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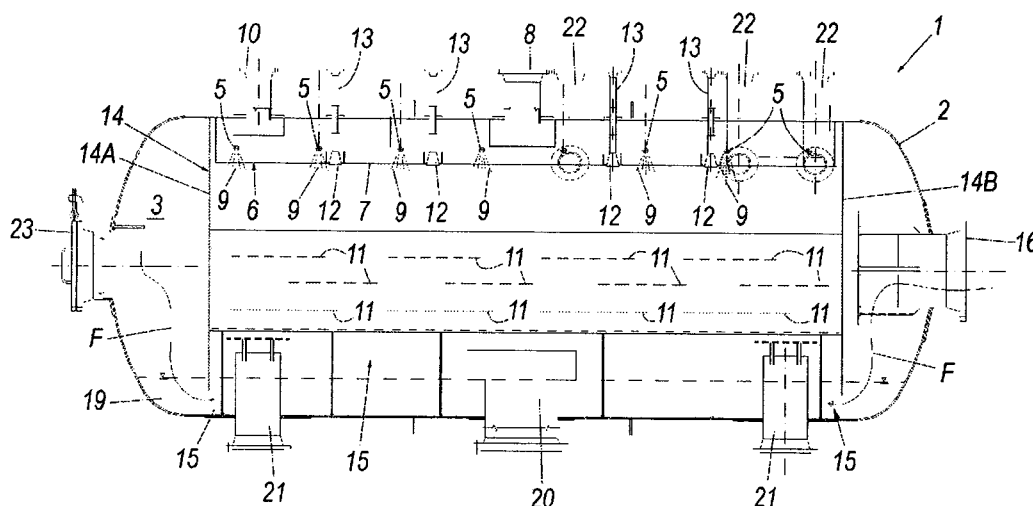
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(54) Title: **DEGASSER**



(57) Abstract: A degasser comprising a shell in which a plurality of nozzles are present for spraying into the shell a liquid fed to them, a plurality of plates being provided within the shell to receive said liquid sprayed by said nozzles, said plates being disposed such that the liquid is able to run from the upper plates to the lower plates, a port being provided for steam entry into said shell, and conveyor means for directing said steam between said plates, the steam being directed from the lower plates to the upper plates, at least one first outlet being provided to extract the degassed liquid from the bottom of said degasser, said first outlet being provided in such a manner as to enable a layer of degassed liquid to form on the bottom of said container when in use, and at least one second outlet to enable a minimum part of said steam plus degassed gases to be extracted from the interior of said shell, said conveyor means conveying said entering steam such as to make it bubble through said layer of degassed liquid, to hence further reduce its concentration of dissolved gases.

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## **DEGASSER**

The present invention relates to a pressure degasser for treating boiler feed fluid. It relates in particular to a degasser of combined spray and tray  
5 type.

Known pressure degassers (commonly known merely as "degassers") comprise a shell into which pressurized steam is fed. The pressurized steam comes into intimate contact with a plurality of fluid jets to be degassed, these being generated by suitable nozzles. The fluid then falls  
10 onto plates which are struck by a counter-current steam flow. The fluid runs from the upper plates to the lower plates and the degassing process terminates. The fluid processed in this manner deposits on the bottom of the shell, from which it is withdrawn ready for use.

A drawback of known degassers is that the gas quantity dissolved in the  
15 liquid on termination of a thermal degassing process is too high.

An object of the present invention is therefore to provide a degasser which improves the degree of fluid purification, so reducing the gas quantity dissolved in the fluid on termination of thermal degassing compared with traditional degassers.

20 These and other objects are attained by a degasser in accordance with the technical teachings of the accompanying claims.

