US 20190323349A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2019/0323349 A1

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(43) Pub. Date: Oct. 24, 2019

(54) SCREW ROTOR DEVICE

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(21) Appl. No.: **16/462,279**

(22) PCT Filed: **Nov. 20, 2017**

(86) PCT No.: **PCT/GB2017/053481**

§ 371 (c)(1),
(2) Date: **May 20, 2019**

(30) **Foreign Application Priority Data**

Nov. 21, 2016 (GB) 1619656.0

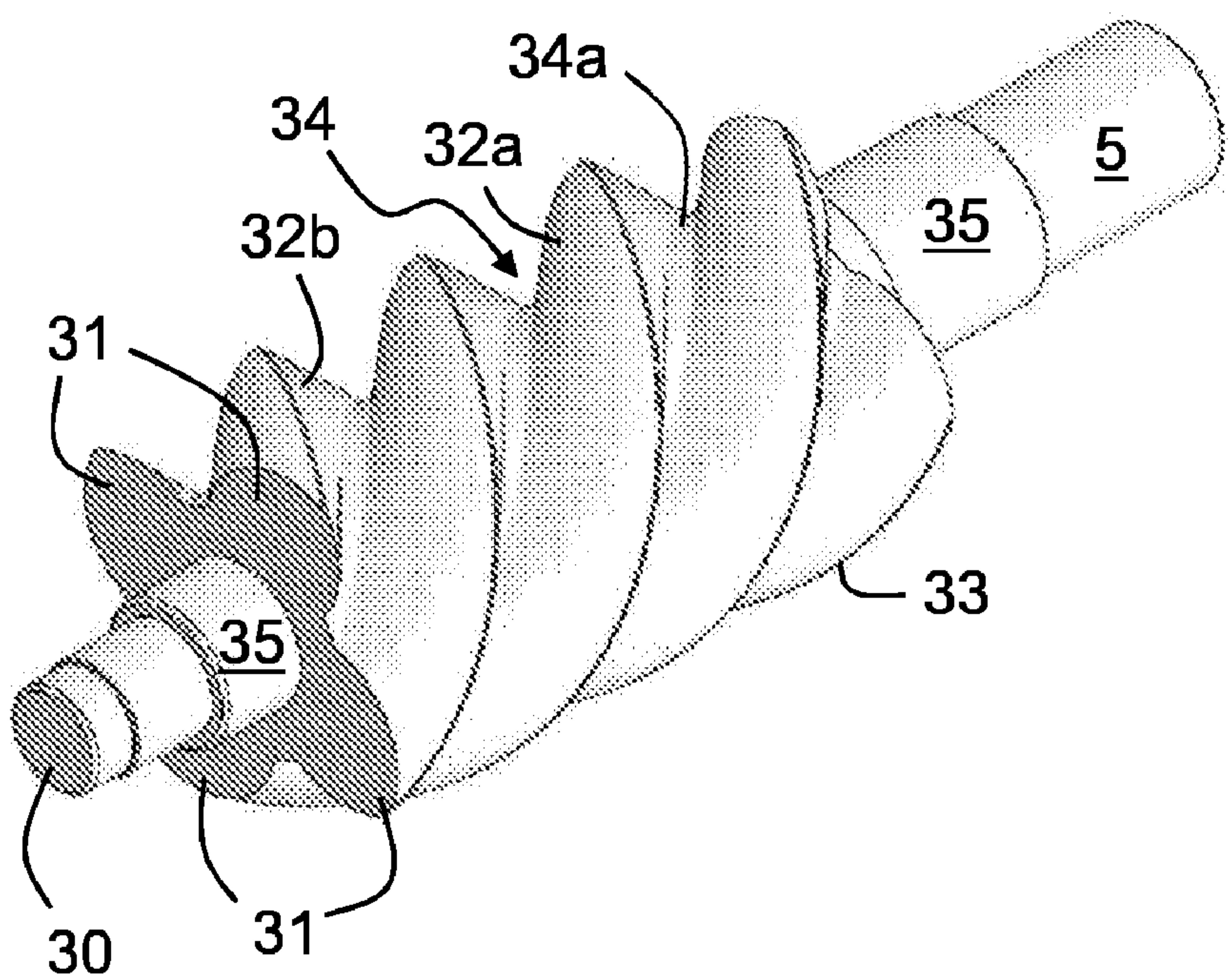
Publication Classification

(51) **Int. Cl.**
F01C 1/08 (2006.01)
F01C 21/08 (2006.01)

(52) **U.S. Cl.**
CPC ***F01C 1/082*** (2013.01); ***F01C 21/08*** (2013.01)

(57) **ABSTRACT**

A screw rotor device includes a first rotor having a plurality of helical lobes about its periphery, a second rotor having a plurality of helical flutes about its periphery and a housing with a high pressure port and a low pressure port. The first and second rotors are rotatably mounted within the housing such that the lobes intermesh with the flutes for conveying, in use, a fluid between the high pressure port and the low pressure port. At least one of the rotors has a helical profile that changes along its length such that a gap is described between intermeshing lobes and flutes adjacent the high pressure port which is larger than a gap described between intermeshing lobes and flutes adjacent the low pressure port. The screw rotor device may be used for conveying a fluid.



