



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.02.2016 Bulletin 2016/07

(51) Int Cl.:
F23B 30/04 (2006.01) **F23L 3/00** (2006.01)
F23L 1/00 (2006.01) **F23L 13/08** (2006.01)

(21) Application number: **15460041.5**

(22) Date of filing: **13.08.2015**

(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
Designated Validation States:
MA

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(30) Priority: **14.08.2014 PL 40918614**

(54) **THE AERATION MECHANISM OF THE COMBUSTION CHAMBER IN A PELLET BURNER**

(57) An aeration mechanism of a combustion chamber in a pellet burner concerns a burner comprising a steel body (1) with an inlet hole (2) for pellets and a rotary combustion chamber (3), surrounded by a cylindrical, fixed cover (4) permanently connected with the body, in addition, a space between the combustion chamber and the cover is a ring-shaped duct (conduit) (5) supplying air to the combustion chamber throughout the inlet holes (6) and/or inflating nozzles placed on its circumference.

In a solution according to the invention the rotary combustion chamber has several longitudinal diaphragms (7) arranged in a form of shutters swingably mounted on the outer surface of the combustion chamber and obscuring the inlet holes of air, working together with a fixed control ring (8) situated perpendicularly to the longitudinal axis of the chamber around its rear part, in addition, an inner surface (9) of the control ring has a shape of arcs of two radius (R , r) connected with each other by short, straight segments and functions as a cam pressing the diaphragms to the combustion chamber surface or releasing them in accordance with a sequence of the preset phases.

The combustion chamber has a form of a prism or a truncated pyramid a base of which is a regular polygon.

The diaphragms are arranged in twos on either side wall (10) of the combustion chamber.

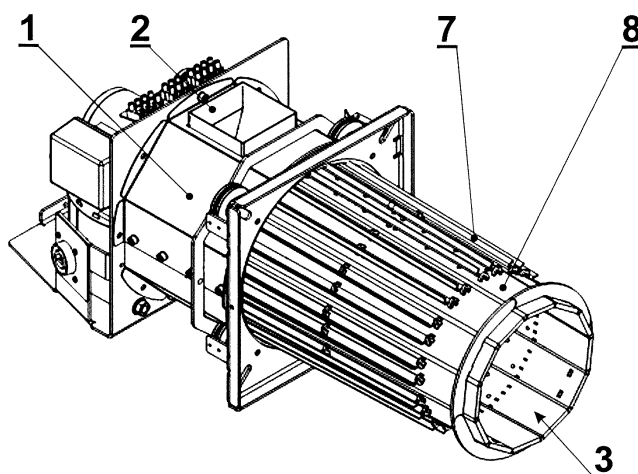


Fig. 3

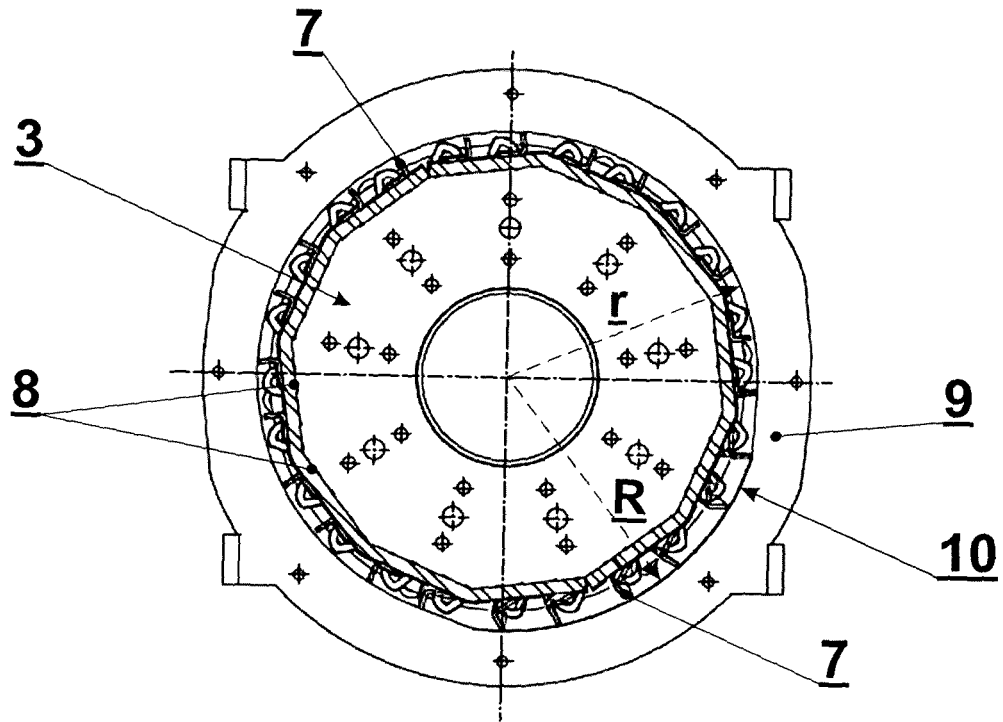


Fig. 6

Description

[0001] The subject of the invention is a mechanism of aeration of the combustion chamber in a burner designed for burning pellets and agropellets which can be applied both in households and other buildings - starting on hotels, pizza restaurants, bakeries, communal facilities such as, for instance, hospitals, nursery schools, high schools, banks, cinemas, malls, to ÷ greenhouses, poly-tunnels, grain and crop dryers and store or production rooms.

[0002] Smaller and smaller reserves of gaseous, liquid and solid fuels in the world, the environmental pollution caused by fossil fuels, the noxious carbon dioxide emissions, and, in addition, a continuous clear increase in the prices of those fuels, from many years contribute to an increase in interest in cheaper, alternative, and renewable sources of energy.

