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(54) **COMPRESSION MOULDING APPARATUSES AND METHODS**

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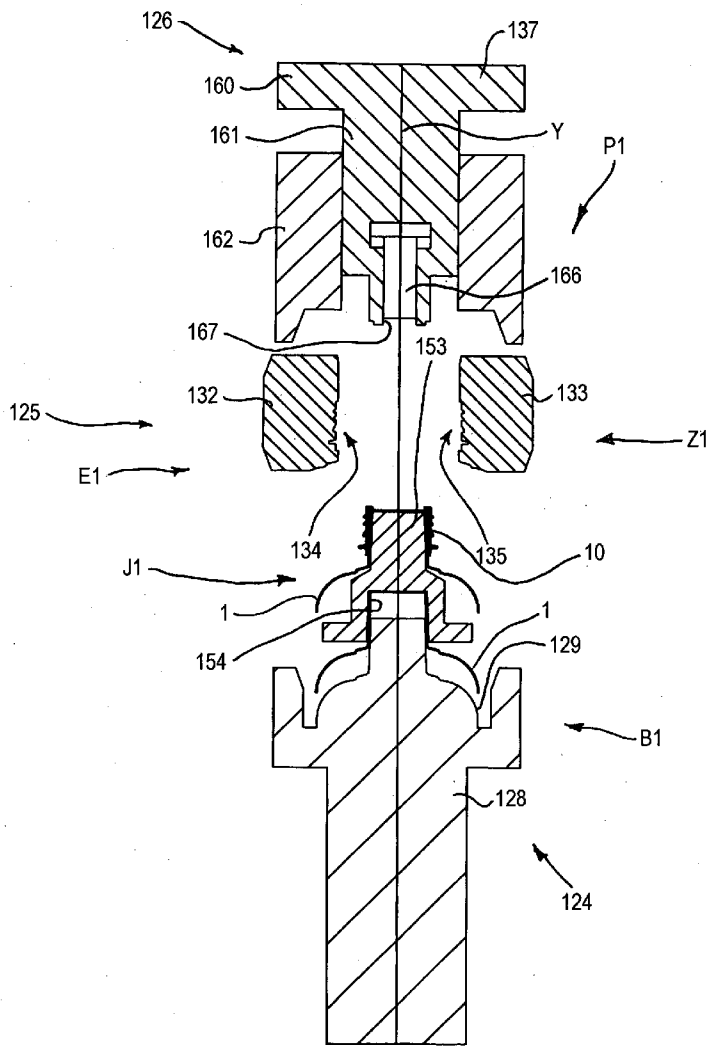
(52) **U.S. Cl.** **264/266**; 425/517

(57) **ABSTRACT**

An apparatus includes a first mould part suitable for receiving an object, a die arrangement arranged for surrounding a zone of the object and a second mould part cooperating with the die arrangement and with the first mould part in order to compression-mould plastics on the object in the zone.



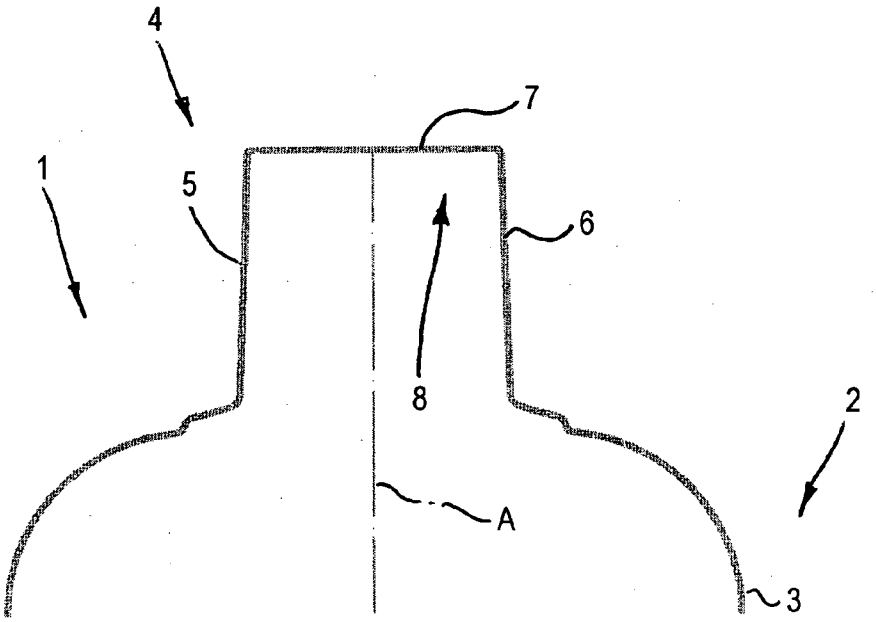
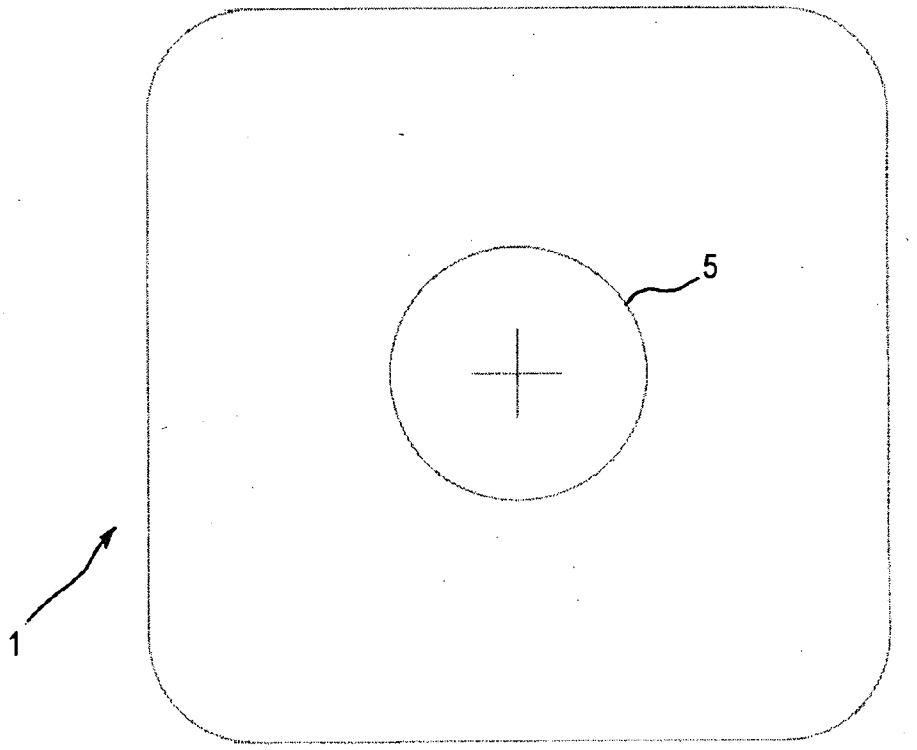


Fig. 1



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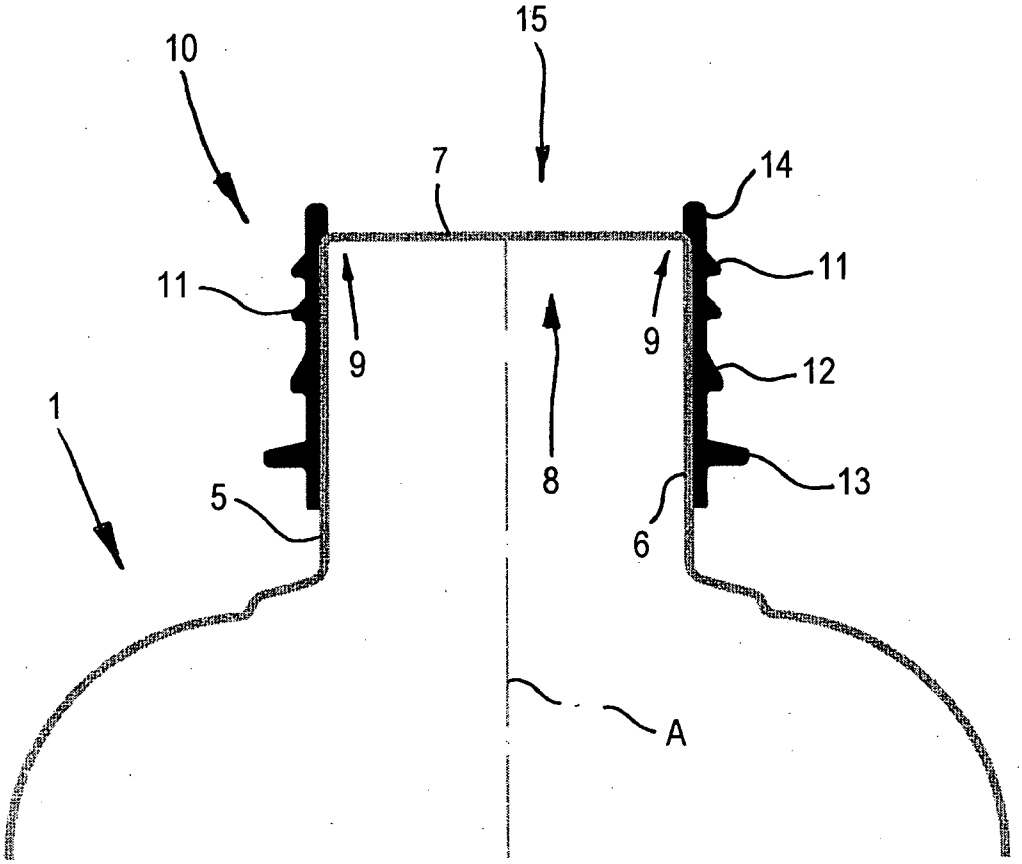
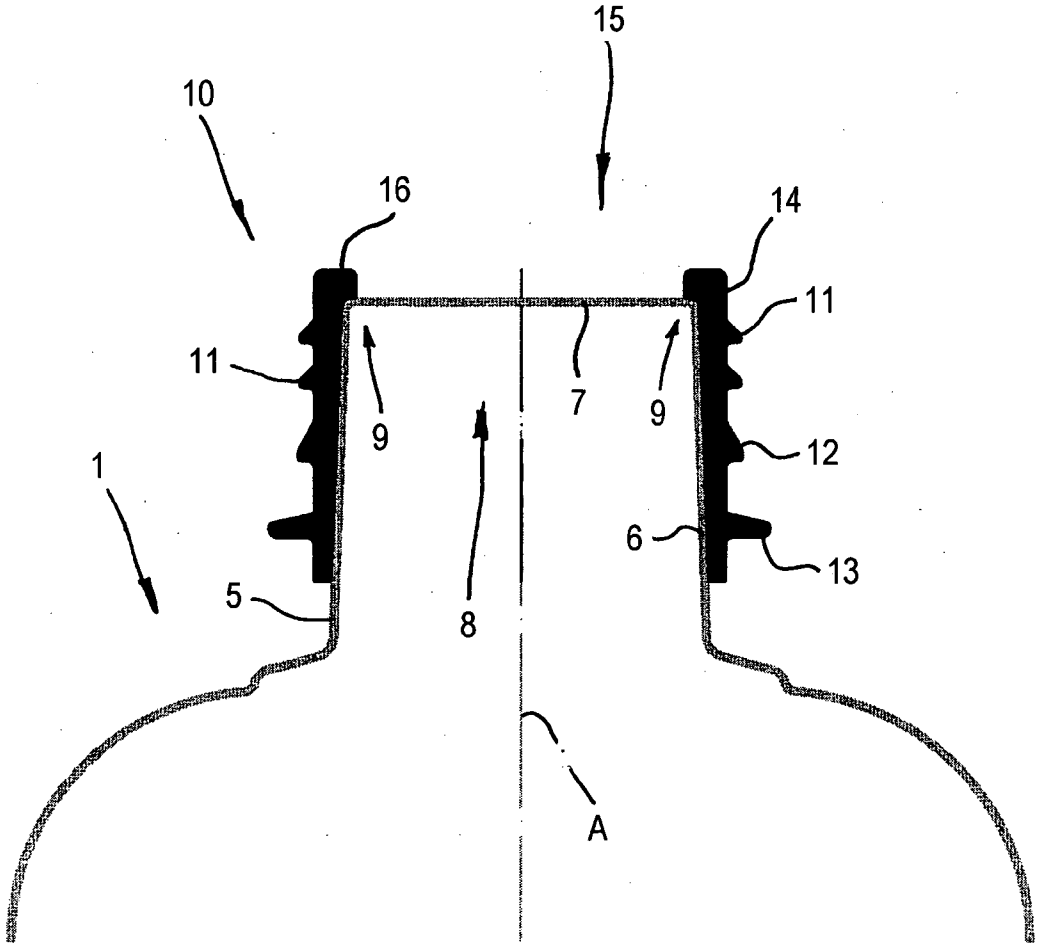


Fig. 3



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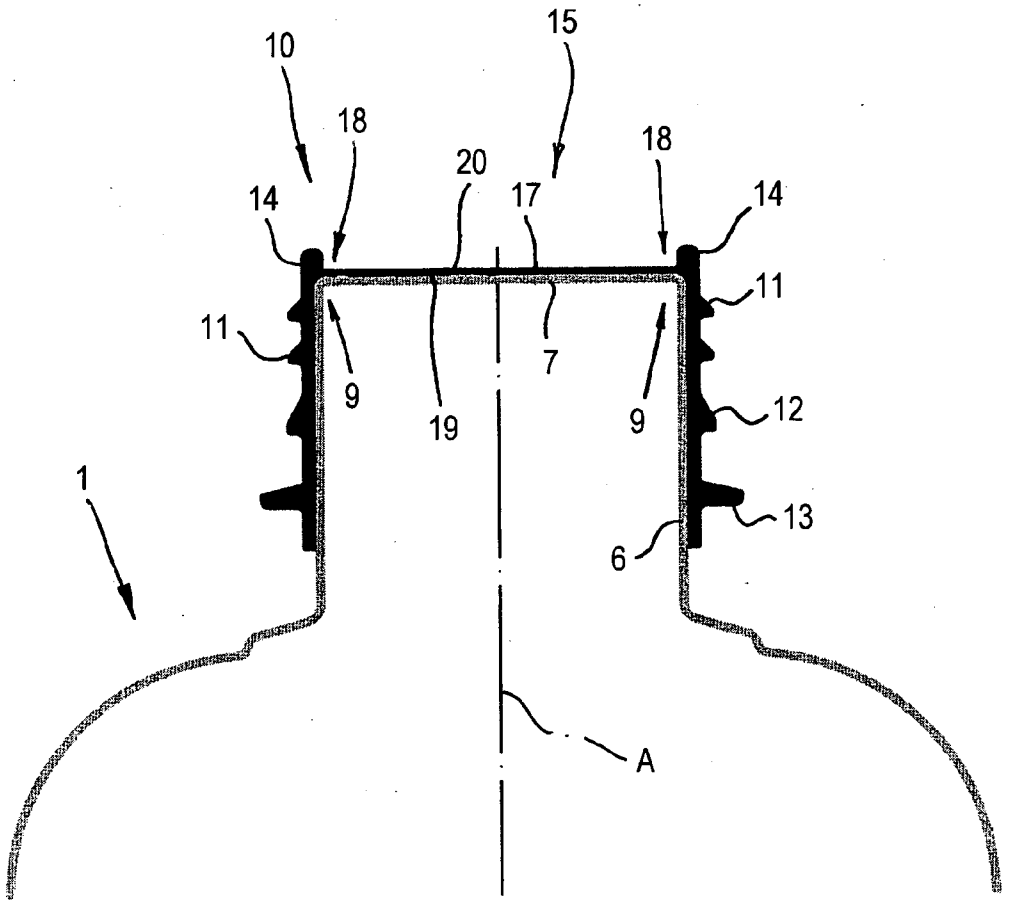

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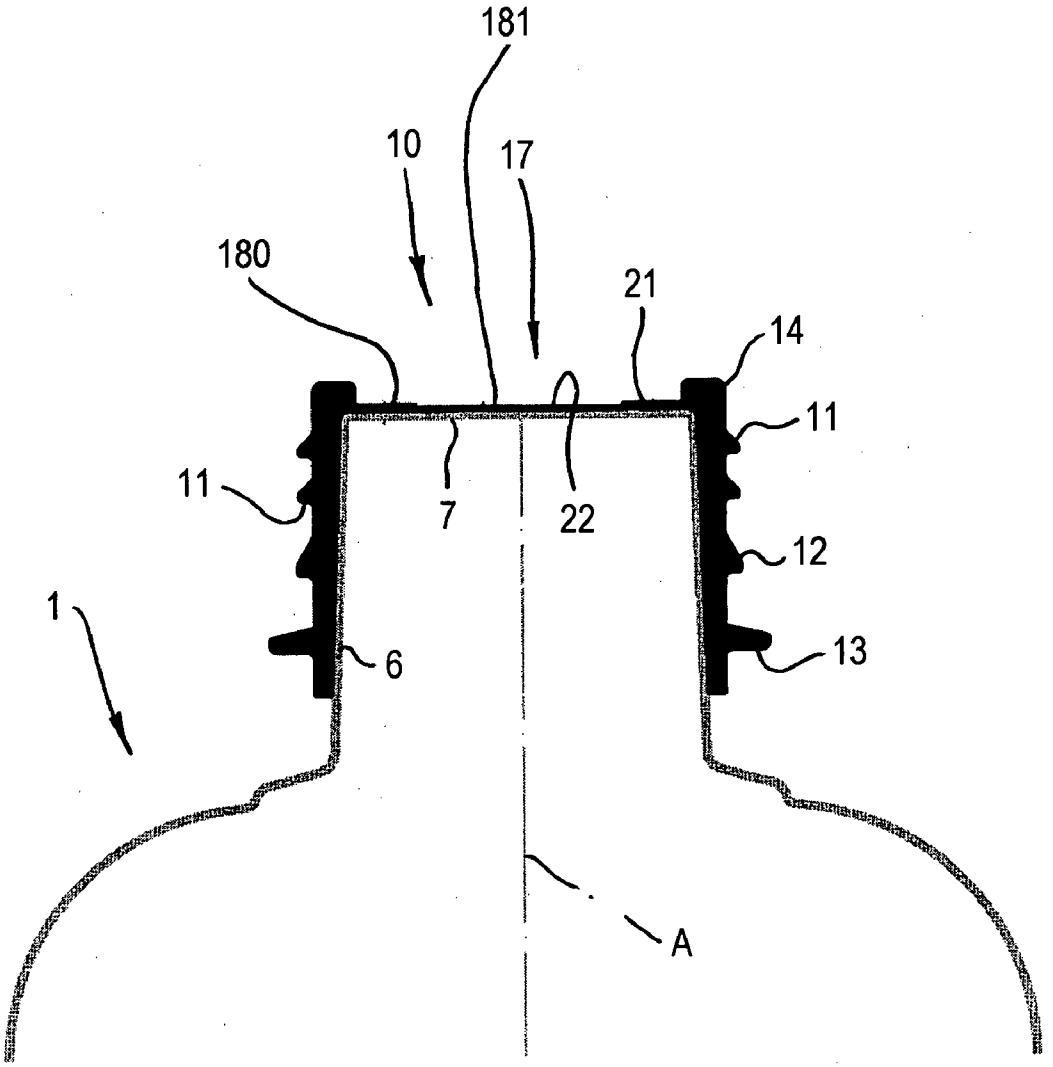

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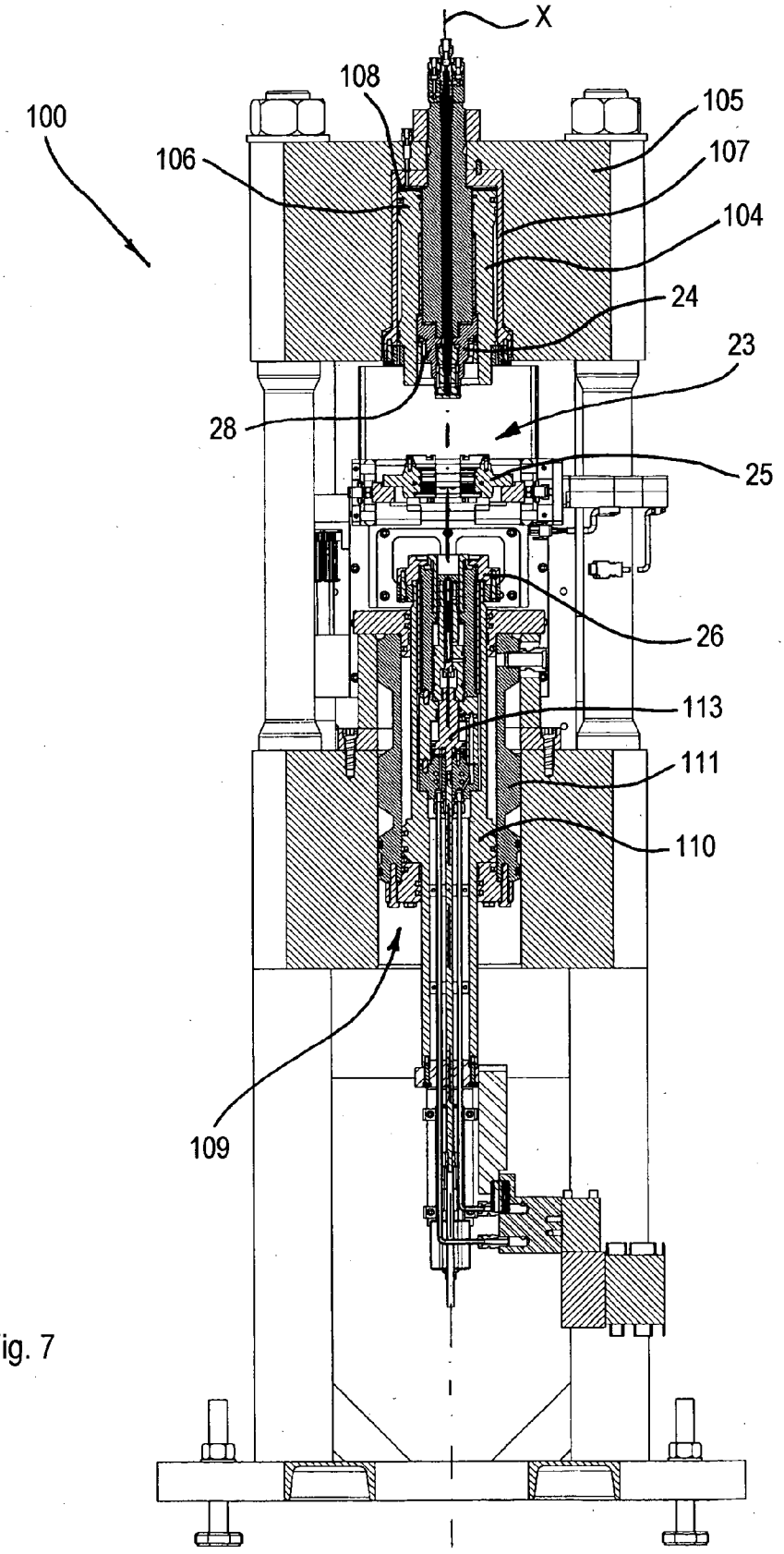

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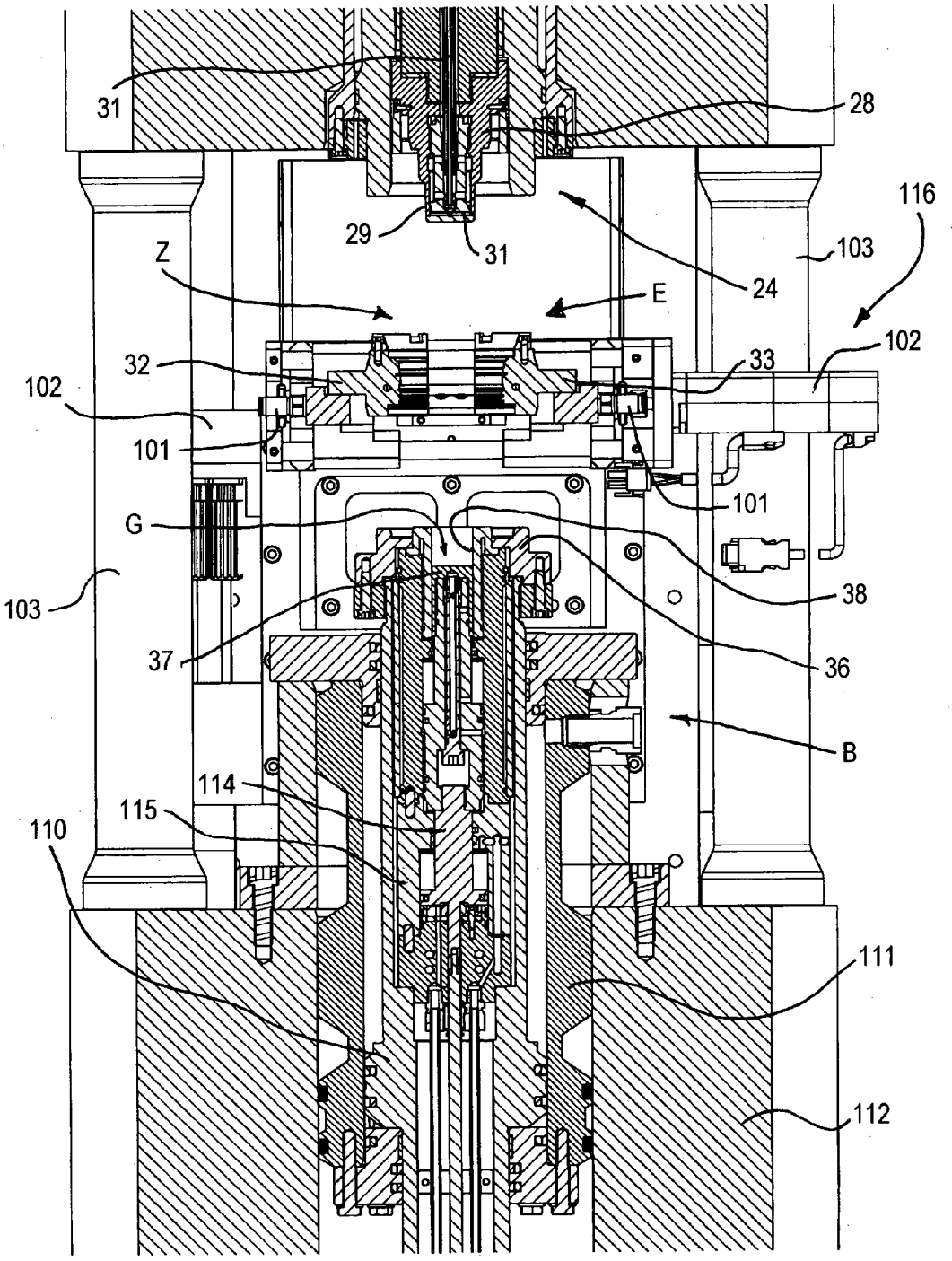
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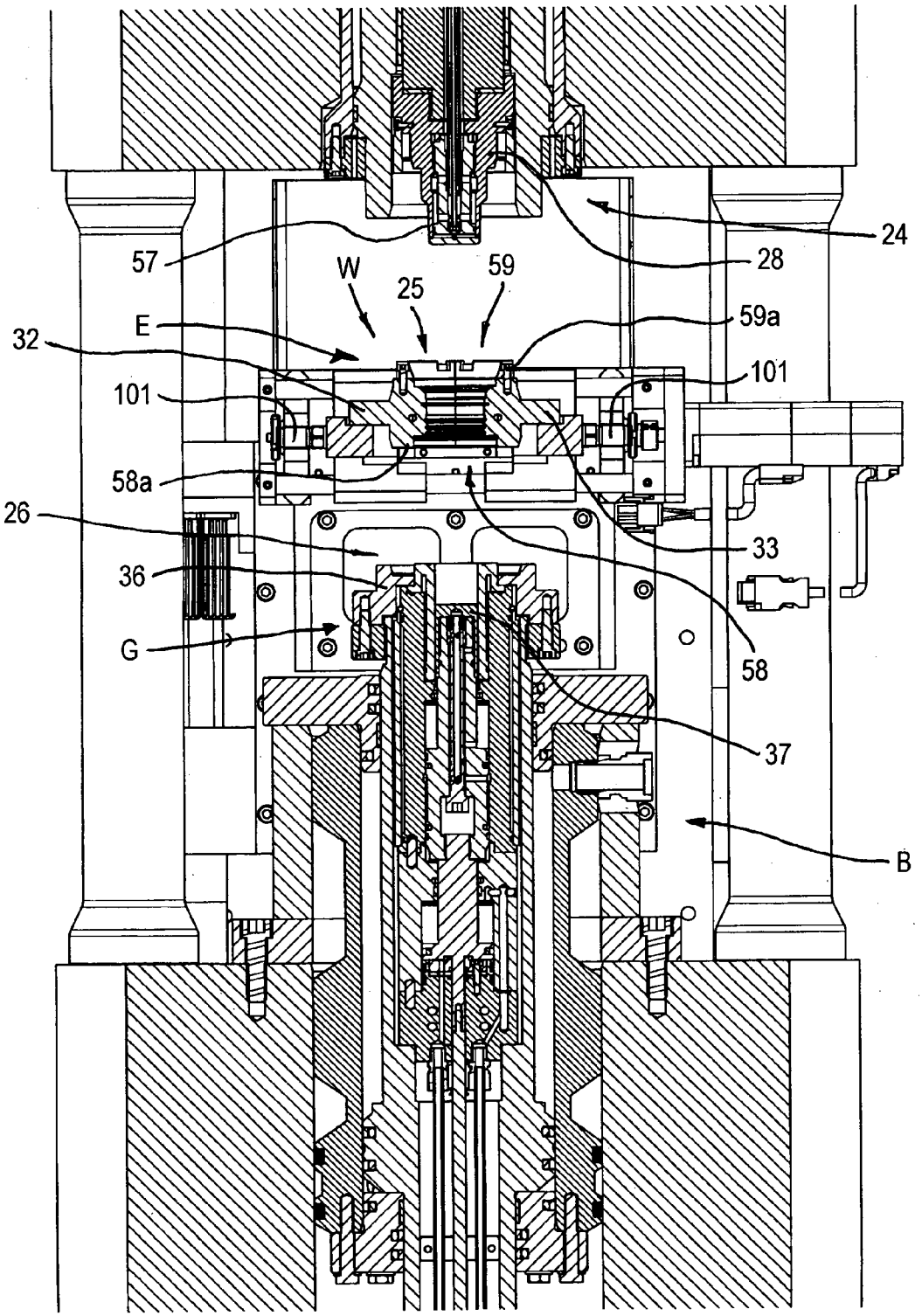
Fig. 8



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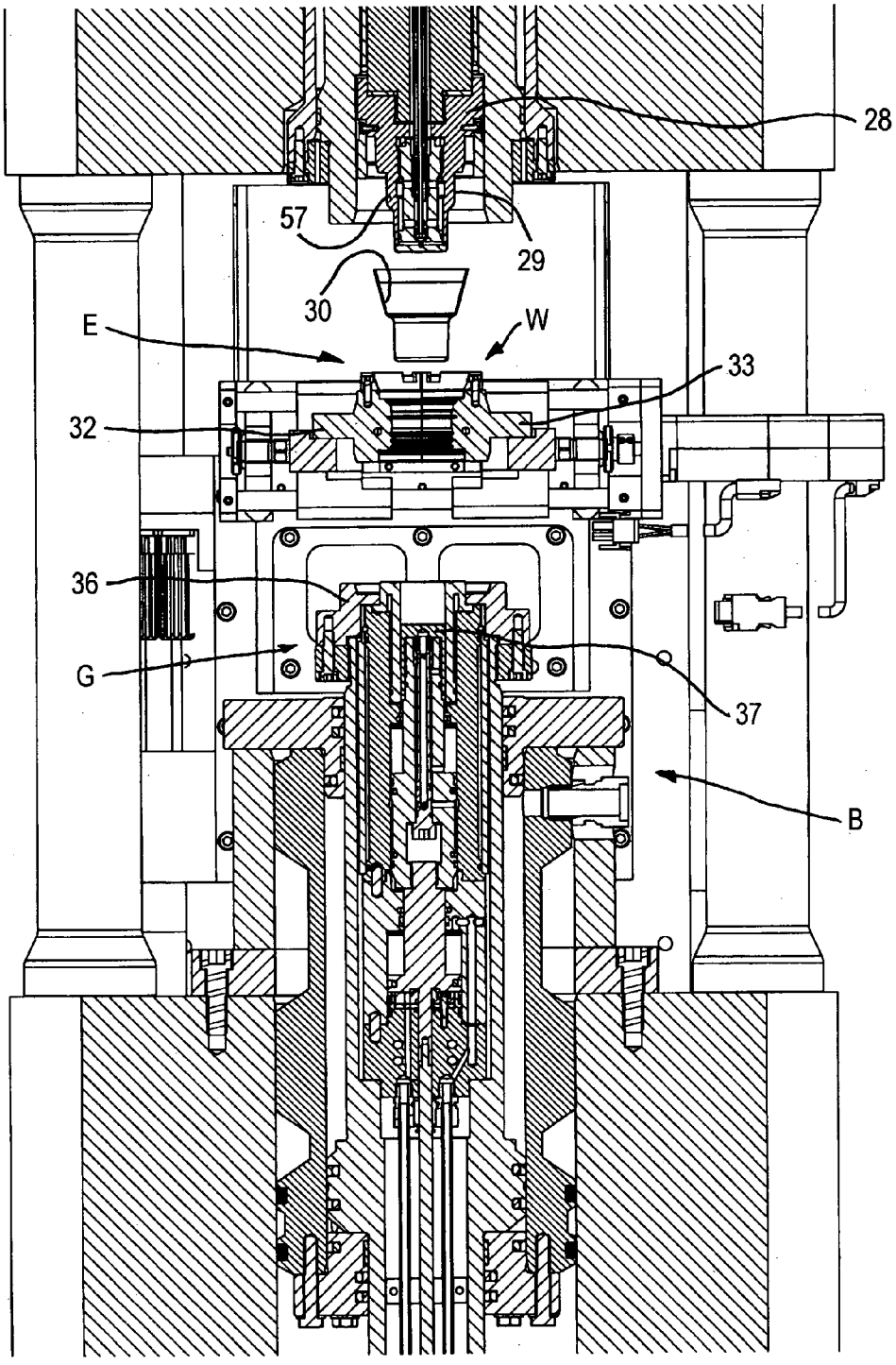

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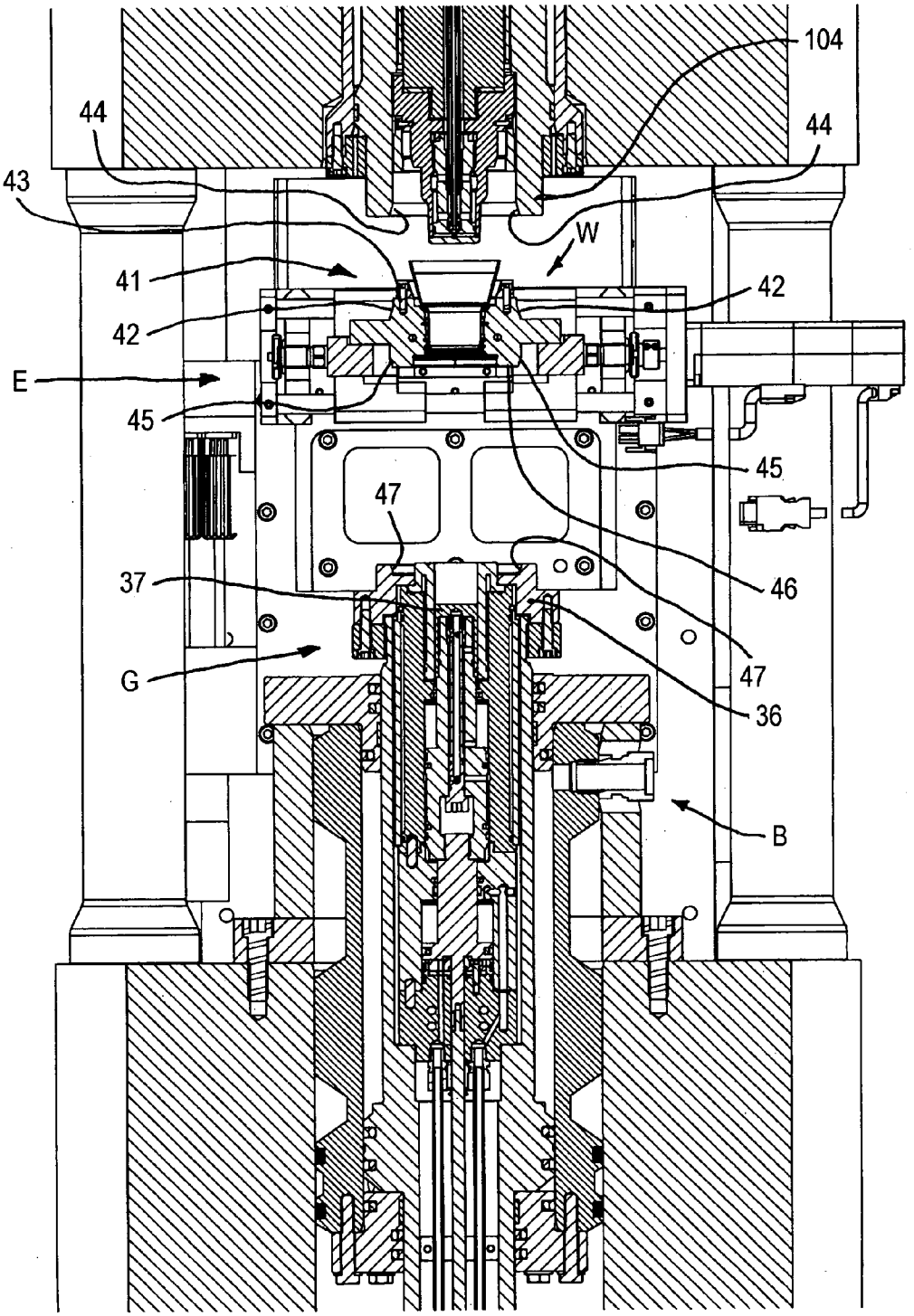

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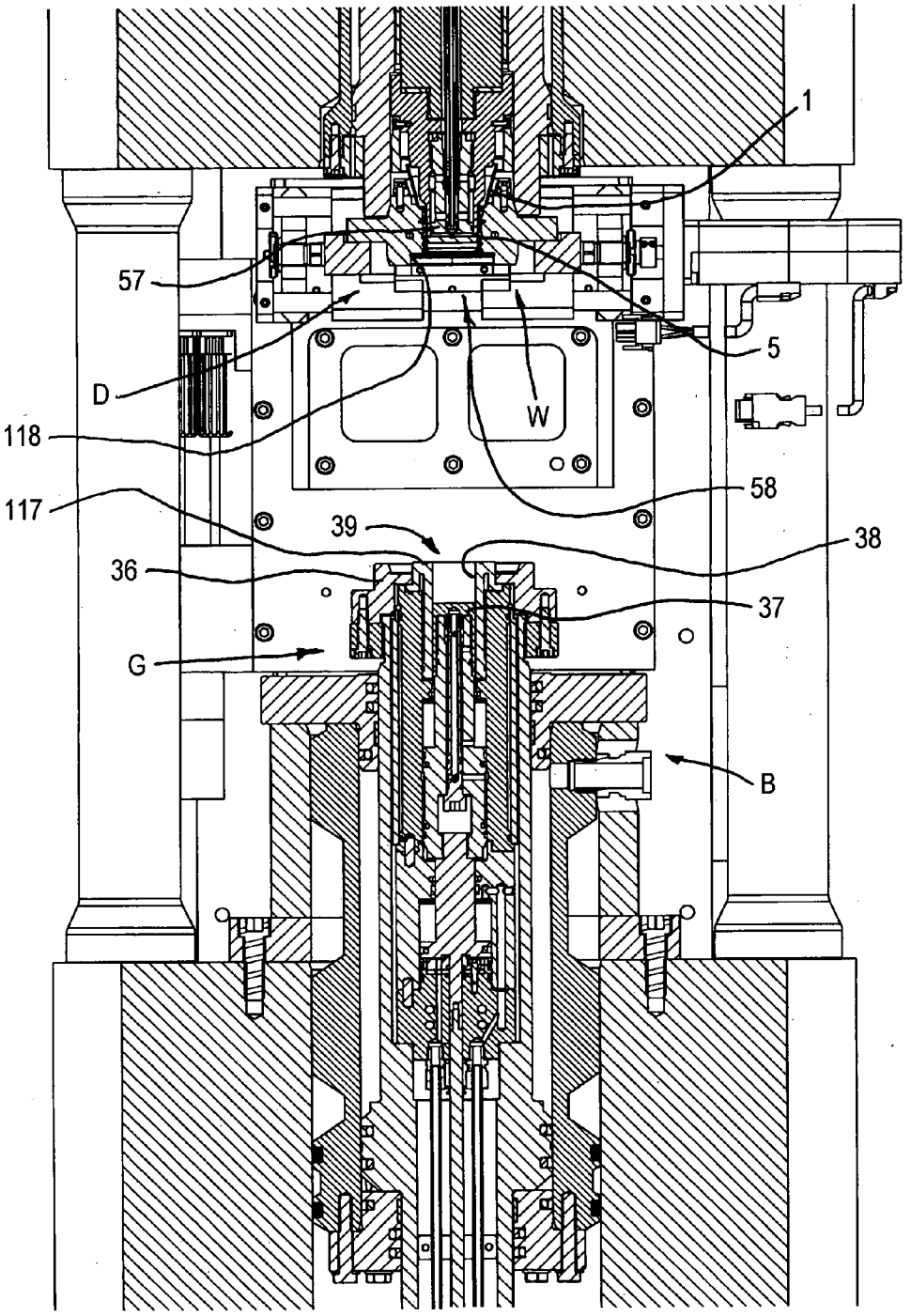

