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(54) Heat exchangers.

(57) A heat exchanger, for use especially but not exclusively in a gas-fired appliance, is of unitary construction and comprising a water inlet manifold and a water outlet manifold interconnected in water flow communicating relationship by at least one externally-finned heat exchange tube.

A preferred heat exchanger consists of three parallel externally-finned heat exchanger tubes integral with the end manifolds.

With such a unitary heat exchange structure it will be manifest that during installation and servicing, save for water pipe connections to the manifolds and a drain plug, there are no sealing requirements and consequently there are no possible leakage paths from the heat exchanger per se.

The heat exchanger is preferably but not exclusively formed of cast-iron and is preferably but not exclusively formed using a green sand moulding process with the fins disposed as closely together as is possible within the limitations of the moulding process. The fins are preferably of radiussed configuration and also of converging configuration both transversely and axially of the respective heat exchanger tube to facilitate the moulding process.

Turbulence-creating means is provided between at least some of the adjacent fins of the or each heat exchange tube to ensure re-mixing of combustion products of different temperature in the region of the heat exchange tube to improve the heat transfer qualities of the heat exchanger.

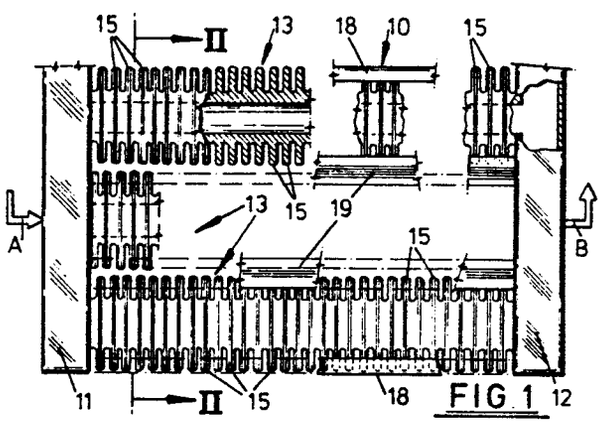

FIG 1

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HEAT EXCHANGERS

This invention relates to heat exchangers for use especially but not exclusively to heat exchangers for use in gas fired appliances.

Such heat exchangers as is well known are employed to provide domestic hot water supplies and/or hot water central heating.

Conventionally such heat exchangers comprise at least two parallel heavy cast-iron hollow heat exchanger chambers coupled together for liquid flow therebetween and coupled also to water inlet and water outlet manifolds and piping. The hot gases pass from the gas burner or burners up between the heat exchanger chambers to a flue system, heat being transferred from the hot gases to the water flowing through the heat exchanger .

With such a heat exchanger assembly various water seals are necessary at the junctions between pipes, manifolds and heat exchanger chambers and these are always likely to leak which is unsatisfactory. Also such a heat exchanger assembly is heavy and relatively awkwardly shaped so that the installation of a gas-fired appliance incorporating same is sometimes difficult and usually laborious.

It is an object of the present invention to obviate or mitigate the aforesaid drawbacks.

According to the present invention there is provided a heat exchanger for use especially but not exclusively in a gas fired appliance, the heat exchanger being of unitary construction and comprising a water inlet manifold and a water outlet manifold interconnected in water flow communicating relationship by at least one externally-finned heat exchange tube.

Such a heat exchanger is therefore of single pass configuration.

It is preferred that the heat exchanger be multipass, either parallel or series flow.

A preferred heat exchanger thus consists of three parallel externally-finned heat exchanger tubes integral with the end manifolds.

With such a heat exchange structure it will be manifest that during installation and servicing, save for water pipe connections to the manifolds and a drain plug, there are no sealing requirements and consequently there are no possible leakage paths from the heat exchanger per se.

The aforesaid triple pass heat exchanger preferably has parallel water flow between the end manifolds. The water flow may alternatively be series flow.

