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(54) **EJECTOR-TYPE VACUUM PUMP**

(57) An ejector-type vacuum pump is described, said ejector-type vacuum pump being configured to accommodate two or more ejector cells, each of which two or more ejector cells is separately accessible and replaceable from the outside of the ejector-type vacuum pump. An ejector-cell can be replaced with a passive ejector-cell replacement insert, thereby allowing for facilitated modulation of the suction power. Also, modulation of the suction power can easily be accomplished by replacing an ejector cell with another ejector cell having different nozzle characteristics.

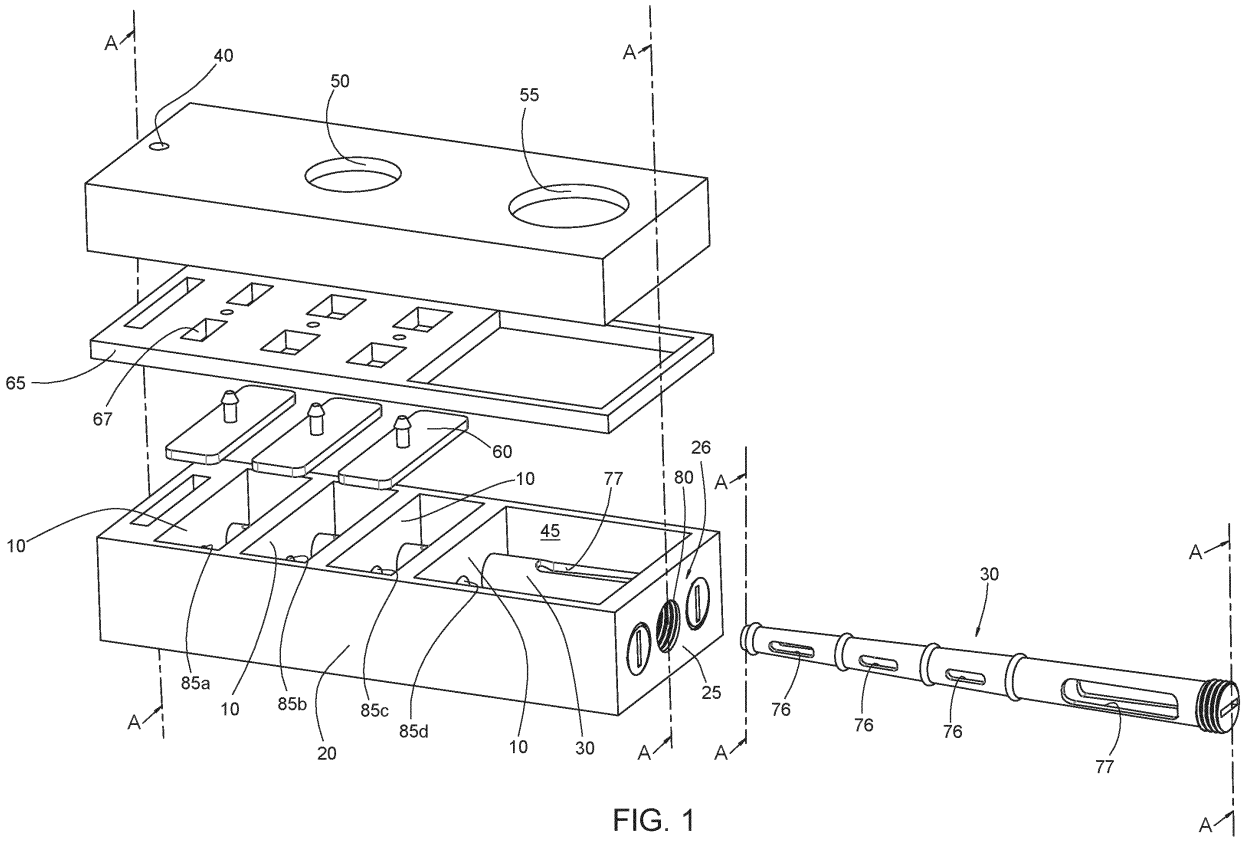

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a vacuum generator, and more particularly to an ejector-type vacuum pump having one or more ejector cells, each of which one or more ejector cells is separately accessible and replaceable from the outside of the ejector-type vacuum pump. A separate ejector-cell of the inventive vacuum pump can be replaced with a passive ejector-cell replacement insert, thereby allowing for facilitated modulation of the suction power of the inventive vacuum pump.

BACKGROUND ART

[0002] Vacuum generators are known in the art. The vacuum generators referred to herein are fed with a flow of pressurized air which produces a reduced pressure in the vacuum generator. Such vacuum generator comprises one or more ejector cells. An ejector cell may also be referred to as a venturi cell. The one or more ejector cells are typically multi-staged. In each stage vacuum can be generated. For each stage in a vacuum generator a suction chamber is provided. A vacuum generator comprising one or more multi-stage ejector cells may be referred to as a multi-stage ejector-type vacuum pump. In the case of a multi-stage ejector-type vacuum pump having two or more, typically two, three or four ejector cells, the ejector cells may be connected in parallel, so that, for each stage, there is a suction chamber shared by the ejector cells. A multi-stage ejector-type vacuum pump wherein the ejector cells are formed internally in the pump body is known e.g. from WO 1999/049216.

