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(54) **Solid fuel heating appliance with automatic loading up**

(57) Solid fuel heating appliance with automatic loading up and high safety and efficiency, comprising a tank (10), in which a solid fuel (11) to be sent towards a combustion chamber (13) is loaded, which combustion chamber is provided with at least one external wall (30) in front of which a user can be placed; wherein, fingering means (18) are mounted on a support placed parallel to said external wall, said fingering means being suitable for detecting a value of volume of solid fuel within said combustion chamber, which is less than at least one predetermined threshold value; said fingering means are connected to at least one operating device (19) and to at least one switch (32), suitable for activating a lifting mechanism for introducing solid fuel into said combustion chamber.

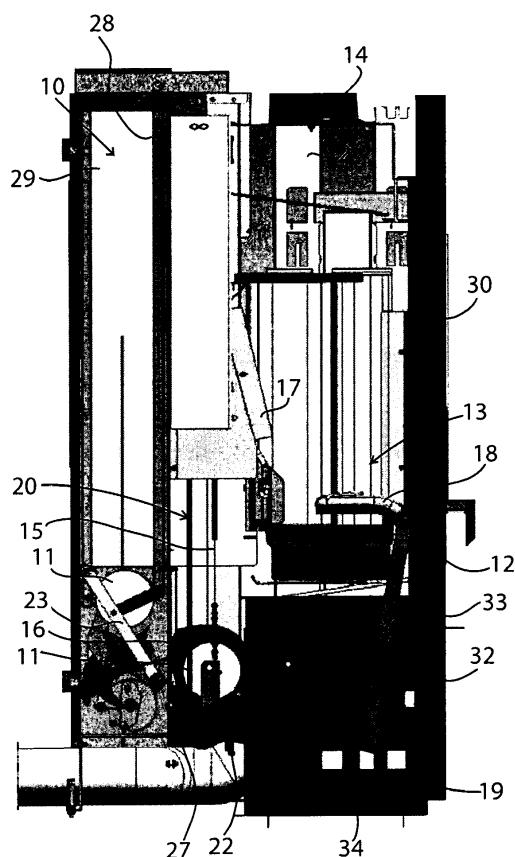


Fig.1

Description

[0001] The present invention generally relates to a solid fuel heating apparatus with automatic high safety and efficient loading up.

[0002] The invention particularly relates to a new solid fuel heating appliance, such as by way of example a stove, a fireplace, a fireplace insert, an oven insert, a thermo-stove, a simple heater and/or a heating system and the like, which operate with solid fuel, such as wood logs and/or any kind of biomass.

[0003] The heating device can be loaded with solid fuel even during its working, i.e. when the heating device is switched on, and the loading up of the solid fuel can take place automatically, in a progressive way and with safe for the user.

[0004] On the other hand, the heating device according to the invention can also be switched off even when the tank is partially filled; specifically, after having burned a predetermined amount of solid fuel (remaining in the stove burner and within a compartment that is placed below a closing door provided in the solid fuel tank), the device can be switched off, thus keeping the residual fuel in the tank, and, then, the device can again be switched on.

[0005] The classic type of solid fuel heating devices have a specific compartment with a manual opening for housing the solid fuel; in this way, it is also possible to load and/or control the amount of solid fuel that is placed in the combustion chamber.

[0006] In the field of domestic heating, solid fuel heating apparatus are also known, wherein the loading up of the solid fuel is provided by means of automated mechanisms; said heating apparatus are particularly used for burning granules of solid fuel (pellets), wood sawdust and/or any kind of biomass, such as corn seeds, soybeans, barley, etc.

[0007] Said stoves are also equipped with operating autonomy systems and control system, comprising an electronic control unit that controls the stove by adjusting the burning power and by discharging a required amount of pellets in the combustion chamber; the stove usually also includes a front grid, which guarantees an optimal diffusion of hot air, also by using tangential fans, which allow a fast and effective heat distribution.

[0008] Said stoves usually include air extractors and air fans, which are provided for an effective circulation of primary and secondary air flows, thus ensuring the effective evacuation of the exhaust fumes, a containment structure, a combustion chamber for burning the granular solid fuel and means for inserting and loading up the granular fuel inside the containment and combustion chamber.

[0009] Said granular fuel is initially switched on manually by the user or automatically by means of an ignition device, while, in successive steps, according to the heating appliance settings or to heating needs of the user, new further granular solid fuel is added at regular inter-

vals of time, in order to maintain the combustion inside the combustion chamber.

[0010] The granular solid fuel is usually loaded up through an upper reservoir which is further provided, laterally to the brazier, of one or more internal compartments, with or without one or more removable ash collecting trays.

[0011] Furthermore, a control panel is also provided, that is normally available by means of a remote control, which allows the user an automatic switching on and setting the heating power of the heating device, so that the user can set, through a room thermostat, the desired temperature and therefore the amount of granular solid fuel to be burned.

[0012] However, the known solid fuel heating devices, either with manual or automatic loading up of the fuel, have some drawbacks.

[0013] A first drawback is constituted by the fact that, in case of manual loading, during the opening of the stove for loading the solid fuel the user is greatly and dangerously exposed to the output of pieces of solid fuel and/or sparks coming from the stove; furthermore, said opening phase necessarily causes a partial dispersion in the environment of combustion fumes and heat.

