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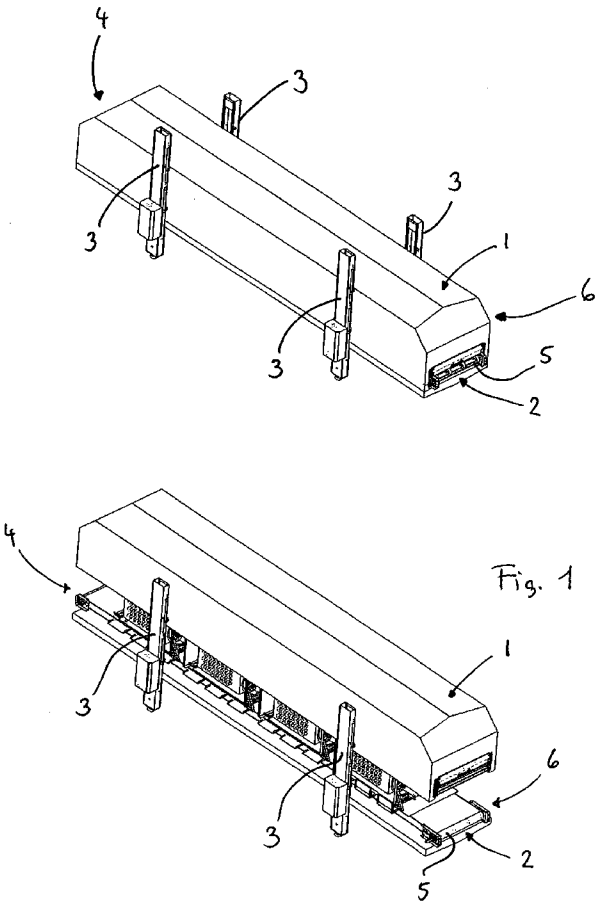

Fig. 1

(57) **Abstract:** Apparatus for thermal gas treatment of objects carried on an endless conveyor, in particular food items, where said apparatus comprises: - a housing separated in two or more sections, where a first section comprises means for moving said first section in relation to a second section; an endless conveyor belt arranged inside said housing and projecting outside said housing in a first and second end, where said endless conveyor has an upper run suitable to carry the objects and a lower return run; - two or more gas conditioning units arranged inside said housing, where the units are arranged one downstream of another along the conveyor, for directing a treated gas towards the endless conveyor; substantially gas tight partitions separating the gas conditioning units from each other, creating separate treatment zones, where said treatment zones are only connected adjacent the endless conveyor; where said housing substantially completely encloses said gas conditioning units, partitions treatment zones and the endless conveyor except for the first and second end sections.

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Apparatus for thermal gas treatment

Field of the Invention

The present invention discloses an apparatus for thermal gas treatment of objects carried on an endless conveyor where the objects may be in particular food items.

Background of the Invention

In the art a number of apparatus for thermal gas treatment of objects and in particular food items are known where historically the development of these apparatuses whether they were for heating i.e. baking, thawing or warming objects or for cooling/freezing of objects has followed the trend from providing efficiency such that the treatment of the objects was carried out in a faster, more economical way or that the apparatus as such had a smaller size whereby the surroundings in which the apparatus was to be placed could be utilized for other purposes or in order to improve productivity by adding more apparatus in the same space. Gradually, the trend in this development has been to maintain the development of efficiency, but at the same time improve the hygiene in connection with treating food stuffs. For these reasons a number of devices have been developed where more and more access has been provided to the interior of the apparatus in order to be able to clean and thereby maintain a relatively high hygienic standard.

From the art is known a device disclosed in US 3455120 wherein a relatively long freezer is disclosed where the interior of the freezer is separated into zones such that objects carried on a conveyor may be exposed to a treatment programme, i.e. different conditions in different compartments in order to achieve an improved process. The apparatus is enclosed in a housing, where access may only be gained to the housing by removing covers arranged on top of the freezer. Furthermore, the covers are integral with a gas distribution chamber and the fan installation. Removing the covers is a relatively heavy job, and furthermore the fan and the gas distribution chamber is not readily accessible. The gas distribution chamber and the fan is enclosed in a chamber construction and not designed to be accessible for cleaning.

The evaporator and source of gas for the treatment of the objects is arranged underneath and along the conveyor belt extending through more treatment zones such that adjustment of the temperature depends on how the evaporator is operated which will influence more treatment zones. Furthermore, it is possible to add vaporised, liquefied gas in the return gas channel such that it will be sucked into the gas distribution chamber by the fan. These arrangements are all creating a rather complicated apparatus where in particular cleaning issues have not been addressed, and even from a maintenance point of view the removal of the cover parts requires an effort which does not fall within the everyday cleaning and maintenance procedures.

A further example of a prior art apparatus for thermal gas treatment of objects is known from EP0859199 wherein an oven particularly an air impingement oven is disclosed. The housing of the oven comprises an upper part and a lower part which by means of telescopes may be separated such that the upper part may be elevated in relation to the lower part whereby access may be gained to the interior of the oven. In order to provide a gas tight connection between the upper and lower sections a liquid seal is provided between the two housing sections. Furthermore, separate fans and pressure chambers are arranged on either side, i.e. upper and lower side of the conveyor belt in order to provide the gas treatment necessary for the task at hand. The products are carried on a conveyor belt which conveyor belt is positioned between upper and lower baffle plates which creates the impingement, i.e. the jets of gas impinging on the products carried on the conveyor belt. The upper and lower fans which create the pressure necessary in order to create the impingement jets are arranged in a pressure chamber above respectively below the conveyor belt such that for cleaning purposes the personnel carrying out this task will not only have to elevate the upper housing section in relation to the lower housing section but will also have to remove in an non-specified manner parts of the upper and lower pressure chambers in order to gain access to the interior of the pressure chambers and thereby to the fans and impingement baffles. The arrangement of a fan system below the conveyor belt requires that the lower housing has upstanding walls in order to provide for the gas circulation and accommodate the lower installation, i.e. the fans and pressure chamber. These upstanding walls make it difficult to clean and inspect the lower fan installation in the lower pressure chamber.

Object of the Invention

Consequently it is an object of the present invention to improve the efficiency of prior art devices and at the same time increase the accessibility to all parts of the apparatus for cleaning and maintenance purposes such that both the versatility and efficiency of the apparatus as well as the hygienic standard of said apparatus is improved.

Description of the Invention

The present invention addresses this by providing an apparatus for thermal gas treatment of objects carried on an endless conveyor, in particular food items, where said apparatus comprises:

- a housing separated in two or more sections, where a first section comprises means for moving said first section in relation to a second section;
- an endless conveyor belt arranged inside said housing and projecting outside said housing in a first and second end, where said endless conveyor has an upper run suitable to carry the objects and a lower return run;
- two or more gas conditioning units arranged inside said housing, where the units are arranged one downstream of another along the conveyor, for directing a treated gas towards the endless conveyor;
- substantially gas tight partitions separating the gas conditioning units from each other, creating separate treatment zones, where said treatment zones are only connected adjacent the endless conveyor;

where said housing substantially completely encloses said gas conditioning units, partitions treatment zones and the endless conveyor except for the first and second end sections.

The apparatus as disclosed above provides numerous advantages both relating to efficiency but especially relating to easy access for thorough cleaning which again may improve the hygienic standard. The substantially gas tight partitions creating separate treatment zones having their own gas conditioning units makes it possible to carry out different treatments along the conveyor. As an example it may be advantageous to have a very high gas circulation speed together with a very low gas temperature in a first zone in order to create a crust on the objects to be treated for example in a freezing process whereas the thorough freezing of the object may more desirably be carried out

out in a less rapid manner such that adjacent downstream treatment zones may have less gas circulation at a less cold temperature. Other variations may be possible, for example for other types of products it may be desirable to provide a very careful freezing process such that the temperature through the separate treatment zones in the freezer will slowly decrease downstream, such that the objects will be exposed to harder and harder freezing which depending on the object to be frozen may provide for a better quality product, i.e. the integrity and texture of the product may be maintained.

The first and second sections of the housing may be moved in relation to each other such that for example the second section may be a foundation plate properly insulated and in most cases elevated from the surface on which the apparatus is placed whereas the first section may have a bell-shape such that it encloses the working parts of the apparatus as such and by engagement with the lower second section in a gas tight manner, creates a housing having substantially gas tight properties and equipped with the appropriate insulation necessary for the proper functioning of the apparatus. The housing will typically be made from sandwich panels where the outer skin of the sandwich panel is made from a stainless steel plate material and the interior insulating material may be selected freely, but in preferred embodiments a foam material such as for example polyurethane foam, is used.

