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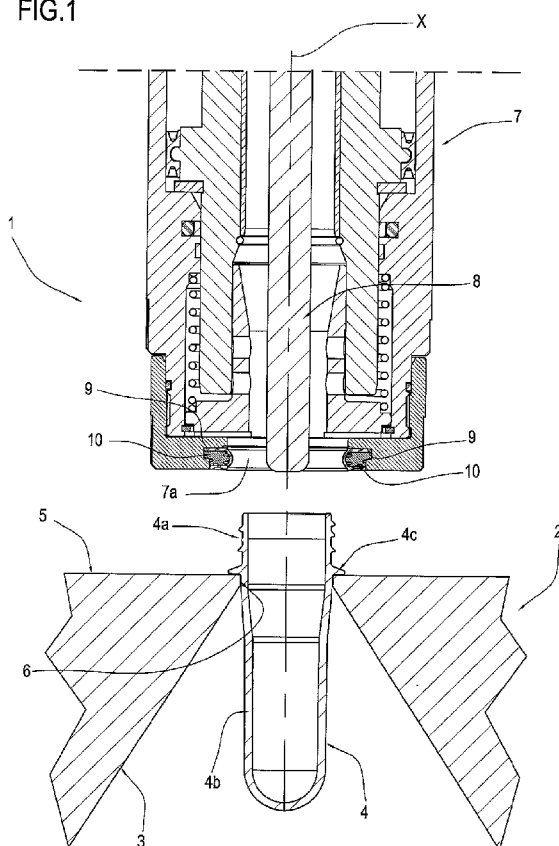
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- (54) Title:** APPARATUS FOR BLOW-MOULDING PARISONS

FIG. 1



(57) Abstract: An apparatus for blow-moulding parisons (4) to make plastic containers comprises a bottom mould (2) for housing a parison and having a cavity (3) from which the upper neck (4a) of the parison (4) protrudes, a blow-moulding cylinder (7) extending lengthways around a central axis (X) and positioned above the mould (2); the cylinder has a bottom opening (7a) for feeding a fluid under pressure into the parison (4) and is mobile vertically along the axis (X) between a raised, non-operating position and a lowered blow-moulding position where the cylinder (7) encompasses the neck (4a) of the parison (4) and blows the fluid under pressure into the parison (4) itself, a sealing gasket (10) positioned at the bottom opening (7a) of the blow-moulding cylinder (7); the convexity of the gasket (10) faces the central axis (X) of the cylinder (7).



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Description

Apparatus for blow-moulding parisons

Technical Field

This invention relates to an apparatus for blow-moulding plastic containers.

The invention also relates to a blow-moulding wheel comprising the apparatus and used for making plastic containers.

Background Art

The apparatus according to the invention can be used in all types of blow-moulding machines, whether rotary or linear blow-moulding machines.

The invention relates in particular to an apparatus for blow-moulding parisons for making plastic bottles.

This specification refers to parisons made of PET without thereby limiting the scope of the invention.

As is known, in an installation for making plastic bottles, each parison is preheated to a predetermined temperature in an oven and is then fed to a blow-moulding wheel.

The blow-moulding wheel comprises a plurality of blow-moulding apparatuses designed to convert each parison into a respective bottle.

Each blow-moulding apparatus comprises a lower mould, designed to receive a respective parison, and a blow-moulding cylinder located above the mould and mobile between a raised, non-operating position and a lowered blow-moulding position.

The mould cavity has the shape of the bottle to be made.

The mould has an upper opening that is smaller in diameter than the annular edge of the neck of the parison.

The parison is therefore inserted into the mould as far as its annular edge.

The neck of the parison protrudes from the mould.

Once the parison has been inserted into the mould, the blow-moulding cylinder moves down to the moulding position and blows a fluid under pressure into the parison in such a way that the parison expands and takes on the shape of the mould.

International patent application WO 2007020137 describes a blow-moulding device comprising:

- a mould comprising two half-moulds, designed to accommodate the parison and having a horizontal top wall with an orifice from which the neck of the parison protrudes;
- a blow-moulding cylinder with a pressurized fluid outlet mouth for blowing the fluid under pressure into the parison through the latter's neck, and comprising a sealing gasket designed to rest on the horizontal wall of the mould and to encompass the bottle neck.

The sealing gasket extends radially towards the inside of the blow-moulding cylinder in such a way as to rest in a groove inside the cylinder itself.

The gasket also comprises a free edge designed to rest on the horizontal wall of the mould.

The fluid under pressure fed in by the blow-moulding cylinder presses a portion of the gasket against the groove wall and the free edge against the horizontal wall of the mould to prevent the fluid under pressure from escaping from the cylinder.

This solution is not, however, free of disadvantages.

In particular, in this solution, the blow-moulding cylinder does not come into contact with the horizontal wall of the mould and so, to guarantee an effective seal during blow-moulding operations, the free edge of the gasket must be pressed against the horizontal wall of the mould before starting to blow the fluid in (in other words, the seal must be pre-loaded to a predetermined value to ensure tightness when blowing starts).

Pre-loading is achieved by deforming the seal according to the predetermined value as the blow-moulding cylinder moves down.

The initial deformation impressed on the gasket is concentrated in the area of the free lip and is not therefore uniformly distributed over the whole surface of the gasket.

On account of the non-uniformity of the deformation that the gasket undergoes, localized stretching of the gasket occurs and the gasket inevitably loses its sealing capacity.

