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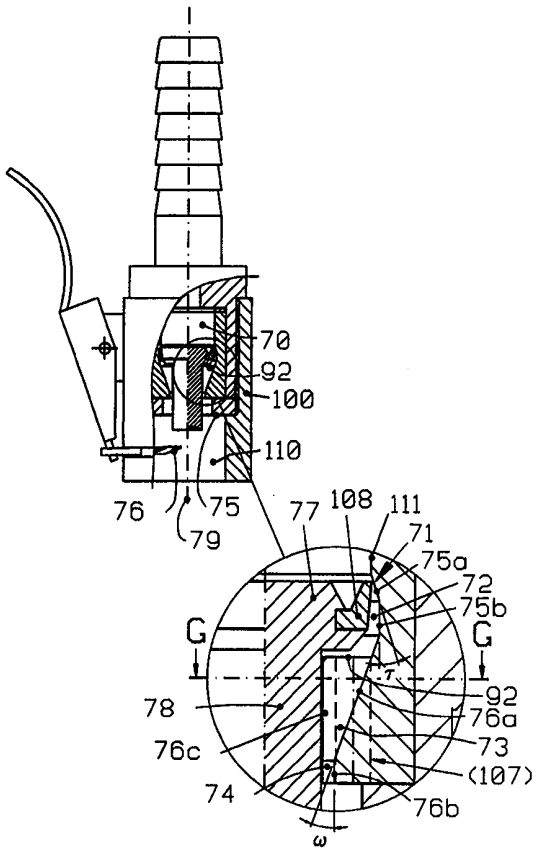
(54) Title: VALVE ACTUATOR

(57) Abstract

The purpose of the invention is to provide a valve actuator with an activating pin of a simple construction. This task is solved by the present invention as recited in claim 1; where in the first position the piston (77, 84) is at a first predetermined distance from the first end (92) of the cylinder (70, 99, 136, 142), in the second position the piston (77, 84) is at a second predetermined distance from the first end (92) of the cylinder (70, 99, 136, 142), said second predetermined distance being larger than said first predetermined distance, and the housing (100, 104, 120, 121, 149, 132) comprises a channel (71, 72, 73, 74, 80, 81, 133, 134, 135) for allowing the conduction of gaseous and/or liquid media between the cylinder (70, 99, 136, 142) and the coupling section (103, 110, 130, 147) when the piston is in the first piston position, inhibiting the conduction of gaseous and/or liquid media between the cylinder (70, 99, 136, 142) and the coupling section (103, 110, 130, 147) when the piston is in the second piston position.



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Valve Actuator 1

FIELD OF THE INVENTION

The present invention relates generally to a valve actuator for valves having a spring-force operated valve core.

BACKGROUND OF THE INVENTION

A valve connector having an activating pin which can move towards a valve under the pressure of liquid and/or gaseous media from a pressure source is well-known from PCT/DK96/00055 and PCT/DK97/00223. However, one disadvantage of conventionel activating pins is their several tiny parts. The complexity of these conventional activating pins makes production of conventional valve connectors more expensive than necessary.

SUMMARY OF THE INVENTION

The present invention provides a valve actuator which comprises an inexpensive combination of a cylinder, within in which the activating pin moves and an activating pin, having a simple construction. This combination can be used in stationary constructions, such as chemical plants, where the activating pin engages the core of a spring force operated valve (e.g. a release valve), as well as in valve connectors (e.g. for inflating vehicle tires). The disadvantage of conventional valve connectors have been overcome by the valve actuator of the present invention. This valve actuator features a piston that in the first position is at a first predetermined distance from the first end of the cylinder. In the piston's second position, it is at a second predetermined distance from the first end of the cylinder. The second predetermined distance is larger than the first predetermined distance and the housing comprises a channel for allowing conduction of gaseous and/or liquid media between the cylinder and the coupling section when the piston is in the first position, thereby inhibiting conduction of gaseous and/or liquid media between the cylinder and the coupling section when the piston is in the second position.

One embodiment of the valve actuator of the present invention features an activating pin with no center drilling and a feed channel from the pressure source to the valve. This feed channel comprises an enlargment of the cylinder diameter which is arrangend around the piston of the activating pin in the bottom of the cylinder, when the piston is in the first position, enabling the medium from the pressure source to flow to the opened core of the spring-force operated valve, e.g. a Schrader valve. The enlargement of the cylinder's diameter may be uniform, or the cylinder wall may contain one or several sections near the

bottom of the cylinder where the distance between the center line of the cylinder and the cylinder wall increases so that gaseous and/or liquid media can freely flow around the edge of the piston when the piston is in the first position. A variant of this embodiment has a valve actuator arrangement of which its cylinder has twice the enlargement of the diameter. The in-between distance of the enlargements can be the same as the in-between distance of the sealing levels of the sealing means. When three valves of different sizes can be coupled the valve actuator comprises a cylinder with three enlargements. It is however also possible to connect valves of different sizes to a single arrangement for the enlargement of the diameter of the cylinder. Now therefore the amount of enlargements can be different from the amount of different valve sizes which can be coupled.