[0003] WO 2022/269363 discloses, in Fig. 7, a 2-staged, and, in Fig. 2, a 3-staged ejector-type vacuum pump having four venturi cells. The four venturi cells are arranged in a cluster 40, which cluster can be inserted in one piece into the vacuum generator 1. Thereby, the number of seals required can be kept low. According to WO 2022/269363, a large number of seals, as required when a venturi cell has a cylindrical body allowing easy insertion into a vacuum pump body, promotes the risk of leaks. Also, according to WO 2022/269363, the use of individual venturi cells, as used in EP 2827004 and EP 1064464, would require the assembly and disassembly of each of the cells inserted in the pump body, which increases the time of manufacture of the pump, and the time of its maintenance. The cluster 40 is inserted into a housing 10 and secured therein by the rear face 10d of the housing. The flow rates sucked in and consumed by the vacuum generator disclosed in WO 2022/269363 can be reduced by modulating the number of venturi cells. For this purpose, once the cluster has been removed from the housing, any one of the four three-staged venturi cells can be deactivated by insertion of four plugs 50, 51, 52, 53 into the desired venturi cell. Such modulation moreover requires removal of the cluster in order for the cluster to be accessible for plugging of the desired venturi cell therein.

[0004] It would be desirable to be able to facilitate modulation of the suction power of a vacuum generator.

SUMMARY OF THE INVENTION

[0005] According to the present invention, for an ejector-type vacuum pump having one or more ejector cells, such as disclosed in WO 2022/269363, this object has been accomplished by making each one said one or more ejector cells separately accessible and replaceable from the outside of the ejector-type vacuum pump.

[0006] Accordingly, in one aspect the invention relates to an ejector-type vacuum pump 1 configured to be able to accommodate therein two or more removable ejector cells, the ejector-type vacuum pump comprising: a pump body **10;** a housing **20** configured to accommodate the pump body **10;** two or more removable ejector cells **30;** an inlet **40** provided in the housing configured to receive pressurized air; a suction opening **50** provided in the housing; seals **70** configured to air-tightly seal the two or more ejector cells **30** to the pump body **10,** said two or more ejector cells **30** being removable from the pump body **10** and configured to be secured in an operational position within the housing **20** in an ejector cell seat **85** formed in the pump body, wherein the two or more ejector cells **30** are separate, the pump body **10** exhibits two or more separate ejector cell seats **85** formed in the pump body configured to accommodate the two or more ejector cells, wherein the number of separate cell seats corresponds to the number of the separate ejector cells, wherein, in each one of which separate ejector cell seats **85** a separate ejector cells **30** is fitted, and, wherein the housing **20,** in a rear wall **25** thereof, has a separate opening **80** for each one of said one or two or more ejector cells **30** configured to allow for insertion and removal of a separate ejector cell **30** through said separate opening **80.**

[0007] The present invention allows for readily access of an ejector cell **30** from the outside of the vacuum pump **1** without the vacuum pump having to be opened. A separate ejector cell **30** of the invention can be removed from its position in the vacuum pump for maintenance or for replacement thereof. Thereby, exposure of the interior of the pump, and also of any further ejector cells **30** is minimised, and hence, the risk of fouling or contamination is reduced.

[0008] According to the invention, a separate ejector cell **30** of the two or more separate ejector-cells of the inventive ejector-type vacuum pump 1 can be replaced with a separate ejector-cell replacement insert **35,** configured to correspond to a fully air-tightly plugged ejector cell **30,** which is inserted into one of the two or more separate openings **80.**

[0009] Accordingly, in another aspect the invention relates to an ejector-type vacuum pump **1** configured

to be able to accommodate therein two or more ejector cells, the ejector-type vacuum pump comprising: a pump body **10;** a housing **20** configured to accommodate the pump body **10;** one or more ejector cells **30;** an inlet **40** provided in the housing configured to receive pressurized air; a suction opening **50** provided in the housing; seals **70** configured to air-tightly seal the one or more ejector cells **30** to the pump body **10,** said one or more ejector cells **30** being removable from the pump body **10** and configured to be secured in an operational position within the housing **20** in an ejector cell seat **85** formed in the pump body, wherein the ejector-type vacuum pump **1** additionally comprises one or more removable ejector-cell replacement inserts **35,** each of which one or more removable ejector-cell replacement inserts **35** is configured to correspond to a fully air-tightly plugged ejector cell **30,** in that each one of said one or more removable ejector cells **30** and said one or more removable ejector-cell replacement inserts **35** is separate, in that the pump body **10** exhibits two or more separate ejector cell seats **85** formed in the pump body configured to be able to accommodate the one or more separate ejector cells and the one or more ejector-cell replacement inserts **35,** wherein the number of separate ejector cell seats **85** corresponds to the total number of separate removable ejector cells **30** and separate removable ejector-cell replacement inserts **35,** wherein, in each one of which separate ejector cell seat **85** a separate ejector cell **30** or a separate ejector-cell replacement insert **35** is fitted, wherein the seals **70** are additionally configured to air-tightly seal the one or more separate ejector-cell replacement inserts **35** to the pump body **10,** said one or more separate removable ejector-cell replacement inserts **35** being removable from the pump body **10** and configured to be secured within the housing **20** and, in that the housing **20,** in a rear wall **25** thereof, has a separate opening **80** for each one of said one or one or more ejector cells **30** and for each one of said one or more ejector-cell replacement inserts **35** configured to allow for insertion and removal of a separate ejector cell **30,** and a separate ejector-replacement **35,** respectively, through said separate opening **80.**

[0010] By replacement of a separate ejector cell **30** with a separate ejector-cell replacement insert **35,** the suction power of the vacuum pump **1** will be reduced. The invention thus allows for modulating the suction power performance of the vacuum pump by regulating the number of active or operatable ejector cells in the vacuum pump. The higher the number of ejector-cells **30** the vacuum pump is configured to accommodate, the larger the degree of modulation available by replacement of one or more individual ejector-cells with a corresponding number of individual ejector-cell replacement inserts **35.**

[0011] The seals **70** are preferably recessed into the inventive individual ejector-cell replacement insert **35,** so that also the associated seals will be removed from the pump body along with the ejector-cell replacement insert upon removal of the individual ejector-cell replacement insert from the pump body. This way the seals can easily be inspected, cleaned, and replaced, e.g. due to wear, when needed.

