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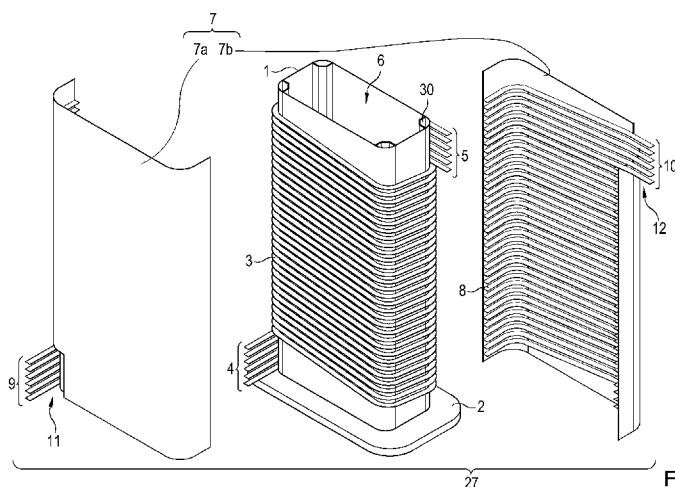


Fig. 1

(57) Abstract: A device for pneumatically conveying shaped parts and a method for controlling the device, such that shaped parts leaving the device have a temperature that is below a predefined discharge temperature. The device has at least one helical conveyor channel wrapped around a first hollow body. The at least one helical conveyor channel furthermore has an inlet opening and an outlet opening for the shaped parts conveyed therein. The first hollow body defines a plenum therein that is configured to duct air into the at least one helical conveyor channel for conveying the shaped parts there along.

**DEVICE AND METHOD FOR PNEUMATICALLY CONVEYING
SHAPED PARTS**

TECHNICAL FIELD

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The invention relates to a device and method for pneumatically conveying shaped parts.

BACKGROUND

10 Injection molding machines for simultaneously producing a large number of shaped parts are well-known in the art. Following the actual injection molding process, the large number of shaped parts must be simultaneously transferred for further processing.

Upon exit from the injection molding machine shaped parts typically require additional
15 downstream cooling to a temperature at which they are dimensional stable. Commonly upon exit from the molding machine, the shaped parts are transferred to a cooling means such as a cooling conveyor or a cooling box. Typically, the shaped parts enter the cooling device somewhat chaotically, i.e. in a disordered arrangement thereof. Following the cooling process, the shaped parts commonly are transferred from the cooling means to a temporary storage means from which
20 they are subsequently removed and then aligned relative to each other for further processing. Thus, for cooling and intermediate storage of the shaped parts, the shaped parts are in a disordered state and, for further processing of the shaped parts, the shaped parts must be arranged from the disordered state into an ordered state. Accordingly, expensive and complex means are required to reorder the shaped parts, wherein a malfunction thereof can interrupt the entire process causing
25 further problems and costs.

SUMMARY

The device according to the invention has at least one helical conveyor channel wrapped around a
30 first hollow body. The at least one helical conveyor channel furthermore has an inlet opening and an outlet opening for the shaped parts conveyed therein, wherein the first hollow body defines a plenum therein that is configured to duct air into the at least one helical conveyor channel for conveying the shaped parts there along. Accordingly, an arrangement is provided which is less

complex and less prone to break down and which further is cost effective. The device according to the invention simultaneously functions as a cooling means and as a means for intermediate storage. The ordered structure the shaped parts present in their arrangement upon leaving the injection mold, thus needs not to be brought into a disordered state and hereinafter back into an ordered state, but rather the shaped parts may be maintained in the ordered state of their arrangement until subjected to further processing. Accordingly, the handling of the shaped parts up to their further processing is less prone to breakdown so that the production line can be operated without breakdowns for a long term. According to an embodiment of the invention, for example, a self-contained conveyor channel is wrapped helically around the first hollow body.

Further details and advantages of the device according to the invention follow from the sub-claims.

According to an embodiment of a device which is low-priced and of a relatively simple design, a first boundary of the at least one helical conveyor channel is provided by means of a first helical web arranged on the exterior of a first hollow body, and an adjacent second boundary is provided by means of a second helical web arranged on the interior of a second hollow body.

For keeping the installation space of the device small while providing for the requisite dimension thereof, the at least one helical conveyor channel has a plurality of windings. The number of windings is such determined that as many shaped parts as needed for an uninterrupted operation of the production line, which comprises an injection molding machine and means for further processing of the shaped parts, can be temporarily taken on storage. At the same time, the at least one helical conveyor channel may be provided with a length sufficient for cooling the shaped parts down to a target exit temperature which, for cooling closure caps, is about 104°F.

The device should be easy in its assembling and the manufacture thereof should require little effort. To this end, the second hollow body is such designed that it can be split up or opened. During assembly, the second hollow body can be arranged such that it encircles the first hollow body while the at least one helical web thereof engages between the windings of the at least one web of the first hollow body. Accordingly, the device can be opened, for example, for cleaning or trouble shooting.

For avoiding that the shaped parts during their transport through the conveyor channel can get stuck, the cross-section of the conveyor channel over the entire length thereof may be kept constant. To this end, the second hollow body has a greater cross-section than the first hollow body, wherein the cross-sections are congruent to each other. Ideally, the difference in the cross-section is such dimensioned that the at least one web of the first hollow body does not touch the inner wall of the second hollow body and that the at least one web of the second hollow body does not touch the outer wall of the first hollow body. Accordingly, at least one helical conveyor channel is provided, wherein stress between the two hollow bodies which could cause malfunctions, cannot occur.

In order to be adaptable to shaped parts of different kind or size, the at least one helical conveyor channel is adjustable in height, such that it can be adapted to the height of an injection molded article. To this end, the position of the two hollow bodies relative to each other is adjustable in height. If, for example, the at least one web of the second hollow body, provides for the upper boundary of the conveyor channel, then the conveyor channel is enlarged in height as soon as the second hollow body relative to the first hollow body is displaced upwards. It is immaterial which one of the two hollow bodies is fixedly mounted in position and which hollow body is such arranged that it is adjustable in height.

For its use as an intermediate storage means, at least the outlet of the conveyor channel is controllable. Means for controlling the outlet opening of the at least one conveyor channel are provided which means may be in the form of a gate or a bolt interlock and which, by way of an controller unit, are such controllable that they open and close the outlet opening. In order to also separate the shaped parts from each other, for example, two of the above gates or bolt interlocks may be arranged in series.

If the individual windings of the at least one helical conveyor channel are not in direct contact with each other, a spacing between them is created, wherein said spacing can be used as an air channel. According to an embodiment of the invention, the at least one air channel has openings through which air exiting the air channel enters the at least one conveyor channel. Preferably, air exit openings furthermore are provided between the interior of the first hollow body and the at least one air channel, wherein via said air exit openings conveying air enters the at least one air channel.

For reducing frictional effects and for impeding the conveying of the shaped parts in the at least one conveyor channel, the shaped parts should be maintained in a floating state. According to an embodiment of the invention, the openings for the conveying air therefore are provided in the
5 bottom web of the at least one helical conveyor channel.

According to a further embodiment of the invention, conveying air is directly blown into the at least one conveyor channel. Openings of the first hollow body are provided through which conveying air exiting the interior of the first hollow body enters the at least one conveyor channel.
10 According to this embodiment, the spacing between the individual windings may be used for different purposes.

For example, cooling air can be supplied via an air channel that is defined by said spacing. Furthermore, it is possible that cooling air can be blown into the upper region of the device and
15 thus cooling air can be supplied in a direction that is opposite to the conveying direction of the shaped parts. In this way, a highly efficient cooling of the shaped parts is provided, as the difference in temperature between the shaped parts and the cooling air is about equal over the entire length of the at least one conveyor channel. According to an improvement of the above embodiment of the invention cooling air therefore is blown from top to bottom into the at least one
20 ventilation duct.

In both of the above embodiments, conveying air may be such supplied that the shaped parts accommodated in the at least one conveyor channel are being pushed from the lower region of the at least one conveyor channel to the upper region thereof. To this end, the openings are formed in
25 such a way that conveying air enters the at least one conveyor channel in the conveying direction of the shaped parts. Such a thing can be accomplished by way of U-shaped cuttings or die-cuttings provided in the dividing walls wherein the free ends of the accordingly provided flaps are pushed into the at least one conveyor channel in conveying direction or out of the at least one conveyor channel against the conveying direction.

