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(71) Applicant: **Pateritsas, Georgios**
34014 Eyboias (GR)

(72) Inventor: **Pateritsas, Georgios**
34014 Eyboias (GR)

(74) Representative: **Koutifari, Ekaterini Georgiou**
2 Ypsilantou Street
GR-106 75 Athens (GR)

(54) **SOLID FUEL BURNER WITH RECIPROCATING FUEL FEEDING SYSTEM**

(57) The present invention provides an improved solid fuel burner and more particularly a high efficiency burner comprising a combustion chamber having a grate plate (4) at the bottom thereof and a reciprocating fuel feeding system (5, 6, 7) for feeding the fuel material in the com-

bustion chamber and simultaneously cleaning said combustion chamber from the accumulated ash and residue of combustion, and applications thereof for domestic and industrial use.

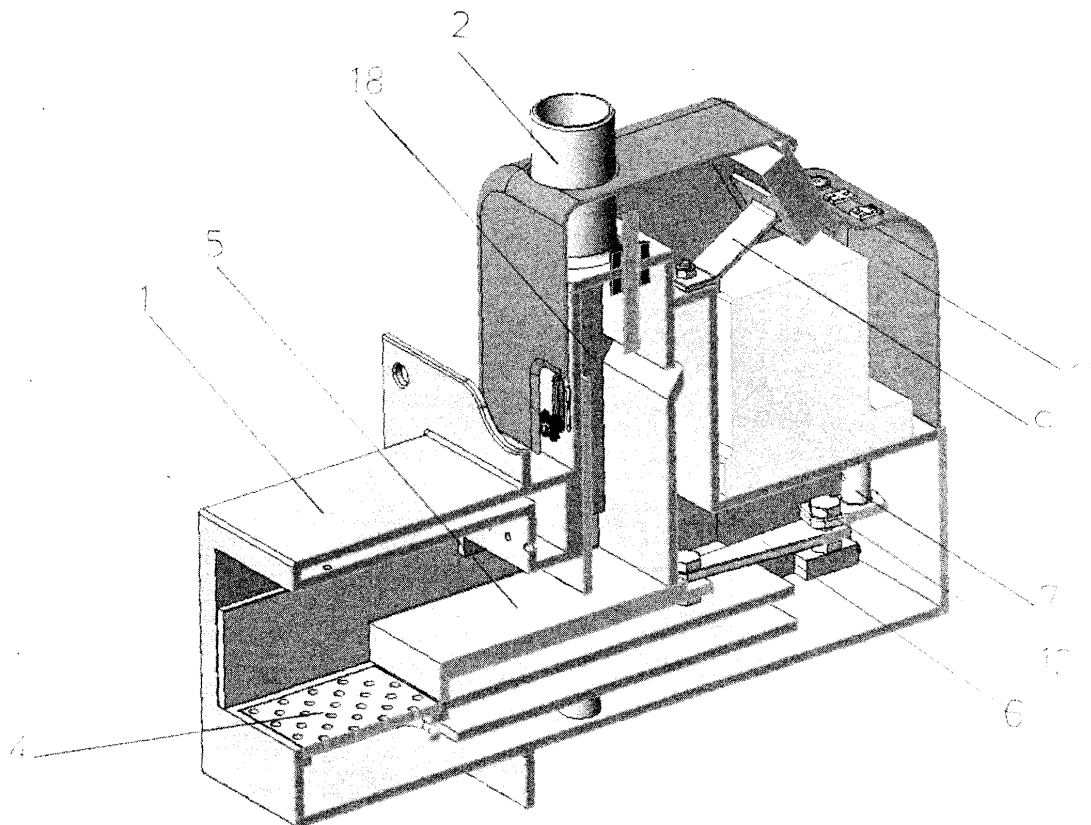


Fig. 7

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to an improved solid fuel burner and more particularly to a high efficiency solid fuel burner comprising a combustion chamber combined with a reciprocating fuel feeding system for feeding the fuel material in the combustion chamber and automatic ash removal from said combustion chamber, and applications thereof for heating and hot water production systems in domestic, commercial or industrial buildings.