Further characteristics and advantages of the invention will be apparent from the description of a preferred but non-exclusive embodiment of the degasser, illustrated by way of non-limiting example in the accompanying  
25 drawings, in which:

Figure 1 is a schematic side view of a horizontal degasser of the present invention;

Figure 2 is a schematic plan view of the degasser of Figure 1, with some parts omitted for simplicity;

30 Figure 3 is a schematic side view of a different embodiment of the degasser of the present invention (vertical degasser);

Figure 4A is a schematic plan view of the degasser of Figure 3, showing the arrangement of plates present at level II, IV and VI (and possible further even levels) of the degasser;

Figure 4B is similar to Figure 4A but shows the plates of levels I, III and V (and possible further odd levels);

Figure 5 is a schematic view of a different embodiment of the roof of a vertical degasser such as that of Figure 3, showing a plurality of nozzles;

Figure 6 is a schematic view showing the plan arrangement of the nozzles of Figure 5;

Figure 7 is a schematic view showing the mounting of the nozzles of Figure 5 and of the nozzles shown in Figure 3;

Figure 8 represents schematically the chamber shown in Figure 3, while Figures 9, 10 and 11 represent sections taken on the lines 9-9, 10-10 and 11-11 of Figure 8; in this group of Figures,  $\alpha$  indicates angles of  $30^\circ$ ,  $\beta$  indicates angles of  $60^\circ$ ,  $\theta$  indicates angles of about  $18^\circ$ , and  $\Delta$  indicates angles of  $15^\circ$ .

With reference to said figures, these show a degasser indicated overall by the reference numeral 1.

The degasser comprises a shell 2 constructed to maintain in its interior 3 a predetermined pressure greater than the external pressure.

Inside the shell 2 a plurality of nozzles 5 are present, fed with liquid to be degassed. The fluid is fed under pressure to a chamber 6 provided at the roof of the shell. This chamber 6 presents a surface 7 of interface with the shell interior. Said nozzles 5 are disposed on this surface 7 as explained hereinafter with reference to the vertical degasser of Figure 3. The method for fixing these is in fact the same for both structures.

Each nozzle 5 is arranged to spray into the shell interior the fluid (preferably makeup and/or condensate water) to be degassed, fed to the chamber 6 through the inlet 8 and 10. Each nozzle 5 emits a jet forming a cone with an angle at its vertex between  $55^\circ$  and  $65^\circ$ , but preferably  $60^\circ$ .

In the surface of the chamber 6 apertures 12 are provided connected by pipes 13 to a steam and gas elimination system. These pipes together

with the apertures 12 form outlets to enable gases removed from the fluid within the shell to be extracted.

A plurality of plates 11 are provided on several levels within the shell interior below the nozzles 5. The plates 11 are arranged to receive said liquid sprayed by the nozzles 5 and are particularly disposed such that the liquid can run from the upper plates to the lower plates. Advantageously, the plates 11 present a plurality of holes of diameter between 2.5 and 5 mm, preferably 3 mm or 4 mm. The holes are mutually positioned at the vertices of an equilateral triangle of side from 10 to 12 mm. Each plate can also perimetally present a rim enabling a certain quantity of liquid to be accumulated and compelling the liquid to flow out towards the lower plates only via said holes, to create ideal capillary tubes of fluid which are struck in counter-current by the steam.

All the plates 11 are surrounded perimetally by a housing 14 which substantially compels the steam to pass through the plates 11 from the bottom downwards, after bubbling through the fluid in the bottom of the shell 2. In this respect the housing 14 presents vertical walls 14A, 14B, 14C, 14D which reach as far as the top of the shell and are welded to its roof. However, the housing presents a lower opening 15 enabling the steam to flow into its interior. Advantageously the opening is regulated such that the rate at which said steam passes through it is less than 15 m/s for horizontal degassers (10 m/s for vertical degassers), this preventing undesirable overflow phenomena.

In this respect, as visible in Figures 1 and 2, the container comprises a port 16 for steam entry into the shell 2. To reach the outlet apertures 12, the steam is obliged to take the path defined by the arrows F, and substantially to turn about the housing 14 and flow towards the opening 15 provided in the housing 14 in proximity to the bottom of the shell 2. Essentially, the steam flows between the inner wall of the shell and the housing 14.