[0014] Moreover, as said loading operation is manually carried out, the user cannot leave the stove (also for a long time) because he/she has to control the solid fuel level in the combustion chamber, so as to avoid the risk that the flame turns off.

[0015] A second drawback of the known heating devices, particularly the automatic loading and granular solid fuel heating devices, is constituted by the fact that the containment structures of said devices are suitable only for using granular solid fuel which, on the other hand, in view of its dimensional characteristics, quality and calorific energy features, can be properly used only with some specific heating devices.

[0016] In fact, the automatic heating devices working with granular solid fuel include a tank or reservoir in which fuel is inserted and from which it is picked up and moved towards the combustion chamber, through inserting means that are connected with the combustion chamber and that are usually structurally supported by the tank, to which are firmly fixed.

[0017] The heating devices' mechanisms for supporting, discharging and inserting solid fuel have structural dimensions and technical features such as to support the weight and the heat generated from the granular solid fuel, mostly pressed, i.e. pellets.

[0018] It follows, however, that it is almost impossible to load the tank with solid fuel having a not granular composition because the structure of the heating device is made so as to prevent any movements or loadings of solid pieces having non-uniform dimensions and having in any case dimensions exceeding the granular dimensions (for which the apparatus was designed).

[0019] A further drawback is constituted by the fact that the known solid fuel automatic heating devices are not

provided with control devices which may allow the use of fuel of size and characteristics different from the features originally provided for said stoves.

[0020] Specifically, a user is not able to use solid fuel which is different from the granular fuel that is usually commercially available and that is described in the instructions of the heating device.

[0021] Therefore, it is not possible, for example, to use wooden logs, which are however more available with respect to the granular fuel and which have much lower costs with respect to the pellet.

[0022] A further drawback is constituted by the fact that the known solid fuel automatic heating devices generally have their combustion chambers that are placed adjacent to the loading chambers of the solid fuel.

[0023] This structural feature causes reduced safety for the user as possible mechanical locks of the opening and fuel inserting door may cause burning of the solid fuel remaining in the tank, thus also causing a fire of the heating appliance.

[0024] The present invention is devoted to solve the above mentioned drawbacks of the prior art.

[0025] In detail, a main purpose of the present invention is to provide a solid fuel heating device with automatic loading up and high safety and efficiency that, during its use, allows the fuel loading without the user having made to open the combustion chamber, thus avoiding the consequent dispersion of fuel pieces or sparks in the environment, as well as combustion fumes and heat.

[0026] In other words, the main purpose of the invention is to make available a solid fuel heating appliance with automatic loading up and high safety and efficiency that reduces risks for the user due to the contact of the combustion chamber during the heating device operation.

[0027] Within this aim, it is another purpose of the present invention to prevent a continuous presence of the user during the heating device operation for controlling the level of the solid fuel as well as for supplying further solid fuel once the load of the combustion chamber is over.

[0028] It is another purpose of the invention to provide a solid fuel heating apparatus with automatic loading up and high safety and efficiency, which allows to use wooden logs, plywood logs, compressed chipboard logs and the like, said logs having a cylindrical geometry, and which allows to carry out an efficient and practical loading up, even considering that the above mentioned solid fuel is more available with respect to the pellet.

[0029] These and other purposes are achieved by means of a solid fuel heating appliance with automatic loading up and high safety and efficiency, according to the enclosed claim 1; further detail features of the invention are given in the following dependent claims.

[0030] Advantageously, the solid fuel heating apparatus, which is the object of the present invention, provides, in use, low heat dispersions and/or low flue gases leakages flowing into the environment, with respect to prior

art, when the solid fuel is loaded, since the solid fuel loading means are placed inside the heating device and there is no need of a manual opening of the combustion chamber by the user.

[0031] Consequently, the invention greatly reduces the risk of fire that may arise during the manual loading of the solid fuel by the user.

[0032] Still advantageously, the solid fuel heating appliance with automatic loading up and high safety and efficiency of the invention ensures that the user can continuously receive the heat produced by combustion of the solid fuel, without being forced to intervene or visually control the solid fuel inside the combustion chamber.

[0033] In fact, in operative conditions, fingering means are used for detecting lack of the solid fuel or a decrease of said fuel inside the combustion chamber; the fingering means are also able to control a further insertion of solid fuel within said the combustion chamber on the basis of certain settings made by the user.

[0034] Equally advantageously, the solid fuel heating appliance with automatic loading up and high safety and efficiency of the invention includes a solid fuel loading system including a lever mechanism, which is made so that the combustion chamber can never come into direct contact, during the opening of the fuel loading door, with the fuel tank; this leads to greater safety and to reduced risk of fire of the heating appliance due to a possible combustion of the tank during the heating appliance operation.

[0035] Other purposes and advantages of the present invention will become clear from the following description, which relates to a preferred embodiment of the solid fuel heating appliance with automatic loading up and high safety and efficiency, which is the object of the present invention, and from the enclosed drawings, in which:

- figure 1 is a section view of a solid fuel heating appliance with automatic loading up and high safety and efficiency, according to the present invention, which include fingering means in a rest position;
- figure 2 shows the solid fuel heating appliance with automatic loading up and high safety and efficiency of figure 1, in a middle position;
- figure 3 shows a technical detail of the heating appliance of figure 1, in a loading position;
- figure 4 shows the solid fuel heating appliance with automatic loading up and high safety and efficiency of figure 1, during the combustion phase;
- figure 5 shows a technical detail of a preferred embodiment of the solid fuel heating appliance with automatic loading up and high safety and efficiency of the invention, in a first position;
- figure 6 shows the technical features of figure 5, in a second position.

