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(54) Title: PRESSURE RELIEVE MECHANISM FOR A MEDICAL DELIVERY DEVICE

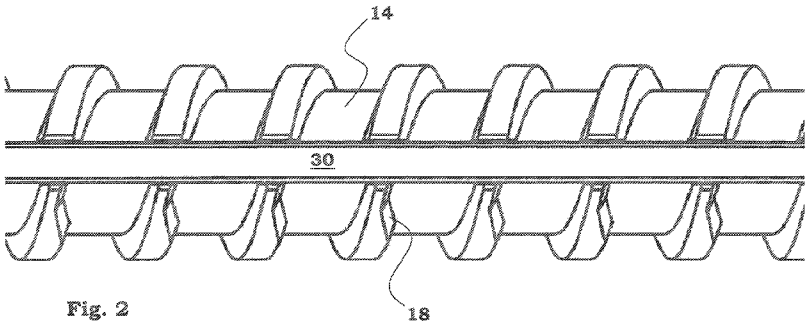


Fig. 2

(57) Abstract: The present invention relates to a pressure relief mechanism for a medicament delivery device, which delivery device comprises a medicament container (12), a threaded plunger rod (14) capable of acting on said container (12) for expelling a dose of medicament, a threaded nut (20) arranged to cooperate with said plunger rod (14), wherein said pressure relief mechanism comprises at least one alteration in the pitch (18) of the threads of the plunger rod around its circumference.

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PRESSURE RELIEVE MECHANISM FOR A MEDICAL DELIVERY DEVICE

TECHNICAL AREA

The present invention relates to a pressure relief mechanism, and in particular in connection with medicament delivery devices where the medicament is in a container and is exposed to pressure when the medicament is to be delivered.

TECHNICAL BACKGROUND

There are numerous devices for delivering medicament on the market and also patented where the medicament is arranged in a container, such as a syringe, cartridge and the like, and wherein the medicament is exposed to pressure when it is to be delivered. A very common design is a generally tubular compartment having a stopper in one end of the compartment and a needle unit attached to the opposite end of the compartment.

In order to deliver a quantity of medicament, the stopper is exposed to pressure, i.e. pushed into the compartment by a pusher rod, which could be done manually by a finger, which is the case for simple handheld syringes, or by pressure means such as springs, which is common in automatic or semi-automatic injectors.

In many instances it is desirable to be able to deliver a certain specified quantity of the medicament. This is for example the case with a multi-dose injection device, which is capable of delivering a number of specified, set, doses until the compartment is empty. One example is disclosed in the European patent application No. 05104734.8 where specific doses can be set before injection. The injection device disclosed is arranged with spring means for exerting a pressure on the medicament for delivering a specific dose, i.e. pushing the plunger rod and thus the stopper into the cartridge.

The delivery of a dose requires a certain force from the spring means in order to overcome the friction between the somewhat resilient stopper and the inner surface of the cartridge and also to be able to press the medicament in liquid

form through a rather small passage in the needle, possibly within a predetermined time.

Due to the elasticity of the components under pressure such as the stopper and also the medicament of non-newtonian, there is a prevailing pressure even when the stopper has been moved a predetermined distance and the dose has been delivered. This is in particular pronounced when handling medicament with rather high viscosity, medicament having resilient properties.

With this type of substance with high viscosity, and because very small needles are often used, a rather large force is required and because of the elasticity of the components, often a certain small quantity of the substance comes out of the needle even after performed injection when the pressure is relieved, i.e. there is some dripping from the needle, which is unwanted, in particular when treating a patient and the substance may be dripping on the patient's skin, possibly causing irritation or inconvenient, undesirable effects.

The above mentioned gel-based substances are typically injected manually, i.e. a normal type of syringe is used. Because of the rather large forces required for injecting the substances, and also due to the many small injections needed for a treatment, it is tiresome for the operator to use such a syringe during a treatment.

There are thus a number of aspects that are addressed with the present invention.

BRIEF DESCRIPTION OF THE INVENTION

The aim of the present invention is to minimise the unwanted expelling of excess medicament after a delicery.