Advantageously the shape of the walls of the housing 14 also obliges the steam to flow from the lower plates 11 to the upper plates, towards the apertures 12.

On the bottom of the shell 2 an outlet 20 is present to extract the degassed liquid from the bottom of said degasser. The outlet is provided such as to enable a layer 19 of degassed liquid to form on the container bottom when in use. The liquid level is indicated in Figures 1 and 3 by a dashed line. In contrast, the housing has the opening 15 completely immersed in the liquid present on the bottom of the container when in use. Hence the inflow of steam from the port 16 causes the steam to bubble through the liquid present on the bottom of the housing 2, which liquid hence becoming further degassed.

To complete the description, the shell presents one or more equalization pipes 21, safety valves 22 in the roof, and a closable aperture 23 for inspection.

Figure 3 shows a vertical degasser in which those parts functionally similar to those of the preceding embodiment are indicated by the same reference numerals and will not be further described.

In this embodiment the housing 14 does not surround the plates but is defined by a cylindrical wall 14E connected to the inner wall of the shell 2 and a closure ring 14F. Again in this case the housing presents an opening 15 which, when the degasser is operative, is immersed in the liquid on the bottom of the degasser. Hence again in this case the path of the steam fed by the port is obligatory. In this respect, before reaching the plates 11 it has to bubble through the liquid present on the bottom.

Advantageously, in both the preceding embodiments, the steam "rotates" about the housing before bubbling through the water, to hence recover the heat dispersed to the outside of the housing and recycle it into the housing itself. This results in a substantial advantage in terms of thermal yield.

Figures 4A and 4B show the arrangement of the plates 11 and in particular the arrangement of levels I, III and V in Figure 4B and II, IV and VI in

Figure 4A. These levels are also shown in Figure 3. This arrangement enables optimal heat transfer between the counter-current fluid and steam. Figures 6 and 8 show schematically the arrangement of the nozzles for the two types of vertical degasser. These are disposed in groups of elements  
5 equidistant along circles concentric to the shell axis in Figure 6, and in parallel planes in Figure 8.

As can be seen, the surface 7 of the chamber 6 presents a plurality of cylindrical housings 25, each receiving a nozzle 5. The nozzle is formed from a valve body 26 in which a stem 27 is housed. The valve body 26  
10 presents a threaded cylindrical portion, which cooperates with a suitable thread of each cylindrical housing 25 to fix the nozzle in position.