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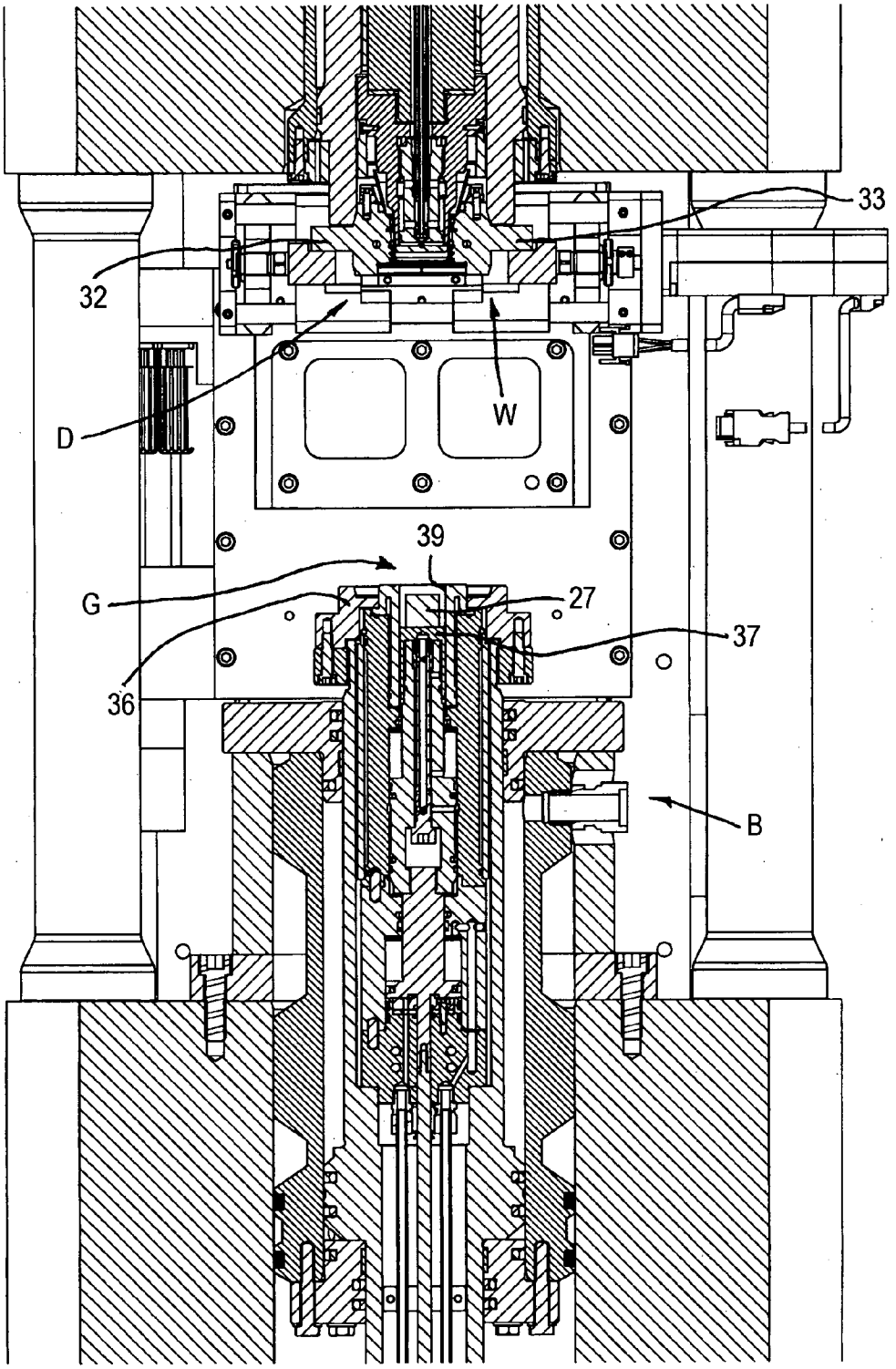

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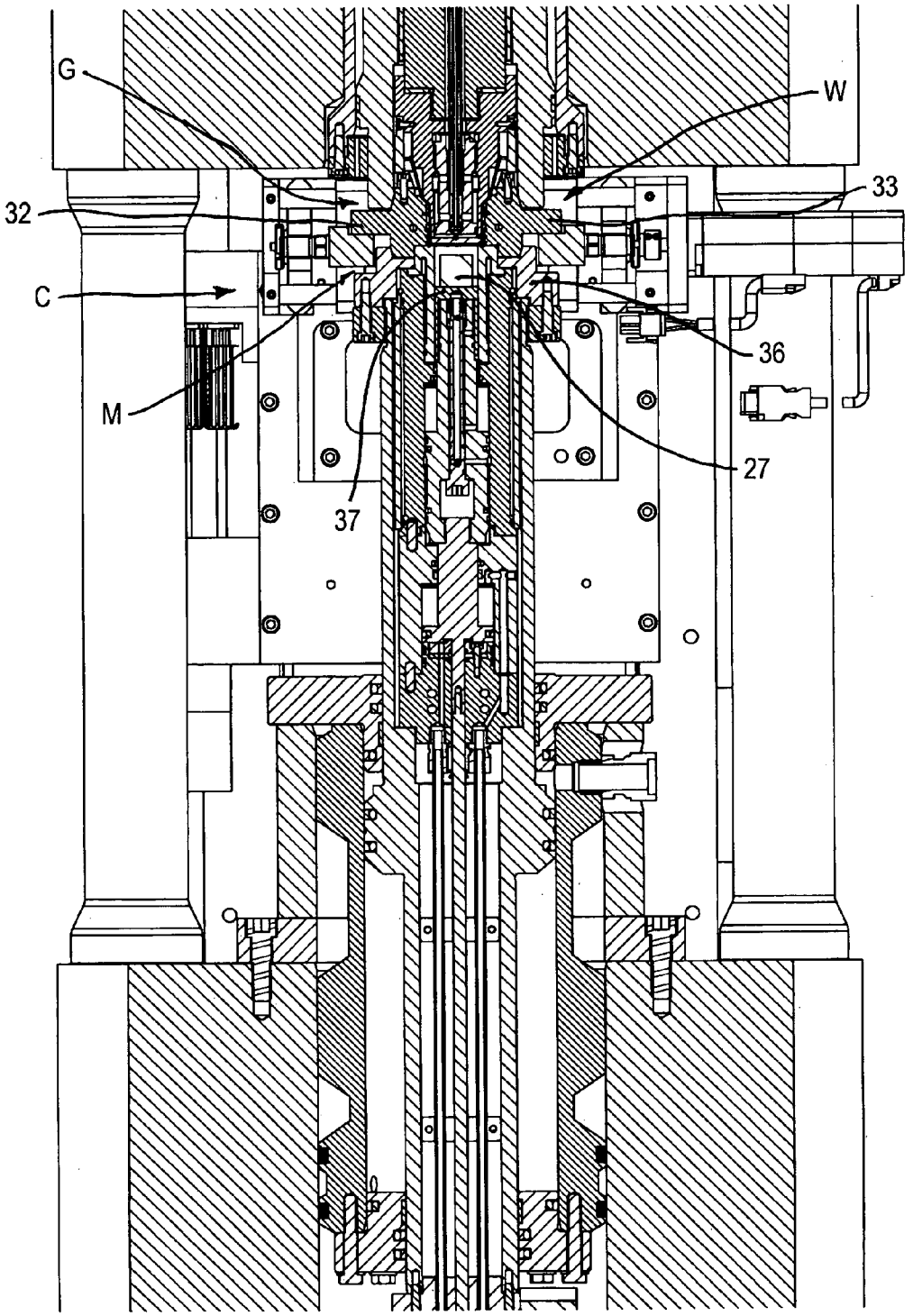

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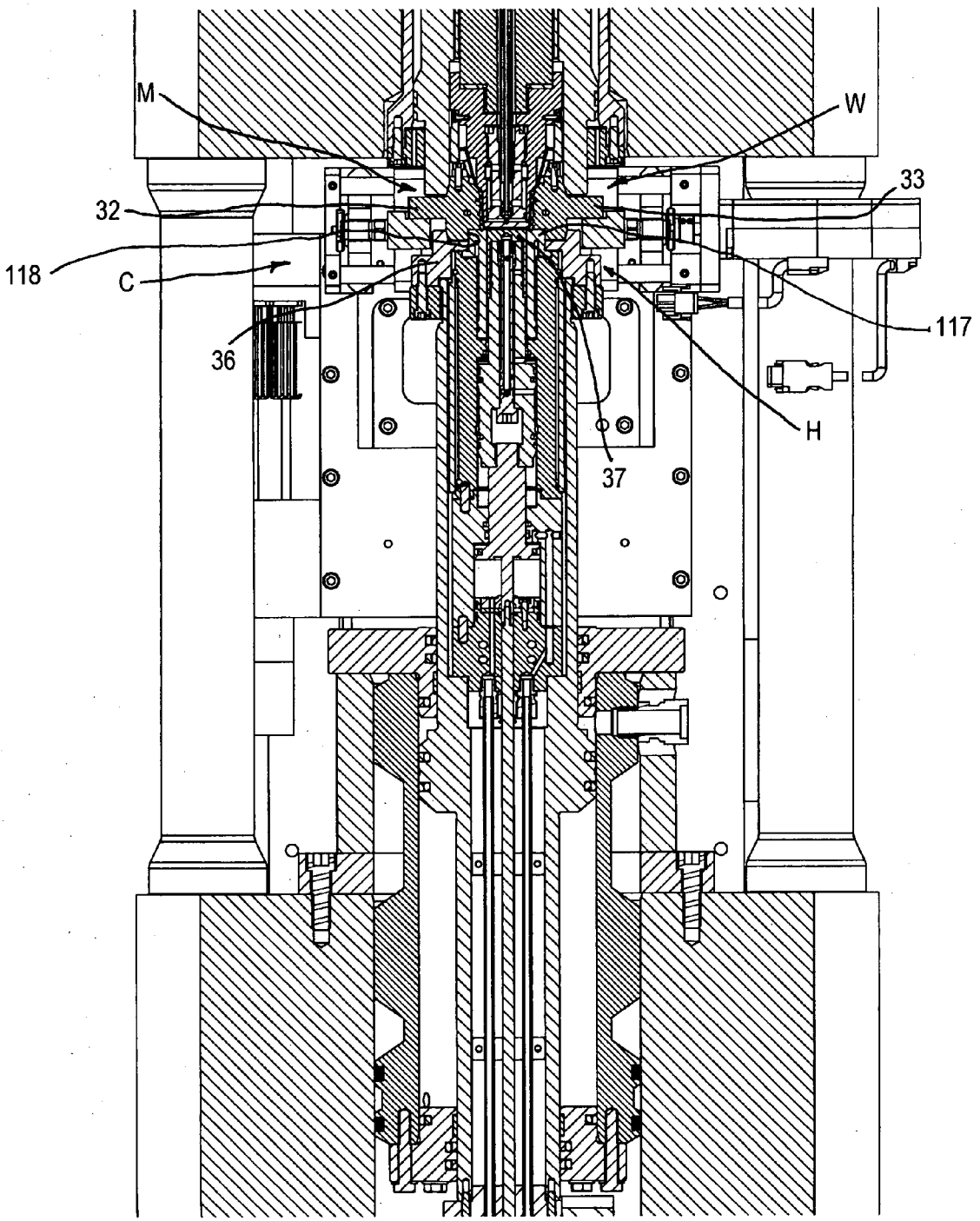

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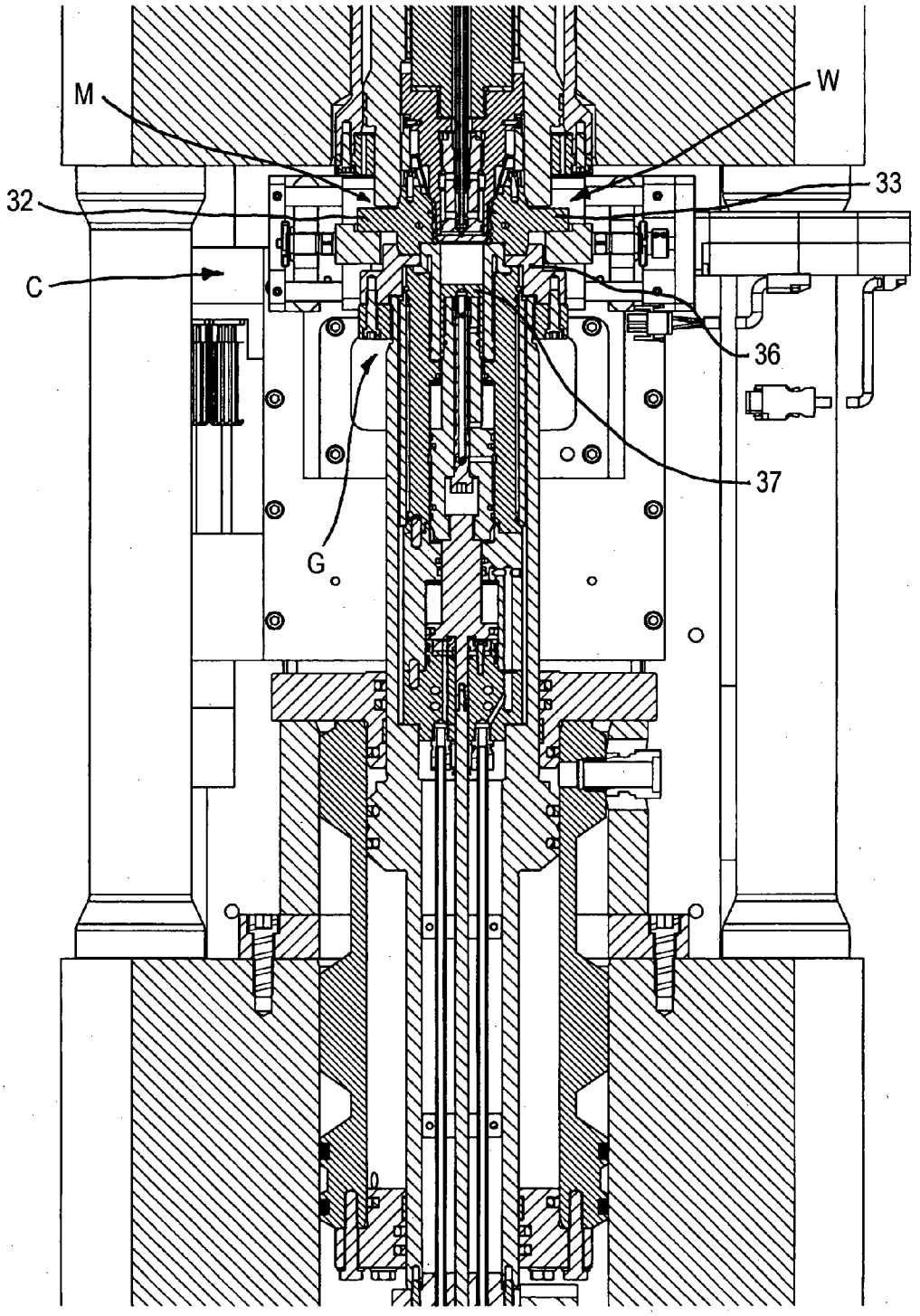

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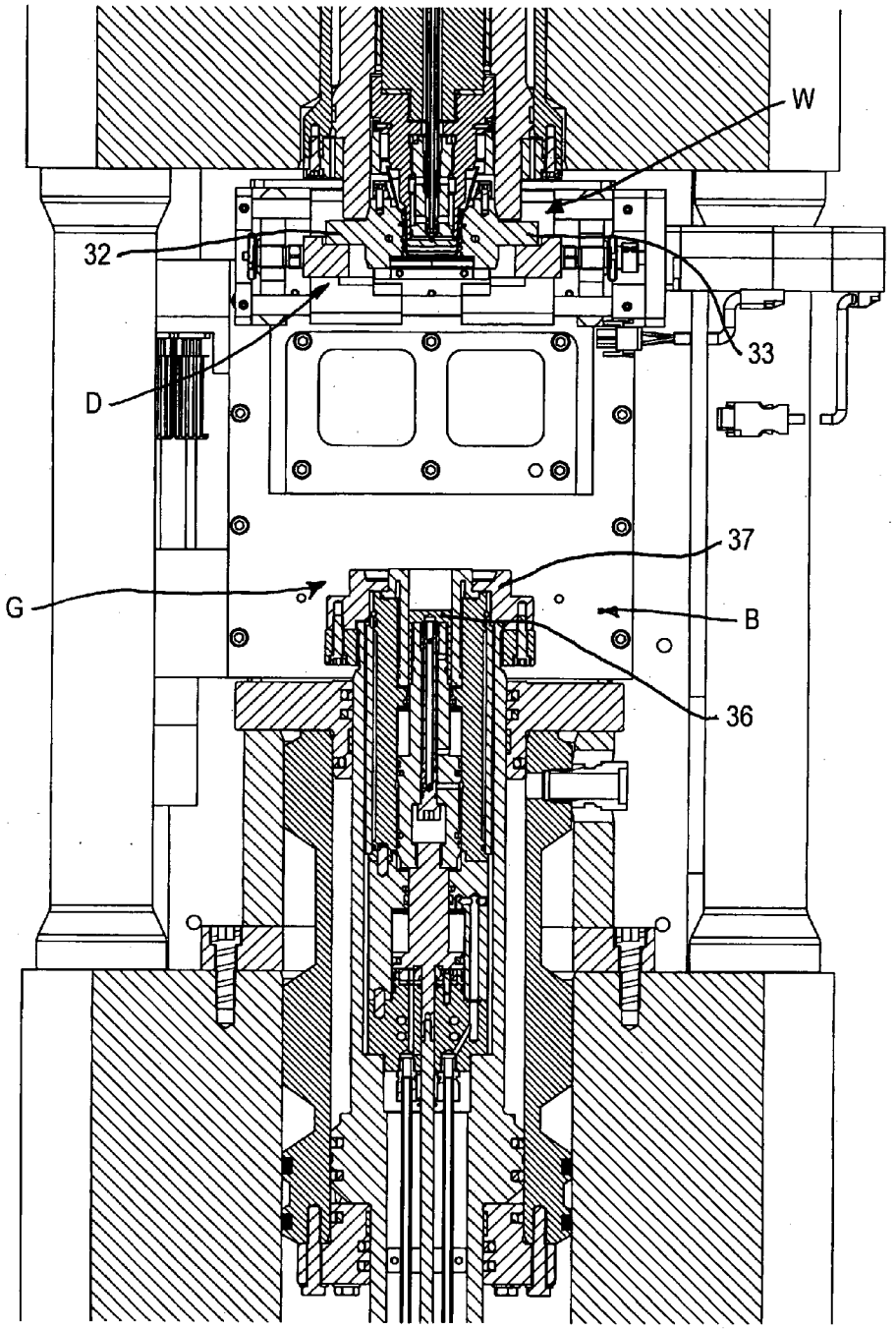

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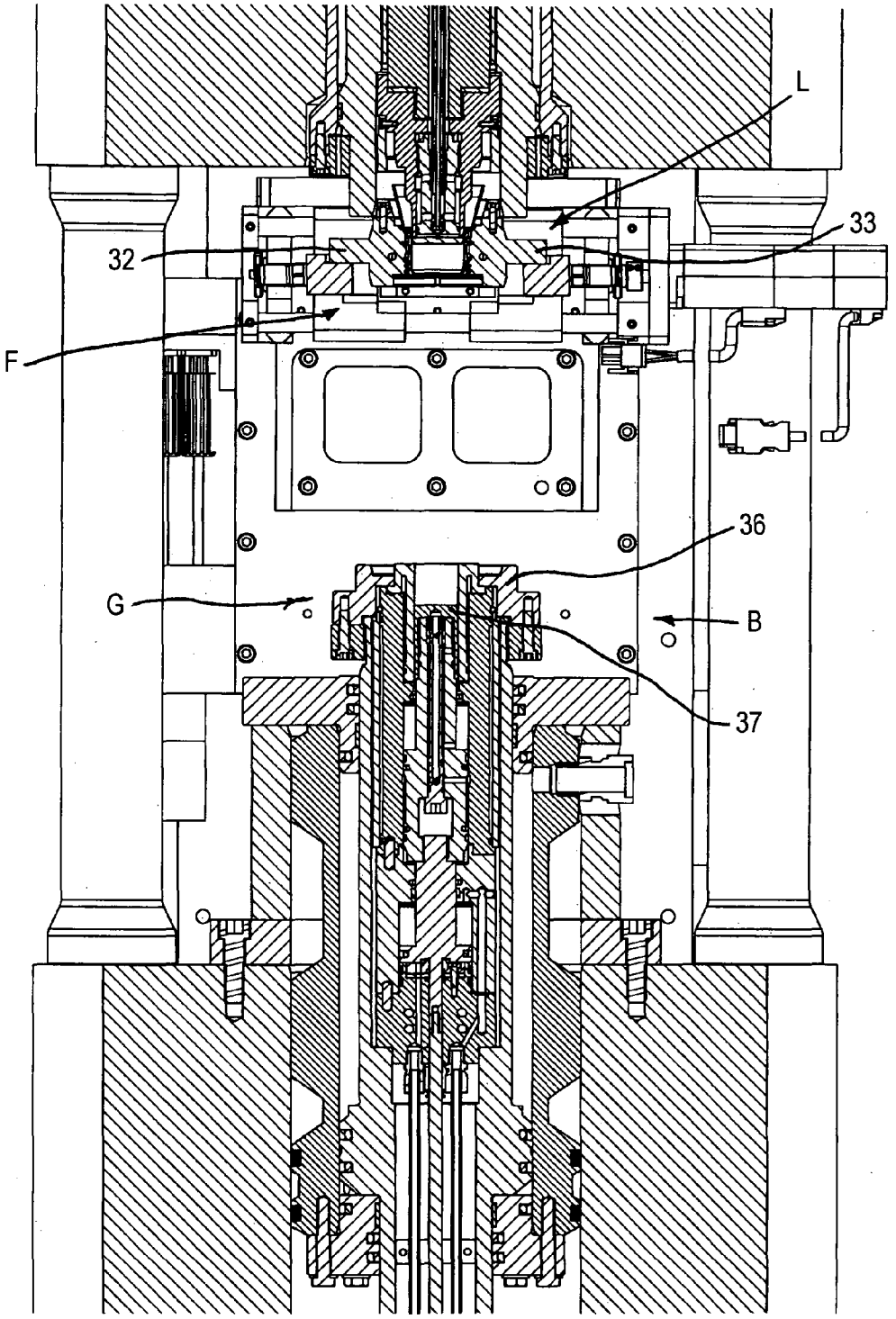

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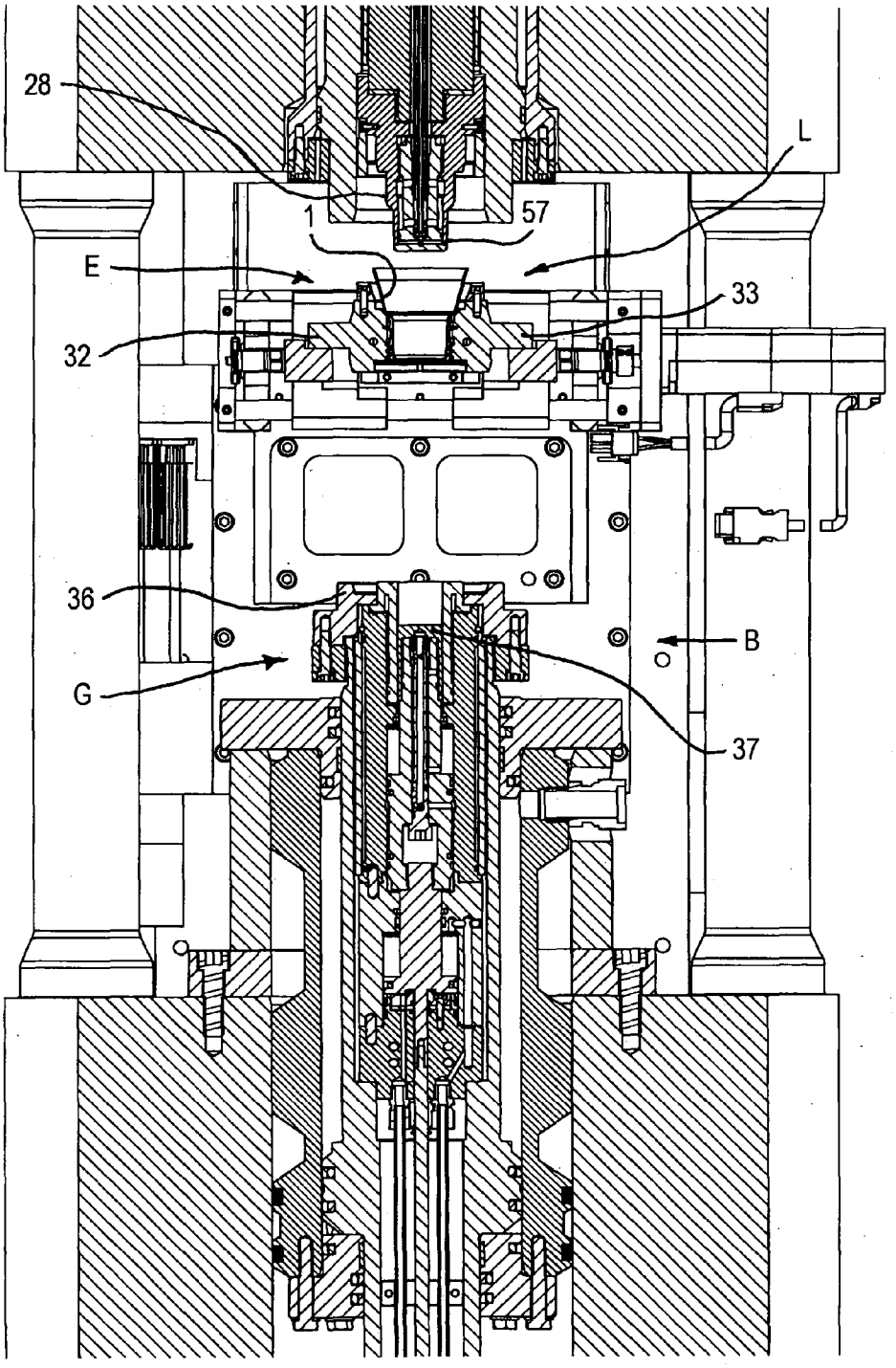

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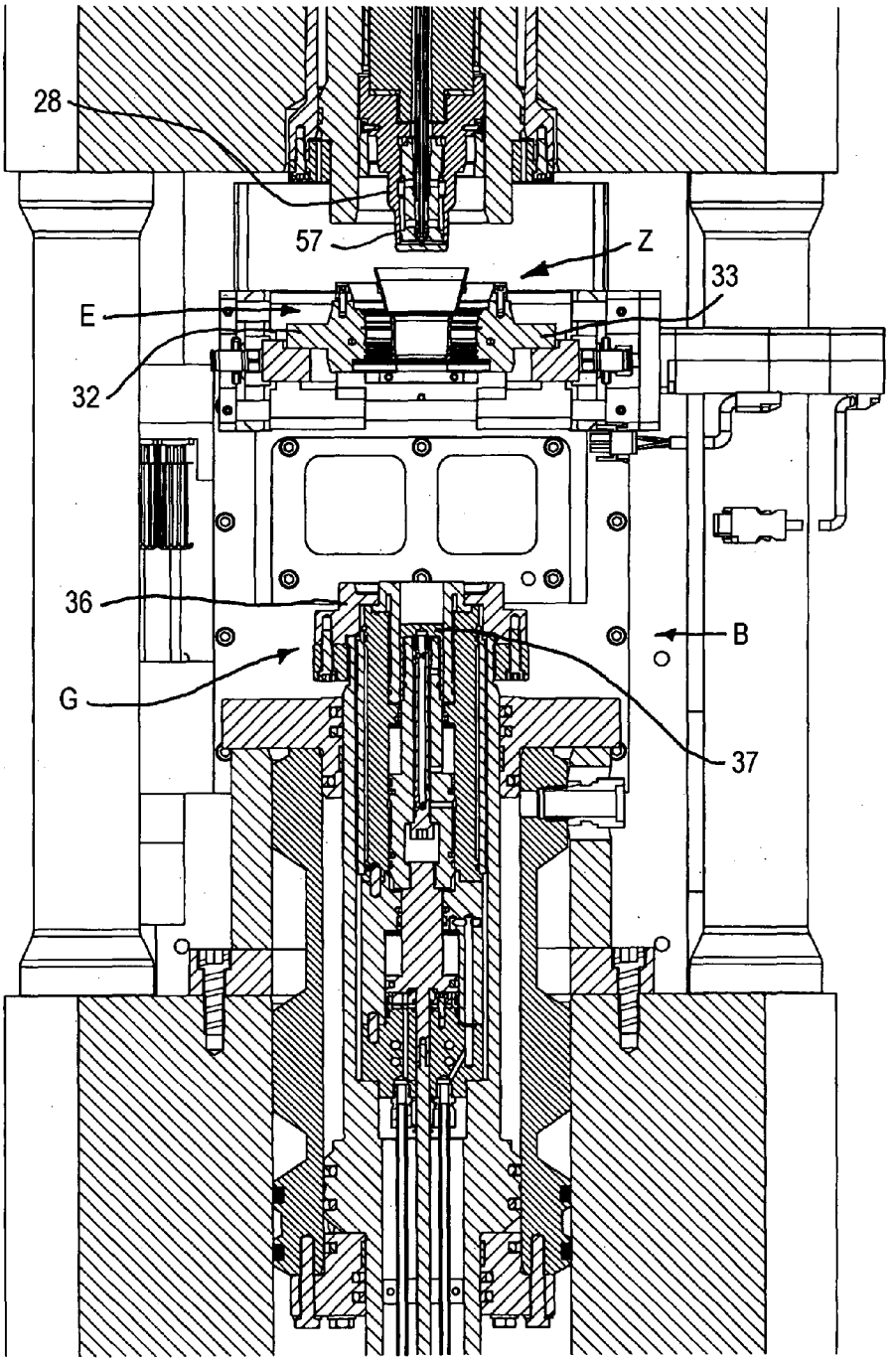

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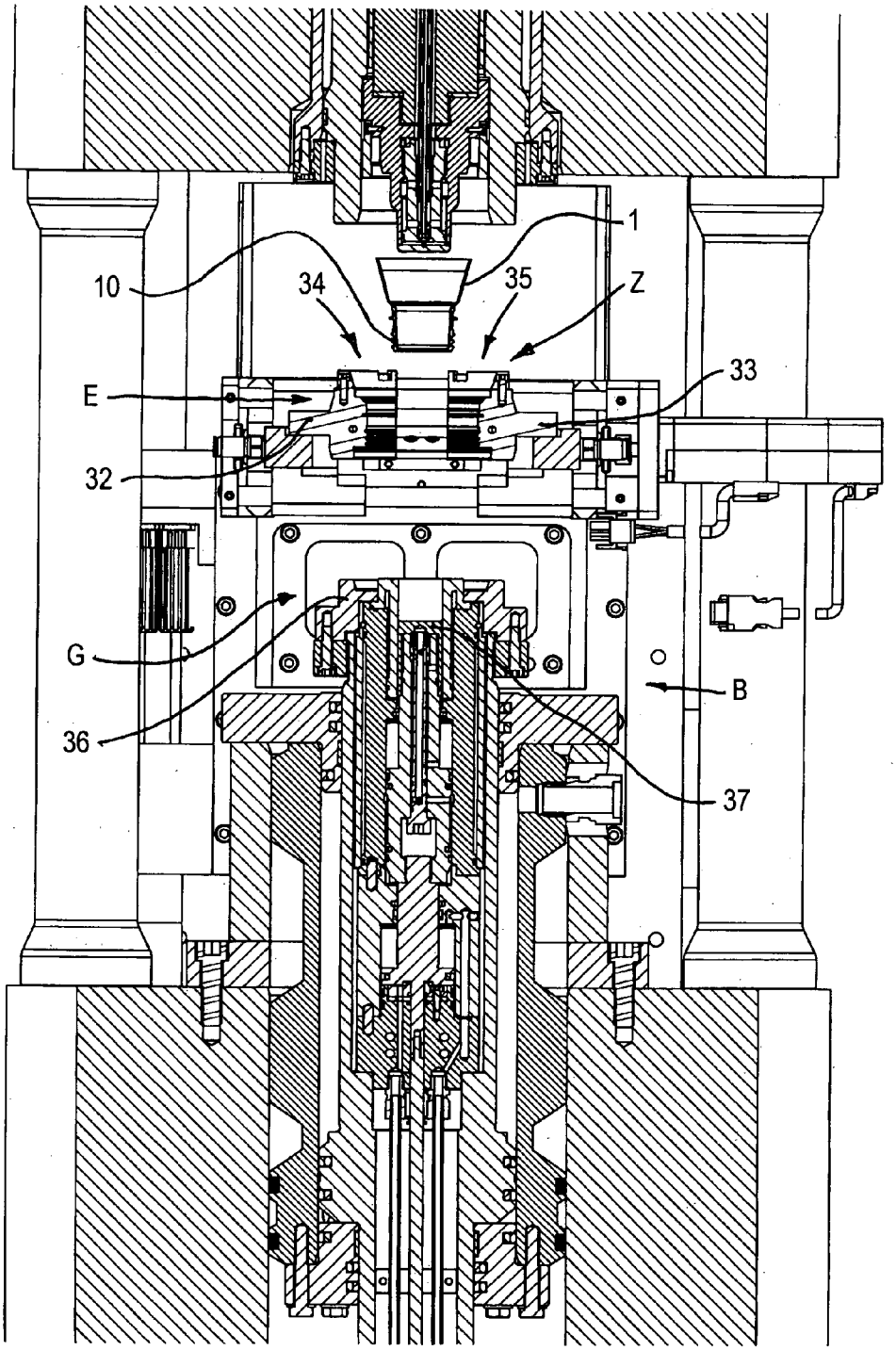

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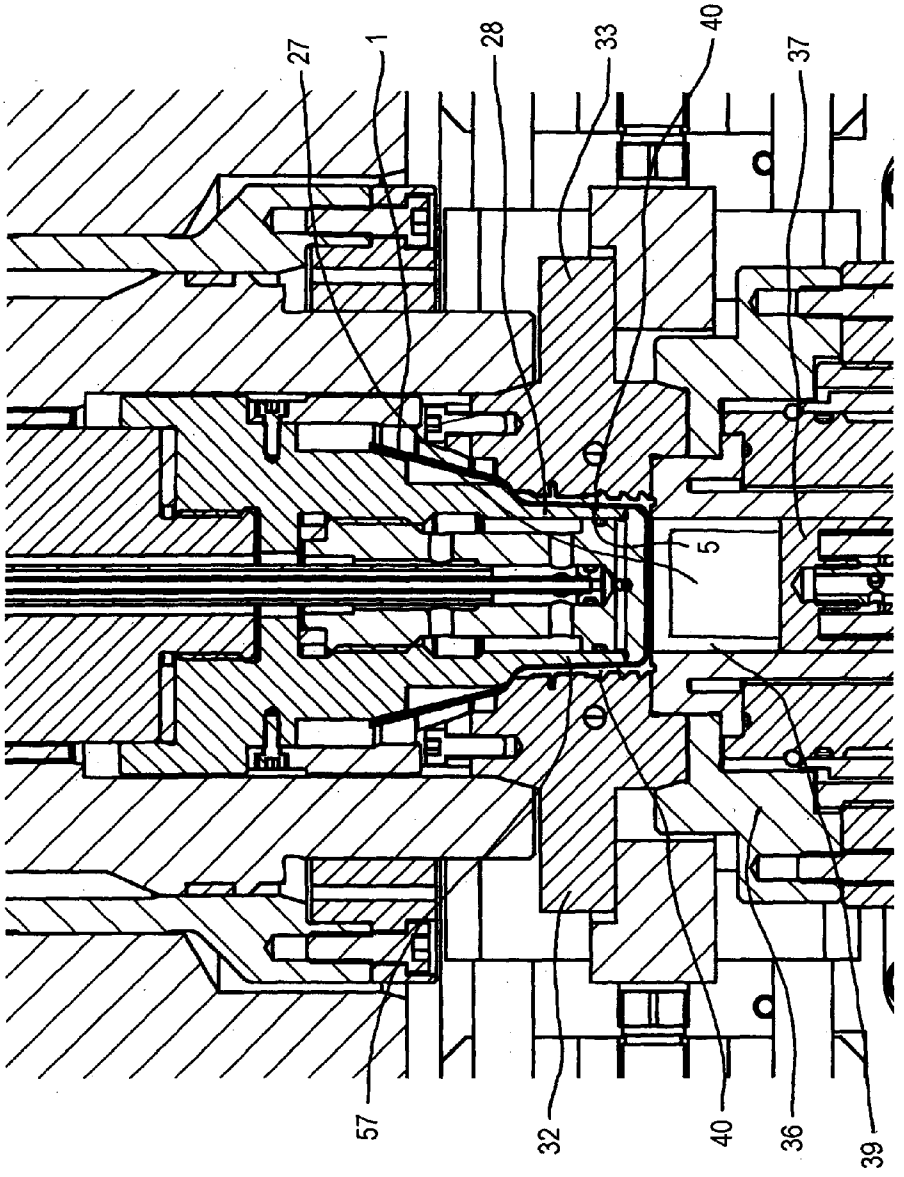

