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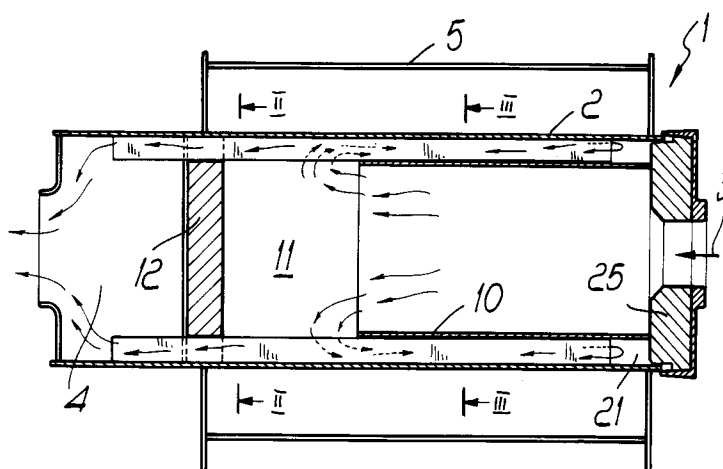
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(54) **Boiler for household heating, with triple flue gas flow, operating at low temperature and with low nitrogen oxide values.**

(57) Boiler (1) for household heating with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, that comprises a furnace tube (2) that is connected to a burner (3) at one end and forms the flue gas chamber (4) at the other end. The furnace tube is surrounded by the heat exchange water (5). The boiler comprises, in the furnace tube

(2), on the side of the burner, a sleeve (10), which together with the furnace tube (2) forms an air space in which there are first ducts, which allow the flue gases to flow towards the manifold in the region of the head of the burner (3), and second ducts, which lead into the flue gas chamber (4), which is separated from the burner by a wall (12).

*Fig. 1***EP 0 684 431 A1**

The present invention relates to a boiler for household heating, with triple flue gas flow, operating at low temperature and with low nitrogen oxide values.

It is known that in heating boilers the furnaces and the exchange elements must take into account, in their design and production, several requirements, including the need to limit the formation of nitrogen oxides and to avoid condensation on the cold walls in the end region of the flue gas circulation system.

Currently commercially available solutions have generally failed to yield optimum results, as it has not always been possible to reconcile the two opposite requirements of having a low flue gas temperature to avoid the formation of nitrogen oxides and of having a temperature that is high enough to avoid condensation.

Therefore, an aim of the invention is indeed to solve the problems described above by providing a boiler for household heating with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, that allows to provide considerable functional and structural improvements to conventional solutions.

Within the scope of the above aim, a particular object of the invention is to provide a boiler in which it is possible to contain the three passages or flue gas flows inside the furnace tube without flame injection.

Another object of the present invention is to provide a heating boiler which by virtue of its particular constructive characteristics is capable of giving the greatest assurances of reliability and safety in use.

Another object of the present invention is to provide a household heating boiler with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, that can be easily obtained starting from commonly commercially available elements and materials and is furthermore competitive from a merely economic point of view.

This aim, these objects, and others which will become apparent hereinafter are achieved by a boiler for household heating with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, according to the invention, that comprises a furnace tube that is connected to the burner at one end and forms the flue gas chamber at the other end, said furnace tube being surrounded by the heat exchange water; characterized in that it comprises, in said furnace tube, on the side of said burner, a sleeve, which together with said furnace tube forms an air space in which there are first ducts, which allow the flue gases to flow towards a manifold in the region of the head of the burner, and second ducts, which lead into said flue gas chamber, which is separated from said

burner by a wall.

Further characteristics and advantages will become apparent from the description of a preferred but not exclusive embodiment of a boiler for household heating with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic sectional view of the heating boiler according to the invention;

figure 2 is a sectional view of the furnace tube, taken along the plane II-II of figure 1;

figure 3 is a sectional view of the furnace tube, taken along the plane III-III of figure 3;

figures 4, 5, and 6 are enlarged-scale sectional views of three different embodiments, taken along the plane III-III of figure 1.

With reference to the above figures, the boiler for household heating with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, according to the invention, is generally designated by the reference numeral 1 and comprises a cylindrical furnace tube 2 which is connected, at one end, to the burner, which is generally designated by the arrow 3, and forms a flue gas chamber 4 at the other end.

A boiler 5 is formed around the furnace tube 2, and more specifically along part of its longitudinal extension; said boiler in practice keeps the heat exchange water in contact with the outer surface of the furnace tube 2.