This aim is obtained according to the present invention by the features of the independent patent claim.

Preferable embodiments of the present invention form the subject of the dependent patent claims.

According to a major aspect of the invention, it is characterised by a pressure relief mechanism for a medicament delivery device, which delivery device comprises a medicament container comprising a proximal opening with or for receiving a delivery member and an axially movable stopper; a threaded plunger rod arranged with threads having a pitch of a certain angle on its outer circumference surface and arranged to exert pressure on the stopper for expelling the medicament through the delivery member; a threaded nut interactively connected to said plunger rod driving means operably connected to said nut; and activation means operably connected to said driving means; wherein said pressure relief mechanism comprises at least one alteration in the pitch of the threads of the plunger rod arranged to interact with a number of protrusions around the inner circumferential surface of the nut for releasing the pressure exerted on the stopper by the relative rotational movement between the plunger rod and the nut.

According to another aspect of the invention, the relative rotational movement between the plunger rod and the nut until the alteration in the pitch corresponds to a predetermined dose to be delivered from the medicament container.

According to a further aspect of the invention the driving means comprises a force member, a force drive member, and a driver member which is arranged slidable around said threaded plunger rod and rotationally locked to said threaded plunger rod.

The advantages with the present invention are several. The pressure relief according to the invention minimizes the risk of dripping from the delivery member after performed delivery. Further there is an advantage that the pressure relief mechanism is “built-in” in the design of the plunger rod, whereby

the number of components can be reduced, in that it can be said that the plunger rod performs two functions.

The number of pressure relief functions around one turn of the plunger rod may be varied depending on the desired dose size. Preferably the plunger rod is driven by a force member, which may be a leaf spring that can be tensioned several times by the user.

These and other aspects of and advantages with the present invention will become apparent from the following detailed description and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed description of the invention, reference will be made to the accompanying drawings, of which

Fig. 1	shows an example of an injector comprising the present invention,
Fig. 2	shows a detailed view of a part of a plunger rod according to the present invention,
Fig. 3	shows a detailed view in perspective of a nut intended to cooperate with the plunger rod of Fig. 2,
Fig. 4a	is a cross-sectional view of the nut of Fig. 3, taken along line IVa-IVa,
Fig. 4b	is a cross-sectional view of the nut taken 90° in relation to Fig. 4a, and
Fig. 5	is a drive member for the plunger rod of Fig. 2.

DETAILED DESCRIPTION OF THE INVENTION

In the present application, when the term “distal part/end” is used, this refers to the part/end of the medicament delivery device, or the parts/ends of the members thereof, which under use of the medicament delivery device is located the furthest away from the medicament delivery site of the patient. Correspondingly, when the term “proximal part/end” is used, this refers to the

part/end of the medicament delivery device, or the parts/ends of the members thereof, which under use of the medicament delivery device is located closest to the medicament delivery site of the patient.

Figure 1 shows a non-limiting example of a medicament delivery device where the present invention could be utilized. The delivery device comprises a housing 10 having opposing proximal and distal ends, and is designed to be held in one hand for delivering repeated small quantities of medicament step by step. It is however understood that other types of delivery devices may have the pressure relief mechanism to be described in detail below. As seen in Fig. 1, inside and at the proximal end of the housing a medicament container 12 is arranged having a proximal opening with or for receiving a delivery member as a needle and an axially movable stopper. Said medicament delivery device further comprises a threaded plunger rod 14 arranged with threads having a pitch of a certain angle on its outer circumference surface and arranged to exert pressure on the stopper for expelling the medicament through the delivery member, a threaded nut 20 interactively connected to the plunger rod 14, driving means operably connected to said nut, and activation means operably connected to said driving means. The driving means comprises a force member 16 as a leaf spring, a force drive member and a driver member 24.

According to the present invention, the plunger rod 14 is arranged with threads of a specific configuration on its outer circumference surface, as seen in Fig. 2. The threads have a "basic" pitch of a certain angle. However, the pitch increases over a certain angle range until this increased pitch is altered or interrupted, the function of which will be explained below. The interruption could be either immediate or gradual, as shown in Fig. 2, where a sloping surface 18 is arranged.