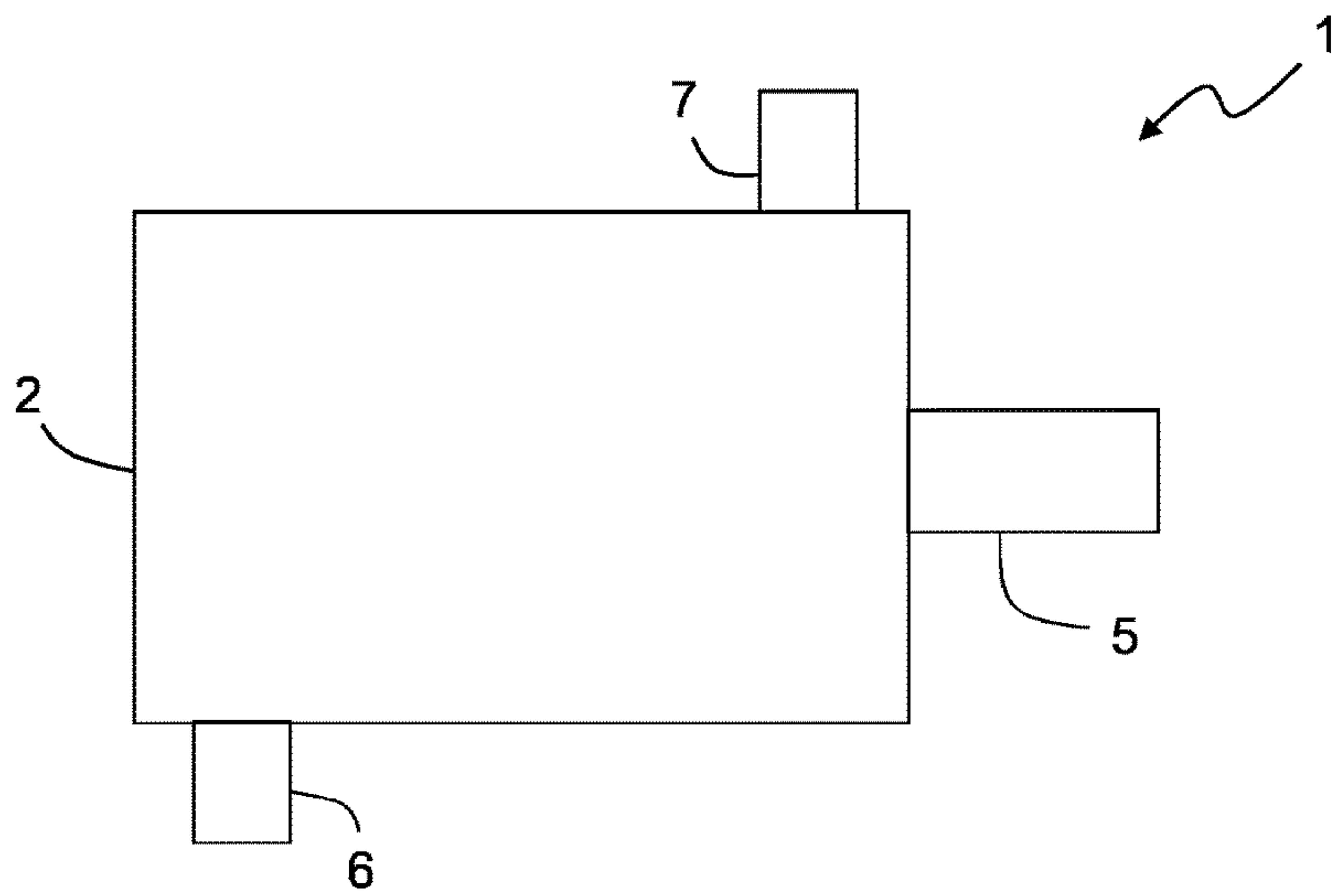


FIGURE 1

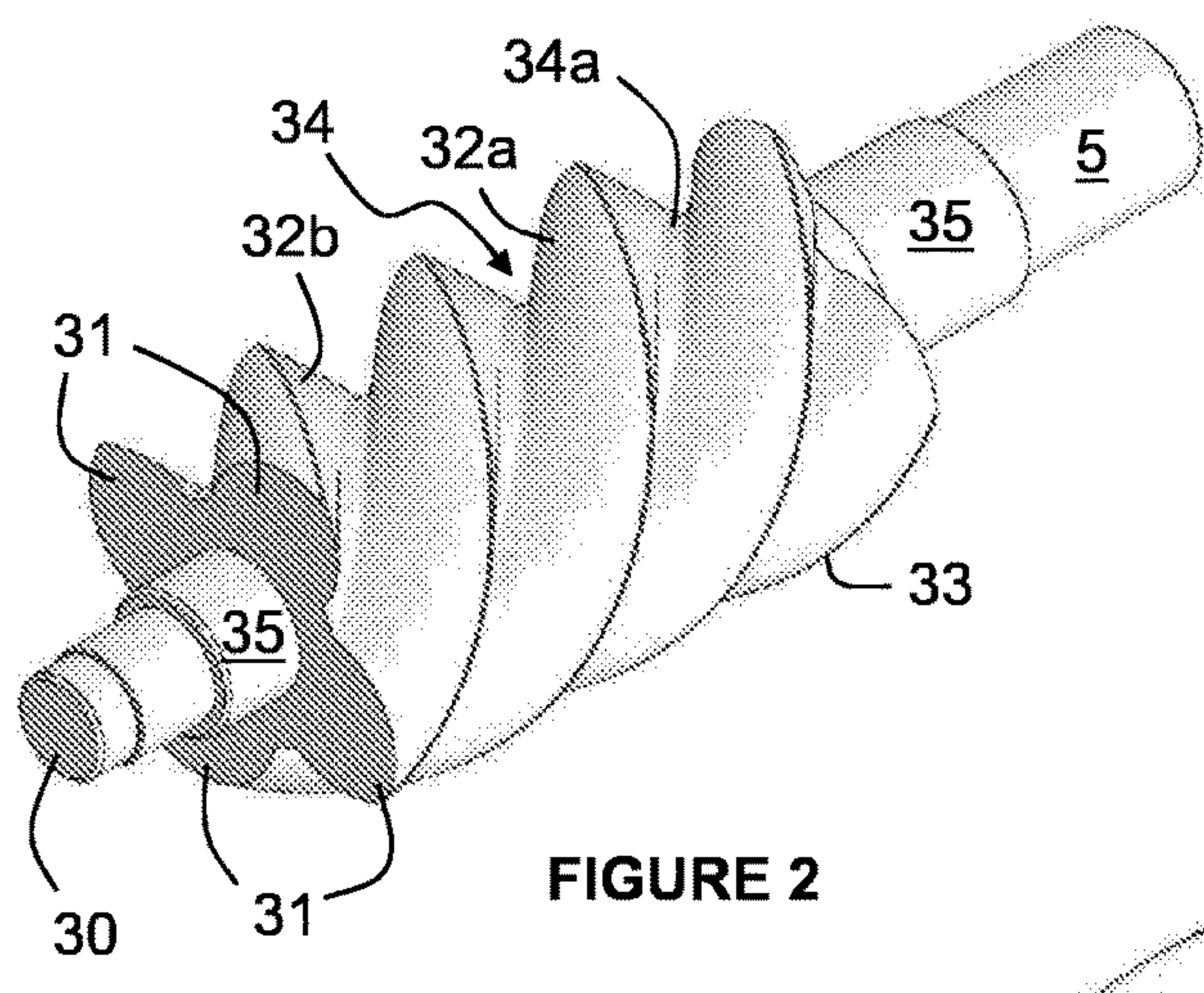


FIGURE 2

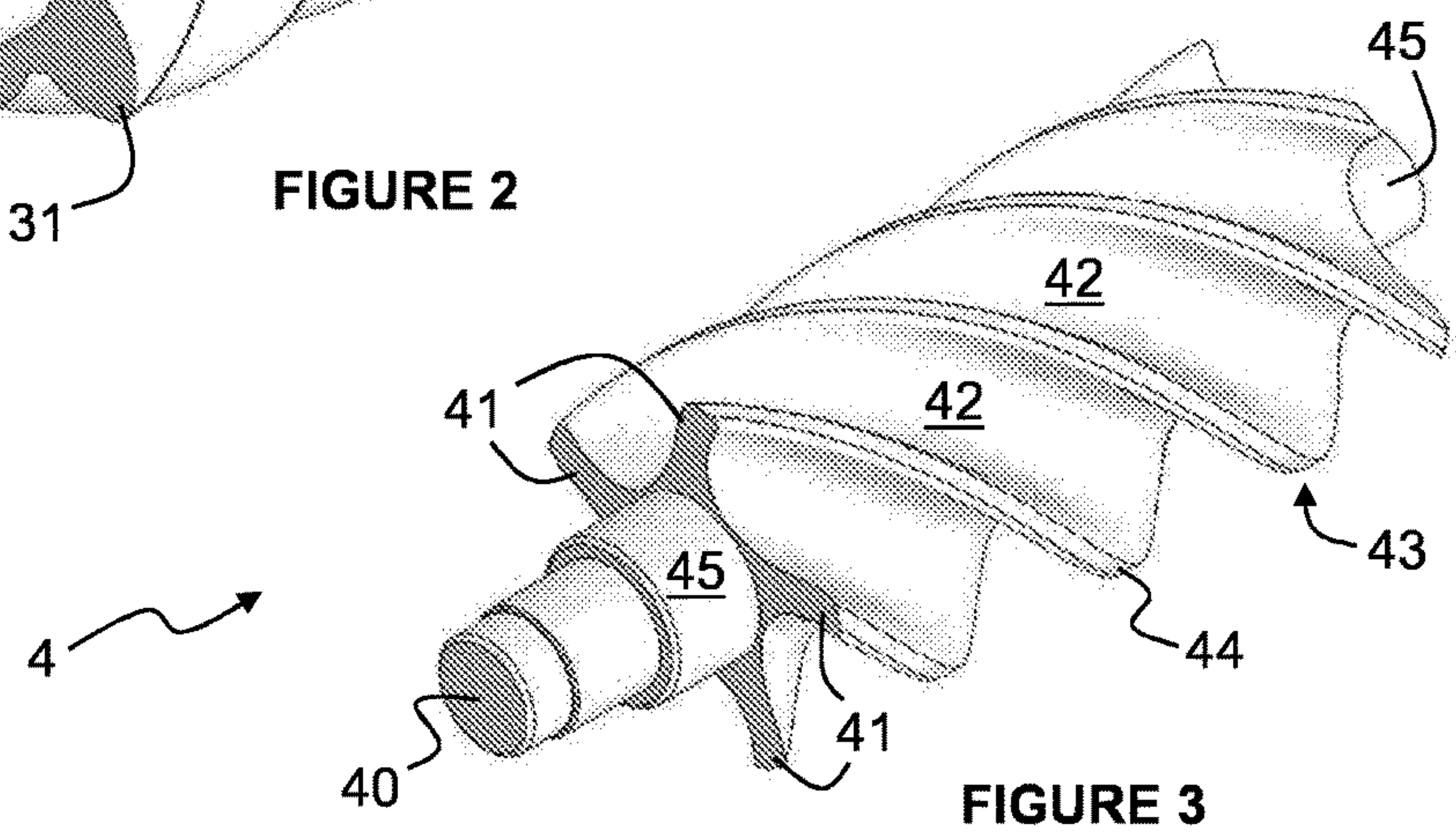


FIGURE 3

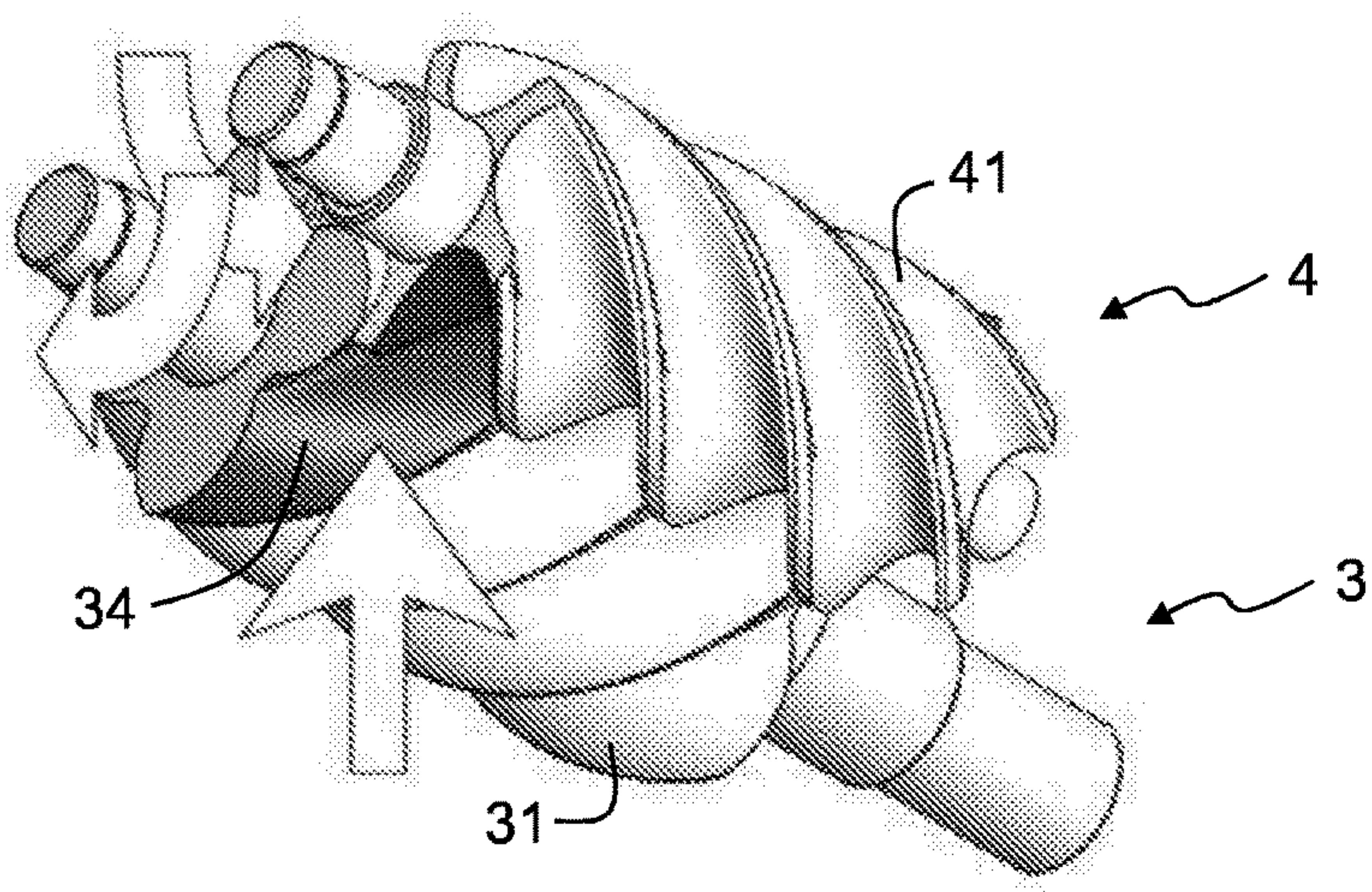


FIGURE 4

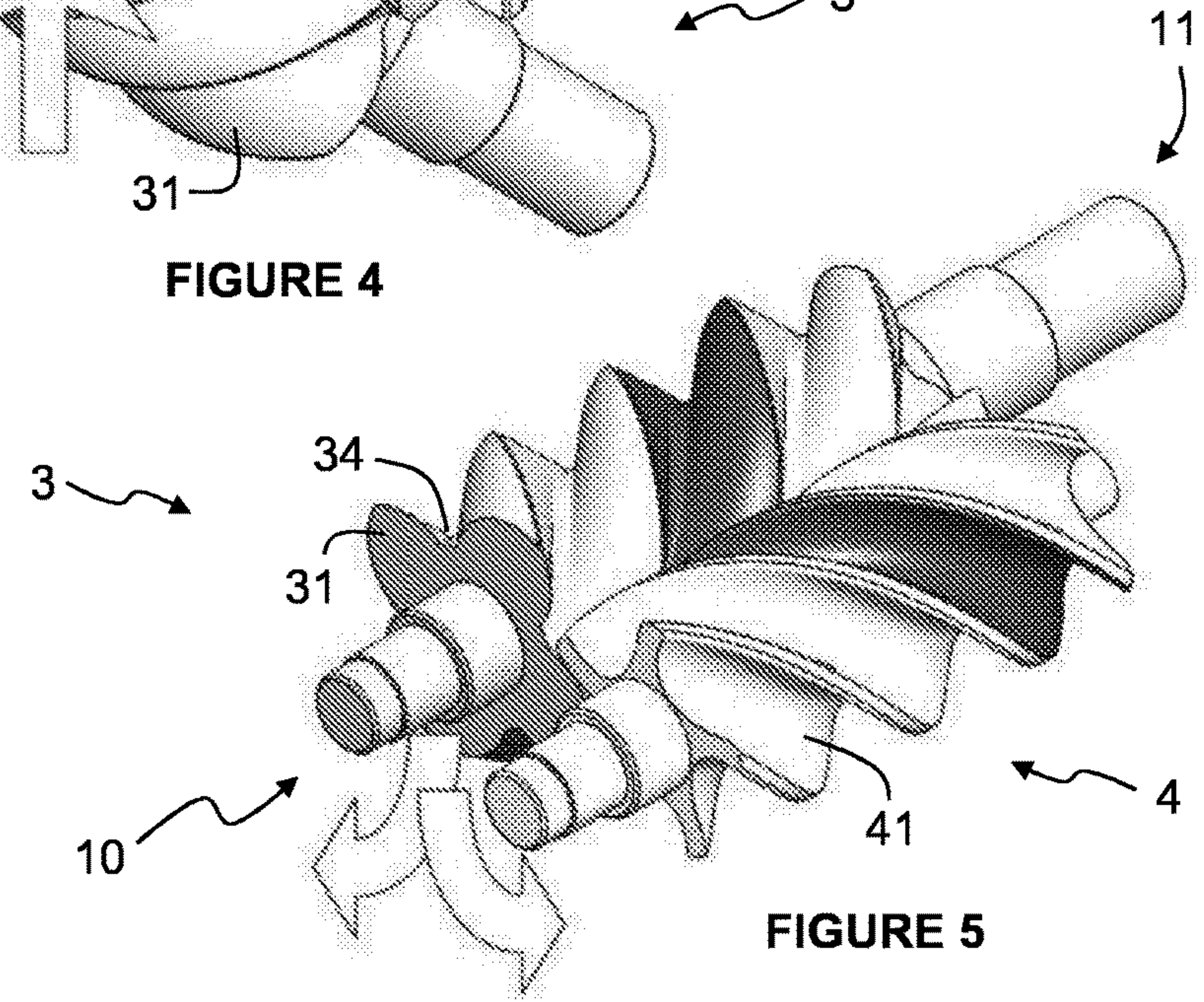


FIGURE 5

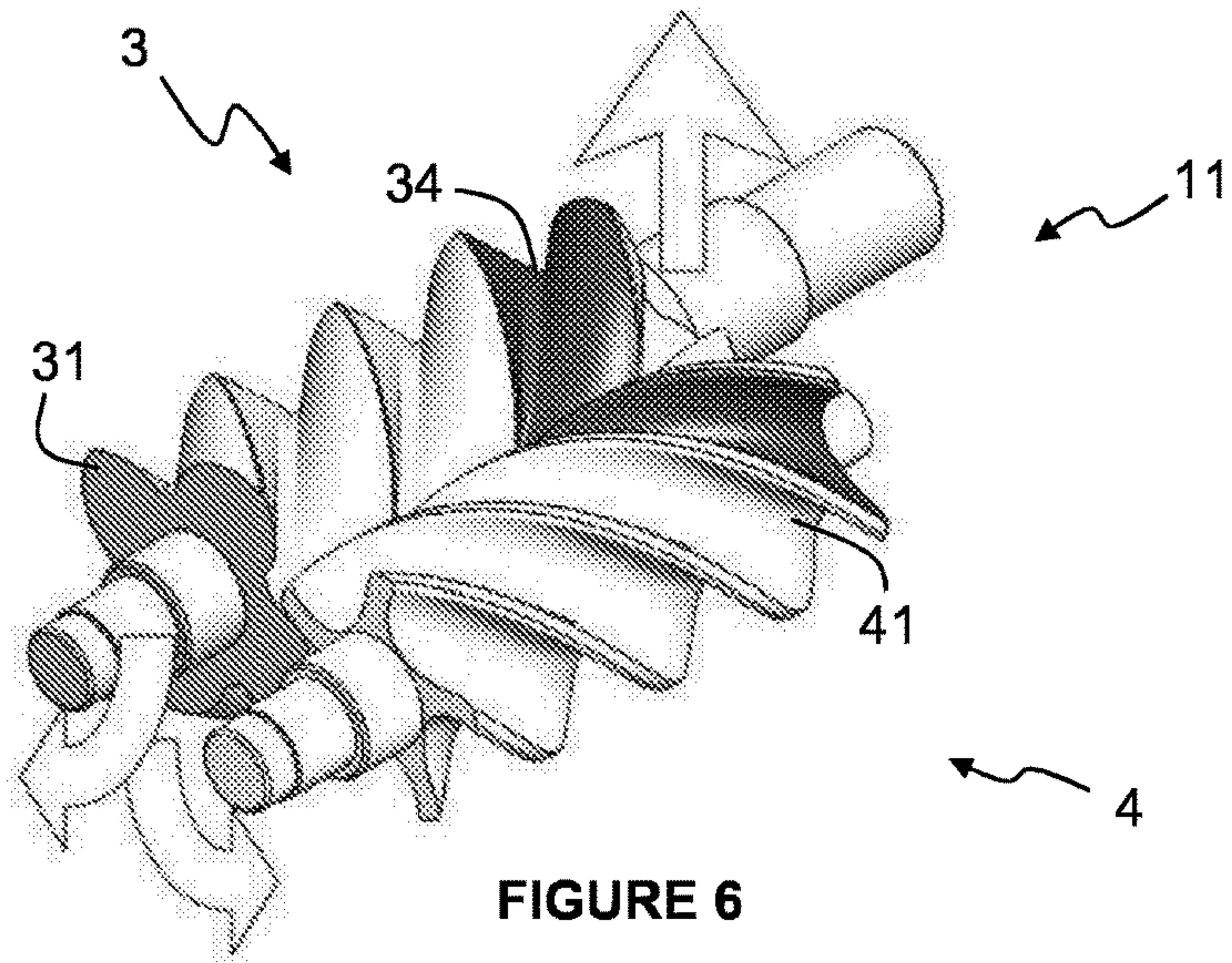


FIGURE 6

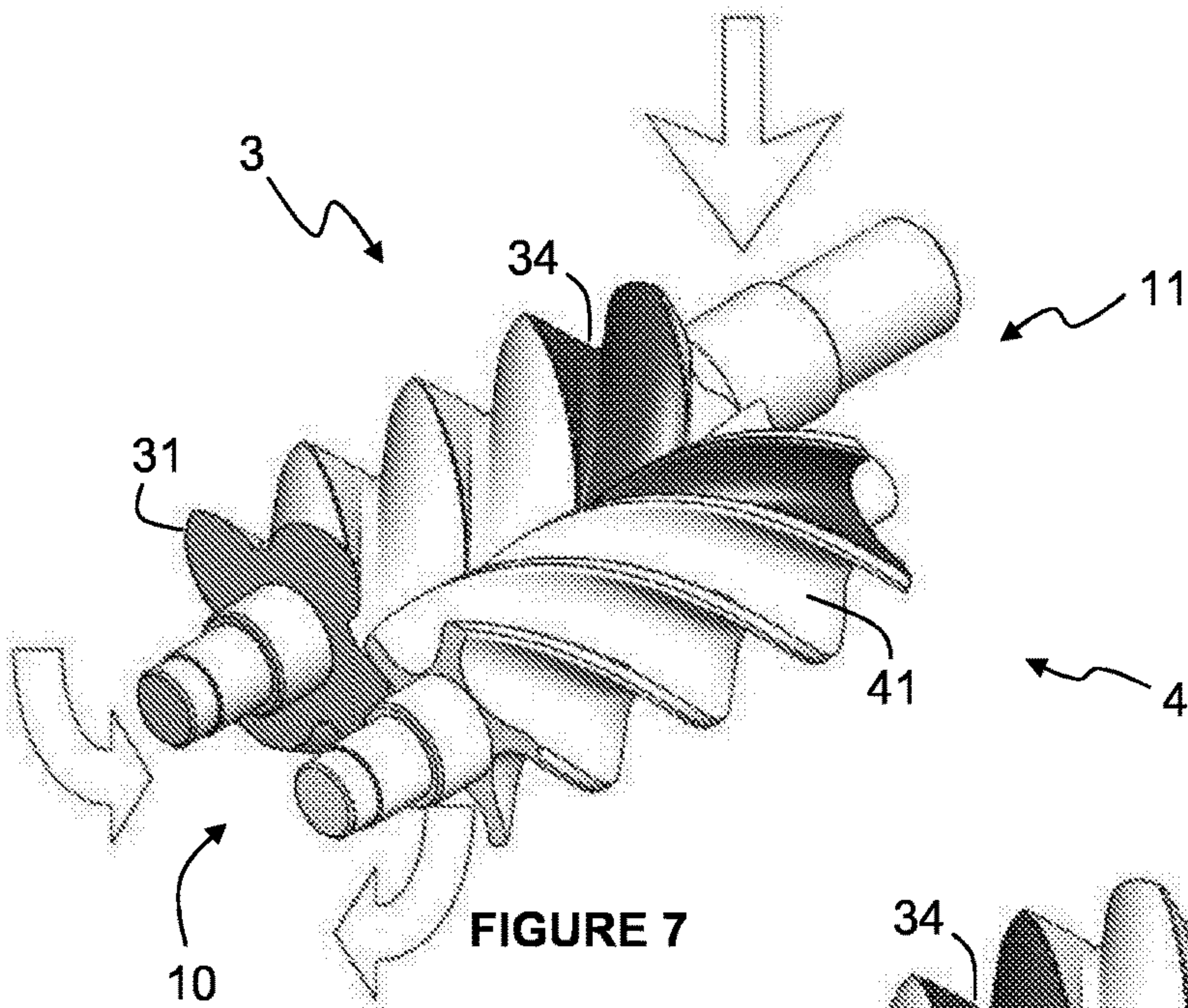


FIGURE 7

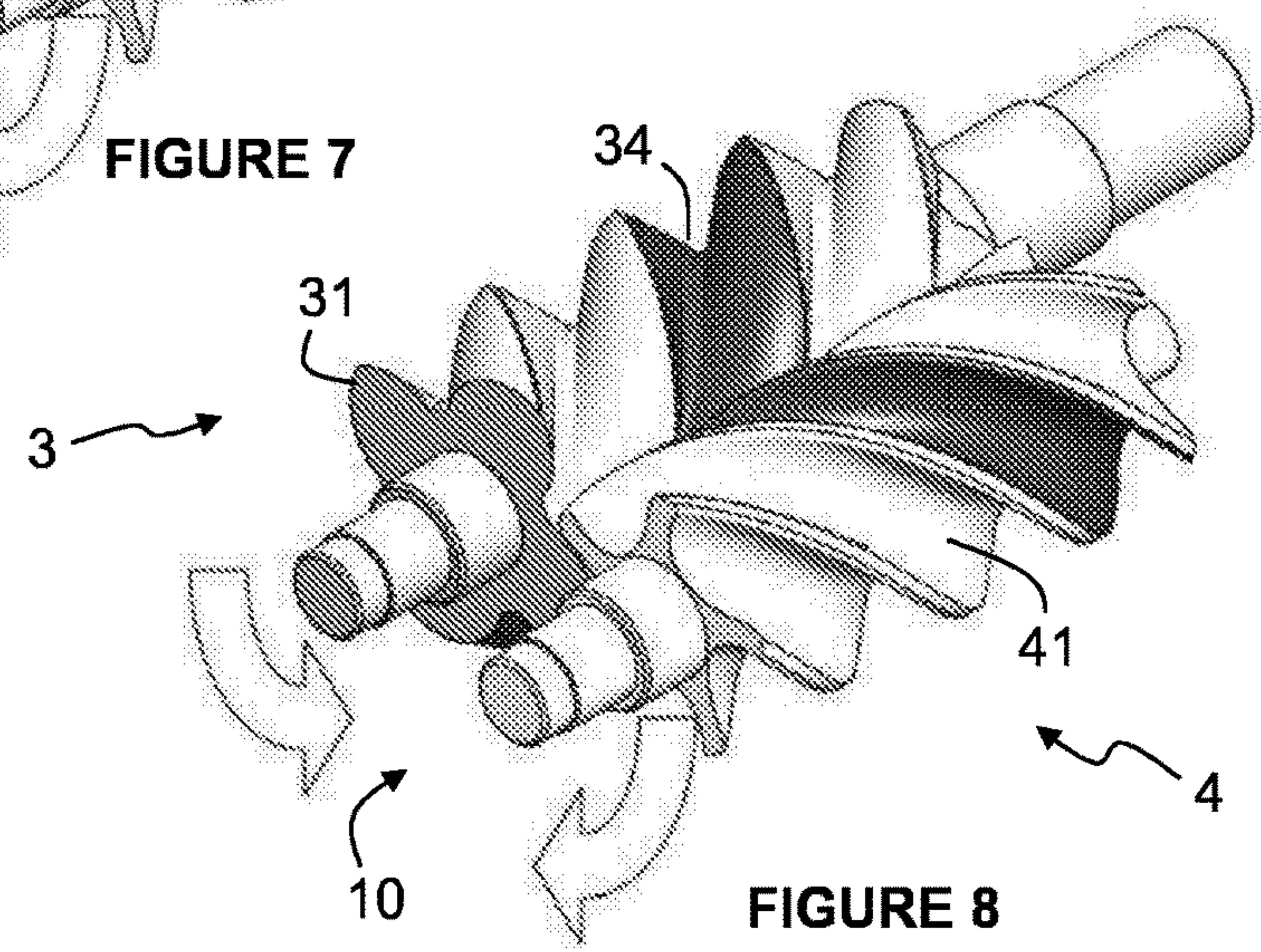


FIGURE 8

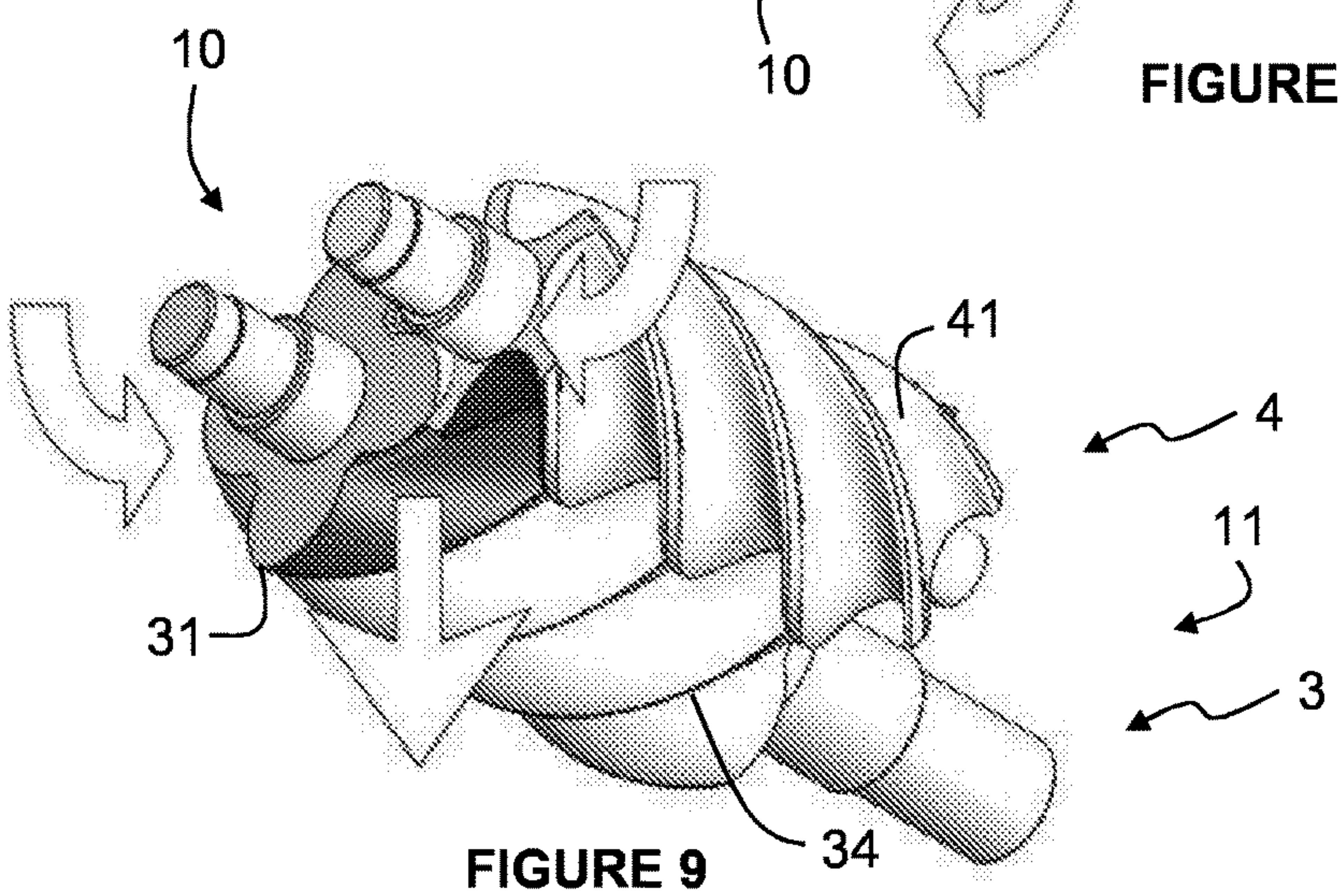


FIGURE 9

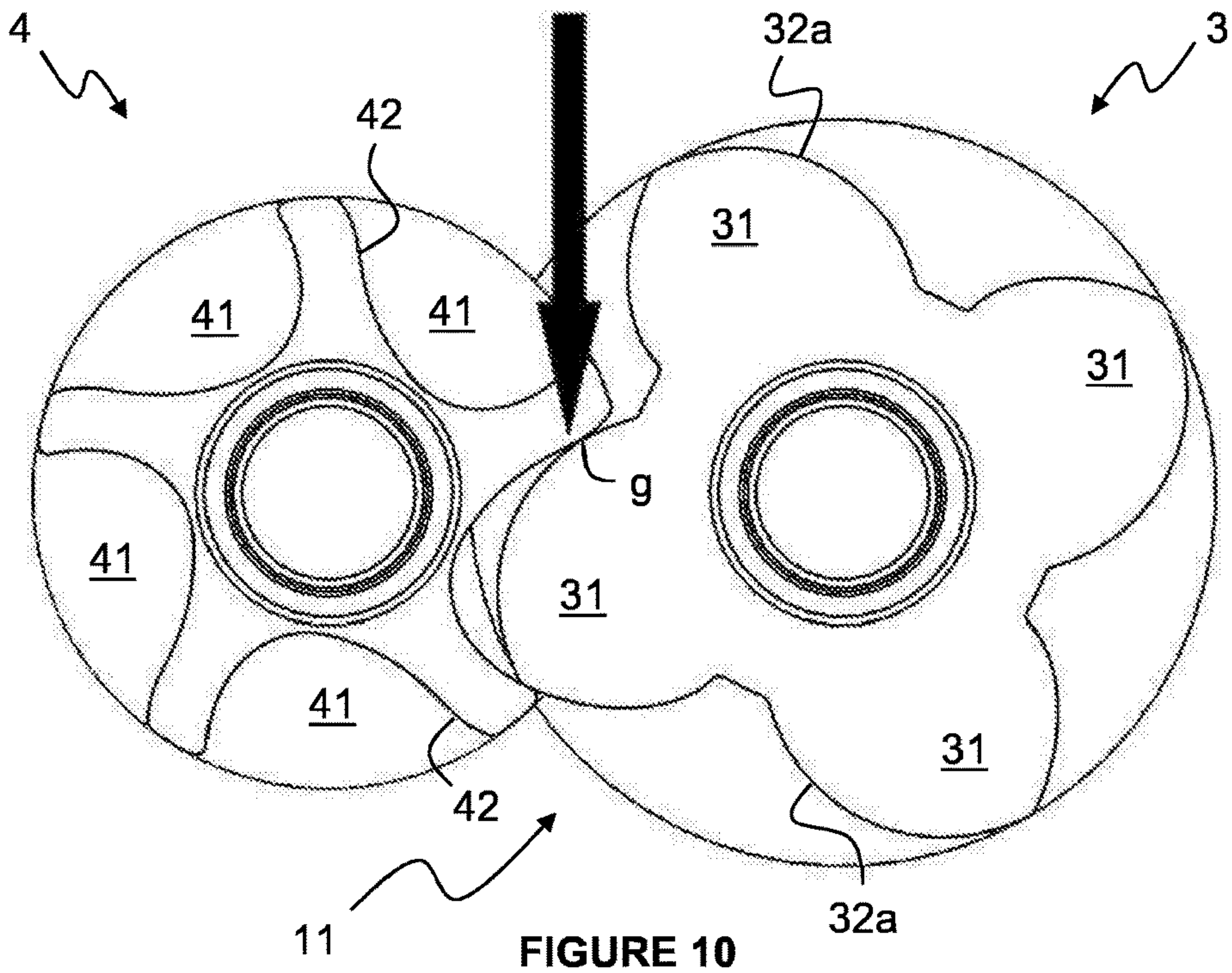


FIGURE 10

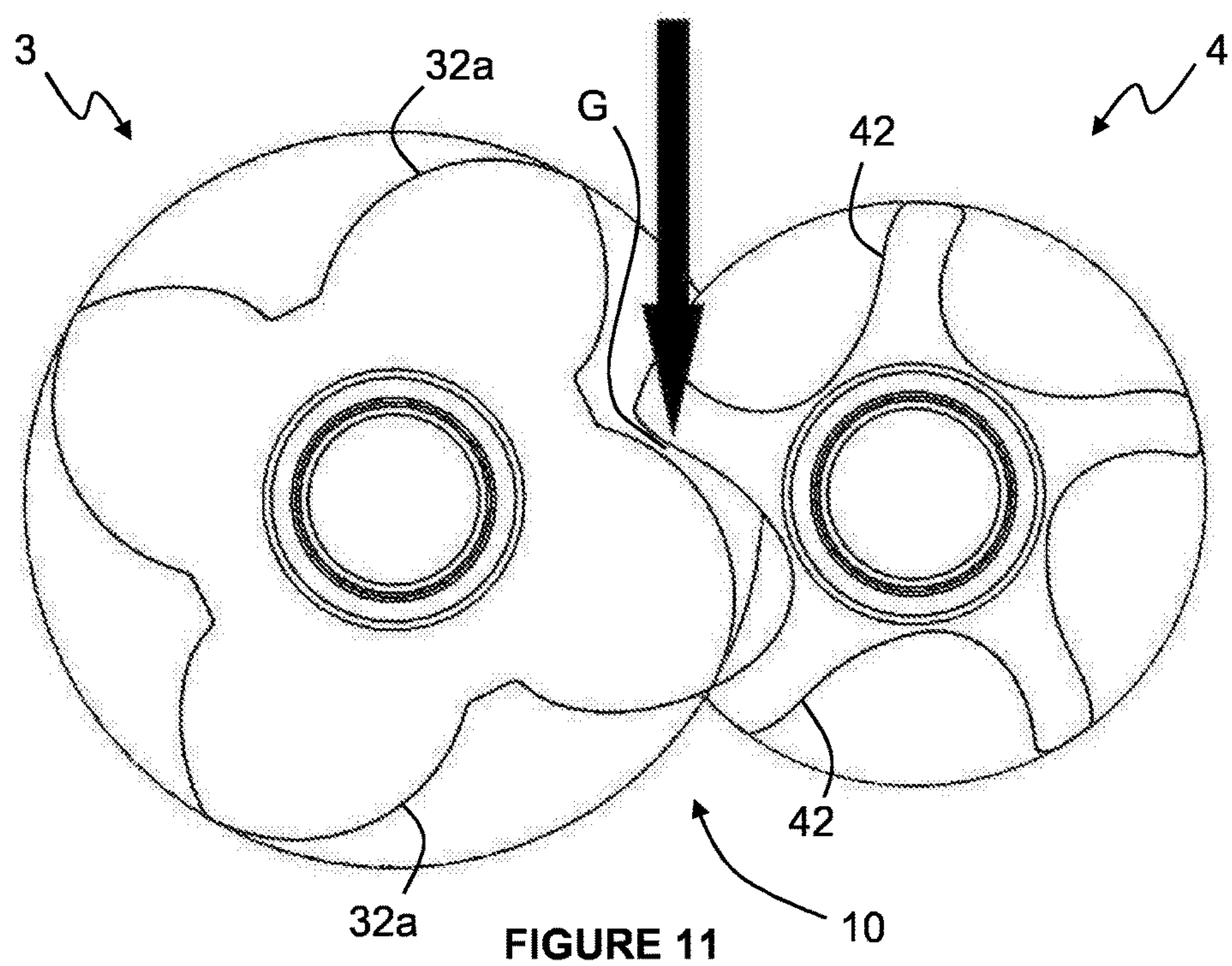


FIGURE 11

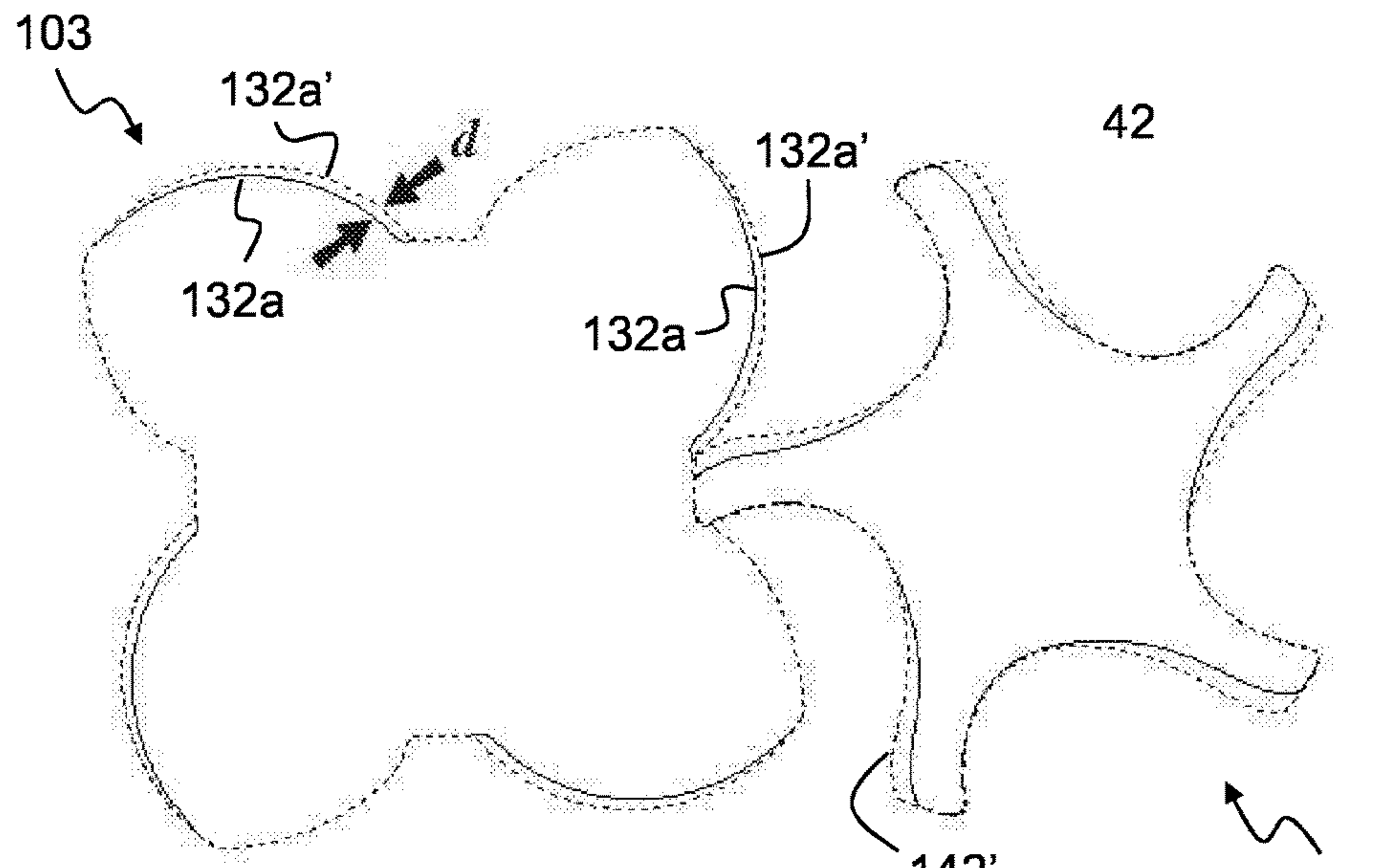


FIGURE 12

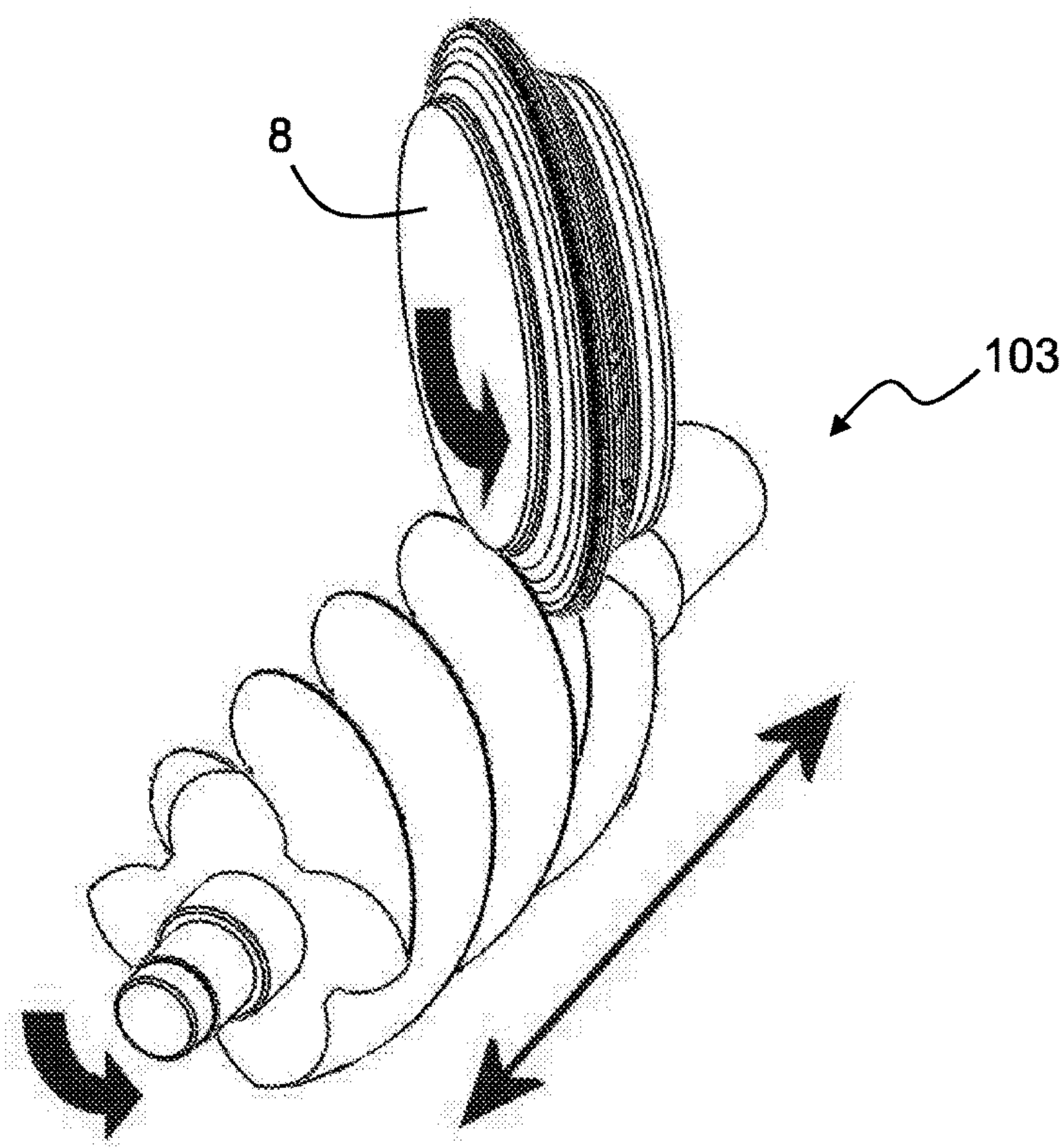


FIGURE 13

SCREW ROTOR DEVICE

TECHNICAL FIELD

[0001] This invention relates generally to screw rotor devices for conveying a fluid. More specifically, although not exclusively, this invention relates to screw rotor expanders, e.g. for capturing or recovering energy from a pressurised fluid, such as steam or vehicle exhaust gases, and to compressors.

BACKGROUND

[0002] Conventional screw rotor machine designs include two or more rotors enclosed within a housing or casing that surrounds the outer surface of the threads of the rotor to provide radial containment of a fluid to be conveyed. The rotors generally include a male rotor with a series of helical lobes about its periphery and a female rotor with a series of cooperating helical flutes. Typically, the female rotor is driven by the rotation of the male rotor.

