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(54) **Heating apparatus with automatic feeding of solid fuel, particularly wood logs**

(57) A heating apparatus (19) with automatic feeding of solid fuel, particularly small wood logs (11), comprising a tank or reservoir (10), inside which solid fuel unit portions to be sent into a combustion chamber (13) of the heating apparatus (19) are loaded, wherein said reservoir (10) is communicating with at least one loading compartment (20), inside which each portion of solid fuel is elevated up to a height so as to introduce it into the combustion chamber (13); in particular, the reservoir (10) and the loading compartment (20) are in communication with each other by means of a loading mechanism (23), which includes a first containing and transporting shaped element (32), able to take each small wood log (11) from the reservoir (10) and to place it onto a second shaped element (22), which is also able to contain the log (11) and to transport it into the combustion chamber (13).

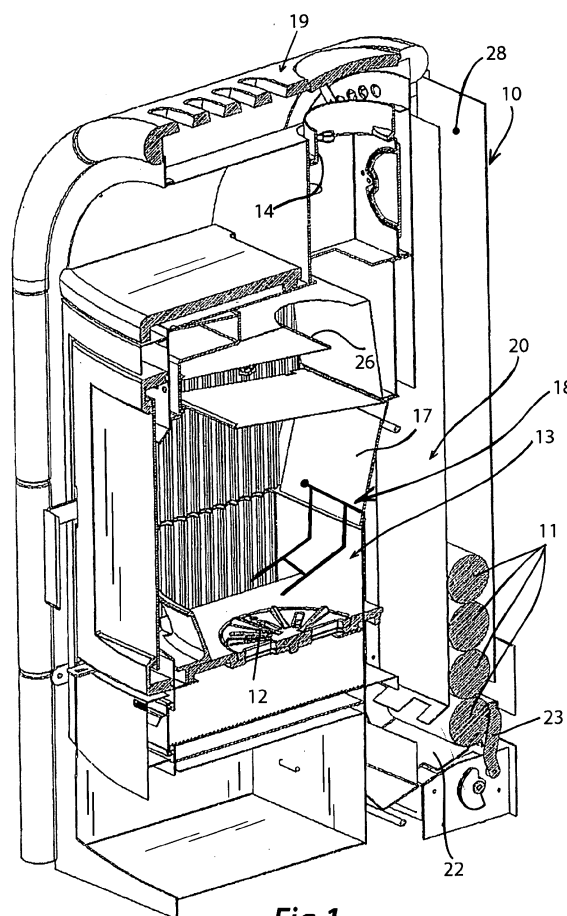


Fig.1

Description

[0001] The present invention generally relates to a heating apparatus with automatic feeding of solid fuel and, in particular, with automatic feeding of small logs and/or compressed sawdust or the like.

[0002] In particular, the invention relates to a device for loading small logs within the combustion chamber of heating appliances, such as for example stoves, fireplaces, fireplace inserts, oven inserts, thermo-stoves, heaters and/or heating devices in general and the like.

[0003] The heating apparatus according to the invention can be loaded with small logs or with compressed wood sawdust during working and said loading can take place automatically and in a gradual and safe manner for the user, as well as the apparatus can be turned off even when the solid fuel tank is partially filled and then turned on again.

[0004] Known solid fuel heating devices have a specific compartment with a manual opening for loading the solid fuel, in order to load and/or control the amount of fuel within the combustion chamber.

[0005] Among the domestic heating systems, solid fuel heating devices (the so-called stoves) are also known; they are fed by means of automated loading mechanisms of the fuel and used particularly for granular solid fuel (pellets), wood sawdust and/or biomass, such as corn, soybeans, barley, etc.

[0006] Moreover, such stoves have an autonomous working and are equipped with control systems including an electronic unit which is able to adjust the fire power and to control the quantity of pellets to put within the combustion chamber; the stove also usually includes a front grid for diffusing hot air in a suitable way, also thanks to the use of cross-flow fans, which allow a fast and effective distribution of heat.

[0007] Such stoves are also usually provided with pullers and/or blowers, which allow the circulation of primary and secondary air flux, thus ensuring the effective evacuation of the exhaust fumes, with a containment structure of the solid fuel, with a combustion chamber of said solid fuel and with means for introducing and loading the solid fuel within the combustion chamber.

[0008] Said solid fuel is manually burned by the user or can be automatically burned by means of an integrated ignition device; furthermore, on the basis of the settings of the heating appliance or on the basis of the heating requirements, further solid fuel is added at regular intervals of time, in order to feed the combustion within the combustion chamber.

[0009] The loading of the solid fuel is usually done by means of an upper tank which is provided, laterally to the brazier, of one or more internal compartments, which may be equipped with one or more removable trays for collecting the residual ashes.

[0010] Furthermore, a control panel is also provided, which can also be activated by means of a remote control, which allows the user the automatic switching and setting

of the heating power of the appliance, so that the user can be set, through a thermostat, the desired temperature value and therefore the quantity of solid fuel to be introduced in the combustion chamber.

[0011] However, the known heating devices with manual or automatic charge, and, in particular, the heating devices using small logs as a solid fuel, have some drawbacks, such as the danger of the fuel loading phase (which also causes a partial dispersion of combustion and heat fumes in the environment, when the device is manually loaded), the need for a continuous control of the loaded solid fuel by the user, as well as the difficulty for removing and inserting the small logs, when the small logs are used as solid fuel, due to their dimensions and their organoleptic features.

[0012] In fact, the known heating apparatus do not allow any movement or loading of logs having uneven dimensions and in any case dimensions exceeding the granular ones (such as the pellet, for example); thus, it is not possible to use small wood logs, which however are easily retrievable and have a much lower cost with respect to the granular fuel.

[0013] The European patent EP1865254B1 discloses a heating device with automatic feeding of solid fuel, wherein the solid fuel, such as in particular the small logs, has variable shapes and quality features; moreover, the automatic entry of the logs into the combustion chamber is set as a function of the quantity of solid fuel which is already placed within the combustion chamber.

[0014] In particular, the above patent discloses a vertical structure for containing and supporting the small wood logs (which can be manually loaded by a user) and said structure is positioned on the back of the heating device and connected with the combustion chamber of said heating device; the structure comprises a device for conveying the logs, which consists of a pair of toothed wheels and of a pair of chains, on which a plurality of supporting plates for conveying the logs are fixed, and a door, which is placed below the conveying device and which can be opened, through a microswitch, to allow the transit of one or more logs when no solid fuel is loaded within the combustion chamber.

[0015] However, even this appliance still has some drawbacks during the working of the logs conveying device, because the variable shapes of the wood logs (which have a substantially cylindrical shape, but which do not have homogeneous and/or linear structures and measures) often cause, when the logs fall down towards the combustion chamber, jamming of the logs and therefore a failure in the opening or a partial opening of the door when the log is going to enter within the combustion chamber, as well as the trapping of said log against the door and the consequent switching off of the heating unit because the solid fuel is exhausted within the combustion chamber.

[0016] Moreover, the loading device disclosed in EP1865254B1 is extremely complex and expensive, because toothed wheels and belts or transport chains are

needed, as well as a series of supporting plates, each of which is able to contain and transport a single small log; the device also allows for containing and conveying not many logs, because at least one supporting plate is provided between two small wood logs.

[0017] The present invention intends to solve the above-identified drawbacks of the prior art.

[0018] Specifically, the main object of the present invention is to provide a heating apparatus with automatic feeding of solid fuel and, in particular, of small wood logs, which allows the loading of the solid fuel even when the heating apparatus is working, without the user should open the combustion chamber, thus preventing the risk for the user of contacting the combustion chamber.

[0019] Another object of the present invention is to provide a heating apparatus with automatic feeding of solid fuel and, in particular, of small wood logs, which avoids the user's continuous control of the combustion chamber for checking the quantity of solid fuel within the combustion chamber and for adding solid fuel, once the solid fuel inside the combustion chamber is exhausted, and which allows to use various types of small logs and/or compressed sawdust having a substantially cylindrical geometry and having variable dimensions and/or structure.

[0020] A further object of the present invention is to provide a heating apparatus with automatic feeding of solid fuel, in particular of small wood logs, which allows a practical, safe, efficient and reliable loading of the solid fuel into the combustion chamber, with respect to the prior art.

[0021] Another object of the invention is to provide a heating apparatus with automatic feeding of solid fuel, which has a simple structure and low costs, with respect to the prior art.

[0022] These and other objects are achieved by means of a heating device for automatic feeding of solid fuel, according to the alleged claim 1; other features of the invention are set forth in detail in the dependent claims.

[0023] Advantageously, the solid fuel heating apparatus and, in particular, the small logs heating apparatus, which is the object of the present invention, allows to adjust, depending on the quantity of solid fuel standing in the combustion chamber, the automatic introduction into said chamber of the small wood logs coming from an automatic loading device, which is installed outside the heating apparatus, so as to allow also to obtain a safe operation and a lower dispersion of heat and/or combustion gases into the environment, compared to known heating devices.

