water jacket 13 and the firebox 4 is minimised due to the poor conductivity of the heat insulating layer in the initial stages of combustion.

A removable grate 3 may be adjusted to any height by means of supports 14 wherein the volume of the firebox 4 may be varied thereby providing a means of controlling the heat output of the fire. Adjustment of the height of the grate 3 also determines the volume of the ashpit 2 whereby when a small firebox volume is employed a large ashpit volume is obtained thereby minimising the frequency with which residues must be removed from the ashpit.

The pipes 5 are positioned intermediate the firebox 4 and the cavity space 6 projecting outwardly, parallel with the side cheeks, from the exposed portion 15 of the water jacket 13, comprising the rear wall of the boiler unit intermediate the firebrick layer 9 and the cavity space 6.

The pipes 5 are arranged in alternately spaced rows and function as baffles wherein the upward flow of hot flue gases is obstructed thereby increasing the length of the exit path of the hot flue gases and optimising hot flue gas-pipe contact, and consequently heat transfer.

The perpendicular orientation of the pipes 5 provides for easy cleaning wherein said pipes may be scraped clean (i.e. condensed smoke/soot may be removed) by means of, for example, a slightly larger pipe with a sliding fit which is preferably provided with a cutting edge at one end.

The position of the pipes 5 is such that heat is extracted from the hot flue gases immediately prior to entering the flue or chimney thereby ensuring that the temperature of the flue gases is at a maximum. The high temperature of the flue gases used to heat water within the pipes 5 is facilitated by means of the refractory insulating layer 9 wherein only completely vaporized species which are about to enter the flue are permitted to make direct contact with, and effect heat transfer with, the water jacket 13 or pipes 5.

The heat insulating characteristics of the refractory layer 9 prevent direct contact of the relatively cool surface of the water jacket 13 and burning fuels in the firebox 4. The consequences of this are fourfold. In the initial stages of ignition of the fire the cool surface of the water bearing pipes 5 and water jacket 13 do not inhibit rapid ignition of the fuel. Secondly, the burning fuel may reach exceptionally high temperatures due to the absence of any cool surfaces making contact with the fuel which may reduce the rate of heat generation. Thirdly, due to the nature of refractory layer 9 significant heat build-up may be achieved within the layer 9 over prolonged periods whereby the layer 9 then functions as a heat reservoir wherein heat may be transferred to the water contained within the water jacket 13 adjacent the layer 9 thereby providing a secondary region of heat transfer i.e. a pre-heating area. Fourthly, due to the high fire temperatures achieved and the construction described, only exceptionally hot flue gases make contact with the pipes 5 to undergo heat transfer.

The hot flue gases contain negligible amounts of smoke particles and residues due to complete combustion and vaporisation of the fuel and the high temperatures reached whereby condensation and accumulation of smoke and soot on the water jacket 13 and pipes 5 is minimised thereby further reducing the frequency of chimney and pipe cleaning required. The ultimate exit fumes of the heating system are substantially "smoke-free", thereby allowing a wide range of fuels to be combusted in designated smokeless zones.

Figure 2 shows a cross-section through the line AA of the embodiment described in Figure 1. The principal features of the invention when in use may be more clearly described with respect to the present construction.

Cool water enters the system through the inlet 16 at the base 17 of the unit, adjacent the ashpit 2, and it flows upwardly through the water jacket 13, which is located immediately adjacent to the refractory insulating layer 9 in the ashpit 2 - firebox 4 region. Direct heat transfer between the cool water jacket 13 and the hot firebox 4 and ashpit 2 is prevented, in the initial stages of combustion, by means of the insulating layer 9 thereby ensuring that the heat generated by the smouldering or burning fuel particles is not diminished by the relatively cool incoming water. However, over a period of time, significant heat build-up takes place in the refractory layer 9 whereby a pre-heating phase of the water entering the system takes place.

The water flows upwards by means of a pump (not shown) through the water jacket 13 past the firebox 4 region until it enters the principal region of heat transfer defined by the pipes 5. As shown, no insulating material is present intermediate the water jacket 13 and hot flue gases in the principal region of heat transfer 18.