Moreover, the localized stretching significantly accelerates gasket wear.

Further, the shape of the gasket, which rests against and adheres to the groove inside the blow-moulding cylinder, is such that a considerably large volume is created in the blow-moulding cylinder: that means a very large amount

of fluid under pressure (at approximately 40 bar) is required for blow-moulding the parison in order to properly fill the entire volume of the cylinder.

Furthermore, WO 2007020137 has another disadvantage, associated with the design of the sealing joint (i.e. the sealing gasket). In particular, the free lower edge of the gasket, which forms an elastic annular lip, receives a pressure force (when the blowing fluid is injected) which imparts a rotation of said lip towards the outside of the nozzle. Indeed, only the movement of said lip downwards in axial direction provides a positive effect for the sealing purpose.

Hence, a portion of the pressure established by the blowing fluid has a negative effect, because it does not contribute to the sealing effect, and rather it entails a risk of deterioration of the sealing lip (generating a friction between the sealing lip and the surface against which the lip rests).

Compressing a fluid to a pressure of 40 bar is a very expensive operation: for this reason, the need to use a high volume of pressurized fluid involves a considerable and all but negligible increase in machine running costs.

Aim of the Invention

In this context, the basic purpose of this invention is to provide a blow-moulding apparatus that overcomes the above mentioned disadvantages of the prior art.

In particular, this invention has for an aim to provide a blow-moulding apparatus that can guarantee an effective fluid seal without subjecting the components of the apparatus to high stresses.

Another aim of the invention is to provide a blow-moulding apparatus whose components are subject to limited wear.

Yet another aim of the invention is to provide a blow-moulding apparatus having low running costs.

The technical purpose and aims stated above are substantially achieved by a blow-moulding apparatus comprising the technical characteristics set out in one or more of the appended claims.

Brief Description of the Drawings

Further characteristics and advantages of the invention are more apparent in the detailed description below, with reference to a preferred, non-limiting, embodiment of a blow-moulding apparatus, illustrated in the accompanying drawings in which:

- Figure 1 is a schematic section view of a blow-moulding apparatus according to the invention in a first operating position;
- Figure 2 is a schematic section view of a blow-moulding apparatus according to the invention in a second operating position;
- Figure 3 is a schematic section view of a blow-moulding apparatus according to the invention in a third operating position;
- Figure 4 illustrates an enlarged detail from Figure 1;
- Figure 5 illustrates an enlarged detail from Figure 3;
- Figures 6 to 9 illustrate other possible embodiments of a detail of the apparatus according to the invention.

Detailed Description of the Preferred Embodiments of the Invention

With reference to the accompanying drawings, in particular Figure 1, the numeral 1 denotes in its entirety an apparatus for blow-moulding parisons to make containers.

In this description, the containers made using the apparatus according to the invention are plastic bottles but without thereby limiting the scope of the inventive concept.

The plastic bottles are made by blow-moulding parisons made of PET.

The apparatus 1 comprises a bottom mould 2, having an internal cavity 3 designed to accommodate a respective parison 4, and a horizontal upper wall 5 with an opening 6 made in it.

The parison 4 comprises a top portion or neck 4a, also known by the term "finish", said neck 4a not being modified during blow-moulding, and a tubular structure 4b that is blow-moulded inside the mould 2 and takes on the shape of the cavity 3 in the mould 2 and, hence, the shape of the bottle.

When a parison 4 is inserted into the mould 2, the neck 4a of the parison 4 protrudes from the horizontal wall 5 of the mould 2 through the opening 6.

The neck 4a comprises an annular edge 4c at the bottom of it, which rests on the horizontal wall 5.

The blow-moulding apparatus 1 also comprises a blow-moulding cylinder 7 mounted above the mould 2 and extending lengthways along a central axis X.

The cylinder 7 is mobile vertically along the axis X.

The blow-moulding cylinder 7 has a bottom opening 7a through which a fluid is blown into the parison 4 under pressure.

More in detail, the blow-moulding cylinder 7 comprises a rod 8 for stretching symmetrically about the axis X and located inside the cylinder 7 itself.

The stretching rod 8 is mobile vertically relative to the blow-moulding cylinder 7 and is designed to be inserted into the parison 4 and to elongate the parison 4 during the blow-moulding operation.

The blow-moulding cylinder 7 is in turn mobile between a raised, non-operating position, illustrated in Figure 1, and a lowered, blow-moulding position, illustrated in Figure 3.

In the lowered, blow-moulding position, the bottom opening 7a of the cylinder 7 encompasses the neck 4a of the parison 4 and the cylinder 7 rests on the horizontal wall 5 of the mould 2.

At its bottom opening 7a, the blow-moulding cylinder 7 comprises a seat 9 for housing a sealing gasket 10.

As shown in Figure 4, the seat 9 is formed by a horizontal top wall 11 and a lateral wall 12, indicated in the following as vertical wall 12, the word "vertical" being not to be interpreted as a limitation with respect to the orientation of said wall.

In the embodiments of figures 5 and 9, the vertical wall 12 of the seat 9 of the cylinder 7 is step-shaped.

The sealing gasket 10 is housed in the seat 9.

The sealing gasket 10 defines a top section 10A and a bottom section 10B which abut said vertical wall 12. Therefore, the vertical wall 12 of the seat 9 of the cylinder 7 defines a mechanical constraint able to prevent radial movements of said top section 10A and a bottom section 10B of the sealing gasket 10 away from the axis X of the cylinder 7.

