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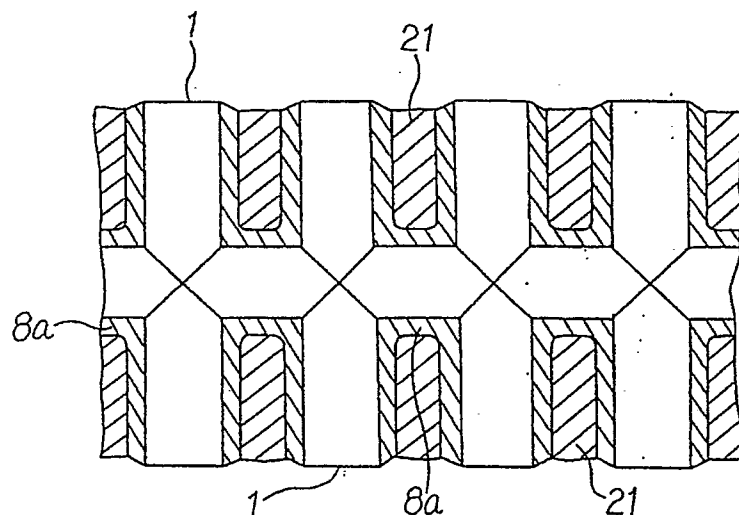
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(54) **Variable-pressure once-through boiler furnace evaporating tube unit.**

(57) Disclosed is a variable-pressure once-through boiler furnace evaporating tube unit in which upper headers disposed at the upper end are connected via perpendicular evaporating tubes to lower headers disposed at the lower end, thus constituting a fur-

nace wall. The adjacent evaporating tubes constituting the furnace wall communicate with each other at the middle portions between the upper headers and the lower headers, so as the fluids in the respective evaporating tubes are intermixed.

Fig. 4

**EP 0 462 486 A1**

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention is directed generally to a boiler for thermal power generation, and more particularly, to an evaporating tube unit for shaping a furnace wall of a once-through boiler in which a variable-pressure operation is carried out.

2. Description of the Prior Art:

FIG. 8 is an entire perspective view showing one example of a conventional vertical tube type variable-pressure operating once-through boiler. FIG. 9 is a perspective view fully illustrating a furnace wall part thereof.

A multiplicity of furnace wall tubes 10, 11, the lower ends of which are connected to a lower collecting header 14, are disposed in front and in rear. Furnace wall tubes 12, 13 connected to lower wall headers 15, 16 are disposed sideways. The upper ends of these furnace wall tubes 10, 11, 12, 13 are connected respectively to upper headers 17, 18, 19, 20, thus constituting a furnace. Normally, the furnace wall tubes 10, 11, 12, 13 are, as illustrated in FIG. 9, constructed of rifle tubes. The conventional structure is such that the adjacent furnace tubes do not, through integrally welded with fins 21, communicate with each other. Internal fluids flowing in from the lower collecting header 14 and the lower wall headers 15, 16 independently run through the rifle tubes till the fluids flow in the upper headers 17, 18, 19, 20.

As described above, in the conventional vertical tube type variable-pressure operating once-through boiler, the furnace evaporating tube is composed of a single tube from an inlet of the lower part to an outlet of the uppermost part. Namely, the furnace tube is not required to be divided typically as a boiler function. For this reason, the most economical construction has hitherto been selected.

As explained earlier, in the prior art vertical tube type variable-pressure operating boiler, the furnace evaporating tube is constructed of the single tube from the inlet to the outlet. Therefore, even if the evaporating tube is designed to set the furnace outlet at a saturation temperature under in a static state, an overheating condition is developed in a dynamic state. Heat absorption within the furnace wall becomes ununiform. As a result of this, an imbalance of fluid temperature becomes excessive at the furnace outlet, with the result that excessive stress acts on the furnace wall. More specifically, there are produced portions in which a dryness differs due to ununiformity in heat absorption. In this case, the portion having a high dryness

increases in volumetric flow rate but decreases in weight flow rate, which in turn further increases the dryness. Whereas in the portion having a low dryness, the dryness reversely further decreases. the imbalance increasingly grows.