[0012] The annular seals **70** are preferably recessed into the inventive separate ejector cell **30,** so that also the associated seals will be removed from the pump body along with the separate ejector cell upon removal of the individual separate ejector cell from the pump body. This way the seals can easily be inspected, cleaned, and replaced, e.g. due to wear, when needed. According to the present invention, the separate ejector cell **30** does not include a valve, such as e.g. a non-return valve.

[0013] Preferably, the seals **70** are annular. The annular form is believed to facilitate effective sealing, both for an ejector cell **30** and for an ejector-cell replacement insert **35,** as compared to other geometries.

[0014] The inventive individual ejector-cell replacement insert **35** is configured to correspond to a fully air-tightly plugged individual ejector cell **30,** which is inserted into one or more of the separate openings **80.** The seals **70** are configured to air-tightly seal the ejector-cell replacement insert **35** to the pump body **10.**

[0015] By replacement of a separate ejector-cell replacement insert **35** with a separate ejector cell **30,** the suction power of the vacuum pump **1** will be reduced. The invention thus allows for modulating the suction power performance of the vacuum pump by regulating the number of active or operatable ejector cells in the vacuum pump. The higher the number of ejector-cells the vacuum pump is configured to accommodate, the larger the degree of modulation available by replacement of one or more individual ejector-cells with a corresponding number of separate ejector-cell replacement inserts.

[0016] As opposed to the vacuum generator of WO 2022/269363, an individual ejector cell **30** of the inventive vacuum pump **1** can be removed without opening the vacuum pump, without exposing the interior of the pump and/or other ejector cells, thereby risking fouling of the exposed parts, and, also as opposed to the vacuum generator of WO 2022/269363, plugging of an individual ejector cell **30** merely requires replacement, from the outside of the pump, of the individual ejector cell **30** with an individual ejector-cell replacement insert **35.** The removed ejector cell **30** itself does not have to be plugged or modified in any way, but can safely be stored away until needed again, ready for use as is.

[0017] The enhanced modulation of pump performance according to the invention is believed to assist in reducing energy consumption and costs.

[0018] Further embodiments and advantages of the invention will be apparent from the following detailed description and appended claims.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

[0019]

Figure 1 shows an exploded perspective view of a

multi-stage embodiment of the ejector-type vacuum pump **1** of the invention comprising three stages and having three ejector-cells **30,** one of which has been removed, leaving open an opening **80** in the vacuum pump housing **20.**

Figure 2 shows a view of a cross-section in the plane **A-A** as indicated in **FIG. 1,** wherein the three stages of vacuum pump **1** and the ejector-cell seats **(85a-85d),** in which seats the removed ejector cell is to be accommodated, can be seen.

Figure 3 shows a side view of the removed ejector-cell **30** in **FIG. 1.**

Figure 4 shows a more detailed cross-sectional view of the ejector-cell **30** in **FIG. 3** along the line **B-B,** wherein the three stages of ejector-cell **30** can be seen.

Figure 5 shows a side view of an embodiment of an ejector-cell replacement insert **35,** configured to replace the removed ejector-cell **30** shown in FIGS. 1-4.

Figure 6 shows a cross-sectional view of the ejector-cell replacement insert **35** in **FIG.** 5 along the line **C-C.**

DETAILED DESCRIPTION OF THE INVENTION

[0020] The inventive vacuum pump **1** is configured to be able to accommodate two or more ejector cells **30.** Accordingly, in an embodiment with only two ejector cell seats **85,** each one of the two seats can be fitted with an individual ejector cell **30,** one of which could be replaced with an ejector-cell replacement insert **35,** so that the inventive vacuum pump will comprise at least one ejector cell **30** also in a situation wherein one ejector cell has been replaced with an ejector-cell replacement insert **35.** Typically, the inventive vacuum pump 1 is configured to accommodate three or more ejector cells, such as 3, 4, 5 or 6 separate ejector cells. The ejector cells are arranged in parallel, and can e.g. be stacked in layers, such as e.g. divided into 2, 3 or 4 layers each having e.g. 2 to 4 ejector cells, or arranged so as to form a cylinder.

[0021] The number of stages of an inventive multi-stage ejector-type vacuum pump can typically be 2, 3 or 4. In the case of 2, 3, or 4 stages, for improved maintained vacuum level after discontinued flow of pressurized air, a check-valve **60** (not shown) common to all stages of the inventive multi-stage vacuum pump may be provided connected to the suction opening **50.** For an enhanced vacuum level and for energy saving purposes, it is preferred that a separate check-valve **60** be provided for each one of all stages, e.g. such as shown in **FIGS. 1** and **2.** When present, the check-valve of a certain stage is preferably common to all injectors of that stage, e.g. such as shown in **FIGS. 1** and **2.** When present, a check-valve **60** (not shown) may be common to two or more stages of the inventive multi-stage vacuum pump **1.** Preferably, however, as already pointed out above, and, as shown in **FIGS. 1** and **2,** a separate a separate check-valve **60** is provided for each one of the stages. When two or more stages are included in the inventive ejector-type vacuum pump **1,** a common vacuum chamber **47** is provided, such as shown in **FIGS. 1** and **2,** into which chamber each one of the stages opens. The common vacuum chamber **47** is configured to fluidly connect all stages of an inventive multi-stage vacuum pump embodiment **1** with the suction opening **50.**

[0022] A check-valve **60** can e.g. simply be embodied as a flap valve, such as shown in **FIG. 1.** A flap valve **60** can suitably be made from a flexible material, such as an elastomer. When a separate check-valve **60** is provided for each one of the stages, the check-valves can be attached to a valve-opening plate **65** having openings **67** configured to fluidly connect the stages of the inventive multi-stage ejector-type vacuum pump **1** with the common vacuum chamber **47,** such as indicated in **FIGS. 1** and **2.**