[0024] Also advantageously, the device for loading the solid fuel consists of a mechanism including levers and cams and made so as to avoid a direct contact between the combustion chamber and the tank containing the solid fuel; this is an additional safety for the user, since the risk of any fire caused by the possible combustion of the solid fuel contained in the tank, when the heating device is working, is greatly reduced.

[0025] Furthermore, the heating apparatus according

to the invention guarantees a continuous operation, avoiding for the user the need of continuously monitoring the quantity of solid fuel standing in the combustion chamber and also avoiding jamming and/or failings of working during the load of the solid fuel.

[0026] Finally, it is possible to use small wood logs as solid fuel, said logs having a substantially cylindrical geometry, with different diameter sizes.

[0027] Further objects and advantages of the present invention will become clear from the following description, relating to a preferred, but not limited, embodiment of the heating apparatus with automatic loading of solid fuel, in particular of small logs, which is the object of the invention, and from the alleged drawings, in which:

- figure 1 is a partial perspective schematic view of a heating apparatus with automatic loading of solid fuel, in particular of small logs, according to the present invention;
- figure 2 is a partial longitudinal section view of the heating apparatus with automatic loading of solid fuel of figure 1, according to the present invention;
- figure 3 shows a detailed perspective view of a first cam and of a relative lever system, able to load each small log, which are used in the heating apparatus with automatic loading according to the present invention;
- figures 4 and 4A show detailed perspective views of a second cam and of a relative lever system, able to load each small log, which are used in the heating apparatus with automatic loading according to the present invention;
- figures 5 and 5A show detailed perspective views of a third cam and of a relative lever system, able to load each small log, which are used in the heating apparatus with automatic loading according to the present invention;
- figures 6, 7, 8, 9 and 10 show detailed perspective views of different loading phases of a single small log which is fed inside the heating apparatus according to the present invention;
- figure 11 shows a side perspective view of the device for loading small logs into the heating apparatus with automatic loading of solid fuel, according to the present invention.

[0028] Firstly, we underline the fact that, although the following description and the alleged drawings refer to a particular type of high-safety solid fuel automatic heating device and, in particular, to a solid fuel stove using, as a solid fuel, wood compressed into small logs or briquettes and/or wood shavings and/or sawdust, the innovative concept described in the present invention can be easily extended to any other type of heating appliance using any kind of solid fuel having substantially cylindrical shape.

[0029] Referring particularly to the above mentioned figures 1 and 2, 10 indicates a containment structure or

tank of the heating apparatus 19, according to the present invention; the tank 10, according to a first preferred, but not limited, embodiment of the present invention, is placed behind the heating apparatus 19, but, alternatively, said loading or storage tank 10 can be positioned laterally with respect to the heating appliance.

[0030] The solid fuel is manually loaded inside the tank 10 in form of small wood logs 11, having a substantially cylindrical shape and with variable length and diameter, which are stacked one over the other.

[0031] In particular, the tank 10 is connected, by means of a loading mechanism 23 (whose operation will be explained in detail in the following), to a compartment or loading chamber 20, to which are fixed a series of support means comprising at least one cradle 22 for housing each small log 11 and able to be lifted and brought into the combustion chamber 13 of the heating appliance by means of a lifting mechanism usually comprising two toothed wheels 16 and a conveyor belt or chain 15.

[0032] Moreover, the storage tank 10 (which is preferably placed in a longitudinal or oblique direction) containing the small logs 11 is fed through a lateral or rear (not shown in the drawings) filling opening 28, which can be closed through a door 29 (the door 29 may be made with transparent or partially transparent material, so as to allow the user to control the level of the solid fuel inside the tank 10, and may include means for a stable closure, for example of the snap type).

[0033] The small wood logs 11 are stacked, by the user, in the storage tank 10 until the loading mechanism 23 allows the log 11 placed in the bottom of the tank 10 to slide on the cradle 22, which is placed in the adjacent loading compartment 20.

[0034] The combustion chamber 13 of the heating apparatus 19 has at least one brazier 12 and an outlet opening 26 for discharging the combustion gases and fumes, which is connected with the chimney 14.

[0035] Furthermore, the back wall of the combustion chamber 13 is also provided with an opening, which can be closed through a door 17 and from which each small log 11 is introduced into the combustion chamber 13; the door 17 also has suitable touch means 18, which are able to detect the presence of a load of solid fuel, according to predefined parameters, placed on the brazier 12 of the combustion chamber 13; therefore, at least one sensor, connected to a micro-switch, is connected to at least one touch means 18 for enabling the loading mechanism 23 to release another small log 11 on the cradle 22 and for bringing said log 11, through the belt or chain lifting system 15, into the combustion chamber 13 of the heating appliance 19.

[0036] As noted above, the combustion chamber 13 of the heating apparatus 19 is divided from the small logs storage tank 10 by means of the loading compartment 20, within which each single log 11 is raised, once it is placed on the cradle 22, and placed in correspondence of the pivoting door 17, which is therefore opened by the

same log 11 during its vertical ascent, before being discharged into the combustion chamber 13 thanks to the forward lean of the cradle 22.

[0037] According to the present invention, the mechanism 23 for loading each single small log 11 on the cradle 22 substantially includes a frame box 30, provided with a base 31 and placed for supporting a pivoting cradle 32, which is provided for bringing the small wood log 11, and three cams 21, 24, 25, which are pivoted on a single axis of rotation 27, which, in turn, is driven by an electric motor (this mechanism is shown in detail in figures 3, 4, 4A, 5, 5A, 6, 7 and 8).

[0038] Each of said three cams 21, 24, 25 performs a different function, however they simultaneously act on the loading mechanism 23 as shown in the following.

[0039] Firstly, the cam 21 drives a plurality of levers 33 (fig. 3), which operate on the stack of small logs 11 placed in the loading tank 10, allowing to block the last log 11 of the stack and allowing the release of one single log 11 at a time when the sensor connected to the touch means 18 has given a command to load the solid fuel into the combustion chamber 13.

[0040] On the other hand, the cam 24 actuates another system of levers 34 (fig. 4, 4A), which control the actuation of the tilting cradle 32 for bringing the small log 11, thus allowing the same cradle 32 to rise until it reaches the level of the last log 11 of the stack which is placed in the loading tank 10, when said last log 11 is released thanks to the action of the first cam 21 (as described above).

[0041] Finally, a third cam 25, again through a system of levers 35 (fig. 5, 5A), drives, simultaneously with the cam 24, the tilting cradle 32 and allows it to tilt from a substantially horizontal position, when the log 11 is drawn from the loading tank 10 (as shown in the alleged fig. 6, 7 and 9), to a substantially oblique end position (as shown in the alleged fig. 8 and 10), in order to allow the discharge of the drawn log 11 on the cradle 22, which is also able to bring the log 11 into the combustion chamber 13 of the heating apparatus 19 (as described above).

[0042] A further system of levers 36, which are pivoted on a side plate 37 of the frame box 30, is also fixed to one of the side walls 38 of the loading tank 10, so that a user can command, by manually acting on a control knob of the system of levers 36, a lateral shift of the wall 38 (continuously or according to pre-established steps), so as to adjust the internal space of the tank 10 and to have therefore the possibility of loading small wood logs 11 of different diameters, since the market offers various sizes of diameter of said logs 11, typically between a minimum value of 60 mm and a maximum value of 120 mm.

[0043] As the loading of the solid fuel can take place laterally or behind the combustion chamber 13 of the heating apparatus and considering that said loading occurs in a separated tank 10, which does not directly communicate with said combustion chamber 13, it follows that, first of all, the structure of the heating apparatus according to the invention is extremely safe, both during

normal operation or in case of any failure.

[0044] The chain loading mechanism 23, constituted by the three cams system as described above, which allows the release of one single log 11 at a time from the loading tank 10 onto a first transfer cradle 32, before the log 11 is brought upwardly by means of the cradle 22, also allows to avoid any problem of jamming in the process of loading of the solid fuel into the combustion chamber 13, due to possible staggered placements of the logs 11 stacked in the tank 10 during their down following the drawing of each small log 11.

[0045] Moreover, the touch means 18, which are connected to suitable sensors and micro-switches, allow to automatically activate, in an extremely effective and reliable way, the phase of introduction of the solid fuel (the small log 11) when at least said touch means 18 detect a volume of solid fuel below a predetermined value or below a predetermined interval of values; this allows to achieve high safety standards and avoids the user to manually control and/or load the solid fuel when the volume of said solid fuel decreases inside the combustion chamber, while maintaining the desired combustion for the entire period of working of the heating apparatus.

[0046] Also, when the loading system is off or down, the heating apparatus is able to work normally as a traditional wood stove with manual loading.

[0047] Finally, since the market offers small wood logs 11 having different diameters, the loading mechanism 23 further allows the user to be able to adjust, in a continuous or discrete way and manually or automatically, the size of the tank 10, so as to load in said tank 10 small logs 11 having different sizes of diameter.