The substantially gas tight partitions are preferably fastened to the second section, i.e. the bottom section, such that as the bell is elevated the partitions will remain on the second section and be freely accessible for cleaning and maintenance purposes. In order to provide the substantially gas tight connection between the partitions and the inside of the housing, the first section of the housing or at least the inner walls of the first section of the housing has a diminishing width upwards corresponding to an upwards taper of the partitions such that when the housing sections are in mutual engagement, the partitions will engage the inside walls of the first section of the housing, and as the housing is moved upwards, the taper will provide for easy release such that the partitions are not influenced by the movement of the housing sections in relation to each other.

It is clear that the continuous conveyor going through all the separate treatment zones will create a gas leak between adjacent treatment zones, Tests, however, have shown that very little exchange of treatment gas through the necessary aperture in the partitions between adjacent zones occurs, and as similar treatments, i.e. cooling or heating, are taking place on both sides of the partition, it is only when relatively large differences in pressure is created on either side of the partition that an exchange of treatment gas between two zones may occur.

As the first section of the housing is elevated relative to the second section, all the components of the apparatus which may be polluted or otherwise come into contact with residue from the objects being treated in the apparatus are accessible for easy cleaning and no dismantling movement or opening of doors and the like is necessary in order to access any of the features of the invention, as will be clear from the following description.

In a further advantageous embodiment of the invention the gas treatment of objects on the conveyor includes an impingement process, where the apparatus further in at least one treatment zone comprises:

- a heating or cooling element, providing passage of a gas thereby allowing heat exchange with said heating or cooling element;
- a fan, said fan having an intake and an outlet side;
- a gas pressure distribution system connected to the outlet side of the fan or the gas conditioning units, and further comprising an upper gas distribution chamber arranged above the endless conveyor, said chamber having an upper and lower plate member, where at least part of the lower plate member is provided with impingement nozzles or apertures, and that the upper plate member, during use is substantially in engagement with one of the sections of the housing.

In order to create the impingement effect it is necessary to create jets of the treatment gas, and this is typically done by elevating the pressure on one side of an impingement plate relative to the other side and provide impingement nozzles for example in the shape of holes in said impingement plate whereby jets of the treatment gas will be created. By directing the jets towards the objects to be treated the so-called impingement process is formed. The invention therefore provides a gas pressure distribution system

system connected to the outlet side of the fan in order to create the pressure necessary in order to create the gas jets and thereby the impingement process. As the evaporator and the fan for creating the necessary pressure is arranged inside each treatment zone, it is necessary to provide a gas distribution chamber in order to be able to distribute the gas evenly along the conveyor through that treatment zone. For this purpose a gas distribution chamber is arranged above and below the endless conveyor such that the impingement process may occur both from above and below. The gas which has already been impinged upon the objects and thereby been heated is sucked back into the treatment unit, i.e. the evaporator, by the pressure difference between the inlet and outlet sides of the fan.

In order for the gas distribution chamber to be substantially gas tight and thereby be able to maintain a gas pressure above the conveyor belt the upper and lower plate members are in substantially gas tight engagement with the housing during operation. Due to the tapered configuration of the housing as explained above the plates have been dimensioned to fit to this taper such that as the first section of the housing is lowered over the treatment equipment inside the housing the horizontal plates will engage the substantially vertical tapered inside walls of the housing thereby creating a substantially gas tight connection whereby it becomes possible to maintain a gas pressure above the treatment zone.

In a further advantageous embodiment of the invention one or more channels connects the upper gas distribution chamber with one or more lower gas distribution chambers, where each channel is partly integral with a section of the housing, and where the lower gas distribution channels are arranged under the upper run of the conveyor belt, and transverse the conveyor belts travelling direction, and where an upper plate member of said lower gas distribution chamber is provided with impingement nozzles or apertures.

In order to provide a gas circulation around the treatment zone it is necessary to provide channels such that the pressurized gas may be provided in the lower gas distribution chamber in order to provide for impingement from below onto the conveyor belt. At the same time, with the present construction it is not possible to interconnect the upper and

upper and lower gas distribution chambers in that it is necessary to provide space for the return gas, i.e. for the gas that needs to be circulated back to the fan and gas conditioning unit. For this purpose channels are provided where the channels comprise a connecting plate from the upper to the lower gas distribution chamber immediately adjacent the side edges of the conveyor belt and a closing part of the channel being integral with the inside of the first section of the housing, i.e. the part which is elevated relative to the second section. Due to the tapered configuration of the housing the channel part will be easy to remove from the corresponding channel plate connected to the upper and lower plate member whereby full accessibility will be provided to the upper and lower gas distribution chambers and to the channels connecting these during use of the apparatus. Between the channels, space is provided for circulating the return air back to the gas conditioning unit.

Although the apparatus for thermal gas treatment may both be used as already mentioned above for heating or cooling objects, in a further preferred embodiment the apparatus is a freezer and the gas conditioning unit includes an evaporator.

In a still further advantageous embodiment of the invention the gas treatment of objects on the conveyor includes a gas blasting process, where the apparatus further, in at least one treatment zone comprises:

- a heating or cooling element, providing passage of a gas thereby allowing heat exchange with said heating or cooling element;
- a fan, said fan having an intake and an outlet side;
- a gas pressure distribution system connected to the outlet side of the fan or the gas conditioning units, and further comprising an upper gas distribution chamber arranged above the endless conveyor, said chamber having an upper and lower plate member, where said plate member is provided with longitudinal relatively narrow apertures arranged transverse of the conveyor belts' travelling direction and that the upper plate member, during use is substantially in engagement with one of the sections of the housing.

Gas blasting is a different treatment from the impingement in that the gas directly from the conditioning unit is brought into contact with the objects on the conveyor, and due to the circulation of the gas a continuous gas flow is created on or around the objects

such that heat exchange may occur between the objects and the treatment gas. The gas pressure distribution system is provided in order to distribute the gas substantially evenly over the entire area of the conveyor belt in that particular treatment zone such that a homogenous and substantially unitary treatment of the products in that zone may be achieved. In order to facilitate the distribution of gas evenly and on both sides of the conveyor, plate members are provided above and below the conveyor belt where relatively narrow apertures are arranged in the plate member such that a gas flow will emit from these apertures but at the same time a certain flow resistance is created in order to distribute the gas to adjacent apertures whereby the substantially homogenous gas distribution in the treatment zone is achieved.

In a further advantageous embodiment the apertures are provided with gas direction means in the shape of guide plates, where said gas direction means provides for a gas flow against or along the travel direction or transverse to the travel direction of the endless conveyor belt. The gas direction means may direct the emitted gas in a determined direction, for example against the travel of the conveyor belt in one treatment zone and in an adjacent treatment zone in the same direction as the travel of the conveyor belt, whereby it is ensured that the objects on the conveyor belt is treated effectively by the treatment gas.

In a still further advantageous embodiment of the invention, the upper and lower horizontal plate members, are configured so that they may be removed by sliding the plates in and/or out, and be replaced by plates of the same or of a different type. This embodiment facilitates a relatively simple manner in which to alter the apparatus from carrying out for example an impingement freezing process to a blast freezing process, simply by replacing the impingement plates by plates suitable for the blast freezing process. The advantageous embodiment is facilitated by the fact that the housing may be moved upwards, thereby exposing the horizontal plates, along with all other equipment inside the freezer. This construction necessitates that the horizontal plates are carried on or by members spanning cross-wise relative to the transport direction. The plates may therefore, by simple means in the bearings be made to slide in the same direction, facilitating cleaning and replacement. This facility furthermore increases the versatility of the apparatus, as different sections may carry out different types of thermal

mal treatment, which, depending on the products being treated, may provide for a more effective and higher quality process. Also from a hygienic point of view, improved cleaning may be achieved.

The construction is also relatively simple, in that the first section will maintain the plates in their proper position during operation.

In a further advantageous embodiment the housing is separated horizontally, such that the endless conveyor belt, the two or more gas conditioning units, and the substantially gas tight partitions separating the gas conditioning units from each other, creating separate treatment zones are provided on a lower section of said housing, and where an upper section by means of telescoping lifting means may be elevated or lowered from or onto respectively said lower section, whereby in the lowered position the lower and upper sections enclose the apparatus apart from the first and second ends of the conveyor belt, and in the elevated position of the upper section, the endless conveyor belt, the two or more gas conditioning units, the gas distribution chambers and channels and the substantially gas tight partitions separating the gas conditioning units from each other, creating separate treatment zones are accessible for inspection, repair, service and cleaning.

The advantages of such an arrangement has already been mentioned and discussed above in that it is clear that as the bell-shaped first housing unit in its elevated position provides free access to all the components of the interior of the apparatus for cleaning and maintenance provides substantial advantages in comparison to the prior art.

In a further advantageous embodiment the housing sections comprise means for creating a substantially gas tight assembly where the sections are in mutual contact. This assembly may for example include projecting members or a ridge provided on the lower first section with mutual engagement means or corresponding valley means in the upper section, such that in addition to providing a gas tight connection it also provides for a mechanically stable connection which will be able to withstand the increased pressure which will be present inside the housing and exerting its pressure on the inside walls of the housing in order to create the treatments discussed above.

