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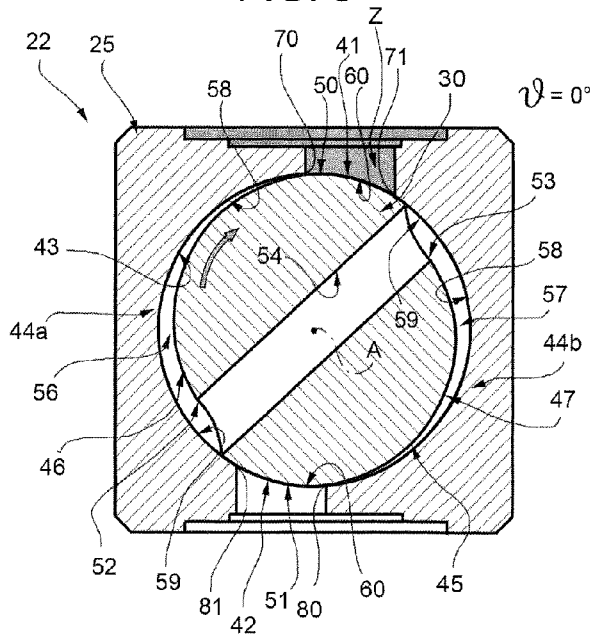
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(54) Title: SHUTTER FOR A VALVE AND CORRESPONDING VALVE FOR CONTROLLING AN AIR FLOW AND RELATIVE VALVE

FIG. 5



(57) Abstract: There is described a shutter (30) for a valve (22) for controlling an air flow; shutter (30) is selectively rotatable about an axis (A) and adapted to be housed inside a body (25) of valve (22), and comprises a surface (45) disposed about axis (A); surface (45) comprises at least one first curved portion (46, 47) shaped eccentrically relative to axis (A) so as to define, in use and together with body (25), at least one first passage (56, 57) for the air flow.

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SHUTTER FOR A VALVE AND CORRESPONDING VALVE FOR CONTROLLING AN AIR FLOW AND RELATIVE VALVE

TECHNICAL FIELD

5 The present invention relates to shutter for a valve for controlling an air flow in a packaging machine.

BACKGROUND ART

As it is known, many food products, such as fruit
10 juice, pasteurized or UHT (ultra-high-temperature treated) milk, wine, tomato sauce, etc., are sold in packages made of sterilized packaging material.

A typical example of this type of package is the parallelepiped-shaped package for liquid or pourable
15 food products known as Tetra Brik Aseptic (registered trademark), which is made by folding and sealing laminated strip packaging material.

The packaging material has a multilayer structure substantially comprising a base layer for stiffness and
20 strength, which may be defined by a layer of fibrous material, e.g. paper, or mineral-filled polypropylene material; and a number of layers of heat-seal plastic material, e.g. polyethylene film, covering both sides of the base layer.

25 In the case of aseptic packages for long-storage products, such as UHT milk, the packaging material may also comprise a layer of gas- and light-barrier material, e.g. aluminium foil or ethyl vinyl alcohol (EVOH) film, which is superimposed on a layer of heat-
30 seal plastic material, and is in turn covered with another layer of heat-seal plastic material forming the inner face of the package eventually contacting the food product.

As is known, packages of this sort are produced on fully automatic packaging machines, on which the tube is formed continuously from the web-fed packaging material. More specifically, the web of packaging material is unwound off a reel and fed through a station for applying a sealing strip of heat-seal plastic material, and through an aseptic chamber on the packaging machine, where it is sterilized, e.g. by applying a sterilizing agent such as hydrogen peroxide, which is subsequently evaporated by heating.

The web of packaging material is then fed through a number of forming assemblies which interact with the packaging material to fold it gradually from strip form into a tube shape.

More specifically, a first portion of the sealing strip is applied to a first longitudinal edge of the packaging material, on the face of the material eventually forming the inside of the packages; and a second portion of the sealing strip projects from the first longitudinal edge.

The forming assemblies are arranged in succession, and comprise respective roller folding members defining a number of packaging material passages varying gradually in cross-section from a C shape to a substantially circular shape.

On interacting with the folding members, the second longitudinal edge is laid on the outside of the first longitudinal edge with respect to the axis of the tube being formed. More specifically, the sealing strip is located entirely inside the tube, and the face of the second longitudinal edge facing the axis of the tube is superimposed partly on the second portion of the sealing strip, and partly on the face of the first longitudinal

edge located on the opposite side to the first portion of the sealing strip.

Packaging machines of the above type are known in which the first and second longitudinal edges are heat
5 sealed within the aseptic chamber to form a longitudinal seal along the tube, which is then filled with the sterilized or pasteurized food product.

Furthermore, the packaging machines of the above type comprise a forming unit in which the tube and is
10 sealed and cut along equally spaced cross sections to form pillow packs.

The forming unit comprise two or more jaws which cyclically interact with the tube to seal it.

The pillow packs are then folded mechanically to
15 form respective packages at a folding unit, which is arranged downstream of the movable components of the forming unit.

In detail, the forming unit is arranged downstream of the aseptic chamber, with reference to the advancing
20 direction of the tube.

The above described packaging machine comprises a plurality of branches which output relative flows of hot sterile air, e.g. at a temperature ranging between 5 to 280 °C, inside the aseptic chamber.

25 In particular, a first branch comprises a plurality of nozzles which output a first hot sterile air flow inside the aseptic chamber in order to keep it at the given value of temperature and pressure greater than the environment pressure.

30 A second branch comprises a nozzle which outputs a second hot sterile air flow onto the superimposed longitudinal edges, so as to form the longitudinal seal along the tube.

A third branch comprises a nozzle which is arranged downstream of the second branch, proceeding according to the advancing direction of the tube.

The third branch is activated only when the operation of the packaging machine starts again after an interruption.

In case of interruption, the portion of packaging material facing the nozzle of the second branch cools down, after having been previously heated.

The re-start of the packaging machine brings that portion in front of the nozzle of the third branch. At this stage, the nozzle of third branch is operated to output a third hot sterile air flow towards the packaging material. That third hot sterile air flow heats again this portion of the packaging material and ensure that the complete formation of the longitudinal seal.

Finally, a fourth branch comprises a nozzle which outputs a hot sterile air flow onto the web packaging material upstream of the aseptic chamber and before the packaging material is formed into a tube shape, in order to remove, by heating, the residual of hydrogen peroxide from the packaging material.

The above identified hot sterile air flows are regulated by respective control valves.

In particular, control valves are known which substantially comprise:

- an outer body which defines an inlet opening and outlet opening for the sterile air flow; and
- a disk or ball shaped shutter housed inside the outer body.

The shutter can be rotated between:

- a fully open position in which it allows the hot

sterile air to flow from the inlet opening to the outlet opening of the body; and

- a fully closed position in which it prevents the hot sterile air from flowing between the inlet opening and the outlet opening.

Due to the shape and construction of the shutter, the known valve has a poor capability of smoothly modulating the flow of hot sterile air flow.

In particular, with the known valve, the amount of sterile air flow suddenly grows from zero to the maximum value, when the shutter rotates from the fully closed position to the fully open position.

In other words, the plot of sterile air flow versus a rotation angle of the shutter is steep, is highly non-linear and reaches the maximum value after a small rotation angle of the shutter.

As a result, the hot sterile air flow is not precisely controllable.

A need is felt within the industry to obtain a variation as linear as possible of the sterile air flow in relation to the rotation angle for a wide range of rotation angle of the shutter, with a limited number of components and without affecting the possibility of preserving the sterility of the shutter.

DISCLOSURE OF INVENTION

It is therefore an object of the present invention to provide a shutter for a valve for controlling a sterile air flow in a packaging machine.

This object is achieved by a shutter as claimed in claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred, non-limiting embodiment of the present invention will be described by way of example with

reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a valve comprising a shutter, in accordance with the present invention;

5 Figure 2 is a perspective exploded view of the valve of Figure 1;

Figure 3 is a perspective view of a body of the valve of Figures 1 and 2, with parts removed for clarity;

10 Figure 4 is a transversal section of the valve of Figures 1 to 3;

Figures 5 to 10 show the transversal section of the valve of Figures 1 to 4 in respective different operative positions;

15 Figure 11 is a graphic of the sterile air flow versus the rotation angle of the shutter, for the valve of Figures 1 to 10;

Figure 12 is a schematic view of a packaging machine into which a plurality of valves of Figure 1 to
20 11 are installed, with parts removed for clarity; and

Figure 13 is a perspective view of the packaging machine of Figure 12.