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At the inlet of the at least one conveyor channel, the temperature of the shaped parts is about 212°F, whereas the maximum temperature at which the shaped parts are forwarded for further

processing is at about 104°F. For keeping the shaped parts within the at least one conveyor channel as long as they need for reaching the above temperature of about 104°F, means for controlling the outlet opening are provided. For controlling said means properly, the temperature of the shaped parts is ascertainable. Accordingly, in the upper region of the at least one conveyor channel at least one temperature sensor is provided which is such configured that in the proximity of the means for controlling the outlet opening the temperature of the shaped parts can be determined. A direct control of the outlet temperature of the shaped parts can be realized if the temperature of the shaped parts is determined directly inside the device in front of the outlet opening. An indirect, and from a technical point of view less complex temperature control can be accomplished if the temperature of the shaped parts is determined upstream of the outlet opening.

Shaped parts to be cooled in the device can vary in mass, material and dimensions. Depending on these parameters, also the input rate may vary. Thus, it is desirable that the device can be adapted accordingly. According to the invention a conditioning device is provided for conditioning the air. The conditioning device is able to adjust at least the temperature and the humidity of the air.

The air is ducted into the at least one conveyor channel via the interior of the first hollow body and at least via openings of the first hollow body. To distribute the air as uniformly as possible to all openings normally a diffuser has to be used. To reduce costs and to avoid the use of a diffuser, according to an embodiment of the invention a hood is provided at the top of the first hollow body for pressurizing the interior thereof by way of at least one fan.

In an embodiment of the invention a number of controllable fans is provided for varying the temperature conditions in parts of the at least one conveyor channel. In this way it is possible to have, for example, different temperatures and different pressures in different levels of the device.

According to the invention an inlet is provided in the hood for ducting air into the interior of the first hollow body. In one embodiment of the invention this air is guided to the inlet by means of at least one fan positioned outside of the interior of the first hollow body.

Due to the helical arrangement of the at least one conveyor channel, the device for pneumatically conveying shaped parts has a compact design which requires only little space. For avoiding the

waste of space for additional device components, at least one fan is provided in the interior of the first hollow body. As the conveying air also removes heat from the shaped parts, a single fan may be sufficient. However, several fans can be provided as well, which fans either deliver conveying air or which fans are divided into groups with one group thereof being responsible for the supply
5 of conveying air and the other group being responsible for a separate stream of cooling air.

To duct air out of the at least one conveyor channel, openings may be provided in the wall of the second hollow body. Accordingly, the air is ducted out of the at least one conveyor channel without any particular control. More advantageously, one or more exhaustion channels are
10 provided to duct air out of the at least one conveyor channel. The flow rate of the air through these exhaustion channels is controllable so that the pressure inside the at least one conveyor channel can be adapted.

When conveying shaped parts through the device with uniform velocity, the shaped parts may get
15 jammed at the edges of the windings. According to an embodiment of the invention, the velocity of the shaped parts therefore may be reduced at the edges. According to the invention the cross section of the first hollow body is formed as a rectangle having rounded edges and an exhaustion channel is provided in each of the edges, wherein air is ducted from the at least one conveyor channel to the exhaustion channels via openings in the wall between the at least one conveyor
20 channel and the exhaust channels positioned in each winding of the at least one conveyor channel. According to this embodiment, the device is segmented into different pressure zones. Along the four side walls of the device four high pressure zones are provided. In these zones, openings of the at least one conveyor channel only allows for the input of air. Along the four edges of the device, four low pressure zones are provided. In these zones the at least one conveyor channel has only
25 output openings for the air. In this way, air pressure is setup in a manner that promotes conveyance of the shaped parts in a more positive manner. Accordingly, fresh cooled air is introduced into the input openings along the side walls of the device and as the air exhausts along the edges of the device it is replaced four times during a single winding. The temperature of the conveyance path is kept as low and as uniform as possible thereby providing the highest possible temperature
30 differential for promoting cooling of the shaped parts.

In order to build up pressure within the interior of the first hollow body, a hood is provided to cover the above opening of the interior. Also the exhaustion channels are inside the interior of the first hollow body and therefore are covered by the hood as well. According to the invention, at least one outlet is provided in the hood for ducting air out of the exhaustion channels.

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According to the embodiment described so far, only a single conveyor channel is provided which conveyor channel is helical and is formed in the space between the outside of the first hollow body and the inside of the second hollow body. For handling a larger amount of shaped parts, according to the invention a plurality of conveyor channels arranged in parallel is provided. Each conveyor channel of said plurality of conveyor channels has an inlet opening and an outlet opening. Of course the additional conveyor channels individually or in entirety may be combined with the features described under the above with respect to the at least one helical conveyor channel.

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The further processing of the shaped parts usually does not take place in parallel but rather in series. Thus, the shaped parts leaving the individual conveyor channels may be merged and fed into a single common line. Downstream of the means for controlling the outlet opening of each of the plurality of conveyor channels, a means for merging the shaped parts into a common discharge channel is provided. Preferably, the common discharge channel is such configured that the shaped parts are discharged by gravity. In such a case, the means for merging the shaped parts has a stack facing downwards, wherein the individual conveyor channels or extensions thereof gently end in said stack.

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The invention is also directed to a system for molding shaped parts. According to the invention, this system has at least an injection molding machine, a device for pneumatically conveying shaped parts as described above and an air conditioner.

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In accordance with the invention, the means for controlling the outlet opening, be it the one of a single conveyor channel or the ones of the plurality of conveyor channels, is such controlled that a shaped part is only allowed to leave the conveyor channel if the temperature thereof is below the value of a predefined outlet temperature. To this end, means for either directly or indirectly determining the temperature of the shaped parts are provided.

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As the conveying air or the conveying and cooling air continuously impinge on the at least one conveyor channel, the degree the shaped parts cool down depend on their residence time within the at least one conveyor channel. Preferably, the means for controlling the outlet opening(s) therefore manipulate that residence time. However, it is also possible to control the temperature of the conveying air or the temperature of the conveying and the cooling air in such a way that the shaped parts leaving the conveyor channel(s) do not exceed the predefined maximum temperature. Of course it is also possible to adjust the rate of air flow accordingly.

When starting the system, the shaped parts introduced via the inlet opening of the device will be conveyed directly to the output opening within a period that is much shorter than the residence time needed to reach the predetermined output temperature. According to the invention the means for controlling the outlet opening therefore will be closed as soon as shaped parts enter the at least one helical conveyor channel.

It is an object of the method according to the invention to hold the shaped parts in the device for a predetermined period of time. This can be achieved if the outlet rate follows the inlet rate in accordance with that predetermined period of time. In other words, the outlet rate should be equal to the inlet rate with an offset as great as the predetermined time period. According the invention the means for controlling the outlet opening therefore will remain closed in a first step, until the shaped parts in front of the outlet opening have accumulated to a predefined level in the direction of the inlet opening and in a second step the means for controlling the outlet opening will be opened intermittently so that the outlet rate of the shaped parts is equal to the inlet rate thereof.

In case in the further processing of the shaped parts something goes wrong and it is not possible to open the outlet opening of the at least one conveyor channel it is necessary to have the requisite time for shutting the injection molding machine down in an ordered manner. According to the invention, it is provided that in case the means for controlling the outlet opening are being closed for a longer period, the shaped parts in front of the outlet opening will accumulate in the direction of the inlet opening below the aforesaid predefined level.

Further details and advantages of the invention will now become apparent to those skilled in the art upon review of the following description of non-limiting embodiments in conjunction with the accompanying drawings.

5 **DETAILED DESCRIPTION OF THE DRAWINGS**

The non-limiting embodiments will be more fully appreciated by reference to the accompanying drawings, in which:

10 FIG. 1 is an exploded view of an embodiment of a cooling conveyor according to the present invention;

FIG. 2a is a top view of a further embodiment of a cooling conveyor in accordance with the present invention, with the cooling conveyor having means for separating the shaped parts from
15 each other;

FIG. 2b is a side view of the embodiment of FIG. 2a;

FIG. 3 is a functional diagram of the cooling conveyor according to the present invention;
20

FIGs. 4a and 4b each show a cross-sectional view of an embodiment of a cooling conveyor according to the present invention adjusted for different shaped parts.

FIG. 5 is a partial cross sectional view of another embodiment of the invention;
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FIG. 6 is a side view of the embodiment closed with a hood;

FIGs. 7a and 7b each show an injection molding system;

30 FIG. 8 is a top view of a further embodiment of the means for controlling the outlet openings;

FIGs. 9a and 9b each showing a side view of a first gate of the embodiment of Fig. 8 in different conditions.

The drawings are not necessarily to scale and may be illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details that are not necessary for an understanding of the embodiments or that render other details difficult to perceive may have been omitted.