A sleeve 10 is provided inside the furnace tube 2 towards the burner 3 and is termed "dry" in the jargon since it has no water on the side that is not exposed to the flame. The sleeve 10 is preferably made of ferritic or austenitic alloyed steel and runs along part of the intake chamber, designated by the reference numeral 11, which is formed between the part for connection to the burner 3 and a wall 12 that in practice interrupts the furnace tube.

First flue gas passage ducts 20 are formed in the air space that is delimited between the sleeve 10 and the furnace tube 2 and in practice allow the flue gases to flow from the intake chamber 11 towards a manifold 21 that is formed inside the furnace tube 2 towards the region where the burner 3 is located.

Second ducts 30 are arranged between the first ducts 20, run in contact with the surface of the furnace tube 2, and end in the flue gas chamber 4, passing beyond the wall 12.

In practice, the flue gases flow axially through the sleeve 10, and since they are unable to reach the flue gas chamber 4 due to the wall 12, once they have passed beyond the edge of the sleeve 10 they flow radially and reverse their direction, flowing through the first ducts 20 so as to reach the manifold 21, which is protected, on the burner side,

by a refractory layer 25; the flue gases then enter the second ducts 30 that lead into the flue gas chamber 4.

The second ducts 30 are fixed to the furnace tube 2 by means of welding beads 40, thus forming a wide region of contact that facilitates heat exchange.

As clearly shown in figure 4, the ducts 30 can have a substantially trapezoidal shape, with the welding beads 40 arranged outside the longer parallel side or optionally, as shown in figure 6, the welding spots, designated by the reference numeral 40a, can affect recesses 41 formed on the outer surface of the trapezoidal shape of the ducts 30; an air space is formed between the base of the trapezoid and the furnace tube and is an important element in calibrating heat transmission.

Optionally, as shown in figure 5, the ducts 30 can also be formed by means of a U-shaped body, designated by the reference numeral 30a, which is provided with beads 40b, at its free arms, for welding it to the furnace.

The described arrangement allows to form a triple-flow flue gas path that allows to limit the formation of nitrogen oxides, as the time for which the flue gases remain at high temperature, that is to say, inside the sleeve, is very short.

Once the end of the sleeve 10 has been passed, the temperature drops due to lack of direct heat irradiation towards the tubes, which have a special cross-section, and furthermore the temperature towards the exposed part of the furnace tube is much lower, as said furnace tube 2 is inside the heat exchange water.

The sleeve 10 also limits the formation of oxides, preventing further contacts between the flue gases during the second pass or flow and the comburent air.

The solution also avoids condensation inside the second ducts 30, as the flue gases that flow through them transfer heat to the water through the wall that is in contact with the furnace tube, but the temperature reduction of the flue gases is limited by the fact that at the same time said flue gases receive heat from the flue gases that enter the first ducts, which are placed alternately between the second ducts, and that in the end region, that is to say, in the part directly upstream of the outlet that leads into the flue gas chamber, they receive heat by direct irradiation of the flue gases that are in the furnace and are still at high temperature.

It should also be noted that the deformation of the sleeve caused by thermal expansion has the purpose of moving the surface of the sleeve into close contact with the second ducts, thus increasing the flow of heat by conduction.

A triple-pass household heating boiler is thus provided in practice, wherein the third pass is pro-

vided by means of ducts that are delimited by the wall itself of the furnace tube and by profiled elements that can have an open or closed cross-section.

Furthermore, the provision of a portion, more specifically the end portion, of the third pass that is exposed to direct irradiation of the flue gases that are inside the intake chamber allows to avoid condensation inside said ducts, as said ducts are exposed to direct heat irradiation in the region that might be most critical for condensation.

Furthermore, the last portion of the second ducts is not wet externally by the water, and therefore condensation cannot occur as heat is not removed from the flue gases.

From the above description it is therefore evident that the invention achieves the intended aim and objects, and in particular the fact is stressed that a boiler for household heating with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, is provided that allows to optimize performance by virtue of an efficient choice of the shapes of the ducts and of the various cross-sections.

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the same inventive concept.

All the details may furthermore be replaced with other technically equivalent elements.

