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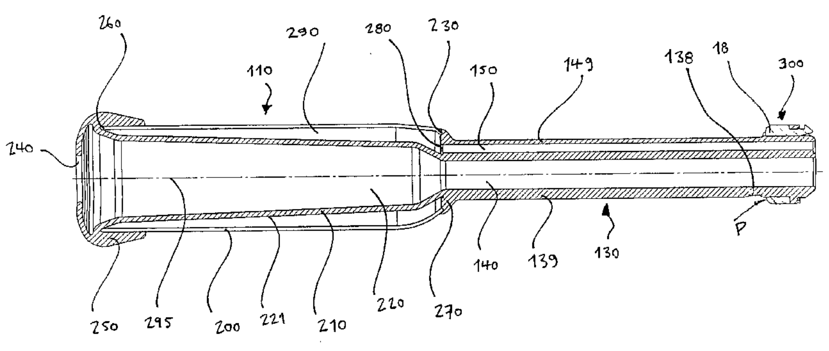

FIG. 2

(57) Abstract: A milking system liner assembly comprises a resilient liner (210) having an inner and an outer surface (220; 221), the inner surface being configured to engage a teat and the outer surface being configured to define, together with a rigid outer shell (200), a space (290) to which a vacuum can be applied; a milk conduit (139) for leading milk away from the inner surface of the liner and formed integrally with the liner; and a vacuum conduit (149) for applying a vacuum to said space; wherein the milk and vacuum conduits are integral along the entire length of at least one of the conduits.

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TITLE: MILKING SYSTEM

DESCRIPTION

TECHNICAL FIELD

The present invention relates to systems for milking animals such as cows, buffalo, sheep and goats.

BACKGROUND ART

Milking systems can be classified into three groups:

1. 'Manual', i.e. hand milking.

2. 'Semi-automatic' whereby milking clusters are attached via a long milk tube to a milk line. Each milking cluster comprises multiple teat cups each connected by a short milk tube to a single milk manifold known as a 'claw' from whence milk is fed into the long milk tube. An operator places the teat cups on the cows' teats.

3. 'Automatic' systems are robotic and do not require an operator. Nor do they use a claw, each teat cup instead

being connected via a long milk tube to the milk processing plant. A milk tube for use in an automatic system and having a plurality of integrally-moulded peripheral ducts is known e.g. from AU2007/202732 and US6397893.

A teat cup typically comprises a rigid shell surrounding a flexible liner which engages the teat of the animal. By application of a vacuum to the space between the interior of the shell and the exterior of the liner, followed by release of the vacuum, the animal teat is massaged in such a way as to cause expression of milk, which is led away from the teat cup by a milk tube.

In cluster milking systems, the milk tube may be connected to the teat cup by a connector or may be integral with the teat cup liner - a so-called 'monoblock' liner - as known e.g. from WO00/76299 and US design patent no. 447,840. There is a separate connection to the teat cup for a 'pulsation' or 'pulse' tube through which vacuum is applied. Each teat cup is connected by short lengths of milk tubing and pulse tubing to corresponding spaced milk and pulse connections on a claw assembly.

DISCLOSURE OF INVENTION

Accordingly, the invention provides a milking system liner assembly comprising:

a resilient liner having an inner and an outer surface, the inner surface being configured to engage a teat and the outer surface being configured to define, together with a rigid outer shell, a space to which a vacuum can be applied;

a milk conduit for leading milk away from the inner surface of the liner and formed integrally with the liner; and

a vacuum conduit for applying a vacuum to said space;

wherein the milk and vacuum conduits are integral along the entire length of at least one of the conduits.

By virtue of the first and second conduits of the assembly being integral along the entire length of at least one of the conduits, the milking cluster of the invention is easier to clean than conventional milking clusters employing separate, non-integral milk and pulse tubes. For example, a four-teat-cup milking cluster according to the invention has only four integral milk/pulse tubes to clean rather than the eight tubes of a conventional milk cluster.

The assembly may have a flange that surrounds both the milk conduit and the vacuum conduit and that is configured to sealingly engage an aperture in a rigid outer shell which, together with the outer surface of the resilient liner, defines a space to which a vacuum can be applied.

In this way, only a single aperture is required in the rigid outer shell to accommodate both milk and vacuum connections. This in turn may make the shell easier to manufacture. A single aperture may also be easier to connect compared with conventional milking cluster teat cups having separate connections for milk and vacuum. Having fewer connections, the teat cup of the invention may also be easier to keep clean. Such an arrangement may also present less restriction to flow than conventional nipple connections, which may reduce energy consumption or allow greater energy consumption elsewhere in the system, e.g. the use of a smaller bore conduit.

The milk and vacuum conduits may be formed integrally with said flange. The flange may be configured to substantially align the longitudinal axis of the resilient liner with the longitudinal axis of an outer shell.

The flange may be configured to position the bore of the vacuum conduit offset from the longitudinal axis of a rigid outer shell.

The milk conduit and vacuum conduit may share a common wall. The longitudinal axes of the milk and vacuum conduits may be transversely spaced. The bore of the milk conduit may be circular in cross-section, while the bore of the vacuum conduit may be crescent-shaped in cross-section. The convex surface of the crescent shape bore of the vacuum conduit and the concave surface of the circular bore of the milk conduit may be configured so as to define between them a wall of substantially constant thickness.

The assembly may comprise a single fixing configured to connect both the milk conduit and the vacuum conduit to a claw of a milking cluster. This enables connection of a teat cup to a claw in a single step and in contrast to conventional milking clusters where the milk and vacuum conduits for each teat cup have to be individually connected to the claw.

Advantageously, the single fixing is configured such that a first interface between the milk conduit and the claw lies in the same plane as a second interface between the vacuum conduit and the claw.

That part of the single fixing configured to define the first interface may be planar, as may that part of the single fixing configured to define the second interface. Compared with the nipple connection conventionally used in milking clusters, such planar interfaces may be easier to keep clean. They may also present less resistance to flow than a conventional nipple connection.

The respective parts of the single fixing configured to define the first and second interfaces may be substantially contiguous. Again, this may make for a cleaner exterior compared to conventional milking clusters where milk and vacuum connections are spaced.

The single fixing may comprise at least one snap fitting. The snap fitting may comprise at least one resilient leg configured to engage a surface lying substantially parallel to at least one of the first interface between the milk conduit and the claw and the second interface between the vacuum conduit and the claw. The connection of such a snap fitting may require less physical effort than conventional connections in which a rubber tube must be forced over a nipple or a rubber flange forced through a hole.

The at least one resilient leg may be attached to, i.e. form part of an assembly with, the integrated milk and vacuum conduits, while the surface may be attached to, i.e. form part of an assembly with, the claw.

The surface may be configured to be moveable so as to push the integrated milk and conduits into engagement with the claw.

The invention also provides a teat cup assembly for a milking system comprising a milking system liner assembly as set out above and a rigid outer shell surrounding the resilient liner of the milking system liner assembly.

The invention also provides a milking cluster comprising at least one teat cup assembly as set out above and connected to a claw assembly.

There is also disclosed a milking cluster comprising: at least one teat cup; a claw assembly; a flexible milk conduit comprising a wall having an interior surface defining a bore, the conduit being connected at one end to the claw assembly and at the other end to the teat cup; and a support member for said conduit having greater rigidity in bending than the flexible conduit, the support member being attached to said one end of the conduit and engaging an exterior surface of said wall at a point partially along said flexible conduit.

The properties of the teat cup, claw assembly, flexible conduit and the support member are advantageously chosen such that, when the milking cluster is in its operative orientation with the teat cup unsupported, the conduit bends such that the bore closes.

In contrast to conventional nipple-less liners using a flange, such a milking cluster does not require means such as a clip or a wire bracket to enable shut off (i.e. closure of the liner bore). This results in a simpler construction that may also be cleaner, having fewer dirt traps compared to the aforementioned conventional arrangement. Unlike conventional connections in which the liner is forced over a nipple, support is provided by a member attached to the conduit rather than the claw.

Advantageously, the support member may be a sleeve entirely surrounding the circumferential periphery of the conduit. The support member may also comprise a connector or fixing for attaching the milk conduit to the claw.

BRIEF DESCRIPTION OF DRAWINGS

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figures 1A and 1B are perspective and section views respectively of a milking cluster according to an embodiment of the invention;

Figure 2 is a cross-section taken along the longitudinal axis of a teat cup and conduit member according to an embodiment of the present invention;

Figure 3 shows the milking cluster of figure 1A with the conduit members disconnected;

Figure 4 is an exploded perspective view of the teat cup and conduit member shown in figure 2;

Figure 5 shows the detail indicated at D in figure 1B and in a first position;

Figure 6 shows the detail of figure 5 in a second position;

Figure 7 is a detail view in direction E of figure 6;

Figure 8 is a perspective sectional view from below of the detail of figure 5 in a third position;

Figure 9 is a perspective sectional view from above of the detail of figure 5 in a fourth position;

Figure 10 is a side view of a conduit assembly;

Figure 11 is a cross-sectional view of an alternative embodiment of the milking system liner assembly of the invention;

Figure 12 is a perspective view of another embodiment of the milking system liner assembly of the invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Figures 1A and 1B are perspective and cross-sectional views respectively of a milking cluster 100. Four teat cups 110 are each connected to a claw assembly 120 by a respective conduit member 130.