SUMMARY OF THE INVENTION

It is a primary object of the present invention, which has been devised to obviate the foregoing problems inherent in the prior art, to provide a variable-pressure once-through boiler furnace evaporating tube unit comprising: upper headers disposed at the upper end; lower headers disposed at the lower end; and a plurality of perpendicular evaporating tubes for connecting the upper headers to the lower headers to constitute a furnace wall, characterized in that the adjacent evaporating tubes constituting the furnace wall communicate with each other at the middle portions between the upper headers and the lower headers.

In this variable-pressure once-through boiler furnace evaporating tube, the adjacent evaporating tubes communicate with each other via headers disposed outwardly of a furnace wall surface.

In the variable-pressure once-through boiler furnace evaporating tube, the adjacent evaporating tubes communicate with each other via cross branch tubes disposed inwardly of the furnace wall surface.

According to the present invention, the adjacent perpendicular furnace wall tubes communicate with each other at the middle portions of the upper and lower headers. With this arrangement, the internal fluids flowing in from the lower part of the furnace are mixed with each other at the communicating portions and made uniform in the upper part of the furnace. Even if the dryness becomes uneven due to the ununiformity of the heat absorption in the lower part of the furnace, the fluids in the respective furnace wall tubes each having a different dryness horizontally run in the form of gas-liquid double-layer flows and then intermixed at the communicating portions. These flows approximate infinitely to uniform mixed double-layer flows, thereby minimizing a difference in temperature between the portions overheated in the dynamic state in the furnace upper part.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention become apparent during the following discussion taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view showing a first embodiment of the present invention;

FIG. 2 is a view taken in an arrowed direction II

of FIG. 1, depicting an interior of a boiler furnace;

FIG. 3 is an entire perspective view showing one example of the boiler to which the present invention is applied;

FIGS. 4 to 7 in combination show a second embodiment of this invention;

FIGS. 4 and 6 are vertical sectional views each illustrating a furnace wall at a part A of FIG. 3;

FIGS. 5 and 7 are horizontal sectional views each illustrating a furnace wall at a part B of FIG. 3;

FIG. 8 is an entire perspective view showing one example of a conventional vertical tube type variable-pressure operating once-through boiler; and

FIG. 9 is a perspective view fully illustrating the furnace wall of the same boiler.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a perspective view showing a first embodiment of the present invention. FIG. 2 is a view taken in an arrowed direction II of FIG. 1, illustrating an interior of a boiler furnace. FIG. 3 is an entire perspective view showing one example of a boiler to which the present invention is applied.

Disposed rectangularly at the upper end of the boiler furnace in FIG. 3 are an upper front wall header 4 of the front part, an upper rear wall header 5 of the rear part and upper side wall headers 6, 6 on both sides. On the other hand, a lower collecting header 2 is disposed to extend on both sides of the lowermost part at the lower end thereof, and a plurality of furnace wall tubes 1 extend forwards and backwards therefrom to shape a furnace bottom. The wall tubes are thereafter connected to constitute front and rear walls. Lower wall headers 3, 3 are disposed on both sides. The plurality of furnace wall tubes 1 are so connected thereto as to be directed upwards. The upper ends of the vertical furnace wall tubes 1 are connected to the upper front wall header 4, the upper rear wall header 5 and the upper side wall headers 6, 6, thus constituting the furnace.

In this embodiment, as illustrated in FIGS. 1 and 2, the plurality of furnace wall tubes 1 constituting the furnace wall are alternately bent outwards along the horizontal planes of upper and lower two portions at the middle part (a part indicated by the symbol A in FIG. 3) between the upper headers 4, 5, 6, 6 and the lower headers 2, 3, 3. The furnace wall tubes 1 are connected to a middle header 7 disposed outwardly of the furnace wall surface. Hence, the adjacent furnace wall tubes 1 communicate with each other via this middle header 7. Even when the dryness becomes

ununiform at the lower part of the furnace, the ununiform fluids are mixed with each other, whereby these fluids are made uniform at the upper part of the furnace.

In the example illustrated in FIGS. 1 and 2, the furnace wall tubes 1 are alternately bent along the horizontal planes of the upper and lower two portions. If these tubes are bent along the horizontal plane of one portion, the same effects can be also obtained.

FIGS. 4 and 5 show a second embodiment of this invention. FIG. 4 is a vertical sectional view depicting the furnace wall at the part A of FIG. 3. FIG. 5 is a horizontal sectional view illustrating the furnace wall of the part B of FIG. 3.