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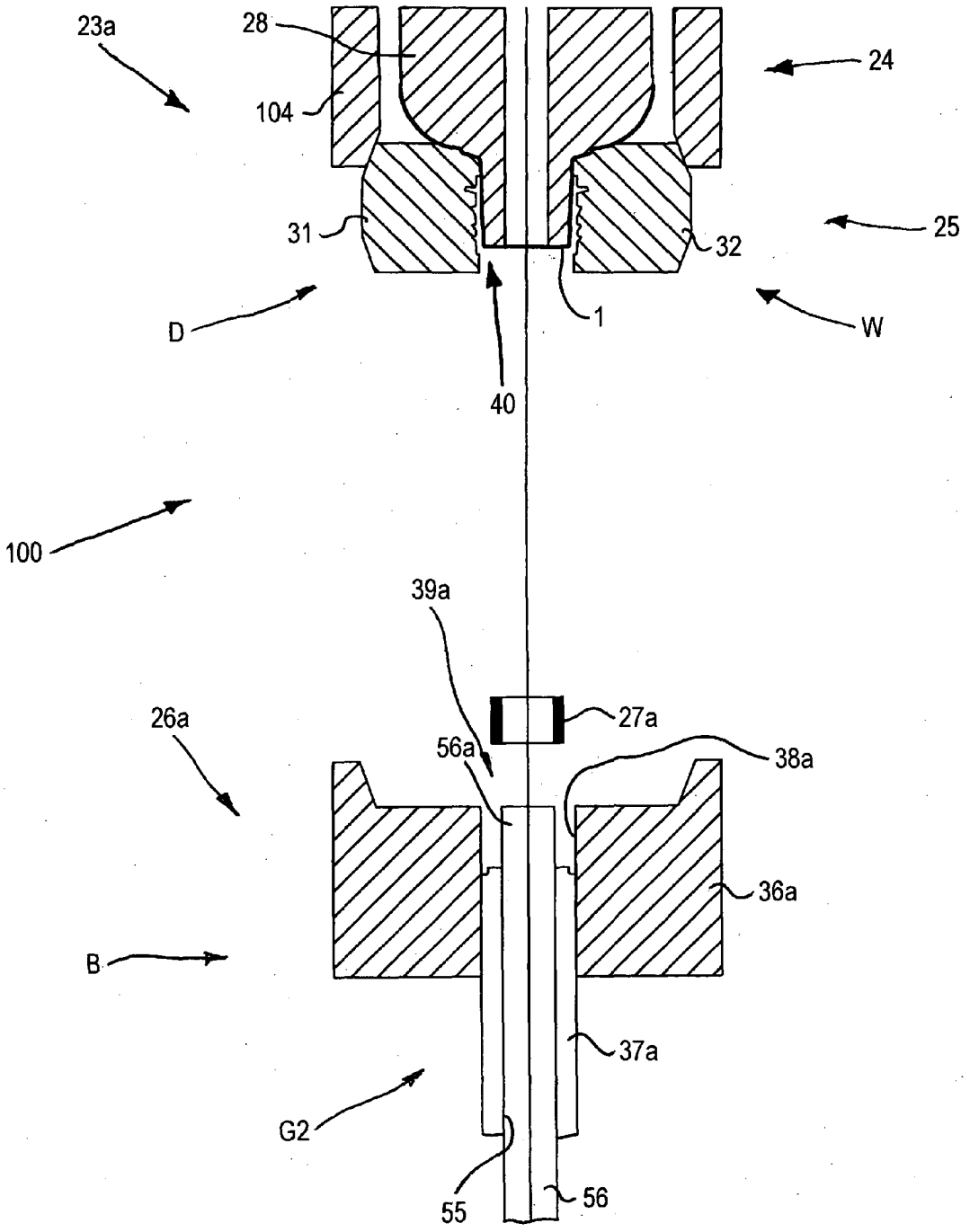
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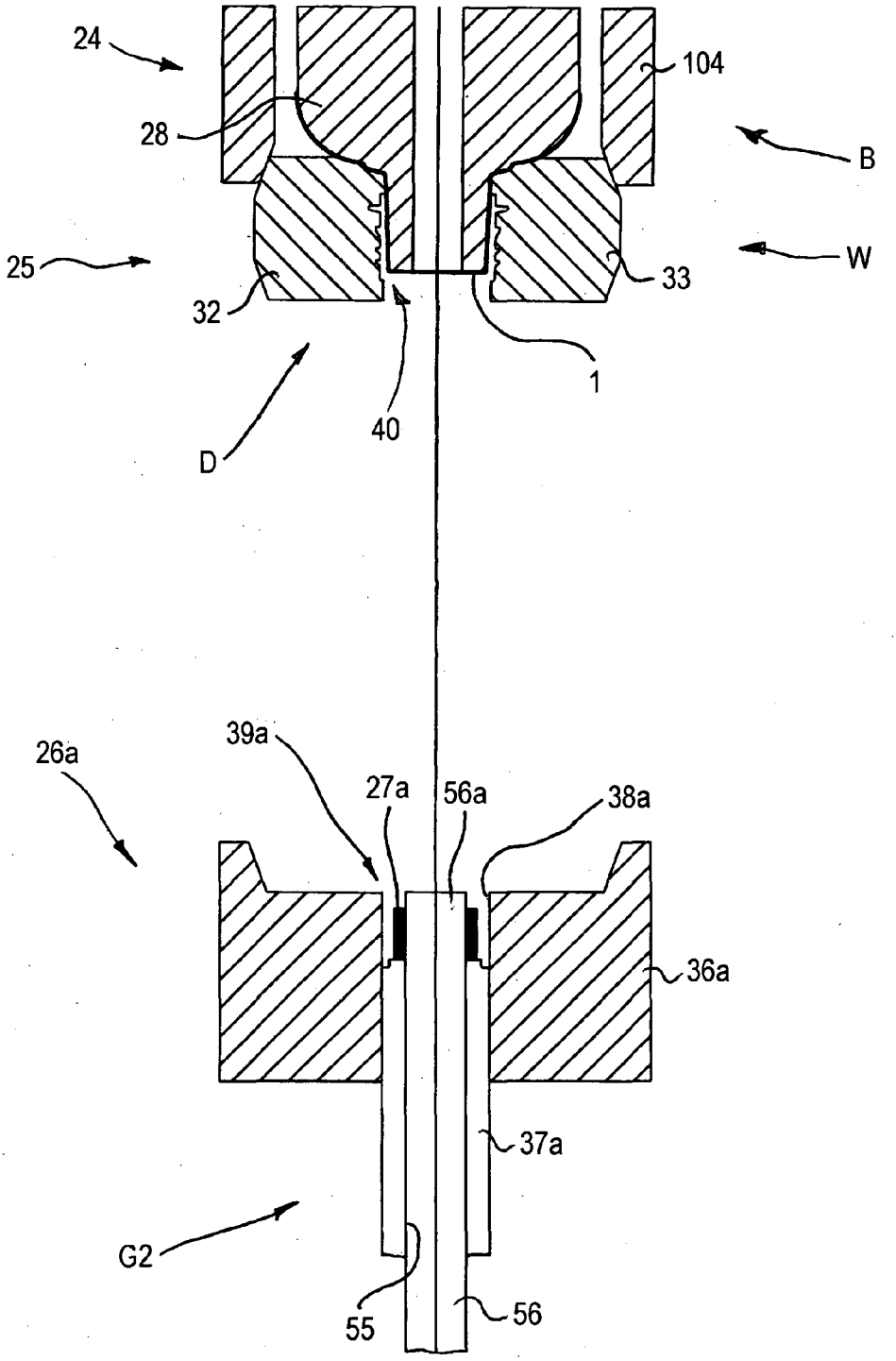
Fig. 23



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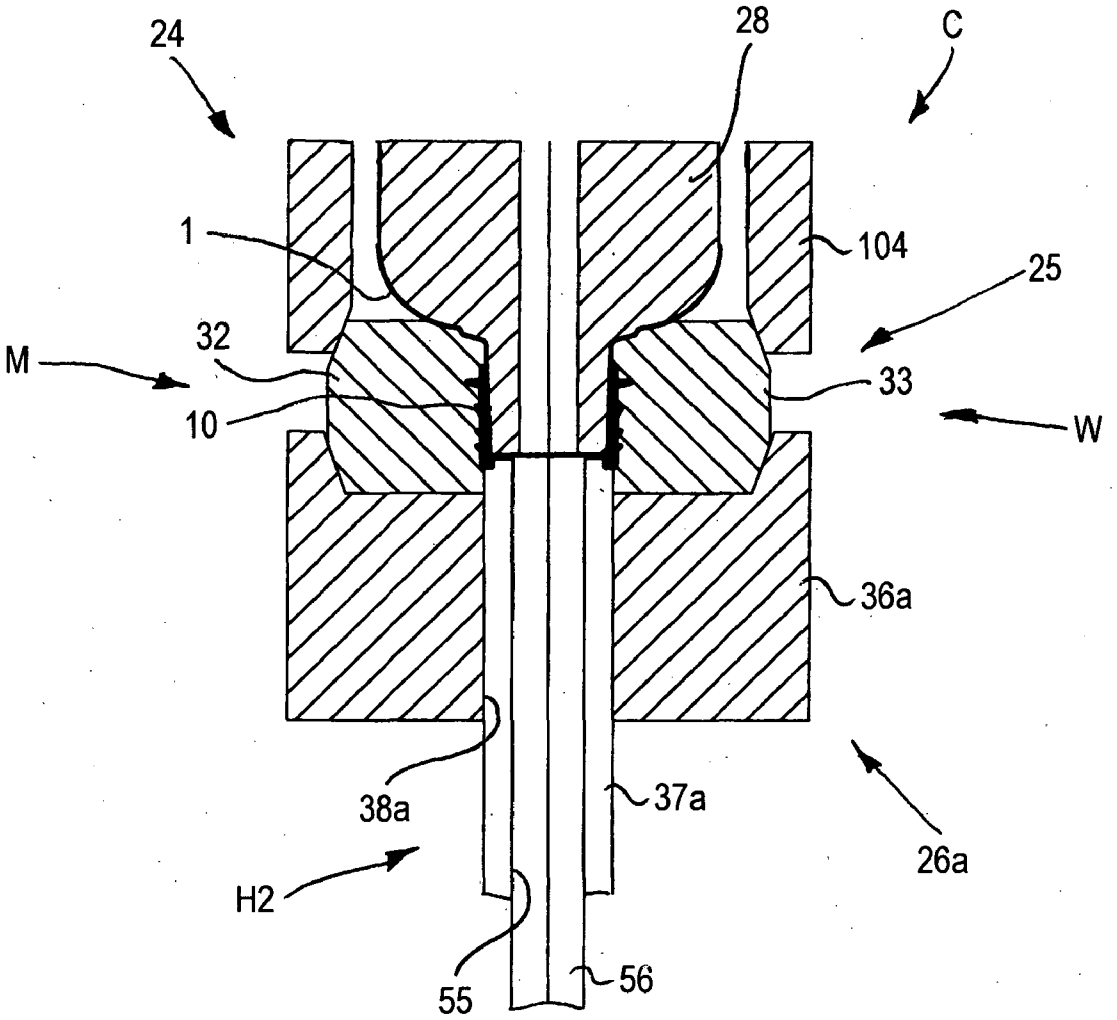

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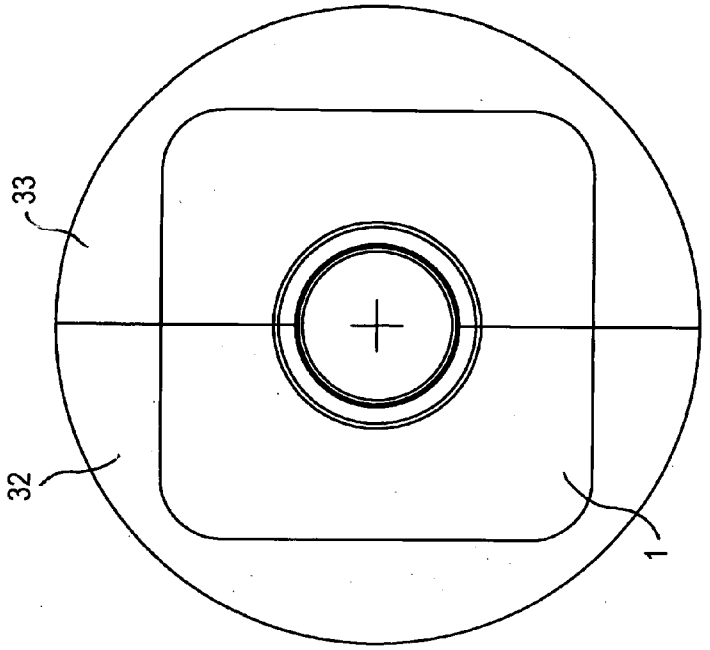

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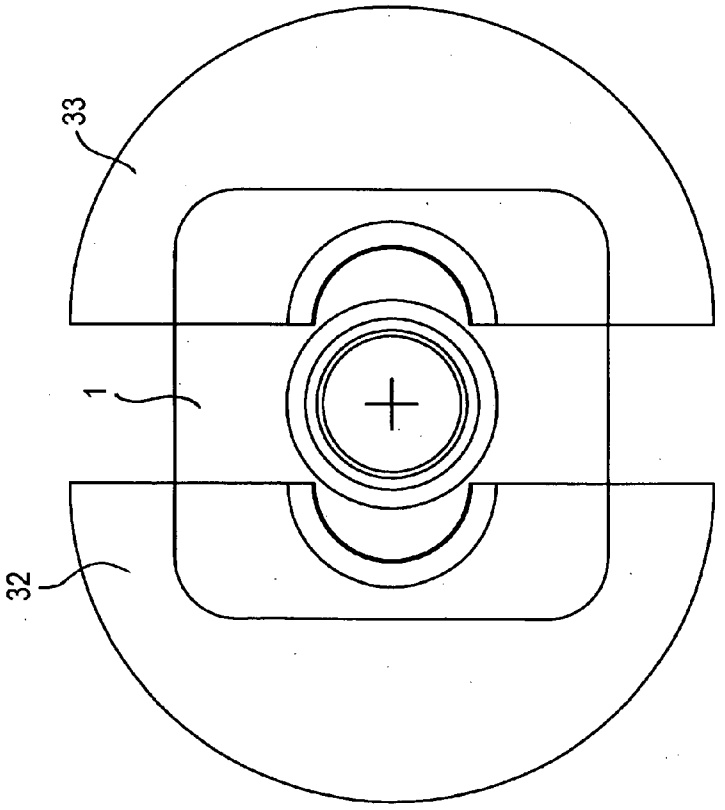

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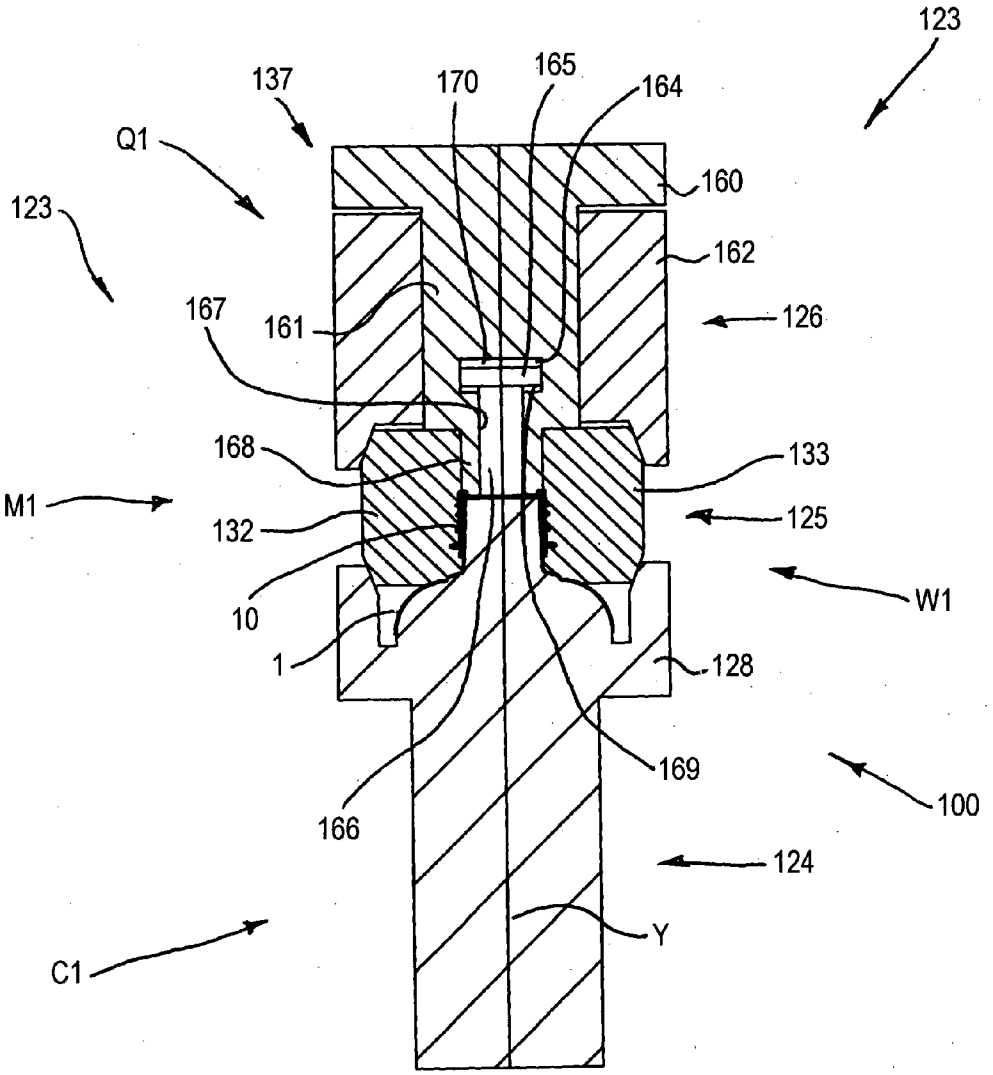
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Fig. 28

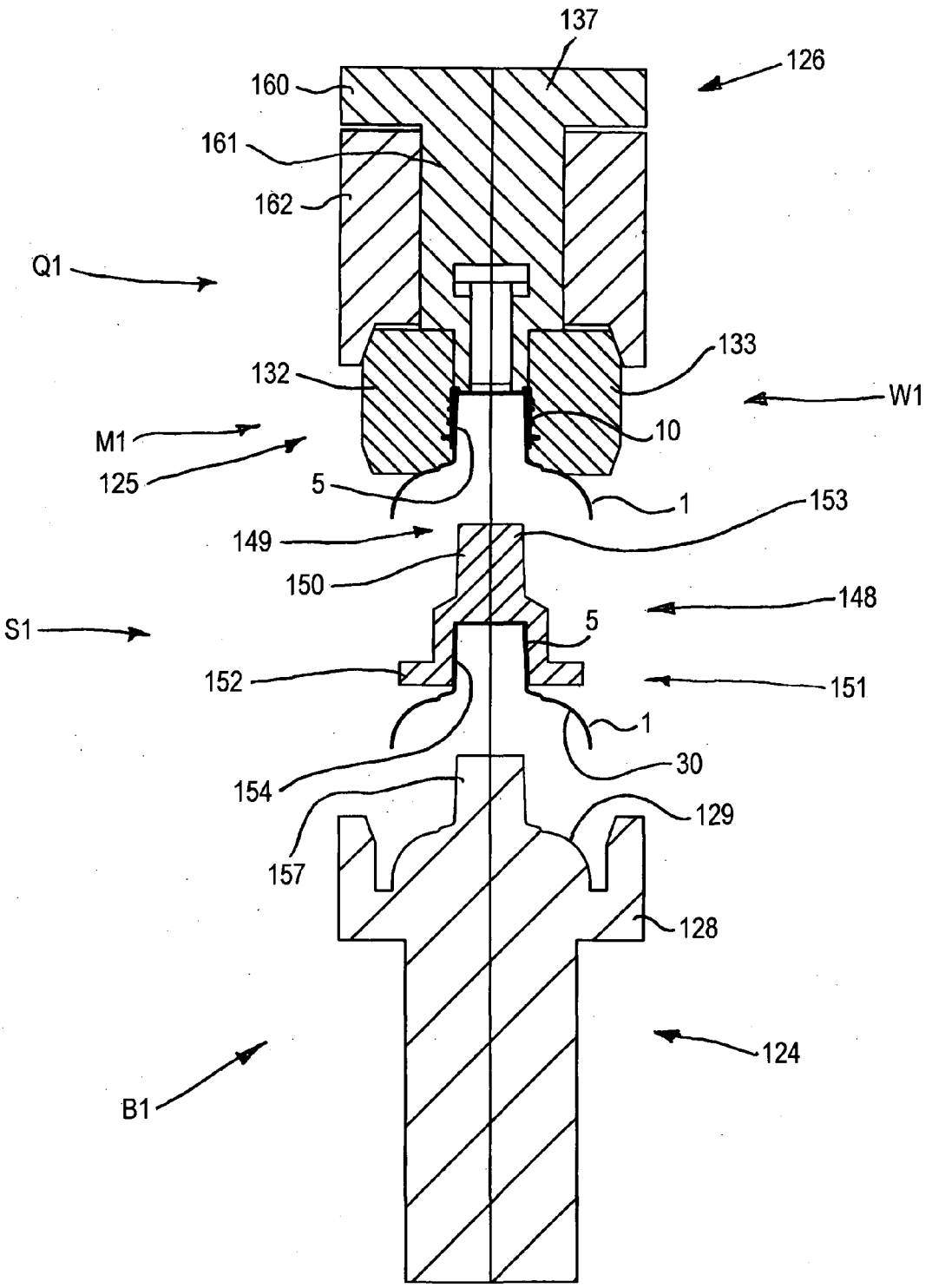
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Fig. 29

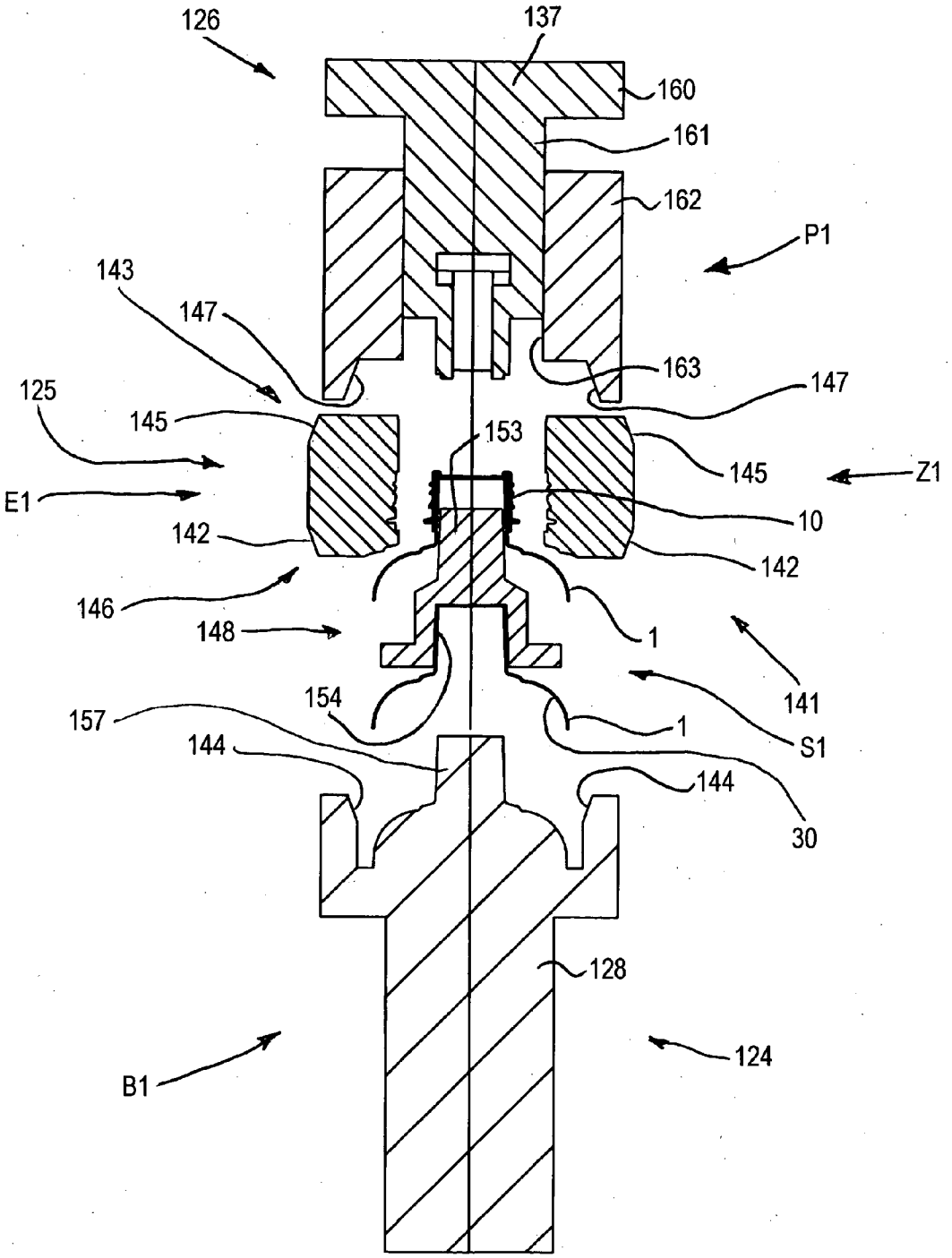
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Fig. 30

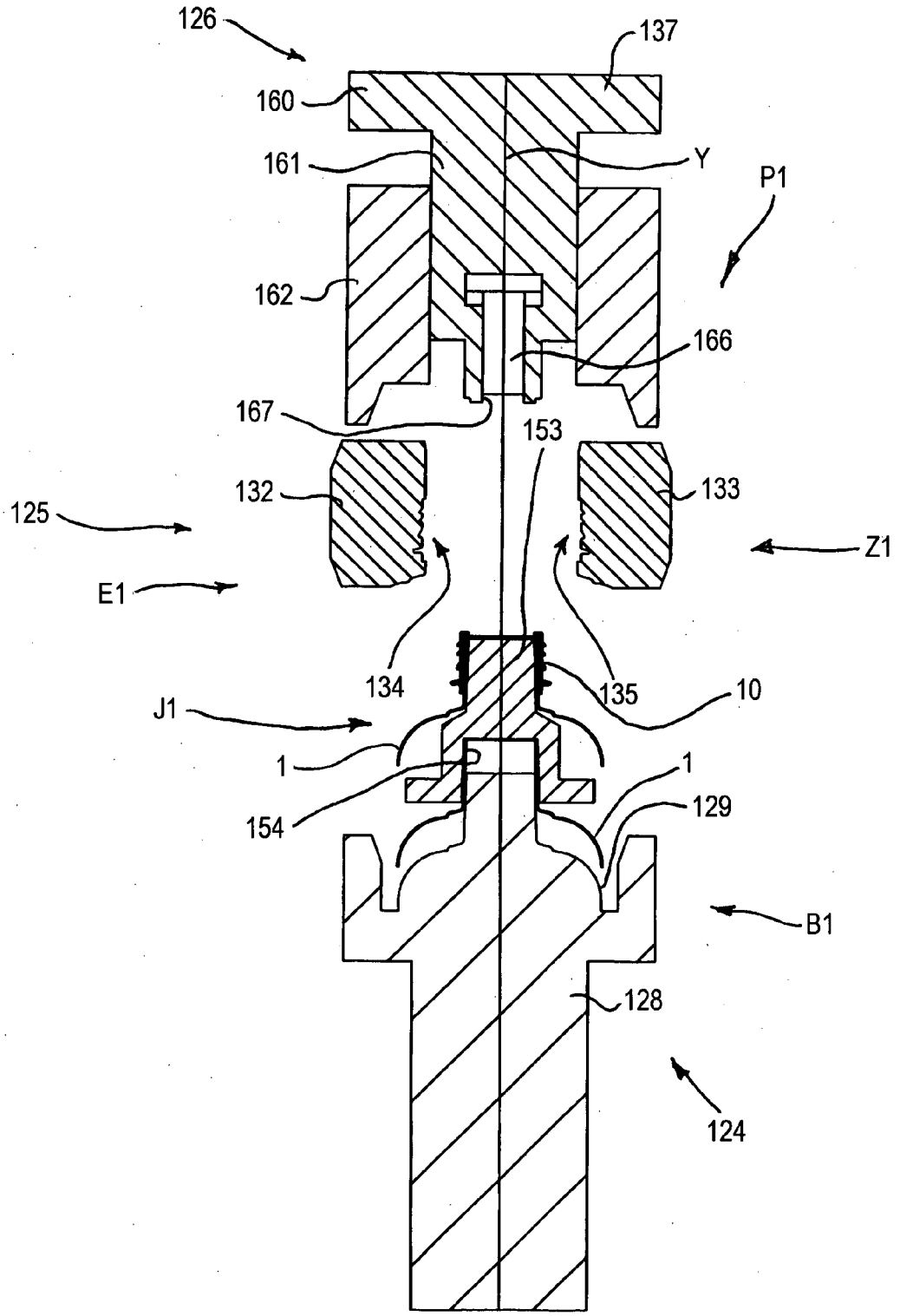
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Fig. 31

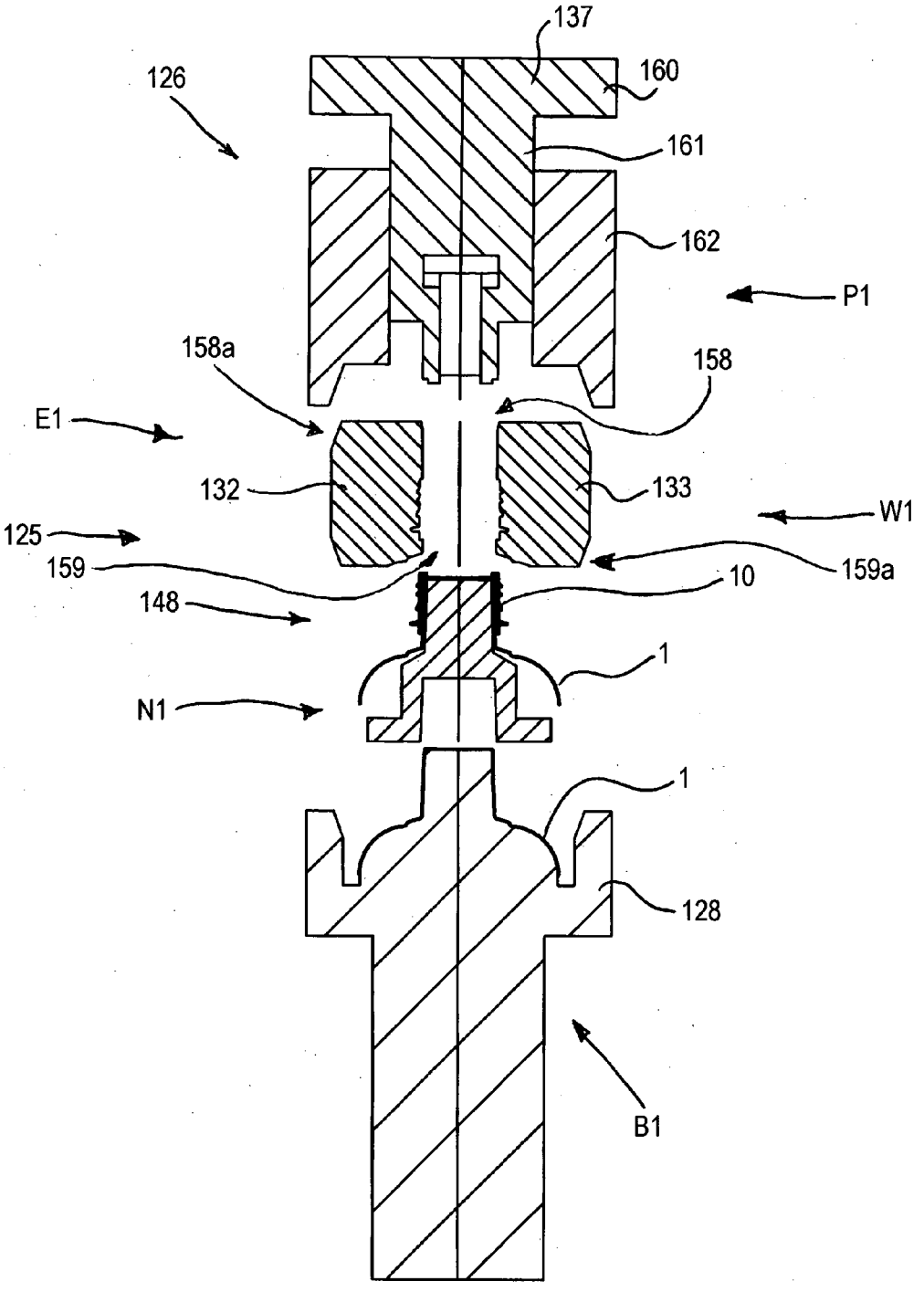
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Fig. 32

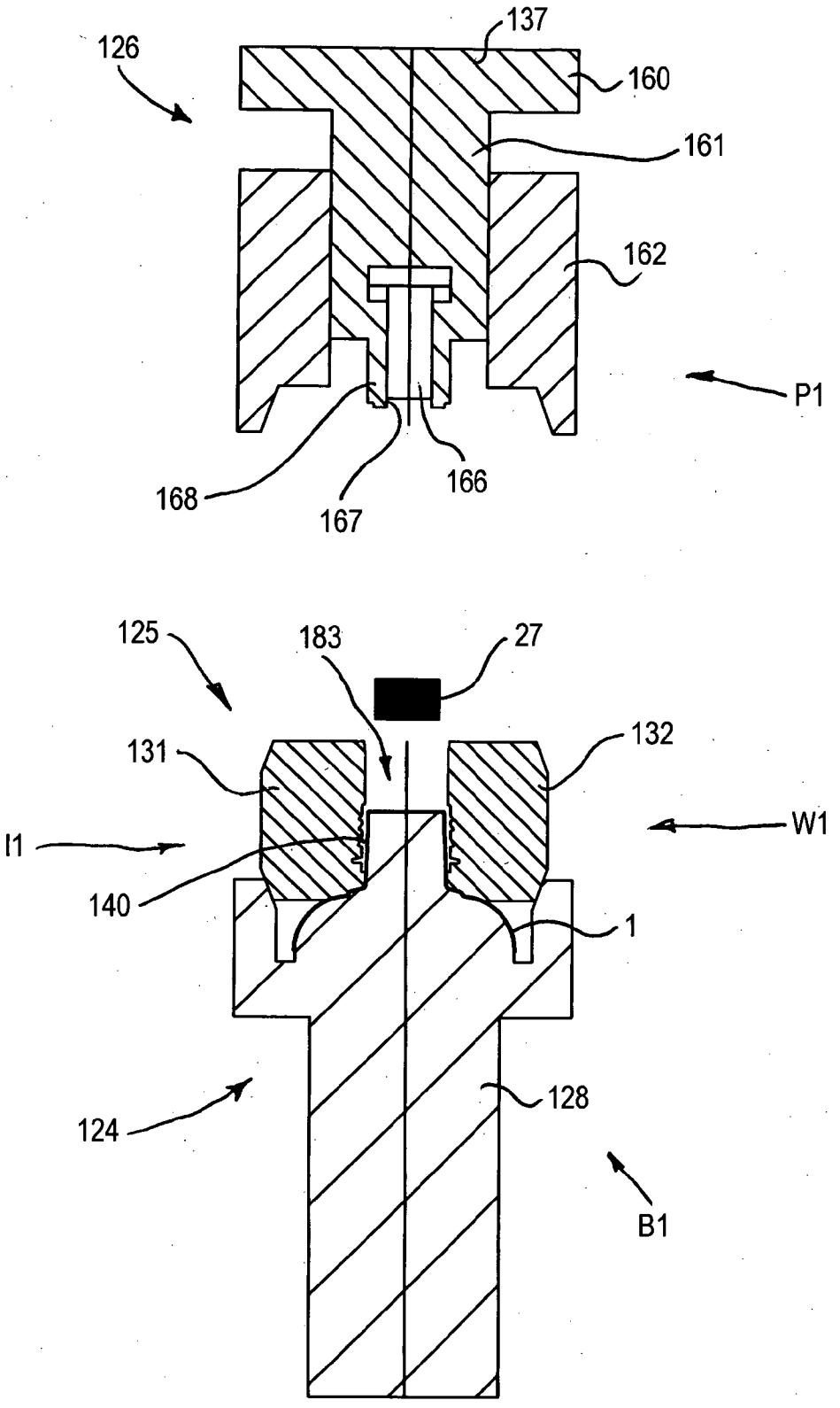
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Fig. 33

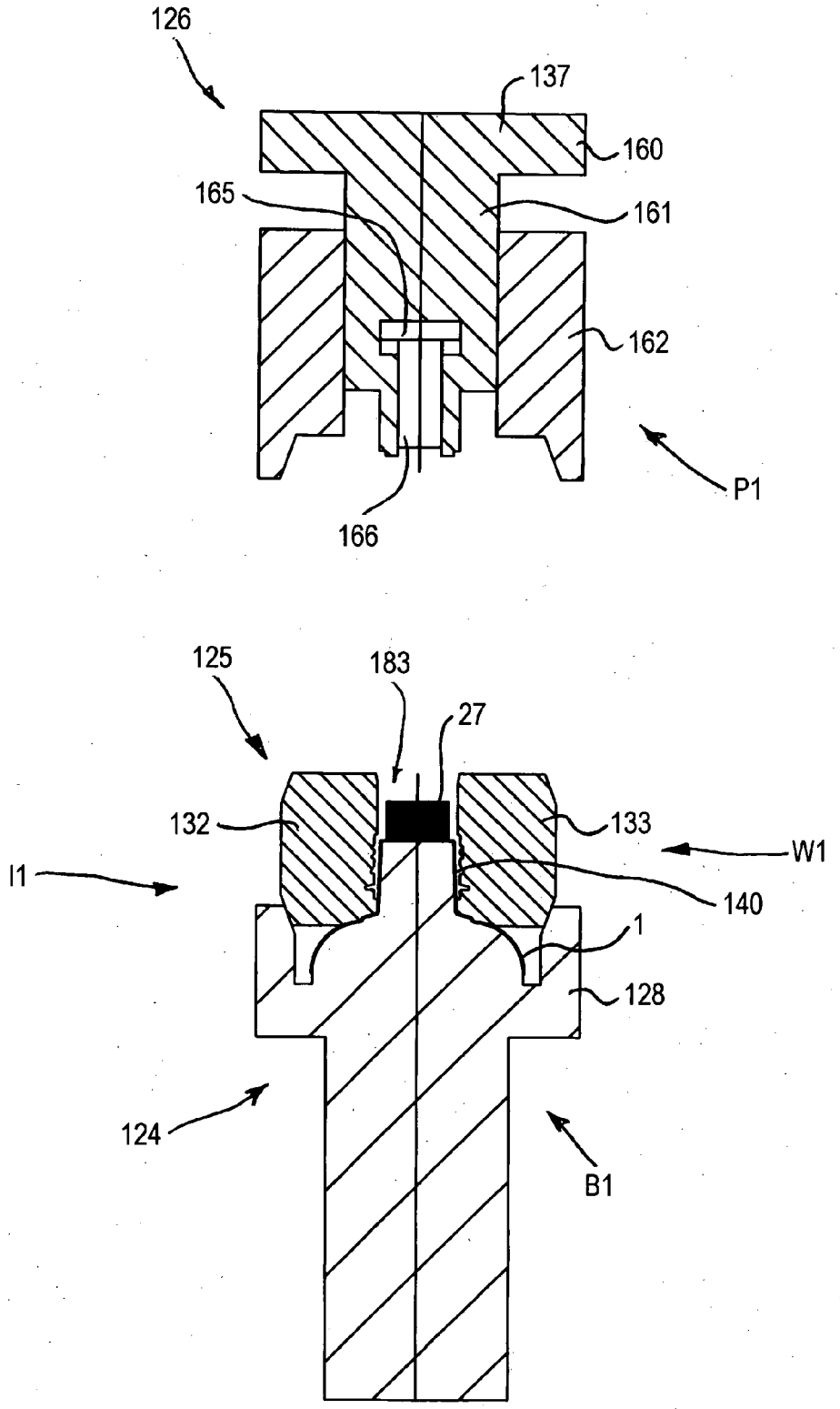
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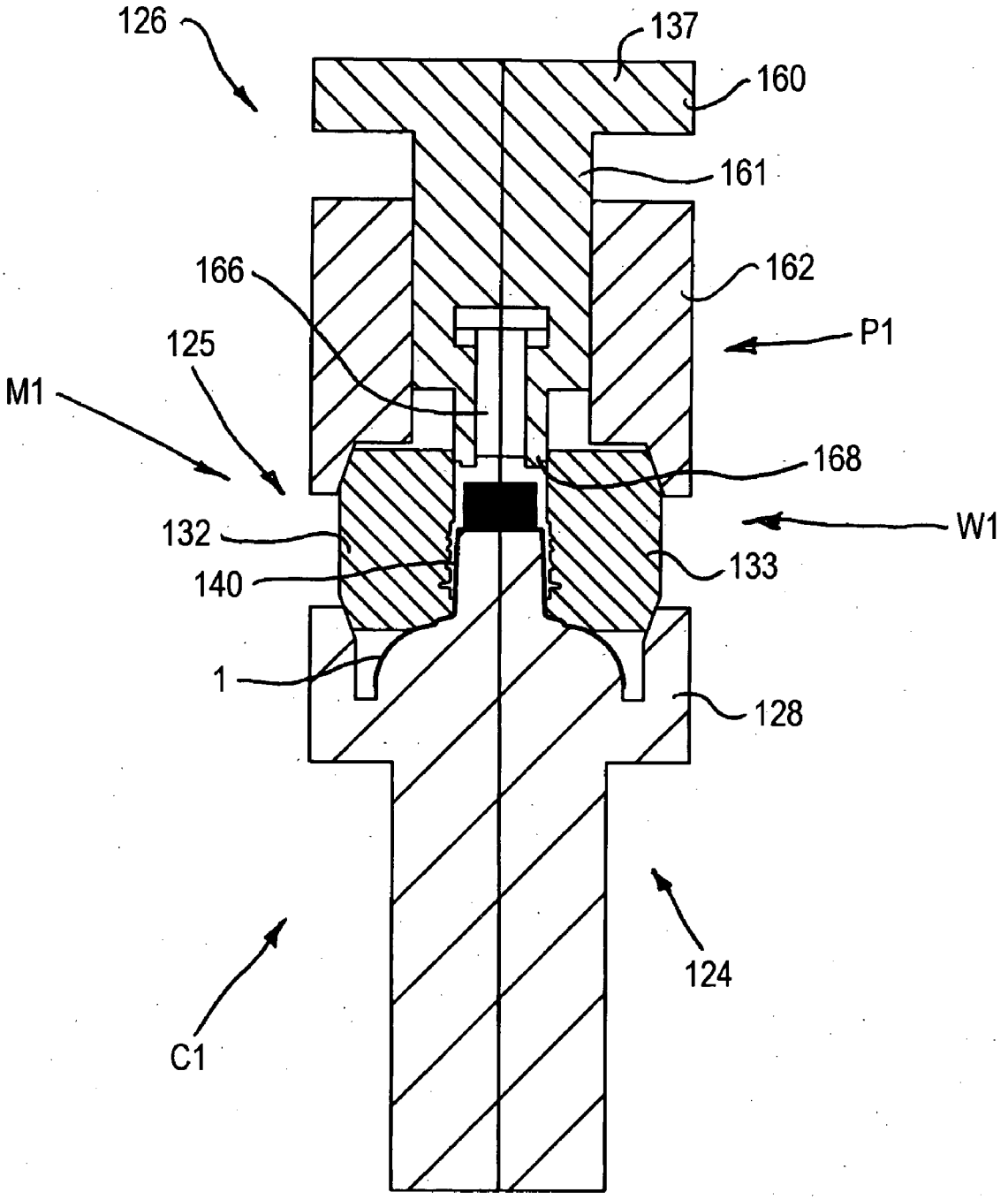
Fig. 34