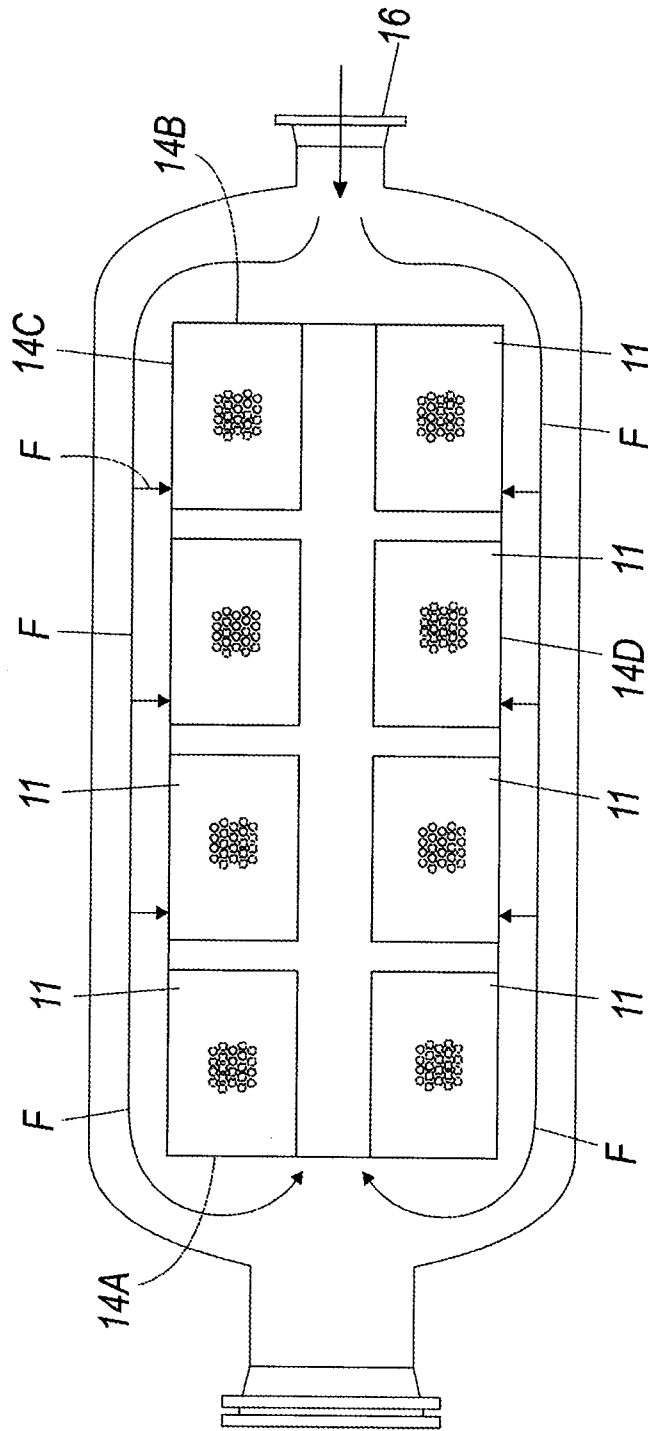
Various embodiments have been described but others can be conceived utilizing the same inventive concept.