[0048] From the above description, the features of the heating apparatus with automatic loading of solid fuel, which is the object of the present invention, as well as the advantages of said heating apparatus, are extremely clear.

[0049] Finally, it is also clear that other variants can be made to the heating apparatus of the present application according to the appended claims.

Claims

1. Heating apparatus (19) with automatic feeding of solid fuel, particularly logs of wood (11), comprising at least one tank or reservoir (10), inside which solid fuel is loaded in preset unit portions to be sent in a combustion chamber (13) of the heating apparatus (19), wherein said reservoir (10) is communicating with at least one loading compartment (20), inside which each portion of solid fuel is elevated from a height substantially corresponding to the bottom of said reservoir (10) up to a height substantially corresponding to at least one door (17) that can be operated for the opening so as to make said loading compartment (20) communicate with said combustion chamber (13), and wherein said combustion

chamber (13) and said reservoir (10) are separated from said loading compartment (20), **characterized in that** said reservoir (10) and said loading compartment (20) are in communication with each other by means of a loading mechanism (23) for loading each portion of solid fuel on at least a first containing and transporting shaped element (22), said loading mechanism (23) comprising a plurality of cams (21, 24, 25), that rotate about at least one pivot axis of rotation (27), which is, in turn, operated by operating means, that act on respective levers (33, 34, 35) connected to at least a second containing and transporting shaped element for containing and transporting (32) each portion of solid fuel, said second containing and transporting shaped element (32) being operated from at least a first position, in which each portion of solid fuel is taken from said reservoir (10), to at least a second position, in which each portion of solid fuel, taken from the reservoir (10), is placed on said first containing and transporting shaped element (22).

2. Heating apparatus (19) according to claim 1, **characterized in that** said second containing and transporting shaped element (32) for containing and transporting each portion of solid fuel is shaped like a balancing cradle, that can be operated in a translation for transferring said portion of solid fuel on said first containing and transporting shaped element (22) for containing and transporting each portion of solid fuel.

3. Heating apparatus (19) according to claim 1, **characterized in that** at least a first cam (21) of said loading mechanism (23) operates a first leverage system (33), that is moved from a first position, in which said portions of solid fuel inside said reservoir (10) are blocked, to a second position, in which at least one of said portions of solid fuel is free to fall by gravity on said second containing and transporting shaped element (32) for containing and transporting each portion of solid fuel.