Advantageously the connection between the upper and lower section may in cases where the apparatus is designed for freezing include heating means such that it is possible to thaw the gas tight assembly in order to release the two sections from each other. This is particularly true for freezing in that the gas tight assembly although the housing may be insulated may create a thermal bridge and thereby moisture may condensate and freeze in particular around the connection between the upper and lower sections of the housing.

In a still further advantageous embodiment of the invention where the apparatus is used for freezing the evaporator is arranged for horizontal gas flow through said evaporator, and the pressure distribution system includes a pressure distribution section downstream of the evaporator connected to the upper and lower gas distribution chambers, and the gas after having passed the objects on the conveyor is directed to the intake side of the fan, partly along the conveyor and mainly below the lower gas distribution chambers.

This embodiment provides advantages relating to the overall size of the apparatus in that the very compact construction of the fan being in direct connection with the evaporator and having the gas distribution chambers immediately connecting to the evaporator is a space saving construction. At the same time plenty of space is provided for the return gas being able to circulate back to the fan and thereby being pressurized through the evaporator which provides for a high efficiency of the freezer.

In a further advantageous embodiment the evaporator is arranged for a vertical gasflow through said evaporator, and that the pressure distribution system includes a pressure distribution section above and upstream of the evaporator, and that the upper gas distribution chamber is arranged between the evaporator and the conveyor and that lower gas distribution chambers are connected by means of channels arranged in the housing section to said upper gas distribution chamber, and that the gas after having passed the objects on the conveyor is directed to the intake side of the fan, partly along the conveyor and mainly below the lower gas distribution chambers, and along one closed side of the evaporator.

In this embodiment the motor of the fan is arranged outside the housing having an axle going through the upper section of the housing connecting to the vane/blade construction of the fan. As the upper section of the housing is elevated the fan motor and the vane/blade construction of the fan is elevated with the upper section, whereas an inlet funnel for directing the return air into the fan is maintained on the lower section of the housing. In this manner it is provided that also the interior parts of the fan may be thoroughly cleaned and at the same time the motor for driving the fan is maintained at an ambient temperature which lessens the power consumption and provides for a less aggressive environment than had the motor been inside the housing where the pressurized cool gas would have been constantly impacting on the motor. In this embodiment a pressure chamber is provided above the evaporator and a further pressure chamber in the shape of the gas distribution chamber provided below the evaporator.

Due to the partitions between each treatment zone it is possible to build up the evaporator fan and gas distribution chambers as units such that if one unit breaks down, for example due to leakage in the evaporator or failure in the fans the whole unit may be replaced by a new standby unit such that production down time may be kept at a minimum. The evaporators and fans are self-contained units which are not necessarily reliable on the rest of the construction and as such may easily be replaced by a further separate unit. In the same manner it is possible to have units where the gas is directed towards the objects on the conveyor belt in the shape of impingement jets and other units where gas blasting or other gas treatment is carried out and in an easy way substitute one element by another such that impingement units may easily be replaced by blasting units or vice versa.

Description of the Drawing

The invention will now be described with reference to the accompanying drawing wherein

Figure 1: illustrates a first embodiment in production mode;

Figure 2: illustrates the apparatus in a cleaning mode;

Figure 3: illustrates the invention in a transparent view allowing a view to the different parts of the apparatus;

Figure 4: illustrates a cross section of the first embodiment;

Figure 5: illustrates a second embodiment in a cleaning mode;

Figure 6: illustrates the invention in a transparent view allowing a view to the different parts of the apparatus;

Figure 6a: illustrates a cross section of the second embodiment;

Figure 7: illustrates details of the gas flow inside the apparatus:

Figures 8a, 8b, 9a,9b, 10a, 10b: illustrates details of the connection between the housing and the gas pressure distribution channels.

Detailed description of preferred embodiments

In figure 1 is illustrated an overview of what a first embodiment of the freezer will look like in its operating mode. A second embodiment will be explained below with reference to figure 5.

In the first embodiment as depicted in figures 1-4 the apparatus includes a housing in two sections, a first upper section 1 and a second lower section 2. Means in the shape of telescopes 3 are provided in order to be able to elevate the first section 1 in relation to the second section 2 as illustrated with reference to figure 2.

The first section 1 has a bell-shape such that the second section 2 may be described as a platform where the first section 1 fits over the equipment necessary in order to treat the products placed on a conveyor which conveyor runs from a first end 4 of the apparatus to a second end 6. In the illustration the conveyor belt's structure 5 is visible whereas the conveyor belt itself has been removed. The two sections 1, 2 of the housing in this manner substantially fully encloses the apparatus and only allows the conveyor belt to project outside the housing in the first and second ends 4, 6 as illustrated by the conveyor structure 5 in figure 1.

Turning to figure 2 the telescopic means 3 has been activated in order to elevate the first section of the housing 1 in relation to the second section 2. For the sake of clarity only two telescopic means 3 are illustrated. When the first section 1 is elevated relative to the second section 2, i.e. the freezer is open, access may easily be gained to all the installations arranged inside the housing. As may be seen in the illustrated embodiment

bodiment four evaporators 7 are arranged along the conveyor belt 5 in a manner such that four treatment zones will be created inside the housing. Each treatment zone is separated from an adjacent treatment zone by a partition wall 8.

In the illustrated embodiment the apparatus is equipped to carry out an impingement freezing process such that a pressure distribution chamber 10 is illustrated below each evaporator 7 as will be further explained in detail blow. In order to create an impingement process impinging upon products carried on the conveyor 5 from below, pressure distribution channels 11 are arranged beneath the conveyor belt 5, but in connection with the pressure distribution chamber 10 as will also be explained below. In this example three impingement channels 11 are arranged underneath each evaporator 7 but any number of impingement channels may be provided.

Turning to figure 3 the first section 1 of the housing has been illustrated as transparent in order to illustrate the machinery inside the apparatus. Adjacent each evaporator 7 is arranged two fans 12, 13. For clarity reasons the partition walls 8 as discussed with reference to figure 2 are not illustrated except for the partition walls adjacent the first and second end 4, 6 of the apparatus such that it should be evident that partition walls are provided in order to create four distinct treatment zones inside the apparatus.

In figure 4 is illustrated a cross section through the apparatus according to the first embodiment where like reference numbers denote like features.

As is evident from this figure a gas treatment zone illustrated with a bracket 20, i.e. the space inside the housing between two partitions 8 is a more or less self-standing unit which in fact may be manufactured as an independent unit such that for repair reasons or thorough cleaning the unit may be replaced by a comparable unit while the unit in question is being attended to regarding repair work or cleaning.

In figures 5, 6 and 6a is illustrated a second embodiment of the invention where the orientation of the evaporator has been turned 90° in relation to the first embodiment. In the first embodiment of the invention as illustrated with reference to figures 1-4 as discussed above, the fans will create a horizontal airflow, i.e. parallel to the conveyor belt

belt through the evaporators 7. This embodiment requires a particular arrangement of the gas distribution means as will be elaborated below. In the embodiment illustrated with reference to figures 5, 6 and 6a the evaporators are arranged for gas flow in a vertical direction, i.e. perpendicular to the travelling direction of the conveyor belt. Apart from this, the underlying construction is corresponding to the construction discussed above such that the housing consists of two sections, an upper first section 1, a second lower section 2, means in the shape of telescopes 3 to elevate and lower the first section 1 in relation to the second section 2 whereby access may be gained to the interior of the freezer.

As distinct from the first embodiment the motors 21 powering the fans are arranged outside the housing 1, but via an axle connected to the vanes/blades 22 (see figure 6) such that the gas inside the housing during operation may be pressurized and forced through the evaporator an onto products/objects placed on the conveyor belt 5.

In figure 6 is like in figure 3 illustrated an embodiment, where the first section of the housing 1 is drawn as transparent in order to illustrate the interior arrangement inside the freezer.

As may be seen the fan motors 21 are connected through the housing 1 to the vanes/blades of the fan. Also clearly visible are the partitions separating each evaporator from the adjacent evaporator thereby creating treatment zones which zones may have different characteristics relating to temperature, air speed, etc. in comparison to other treatment zones in the apparatus.

A further feature which is indicated are the integrated gas chamber channel's end pieces 30 which will be discussed below with reference to figures 8-10. What is evident from the figure, however, is the fact that the ends of the pressurized chambers and channels 10, 11 as well as the spaces for returning the gas to be pressurized through the evaporator are freely accessible for inspection and cleaning once the first upper section 1 of the housing has been elevated as illustrated in figures 5 and 6. In figure 6a is illustrated a cross section comparable to the cross section illustrated in figure 4 where it may clearly be seen that the motors 21 are arranged outside the housing section 1 but connected by

tion 1 but connected by an axle to the blades/vanes 22 inside the housing.

