



US 20190154359A1

(19) **United States**(12) **Patent Application Publication**
Chamberlain(10) **Pub. No.: US 2019/0154359 A1**(43) **Pub. Date: May 23, 2019**(54) **COMBUSTION HEATING APPARATUS**(71) Applicant: **Luke Chamberlain**, Ringwood (GB)(72) Inventor: **Luke Chamberlain**, Ringwood (GB)(21) Appl. No.: **16/251,067**(22) Filed: **Jan. 17, 2019****Related U.S. Application Data**(63) Continuation-in-part of application No. 14/420,285,
filed on Feb. 6, 2015, now Pat. No. 10,184,731.**Publication Classification**(51) **Int. Cl.**

<i>F28D 21/00</i>	(2006.01)
<i>F24D 12/00</i>	(2006.01)
<i>F24H 8/00</i>	(2006.01)
<i>F24H 9/00</i>	(2006.01)
<i>F28D 7/00</i>	(2006.01)
<i>F28D 7/02</i>	(2006.01)
<i>F28D 7/10</i>	(2006.01)
<i>F28D 7/16</i>	(2006.01)
<i>F28D 15/02</i>	(2006.01)

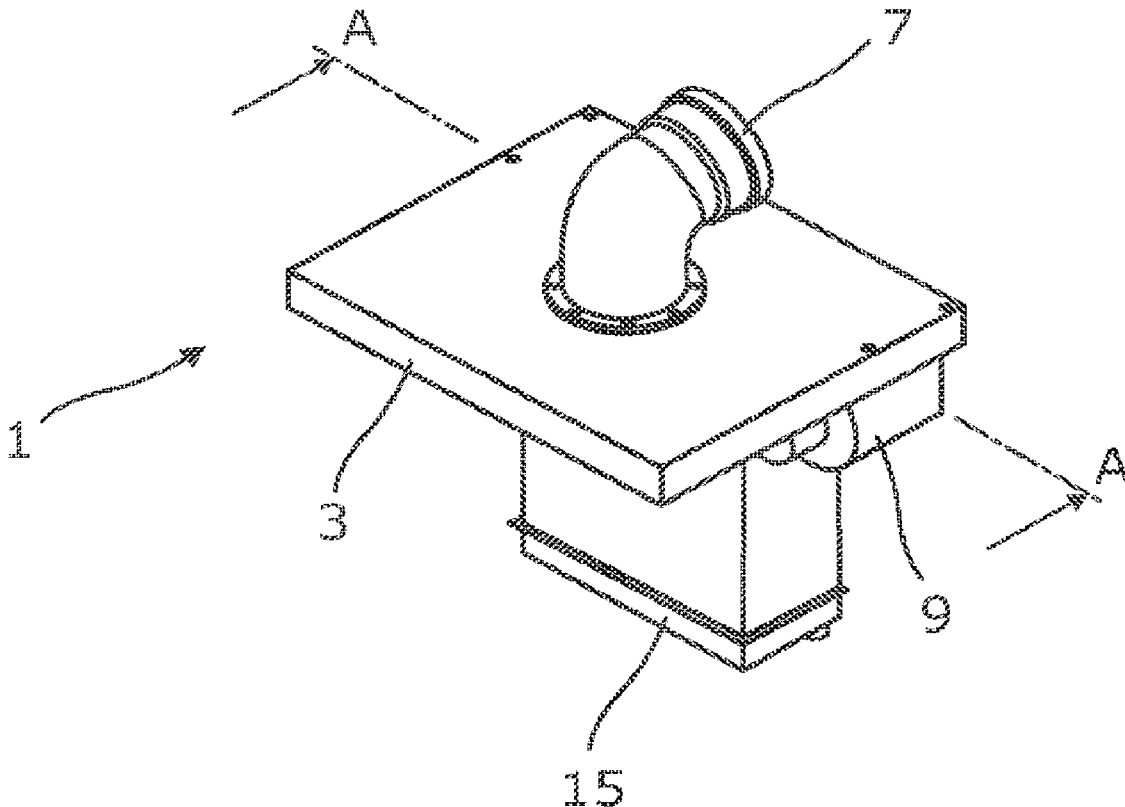
(52) **U.S. Cl.**

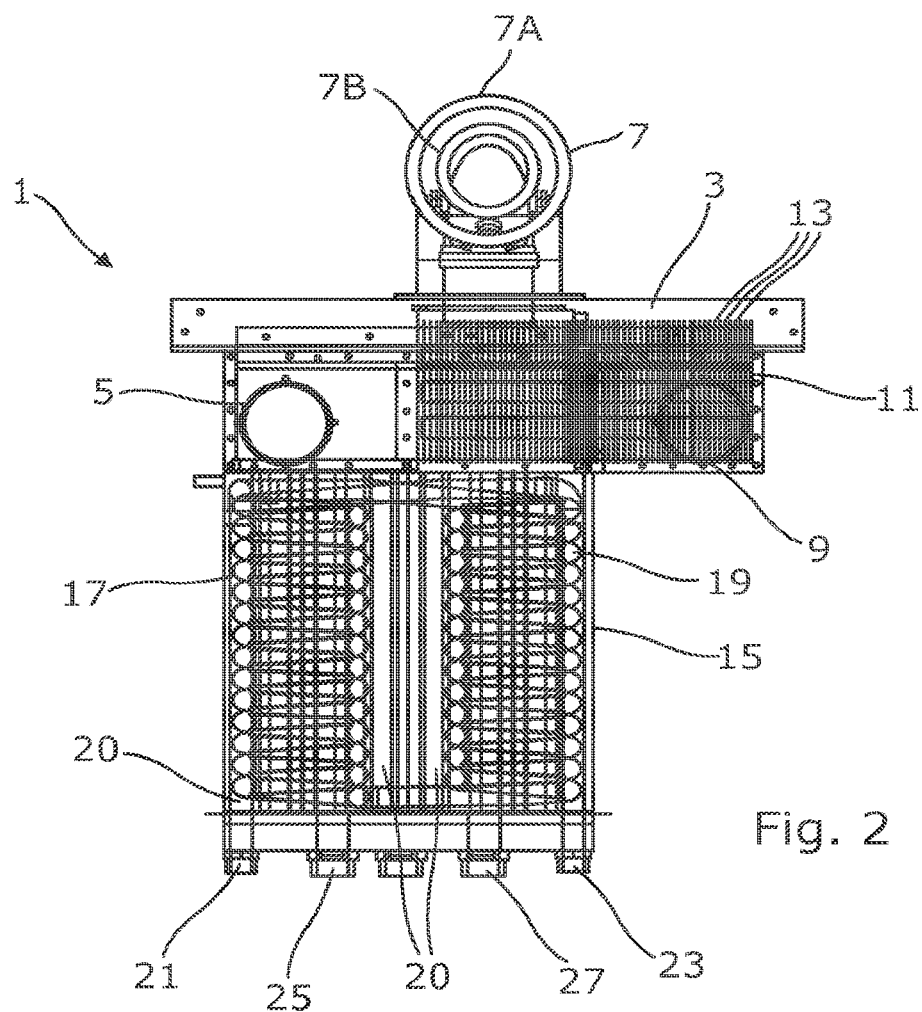
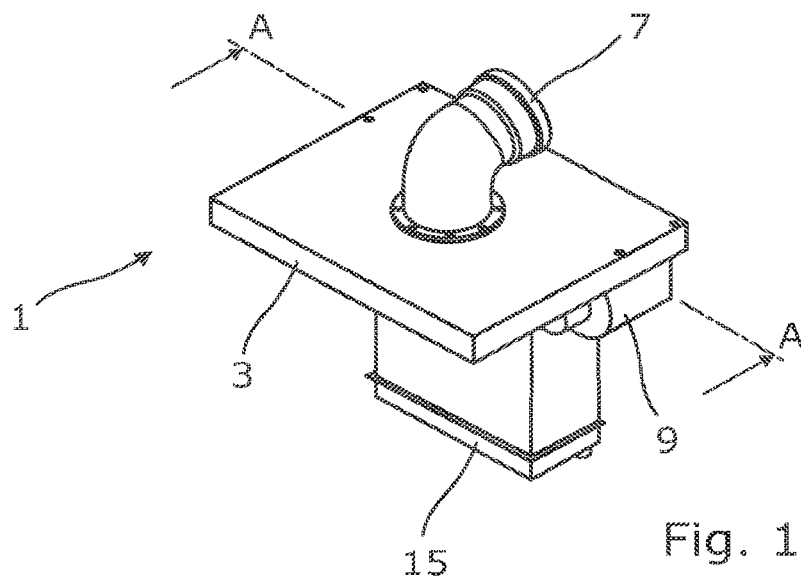
CPC *F28D 21/0007* (2013.01); *F24D 12/00*
(2013.01); *F24H 8/00* (2013.01); *F24H*
9/0084 (2013.01); *F28D 7/0091* (2013.01);
F24D 2220/07 (2013.01); *F28D 7/106*
(2013.01); *F28D 7/16* (2013.01); *F28D*
15/0275 (2013.01); *F28D 21/0008* (2013.01);
F24D 2200/18 (2013.01); *F28D 7/024*
(2013.01)