Preferably, the pipes 5 are of 1 1/2 inches in diameter and are closed at one end 19. The pipes extend from the rear wall 15 of the water jacket 13 to a point approximately midway across the width of the water jacket 13. The high temperatures generated by the uninhibited combustion of fuel in the firebox 4 ensure that all hot elements reaching the outer surface of the pipes 5 and the exposed surfaces of the water jacket 13 are in the gas phase or are vaporised - hot flue gases. The principal process of heat transfer therefore takes place between the relatively cool water present in the pipes 5 and water jacket 13 across the metal-hot flue gas interface.

In the present embodiment, as the temperature of the water entering the heat transfer region increases, the water volume also increases wherein the water density falls. The decrease in the density of the hot water results in the formation of two water phases in the pipes 5 such that as the cool water travels along the pipes its temperature and density increases thereby causing it to rise and float upon the cooler water entering the heat transfer system. The process of heat transfer continues throughout the system whereby the hot water rises continuously thereby ensuring that the hottest water always exits from the system at outlet 20.

The hot flue gases rise over and between the baffle type configuration of the pipes 5 towards the chimney 7 whereby said gases are discharged. A cavity space 6 is positioned intermediate the heat transfer system and the exit flue 7 wherein the opening to the chimney proper is located. The cavity 6 is warmed by the exiting warm flue gases thereby preventing condensation of any smoke particles which may be present in the exiting gases on the top of the boiler apparatus. The cavity 6 therefore minimises accumulations of soot in the flue 7 area, thereby enhancing the "easy-clean" characteristics of the present invention. Suitably, the floor of the cavity space 6 comprises perforations whereby expansion of the cavity 6 upon heating is compensated for. Furthermore, the high temperatures reached in the cavity space 6 in combination with the filtering effect of the perforations further reduces the smoke content of the exiting gases.

The rate of fuel consumption by the boiler unit is determined by means of the firebox 4 size and the draft system. The size of the firebox 4 is controlled by adjusting the height of the grate 3 which results in a decrease of the firebox 4 volume while lowering of the grate 3 results in an increase in the firebox 4 volume.

In an alternative embodiment of the present invention a dual grate system may be employed wherein the firebox 4 may comprise an upper and lower grate. In the dual grate system typical fossil fuels such as coal pieces may be burned on the upper grate and materials which are less combustible or require higher burning temperatures may be burned on the lower grate. The advantages of placing less combustible materials on a lower grate are twofold. Firstly, the heat of combustion radiating from the upper grate removes any traces of moisture within the fuel thereby increasing the fuels combustibility. Secondly, the smouldering/burning fuel present on the lower grate is 'pulled' up into the primary grate region, by means of the draft system of the unit, wherein the fuel is completely combusted by the exceptionally high temperatures attained in this region. Examples of the fuels which may be combusted in this manner are plastics and solid fuel such as an unopened bale of briquettes.

The draft system of the boiler is controlled by means of the damper 8 wherein the diameter of the exit from the region of heat transfer into the chimney flue proper may be increased or decreased as required. The diameter of the exit controls the "pull" on the fire i.e. the air supply to the fire. The air supply provides a means by which the rate of burning may be controlled. Advantageously, for maximum efficiency, the damper 8 is adjusted to optimise the "pull" wherein, to ensure efficient combustion, the air supply always exceeds that which is chemically required. The efficiency of the draft system of the present invention is further enhanced by means of doors 22 to the front of the firebox 4. The presence of the doors 22 results in significant increases in "pull" on the fire thereby generating higher burning temperatures.

The present embodiment is particularly preferred with regard to safety as the firegrate is not exposed and doors 22 provided across the front of said firegrate produce a stove-like unit (see Fig. 2). Access to the pipes 5 for cleaning or maintenance purposes may be had by means of secondary doors 23 or a panel positioned to the front of the pipes 5. Advantageously, the pipe access panel or doors and the firegrate doors are similar in design wherein the unit is aesthetically appealing.