BACKGROUND OF THE INVENTION

[0002] Under the term "biomass" it is included all materials of organic origin (plant or animal) used for energy production. Biomass is considered as a renewable source of energy, since during burning it does not cause an increase of carbon dioxide in the environment, but the same amount of carbon dioxide (CO₂) that is released during the combustion of biomass, it is bound again from the plants to generate biomass.

The most common form of biomass available in the market is the wood pellets in various sizes. Other marketed biomass products are wood, straw, sawdust, fruit seeds, canola, cork waste, etc.

[0003] Biomass, besides protecting the environment, allows an energy saving that is greater than fossil fuels. Generally, the pellet is a fuel material much cheaper in comparison to ordinary fuels.

The solid biomass burner or solid fuel burner is an alternative ecological solution, which uses as fuel material the above mentioned products of organic origin. In any case, there are some differences, e.g. a pellet boiler burns exclusively only pellets, while the biomass burner burns all kind of biomass, including pellets.

Nevertheless, the burning of solid fuels having excessive humidity and different sizes from are not preferred, since the burning of such fuels result in excessive emission of particles due to non complete combustion.

[0004] One of the problems of the biomass burners available on the market is the continuous and efficient supply of the fuel material to the combustion chamber and the accumulation of ash in the combustion chamber and ash removal from the burner.

[0005] Several solid fuel burners are already known, wherein various solutions for ash and combustion residue removal have been used, such as manual cleaning with brush, semi-automatic systems using a lever, which removes the residue of combustion from the combustion chamber or automatic systems using an aircompressor. The cleaning frequency differs from burner to burner.

[0006] The accumulation of ash in the burner results in a less efficient combustion, since the continuous accumulation of ash during the operation of the burner does not permit the supply of the fresh fuel material in the combustion chamber, and thus, it results to a non-complete

combustion and a continuously deterioration of the efficiency degree of the burner.

Moreover, the continuous accumulation of ash often leads to interruption of the burner operation, a phenomenon which is considered as the biggest problem especially in the combustion of solid fuels with excessive humidity and ash percentages.

[0007] Still, it is already known another type of burner, wherein the feeding of the fuel material in the combustion chamber is performed by dropping said fuel material from a higher level in the combustion chamber. This results in that the fuel material impinges on the accumulated ash and then moves away from the combustion chamber with the help of air excess. This specific type of burner has small volume and weight, and is characterized by low consumption of electric power. However, during combustion the heat output can be very low because of the limited combustion chamber, and only pellets of certain specifications may be used as fuel material in said burner. Furthermore, due to the fact that said burner has very small combustion chamber, it requires frequent ash removal which is not an easy process. In addition, for the burning of pellets it is required highly excess of air, which entails high flame speed, resulting in high exhaust gas velocities and thus, reducing the yield of the overall heating system, as the heat losses from the exhaust gas are significantly higher due to the fact that the heat exchange between the exhaust gas and heat exchanger cannot take place.

[0008] Moreover, it is also known another type of pellet burner with an automatic cleaning system of the burner, wherein the bottom plate of the burning chamber is removed from its position, subsequently the ash is scraped from said bottom plate and the ash is placed in the ash tray, and then the bottom plate is positioned again in the bottom of the burning chamber. Said burner uses only pellets as fuel material, while the burner applications are very limited, e.g. said burner cannot be installed in a boiler.

These known systems that use pellets comprise a steel boiler, a solid fuel burner, a supply hopper and the feeding of the fuel material in the combustion chamber is carried out by a feeding screw.

[0009] Although each of the known systems represents an attempt to overcome the problems associated with the fuel feeding and the cleaning of the solid fuel burner, there is still a need for an improved highly efficient solid fuel burner that can be easily installed and less complex in construction with eliminated ash removal and fuel feeding problems.

SUMMARY OF THE INVENTION

[0010] It is, therefore, an object of the present invention to provide an improved high-efficiency solid fuel burner for hot water production to be used in domestic supply and heating applications, which overcomes the deficiencies of the prior art, and avoids the fuel feeding and ash removal problems of the burner.