The top section 10A and the bottom section 10B are joined by a curved portion 17.

Said curved portion 17 is shaped as to define a convexity directed towards the central axis X of the cylinder 7.

The gasket 10 is coupled to the cylinder 7 (i.e. to the seat 9 of the cylinder 7) in such a way that the vertical wall 12 of the seat 9 defines mechanical constraints configured to establish reaction forces directed in radial direction towards the axis X of the cylinder 7, in response to a pressure applied to the gasket 10 by the fluid under pressure.

Hence, the (vertical wall 12 of the) seat 9 of the cylinder 7 and the gasket 10 are configured in such a way that reaction forces directed in radial direction towards the axis X of the cylinder 7 are established at the contact surfaces between the vertical wall 12 and the top section 10A and the bottom section 10B

of the gasket 10, in response to a pressure applied to the gasket 10 by the fluid under pressure.

Preferably, the top section 10A of the sealing gasket 10 is designed to rest on a horizontal wall 11 of the blow-moulding cylinder 7. Hence, the horizontal wall 11 of the cylinder 7 provides a mechanical constraint able to prevent the top section 10A of the sealing gasket 10 to move (vertically) upward (away from the mould).

When the fluid under pressure is injected in the cylinder 7, the fluid under pressure acts on the convex portion of the gasket 10 and tends to strengthen the gasket itself (thus increasing the curvature radius of the gasket 10).

In this light, the fact that the lateral wall 12 defines said constraints for the (top section 10A and the) bottom section 10B of the gasket 10 allows, advantageously, the lower part of the gasket to move downwards and abut against the surface of the mould (or of the parison) providing the sealing effect, with no risk of rotation or friction of the lower part of the gasket (in fact, the bottom section 10B of the gasket is not free to move, because of said mechanical constraint provided by the lateral wall 12).

The fact that the horizontal wall 11 defines said constraint for the top section 10A of the gasket 10 allows, advantageously, to make sure that the whole pressure exerted by the fluid against the convexity of the gasket gives rise to a movement of the lower portion of the gasket downwards (towards the mould), avoiding any movement of the gasket upwards, away from the mould.

It has to be observed that (at least a portion of) the sealing gasket 10 is made of elastically deformable material, whereby said thrust of the pressure fluid squeezes the sealing gasket 10 causing an elongation of the gasket 10 towards the parison.

In other words, (at least a portion of) the sealing gasket 10 is made of elastically deformable material in such a way that the thrust of the pressure fluid on the gasket 10 causes a downward migration of a portion of said material, thus entailing an elongation of the gasket 10 towards the parison.

In this light, the fact that the lateral wall 12 defines said constraints for the portions of the sealing gasket 10 in contact therewith allows said squeezing effect.

The fact that the horizontal wall 11 defines said constraint for the top section 10A of the gasket 10 makes sure that said squeezing effect contributes solely to the elongation of the gasket 10 downwards, i.e. towards the parison (avoiding any upward elongation).

More in detail, the sealing gasket 10 comprises an energizing inside portion 13 and an outside sealing portion 14.

The outside portion 14 comprises a straight horizontal section 15 at the top and a straight horizontal section 16 at the bottom.

The straight horizontal section 15 at the top abuts the above mentioned horizontal wall 11 of the seat 9.

The straight horizontal section 15 at the top and the straight horizontal section 16 at the bottom are joined to each other by said curved portion 17.

Advantageously, the convexity of the curved portion 17 faces the central axis X of the cylinder 7.

The inside portion 13 of the sealing gasket 10 comprises a protrusion 18, designed to rest on the step of the vertical wall 12, and a central body 19 with a plurality of protuberances 20 along its perimeter.

As illustrated in Figure 5, the outside portion 14 of the gasket 10 abuts the protuberances 20.

Advantageously, the inside portion 13 is stiffer than the outside portion 14.

The connecting zones between two adjacent protuberances 20 form respective hollows 21.

The protuberances 20 of the inside portion act as points of abutment for the outside portion 14, which is deformed around the protuberances.

Advantageously, this makes it possible to control the extent and zones of deformation on the outside portion 14.

On its underside, the straight section 16 at the bottom of the outside portion 14 comprises two protruding elements, respectively first 22 and second 23, designed to come into contact with the horizontal wall 5 of the mould 2.

Figure 9 shows another embodiment of the gasket 10 where, instead of the straight section 16 at the bottom of the gasket 10, there is a Z-shaped section 24 comprising a first protruding element 25 designed to come into contact with the horizontal wall 5 of the mould 2 and a second protruding element 26 designed to come into contact with the annular edge 4c of the parison 4.

More in detail, in this embodiment, the gasket 10 creates a seal by abutting at least partly against the annular edge 4c of the neck 4a of the parison 4.

Figures 6 to 8 show further embodiments of the gasket 10 of a blow-moulding apparatus according to the invention.

In the embodiment of Figure 6, the gasket 10 comprises a single portion 27 formed by two flexible lobes 28 positioned symmetrically about an axis A.

The thickness of the lobes 28 varies, increasing from the axis of symmetry A towards the respective ends.

In this embodiment, too, the convexity of the sealing gasket 10 faces the axis X of the blow-moulding cylinder 7.

In the embodiment of Figure 7, the gasket 10 is in the shape of a bridge and comprises a first inside section 29 whose convexity faces the axis X and a second outside section 30 whose convexity also faces the axis X.