[0003] In addition to the use of wind power, solar radiation or hydroenergetics, the most often used source of renewable fuels are biomass, mainly of plant origin (so called fitomass), and also biomass of animal origin (so called zoomass) and even biomass of the microorganism origin (plankton, for instance) as well.

[0004] In all design solutions known up to now, there were some efforts taken for eliminating the use of conventional fuels towards the renewable ones, thereby supporting the actions towards the environmental protection, the elimination of the carbon dioxide emissions including, and making use of the after-production waste, coming from the wood industry or agricultural production.

[0005] There are known the heating stoves for burning biomass, especially the ones with a hearth for burning straw formed into bales, and the burners for burning biomass in a form of pellets. Pellets (pellet - ball, tablet, granule, pill, in English) are becoming more and more popular, renewable, ecological, solid fuels in granular form created by the high press machines from the after-production wood waste, i.e. wood biomass: sawdust, wood shavings, bark of deciduous tree wood with a low resin content, and from the agricultural production waste, so called agropellets, especially coming from the process waste, such as stones, husk, cereal, stems and hay of green biomass. Both pellets and agropellets are made in granular form, shaped in balls or, more often, in cylinder of 6 ÷ 25 mm in diameter, and of up to several centimetres length. Pellets are completely ecological, produced entirely from natural materials, with no additives i.e. without any adhesive substances, bound by natural organic compounds only, i.e. lignins present in cellular structures of plant. The pellets are a kind of briquette and have excellent energetic values - their calorific value is same as the one for wood (the pellets calorific value fluctuates in a range from 4,8 to 5 kWh/kg or 18 to 20 MJ/kg), and they are characterised by low humidity values (4,3 ÷ 10%). Furthermore the specific pellet's feature is a lack of the noxious gas emissions during combustion processes (smoke coming out chimney smells like burnt

wood), and a small amount of ash left after burning (up to 1%), which additionally can be used as an excellent ecological fertilizer. For that reason this kind of fuel is called as "green coal" or "green energy". As a matter of fact, agropellets have energetic properties slightly worse (their caloric values fluctuate in a range from about 15 to 18 MJ/kg, and the amount of ash left after burning is of 5%), but they are cheaper fuel.

[0006] Pellets and agropellets are prized for their high comfort of use, and therefore they are successfully applied as a very effective fuel for the individual boilers of central heating systems, stoves, fireplaces, and other heating devices designed for heating buildings and rooms, and equipped with a container for pellets, a dosing device for pellets and a feeder (*conveyor?*). The burners designed for burning pellets, made of heat-resistant, acid-resistant, and stainless materials, are mounted in the doors of any heating boilers, the oil-, gas-, or solid fuel ones.

[0007] There is known a pellet burner which is an automatic device having a fire grate with a built-in heating element which starts the burner operation. A screw feeder supplies a small amount of the fuel in order to activate the burner. During this activation process a cycle of pre-heating the fuel and firing up the created seeds of flames by the precisely operating fan occurs. This burner is equipped with an electronic control module. This module, having analyzed a signal coming from a photocell built in the burner body, starts a process of dosing air to ignite a portion of pellets placed on the burner's fire grate. Having fired up the first portion of pellets and having reanalyzed the photocell signal, the control module starts precise dosing a fuel and air mixture in order to get a continuous process of degassing fuel. The automatics of the burner maintains the optimal composition of the fuel and air mixture by analyzing the photocell signals and controlling pressure values in the combustion chamber.

[0008] There is a burner, known from the Polish application description P.400056 (A1), for gasifying and burning biomass, especially the wood pellet one, by using wood distillation gas formed while burning wood. shown in the drawing **Pos. 1** and which is characterized by having a cylindrical housing of the burner (1), inside of which a gasifying fire grate (2) is coaxially situated. A space inside a gasifying grate (2) forms a burn-and-glow chamber used for conversion of biomass, especially wood pellets, into wood distillation gas. There are side holes (3) located on a circumference of this grate, and there is an after-burning nozzle (4) adjacent to the burner housing from the top. The gasifying grate (2) is bell-shaped, directed its upper part down forming a bottom (5) of the burner, in which the lower holes (6) are symmetrically located. There is an aeration pillar (7) in the bottom (5) of the burner with holes circumferentially located along its full height. The open part of the aeration pillar (7) is fixed on the burner's bottom and the upper part of the pillar is closed. The burner housing (1) in its lower part is formed by an air-cleaner chamber (8) to which from

bottom an air duct (13) and an aeration duct (12) are connected. The air-cleaner chamber (8) at the bottom is ended by an ash chamber (9). There are an ash remover bolt (10) and an ash container (11) situated in the ash chamber. From one side there is a screw feeder (15) dosing pellet biomass for the burner, aslant connected through a hole (14) to a side wall of the after-burning nozzle. The burner according to this solution enables a gasification process of wood pellets to be performed, that is the wood pellets conversion into a gaseous state in order to produce heat energy is possible. This burner is designed for central heating stoves, water boilers, and coal stoves with a fixed grate inside of which it can be mounted as an insert.

[0009] According to the Polish utility model no. Ru. 66962 there is a burner for the central heating boiler as shown in the drawing **Pos. 2a** and **Pos. 2b** having a grate and a housing which has a feeder's outlet hole and a fan situated in its lower part. The grate is comprised of a semi-cylindrical shaped surface forming a basin which is extended in front by a flat surface element placed below it. There are primary air holes provided in the burner housing. The burner housing together with the grate form a monolithic unit.