A second embodiment of the present invention features a channel through a part of the body of the valve actuator. The channel forms a passage for gaseous and/or liquid media between the cylinder and the part of the valve actuator which is coupled to the valve. The opening of the channel in the cylinder is located such that, when the piston is in the first position, pressurized gaseous and/or liquid media flowing from the pressure source to the cylinder may flow further through the channel to the valve. When the piston is in the second position, it blocks the opening of the channel in the cylinder so that the flow of pressurized gaseous and/or liquid media is not possible.

Instead of air, (mixes of) gases and/or liquids of any kind can activate and flow around the embodiments of the activating pin in the valve actuator. The invention can be used in all types of valve connectors to which a spring-force operated core (e.g. a Schrader valve) can be coupled irrespective of the method of coupling or the amount of coupling holes in the connector. Furthermore the invention can be coupled to for example a foot pump, car pump, or compressor. The invention can also be integrated in any pressure source (e.g. a handpump or a pressure vessel) irrespective of the availability of a securing means in the valve connector. It is also possible for the invention to be used in permanent constructions where the activating pin of the actuator engages the core of a permanently mounted valve.

Any possible combination of embodiments shown in the specification fall into the scope of the present invention. The various embodiments described above are provided by way of illustration and should not be constructed to limit the invention. Those skilled in the art will readily recognize various modifications and changes which may be made to the present invention without strictly following the exemplary embodiments and applications illustrated and described herein, and without departing from the true spirit and scope of the present

invention.

DESCRIPTION OF THE DRAWINGS

The foregoing features and other aspects of the invention are explained in the following description in connection with the accompagning drawings, wherein:

Figure 1	shows a first embodiment in a clip-on valve connector to which a Schrader valve can be coupled,
Figure 1A	shows an enlargement of a part of Figure 1 with channels around the activating pin,
Figure 1B	shows section G-G of Figure 1A,
Figure 2	shows a second embodiment in a universal clip-on valve connector with a streamlined activating pin,
Figure 2A	shows an enlargement of Figure 2,
Figure 2B	shows section H-H of Fig. 2A,
Figure 3	shows a third embodiment in a squeeze-on valve connector,
Figure 3A	shows an enlargement of a detail of Figure 3,
Figure 4	shows an activating pin and the wall of the cylinder in a permanent assembly (e.g. from a chemical plant),
Figure 5	shows a fourth embodiment in a universal valve connector.

Figure 1 shows an valve actuator in a clip-on valve connector to be connected to e.g. a Schrader valve. The activating pin is very near the first end 92 of the cylinder 70. The connector has a housing 100 and the sealing means comprises one annular portion 75. The securing means comprises temporary thread 76. The housing also has a center axis 79 and a coupling hole 110.

Figure 1A shows an enlarged part of Figure 1. The cylinder 70 has a wall 111 with a diameter which fits the piston ring 108 of the piston 77. Near its first end 92 it comprises wall parts 75a,75b,76a with an enlarged diameter, comprising flow channels 71,72,73 between the piston means 77,108 when the activating pin has enough opened the core of the valve. The flow from the pressure source to the valve can now be established. The first end 92 of the cylinder 70 functions here as a stop for the movement of the activating pin. The channels 73 and 74 are parts of the piston control means 76c. These parts can have several

shapes which depend on the chosen production technique: e.g., channels 73,74 as sector parts of a circle and (107) as cylinders made by injection moulding, while alternatively channels (107) could also be drilled. Channels 73,74 could be considered 'flower shaped', and are constructed to reduce aerodynamic drag. The wall 75a has an angle τ with the center axis 79, which is larger than 0° and smaller than 20°, normally in the interval $1° < \tau < 12°$ with respect to the direction of the gaseous and/or liquid medium or media, respectively coming from the pressure source. The piston control means 76c has three groves with wal 76a and 76b, respectively. The wall 76a has an angle ω which is larger than 0° and smaller than 20° (usually in the interval between 6° and 12°) with respect to the direction of the gaseous and/or liquid medium or media coming from the pressure source. The alternative for the forementioned channels 73 and 74 are channels (107) where the piston control has no grooves. In this alternative, a hole (107) parallel to the center axis 79 and beside the piston control connects channel 75b and the coupling hole (shown as three holes with dotted lines).