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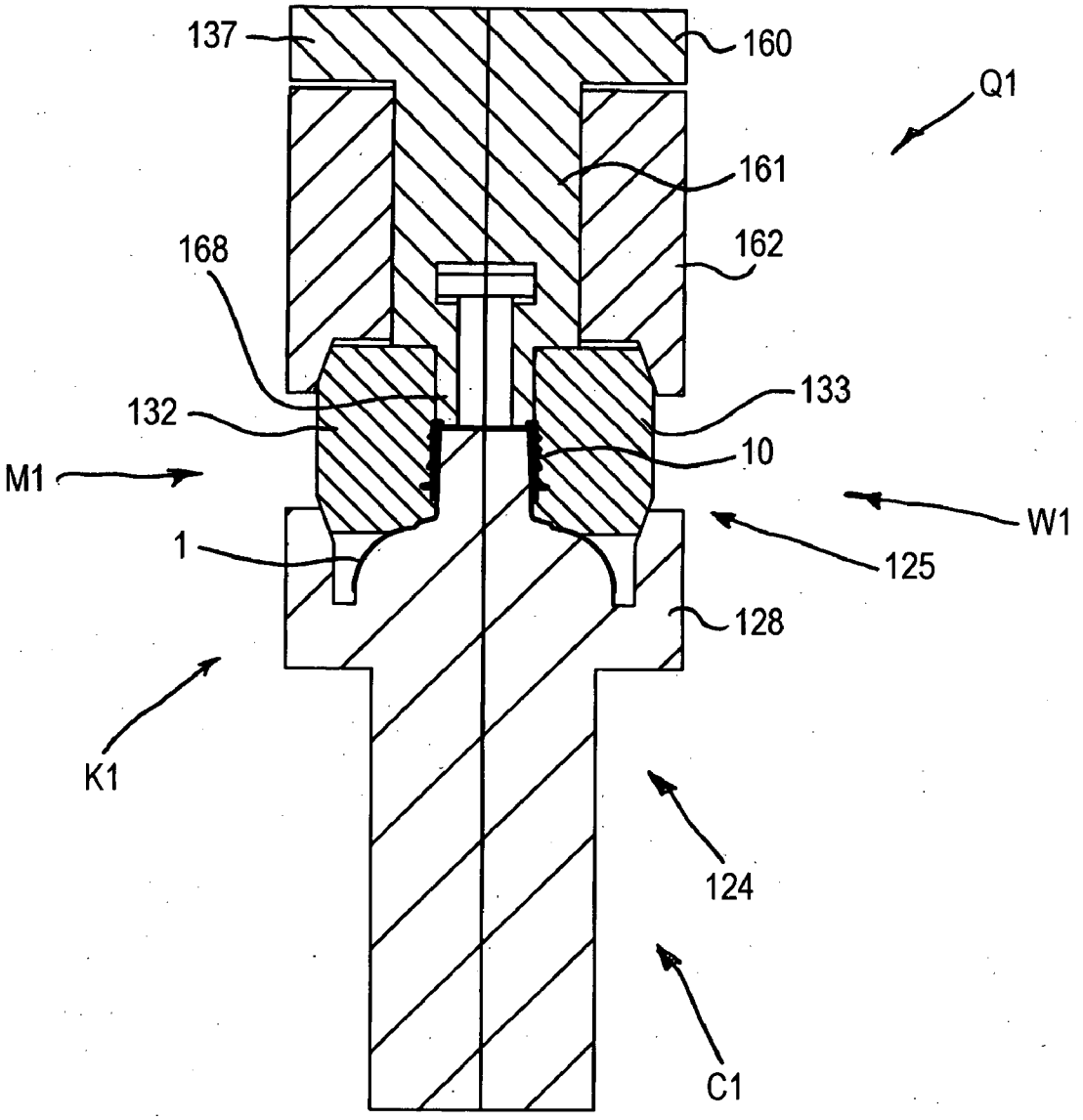

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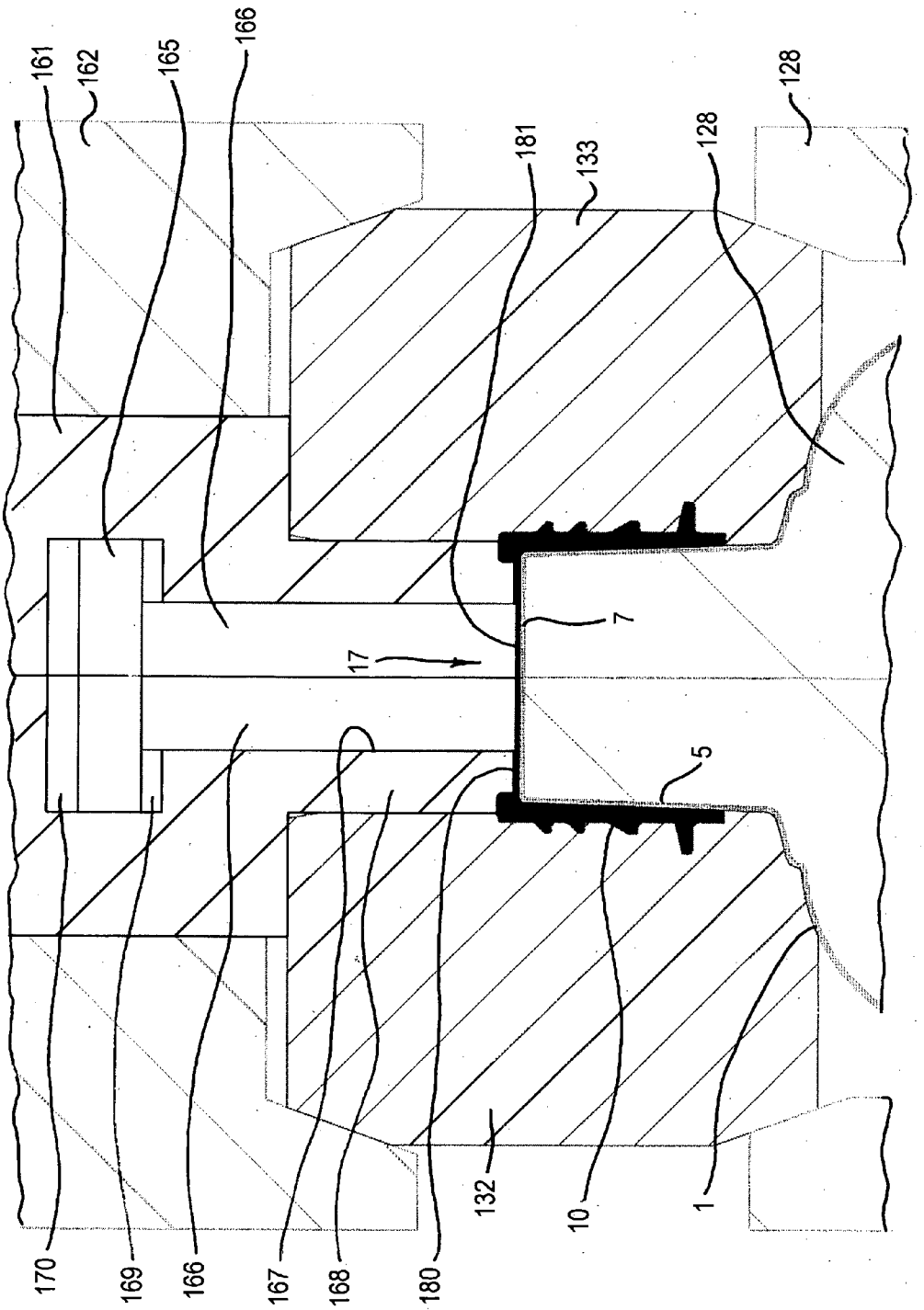
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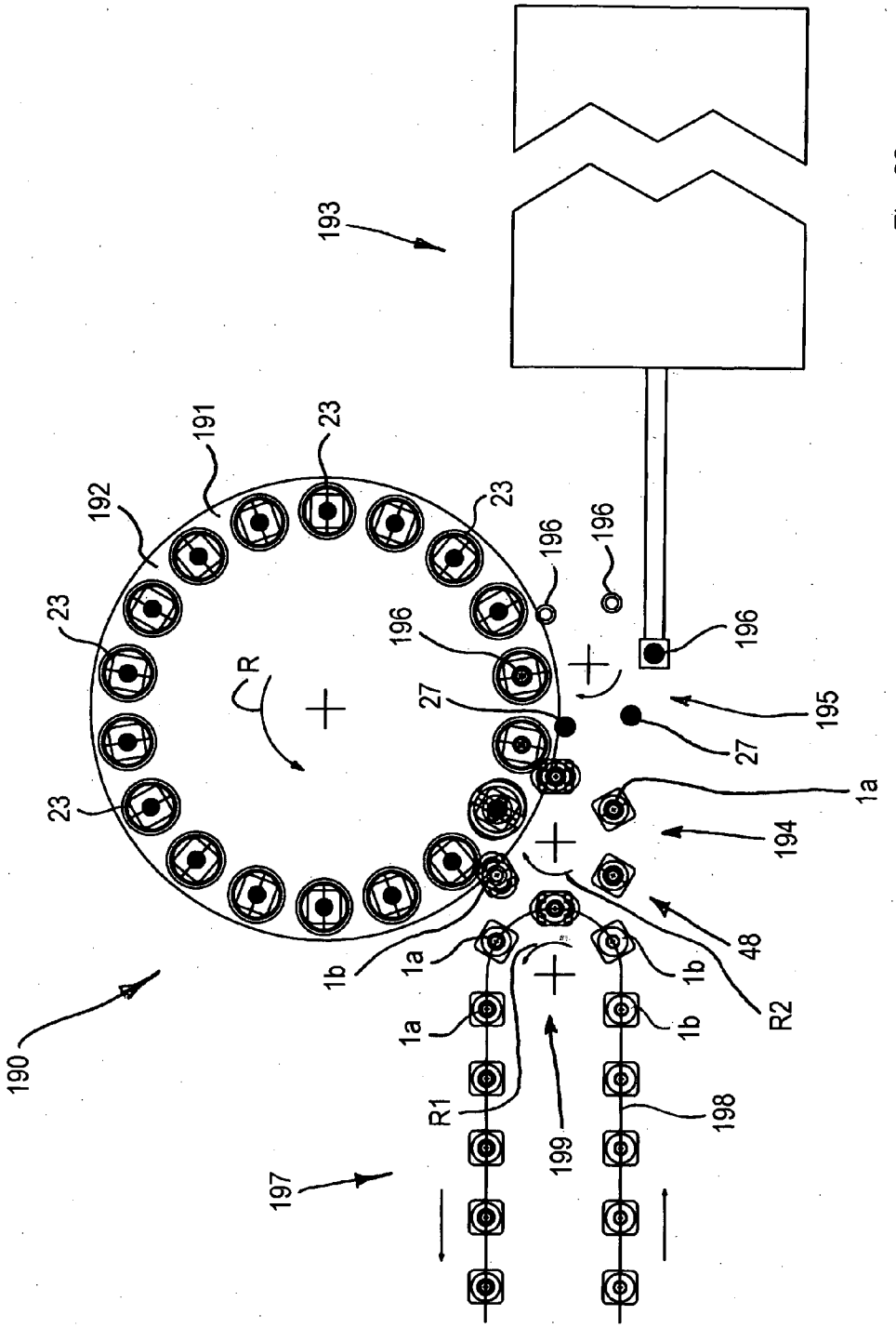
Fig. 37



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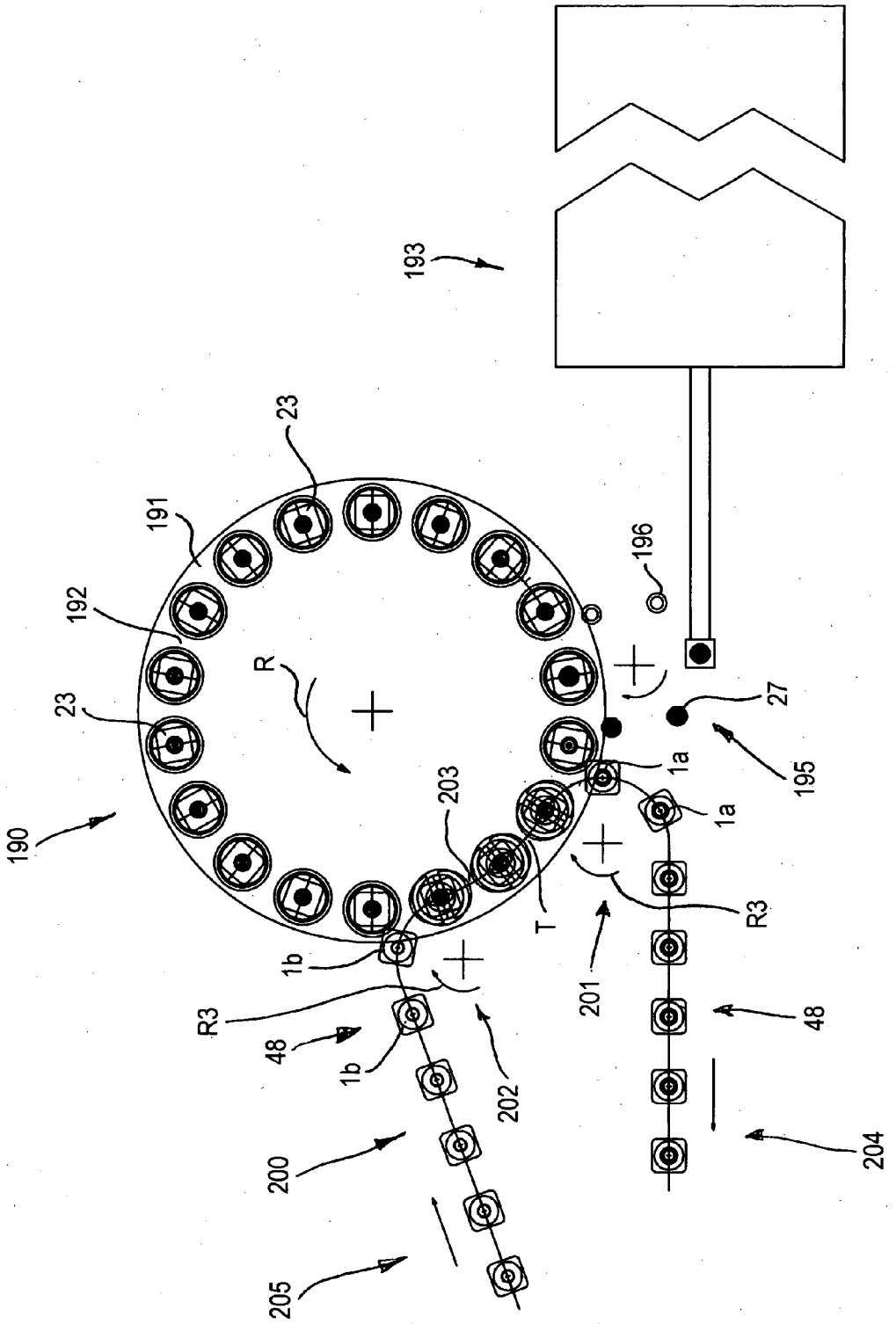
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Fig. 39

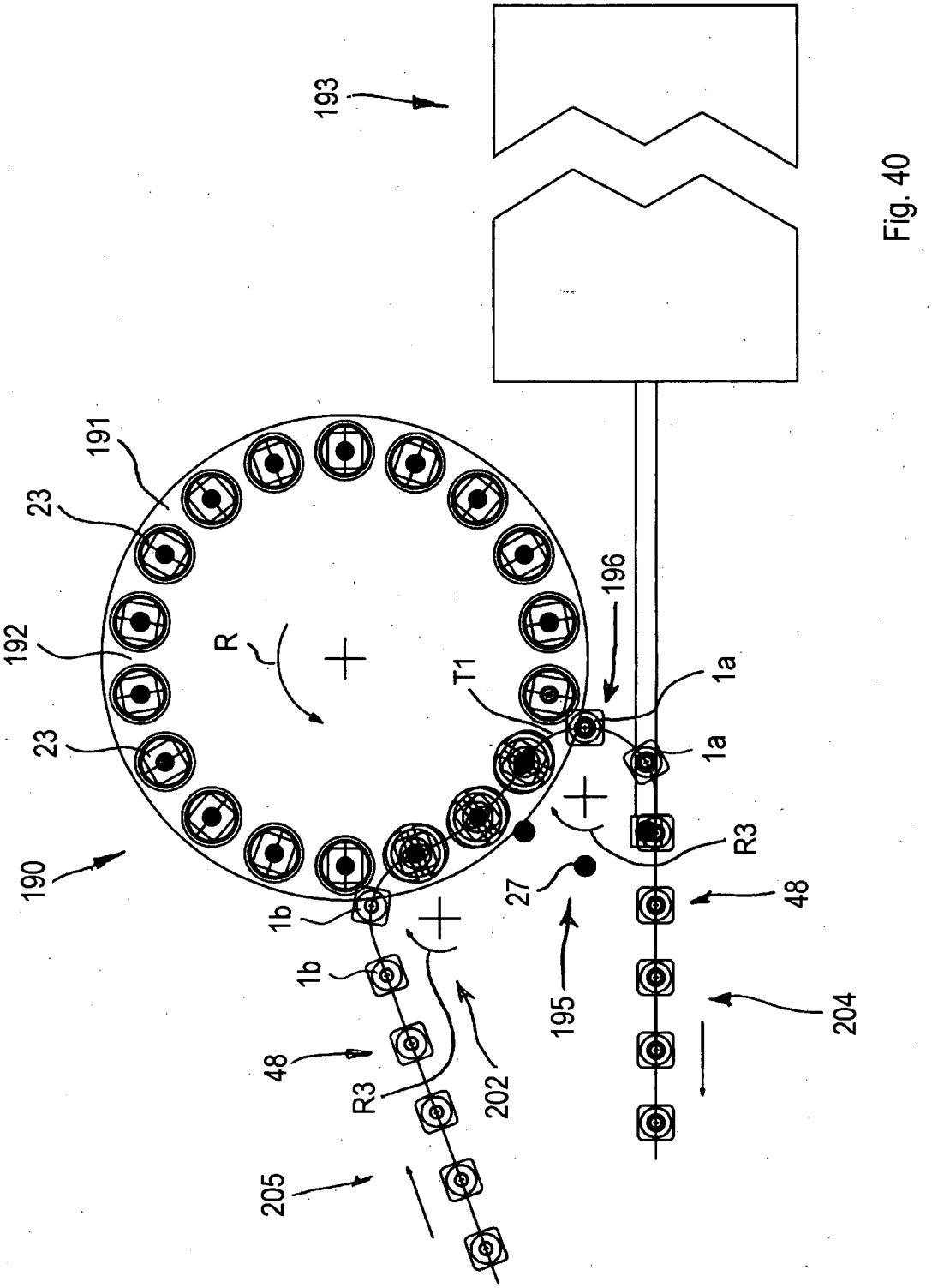
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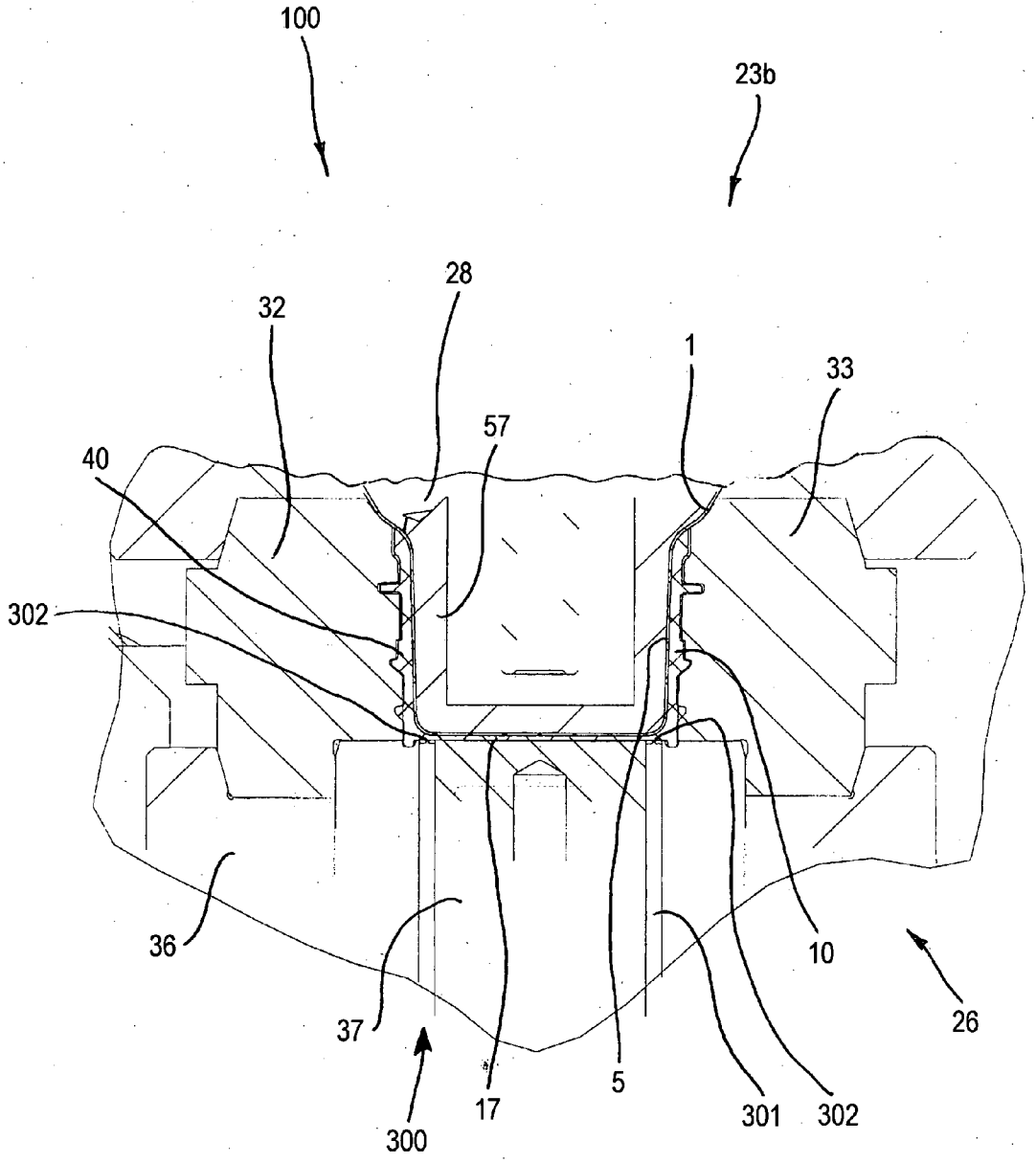
Fig. 40



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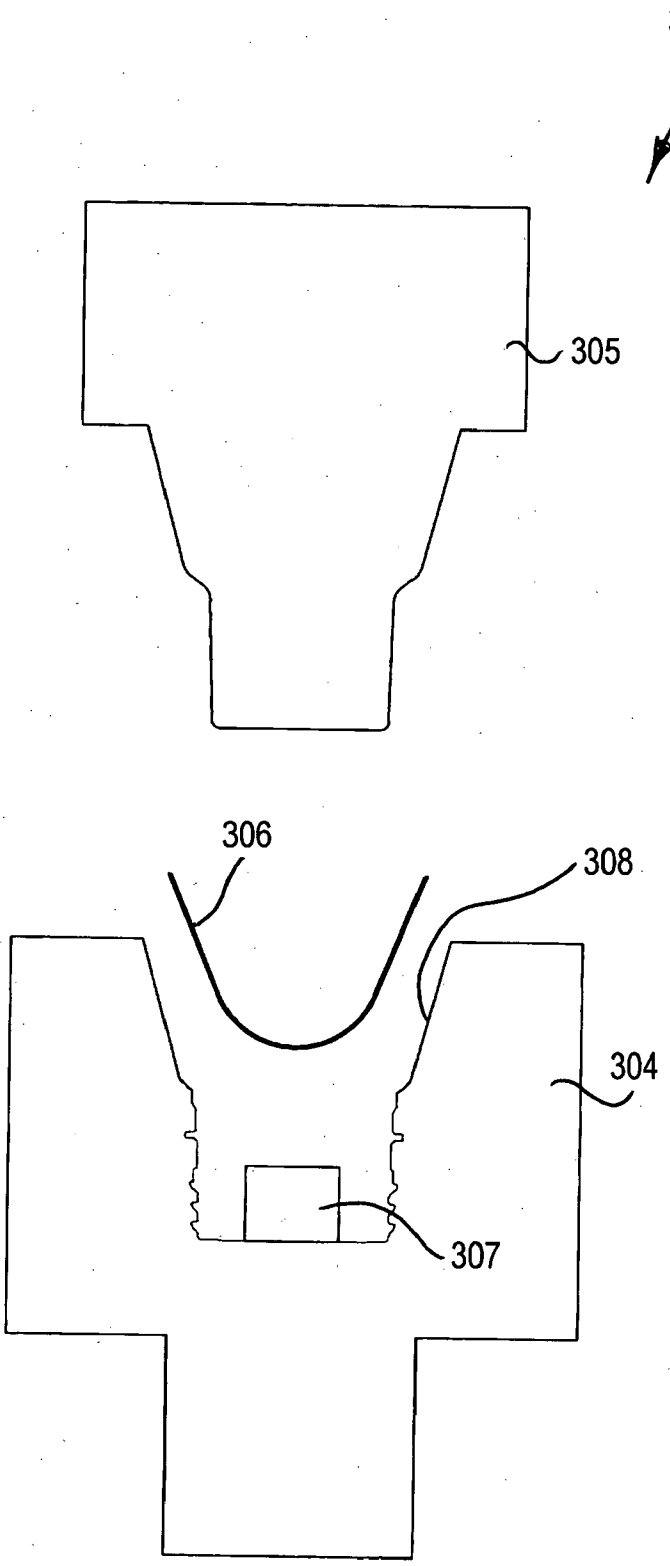

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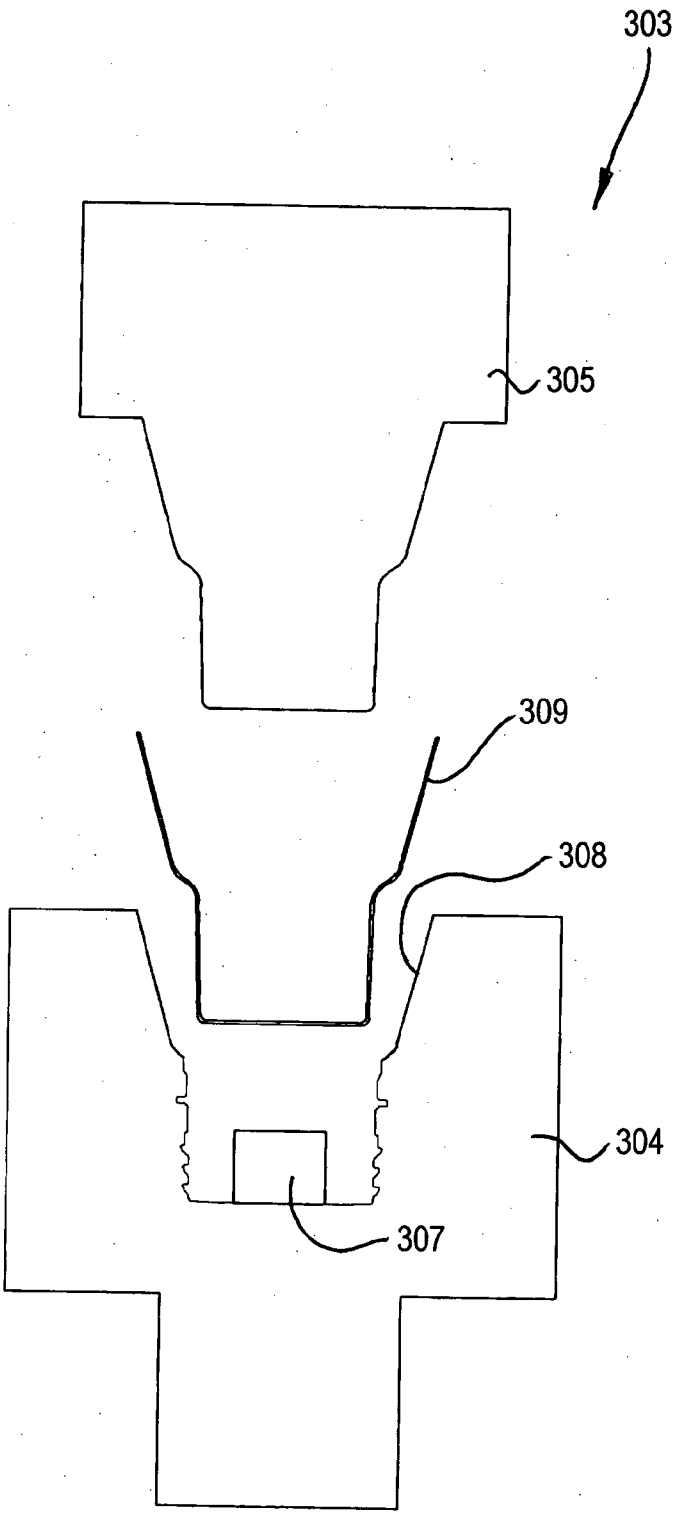

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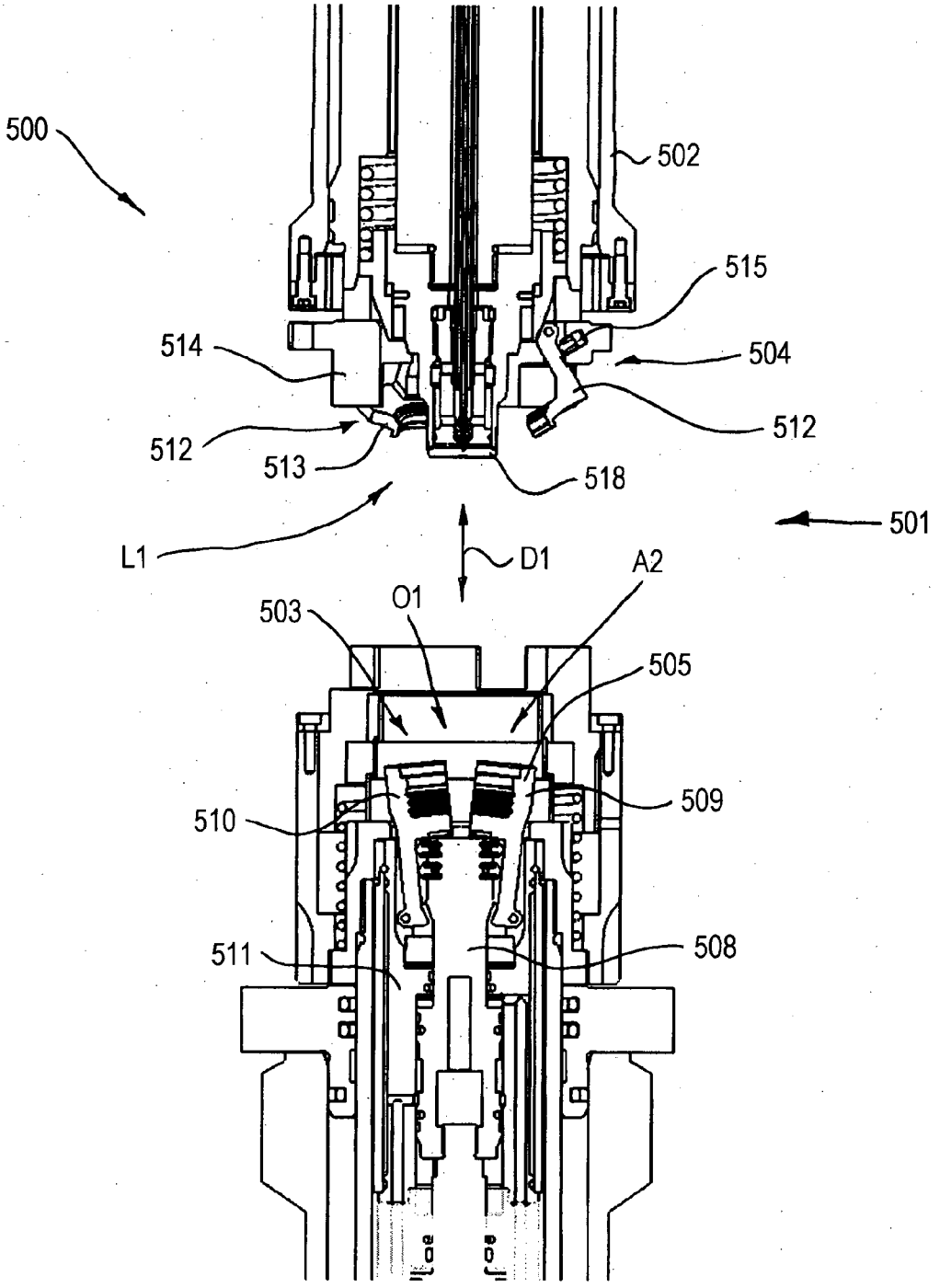
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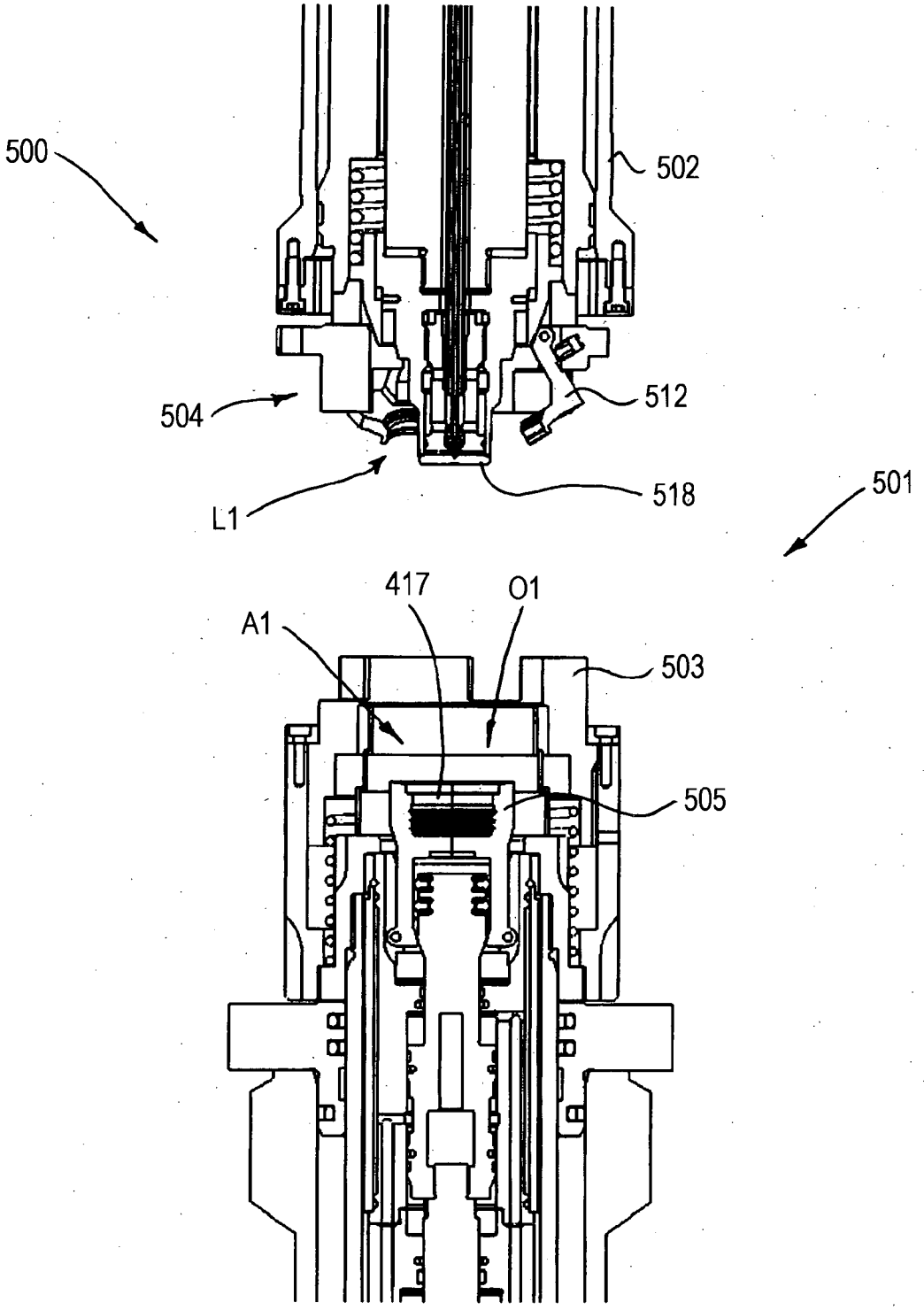
Fig. 44



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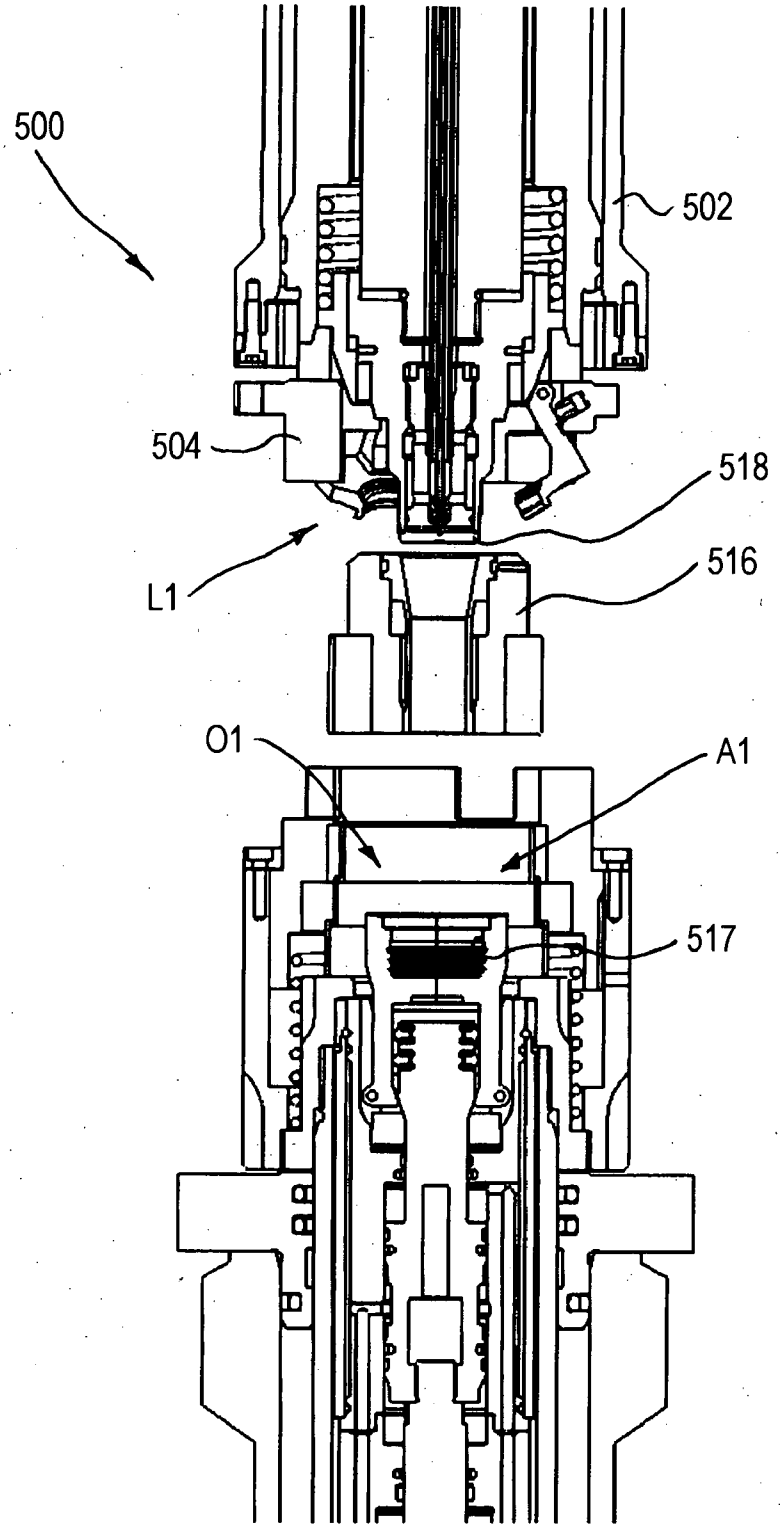