[0010] There is also known a pellet burner disclosed in the European Patent Application no. EP1359372 B1, shown in the drawing **Pos. 3a**, **Pos. 3b** and **Pos. 3c**. The burner comprises a main body (1) and a combustion chamber (2), in which there is a flow of hot combustion gases moving basically along the (F) direction. Inside the combustion chamber (2) there is a grate (3) bent back in relation to the (F) direction of flow of combustion gases and having a concave cross section. There are some inflating nozzles (16) located on the grate's surface for blowing up air throughout holes (17) situated on their side surfaces. Means of providing air include at least: one hole for primary air adapted for supplying air to said nozzles (16) throughout a duct (9) below the grate (3); the primary air holes above the lower part of the grate (3) and at least one secondary air duct (12) for blowing-in air in a basically axial zone of the combustion chamber (2).

[0011] In all solutions known until now there are burners designed for burning pellets that operate on a fixed-body basis, with a fixed or a rotary combustion chamber, with a multi-point blow-in of air, and the air is supplied to the hearth throughout the holes and/or the nozzles located in some different places around the combustion chamber. The disadvantage of these solutions consists largely in a lack of any effective control of the amount of air supplied to the combustion chamber, and such inability of controlling it results in the over-oxidation or under-oxidation of the burner.

[0012] The aim of the invention was to develop such mechanism of the combustion chamber aeration in the burner designed for pellets and agropellets burning that enables the burner to obtain even higher effectivity of using pellets-like renewable fuels by means of a continuous adjustment of the amount of air supplied to the com-

bustion chamber that affects the economics of the combustion parameters.

[0013] The mechanism of the combustion chamber aeration in a pellets burner, which is the subject of the invention, concerns the burner comprising a steel body in a form of a fixed housing with an inlet hole for pellets and a rotary combustion chamber surrounded with a cylindrical, fixed cover permanently connected with the body, in addition there is a space between the combustion chamber and the cover which forms a ring-shaped duct supplying air to the combustion chamber throughout the holes and/or inflating nozzles located on its circumference.

[0014] In the solution according to the invention the rotary combustion chamber is equipped with several longitudinal diaphragms arranged in a form of shutters swingably mounted on the outer surface of the combustion chamber, which obscure the inlet holes of air and operate together with a fixed control ring situated perpendicularly to the longitudinal axis of the chamber around its rear part, in addition, an inner surface of the control ring functions as a cam pressing the diaphragms to the combustion chamber surface or releasing them in accordance with a sequence of the preset phases.

The combustion chamber has a form of a prism or a truncated pyramid a base of which is a regular polygon. In a preferable solution the combustion chamber has a form of a prism a base of which is a regular dodecagon, and in the most advantageous solution the combustion chamber has a form of a truncated pyramid a base of which is a regular dodecagon.

The diaphragms are arranged in twos on either side wall of the combustion chamber.

The inner surface of the control ring has a shape of arcs of two radius which are connected with each other by short, straight segments.

[0015] Owing to the solution according to the invention an ability of a continuous adjustment of the rotary combustion chamber aeration has been developed, that allows supplying a precisely matched amount of air to the inside of the chamber, obtaining the optimum aeration of the hearth, and maintaining the optimum composition of the fuel and air mixture during all phases of combustion - starting from lighting the fire throughout all stages of maintaining the fire at the preset temperature of combustion, up to the fire suppression.

[0016] The subject of the invention presented in an exemplary embodiment is shown in a schematic drawing, where:

Fig. 1 is a side view of the pellet burner, Fig. 2 is a cross section of the pellets burner along plane II-II of Fig. 1, Fig. 3 is a perspective view of the pellets burner without a combustion chamber cover, Fig. 4 is a side view of the combustion chamber without its cover, Fig. 5 is a longitudinal section in plane V-V of Fig. 4, Fig. 6 is a cross section of the burner combustion chamber in plane VI-VI of Fig. 4, Fig. 7 is a

schematic diagram for opening and closure phases of the inlet holes at the rotation of the combustion chamber by 360°, Fig. 8 is a schematic diagram for opening phase, Fig. 9 is a schematic diagram for the closure phase of the inlet holes of air.

[0017] The aeration mechanism of the combustion chamber according to the invention has been applied in the pellet burner comprising a steel body **1**, being a fixed housing with an inlet hole **2** for pellets and a rotary combustion chamber **3** surrounded by a cylindrical, fixed cover **4** permanently connected with a body **1**, in addition, a space between the combustion chamber **3** and the cover **4** is a ring-shaped duct **5** supplying air to the combustion chamber **3** throughout inlet holes **6** placed on its circumference.

[0018] A rotary combustion chamber **3**, having a form a truncated pyramid a base of which is a regular dodecagon, has 24 longitudinal diaphragms **7** arranged in a form of shutters, placed in twos on either side wall **10** of the combustion chamber **3**. The diaphragms **7** are swingably mounted on the outer surface of the combustion chamber **3** and obscure the inlet holes of air **6** cooperating with a fixed control ring **8** situated perpendicularly to the longitudinal axis of the chamber **3** around its rear part, in addition the inner surface **9** of the control ring **8** has a shape of arcs of two radius **R** and **r**, which are connected with each other by short, straight segments and functions as a cam pressing the diaphragms to the combustion chamber **3** surface or releasing them (thereby supplying the air or cutting off its inflow) in accordance with a sequence of four preset phases, as follows:

Phase I - in this phase the **diaphragms 7** are closed, adhering to outer surface of the combustion chamber **3**. The edges of the diaphragms **7** are being pressed by the control ring **8**;

Phase II - this phase controls time of opening the diaphragms **7**. The diaphragms **7** are gravitationally opened, and they are supported on the control ring **8**;

Phase III - in this phase the diaphragms **7** are open at the angle of 40° and are supplying the air. The gravitational force makes the diaphragms **7** edges abut against the edges of the control ring **8**;

Phase IV - this phase IV controls time of closing the diaphragms **7**. The control ring **8** adjusts its outer diameter that causes the closure of the diaphragms **7** and cuts off the supply of air.