Figure 1B shows section G-G from Figure 1A, with the channels 73 and 74 and the stop 92. The alternative channel (107) is sketched by dotted lines.

Figure 2 shows a valve actuator in a universal clip-on valve connector with the housing 104 and with a sealing means comprising a first annular portion 82 and a second annular portion 83 situated coaxially with the center axis 86 of the coupling hole, in the direction of the center axis 86 of the coupling hole 103. The first annular portion 82 is closer to the opening 102 of the coupling hole than the second annular portion 83, and the inner diameter of the first annular portion 82 is larger than the inner diameter of the second annular portion 83. The coupled valves can be secured by at least one 'clip' (= i.e. temporary thread) 76. However, two clips opposite each other 93 are preferable. A taper cone 101 near the sealing surface 82 helps center the valve. The taper cone has an angle $\tilde{\omega}$ with the center axis 86, and normally this angle is $> 45°$. A seperate cylinder 96 with wall 107 is shown which is sealed in cylinder 99. It is fastened by for example a snap-lock 97 in the wall of the cylinder 99. This is an economical way of making the negative slip angle of the wall 75a possible. The cylinder 96 has distant from the piston stop 95 an angle ς, so that the piston ring 108 is non-sealing there.

Figure 2A shows the channels 80 and 81 respectively defined by the walls 87 and 88 of the piston control means, respectively. The activating pin is streamlined with the piston 84 and the piston rod 85. The wall 87 has an angle $\varkappa$ with the center axis 86 seen in the direction of the medium coming from the pressure source, which is larger than 0° and

smaller than 20° (usually in the interval between 6° and 12°). The stepped surface 98 of wall of cylinder 99 which makes an air tight connection from the wall of the cylinder 96 to the cylinder 99. It is of course also possible to make the air tight connection on the other side of the cylinder. In the bottom of the cylinder 96 is the wall 101 shown which together with the piston ring 115 form channel 71.

Figure 2B shows section H-H of Figure 2A and the stop 95 for the movement of the activating pin. Also shown is the wall 88 and the channel 81.

Figure 3 shows an activating pin which is comparable of the one from Figure 1. The piston 129 is also shown. The piston rod 131 need not to be sealed against the piston control. The cylinder 136 of the valve actuator is within cylinder 132 of the valve connector. The coupling section 130 is also shown.

Figure 3A shows a channel 133 with an expansion 135 and a radial drilling 134. The piston ring 139 opens and closes this channel at its orifice 137, depending on the position of the activating pin. The direction of the channel 134 in relation to the center axis is comparable with the angle τ of channel 71 of Fig. 1A. The wall of expansion 135 has an angle comparable to angle ω of the wall 76a Fig. 1A. Also shown is the wall 138 of the cylinder 136.

Figure 4 shows an activating pin and its cylinder, which was shown in Figure 1. This is built in an assembled pipeline housing means 120,121 or the like, in which a spring-force operated valve 122 is situated, e.g. a Schrader valve. The activating pin is engaging with the core 123 of the valve.

Figure 5 shows a valve actuator in a universal valve connector. It is comparable with the one of Figure 1. However, two sealing means 140, 141 with an in-between distance A can seal two valves of different sizes. Two enlargements 1 and 2 of the diameter of the cylinder 142 are shown, with the in-between distance B. An activating pin 143 is also shown, with two engaging levels on a distance B. The in-between distances can be equal or different if for example the valves are of a different type, so that the distance from the core to the sealing is not the same. Between the two channel portions is a cylindrical part 144, with channel portion 145, which fits the piston ring 108. Also is shown the center axis 146, the coupling section 147 and its opening 148 from the housing 149.

PATENT CLAIMS

1. Valve actuator for operating with valves having a spring-force operated valve lever, comprising

- a housing connected to a pressure source;
- within the housing
  - a coupling section for coupling to valves,
  - a cylinder comprising a first end and a second end, the first end being closer to the coupling section than the second end, and
  - means for conducting gaseous and/or liquid media between the pressure source and the cylinder;
- an activating pin for engaging with the spring-force operated valve lever; and
- a piston that is
  - fixedly coupled to the activating pin,
  - located in the cylinder and
  - movable within the cylinder between a first position and a second position

characterized by the fact that

- in the first position the piston (77,84) is at a first predetermined distance from the first end (92) of the cylinder (70,99,136,142),
- in the second position the piston (77,84) is at a second predetermined distance from the first end (92) of the cylinder (70,99,136,142), said second predetermined distance being larger than said first predetermined distance, and
- the housing (100,104,120,121,132,149) comprises a channel (71,72,73,74,80,81,133,134, 135) for
  - allowing the conduction of gaseous and/or liquid media between the cylinder (70,99,136,142) and the coupling section (110,103) when the piston is in the first piston position,
  - inhibiting the conduction of gaseous and/or liquid media between the cylinder (70,99,136,142) and the coupling section (110,103) when the piston is in the second piston position.