DETAILED DESCRIPTION OF THE NON-LIMITING EMBODIMENT(S)

Reference will now be made in detail to various non-limiting embodiment(s) of a cooling conveyor. It should be understood that other non-limiting embodiment(s), modifications and equivalents will be evident to one of ordinary skill in the art in view of the non-limiting embodiment(s) disclosed herein and that these variants should be considered to be within scope of the appended claims.

Furthermore, it will be recognized by one of ordinary skill in the art that certain structural and operational details of the non-limiting embodiment(s) discussed hereafter may be modified or omitted (i.e. non-essential) altogether. In other instances, well known methods, procedures, and components have not been described in detail.

Cooling conveyor 27 depicted by FIG. 1 has a first hollow body 1 mounted to a base 2. First hollow body 1 is formed as an rectangular block, wherein the longitudinal edges thereof are chamfered along a radius. Six first webs 3 arranged in parallel are attached to the exterior wall of first hollow body 1 and are helically wrapped around the same. The bottom end of first webs 3 is arranged in a plane of the narrow side of hollow body 1, wherein said plane is perpendicular to the wide side of hollow body 1. The upper end of first webs 3 is arranged in a plane of the wide side of hollow body 1, wherein said plane is perpendicular to the narrow side of the hollow body.

Within the interior space 6 of first hollow body 1 along its four side edges exhaustion channel 30 is provided. Opening in the wall of first hollow body 1 (not shown in the drawings) through which air may enter into interior space 6 are provided.

A second hollow body 7 is divided into two halves 7a and 7b, wherein the two halves either may be connected with each other (not shown) and/or mounted to first hollow body 1. Second webs 8 are mounted to the interior wall of second hollow body 7. Second webs 8 are such arranged that at
5 a closed state of second hollow body 7, i.e. a state where the two halves 7a and 7b have been put together, thereby forming second hollow body 7, said second webs 8 also provide six webs which are arranged in parallel and which helically wrap around the interior wall of second hollow body 7 from the bottom end to the upper end thereof. Taken in isolation, the two halves 7a and 7b only have a plurality of webs which run in parallel and which, in conveying direction, are inclined
10 upwards. For avoiding difficulty when assembling the two halves 7a and 7b, webs 8 should be arranged in such a way that adjacent webs overlap slightly and that the webs which are arranged in conveying direction, always abut against the lower side of the webs arranged opposite to the conveying direction.

15 For mounting first half 7a of second hollow body 7 to first hollow body 1, at the lower boundary of half 7a a recess 11 is provided. When assembling half 7a and first hollow body 1, via said recess 11 the lower ends 4 of webs 3 are allowed to slide underneath the respective ends of webs 8. Accordingly, the inlet to six channels of the cooling conveyor provided according to the present invention is created.

20 An additional recess 12 is arranged at the upper boundary of the other half 7b of second hollow body 7, thereby providing for the outlet of said six channels of the cooling conveyor. Accordingly, i.e. when assembling half 7b and first hollow body 1, upper ends 5 of webs 3 are allowed to slide underneath upper ends 10 of webs 8 via said recess 12.

25 By connecting halves 7a and 7b of second hollow body 7 to first hollow body 1, a system having six helical channels running in parallel is provided between the exterior wall of first hollow body 1 and the interior wall of second hollow body 7. The bottom of each channel is provided by means of first webs 3, and the top of each channel is provided by means of second webs 8, wherein the
30 interior wall of each channel is provided by the exterior wall of first hollow body 1 and the exterior wall of each channel is provided by the interior wall of second hollow body 7.

Webs 3 and 8 may be attached to first and second hollow body in many ways. For example, along the longitudinal edges of the webs small flaps may be provided and corresponding slots may be formed in the walls of the hollow bodies. Thus, via a detachable plug connection, the webs can be fixed to the hollow bodies.

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As the conveyor channels are formed at the exterior wall of the first hollow body, interior space 6 is unobstructed. Interior space 6, for example, may accommodate the requisite fan, thereby avoiding waste of additional space which otherwise would be needed for accommodating the fan. Even if several fans are needed, interior space 6 is sufficiently large for their accommodation. In case cooled air is needed, the fan arranged in the interior space may be connected to an air conditioner arranged outside of the interior space.

10

FIGs. 2a and 2b show cooling conveyor 27 in the fully assembled state, wherein FIG. 2a depicts a top view thereof and FIG. 2b a side view. Similar to FIG. 1, also FIG. 2a depicts base 2, second, i.e. outer hollow body 7, first, i.e. inner hollow body 1, lower end 4 of first webs 3 at the conveyor channel's inlet and upper end 5 of first webs 3 at the conveyor channel's outlet. At upper end 5 of first webs 3 shaped parts 20 are shown. The depicted shaped parts are closure caps 20 for plastic bottles and which have been produced by injection molding. However, it should be stressed that cooling conveyor 27 of course can handle any desired shaped parts.

15

Outlet recess 12 of second hollow body 7 can be seen in both FIG. 2a and FIG. 2b. One half of a closure cap 20 is covered by the rim of outlet recess 12. From FIG. 2b, one furthermore can see that six ends 5, one above the other, of first webs 3 extend through the outlet recess and that therefore six closure caps always simultaneously queue at separation means 14.

20

When processing closure caps, it is desirable to re-orient the closure caps prior to separating them from each other. To this end, a means for rotation 13 is provided. Means for rotation 13 may be designed in different ways and therefore said means for rotation 13 are not depicted by the drawings in more detail. A means for rotation configured in a simple manner has a closed channel with a cross-section which is adapted to the closure caps such that they may be conveyed without getting jammed. The channel is rotated along its longitudinal axis such that its cross-section on one side (in the present case the side facing cooling conveyor 27) equals a horizontal rectangle and the

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cross-section on the other side equals an upright rectangle. On their way through such a channel, closure caps 20 are rotated about an angle of 90° and thus are brought from a sliding position into a rolling position.

5 In each of its six planes, means for separating 14 the shaped parts from each other have a first 15 and a second separating pin 16, wherein the tips of the pins may engage with the respective separating channel. Separating pins 15 and 16 may be independently controlled, e.g. by way of a magnetic or pneumatic control. The pins may be brought from an inoperative position into a position in which they extend into the opening of a closure cap. Details of this mechanism will be
10 explained in more detail under the below.

At the outlet of cooling conveyor 27, a temperature sensor 19 for determining the outlet temperature of closure caps 20 is provided. For the sake of clarity, temperature sensor 19 is schematically shown in FIGs. 2a and 3. For contact-free thermometry, temperature sensor 19, for
15 example, may be provided by way of a pyrometer (radiation thermometer), and preferably it is arranged in close proximity to the outlet of cooling conveyor 27. If the six conveyor channels are all controlled in the same manner, then a single temperature sensor for one of the conveyor channels is sufficient, whereas a temperature sensor for each conveyor channel is required if each conveyor channel is independently controlled.

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In conveying direction and downstream of separation pins 15 and 16, the separating channels are connected with each other via a common drop shaft 17. Drop shaft 17 ends in chute 18, leading from a vertical alignment to an almost horizontal alignment. Accordingly, the closure caps are singularized with merging into a single file and are thus in the same alignment as they were in the
25 cooling conveyor.

FIG. 2a furthermore depicts an alternative of conveying air for cooling conveyor 27. Accordingly, a fan 23 is provided outside cooling conveyor 27. By means of an air conditioner 35, air coming from fan 23 is cooled prior it is ducted to interior space 6 of first hollow body 1. Thence the air
30 (illustrated by way of upright arrows directing toward straight portions of the sidewalls) via openings ducts (not shown) into a space defined between first hollow body 1 and second hollow body 2. At the corners the air (illustrated in FIG. 2a by way of arrows in the corners) via openings

(not shown) exits the conveyor channels and enters the four exhaust channels. Accordingly, the air is collected and again delivered to the suction side of fan 23.

FIG. 3 schematically depicts a cooling conveyor 27, wherein in the interior space thereof five
5 controllable fans 23A - 23E are arranged. Furthermore, a controller 21 is provided which receives data from an input meter 22, a level sensor 24 as well as from a temperature sensor 19 arranged at the outlet of cooling conveyor 27. Both, controllable fans 23 and separation device 14 are controlled via the controller 21. If fans 23 are controlled differently, different condition zones can be generated in different levels of cooling conveyor 27.