[0023] An exhaust chamber **45** is formed in the inventive pump from which exhaust air is exited through exhaust opening **55.** The exhaust chamber **45** is configured to receive exhaust air being expelled from the ejector cells **30** from the last stage of the ejector pump. Each ejector cell **30** is provided with one or more exhaust openings **77,** which open into exhaust chamber **45.**

[0024] The ejector-cell replacement insert **35** has a form similar to that of an ejector-cell **30.** Since the function of the ejector-cell replacement insert **35** is plugging an ejector-cell position in the vacuum pump body **10,** it can be made simple and light-weight, such as in a suitable plastic material. Similar seals **70** are used both for the ejector-cell replacement insert **35** and for the ejector-cell **30.** In a preferred embodiment the inventive ejector-cell replacement insert **35** is integrally formed in one piece, with exception for the seals **70,** as shown in **FIG. 4.**

[0025] The ejector-cell **30** and ejector-cell replacement insert **35,** respectively, preferably comprise a locking portion **90** configured to be releasably secured to the housing **20** from the outside in the separate opening **80.** The locking portion **90** is preferably attached to the ejector-cell **30** and ejector-cell replacement insert **35,** respectively, so as to allow for the ejector-cell **30** and ejector-cell replacement insert **35** to be pulled out from the vacuum pump by pulling the locking portion **90.** The type of locking of locking portion **90** to the housing **20** is not critical and be a twist-lock fitting, e.g. such as shown in the **FIGS.,** or a quick release coupling, such as e.g. of bayonet-type (not shown).

[0026] An ejector-cell **30** and an ejector-cell replacement insert **35** preferably comprise similar locking portions **90.**

[0027] The locking portion **90** could be formed as a separate member, i.e. as locking member **90** (not

shown). The attachment of a separate locking member **90** to an ejector-cell **30** or to an ejector-cell replacement insert **35,** can suitably be a snap fitting (not shown).

[0028] In one embodiment, locking member **90** is rotatably attached to the ejector-cell **30** (not shown) and to the ejector-cell replacement insert **35** (not shown), such that when the locking member **90** is a twist lock member, the locking member can be twisted without the ejector-cell or the ejector-cell replacement insert being twisted.

[0029] When the locking portion **90** has been unlocked from the opening **80,** the ejector-cell or the ejector-cell replacement insert can be pulled out from the vacuum pump by pulling the locking portion which is attached to the ejector-cell **30** or the ejector-cell replacement insert **35.**

[0030] For improved structural integrity and ease of manufacture of an inventive ejector-cell replacement insert **35,** it is preferred to make the locking portion **90** integral with the ejector-cell replacement insert **35** as shown in **FIGS. 5** and **6.** For enhanced ease of manufacture, and for simplified marking of an ejector cell **30,** e.g. colour marking corresponding to the performance of the ejector cell, it is presently preferred for the ejector-cell **30** that the locking portion **90** is formed as a separate locking member **90,** preferably configured to be snap fitted on to the ejector cell **30.** For improved robustness of an inventive ejector cell **30** having a separate locking member **90** attached thereto, it is preferred that the locking member in its attached position to the ejector cell **30** is prevented from rotation, e.g. by one or more peripheral protrusions (not shown) formed on the rear part of the ejector cell **30,** and one or more corresponding openings or recesses (not shown) formed in the locking member **90** into which opening or recess a peripheral protrusion fits.

[0031] Each ejector cell comprises in its front-end a first nozzle **75** configured to receive pressurized air from inlet **40.** A given first nozzle **75** can be configured to provide a certain maximum performance. Accordingly, different first nozzles can be used to provide different maximum performance to different ejector cells. Hence, according to the invention modulation of the suction power can easily be accomplished by replacing an ejector cell with another ejector cell having different nozzle characteristics. In preferred embodiments, the first nozzle **75** of an ejector cell **30** is configured to be replaceably attached to the ejector cell, such as by means of a snap fitting.

[0032] While there will be a nozzle provided for each stage of the inventive ejector pump, all of which could be configured differently in different ejector cells, it is presently considered more efficient and hence preferred to provide the variability of nozzle characteristics by varying the first nozzle **75** only. Accordingly, in a preferred embodiment, the first nozzle is configured to be attached to the ejector cell **30.** In such embodiments, such as shown in **FIG. 3,** the number of seals **70** on an ejector cell equals the number of stages + 1, i.e. one for each one of the four portions **a, b, c,** and **d** forming cell seat **85.** Accordingly, the ejector-cell shown **30** in **FIGS. 3** and **4,** having three nozzles, which is configured to be used in a three-staged ejector pump, consequently exhibits 4 seals **70.** Similarly, an ejector-cell replacement insert **35** such as shown in **FIGS.** 5 and **6,** which is configured to be used in a three-staged ejector pump, consequently also exhibits 4 seals **70.**

[0033] For each nozzle of an ejector cell **30,** one or more inlet openings **76** are provided on the ejector cell aft of the nozzle.

[0034] The performance of a given ejector cell is preferably configured to be recognizable from the outside, e.g. from a colour code or a marking provided on the outer surface **100** of the locking portion **90,** which portion for this purpose preferably takes the form of a separate locking member **90.** Similarly, an ejector-cell replacement insert **35** is preferably also configured to be recognizable from the outside.

[0035] The cell seats **85** preferably exhibit a stopping means configured to prevent an ejector cell or an injector-cell replacement insert from being further inserted, beyond the stopping means, into the pump body. In a preferred embodiment, the front-end portion **85a** of each cell seat **85** exhibits a reduced diameter (not shown) configured to prevent the first nozzle **75** of an ejector cell **30** from being further introduced into the pump body. As will be understood from the present disclosure, the stopping means must be configured to allow for pressurized air to enter into the first nozzle.