Figure 8 shows yet another embodiment of the gasket 10.

In this embodiment, the gasket 10 has the shape of a “bean” whose convexity faces the axis X.

In use, a parison 4 is placed in customary manner, not further described, inside a mould 2.

As shown in Figures 1, 2, 3, 4 and 5, when a parison 4 is placed in the mould 2, the tubular structure 4b of the parison 4 is inside the cavity 3 of the mould 2, while the neck 4a of the parison 4 protrudes from the horizontal wall 5 and the annular edge 4c of the neck 4a rests on the horizontal wall 5.

Under these conditions, the blow-moulding cylinder 7 moves to the lowered blow-moulding position, in contact with the horizontal wall 5 of the mould 2.

When the cylinder 7 is in the lowered position, the stretching rod 8 slides downwards within the parison 4 and, at the same time, fluid is blown under pressure into the parison 4 through the opening 7a in the cylinder 7.

The combined action of the stretching rod 8 and of the pressurized fluid cause the parison 4 to expand inside the cavity 3 of the mould 2 until it has the required shape of a bottle.

During the blow-moulding step, the sealing gasket 10, located at the opening 7a, rests on the horizontal wall 5 of the mould 2.

As shown in Figure 5, the fluid blown in under pressure by the blow-moulding cylinder 7 is discharged through the opening 7a.

Advantageously, the pressure of the fluid applies a normal uniform thrust on the surface of the curved portion 17 of the gasket 10.

The thrust applied by the fluid tends to increase the curvature radius of the curved portion 17 itself.

Further, advantageously, the inside portion 13 of the gasket 10 is stiffer than the outside portion 14.

Thus, the outside portion 14 is deformed at the hollows 21 of the inside portion 13, creating a “toggle effect”.

Thus, the gasket 10 applies pressure on the horizontal wall 5 of the mould by means of the two protruding elements 22, 23 and pressure on the seat 9 of the blow-moulding cylinder 7 by means of the above mentioned straight section 15 at the top.

The invention described above achieves important advantages.

The gasket allows an optimum seal to be obtained without having to be initially preloaded. Further, the fluid under pressure acts uniformly on the whole of the outside portion of the seal, thus creating uniform stresses which greatly reduce the gasket wear rate.

Moreover, the uniform distribution of the pressurized fluid does not cause localized stretching of the gasket.

Claims

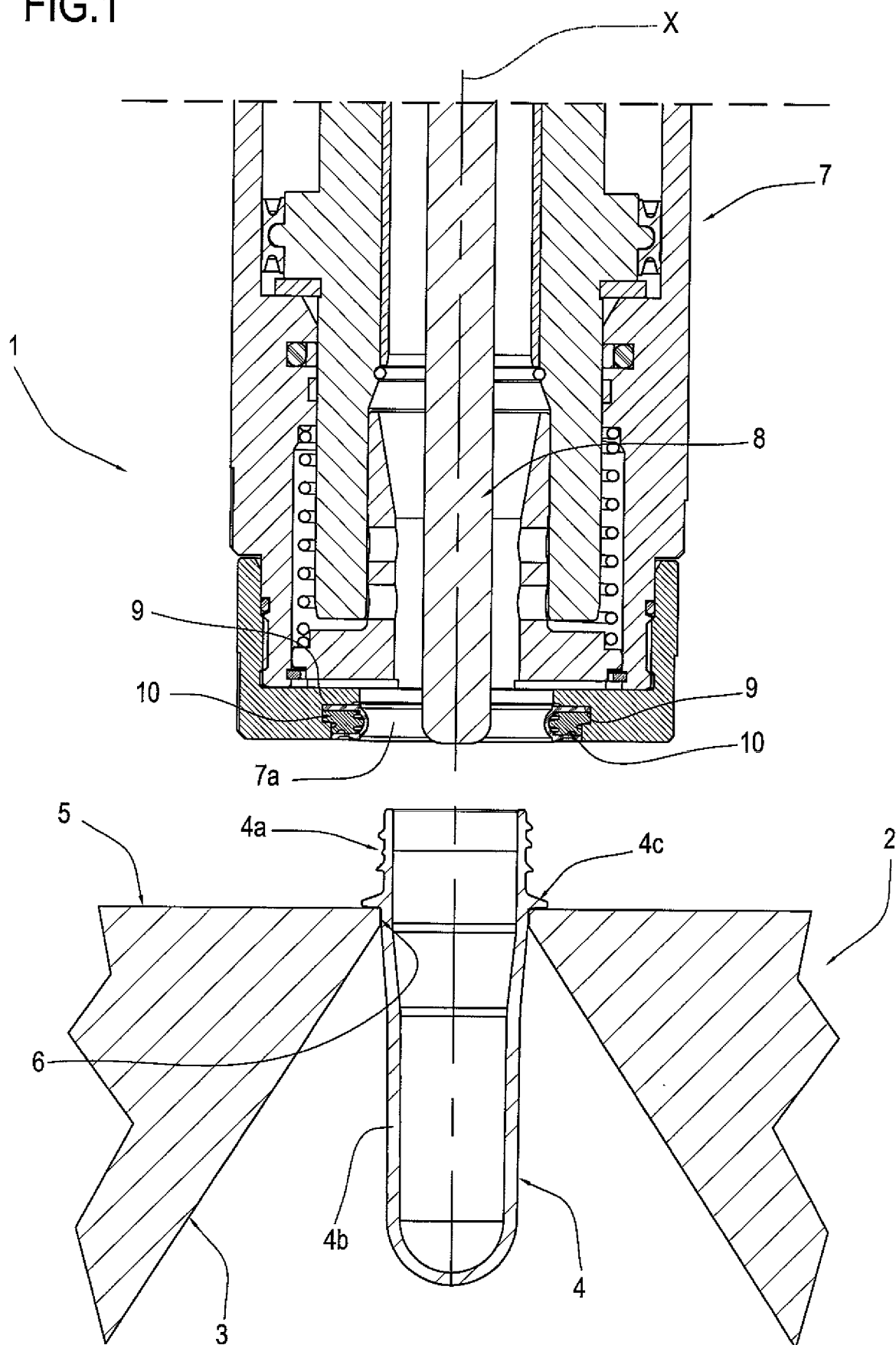
- 1) An apparatus for blow-moulding parisons (4) to make plastic containers, in particular bottles, comprising:
 - a bottom mould (2) for housing at least one of said parisons and having a cavity (3) from which the upper neck (4a) of the parison (4) protrudes;
 - a blow-moulding cylinder (7) extending lengthways around a central axis (X) and positioned above the mould (2), said cylinder (7) having a bottom opening (7a) for feeding a fluid under pressure into the parison (4) and being mobile vertically along the axis (X) between a raised, non-operating position and a lowered blow-moulding position where the cylinder (7) encompasses the neck (4a) of the parison (4) and blows the fluid under pressure into the parison (4) itself;
 - a sealing gasket (10) positioned in a seat (9) defined at the bottom opening (7a) of the blow-moulding cylinder (7) and having a lateral wall (12) characterized in that, in combination:
 - the sealing gasket (10) defines a top section (10A) and a bottom section (10B) which abut said vertical wall (12), whereby said lateral wall (12) constitutes a mechanical constraint able to prevent radial movements of said top section (10A) and a bottom section (10B) of the sealing gasket (10) away from the axis (X) of the cylinder (7);
 - the top section (10A) and the bottom section (10B) are joined by a curved portion 17 having a convexity facing the central axis (X) of the cylinder (7), in such a way that the fluid under pressure acting on said convexity of the gasket (10) applies a thrust on the gasket (10) tending to increase the curvature radius of the gasket (10) itself.
- 2) The blow-moulding apparatus according to claim 1, wherein the top section (10A) of the sealing gasket (10) is designed to rest on a horizontal wall (11) of the blow-moulding cylinder (7).
- 3) The blow-moulding apparatus according to claim 1 or 2, wherein the sealing gasket (10) is made of elastically deformable material, whereby said thrust of the pressure fluid squeezes the sealing gasket (10) causing an elongation of the gasket towards the parison.