[0003] The flutes of the female rotor are shaped to cooperate with the lobes of the male rotor as the rotors rotate relative to one another to convey a fluid along the device. The outer surfaces of each intermeshing portions of the lobes of the male rotor with the flutes of the female rotor are normally in contact with one another along the entire length of the rotors, thereby to minimise leakage therebetween.

[0004] It has been observed that, in the case of screw compressors, this meshing contact between the rotors can result in vibrations, which may damage or wear components of the device prematurely. JPS5937290 seeks to mitigate such vibrations by limiting the zone of contact either to the outlet region of the compressor or to make half of the flutes deeper such that contact with the lobes only occurs with the shallower flutes.

[0005] The applicant has observed that, whilst this design may mitigate the vibrations that can be caused by the meshing contact between rotors, the design could be improved.

[0006] It is therefore a first non-exclusive object of the invention to provide a screw rotor device that overcomes, or at least mitigates the issues associated with known designs. It is a more general, non-exclusive object of the invention to provide an improved screw rotor device, for example one that is more efficient and/or less prone to damage or premature wear.

SUMMARY OF THE INVENTION

[0007] A first aspect of the invention provides a screw rotor device comprising a first rotor having a plurality of helical lobes about its periphery, a second rotor having a plurality of helical flutes about its periphery and a housing with a high pressure port and a low pressure port, the first and second rotors being rotatably mounted within the housing such that the lobes intermesh with the flutes for conveying, in use, a fluid between the high pressure port and the low pressure port, wherein intermeshing portions of the rotors adjacent the high pressure port comprise a gap therebetween that is greater than a corresponding gap between intermeshing portions of the rotor adjacent the low pressure port.