In practice, the materials employed, as well as the contingent shapes and dimensions, may be any according to the requirements.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

## Claims

1. Boiler (1) for household heating with triple flue gas flow, operating at low temperature and with low nitrogen oxide values, which comprises a furnace tube (2) that is connected to the burner (3) at one end and forms the flue gas chamber (4) at the other end, said furnace tube (2) being surrounded by the heat exchange water (5); characterized in that it comprises, in said furnace tube (2), on the side of said burner (3), a sleeve (10), which together with said furnace tube (2) forms an air space in which there are first ducts (20), which allow the flue gases to flow towards a manifold (21) in the region of the head of the burner (3), and second ducts (30), which lead into said flue gas chamber (4),

which is separated from said burner (3) by a wall (12).

2. Boiler according to claim 1, characterized in that said sleeve (10) runs along a portion of the intake chamber (11) that is formed between said burner (3) and said wall (12). 5
3. Boiler according to the preceding claims, characterized in that the last portion of the second ducts (30) is not wet externally by the water. 10
4. Boiler according to one or more of the preceding claims, characterized in that said first ducts (20) are placed alternately between said second ducts (30). 15
5. Boiler according to one or more of the preceding claims, characterized in that said second ducts (30) are connected to said furnace tube (2) by means of welding beads (40) that are adapted to increase the region where heat exchange occurs by contact with said furnace tube (2). 20
6. Boiler according to one or more of the preceding claims, characterized in that said second ducts (30) have a substantially trapezoidal shape, with said welding beads (40) arranged on the outside of the longer parallel side. 25 30
7. Boiler according to one or more of the preceding claims, characterized in that an air space is formed between the wall of the second ducts (30), which have a closed profile, and the wall of the furnace tube (2). 35
8. Boiler according to one or more of the preceding claims, characterized in that said second ducts (30) are formed by means of a U-shaped body (30a) which is connected, at the free ends of its arms, to said furnace tube (2) by means of welding beads (40b). 40
9. Boiler according to one or more of the preceding claims, characterized in that said second ducts (30) are subjected, at their end portion, to the heat irradiation of the flue gases in said intake chamber (11). 45
10. Boiler according to one or more of the preceding claims, characterized in that the temperature of the flue gases in said first ducts (20) drops due to the elimination of direct irradiation due to said sleeve (10). 50 55
11. Boiler according to one or more of the preceding claims, characterized in that the thermal

expansion of said sleeve (10) is adapted to increase surface contact with said second ducts (30) to increase heat exchange by conduction.

12. Boiler according to one or more of the preceding claims, characterized in that the three flows of flue gas occur inside said furnace tube (2).