[0036] We firstly underline that, although the following description and the enclosed drawings refer to a particular type of a solid fuel automatic heating device with

high safety and, in particular, to a stove using, as solid fuel, compressed wood, such as wooden logs or briquettes composed of wood shavings and/or sawdust, the innovative idea that is described in the present invention can be easily extended to any other type of heating appliance using any kind of solid fuel having a cylindrical shape.

[0037] Referring to the enclosed figures, 10 generally indicates a containment structure or tank, inside which the solid fuel in the form of briquettes or wooden logs 11 is loaded.

[0038] In particular, according to the invention, the tank 10 is connected, by means of a loading mechanism including at least one lever 23, with a compartment or loading chamber 20 comprising a containment structure with a plurality of support means comprising at least one cradle 22, which is hinged to the containment structure of the compartment 20, for placing each single log 11.

[0039] Specifically, each single log 11 is made of a cylindrical wooden log having a variable length and is loaded and particularly stacked, by the user, in the storage tank 10 (as shown in detail in the enclosed figures 2A and 2B), until the loading mechanism allows the log 11 placed lower within the tank 10 to dynamically slide in the adjacent loading compartment 20, so that said log 11 is housed within the positioning cradle 22.

[0040] Subsequently, the log 11, which is translated in the load compartment 20, is moved up from the starting plane of the cradle 22 and within said loading compartment 20, by means of hinges connecting the cradle 22 to the walls of the compartment load 20 and through known return systems, such as for example chain systems 15.

[0041] A combustion chamber 13 is placed near the storage tank 10 and the loading compartment 20 and a brazier or fireside 12, as well as an outlet opening 26 which is connected with the chimney 14 for externally discharging the combustion fumes are provided in said combustion chamber 13.

[0042] An opening, which is closable by means of a door 17, is also provided on the bottom wall of the combustion chamber 13 for communicating with the loading compartment 20 and for entering the wooden logs 11. A fire mouth or port is also provided on the outer wall 30 of the combustion chamber 13, on the opposite side of the door 17. In correspondence of the brazier 12 and in a position which is parallel to the bottom side of the combustion chamber 13, a support 31 is placed and prefixed fingering means 18 are mounted on said support 31 for detecting a predetermined load of solid fuel (according to prefixed settings) that is contained inside the brazier 12.

[0043] At least one fingering means 18 is connected with at least one actuator device 19, which is also connected with an external micro-switch for giving a consent signal to the loading mechanism in order to introduce a new load of solid fuel (specifically, a new log 11) in the combustion chamber 13 (as shown in detail in the en-

closed figure 3).

[0044] In a preferred embodiment, shown in the enclosed figure 1, the actuator device 19 comprises a lever 33, which is integrally connected with the fingering means 18, and a chain 34 for connecting the lever 33 and the loading cradle 22. The fingering means 18 are able to have a first loading position and a second resting position. In the loading position, a log 11 is placed inside the brazier 12 and the fingering means 18 rest on said log 11. When the log 11 wears out, the fingering means 18 rotate downward by rotating the lever 33 down. When the resting position is reached (figure 1), the lever 33 contacts the external micro-switch 32, which gives in turn a consent signal for activating a loading cycle, by raising the loading cradle 22, which also pulls the chain 34 and therefore the fingering means 18 which raise in a loading position (figure 2), by means of the lever 33, in order to allow a new log 11 to slide properly in the brazier 12.

[0045] As already mentioned, the combustion chamber 13 is separated from the storage tank 10 and from the loading compartment 20 within which each single log 11 of solid fuel is raised, by means of a chain loading mechanism 15, once placed on the cradle 22, for each opening of the combustion chamber's door 17.

[0046] Once placed the log 11 in the combustion chamber 13, the cradle 22 begins to fall and mechanically causes the closing of the door 17 and the lowering of the fingering means 18 which therefore lean over the log 11.

[0047] The lever 33, which is firmly connected with the fingering means 18, now moves by gravity. In fact, the lever 33, as the log 11 burns, thus decreasing its volume, will move towards the micro-switch 32 and, when a prefixed volume is reached, it will activate the micro-switch 32, thus actuating again a new load cycle.

[0048] In correspondence with the bottom of the tank 10 and between the tank 10 and the loading compartment 20 a flap 16 is provided for allowing, in the open position, the passage of the log 11, which is placed lower in the tank 10, from said tank 10 into the cradle 22 of the compartment load 20.

[0049] The door 16 is automatically opened, by means of the lever 23, when a consent signal is given on the basis of a further signal which is detected by one or more mechanical and/or electrical sensors and which is able to control, in a known manner, the transport and supply mechanisms of the solid fuel, respectively, in the load compartment 20 and in the combustion chamber 13, according to the detected fuel consumption.

[0050] In the initial position shown in figure 1, the storage tank 10 (which has preferably a longitudinal or oblique shape) which contains the solid fuel can be fed through a side filling opening 28, closable by means of a door 29 (which can be made of a transparent or partially transparent material to allow the user to control the filling level of the tank 10 and which may include firmly closure means, for example of the snap-acting type), and is connected, through the door 16, with the load compartment 20.