**CLAIMS**

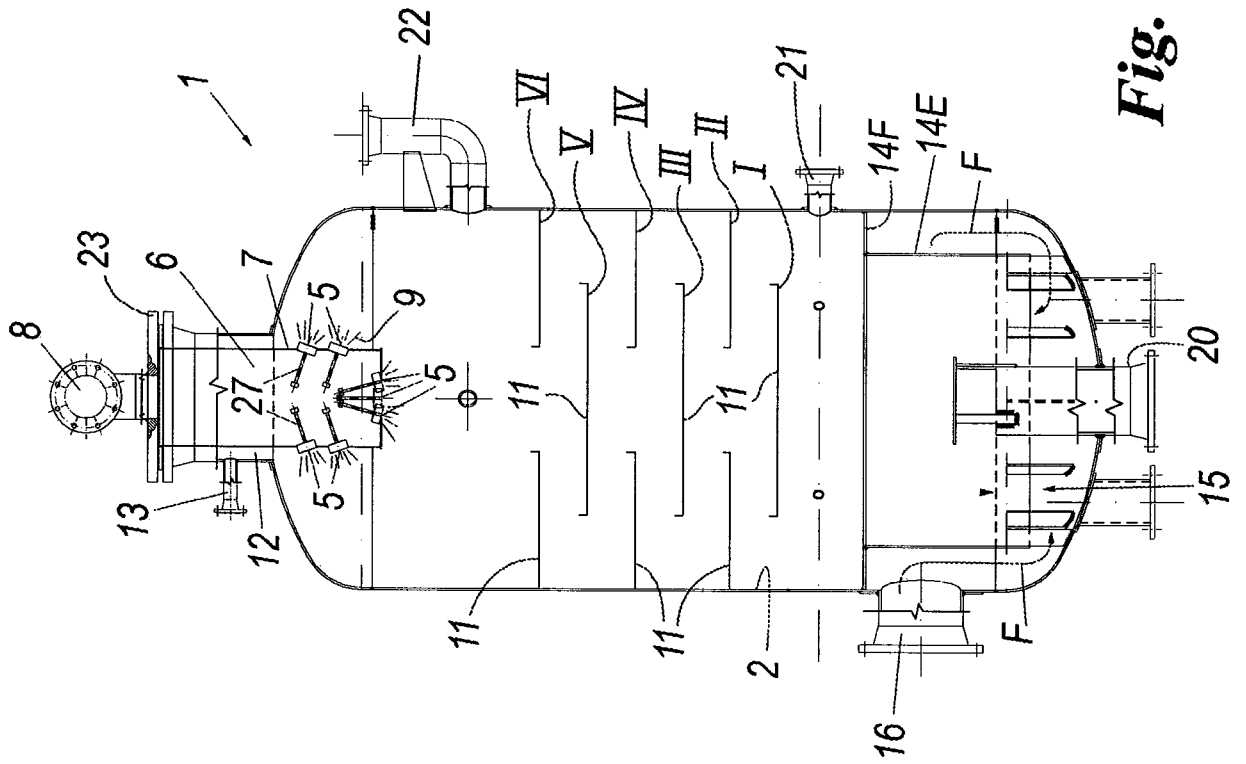
1. A degasser comprising a shell in which a plurality of nozzles are present for spraying into the shell a liquid fed to them, a plurality of plates being provided within the shell to receive said liquid sprayed by said  
5 nozzles, said plates being disposed such that the liquid is able to run from the upper plates to the lower plates, a port being provided for steam entry into said shell, and conveyor means for directing said steam between said plates, the steam being directed from the lower plates to the upper plates, at least one first outlet being provided to extract the degassed liquid from  
10 the bottom of said degasser, said first outlet being provided in such a manner as to enable a layer of degassed liquid to form on the bottom of said shell when in use, and at least one second outlet to enable a minimum part of said steam plus gases to be extracted from the interior of said shell, characterised in that said conveyor means convey said entering  
15 steam such as to make it bubble through said layer of degassed liquid, to hence further reduce its concentration of dissolved gases.
2. A degasser as claimed in claim 1, characterised in that said plates are disposed in a housing which perimetally surrounds them, said housing comprising said nozzles and said second outlets in its roof and  
20 comprising lowerly at least one opening which when in use is immersed in said layer of degassed liquid and is arranged to receive the flow of said steam.
3. A degasser as claimed in claim 2, characterised in that the area of the opening is regulated such that the velocity of said steam through it is  
25 less than 10 m/s in the case of a vertical degasser and less than 15 m/s in the case of a horizontal degasser.
4. A degasser as claimed in claim 2, characterised in that the conveyor means are defined by the inner surface of said shell and by the outer surfaces of said housing.
- 30 5. A degasser as claimed in claim 1, characterised in that each of said plates presents a plurality of holes in its surface.

6. A degasser as claimed in the preceding claim, characterised in that said holes have a diameter between 2.5 and 5 mm.
7. A degasser as claimed in claim 6, characterised in that said holes are mutually positioned at the vertices of an equilateral triangle of side  
5 either 10 or 12 mm.
8. A degasser as claimed in claim 5, characterised in that each plate presents a perimetral rim.
9. A degasser as claimed in claim 1, characterised in that the shell presents at its roof a chamber into which said liquid to be degassed is fed,  
10 said chamber being provided with a surface of interface with the interior of said shell in which a plurality of cylindrical housings are present, each receiving a nozzle presenting a valve body in which a stem is housed, said valve body presenting a threaded cylindrical portion arranged to cooperate with a suitable thread of the cylindrical housing to fix the nozzle in position.
- 15 10. A degasser as claimed in claim 1, characterised in that said nozzles are arranged to generate a cone with its vertex angle between  $55^\circ$  and  $65^\circ$ .