4. Heating apparatus (19) according to claim 3, **characterized in that** at least a second cam (24) of said loading mechanism (23) operates a second leverage system (34), that drives said second containing and transporting shaped element (32) for containing and transporting each portion of solid fuel to an height substantially equal to the height of at least a portion of solid fuel placed on the bottom of said reservoir (10), when said portion of solid fuel falls by gravity on said second containing and transporting shaped element (32), by means of said first cam (21).

5. Heating apparatus (19) according to claim 4, **characterized in that** at least a third cam (25) of said loading mechanism (23) drives, by means of a third

leverage system (35) and at the same time of said second cam (24), said second containing and transporting shaped element (32), that balances from a first position, that is substantially horizontal, in which it takes said portion of solid fuel from said reservoir (10), to a second limit position, almost oblique, that lets the unloading of said portion of solid fuel on said first containing and transporting shaped element (22).

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6. Heating apparatus (19) according to claim 1, **characterized in that** a leverage system (36) is fixed to at least one of the side walls (38) of said reservoir (10), said leverage system (36) being able to be operated so as to cause a side shifting of said at least one side wall (38) and to adjust the usable space inside the reservoir (10), in order to load portions of solid fuel having many different geometries and sizes.
7. Heating apparatus (19) according to claim 6, **characterized in that** said portions of solid fuel are made up of wood logs (11), which are substantially cylindrically shaped, with many different sizes of the external diameter, said logs (11) being stacked on each other inside said reservoir (10).
8. Heating apparatus (19) according to claim 1, **characterized in that** touching means (18) are provided, being suitable for obtaining the volume of solid fuel inside said combustion chamber (13), said volume being smaller than at least a predetermined threshold value, said touching means (18) being linked to at least one sensor and at least one switching device, suitable for operating said loading mechanism (23).
9. Heating apparatus (19) according to claim 1, **characterized in that** said loading mechanism (23) is suitable for a single portion of solid fuel for each opening of said door (17).
10. Heating apparatus (19) according to claim 1, **characterized in that** said reservoir (10) for containing or stocking solid fuel is placed behind or laterally with respect of said combustion chamber (13) of the heating apparatus (19).

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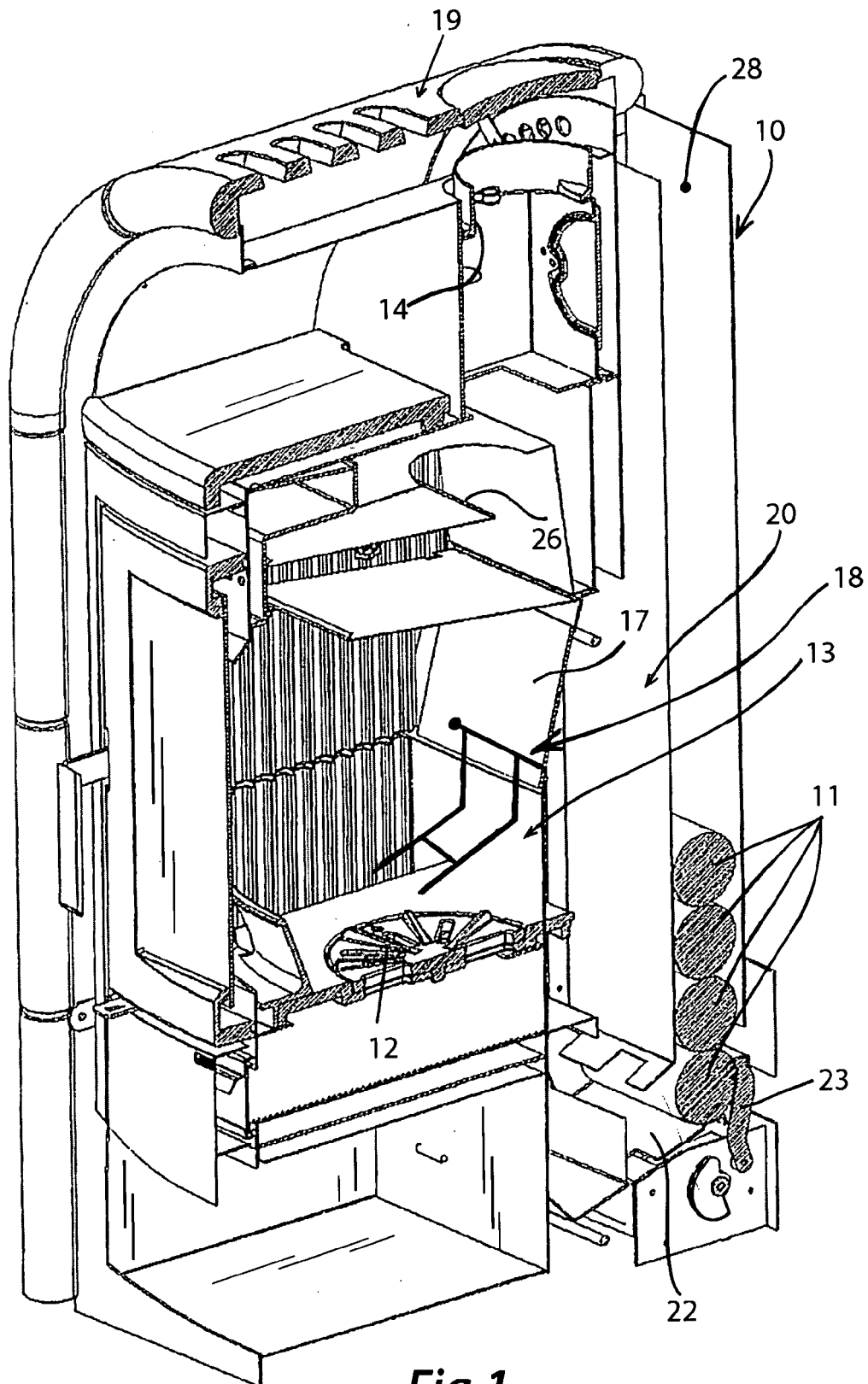
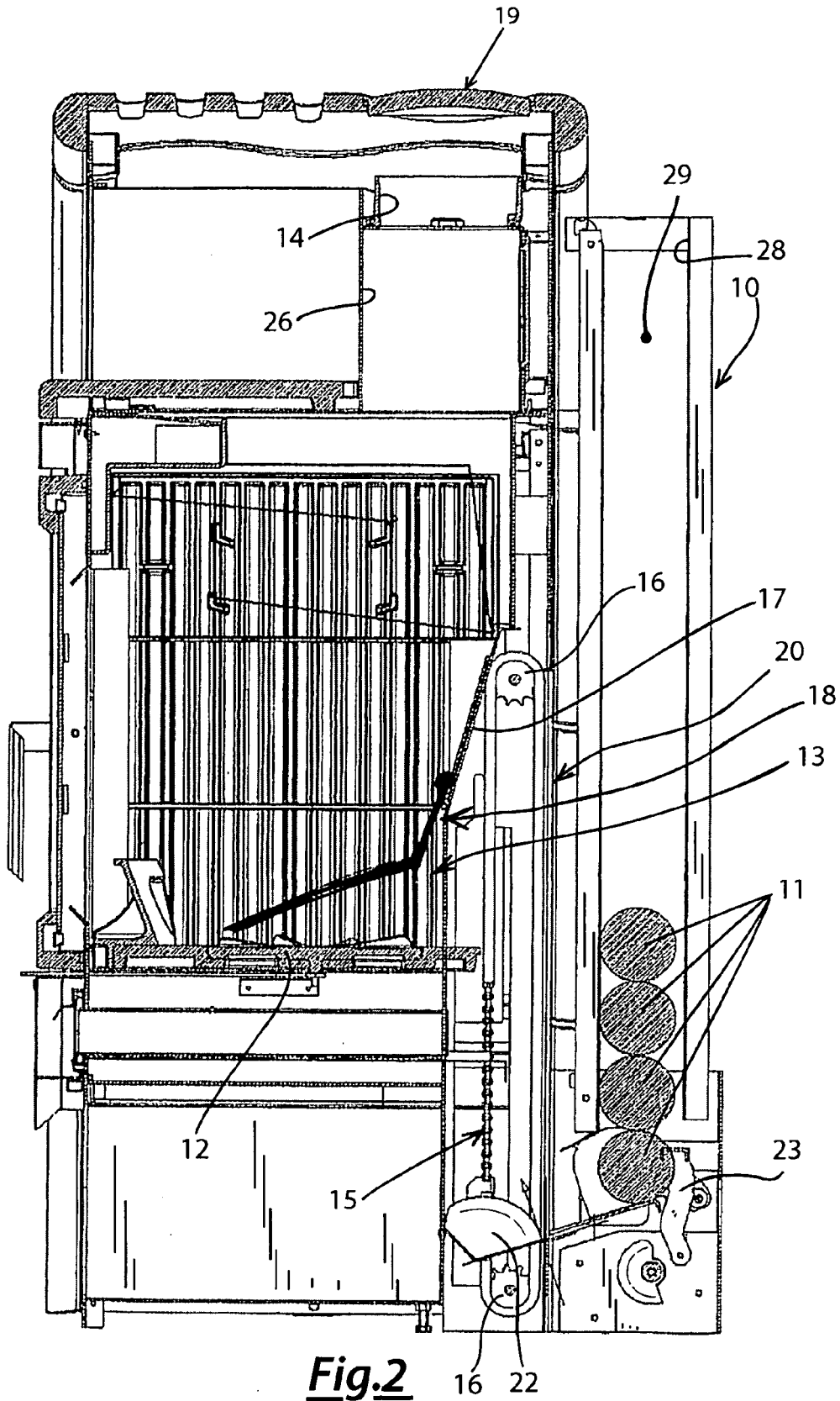