[0051] When the mechanism allows the action, that is to say when the solid fuel contained in the combustion chamber 13 is less than a predetermined amount, the log 11 which is placed in the lower position inside the tank 10 slides down by gravity, thanks to the opening movement of the door 16, carried out by the lever 23, the log 11 being thus placed in the load compartment 20.

[0052] A shaped cavity or cradle 22 is provided in correspondence of the door 16 and immediately below the opening 27 of said door 16, through which the log 11 is moved, said cradle 22 being connected by hinges to the loading compartment 20, where the log 11 is placed once it comes out from the opening 27.

[0053] When the door 16 is completely opened and when the solid fuel piece or log 11 is completely positioned inside the cradle 22, the door 16 is automatically closed by retaining the other logs 11 in the starting stacked position.

[0054] Considering that the loading of the solid fuel takes place at one side of the heating appliance heating and considering that said loading occurs in the tank 10, which is separate and which is not directly connected with the combustion chamber 13, it follows that firstly the structure of the heating appliance according to the invention is extremely safe for the user, even in case of any failure and/or malfunction.

[0055] Furthermore, the chain load mechanism 15, which is able to take upwards each log 11 that is housed in the cradle 22 till to reach a level placed in correspondence of the door 17 (which in a resting position is able to close the opening of the combustion chamber 13), also allows to slide the log 11 into the combustion chamber 13 only by gravity. In other words, said log 11, by exerting pressure on the door 17, is automatically pushed into the combustion chamber 13.

[0056] Moreover, according to the invention, the opening of the door 17 of the combustion chamber 13 is carried out only as a result of the passage of the log 11, as said door 17 is always closed when the solid fuel goes up in the load compartment 20 (figure 1), as well as during the whole combustion phase (figure 4), because the door 17 is not connected to the fingering means 18, either directly or indirectly (through the actuator 19).

[0057] The volume of the solid fuel log 11 is therefore able to maintain each fingering means 18 in a raised and inclined position and is able to stop, through the actuator 19, any new load cycle of the solid fuel until a predetermined decrease in volume of the log 11 is detected.

[0058] The actuator 19, which is connected with at least one fingering means 18 and with at least one external micro-switch 32, allows to further activate the mechanism of introduction of the solid fuel load (a new log 11) when at least one of said fingering means 18 detects a volume of the log 11 which is below a predetermined quantity or below an interval of predetermined quantities.

[0059] In particular, the fingering means 18 detect the absence and/or a decrease in volume of the solid fuel

log 11 when the solid fuel wears out in the combustion chamber 13, and, in that case, they give a consent signal to the external micro-switch 32 for loading a new log 11.

[0060] In a preferred embodiment of the invention, which is shown in figures 5 and 6, it is possible to stop the fingering means 18 in a manual position.

[0061] In particular, to operate the heating device in a manual mode, it is necessary to raise the fingering means 18 and to shift a button 35 from the A position (figure 5) to the B position (figure 6). Said shifting in the B position allows a mechanical locking of the lever 33, which therefore does not drive the micro-switch 32. Moreover, advantageously, the fingering means 18 act as a log guard, i.e. they are provided for protecting the environment from splinters and/or burning embers that may escape out from the combustion chamber 13.

[0062] According to a further embodiment, not shown in the enclosed figures, the heating device is equipped with two safety systems that are able to switch off the electric current powering the motors of the load cycle when the door 16 of the tank 10 or the door 17 of the combustion chamber 13 is opened. These safety systems significantly increase safety when the wood is loaded in the brazier 12 (if the heating unit operates in a manual mode) and when the logs 11 are loaded in the tank 10 (if the heating unit operates in an automatic mode).

[0063] It is therefore clear that the use of the heating appliance according to the present invention allows to achieve high standards of safety (since loading of the solid fuel takes place in a separate room, which does not directly communicate with the combustion chamber), as well as to obtain a reliable and optimal automatic operation, thus avoiding the user having to perform manual actions for loading the solid fuel when the volume of the fuel decreases within the combustion chamber and maintaining, at the same time, the desired combustion throughout the whole operation period.

[0064] In addition, when the loading system is off or inactive, the heating device is able to normally operate as a traditional wood stove with manual loading.

[0065] From the above description the characteristics of the solid fuel heating appliance with automatic loading up and high safety and efficiency, which is the object of the present invention, are clear as well as the related advantages.

[0066] Finally, it is also clear that many other variations may be made in the solid fuel heating device of the invention, without departing from the principles of novelty inherent in the inventive idea, as well as it is clear that, in the practical embodiment of the invention, the materials, the shapes and dimensions of the technical details that are illustrated may be any according to requirements and they may be replaced with other details that are technically equivalent.