In this embodiment, the adjacent wall tubes 1 communicate with each other via cross branch tubes 8a. At the corner part (a part B of FIG. 3), the cross branch tubes 8a are connected via elbows 9a to the respective wall surfaces (front surface, rear surface and side surfaces) of the furnace. The internal fluids are thereby movable. This embodiment also exhibits the same operating effects as those of the first embodiment.

In the example shown in FIG. 4, the upper and lower furnace wall tubes 1 at the cross branch tubes 8a are disposed on the same perpendicular axial line. However, these upper and lower furnace wall tubes 1 are alternately disposed and may communicate with each other via cross branch tubes 8b illustrated in FIG. 6. FIG. 5 shows an example where the furnace wall tubes 1 are provided at the corner part of the furnace. If no furnace wall tube exists at the corner part, the respective wall surfaces may be connected by using elbows 9b shown in FIG. 7.

In the case of a furnace designed so that an ununiform degree of the heat absorption at the furnace lower part is large, particularly the uniformity can be made effective by adopting the first embodiment which uses mainly the middle headers. In a furnace capable of setting the uniformity to a small degree, it is effective to employ the structurally simple cross branch tubes of the second embodiment.

Note that the present invention is effective especially in coal burning and oil burning. In gas burning, the present invention is effective in such a design that the ununiform degree of the heat absorption of the furnace is particularly large, or an overheating degree at the furnace outlet has to be set high.

According to the present invention, all the adjacent tubes are horizontally connected to each other in the middle of the plurality of furnace wall tubes of the vertical tube type furnace variable-pressure operating boiler. With this arrangement, the internal fluids are movable between the neighboring tubes.

It is therefore possible to minimize the imbalance of the fluid temperatures which is caused at the furnace outlet. This eliminates the possibility that the excessive stress acts on the furnace wall.

Although the illustrative embodiments of the present invention have been described in detail with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those embodiments. Various changes or modifications may be effected therein without departing from the scope or spirit of the invention.

Claims

1. A variable-pressure once-through boiler furnace evaporating tube unit comprising:
 - upper headers disposed at the upper end;
 - lower headers disposed at the lower end;
 - and
 - a plurality of perpendicular evaporating tubes for connecting said upper headers to said lower headers to constitute a furnace wall, characterized in that said adjacent evaporating tubes constituting said furnace wall communicate with each other at the middle portions between said upper headers and said lower headers.
2. The variable-pressure once-through boiler furnace evaporating tube unit as set forth in claim 1), wherein said adjacent evaporating tubes communicate with each other via headers disposed outwardly of a furnace wall surface.
3. The variable-pressure once-through boiler furnace evaporating tube unit as set forth in claim 1), wherein said adjacent evaporating tubes communicate with each other via cross branch tubes disposed inwardly of the furnace wall surface.

