(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 503 238 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.09.2012 Bulletin 2012/39

(51) Int Cl.:
F23M 5/00 *(2006.01)* ***F23C 3/00*** *(2006.01)*

(21) Application number: **11305321.9**

(22) Date of filing: **22.03.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicants:
- **Martins Ferreira, Guilherme**
  Sao Paulo (BR)
- **von Rainer Fabiani, Luis filipe**
  Sao Paulo (BR)
- **de Pinho, Luiz Felipe**
  Sao Paulo (BR)
- **de Sousa Borges, Rodrigo**
  Sao Paulo (BR)

(72) Inventors:
- **Martins Ferreira, Guilherme**
  Sao Paulo (BR)
- **von Rainer Fabiani, Luis filipe**
  Sao Paulo (BR)
- **de Pinho, Luiz Felipe**
  Sao Paulo (BR)
- **de Sousa Borges, Rodrigo**
  Sao Paulo (BR)

(74) Representative: **Thinat, Michel**
Cabinet Madeuf,
56 A, rue du Faubourg Saint-Honoré
75008 Paris (FR)

(54) Combustion chamber

(57) The present application relates to a combustion chamber (1) which aims to allow the use of solid fuels in place of liquid and gaseous fuels; the chamber (1) is connected to a combustion air fan (3), a solid fuel transportation air blower (13), a device with gravimetric solids dosing system (12), conveying air and primary air pipes, measurement and auxiliary fuel control rack (oil and natural gas) (16).

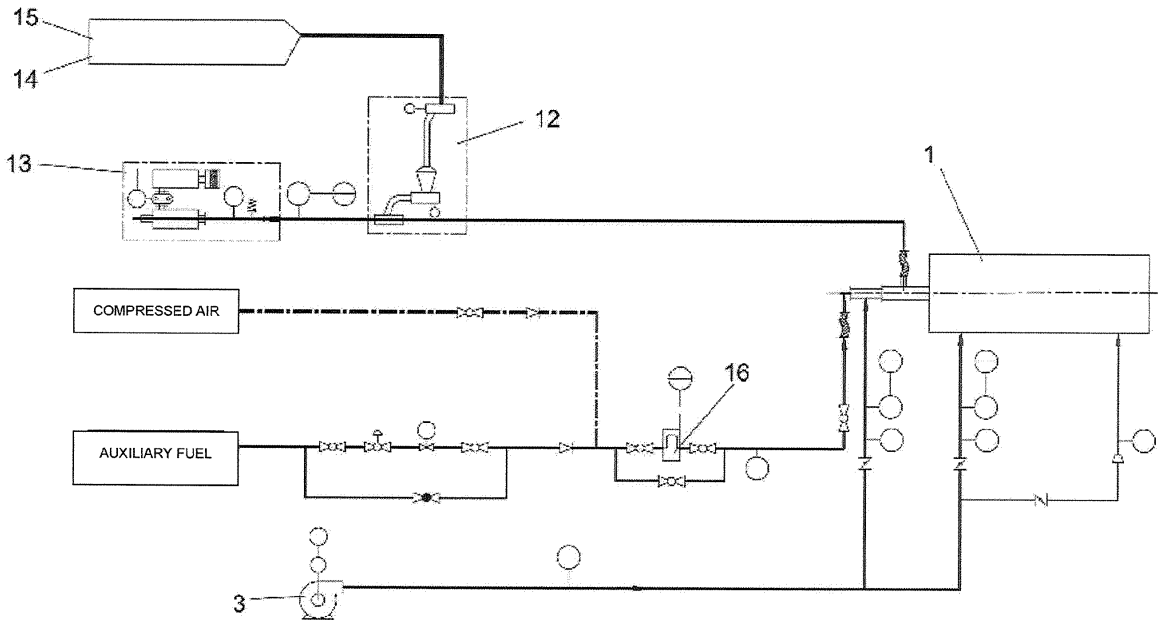


FIG. 1

EP 2 503 238 A1

Description

[0001] The present patent of invention application refers to a combustion chamber, which aims at enabling the use of solid fuels in processes with temperatures not high enough to allow the direct injection and burning of solid fuels.

[0002] The attractiveness of using solids e.g. pulverized petcoke for replacing liquid and gaseous fuels is fundamentally at a much lower price of solid fuels when compared with liquid and gaseous fuels. For such reason, processes in which fuel costs are important, the substitution of liquid and gaseous fuels by solid fuels becomes very attractive.

PRIOR ART

[0003] Patent application PI 0406727-4 refers to a method and apparatus by which a flame-free combustion can be precipitated and maintained within the essentially oval combustion chamber of an integrated heater/burner unit. The invention provides an air inlet and a fuel source in combination with recirculation residual gas within the combustion chamber of the apparatus to precipitate and sustain a flame-free combustion of the gases combined over and within a narrowly defined limit. The air is introduced into the oval combustion chamber through an air inlet. The fuel gas is combined with residual recirculation gases with continued warming of the residual recirculation gas, the air introduced or both, the residual gas and the air until the temperature at the limiting interface between air and the inert fuel gas exceeds a temperature of self-ignition of the limiting interface components. A fuel gas stream without a flame portion is combined with the residual recirculation gas, and then left to spread with the air stream in a sufficient measure to maintain the flame-free combustion and the operating temperature of the chamber between 1500 and 1900 Fahrenheit. The essentially oval configuration of the integrated heater/burner allows increased mass and circulation rates than those possible with contemporary art heaters, and as a consequence, provides a uniform complete, cooling combustion, resulting in low emissions of NOx.

[0004] However, the aforementioned chamber does not allow burning of solid fuels, such as proposed in the present application.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present application will be explained in detail with the aid of figures attached.

Figure 1 shows an overview of the burning system for solid fuels;
Figure 2 shows a front view of the physical layout of the proposed system and indicates the placement of equipment;
Figure 3 shows a side view of the physical layout of the proposed system shown in Figure 2;
Figure 4 shows a front perspective view of the combustion chamber;
Figure 5 shows an exploded rear perspective view of the combustion chamber;
Figure 6 shows a partial cut front view of the combustion chamber;
Figure 7 shows a cross-sectional view of the body of the combustion chamber and an enlarged detail of the body of the combustion chamber;
Figure 8 shows a top view of the combustion chamber assembled on a displacement trolley;
Figure 9 shows a right lateral view of the combustion chamber assembled on a displacement trolley;
Figure 10 shows a left side view of the combustion chamber assembled on a displacement trolley;
Figure 11 shows a front view of the chamber combustion assembled on a displacement trolley, and
Figure 12 shows an enlarged detail of the wheels disposition of the combustion chamber trolley on the chamber's transport rails.

DETAILED DESCRIPTION OF THE INVENTION

[0006] The combustion chamber (1) described below has the purpose of enabling the use of solid fuels (14) in processes with temperatures not high enough to allow the direct injection and burning of solid fuels (14). Among the main fuels to be used there can be cited:

- Petroleum coke;
- Coal;
- Charcoal;
- Charcoal chaff;
- Biomass (bagasse, sawdust, wood, etc).
- Other grinded fuels.