[0036] In preferred embodiments, a tool coupling portion is provided in the outer surface **100** of the locking portion **90.** For simplified locking, unlocking and replacement of an ejector cell or ejector-cell replacement insert, the tool coupling portion can e.g. be embodied as a recess in the surface **100** configured to couple with a tool, e.g. a slot **110** configured to couple which e.g. a coin or screw driver, e.g. as shown in **FIGS. 1, 2, 4,** and **6.**

[0037] For a desired quick response time of the inventive ejector pump **1,** the inner volume of the pump should be kept small.

LIST OF REFERENCE NUMERALS USED

[0038]

1	ejector-type vacuum pump
10	pump body
20	vacuum pump housing
25	rear wall of housing 20
26	outer surface of the rear wall 25
30	removable ejector cell
35	ejector-cell replacement insert
40	inlet for pressurized air
45	exhaust chamber
47	common vacuum chamber
50	suction opening
55	exhaust opening
60	check-valve
65	valve opening plate

67 valve opening
70 seals
75 first nozzle of ejector cell
76 ejector-cell inlet opening
77 ejector-cell exhaust opening
80 separate ejector-cell opening
85 separate ejector-cell seat
90 locking portion
100 outer surface of locking portion 90
110 tool coupling portion in outer surface of locking portion
A-A section through vacuum pump and separate removed ejector cell
B-B section through a separate ejector cell
C-C section through a separate ejector-cell replacement insert

Claims

1. An ejector-type vacuum pump (1) configured to be able to accommodate therein two or more ejector cells, the ejector-type vacuum pump comprising: a pump body (10); a housing (20) configured to accommodate the pump body (10); two or more ejector cells (30); an inlet (40) provided in the housing configured to receive pressurized air; a suction opening (50) provided in the housing; seals (70), configured to air-tightly seal the two or more ejector cells (30) to the pump body (10), said two or more ejector cells (30) being removable from the pump body (10) and configured to be secured in an operational position within the housing (20) in an ejector cell seat (85) formed in the pump body, **characterized in that** the two or more removable ejector cells (30) are separate, the pump body (10) exhibits two or more separate ejector cell seats (85) formed in the pump body configured to accommodate the two or more separate removable ejector cells, wherein the number of separate cell seats (85) corresponds to the number of separate removable ejector cells (30), wherein, in each one of said separate ejector cell seats (85) a separate removable ejector cell (30) is fitted, and, **in that** the housing (20), in a rear wall (25) thereof, has a separate opening (80) for each one of said two or more separate removable ejector cells (30) configured to allow for insertion and removal of a separate removable ejector cell (30) through said separate opening (80).

2. The ejector-type vacuum pump (1) of claim 1, wherein each one of the two or more ejector cells (30) comprises a locking portion (90) configured to be releasably secured to the housing (20) from the outside in said separate opening (80).

3. The ejector-type vacuum pump (1) of claim 2, wherein the locking portion (90) is formed as a separate member axially attached to the respective ejector cell (30).

4. The ejector-type vacuum pump (1) of claim 2 or 3, wherein, in an outer surface (100) of the locking portion (90), a tool coupling portion (110) is formed.

5. The ejector-type vacuum pump (1) of any one of the previous claims, wherein a nominal maximum performance of each ejector cell (30) is recognizable from the outside, e.g. from the outer surface (100) of the locking portion (90) having a certain colour or a marking provided on the outer surface (100) of the locking portion (90) corresponding to a certain nominal maximum performance of the ejector cell (30).

6. The ejector-type vacuum pump (1) of any one of the previous claims, wherein the seals (70) are annular and are recessed into the two or more ejector cells (30).

7. An ejector-type vacuum pump (1) configured to be able to accommodate therein two or more ejector cells, the ejector-type vacuum pump comprising: a pump body (10); a housing (20) configured to accommodate the pump body (10); one or more ejector cells (30); an inlet (40) provided in the housing configured to receive pressurized air; a suction opening (50) provided in the housing; seals (70) configured to air-tightly seal the one or more ejector cells (30) to the pump body (10), said one or more ejector cells (30) being removable from the pump body (10) and configured to be secured in an operational position within the housing (20) in an ejector cell seat (85) formed in the pump body, **characterized in** additionally comprising one or more removable ejector-cell replacement inserts (35), each of which one or more removable ejector-cell replacement inserts (35) is configured to correspond to a fully air-tightly plugged ejector cell (30), **in that** each one of said one or more removable ejector cells (30) and said one or more removable ejector-cell replacement inserts (35) is separate, **in that** the pump body (10) exhibits two or more separate ejector cell seats (85) formed in the pump body configured to be able to accommodate the one or more separate ejector cells and the one or more ejector-cell replacement inserts (35), wherein the number of separate ejector cell seats (85) corresponds to the total number of separate removable ejector cells (30) and separate removable ejector-cell replacement inserts (35), wherein, in each one of which separate ejector cell seat (85) a separate ejector cell (30) or a separate ejector-cell replacement insert (35) is fitted, wherein the seals (70) are additionally configured to air-tightly seal the one or more separate ejector-cell replacement inserts (35) to the pump body (10), said one or more separate removable ejector-cell replacement inserts (35) being removable from the pump body (10) and con-

figured to be secured within the housing (20) and, **in that** the housing (20), in a rear wall (25) thereof, has a separate opening (80) for each one of said one or one or more ejector cells (30) and for each one of said one or more ejector-cell replacement inserts (35) configured to allow for insertion and removal of a separate ejector cell (30), and a separate ejector-replacement (35), respectively, through said separate opening (80).

8. The ejector-type vacuum pump (1) of claim 7, wherein each one of the one or more ejector-cell replacement inserts (35), comprises a locking portion (90) configured to be releasably secured to the housing (20) from the outside in said separate opening (80).