Fig.1



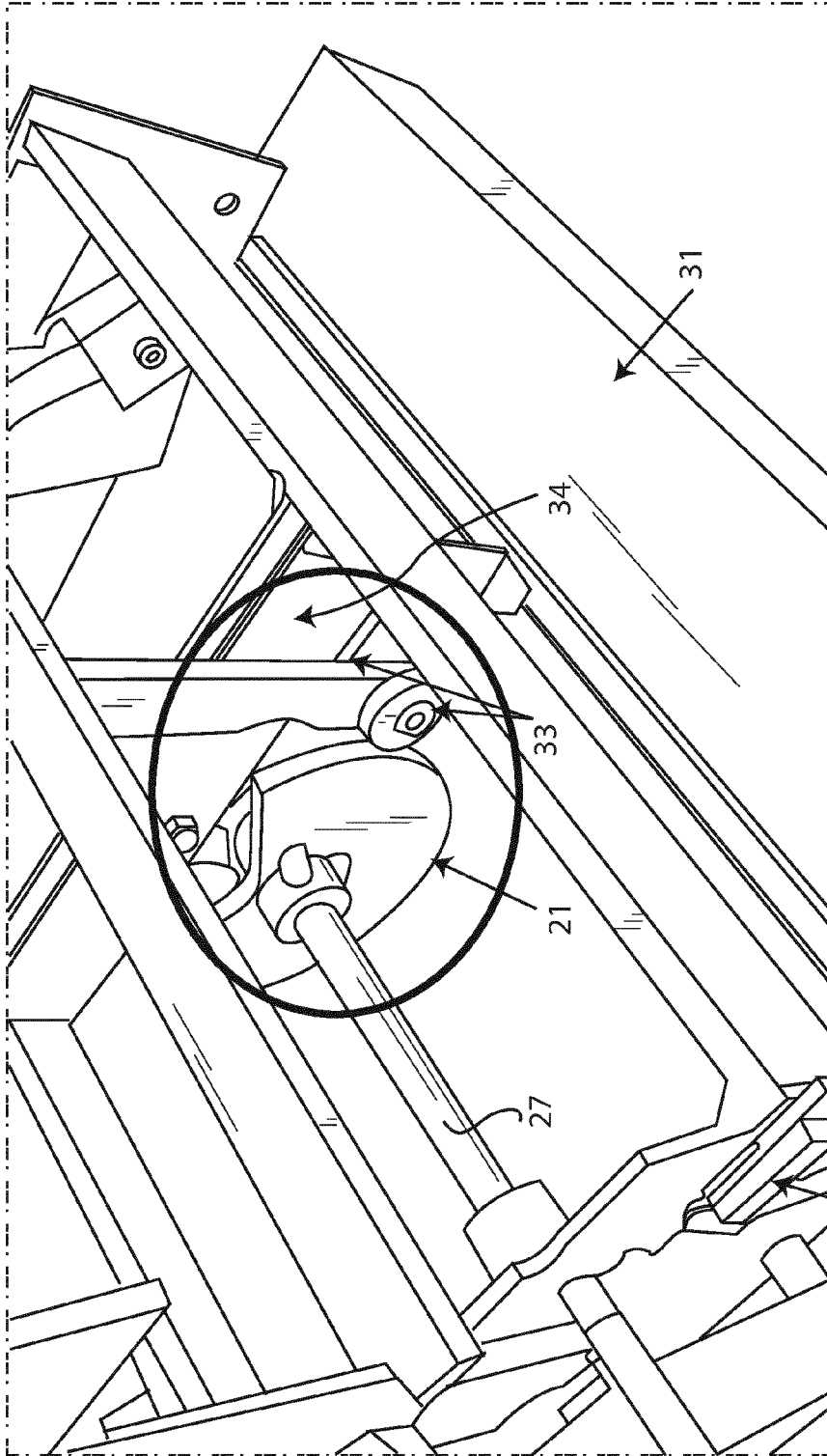


Fig.3

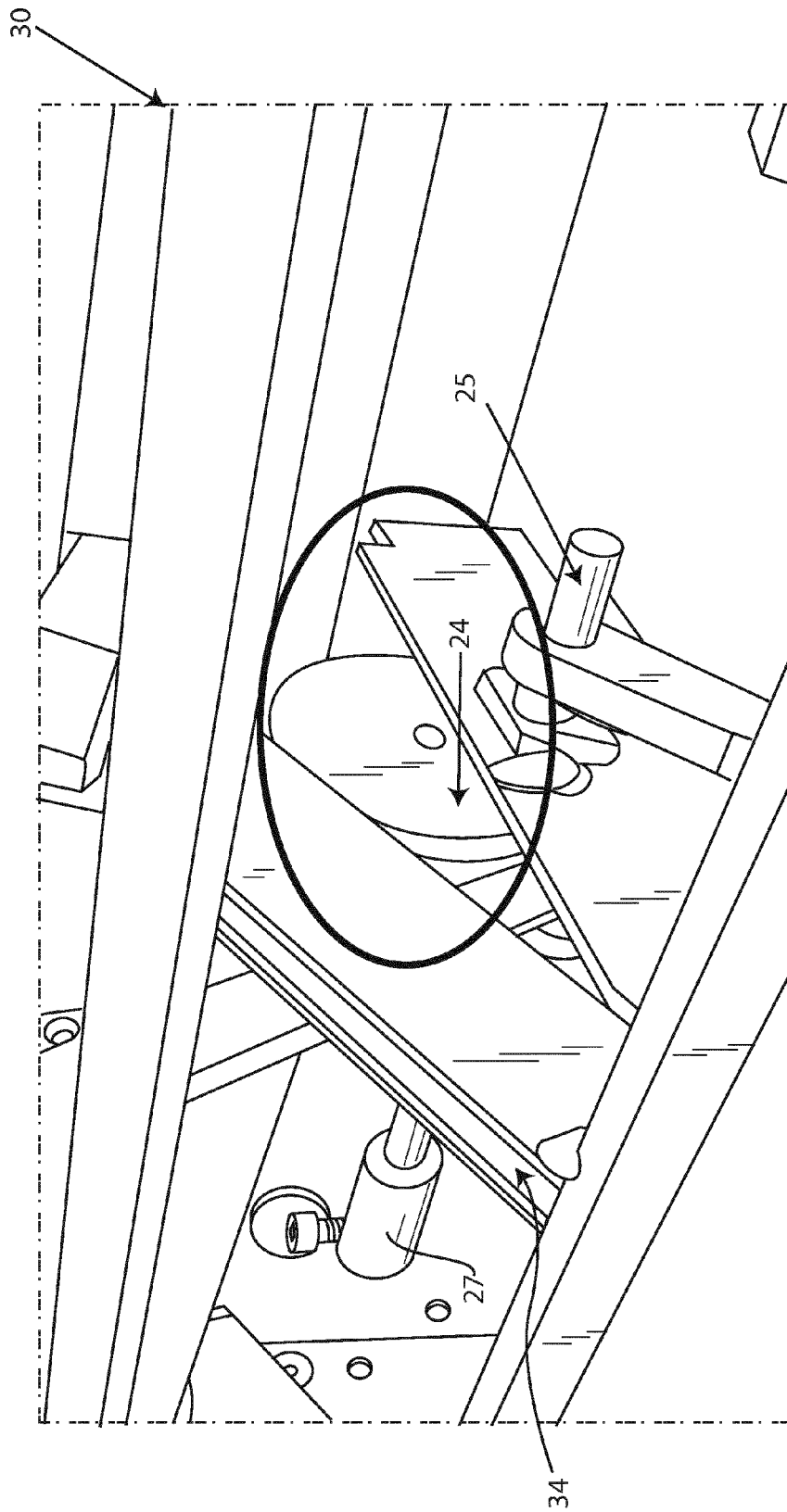
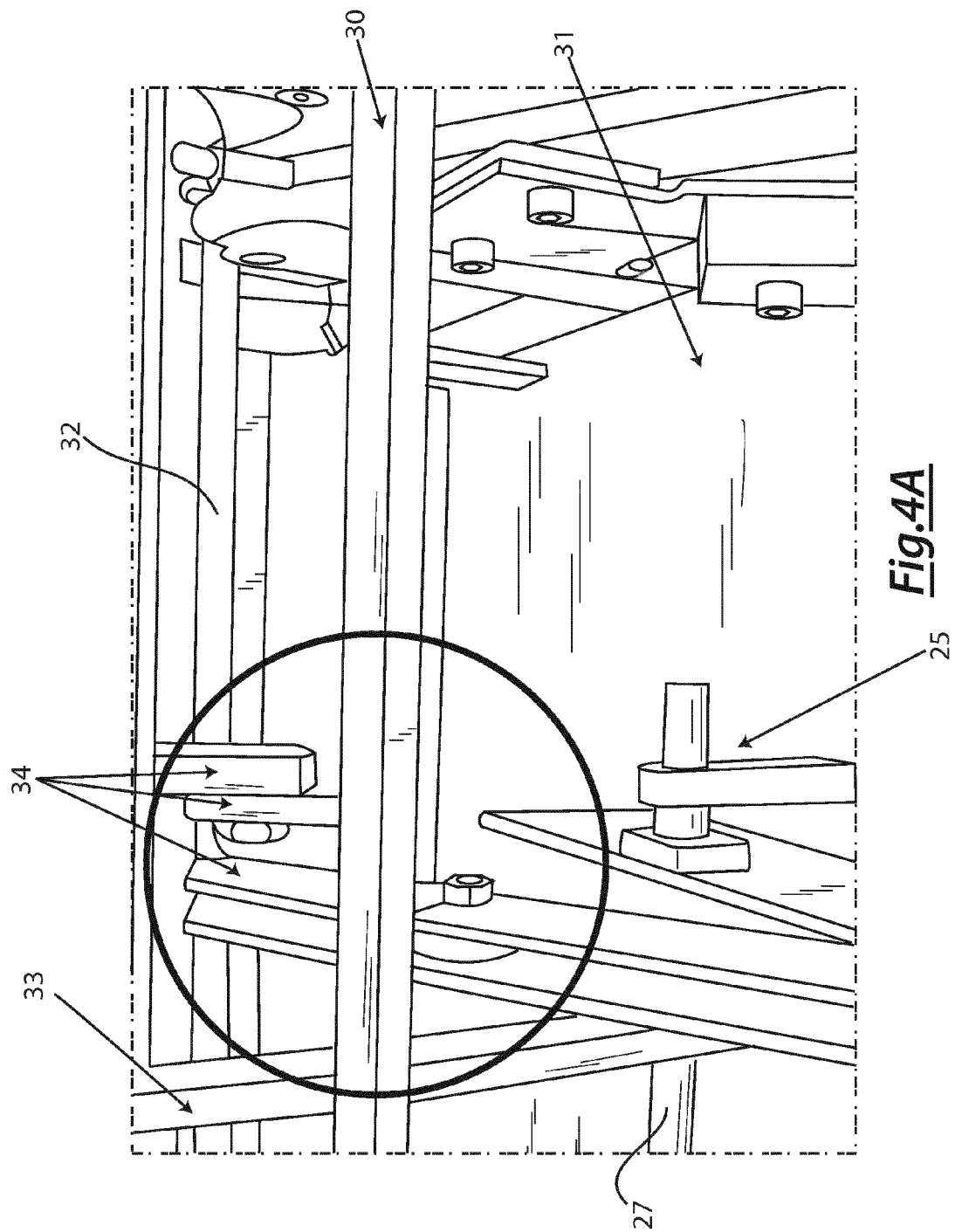