- 4) The blow-moulding apparatus according to any of the foregoing claims, wherein the gasket (10) comprises two portions, an inside portion (13) and an outside portion (14).
- 5) The blow-moulding apparatus according to claim 4, wherein the convexity of the outside portion (14) faces the axis (X).
- 6) The blow-moulding apparatus according to claim 4 or 5, wherein the inside portion (13) is stiffer than the outside portion (14).
- 7) The blow-moulding apparatus according to claim 6, wherein the inside portion (13) comprises at least one protuberance (20) designed to form a respective point of abutment for the outside portion (14) so that the outside portion (14) is deformed around the protuberance (20).
- 8) The blow-moulding apparatus according to claim 7, wherein the inside portion (13) comprises a plurality of protuberances (20).
- 9) The blow-moulding apparatus according to claim 7 or 8, wherein the inside portion (13) comprises three protuberances (20).
- 10) The blow-moulding apparatus according to any of the foregoing claims, wherein at least an outside portion (14) of the sealing gasket (10) comprises a first straight section (15) at the top of it designed to rest on a horizontal wall (11) of the blow-moulding cylinder (7), and a second straight section (16) at the bottom of it designed to rest on the horizontal wall (5) of the mould (2), the first straight section (15) and the second straight section (16) being joined to each other by a curved portion (17) whose convexity faces the axis (X).
- 11) The blow-moulding apparatus according to any of the foregoing claims, wherein at least an outside portion (14) of the sealing gasket (10) comprises a first straight section (15) at the top of it designed to rest on a horizontal wall (11) of the blow-moulding cylinder (7), and a second straight section (16) at the bottom of it designed to rest on an annular edge (4c) of the neck (4a) of the parison (4), the first straight section (15) and the second straight section (16) being joined to each other by a curved portion (17) whose convexity faces the axis (X).

12) A parison blow-moulding wheel for making plastic containers, in particular bottles, characterized in that it comprises a plurality of blow-moulding apparatuses according to any of the foregoing claims.