As shown in figure 2, which is a longitudinal cross-section through the teat cup 110 and conduit member 130, each conduit member 130 comprises a milk conduit 139 defining a milk passageway or bore 140 and a vacuum conduit 149 defining a vacuum passageway or bore 150. Whilst the milk and vacuum passageways are of necessity separate, it will be seen that the two conduits 139 and 149 are integrated into one piece, i.e. are monolithic, along the entire length of the milk conduit. In the embodiment shown, milk and vacuum conduits have the same length, not least as a result of a shared single fixing 300 discussed in more detail below. However, it will be appreciated that there may be other arrangements in which the two conduits have different lengths, in which case the milk and vacuum conduits will only be integral along the entire length of one of the conduits.

Each milk conduit 139 feeds milk from its respective teat cup into a milk collection chamber 170 from where it is led away by pipe 160 for further processing. Each vacuum conduit 149 supplies vacuum to its respective teat cup from a vacuum manifold 180 mounted on top of chamber 170 and connected to a vacuum source via pipes 190.

As evident from figure 1, the milking cluster of the present invention is significantly easier to clean than conventional milking clusters, having only one member - the conduit assembly 130 - extending between each teat cup and the claw rather than the two separate milk and vacuum short pipes used in conventional milking clusters. This applies both to arrangements of the kind shown in figure 1, with milk and vacuum conduits of substantially the same length, and to arrangements in which the milk and vacuum conduits are of different length.

Similar benefits also result when the milking system liner assembly of the invention (and comprising liner 210, integral milk conduit 139 and vacuum conduit 149) is used in automatic or "robotic" systems.

Regardless of the system used, the milking system liner assembly can be detached from the rigid outer shell for replacement as necessary. Referring to the cross-section of figure 2, a teat cup 110 comprises a rigid - typically metallic - tubular outer shell 200 surrounding a resilient - typically rubber - tubular liner 210 configured to engage a teat. One end of the resilient liner 210 has an opening 240 for admission of a teat and which is surrounded by a collar 250 which engages the periphery 260 of one end of the tubular outer shell 200, as is known per se.

The inner surface 220 of the resilient liner 210 is fluidly connected at its other end to milk conduit 139 via a first aperture 230 at the other end of the tubular outer shell 200. It will be seen that the liner 210 and milk conduit 139 are in fact one-piece and integral. The other end of the resilient liner 210 has a circumferential flange 270 configured to engage the periphery of the first aperture 230, thereby tensioning the liner 210 within the shell 200. In the embodiment shown, the flange substantially aligns the longitudinal axis 295 of the liner with the longitudinal axis of the tubular outer shell 200.

As is known, a pulsed vacuum is applied to the space 290 between the outer surface 221 of the liner and outer shell (hereafter 'vacuum chamber') to cause the liner to massage the teat and express milk. In contrast to conventional milking clusters, however, the pulsed vacuum is applied to the vacuum chamber not via a separate nipple connection located on the outer shell but instead via the same first aperture 230 through which the liner 210 is connected with the milk conduit 139.

In the embodiment shown, this is achieved by a second aperture 280 formed in the flange 270, offset from the longitudinal axis of the outer shell, and which communicates the vacuum chamber 290 with the vacuum conduit. In the embodiment shown, vacuum conduit 149 is integral with the flange, the milk conduit 139 and also the liner 210.

It will be appreciated that such an arrangement without a separate vacuum nipple may make the outer shell easier to manufacture. Moreover, a single aperture may also be easier to connect compared with conventional milking cluster teat cups having separate connections for milk and vacuum. Fewer connections may also make the teat cup easier to keep clean.

Figure 3 illustrates how the teat cups 110 with their associated conduit assemblies 130 are detached/attached from the claw assembly 120. Both the milk conduit 139 and the vacuum conduit 149 are connected to the claw by a single fixing 300, allowing both milk and vacuum conduits to be connected in a single step. This is in contrast to conventional milking clusters where the milk and vacuum conduits for each teat cup have to be individually connected to the claw. Further detail of the fixing is shown in figure 4, which is an exploded perspective view of a teat cup and conduit assembly.

Detail of the connection between fixing 300 and the claw 120 is shown in the detailed cross-sectional view of figure 5, with a cross-sectional view of the milking cluster 100 as a whole being shown in figure 1B. Claw 120 is attached to and forms part of an assembly with a clamping plate (shown cross-hatched at 10) which engages upper shoulders 40 on three legs 12,14 and 16 (not shown in figure 5) which are mounted around a ring 18 attached to, and forming part of an assembly with, the bottom end of the integral conduit assembly 130.

As discussed below, clamping plate attaches the assembly 130 to the claw 120 and is also moveable so as to push the common end face of the integrated milk and vacuum conduits 139,149 against a corresponding seat 310 on the claw, thereby ensuring a seal between the passage 140 in the milk conduit 139 and the corresponding milk passage 330 in the claw and between the passage 150 in the vacuum conduit 149 and the corresponding vacuum passage 340 in the claw.

It will be appreciated that the resilient legs 12,14,16 and clamping plate 10 cooperate in the manner of a snap fitting.

It will also be noted that the (first) interface 350 between the milk conduit and the claw lies in the same plane as the (second) interface 360 between the vacuum conduit and the claw. Connection is further facilitated by the surface of the clamping plate 10 with which the resilient legs engage being substantially parallel to at least one of the first or second interfaces 350,360.

The interfaces 350,360 are themselves also planar. Compared with the nipple connection conventionally used in milking clusters, such planar interfaces may be easier to keep clean and may also present less resistance to flow than a conventional nipple connection.

Clamping plate 10 is held in engagement by the over-centre mechanism, which is more clearly shown at 370 in figure 1 (mechanism released) and figure 3 (mechanism tensioned). To remove a conduit assembly 130 from the claw, the over-centre mechanism is first released, allowing the clamping plate 10 to move upwards under the force of spring 20, as indicated by arrow A in figure 6. This in turn allows the conduit assembly 130 and its fixing 300, in particular the leg 12, to pivot about a slot 30 in the clamping plate 10, as indicated by arrow B in figure 6 and allows legs 14 and 16 to move free of corresponding slots 54,56 in the body of the claw, the latter being shown more clearly in the plan view of figure 7. From figure 7 and figure 5 it will also be evident that the first and second interfaces 350,360 are substantially contiguous. Amongst other things, this may make for a cleaner exterior compared to conventional milking clusters where milk and vacuum connections are spaced.

However, as shown in figure 8, the upper shoulder 40 of leg 14 continues to abut the lower surface of the clamping plate (shown cross-hatched at 10). Re-locking the over-centre mechanism pushes clamping plate 10 down, forcing legs 14 and 16 onto an inclined face 58 of the claw body such that the legs bend inwards and disengage their corresponding slots 34,36 in the clamping plate 10 - see figure 9. The liner can then be completely removed from the claw by pivoting it about leg 12.

Figure 10 illustrates the shut-off or closure of a conduit when the teat cups are not supported and held upright by engagement with a teat. Support member 18 is attached to one end of the conduit and is of a material such as plastic having greater rigidity in bending than the - typically rubber - flexible conduit assembly 130. The member engages the external surface of the conduit at a point P along its length and, in the example shown, is a sleeve or ring 18 that completely encircles the circumferential periphery of the conduit. When the milking cluster is in its operative orientation with the teat cup unsupported - as shown in figure 10 - the conduit bends over the support member such that the bore closes.

Properties such as the weight of the teat cup, the angle of the interface claw assembly, the bore dimensions and material properties of the conduit assembly 130 and the dimensions of the support member ring 18 can be chosen to facilitate this. In the example shown in figures 2 and 10, the thickness of the wall of that side of the milk conduit 139 opposite to the vacuum conduit 149 is 4.50mm and has an external 'radius of 10.75mm. That part 138 of the wall opposite the vacuum conduit and immediately adjacent that end of the sleeve 18 which engages the exterior surface of the wall at a point (A) partially along the length said flexible conduit has a reduced external radius of 9.90mm so as to facilitate bending of the conduit at that point without compromising the ability of the conduit as a whole to resist collapse due to the milking vacuum. The conduits may be made of food grade nitrile rubber with a hardness of 50 IRHD, a tear strength of 15 kN/m and an elongation at break strength of 350%.

As shown in figure 7, the milk and vacuum conduits share a common wall, the bore of the milk conduit 139 being circular in cross-section while the bore of the vacuum conduit 149 is crescent-shaped in cross-section. The convex surface of the crescent shape bore of the vacuum conduit and the concave surface of the circular bore of the milk conduit are configured so as to define between them a wall of substantially constant thickness. Such arrangements may allow conduit passageways of smaller cross-section, for example a pulse conduit passageway cross section of 35mm2 rather than the 41mm2 of the 7.2mm diameter pulse tubing used on conventional milking clusters. Further additional conduits (not shown) may also be integrated into the conduit assembly for transport of other gases or fluids, for example teat dip for application to a teat after milking. In particular, a third conduit having a crescent-shaped bore may be located on the side of the circular milk conduit diametrically opposite the vacuum conduit.