[0007] The attractiveness of using solids for replacing liquid and gaseous fuels is fundamentally at a much lower price of solid fuels when compared with liquid and gaseous fuels. For such reason, processes in which fuel costs are important, the substitution of liquid and gaseous fuels by solid fuels becomes very attractive. Among the main processes, there can be cited:

- Rotary Dryers, Fluidized Bed Dryers, Rapid Dryers, etc.
- Rotary Vertical Calciners, etc.
- Rotary Vertical Furnaces, etc.

[0008] The start of the burning of solids must be preceded by heating the chamber with an auxiliary fuel which can be liquid (diesel oil, bunker oil, etc.) or gaseous (natural gas, LPG, etc). Once the chamber is heated, one can start the injection of solid fuels, since the process is self-sustained.

General Aspects

[0009] An overview of the system for burning solid fuels (14) can be obtained in Figure 1 - Engineering Flowchart. In it, it is possible to view the main equipment and instruments that make up the burning system together with the combustion chamber (1).

[0010] Figures 2 and 3 show the physical layout of the proposed system and indicate the placement of equipment. Among the main components of the system there can be cited:

- Combustion chamber (1);
- Support and displacement trolley, or other support (2);
- Combustion air fan (3);
- Solid fuel conveying air blower (13);
- Gravimetric solids dosing system (12);
- Conveying air and primary air pipes (7);
- Measurement and auxiliary fuel control rack (oil and natural gas) (16).

Combustion Chamber

[0011] Figures 4, 5 and 7 show the combustion chamber assembly (1).

[0012] This combustion chamber (1) is responsible for allowing the ignition of solid fuels (14) (grinded, crushed, etc.), producing a flame at the outlet. For this, the main feature of this chamber is its high internal temperature above 2732 Fahrenheit. In addition, the preheated primary air as well as its internal environment with a low dust concentration, also contributes to the proper burning of solid fuel (14).

[0013] The air introduced into the jacket (17) will be tangentially injected into the inner chamber (through stainless steel pipes (6)) and at high speed. This will promote an intense rotation within the combustion chamber (1), causing the residence time of solid particles (14) to be quite high (as particles will be centrifuged, staying close to the periphery as they are consumed), thus allowing an efficient burn with partial combustion of solids, with no residual fuel leftover, turning the solid fuel into a combustible gas. The solid fuel (14) will also be tangentially introduced, in order to maximize the rotation within the combustion chamber (1) and thus contribute so that the fuel combustion and gasification are the best possible. The chamber comprises:

An inner housing (4) constructed with stainless steel or carbon steel plates, coated with low density ceramic fiber plates (19) and high alumina and low iron oxide content refractory material coating (18). Inclined cross tubes (6) will promote the tangential injection of primary air. Due to its geometry, the chamber (1) will retain, through a mechanism of centrifugation, the solid fuel particles (14) thereto introduced and will allow the oxidation reaction of all or part of such fuel and the output of ignited gases and particles through the discharge outlet that is coaxial to the chamber (1);

[0014] An outer casing (5) (constructed with stainless steel or carbon steel plates) which, once fitted around the inner housing (4), makes up a jacket (17) that will provide internal cooling of the housing (4) and a pre-heating of the air used in the centrifugation of the solid fuel particles (14).

[0015] The air injectors (6) are stainless steel tubes that allow the tangential injection of primary air on the cylindrical portion of the chamber (1);

[0016] The fuel injection will occur tangentially in the same rotation direction of the primary air injectors (6) through its own nozzle;

[0017] Burner nozzle: connection to fit the gas or oil lance to be used for preheating the chamber and adjusting the flame;

[0018] Pilot connection point: destined for the introduction of a gas lance to be used for firing the oil burner;

[0019] Viewers.

Rail and Support Trolley

[0020] The combustion chamber (1) in a preferred form of constructive implementation could be supported on a support trolley (2) consisting of square or round section pipes (11), in order to increase the rigidity of the structure which in turn is assembled on a displacement rail (8) comprising a flat support bar (9) and a square bar (10) acting as the rail itself.

Solid Fuel Pneumatic Conveying System

[0021] Once measured, the solid fuel (14) from the silo (15) will be introduced into a pneumatic conveying line which shall lead it towards the combustion chamber (1).

[0022] The introduction of particles (14) in the pressurized air circuit will be made or either by an equipment with a dosing system (12) or more simply by a solids pump or even an eductor.

[0023] A roots-type blower will be employed to supply the conveying air. Such blower is assigned by (13) in the installation flowchart (figure 1).

Primary Adjustment Air System

[0024] Aiming to obtain adequate conditions for solid fuel combustion, one must install a fan (3) and a primary adjustment air piping (7), as shown in Figure 3. The manometric pressure required for this air can reach up to 100 mbar.

[0025] This fan (3) shall have its drive motor fed with variable frequency through the use of a frequency converter. Such feature will be required to perform adjustments to the primary air flow depending on the system operating conditions.

Claims

1. Combustion chamber, wherein its ignition takes place through gasification obtained by partial combustion of solid fuels, that can be pulverized, grinded, or crushed, designed to be adapted with a combustion air fan (3), a solid fuel conveying air blower (13), a device with gravimetric solids dosing system (12), air conveying and primary air pipes (7), measurement and auxiliary fuel control rack (16); said combustion chamber (1) comprising an inner housing (4), a ceramics insulation (19) internally lined with refractory material (18), an outer housing (5) assembled around the inner housing (4) setting a jacket (17) with passage of inclined cross tubes (6).

2. Combustion chamber of claim 1 in a preferred way of constructive implementation, wherein the combustion chamber is mounted on a displacement trolley (2) comprising tubes (11), which is supported on a displacement rail (8) comprising a flat support bar (9) and a square bar (10) as the track itself.