10 In order to provide a cooling conveyor for different shaped parts, first 3 and second webs 8 have a width slightly larger than the width of the shaped parts to be conveyed. First hollow body 1 which does not undergo any alterations, is fixedly attached to base 2. Second hollow body 7 is adapted to the width of first 3 and second webs 8, and thus it is also adapted to the width of the shaped parts
15 to be conveyed. As already mentioned under the above, slots are provided in both the first and the second hollow body such that webs 3 and 8 via respective flaps arranged along the longitudinal edges of said webs, can readily be attached to first 1 and second hollow body 7. Halves 7a and 7b of the second hollow body are wrapped around first hollow body 1 in such a way that webs 8 attached to second hollow body 7 get located underneath webs 3 attached to first hollow body 1.

20 By way of displacing (i.e. raise or lower) second hollow body 7 relative to first hollow body 1, the height of the thus resulting conveyor channels arranged in the space between the two hollow bodies, may be adjusted. FIGs. 4a and 4b illustrate this mechanism in more detail. Lowering second hollow body 7 relative to first hollow body 1, the height of conveyor channels 29 is reduced accordingly. Lifting second hollow body 7 relative to first hollow body 1, the height of
25 conveyor channels 29 is increased. FIG. 4a depicts an adjustment according to which the height of conveyor channels 29 is reduced. Such an adjustment is needed for conveying shaped parts 20 having a small height. In contrast thereto, FIG. 4b shows an adjustment needed for conveying shaped parts 20 having a greater height. The chosen adjustment may be fixed in many ways, for
30 example, by means of a correspondingly adjustable mounting connecting second hollow body 7 to base 2.

FIGs. 4a and 4b furthermore illustrate different ways for conveying air within the cooling conveyor 27. According to FIG. 4a, by way of fans 23 arranged in interior space 6, conveying air 25 via air passages is blown into air channels 28 arranged between conveyor channels 29. While conveyor channels 29 are provided with the first webs forming the bottom thereof and second webs 8 forming the top, with respect to air channels 28 quite the opposite is the case as second webs 8 form the bottom and first webs 3 form the top.

Ideally conveying air 25 is blown into air channels 28 in such a way that it moves in conveying direction. By means of correspondingly directed openings (not shown) defined through the first webs 3, conveying air 25 enters conveyor channels 29 and pushes closure caps 20 in conveying direction.

FIG. 4b illustrates an alternative way for conveying air within the cooling conveyor. Accordingly, conveying air via correspondingly directed openings of first hollow body 1 is directly blown into conveyor channels 29 and pushes closure caps 20 in conveying direction. In this embodiment, air channels 28 arranged between conveyor channels 29 are not needed for conveying closure caps 20. Thus, said air channels may be used for different purposes. For example, separate cooling air 26 (depicted by dotted arrows) may be blown into air channels 28. In this way, air supplied by a cooler (not depicted) may be used for cooling closure caps 20, whereas for conveying closure caps 20 uncooled ambient air may be used.

For increasing the cooling efficiency for cooling the closure caps, in the embodiment according to FIG. 4b, cooling air 26 may be supplied in a direction that is opposite to the conveying direction. This means that in the lower region of the cooling conveyor, i.e. in proximity to the inlet thereof, thus at a place where the temperature difference between the hot closure caps and the ambient air is sufficiently high, the cooling of the closure caps primarily is provided by means of the conveying air present in conveyor channels 29. In the upper region of the cooling conveyor where the temperature difference between the cooler closure caps and heated ambient air decreases, the temperature difference relative to the cooling air which is still cold is relatively high and therefore in the upper region of the cooling conveyor a highly efficient cooling of the closure caps is provided.

FIG. 5 shows a partial cross-sectional view of another embodiment of the invention. In this embodiment channel web 38 wrapped around the first hollow body is formed as a hollow body and provides an air channel. Via openings 36 provided in the wall of the first hollow body, pressurized air of interior space 6 of first hollow body 1 is ducted into channel web 38. Via nozzle openings 37, the air enters conveyor channel 29. As channel web 38 forms the bottom of conveyor channel 29, the shaped parts to be conveyed remain in a floating state. Accordingly, losses through friction can be minimized and less energy is needed for conveying the shaped parts through the cooling conveyor. By way of the shape of nozzle openings 37 directing the air in conveying direction, advance of the shaped parts is accomplished.

With reference back to FIGS. 2a, 2b and 5, it may be further appreciated that the closure caps 20 are supplied to cooling conveyor 27 via six lines arranged in parallel and through inlet recess 11 of second hollow body 7. By way of fans 23A to 23E which can be independently activated and controlled, for a certain period of time closure caps 20 may be kept on a predefined level. In this way, it is possible to vary the residence time of closure caps 20 and the cooling time thereof and thus to adapt the residence and cooling time to the requirements as needed.

If, for example, the temperature sensor detects a temperature which is too high, either the cooling time may be extended or the cooling conditions may be improved. The latter may be achieved, for example, by increasing the air stream or, alternatively, by cooling the air stream.

Normally, the filling level of the cooling conveyor may be determined by comparison of input meter 24 and the means for controlling the outlet opening, which in the embodiment according to FIGS. 2a and 2b is realized by means of separation device 14. As controller 21 controls separation device 14, it is readily possible to count closure caps 20 leaving cooling conveyor 27 via said controller 21. A comparison of that output meter with the input meter then reveals the filling level of the cooling conveyor. Alternatively, the filling level of the cooling conveyor may be determined by a level sensor 24.

For modifying the cooling conditions, one or more of fans 23A to 23E may be operated with precooled air. If the cooling conditions must be improved as, for example, the residence time

cannot be extended any further, the performance of the fans operated with precooled air can be increased by way of decreasing the performance of the fans operated with ambient air.

5 Closure caps 20 are only discharged by separation means 14 controlling the output of cooling conveyor 27, if the temperature of the closure caps is within the predetermined temperature range.

If the temperature of closure cap 20c measured by temperature sensor 19 is within the predetermined temperature range, then second separating pin 16 extending into the void of closure cap 20c and abutting against its inner wall, is withdrawn. Accordingly, closure cap 20c is released
10 and moves toward drop shaft 17. As there are six separation channels arranged one upon the other, it is desirable to synchronize the movements of the second separation pins. In doing so, six closure caps 20c simultaneously reach drop shaft 17 and through drop shaft 17 they enter chute 18.

Withdrawal of second separation pin 16 not only moves closure cap 20c toward drop shaft 17, but
15 rather closure cap 20b is been displaced as well, such that first separation pin 15 now abuts against that side (shown left in the drawing) of the inner wall of closure cap 20b, thereby blocking any further displacement of closure cap 20b and of any closure caps arranged upstream of closure cap 20b.

20 Hereinafter, second separation pin 16 again is extended such that both separation pin 15 and separation pin 16 dip into the void of closure cap 20b. First separation pin 15 is then withdrawn, such that the closure caps are allowed to move in conveying direction until second separation pin 16 abuts against the left side of the inner wall of closure cap 20b. Now closure cap 20a is located opposite first separation pin 15. As soon as separation pin 15 has been driven into the void of
25 closure cap 20a, the initial situation has been re-established and the next step of separation may start.

FIG. 6 depicts cooling conveyor 27 which interior space 6 is closed by a hood 31 having an inlet and an outlet. The exhaust channels arranged in interior space 6 (not shown) are joined at outlet
30 33. According to an embodiment of the present invention having at least one fan 23 arranged outside cooling conveyor 27, pressurized air is directed to interior space 6 via inlet 32. According

to another embodiment of the present invention having at least one fan arranged in interior space 6, via inlet 32 either ambient air or air coming from an air conditioner is sucked in.

FIGs. 7a and 7b depict an injection molding system, wherein FIG. 7a is a top view and FIG. 7b a side view. Cooling conveyor 27 is directly coupled to injection molding machine 34. An air conditioner 35 supplies cooling conveyor 27 with cooled and dried air.

FIG. 8 as well as FIGs. 9a and 9b depict a further embodiment of a separation device. Closure caps 20 are conveyed by way of at least one fan 23 from six conveyor channels to six straight channels each having a bottom terminating at a turning disk 39. A separation means is provided by first gate 40 and second gate 41.

FIGs. 9a and 9b depict a sectional view along a line through the first gate 40, wherein FIG. 9a depicts the locking position, whereas FIG. 9b depicts the open position of first gate 40. In the locking position, pusher 43, movable in the direction of the shown arrow, has been displaced to the right, such that locking pins 44 are pushed into the wedge-shaped clearances between the closure caps. As the distance between the channel walls only slightly exceeds the diameter of the closure caps, the closure caps of the second row as well as any closure caps arranged behind said second row are hindered from further transport.