Fig. 4



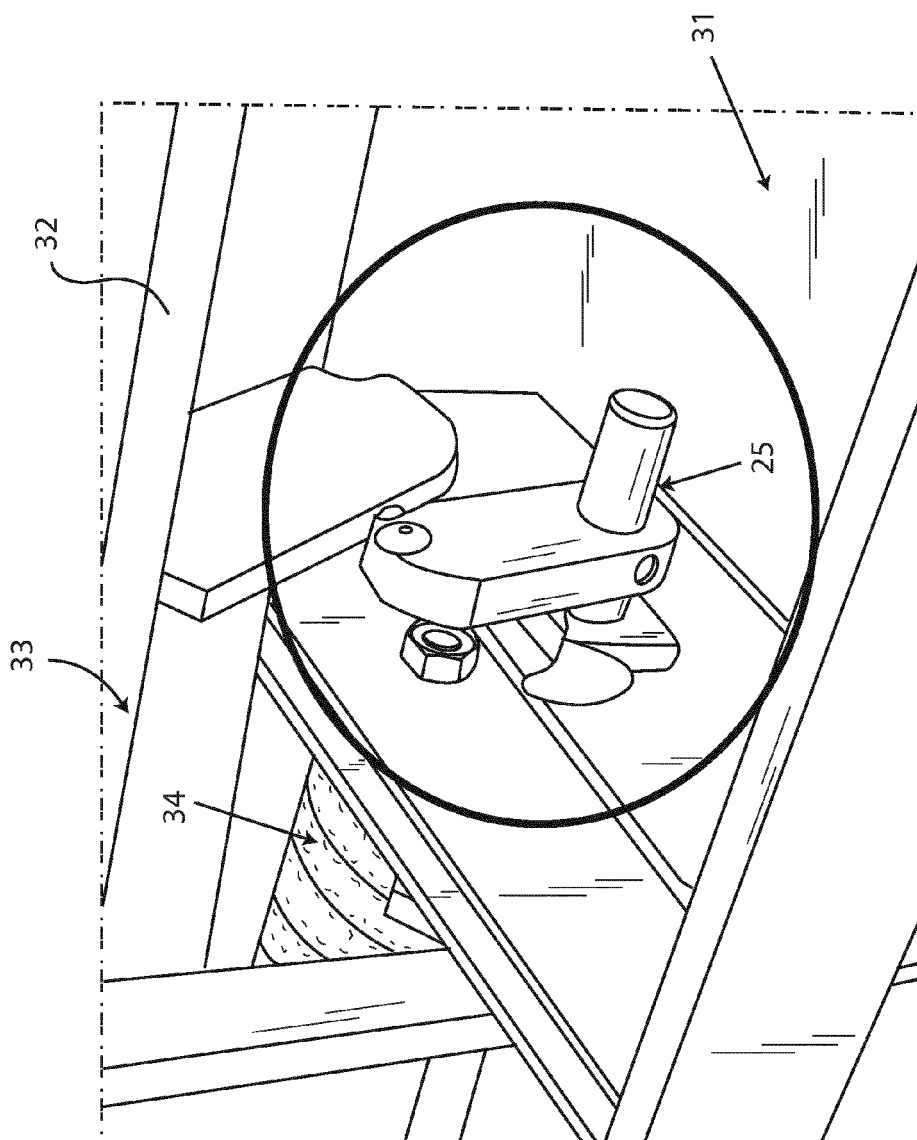


Fig. 5

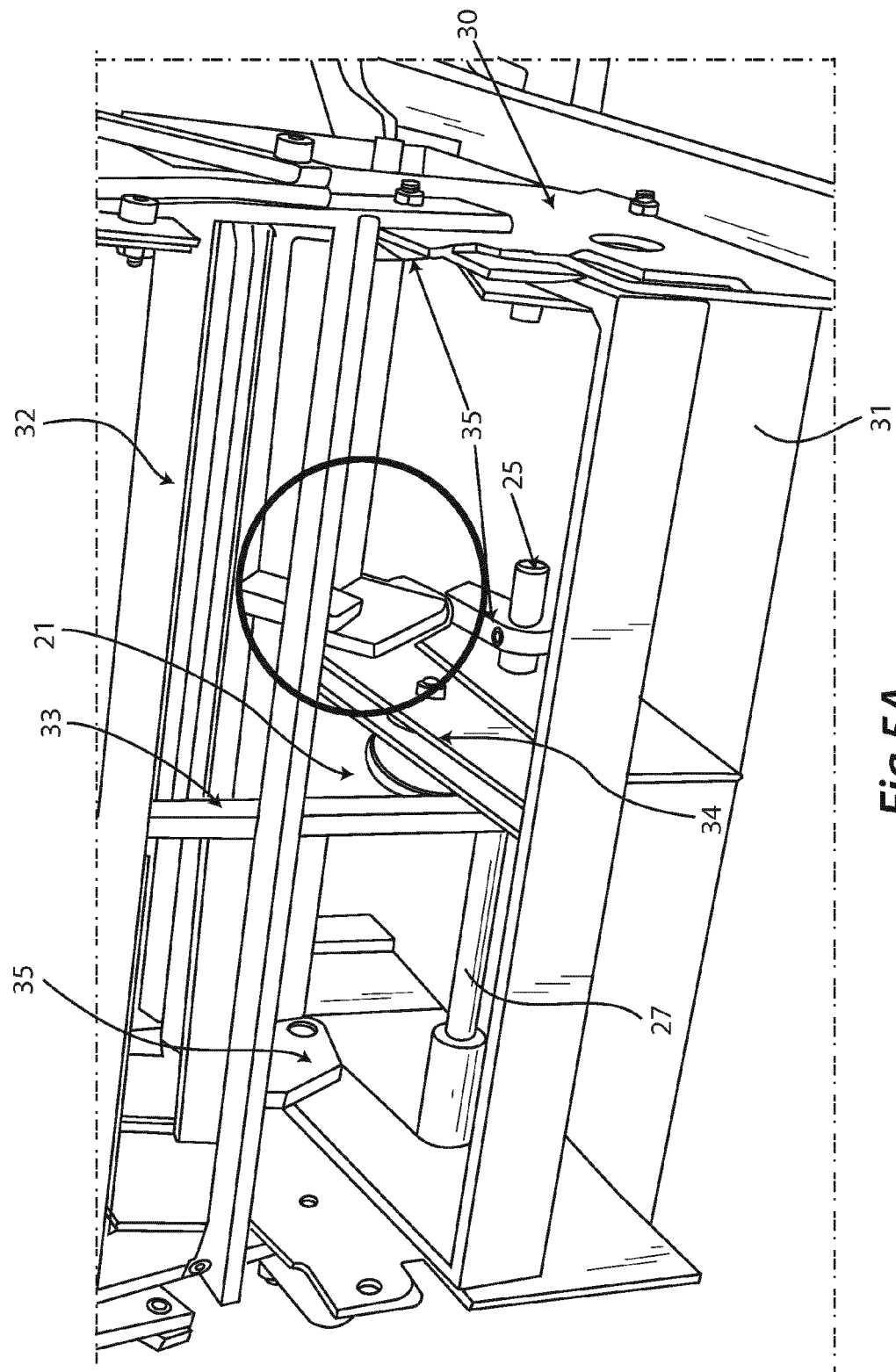
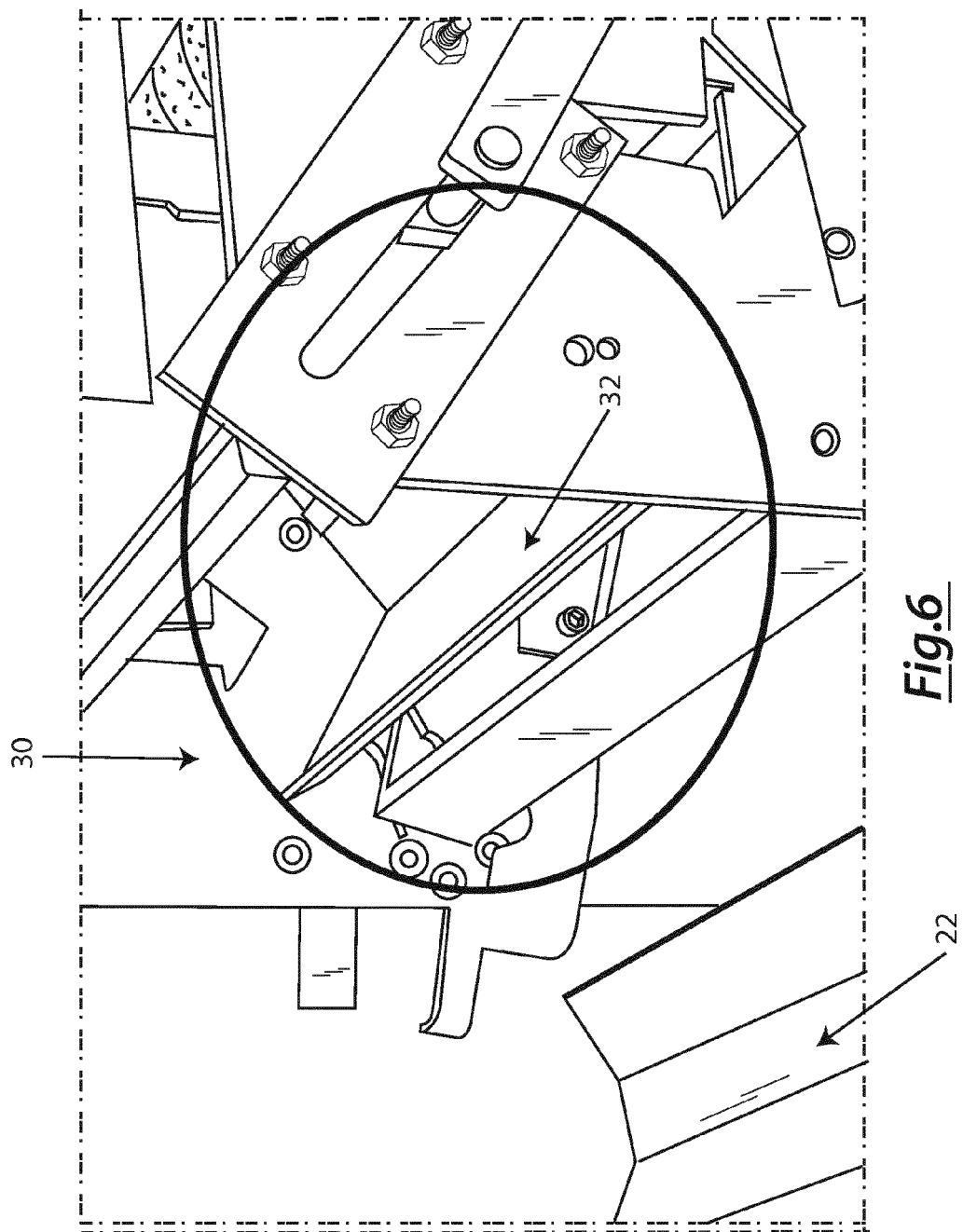