The heat exchanger is preferably but not exclusively formed of cast-iron and is preferably but not exclusively formed using a green sand moulding process.

The fins are disposed as closely together as is possible within the limitations of the moulding process and the fins are preferably of radiussed configuration and also of converging configuration both transversely and axially of the respective heat exchanger tube to facilitate the moulding process.

The water flow passage of the or each heat exchange tube may be of oval configuration. Alternatively, it is circular.

Preferably there is provided between at least some of the adjacent fins of the or each heat exchange tube a turbulence-creating means ensuring re-mixing of combustion products of different temperature in the region of the heat exchange tube to improve the heat transfer qualitites of the heat exchanger.

Preferably there is a stirring (turbulance-creating) baffle or pin between each pair of adjacent fins of a respective heat exchange tube.

The baffles are preferably provided by a substantially curved or U-shaped strip of metal formed with parallel slots and mounted between the end manifolds parallel with the heat exchange tube or tubes to accommodate a fin in each slot.

The stirrer pins are preferably carried by an arcuate mounting strip (single or double arc) mounted between the end manifolds parallel with the heat exchange tubes.

The aforesaid heat exchanger when fitted in a gas-fired appliance can be employed with a conventional burner arrangement and a conventional flue arrangement.

It is well known to those skilled in the art that primary air for a gas burner of a gas-fired appliance is "dragged in" to the burner by a gas injector/venturi arrangement, which air is collected from any convenient source, e.g. atmosphere, normally adjacent the appliance. Secondary air for the gas burner is relatively much more gently entrained and as a result an area of the gas burner near to primary air inlet is often robbed of secondary air due to the intense action ofthe air injector/venturi arrangement. This produces bad combustion especially in the aforesaid area.

It is, therefore, preferred that a burner arrangement be employed in which the primary and secondary air inlets are separated, preferably by an insulated wall whereby the spread of secondary air is not affected and so an even burning is produced thus giving better combustion.

With this arrangement, therefore, there is achieved better combustion (improved CO/CO_2 ratio) resulting from shorter, tighter flames.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a plan view of a heat exchanger according to the invention;

Fig. 2 is a section on the line II-II of Fig. 1;

Figs. 3 and 4 are details of the fins of a heat exchange tube;

Fig. 4A is a detail view of apair of adjacent fins showing the temperature gradient;

Fig. 5 is a diagrammatic perspective view of a gas-fired appliance incorporating the present invention; and

Fig. 6 is a detail view of a preferred turbulence-creating means.

The heat exchanger 10 is a one-piece moulded cast-iron structure, preferably manufactured, as aforesaid by a green sand moulding process knownper se and therefore not described in detail.

The heat exchanger 10 comprises an end water inlet manifold 11 and an end water outlet manifold 12 to which piping (not shown) would be appropriately connected.

The two end manifolds 11 and 12 are connected by three identical parallel heat exchange tubes 13 in water flow communication with the manifolds 11, 12.

The water flow is indicated by arrows A and B and, in this embodiment, is parallel through the tubes 13.

Each tube 13 comprises a passage 14 of oval cross-section with external fins 15 disposed as closely as possible together within the limits of the moulding process.

An example of a preferred surface area of finned heat exchange tube is 218400 square millimetres.

The fins 15 are radiussed as indicated at R, and are of slightly converging configuration transversely as indicated at TR and axially as indicated at AX to facilitate the moulding process.

When the heat exchanger 10 is fitted in a gas-fired appliance generally indicated at 16 (Fig. 5) there is preferably associated with same turbulance-creating means 17 for re-mixing the products of combustion within the appliance at the heat exchanger.

Such means 17 comprises either a single arcuate strip 18 or a double-arcuate strip 19 fitted parallel with the heat exchange chambers 13 and having stirring pins 20 extending therefrom into the adjacent inter-fin spaces.