BEST MODE FOR CARRYING OUT THE INVENTION

25 Number 1 in Figures 12 and 13 indicates as a whole a packaging machine for continuously producing sealed packages 4 of a food product from a web 3 of packaging material, which is unwound off a reel 75 and fed along a forming path P.

30 Machine 1 preferably produces sealed packages 4 of a pourable food product, such as pasteurized or UHT milk, fruit juice, wine, peas, beans, etc.

Machine 1 may also produce sealed packages 4 of a food product that is pourable when producing packages 4,

and sets after packages 4 are sealed. One example of such a food product is a portion of cheese, that is melted when producing packages 4, and sets after packages 4 are sealed.

5 The packaging material has a multilayer structure substantially comprising a base layer for stiffness and strength, which may be defined by a layer of fibrous material, e.g. paper, or mineral-filled polypropylene material; and a number of layers of heat-seal plastic
10 material, e.g. polyethylene film, covering both sides of the base layer.

Machine 1 substantially comprises, proceeding along path P:

- a number of guide members 5, e.g. rollers or
15 similar, which feed web 3 along path P;

- a sterilizing station 6 for sterilizing web 3 of packaging material;

- a forming station 7 for forming a tube 10 of
packaging material having an axis A;

20 - a station 8 for heat sealing a longitudinal seal 11 along tube 10;

- a filling device 12 for pouring the sterilized or sterile-processed food continuously into tube 10; and

25 - a forming unit 13 for transversally sealing and cutting tube 10, so as to form pillow packs 2 which are subsequently folded (in not-shown way) into relative packages 4.

In detail, sterilizing station 6 comprises, proceeding along path P, (Figure 12):

30 - a tank 14 filled with a sterilizing agent, such as hydrogen peroxide, through which web 3 is advanced; and

- a nozzle 15 arranged downstream of tank 14

proceeding along path P, and adapted to blow a jet of hot sterile air onto web 3 coming out from tank 14, so as to remove, by evaporation, the hydrogen peroxide.

Station 7 comprises a number of forming assemblies 40 arranged successively along path P, and which interact gradually with web 3 to fold it into the form of tube 10.

More specifically, forming assemblies 40 comprise respective numbers of rollers defining respective compulsory packaging material passages, the respective sections of which vary gradually from a C shape to a substantially circular shape.

Station 8 comprises a plurality of nozzles 17 adapted to blow hot sterile air onto superimposed longitudinal edges 16 (Figure 13) of tube 10 in order to heat seal the packaging material of edge 16 and thus creating longitudinal seal 11 (Figure 13).

In this way, seal 11 can be formed even when the packaging material does not comprise a layer of conductive material, e.g. aluminum.

Furthermore, station 8 comprises a plurality of so-called "short stop" nozzles 18 which are arranged downstream of nozzle 17, proceeding along path P.

Furthermore, nozzles 18 are arranged in front of superimposed edges 16 of tube 10.

In case of interruption of the operation of packaging machine 1, previously heated superimposed longitudinal edges 16 arranged in front of nozzles 18 cool down.

In this case, when machine 1 starts again, nozzles 18 are activated in order to eject a hot sterile air flow onto cooled down superimposed edges 16, so as to heat seal the packaging material of edges 16 and ensure

that longitudinal seal 11 is perfectly formed.

Machine 1 also comprises (Figure 12):

- an aseptic chamber 19 which houses station 7 and 8 and is filled with sterile air at a temperature and a pressure greater than those of the environment; and
- a rail 20 provided with a plurality of nozzles 21 adapted to blow hot sterile air inside chamber 19.

In particular, filling device 12 fills tube 10 with pourable product inside aseptic chamber 19.

Machine 1 also comprises a plurality of branches 9, four in the embodiment shown, fed with hot sterile air at a certain pressure preferably by the same source and comprising relative control valves 22 for controlling the flows of hot sterile air flows to be fed to respective nozzles 15, 17, 18, 21.

Furthermore, valves 22 are configured to control the flow of hot sterile air at a temperature ranging from 5 to 280 °C.

In particular, valves 22 are fluidly connected with respective nozzles 15, 17, 18, 21 by respective conduits 24.

Valves 22 being identical, in the example described herein, only one is described below.

With reference to Figures 1 to 10, valve 22 substantially comprises:

- a body 25 defining an inlet opening 26 and an outlet opening 27 for the hot sterile air flow;
- a shutter 30 housed inside body 25 in a rotary manner about an its own axis A; and
- a rotary actuator 31 operatively connected with shutter 30 for setting it in a given angular position relative to body 25 and about axis A.

In detail, body 25 is symmetrical about axis A, is

box-shaped and comprises:

- a pair of opposite walls 28, 29 parallel to axis A and which define respective openings 26, 27;

5 - a wall 32 extending orthogonally between walls 28, 29 and orthogonal to axis A; and

- a pair of walls 33a, 33b which extend orthogonally between walls 28, 29, are parallel to axis A and orthogonal to wall 32.

10 Valve 22 also comprises a lid 24 arranged orthogonally to walls 28, 29 and to axis A, and which closes body 25 on the opposite side of wall 32.

With reference to Figures 4 to 10, body 25 further comprises:

15 - a pair of arc-shaped walls 36a, 36b opposite to relative walls 33a, 33b, having relative concavities facing axis A and circumferentially interrupted about axis A; and

20 - a pair of inlet and outlet conduits 37, 38 which orthogonally protrude from walls 28, 29 towards axis A and have relative inlet and outlet mouths 41, 42 defined by openings 26, 27 respectively.

Mouths 41, 42 are circumferentially interposed between walls 36a, 36b and are arranged at a given radial distance from axis A.

25 Mouth 41 comprises, on the side of axis A, a pair of ends 70, 71 extending parallel to axis A. End 71 is radially closer than end 70 to axis A.

30 Mouth 42 comprises a pair of ends 80, 81 extending parallel to axis A. End 81 is radially closer than end 80 to axis A.

Proceeding about axis A, end 71 is interposed circumferentially between ends 70, 80 and end 81 is interposed circumferentially between ends 80, 70.

Walls 36a, 36b and mouths 41, 42 define a cylindrical seat 43 which houses shutter 30 and is fluidly connected with inlet and outlet openings 26, 27 through conduits 37, 38.

5 More precisely, conduits 37, 38 are symmetrical relative to axis A and are staggered relative to a mid-plane of walls 26, 27.

Actuator 31 comprises a stator 34 and a rotor 35 operatively connected to shutter 30 (Figure 2).

10 In the embodiment shown, actuator 31 is a micro-motor fed with direct current, and comprises a gearbox interposed between rotor 35 and shutter 30.

Actuator 31 is controlled on the basis of the angular position of shutter 30, which is detected by a
15 not-shown sensor.

Shutter 30 is tubular and symmetric about axis A.

Furthermore, shutter 30 comprises a surface 45 (Figures 5 to 10) which is disposed about axis A and faces mouths 41, 42 and wall 36a, 36b.

20 In particular, surface 45 faces the boundary of seat 43.

Surface 45 advantageously comprises (Figures 5 to 10):

- a curved portion 46 shaped eccentrically relative
25 to axis A, so as to define with wall 36a, 36b a passage 56 for hot sterile air flow; and

- a curved portion 47 shaped eccentrically relative to axis A, so as to define with wall 36a, 36b a passage 57 for hot sterile air flow;

30 passages 56 and 57 are fluidly connected to one another.

In other words, portions 46, 47 are cam-shaped and extend at gradually varying radial distances from axis

A.

Shutter 30 also comprises a through radial hole 54 which extends between portions 46, 47 and fluidly connects passage 56 with passage 57.

5 Surface 45 comprises a first half 44a and a second half 44b.

Half 44a comprises a section 50 and portion 46, and half 44b comprises a section 51 and portion 47.

Each half 44a, 44b extends about axis A for an arch
10 of 180 degrees.

In detail, sections 50, 51 extend at the maximum radial distance from axis A, so as to define the maximum radial size of shutter 30.

Sections 50, 51 are opposite to one another
15 relative to axis A.

Portion 46 is interposed circumferentially between sections 51, 50 and portion 47 is interposed circumferentially between sections 50, 51, proceeding according to the rotation sense of shutter 30 shown in
20 Figures 5 to 10.

In the embodiment shown, sections 50, 51 have a certain circumferential size and are separated from wall 36a, 36b by a certain gap. In this way, the hot sterile air may flow inside the gap and sterilizes whole surface
25 45.