(57)

ABSTRACT

A domestic boiler preheater includes a flue box including a combustion gas inlet to receive hot combustion gas from a boiler, and a combustion air inlet to receive air for combustion in a boiler. The preheater includes a condenser including a mains cold water inlet and a mains water outlet arranged such that mains water flows through the condenser prior to being supplied to a boiler combustion chamber. The condenser includes a central heating water return and a central heating water flow outlet arranged such that central heating water flows through the condenser prior to being supplied to the boiler combustion chamber. The condenser includes connections that enable the condenser to be connected to preheated fluid supply pipework from a source of preheated fluid, the preheated fluid including fluid heated by heat from at least one of the combustion gas and a renewable energy source.





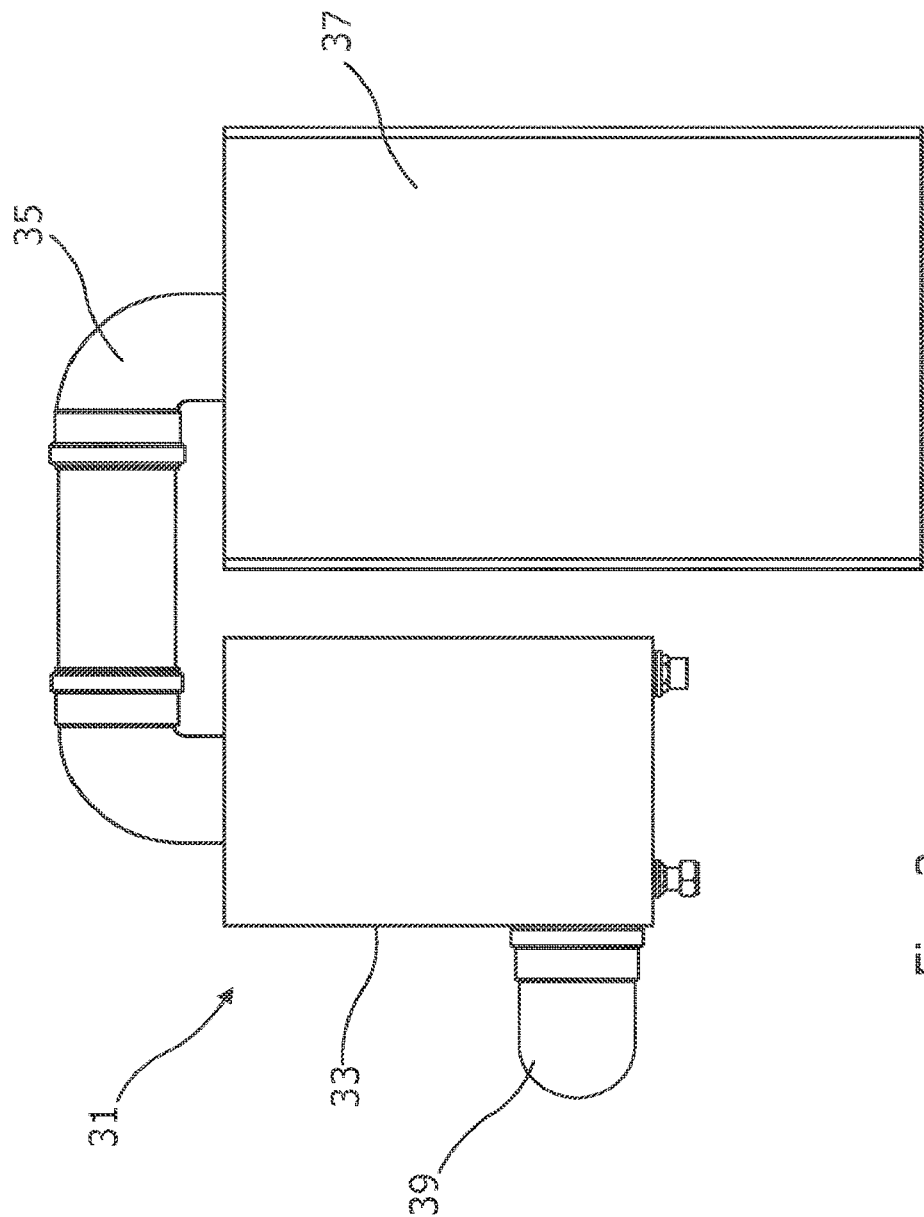


Fig. 3

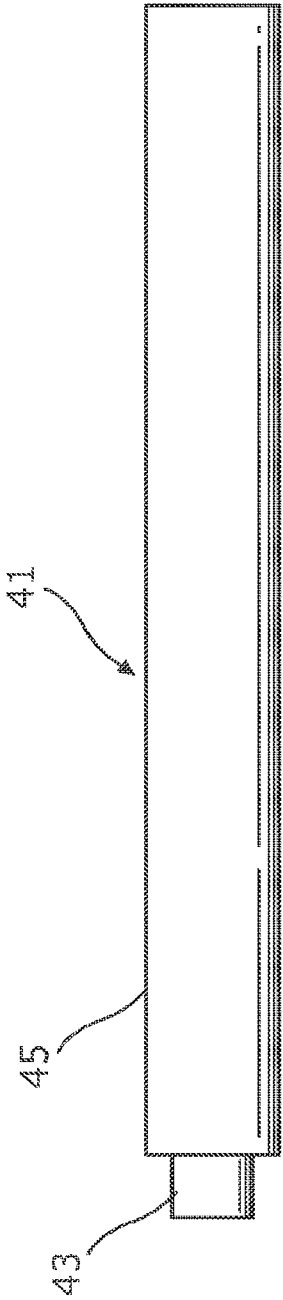


Fig. 4

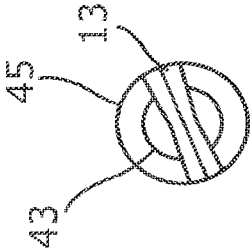


Fig. 6

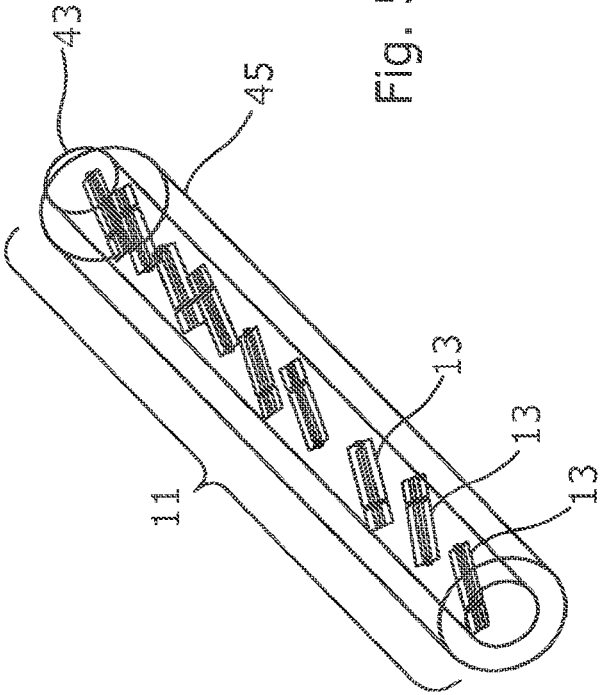


Fig. 5

COMBUSTION HEATING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. application Ser. No. 14/420,285, filed on Feb. 6, 2015, which claims priority to PCT/GB2013/052111, filed on Aug. 7, 2013, which claims priority to GB Application No. 1214131.3, filed on Aug. 7, 2012, the complete disclosures of which, in their entireties, are herein incorporated by reference.