[0019] The above exemplary embodiment of the solution according to the invention does not exhaust possibilities of using the different options of the aeration mechanism of the combustion chamber. The future modifications may concern especially a shape of the combustion chamber **3**, and a shape of the diaphragms **7**, and mainly

the angular values of the individual phases of the diaphragms control.

5 Claims

1. An aeration mechanism of a combustion chamber in a pellet burner, said burner comprises a steel body being a fixed housing with an inlet hole for pellets and a rotary combustion chamber, surrounded by a cylindrical, fixed cover permanently connected with the body, in addition, a space between the combustion chamber and the cover is a ring-shaped duct supplying air to the combustion chamber throughout inlets and/or inflating nozzles placed on its circumference, **characterised in that** the rotary combustion chamber (**3**) has several longitudinal diaphragms (**7**) arranged in a form of shutters swingably mounted on the outer surface of said chamber (**3**) to obscure the inlet holes (**6**) of air and operate together with a fixed control ring (**8**) situated perpendicularly to the longitudinal axis of the chamber around its rear part, in addition, an inner surface (**9**) of the control ring (**8**) functions as a cam pressing the diaphragms (**7**) to the combustion chamber surface (**3**) or releasing them in accordance with a sequence of the preset phases.
2. The mechanism according to claim 1, **characterised in that** the combustion chamber (**3**) has a form of a prism, a base of which is a regular polygon.
3. The mechanism according to claim 2, **characterised in that** the combustion chamber (**3**) has a form of a prism, a base of which is a regular dodecagon.
4. The mechanism according to claim 1, **characterised in that** the combustion chamber (**3**) has a form of a truncated pyramid, a base of which is a regular polygon.
5. The mechanism according to claim 4, **characterised in that** the combustion chamber (**3**) has a form a truncated pyramid, a base of which is a regular dodecagon.
6. The mechanism according to claim 1 or 2 or 3, **characterised in that** the diaphragms (**7**) are arranged in twos on either side wall (**10**) of the combustion chamber (**3**).
7. The mechanism according to claim 1, **characterised in that** the inner surface (**9**) of the control ring (**8**) has a shape of arcs of two radius (**R**, **r**) which are connected with each other by short, straight segments.