Each portion 46, 47 also comprises a relative section 52, 53 interposed between sections 50, 51 and which extend at the minimum radial distance from axis A, so as to define the minimum radial size of shutter 30.

30 With reference to Figure 4, portion 46 comprises, proceeding from section 51 to section 50 according to the rotation sense of shutter 30 shown in Figures 5 to 10:

- a stretch 49 which extends at gradually decreasing radial distances from axis A;

- section 53; and

5 - a stretch 48 which extends at gradually increasing radial distance from axis A.

In a completely analogous way, portion 47 comprises, proceeding from section 50 to section 51 according to the rotation sense of shutter 30 shown in Figures 5 to 10, :

10 - a stretch 49 which extends at gradually decreasing radial distances from axis A;

- section 52; and

- a stretch 48 which extends at gradually increasing radial distance from axis A.

15 Stretch 49 extends about axis A for an arch narrower than the one of stretch 48.

In other words, stretch 49 extends generally circumferentially about axis A for a relatively shorter distance compared to stretch 48.

20 Hole 54 extends between stretches 49.

Hole 54 is elongated parallel to axis A, as shown in Figure 2.

Each passage 56, 57 is radially defined by a relative half 44a, 44b of surface 45 and the boundary of seat 43.
25

Each passage 56 comprises, proceeding from section 51 to section 50 according to the rotating sense of shutter 30 shown in Figures 5 to 10:

30 - a relative portion 59 radially defined between stretch 49 and the boundary of seat 43, and which has gradually increasing radial size; and

- a relative portion 58 radially defined between stretch 48 and the boundary of seat 43, and which has

gradually decreasing radial size; and

- a relative constant radial size portion 60 radially defined between section 50 and the boundary of seat 43.

5 In the very same way, passage 57 comprises, proceeding from section 50 to section 51 according to the rotating sense of shutter 30 shown in Figures 5 to 10:

- a relative portion 59 radially defined between stretch 49 and the boundary of seat 43, and which has gradually increasing radial size;

- a relative portion 58 radially defined between stretch 48 and the boundary of seat 43, and which has gradually decreasing radial size; and

15 - a relative constant radial size portion 60 radially defined between section 51 and the boundary of seat 43.

Hole 54 opens into portions 59 and is interposed between portions 59.

20 With reference to Figures 1 to 4, openings 26, 27 have a length along a direction orthogonal to the length of hole 54.

In greater detail, openings 26, 27 have a length extending orthogonally to axis A and parallel to the plane of walls 28, 29, respectively.

25 Still more precisely, the width of opening 26 measured parallel to axis A decreases, proceeding from one of wall 33b towards other wall 33a orthogonally to axis A.

30 In the embodiment shown, opening 26 is shaped as an isosceles triangle which has a base 61 arranged towards wall 33b and an apex 62 opposite to base 61 and arranged toward wall 33a (Figures 1 and 2).

The width of opening 26 measured parallel to axis A decreases, proceeding from wall 33a towards wall 33b orthogonally to axis A.

Opening 27 is also shaped as an isosceles triangle, which has a base 61 arranged toward wall 33a and apex 62, opposite to base 61, and arranged toward wall 33b (Figure 3).

In other words, openings 26, 27 have an increasing width, proceeding according to the rotation sense of shutter 30 indicated in Figures 4 to 10.

Each shutter 30 of valve 22 is generally kept by relative actuator 31 in a fixed angular position about axis A, on the basis of the amount of hot sterile air flow required by relative nozzle 15, 17, 18, 21.

Alternatively, the angular position of shutter 30 of valves 22 about axis A may be dynamically varied by relative actuators 31.

With reference to Figure 11, it is shown the plot Q of hot sterile air flow coming out from valve 22 alongside rotation angle ϑ of shutter 30 about axis A.

In particular, rotation angle ϑ is zero when section 50 is at a circumferential edge 70 of mouth 41 and section 51 is at a circumferential edge 80 of mouth 42 (Figure 5).

Plot Q substantially comprises:

- a stretch R in which the hot sterile air flow increases in a roughly linear way relative to rotation angle ϑ and which corresponds to rotation angles ϑ ranging from zero to about 120 degrees (Figures 5 to 9);
- a stretch S which is less sloped than stretch R, in which hot sterile air flow linearly increases relative to rotation angle ϑ and which corresponds to rotation angles ϑ ranging from about 120 to about 150

degrees (Figures 9 and 10); and

- a stretch T in which hot sterile air flow linearly decreases relative to rotation angle ϑ and which corresponds to rotation angles ϑ greater than
5 about 150 degrees (Figure 10).

It is important to mention that both the sterile air flow concentrated load losses and the distributed load losses between openings 26, 27 depend on rotation angle ϑ .

10 As far as the distributed load losses are concerned, shutter 30, body 25 and mouths 41, 42 define a preferential path Z (shown in Figures 5 to 10) for the hot sterile air flow. The length of path Z and, therefore, the resulting distributed load losses,
15 depends on rotation angle ϑ .

Path Z is indicated in Figures 5 to 10 by the shaded area.

In greater detail, as shown in Figures 4 to 9, path Z substantially comprises:

20 - the portions of passages 56, 57 arranged between mouths 41, 42 of openings 26, 27 respectively and hole 54; and
- hole 54.

25 The length of the portions of passages 56, 57 depends on rotation angle ϑ whereas the length of hole 54 is constant for each rotation angle ϑ .

30 Concentrated load losses are caused by the fact that the hot sterile air flow is conveyed in restricted sections when moving from mouth 41 into passage 56 and when moving from passage 57 into mouth 42. The width of these restricted sections and, therefore, the resulting concentrated load losses, depend on rotation angle ϑ as visible in Figures 4 to 10.

The combined effects of both concentrated and distributed load losses are illustrated by plot Q, as it will be explained below.

In particular, when rotation angle ϑ equals 0 degree (Figure 5), end 70 of mouth 41 faces section 50 and section 51 faces end 80 of mouth 42.

Accordingly, as shown in Figure 5, the hot sterile air flow tends to move along the whole passage 56, then enters hole 54, moves along the whole passage 57 and finally reaches mouth 42, conduit 38 and outlet opening 27.

In view of the above, path Z is the longest possible, thus maximizing the resulting distributed load loss.

Furthermore, the hot sterile air flow is forced to enter both portions 60 of passage 56, 57. Due to the fact that portions 60 define the radial narrowest sections of passages 56, 57, the resulting concentrated pressure losses are the highest.

As a result of both the highest concentrated and distributed loss, the amount of hot sterile air flow is the minimum when rotation angle ϑ is null.

As rotation angle ϑ is increased by actuator 31 (Figures 6 to 8), mouth 41 opens into portion 58 of passage 56 and portion 58 of passage 57 opens into mouth 42.

Accordingly, the hot sterile air flow tends to move along the path Z formed by:

- only the part of portion 58 of passage 56 interposed between mouth 41 and hole 54;
- hole 54; and
- only the part of portion 58 of passage 57 interposed between hole 54 and mouth 42.

It is therefore apparent that length of path Z decreases, as rotation angle ϑ increases.

Furthermore, due to the fact that portions 58 are radially wider than portions 60 and have progressively increasing radial size, the hot sterile air flow is forced to pass through progressively wider radial section, as rotation angle ϑ increases.

Accordingly, as rotation angle ϑ increases, both the distributed and concentrated pressure losses decrease. As a result, stretch R of plot Q is quasi-linear.

When rotation angle ϑ is about 120 degrees (Figure 9), mouth 41 opens into portion 59 of passage 56 and portion 59 of passage 57 faces mouth 42.

Due to the fact that hole 54 connects stretches 48, 49, the load losses due to the change of section between conduit 37 and passage 60 is particularly low for this range rotation angle ϑ . This reduced load losses would contribute to highly increase the hot sterile air flow which passes through valve 22.

However, it should be taken into account that openings 26, 27 have a length which extends orthogonally to the length of hole 54 and a triangular shape that cooperates with passage 56, 57. This contributes to contain the hot sterile air flow which passes through valve 22.

The Applicant has found that the combination of these two effects causes the quasi-linear shape of stretch S of plot Q and avoids that the flow suddenly increases for rotation angle closer to 120 degrees.

As rotation angle ϑ further increases (Figure 10), section 51 circumferentially overcomes end 70 of mouth 41 and section 52 circumferentially overcomes end 71 of

mouth 42.