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Fig. 1

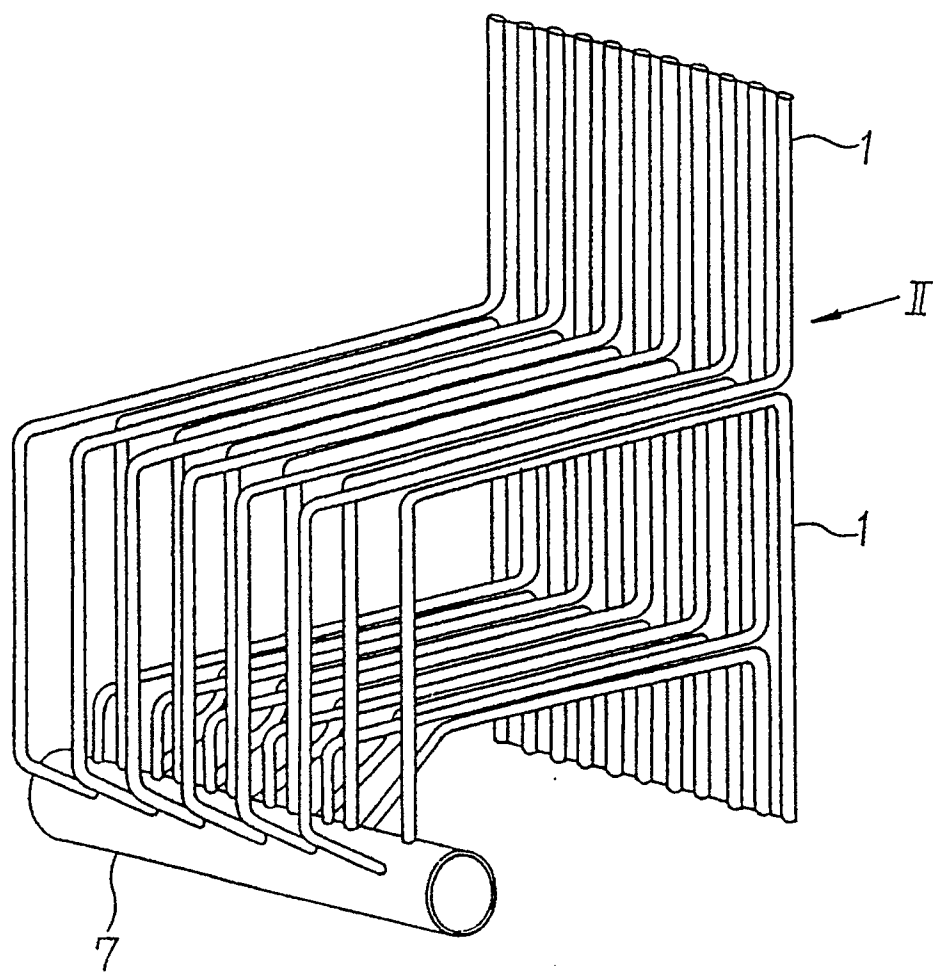


Fig. 2

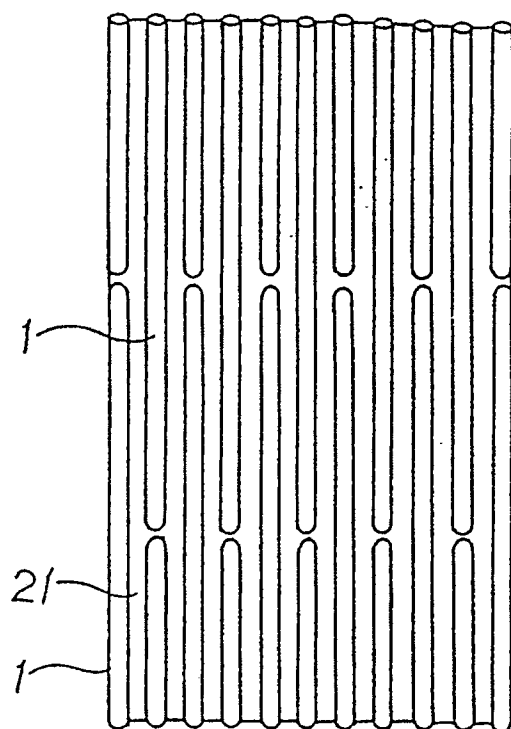


Fig. 3

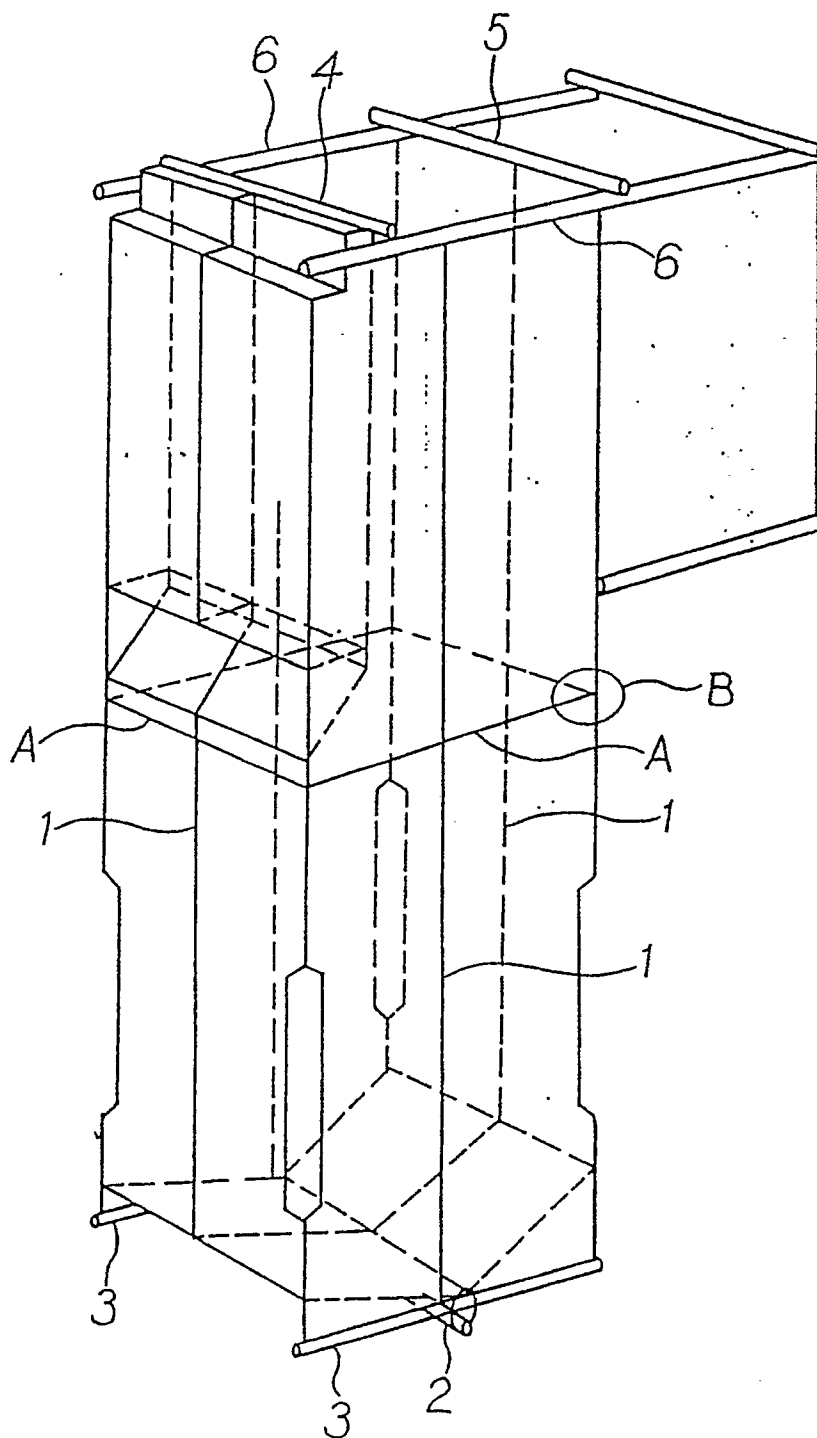


Fig. 4