A plate member 23 is arranged between the evaporator and the adjacent partitions 8 where an inlet opening for the fan is provided in said plate 23, such that it is possible for the fan to retrieve gas which has been used for treatment of objects on the conveyor through the fan and into an upper pressure chamber 24 delimited by said plate member 23 the partitions 8 and the inside wall of the housing 1. The plate member 23 furthermore has an aperture allowing the gas, pressurized in the chamber 24 to pass substantially vertically through the evaporator 7 into a pressure distribution chamber 10 arranged underneath the evaporator. From here on the gas is distributed as already explained above.

With reference to figure 7 the comparable pressurized space 24 as defined with reference to figure 6a above is arranged in the space between the fans 12, 13 and the evaporator and on the other side of the evaporator, i.e. downstream from the evaporator, between the end of the evaporator 7 and the partition 8 which for illustrative purposes is illustrated as being transparent. Furthermore, pressurized gas will be present in the gas distribution chamber 10 arranged below the evaporator 7.

As may be seen in figure 7, the pressure distribution chamber is limited by a lower plate member 30, a part of which extends past the evaporator 7 which in this embodiment is supplied with a waffle structure and impingement nozzles. The upper horizontal limitation of the pressure distribution chamber 10 is created by a further horizontal plate member 31. Furthermore, vertical connection channels 32 are provided for guiding the pressurized gas into the gas distribution channels 11 arranged underneath the conveyor belt 5. The return gas, i.e. the gas that has been forced on the objects on the conveyor belt 5 may return underneath the conveyor belt and the lower pressure distribution channels 11 and return to the inlet side of the fans 12, 13 in the space 33.

The construction of the substantially vertical pressure distribution channels 32 will be explained with reference to figures 8-10. In the figures three different embodiments of the configuration of these channels are illustrated whereas figure 8a, figure 9a and figure 10a illustrate the position when the two housing sections are engaging, i.e. when the

when the installation is ready for production, whereas the figures 8b, 9b and 10b illustrate the situation when the first housing section 1 has been elevated in relation to the second housing section 2 thereby allowing access to the pressure distribution channels 10, 11, 32 for cleaning purposes.

Turning to figure 8a an object 50 may be seen being transported on the conveyor belt 5. Enclosing the conveyor belt is a treatment zone 20.

The selected cross sections illustrated in figures 8, 9 and 10 illustrate the situation where the substantially vertical pressure distribution channels 32 are present. In between these channels 32 the upper plate 31, see also figure 7, extends as illustrated, whereas the lower plate 30 like the upper plate 31 extends all the way through to the inside wall of the housing section 1 indicated by 35. As should be evident from the figures 8a, 9a and 10a is the fact that the vertical channels 32 connect the pressure distribution chamber 10 above the conveyor belt 5 with the lower pressure distribution chamber 11. The plate 30 as well as the upper plate 36 in the lower pressure distribution chamber 11 may be provided with impingement nozzles (not illustrated) in order to impinge the gas onto the objects 50 carried on the conveyor belt 5. The difference in the embodiments illustrated with reference to figures 8, 9 and 10 is the way that the first housing section 1 connects with the treatment zone 20.

In the first embodiment illustrated with reference to figures 8a and 8b the inside wall 35 of the first housing section 1 is illustrated by the hatched cross section is substantially straight. For the purpose of illustration the taper of the housing section 1 as illustrated and explained above is greatly exaggerated, in fact the angle between the first wall section or at least the inner wall 35 of the first wall section 1 and vertical, will be in the range 0-5°.

In the open position, i.e. in the b-figures of figures 8, 9 and 10, the pressure distribution chambers will be fully accessible in that the first wall section 1 has been completely removed. The plate 31 and lower plate 36 of the lower pressure chamber 11 extends further than the inner limitation 37 of the substantially vertical pressure connection channel 32.

Common for all the illustrated embodiments is the fact that the inner wall 35 of the housing section 1 in the longitudinal direction, i.e. perpendicular to the plane of the drawings, will have flanges, acting as skods limiting the extent in the longitudinal direction, i.e. parallel to the travelling direction of the conveyor, of the channel 32 which flanges will connect to the plate 31 and 36 and the inner limitation 37 in order to create the channel 32.

Turning to figure 9a and 9b, the inner wall 35 of the first housing section has been provided with two substantially horizontal flanges 40, 41 which have an extent corresponding to the width of the channel 32 in the longitudinal direction whereby the upper and lower plates 31, 36 will have an extent corresponding to the enclosure of the treatment zone.

This embodiment is furthermore in figure 10 provided with a closure member for the treatment zone which closure member 42 is attached to the flanges as described above limiting the channel 32 and extends in the longitudinal direction such that when elevating the first housing section 1 as illustrated with reference to figure 10b also the treatment zone in the area of the vertical pressure distribution channels 32 is freely available for cleaning or inspection.

In embodiments illustrated with reference to figures 8 and 9 the longitudinal extent of the vertical pressure distribution channels 32 is such that it is possible to clean the conveyor belt and the treatment zone around the conveyor belt even behind the closure member 37. It is, however, clear that making the entire cross section available as described with reference to figure 10, a more convenient and thereby possibly also more thorough cleaning may be possible.

Having described one particular embodiment of the invention it should, however, be evident to the skilled person that more possible designs are available and that the invention should be limited solely by the scope of the appended claims.

CLAIMS

1. Apparatus for thermal gas treatment of objects carried on an endless conveyor, in particular food items, where said apparatus comprises:

- a housing separated in two or more sections, where a first section comprises means for moving said first section in relation to a second section;
- an endless conveyor belt arranged inside said housing and projecting outside said housing in a first and second end, where said endless conveyor has an upper run suitable to carry the objects and a lower return run;
- two or more gas conditioning units arranged inside said housing, where the units are arranged one downstream of another along the conveyor, for directing a treated gas towards the endless conveyor;
- substantially gas tight partitions separating the gas conditioning units from each other, creating separate treatment zones, where said treatment zones are only connected adjacent the endless conveyor;

where said housing substantially completely encloses said gas conditioning units, partitions treatment zones and the endless conveyor except for the first and second end sections.

2. Apparatus according to claim 1, wherein the gas treatment of objects on the conveyor includes an impingement process, where the apparatus further, in at least one treatment zone comprises:

- a heating or cooling element, providing passage of a gas thereby allowing heat exchange with said heating or cooling element;
- a fan, said fan having an intake and an outlet side;
- a gas pressure distribution system connected to the outlet side of the fan or the gas conditioning units, and further comprising an upper gas distribution chamber arranged above the endless conveyor, said chamber having an upper and lower plate member, where at least part of the lower plate member is provided with impingement nozzles or apertures, and that the upper plate member, during use is substantially in engagement with one of the sections of the housing.

3. Apparatus according to claim 2, wherein one or more channels connects the upper gas distribution chamber with one or more lower gas distribution chambers, where each channel is partly integral with a section of the housing, and where the lower gas distribution channels are arranged under the upper run of the conveyor belt, and transverse the conveyor belts travelling direction, and where an upper plate member of said lower gas distribution chamber is provided with impingement nozzles or apertures.

4. Apparatus according to claim 1, 2 or 3, where the apparatus is a freezer and the gas conditioning units includes an evaporator.

5. Apparatus according to claim 1, wherein the gas treatment of objects on the conveyor includes a gas blasting process, where the apparatus further, in at least one treatment zone comprises:

- a heating or cooling element, providing passage of a gas thereby allowing heat exchange with said heating or cooling element;
- a fan, said fan having an intake and an outlet side;
- a gas pressure distribution system connected to the outlet side of the fan or the gas conditioning units, and further comprising an upper gas distribution chamber arranged above the endless conveyor, said chamber having an upper and lower plate member, where said plate member is provided with longitudinal relatively narrow apertures arranged transverse of the conveyor belts' travelling direction and that the upper plate member, during use is substantially in engagement with one of the sections of the housing.

6. Apparatus according to claim 5 wherein the apertures are provided with gas direction means in the shape of guide plates, where said gas direction means provides for a gas flow against or along the travel direction of the endless conveyor belt.

7. Apparatus according to any of claims 2 to 5 wherein the upper and lower horizontal plate members, are configured so that they may be removed by sliding the plates in and/or out, and be replaced by plates of the same or of a different type.

8. Apparatus according to claim 1 wherein the housing is separated horizontally, such that the endless conveyor belt, the two or more gas conditioning units, and the substantially gas tight partitions separating the gas conditioning units from each other, creating separate treatment zones are provided on a lower section of said housing, and where an upper section by means of telescoping lifting means may be elevated or lowered from or onto respectively said lower section, whereby in the lowered position the lower and upper sections enclose the apparatus apart from the first and second ends of the conveyor belt, and in the elevated position of the upper section, the endless conveyor belt, the two or more gas conditioning units, and the substantially gas tight partitions separating the gas conditioning units from each other, creating separate treatment zones are accessible for inspection, repair, service and cleaning.

9. Apparatus according to claim 1 or 7 characterised in that the housing sections comprises means for creating a substantially gas tight assembly, where the sections are in mutual contact.