Accordingly, the hot sterile air flow has to flow through progressively narrowing section, thus increasing the resulting load losses and progressively decreasing
5 the hot sterile air flow in the stretch T of plot Q.

In actual use, web 3 is unwound off reel 75 and fed along path P (Figures 12 and 13).

More specifically, web 3 is fed by guide members 5 along path P and through aseptic chamber 19.

10 In detail, web 3 is at first advanced inside tank 14 so as to be sterilized by the peroxide hydrogen.

Subsequently, nozzle 15 blows a jet of hot sterile air onto web 3, so as to remove the residues of the peroxide hydrogen.

15 Web 3 then passes through stations 7 and 8, which are arranged inside aseptic chamber 19.

In detail, nozzles 21 blow jets of hot sterile air into aseptic chamber 19, so that the latter is kept at a temperature and a pressure greater than environment
20 ones.

Forming assemblies 40 gradually interact with web 3, so as to fold and form tube 10, by superimposing edges 16.

At station 8, superimposed edges 16 are heated by a
25 jet of sterile hot air blown by nozzles 17.

In this way, the packaging material of edges 16 is heated to melt the polyethylene layer and seal 11 is formed.

In the normal operation of machine 1, nozzles 18
30 are not activated.

In case of interruption of the operation of packaging machine 1, previously heated superimposed edges 16 arranged in front of nozzle 18 cool down.

In this case, when machine 1 starts again, nozzles 18 are activated to blow hot sterile air onto these cooled down edges 16, so that seal 11 is correctly formed.

5 The longitudinally sealed tube 10 is filled continuously with the pourable food product by device 12.

Tube 10 is then conveyed to the forming unit 13 where it is gripped, sealed, and cut along equally spaced cross sections to form a succession of packs 2, 10 which are subsequently folded so as to form respective packages 4.

Valves 22 control the flow of hot sterile air at respective nozzles 15, 17, 18, 21.

15 In detail, actuator 31 of each valve 22 sets relative shutter 30 at a given angle ϑ , so that a corresponding hot sterile air flow can reach relative nozzle 15, 17, 18, 21.

The advantages of shutter 30 according to the present invention will be clear from the foregoing 20 description.

In particular, due to the eccentrically shaped portions 46 and 47 of shutter 30, the variation of hot sterile air flow with respect to rotation angle ϑ is 25 substantially piecewise linear and precisely controllable in a wide range of rotation angles ϑ .

In this respect, the Applicant has found that, due to the shape of passages 56, 57, as rotation angle ϑ increases, the hot sterile air flow gently varies 30 without any sudden jump as shown in Figure 11.

In this way, small positioning errors in rotation angle ϑ do not result in any sensible variation in the amount of flow of hot sterile air conveyed to opening

27.

The Applicant has also found that the shape of passage 56, 57 results in a variation of both concentrated and distributed load loss, as rotation angle ϑ increase. This has been found to be effective in extending the range of rotation angles ϑ in which the hot sterile air flow may be controlled.

Furthermore, openings 26, 27 are elongated orthogonally to the length of hole 54.

Accordingly, even when hole 54 faces mouths 41, 42 as shown in Figure 8, there is no sudden increase in the hot sterile air flow conveyed by valve 22. This is shown in stretch S of plot P.

Furthermore, due to the presence of a radial gap between sections 50 and walls 36a, 36b and to the fact that shutter 30 has no components protruding outside body 25, valve 22 may be easily sterilized by the flow of hot sterile air onto surface 45.

Finally, valve 22 has a very limited number of components and is therefore very easy to manufacture and maintain.

Clearly, changes may be made to machine 1 and to the method as described and illustrated herein without, however, departing from the scope defined in the accompanying Claims.

In particular, openings 26, 27 may be rectangular with a length orthogonal to axis A.

Furthermore, openings 26, 27 may have another shape, such as oval or round, for example.

Finally, the application of shutter 30 and valve 22 may be for fluids other than air, such as gasses or liquids, or to control non-sterile fluid flows.

CLAIMS

1.- A shutter (30) for a valve (22) for controlling
an air flow;

said shutter (30) being selectively rotatable about
5 an axis (A) and adapted to be housed inside a body (25)
of said valve (22);

said shutter (30) comprising a surface (45)
disposed about said axis (A);

characterized in that said surface (45) comprises
10 at least one first curved portion (46, 47) shaped
eccentrically relative to said axis (A) so as to define,
in use and together with said body (25), at least one
first passage (56, 57) for said air flow.

2.- The shutter of claim 1, characterized in that
15 said surface (45) comprises a second curved portion (47,
46) shaped eccentrically relative to said axis (A), so
as to define, in use and together with said body (25), a
second passage (57, 56) for said air flow;

said second passage (57, 56) being fluidly
20 connected with said first passage (56, 57).

3.- The shutter of claim 2, characterized by
comprising a through hole (54) interposed between said
first and second curved portions (46, 47), and which, in
use, fluidly connects, said first passage (56, 57) with
25 said second passage (57, 56).

4.- The shutter of any one of the foregoing claims,
characterized in that said surface (45) comprises,
proceeding according to the advancing rotating sense of
said shutter (30) about said axis (A),:

30 - a circumferential first end section (51; 50);
- a first stretch (49) bounded by said first end
section (51; 50) and extending at decreasing radial
distance from said axis (A);

- a second stretch (48) which extends at increasing radial distances from said axis (A); and

- a circumferential second end section (50; 51), which is opposite to said first end section (51; 50) and
5 bounds said second stretch (48) on the opposite side of said first stretch (49).

5.- The shutter of claim 4, characterized in that said end sections (50, 51) extend at a constant radial distance from said axis (A).

10 6.- The shutter of claim 4 or 5, when depending on claim 3, characterized in that said hole (54) opens into said second stretch (49) of at least one of said first and second portions (46, 47).

15 7.- The shutter of any one of the foregoing claims, characterized in that said surface (45) is symmetrical relative to said axis (A).

8.- A valve (22) for controlling an air flow, characterized by comprising:

- a body (25) defining said inlet and an outlet
20 opening (26, 27) for air flow; and

- a shutter (30) according to any one of the previous claims;

said first passage and said second passage (56, 57) being fluidly connected to said inlet and outlet opening
25 (26, 27) respectively.

9.- The valve of claim 8, characterized in that at least one of said inlet opening and outlet opening (26, 27) extend along a first direction; and said hole (54) has a length along a second direction transversal to
30 said first direction.

10.- The valve of claim 9, characterized in that said at least one of said inlet opening and outlet opening (26, 27) has an increasing width, proceeding

according to a direction tangential to said axis (A).

11.- The valve of claim 9 or 10, characterized in that said at least one of said inlet or outlet opening (26, 27) is triangular with a base parallel to said axis (A) and an height orthogonal to said axis (A).
5

12.- The valve of any one of claims 8 to 11, when depending on any one of claims 3 to 7, characterized in that said body (25) comprises an inlet mouth and an outlet mouth (41, 42) which open into said first passage and second passage (56, 57) respectively and are fluidly connected with said inlet opening and outlet opening (26, 27);
10

said inlet mouth, said outlet mouth (41, 42) and said shutter (30) defining a preferential path (Z) for said air flow;
15

said path (Z) comprising the portion of said first passage (56) which extends between said inlet mouth (41) and said hole (54), and the portion of said second passage (57) which extends between said hole (54) and said outlet mouth (42);
20

the length of said path (Z) depending on an angular position (ϑ) of said shutter (30) about said axis (A).