2. Valve actuator according to claim 1, **characterized by the fact that** said first predetermined distance is greater than zero.

3. Valve actuator according to claim 1, **characterized by the fact that** said first predetermined distance is approximately zero.

4. Valve actuator according to claim 3, **characterized by the fact that** it comprises a stopper (92,95) to limit the movement of the piston (77,84) in the first piston position.

5. Valve actuator as according to claim 3, **characterized by the fact that** it comprises a tapered portion (87) at the first end of the cylinder (70,99,136,142) and a conical portion in the piston (84) to coincide with said tapered portion when the piston (84) is in the first piston position.

6. Valve actuator according to claim 1, **characterized by the fact that**

- the cylinder (70,99,136,142) comprises a first cylindrical portion (75b) and a second cylindrical portion (107,111,144), where the diameter of said first cylindrical portion is larger than the diameter of said second cylindrical portion and the diameter of said second cylindrical portion is essentially the same as the diameter of the piston means (77,108,84,115), and

- the first position corresponds to the piston (77,84) being in said first portion and the second position corresponds to the piston (77,84) being in said second portion.

7. Valve actuator according to claim 1, **characterized by the fact that** the housing (132) defines a channel (133,134,135) connecting the coupling hole (130) to an orifice (137) in the wall (138), said orifice (137) being situated at a distance from the first end of the cylinder corresponding to the dimension of the piston means (129) added with said first predetermined distance in the axial direction of the cylinder, so that the orifice (137) is situated between the piston (129) and the second end of the cylinder (136) when the piston (129) is in the first piston position.

8. Valve actuator according to claim 1, **characterized by the fact that** the piston (77) is further movable within the cylinder (142) to a third position and a fourth position, corresponding to a third predetermined distance and a fourth predetermined distance from the first end of the cylinder (142) respectively, where said third predetermined distance is larger than said second predetermined distance and said fourth predetermined distance is larger than said third predetermined distance; and

- the cylinder (142) comprises a second channel for

  - allowing the conduction of gaseous and/or liquid media between the cylinder and the coupling section when the piston is in said third position and

  - inhibiting the conduction of gaseous and/or liquid media between the cylinder and the coupling section when the piston is in said fourth position.

9. Valve actuator according to claim 1, **characterized by the fact that** it comprises within

the coupling section sealing means for sealing the valve actuator onto valves of different types and/or sizes, and the sealing means (105,140,141) comprise a first annular portion (82,141) and a second annular portion (83,140) situated coaxially with the centre axis (86,146) of the coupling section (103,147), in the direction of the centre axis (86,146) of the coupling section (103,147), said first annular portion (82,141) is closer to the opening (102,148) of the coupling section (103,147) than said second annular portion (83,140), and the inner diameter of said first annular portion (82,141) is larger than the inner diameter of said second annular portion (83,140).

10. Valve actuator as claimed in claim 1, **characterized by the fact that** it comprises within the coupling section a securing thread (76,93) for securing the valve actuator onto the inflation valve.

11. Valve actuator as claimed in claim 10, **characterized by the fact that** said securing thread is a temporary securing thread (76,93).