Second gate 41, for example, can be configured as a simple rejection beam which is lifted for opening. As the row of closure caps which is in front of first gate 40 has been locked from further transport, second gate 41 may be opened so that the closure caps which are between the first gate and the second gate may be removed by means of turning disk 39. By means of turning disk 39 and guide bar 45, the closure caps are brought together in one line and now may be subjected to further processing.

Now, second gate 41 is closed again and first gate 40 may be opened. To this end, pusher 43 is moved to the left, wherein locking pins 44 are also displaced from the clearance between channel walls 42 and are positioned directly in front of channel walls 42.

Now, first gate 40 is in its open position and closure caps 20 can be pushed forward until the first row of closure caps again queues at second gate 41.

It is noted that the foregoing has outlined some of the more pertinent non-limiting embodiments. It will be clear to those skilled in the art that modifications to the disclosed non-limiting embodiment(s) can be effected without departing from the spirit and scope thereof. As such, the described non-limiting embodiment(s) ought to be considered to be merely illustrative of some of the more prominent features and applications. Other beneficial results can be realized by applying the non-limiting embodiments in a different manner or modifying them in ways known to those familiar with the art. This includes the mixing and matching of features, elements and/or functions between various non-limiting embodiment(s) is expressly contemplated herein so that one of ordinary skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment may be incorporated into another embodiment as appropriate, unless described otherwise, above. Although the description is made for particular arrangements and methods, the intent and concept thereof may be suitable and applicable to other arrangements and applications.

WHAT IS CLAIMED IS:

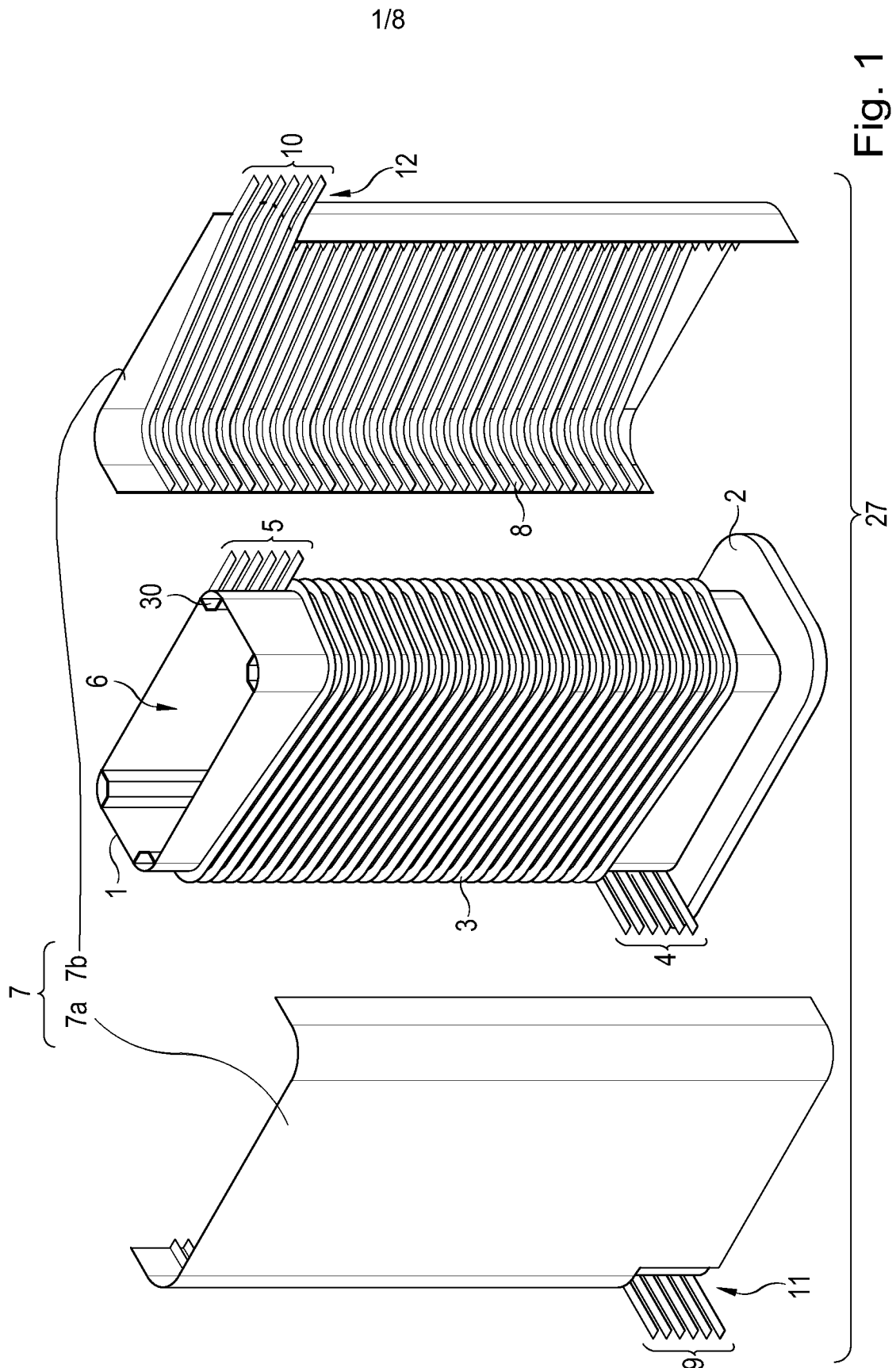
1. A device for pneumatically conveying shaped parts (20), the device (27) having at least one helical conveyor channel (29) wrapped around a first hollow body (1), the at least one helical conveyor channel (29) furthermore having an inlet opening (4, 9) and an outlet opening (5, 10) for the shaped parts (20) conveyed therein, wherein the first hollow body (7) defines a plenum therein that is configured to duct air (25) into the at least one helical conveyor channel (29) for conveying the shaped parts (20) there along.
2. The device according to claim 1, wherein the at least one helical conveyor channel (29) having a first boundary wall formed by a first helical web (3) arranged on the exterior of the first hollow body (1) and a second boundary wall formed by a second helical web (8) arranged on the interior of a second hollow body (7).
3. The device according to any of claim 1 to claim 2, wherein the at least one helical conveyor channel (29) comprises a plurality of windings.
4. The device according to any of claims 2 to 3, wherein the second hollow body (7) is configured to be split up or to be opened.
5. The device according to any of claims 2 to 4, wherein the cross-section of the second hollow body (7) is greater than the cross-section of the first hollow body (1) and congruent therewith.
6. The device according to any of claims 2 to 5, wherein the position of the first (1) and the second hollow body (7) relative to each other is adjustable in height.
7. The device according to any of claims 1 to 6, wherein means (14, 40, 41) are provided for controlling the outlet opening (5, 10).

8. The device according to any of claims 3 to 7, wherein at least one ventilation duct (28) is formed between said windings, and wherein conveying air exits the at least one ventilation duct (28) via openings (36) and enters the at least one helical conveyor channel (29).
9. The device according to claim 8, wherein the openings (36) are provided in the bottom web of the at least one helical conveyor channel (29).
10. The device according to any of claims 1 to 9, wherein the first hollow body (1) has openings allowing conveying air exiting an interior space (6) thereof to enter the at least one helical conveyor channel (29).
11. The device according to claim 10, wherein cooling air (26) is blown from top to bottom into the at least one ventilation duct (28).
12. The device according to claim 8 or 11, wherein the openings are such configured that the air enters the at least one helical conveyor channel (29) in conveying direction of the shaped parts (20).
13. The device according to any of claims 1 to 12, wherein a temperature sensor (19) is provided in the upper region of the device (27), with the temperature sensor being configured for determining the temperature of the shaped parts (20) in proximity to the means (14) controlling the outlet opening (5, 10).
14. The device according to any of claims 1 to 13, wherein a conditioning device (35) for conditioning the air is provided.
15. The device according to any of claims 1 to 14, wherein a hood (31) is provided at the top of the first hollow body (1) for pressurizing the interior (6) of the first hollow body (1) by way of at least one fan (23).
16. The device according to claim 15, wherein a number of controllable fans (23) is provided for varying conditions in parts of the at least one conveyor channel (29).