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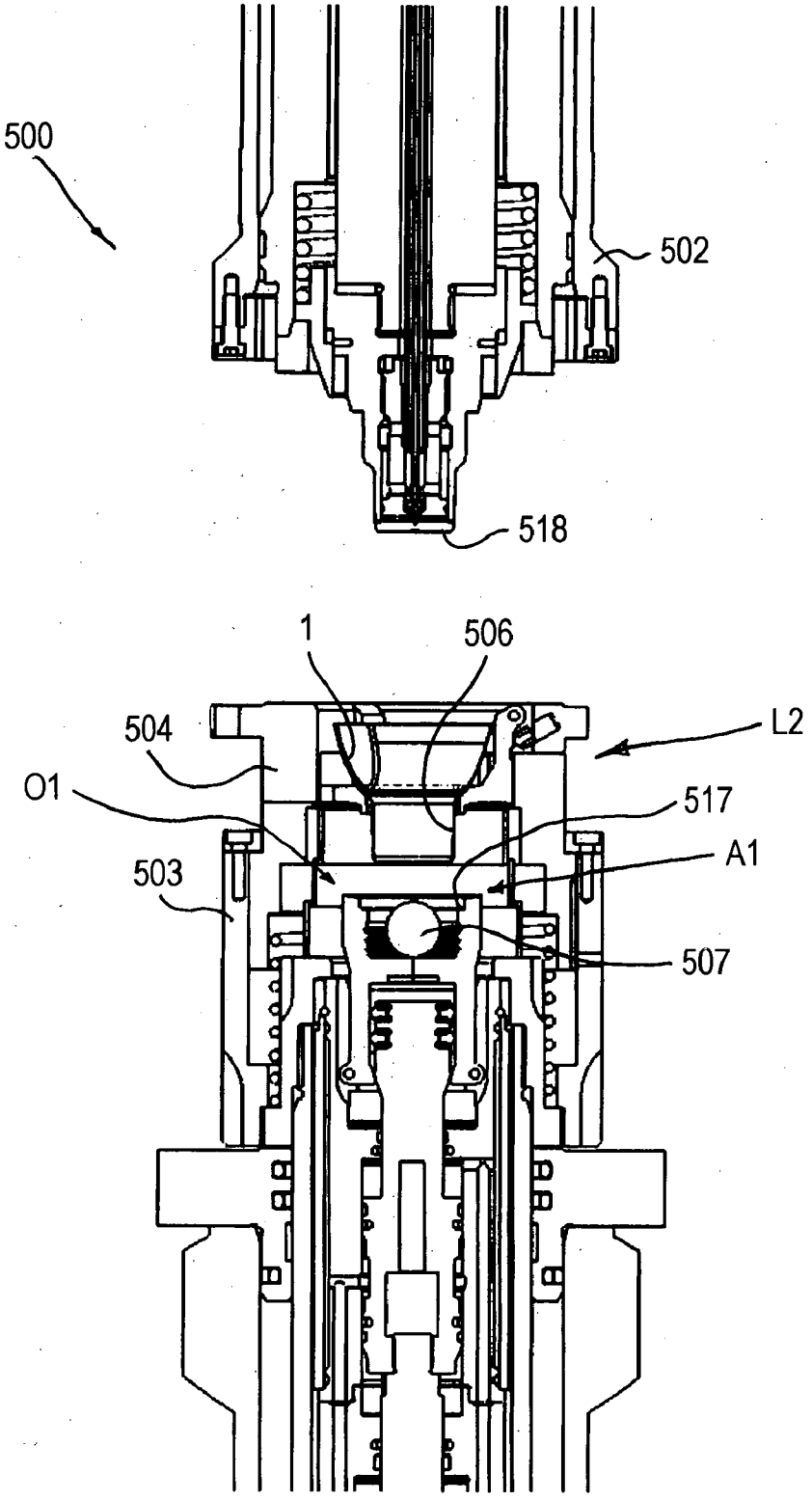

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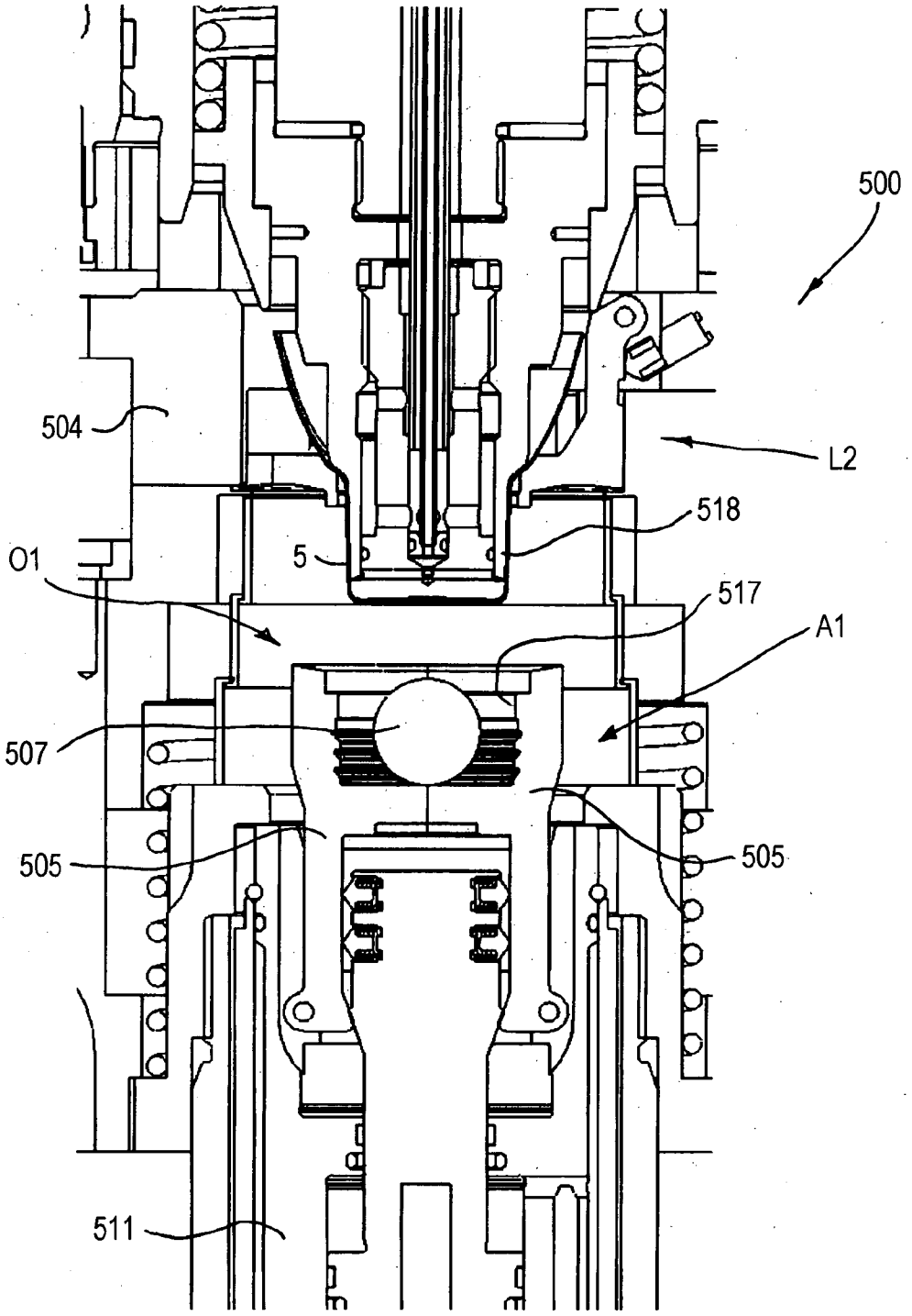

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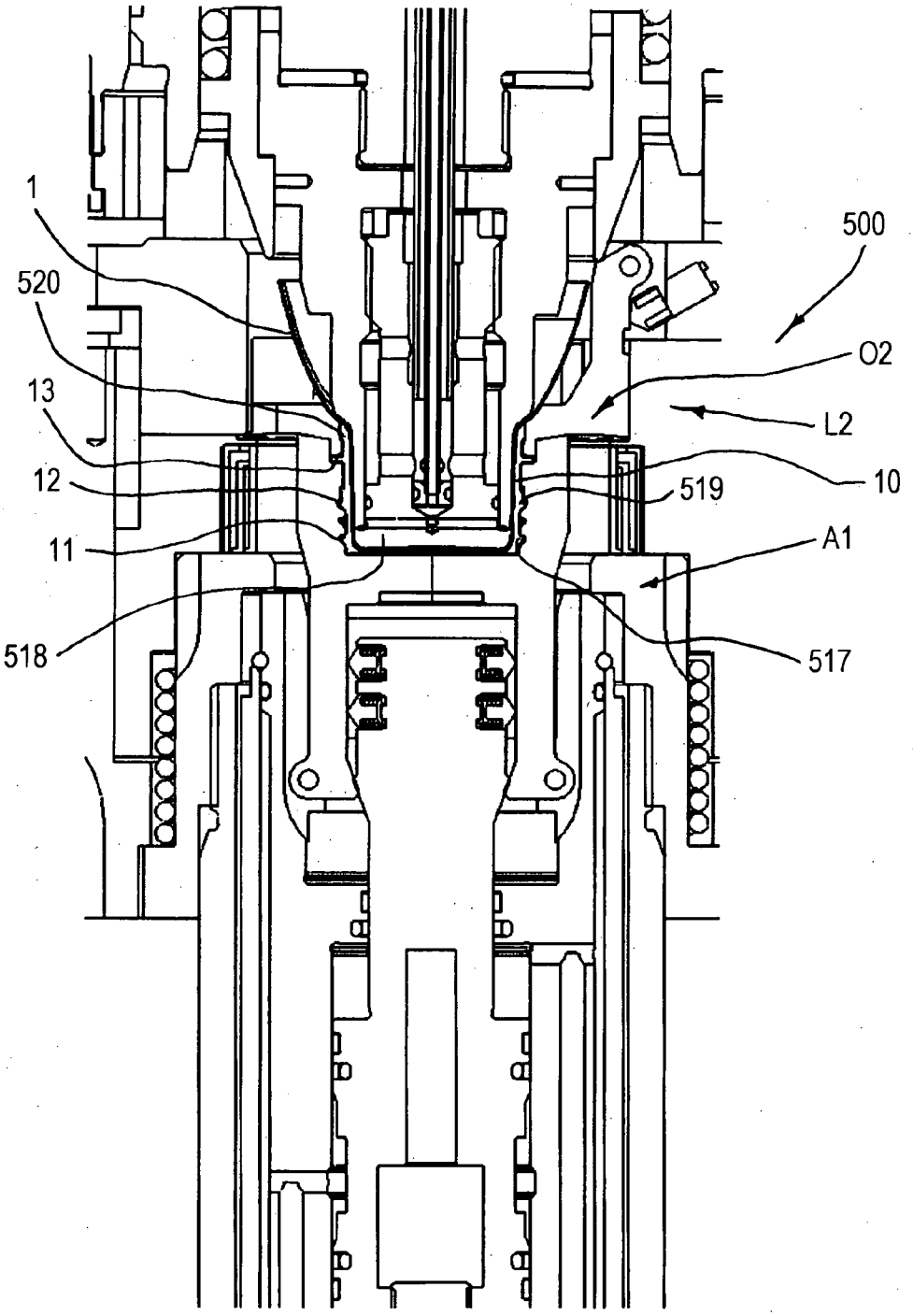