A preferred turbulance-creating means is shown in Fig. 6 and comprises a substantially U-shaped strip 21 with the limbs turned out at 22, the strip having a series of parallel slots 23, each to receive therewithin a fin 15 with the inter-slot metal 24 assisting the creating of turbulence in, and so re-mixing, the combustion products passing through the slots 23.

The close proximity of the fins 15 to each other promotes better heat transfer between burnt gases and the fins 15 due to the boundary layers of adjacent fins 15 having a smaller non-boundary layer area between them. This is illustrated in Fig. 4A where T equals the temperature gradient, B equals a boundary layer, and N equals the normal combustion products flow.

The fin design employed in the heat exchanger allows this closeness of pitch between fins using especially but not exclusively a cast iron casting formed by a green moulding process.

The heat transfer properties of the heat exchanger are further improved due to the aforesaid turbulence-creating means.

As a result of the above it has been found that it is possible to collect enough heat with a single unitary casting.

Referring now to Fig. 5, the gas-fired appliance 16 comprises a casing 25 with an exhaust gas flue system 26, and a gas burner arrangement 27 within the casing 25 below the heat exchanger 10. The gas supply to the burner is indicated at 28.

Primary and secondary air supplies 29 and 30 are separately delivered to the appliance 16 as shown, the supplies being separated by an insulating wall 31. This ensures that the spread of secondary air is not affected by the incoming primary air and so even burning is produced and therefore better combustion.

Exhaust gases leave by the flue system 22 as indicated by arrow 32.

This burner system as aforesaid gives improved combustion (a better CO/CO_2 ratio) than has been possible hitherto.

Claims

1. A heat exchanger for use especially but not exclusively in a gas fired appliance, the heat exchanger being of unitary construction and comprising a water inlet manifold and a water outlet manifold interconnected in water flow communicating relationship by at least one externally-finned heat exchange tube.

2. A heat exchanger as claimed in claim 1, comprising a plurality of parallel externally-finned heat exchanger tubes integral with the end manifolds.

3. A heat exchanger as claimed in claim 2, comprising three parallel externally-finned heat exchanger tubes.

4. A heat exchanger as claimed in any one of claims 1 to 3, formed of cast-iron and formed using a green sand moulding process.

5. A heat exchanger as claimed in claim 4, in which the fins are disposed as closely together as is possible within the limitations of the moulding process.

6. A heat exchanger as claimed in claim 4 or 5, in which the fins are of radiussed configuration and also of converging configuration both transversely and axially of the respective heat exchanger tube to facilitate the moulding process.

7. A heat exchanger as claimed in any one of claims 1 to 6, in which the water flow passage of the or each heat exchange tube is of oval or circular configuration.

8. A heat exchanger as claimed in any one of claims 1 to 7, in which there is provided between at least some of the adjacent fins of the or each heat exchange tube a turbulence-creating means ensuring re-mixing of combustion products of different temperature in the region of the heat exchange tube to improve the heat transfer qualitites of the heat exchanger.

9. A heat exchanger as claimed in claim 8, in which there is a stirring (turbulence-creating) baffle or pin between each pair of adjacent fins of a respective heat exchange tube.

10. A heat exchanger as claimed in claim 9, in which baffles are provided by a substantially curved or U-shaped strip of metal formed with parallel slots and mounted between the end manifolds parallel with the heat exchange tube or tubes to accommodate a fin in each slot.

11. A heat exchanger as claimed in claim 9 or 10, in which the stirrer pins are carried by an arcuate mounting strip (single or double arc) mounted between the end manifolds parallel with the heat exchange tubes.

12. A heat exchanger, substantially as hereinbefore described with reference to the accompanying drawings.

13. A gas-fired appliance incorporating a heat exchanger as claimed in any one of claims 1 to 12.

14. A gas-fired appliance as claimed in claim 13, comprising a burner arrangement having separate primary and secondary air inlets.

15. A gas-fired appliance as claimed in claim 14, in which the primary and secondary air inlets are separated by an insulated wall.