17. The device according to claim 15, wherein an inlet (32) is provided in the hood (31) to duct air into the interior (6) of the first hollow body (1).
18. The device according to any of claims 15 to 17, wherein the at least one fan (23) is provided in the interior (6) of the first hollow body (1).
19. The device according to any of claims 1 to 18, wherein one or more exhaustion channels (30) are provided to duct air out of the at least one conveyor channel (29).
20. The device according to claim 19, wherein the cross section of the first hollow body (1) is formed as a rectangle having rounded edges and an exhaustion channel (30) is provided in each edge thereof, whereby air is ducted from the at least one conveyor channel (29) to the exhaustion channels (30) via openings in the wall between the at least one conveyor channel (29) and the exhaust channels (30) positioned in each winding of the at least one conveyor channel (29).
21. The device according to any of claims 15 to 20, wherein at least one outlet (33) is provided in the hood (31) for ducting air out of the exhaustion channels (30).
22. The device according to any of claims 1 to 21, wherein a plurality of helical conveyor channels (29) arranged in parallel are provided.
23. The device according to claim 22, wherein means (17, 45) are provided for merging the shaped parts (20) with respect to a common discharge channel (18).
24. A system for molding shaped parts (20), the system comprising an injection molding machine (34), a device according to any of claims 1 to 22 and an air conditioner (35).
25. A method for controlling the device (27) according to any of claims 1 to 23, wherein the means (14) for controlling the outlet opening are such controlled that the shaped parts (20)

leaving the at least one helical conveyor channel (29) have a temperature that is below a predefined discharge temperature.

26. The method according to claim 25, wherein the means (14) for controlling the outlet openings determines the residence time of the shaped parts (20) within the at least one helical conveyor channel (29).
27. The method according to claims 24 to 26, wherein the means (14) for controlling the outlet opening (5, 10) will be closed upon shaped parts (20) start entering the at least one helical conveyor channel (29).
28. The method according to any of claims 25 to 27, wherein in a first step the means (14) for controlling the outlet opening (5, 10) remain closed, until the shaped parts (20) in front of the outlet opening (5, 10) have accumulated in the direction of the inlet opening (4, 9) to a predefined level, and in a second step the means (14) for controlling the outlet opening (5, 10) are opened intermittently so that the outlet rate of the shaped parts (20) is equal to the inlet rate thereof.
29. The method according to any of claims 25 to 28, wherein in case the means (14) for controlling the outlet opening (5, 10) remain closed for a longer period of time, the shaped parts (20) in front of the outlet opening (5, 10) are caused to accumulate in the direction of the inlet opening (4, 9) below the predefined level.