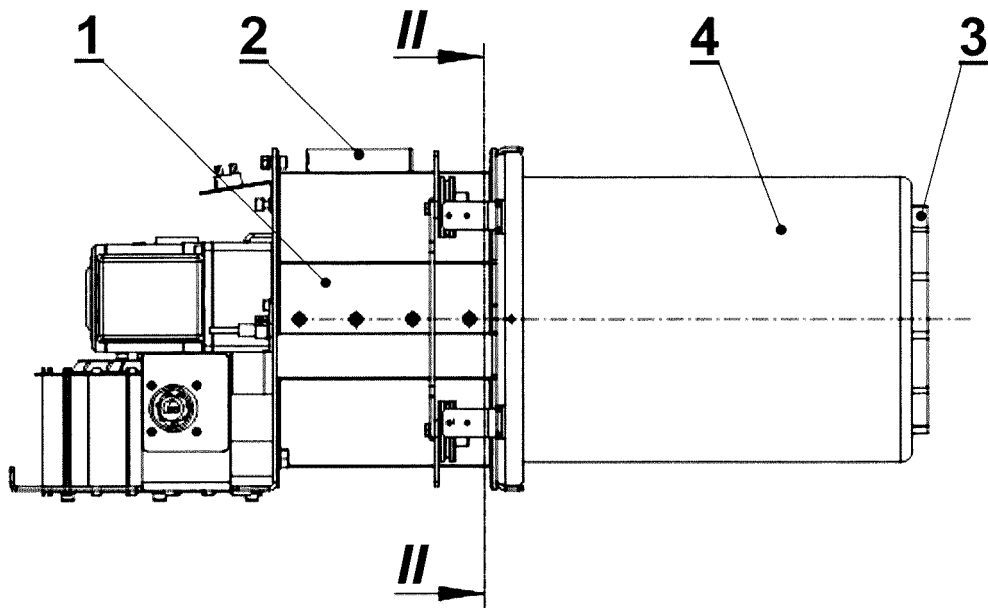


Fig. 1

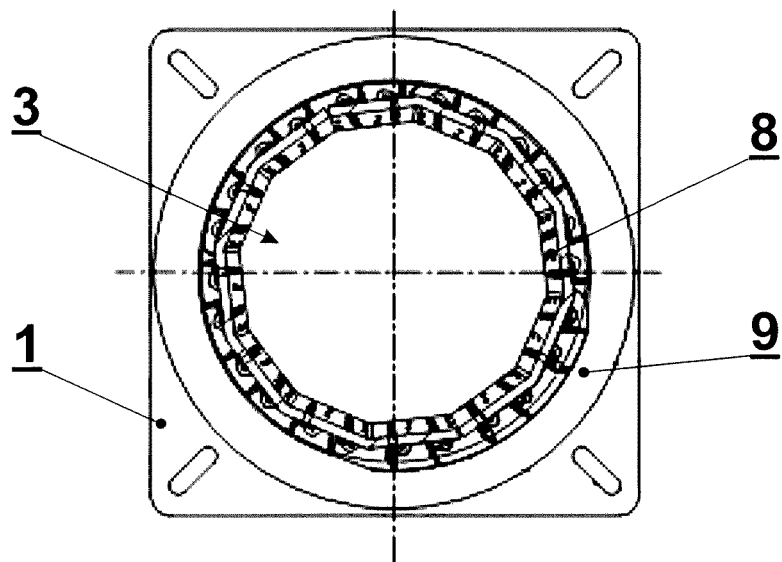


Fig. 2

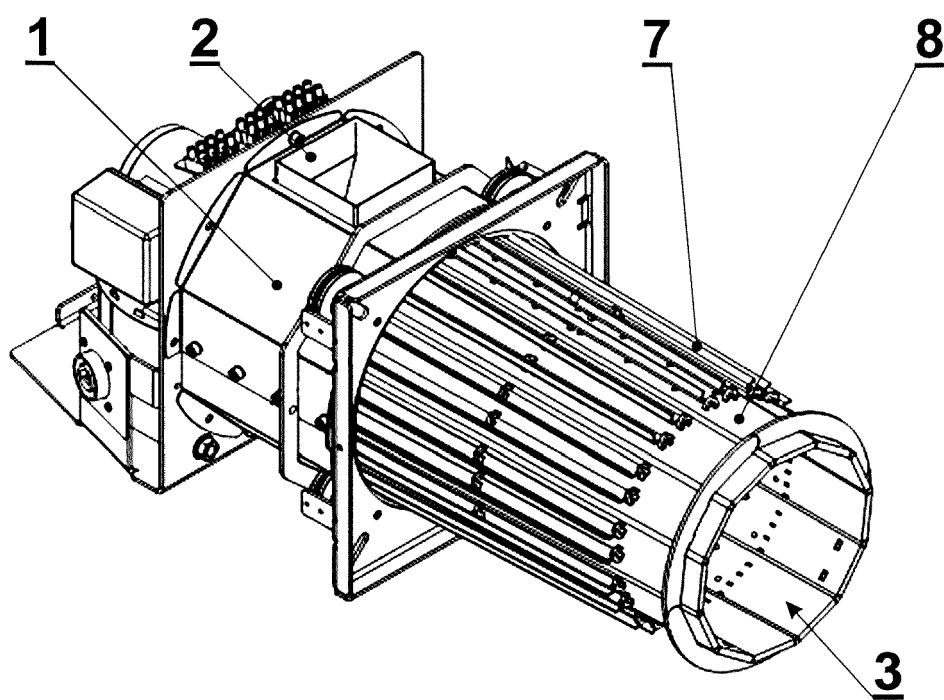


Fig. 3

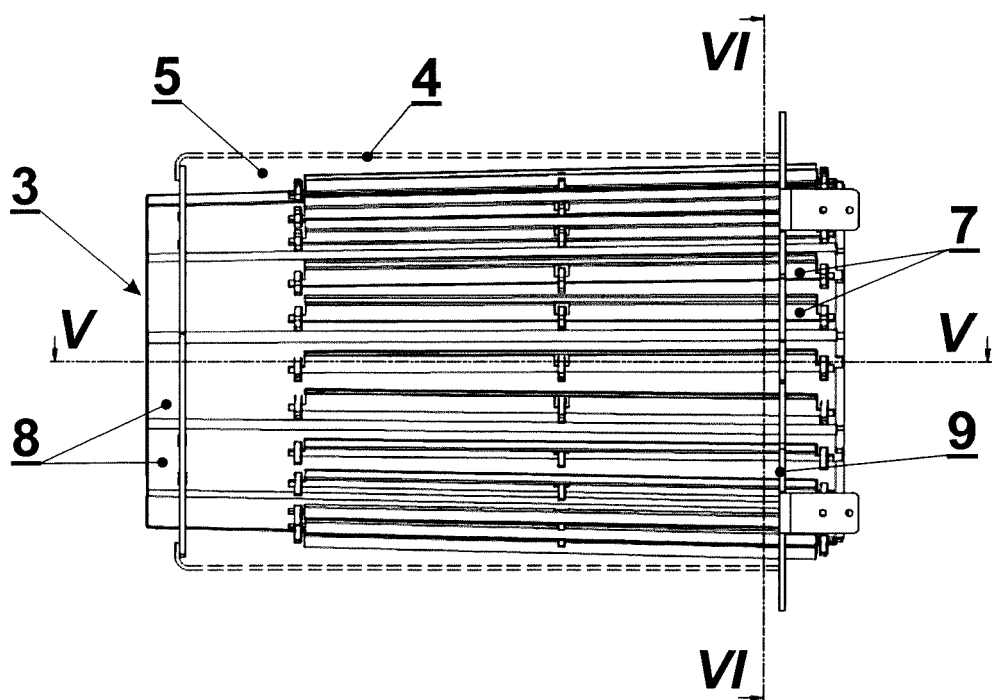