The plunger rod is arranged to cooperate with the nut 20 which is fixedly arranged in relation to the housing, Fig. 3. The nut has a generally tubular shape having a number of protrusions 22 acting as thread segments on its inner

circumferential surface, Fig. 4. The segments have certain shapes to cooperate with the threads of the plunger rod as will be explained.

Therefore, a pressure relief mechanism for the medicament delivery device comprises at least one alteration in the pitch 18 of the threads of the plunger rod arranged to interact with a number of protrusions 22 around the inner circumferential surface of the nut for releasing the pressure exerted on the stopper by the relative rotational movement between the plunger rod and the nut.

Further, according to the present invention, Fig. 5, the driver member comprises a generally cylindrical body having a through-going passage 26. The passage is arranged with longitudinal ledges 28 that are arranged to mate with longitudinal grooves 30 of the plunger rod, thereby providing a rotational lock between them but allowing the plunger rod to slide in relation to the drive member 24. The driver member 24 is further arranged with a drive mechanism 32, e.g. a ratchet, onto which the force member 16 is acting via a corresponding drive mechanism arranged on the force drive member (not shown). Moreover, the driver member has a number of outwardly directed protrusions evenly spaced around its outer circumference surface where the distance between two adjacent protrusions constitutes a certain predetermined dose quantity.

When the device is to be used the force member 16 is wound up by turning a knob 34 at the distal end of the medicament delivery device. The force member is held tensioned due to the interaction of the drive mechanism 32 acting on the corresponding drive mechanism of the force drive member. The activation means comprises an activation button 36 arranged through the housing (not shown) of the medicament delivery device, and an actuation arm 38 pivotally arranged to the force drive member. Thus when the activation button 36 is depressed, the force drive member is released causing the force drive member to act on the driver member 24 via the drive mechanism 32. This action causes the driver member 24 to rotate a certain angular distance as set by the outwardly directed protrusions. Because of the rotational lock between the

driver member 24 and the plunger rod 14, the plunger rod is rotated that certain distance. The rotation of the plunger rod causes it to move towards the proximal end of the medicament delivery device and to exert a pressure on the stopper within the medicament container 12, which in turn is moved and medicament is expelled through the delivery member. In this it is to be understood that the distance between the protrusions of the driver member, together with the pitch of the thread of the plunger rod constitutes a certain predetermined dose quantity. I.e. in order to set a specific dose, which is done during manufacture of the device, a certain distance is chosen between the protrusions as well as a certain pitch of the threads of the plunger rod.

When the plunger rod 14 has rotated almost the full distance as set by the driver member 24, the protrusions 22 of the nut 20 reach the end of the increased pitch of the threads of the plunger rod and fall into the sudden alteration of pitch 18. This movement causes a pressure relief of the plunger rod and thus a pressure relief of the content of the container. This pressure relief minimizes the risk of dripping from the delivery member after performed delivery. In this context it is to be understood that the pitch alterations 18 of the plunger rod threads and the ratchet 32 of the driver member 24 are positioned in relation to each other in order to obtain the desired pressure relief at the end of the rotational movement of the plunger rod. It is also to be understood that the number of pitch alterations 18 around a full turn of the plunger rod may be varied depending on the amount of medicament to be delivered. In this context it is also to be understood that the amount of medicament also depends on the pitch of the plunger rod threads. The amount of pressure relief can be adjusted by the height of the pitch alterations. The relief may also be adjusted from rather abrupt with a steep transition surface to a gently sloping transition surface.

In order that the protrusions do not become too thin in order to fit between the threads of the plunger rod, they may be provided with cut-outs 42, as seen in Fig. 4, which accommodate the adjacent thread.

Even though it has been described that the nut is fixed to the housing and the driver member is made rotatable, it is to be understood that a force member could act on a rotatable nut and that the driver member is fixed. In the latter case then the plunger rod does not rotate but is merely moved axially by the rotating nut. It is also to be understood that the nut may be a part integrated to the housing.