[0011] It is another object of the present invention to provide a high-efficiency solid fuel burner, which is less complex and can be easily installed in any heating and hot water production system for domestic, commercial and/or industrial use and with low manufacturing costs.

[0012] In accordance with the above objects of the present invention, a solid fuel burner for domestic and/or industrial use is provided comprising a main body having a horizontal chamber, wherein inside one end of said chamber is provided a combustion chamber, and on the other end of said chamber a reciprocating fuel feeding system is located, wherein said reciprocating fuel feeding system comprises a feeding piston, which in a forward movement transfers inside said horizontal chamber up to the combustion chamber a quantity of the fuel material and simultaneously, pushes the ash and residue of the combustion from the open end side of the combustion chamber into an ash tray, and subsequently, the feeding piston in a reciprocating movement returns to its original position.

[0013] Further preferred embodiments of the present invention are defined in the dependent claims 2-7.

[0014] Other objects and advantages of the present invention will become apparent to those skilled in the art in view of the following detailed description in conjunction with the accompanying drawings, wherein like reference numbers refer to similar parts throughout the drawings, and wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 shows a schematic vertical section of the main body of the burner according to the present invention.

Fig. 2, 3 and 4 show the feeding piston of the burner according to the present invention in a schematic view, a vertical section and a front view, respectively. Fig. 5 shows a schematic view of the connecting rod of the reciprocating fuel feeding system of the burner according to the present invention.

Fig. 6 shows a schematic view of the connecting element between motor and connecting rod of the reciprocating fuel feeding system of the burner according to the present invention.

Fig. 7 shows a partly schematic vertical section/view of the solid fuel burner according to the present invention, and

Fig. 8 shows a panoramic view of the components of the solid fuel burner according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016] The solid fuel burner according to the present invention comprises a main body (1) which comprises a vertical tube (23) for fuel supply and a horizontal chamber

(22), wherein inside one end of said chamber is provided a combustion chamber (figure 1) and on the other end side a reciprocating fuel feeding system is located.

The vertical fuel supply tube (23) of the main body at its upper end is provided with a fuel supply connection portion (2) suitable to be connected to a fuel hopper or silo. The combustion chamber at its bottom is provided with a grate plate (4) which has a plurality of slots to permit the air flow. The combustion chamber may have any shape, however the grate plate (4) is preferably rectangular and may be removable for easy cleaning.

The reciprocating fuel feeding system comprises a feeding piston (5), a connecting rod (6) and a connecting element (7) between motor and connecting rod (6) for transmitting the reciprocating movement to the feeding piston (5).

[0017] Figures 2, 3 and 4, show the feeding piston (5) according to the present invention, which has the shape of capital letter H and comprises two vertical metal plates (51, 52) partly connected to one another by a horizontal plate (53). The horizontal plate (53) at its front end has a vertical protrusion downwards to facilitate the transfer of the fuel material, and at its other end has a slot suitable to be connected with the connecting rod (6).

[0018] Figure 5 shows the connecting rod (6) which is shaped approximately as a blade, and at its both ends has openings so as to be connected on one end with the feeding piston (5) and on the other end to be connected by a screw (12) with the connecting element (7) (figure 6) so as to permit the transmission of the movement of the motor to the feeding piston (5) and to follow the reciprocating movement of the piston (5).

[0019] The solid fuel material is stored in an external or integrated with the burner/boiler pellet hopper or a silo of large dimensions (not depicted in the drawings). From the silo via feeding screw, a quantity of fuel material is supplied through connection portion (2) and from there falls by gravity through the vertical tube (23) on the horizontal chamber (22) of the main body (1). Subsequently, when the feeding piston (5) is activated, the fuel material is pushed by the vertical protrusion of the feeding piston (5) in the combustion chamber. The ignition of the fuel in the combustion chamber and onto the grate plate (4) is done automatically by means of electrical resistance. After ignition, the quantity of the fuel material transferred by means of the feeding piston (5) in the combustion chamber is burned, and then the feeding piston (5) with reciprocating movement returns to its original position. During the next feeding of the fuel material, the feeding piston (5) transfers fuel material to the combustion chamber and simultaneously pushes the ash and any residue of combustion from the previous quantity of the fuel material to the open end side of the combustion hearth and from there fall into an ash tray of the boiler and thus, the burner is self-cleaned.