Claims

1. Solid fuel heating appliance with automatic loading up and high safety and efficiency, comprising a tank (10), in which a solid fuel (11) to be sent towards a combustion chamber (13) is loaded, which combustion chamber (13) is provided with at least one external wall (30) in front of which a user can be placed, **characterized in that** fingering means (18) are mounted on a support (31) placed parallel to said external wall (30), said fingering means (18) being suitable for detecting a value of volume of solid fuel (11) within said combustion chamber (13), which is less than at least one predetermined threshold value, said fingering means (18) being connected to at least one operating device (19) and to at least one switch (32), suitable for activating a lifting mechanism for introducing solid fuel (11) into said combustion chamber (13).
2. Heating appliance according to claim 1, **characterized in that** said tank (10) is in direct communication, through at least one first opening (27) closable by at least one first door (16), with at least one load compartment (20), in which said solid fuel (11), which comes from said tank (10) and is sent to said load compartment (20), through said first opening (27), is raised by means of said lifting mechanism from an altitude which substantially corresponds to said first opening (27) to an altitude which substantially corresponds to at least one second door (17), able to directly connect said load compartment (20) with said combustion chamber (13), said solid fuel (11) being introduced from said load compartment (20) to said combustion chamber (13) thanks to its gravitational force which causes the opening of said second door (17), said combustion chamber (13) and said tank (10) being separated from said load compartment (20).
3. Heating appliance according to claim 1 or 2, **characterized in that** at least one shaped support element (22) supports said solid fuel (11) within said load compartment (20) during the activation of said lifting mechanism.
4. Heating appliance according to claim 3, **characterized in that** said operating device (19) comprises a lever (33) provided with a first and a second end, said first end being integral with said fingering means (18), and said second end being connected to said shaped support element (22), said fingering means (18) moving from a first loading position to a second rest position through a third intermediate position, said first loading position providing said fingering means (18) are raised with respect to said solid fuel (11) by said lever (33), said lever (33) being pulled by said shaped support element (22) during the introduction of solid fuel (11) into said combustion chamber (13), said second rest position providing said fingering means (18) pushing downward, said lever (33) operating said switch (32), and said third intermediate position providing said lever (33) moving by gravity downward, said fingering means (18) contacting said solid fuel (11) which is loaded into said combustion chamber (13) and said shaped support element (22) moving downward.
5. Heating appliance according to claim 4 **characterized in that** said operating device (19) comprises transmitting means (34), for transmitting the motion of said lever (33) to said shaped support element (22) and/or vice-versa.
6. Heating appliance according to any of claims 4-5, **characterized in that** it provides a button (35) that can move from a first position (A) in which said heating appliance works, to a second position (B) in which said fingering means (18) are mechanically blocked in a rising position, so as said lever (33) does not operate said switch (32).
7. Heating appliance according to any of claims 1-6, **characterized in that** it provides at least one safety system that is able to isolate said heating appliance from the supply current supplying said lifting mechanism, when said first door (16) and/or said second door (17) is open.
8. Heating appliance according to any of claims 1-7, **characterized in that** said second door (17) is mechanically closed during the steps of combusting said solid fuel (11) and of moving said lifting mechanism of said load compartment (20).
9. Heating appliance according to any of claims 1-8, **characterized in that** said lifting mechanism moves a single piece of solid fuel (11) for each opening of said second door (17).
10. Heating appliance according to any of claims 1-9, **characterized in that** said solid fuel (11) is loaded into said tank (10) through a load opening (28), which is closable by a door (29) made of transparent or partially transparent material to allow the user to control the filling level of the tank (10) with said solid fuel (11).