Fig. 49

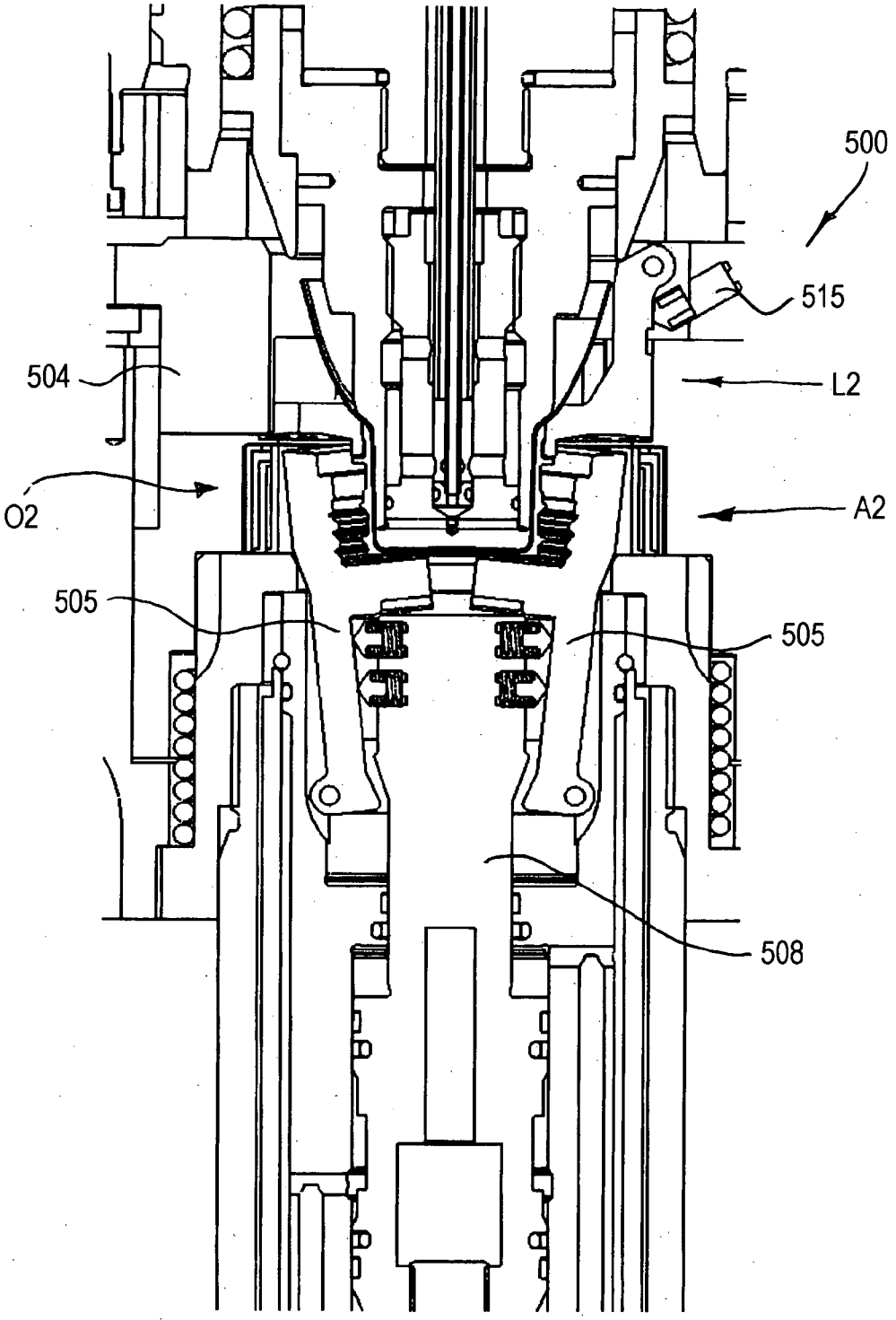

Fig. 50

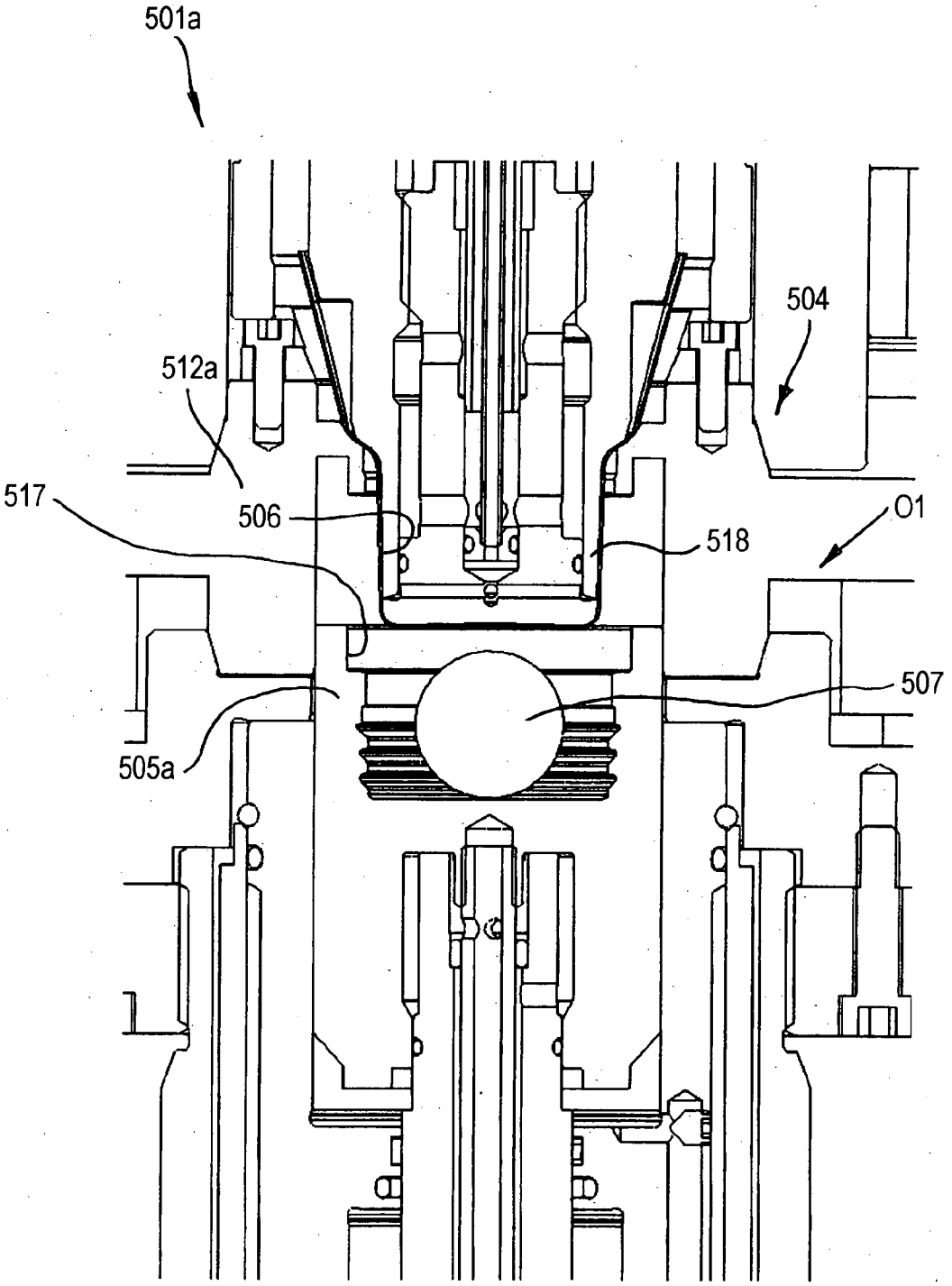

Fig. 51

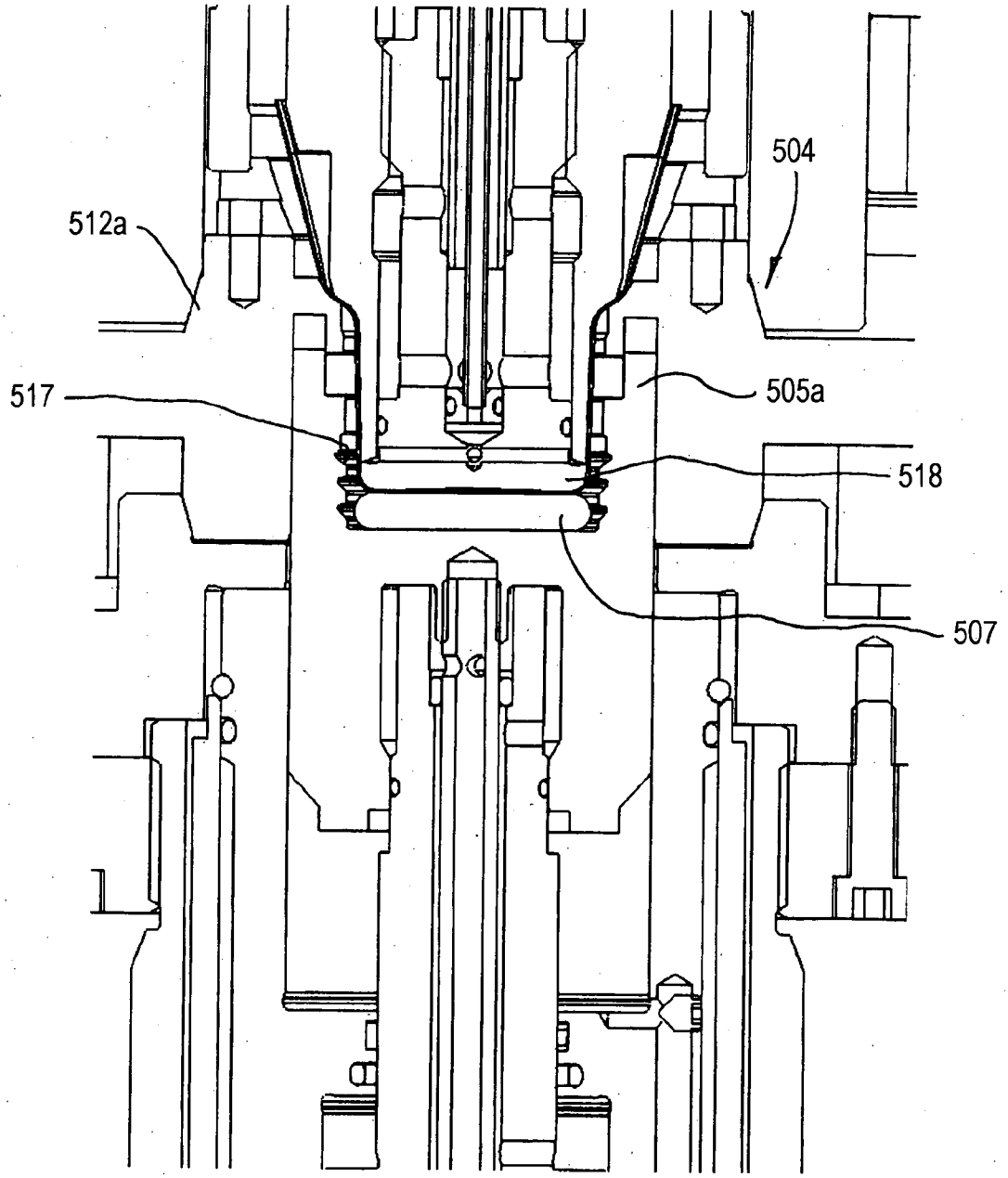

Fig. 52

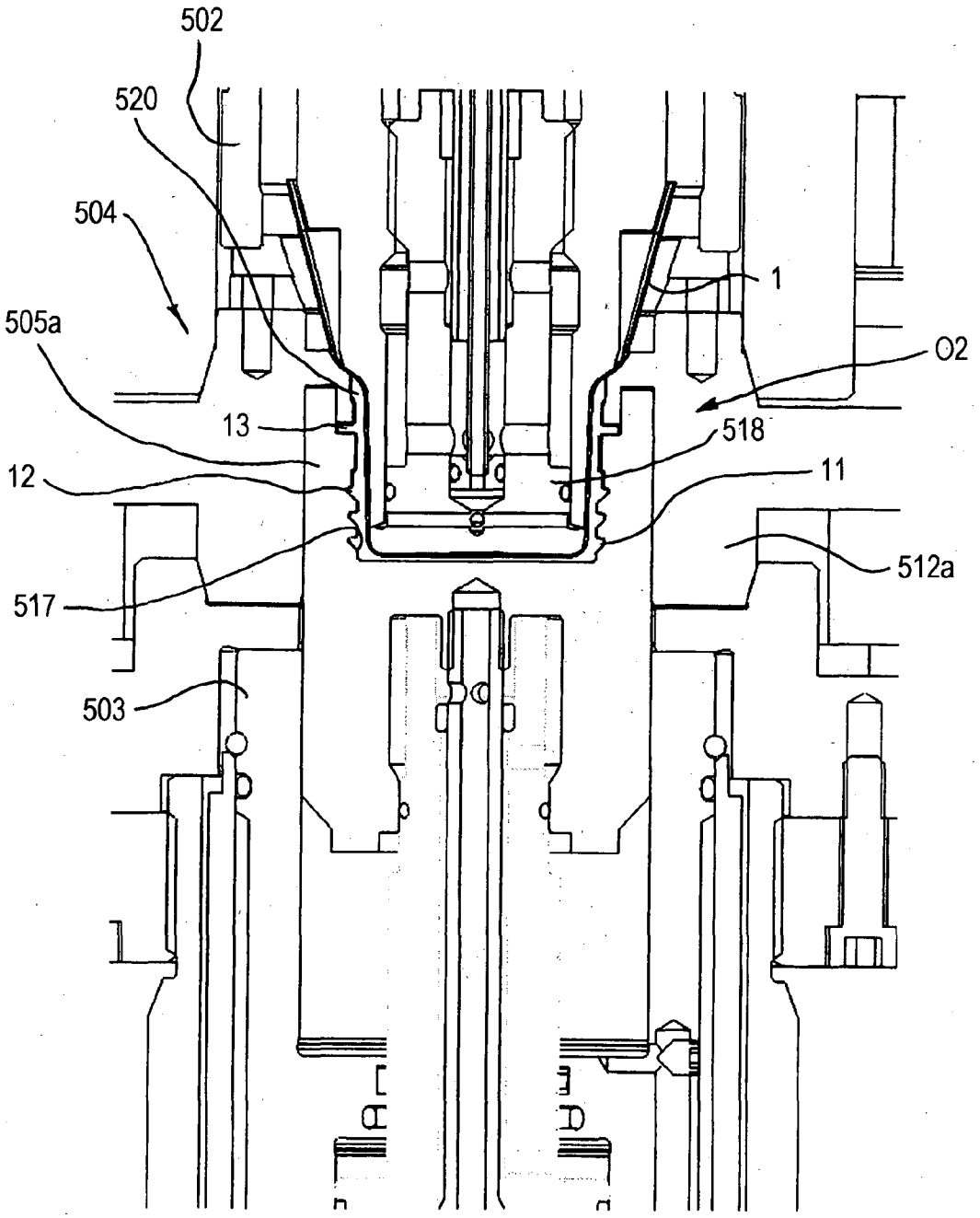

Fig. 53

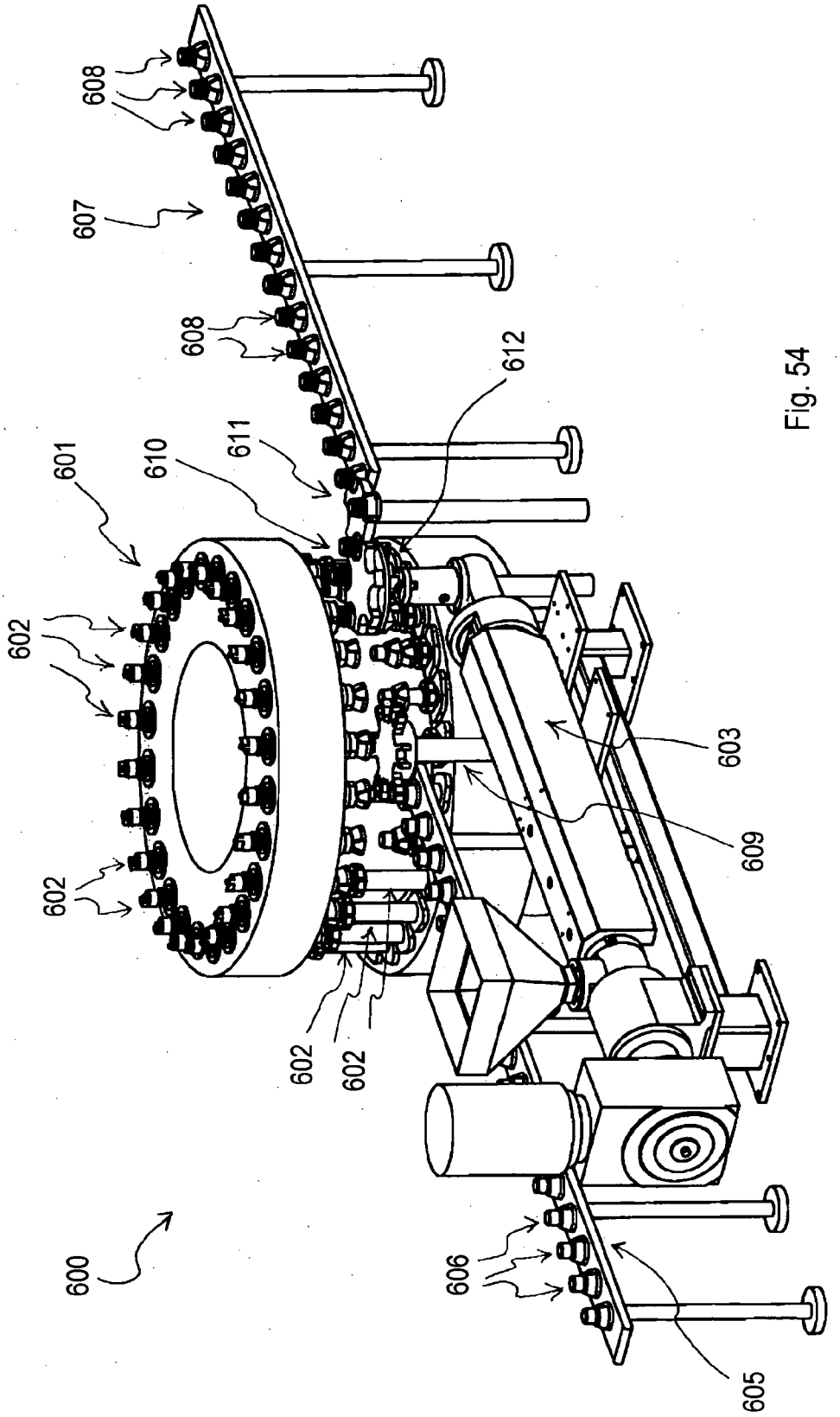

Fig. 54

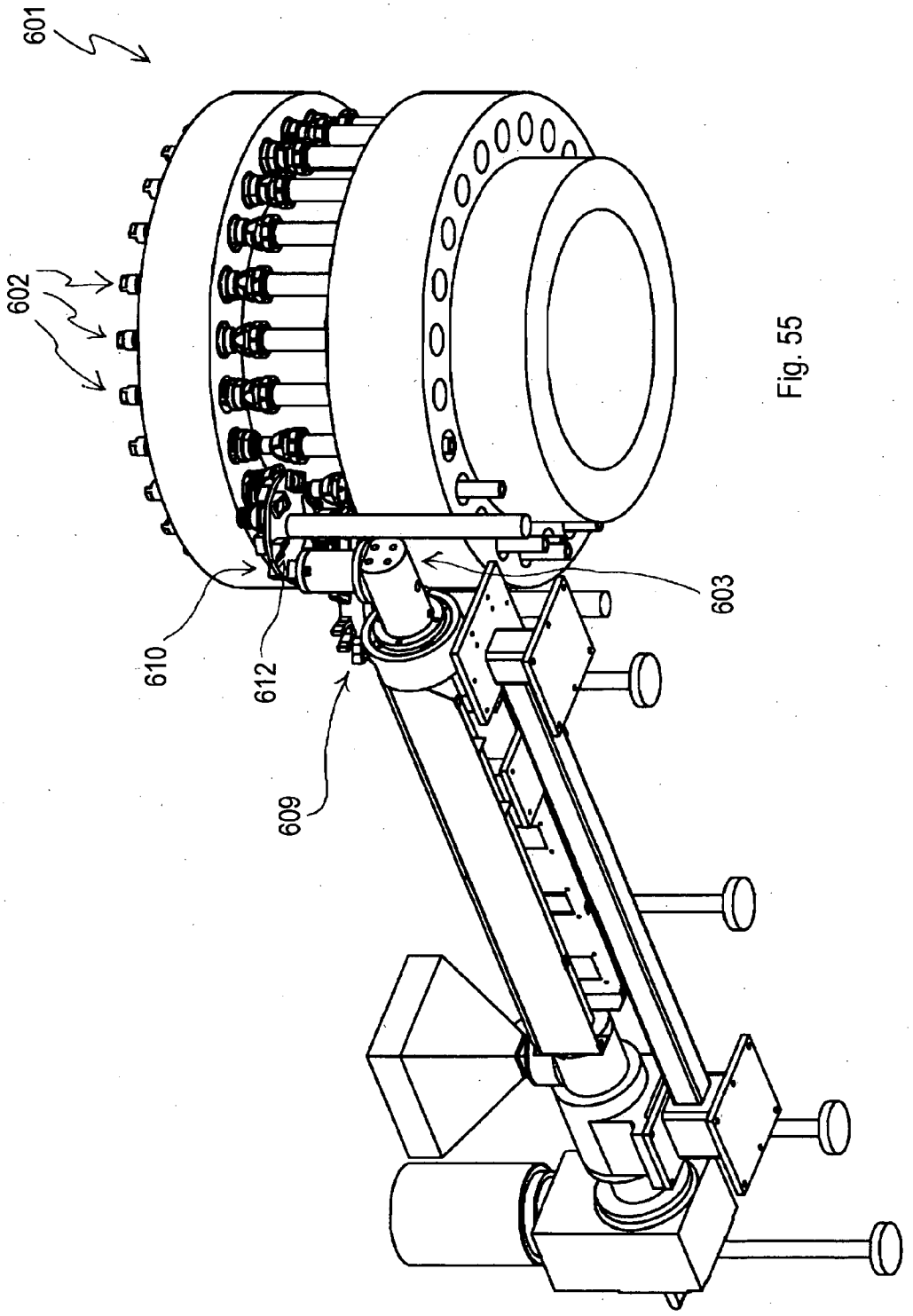

Fig. 55

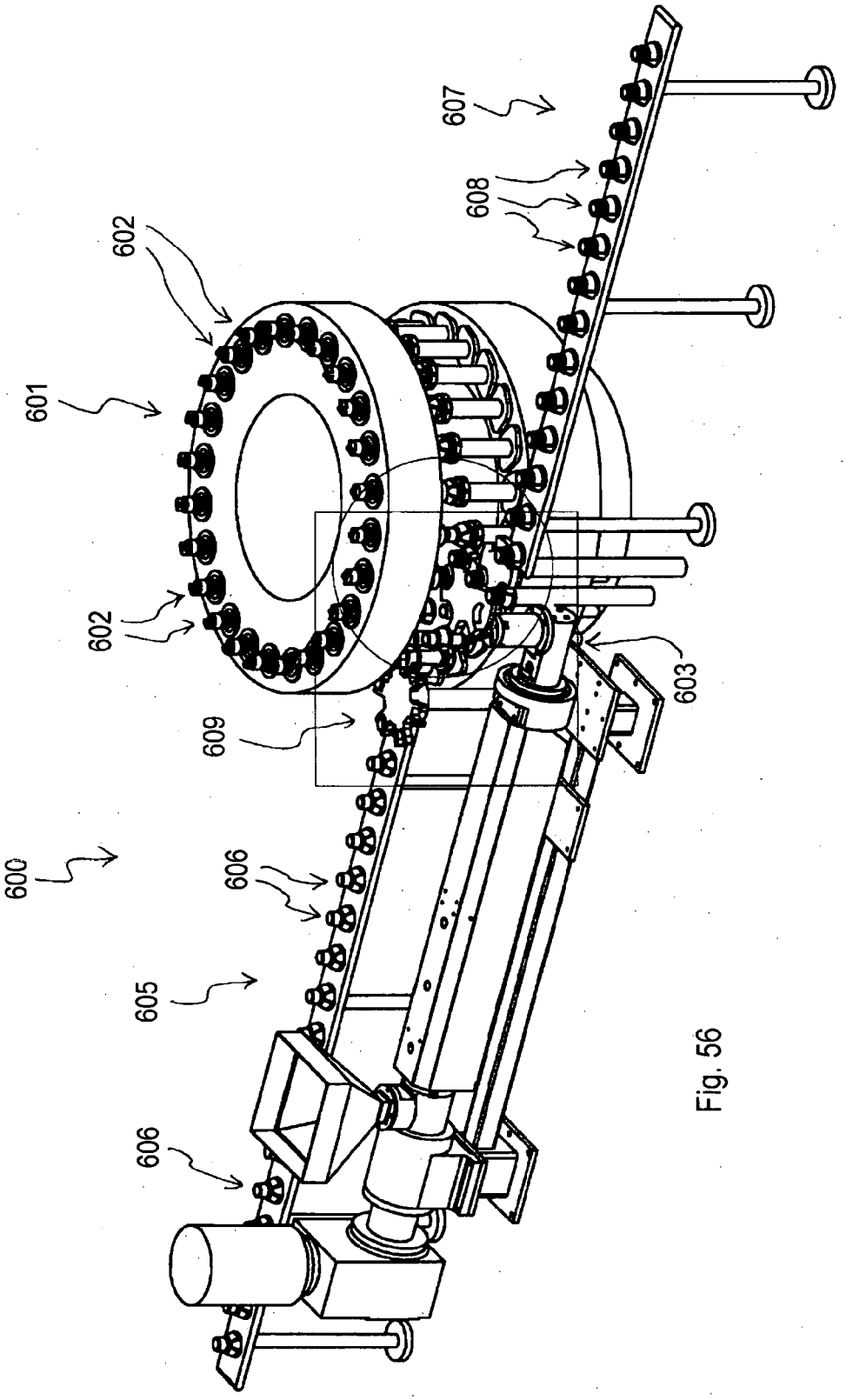

Fig. 56

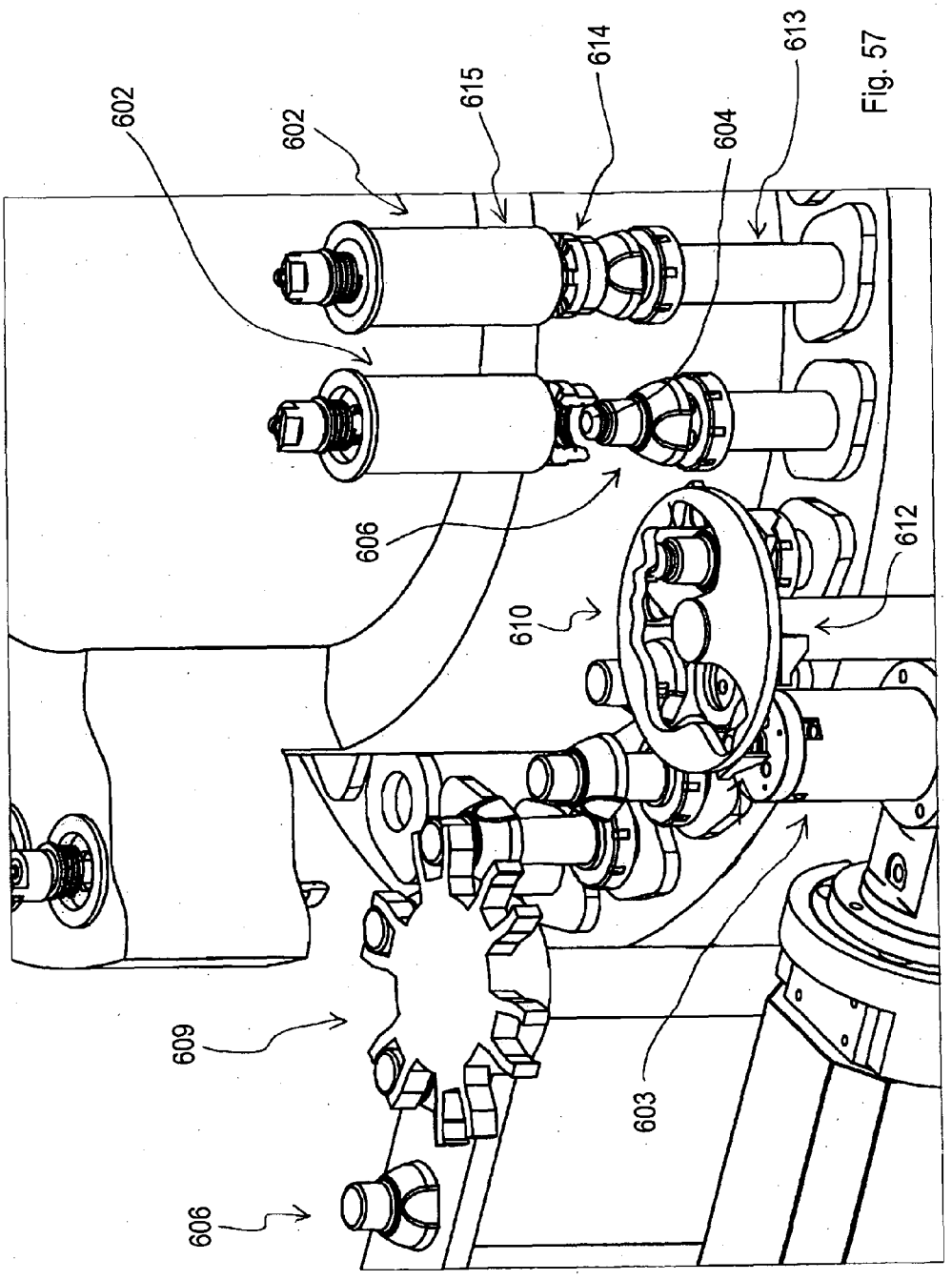

Fig. 57

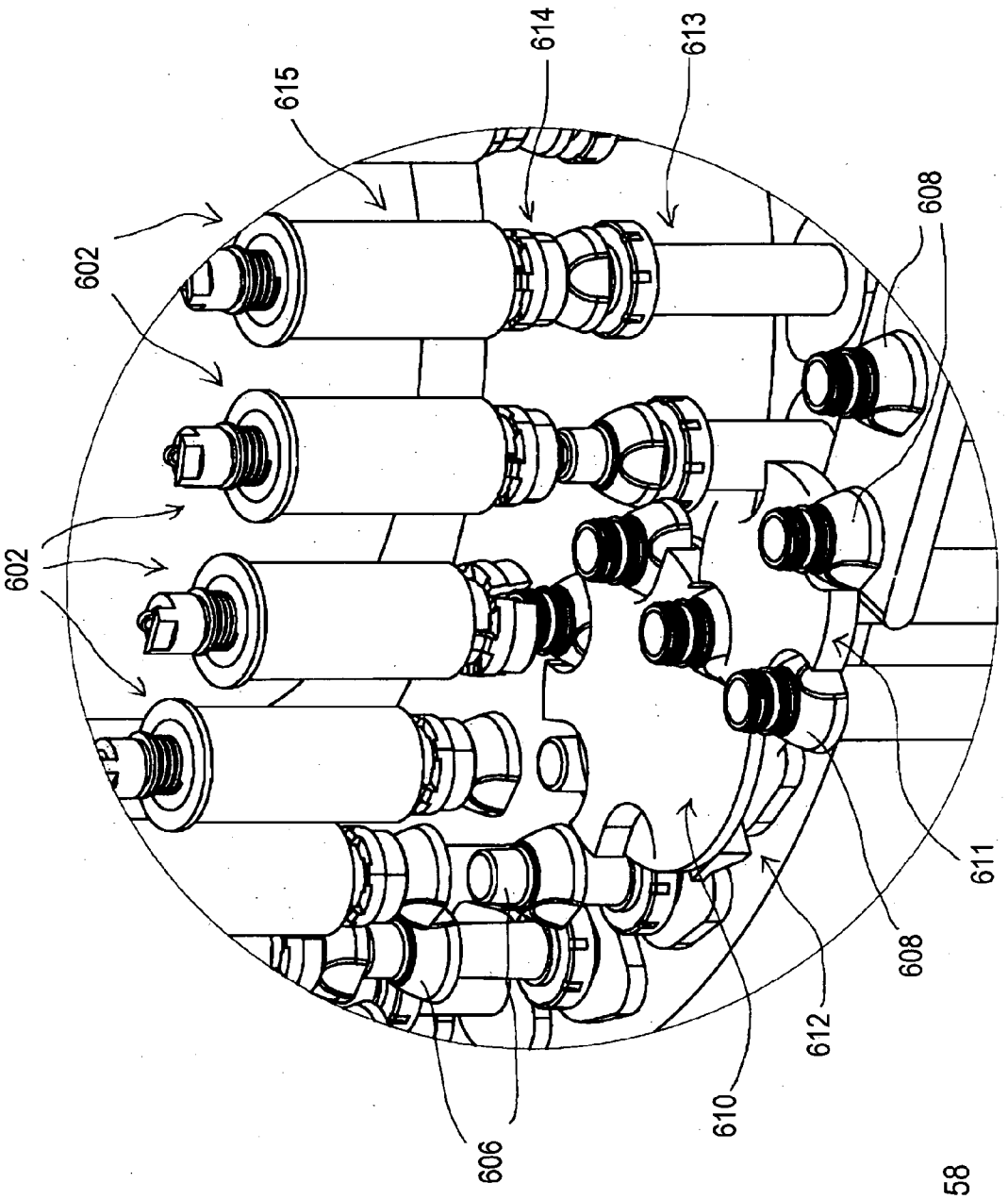

Fig. 58

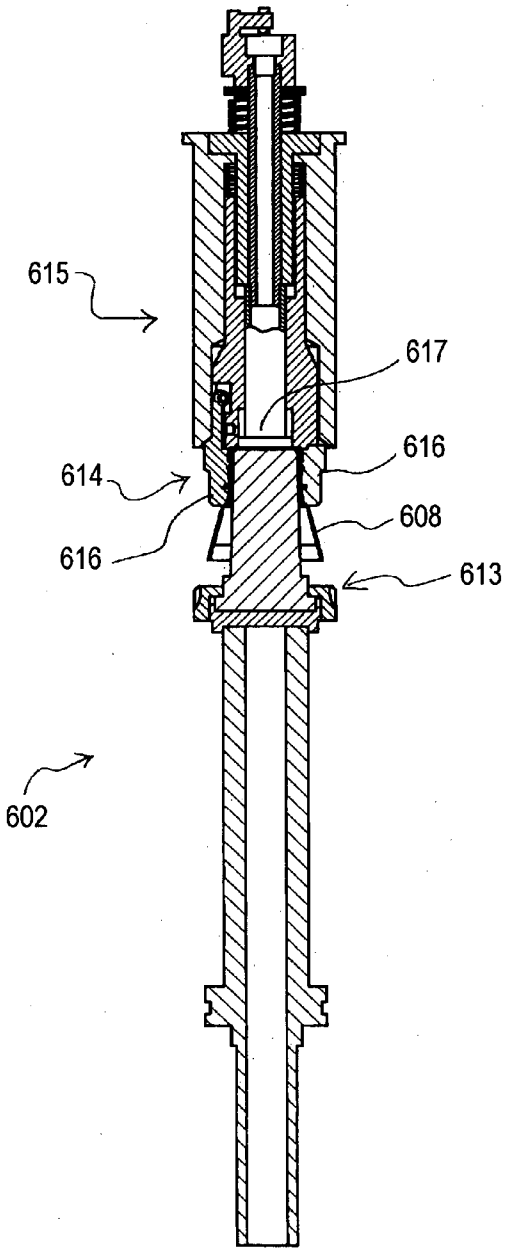
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Fig. 59

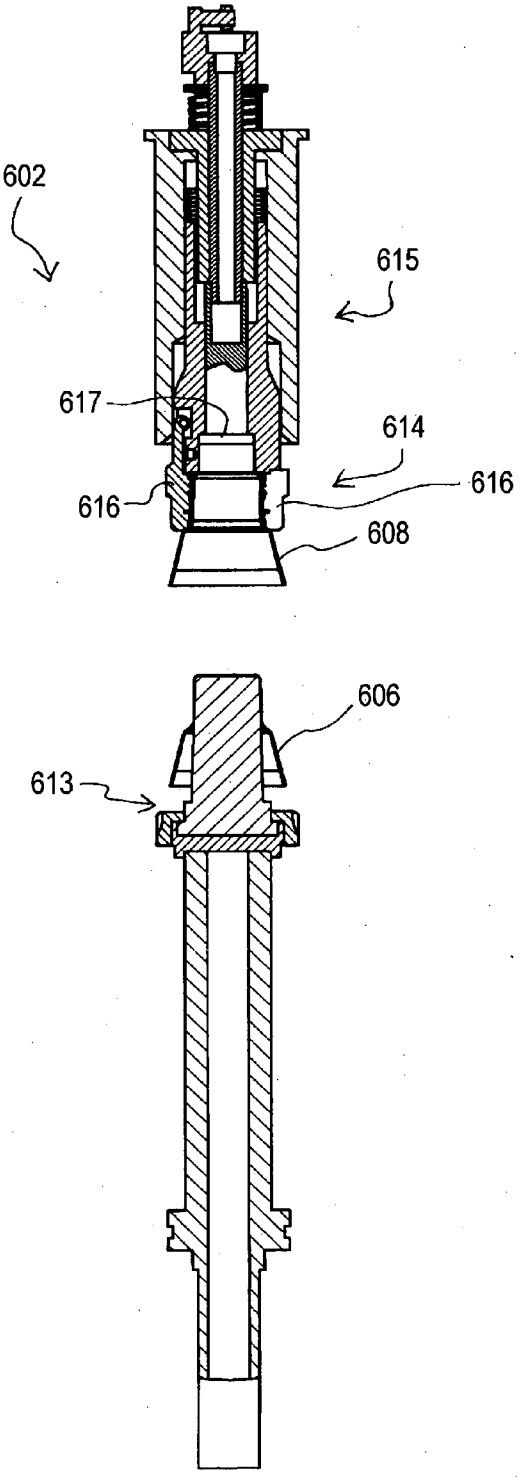
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Fig. 60

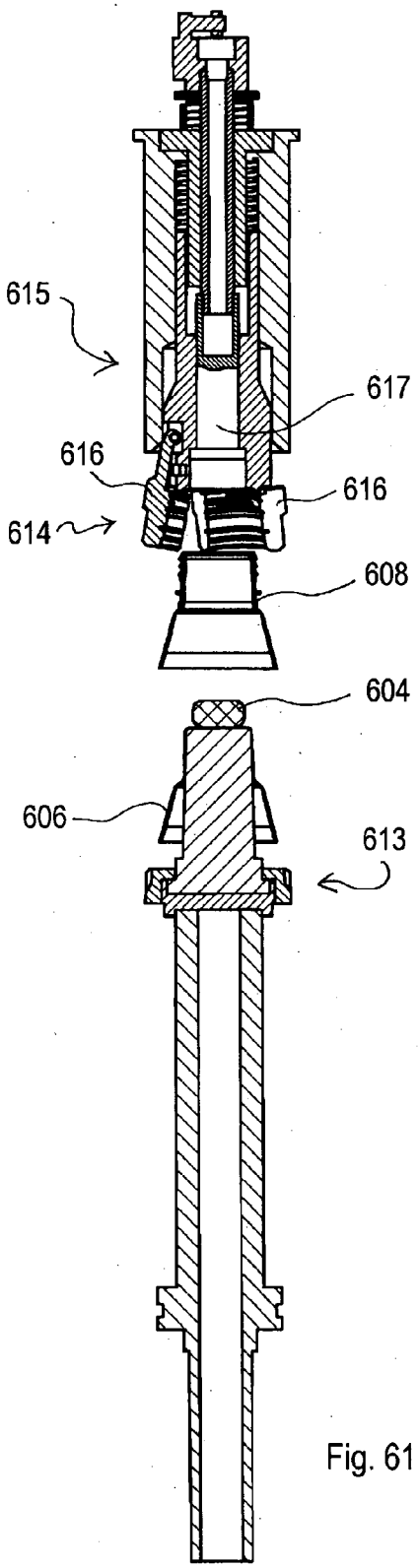


Fig. 61

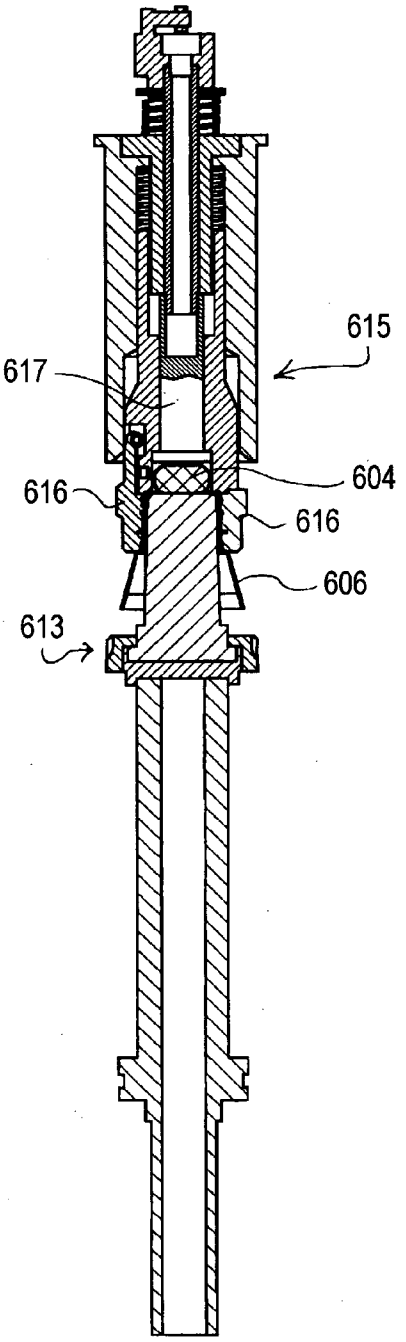


Fig. 62

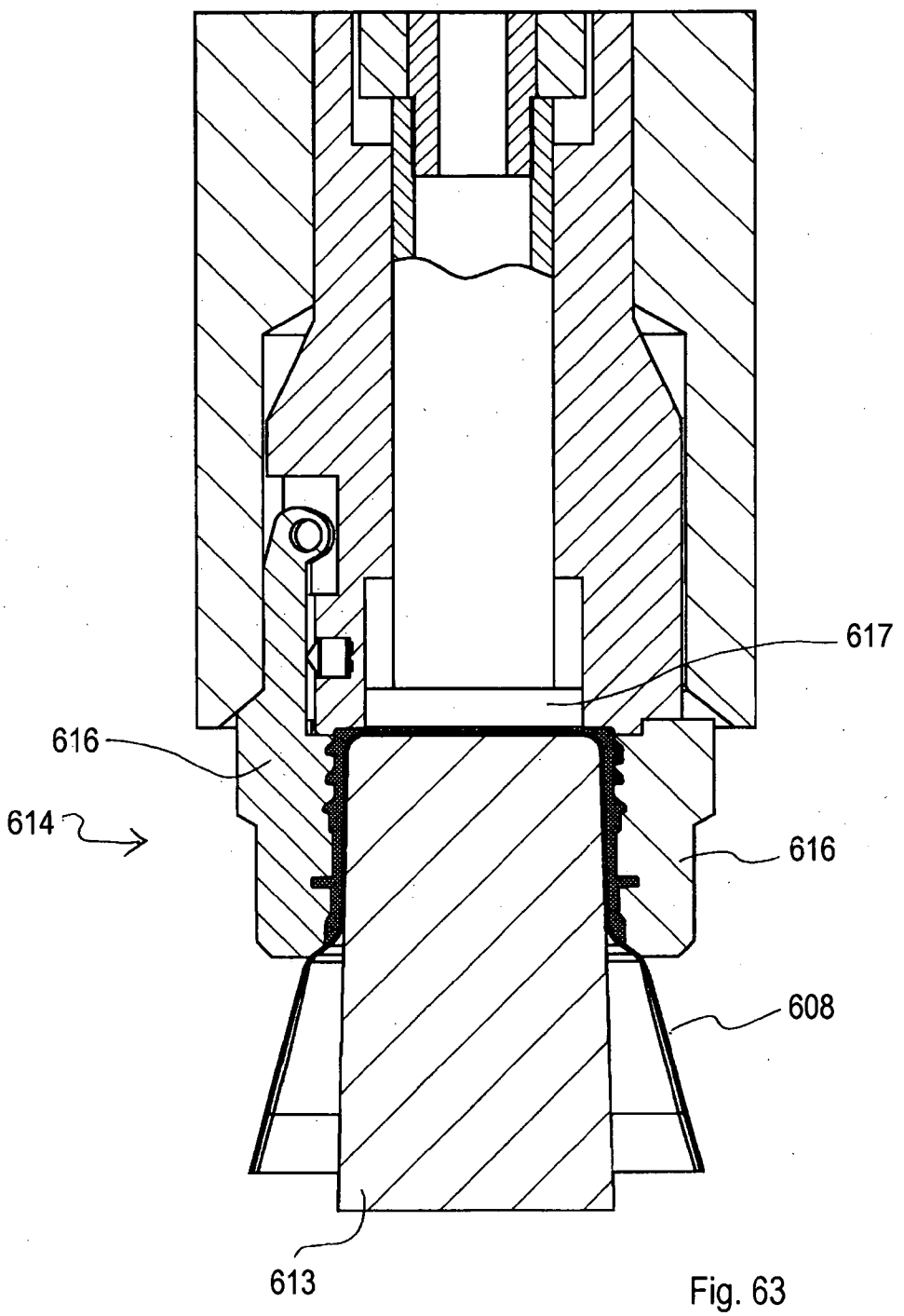
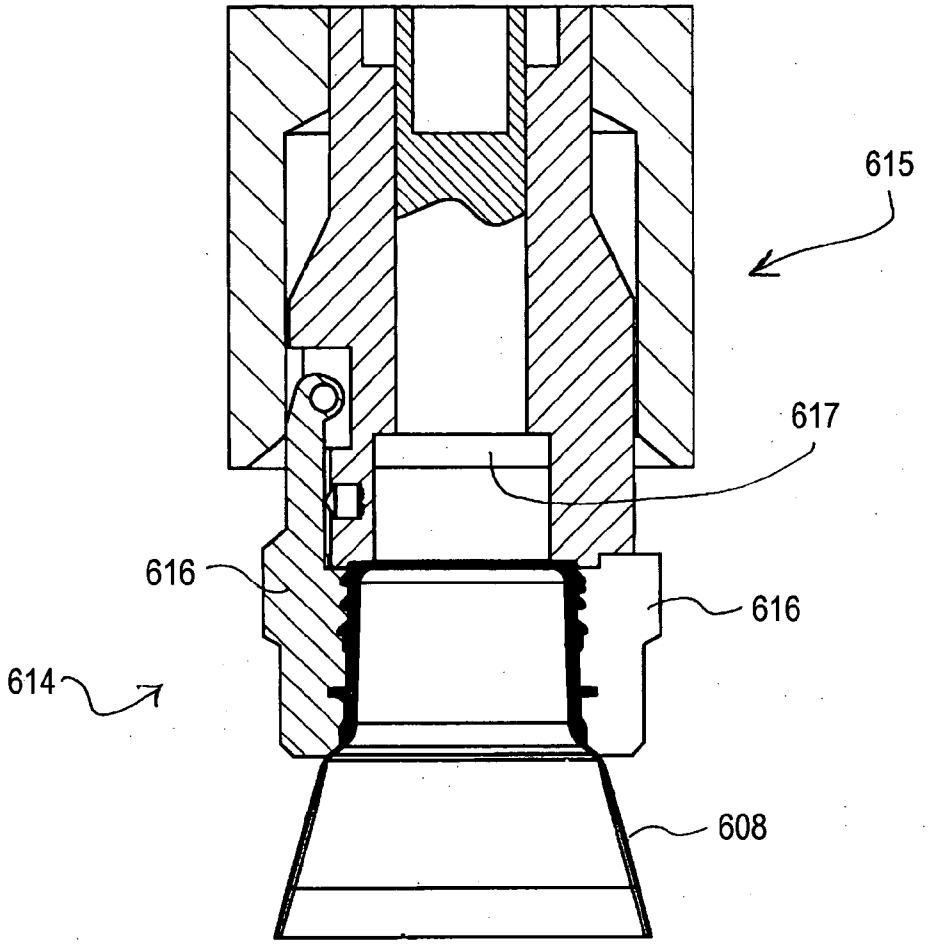


Fig. 63



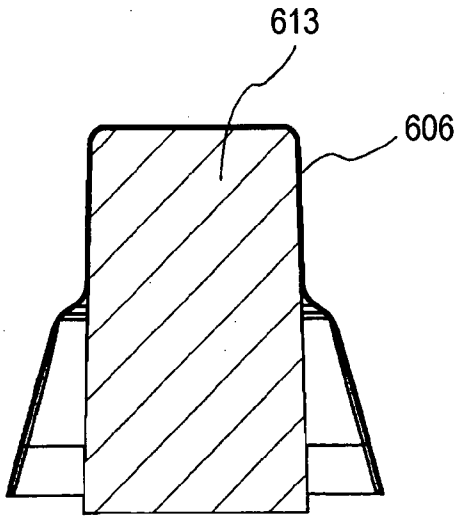


Fig. 64

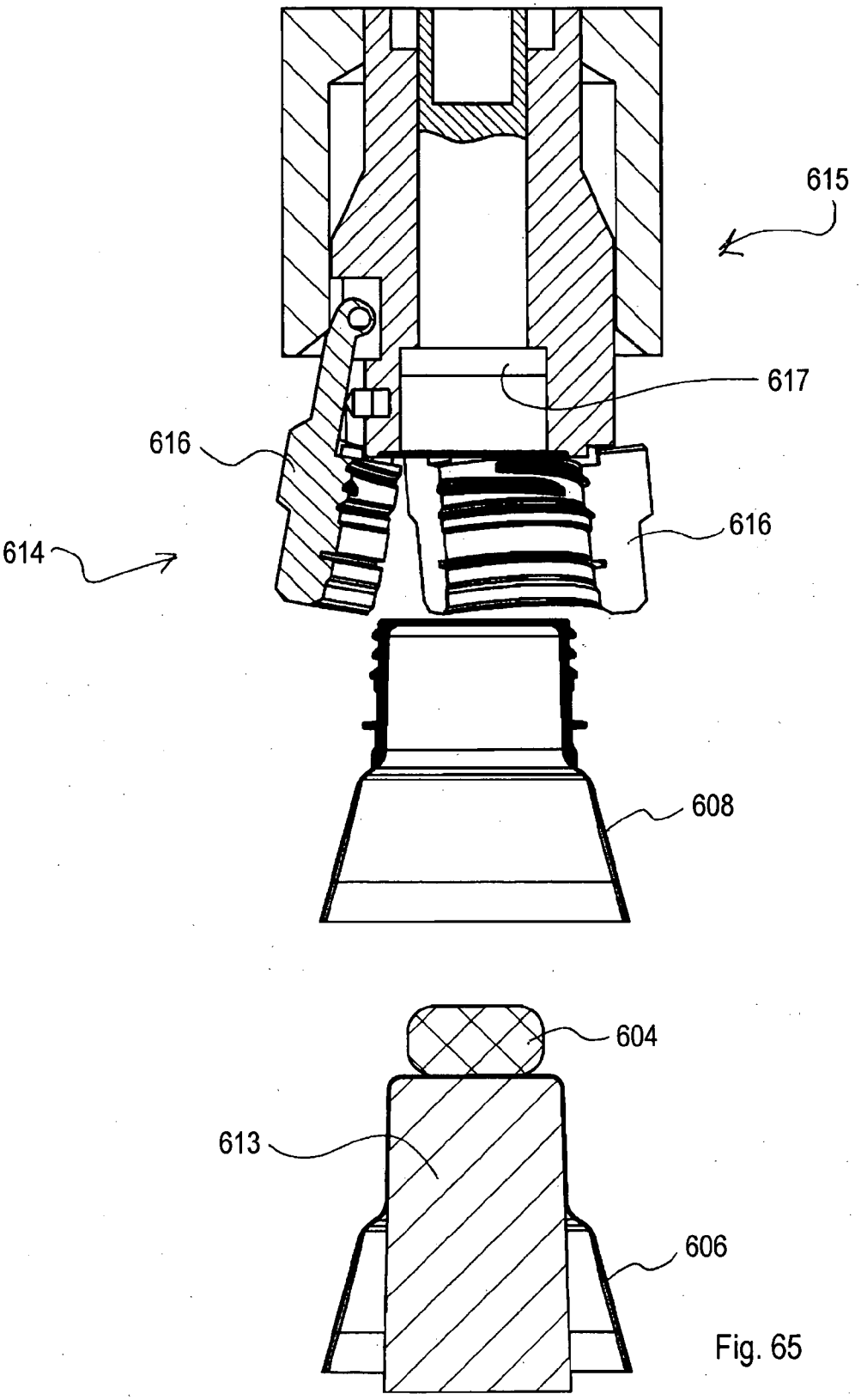


Fig. 65

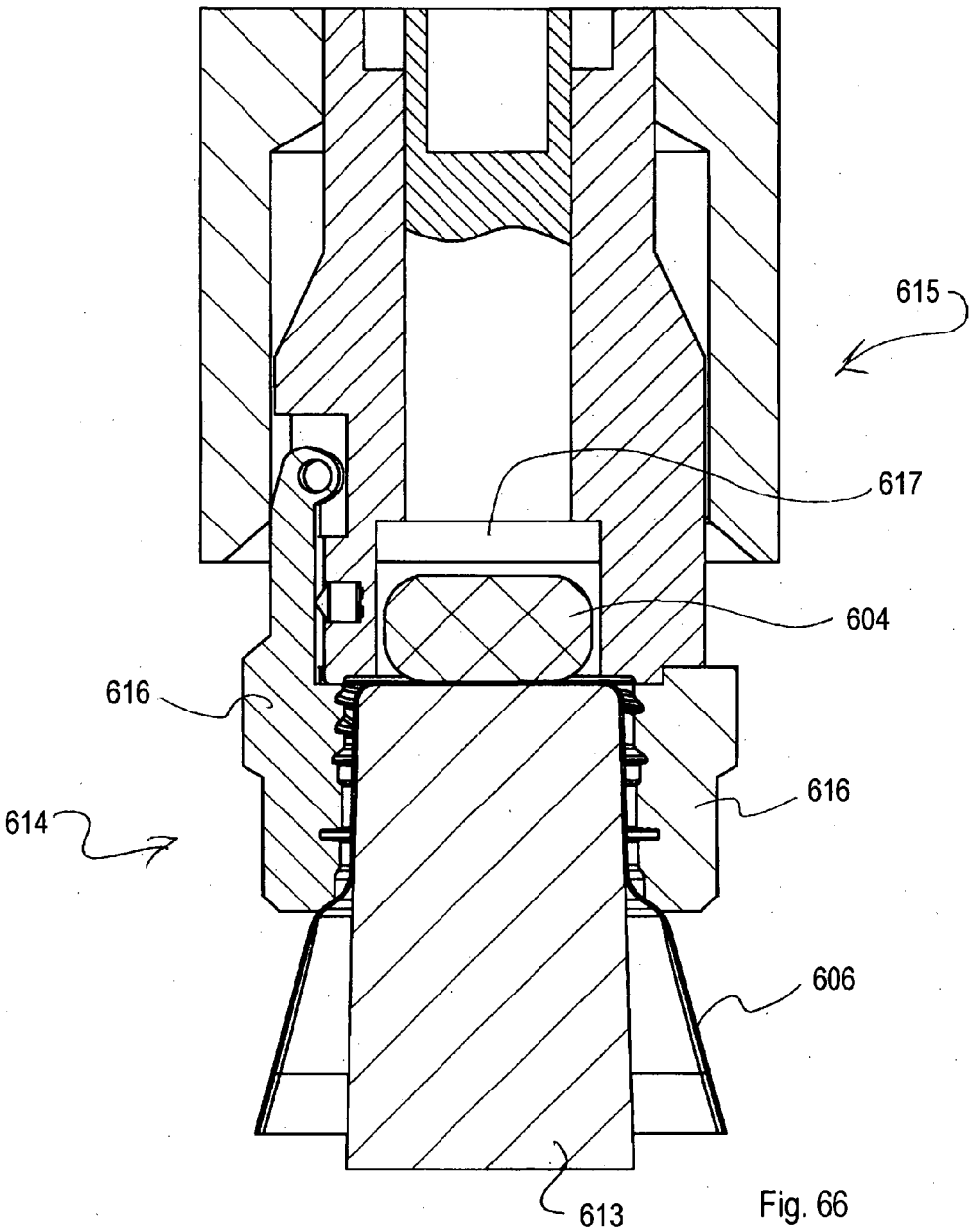


Fig. 66

COMPRESSION MOULDING APPARATUSES AND METHODS

[0001] The invention relates to apparatuses and methods for compression-moulding plastics on objects, in particular for compression-moulding a threaded portion on a dispensing element with which domes associable with containers are provided.

[0002] Containers are known that are made of cardboard or of cardboard associated with one or several layers made of plastics and/or of metal, at an end of which a dome comprising a dispensing element is fixed.

[0003] The dispensing element has an end in which an opening is made through which a product contained inside the containers can be dispensed.

[0004] Alternatively, this opening can be defined only after a closing portion of the aforesaid end has been removed from the dispensing element.

[0005] In this case, the aforesaid end can be provided with a weakening line that enables the aforesaid closing portion to be removed from the dispensing element.

[0006] The dome is made of plastics and may comprise one or more layers of material that constitutes a barrier to gases and/or to light, in such a way that the products contained in the containers are maintained whole.

[0007] The dome is obtained through injection-moulding of plastics. A drawback of known domes is that injection-moulding entails lengthy manufacturing and therefore low productivity of the forming apparatuses, as all the plastics that form a dome have to be injected through the same forming mould orifice, this orifice having very reduced dimensions.

[0008] In addition, if the dome is provided with a barrier layer, it is very difficult to inject simultaneously the material that forms an internal wall and an external wall of the dome and the material that forms the barrier layer.

[0009] The dome is still more difficult to make if several barrier layers are provided that are obtained from different materials and if the internal wall and the external wall of the containers are made of materials that are different from one another.

[0010] An object of the invention is to facilitate manufacturing of objects made of plastics.

[0011] A further object is to facilitate manufacturing of objects comprising a portion having a complex shape and provided with a layer that acts as a barrier to light and/or to gases.

[0012] In a first aspect of the invention, an apparatus is provided comprising a first mould part suitable for receiving an object, die means arranged for surrounding a zone of said object and a second mould part cooperating with said die means and with said first mould part so as to compression-mould plastics on said object in said zone.

[0013] In a second aspect of the invention, an apparatus is provided comprising punch means arranged for engaging a hollow portion of an object, supporting and retaining means arranged for clamping said object against said punch means and mould cavity means arranged for receiving a dose of plastics, said punch means and said mould cavity means cooperating mutually for compression-moulding said dose of plastics on said object.

[0014] Owing to these aspects of the invention, it is possible to make an object and subsequently compression-mould a portion having a complex shape in a desired zone of the object.

[0015] The apparatus according to the invention, is provided with great productivity, inasmuch as a dose of plastics intended for forming the portion with a complex shape is received between the second mould part and the die means, or between the punch means and the mould cavity means, and does not have to be injected through orifices of small dimensions, as occurs in the prior art.

[0016] In other words, with the apparatus according to the invention it is possible to obtain a portion with a complex shape on an object by means of a work cycle that is much shorter than a work cycle of known injection-moulding machines.

[0017] In particular, in the case of closing devices associable with containers and provided with a layer of material having barrier properties to gases and/or to light, it is possible to manufacture a substantially planar multilayered laminar element, for example by co-extrusion, thermoforming, for example through drawing and/or blowing, the laminar element to obtain domes provided with a dispensing element devoid of a threaded portion and subsequently form plastics directly on the dispensing element to obtain the threaded portion.

[0018] This enables the difficulties to be avoided that are connected with co-injection of different materials to obtain an object with an articulated shape, such as a dome provided with a threaded portion.

[0019] In a third aspect of the invention, a method is provided, comprising delivering to a mould a container part provided with a dispensing element and plastics in a pasty state and pressing together said container part and said plastics for compression-moulding said plastics on said container part.

[0020] In an embodiment, said compression-moulding comprises making a container neck element with said plastics—in particular a container neck element provided with threading—on said dispensing element.

[0021] In a further embodiment, said compression-moulding comprises making a layer with said plastics that covers, at least partially, an external surface of said object and a container neck element—in particular a container neck element provided with threading—on said dispensing element.

[0022] The container part may comprise a layer of barrier material to gases and/or to light.

[0023] The container part may be obtained by thermoforming, for example through drawing and/or blowing, a substantially planar multilayered laminar element.

[0024] Owing to this aspect of the invention, it is possible to make a container part and subsequently compression-moulding a container neck element, i.e. a portion having a complex shape, on a dispensing element, i.e. on a desired zone, of the container part.

[0025] In an embodiment, the plastics that have to be compression-moulded comprise scraps of material used for manufacturing the container part, the aforesaid scraps being ground and heated before being delivered to the mould.

[0026] In particular, in the case of thermoforming, a substantially planar laminar element is deformed to obtain a plurality of container parts that are alongside one another and connected by non-deformed portions of the laminar element.

Subsequently, the container parts are separated from the non-deformed portions of the laminar element and these latter are scrapped.

[0027] Owing to the invention, the non-deformed portions of the laminar element can be used to form on the dispensing element of a container part a container neck element, and possibly an external layer of the container part.

[0028] The non-deformed portions of the laminar element can be recycled, with clear economic advantages, even if the laminar element comprises a barrier material layer.

[0029] The barrier material, once it has been ground and heated, loses the barrier properties to gases and/or to light. However, this does not constitute a drawback as the plastics obtained by grinding and heating the scraps have to be applied to a container part that in turn comprises a barrier material layer.

[0030] In a fourth aspect of the invention, a method is provided, comprising delivering to a mould a sheet of plastics and plastics in a pasty state and pressing together said sheet and said plastics for obtaining from said sheet a container part provided with a dispensing element and for compression-moulding said plastics on said container part.

[0031] In an embodiment, said compression-moulding comprises making with said plastics a container neck element—in particular a container neck element provided with threading—on said dispensing element.

[0032] In a further embodiment, said compression-moulding comprises making with said plastics a layer that covers, at least partially, an external surface of said object and a container neck element—in particular a container neck element provided with threading—on said dispensing element.

[0033] The sheet of plastics may comprise a layer of material having barrier properties to gases and/or to light.

[0034] Owing to this aspect of the invention, it is possible to make a container part and simultaneously compression-moulding a container neck element, i.e. a portion having a complex shape, on a dispensing element, i.e. on a desired zone of the container part.

[0035] Owing to this aspect of the invention, it is not necessary to manufacture separately the container part, for example through thermoforming.

[0036] In an embodiment, the plastics that have to be compression-moulded comprise scraps of the sheet of plastics, the aforesaid scraps being ground and heated before being delivered to the mould.

[0037] In this way, it is possible to recycle wastes of material that would otherwise have to be scrapped.

[0038] This is particularly advantageous in the case of a sheet of plastics provided with a layer of barrier material to gases and/or to light, which is very costly.

[0039] In a fifth aspect of the invention, a method is made available that comprises placing a dose of plastics on an object housed on a first mould part, moving the object carried by the first mould part towards a second mould part with the dose adhering to the object, and at least partially surrounding the object with die means so as to define a forming cavity in which the dose is compression-moulded around the object, the aforesaid moving-towards operation being performed at least partially before said surrounding operation.

[0040] Owing to this aspect of the invention, it is possible to simplify and accelerate compression-overmoulding, exploiting the capacity of the dose of plastics to adhere in pasty state to the object to be overmoulded.

[0041] The invention can be better understood and implemented with reference to the attached drawings, which illustrate some embodiments thereof by way of non-limiting example, in which:

[0042] FIG. **1** is a longitudinal section of a dome that is associable with a container and provided with a dispensing element;

[0043] FIG. **2** is a plan view of the dome in FIG. **1**;

[0044] FIG. **3** is a section like that in FIG. **1** showing a dome on the dispensing element of which a threaded portion has been compression-moulded;

[0045] FIG. **4** is a section like that in FIG. **3** showing a threaded portion made according to a version;

[0046] FIG. **5** is a section like that in FIG. **3** showing a threaded portion made according to a further version;

[0047] FIG. **6** is a section like that in FIG. **3** showing a threaded portion made according to a still further version;

[0048] FIG. **7** is a longitudinal section of an apparatus for compression-moulding plastics on an object;

[0049] FIGS. **8** to **21** are fragmentary longitudinal sections showing subsequent steps of an operating cycle of the apparatus in FIG. **7**;

[0050] FIG. **22** is a fragmentary longitudinal section of the apparatus in FIG. **7**, showing a forming chamber arranged for receiving plastics;

[0051] FIGS. **23** to **25** are schematic longitudinal sections of a further embodiment of an apparatus for compression-moulding plastics on an object showing subsequent steps of an operating cycle of the apparatus;

[0052] FIG. **26** is a schematic plan view of die means of an apparatus for compression-moulding plastics on an object in an open configuration;

[0053] FIG. **27** is a view like that in FIG. **26** showing the die means in a closed configuration;

[0054] FIGS. **28** to **36** are schematic longitudinal sections of a still further embodiment of an apparatus for compression-moulding plastics on an object showing subsequent steps of an operating cycle of the apparatus;

[0055] FIG. **37** is an enlarged detail of FIG. **36**;

[0056] FIG. **38** is a schematic plan view of a machine for compression-moulding plastics on objects;

[0057] FIG. **39** is a view like that in FIG. **38** showing a version of the machine;

[0058] FIG. **40** is a view like that in FIG. **38** showing a further version of the machine;

[0059] FIG. **41** is a longitudinal section of an embodiment of an apparatus for compression-moulding plastics on an object;

[0060] FIG. **42** is a longitudinal section of an apparatus for pressing together a sheet of plastics and a dose of plastics;

[0061] FIG. **43** is a longitudinal section of an apparatus for pressing together a sheet of plastics and a dose of plastics made according to a further version;

[0062] FIGS. **44** to **50** are schematic longitudinal sections of a further embodiment of an apparatus for compression-moulding plastics on an object showing subsequent steps of an operating cycle of the apparatus;

[0063] FIGS. **51** to **53** are schematic longitudinal sections of a still further embodiment of an apparatus for compression-moulding plastics on an object showing subsequent steps of an operating cycle of the apparatus;

[0064] FIG. **54** is a view of still another embodiment of the machine for compression-moulding plastics on objects;

[0065] FIG. **55** is a partial bottom view of the machine in FIG. **54**;

[0066] FIG. **56** is a view of the machine in FIG. **54** from another perspective;

[0067] FIG. **57** is an enlarged detail of FIG. **56**;

[0068] FIG. **58** is another detail of FIG. **56**;

[0069] FIGS. **59** to **62** show four steps of the operation of a single moulding apparatus of the moulding machine in FIG. **54**;

[0070] FIGS. **63** to **66** show four enlargements of the Figures, respectively from **59** to **62**.

[0071] With reference to FIGS. **1** to **6**, a dome **1** is shown that is associable with a container, for example made of cardboard, or made of a multilayered laminar element obtained by associating one or more sheets of cardboard with one or more sheets of plastics and/or metallic material.

[0072] The cardboard—or the multilayered laminar element—is folded in such a way as to define a casing—for example with a substantially parallelepipedon shape—at an open end of which the dome **1** is fixed.

[0073] The dome **1** is made of plastics.

[0074] Advantageously, the dome **1** can be made through thermoforming a sheet material.

[0075] Thermoforming may comprise drawing and/or forming by blowing.

[0076] The sheet material may comprise one or more layers that are made of a material having barrier properties to light and/or to gases.

[0077] The sheet material can be obtained through co-extrusion.

[0078] The dome **1** comprises a first end **2** in which a connecting zone **3** is defined intended for being fixed to a container, and a second end **4**, opposite the first end **2**, in which a dispensing body **5** is defined.

[0079] The dispensing body **5** comprises a side wall **6**—for example with a cylindrical or conical shape—and an end wall **7** connected removably to the side wall **6**.

[0080] The end wall **7** is intended to be removed from the side wall **6** during a first opening of the container in such a way that in the dispensing body **5** there is defined a dispensing opening **8** through which a product contained inside the container can be dispensed.

[0081] Between the end wall **7** and the side wall **6** a line of intended separation **9** extends, the line of intended separation **6** being made, for example, by a cutting tool, an ultrasonic device, a laser device, and the like.

[0082] Alternatively, the dispensing body **5** may be devoid of the end wall **7**.

[0083] With the dispensing body **5** there is associated a container neck element **10** comprising a threaded portion **11**. The container neck element **10** may further comprise an annular bead **12** arranged for interacting with an opening indicating device of a cap associable with the container neck element **10** and an annular ridge **13**.