Figure 11 is a cross-sectional view of an alternative embodiment of the milking system liner assembly of the invention. As in the embodiment of figure 2, assembly 130 comprises a resilient liner 210, a milk conduit 139 defining a bore or passageway 140 and a vacuum conduit 149 defining a corresponding bore or passageway 150.

Unlike figure 2, the embodiment of figure 11 does not have a flange that seals both milk and vacuum conduits against a single aperture in a rigid outer shell. Rather, the rigid outer shell 400 has both an aperture 410 against which the milk conduit seals (e.g. by means of a flange 430) and a nipple 420 which communicates with vacuum chamber 290 and which is sealingly engaged by vacuum conduit 149. Nevertheless, the milk and vacuum conduits are integral along the entire length of the vacuum conduit. Not least, this makes the milking system easier to clean than conventional arrangements employing separate, non-integral milk and vacuum conduits.

Figure 12 is a perspective view of another embodiment of the milking system liner assembly of the invention. The embodiment shares with figure 2 the feature of a flange 270 that surrounds both the bore of the milk conduit 139 and the bore 150 of the vacuum conduit 149, the flange being integral with the two conduits. The milk and vacuum conduits 139,149 are integral along their length and are also permanently bent (as indicated at 510) in a plane containing the longitudinal axis 295 of the liner 210. In the embodiment shown the conduits bend through an angle (between liner axis 295 and milk conduit axis 500) of approximately 90 degrees. A bend facilitates connection of the liner (and its rigid outer shell, not shown) to the rest of the milking system where clearance below the underside of the animal is limited, e.g. in the case of goat or sheep milking.

It should be understood that this invention has been described by way of examples only and that a wide variety of modifications can be made without departing from the scope of the invention.

CLAIMS

1. A milking system liner assembly comprising:

a resilient liner having an inner and an outer surface, the inner surface being configured to engage a teat and the outer surface being configured to define, together with a rigid outer shell, a space to which a vacuum can be applied;

a milk conduit for leading milk away from the inner surface of the liner and formed integrally with the liner; and

a vacuum conduit for applying a vacuum to said space;

wherein the milk and vacuum conduits are integral along the entire length of at least one of the conduits.

2. A milking system liner assembly according to claim 1, wherein the assembly has a flange that surrounds both the bore of the milk conduit and the bore of the vacuum conduit and that is configured to sealingly engage an aperture in a rigid outer shell.

3. A milking system liner assembly according to claim 2, wherein the milk and vacuum conduits are integral with said flange.

4. A milking system liner assembly according to claim 3, wherein the flange is configured to substantially align the longitudinal axis of the resilient liner with the longitudinal axis of a rigid outer shell.

5. A milking system liner assembly according to claim 4, wherein the flange is configured to position the bore of the vacuum conduit offset from the longitudinal axis of a rigid outer shell.

6. A milking system liner assembly according to any preceding claim, wherein the milk conduit and vacuum conduit share a common wall.

7. A milking system liner assembly according to claim 6, wherein the respective longitudinal axes of the milk and vacuum conduits are transversely spaced.

8. A milking system liner assembly according to claim 7, wherein the bore of the milk conduit is circular in cross-section, while the bore of the vacuum conduit is crescent-shaped in cross-section.

9. A milking system liner assembly according to claim 8, wherein the convex surface of the crescent shape bore of the vacuum conduit and the concave surface of the circular bore of the milk conduit are configured so as to define between them a wall of substantially constant thickness.

10. A milking system liner assembly according to any preceding claim, wherein the assembly comprises a single fixing configured to connect both the milk conduit and the vacuum conduit to a claw of a milking cluster.

11. A milking system liner assembly according to claim 10, wherein the single fixing is configured such that a first interface between the milk conduit and the claw lies in the same plane as a second interface between the vacuum conduit and the claw.

12. A milking system liner assembly according to claim 11, wherein that part of the single fixing configured to define the first interface is planar and that part of the single fixing configured to define the second interface is also planar.

13. A milking system liner assembly according to claim 12, wherein the respective parts of the single fixing configured to define the first and second interfaces are substantially contiguous.

14. A milking system liner assembly according to any one of claims 10 to 13, wherein the single fixing comprises at least one snap fitting.

15. A teat cup assembly for a milking system comprising a milking system liner assembly according to any preceding claim and a rigid outer shell surrounding the resilient liner of the milking system liner assembly.

16. A milking cluster comprising at least one teat cup

assembly according to claim 15 and connected to a claw assembly.