13.- The valve of any one of claims 8 to 12, characterized by comprising an actuator (31) for selectively rotating said shutter (30) relative to said body (25).
25

14.- A packaging machine for producing sealed packages (4) of pourable food product from a web (3) of packaging material, comprising:
30

- a sterilizing station (6) in which a sterilizing agent is applied onto said web (3); and/or

- a first nozzle (15) for blowing a first flow of sterile air at a given temperature in order to remove

said sterilizing agent from said web (3); and/or

- an aseptic chamber (19) through which said web (3) is fed and within which a tube (10) is formed from said web (3); and/or

5 - at least one second nozzle (21) for blowing a second flow of sterile air a second given temperature inside said aseptic chamber (19);

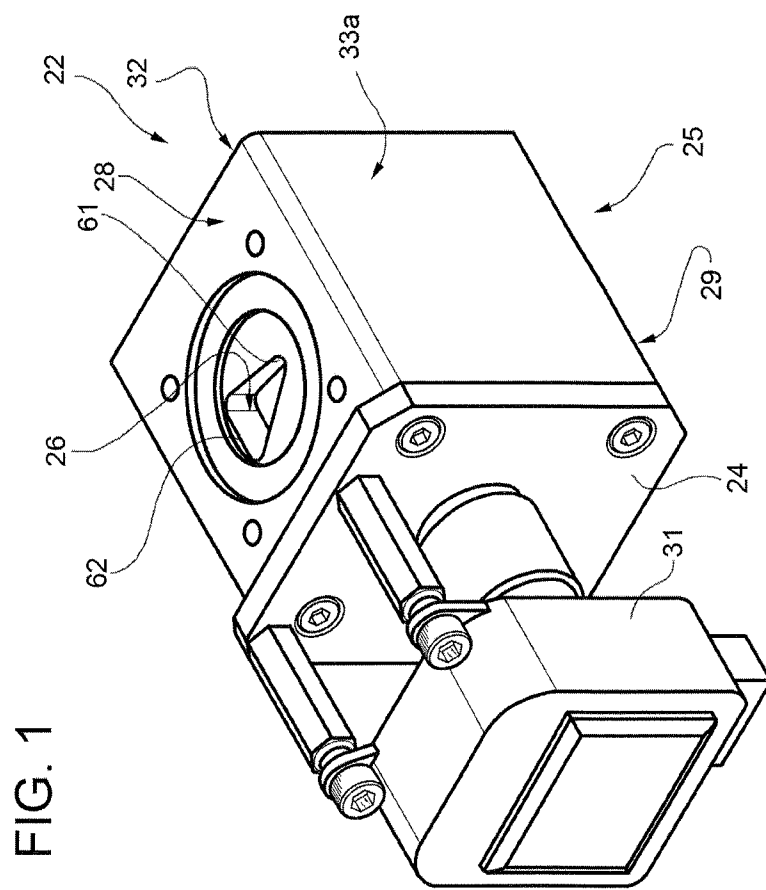
- a third nozzle (17) arranged inside said aseptic chamber (19) and adapted to blow a third flow of sterile
10 air onto superimposed longitudinal edges (16) of said tube (10), in order to form a longitudinal seal of said tube (10); and

- a fourth nozzle (18) arranged inside said aseptic chamber (19) and adapted to blow a fourth flow of
15 sterile air onto said longitudinal edges (16) of said tube (10), in case that the advancement of said tube (10) starts again after having been previously interrupted; and

- at least one valve (22) according to any one of
20 claims 8 to 13, which is fluidly connected with a respective one of said first, second, third and fourth nozzle (15, 21, 17, 18) for regulating relative said sterile air flow.