[0084] The container neck element **10** is obtained by compression-moulding plastics on the dispensing body **5**—as will be disclosed in greater detail below—in such a way that the container neck element **10** surrounds, at least partially, the side wall **5**.

[0085] The container neck element **10** comprises an end zone **14** that defines in the container neck element **10** a further dispensing opening **15** that is substantially superimposed on the dispensing opening **8** to enable the product contained inside the container to be dispensed.

[0086] As shown in FIG. **3**, the end zone **14** extends substantially parallelly to the side wall **6** and constitutes a prolongation of the side wall **6**. In particular, the end zone **14** is shaped in such a way as to receive the mouth of a user.

[0087] The further dispensing opening **15** has a diameter which is substantially the same as the diameter of the dispensing opening **8**.

[0088] As shown in FIG. **4**, the end zone **14** comprises an annular appendage **16** that extends towards a longitudinal axis A of the dome **1** in such a way as to partially cover the end wall **7**. In particular, the end zone **14** is shaped in such a way as to receive the mouth of a user.

[0089] The further dispensing opening **15** has a diameter which is less than the diameter of the dispensing opening **8**.

[0090] As shown in FIG. **5**, the container neck element **10** comprises a further end wall **17** connected in a removable manner to the end zone **14**.

[0091] The further end wall **17** is intended to be removed from the end zone **14** during a first opening of the container in such a way that in the dispensing body **5** the further dispensing opening **15** is defined.

[0092] Between the further end wall **17** and the end zone **14** a further line of intended separation **18** extends, the further line of intended separation **18** being made, for example, by a cutting tool, an ultrasonic device, a laser device, or directly during forming of the container neck element **10**, as will be disclosed in greater detail below.

[0093] The further end wall **17** extends substantially parallelly to the end wall **7**.

[0094] The further end wall **17** has a substantially constant thickness.

[0095] The further end wall **17** comprises a first face **19** that can be fixed to the end wall **7** and a second face **20** that can be fixed, for example through ultrasonic welding, to a cap associated with the container neck element **10**, for example to a cap screwed onto the threaded portion **11**.

[0096] When the cap is unscrewed from the threaded portion **11**, the container neck element **10** breaks at the further line of intended separation **18** in such a way that the further end wall **17** separates from the container neck element **10**, making the further dispensing opening **15** accessible.

[0097] Similarly, the dome **1** breaks at the line of intended separation **9**, in such a way that the end wall **7** separates from the dispensing body **5**, making the dispensing opening **8** accessible.

[0098] As shown in FIG. **6**, the further end wall **17** comprises a first zone **21**, which is nearer the end zone **14**, and a second zone **22**, which is further from the end zone **14**. The first zone **21** has a substantially annular shape whilst the second zone **22** has a substantially circular shape, the first zone **21** surrounding the second zone **22**. The first zone **21** has a different thickness from the thickness of the second zone **22**.

[0099] With reference to FIGS. **7** to **21** there is shown an apparatus **100** for compression-moulding plastics on objects, in particular an apparatus for compression-moulding a container neck element **10**—provided with a threaded portion **11**—on a dome **1**.

[0100] The apparatus **100** comprises a mould **23** provided with a first mould part **24** arranged for receiving a dome **1** on which a container neck element **10** has to be compression-moulded, compression-moulding die means **25** and a second mould part **26**.

[0101] The second mould part **26**, the compression-moulding die means **25** and the first mould part **24** cooperate

mutually so as to shape a dose **27** of plastics in a pasty state to obtain the container neck element **10**.

[0102] The first mould part **24**, the compression-moulding die means **25** and the second mould part **26** are substantially aligned along a longitudinal axis X of the mould **23**.

[0103] In particular, the first mould part **24** is arranged above the compression-moulding die means **25** and the compression-moulding die means **25** is arranged above the second mould part **26**.

[0104] The first mould part **24** comprises a supporting body **28** provided with an abutting surface **29** arranged for restingly receiving a dome **1**.

[0105] The supporting body **28** is fixed to an upper frame **105** of the apparatus **100** and is maintained in a fixed position during operation of the apparatus **100**.

[0106] The abutting surface **29** is shaped in such a way as to interact in a shapingly coupled manner with a corresponding internal surface **30** of the dome **1**.

[0107] The supporting body **28** comprises a protuberance **57** arranged for penetrating inside the dispensing body **5**, when the internal surface **30** rests on the abutting surface **29**.

[0108] When the dome **1** is positioned on the supporting body **28**, the dispensing body **5** faces downwards and is arranged at a lower height than the connecting zone **3**.

[0109] The supporting body **28** is crossed by a conduit **31** through which air can be sucked, in such a way that the dome **1** is made to adhere to the supporting body **28**.

[0110] In addition, air can be blown through the conduit **31** in such a way that the dome **1**—after a container neck element **10** has been compression-moulded thereupon—is induced to disengage from the supporting body **28**.

[0111] Alternatively, in the supporting body **28** a first conduit and a second conduit can be provided that are distinct from one another, the first conduit being arranged for sucking air and the second conduit being arranged for blowing air.

[0112] The protuberance **57** can be subjected to surface treatment by means of which on the abutting surface **29** roughness—or grooves—are made, defining channels that promote evacuation of the air when the dome **1** is fitted on the supporting body **28**.

[0113] In addition to sucking air—or instead of sucking air—the dome **1** can be retained on the supporting body **28** through mechanical interference.

[0114] The compression-moulding die means **25** comprises a first half mould **32** and a second half mould **33**.

[0115] The mould **23** comprises driving means **101**, for example pneumatic or hydraulic cylinders, arranged for moving the first half mould **32** and the second half mould **33** towards and away from one another transversely to the longitudinal axis X.

[0116] The first half mould **32** and the second half mould **33** are movable between a closed configuration W, shown in FIGS. **9** to **17**, in which the first half mould **32** and the second half mould **33** are placed in mutual contact, and an open configuration Z, shown in FIGS. **8**, **20** and **21**, in which the first half mould **32** and the second half mould **33** are mutually spaced apart to enable a dome **1** on which a container neck element **10** has been compression-moulded to be extracted.

[0117] When the first half mould **32** and the second half mould **33** are in the closed configuration W, in a first zone **59***a* of the compression-moulding die means **25** first opening means **59** is defined that faces the first mould part **24** and in a second zone **58***a* of the compression-moulding die means **25**, opposite the first zone **59***a*, second opening means **58** is defined that faces the first mould part **24**.

[0118] The first opening means **59** enables the protuberance **57** to penetrate inside the compression-moulding die means **25**.

[0119] Similarly, the second opening means **58** enables a forming element **37** of the second mould part **26** to press the dose **27** inside the compression-moulding die means **25**. In particular, a protruding portion **117** of the base body **36** is received in a lower zone **118** of the second opening **58**. In addition, the second opening means **58** enables the forming element **37** to penetrate inside the compression-moulding die means **25**.

[0120] The first half mould **32** comprises a first moulding cavity **34** and the second half mould **33** comprises a second moulding cavity **35**.

[0121] When the first half mould **32** and the second half mould **33** are in the closed configuration W, the first moulding cavity and the second moulding cavity **35** cooperate with the dispensing body **5** to define a forming chamber **40**, shown in FIG. **22**, inside which a dose **27** is given the shape of the container neck element **10**.

[0122] The mould **23** further comprises moving means **116** arranged for moving the compression-moulding die means **25** along the longitudinal axis X. The moving means **116** comprises a carriage **102** supporting the first half mould **32** and the second half mould **33**—and the driving means **101**—and slidable on guiding columns **103**. The moving means **116** further comprises a linear guiding device provided with a driving motor.

[0123] The compression-moulding die means **25** comprises closure promoting means **41** arranged for maintaining the first half mould **32** and the second half mould **33** in the closed configuration W.

[0124] The closure promoting means **41** comprises first conical surface means **42** obtained in an end zone **43** of the first half mould **32** and of the second half mould **33** and arranged for cooperating with further first conical surface means **44** obtained in a closing element **104** of the first mould part **26**. The closing element **104** has the shape of a sleeve extending around the supporting body **28** and is shaped in such a way as to prevent the first half mould **32** and the second half mould **33** from moving away from one another when the pressure of the plastics increases inside the forming chamber **40**. The closing element **104** is movable along the longitudinal axis X. The closing element **104** comprises a piston body **106** received in a cylinder **107** fixed to the upper frame **105**.

[0125] Between the cylinder **107** and the piston body **106** there is defined a chamber **108** arranged for receiving an operating fluid, for example pressurised air.

[0126] The cylinder **107** and the piston body **106**—and the operating fluid interposed therebetween—define a gas spring that pushes the closing element **104** towards the compression-moulding die means **25** and towards the second mould part **26**. The closure promoting means **41** further comprises second conical surface means **45** obtained in a further end zone **46** of the first half mould **32** and of the second half mould **33**, opposite the end zone **43**, and arranged for cooperating with further second conical surface means **47** obtained in a base body **36** of the second mould part **26** arranged for interacting with the compression-moulding die means **25**.

[0127] The base body **36** is provided with a seat **38** in which the forming element **37** is slidable.

[0128] The apparatus **100** comprises a main actuator **109**, for example a hydraulic actuator, arranged for moving the second mould part **26** along the longitudinal axis X. The main actuator **109** comprises a main piston **110** that is slidable in a main cylinder **111** provided in a lower frame **112** of the apparatus **100**. In particular, the base body **36** is fixed to an end of the main piston **110**.

[0129] The main actuator **109** moves the second mould part **26** between a lowered position B, shown in FIGS. **8** to **13** and in FIGS. **17** to **21**, in which the second mould part **26** does not interact with the compression-moulding die means **25** and with the first mould part **24**, and a raised position C, shown in FIGS. **14** to **16**, in which the second mould part **26** interacts with the compression-moulding die means **25** and with the first mould part **24**.

[0130] The apparatus **100** further comprises a secondary actuator **113**, for example a hydraulic actuator, arranged for moving the forming element **37** with respect to the base body **36** along the longitudinal axis X. The secondary actuator **113** comprises a secondary piston **114** that is slidable in a secondary cylinder **115** provided in the main piston **110**. In particular, the forming element **37** defines an end portion of the secondary piston **114**.

[0131] The secondary actuator **113** moves the forming element **37** between a retracted position G, shown in FIGS. **8** to **14** and in FIGS. **16** to **21**, in which the forming element **37** is received inside the seat **38** in such a way that the forming element **37** and the seat **38** define a cavity **39** arranged for receiving the dose **27**, and an extended position H, shown in FIG. **15**, in which the forming element **37** presses the dose **27** inside the forming chamber **40** to form a container neck element **10**.

[0132] A work cycle of the apparatus **100** is disclosed with reference to FIGS. **8** to **21**.

[0133] In FIG. **8** there is shown a step of the work cycle in which a dome **1**, on which a container neck element **10** was compression-moulded, has been removed from the mould **23**.

[0134] The second mould part **26** is in the lowered configuration B and the forming element **37** is in the retracted position G.

[0135] The compression-moulding die means **25** is in a removal and supply position E, in which a dome **1**, on which a container neck element **10** was compression-moulded, is removed from the compression-moulding die means **25** by a first handling device and a further dome **1**, on which a container neck element **10** has to be compression-moulded, is deposited in the compression-moulding die means **25** by a second handling device. Alternatively, a single handling device may be provided that both removes and deposits the domes **1**.

[0136] In a subsequent step of the work cycle, shown in FIG. **9**, the driving means **101** positions the first half mould **32** and the second half mould **33** in the closed configuration W.

[0137] In subsequent steps of the work cycle, shown in FIGS. **10** and **11**, a dome **1** is inserted into a zone defined between the first mould part **24** and the compression-moulding die means **25** and is deposited in the compression-moulding die means **25**. Alternatively, the dome **1** can be positioned on the supporting body **28** and retained on the supporting body **28** by sucking air through the conduit **31** and/or through mechanical interference.

[0138] FIG. **12** shows a step of the work cycle in which the moving means **116** moves the compression-moulding die means **25** from the removal and supply position E to an insertion position D, in which the compression-moulding die means **25** is placed in contact with the closing element **104**.

[0139] The compression-moulding die means **25**, in the insertion position D, makes the dome **1** interact with the supporting body **28**, in such a way that the protuberance **57** is received inside the dispensing body **5**.

[0140] In the insertion position D the compression-moulding die means **25** clamps the dome **1**, on which the container neck element **10** has to be compression-moulded, against the first mould part **24** and defines the forming chamber **40**.

[0141] In a subsequent step of the work cycle, shown in FIG. **13**, a dose **27** is deposited inside the cavity **39**.

[0142] Subsequently, as shown in FIG. **14**, the main actuator **109** moves the second mould part **26** from the lowered position B to the raised position C. The forming element **37** is maintained in the retracted configuration G, in such a way that the dose **27** is contained in the cavity **39**.

[0143] The driving motor of the linear guiding device of the moving means **116** is deactivated—i.e. placed in an idle operational configuration—just before the base body **36** interacts with the compression-moulding die means **25**. In this way, the main actuator **109**, through the second mould part **26**, moves the compression-moulding die means **25** upwards, overcoming the resistance exerted by the gas spring defined by the cylinder **107** and by the piston body **106** and by the operating fluid interposed therebetween. The compression-moulding mould means **25** therefore passes from the insertion position D to a forming position M.

[0144] When the second mould part **26** is in the raised position C, the base body **36** and the compression-moulding die means **25** are in mutual contact in such a way that the cavity **39** and the forming chamber **40** are isolated from the external environment and are mutually connected. This ensures that there are no leaks of plastics from the mould **23** during the subsequent steps of the work cycle.

[0145] Subsequently, as shown in FIG. **15**, the secondary actuator **113** moves the forming element **37** from the retracted position G to the extended position H. In this way, the dose **27** is pressed inside the forming chamber **40** to form the container neck element **10** on the dome **1**.

[0146] The secondary actuator **113** is operationally associated with a valve that controls the forming element **37** both through a pressure control and a force control.

[0147] The secondary actuator **113** controls the movement of the forming element **37** with respect to the base body **36**—i.e. the raising of the forming element **37**—until a preset pressure value is reached inside the forming chamber **40**.

[0148] In this way, the final position reached by the forming element **37** can vary by passing from one work cycle to another work cycle. The forming element **37** thus enables plastics dosing errors to be compensated—i.e. errors due to doses comprising a quantity of plastics which is greater than or lesser than a theoretically set quantity—by varying the final position thereof. Doses that are different from one another give rise to container neck elements **10** that differ only in the thickness of the further end wall **17**. Further end walls **17** having thicknesses that are variable within a certain range do not prejudice the properties of the domes **1**, which are therefore qualitatively acceptable. This is in particular due to the fact that the further end walls **17** have to be removed from the domes **1** at the latest at the moment of the first opening of a cap associated with the container neck element **10**.

[0149] Still subsequently, the secondary actuator **113** moves the forming element **37** from the extended position H to the retracted position G, as shown in FIG. **16**, and the main actuator **109** moves the second mould part **26** from the raised position C to the lowered position B, as shown in FIG. **17**. The driving motor of the linear guiding device of the moving means **116** is maintained deactivated—i.e. placed in an idle operational configuration—until the main piston **110** has completed a preset stroke. In this way, the gas spring defined by the cylinder **107** and by the piston body **106** and by the operating fluid that is interposed therebetween moves the compression-moulding die means **25** downwards. The compression-moulding die means **25** thus moves from the forming position M to the insertion position D.

[0150] In a subsequent step of the work cycle, shown in FIG. **18**, the moving means **116** moves the compression-moulding die means **25** from the insertion position D to an extraction position F, in which the dome **1** on which the container neck element **10** is compression-moulded is separated from the supporting body **28**.

[0151] When the compression-moulding die means **25** is in the extraction position F, the protuberance **57** is partially received inside the dispensing body **8**.

[0152] The driving means **101** moves the first half mould **32** and the second half mould **33** from the closed configuration W to a detachment configuration L, in which the dome **1** on which the container neck element **10** has been compression-moulded is detached from the first half mould **32** and from the second half mould **33**.

[0153] The protuberance **57** acts as an abutting means that prevents the dome **1** from remaining attached to the first half mould **32** or to the second half mould **33** when the first half mould **32** or the second half mould **33** move away from one another. The first half mould **32** and the second half mould **33**, in the detachment configuration L, support the dome **1**.

[0154] In other words, the first half mould **32** and the second half mould **33**, by passing from the closed configuration W to the detachment configuration L, move away from one another by a small distance, this distance enables the dome **1** to be separated from the first half mould **32** and from the second half mould **33**, but does not prevent the compression-moulding die means **25** from being able to support the dome **1**.

[0155] Subsequently, as shown in FIG. **19**, the moving means **116** moves the compression-moulding die means **25** from the extraction position F to the removal and supply position E.

[0156] Still subsequently, the driving means **101** moves the first half mould **32** and the second half mould **33** from the closed configuration W to the open configuration Z, as shown in FIG. **20**, and the dome **1** on which the container neck element **10** has been compression-moulded is removed from the mould **23**, as shown in FIG. **21**.

[0157] In an embodiment that is not shown the second mould part is maintained in a fixed position and the first mould part is movable towards and away from the second mould part.

[0158] In a further embodiment that is not shown the first mould part and the second mould part are both movable.

[0159] With reference to FIGS. **23** to **25**, an apparatus **100** is shown schematically that is provided with a mould **23***a* comprising a first mould part **24** and compression-moulding die means **25** of the type shown in FIGS. **7** to **22** and a second mould part **26***a* made according to a version.

[0160] The compression-moulding die means **25** is shown schematically in FIGS. **26** and **27**.

[0161] The second mould part **26***a* comprises a base body **36***a* and a forming element **37***a* that is slidable in a seat **38***a* obtained in the base body **36***a*.

[0162] The forming element **37***a* is provided with a groove **55** inside which an elongated body **56** is slidable.

[0163] The apparatus **100** comprises a secondary actuator, which is not shown, that is arranged for moving the forming element **37***a* between a retracted position G**2**, shown in FIGS. **23** and **24**, in which the forming element **37***a* is received inside the seat **38***a* in such a way that the forming element **37***a* and the seat **38***a* define a cavity **39***a* arranged for receiving a dose **27***a* of plastics in a pasty state having an annular shape, and an extended position H**2**, shown in FIG. **25**, in which the forming element **37** presses the dose **27***a* inside the compression-moulding die means **25** to form a container neck element **10**.

[0164] The apparatus **100** further comprises a further secondary actuator arranged for moving the elongated body **56** with respect to the forming element **37***a*.

[0165] An initial part of a work cycle of the apparatus **100** is carried out in the manner disclosed with reference to FIGS. **8** to **13**.

[0166] As shown in FIG. **23**, the second mould part **26** is in the lowered configuration B, the forming element **37** is in the retracted position G**2**. The compression-moulding die means **25** is in the insertion position D and the first half mould **32** and the second half mould **33** are in the closed configuration W.

[0167] The dose **27***a* is delivered to the mould **23***a*.

[0168] When the forming element **37***a* is in the retracted position G**2**, an end **56***a* of the elongated body **56** projects from the groove **55** to the compression-moulding die means **25**, in such a way that the dose **27***a* surrounds the end **56***a*, as shown in FIG. **24**.

[0169] Subsequently, as shown in FIG. **25**, the main actuator moves the second mould part **26** from the lowered position B to the raised position C. The compression-moulding die means **25** moves from the insertion position D to the forming position M.

[0170] The secondary actuator moves the forming element **37***a* from the retracted position G**2** to the extended position H**2**. In this way, the dose **27***a* is pressed inside the forming chamber **40** to form the container neck element **10** on the dome **1**.

[0171] Before the dose **27***a* occupies the forming chamber **40**, the elongated body **56** is made to abut against the end wall **7** of the dome **1** positioned on the supporting body **28**.

[0172] In this way, the elongated body **56** prevents the plastics that form the dose **27***a* from interacting with a central portion of the end wall **7**.

[0173] The elongated body **56** thus enables container neck elements **10** to be obtained that are devoid of the further end wall **17**, i.e. container neck elements **10** of the type shown in FIGS. **3** and **4**.

[0174] Subsequently, a final part of a work cycle of the mould **23***a* is carried out in the manner disclosed with reference to FIGS. **16** to **21**.

[0175] With reference to FIGS. **28** to **37**, there is shown an apparatus **100** provided with a mould **123** comprising a first mould part **124** arranged for receiving a dome **1** on which a container neck element **10** has to be compression-moulded, compression-moulding die means **125** and a second mould part **126**.

[0176] The second mould part **126**, the compression-moulding die means **125** and the first mould part **124** cooperate together so as to shape a dose **27** of plastics to obtain the container neck element **10**.

[0177] The first mould part **124**, the compression-moulding die means **125** and the second mould part **126** are substantially aligned along a longitudinal axis Y of the mould **123**.

[0178] In particular, the second mould part **126** is arranged above the compression-moulding die means **125** and the compression-moulding die means **125** is arranged above the first mould part **124**.

[0179] The first mould part **124** comprises a supporting body **128** provided with an abutting surface **129** arranged for restingly receiving a dome **1**.

[0180] The abutting surface **129** is shaped in such a way as to interact in a shapingly coupled manner with a corresponding internal surface **30** of the dome **1**.

[0181] The supporting body **128** comprises a protuberance **157** arranged for penetrating inside the dispensing body **5**, when the internal surface **30** rests on the abutting surface **129**. When the dome **1** is positioned on the supporting body **128**, the dispensing body **5** faces upwards and is arranged at a height that is greater than the connecting zone **3**.

[0182] The mould **123** further comprises an actuator, for example a hydraulic actuator, arranged for moving the first mould part **124** between a lowered position B**1**, shown in FIGS. **29** to **34**, in which the supporting element **128** receives a dome **1**, and a raised position C**1**, shown in FIGS. **28** and **36**, in which the supporting element **128** cooperates with the compression-moulding die means **125** and with the second mould, part **126** to shape the dose **27** to obtain the container neck element **10**.

[0183] The compression-moulding die means **125** comprises a first half mould **132** and a second half mould **133**.

[0184] The apparatus **100** comprises driving means arranged for moving the first half mould **132** and the second half mould **133** towards and away from one another transversely with respect to the longitudinal axis Y.

[0185] The first half mould **132** and the second half mould **133** are movable between a closed configuration W**1**, shown in FIGS. **28**, **29** and **32** to **36**, in which the first half mould **132** and the second half mould **133** are placed in mutual contact, and an open configuration Z**1**, shown in FIGS. **30** and **31**, in which the first half mould **132** and the second half mould **133** are mutually spaced apart to enable a dome **1** on which the container neck element **10** has been formed to be removed from the compression-moulding die means **125** and a further dome **1** on which a container neck element **10** has to be formed to be delivered to the compression-moulding die means **125**.

[0186] When the first half mould **132** and the second half mould **133** are in the closed configuration W**1**, in a first zone **159***a* of the compression-moulding die means **125** first opening means **159** is defined that faces the first mould part **124** and in a second zone **158***a* of the compression-moulding die means **125**, opposite the first zone **159***a*, second opening means **158** is defined that faces the second mould part **126**.

[0187] The second opening means **158** enables a forming body **137** of the second mould part **126** to penetrate inside the compression-moulding die means **25**.

[0188] Similarly, the first opening means **159** enables the protuberance **157**—with which the dispensing body **5** is associated—to penetrate inside the compression-moulding die means **125**.

[0189] The first half mould **132** comprises a first moulding cavity **134** and the second half mould **133** comprises a second moulding cavity **135**.

[0190] When the first half mould **132** and the second half mould **133** are in the closed configuration W**1**, the first moulding cavity **134** and the second moulding cavity **135** cooperate with the dispensing body **5** to define a forming chamber **140** inside which the dose **27** is given the shape of the container neck element **10**.

[0191] The mould **123** further comprises moving means arranged for moving the compression-moulding die means **125** along the longitudinal axis Y. The compression-moulding die means **125** can assume a forming position M**1**, shown in FIGS. **28**, **29** and **36**, in which the compression-moulding die means **125** cooperates with the first mould part **124** and with the second mould part **126** to shape the dose **27** to obtain the container neck element **10**, a delivery position E**1**, shown in FIGS. **30** to **32**, in which the compression-moulding die means **125** is spaced apart from the first mould part **124** and from the second mould part **126** to deliver a dome **1** on which the container neck element **10** has been moulded, and a locking position I**1**, shown in FIGS. **33** and **34**, in which the compression-moulding die means **125** presses a further dome **1** on which a container neck element **10** has to be formed against the first mould part **124**.

[0192] The compression-moulding die means **125** comprises closure promoting means **141** arranged for maintaining the first half mould **132** and the second half mould **133** in the closed configuration W**1**.

[0193] The closure promoting means **141** comprises first conical surface means **142** obtained in an end zone **143** of the first half mould **132** and of the second half mould **133** and arranged for cooperating with further first conical surface means **144** obtained in the first mould part **124**.

[0194] The closure promoting means **141** further comprises second conical surface means **145** obtained in a further end zone **146** of the first half mould **132** and of the second half mould **133**, opposite the end zone **143**, and arranged for cooperating with further second conical surface means **147** obtained in the second mould part **126**.

[0195] The forming body **137** is provided with a first member **160** that is further from the compression-moulding die means **125** and with a second member **161** fixed to the first member **160** and nearer the compression-moulding die means **125**.

[0196] The second member **161** comprises a forming appendage **168** arranged for interacting with the dose **27**.

[0197] The second mould part **126** further comprises a sleeve **162** provided with a seat **163** in which the second member **161** is received.

[0198] In the sleeve **162** the further second conical surface means **147** is obtained.

[0199] The forming body **137** is maintained in a fixed position, the sleeve **162** being slidable along the second member **161**. The sleeve **162** is movable between a rest position P**1**, shown in FIGS. **30** to **35**, in which the sleeve **162** is further from the first member **160**, and an operating position Q**1**, shown in FIGS. **28**, **29** and **36**, in which the sleeve **162** is nearer the first member **160**.

[0200] The second mould part **126** may comprise elastic means; which is not shown, which induces the sleeve **162** to assume the rest configuration P**1**. The elastic means may be of the pneumatic spring type, as disclosed with reference to FIGS. **7** to **22**.

[0201] The second mould part **126** further comprises chamber means **164** obtained in the second member **161** and inside which a piston **165** is movable.

[0202] The piston **165** defines in the chamber means **164** a first chamber **169** and a second chamber **170**, each of which can be supplied with an operating fluid through conduit means, which is not shown.

[0203] To the piston **165** a stem **166** is fixed that extends to the compression-moulding die means **125** through a hole **167** obtained in the second member **161** and such as to pass through the forming appendage **168**.

[0204] The piston **165** and the chamber means **164** cooperate to define a further actuator that drives the stem **166**.

[0205] A work cycle of the apparatus **100** is disclosed with reference to FIGS. **28** to **36**.

[0206] In FIG. **28** a step of the work cycle is shown in which a container neck element **10** has been compression-moulded on a dome **1**.

[0207] The dome **1** is maintained in the mould **123** for a period of time during which the container neck element **10** cools and the shape thereof is stabilised.

[0208] The first mould part **124** is in the raised position C**1**, the compression-moulding die means **125** is in the forming position M**1**, the first half mould **132** and the second half mould **133** are in the closed configuration W**1**, the sleeve **162** is in the operating position Q**1**.

[0209] Subsequently, as shown in FIG. **29**, the actuator moves the first mould part **124** from the raised position C**1** to the lowered position E**1**.

[0210] The compression-moulding die means **125** is in the forming position M**1**.

[0211] The sleeve **162** is in the operating position Q**1**.

[0212] The first half mould **132** and the second half mould **133** are in the closed configuration W**1** and retain the dome **1** on which a container neck element **10** has been compression-moulded.

[0213] In FIG. **29** a handling device **148** is further shown comprising a first end **149**, facing the compression-moulding die means **125**, at which a first handling element **150** is obtained, the first handling element **150** being arranged for removing from the first half mould **132** and from the second half mould **133** the dome **1** on which a container neck element **10** has been compression-moulded.

[0214] The handling device **148** further comprises a second end **151**, opposite the first end **149** and facing the first mould part **124**, at which a second handling element **152** is obtained that is arranged for delivering to the first mould part **124** a further dome **1** on which the container neck element **10** has to be compression-moulded.

[0215] The handling device **148** is introduced between the first mould part **124** and the compression-moulding die means **125** and assumes a raised removal configuration S**1**, shown in FIGS. **29** and **30**.

[0216] The first handling element **150** comprises a protruding element **153**—substantially shaped like the protuberance **157**—which, in the raised removal configuration S**1** is aligned with the dome **1** on which a container neck element **10** was compression-moulded in such a way that the protruding element **153** and the dispensing body **5**—and the container neck element **10** that surrounds the dispensing body **5**—are substantially coaxial.

[0217] The second handling element **152** comprises a seat **154** that partially receives a further dome **1** on which the container neck element **10** has to be compression-moulded.

[0218] In the raised removal configuration S**1**, the further dome **1** on which the container neck element **10** has to be compression-moulded is spaced apart from the first mould part **124**.

[0219] Subsequently, as shown in FIG. **30**, the first mould part **124** is in the lowered position B**1**.

[0220] The compression-moulding die means **125** passes from the forming position M**1** to the delivery position E**1**.

[0221] The elastic means moves the sleeve **162** from the operating position Q**1** to the rest position P**1**.

[0222] The driving means moves the first half mould **132** and the second half mould **133** from the closed configuration W**1** to the open configuration Z**1**.

[0223] The dome **1** on which the container neck element **10** was moulded is released by the first half mould **132** and by the second half mould **133**, reaches—for example by gravity—the handling device **148** and engages the protruding element **153**.

[0224] In the work cycle step shown in FIG. **31**, the first mould part **124** is in the lowered position B**1**, the compression-moulding die means **125** is in the delivery position E**1** and the sleeve is in the rest position P**1**.

[0225] The first half mould **132** and the second half mould **133** are in the open configuration Z**1**.

[0226] Subsequently, the driving means moves the first half mould **132** and the second half mould **133** from the open configuration Z**1** to the closed configuration W**1**.

[0227] The handling device **148** is moved along the longitudinal axis Y in such a way as to assume a lowered releasing position J**1**, in which the seat **154** delivers the further dome **1** on which the container neck element **10** has to be compression-moulded to the first mould part **124**.

[0228] In the work cycle step shown in FIG. **32**, the first mould part **124** is in the lowered position B**1**, the compression-moulding die means **125** is in the delivery position E**1** and the sleeve **162** is in the rest position P**1**.

[0229] The handling device **148** is moved along the longitudinal axis Y in such a way as to assume an intermediate moving position N**1** in which the handling device **48**—and the dome **1** on which a container neck element **10** was compression-moulded—is extracted from a zone interposed between the first mould part **124** and the compression-moulding die means **125**.

[0230] The handling element **148**, when it is in the intermediate moving position N**1**, can be moved transversely with respect to the longitudinal axis Y without interfering with the first mould part **124** and with the moulding die means **125**.

[0231] In an embodiment of the mould **123** which is not shown, the handling device can always be maintained at the same vertical height.

[0232] In this case, the compression-moulding die means **125** and the first mould part **124** are moved along the longitudinal axis Y to, respectively, deliver the dome **1** on which a container neck element **10** was compression-moulded and remove the further dome **1** on which the container neck element **10** has to be compression-moulded.

[0233] In subsequent steps of the work cycle shown in FIGS. **33** and **34**, the first mould part **124** is in the lowered position B**1**, the first half mould **132** and the second half mould **133** are in the closed configuration W**1** and the sleeve **162** is in the rest position P**1**.

[0234] The further moving means moves the compression-moulding die means **125** from the delivery position E**1** to the locking position I**1**.

[0235] The driving means maintains the first half mould **132** and the second half mould **133** in the closed configuration W**1**.

[0236] The compression-moulding die means **125** and the first mould part **124** define a further cavity **183** arranged for receiving the dose **27**.

[0237] In the locking position I**1** the compression-moulding die means **125** clamps the further dome **1**, on which the container neck element **10** has to be compression-moulded, against the first mould part **124** and defines the forming chamber **140**. Supplying means, which is not shown, delivers a dose **27** to the mould **123**, the dose **27** being received in the further cavity **183**.

[0238] Subsequently, as shown in FIGS. **34** and **35**, the actuator moves the first mould part from the lowered position B**1** to the raised position C**1**. The compression-moulding die means **125** moves from the locking position I**1** to the forming position M**1**.

[0239] Subsequently, as shown in FIG. **36**, the die means **125** interacts with the sleeve **162** and, by overcoming the resistance of the elastic means, moves the sleeve **162** from the rest position P**1** to the operating position Q**1**.

[0240] The dose **27**, moved from the first mould part **124**, interacts with the second mould part **126**.

[0241] The forming appendage **168** pushes the dose **27** inside the forming chamber **40** to shape the dose **27**.

[0242] The mould **123** assumes an operational configuration K**1** in which both the forming body **137** and the protuberance **157** extend inside the die means **125**—respectively through the second opening means **158** and the first opening means **159**—to compression-mould the dose **27**.

[0243] By suitably checking the quantity of operating fluid present in the first chamber **169** and in the second chamber **170** and the pressure of the operating fluid in the first chamber **169** and in the second chamber **170** it is possible to vary the position of the stem **166**.

[0244] The stem **166** can be completely received in the hole **167**, or protrude partially from the hole **167**, as shown in FIG. **37**. The stem **166** enables domes **1** to be obtained, one of which is shown in FIG. **6** as well as in FIG. **37**, provided with a container neck element **10** comprising a further end wall **17** having a non-uniform thickness.

[0245] In particular, the further end wall **17** comprises a peripheral annular zone **180** having a substantially constant thickness and a central zone **181** having a thickness that may assume values that are different from one dome to the other. The further end wall **17** can be welded, at the peripheral annular zone **180**, to a cap that is screwable on a threaded container neck element.

[0246] In addition, at the peripheral annular zone **180** the further line of intended separation **18** can be made.

[0247] Unlike the peripheral annular zone **180**, the central zone **181** does not undergo any further processing after compression moulding.

[0248] As a result, a difference in the thickness of the central zone **181**—albeit of a very slight amount—that is detectable by comparing domes made in various work cycles does not constitute a defect of the domes.

[0249] The stem **166** enables plastics dosing errors and dimensional differences in the thickness of the sheet material from which the dome **1** was obtained by thermoforming to be compensated.

[0250] In particular, if in the mould **123** a dose is deposited that is smaller than a preset amount, the stem **166** is projected to the outside of the hole **167**—as shown in FIG. **37**—to ensure effective compression of the plastics and thus correct forming.

[0251] In this case, the container neck element **10** comprises a further end wall **17** in which the central zone **181** has less thickness than that of the peripheral annular zone **180**.

[0252] If a dose is deposited in the mould **123** that is greater than a preset amount, the stem **166** is pushed inside the hole **167** in such a way that the excess of plastics can be received in the hole **167**.

[0253] In this case, the container neck element **10** comprises a further end wall **17** in which the central zone **181** has a greater thickness than that of the peripheral annular zone **180**.

[0254] With reference to FIGS. **38** to **40**, some embodiments of a machine **190** for compression-moulding plastics on objects are shown comprising a rotatable forming carousel **191** that supports a plurality of apparatuses **100**, i.e. a plurality of moulds, of the same type as those disclosed above.

[0255] Subsequently, in order not to complicate the description, reference will be made to moulds **23** of the type disclosed with reference to FIGS. **7** to **22**.

[0256] Everything that is affirmed with reference to the moulds **23** has to be considered to refer also to the moulds **23***a* in FIGS. **23** to **25** and to the moulds **123** in FIGS. **28** to **37** and to the moulds **501** that will be disclosed below with reference to FIGS. **44** to **50** and to the moulds **501***a* that will be disclosed below with reference to FIGS. **51** to **53**. The moulds, **23** are mounted in a peripheral zone **192** of the forming carousel **191**.

[0257] The moulds **23** are positioned at substantially constant angular intervals on the forming carousel **191**.

[0258] An extruder **193** is further provided which is arranged for dispensing doses of plastics in a pasty state with which the forming carousel **191** is supplied.

[0259] Subsequently, in order not to complicate the description, reference will be made to doses **27** of the type disclosed with reference to FIGS. **7** to **22** and to FIGS. **28** to **37**. Everything that is affirmed with reference to the doses **27** has to be considered to refer also to the doses **27***a* in FIGS. **23** to **25**.

[0260] The machine **190** further comprises a supplying carousel **195** arranged for removing the doses **27** from the extruder **193** and delivering the doses **27** to the moulds **23**.

[0261] The supplying carousel **195** comprises a plurality of grasping elements **196** arranged peripherally on the supplying carousel **195**.

[0262] The grasping elements **196** are positioned at substantially constant angular intervals on the supplying carousel **195**.

[0263] With reference to FIG. **38**, an embodiment of the machine **190** is shown comprising, in addition to the forming carousel **191** and to the supplying carousel **195**, a transferring carousel **194** positioned laterally with respect to the forming carousel **191** and arranged for supporting a plurality of handling devices **48**.

[0264] The handling devices **48** are mounted in a peripheral region of the transferring carousel **194**.

[0265] The handling devices **48** are positioned at substantially constant angular intervals on the transferring carousel **194**. The machine **190** further comprises a conveying device **197**, provided with a flexible conveying element **198**,

arranged laterally with respect to the transferring carousel **194** and partially wound, near the transferring carousel **194**, on a rotating body **199**.

[0266] The transferring carousel **194** is rotated in a direction R**1**. The rotating body **199** is rotated in a further direction R**2**, opposite the direction R**1**.

[0267] In operation, each handling device **48** of the transferring carousel **194** delivers to the flexible conveying element **198** a dome **1***a* on which a container neck element **10** was compression-moulded and removes from the flexible conveying element **198** a dome **1***b* on which a container neck element **10** has to be compression-moulded.

[0268] Subsequently, the handling device **48** delivers to a mould **23** the further dome **1***b* on which a container neck element **10** has to be compression-moulded and removes from the mould **23** another dome **1***a* on which a container neck element **10** was compression-moulded.

[0269] Still subsequently, the supplying carousel **195**—arranged downstream of the transferring carousel **194** with respect to a rotation direction R of the forming carousel **191**—deposits a dose **27** in the mould **23** to which the dome **1***b* was delivered on which a container neck element **10** has to be compression-moulded.

[0270] Still subsequently, whilst the forming carousel **191** rotates, the container neck element **10** is compression-moulded according to what is disclosed with reference to FIGS. **7** to **22**, or to FIGS. **23** to **25**, or to FIGS. **28** to **37**, or to FIGS. **42** to **50**, or to FIGS. **51** to **53**. With reference to FIG. **39**, there is shown a further embodiment of the machine **190** comprising, in addition to the forming carousel **191** and to the supplying carousel **194**, flexible conveying means **200**—provided, for example, with a belt conveying element, or with a chain conveying element—positioned laterally with respect to the forming carousel **191** and arranged for supporting a plurality of handling devices **48**.

[0271] The flexible conveying means **200** comprises a first portion **204** provided with handling elements **48** that move away from the forming carousel **191** domes **1***a* on which a container neck element **10** was compression-moulded and a second portion **205** provided with handling elements **48** that move towards the forming carousel **191** domes **1***b* on which a container neck element **10** has to be compression-moulded.

[0272] The flexible conveying means **200** is partially wound, near the transferring carousel **194**, on a first rotating body **201** and on a second rotating body **202**.

[0273] The forming carousel is rotated in a rotation direction R. The first rotating body **201** and the second rotating body **202** are rotated in a further rotation direction R**3**, opposite the rotation direction R.

[0274] The first rotating body **201** and the second rotating body **202** are shaped in such a way that a further portion **203** of the flexible conveying means **200**—interposed between the first portion **204** and the second portion **205**—is arranged along a part of the trajectory. T defined by the moulds **23** when the forming carousel **191** is rotated.

[0275] In this way, an interval of time of considerable length is provided during which a handling device **48**, after being inserted between the first mould part **24** and the compression-moulding die means **25** of a mould **23**, can remove from the mould **23** a dome **1***a* on which a container neck element **10** was compression-moulded and can deliver to the mould **23** a further dome **1***b* on which a container neck element **10** has to be compression-moulded.

[0276] Subsequently, the supplying carousel **195**—arranged downstream of the flexible conveying means **200** with respect to the rotation direction R—deposits a dose **27** in the mould **23** to which the further dome **1***b* was delivered on which a container neck element **10** has to be compression-moulded.

[0277] Still subsequently, whilst the forming carousel **191** rotates, the container neck element **10** is compression-moulded according to what is disclosed with reference to FIGS. **7** to **22**, or to FIGS. **23** to **25**, or to FIGS. **28** to **37**, or to FIGS. **42** to **50**, or to FIGS. **51** to **53**.