SUMMARY

[0002] The present invention relates to a domestic boiler preheater for a domestic boiler used in buildings to heat water for central heating and/or a hot water supply.

[0003] It is desirable to be able to make the transfer of heat from the combustion process in a domestic boiler more efficient, in order to reduce the amount of fuel used to achieve the desired heating of the supply water. This applies both to the central heating supply water, and to the hot water supply.

[0004] The present invention stems from some work conducted in order to improve the efficiency of domestic boilers.

[0005] According to a first aspect of the invention there is provided a combustion heating apparatus which may be a (domestic) boiler preheater comprising a flue box comprising a combustion gas inlet to receive hot combustion gas from a boiler, and a combustion air inlet to receive air for combustion in a boiler, the preheater further comprising a condenser comprising a mains cold water inlet and a mains water outlet arranged such that mains water flows through the condenser prior to being supplied to a boiler combustion chamber, the condenser further comprising a central heating water return and a central heating water flow outlet arranged such that central heating water flows through the condenser prior to being supplied to the boiler combustion chamber, the condenser further comprising connections that enable the condenser to be connected to preheated fluid supply pipe-work from a source of preheated fluid, the preheated fluid comprising fluid heated by heat from at least one of the combustion gas and a renewable energy source, the condenser being operative to transfer heat from the preheated fluid to at least one of the mains cold water from the mains cold water inlet, or the central heating water from the central heating water return, in order to preheat the mains or central heating water prior to entering the combustion chamber of the boiler.

[0006] Preferably a combustion gas heat exchanger is provided, operative to transfer heat from the combustion gas flowing through the combustion gas inlet to the combustion air flowing through the combustion air inlet such that the combustion air is preheated prior to entering the boiler.

[0007] Preferably the combustion gas heat exchanger is operative to heat the preheated fluid prior to the preheated fluid entering the condenser.

[0008] The combustion gas heat exchanger may comprise part of the flue box, or may comprise part of a separate flue pipe. Either of the foregoing may be incorporated into a combustion heating apparatus at the time of manufacture or at the time of installation of the apparatus, or may be retrofittable (to an existing installed apparatus).

[0009] Preferably the combustion gas heat exchanger comprises at least one heat rod filled with a fluid, heat being

transferred from the combustion gas into the fluid (which may be to vaporize) the fluid, heat being transferred from the (vaporized) fluid to the inlet combustion air, which may include subsequently condensing the fluid.

[0010] The fluid in the heat rods may transfer heat from the exhaust gas to the inlet gas by way of convection.

[0011] The term 'heat rods' is intended to be understood in a broad sense, and includes a portion or component which is intended allow heat transfer from an exhaust gas to inlet air.

[0012] Where the heat rods contain fluid for heat transfer, which may be a gas or a liquid, the fluid is contained in a sealed system or sealed space, which is defined at least in part by an internal surface of the heat rods.

[0013] Where the combustion gas heat exchanger is provided at the flue box, preferably an array of parallel heat rods are provided, although the rods need not be parallel and could at different relative orientations.

[0014] Where the combustion gas heat exchanger is provided in the separate flue pipe, preferably an array of heat rods are provided, spaced along the longitudinal axis of the flue pipe.

[0015] The heat rods may comprise substantially solid metal rods, such as copper rods, whereby heat is conducted by the rods.

[0016] Preferably the condenser comprises an array of tubes some of which are connected between the mains cold water inlet and the mains water outlet so that mains water passes along the tubes, and some of which are connected between the central heating water return and the central heating water flow outlet so that central heating water passes along the tubes, the condenser further comprising a heat exchange coil arranged with the tubes to transfer heat from the preheated fluid to the water in the tubes.

[0017] The renewable energy source may directly heat the preheated fluid and thus may comprise a water heating solar panel, or a ground source heat pump for example.

[0018] According to a second aspect of the invention there is provided a boiler, which may be a domestic boiler, comprising a preheater according to the first aspect of the invention.