25

30



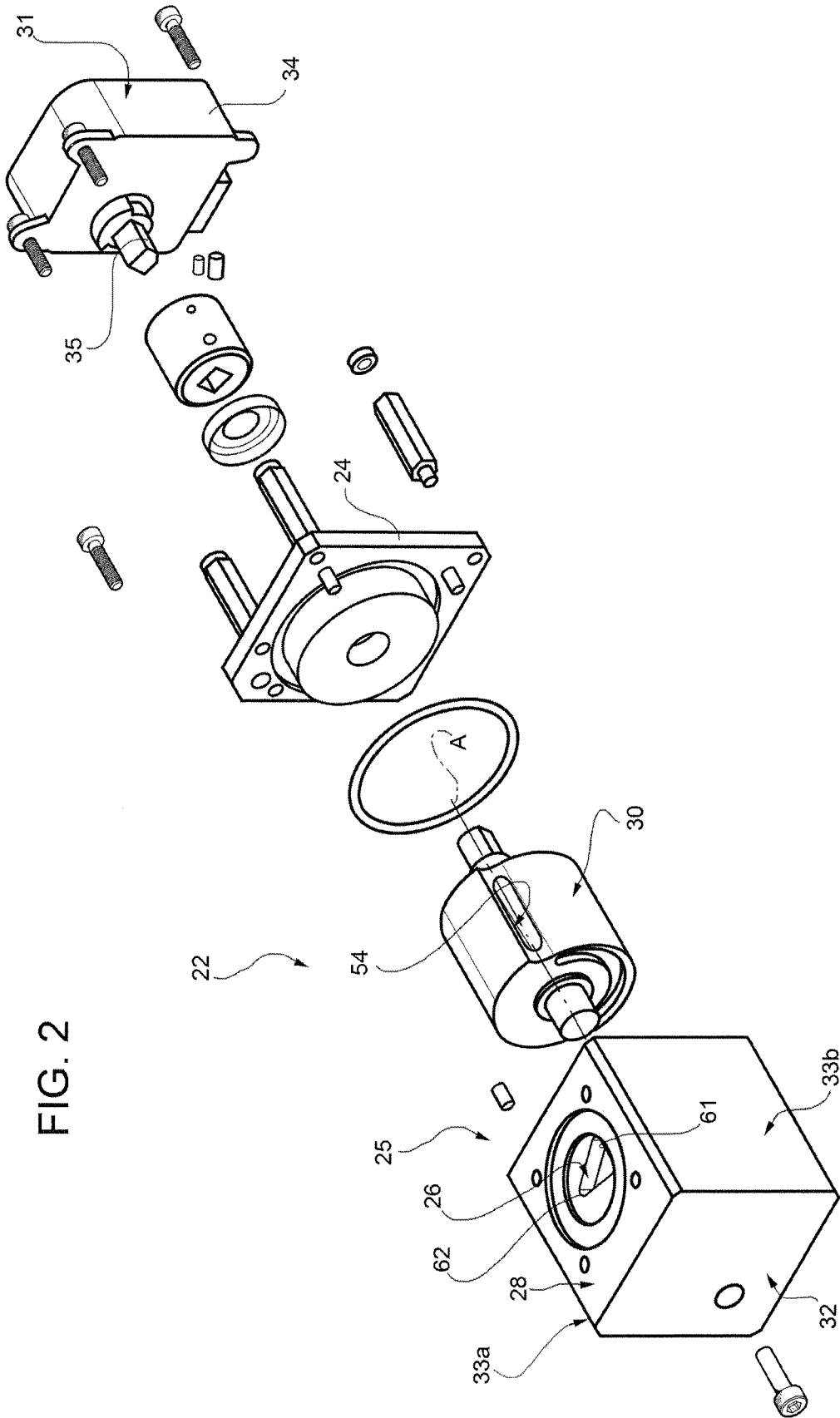


FIG. 2

FIG. 3

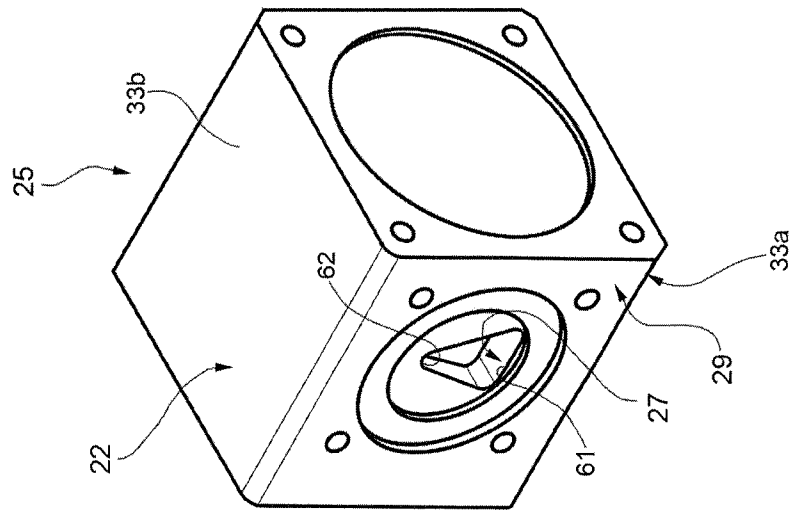


FIG. 4

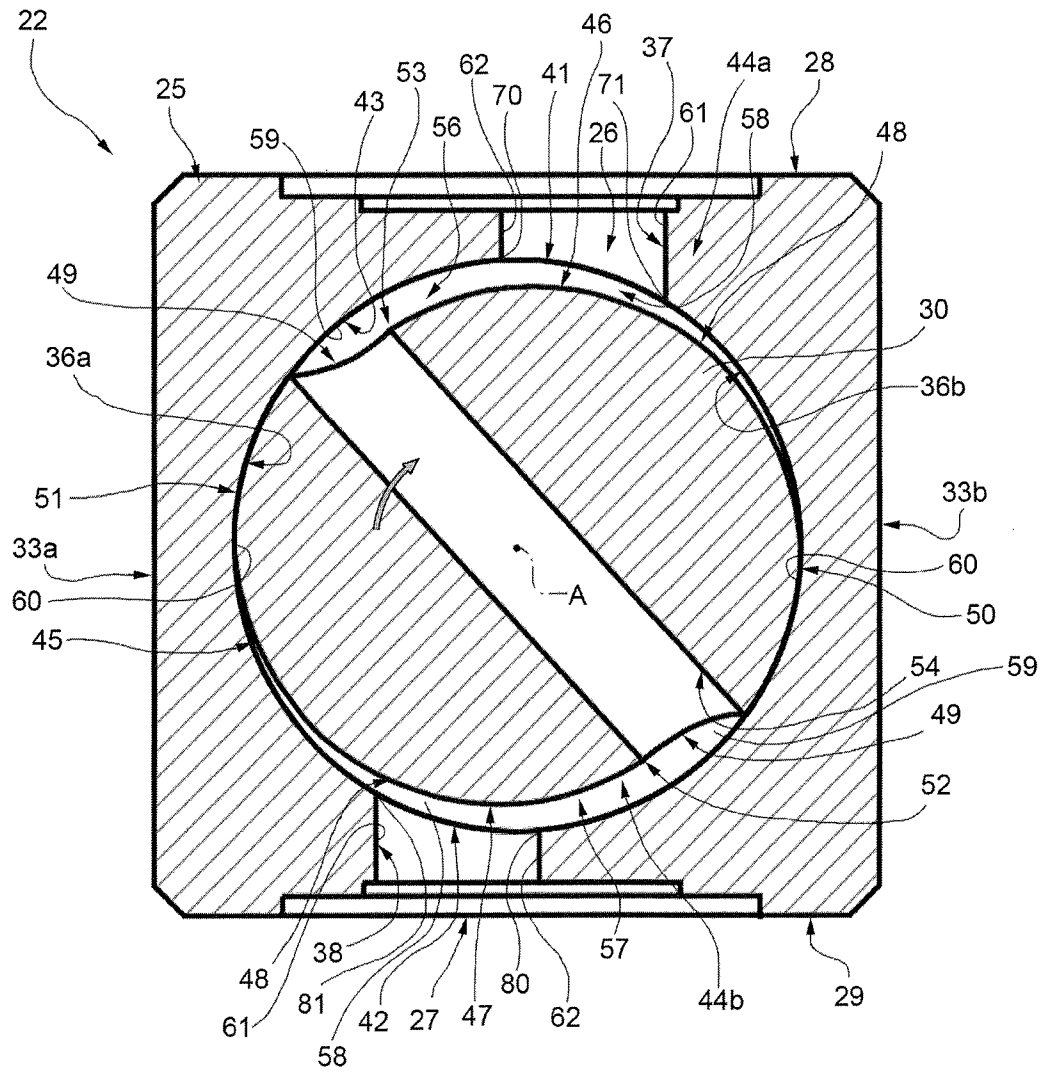


FIG. 5

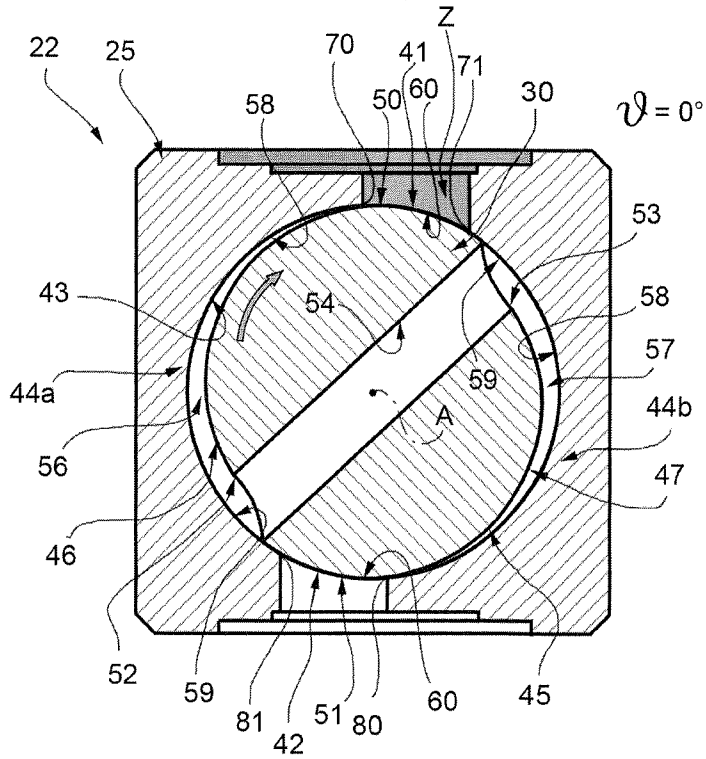


FIG. 6

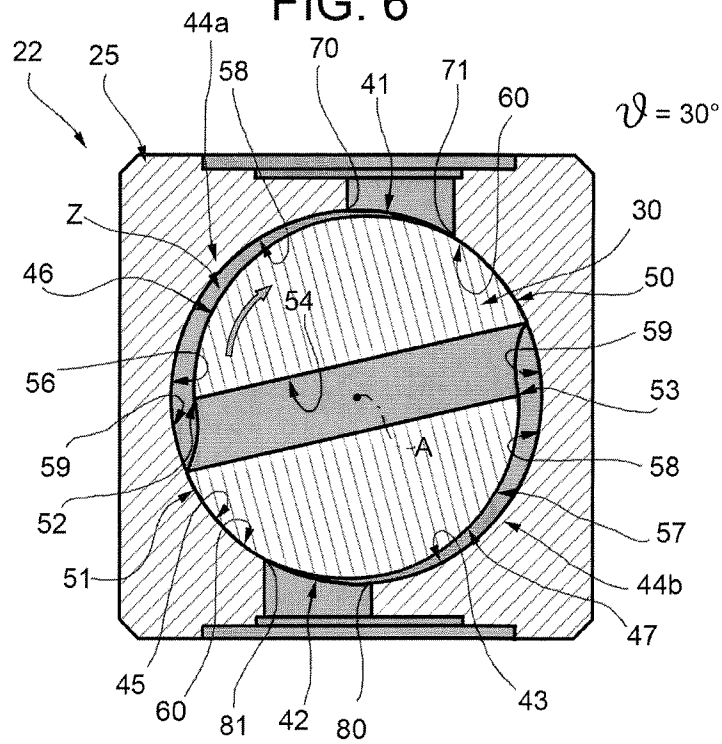


FIG. 7

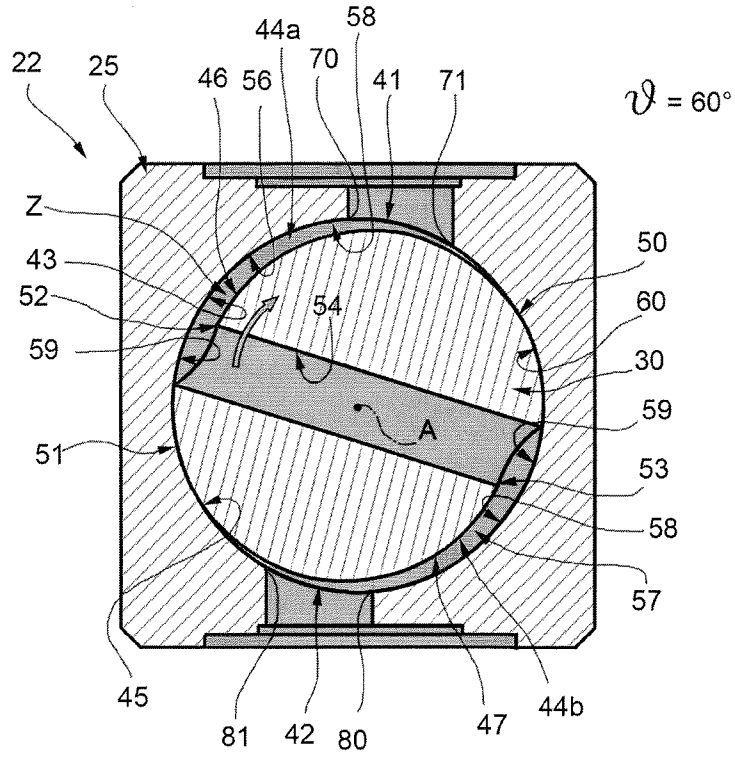


FIG. 8

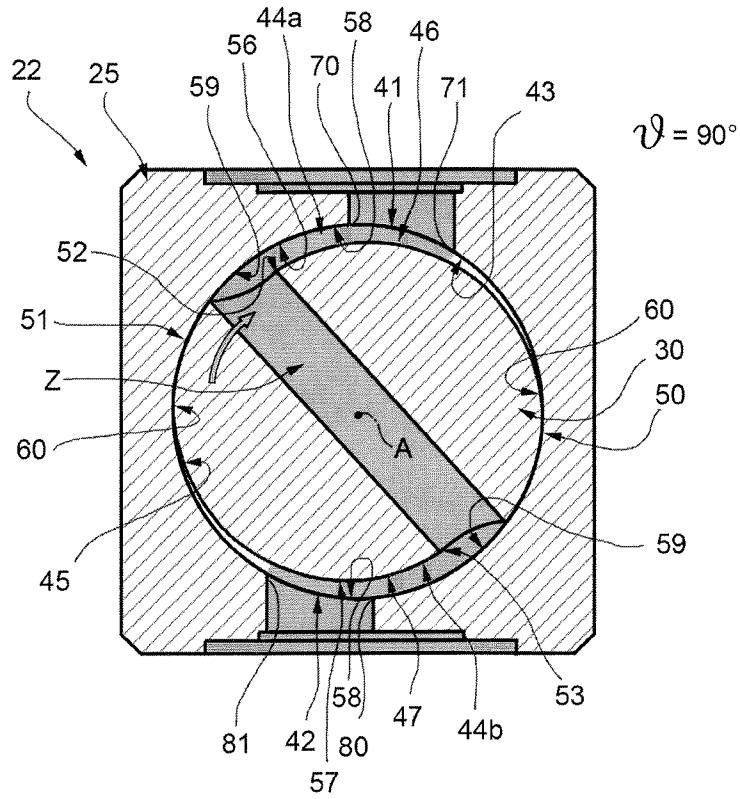


FIG. 9

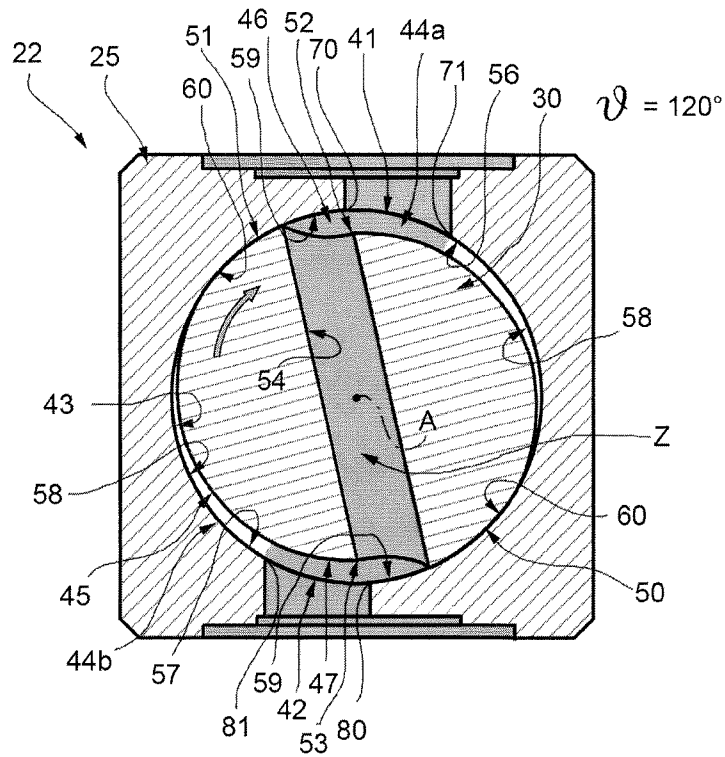


FIG. 10

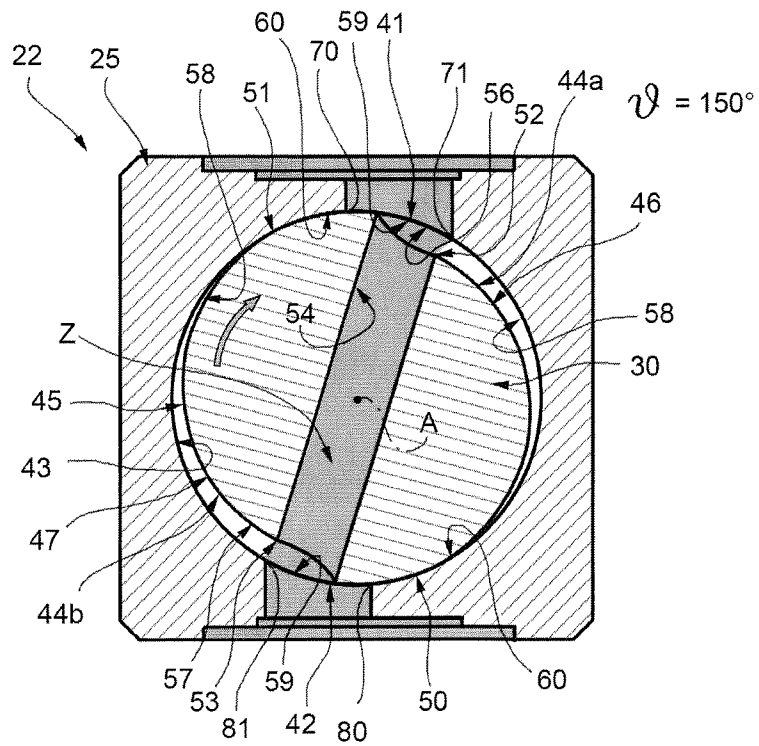


FIG. 11

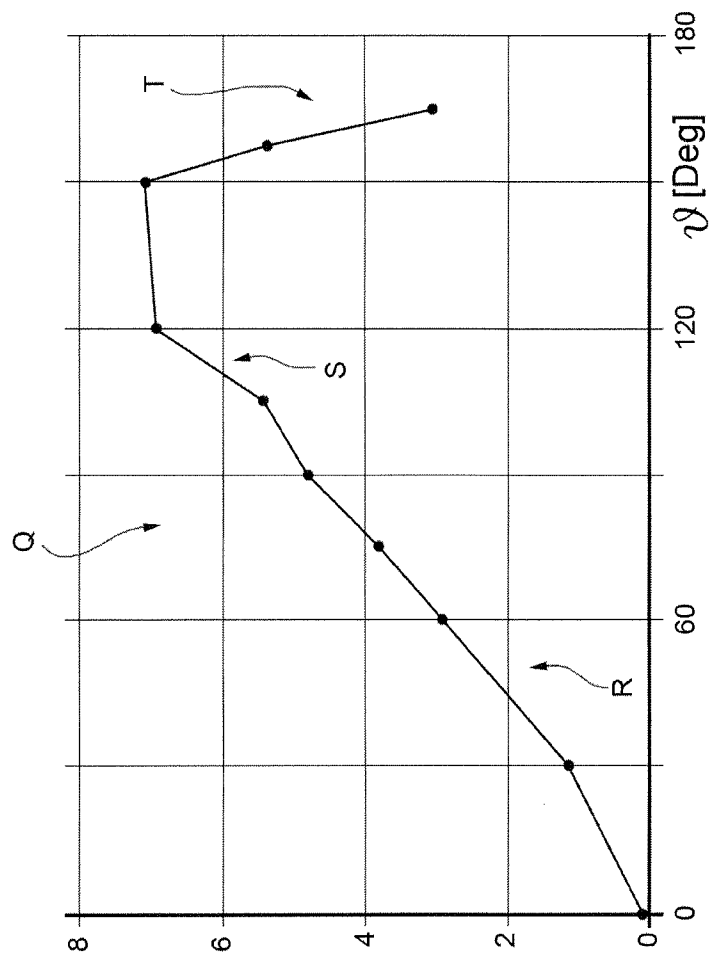


FIG. 12

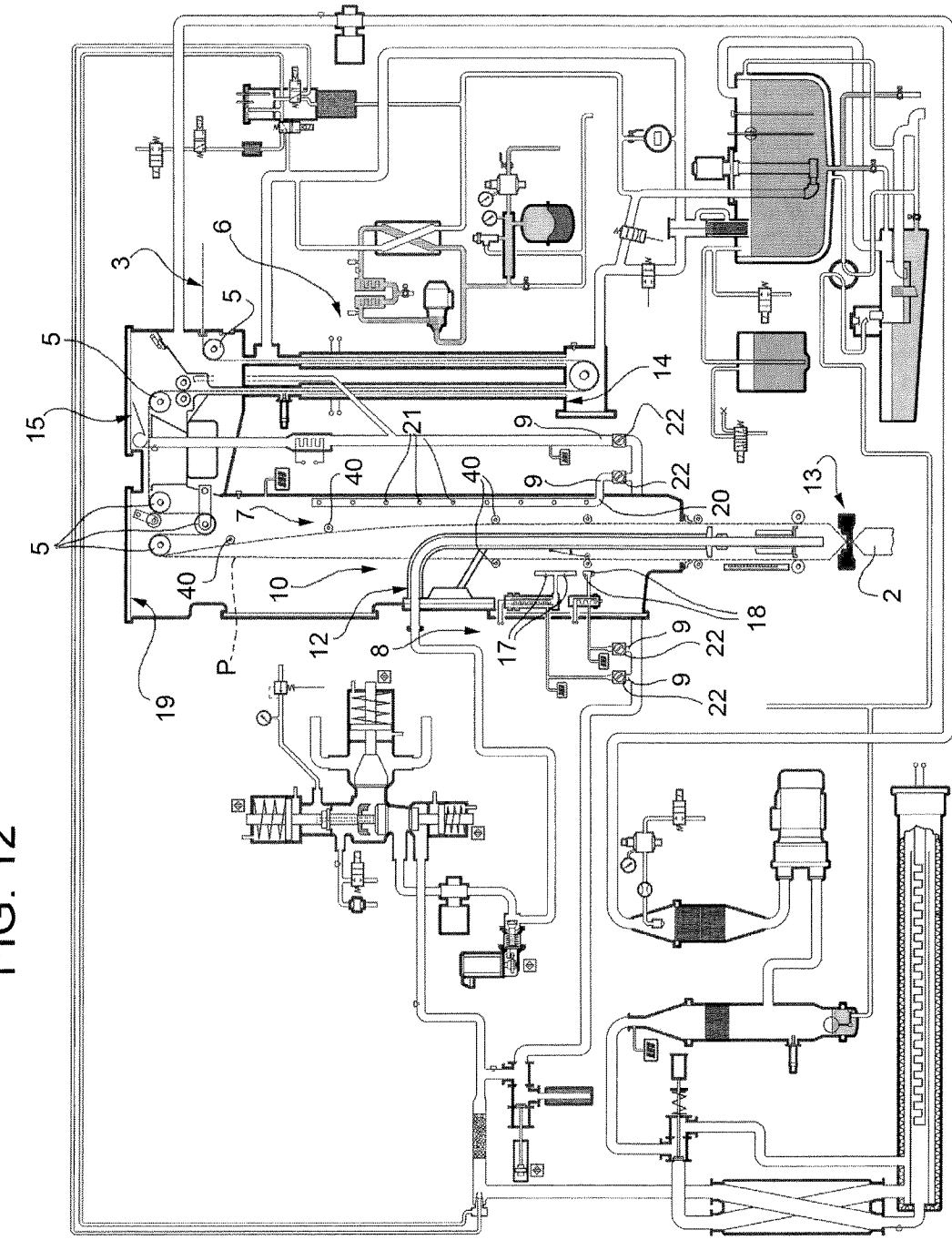
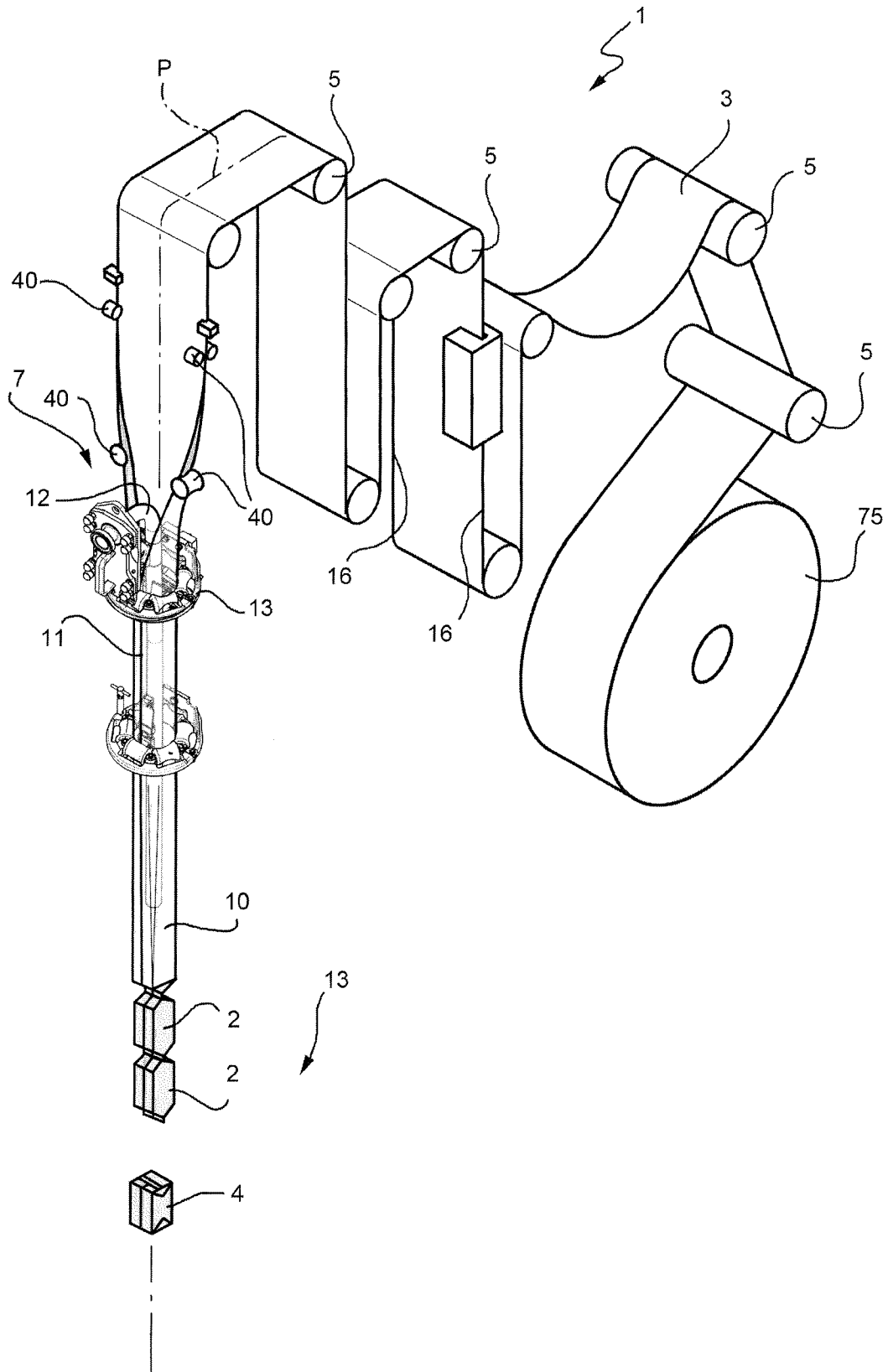


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No PCT/EP2013/065572

A. CLASSIFICATION OF SUBJECT MATTER INV. B65B55/10 F16K5/04 F16K5/10 ADD.				
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) B65B F16K				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data, PAJ				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	US 4 881 718 A (CHAMPAGNE RAYMOND P [US]) 21 November 1989 (1989-11-21) column 1, line 67 - column 3, line 30; figures 1-4	1-14		
X	----- US 3 322 149 A (HAENKY NORMAN H) 30 May 1967 (1967-05-30) column 2, line 5 - column 4, line 53; figures 1-14	1-14		
X	----- US 2005/166964 A1 (HALL OLA [SE]) 4 August 2005 (2005-08-04) paragraph [0018] - paragraph [0026]; figures 1-8 ----- -/--	1-14		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.				
* Special categories of cited documents : <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" 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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; border: none; vertical-align: top;"> "T" 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 "X" 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 "Y" 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 </td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" 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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" 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 "X" 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 "Y" 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	Date of mailing of the international search report			
14 August 2013	26/08/2013			
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Heneghan, Martin			

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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