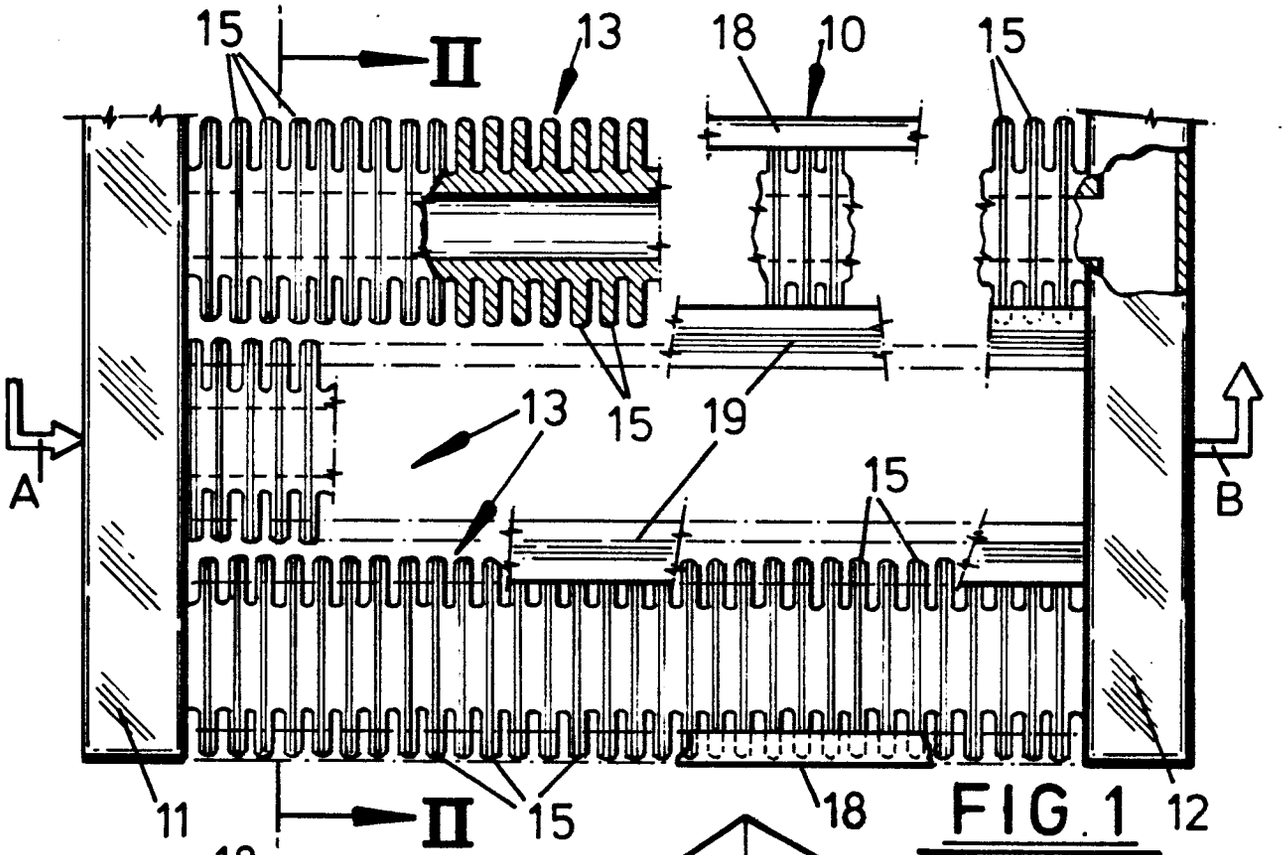

FIG.1

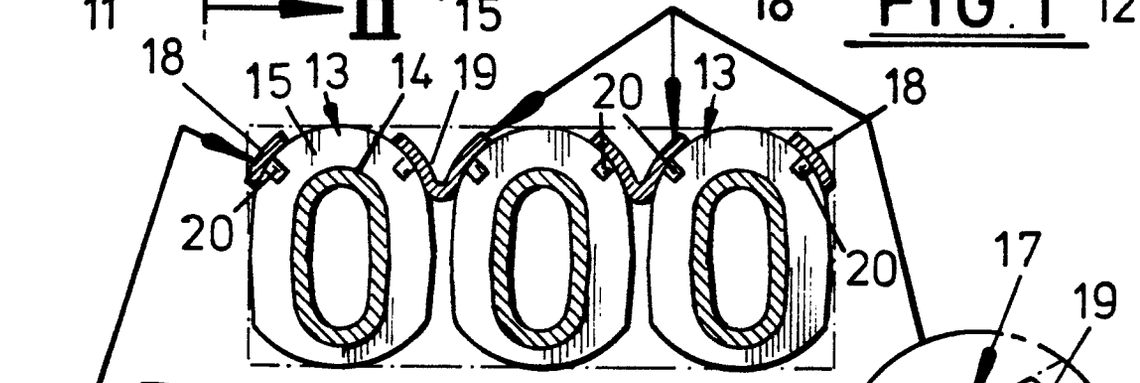

FIG.2

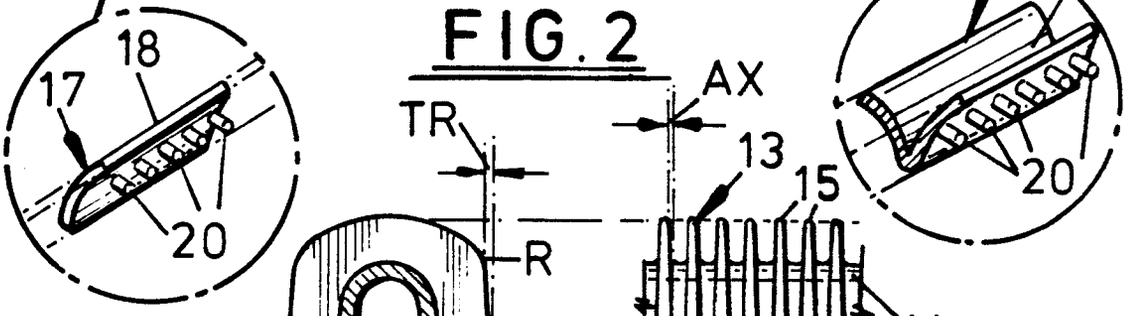