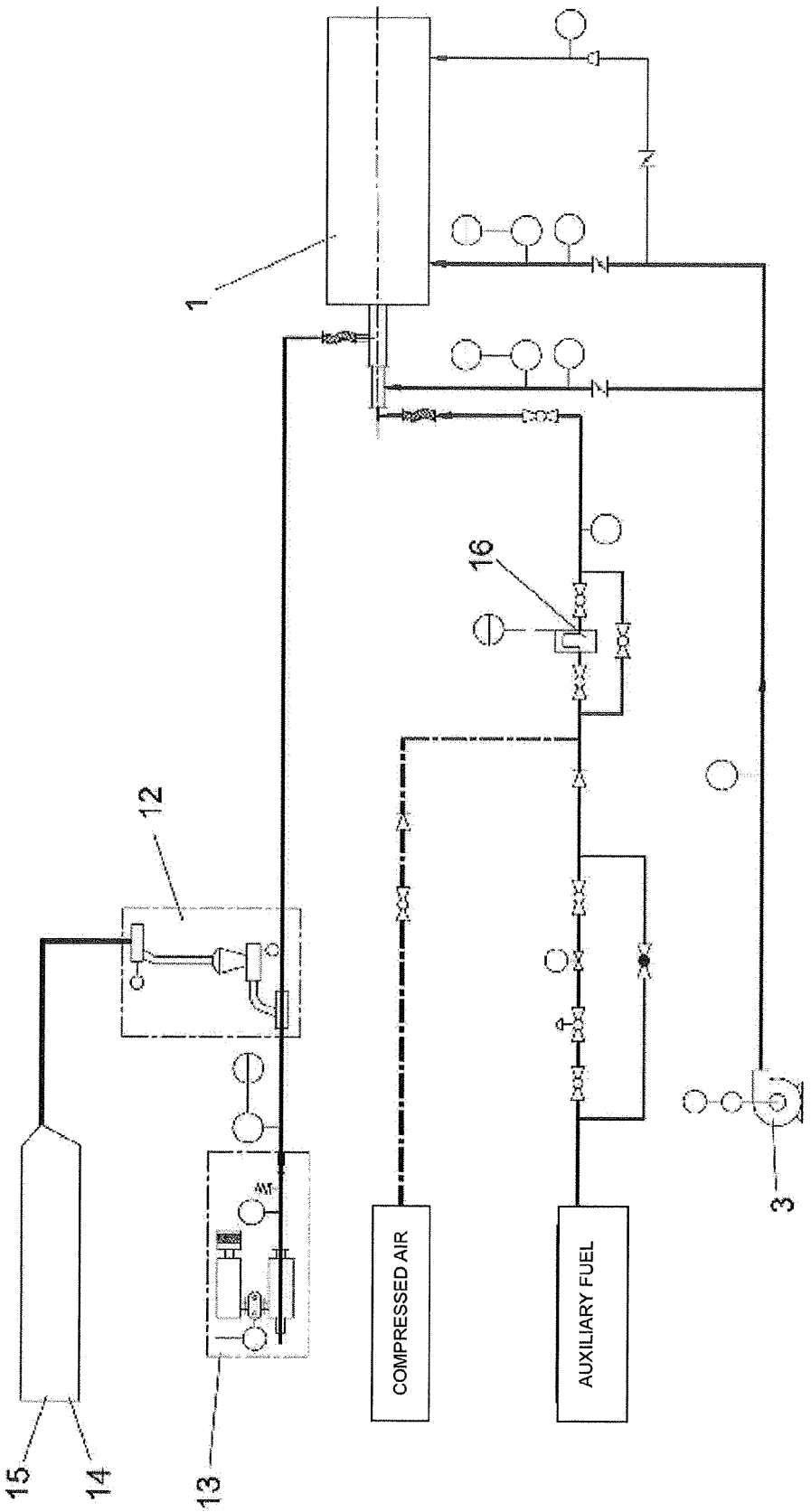


FIG. 1