Fig. 4

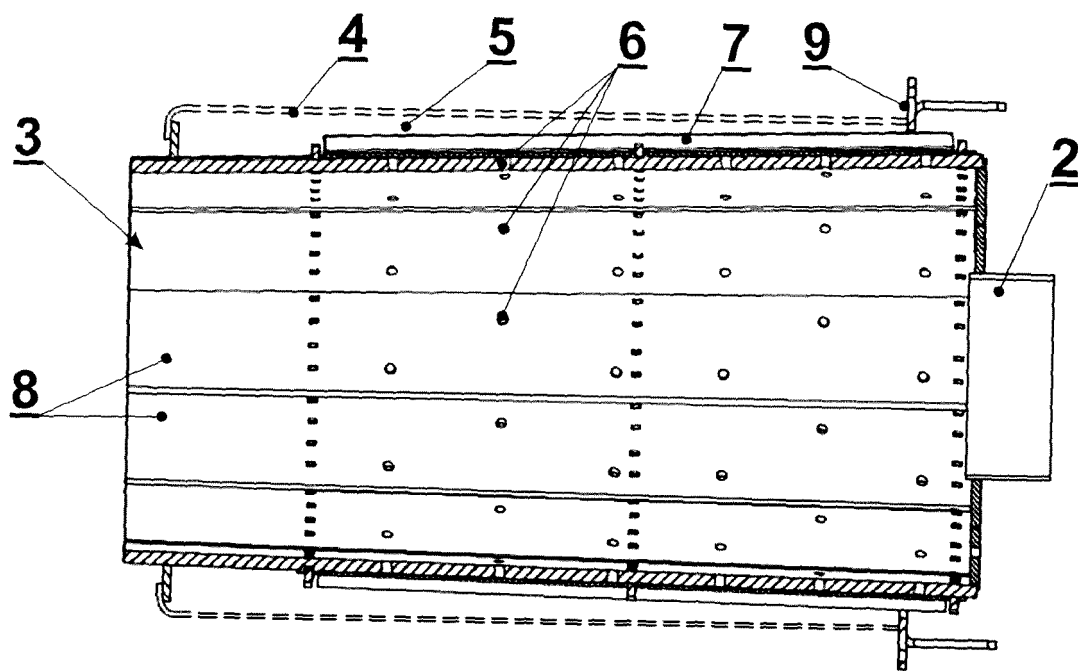


Fig. 5

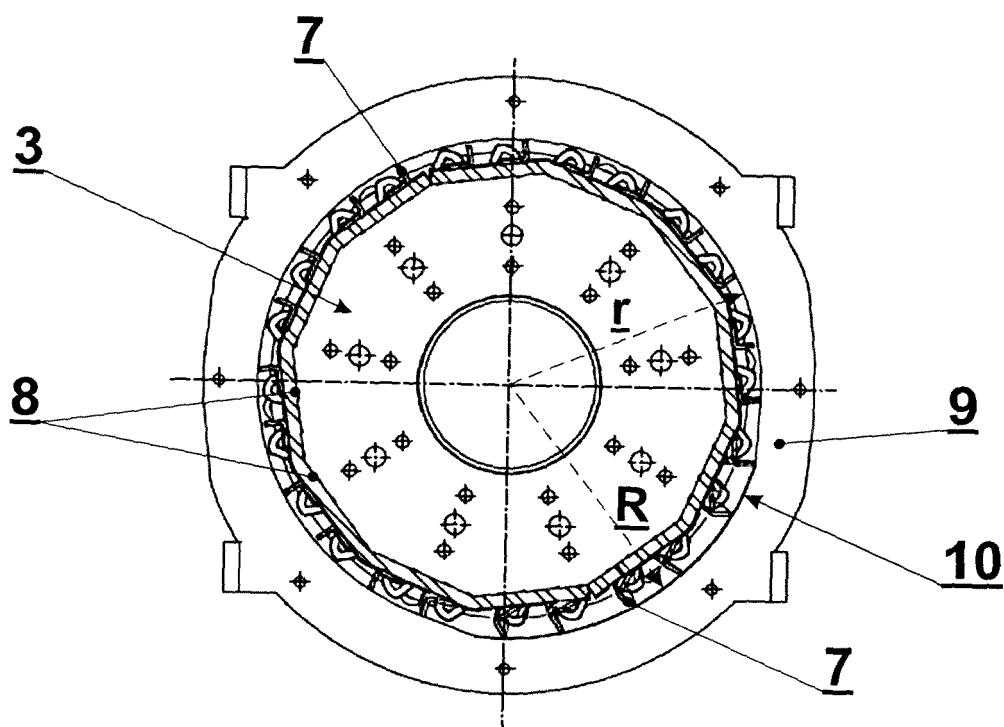


Fig. 6

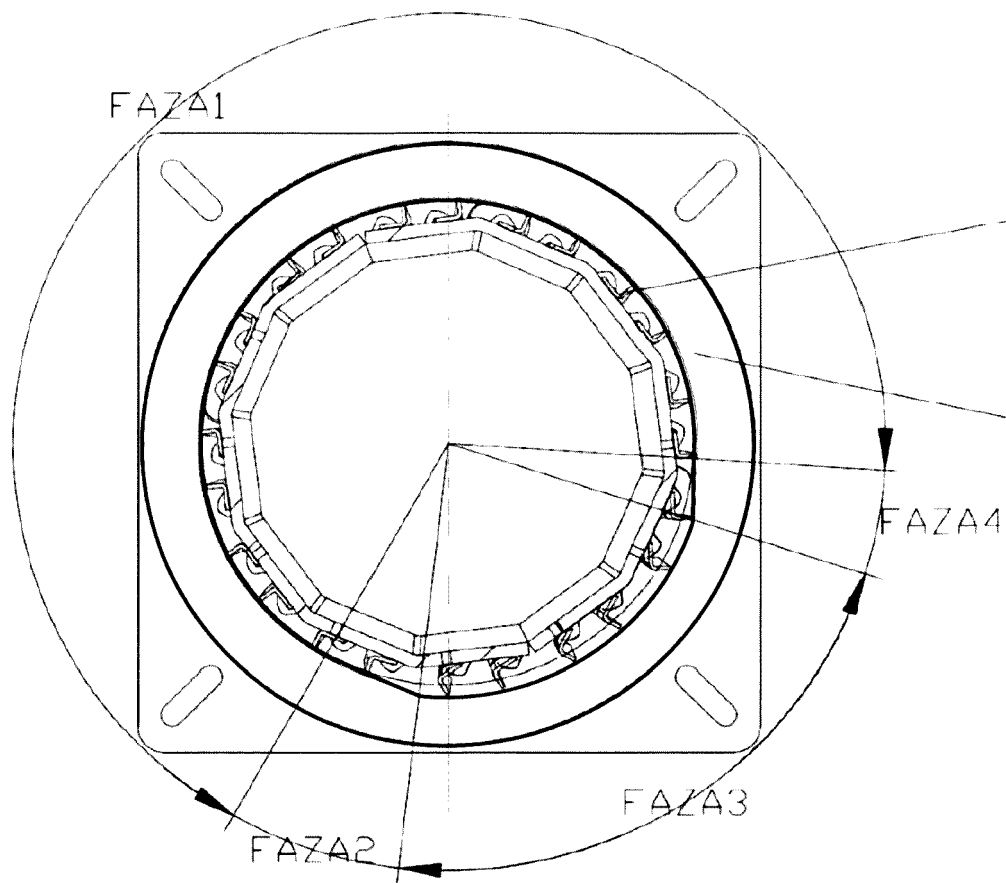


Fig. 7