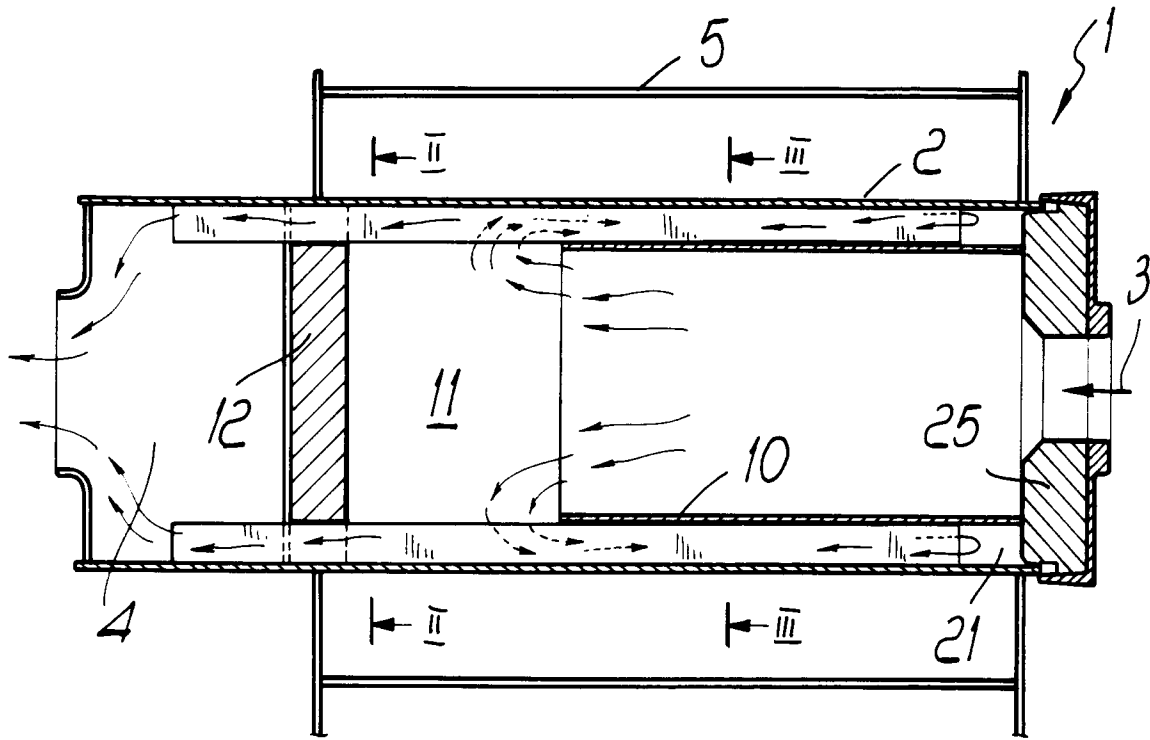


Fig. 1

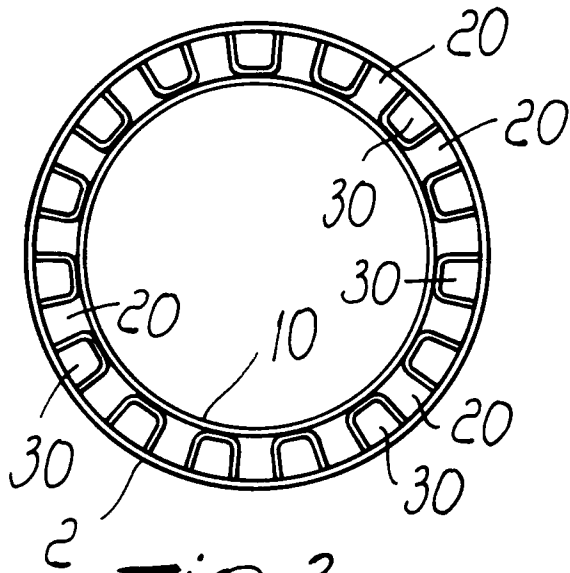


Fig. 3

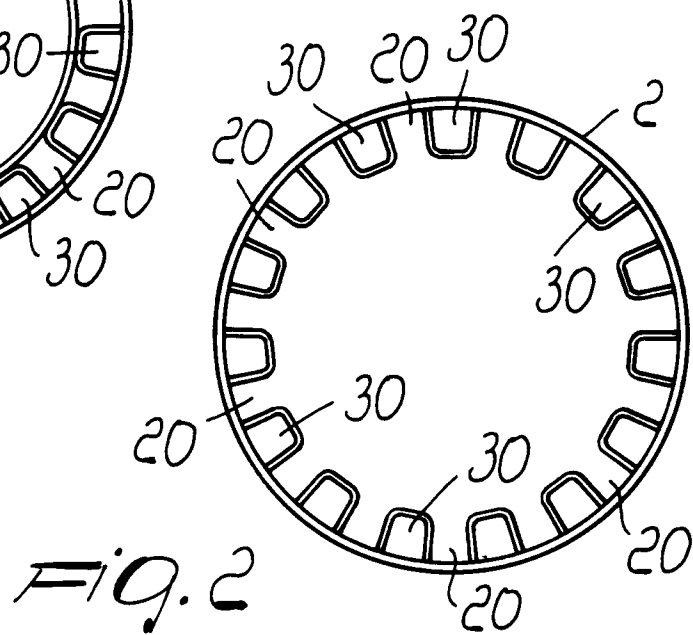


Fig. 2

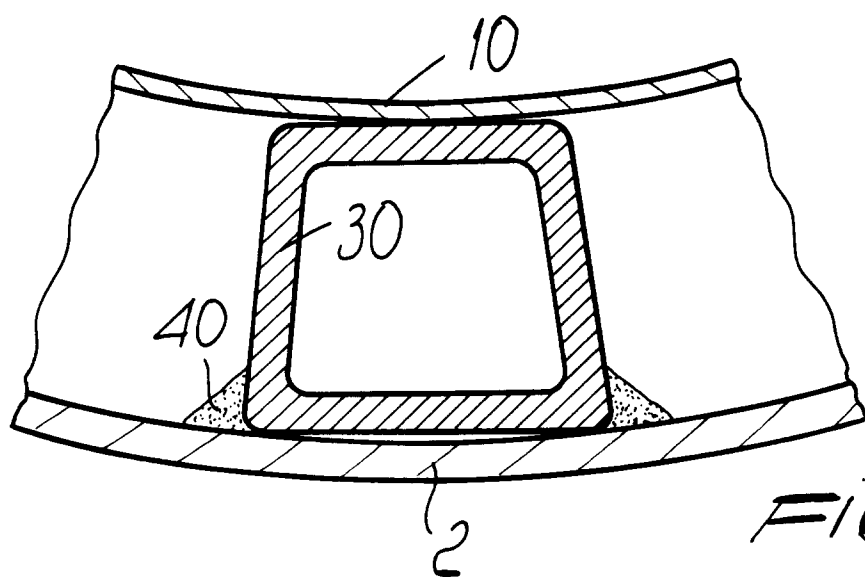


Fig. 4

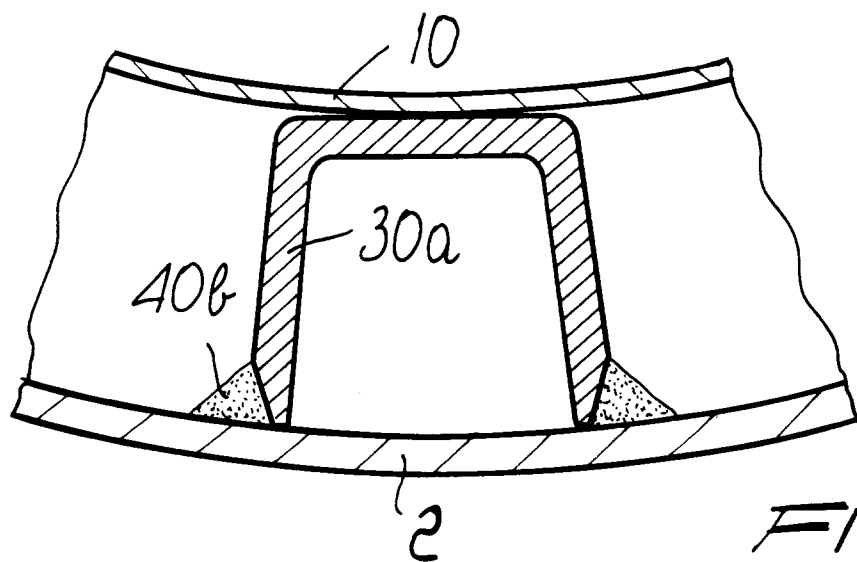


Fig. 5

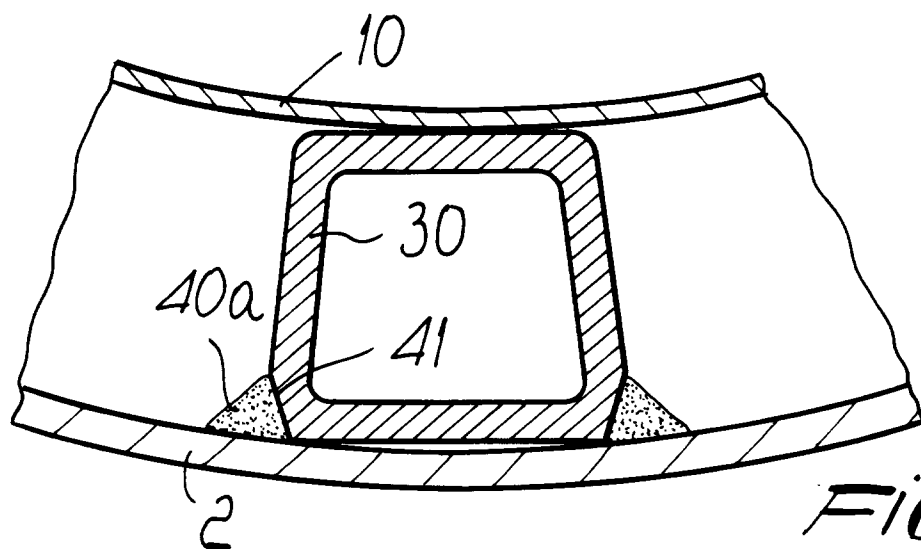


Fig. 6



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## EUROPEAN SEARCH REPORT

Application Number  
EP 95 10 6085

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR-A-1 571 097 (RODOLFO BELLELI C.S.A.S.) 13 June 1969 * page 4, line 18 - page 5, line 40; figures 4,5,24-26 * ---	1,2,4,5	F24H1/26
X	CH-A-659 697 (STUECKLIN & CIE AG) 13 February 1987 * the whole document * -----	1,2,4,5, 7-9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F24H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 5 September 1995	Examiner Van Gestel, H
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document			