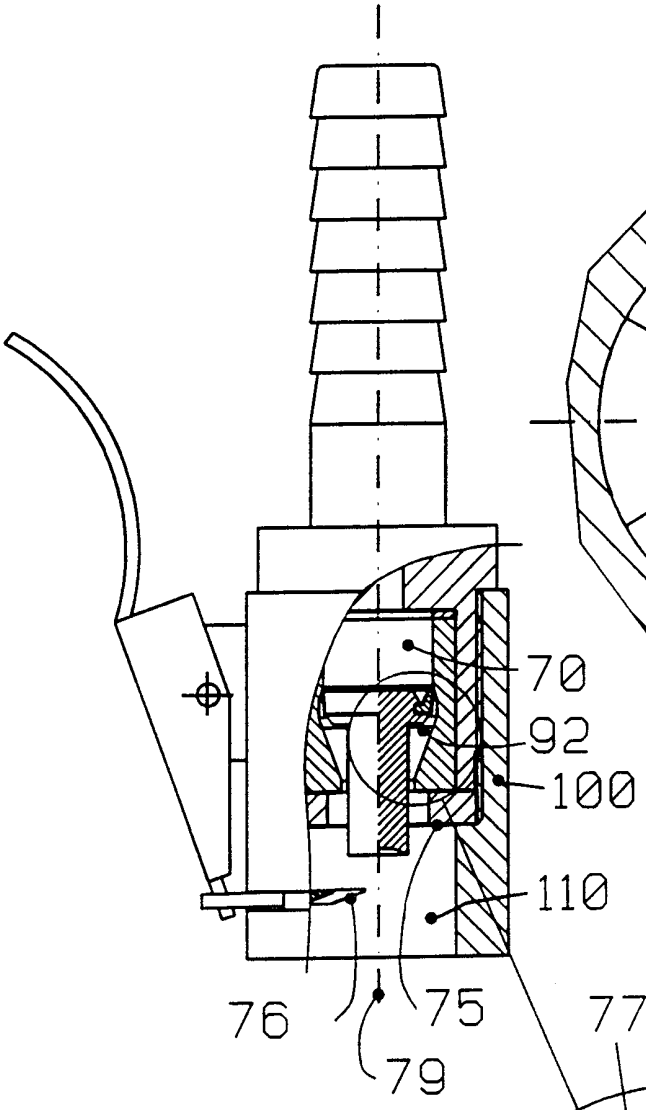

Fig. 1

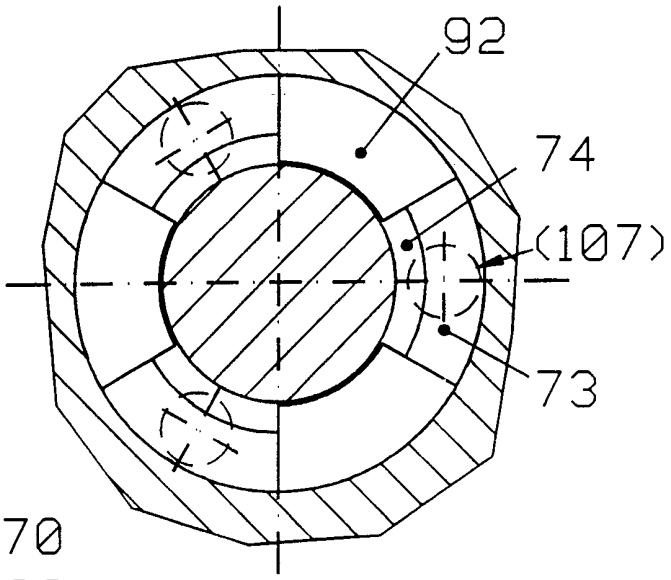

Fig. 1B

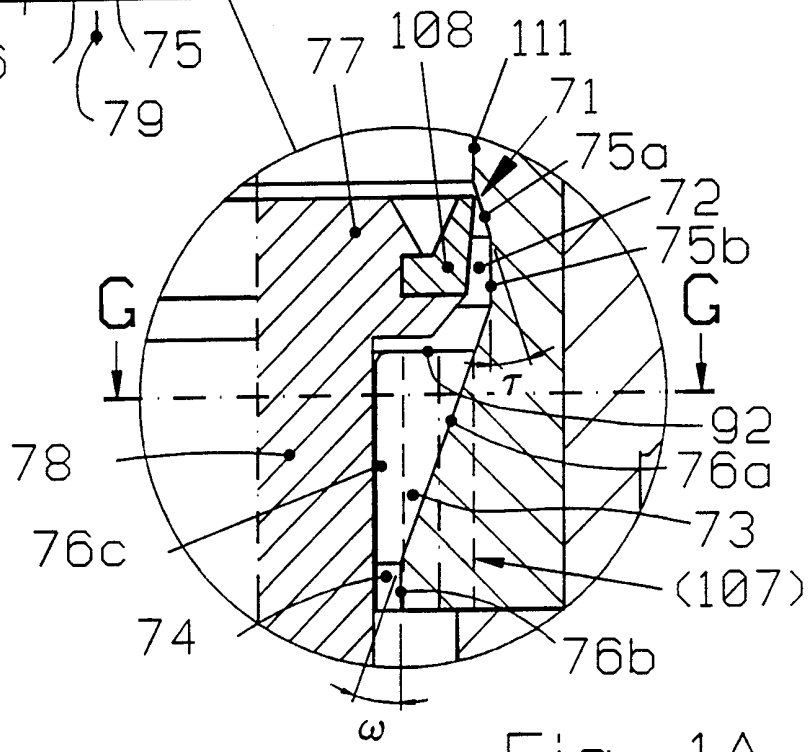

Fig. 1A

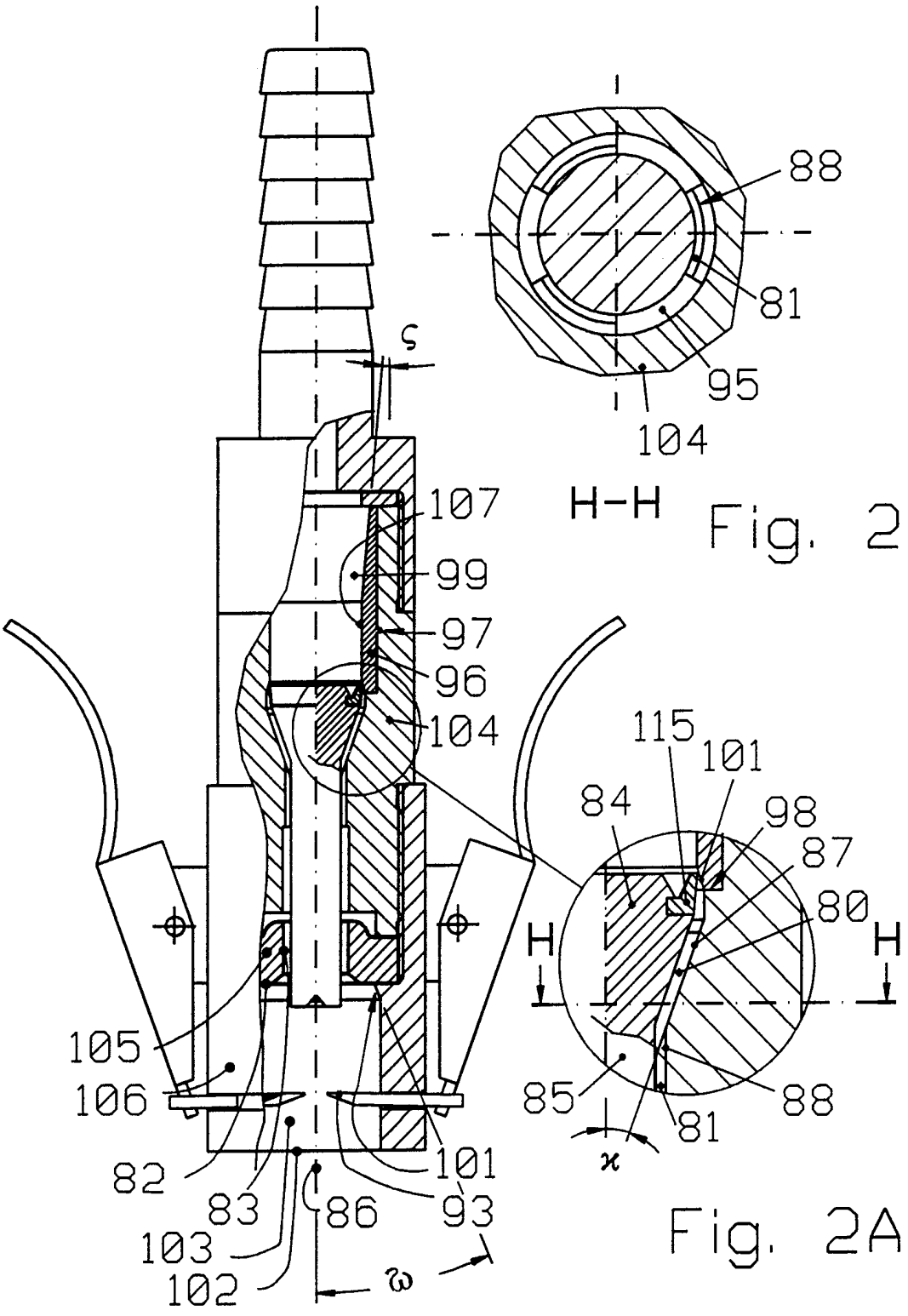

Fig. 2B

Fig. 2A

Fig. 2