[0008] The provision of a gap between intermeshing portions of the rotors at the high pressure end of the device reduces or eliminates contact between the rotors in the region that is exposed to the highest stresses. This inhibits the rotors from ceasing, for example by virtue of the contacting portions being welded together.

[0009] At least one of the rotors may have a profile that varies to describe the gap.

[0010] Another aspect of the invention provides a screw rotor device comprising a first rotor having a plurality of helical lobes about its periphery, a second rotor having a plurality of helical flutes about its periphery and a housing with a high pressure port and a low pressure port, the first and second rotors being rotatably mounted within the housing such that the lobes intermesh with the flutes for conveying, in use, a fluid between the high pressure port and the low pressure port, wherein at least one, for example only one or both, of the rotors has a helical profile that changes along its length such that a gap is described between intermeshing lobes and flutes adjacent the high pressure port which is larger than a gap described between intermeshing lobes and flutes adjacent the low pressure port.

[0011] The gap described between intermeshing lobes and flutes adjacent the low pressure port may comprise a zero gap or a gap of zero or substantially zero. The size, e.g. the circumferential width, of each flute at or adjacent a first of its ends may be greater or larger than its size at or adjacent a second of its ends. The size, e.g. the circumferential width, of each lobe at or adjacent a first of its ends may be less or smaller than its size at or adjacent a second of its ends. The first end of the flute may be adjacent the first end of the lobe and/or the second end of the flute may be adjacent the second end of the lobe.

[0012] The size of each flute adjacent the high pressure port may be greater or larger than its size adjacent the low pressure port. In embodiments, the circumferential width of each flute adjacent the high pressure port is greater than its circumferential width adjacent the low pressure port.

[0013] The size of each lobe of the first rotor adjacent the low pressure port may be greater than its size adjacent the high pressure port. In embodiments, the circumferential width of each lobe adjacent the low pressure port is greater than its circumferential width adjacent the high pressure port.

[0014] The rotors may be driven in a first respective direction. The gap may be at, in, comprised at or in or described between driving surfaces of the intermeshing lobes and flutes. The gap may be described between a leading surface of each intermeshing lobe and a facing surface of a cooperating flute, e.g. when the first rotor drives the second rotor. The gap may be described between a trailing surface of each intermeshing flute and a facing surface of a cooperating lobe, e.g. when the first rotor drives the second rotor. The gap may be described between a trailing surface of each intermeshing lobe and a facing surface of a cooperating flute, e.g. when the second rotor drives the first rotor. The gap may be described between a leading surface of each intermeshing flute and a facing surface of a cooperating lobe, e.g. when the second rotor drives the first rotor.