It is to be understood that the embodiment described above and shown in the drawings is to be regarded only as a non-limiting example of the invention and that it may be modified in many ways within the scope of the patent claim.

PATENT CLAIMS

1. Pressure relief mechanism for a medicament delivery device, which delivery device comprises a medicament container (12) comprising a proximal opening with or for receiving a delivery member and an axially movable stopper; a threaded plunger rod (14) arranged with threads having a pitch of a certain angle on its outer circumference surface and arranged to exert pressure on the stopper for expelling the medicament through the delivery member; a threaded nut (20) interactively connected to said plunger rod (14); driving means operably connected to said nut; and activation means operably connected to said driving means; wherein said pressure relief mechanism comprises at least one alteration in the pitch (18) of the threads of the plunger rod arranged to interact with a number of protrusions (22) around the inner circumferential surface of the nut for releasing the pressure exerted on the stopper by the relative rotational movement between the plunger rod and the nut.

2. Pressure relief mechanism according to claim 1, wherein the relative rotational movement between the plunger rod (14) and the nut (20) until the alteration in the pitch (18) corresponds to a predetermined dose to be delivered from the medicament container (12).

3. Pressure relief mechanism according to any of the preceding claims 1-2 wherein the driving means comprises a force member (16), a force drive member, and a driver member (24) which is arranged slidable around said threaded plunger rod and rotationally locked to said threaded plunger rod.