Fig. 5A



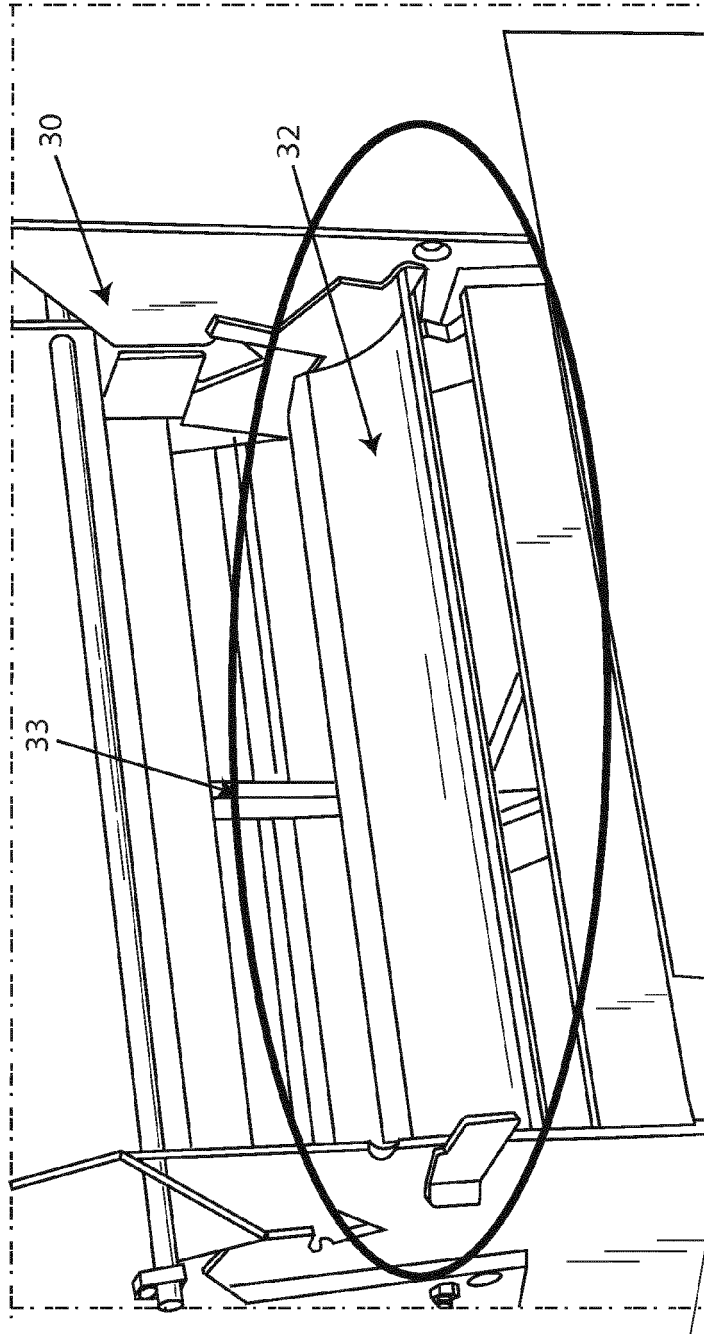


Fig.7

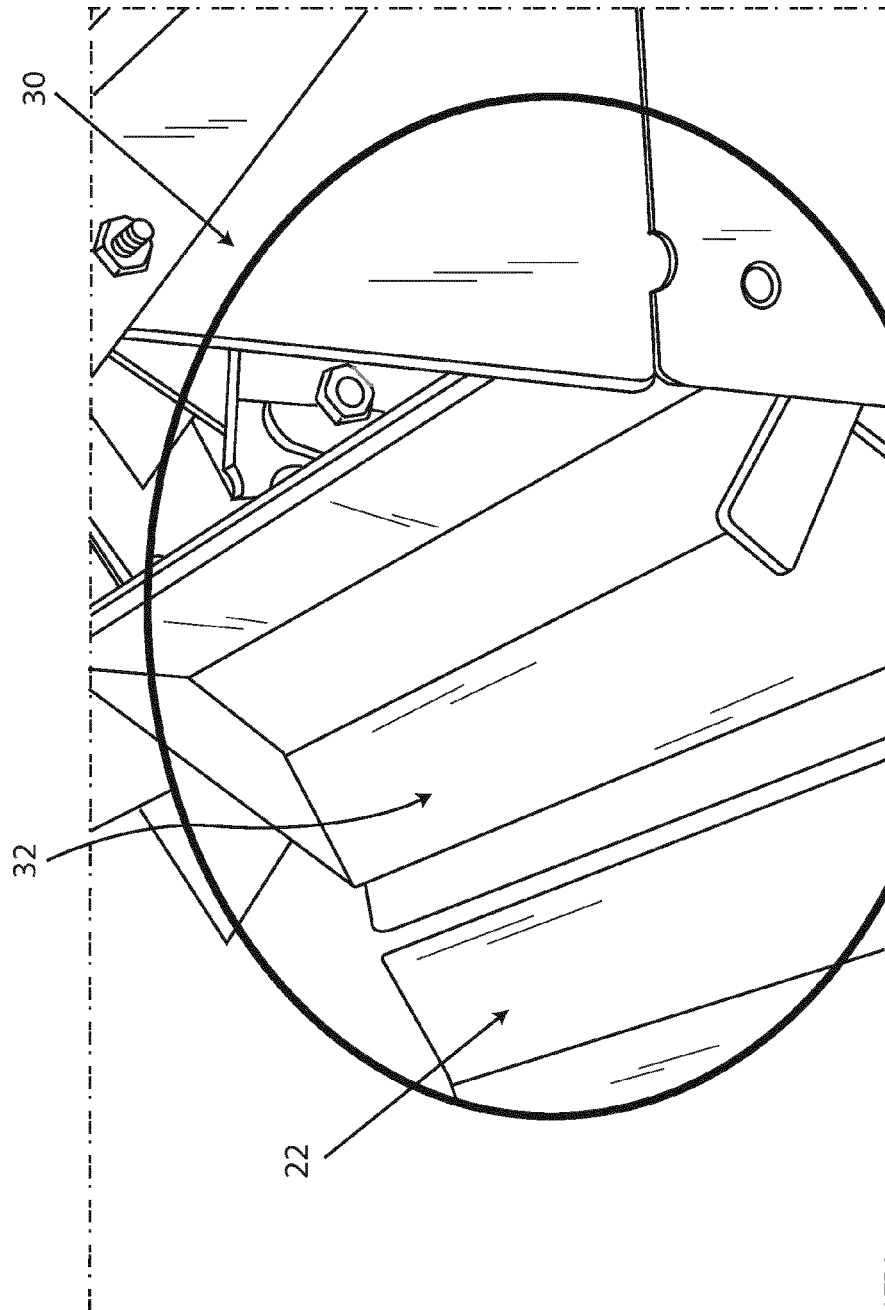
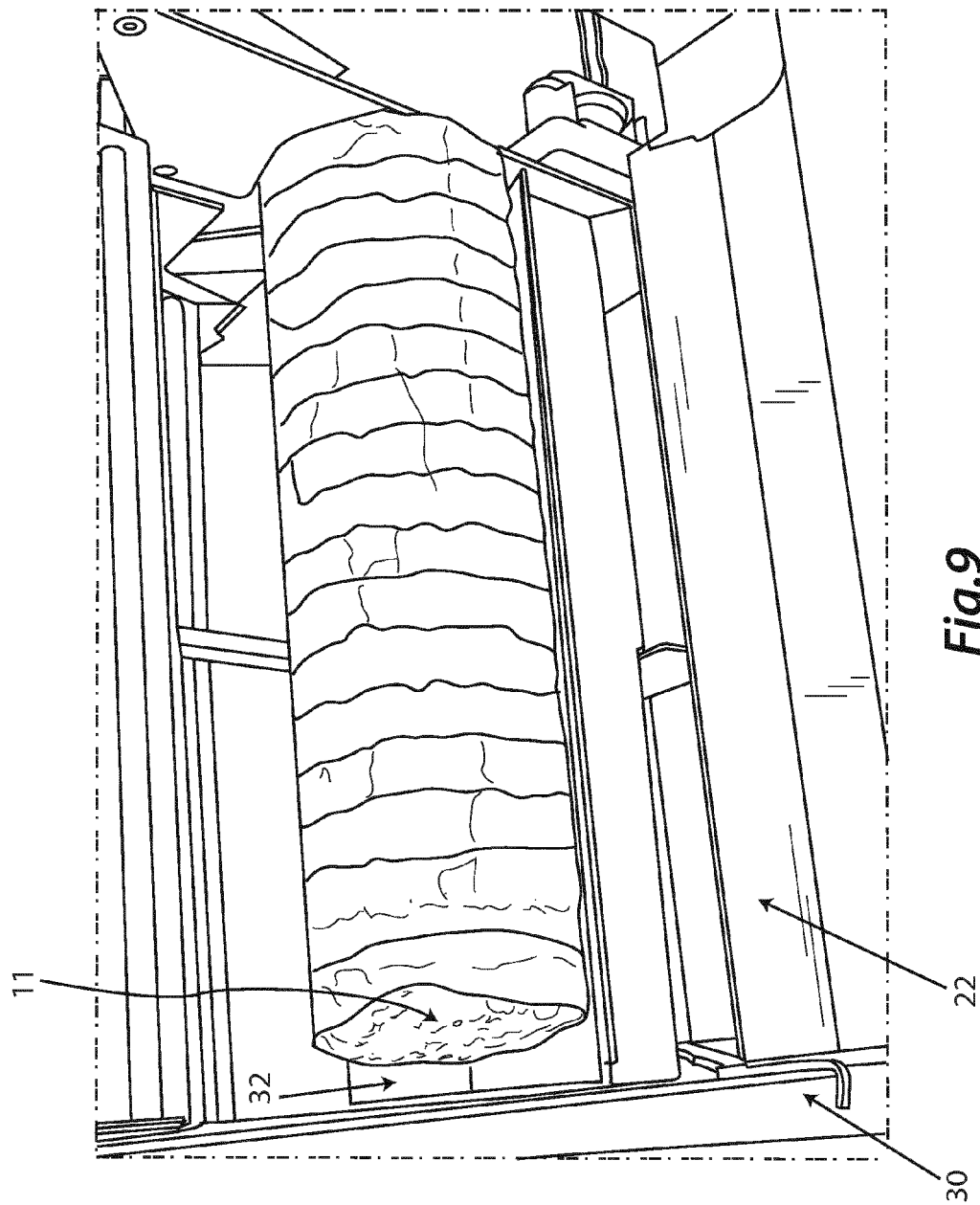