[0015] Additionally or alternatively, the or a further gap may be at, in, comprised at or in or described at or in a trailing region of the intermeshing lobes and flutes. The gap, e.g. in the trailing region of the intermeshing lobes and flutes, may be described between a trailing surface of each intermeshing lobe and a facing surface of a cooperating flute.

[0016] The number of flutes of the second rotor may be greater than the number of lobes of the first rotor. In embodiments, the second rotor has one flute more than the number of lobes of the first rotor. In embodiments, the second rotor has five flutes and the first rotor has four lobes. The at least one rotor may have a helical profile that changes gradually or suddenly or abruptly along at least part of its length or as a step transition part way along its length. The at least one rotor may have a helical profile that is constant along part, at least part or only part, of its length.

[0017] The at least one rotor may comprise the first rotor, for example only the first rotor. Additionally or alternatively, the at least one rotor may comprise the second rotor, for example only the second rotor. In embodiments, the at least one rotor comprises both the first rotor and the second rotor, while in other embodiments the at least one rotor comprises only one of the first and second rotors.

[0018] At least one or each lobe may comprise at least one, e.g. a pair, of concave surfaces, which may converge to a peak. A helical trough may be defined between each lobe. The trough may have a root surface, which may be part-cylindrical. At least one or each flute may comprise a concave surface, for example between a pair of adjacent ridges. Each ridge may include a peak surface, which may be part-cylindrical and/or may be shaped or configured to cooperate with the troughs between the lobes of the first rotor.

[0019] The device may be free of lubricating oil and/or free of timing gears. The device may comprise one or more further rotors each having helical lobes about its periphery. The device may comprise one or more further rotors each having a plurality of helical flutes. The further rotor or rotors may be rotatably mounted within the housing, for example such that the lobes or flutes intermesh with corresponding flutes or lobes on another of the rotors, e.g. for conveying, in use, a fluid between the high pressure port and the low pressure port. At least one of the further rotors may have a helical profile that changes along its length, for example such that a gap is described between intermeshing lobes and flutes adjacent the high pressure port which is larger than a gap described between intermeshing lobes and flutes adjacent the low pressure port.

[0020] Preferably, the device comprises an expander, for example wherein the high pressure port comprises an inlet of the expander and/or the low pressure port comprises an outlet of the expander. Alternatively, the device may comprise a compressor, for example wherein the low pressure port comprises an inlet of the compressor and/or the high pressure port comprises an outlet of the compressor.

[0021] Another aspect of the invention provides a steam generator, for example comprising a device described above.