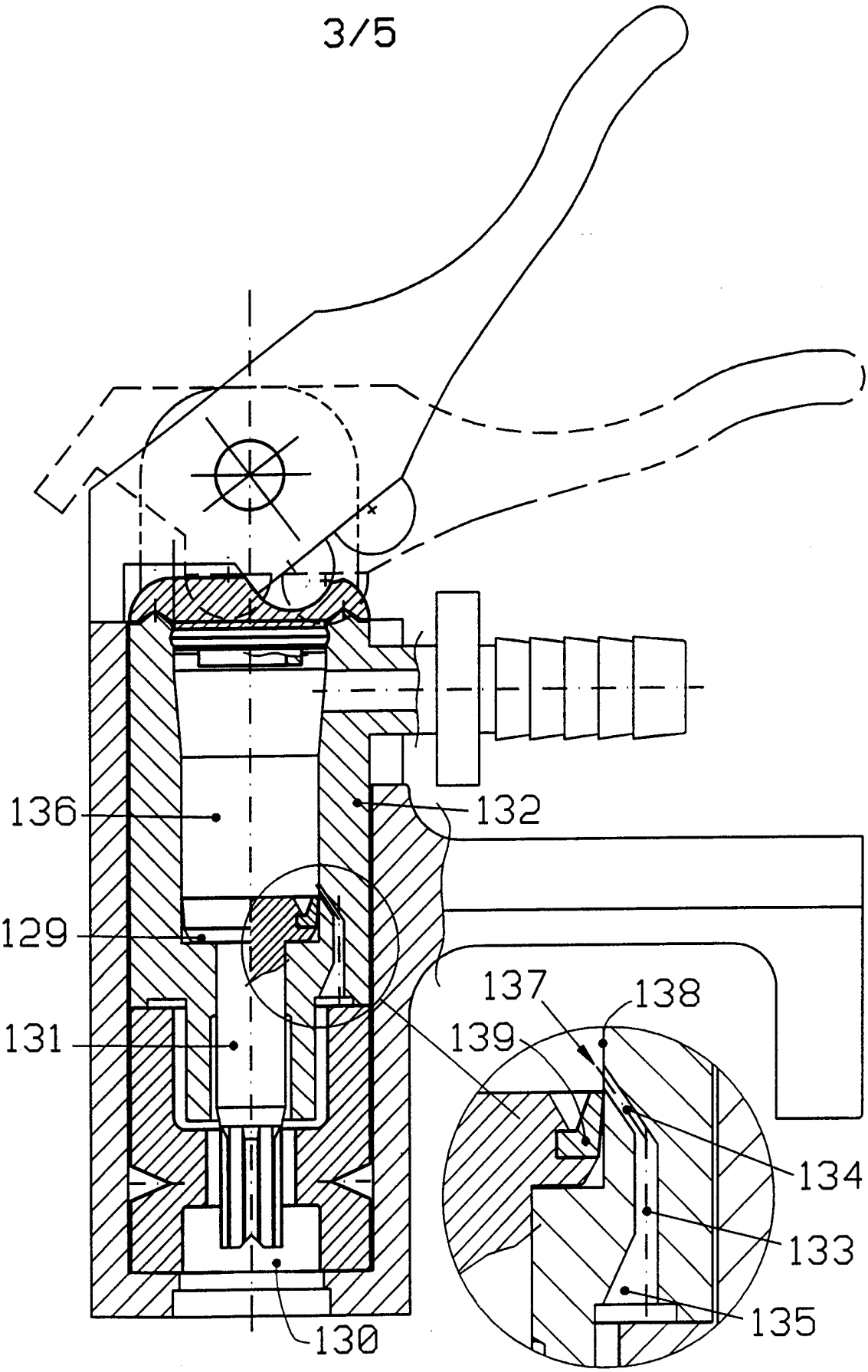

Fig. 3

Fig. 3A

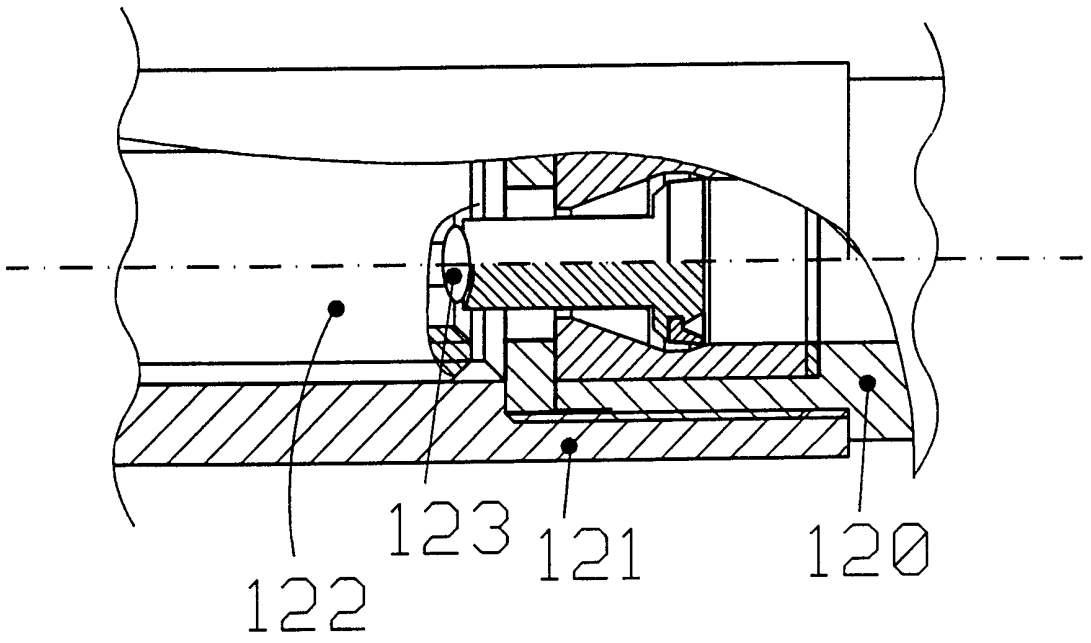

Fig. 4

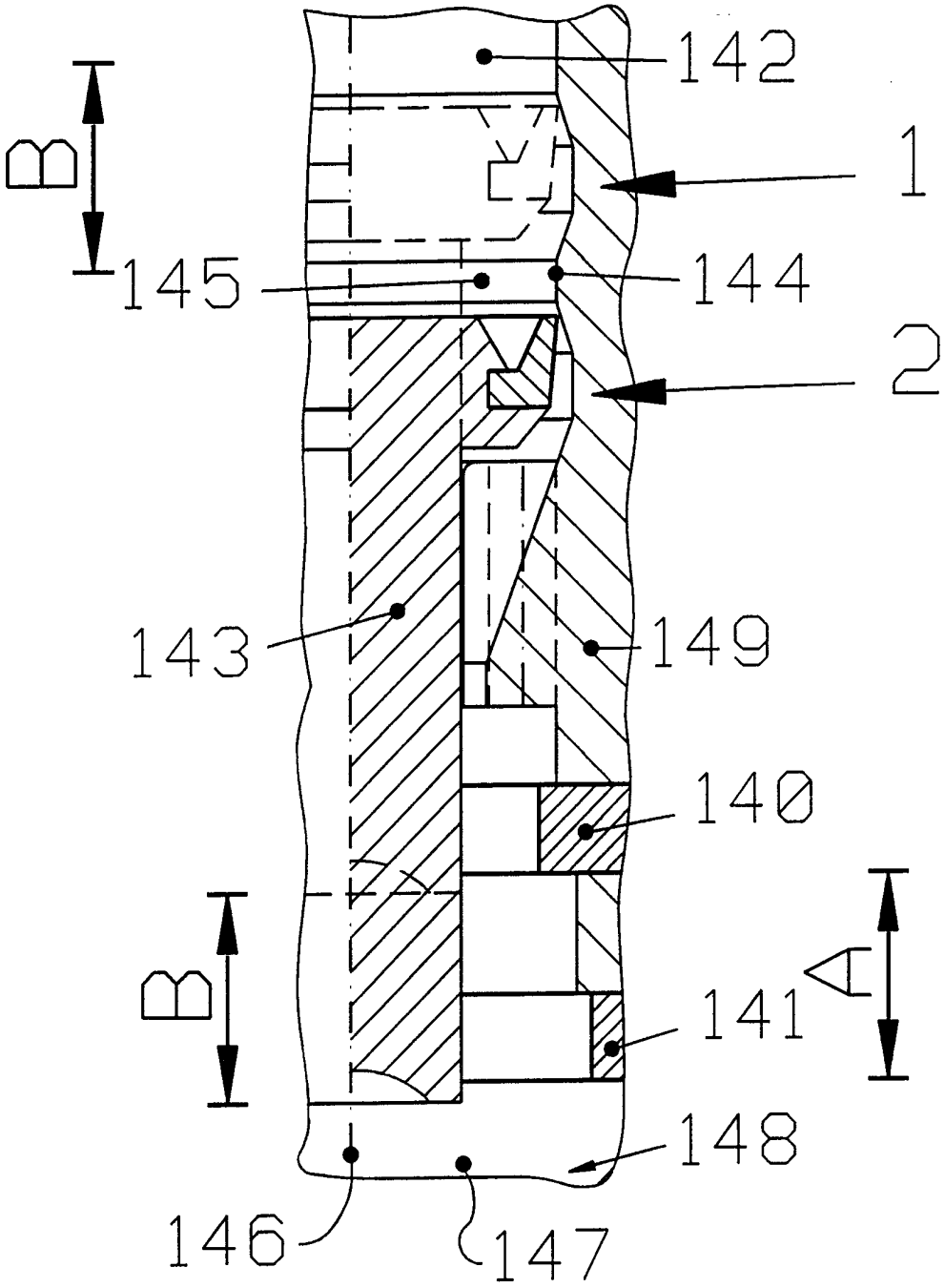

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 98/00507

A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

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

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9610903 A2 (NVB INTERNATIONAL), 18 April 1996 (18.04.96), page 12, line 25 - page 13, line 10, figure 8, pos. 308,309,310,311 -- --------	1-4

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/02/99

International application No.
PCT/DK 98/00507

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