10. Apparatus according to claim 4 wherein the evaporator is arranged for horizontal gas flow through said evaporator, and that the pressure distribution system includes a pressure distribution section downstream of the evaporator connected to the upper and lower gas distribution chambers, and that the gas after having passed the objects on the conveyor is directed to the intake side of the fan, partly along the conveyor and mainly below the lower gas distribution chambers.

11. Apparatus according to claim 4 wherein the evaporator is arranged for vertical gas flow through said evaporator, and that the pressure distribution system includes a pressure distribution section above and upstream of the evaporator, and that the upper gas distribution chamber is arranged between the evaporator and the conveyor and that lower gas distribution chambers are connected by means of channels arranged in the housing section to said upper gas distribution chamber, and that the gas after having passed the objects on the conveyor is directed to the intake side of the fan, partly along the conveyor and mainly below the lower gas distribution chambers, and along one closed side of the evaporator.

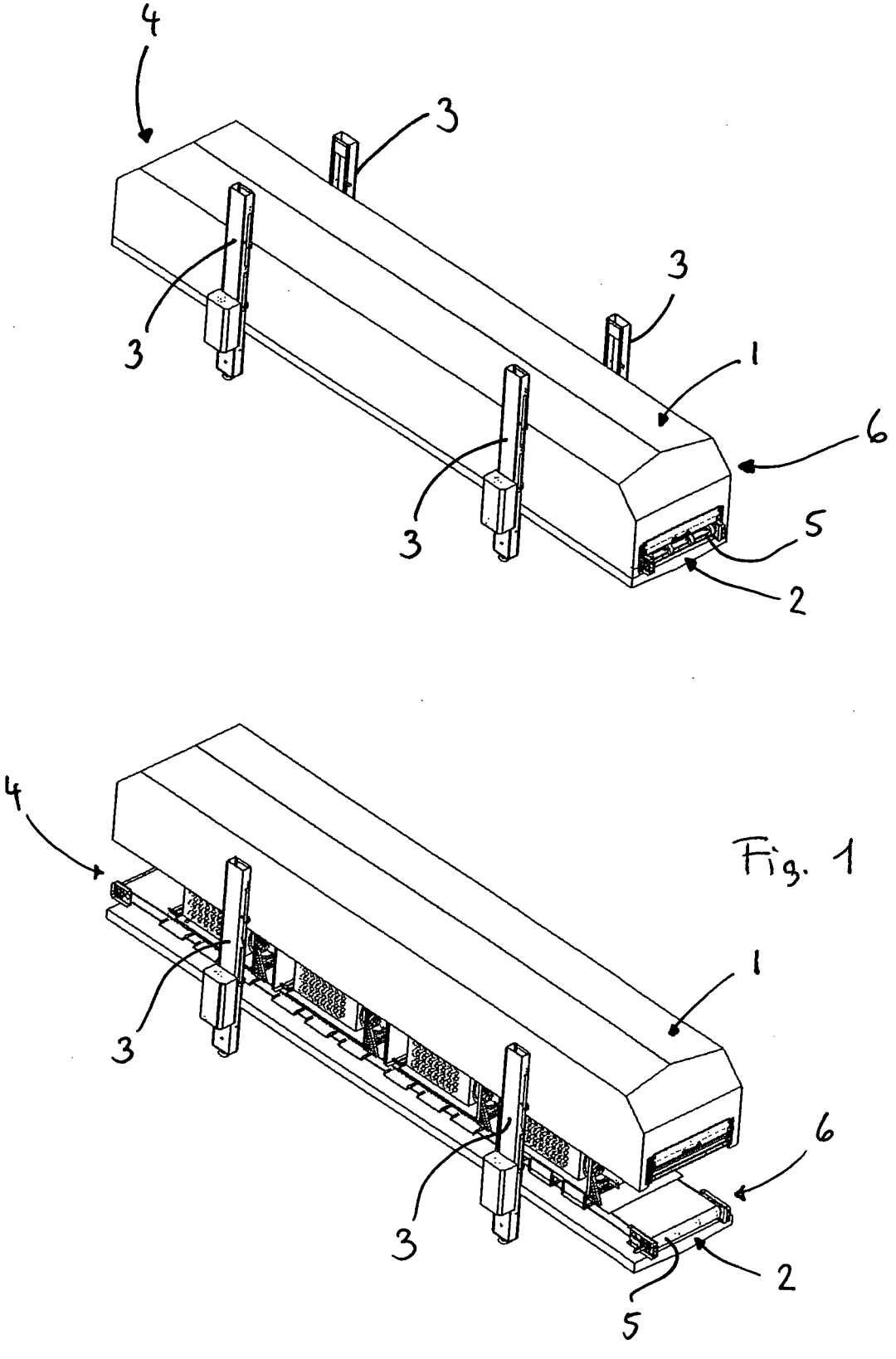


Fig. 1

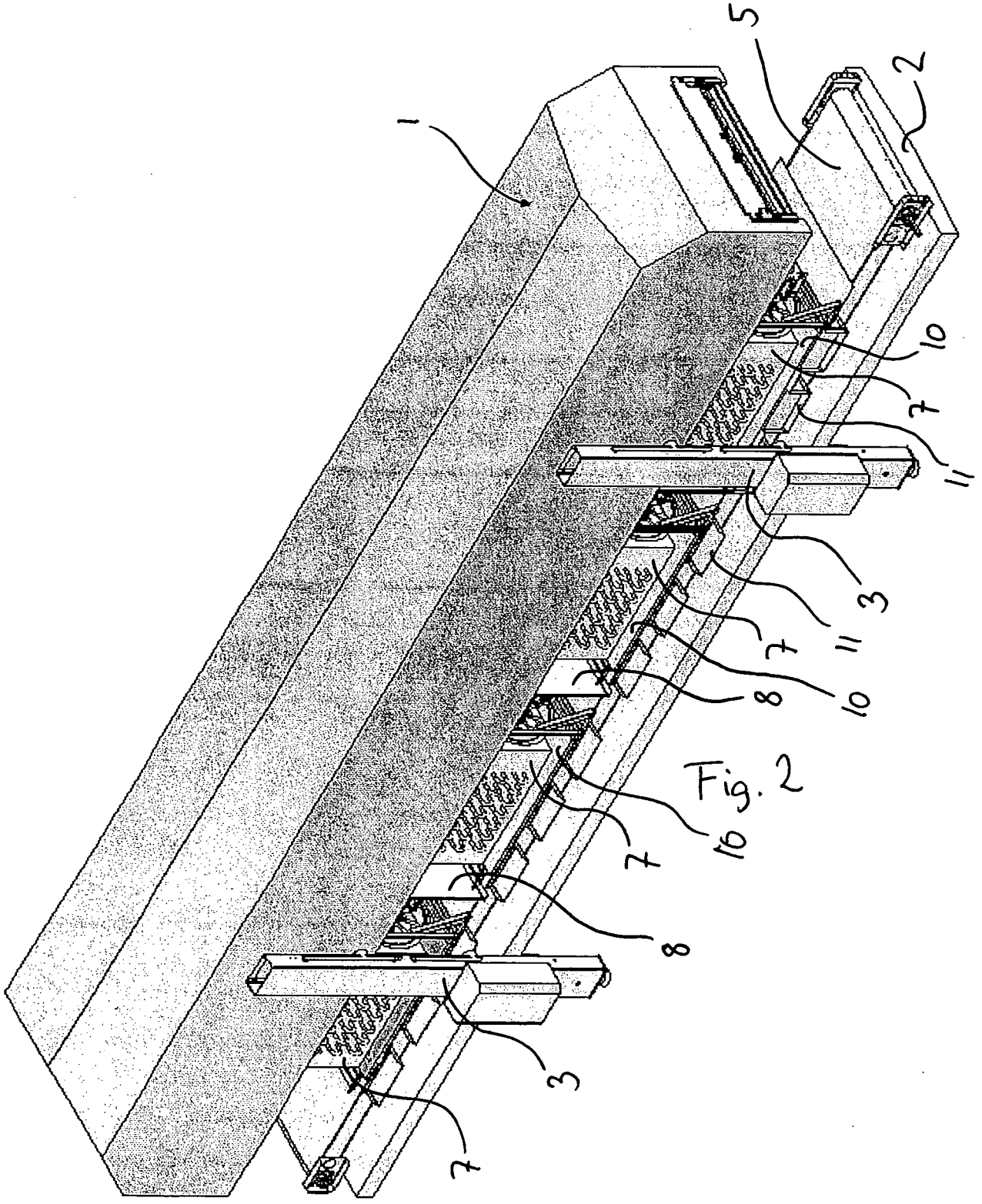


Fig. 2

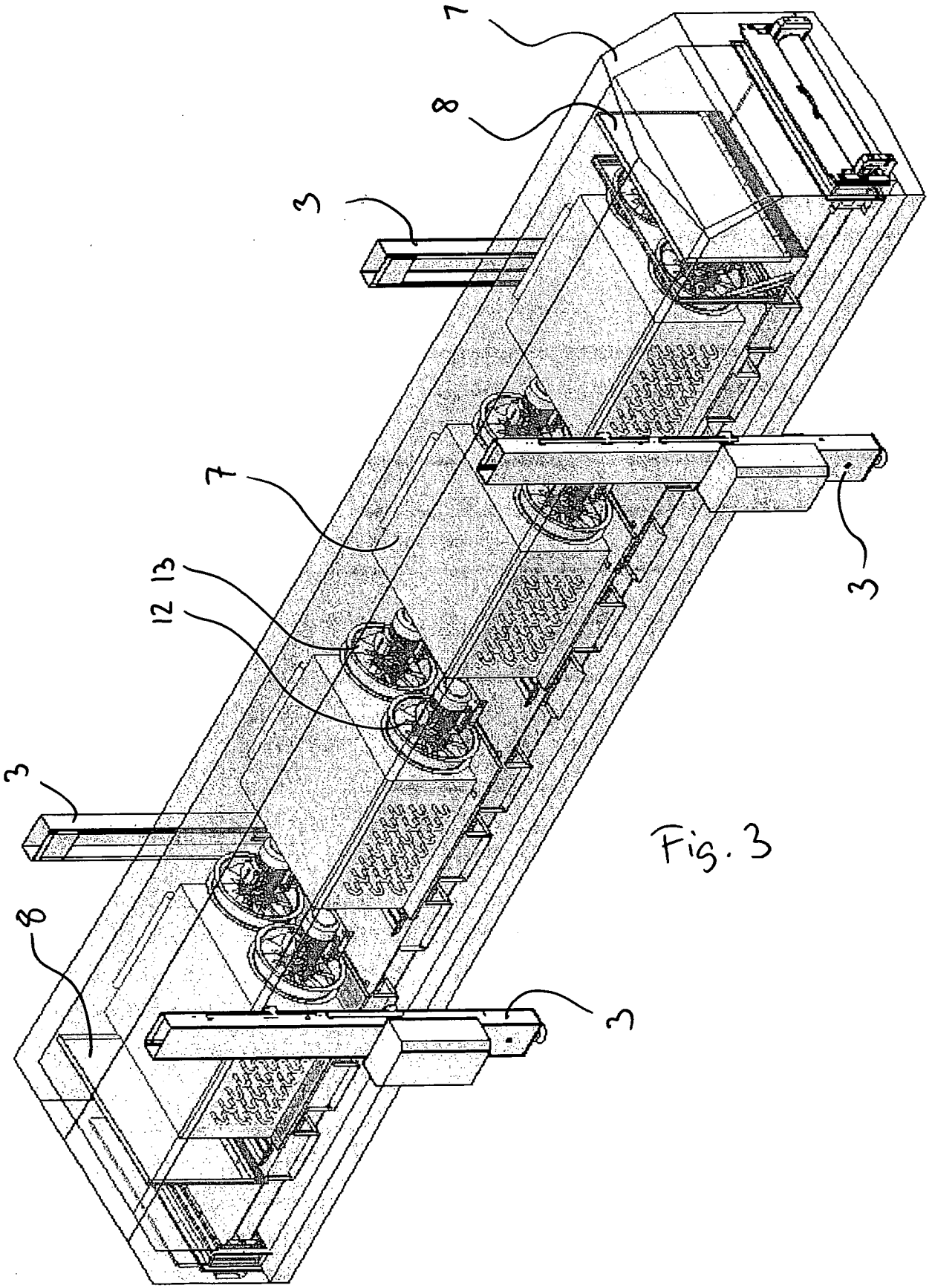


Fig. 3

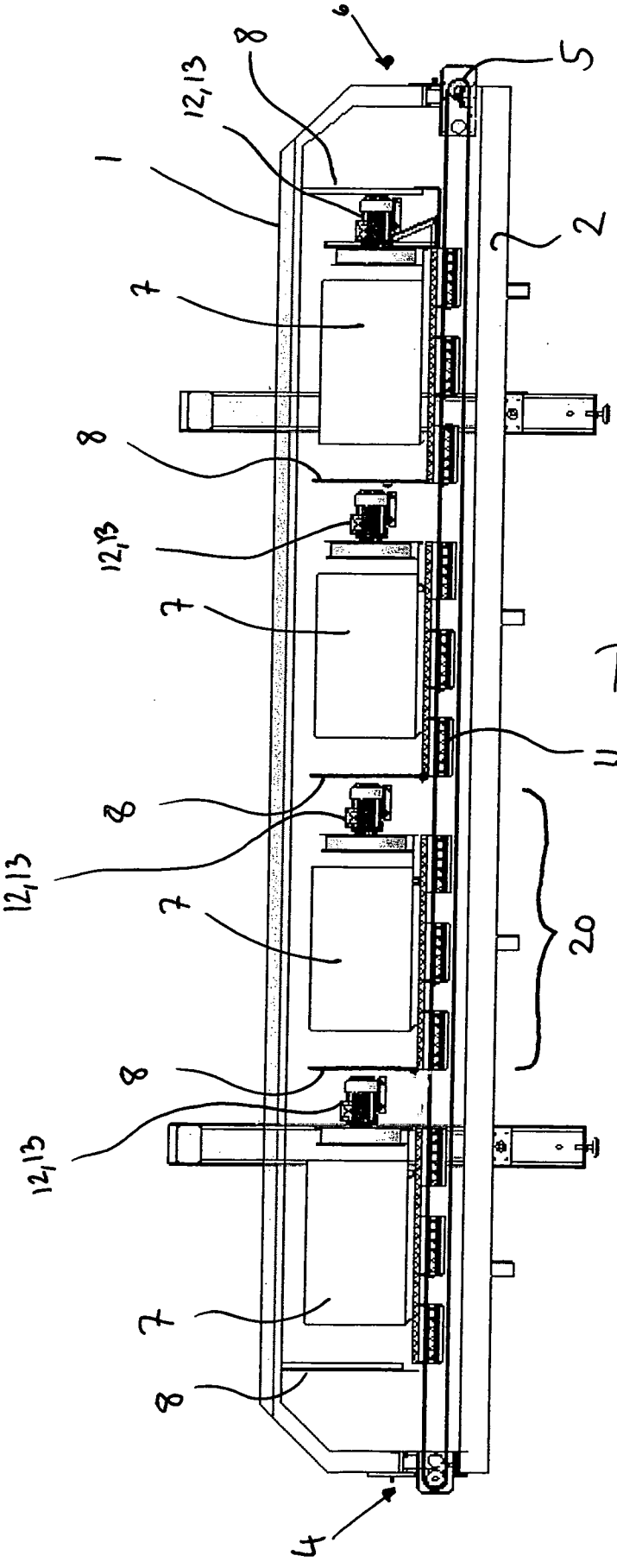


Fig. 4

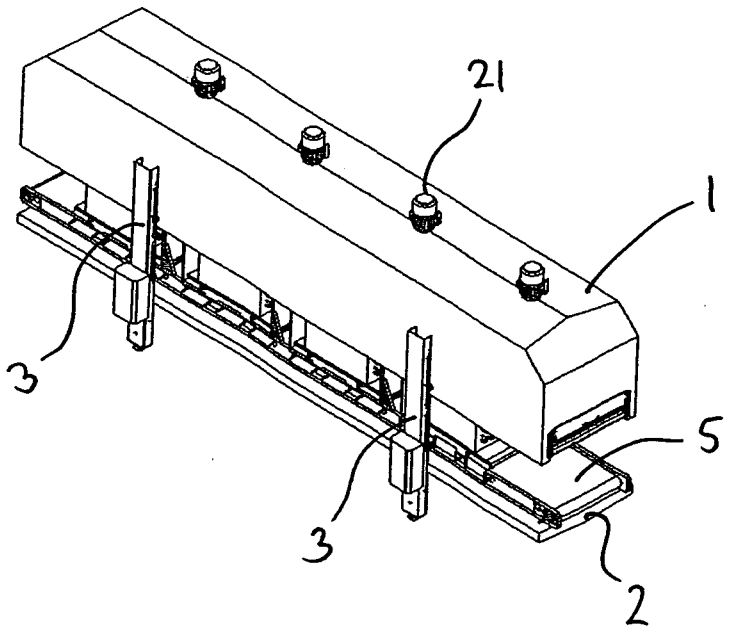
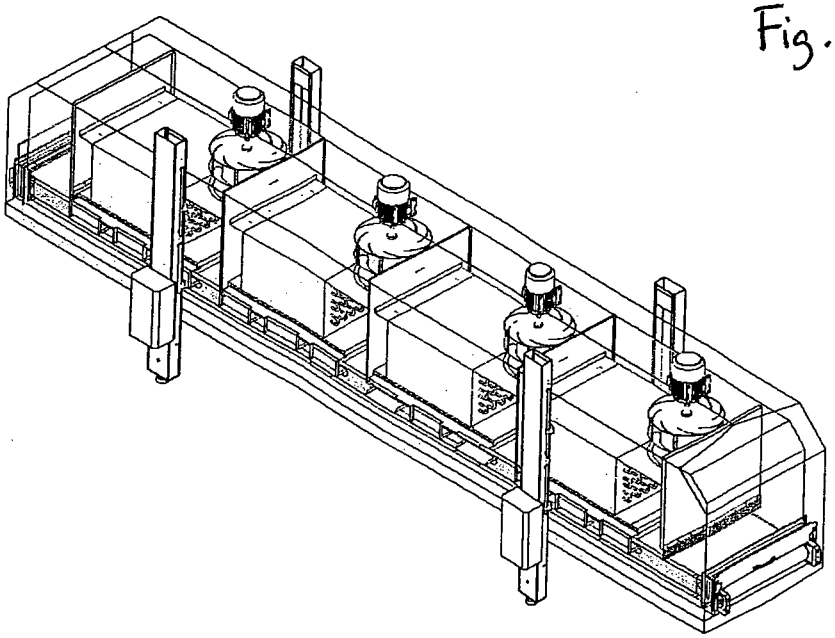