FIG.3

FIG.4

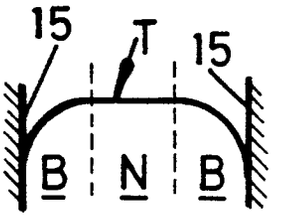

FIG.4A

FIG.5

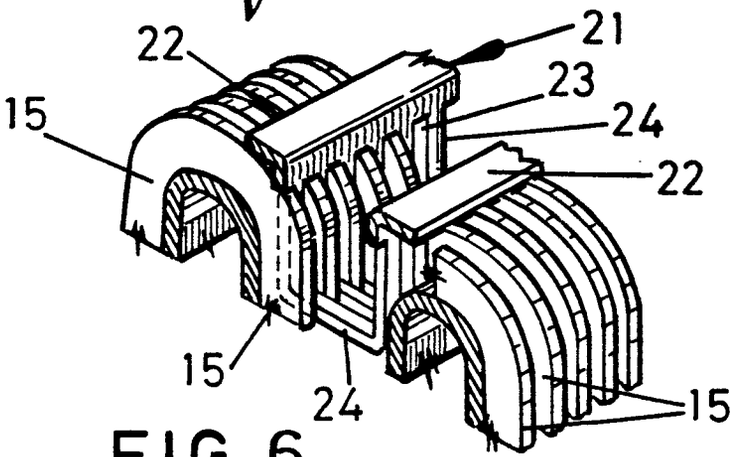

FIG.6