[0020] With the reciprocating fuel feeding system according to the present invention is carried out the fuel feeding in the combustion chamber and simultaneously,

the cleaning of the grate plate (4) from the ashes and any combustion residues.

The feeding piston (5) over the entire burner operation performs continuously the reciprocating movement and in this way during its forward movement pushes the fuel material inside the horizontal chamber (22) to the combustion chamber, and thus, the fuel material is constantly stirred and a complete fuel combustion takes place.

In this way the removal of ash and combustion residues is performed during the operation of the solid fuel burner, due to the fuel feeding mechanism and thus, the combustion is not disturbed and a higher efficiency is achieved by maintaining the combustion chamber clean.

[0021] The solid fuel burner of the present invention is made entirely of cast iron and the various components are made of steel, inox steel or plastic and in general all the materials of the components have increased resistance to high temperatures and pressures. In order to prevent flame retrogression it has been foreseen to place an air compressor or fan (14) for supplying air inside the chamber (22) and air supply for the combustion process. Inside the combustion chamber, the control of the combustion of the solid fuel is achieved by using the combustion air which is blown by the aircompressor or fan (14).

[0022] In addition, the vertical walls of the vertical tube (23) have an opening through which air under pressure enters in the solid fuel burner from the fan (14) and thereby, due to the pressure difference between said vertical opening and the grate plate (4), there is no return of the exhaust gas from the chamber (22) to the fuel feeding silo.

[0023] The operation of the solid fuel burner is fully automated and the burner may have a microprocessor for controlling its operation, a display (16) mounted on a special base (9). Also there is provided a combustion control sensor, and a control sensor for emptying of the silo. All components of the solid fuel burner are covered by a housing (11).

The management of the burner is possible from any point (remote control) over the Internet, from another computer to configure settings and fault diagnosis through a special program.

The design of the combustion hearth is made so as to achieve perfect combustion, proper development of the flame in the combustion chamber and proper distribution of the primary combustion air at points wherein the fuel is located in the combustion chamber and the secondary air necessary for optimal combustion of the volatile gases.

[0024] The control of the fuel feeding from the silo, i.e. the quantity of the fuel material that is fed to the burner from the silo is made by the feeding screw, or optionally may be done by a fuel measurement device (18). The feeding screw, reciprocating fuel feeding system and the feeding piston (5) are all operable automatically by an electric motor.

The ignition system of the burner is automatic, and op-

tionally it can be operated by remote control. Both the motor of the combustion air fan and the motor of the reciprocating fuel feeding system are connected to the main control unit of the burner.

[0025] Said solid fuel burner of the present invention is a solid fuel burner of multiple fuel material, of high efficiency for producing hot water for domestic and industrial use, and may be used for heating applications and hot water supply.

Such an installation comprises a hopper or silo, feeding screw from the silo to the burner, a solid fuel burner according to the present invention and a boiler.

The solid fuel burner of the present invention has small volume and light weight, while the operation requires low power consumption of electricity. In addition, any kind of the solid fuel material may be used, even with fuel having a diameter less than 20 mm, regardless of the moisture and ash content, by effectively addressing the problem of accumulation of ash in the burner. Finally, the solid fuel burner of the present invention can be incorporated with all types of boilers available on the market for effective and economical heating systems.

The solid fuel burner of the present invention makes it possible to burn fuels with very high humidity (about 40%) and a very high percentage of ash (about 30%) with no observable dysfunctions due to the accumulated ash and does not need to be cleaned.

Furthermore, the solid fuel burner of the present invention provides a variety of implementation options to the user, allowing several different installation options, while by allowing the use of various solid fuel materials that are not necessarily of high quality, it is helping to reduce the cost of use. Further, the burner of the present invention exhibits increased efficiency due to more efficient combustion of the fuel material.