Fig. 5



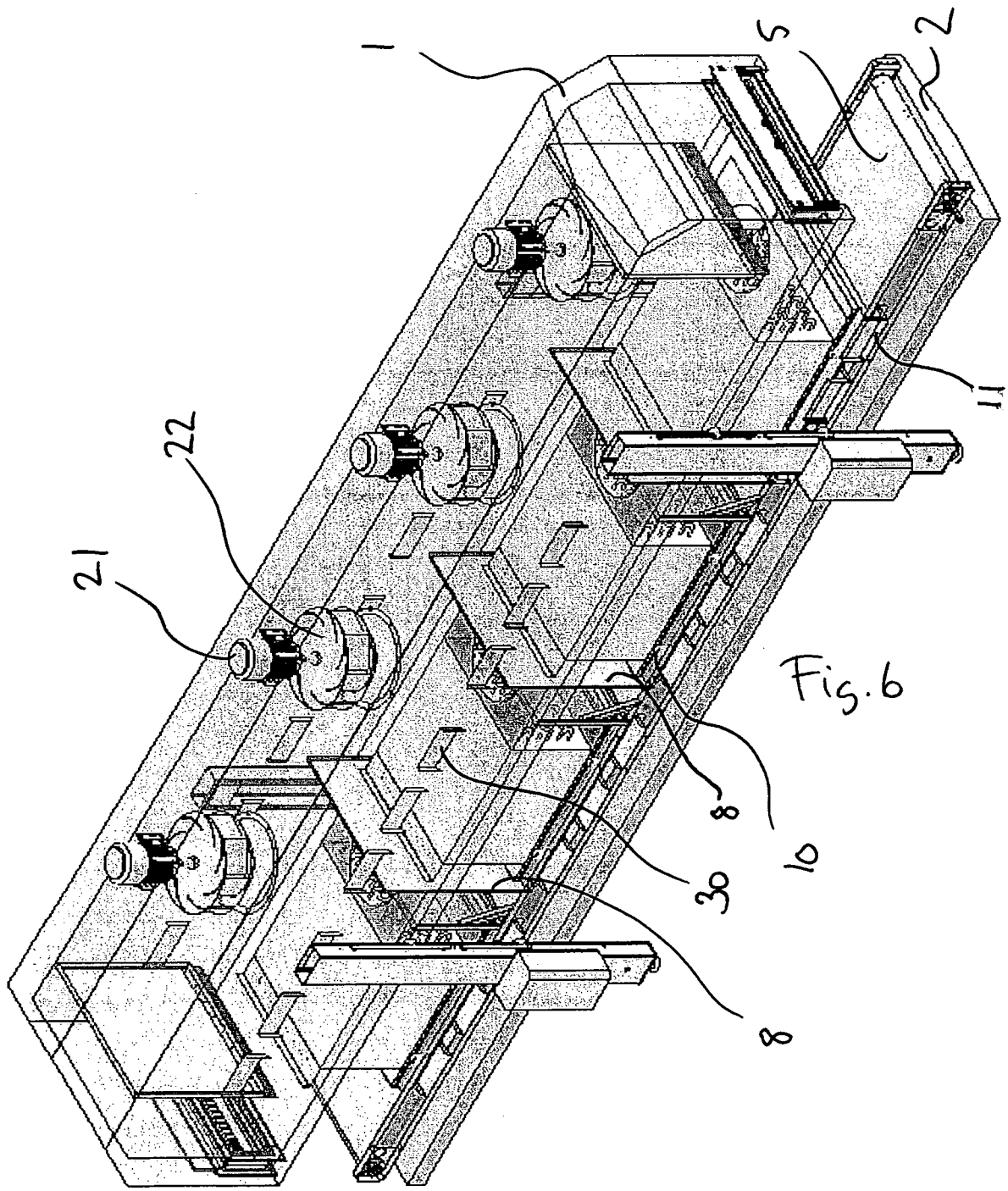


Fig. 6

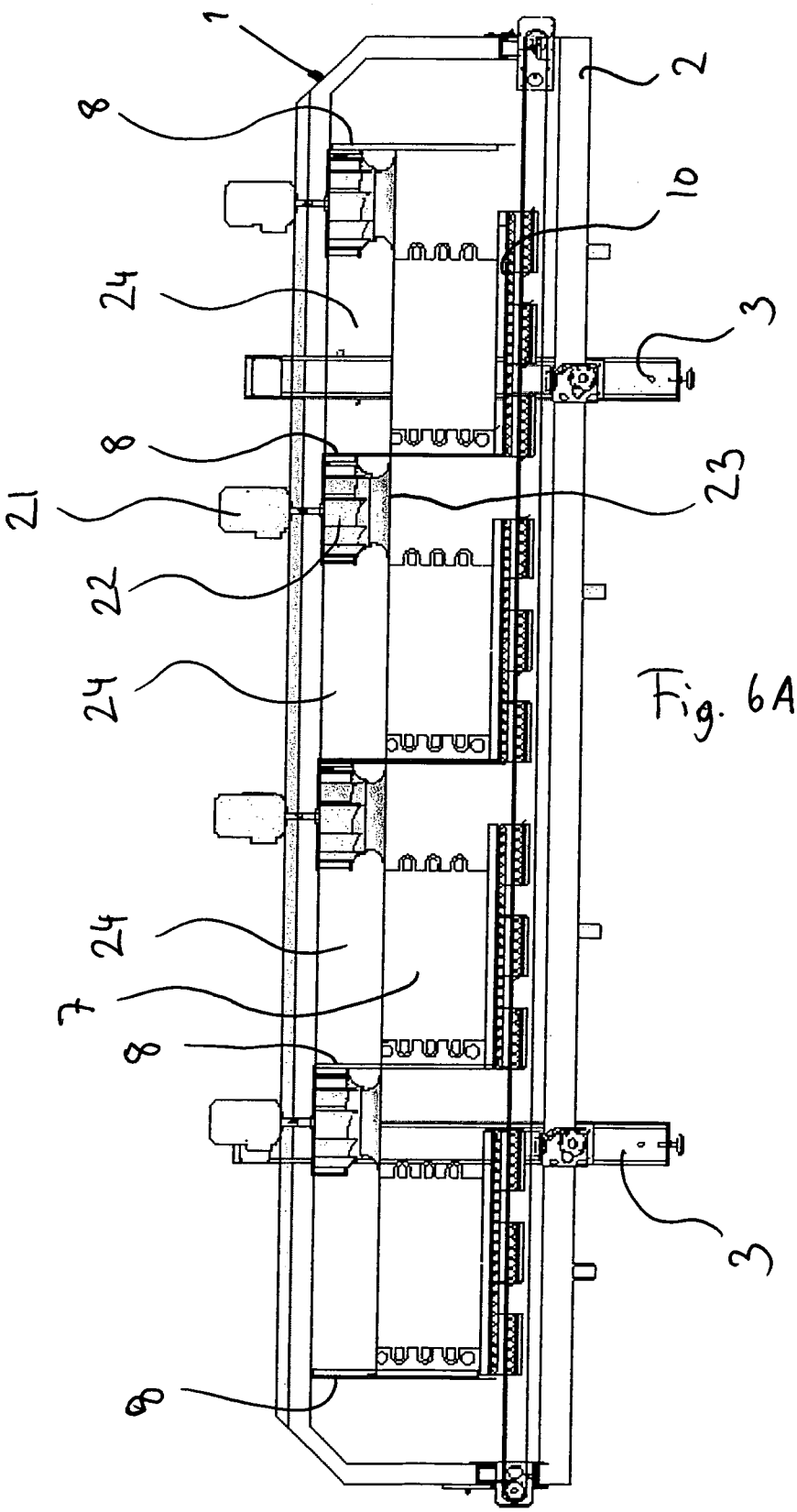


Fig. 6A

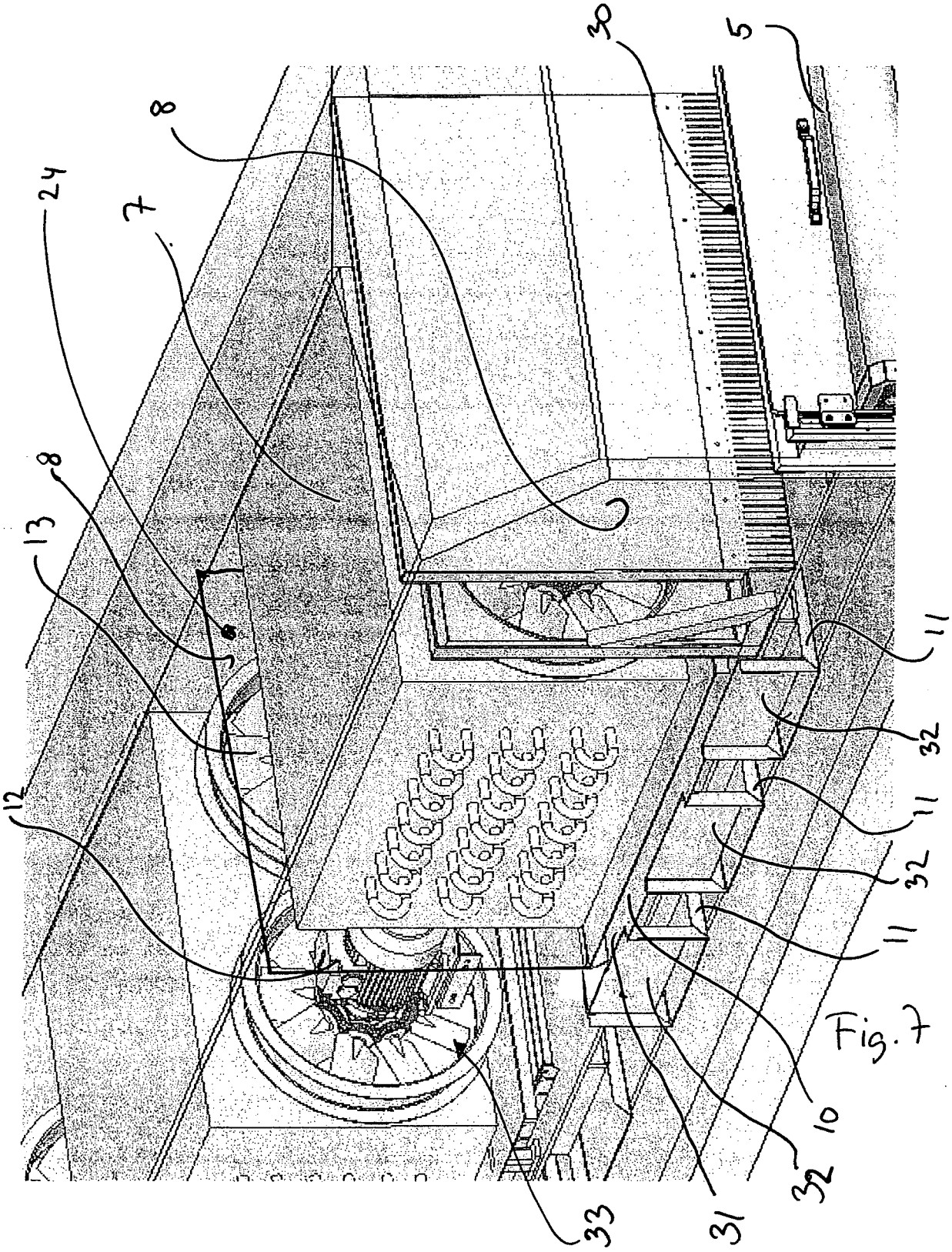