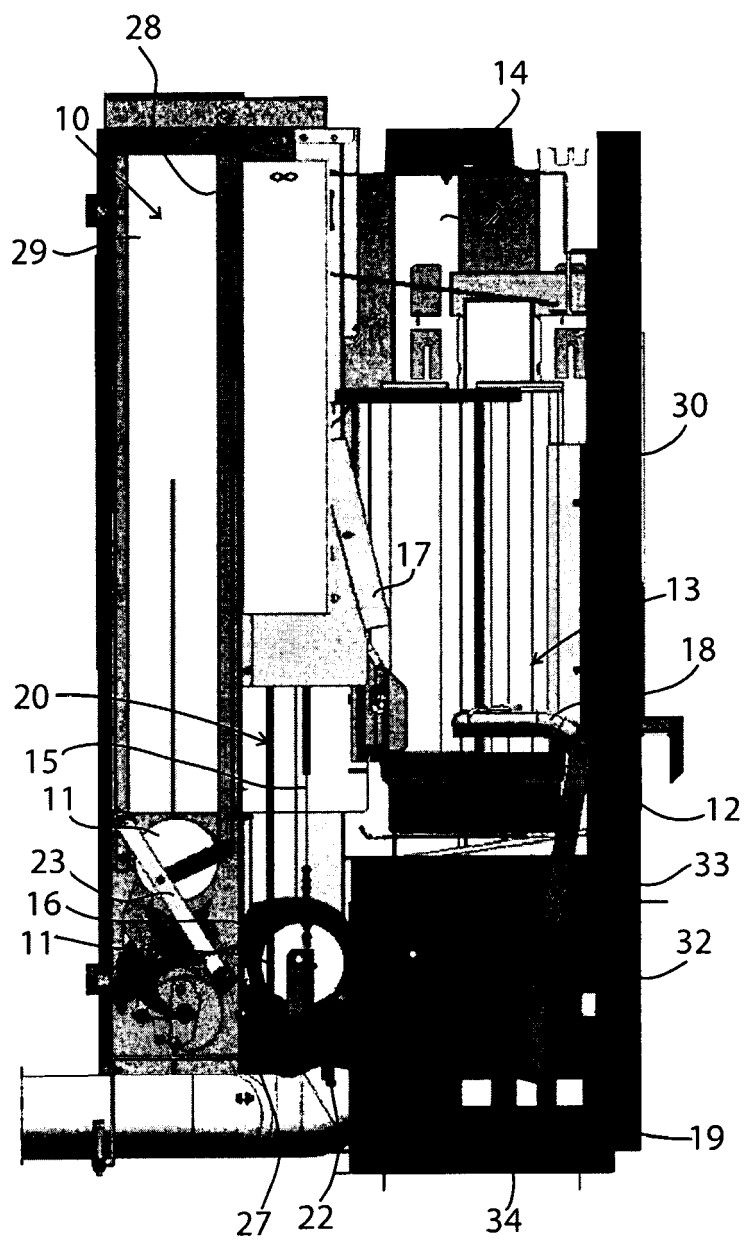


Fig.1

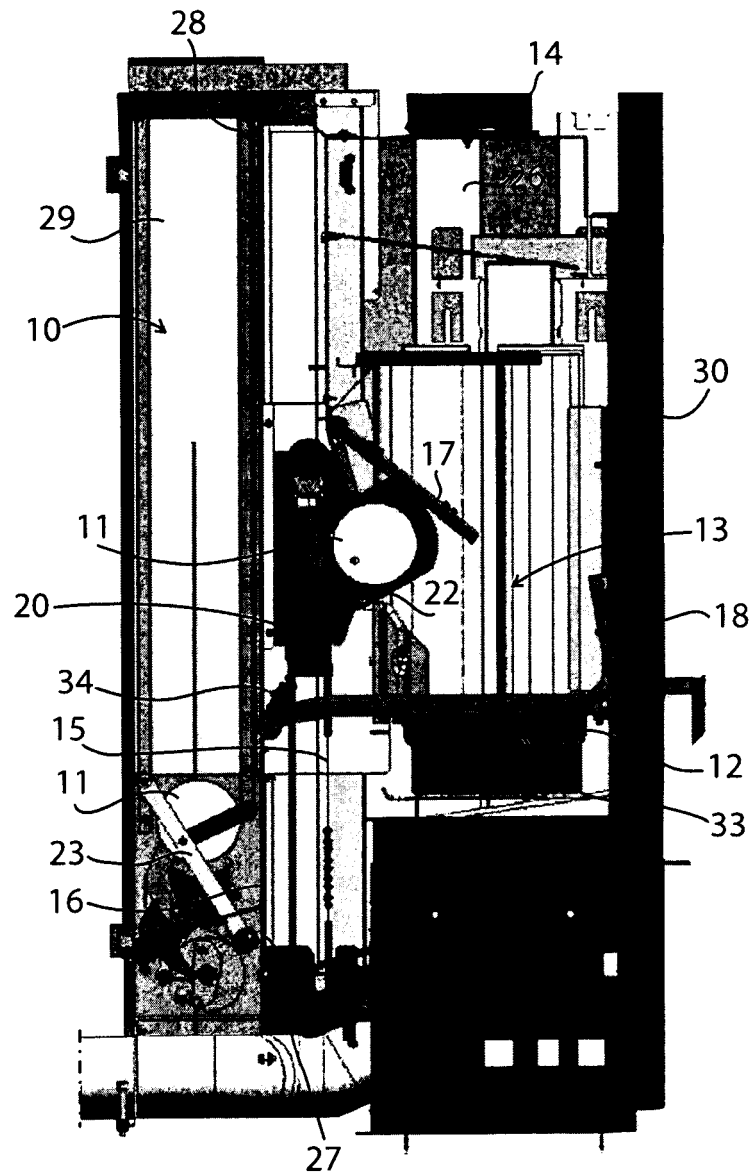


Fig.2

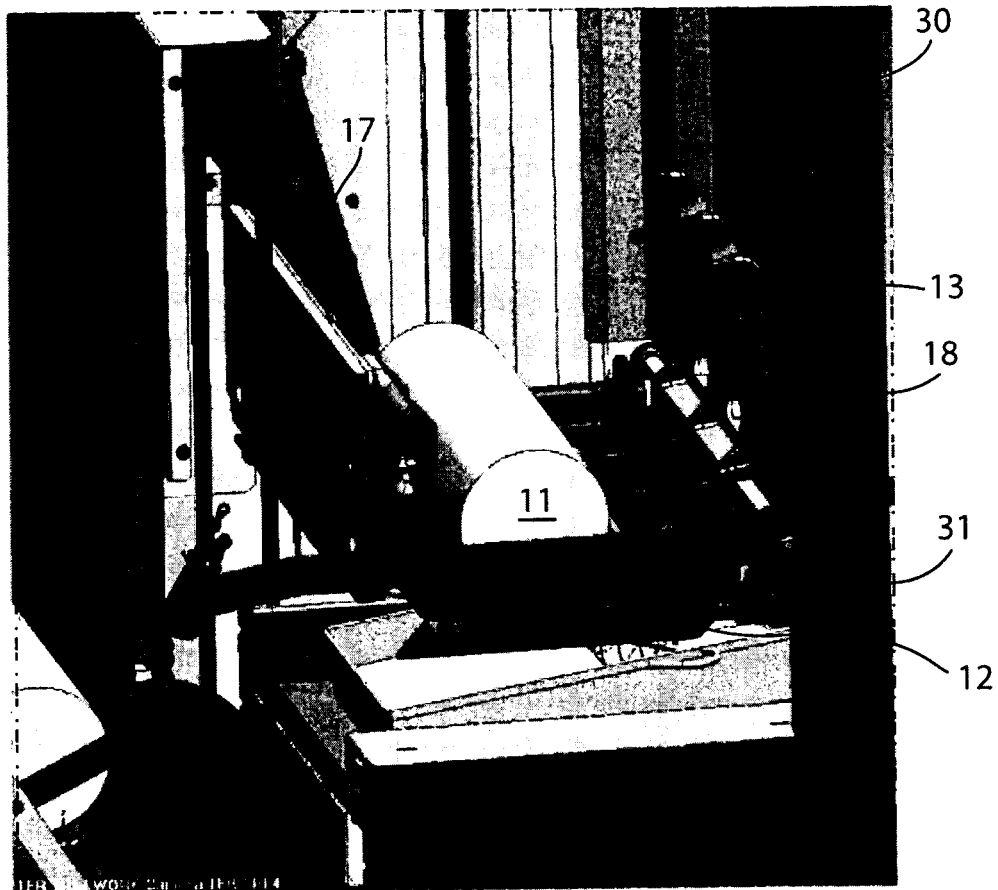


Fig.3

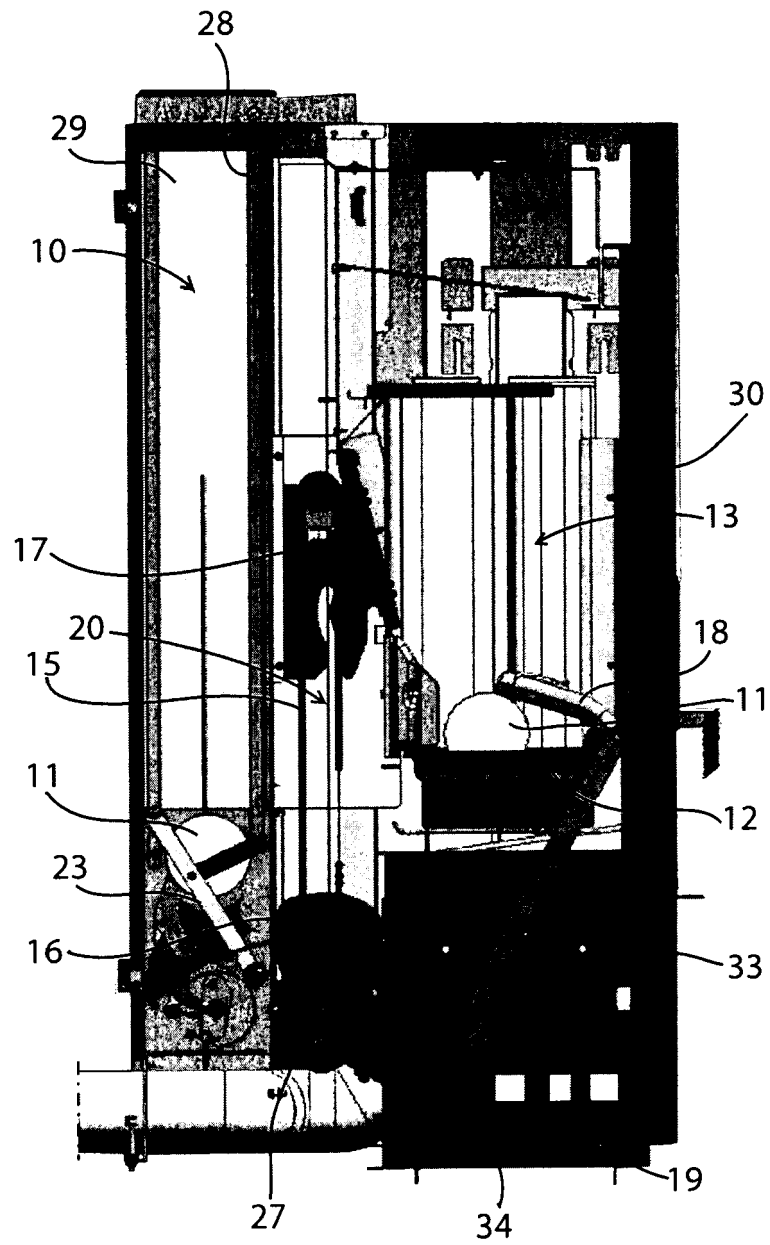


Fig.4