[0019] According to a third aspect of the invention there is provided a flue assembly, which may be a domestic boiler flue assembly comprising a preheater according to the first aspect of the invention.

[0020] According to another aspect of the invention there is provided a flue box comprising the preheater of the first aspect of the invention.

[0021] Although particular mention is made to combustion heating apparatus which for use in a domestic environment or setting, the invention is equally applicable in an industrial setting such as industrial heating applications.

[0022] It will be appreciated that an aspect of the present invention may be viewed as involving the use of heat from exhaust gas produced by a combustion process to pre-heat a hot water supply, a central heating water and preheat incoming air used in the combustion process.

[0023] Other aspects of the present invention may include any combination of the features or limitations referred to herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The present invention may be carried into practice in various ways, but embodiments will now be described by way of example only with reference to the accompanying drawings in which:

[0025] FIG. 1 is a perspective view of a domestic boiler preheater in accordance with the present invention;

[0026] FIG. 2 is a sectional view through line A-A of the preheater of FIG. 1;

[0027] FIG. 3 is a view from the side of another domestic boiler preheater in accordance with the present invention;

[0028] FIG. 4 is a side view of a flue pipe for a domestic boiler preheater in accordance with the present invention;

[0029] FIG. 5 is a perspective sectional view of the flue pipe of FIG. 4; and

[0030] FIG. 6 is an end view of the flue pipe of FIGS. 4 and 5.

DETAILED DESCRIPTION

[0031] Referring initially to FIGS. 1 and 2, a domestic boiler preheater 1 is a self contained unit that is arranged, in this example, to be mounted within and comprise part of a domestic boiler (not shown).

[0032] The preheater 1 comprises an upper flue box 3 which is substantially hollow and provided with an internal combustion gas outlet passageway and an internal inlet air passageway. The combustion gas outlet passageway extends between a combustion gas inlet 5 which receives combustion gas from the boiler in use, and a flue outlet/inlet 7 which in this example comprises a standard 90° flue elbow projecting from the top of the flue box 3. The inlet air passageway extends between the flue outlet/inlet 5 and a combustion air outlet 9 which supplies combustion air to the boiler combustion chamber in use. The flue box 3 thus diverts and separates the combustion gases and inlet air and enables standard flue components to be connected to the flue inlet/outlet 7.

[0033] The flue outlet/inlet 7 in this example is a twin walled concentric flue wherein the hot combustion gas passes through an inner flue 7A in one direction whilst the cold inlet air passes in an opposite direction through an outer flue 7B. Thus, some of the heat in the combustion gas is transferred through the wall of the inner flue 7A to the colder inlet air being drawn through the outer flue 7B.

[0034] A combustion gas heat exchanger 11 is provided in the form of an array of elongate heat rods 13 arranged in the path of the hot combustion gas from the boiler. In this example, the heat exchanger 11 is provided at the flue box 3, but it could alternatively be provided within the boiler combustion chamber for example. The heat exchanger 11 transfers heat from the combustion gas to a fluid within the heat rods 13, the fluid vaporizes as it absorbs heat from the combustion gas and then condenses to transfer the absorbed heat to the inlet combustion air.

[0035] So, in this example, some of the heat from the combustion gas is passed directly into the colder combustion inlet air via the flue itself, whilst some of the heat from the combustion gas is passed into the colder combustion air via an intermediary fluid in the heat rods 13.

[0036] The preheater 1 further comprises a condenser 15 mounted below the flue box 3. The condenser 15 comprises two primary heat exchange coils 17, 19 which extend around an array of parallel water carrying tubes 20 within the

condenser. Some of the water carrying tubes 20 extend between a mains cold water inlet 21, and a mains cold water outlet 23, whilst some extend between a central heating water return inlet 25 and a central heating water flow outlet 27. Thus, mains water flows through some of the tubes 20, and central heating water flows through other of the tubes 20, in use.

[0037] The primary heat exchange coils 17, 19 carry a preheated fluid which transfers heat from the preheated fluid to the mains/central heating water in the tubes 20. This serves to preheat the mains/central heating water prior to entering the combustion chamber of the boiler. The boiler thus has to use less fuel, or even zero fuel, to transfer the necessary heat to the mains and central heating water.