Fig. 7

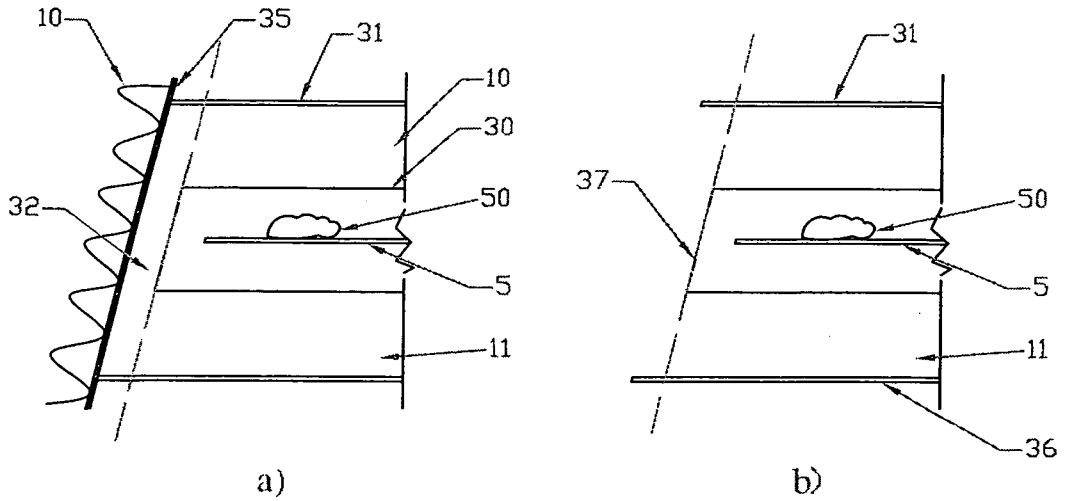


Fig 8

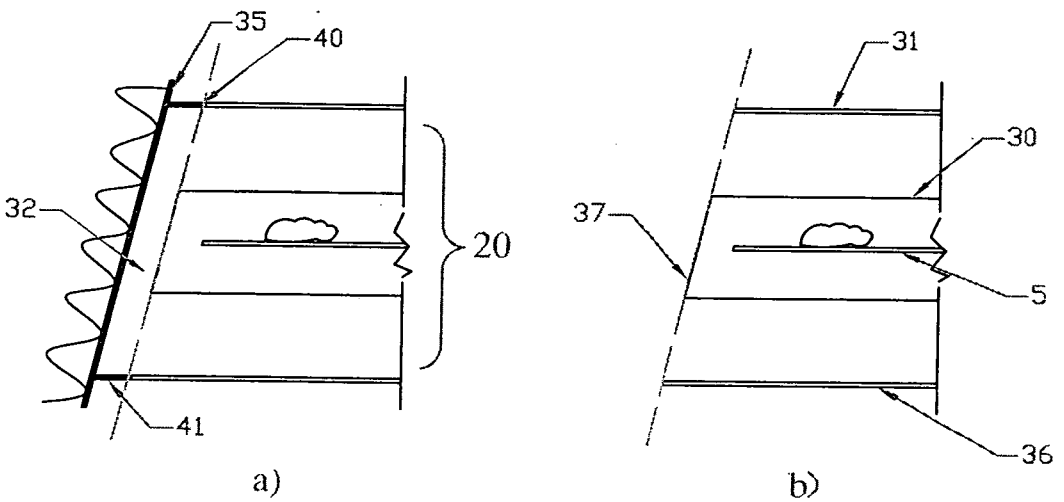


Fig 9

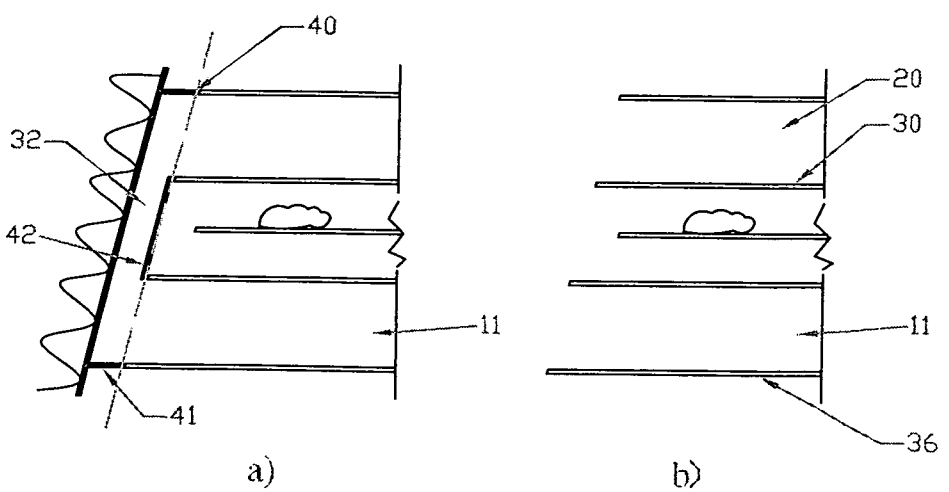


Fig 10