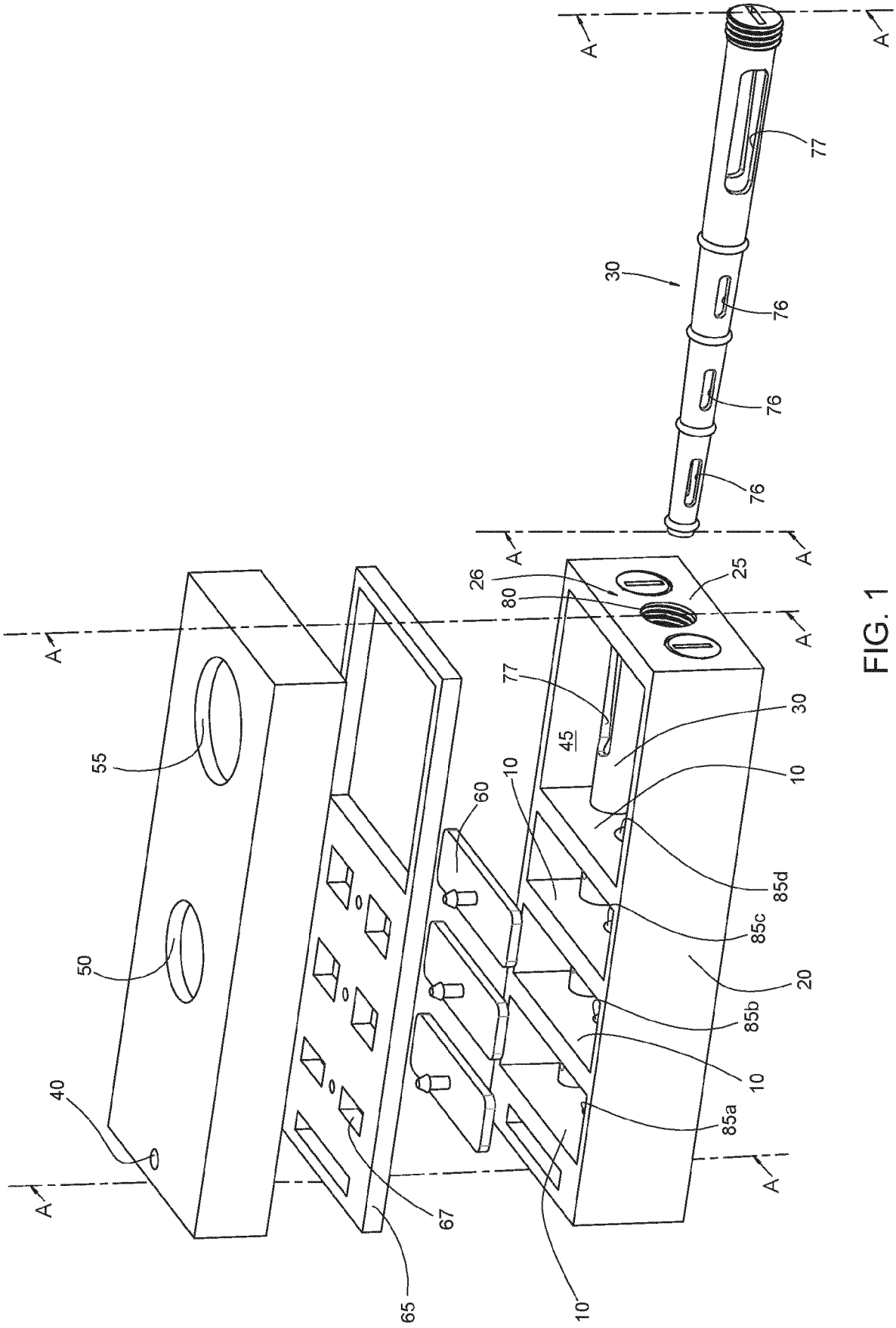
9. The ejector-type vacuum pump (1) of claim 8, wherein, in an outer surface (100) of the locking portion (90), a tool coupling portion (110) is formed.

10. The ejector-type vacuum pump (1) of any one of claims 7-9, wherein an ejector-cell replacement insert (35) is configured to be recognizable from the outside, e.g. from having a certain colour or a marking provided on the outer surface (100) of the locking portion (90).

11. The ejector-type vacuum pump (1) of any one of the previous claims, wherein the ejector-type vacuum pump (1) is a multi-stage ejector-type vacuum pump, preferably comprising 2, 3, or 4 stages, each one of which stages is fluidly connected to the suction opening (50) via a common vacuum chamber (47).

12. The multi-stage ejector-type vacuum pump (1) of claim 11, comprising a check-calve (60) common to one or more of the stages configured to prevent a flow of air from exiting from the common vacuum chamber (47) into the suction opening (50).