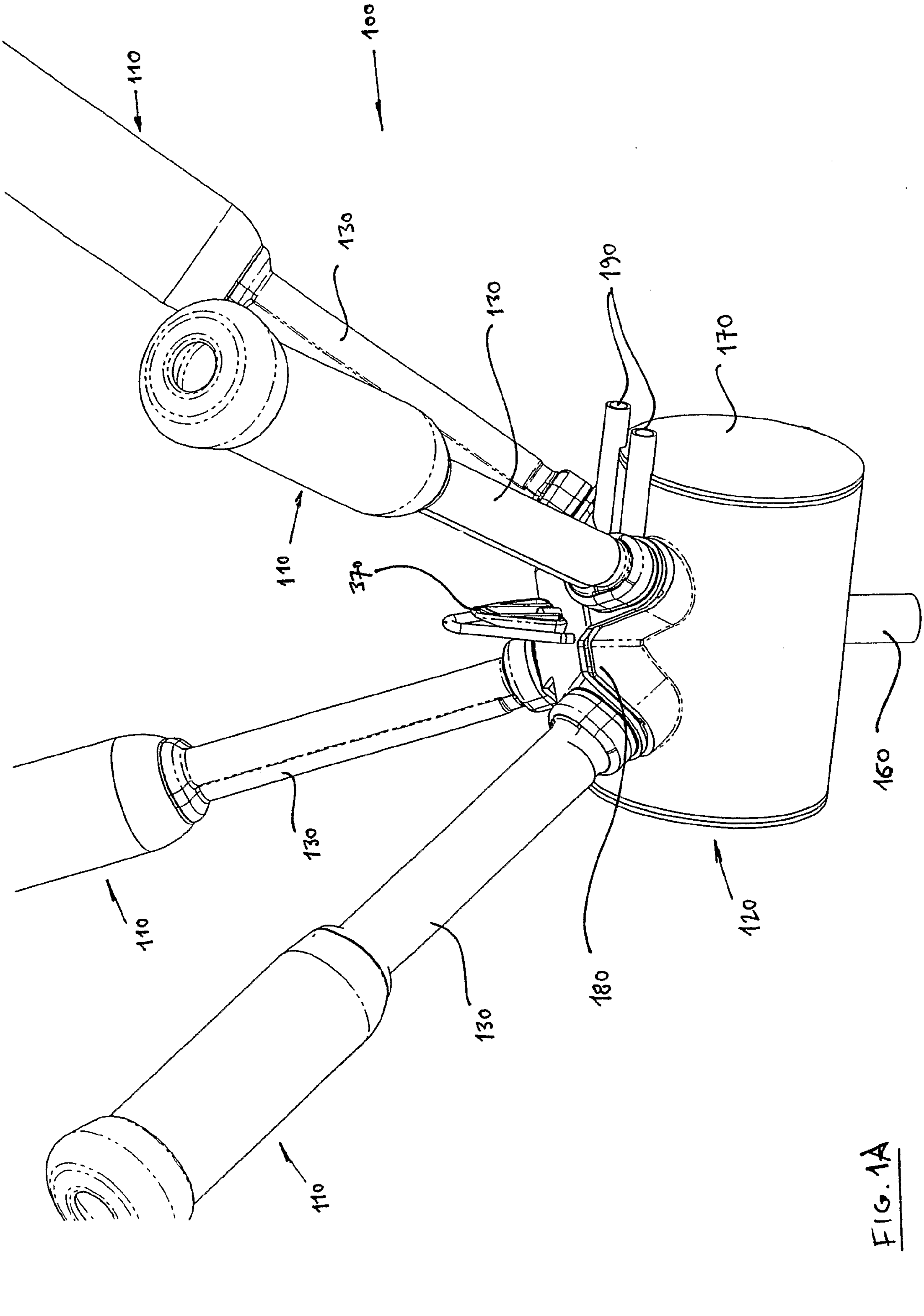


FIG. 1A

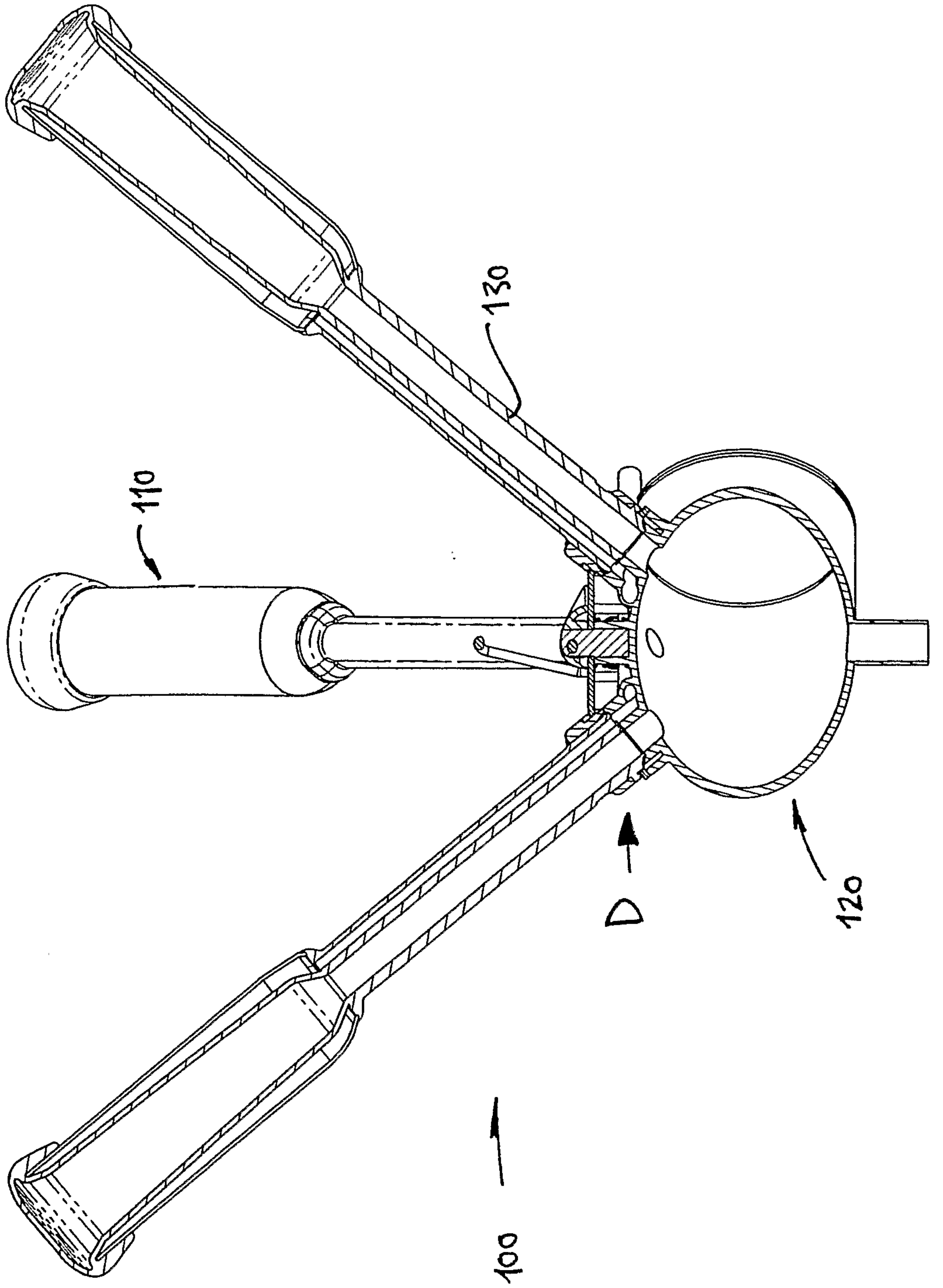
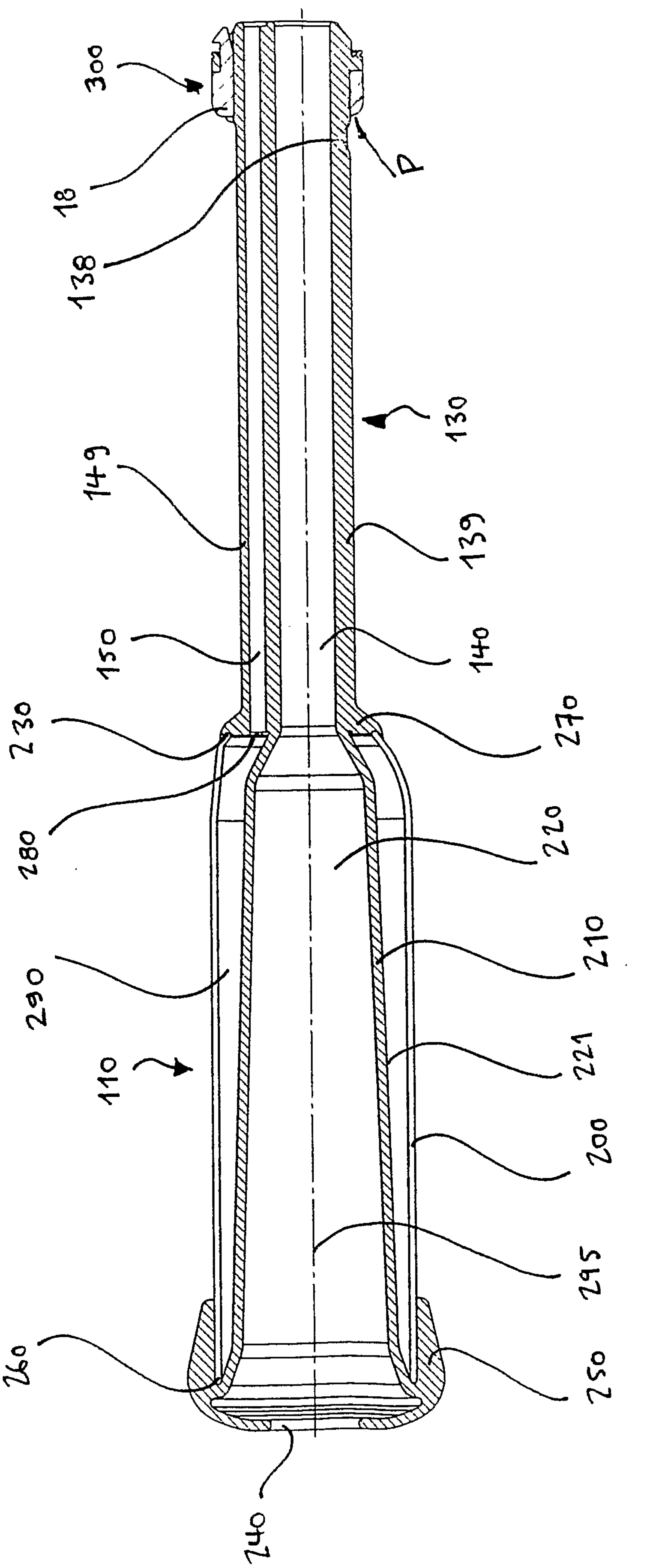


FIG. 1B


300
18
P
138
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149
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FIG. 2