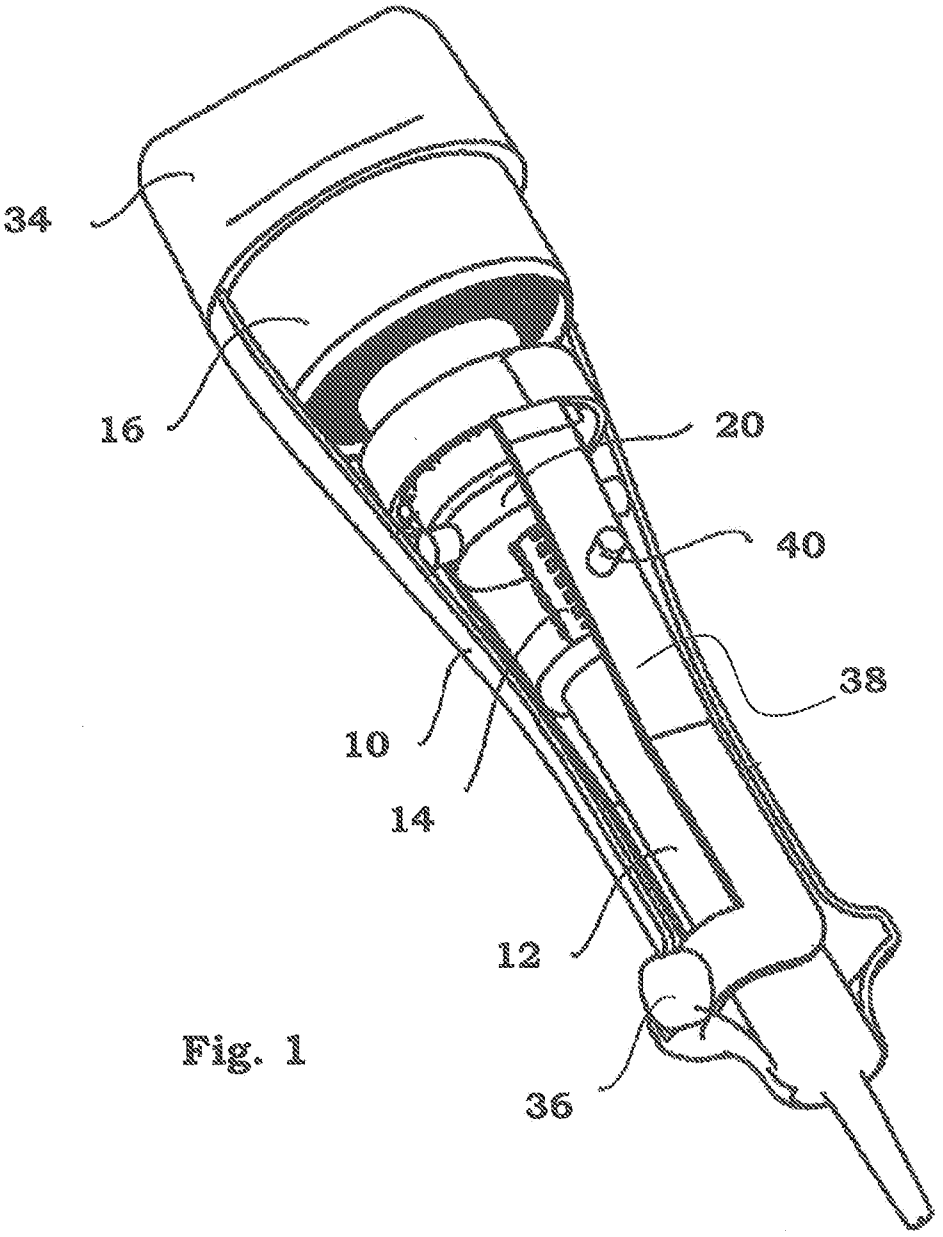


Fig. 1

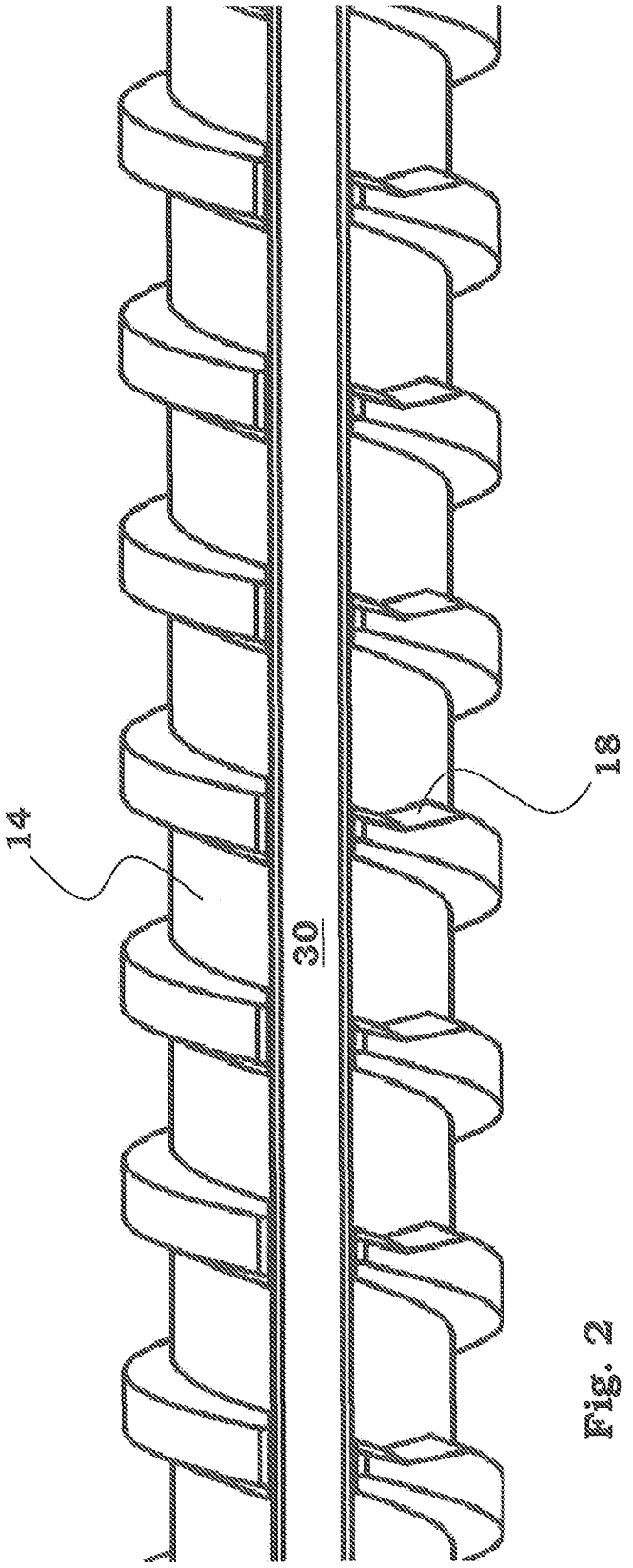


Fig. 2

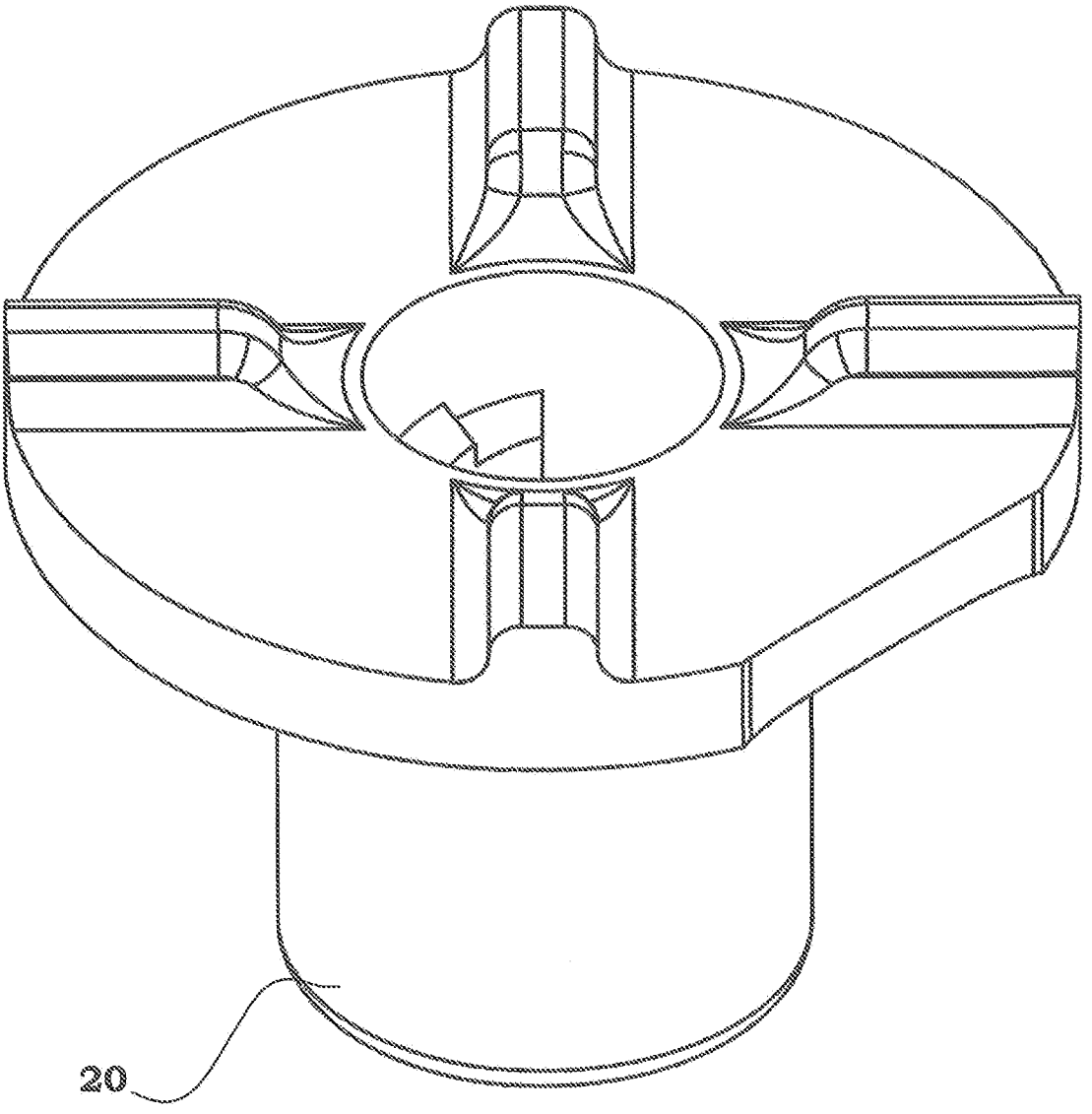


Fig. 3

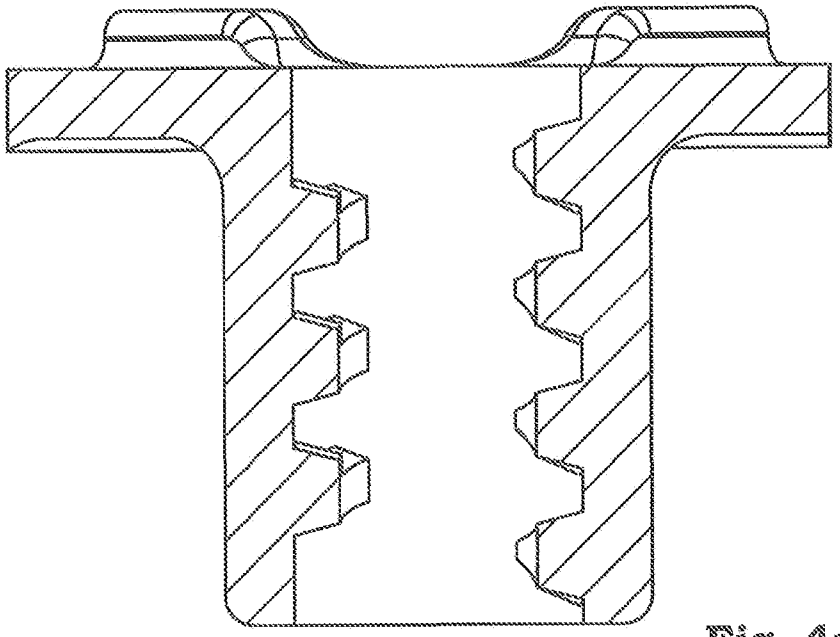


Fig. 4a

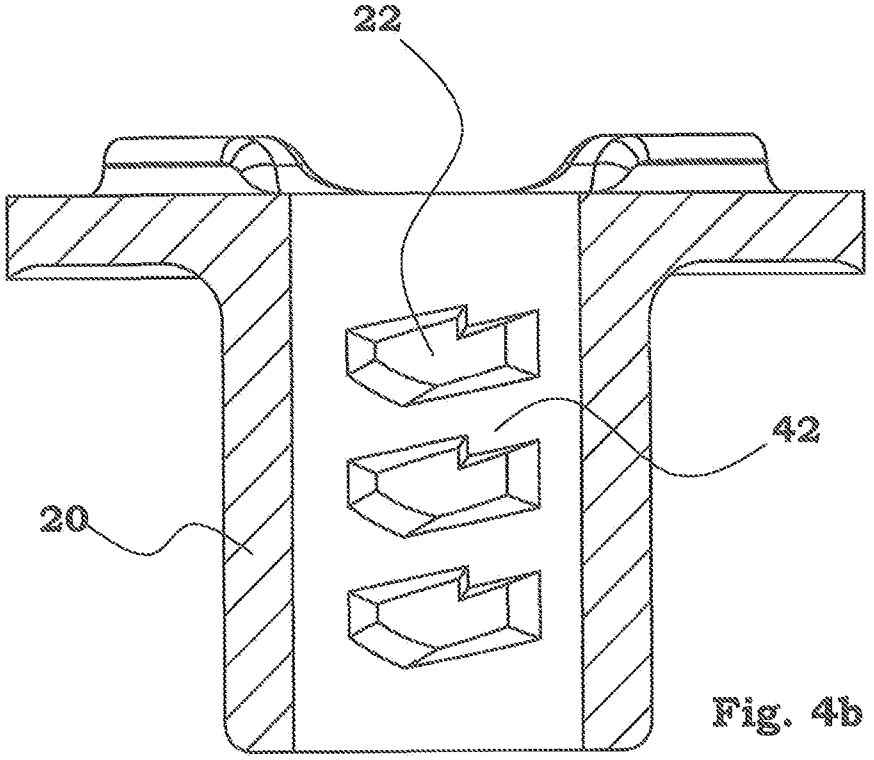


Fig. 4b

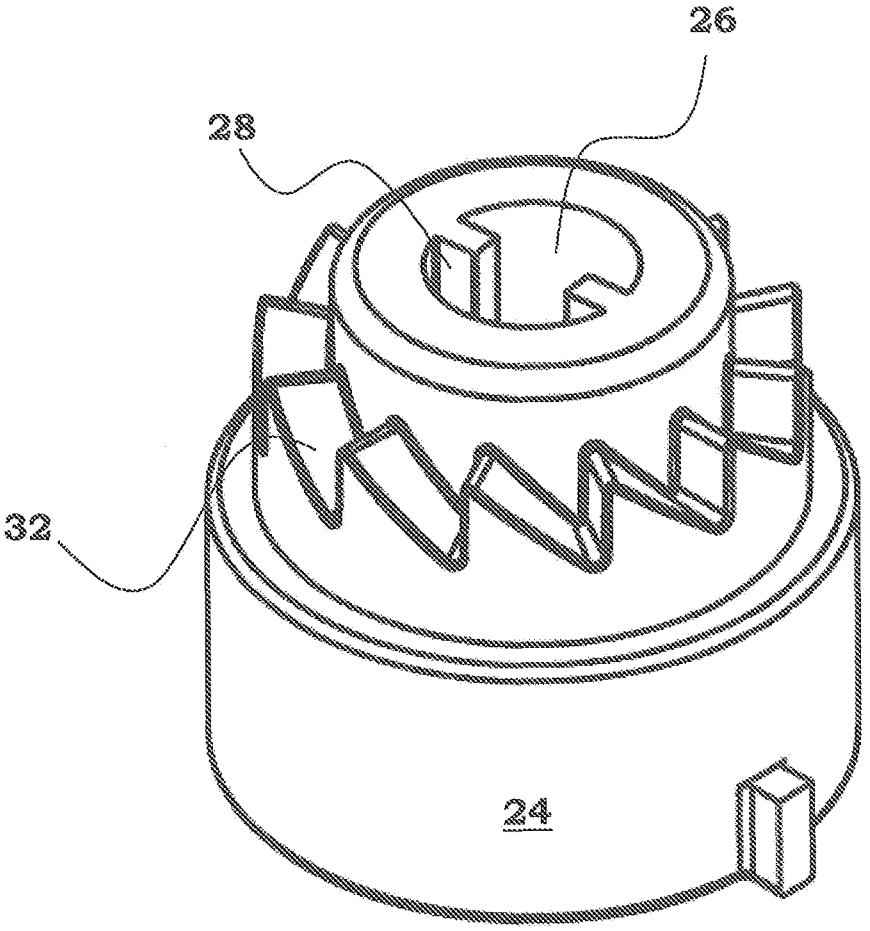


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/055622

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M5/315 A61M5/31

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)
A61M

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.
X	US 2006/247581 A1 (PEDERSEN THOMAS [DK] ET AL) 2 November 2006 (2006-11-02)	1-3
Y	figure 2	1-3
Y	WO 2008/020023 A1 (SHL MEDICAL AB [SE]; KARLSSON ANDERS [SE]; HOEGDAHL STEFAN [SE]) 21 February 2008 (2008-02-21) abstract; figures	1-3
Y	WO 2006/130098 A1 (SHL MEDICAL AB [SE]; KRONESTEDT VICTOR [SE]; BRUNNBERG LENNART [SE]; O) 7 December 2006 (2006-12-07) abstract; figures	1-3

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 October 2009	20/10/2009

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2009/055622

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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WO 2008020023 A1	21-02-2008	AU 2007286315 A1	21-02-2008
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