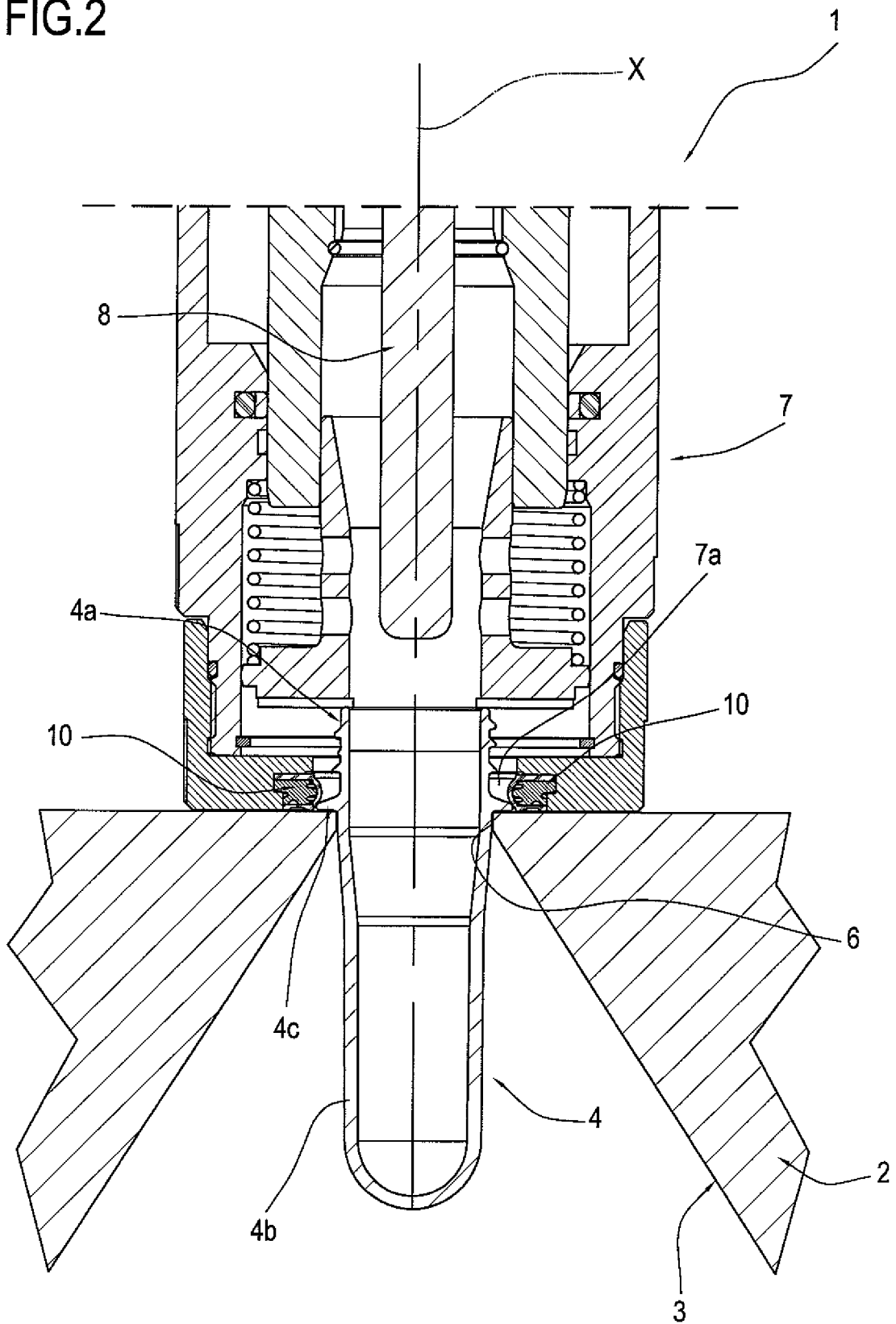
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FIG.1



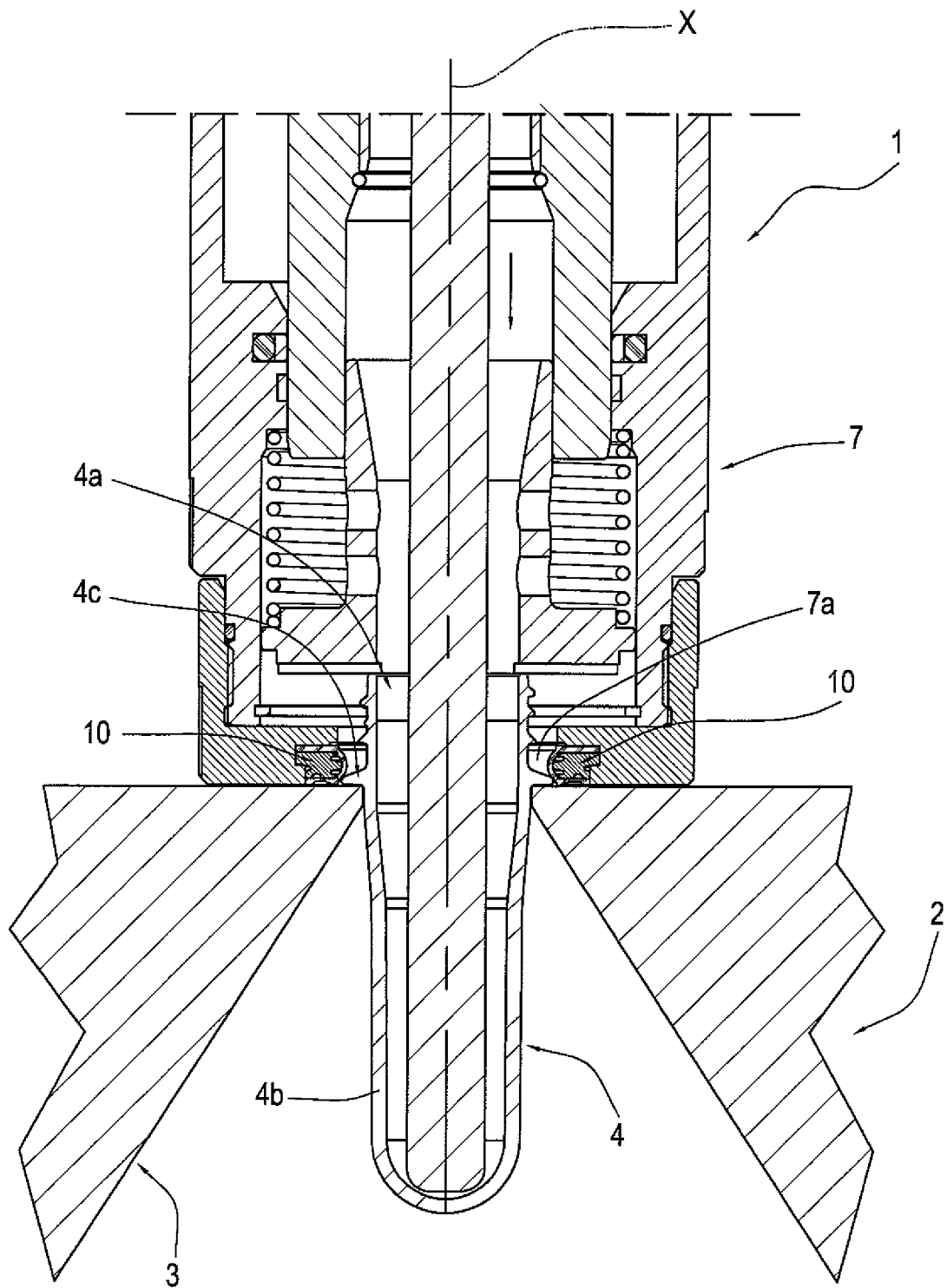
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FIG.2