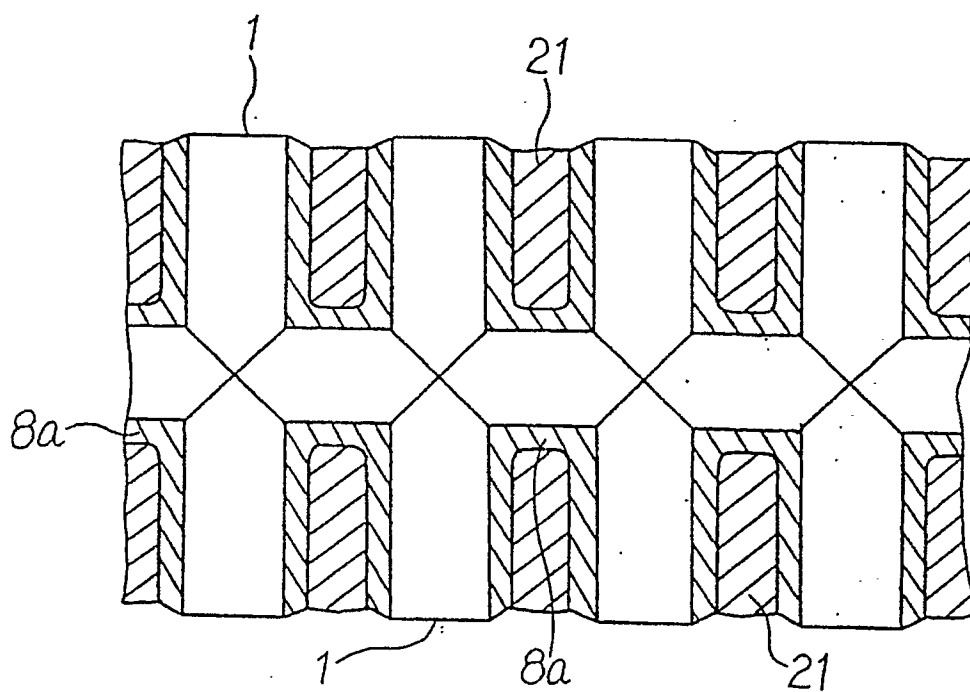


Fig. 5

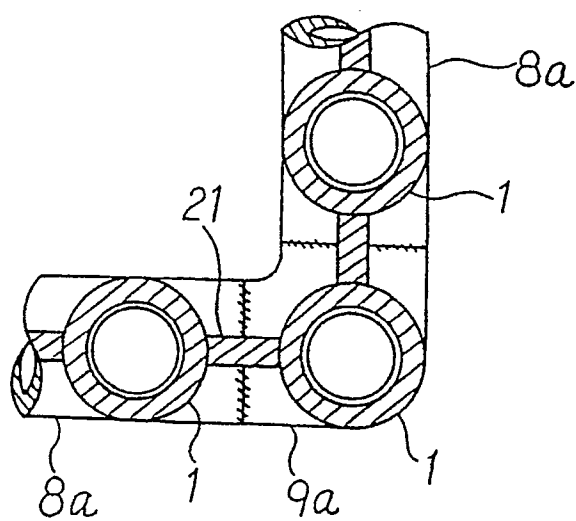


Fig. 6

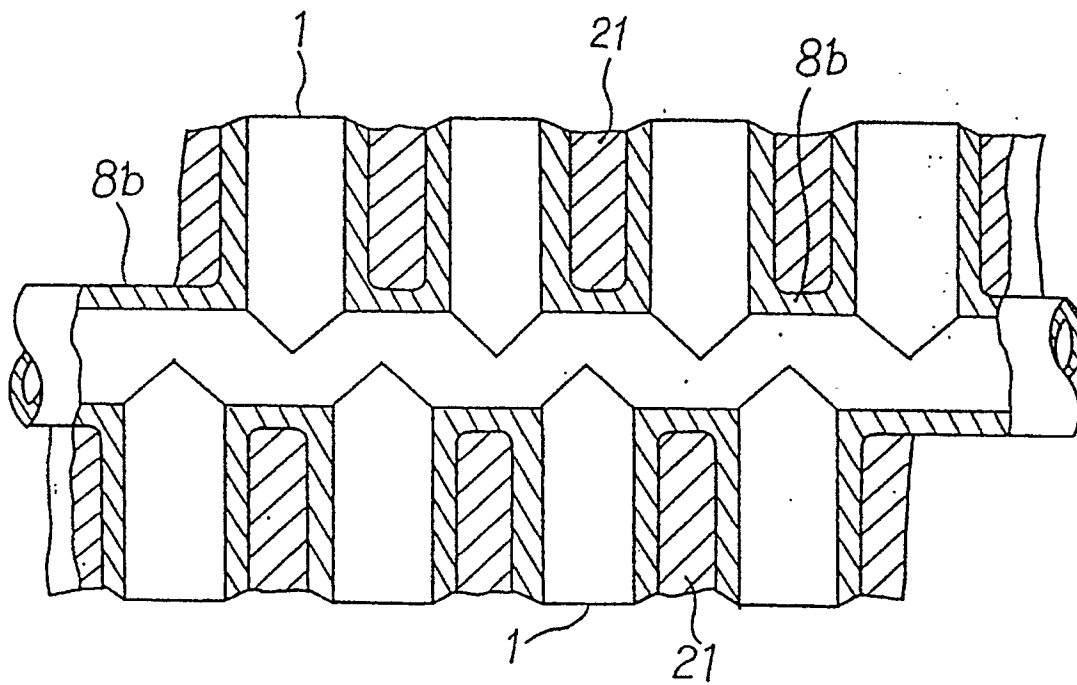


Fig. 7

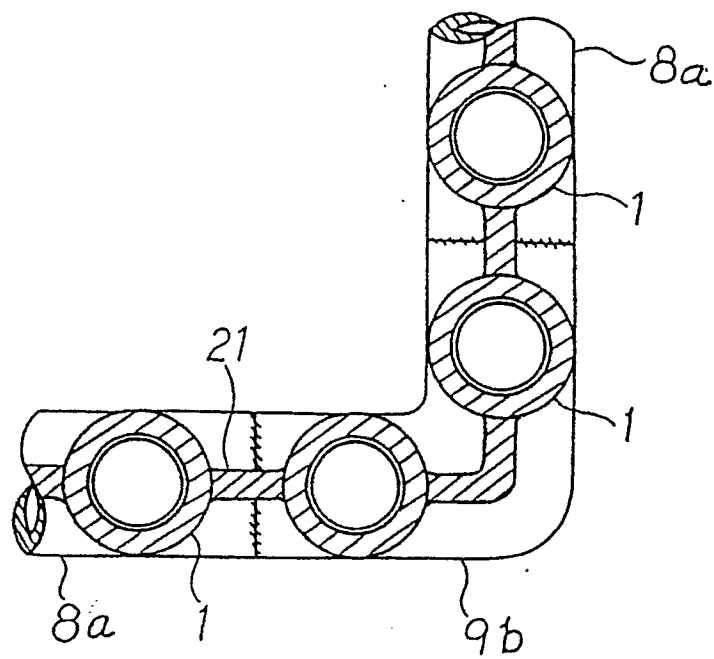


Fig. 8