[0038] The preheated fluid carried by the coils 17, 19 may be preheated by any suitable heat source. Once example of such a heat source is the heat in the combustion gas, and this may be transferred into the preheated fluid via the combustion gas heat exchanger 11 as described above.

[0039] The preheated fluid may be preheated via a renewable energy source. In one example, the preheated fluid may be provided directly from a water heating solar panel, or a ground source heat pump. Preheated fluid may be provided indirectly via an electric water heater powered by electricity from a renewable electricity supply such as photo-voltaic panels, or a wind powered generator for example.

[0040] A combination of sources may be used to preheat the preheated fluid. For example, the fluid may first be heated via a solar panel, and subsequently further heated by the combustion gas heat exchanger 11.

[0041] The preheater 1 is arranged to be an integral part of a new boiler, and may be contained within the boiler housing.

[0042] A suitable controller may be provided to control the flow of water and/or preheated fluid through the preheater, and to control the activation of the combustion chamber accordingly. If sufficient heat is contained in the preheated fluid, that may be sufficient to provide the necessary heat to the water, and in that instance the controller would be operative not to activate the combustion chamber.

[0043] Referring additionally to FIG. 3, another preheater 31 comprises similar features to the preheater 1, like features being given like references.

[0044] Preheater 31 is arranged to be retrofitted in a flue of an existing boiler, that is, it is arranged such that it can be fitted to a boiler flue without requiring the boiler to be replaced. It may therefore be used to increase the efficiency of an existing boiler.

[0045] In this example, the components of the preheater 31 are provided in a standalone housing 33 which is connected in the flue between the flue outlet 35 of the boiler 37, and a standard flue pipe outlet 39 which exits the building. The standalone housing 33 may be arranged to be wall or floor mounted, or may be adapted to be mounted directly on the boiler 37 itself. The preheater 31 comprises the same mains water inlet and outlet, and central heating water flow and returns, as preheater 1, and the internal flue box, combustion gas heat exchanger, and primary coils are also similar.

[0046] Referring additionally to FIGS. 4 to 6, a domestic boiler flue pipe 41 is of the concentric twin walled type with combustion gas flowing in one direction through inner flue pipe 43, and colder inlet combustion air flowing in the other direction through outer flue pipe 45. In this example, the

array of elongate heat rods **13** of the combustion gas heat exchanger **11** is provided in flue pipe **41** itself. Thus, a plurality of heat rods **13** are spaced along the longitudinal axis of the flue pipe **41**, each heat rod **13** extending transversely across the flue pipe **41** from the inner pipe **43** into the outer pipe **45**. Heat is transferred from the hot combustion gas in the inner pipe **43**, to the colder inlet combustion air in the outer pipe **45** by virtue of the fluid within each heat rod **13** vaporizing and subsequently condensing as described above. As can be seen in FIGS. **5** and **6**, each of the heat rods comprises fins which assist with the heat transfer process. As can also be seen from FIG. **5**, the heat rods whilst all extending across the exhaust gas space of the flue, can be arranged at different orientations. Where the heat rods contain a fluid for effecting the heat transfer (e.g. by convection), the rods themselves provide an internal sealed volume in which the fluid is contained.

[0047] The flue pipe **41** thus comprises its own combustion gas heat exchanger **11** which may be used as an alternative, or in addition, to the combustion gas heat exchanger **11** provided on the flue box **3** of the preheater **1**, **31**.

[0048] The flue pipe **41** has been illustrated as a straight pipe, but any other shape or configuration of flue pipe is envisaged. Likewise, any number, orientation and spacing of heat rods **13** may be used as required.

[0049] Likewise, the water carrying tubes **20**, and the heat exchange coils **17**, **19** are exemplary only, and other configurations for heat transfer within the condenser may be used.

[0050] It will be appreciated that the heat rods may comprise substantially solid metal rods, whereby heat is conducted by way of their thermal conductivity.