2/8

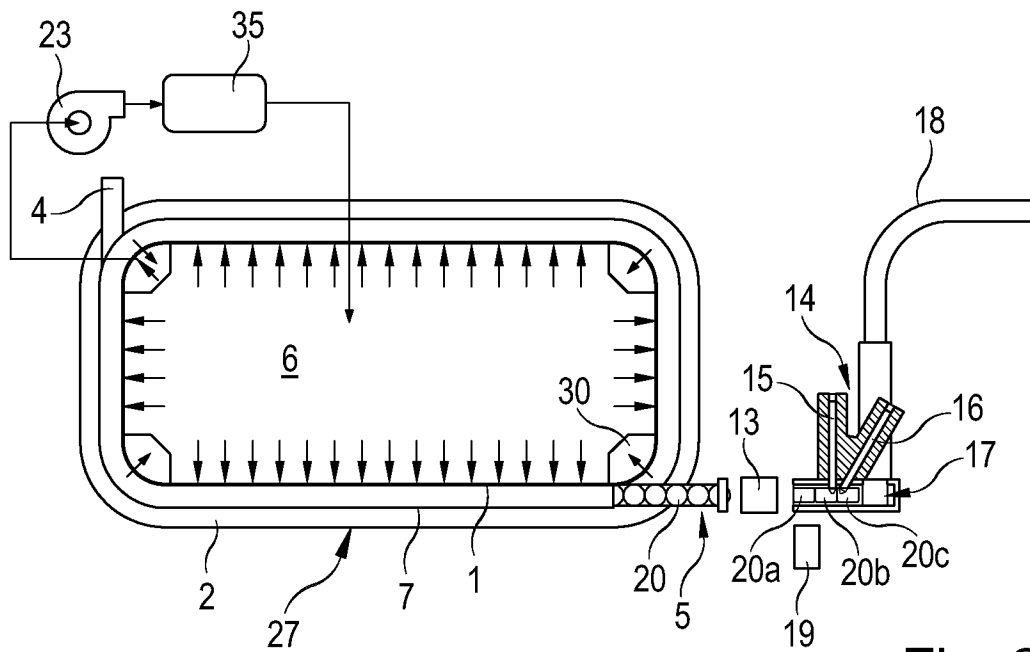


Fig. 2a

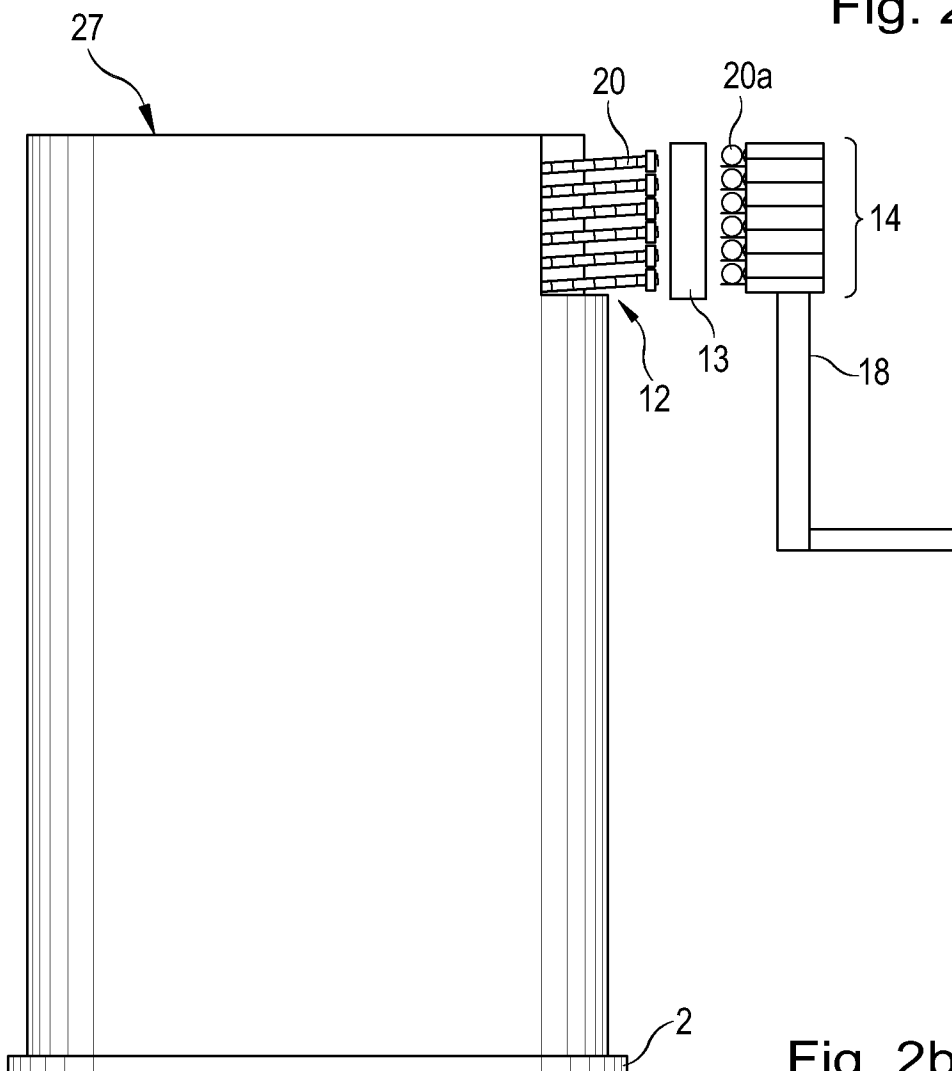


Fig. 2b

3/8

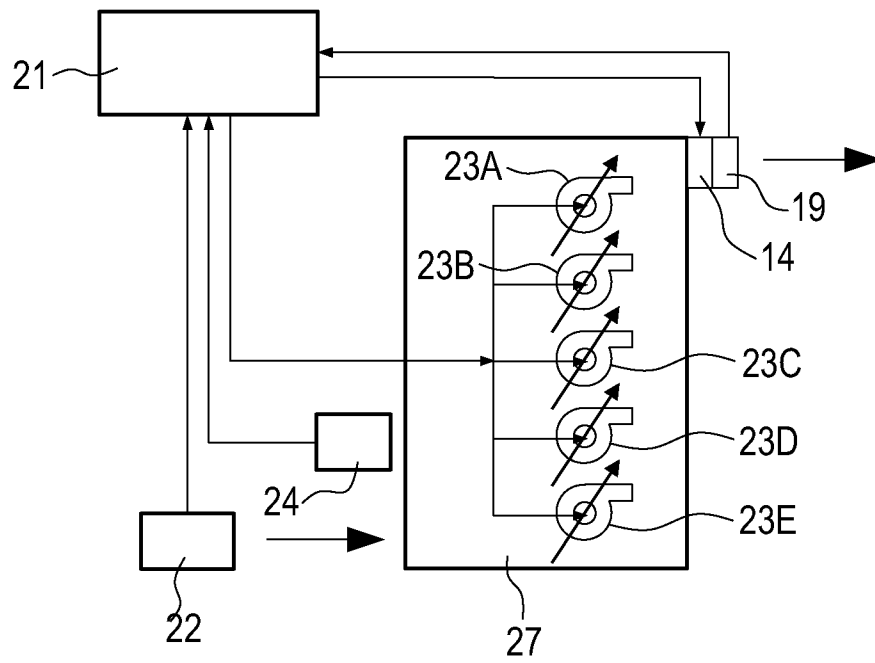


Fig. 3

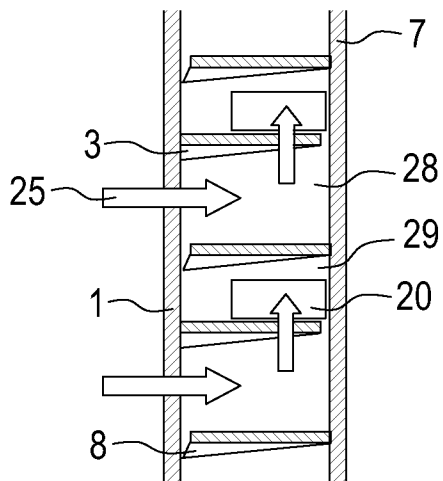


Fig. 4a

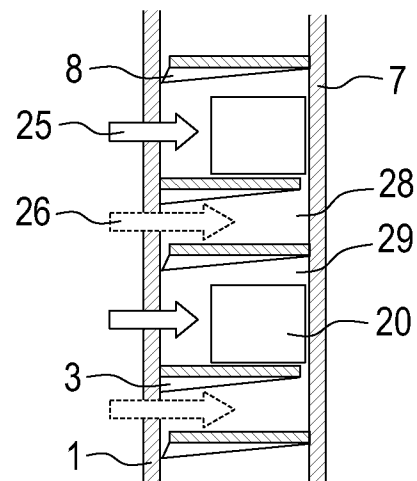


Fig. 4b

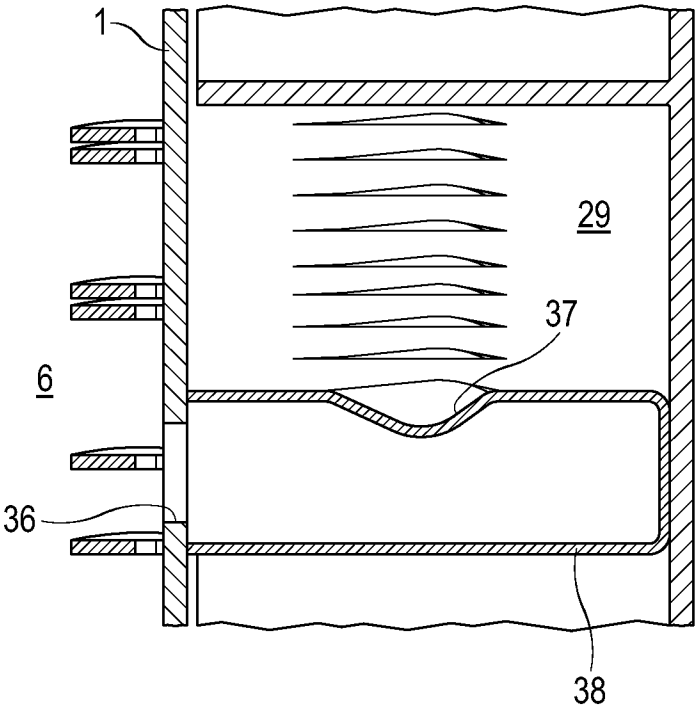


Fig. 5

5/8

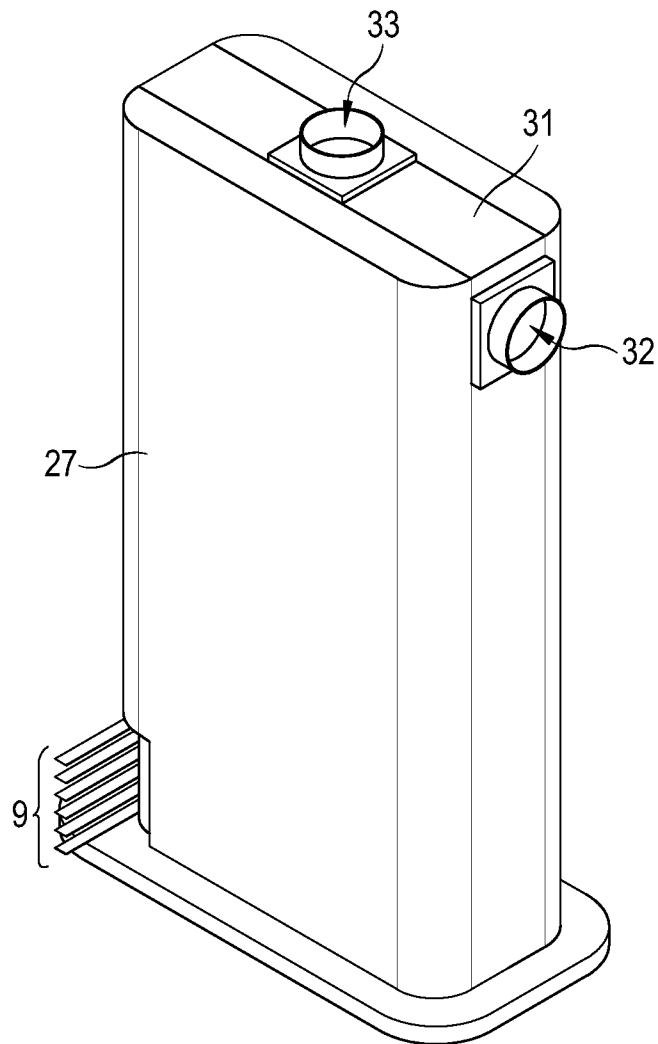


Fig. 6

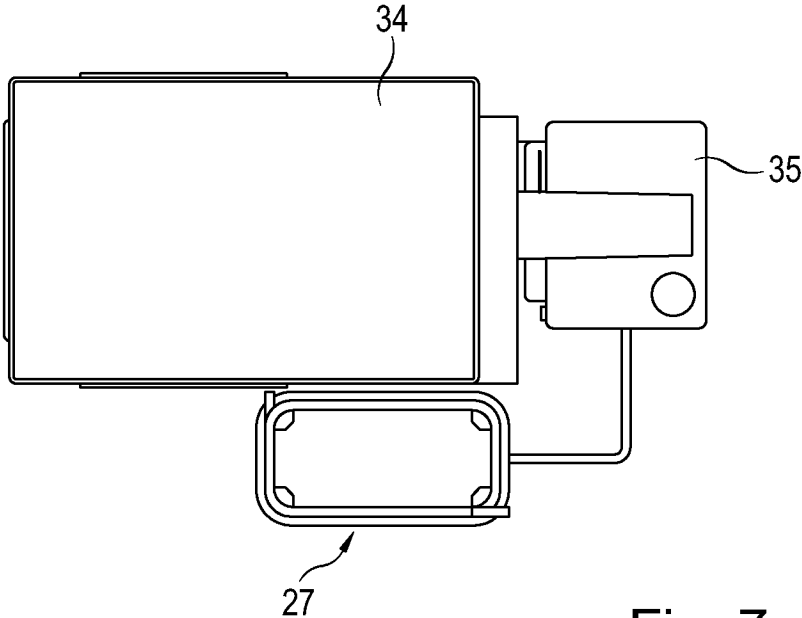


Fig. 7a

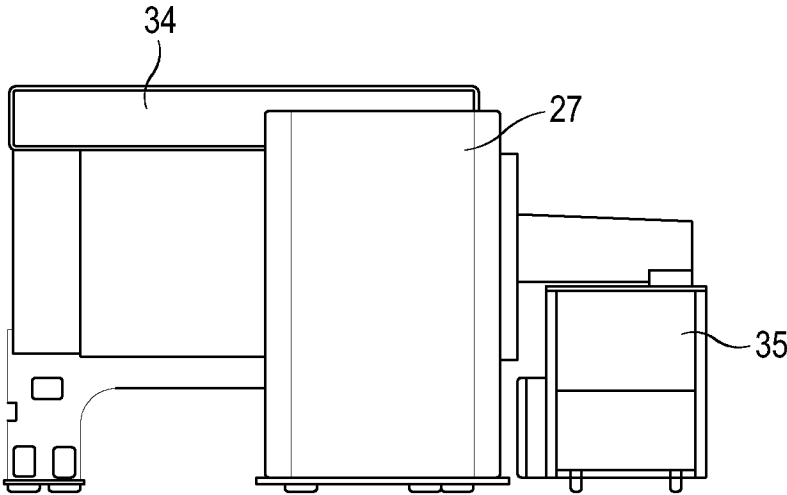


Fig. 7b

7/8

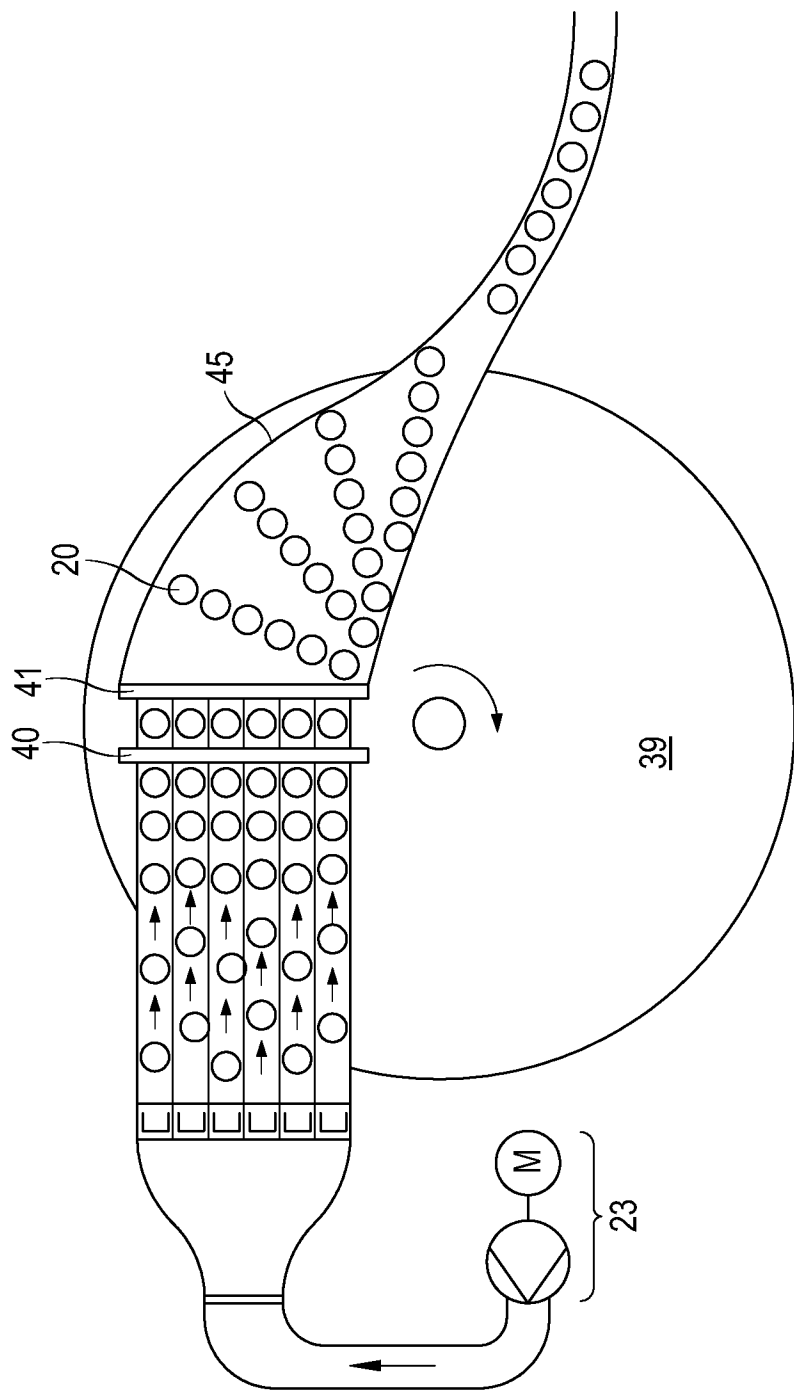


Fig. 8

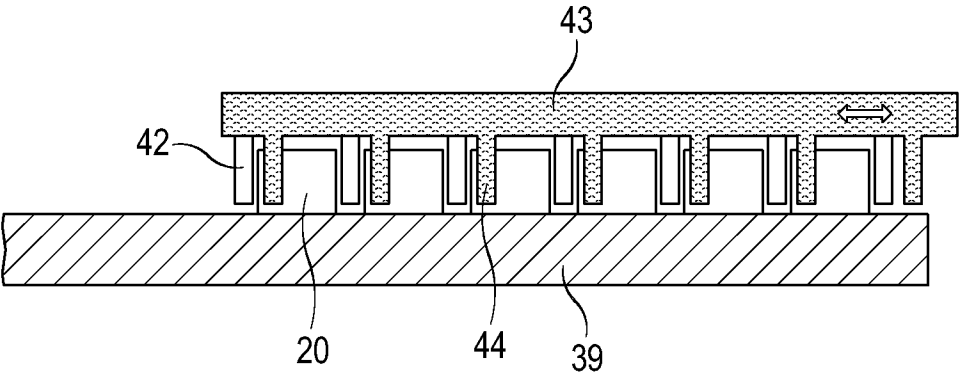


Fig. 9a

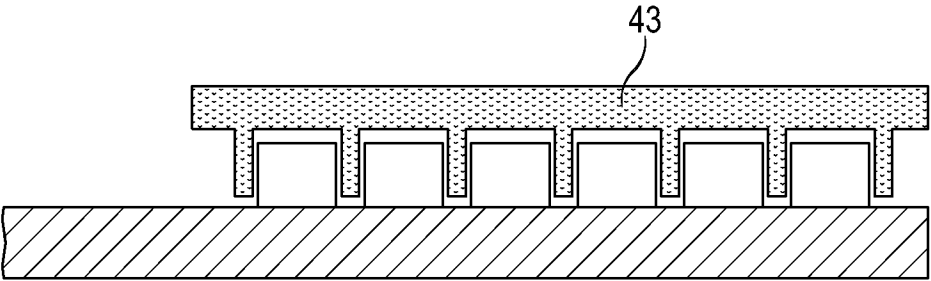


Fig. 9b

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2016/050147

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **B65G 49/00** (2006.01), **B65G 33/02** (2006.01), **B65G 47/74** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: **B65G 49/00** (2006.01), **B65G 33/02** (2006.01), **B65G 47/74** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Questel-Orbit: FAMPAT

Keywords: helix, helical, spiral, cool, dry, plenum, split, hinge

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y Y	GB 1 137 433 A (MAURITZ, L. S.), 18 December 1968 (18-12-1968) The whole document	1, 3, 7 to 12, 15 to 18 and 21 13, 14, 19 and 24 to 29 22 and 23
Y	US 4 875 343 A (JEPPSSON, E. H.), 24 October 1989 (24-10-1989) The whole document	13, 14, 19 and 24 to 29
Y	GB 1 554 170 A (KODAK), 17 October 1979 (17-10-1979) The whole document	22 and 23
A	US 6 364 088 B1 (STEFFENS, E. et al.), 02 April 2002 (02-04-2002) The whole document	1
A	US 2 718 957 A (SPURLIN, W.V.), 27 September 1955 (27-09-1955) The whole document	1

Further documents are listed in the continuation of Box C.

See patent family annex.

* "A" "E" "L" "O" "P"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance earlier application or patent but published on or after the international filing date document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed	"T" "X" "Y" "&"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art document member of the same patent family
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Date of the actual completion of the international search
08 March 2016 (08-03-2016)Date of mailing of the international search report
30 March 2016 (30-03-2016)Name and mailing address of the ISA/CA
Canadian Intellectual Property Office
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Facsimile No.: 819-953-2476

Authorized officer

Felix-Antoine Dandenault (819) 635-4801

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CA2016/050147

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
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US2718957A	27 September 1955 (27-09-1955)	None	