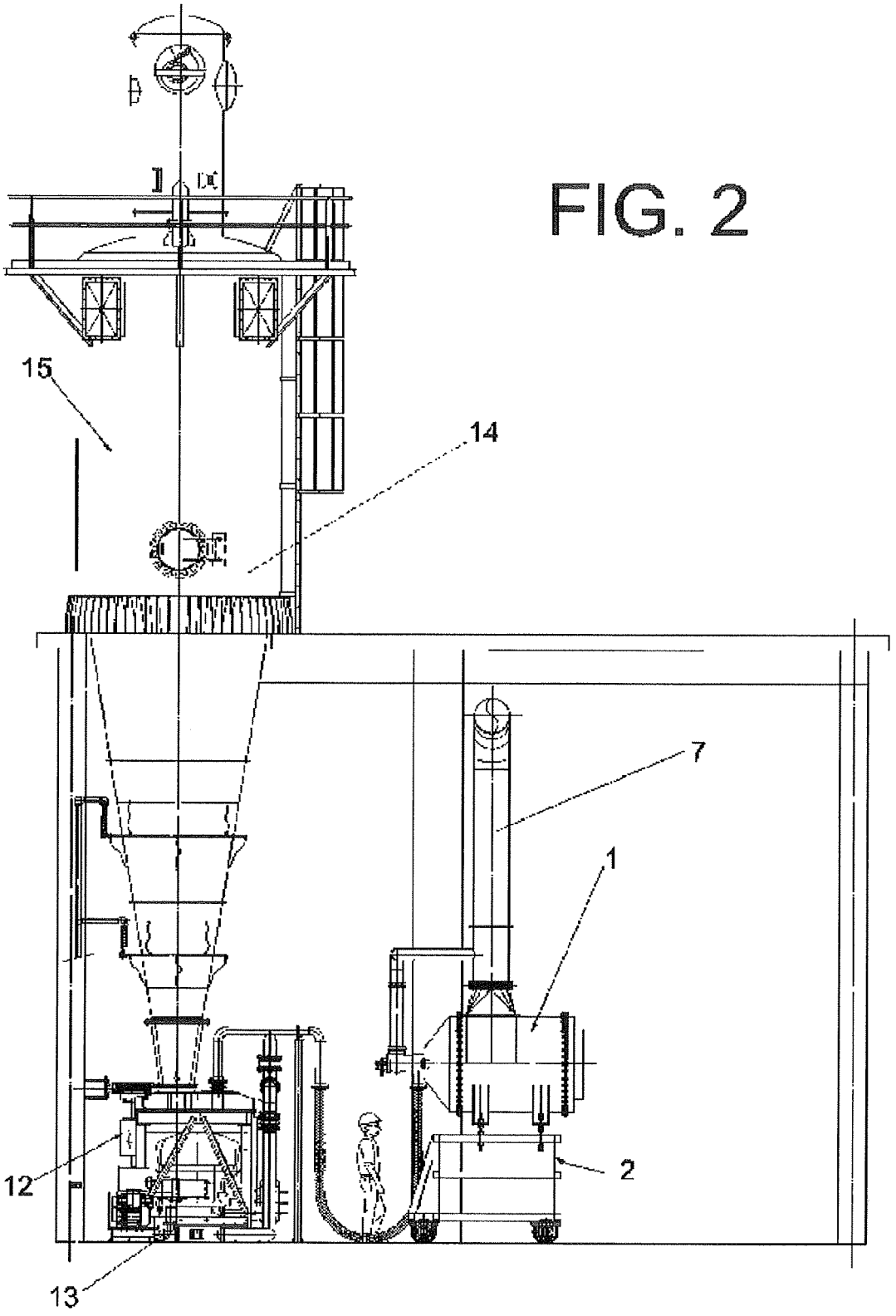
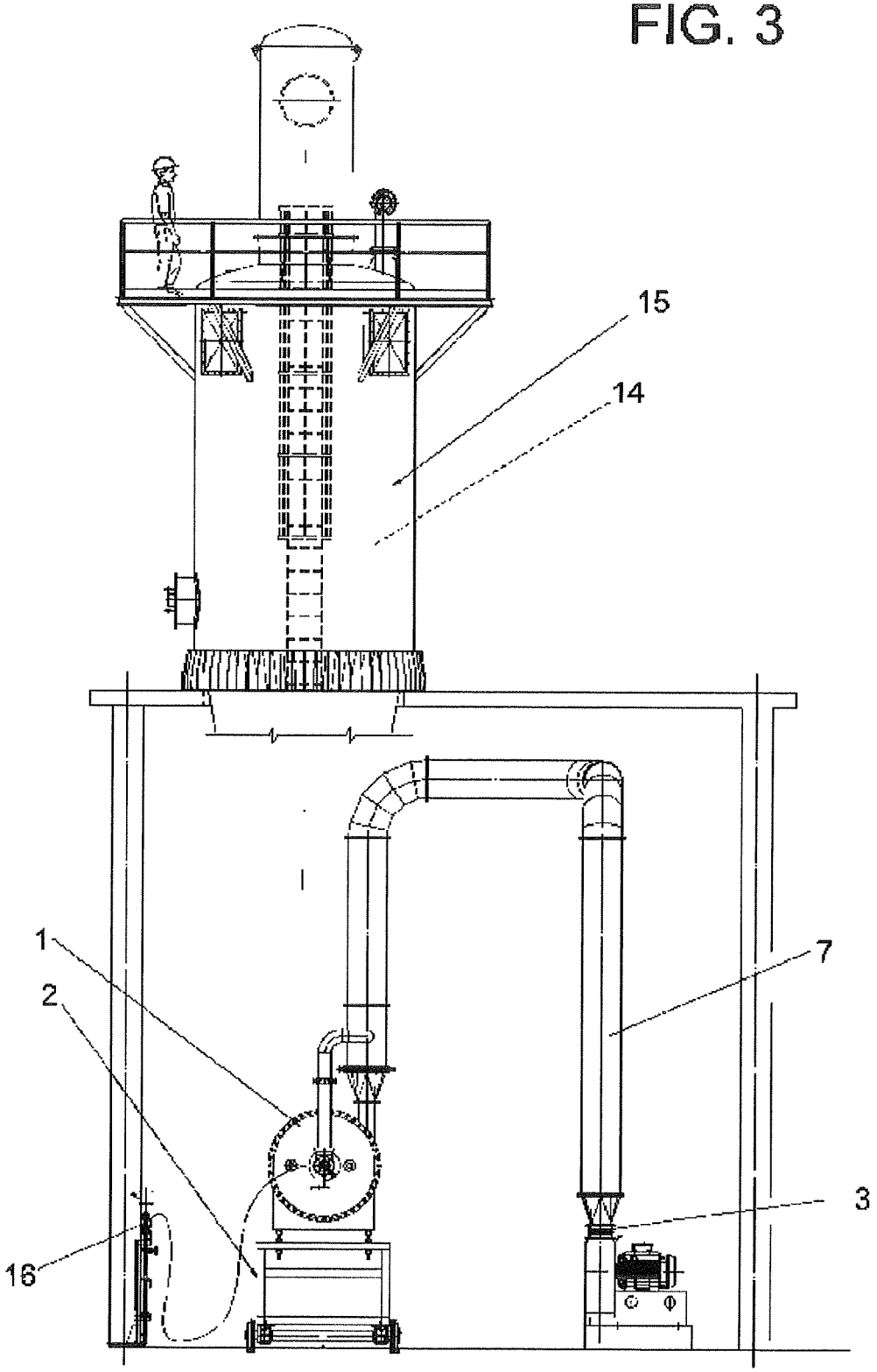