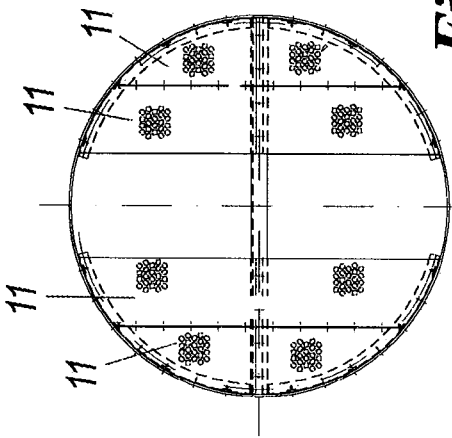




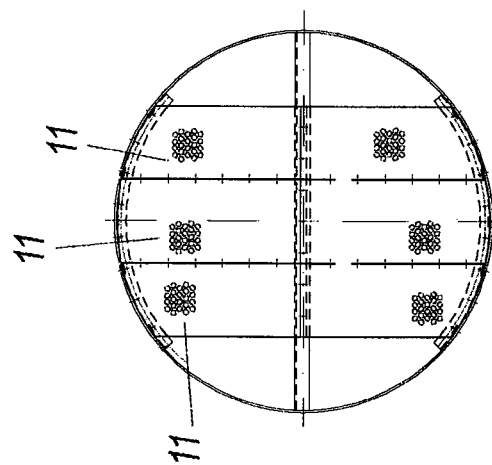
**Fig. 2**



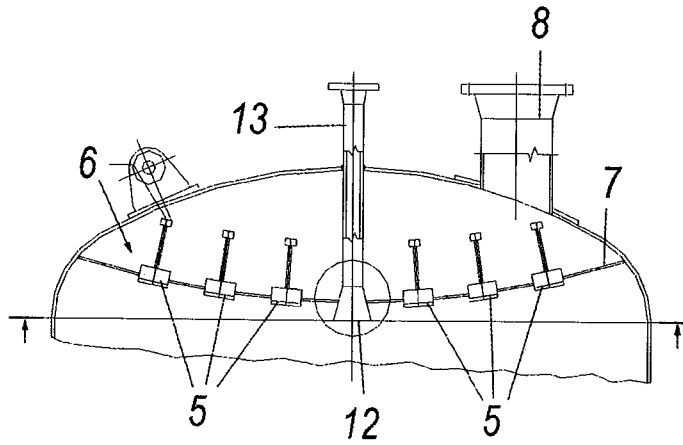
**Fig. 3**



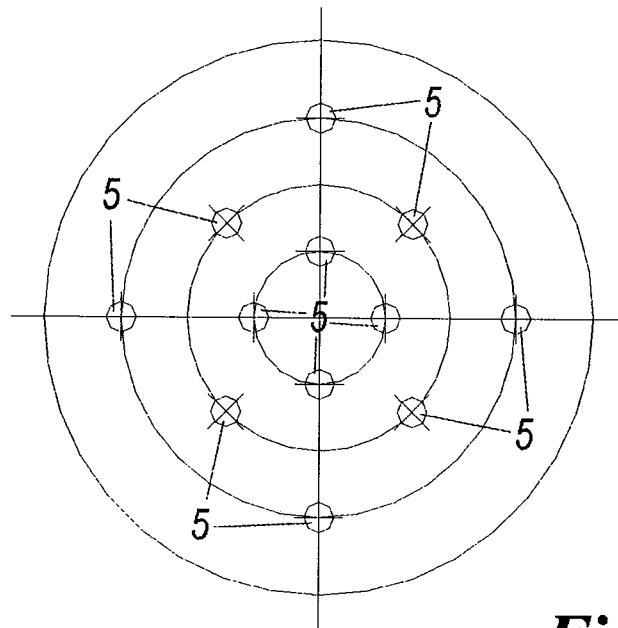
**Fig. 4A**



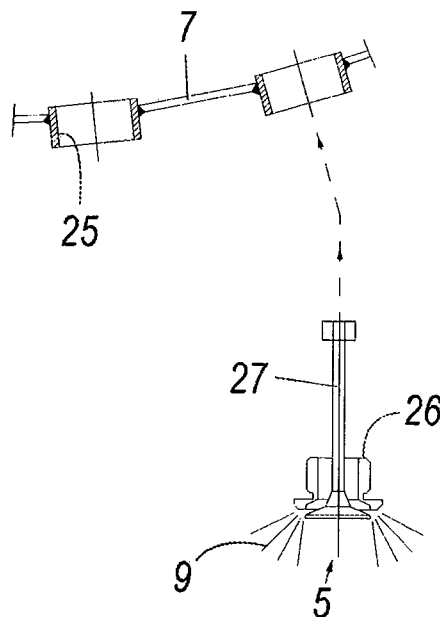