13. The multi-stage ejector-type vacuum pump (1) of claim 11 or 12, comprising a separate respective common check-calve (60) for each one of the one or more stages configured to prevent a flow of air from exiting from a stage into the common vacuum chamber (47) through a valve opening (67).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85d
85c
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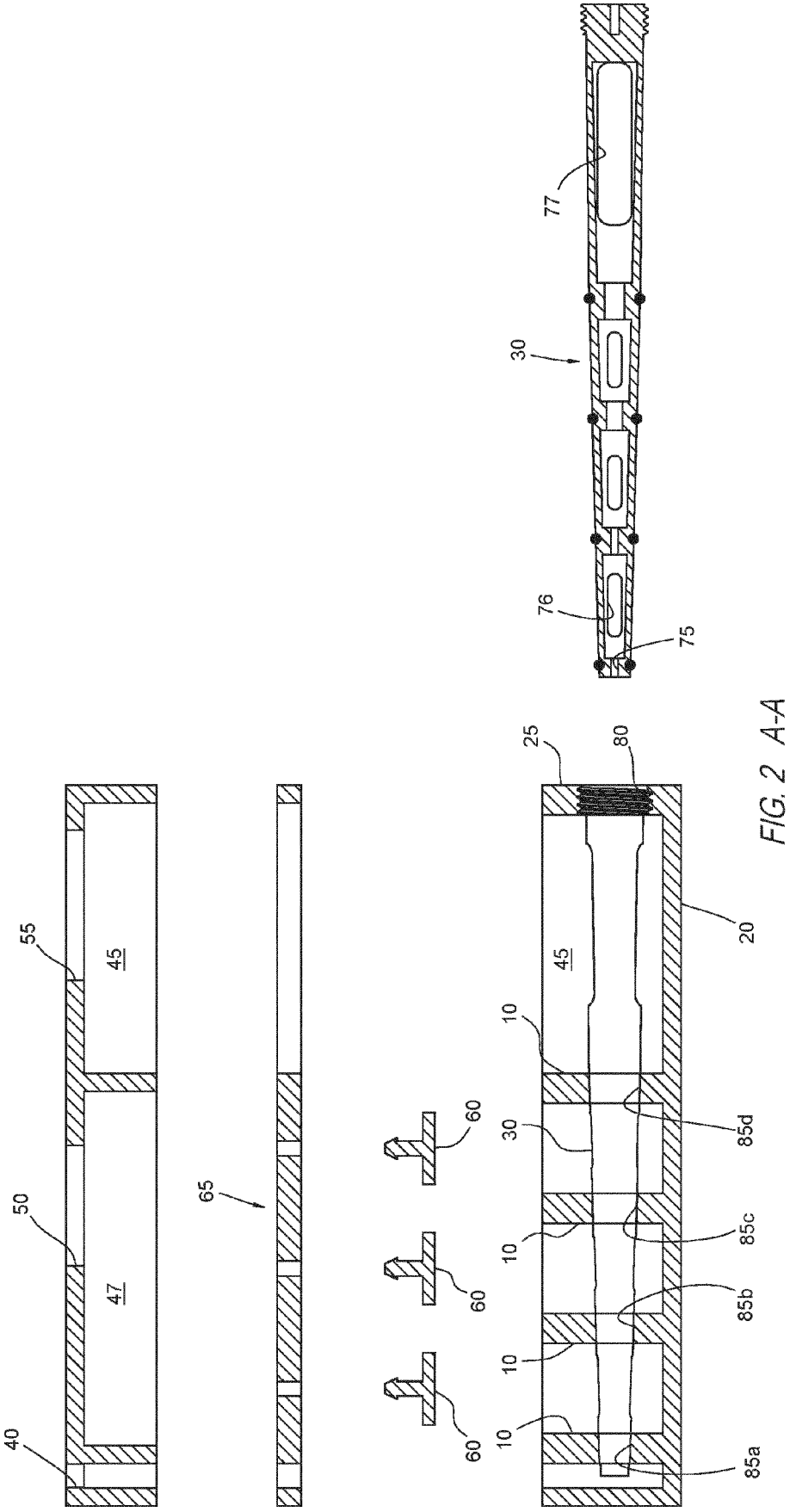
20
85b
10
40
85a
A
A
67
65
10

FIG. 1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85c
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85b
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85a
55
45
50
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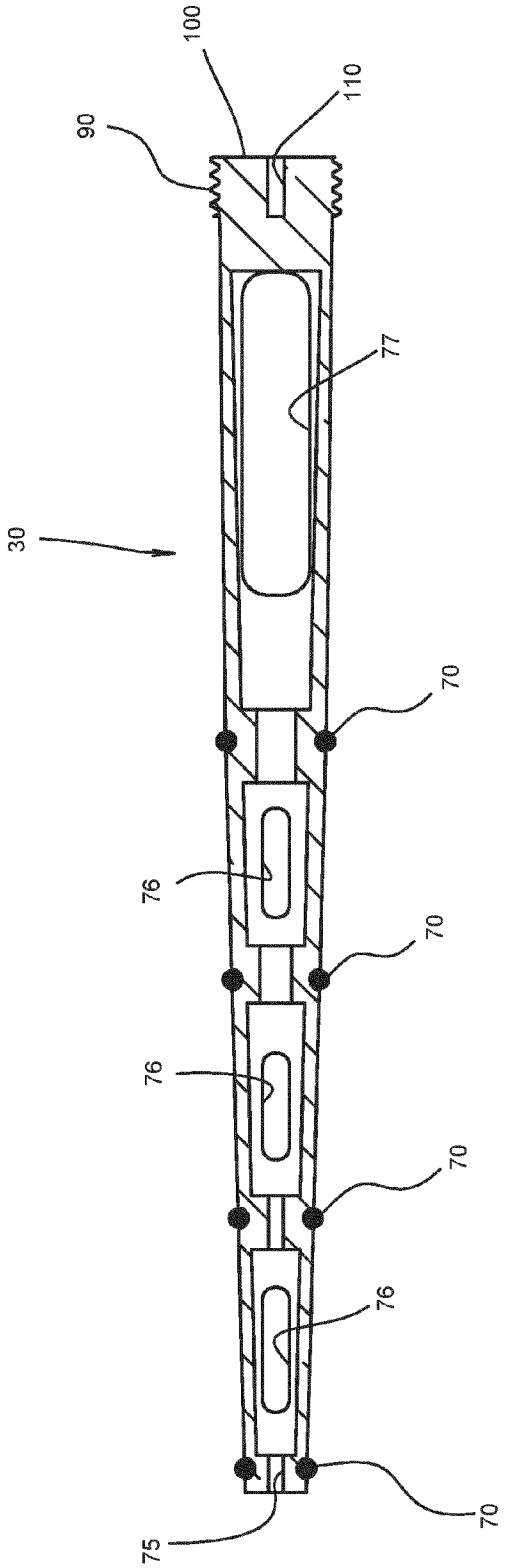
40
65