FIG. 2

FIG. 3



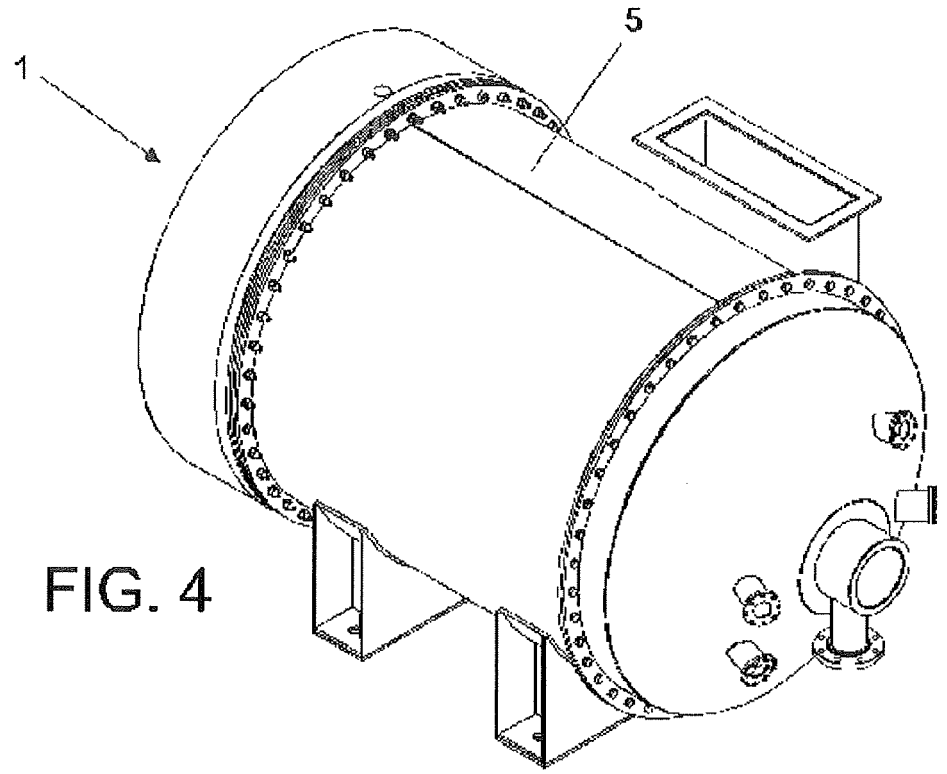


FIG. 4

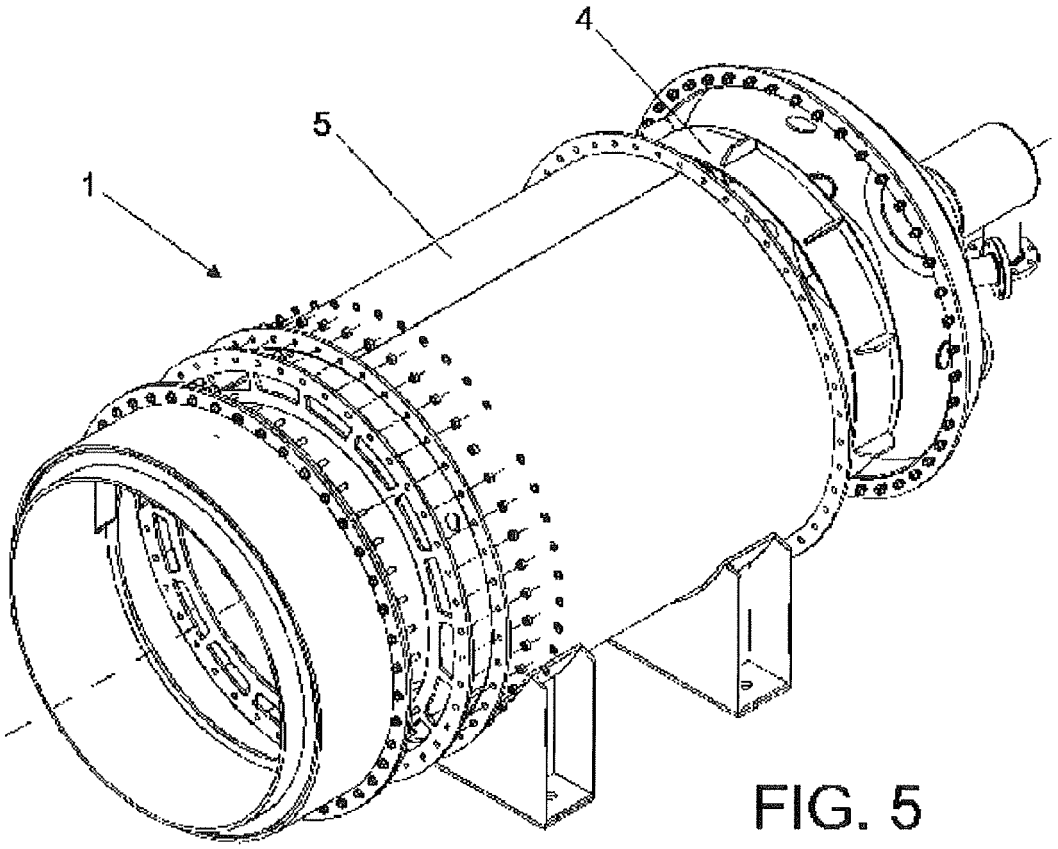


FIG. 5

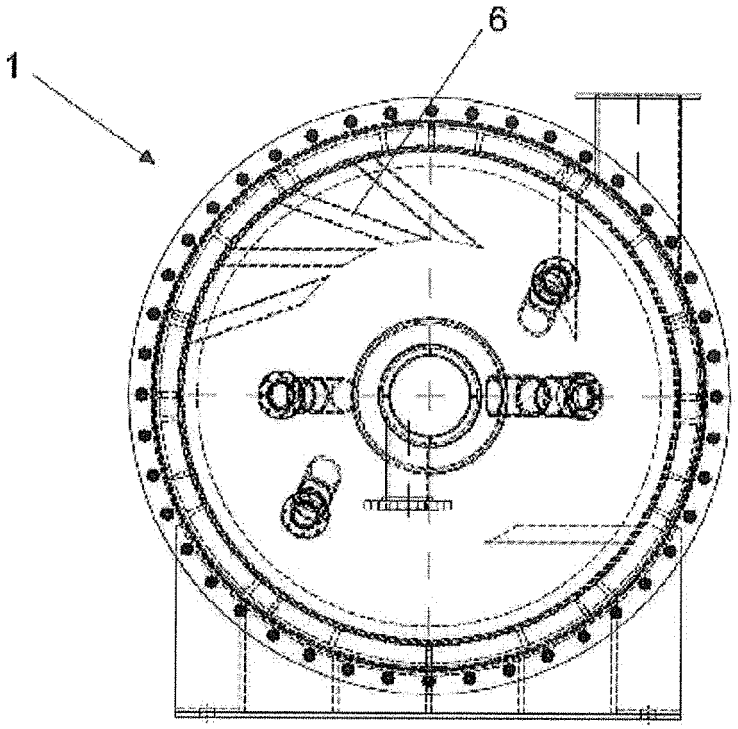


FIG. 6

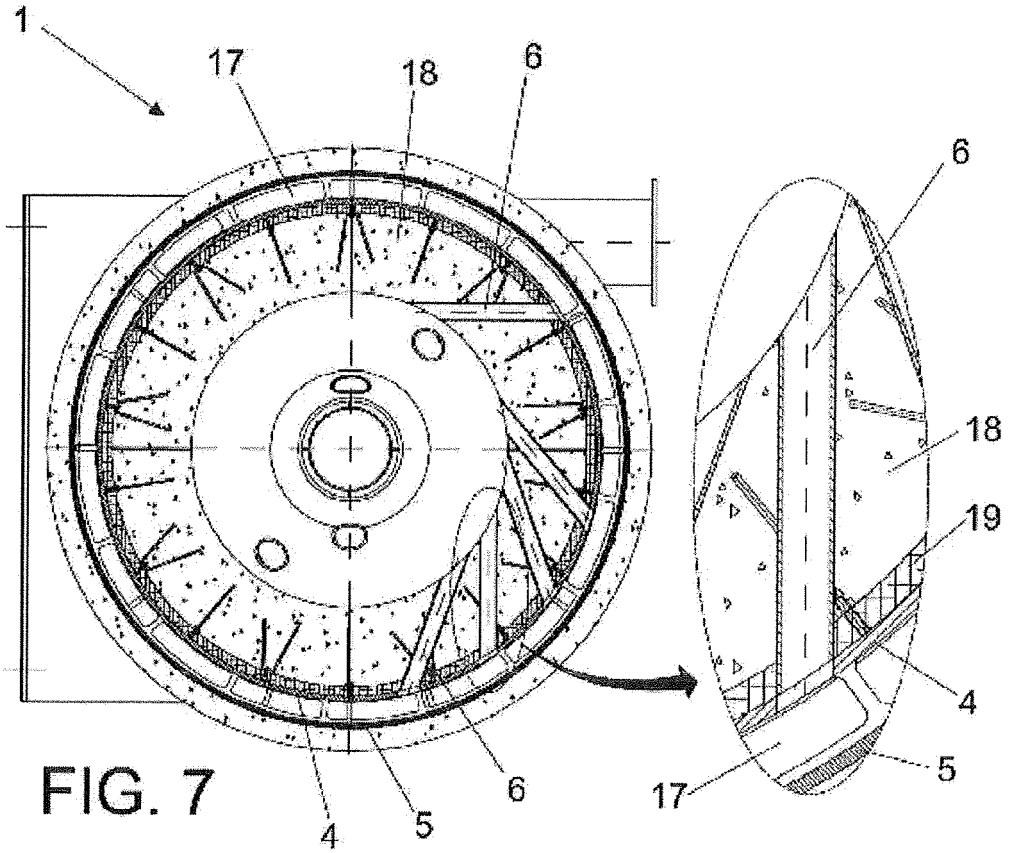


FIG. 7

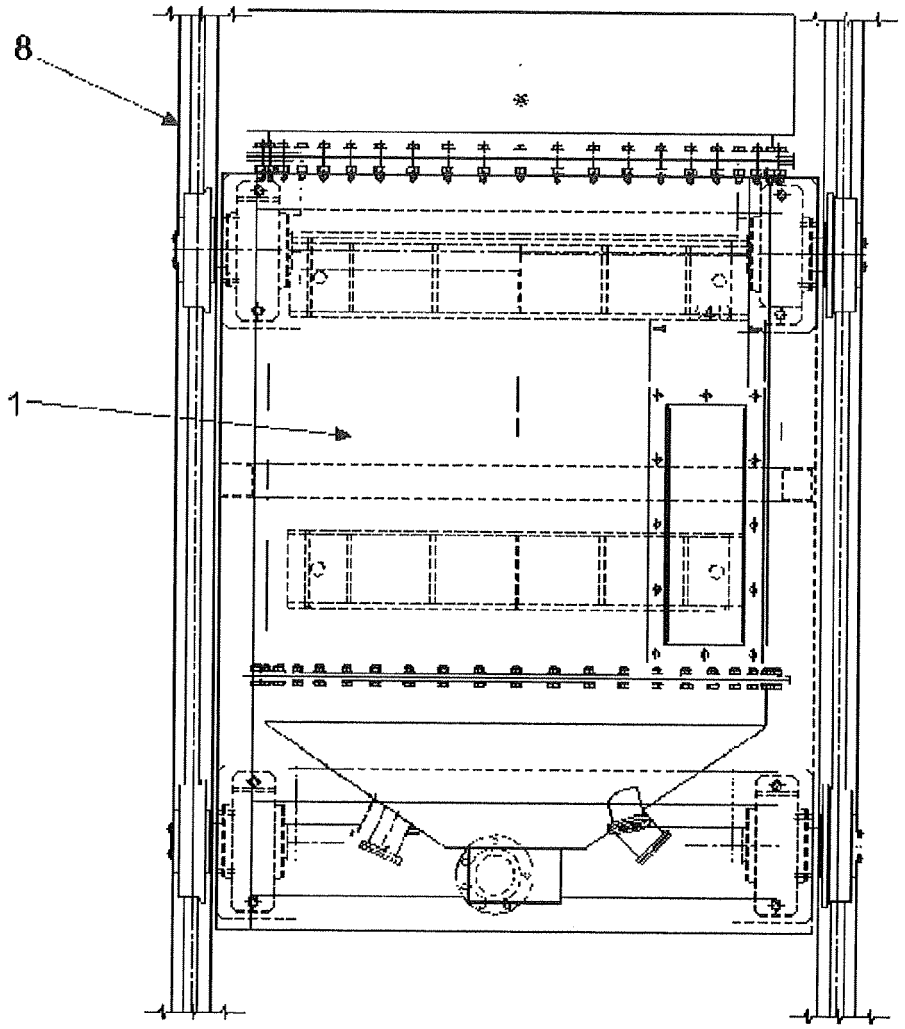


FIG. 8

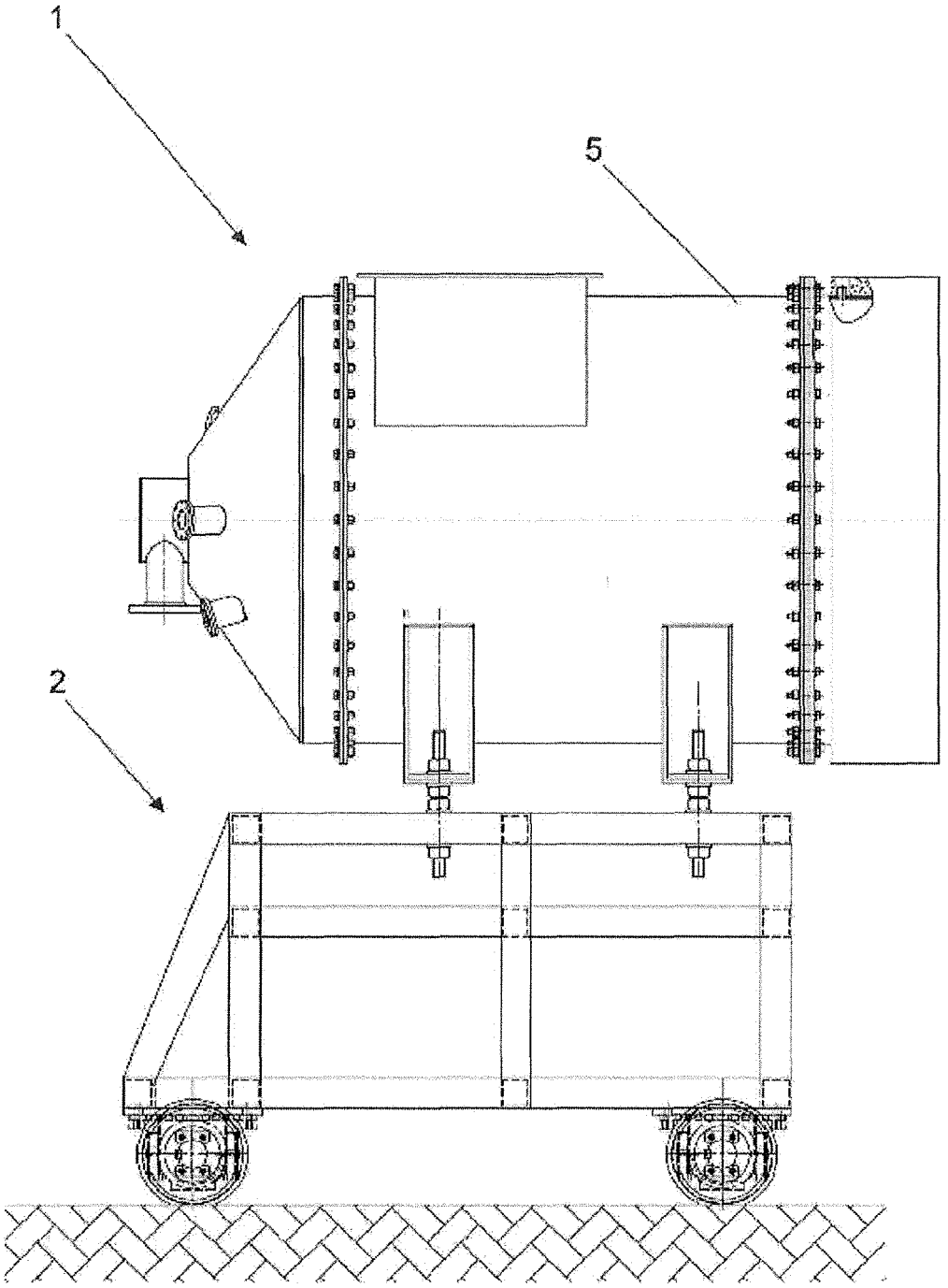


FIG. 9

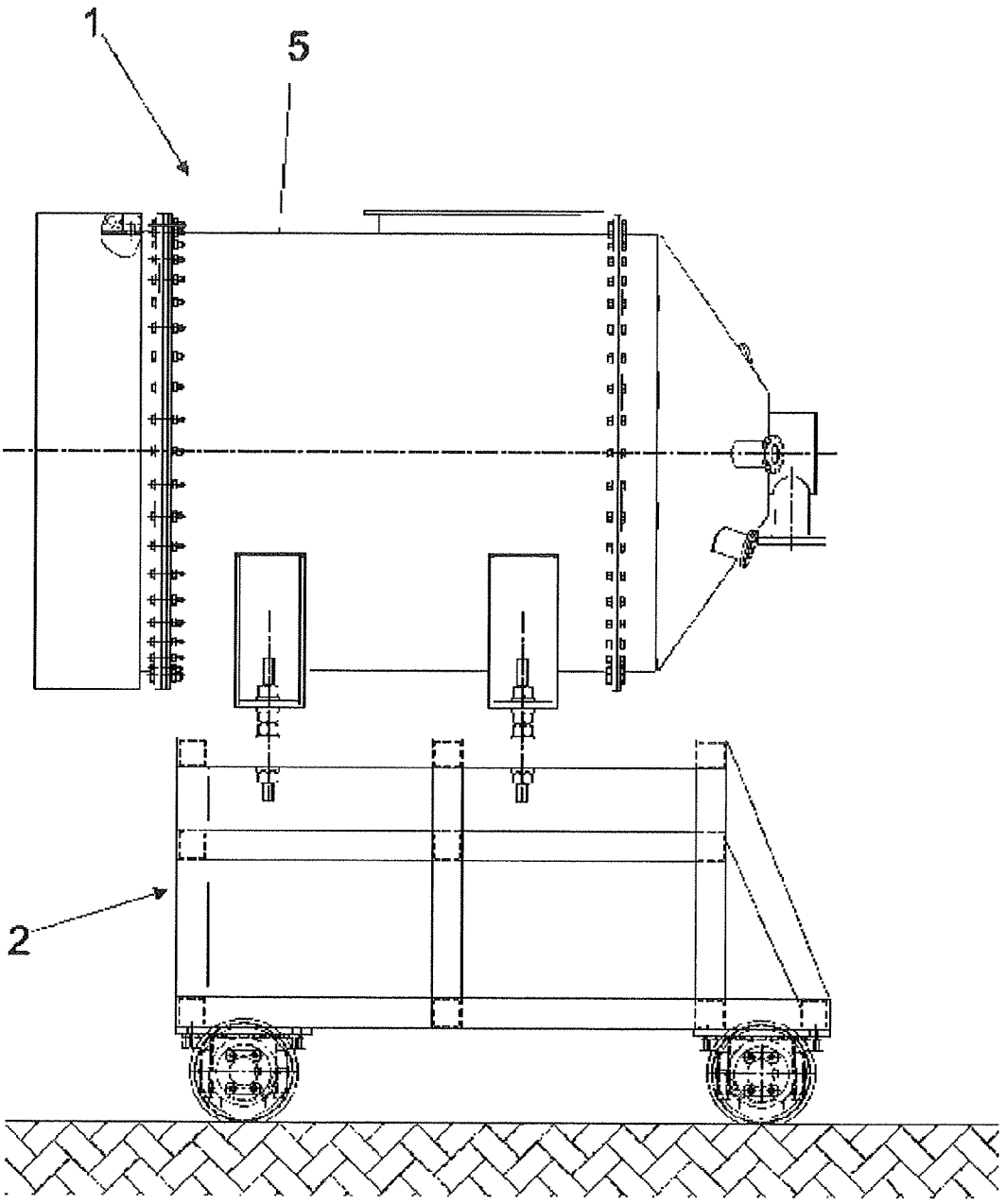


FIG. 10

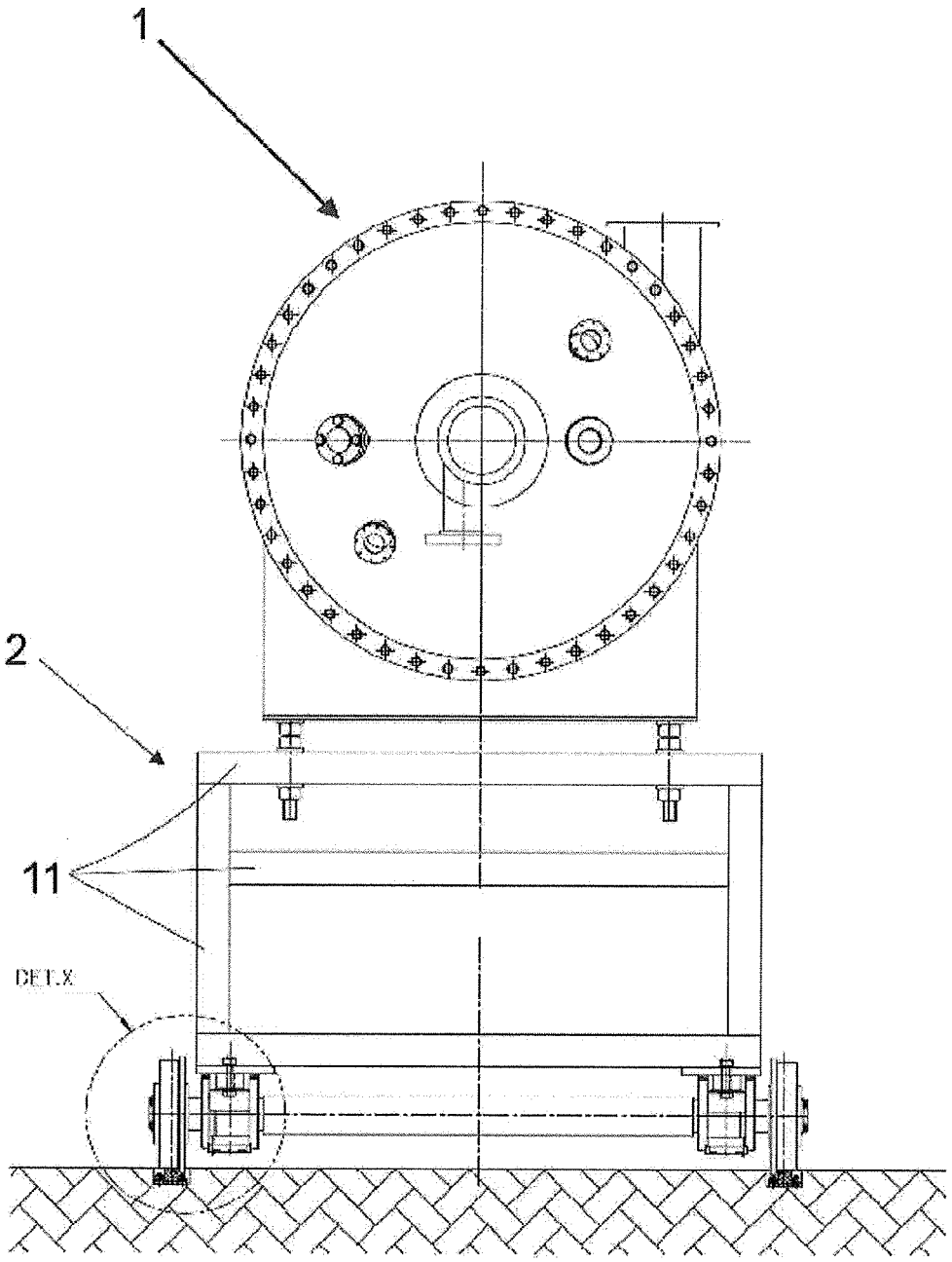
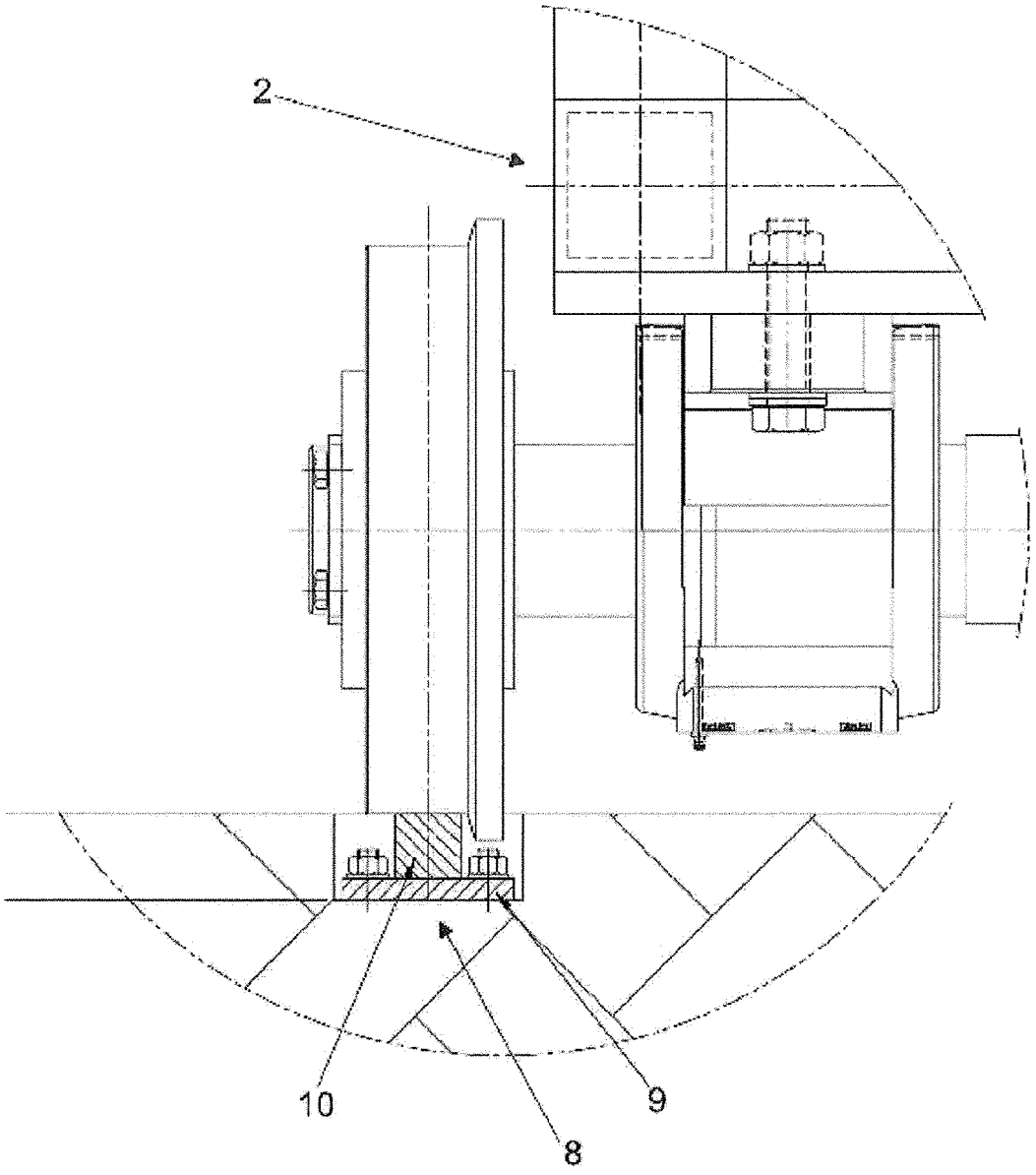


FIG. 11

FIG. 12



X DETAIL

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 30 5321