Fig.8



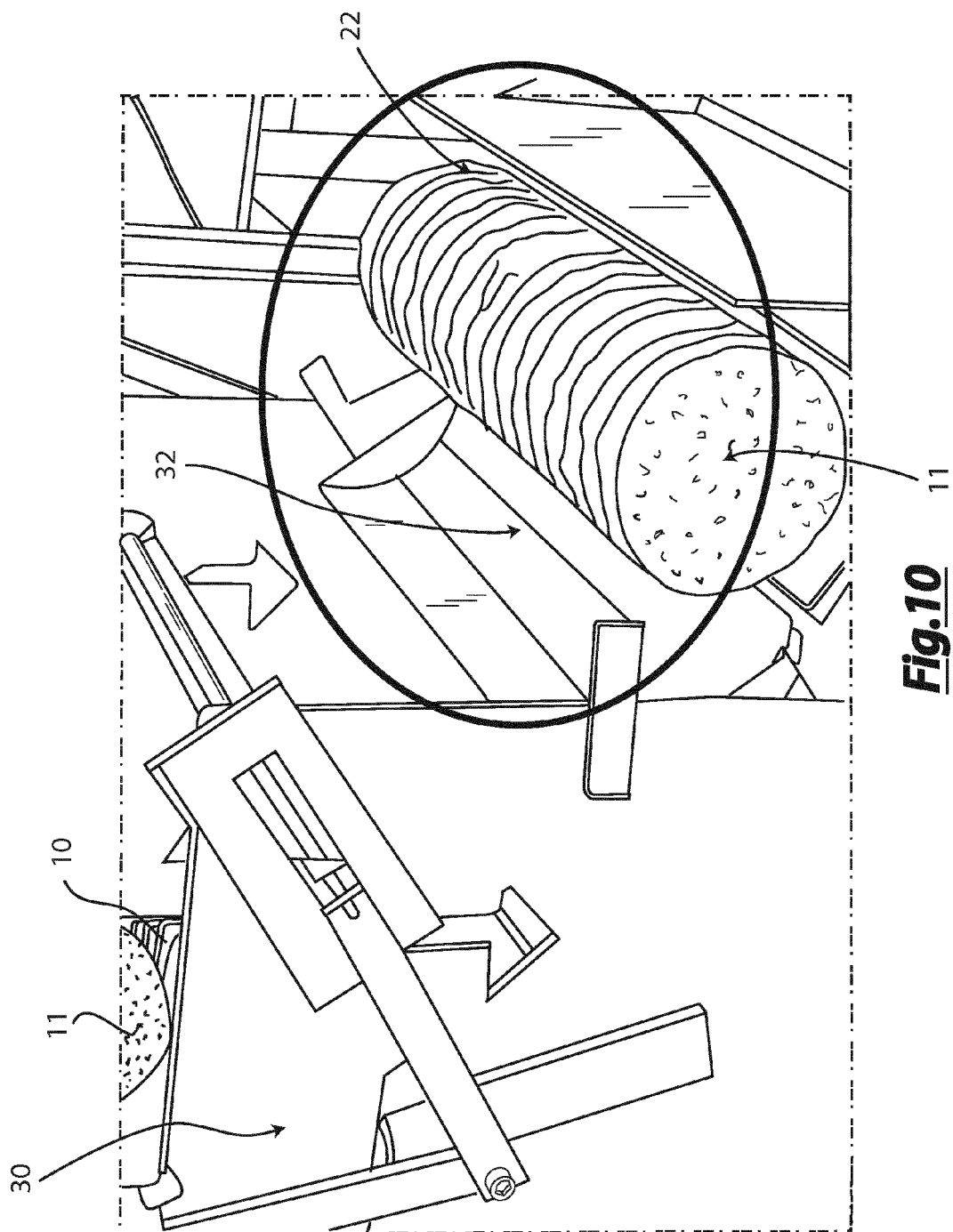


Fig.10

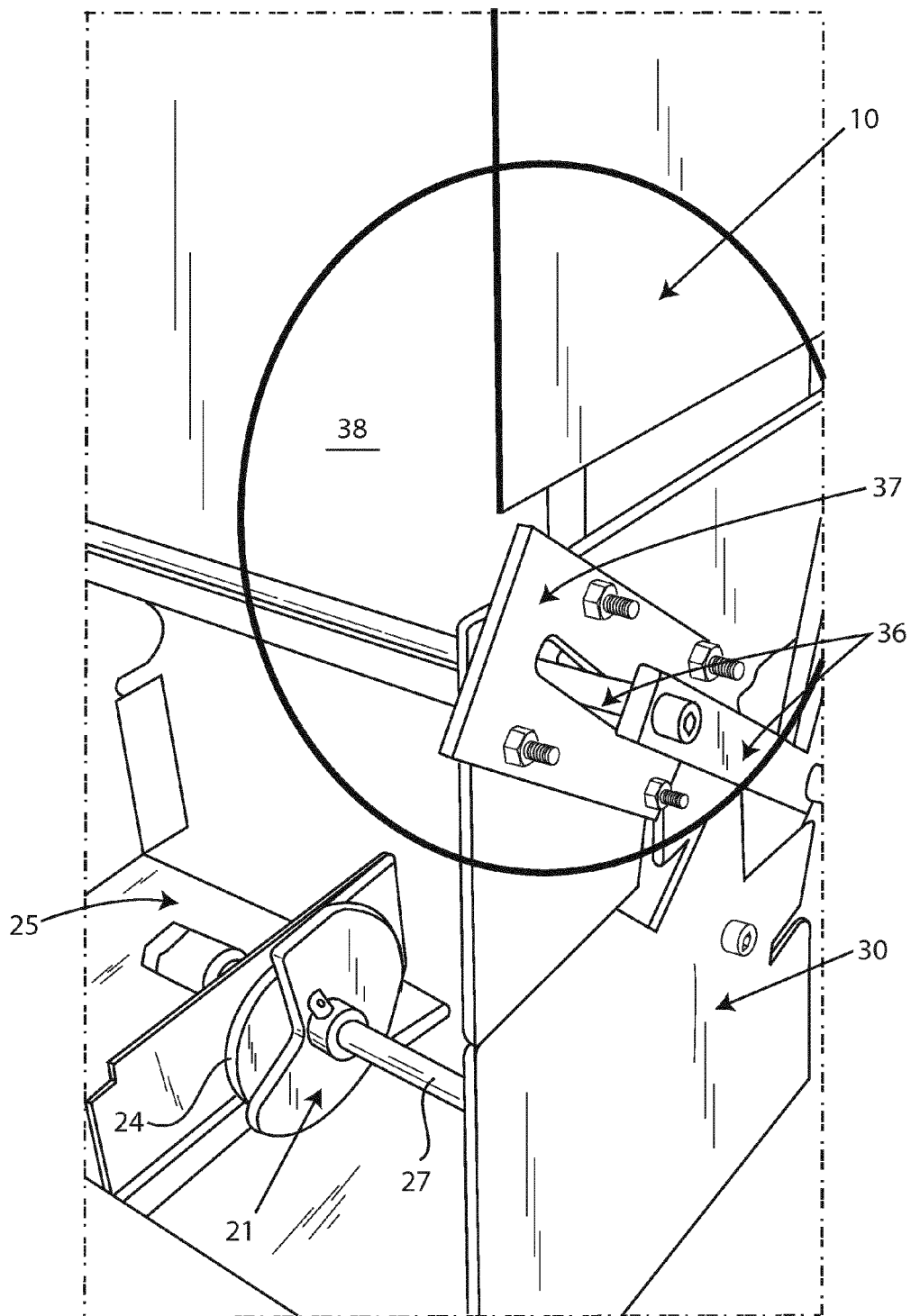


Fig.11



EUROPEAN SEARCH REPORT

Application Number
EP 12 42 5033

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Y	----- US 3 824 937 A (TURNER L ET AL) 23 July 1974 (1974-07-23) * column 4, line 46 - column 9, line 20; figure 1 *	8	TECHNICAL FIELDS SEARCHED (IPC) F24B F23B F23K
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Place of search The Hague		Date of completion of the search 28 June 2012	Examiner Makúch, Milan
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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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1865254 B1 [0013] [0016]