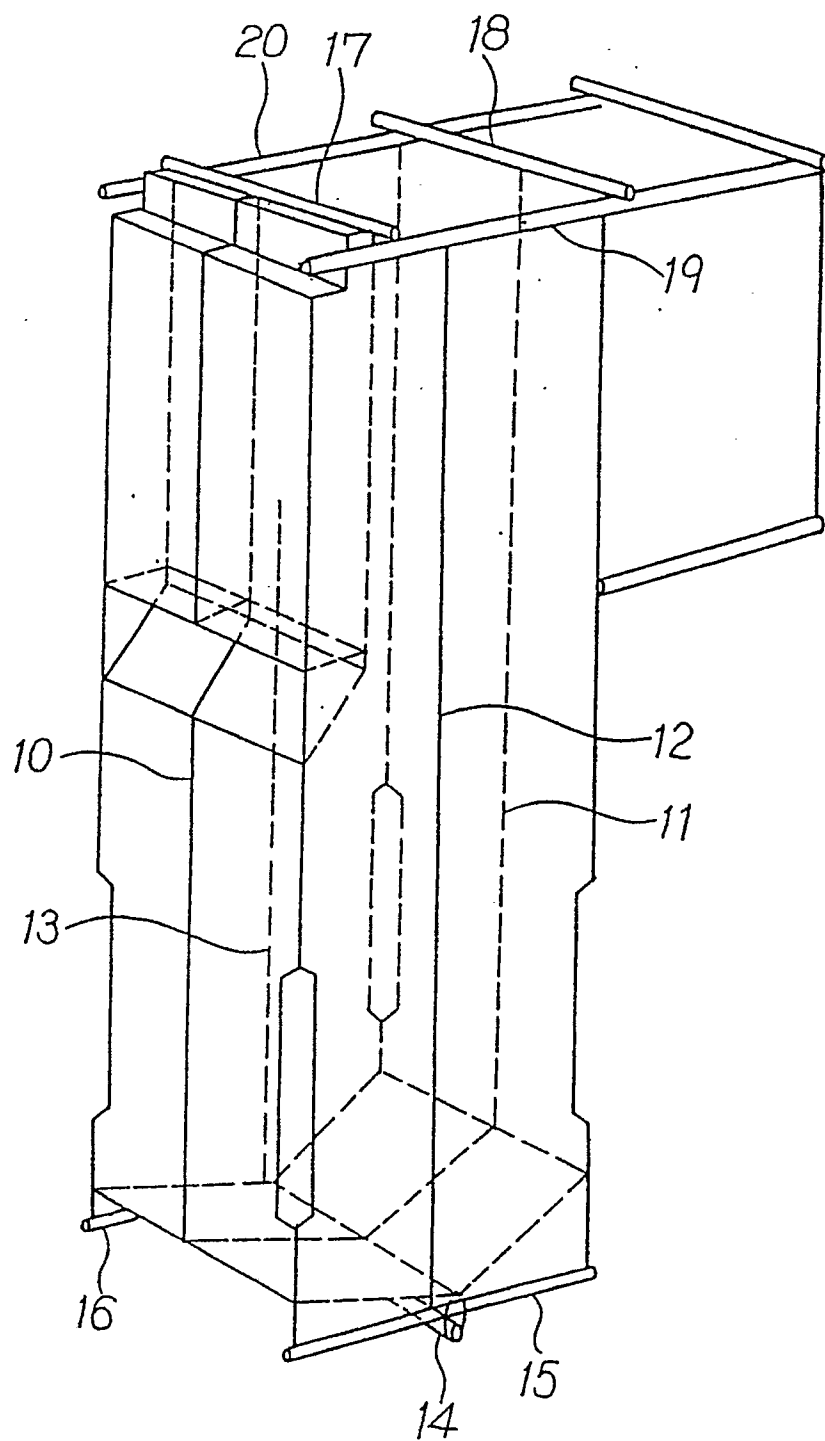
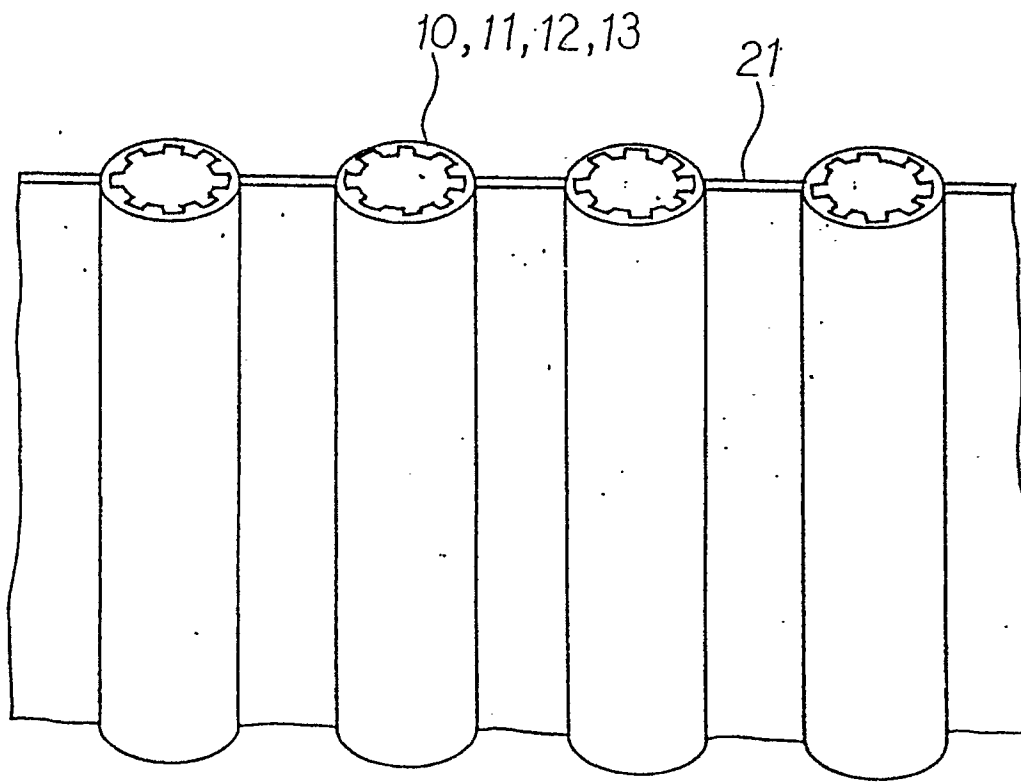


Fig. 9





Application Number

EP 91 10 9486

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.5)
X	US-A-3 308 792 (LAWTON) * Column 2, line 50 - column 3, line 25; figures * - - -	1,2	F 22 B 37/14 F 22 B 29/06
X	GB-A-1 152 340 (COMBUSTION ENGINEERING) * Page 2, lines 97-123; figures * - - -	1,2	
A	BE-A-6 824 98 (SULZER) - - - - -		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5) F 22 B
Place of search The Hague		Date of completion of search 13 September 91	Examiner VAN GHEEL J.U.M.
CATEGORY OF CITED DOCUMENTS 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	