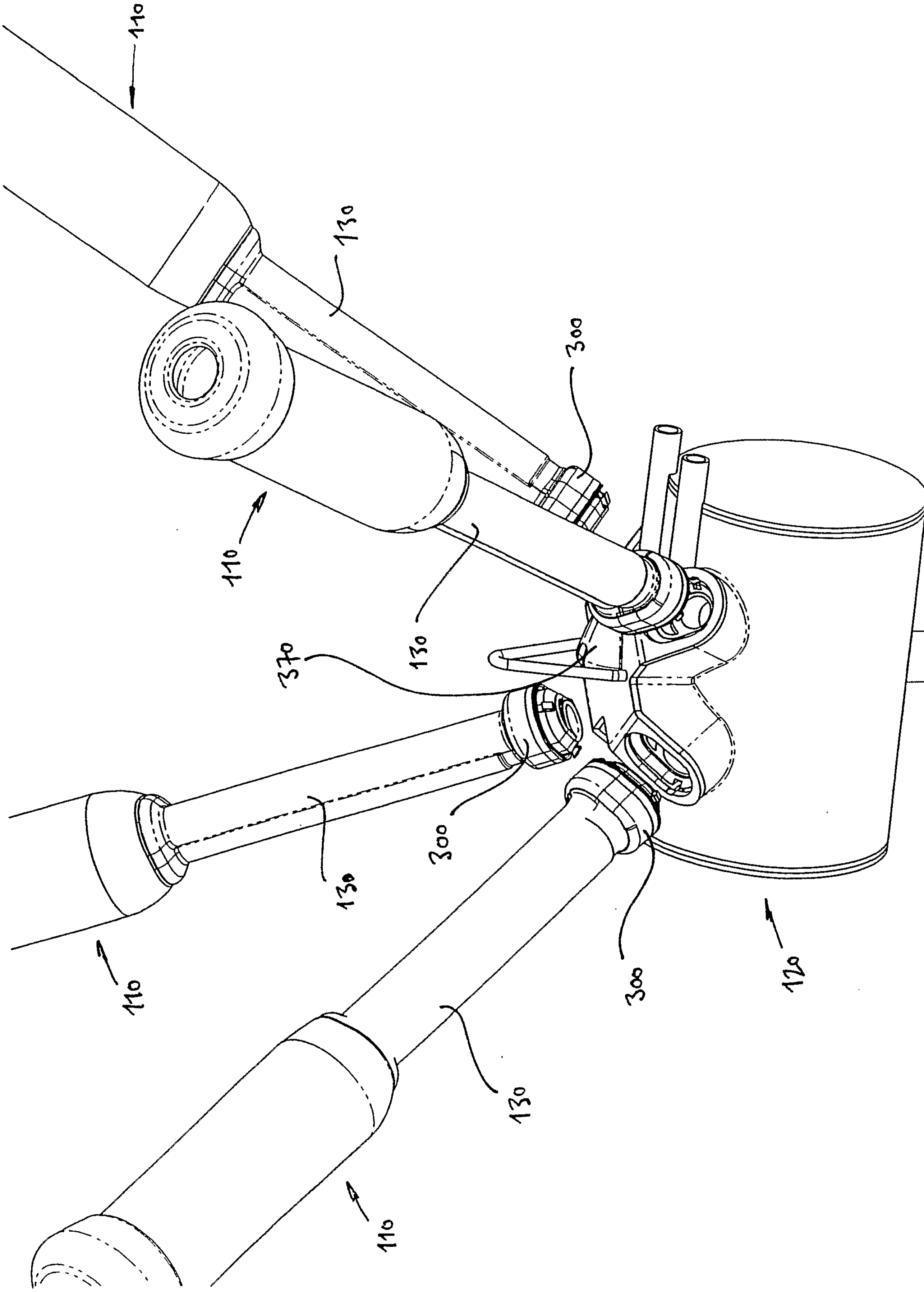


FIG. 3

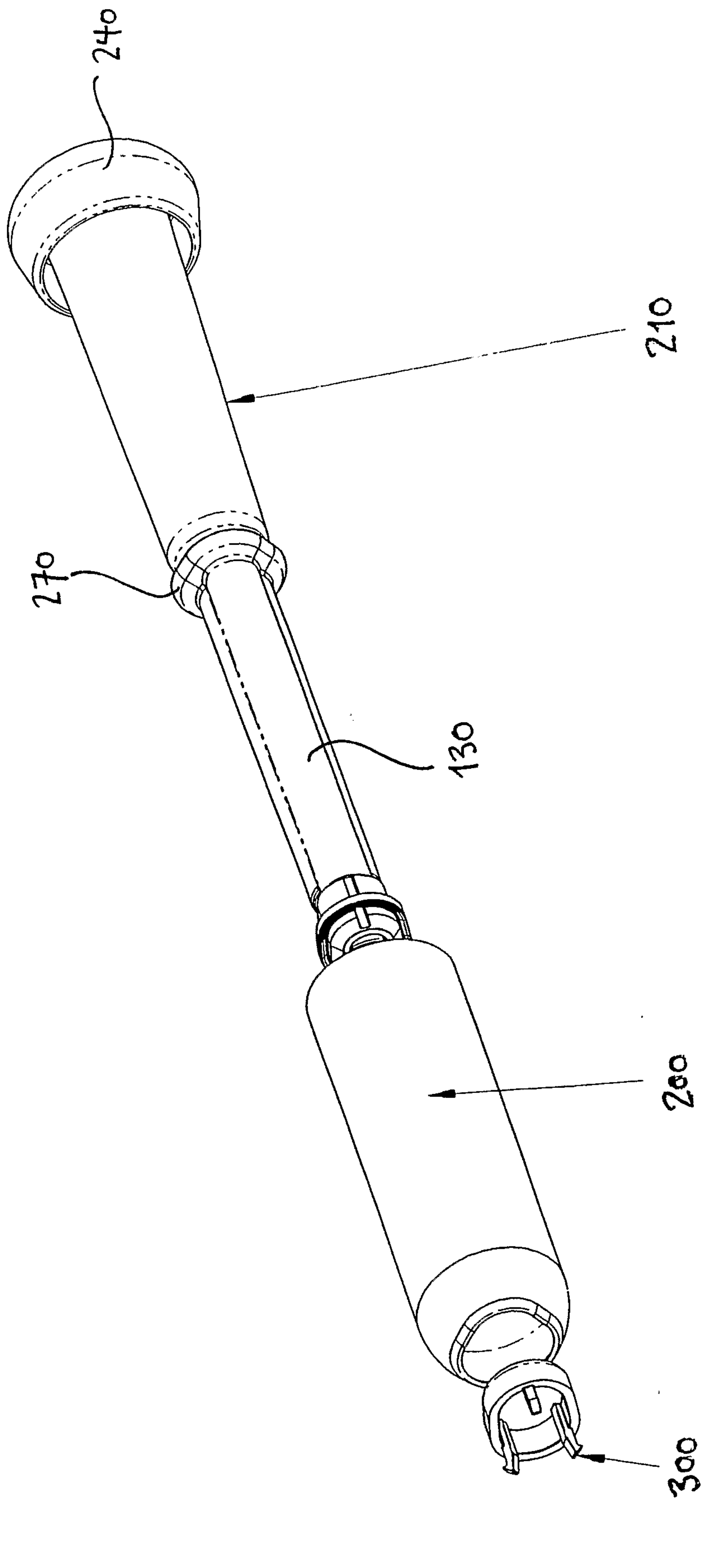


FIG. 4

FIG. 5

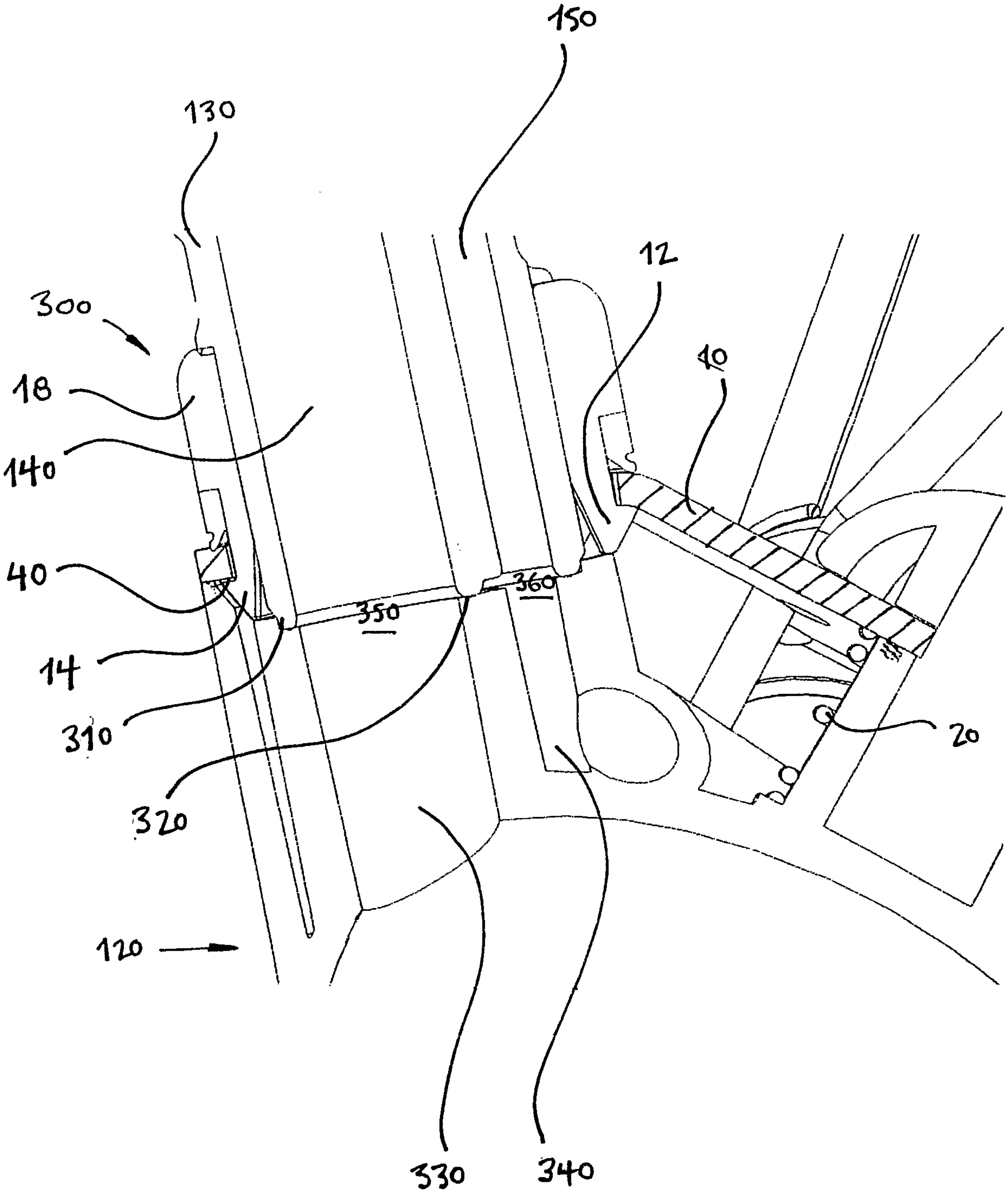


FIG. 6

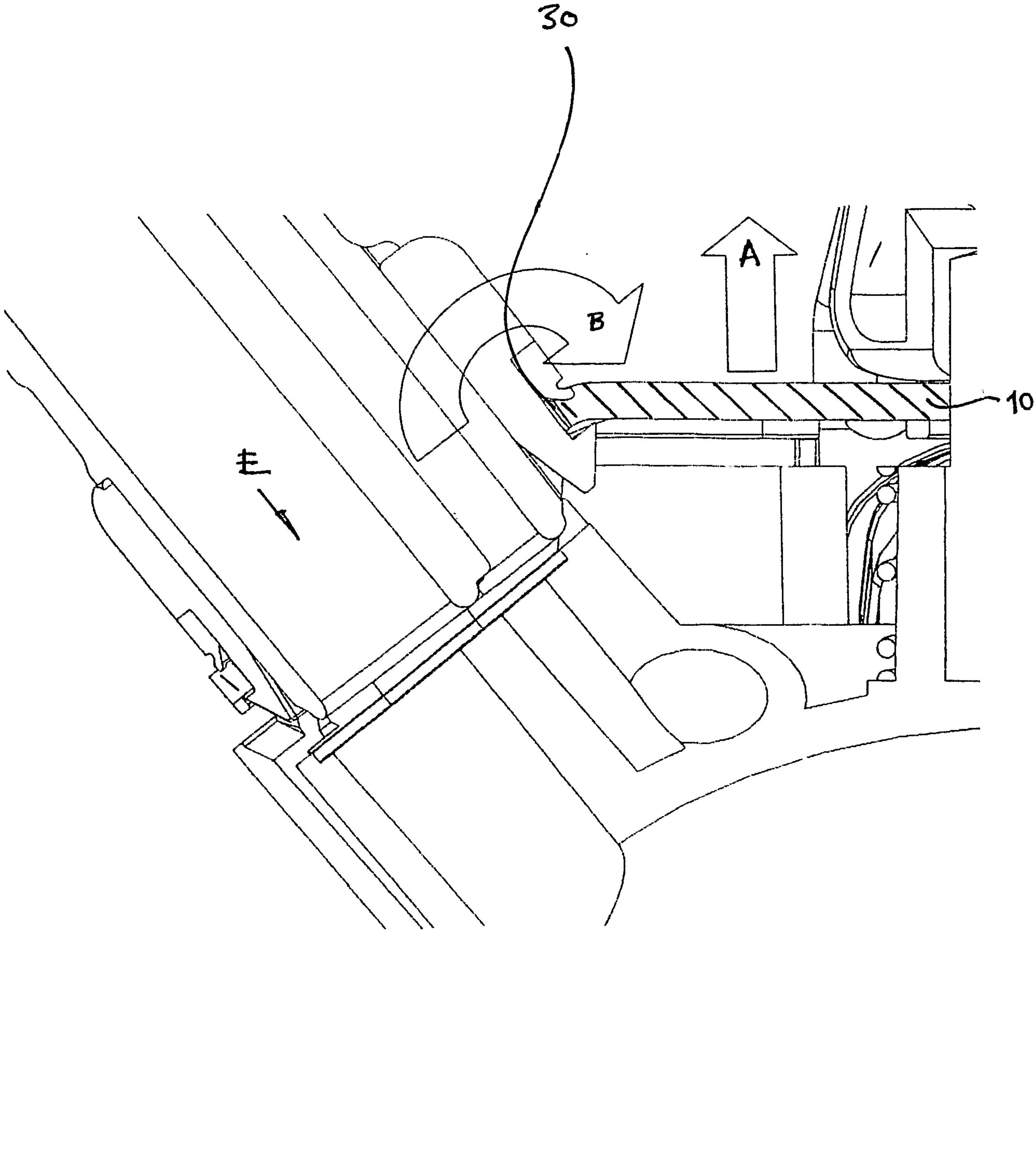


FIG. 7

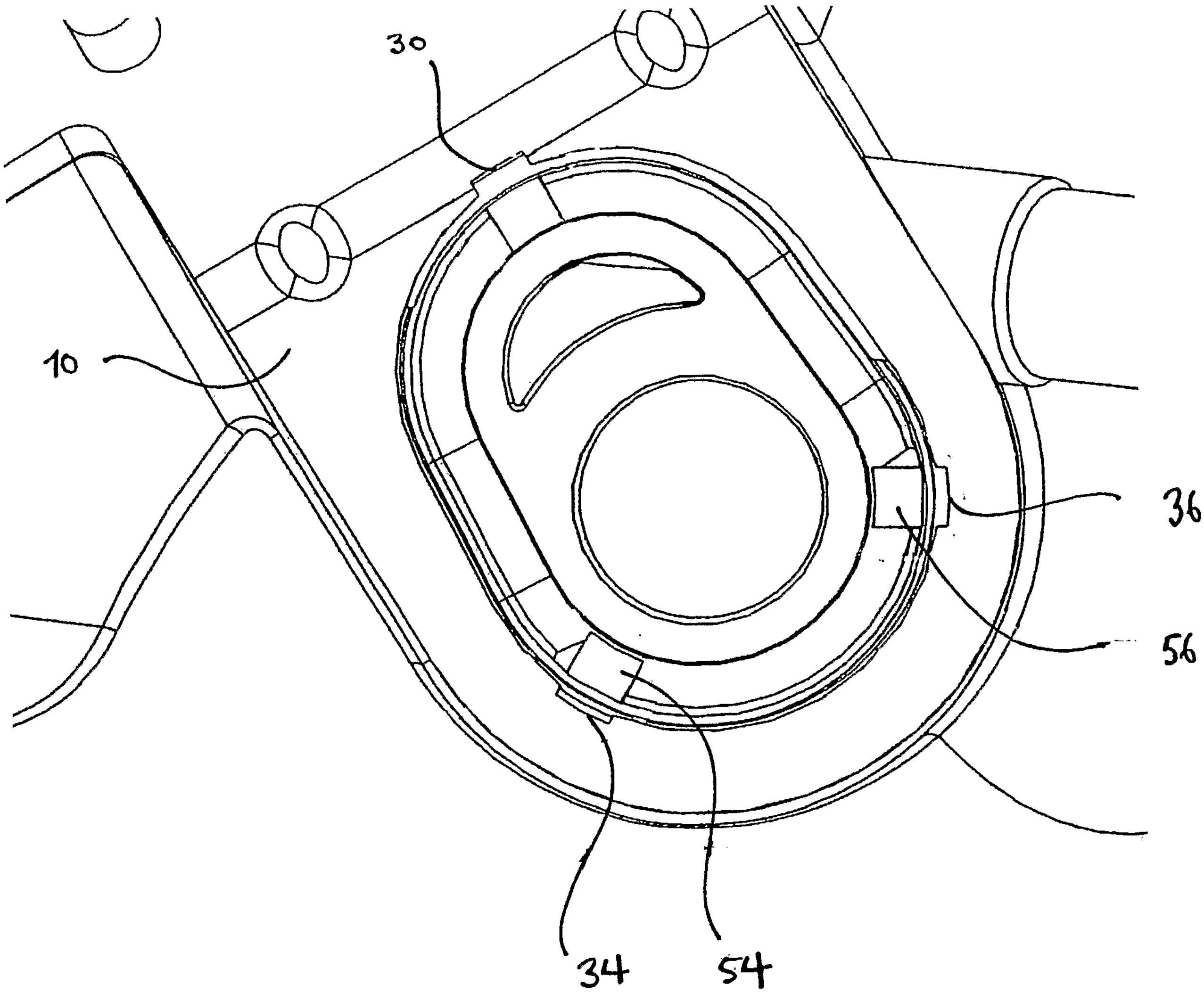


FIG. 8

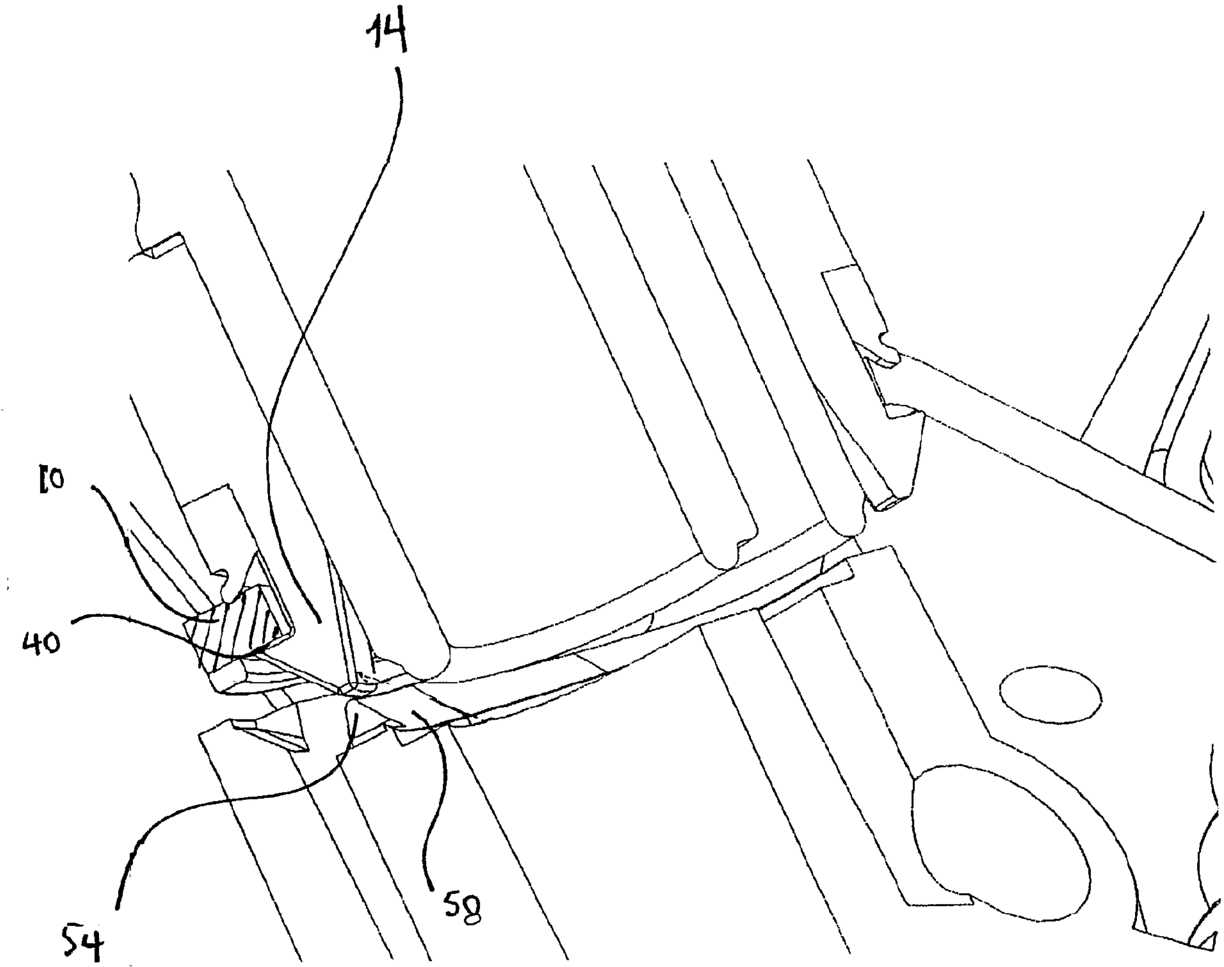


FIG. 9

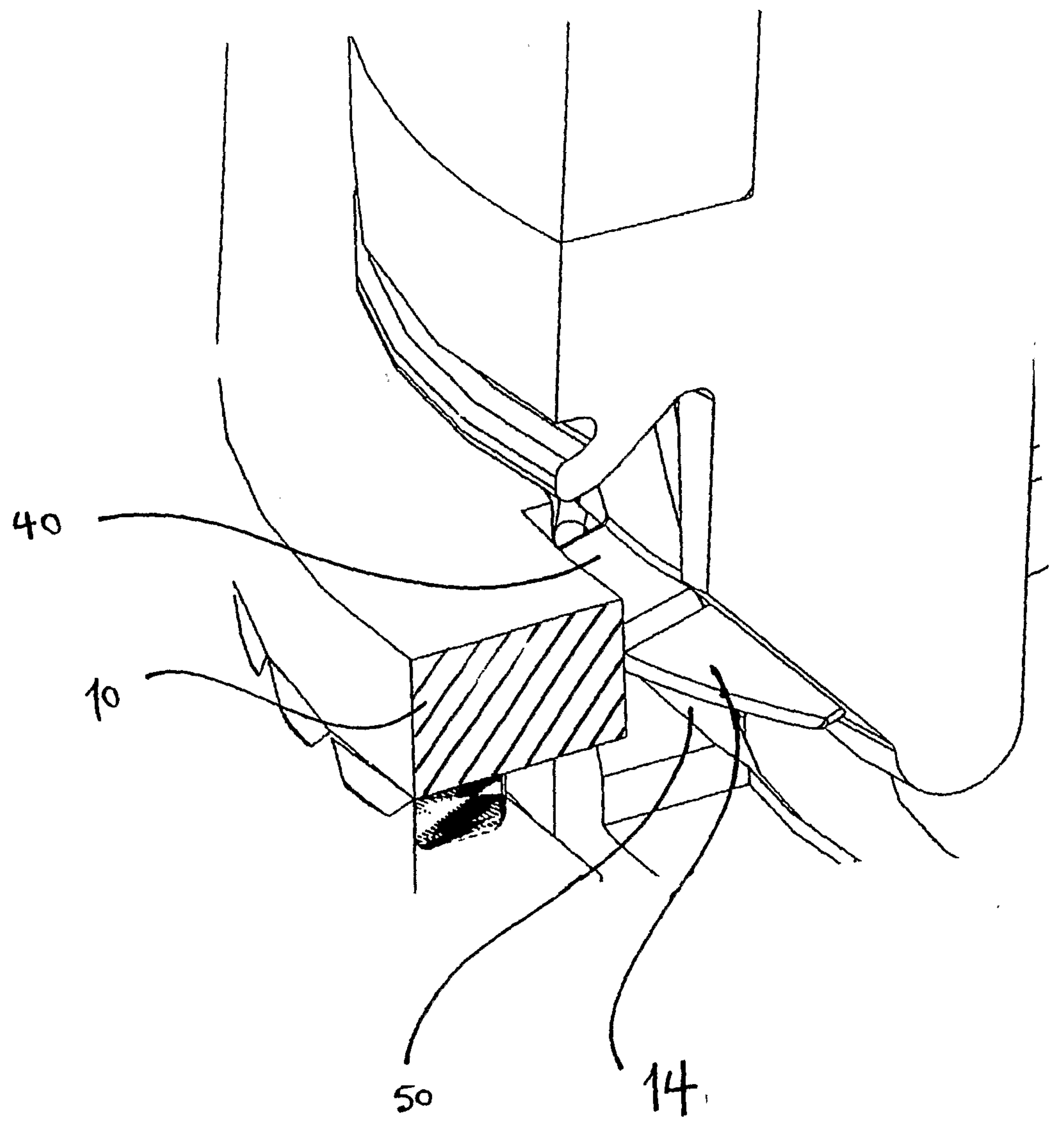


FIG. 10

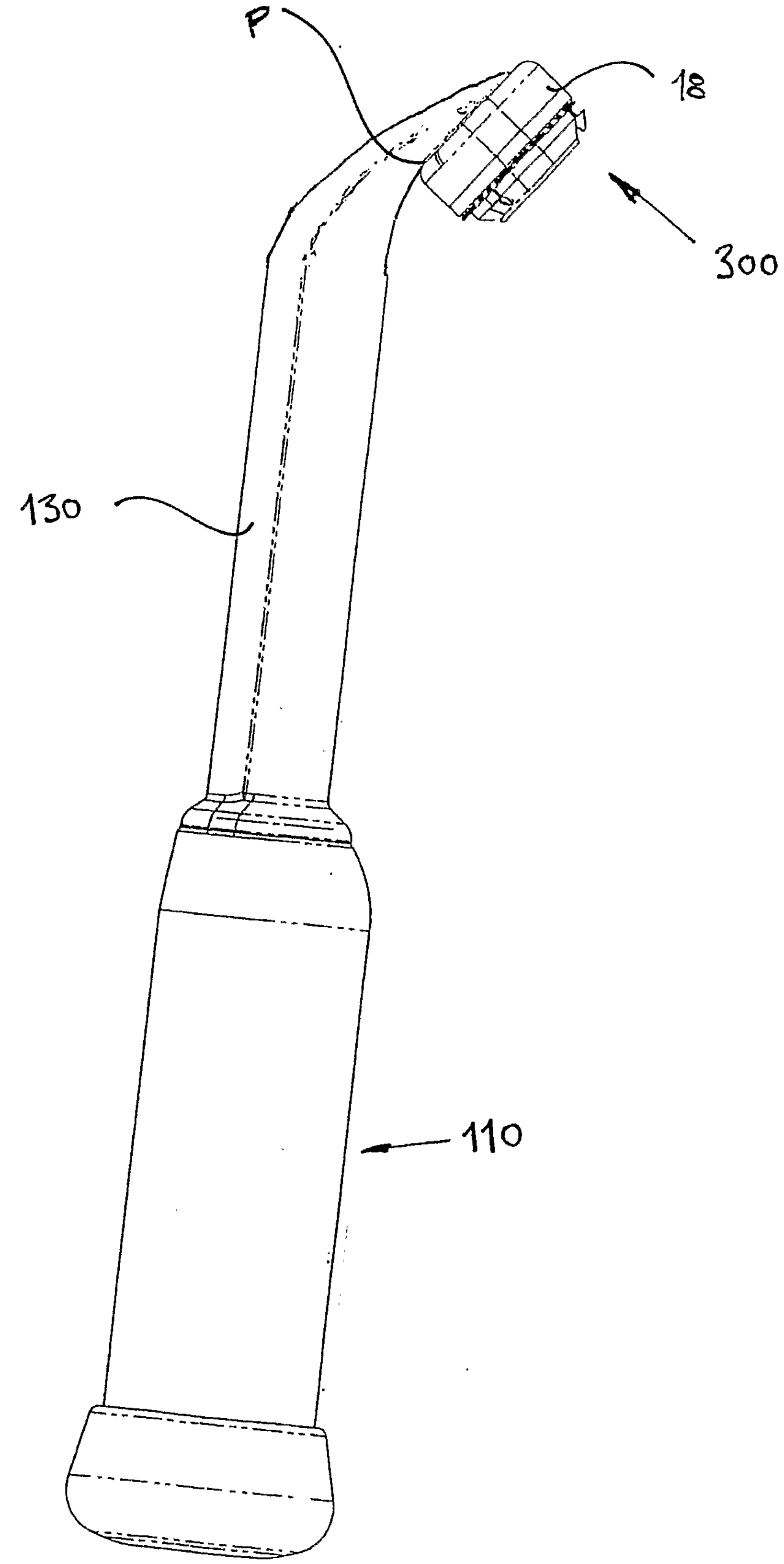


FIG. 11

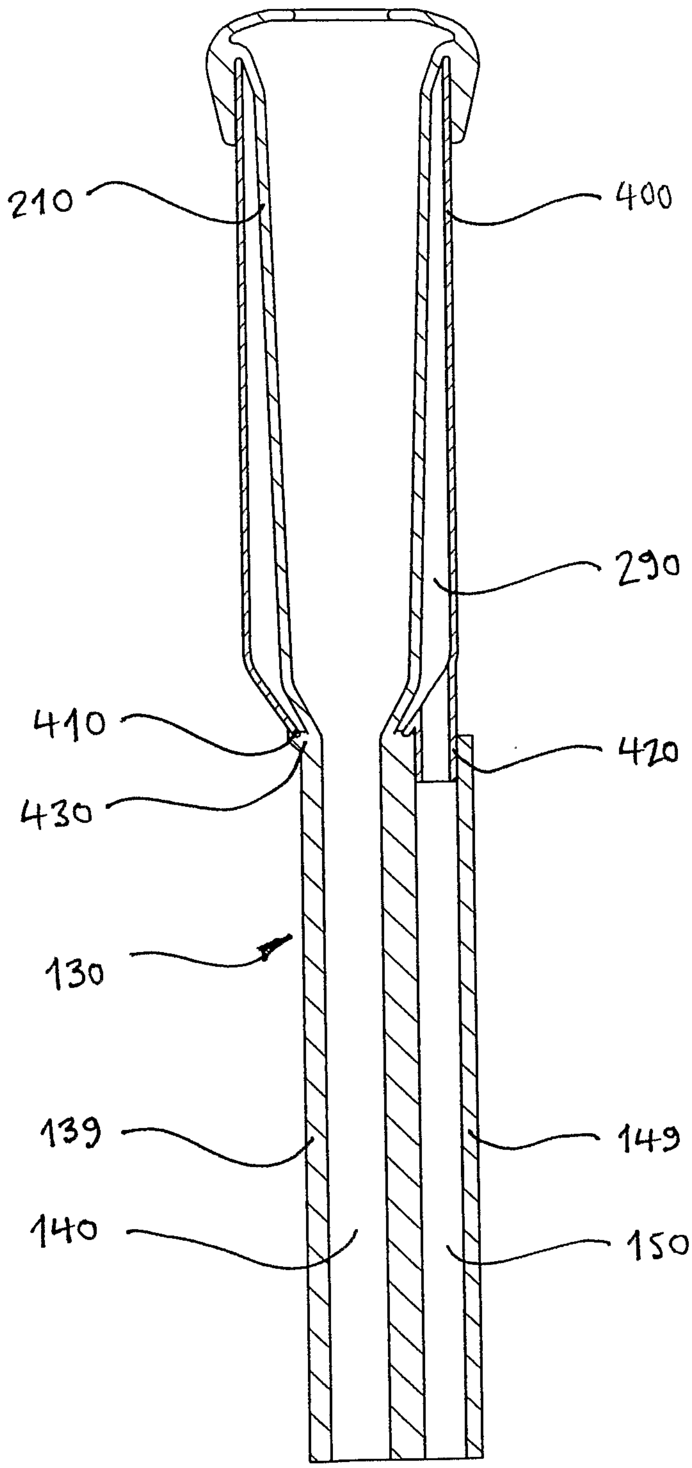