What is claimed is:

1. A combustion heating apparatus preheater comprising: an assembly comprising at least one of a flue box, a flue pipe, and a combustion chamber, wherein the assembly further comprises a combustion chamber gas heat exchanger arranged in use to transfer heat from a combustion gas to inlet combustion air, the heat exchanger comprising an array of heat rods which are filled with fluid or are solid metal rods, and in the case of the fluid filled rods, in use, these are arranged to transfer heat from the gas into the fluid, heat being transferred from the fluid to the inlet combustion air.
2. The apparatus as claimed in claim **1** in which where the heat rods are provided in a flue pipe, said rods arranged to extend transversely of an internal space of the flue pipe.
3. The apparatus as claimed in claim **1** in which the heat rods comprise one or more heat exchange fins.
4. The apparatus as claimed in claim **2** in which the heat rods comprise one or more heat exchange fins.
5. The apparatus as claimed in claim **1** which comprises a plurality of spaced apart heat rods.
6. The apparatus as claimed in claim **5** in which where the heat rods are provided in a flue pipe, they are spaced longitudinally of the flue pipe.
7. The apparatus as claimed in claim **1** in which the pre-heater is module which is arranged to be connected to a flue pipe, either at the time of initial installation or commission of the apparatus, or as a retro-fittable module to the flue pipe.

8. The apparatus as claimed in claim **1** which is for use with a boiler for heating liquid of at least one of a central heating system and a heated water supply system.

9. The apparatus as claimed in claim **1** which is a gas combustion boiler preheater.

10. A combustion heating apparatus preheater comprising: a flue box comprising:

- a combustion gas inlet that receives hot combustion gas from a boiler; and
- a combustion air inlet that receives air for combustion in said boiler;

a condenser comprising:

- a mains cold water inlet;
- a mains water outlet, wherein said mains cold water inlet and said mains water outlet are arranged such that mains water flows through said condenser prior to being supplied to a boiler combustion chamber;
- a central heating water return;
- a central heating water flow outlet, wherein said central heating water return and said central heating water flow outlet are arranged such that central heating water flows through said condenser prior to being supplied to said boiler combustion chamber; and
- a plurality of connections that enable said condenser to be connected to preheated fluid supply pipework from a source of preheated fluid, wherein said preheated fluid comprises fluid heated by heat from any of combustion gas or a renewable energy source;

a combustion gas heat exchanger operative to transfer heat from the combustion gas flowing through the combustion gas inlet to the combustion air flowing through the combustion air inlet such that the combustion air is preheated prior to entering the boiler, wherein said condenser transfers heat from said preheated fluid to at least one of mains cold water from said mains cold water inlet, or central heating water from said central heating water return in order to preheat the mains or central heating water prior to entering said boiler combustion chamber, wherein the combustion gas heat exchanger comprises at least one heat rod filled with a fluid, wherein heat is transferred from the combustion gas into the fluid, and wherein heat is transferred from the vaporized fluid to the inlet combustion air by subsequently condensing the fluid.

11. The preheater as claimed in claim **10**, wherein said combustion gas heat exchanger is operative to heat the preheated fluid prior to the preheated fluid entering the condenser.

12. The preheater as claimed in claim **10**, wherein the combustion gas heat exchanger comprises any of (i) part of the flue box, and (ii) part of a separate flue pipe.

13. The preheater as claimed in claim **10**, wherein the combustion gas heat exchanger is provided at the flue box.

14. The preheater as claimed in claim **10**, further comprising an array of parallel heat rods.

15. The preheater as claimed in claim **14**, wherein the combustion gas heat exchanger is provided in the separate flue pipe.

16. The preheater as claimed in claim **14**, further comprising an array of heat rods spaced along a longitudinal axis of the flue pipe.

17. The preheater as claimed in claim **10**, wherein the condenser comprises an array of tubes some of which are connected between the mains cold water inlet and the mains

water outlet so that mains water passes along the tubes, and some of which are connected between the central heating water return and the central heating water flow outlet so that central heating water passes along the tubes, and wherein the condenser further comprises a heat exchange coil arranged with the tubes to transfer heat from the preheated fluid to the water in the tubes.

18. The preheater as claimed in claim **10**, wherein the renewable energy source is arranged to directly heat the preheated fluid.

19. The preheater as claimed in claim **10**, wherein the renewable energy source is arranged to indirectly heat the preheated fluid.

20. The preheater as claimed in claim **10**, wherein the combustion gas heat exchanger comprises at least one heat rod comprising a substantially solid metal rod.

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