In a preferred embodiment of the present invention the boiler is constructed of mild steel or cast iron although other materials such as ceramics may be employed.

In an alternative embodiment of the present invention any overheating of the doors 22 is prevented by means of a water pipe located to the front of the doors 22 in the region of the grate 3. The pipe is connected to the sides 10,11 of the water jacket 13 whereby the relatively cool water entering the unit maintains the doors at acceptable and safe temperatures.

In yet another embodiment of the invention, smoke may be prevented from escaping when the secondary doors 23 are opened by increasing the "pull" on the fire and smoke by means of a vent 21 in the floor of the cavity space 6 when the secondary doors 23 are closed. When the secondary doors 23 are closed a hinged baffle plate 21a lies across the vent 21. However, when the secondary doors 23 are opened the hinged baffle plate 21a is displaced by means of a rod 21b connected to the secondary doors 23 - thereby opening the vent 21 and automatically increasing the "pull" on the fire and preventing any smoke from escaping.

Preferably, the dimensions of the back boiler unit are as follows - the side cheeks are 1 inch in thickness, the rear panel 2 inches in width and the overall dimensions of the complete unit are as follows - 3 feet in height and 15 inches in width.

The number of pipes 5 which comprise the principal heat transfer region of the present invention may be varied and is determined by the output required of the unit. Advantageously, the output required of the boiler is known prior to construction of the boiler. The dimensions of the water jacket may be varied whereby a large number of pipes may also be accommodated, if desired.

A significant amount of unexploited heat is known to escape up the chimney flue of many heating units. In a further embodiment of the present invention, a multiplicity of modular boiler units, comprising a water jacket and the heat exchange pipes, may be stacked within a chimney in order to make maximum use of any escaping hot flue gases. Stacking of the modular units within the chimney flue results in a U-shaped chimney when viewed from above. Advantageously, additional doors or panels may be incorporated in the chimney breast whereby access to the chimney for cleaning purposes is facilitated.

In yet another embodiment of the present invention an automatic bellows may be incorporated into the unit by means of a thermostatically controlled fan. The bellows provide additional means whereby the burning rate may be controlled. Preferably, the thermostatically controlled fan is positioned beneath the grate 3 wherein the air supply to the fire may be increased or decreased. Advantageously, the fan would operate synergistically with the damper 8 wherein the air draft system is optimised. Suitably, the damper 8 comprises a perforated plate through which the exiting fuel gases are channelled and any particles within the fuel gases are prevented from exiting.

Figure 3 shows a number of attachments which may be used to enhance the performance of the boiler unit. Alternatively, the devices illustrated may be used to increase the efficiency of existing back boiler units or fireplaces.

Figure 3A shows a firebox front cover comprising sheets moulded or shaped to securely cover the firebox region of a fireplace. The front cover 24 further comprises a handle 25 affixed to a front panel 26 in which a number of holes have been included at its base 27 and top 28. Suitably, the holes enclose movable grid systems (not shown) which may be used to control the size of the holes. Preferably, the front cover 24 also comprises a lip 29 to help ensure an airtight fit around the firebox region.

The front cover 24 finds application in fire or boiler systems where front doors 22 are not required are desired. The front cover 24 encourages rapid ignition of combustible materials by providing a draft control system for any suitable fireplace. The volume of air entering the firebox may be controlled by varying the entrance slit size of the holes 27,28 whereby the rate of fuel consumption and the temperatures reached may also be controlled. The front cover 24 also increases fire safety by preventing exposure of the burning fuel thereby providing a system which increases combustion efficiency and decreases fire risk.

The front cover 24 is prevented from overheating by means of the top holes 28. Air entering through top holes 28 circulates behind the front cover 24 thereby cooling the surface and preventing overheating of the front panel 26.