[0278] With reference to FIG. **40**, a further embodiment of the machine **190** is shown that differs from the embodiment of the machine **190** in FIG. **39** in that there is provided a supplying carousel **195** that, instead of being arranged downstream of the flexible conveying means **200** with respect to the rotation direction R, is interposed between the first portion **204** of the flexible conveying means **200** and the second portion **205** of the flexible conveying means **200**.

[0279] In particular, a zone of the conveying means **200** is arranged along a further trajectory T**1** defined by the grasping elements **196** when the supplying carousel **195** is rotated.

[0280] In an embodiment, the supplying carousel **195** is arranged coaxially to, or substitutes, the first rotating body **201**.

[0281] In operation, the supplying carousel **195** delivers a dose **27** to a mould **23** immediately after a dome **1***a*—on which a container neck element **10** was compression-moulded—has been removed from the mould **23***a* and a further dome **1***b* has been delivered on which a container neck element **10** has to be compression-moulded.

[0282] In an embodiment that is not shown, there is provided a removing carousel for removing from a mould **23** a dome **1** on which a container neck element **10** was compression-moulded, an inserting carousel arranged for delivering to the mould **23** a further dome **1** on which a container neck element **10** have to be compression-moulded and a further transferring carousel arranged for depositing in the mould **23** a dose of plastics **27**.

[0283] In another embodiment that is not shown, there is provided a single moving carousel configured so as to remove from a mould **23** a dome **1** on which a container neck element **10** has been compression-moulded, delivering to the mould **23** a further dome **1** on which a container neck element **10** has to be compression-moulded and depositing in the mould **23** a dose of plastics **27**.

[0284] In a further embodiment that is not shown, the forming carousel **191** comprises a plurality of moving elements arranged for moving the domes **1**. The moving elements are supported by the forming carousel **191** and are movable with respect to the forming carousel **191**, for example along a direction arranged substantially radially with respect to the forming carousel **191**.

[0285] In particular, the forming carousel **191** comprises a number of moving elements that is the same as the number of moulds **23**, a moving element corresponding to each mould **23**.

[0286] Each moving element can be shaped as an arm having at one end a gripping element arranged for grasping a dome **1**.

[0287] During operation, each moving element removes a dome **1** from a conveying device and delivers the dome **1** to a corresponding mould **23**, before, or after, a dose **27** has been deposited in the mould **23**.

[0288] Subsequently, the dose **27** is compression-moulded on the dome **1** to obtain a container neck element **10**.

[0289] Still subsequently, the dome **1** on which the container neck element **10** was obtained is extracted from the mould **23** by a removal device and delivered to a further conveying device.

[0290] Alternatively, each moving element can remove from the mould **23** operationally associated therewith the dome **1** on which the container neck element **10** was obtained and deliver the dome **1** to the further delivering device.

[0291] Still alternatively, each moving element can remove from the mould **23** operationally associated therewith the dome **1** on which the container neck element **10** was obtained and move the dome **1** to a peripheral zone of the forming carousel **191** at which the dome **1** is collected by a removal device. In this way, the dome **1** can be removed from the forming carousel **191** more easily than is the case when it is extracted from the mould **23** directly by the removal device.

[0292] With reference to FIG. **41** there is shown an apparatus **100** comprising a mould **23***b* that constitutes a version of the mould **23** disclosed with reference to FIGS. **7** to **22**.

[0293] The mould **23***b* is provided with a second mould part **26** comprising weakening means **300**.

[0294] The weakening means **300** comprises a tubular element **301** that surrounds the forming element **37** and is slidable with respect to the forming element **37**. Movement promoting means is provided that moves the tubular element **301** with respect to the forming element **37**.

[0295] The movement promoting means may comprise a hydraulic, or pneumatic, or electric actuator that moves the tubular element **301** towards or away from the supporting body **28**.

[0296] Alternatively, the movement promoting means may comprise a hydraulic, or pneumatic, or electric actuator that moves the tubular element **301** towards the supporting body **28** and elastic means that moves the tubular element away from the supporting body **28**.

[0297] Still alternatively, the movement promoting means may comprise a hydraulic, or pneumatic, or electric actuator that moves the tubular element **301** towards the supporting body **28**. The tubular element **301** is subsequently moved away from the supporting body—as far as a dead point condition—by a dose **27** inserted inside the apparatus **100** during a subsequent operating cycle.

[0298] The tubular element **301** is provided, at an end facing the compression-moulding die means **25** and the second mould part **24**, with a ridge **302** that deforms the plastics in a pasty state in the chamber **40** to make in the further end wall **17** a portion of reduced thickness, i.e. a portion having lesser thickness with respect to the thickness of a remaining part of the further end wall **17**, this portion of reduced thickness defining the further line of intended separation **18**, shown, for example, in FIG. **5**.

[0299] In this way, it is possible to make the further line of intended separation **18** during the moulding step of the container neck element **10**, in particular, whilst the dome **1** is still inside the mould **23***b*.

[0300] This enables the work cycle and the production system to be simplified, inasmuch as it is not necessary to provide a weakening station arranged downstream of the apparatus **100** in which an incision is made in the further end wall **17**, in particular a non-through incision, to obtain the further line of intended separation **18**.

[0301] With reference to FIG. **42** a method is disclosed to obtain a dome **1** provided with a container neck element **10** in which there is provided simultaneously pressing, into a compression-moulding mould **303** provided with a female half mould **304** and with a male half mould **305** that are mutually movable towards and away from one another, a sheet of plastics **306** and a dose of plastics **307**.

[0302] The sheet of plastics **306** may comprise at least a barrier layer to gases and/or to light.

[0303] The sheet of plastics is not previously formed, for example by thermoforming, before being inserted into the compression-moulding mould **303**.

[0304] The method provides depositing the dose of plastics **307** in a cavity **308** of the female half mould **304**. Subsequently, there is provided inserting the sheet of plastics **306** into the cavity **308**, or possibly interposing the sheet of plastics **306** between the female half mould **304** and the male half mould **305**. Still subsequently, there is provided closing the compression-moulding mould **303** so that the female half mould **304** and the male half mould **305** cooperate to form the dome **1** and the container neck element **10**.

[0305] According to a first embodiment of the method, the sheet of plastics **306** has a thickness that is equal to a final thickness of the dome **1** that has to be obtained. In this case, the dose of plastics **307** forms the container neck element **10**.

[0306] According to a second embodiment of the method, the sheet of plastics **306** has a lesser thickness than a final thickness of the dome **1** that has to be obtained. In this case, the dose of plastics **307**, in addition to forming the container neck element **10**, forms a layer that covers, at least partially, an external surface of the dome **1**.

[0307] With reference to FIG. **43** a further method is disclosed to obtain a dome **1** provided with a container neck element **10** in which there is provided simultaneously pressing, in the compression-moulding mould **303** disclosed with reference to FIG. **42**, a semifinished product made of plastics **309** and a dose of plastics **307**.

[0308] The semifinished product made of plastics **309** is obtained by forming, for example by thermoforming, plastics. The semifinished product made of plastics **309** may comprise at least a barrier layer to gases and/or to light.

[0309] The semifinished product made of plastics **309** has a lesser thickness than a final thickness of the dome **1** that has to be obtained.

[0310] The method provides depositing the dose of plastics **307** in a cavity **308** of the female half mould **304**. Subsequently, there is provided inserting the semifinished product made of plastics **309** into the cavity **308**. Still subsequently, there is provided closing the compression-moulding mould **303** so that the female half mould **304** and the male half mould **305** cooperate to form the dome **1** and the container neck element **10**. The dose of plastics **307**, in addition to forming the container neck element **10**, forms a layer that covers, at least partially, an external surface of the dome **1**. In other words, part of the plastics that form the dose **307** is distributed on the semifinished product made of plastics **209** in such a way as to obtain a dome **1** provided with the container neck element **10** and having a final thickness of desired extent.

[0311] The methods disclosed with reference to FIGS. **42** and **43** can also be actuated by using a mould **23** disclosed with reference to FIGS. **7** to **22**, or a mould **23***a* disclosed with reference to FIGS. **23** to **25**, or a mould **123** disclosed with reference to FIGS. **28** to **37**, or a mould **23***b* disclosed with reference to FIG. **41**, or a mould **501** that will be disclosed

below with reference to FIGS. **44** to **50**, or a mould **501***a* that will be disclosed below with reference to FIGS. **51** to **53**.

[0312] The doses of plastics that have to be compression-moulded on the dome **1** to obtain the container neck element **10**—and possibly at least a portion of an external layer of the dome **1**—can be obtained by grinding and heating wastes generated by production of the domes **1**, or of the sheets of plastics **306**, or of the semifinished products made of plastics **309**. In particular, it is possible to thermoform portions of a sheet material to obtain the domes **1**, or the semifinished products made of plastics **309**, and subsequently separate the domes **1**, or the semifinished products made of plastics **309**, from further portions of the sheet material that have not been subjected to thermoforming.

[0313] This enables a considerable economic benefit to be obtained inasmuch as the aforesaid wastes—for example the portions of sheet material that have not been subjected to thermoforming and which should be scrapped—can be recycled completely. The barrier material to gases and/or to light, if present, does not adversely affect the possibility that the wastes is used to make the container neck element **10**, or part of the dome **1**, in the manner disclosed above.

[0314] With reference to FIGS. **44** to **50** there is shown an apparatus **500** for compression-moulding plastics on objects, in particular an apparatus for compression-moulding a container neck element **10**—provided with a threaded portion **11**—on a dome **1**.

[0315] The apparatus **500** comprises a mould **501** provided with a male half mould **502** and with a female half mould **503**, which are movable towards and away from one another along a moving direction D**1**, and with supporting and retaining means **504** arranged for supporting a dome **1** and for maintaining the dome **1** coupled with a punch **518** of the male half mould **502**. The male half mould **502**, the supporting and retaining means **504** and the female half mould **503** are aligned along the moving direction D**1**, the supporting and retaining means **504** being interposed between the male half mould **502** and the female half mould **503**.

[0316] The punch **518** is shaped in such a way as to engage a hollow zone **506** of the dome **1**.

[0317] The female half mould **503** comprises a plurality of female mould portions **505** that are movable between a forming configuration A**1**, shown in FIGS. **45** to **49**, in which the female mould portions **505** define a mould cavity **517** that receives a dose of plastics **507** and forms the dose of plastics **507**, and a release configuration A**2**, shown in FIGS. **44** and **50**, in which the female mould portions **505** enable a dome **1** to be removed on which the dose **507** was compression-moulded to obtain a container neck **10**.

[0318] The apparatus **500** comprises an actuating device **508** arranged for moving the female mould portions **505** from the forming configuration A**1** to the release configuration A**2**, and vice versa.

[0319] The female mould portions **505** can comprise a first half mould **509** and a second half mould **510** hinged on a supporting element **511**.

[0320] The supporting and retaining means **504** comprises a plurality of supporting and retaining elements **512** that are movable between an open position L**1**, shown in FIGS. **44** to **46**, in which the supporting and retaining elements **512** enable a dome **1** to be removed from the punch **518**, and a closed position L**2**, shown in FIGS. **47** to **50**, in which the supporting and retaining portions **512** lock a dome **1** on the punch **518**.

[0321] The apparatus **1** comprises driving means **515** arranged for moving the supporting and retaining elements **512** from the open position L**1** to the closed position L**2**.

[0322] The supporting and retaining elements **512** may comprise a plurality of angular sectors **513** hinged on a supporting body **514**.

[0323] A work cycle of the apparatus **500** is disclosed with reference to FIGS. **44** to **50**.

[0324] In FIG. **44** there is shown a work cycle step in which a dome **1** on which a container neck element **10** has been formed has been extracted from the mould **501**. The female half mould **503** is distant from the male half mould **502**, the female mould portions **505** are in the release configuration A**2** and the supporting and retaining elements **512** are in the open position L**1**.

[0325] In subsequent work cycle steps, shown in FIGS. **45** and **46**, the actuating device **508** moves the female mould portions **505** from the release configuration A**2** to the forming configuration A**1**. A transferring element **516** deposits a dose **507** inside the mould cavity **517**.

[0326] Subsequently, as shown in FIG. **47**, the driving means **515** moves the supporting and retaining elements **512** from the open position L**1** to the closed position L**2** and a dome **1** is delivered to the supporting and retaining means **504** by distributing means that is not shown.

[0327] The supporting and retaining means **504** moves along the moving direction D**1** until it comes to abut on an upper zone of the female half mould **503**.

[0328] In a subsequent work cycle step, shown in FIG. **48**, the female half mould—and the supporting and retaining means **504**—are moved towards the male half mould **502** until the punch **518** penetrates inside the hollow zone **506** and the supporting and retaining means **504** clamps the dome **1** against the punch **502**.

[0329] In particular, the punch **518** can be shaped so as to engage an inner wall of the dispensing body **5** in a shapingly coupled manner.

[0330] Still subsequently, as shown in FIG. **49**, the mould cavity **517** is moved from a lowered position O**1**, shown in FIGS. **44** to **48**, in which the mould cavity **517** is far from the punch **518**, to a raised position O**2**, shown in FIGS. **49** and **50**, in which the punch **518**, and the dome **1** adhering thereto, are received inside the mould cavity **517**.

[0331] The mould cavity **517**, the supporting and retaining means **504** and the punch **518** cooperate to define a moulding chamber **519** that receives the dispensing body **5** and inside which the dose **507** is pressed to assume the shape of the container neck element **10**.

[0332] In particular, the mould cavity **517** cooperates with the punch **518** to define a prevalent portion of the moulding chamber **519** that forms the further end wall **17**, if present, the threaded portion **11**, and the bead **12** and a part of the annular ridge **13** of the container neck element **10**. The mould cavity **517** cooperates with the supporting and retaining means **504** to define a remaining portion of the moulding chamber **519** that forms a further part of the annular ridge **13** and an end zone **520** of the container neck element **10**.

[0333] In a subsequent work cycle step, shown in FIG. **50**, the actuating device moves the female mould portions **505** from the forming configuration A**1** to the release configuration A**2**.

[0334] Subsequently, the female half mould **503** is moved away from the male half mould **502**, whilst the supporting and

retaining elements **512**—which are in the closed position L**2**—continue to maintain the dome **1** in contact with the punch **518**.

[0335] Still subsequently, the driving means **515** moves the supporting and retaining elements **512** from the closed position L**2** to the open position L**1** so that the dome **1** on which the container neck element **10** was obtained can be removed from the punch **518**.

[0336] With reference to FIGS. **51** to **53** there is shown an apparatus **500***a* provided with a mould **501***a* that differs from the mould shown in FIGS. **44** to **50** by the fact that the female half mould **503** comprises a single portion of female mould **505***a* that defines the mould cavity **517**, rather than a plurality of female mould portions **505**.

[0337] The mould **501***a* differs from the mould shown in FIGS. **44** to **50** also through the fact that the supporting and retaining means **504** comprises a single supporting and retaining element **512***a*, shaped as a tubular body, rather than a plurality of supporting and retaining elements **512**.

[0338] In an embodiment that is not shown the supporting and retaining means **504** comprises a plurality of supporting and retaining elements.

[0339] A work cycle of the apparatus **500***a* comprises a plurality of steps similar to those disclosed with reference to FIGS. **44** to **50**.

[0340] Below, with reference to FIGS. **51** to **53**, there are thus disclosed only some of the steps of the aforesaid work cycle.

[0341] In FIG. **51** there is shown a work cycle step in which the mould cavity **517** that contains the dose of plastics **507** is in the lowered position O**1**. The punch is received inside the hollow zone **506** and the supporting and retaining means **504** clamps the dome **1** against the punch **518**.

[0342] In the work cycle step shown in FIG. **52**, the mould cavity **517** is moved from the lowered position O**1** towards the raised position O**2**. The dose of plastics **507** starts to be pressed between the punch **518** and the mould cavity **517**.

[0343] In a subsequent work cycle step, shown in FIG. **53**, the mould cavity **517** has reached the raised position O**2** and the dose of plastics has been shaped so as to form the container neck element **10** on the dome **1**.

[0344] Subsequently, the female half mould **503** is moved away from the male half mould **502**. The container neck element **10**—in particular the threaded portion **10** and the annular bead **12**—are forced to exit the mould cavity **517**. The container neck element **10**—in particular the threaded portion **10** and the annular bead **12**—undergo a limited elastic deformation that enables the container neck element **10** to be extracted from the mould cavity **517**.

[0345] As part of the annular ridge **13** is formed by the supporting and retaining means **504**—together with the mould cavity **517**—the annular ridge **13** does not constitute an undercut element that prevents the container neck element **10** from being extracted from the mould cavity **517**.

[0346] With reference to FIGS. **54** to **58**, there is illustrated a machine **600** for compression-moulding plastics on objects comprising a rotatable forming carousel **601** that supports a plurality of moulding apparatuses **602** mounted in a peripheral zone of the rotatable forming carousel **601**.

[0347] The moulding apparatuses **602** are positioned at substantially constant angular intervals on the forming carousel **601**. Each moulding apparatus **602** operates with a work cycle that is repeated at each revolution of the forming carousel **601**.

[0348] An extruder **603** is arranged for dispensing a continuous flow of plastics in pasty state from which doses **604** of plastics are taken that are supplied, one after another, to the forming carousel **601**.

[0349] A supplying conveyor **605** is arranged for conveying to the forming carousel **601***a* series of domes **606**, arranged one after another, on each of which a container neck element will be compression-moulded. A removing conveyor **607** is arranged for removing from the forming carousel **601***a* series of overmoulded domes **608**, arranged one after another, on each of which a container neck element has been compression-moulded.

[0350] A first transferring carousel **609** is arranged for transferring each dome **606** from an outlet end of the supplying conveyor **605** to a respective moulding apparatus **602**.

[0351] A second transferring carousel **610** is arranged for transferring each overmoulded dome **608** from a respective moulding apparatus **602** to an inlet end of the removing conveyor **607**.

[0352] A third transferring carousel **611** can be interposed, as in the illustrated example, between the second transferring carousel **610** and the inlet end of the removing conveyor **607** to transfer the overmoulded domes **608**.

[0353] A lower part **612** of the second transferring carousel **610** is configured for periodically removing a dose **604** of plastics from the extruder **603** and transferring the dose **604** to a respective moulding apparatus **602**.

[0354] Each of the aforesaid transferring carousels **609**, **610** and **611** has a substantially known structure and operating mode and therefore such carousels will not be disclosed in greater detail.

[0355] In FIGS. **59** to **62** there is illustrated the operation of a single moulding apparatus **602**.

[0356] Each moulding apparatus **602** has a first mould part **613** arranged for receiving a dome **606** with the concavity of the dome **606** facing downwards, die means **614** for defining at least a part of a cavity for compression-moulding an overmoulded element on the dome **606**, and a second mould part **615** that cooperates with the first part **613** and the die means **614** for compression-moulding the overmoulded element. The die means **614** is optionally configured, as in the illustrated example, to define a threaded part of the overmoulded element.

[0357] The second transferring carousel **610** is configured to deposit each dose **604** above a respective dome **606** carried by the first mould part **613** that is arranged below the second part **615**. The dose **604** made of plastics in pasty state can adhere to the upper wall of the dome **606** and thus move integrally therewith.

[0358] The die means **614** comprises two or more die elements **616** mounted on the second mould part **615**. The die elements **614** can be coupled with the second mould part **615** with the possibility of assuming an open configuration (or delivery/release configuration shown in FIGS. **61** and **65**) in which the die elements **616** facilitate the insertion and the removal of the first mould part **613** inside the die means **614**, and a closed configuration (or forming configuration shown in FIGS. **59**, **60**, **62** and **63**, **64**, **66**) in which the die elements **616** define at least partially the aforesaid forming cavity, with the possibility of retaining in position the overmoulded dome **608** even when the first (lower) mould part **613** is far from the second (upper) part **615** and from the die means **614**. In the specific example, each of the die elements **616** is coupled with the second mould part **615** by a rotating pivot connection with

the possibility of opening and closing (enlarging and tightening) around the first mould part **613**. The die elements **616**, in the specific case, are three, arranged angularly at 120° around a (vertical) axis of reciprocal movement between the first and the second mould part **613** and **615**.

[0359] The second (upper) mould part **615** has a punch element **617** that is axially movable for compression-moulding the dose **604**, i.e. the overmoulding on the dome **606** to obtain the overmoulded dome **608**.

[0360] An operating sequence of a single moulding apparatus **602** of the forming carousel **601** shown in FIGS. **59** to **62** (enlarged in FIGS. **63** to **66**) will now be disclosed in greater detail.

[0361] FIG. **59** (or FIG. **63**) shows the compression-moulding step in which the dose **604** was formed in the forming cavity to make the overmoulded dome **608**. The punch element **617** is in a (lowered) forming position, the die means **614** is in the (closed) forming configuration and the first mould part **613** is in a (raised) forming position.

[0362] In FIG. **60** (or in FIG. **64**) there is shown a subsequent step in which an overmoulded dome **608** is retained by the die means **614** carried by the second (upper) mould part **615** whilst the first mould part **613** is lowered and has received a dome **606** from the first transferring carousel **609**. The die means **614** is still in the (closed) forming configuration in which it retains the overmoulded dome **608**. The distance (in the reciprocal movement direction of the mould parts **613** and **615** that in the specific case is the vertical direction) between the first (lower) mould part **613** and the second (upper) mould part **615** bearing the die means **614** is such as to generate an empty space in which the first transferring carousel **609** can act to position a dome **606** to be overmoulded on the first mould part **613** (whilst the already overmoulded dome **608** is still associated with the second mould part **615** of the moulding apparatus **602**).

[0363] FIG. **61** (or FIG. **65**) shows a subsequent step in which a lower part **612** of the second transferring carousel **610** (not shown for the sake of greater clarity in FIG. **61**) has laid a dose **604** on the dome **606** that is carried by the first mould part **613** whilst an upper part of the second transferring carousel **610** has further received (shortly before, a little after or almost simultaneously to the placing of the dose **604**) the overmoulded dome **608** released by the second mould part **615** (the release being achieved through the fact that the die means **614** has assumed the open configuration).

[0364] FIG. **62** (or FIG. **66**) lastly shows a step that prepares and precedes compression-moulding, in which the first and the second mould part **613** and **615** have move towards one another (for example by raising of the first mould part **613**) and the die means **614** has moved to the closed configuration defining the forming cavity (the die elements **616** being closed after the dome **606** that bears the dose **604** has been taken to the forming configuration). It should be noted that the dose **604** is in a resting relation but also in an adhering relation to the dome **606**. The adhesion ensures movement of the dose **604** integrally with the dome **606** from the moment of placing the dose on the dome (FIG. **61**) to the moment preceding actual forming (FIG. **62**) in which the punch element **617** is ready to be lowered and to compress the dose **604**. The adhesion effect is due to the pasty state of the plastics with which the dose **604** is made.

[0365] The moulding apparatus **602** illustrated in the example in FIGS. **54** to **66** could be provided with a first mould part and/or with die means and/or with a second mould part as in one or more of the examples of moulding apparatuses shown previously (such as, for example, in the apparatus shown in FIGS. **28** to **37**, with the die means controlled according to the method disclosed with reference to FIGS. **59** to **66**).

1-112. (canceled)

113. Apparatus comprising a first mould part suitable for receiving an object, a die arrangement arranged for surrounding a zone of said object and a second mould part cooperating with said die arrangement and with said first mould part so as to compression-mould plastics on said object in said zone, wherein said die arrangement is configured in such a way as to shape a threaded portion around said zone, wherein said object is a container part, said zone being defined in a dispensing body of said container part.

114. Apparatus according to claim **113**, wherein said die arrangement is configured in such a way as to shape a container neck element around said zone.

115. Apparatus according to claim **113**, wherein said die arrangement comprises a first part in which a first opening is obtained and a second part in which a second opening is obtained.

116. Apparatus according to claim **115**, wherein said first part and said second part are positioned in opposite regions of said die arrangement.

117. Apparatus according to claim **115**, wherein said first opening faces said first mould part and said second opening faces said second mould part.

118. Apparatus according to claim **115**, wherein an operating portion arrangement of said second mould part is insertable into said die arrangement through said second opening.

119. Apparatus according to claim **115**, wherein a further operating portion arrangement of said first mould part is insertable into said die arrangement through said first opening.

120. Apparatus according to claim **113**, wherein said second mould part comprises a weakening arrangement that is movable towards and away from said die arrangement and is arranged for deforming said plastics in said zone to obtain a weakening defined by a portion of said zone having a lesser thickness than the thickness of a remaining portion of said zone.

121. Apparatus according to claim **120**, wherein said die arrangement comprises a first part in which a first opening is obtained and a second part in which a second opening is obtained, said weakening arrangement being insertable into said die arrangement through said second opening.

122. Apparatus according to claim **113**, wherein said die arrangement comprises a first half-mould and a second half-mould that are mutually movable towards and away from one another.

123. Apparatus according to claim **122**, and further comprising a driving arrangement arranged for moving said first half-mould and said second half-mould between a closed configuration, in which said die arrangement defines a forming chamber for said plastics, and an open configuration in which said die arrangement releases said object after said plastics has been compression-moulded on said object.

124. Apparatus according to claim **113**, wherein said second mould part comprises a forming element that is slidable in a seat obtained in a base body.

125. Apparatus according to claim **124**, wherein said forming element is movable between a retracted position, in which said forming element is received in said seat and cooperates

with said seat to define a cavity suitable for receiving a dose of said plastics, and an extended position in which said forming element presses said dose in said die arrangement.

126. Apparatus according to claim **124**, wherein said forming element comprises a groove inside which an elongated body is slidable.

127. Apparatus according to claim **126**, wherein said elongated body assumes an operational configuration in which an end of said elongated body interacts with a part of said zone to prevent said plastics adhering to said part.

128. Apparatus according to claim **126**, and further comprising a motor device arranged for moving said elongated body with respect to said forming element.

129. Apparatus according to claim **113**, wherein said second mould part comprises a forming body arranged for being partially received in said die arrangement and provided with a hole inside which a stem is slidable.

130. Apparatus according to claim **129**, wherein a piston is fixed to said stem, said piston being slidable in a chamber arrangement obtained in said forming body.

131. Apparatus according to claim **113**, wherein said first mould part is crossed by a conduit for a fluid.

132. Apparatus according to claim **131**, and further comprising a suction device arranged for sucking said fluid through said conduit.

133. Apparatus according to claim **131**, and further comprising a blowing device arranged for blowing said fluid through said conduit.

134. Apparatus according to claim **113**, wherein said first mould part comprises a supporting body suitable for receiving said object, said supporting body having a surface provided with corrugated elements that enable air to be evacuated when said object is positioned on said supporting body.

135. Apparatus according to claim **113**, wherein said first mould part, said die arrangement and said second mould part are aligned along a longitudinal axis of said apparatus, said die arrangement being interposed between said first mould part and said second mould part.

136. Apparatus according to claim **135**, and further comprising a moving arrangement arranged for moving said first mould part along said longitudinal axis.

137. Apparatus according to claim **135**, and further comprising a further moving arrangement arranged for moving said die arrangement along said longitudinal axis.

138. Apparatus according to claim **135**, and further comprising a still further moving arrangement arranged for moving said second mould part along said longitudinal axis.

139. Apparatus according to claim **113**, wherein said container part is shaped like a dome.

140. Machine for compression-moulding plastics on an object, comprising an apparatus according to claim **113**.

141. Machine according to claim **140**, and comprising a plurality of apparatuses according to claim **113**.

142. Machine according to claim **141**, and further comprising a forming carousel supporting said apparatuses.

143. Machine according to claim **142**, and further comprising a handling arrangement arranged for delivering said object to an apparatus of said plurality of apparatuses and/or for removing said object from an apparatus of said plurality of apparatuses.

144. Machine according to claim **143**, wherein said handling arrangement comprises a plurality of handling devices.

145. Machine according to claim **144**, and further comprising a transferring carousel supporting said handling devices.

146. Machine according to claim **145**, and further comprising a conveying device arranged for receiving from said handling devices objects on which plastics have been compression-moulded and delivering to said handling devices further objects on which plastics have to be compression-moulded.

147. Machine according to claim **146**, wherein said conveying device comprises a flexible conveying element.

148. Machine according to claim **147**, and further comprising a rotating body, positioned near said transferring carousel, on which said flexible conveying element is partially wound.

149. Machine according to claim **148**, wherein said transferring carousel is rotatable in a direction and said rotating body is rotatable in a further direction, said further direction being opposite said direction.

150. Machine according to claim **144**, and further comprising a flexible conveying arrangement supporting said handling devices.

151. Machine according to claim **150**, wherein an interaction portion of said flexible conveying arrangement is arranged along a part of a trajectory defined by said apparatuses when said forming carousel is rotated.

152. Machine according to claim **150**, wherein said flexible conveying arrangement comprises a first portion provided with handling devices that move away from said forming carousel, objects on which plastics have been compression-moulded and a second portion provided with handling devices that move towards said forming carousel further objects on which plastics have been compression-moulded.

153. Machine according to claim **152**, wherein an interaction portion of said flexible conveying arrangement is arranged along a part of a trajectory defined by said apparatuses when said forming carousel is rotated, said interaction portion being interposed between said first portion and said second portion.

154. Machine according to claim **150**, and further comprising a rotating body and a further rotating body, positioned near said forming carousel, on which said flexible conveying arrangement is partially wound.

155. Machine according to claim **154**, wherein said forming carousel is rotatable in a movement direction and said rotating body and said further rotating body are rotatable in a further movement direction, said further movement direction being opposite said movement direction.

156. Machine according to claim **142**, and further comprising a supplying carousel arranged for supplying said forming carousel with doses of said plastics.

157. Machine according to claim **156**, and further comprising a handling arrangement arranged for delivering said object to an apparatus of said plurality of apparatuses and/or for removing said object from an apparatus of said plurality of apparatuses, said handling arrangement comprising a plurality of handling devices, and further comprising a transferring carousel supporting said handling devices, wherein said supplying carousel is positioned downstream of said transferring carousel with respect to a rotation direction of said forming carousel.

158. Machine according to claim **156**, and further comprising a handling arrangement arranged for delivering said object to an apparatus of said plurality of apparatuses and/or for removing said object from an apparatus of said plurality of apparatuses, said handling arrangement comprising a plurality of handling devices, and further comprising a flexible conveying arrangement supporting said handling devices, wherein said supplying carousel is positioned downstream of

said flexible conveying arrangement with respect to a rotation direction of said forming carousel.

159. Machine according to claim **156**, and further comprising a handling arrangement arranged for delivering said object to an apparatus of said plurality of apparatuses and/or for removing said object from an apparatus of said plurality of apparatuses, said handling arrangement comprising a plurality of handling devices, and further comprising a flexible conveying arrangement supporting said handling devices, an interaction portion of said flexible conveying arrangement being arranged along a part of a trajectory defined by said apparatuses when said forming carousel is rotated, wherein said supplying carousel is associated with said interaction portion.

160. Machine according to claim **159**, wherein said supplying carousel is arranged along said interaction portion.

161. Machine according to claim **140**, and further comprising an extruding device arranged for dispensing doses of plastics.

162. A method comprising the steps of delivering to a mould a container part provided with a dispensing element and plastics in a pasty state and pressing together said container part and said plastics for compression-moulding said plastics on said container part, wherein said compression-moulding comprises making with said plastics a container neck element on said dispensing element, wherein said container neck element comprises a threaded portion.

163. Method according to claim **162**, wherein said compression-moulding comprises making with said plastics a layer on at least a portion of an external surface of said container part and the container neck element on said dispensing element.

164. Method according to claim **162**, wherein, before said delivering step, thermoforming a laminar element of plastics to obtain said container part is provided.

165. Method according to claim **162**, wherein said container part comprises a layer of material having barrier properties to gases and/or to light.

166. Method according to claim **162**, wherein said container part comprises a dome provided with a connecting zone suitable for being fixed to a container body and from which said dispensing element leads away.

167. Method according to claim **162**, wherein said plastics comprise scraps of a material from which said container part is made.

168. Method according to claim **167**, and further comprising grinding said scraps before delivering said plastics to said mould.

169. Method according to claim **167**, and further comprising heating said scraps before delivering said plastics to said mould.

170. Method according to claim **162**, wherein, during said compression-moulding, deforming said plastics in a zone is provided to obtain a weakening defined by a portion of said zone having a lesser thickness than the thickness of a remaining portion of said zone.

171. A method comprising the steps of delivering to a mould a sheet of plastics and plastics in a pasty state and pressing together said sheet and said plastics for obtaining from said sheet a container part provided with a dispensing element and for compression-moulding said plastics on said container part, wherein said compression-moulding comprises making with said plastics a container neck element on said dispensing element, wherein said container neck element comprises a threaded portion.

172. Method according to claim **171**, wherein said compression-moulding comprises making with said plastics a layer that covers at least a portion of an external surface of said object and the container neck element on said dispensing element.

173. Method according to claim **171**, wherein said sheet comprises a layer of material having properties acting as a barrier to gases and/or to light.

174. Method according to claim **171**, wherein said container part comprises a dome provided with a connecting zone suitable for being fixed to a container body and from which said dispensing element leads away.

175. Method according to claim **171**, wherein said plastics comprise scraps of a material with which said sheet is made.

176. Method according to claim **175**, and further comprising grinding said scraps before delivering said plastics to said mould.

177. Method according to claim **175**, and further comprising heating said scraps before delivering said plastics to said mould.

178. Method according to claim **171**, wherein, during said compression-moulding, deforming said plastics in a zone is provided to obtain a weakening defined by a portion of said zone having a lesser thickness than the thickness of a remaining portion of said zone.

179. Apparatus comprising a punch arranged for engaging a hollow portion of an object, a supporting and retaining arrangement arranged for clamping said object against said punch and a mould cavity arrangement arranged for receiving a dose of plastics, said punch and said mould cavity arrangement cooperating mutually for compression-moulding said dose of plastics on said object, wherein said mould cavity arrangement is shaped so as to shape a threaded portion on said object, wherein said object is a container part, said dose of plastics being formed on a dispensing body of said container part.

180. Apparatus according to claim **179**, wherein said mould cavity arrangement is shaped so as to shape a container neck element on said object.

181. Apparatus according to claim **179**, wherein said punch, said mould cavity arrangement and said supporting and retaining arrangement define a forming chamber inside which said dose of plastics is compression-moulded.

182. Apparatus according to claim **181**, wherein said mould cavity arrangement comprises a plurality of mutually movable female mould portions.

183. Apparatus according to claim **182**, wherein said female mould portions are movable between a forming configuration in which said female mould portions define a mould cavity arranged for receiving said dose of plastics and for forming said dose of plastics, and a release configuration, in which said female mould portions enable said dome, on which said dose of plastics has been compression-moulded, to be extracted from said mould cavity arrangement.

184. Apparatus according to claim **181**, wherein said mould cavity arrangement comprises a single female mould portion.

185. Apparatus according to claim **179**, wherein said supporting and retaining arrangement comprises a plurality of mutually movable supporting and retaining elements.

186. Apparatus according to claim **179**, wherein said supporting and retaining arrangement comprises a single supporting and retaining element.

187. Apparatus according to claim **186**, wherein said supporting and retaining element is shaped as a tubular body.

188. Apparatus according to claim **179**, wherein said container part is shaped like a dome.

189. A method, comprising the steps of

delivering an object to a first mould part;

placing a dose of plastics on said object which has been delivered to said first mould part;

moving said first mould part bearing said object towards a second mould part, said dose adhering to said object;

surrounding at least partially said object with a die arrangement so that said second mould part and said die arrangement define a forming cavity around said object;

compression-moulding said dose around said object in said forming cavity;

said moving-towards operation preceding at least partially said surrounding operation;

wherein said object comprises a container part provided with a dispensing element; and

wherein said compression-moulding comprises forming with said dose a container neck element on said dispensing element.

190. Method according to claim **189**, wherein after said operation of placing a dose, said first mould part and said die arrangement are moved towards one another.

191. Method according to claim **189**, wherein during said operation of placing a dose, said die arrangement is arranged above said object.

192. Method according to claim **189**, wherein during said operation of placing a dose, said second mould part is arranged above said first mould part.

193. Method according to claim **189**, wherein said object is concave and is delivered to said first mould part with the concavity facing downwards.

194. Method according to claim **189**, wherein said operation of placing a dose comprises removing said dose from a continuous flow of plastics in pasty state dispensed by an extruder and transferring said dose still in pasty state on said object.

195. Method according to claim **189**, wherein said moving-towards operation comprises moving said first mould part at least partially upwards.

196. Method according to claim **189**, wherein during said moving-towards operation, said die arrangement assumes an open configuration for facilitating the introduction of said object and said dose into said die arrangement, and wherein before compression-moulding said dose, said die arrangement is taken to a closed configuration in which it defines said forming cavity.

197. Method according to claim **189**, wherein said container neck element comprises a threaded portion.

198. Method according to claim **189**, wherein said container part comprises a dome provided with a connecting zone suitable for being fixed to a container body and from which said dispensing element leads away.

199. Apparatus, comprising a first mould part suitable for receiving an object, a die arrangement arranged for surrounding a zone of said object and a second mould part cooperating with said die arrangement and with said first mould part so as to compression-mould plastics on said object in said zone, said die arrangement being configured so as to assume at least a closed configuration for defining at least partially a forming cavity that surrounds said zone, and at least an open configuration for receiving/releasing said object, said die arrangement being connected to said second mould part so that a movement between said open and closed configurations comprises a rotation.

200. Apparatus according to claim **199**, wherein said die arrangement comprises two or more die elements pivoted on said second mould part.

201. Apparatus according to claim **199**, wherein said die arrangement is configured in such a way as to shape a threaded portion around said zone.

202. Apparatus according to claim **199**, wherein said die arrangement is configured in such a way as to shape a container neck element around said zone.

203. Apparatus according to claim **199**, wherein said die arrangement comprises a first part in which a first opening is obtained and a second part in which a second opening is obtained.

204. Apparatus according to claim **203**, wherein said first part and said second part are positioned in opposite regions of said die arrangement.

205. Apparatus according to claim **203**, wherein said first opening faces said first mould part and said second opening faces said second mould part.

206. Apparatus according to claim **203**, wherein an operating portion arrangement of said second mould part is insertable into said die arrangement through said second opening.

207. Apparatus according to claim **203**, wherein a further operating portion arrangement of said first mould part is insertable into said die arrangement through said first opening.

208. Apparatus according to claim **199**, wherein said second mould part comprises a weakening arrangement that is movable towards and away from said die arrangement and is arranged for deforming said plastics in said zone to obtain a weakening defined by a portion of said zone having a lesser thickness than the thickness of a remaining portion of said zone.

209. Apparatus according to claim **208**, wherein said die arrangement comprises a first part in which a first opening is obtained and a second part in which a second opening is obtained, said weakening arrangement being insertable into said die arrangement through said second opening.

210. Apparatus according to claim **199**, wherein said die arrangement comprises a first half-mould and a second half-mould that are mutually movable towards and away from one another.

211. Apparatus according to claim **210**, and further comprising a driving arrangement arranged for moving said first half-mould and said second half-mould between a closed configuration, in which said die arrangement defines a forming chamber for said plastics, and an open configuration in which said die arrangement releases said object after said plastics has been compression-moulded on said object.

212. Apparatus according to claim **199**, wherein said second mould part comprises a forming element that is slidable in a seat obtained in a base body.

213. Apparatus according to claim **212**, wherein said forming element is movable between a retracted position, in which said forming element is received in said seat and cooperates with said seat to define a cavity suitable for receiving a dose of said plastics, and an extended position in which said forming element presses said dose in said die arrangement.

214. Apparatus according to claim **212**, wherein said forming element comprises a groove inside which an elongated body is slidable.

215. Apparatus according to claim **214**, wherein said elongated body assumes an operational configuration in which an end of said elongated body interacts with a part of said zone to prevent said plastics adhering to said part.

216. Apparatus according to claim **214**, and further comprising a motor device arranged for moving said elongated body with respect to said forming element.

217. Apparatus according to claim **199**, wherein said second mould part comprises a forming body arranged for being partially received in said die arrangement and provided with a hole inside which a stem is slidable.

218. Apparatus according to claim **217**, a piston is fixed to said stem, said piston being slidable in a chamber arrangement obtained in said forming body.

219. Apparatus according to claim **199**, wherein said first mould part is crossed by a conduit for a fluid.

220. Apparatus according to claim **219**, and further comprising a suction device arranged for sucking said fluid through said conduit.

221. Apparatus according to claim **219**, and further comprising a blowing device arranged for blowing said fluid through said conduit.

222. Apparatus according to claim **199**, wherein said first mould part comprises a supporting body suitable for receiving said object, said supporting body having a surface provided with corrugated elements that enable air to be evacuated when said object is positioned on said supporting body.

223. Apparatus according to claim **199**, wherein said first mould part, said die arrangement and said second mould part are aligned along a longitudinal axis of said apparatus, said die arrangement being interposed between said first mould part and said second mould part.

224. Apparatus according to claim **223**, and further comprising a moving arrangement arranged for moving said first mould part along said longitudinal axis.

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