[0026] While the present invention has been described with respect to the particular embodiments, it will be apparent to those skilled in the art that various changes and modifications in design and construction may be made in the invention without departing from the spirit and scope thereof, as defined in the appended claims.

Claims

1. A solid fuel burner for domestic and/or industrial use, comprising a main body (1) having a horizontal chamber (22), wherein inside one end of said chamber is provided a combustion chamber, and on the other end of said chamber a reciprocating fuel feeding system is located, wherein said fuel feeding system comprises a feeding piston (5), which in a forward movement transfers inside said horizontal chamber (22) up to the combustion chamber a quantity of the fuel material and simultaneously, pushes the ash and residue of the combustion from the open end side of the combustion chamber into an ash tray, and subsequently, the feeding piston (5) in a recip-

rocating movement returns to its original position.

2. The burner according to claim 1, wherein said main body (1) comprises a horizontal chamber (22) and a vertical tube (23) for fuel supply from a silo or hopper, wherein said fuel material is stored. 5
3. The burner according to claim 1, wherein said reciprocating fuel feeding system further comprises a connecting rod (6), having one end connected to the feeding piston (5) and the other end connected to a connecting element (7) between motor and connecting rod (6) for transmitting the reciprocating movement to the feeding piston (5), and wherein during the operation of the solid fuel burner, said reciprocating fuel feeding system is in a continuous reciprocating movement. 10 15
4. The burner according to any preceding claim, wherein said feeding piston (5) has the shape of capital letter H and comprises two vertical metal plates (51, 52) partly connected to one another by a horizontal plate (53), which horizontally at its front end has a vertical protrusion downwards to facilitate the transfer of the fuel material. 20 25
5. The burner according to any preceding claim, wherein said burner is made of cast iron and all the materials of the components of the burner have increased resistance to high temperatures and pressures. 30
6. The burner according to any preceding claim, wherein the burner is provided with an air compressor (14) or a fan for supplying air into the chamber (22) to prevent retrograde of the flame and return of exhaust gas from the chamber (22) into the fuel feeding silo. 35
7. The burner according to any preceding claim, wherein the operation of said burner is completely automated and can be controlled by remote control. 40

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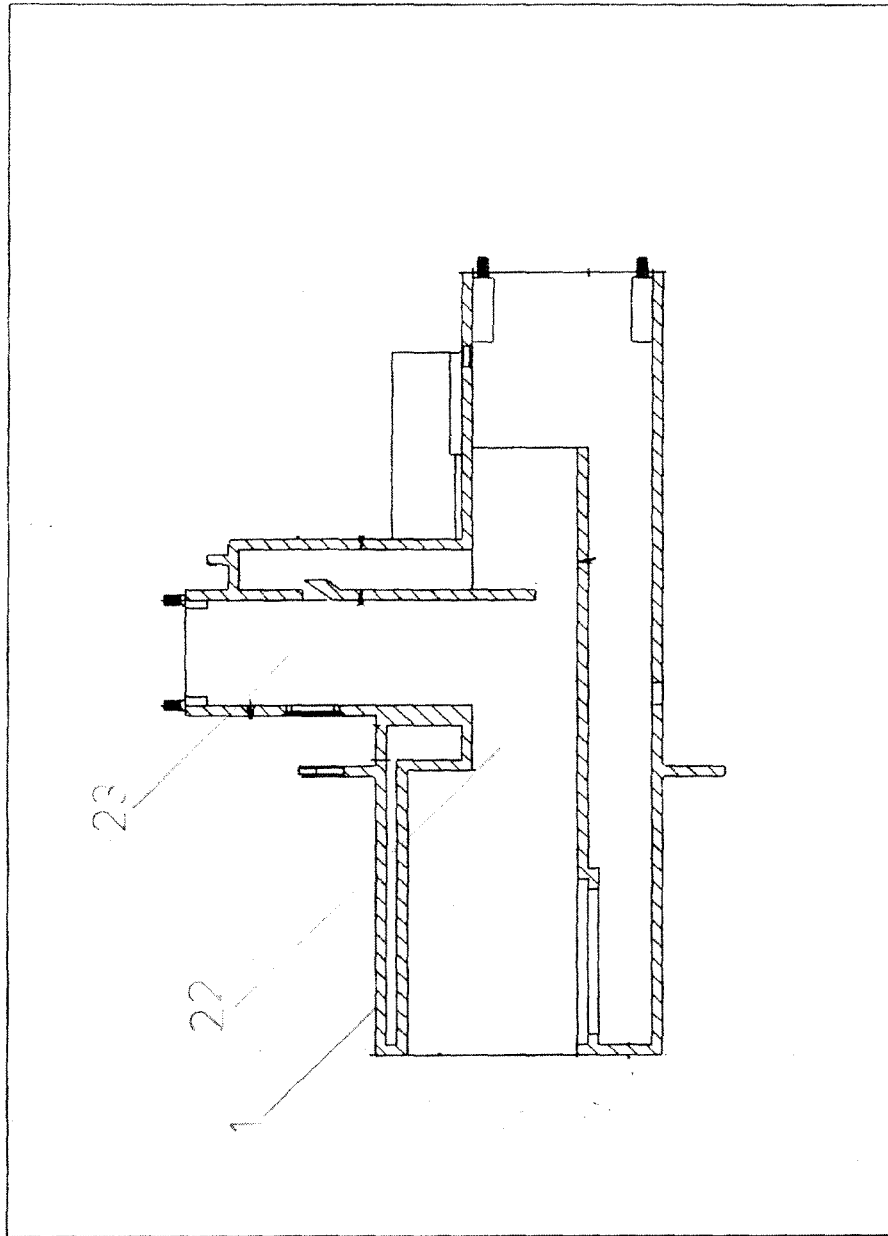