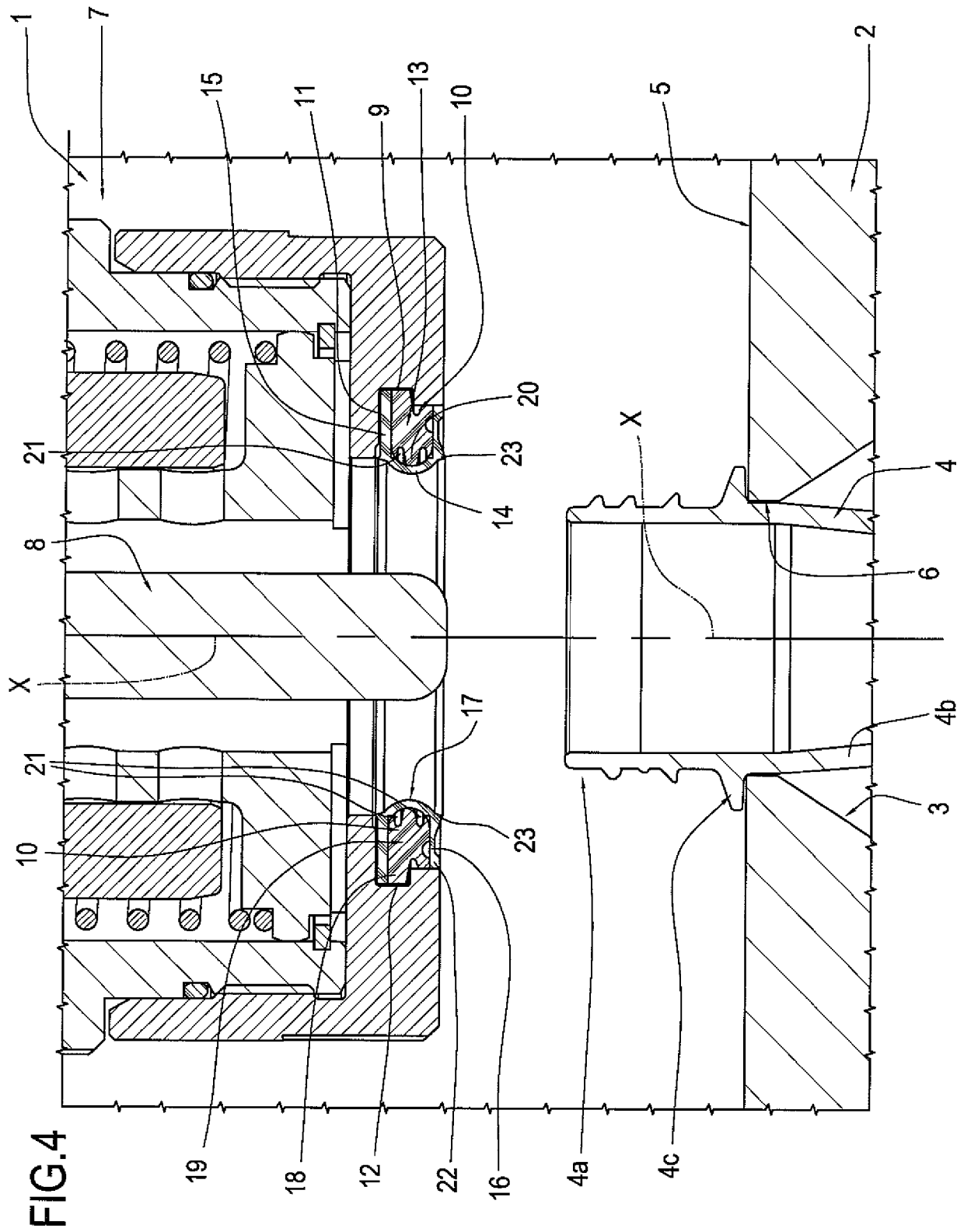


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FIG.3



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FIG.5

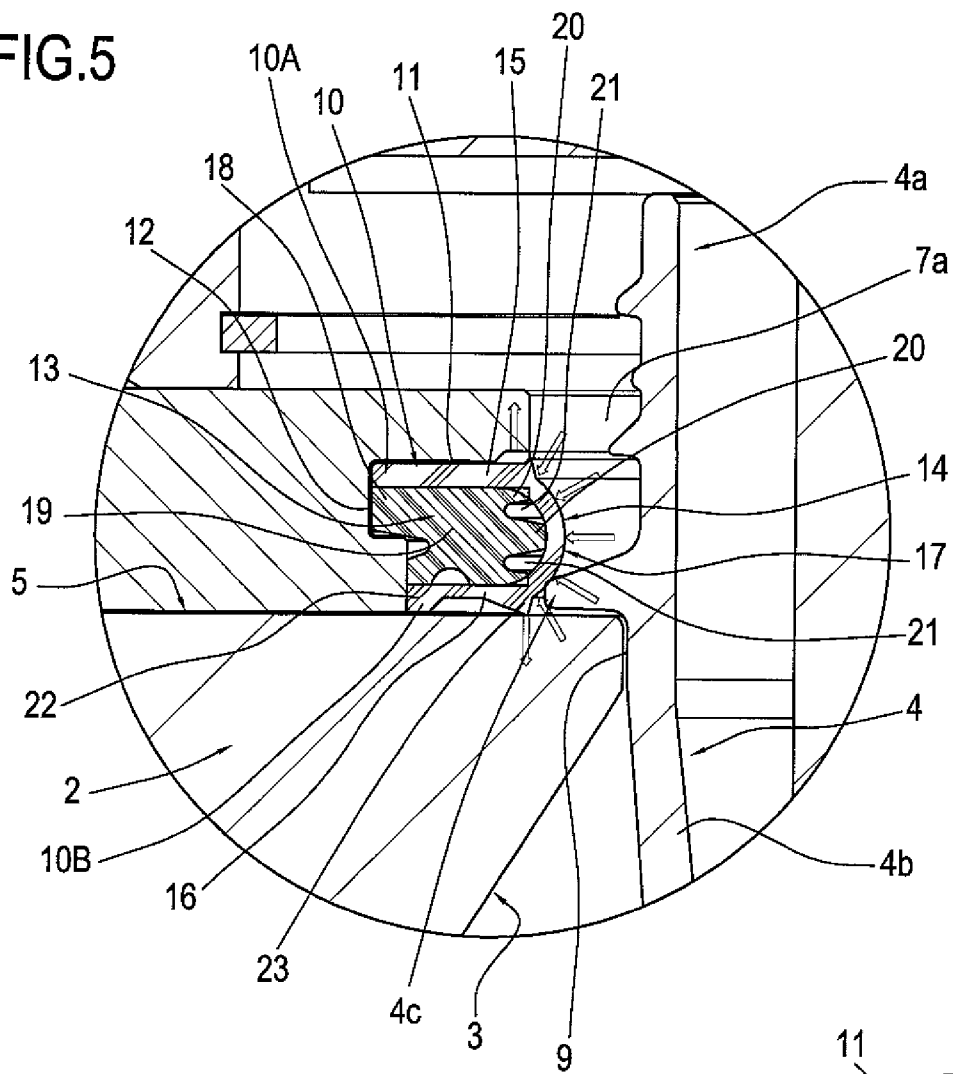