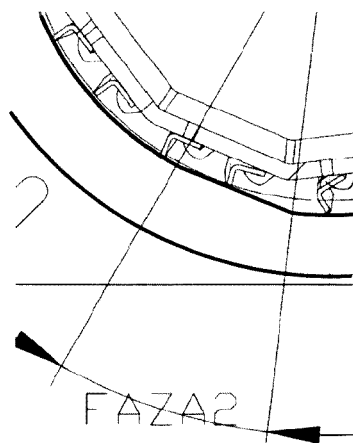


Fig. 8

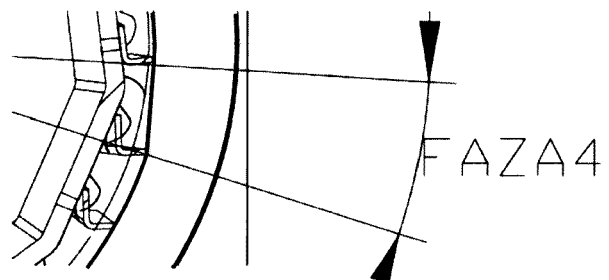
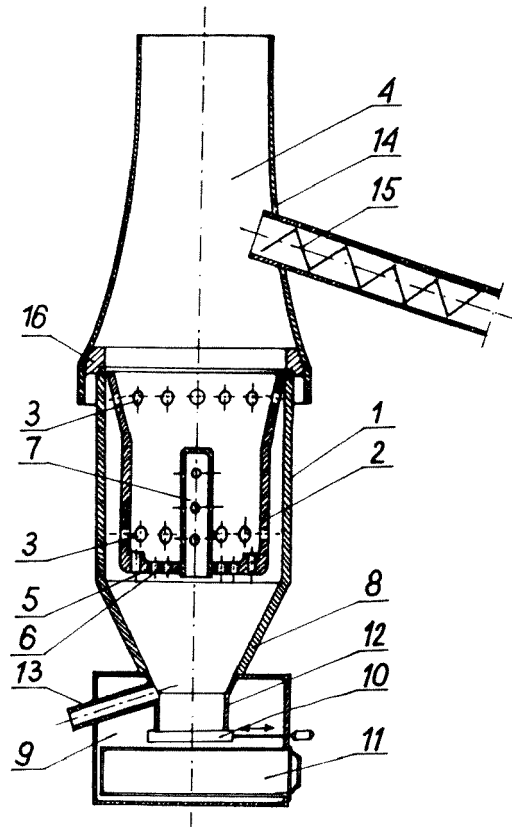
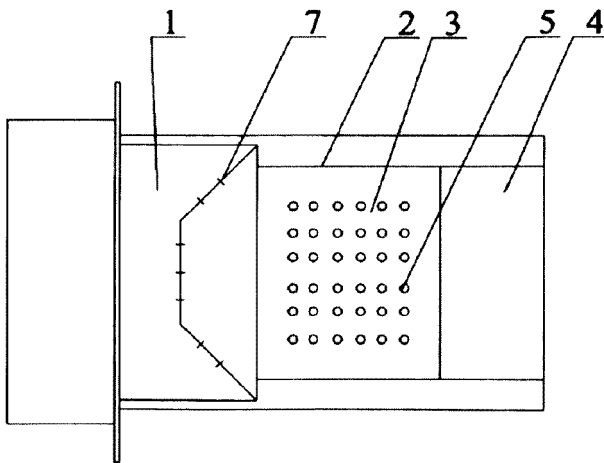