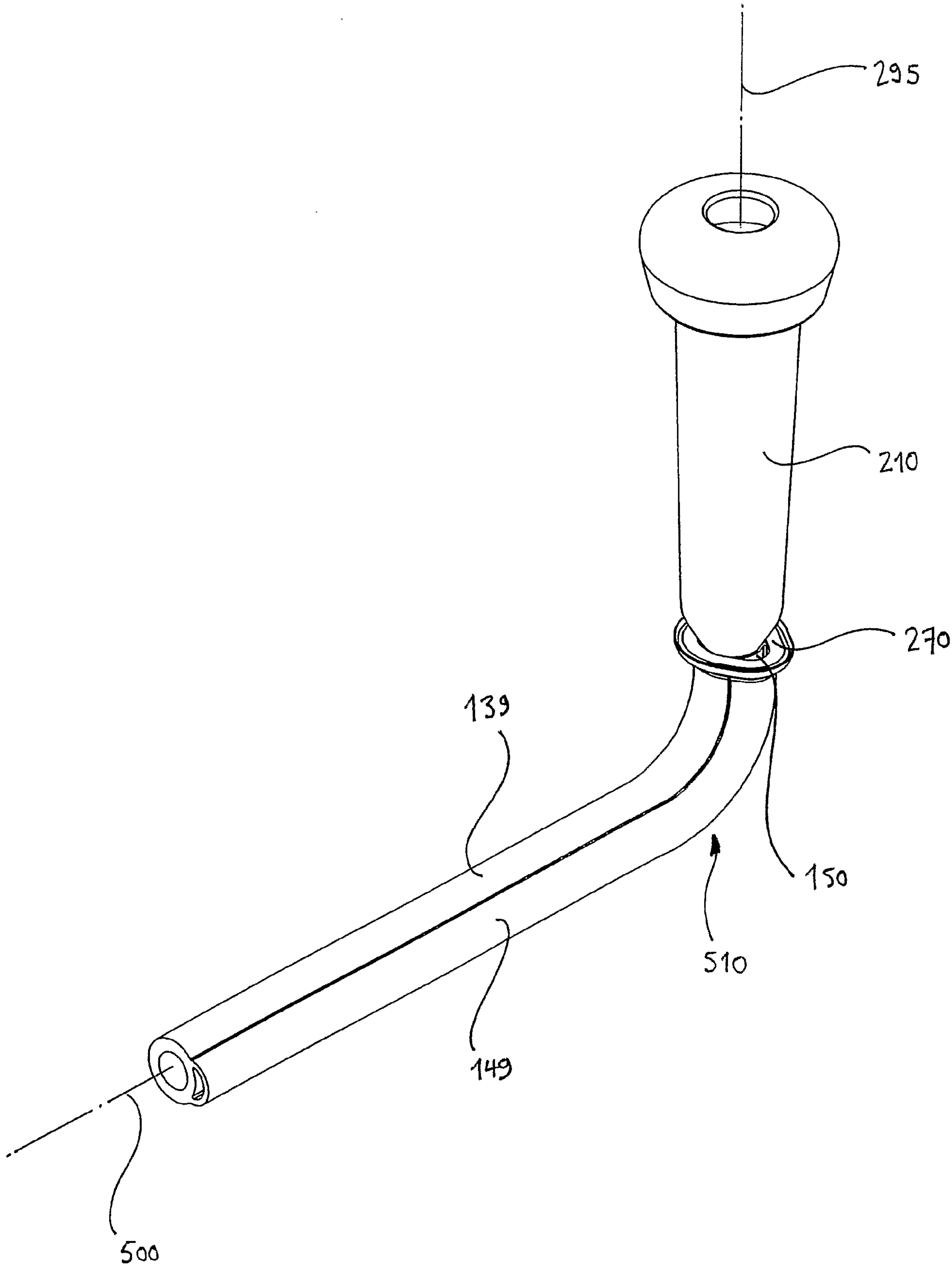


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/001268

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01J5/04 A01J5/08

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01J

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2 408 390 A (GESSLER FREDERICK A) 1 October 1946 (1946-10-01) the whole document	1-7,15, 16
Y	US 2 425 873 A (GESSLER FREDERICK A) 19 August 1947 (1947-08-19) the whole document	1-7,15, 16
A	US 1 896 321 A (MAES ROBERT E) 7 February 1933 (1933-02-07) column 2, lines 105-129; figure 3	1-16
A	WO 00/12924 A (ALFA LAVAL AGRI AB [SE]; JOHANNESSON LEIF [SE]) 9 March 2000 (2000-03-09) pages 5,6; figures 1-6	1-16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 October 2009	03/11/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Simson, Guenter

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	AU 2007 202 732 A1 (MAASLAND NV) 17 January 2008 (2008-01-17) cited in the application pages 5-9	1-16
A	GB 1 083 539 A (GEORGE HENRY SMITH) 13 September 1967 (1967-09-13) the whole document	1-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2009/001268

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
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US 2425873	A	19-08-1947	NONE			
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