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 01/09547 A1 (INDEPENDENT STAVE CO [US]; EICHMEYER DALE [US]; BOSWELL JOHN [US]) 8 February 2001 (2001-02-08) * abstract; figures 6,7 *	1 2	INV. F23M5/00 F23C3/00
X	WO 2006/110870 A2 (ZILKHA BIOMASS ENERGY LLC [US]; ELLIOTT GERALD R [US]; LINDEROTH CARL) 19 October 2006 (2006-10-19) * page 8, line 26 - page 21, line 32; figures 7-10, *	1	
X	US 6 969 250 B1 (KAWAMURA KOTARO [JP] ET AL) 29 November 2005 (2005-11-29) * abstract; figures 7,11,13,24 *	1	
X	US 2 738 776 A (HANS BURG) 20 March 1956 (1956-03-20) * the whole document *	1	
Y	JP 2009 041062 A (TAIHEI DENGYO KAISHA LTD; JFE MECHANICAL CO LTD) 26 February 2009 (2009-02-26) * abstract; figures 1-4 *	2	TECHNICAL FIELDS SEARCHED (IPC) F23M F23C F23G F23B
A	JP 10 009526 A (MIYAMOTO KOGYOSHO KK) 16 January 1998 (1998-01-16) * abstract; figures 5,7 *	2	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 October 2011	Munteh, Louis

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 30 5321

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-10-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0109547 A1	08-02-2001	AU 6890700 A	19-02-2001
WO 2006110870 A2	19-10-2006	AT 478305 T	15-09-2010
		DK 1869307 T3	20-12-2010
		EP 1869307 A2	26-12-2007
		EP 2239499 A1	13-10-2010
		ES 2356355 T3	07-04-2011
		JP 2008536091 A	04-09-2008
		PT 1869307 E	23-11-2010
US 6969250 B1	29-11-2005	EP 1143197 A1	10-10-2001
		WO 0032990 A1	08-06-2000
		JP 4497726 B2	07-07-2010
		JP 2010249509 A	04-11-2010
		TW 438950 B	07-06-2001
US 2738776 A	20-03-1956	NONE	
JP 2009041062 A	26-02-2009	NONE	
JP 10009526 A	16-01-1998	JP 3878247 B2	07-02-2007

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO PI04067274 A **[0003]**