Figure 3B shows a chimney system which may be used to remove flue gases from one or two fire burning units by means of the "branched" nature of the chimney. The chimney system comprises a primary chimney 30 from which two secondary chimneys 31,32 extend to remove flue gases from one or two fires. A feature of the present device is its versatility thereby providing a system whereby more than one back boiler of the present invention may be economically installed in a building. The chimney may be constructed from a metal or other suitable material. Preferably, the secondary chimneys 31,32 further comprise dampers 33,34 whereby the draft system of each fire may be controlled separately. A cap or a fitting to the dampers may be used to seal either or both of the secondary chimneys when not in use. Alternatively, a damper mechanism may be included in the primary chimney 30 whereby the draft system of the two fires may be controlled simultaneously.

Figures 3C and 3D show two back boiler pipe chimney systems which may be used with the back boiler of the present invention. Figure 3C shows pipe-chimney system 35 comprising a wide chimney portion 36 which is surrounded by a water or other liquid bearing narrow jacket region or pipe region 37. The pipe region 37 further comprises an inlet 38. The pipe-chimney system may be used as the chimney with the back boiler of the present invention whereby maximum utilization of heat is effected. With the present chimney-pipe system the significant amounts of heat which escape with the flue gases during combustion undergoes heat-transfer with the water surrounding the chimney 36. The heated water is then returned to the water bearing pipes proper of the back boiler system via an outlet 39.

Due to the significant amount of heat which is known to escape with the flue gases the water within the pipe region 37 may reach extremely high temperatures. These high temperatures may become hazardous when the chimney-pipe system is exposed e.g. when the back boiler is used as a stove.

Figure 3D describes a chimney-pipe system wherein overheating of the water is prevented by means of a relatively wide pipe region 40 which facilitates the circulation of large volumes of water which does not overheat due to the large amounts entering via inlet 42, and circulating and exiting via outlet 43 thereby providing an insulating layer between the narrow chimney flue 41 and the general surroundings of the system.

The relative dimensions of the pipe and chimney portions may be varied in other alternative embodiments as required without departing from the scope of the invention.

CLAIMS

1. A boiler for heating a heat transfer fluid contained therein comprising a fluid reservoir defined by a chamber adapted to at least partially surround a combustion space and a layer of refractory material of sufficient thickness and disposed in such a manner adjacent to the chamber as to conduct heat to the chamber from the combustion space.

2. A boiler according to Claim 1 further comprising an arrangement of heat exchange pipes communicating with and extending forwardly from the chamber above the combustion space.

3. A boiler according to Claim 2 wherein the forwardly-extending heat exchange pipes are closed off at their outermost extremities.

4. A boiler according to any of the preceding claims in which the floor of the combustion space is defined by a removable firegrate.

5. A boiler according to Claim 4 wherein the volume combustion space may be varied by raising or lowering the firegrate.

6. A boiler according to Claim 4 having an upper and a lower firegrate.

7. A boiler according to any of the preceding claims wherein the layer of refractory material is a firebrick or a ceramics material.

8. A boiler according to any of the preceding claims further comprising a closure means to enclose the combustion space.

9. A boiler according to Claim 8, wherein the closure means comprises a firebox front cover comprising gripping means and draft controlling means.

10. A boiler according to Claim 9, wherein the firebox front cover is substantially as described herein with reference to Figure 3A of the accompanying drawings.

11. A boiler as claimed in Claim 8, wherein the closure means comprises a hinged door.

12. A boiler for heating a heat transfer fluid contained therein substantially as hereinbefore dscribed with reference to Figures 1 and 2 of the accompanying drawings.

13. A heating system including a boiler for heating a heat transfer fluid contained therein comprising a fluid reservoir defined by a chamber adapted to at least partially surround a combustion space and a layer of refractory material of sufficient thickness and disposed in such a manner adjacent to the chamber as to conduct heat to the chamber from the combustion space wherein an arrangement of heat exchange pipes extends forwardly from the chamber above the combustion space, which space communicates with a chimney pipe comprising an outer jacket arrangement for circulating heat exchange fluid around at least a part of said chimney pipe.

14. A heating system as claimed in Claim 13 including a chimney pipe arrangement substantially as described herein with reference to Figure 3C or Figure 3D of the accompanying drawings.

Published 1991 at The Patent Office, State House, 66/71 High Holborn, London WC1R 4TP. Further copies may be obtained from The Patent Office.