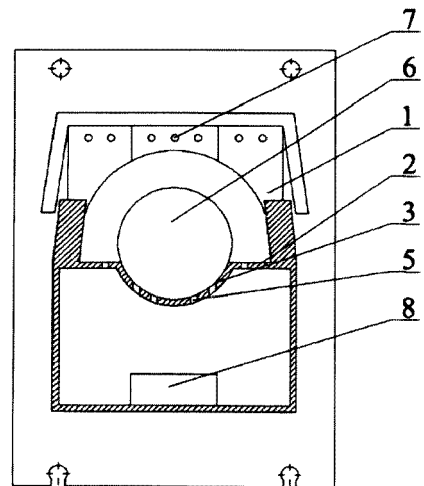
Fig. 9



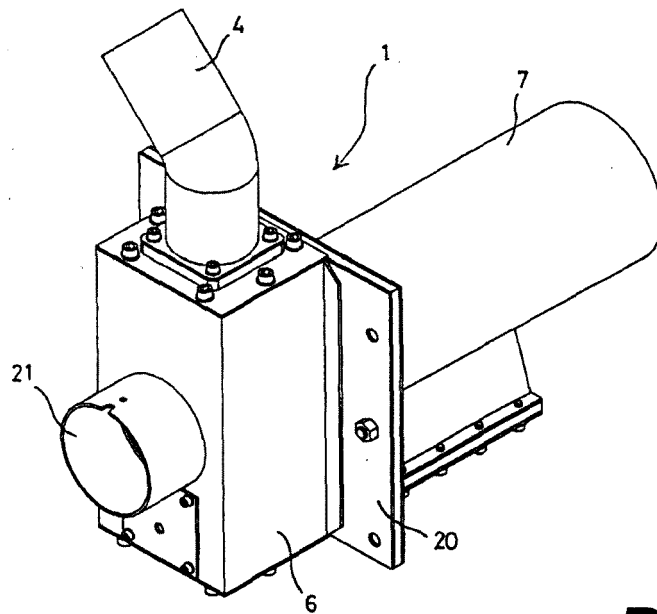
Pos. 1



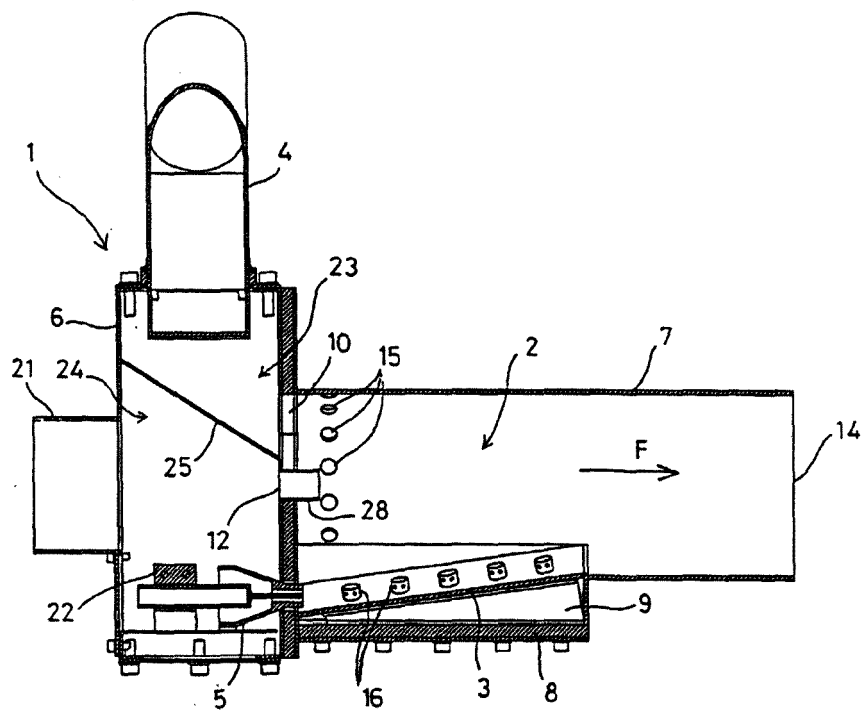
Pos. 2a



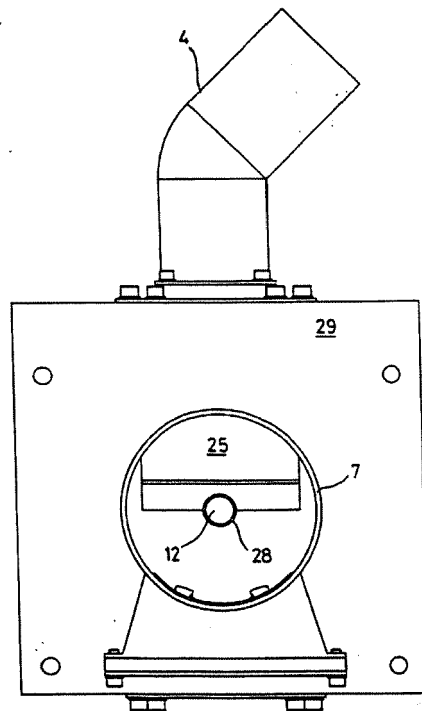
Pos. 2b



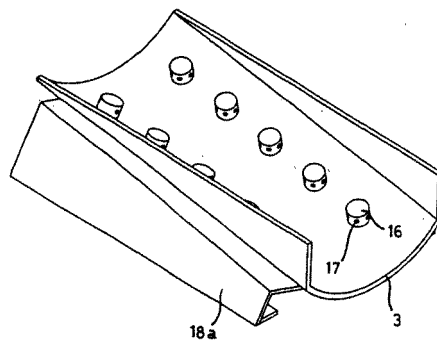
Pos. 3a



Pos. 3b



Pos. 3c



Pos. 3d



EUROPEAN SEARCH REPORT

Application Number
EP 15 46 0041

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A	EP 2 762 819 A1 (KEIML OTTO [AT]) 6 August 2014 (2014-08-06) * paragraphs [0022] - [0027]; figure 1 *	1-7	
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			F23B F23L F23G
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		4 December 2015	Coli, Enrico
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
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