Fig. 1

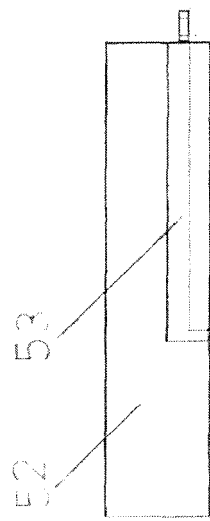


Fig. 3

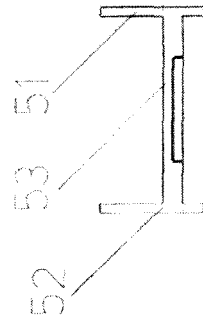


Fig. 4

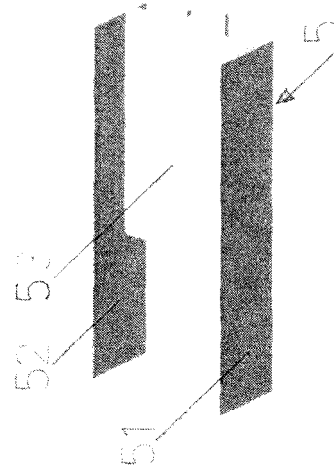


Fig. 2

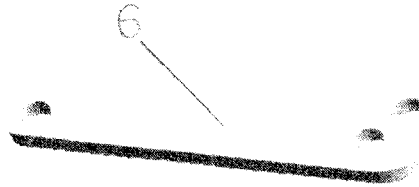


Fig. 5

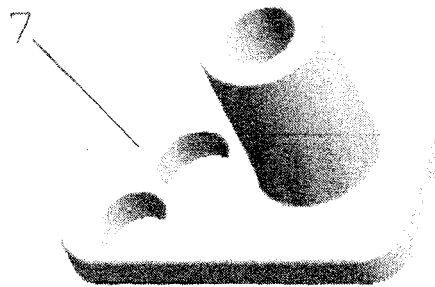


Fig. 6

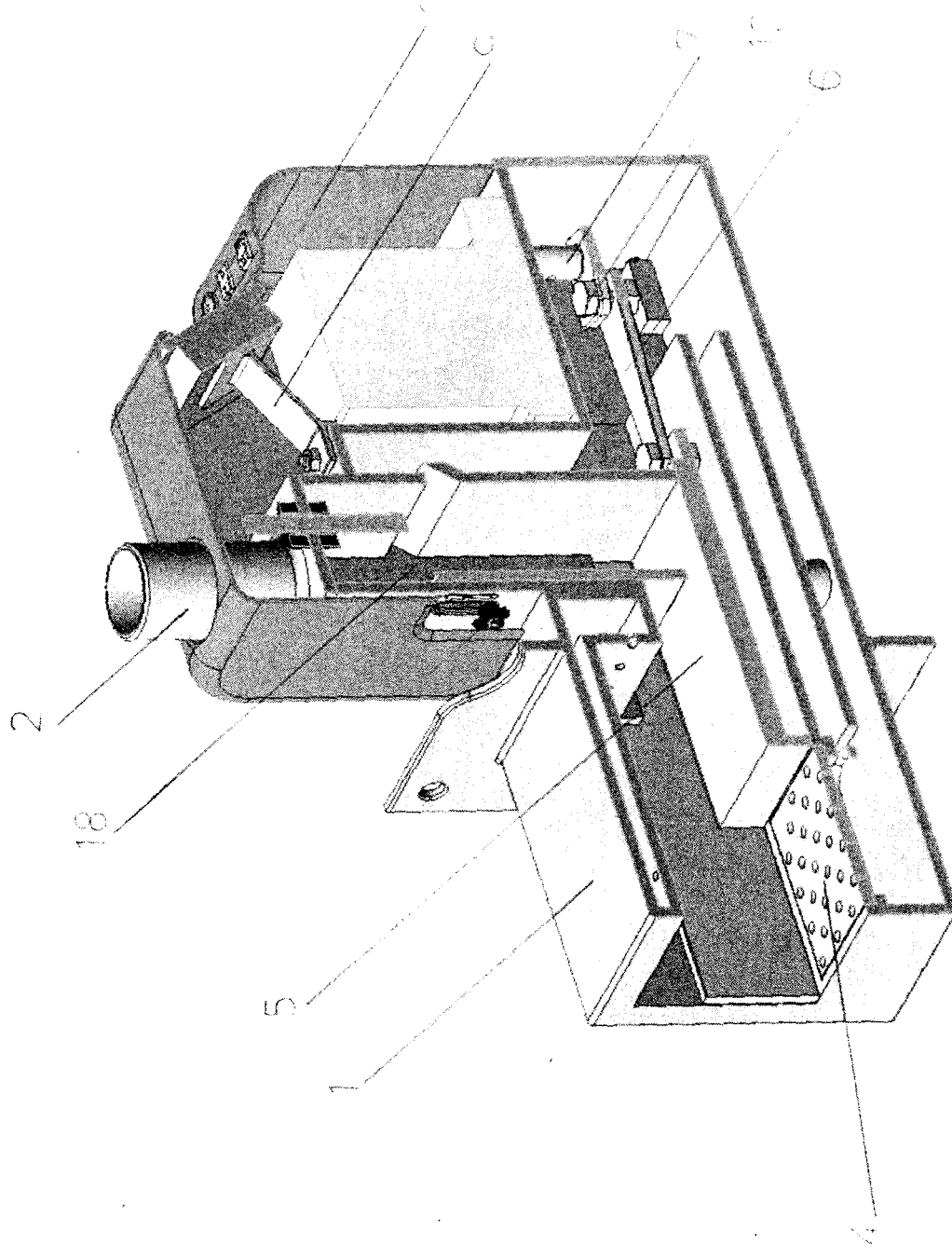


Fig. 7

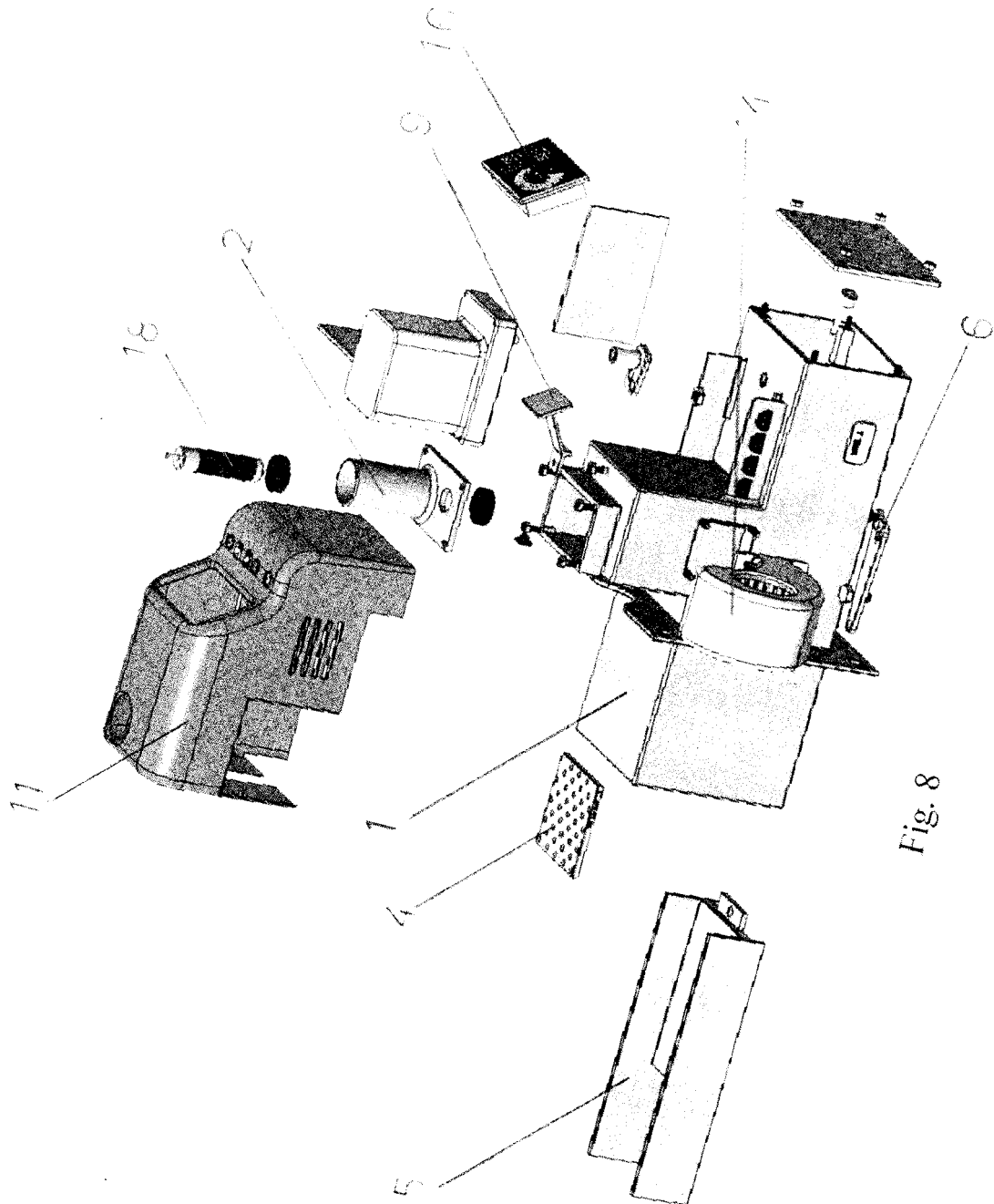


Fig. 8



EUROPEAN SEARCH REPORT

Application Number
EP 15 38 6030

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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	GB 1 027 442 A (SECCACIER) 27 April 1966 (1966-04-27)	1-3,5-7	INV. F23K3/16
Y	* page 2, lines 7-25 * * figure 1 *	4	
Y	----- US 2 563 688 A (MILLER GEORGE N) 7 August 1951 (1951-08-07)	4	
A	* column 4, lines 12-16 * * figures 1, 5 * -----	1-3,5,6	
			TECHNICAL FIELDS SEARCHED (IPC)
			F23K
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 May 2016	Examiner Vogl, Paul
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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
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