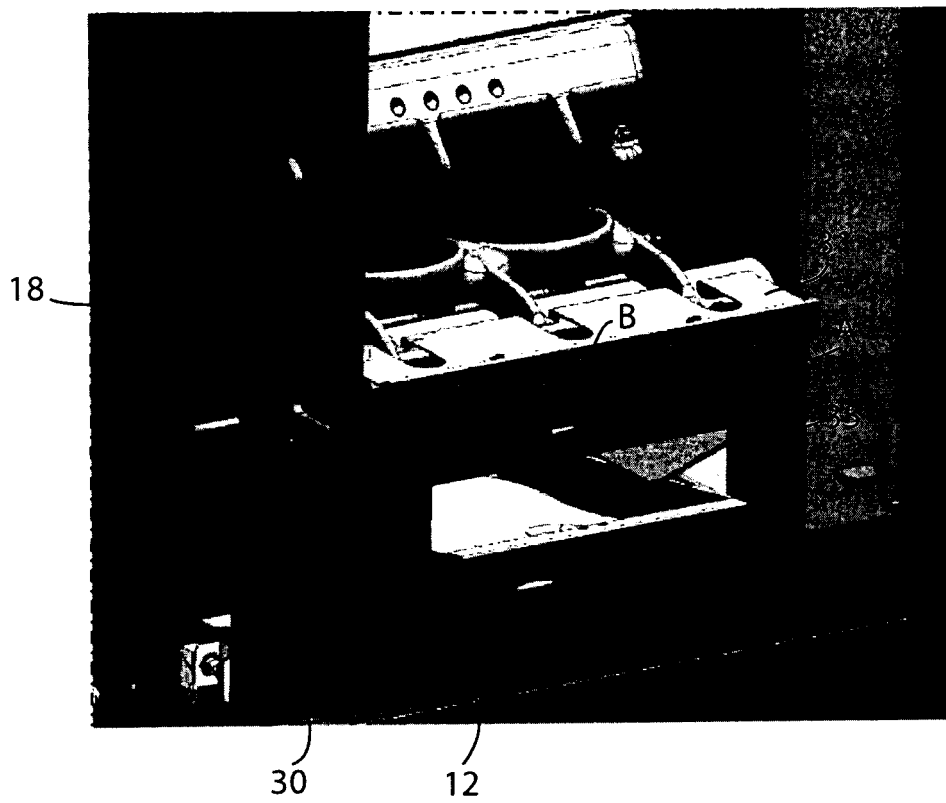


Fig.5

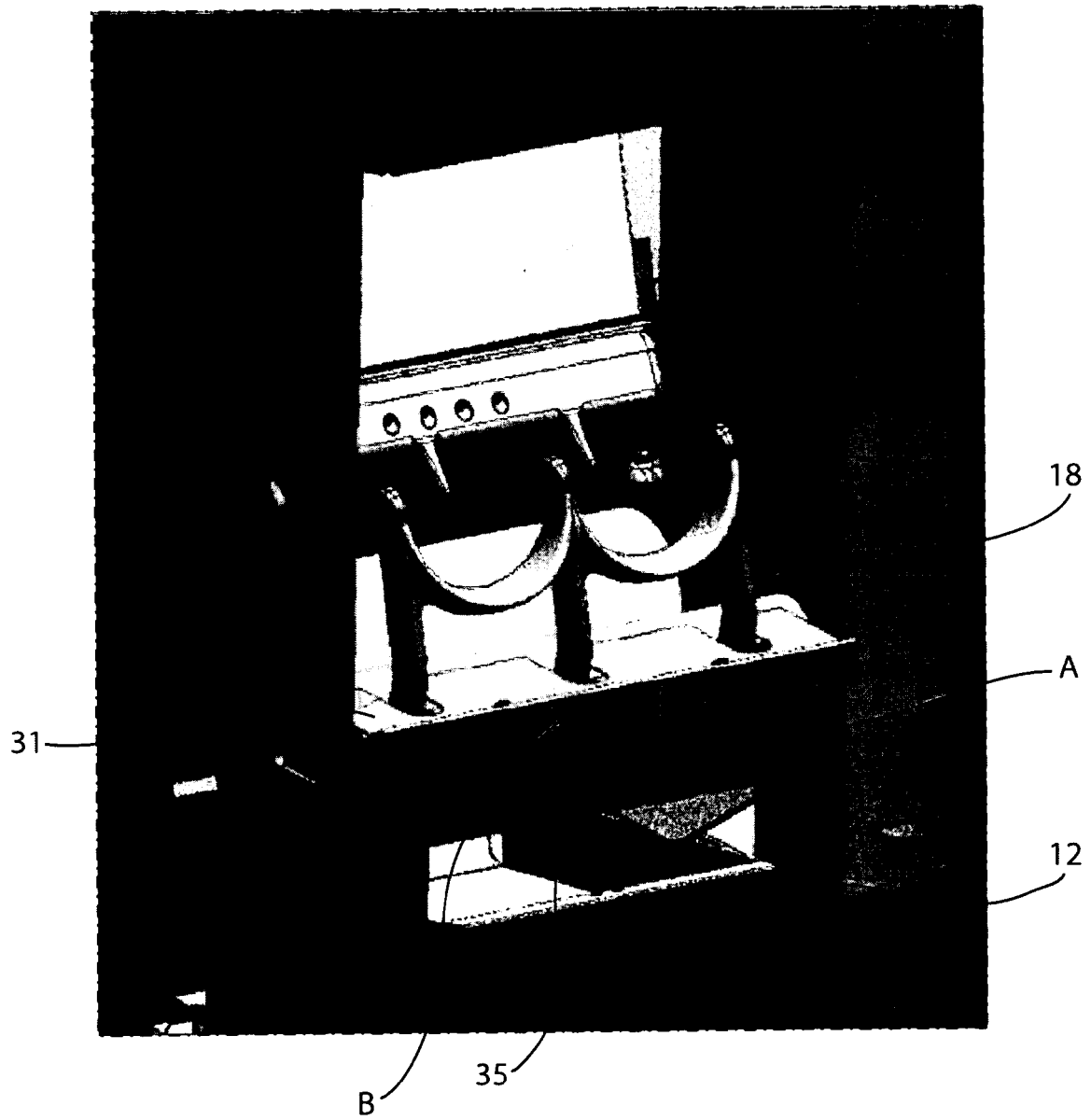


Fig.6



EUROPEAN SEARCH REPORT

 Application Number
 EP 12 42 5172

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 18 September 2014	Examiner 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			

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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.
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