**Fig. 4B**



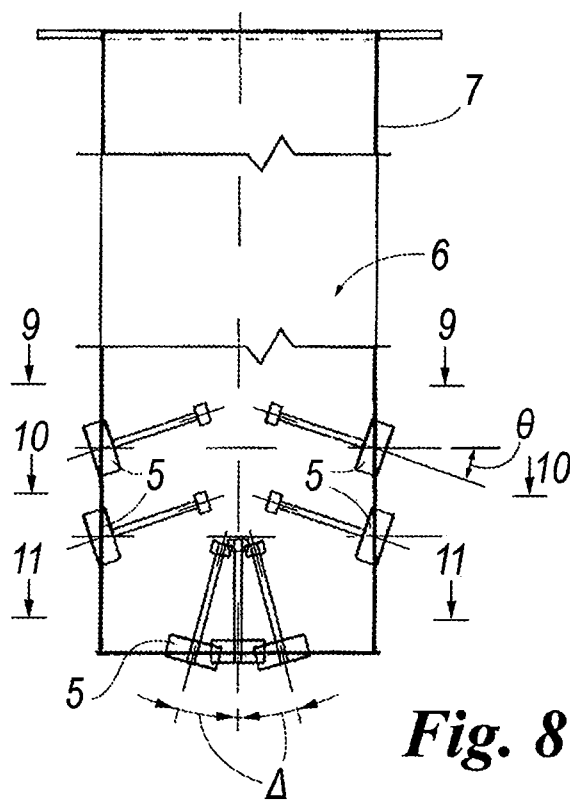
**Fig. 5**



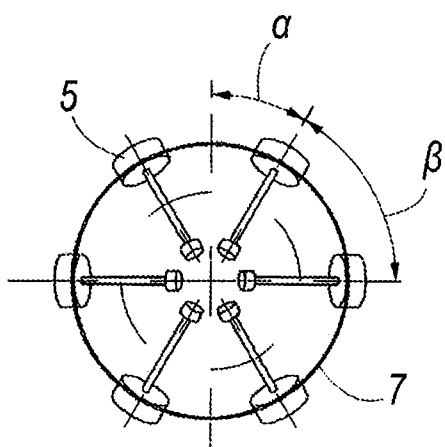
**Fig. 6**



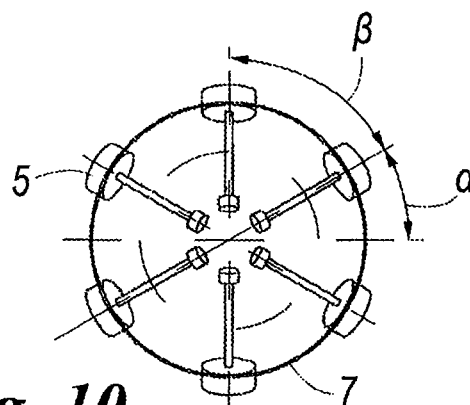
**Fig. 7**



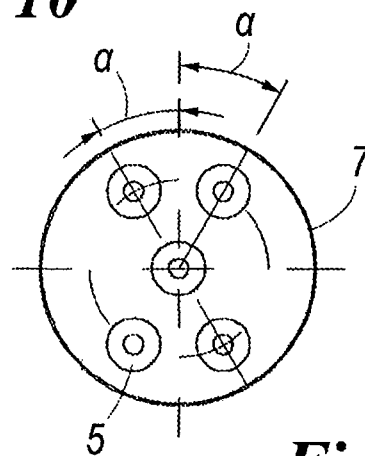
**Fig. 8**



**Fig. 9**



**Fig. 10**



**Fig. 11**