FIG.6

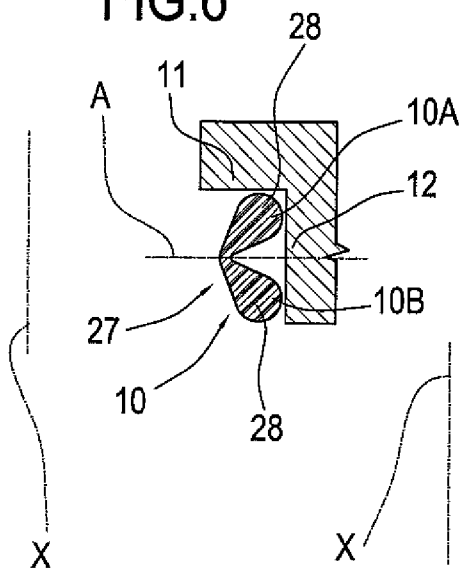


FIG.8

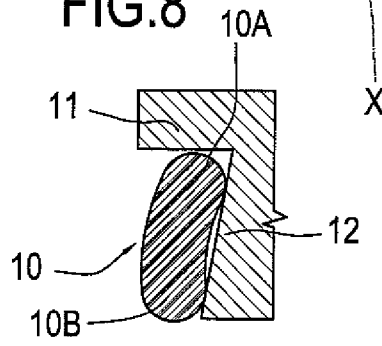
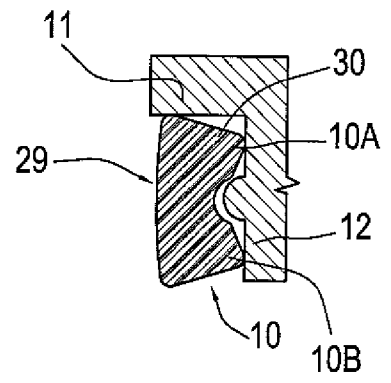


FIG.7



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FIG.9