FIG. 2 A-A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76
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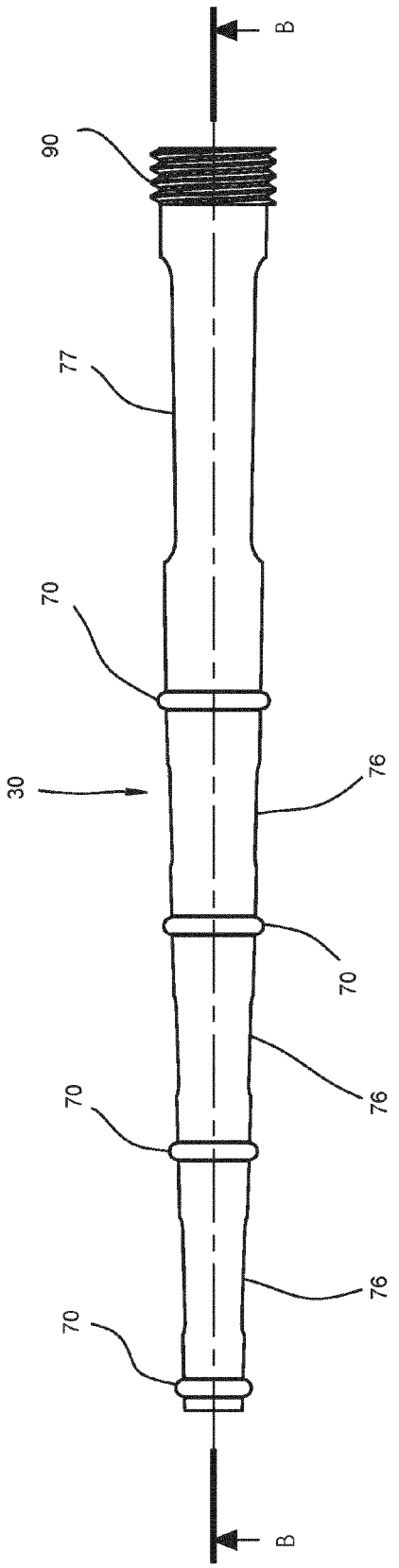
76
70
76
75
70

FIG. 4 B-B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70
B

FIG. 3

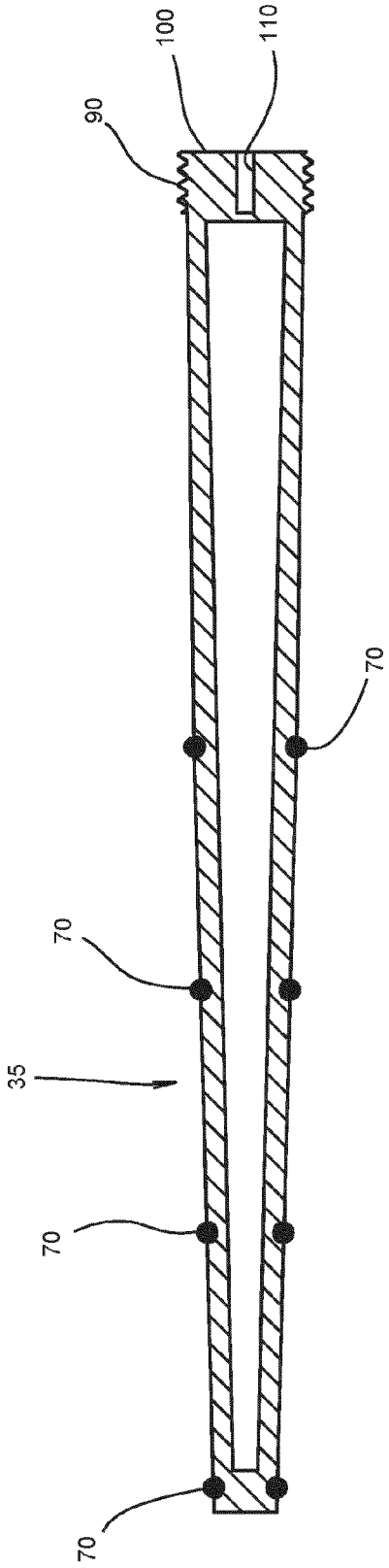

FIG. 6 C-C

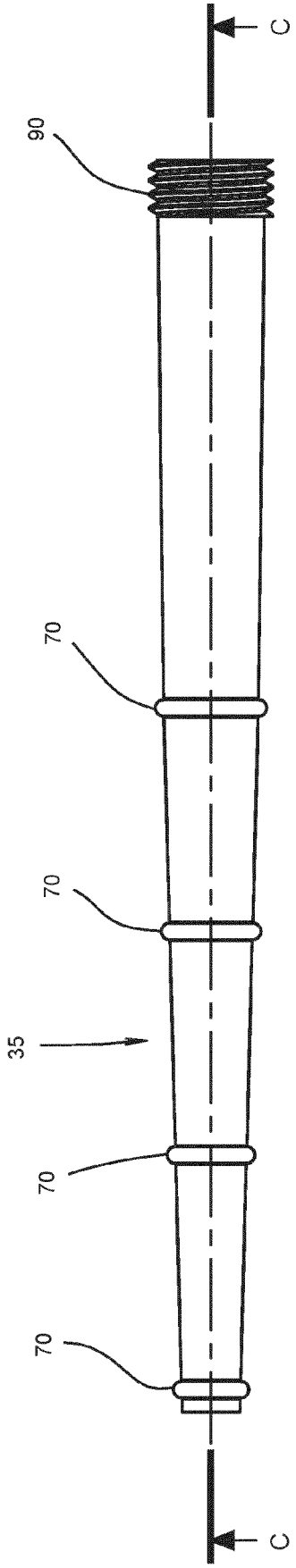

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 1840

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1

Place of search	Date of completion of the search	Examiner
Munich	19 April 2024	Homan, Peter

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