[0022] Another aspect of the invention provides a method of manufacturing a screw rotor for a screw rotor device, for example as described above. The method may comprise forming at least one helical lobe or flute, which may have a constant depth and/or a circumferential width that varies along its length.

[0023] The method may comprise forming the helical lobe or flute with leading and trailing surfaces, for example wherein only one of the leading and trailing surfaces varies along the length of the rotor.

[0024] For the avoidance of doubt, any of the features described herein apply equally to any aspect of the invention. For example, the screw rotor device may comprise any one or more features of the method relevant thereto and/or the method may comprise any one or more features or steps relevant to one or more features of the screw rotor device.

[0025] Another aspect of the invention provides a computer program element comprising and/or describing and/or defining a three-dimensional design for use with a simulation means or a three-dimensional additive or subtractive manufacturing means or device, e.g. a three-dimensional printer or CNC machine, the three-dimensional design comprising an embodiment of the first and/or second screw rotor or any other component of the device described above.

[0026] A further aspect of the invention provides a computer program element comprising computer readable program code means for causing a processor to execute a procedure to implement one or more steps of the aforementioned method.

[0027] A yet further aspect of the invention provides one of the aforementioned computer program elements embodied on a computer readable medium.

[0028] A yet further aspect of the invention provides a computer readable medium having a program stored thereon, where the program is arranged to make a computer execute a procedure to implement one or more steps of the aforementioned method.

[0029] Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. For the avoidance of doubt, the terms “may”, “and/or”, “e.g.”, “for example” and any similar term as used herein should be interpreted as non-limiting such that any feature so-described need not be present. Indeed, any combination of optional features is expressly envisaged without departing from the scope of the invention, whether or not these are expressly claimed. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:

[0031] FIG. **1** is a schematic view of a rotor device according to an embodiment of the invention;

[0032] FIG. **2** is a perspective view of a first rotor incorporated in the device of FIG. **1**;

[0033] FIG. **3** is a perspective view of a second rotor incorporated in the device of FIG. **1**;

[0034] FIG. **4** is a perspective view of the rotors of FIGS. **2** and **3** in an intermeshing relation illustrating their use in an initial stage of an expander configuration;

[0035] FIG. **5** is a perspective view similar to that of FIG. **4** illustrating an intermediate stage of the expander configuration;

[0036] FIG. **6** is a perspective view similar to those of FIGS. **4** and **5** illustrating a final stage of the expander configuration;

[0037] FIG. **7** is a perspective view of the rotors of FIGS. **2** and **3** in an intermeshing relation illustrating their use in an initial stage of a compressor configuration;

[0038] FIG. **8** is a perspective view similar to that of FIG. **7** illustrating an intermediate stage of the compressor configuration;

[0039] FIG. **9** is a perspective view similar to those of FIGS. **7** and **8** illustrating a final stage of the compressor configuration;

[0040] FIG. **10** is an end view of the arrangement of FIGS. **4** to **9** from the low pressure end at the right of the Figures;

[0041] FIG. **11** is an end view of the arrangement of FIGS. **4** to **9** from the high pressure end at the left of the Figures;

[0042] FIG. **12** is a schematic representation of rotor helical profiles at each end of a rotor pair configured according to another embodiment overlaid to illustrate the differences therebetween; and

[0043] FIG. **13** is a perspective view of the first rotor being formed by a method according to an embodiment of the invention.

DETAILED DESCRIPTION

[0044] Referring now to the Figures, there is shown a screw rotor device **1** according to an embodiment of the invention. In this embodiment, the screw rotor device **1** includes a housing or casing **2**, a first rotor **3** and second rotor **4** both rotatably mounted within the housing **2**, a coupling shank **5** connected to the first rotor **3** and extending from one of its ends, a high pressure port **6** located at a first end of the housing **2** and a low pressure port **7** located at a second end of the housing **2**. The screw rotor device **1** according to this embodiment may be configured to operate as either an expander, in which case the coupling shank **5** may be coupled to a generator (not shown), or as a compressor, in which case the coupling shank **5** may be coupled to a drive motor (not shown). The high pressure port **6** functions as an inlet **6** when the screw rotor device **1** is configured to operate as an expander or an outlet when configured to operate as a compressor. Similarly, the low pressure port **7** functions as an inlet when the screw rotor device **1** is configured to operate as a compressor or an outlet when configured to operate as an expander.

[0045] The first rotor **3** includes a shaft **30** with four helical lobes **31** arranged about the periphery of a central region thereof. Each lobe **31** includes a pair of concave surfaces **32*a***, **32*b*** that converge to a peak **33**. A helical trough **34** is defined between each lobe **31** of the first rotor **3**. In this embodiment, each trough **34** includes a root surface **34*a*** which is part-cylindrical. The shaft **30** includes a mounting portion **35** at each side of the central region for rotatably mounting the first rotor **3** within the housing **2**. In this embodiment, the coupling shank **5** is formed integrally with the shaft **30** of the first rotor **3** and extends from one of its ends and out of the housing **2**.

[0046] The second rotor **4** includes a shaft **40** with five helical flutes **41** arranged about the periphery of a central region thereof. Each flute **41** is described by a concave surface **42** between a pair of adjacent ridges **43**. Each ridge includes a peak surface **44** which is part-cylindrical, having a similar shape to the root surface **34*a*** of the first rotor **3** but a slightly smaller size such that the surfaces cooperate in use. The shaft **40** also includes a mounting portion **45** at each side of the central region for rotatably mounting the second rotor **4** within the housing **2**.

[0047] As illustrated in FIGS. **4** to **9**, the first and second rotors **3**, **4** are rotatably mounted within the housing **2** in a side-by-side relationship such that the helical lobes **31** are received within the helical flutes **41** in the normal way. In use, the first rotor **3** and second rotor **4** rotate in opposing directions causing the lobes **31** to intermesh with the flutes **41** and the direction of rotation of the rotors **3**, **4** governs the conveying direction of the fluid along the screw rotor device **1**.

[0048] Referring now to FIGS. **4** to **6**, operation of the device **1** by rotating the rotors **3**, **4** in a first direction will result in a conveying direction from the high pressure port **6** to the low pressure port **7**. In this configuration, the device **1** operates as an expander. In this configuration, the first rotor **3** rotates in a clockwise direction when viewed along the longitudinal axis of the rotor pair **3**, **4** from the end adjacent the high pressure port **6**. The second rotor **4** rotates in a counter-clockwise direction when viewed from the same direction. The conveying direction is from the high pressure port **6** towards the low pressure port **7**.

[0049] As illustrated by the darkened portions in FIG. **4**, a pressurised fluid enters portions of the helical troughs **34** of the first rotor **3** and the helical flutes **41** of the second rotor **4** from the high pressure port **6**. This high pressure fluid F forces rotation of the rotors **3**, **4**, as it is conveyed along the device **1**, as illustrated in FIG. **5**, and out to the low pressure port **7**, as illustrated in FIG. **6**.

[0050] Referring now to FIGS. **7** to **9**, operation of the device **1** by rotating the rotors **3**, **4** in a second direction, opposite the first direction will result in a conveying direction from the low pressure port **7** to the high pressure port **6**. In this configuration, the device **1** operates as a compressor. In this configuration, the first rotor **3** rotates in a counter-clockwise direction when viewed along the longitudinal axis of the rotor pair **3**, **4** from the end adjacent the high pressure port **6**. The second rotor **4** rotates in a clockwise direction when viewed from the same direction.

[0051] As illustrated by the darkened portions in FIG. **7**, a fluid F enters portions of the helical troughs **34** of the first rotor **3** and the helical flutes **41** of the second rotor **4** from the low pressure port **7**. This fluid F is forced along the conveying direction by rotation of the rotors **3**, **4**, as illustrated in FIG. **8**, and out to the high pressure port **6**, as illustrated in FIG. **9**. Rotation of the rotors **3**, **4** is induced by a drive motor (not shown).

[0052] In accordance with the invention and as illustrated more clearly in FIGS. **10** and **11**, at least one of the rotors **3**, **4** has a helical profile that changes along its length to create a gap G described between intermeshing lobes **31** and flutes **41** at a first end **10** of each of the rotors **3**, **4**, corresponding to a region adjacent the high pressure port **6**. The gap G at the first end **10** is larger than a gap g described between intermeshing lobes **31** and flutes **41** at a second end **11** of each of the rotors **3**, **4**, adjacent the low pressure port **7**. In this embodiment, the smaller gap g is illustrated as a zero gap. More particularly, the first rotor **3** and second rotor **4** come into contact with one another in the region indicated by the arrow in FIG. **10**, in the region adjacent the low pressure port **7**. The contact region between the first rotor **3** and second rotor **4** extends along the rotor set for most, approximately 70% in this embodiment, of the threaded length from the end adjacent the low pressure port **7**. Contact between the first rotor **3** and second rotor **4** is required along at least part of the threaded length to allow the rotation of one of the rotors **3**, **4** to drive the other. It will be appreciated that the contact region may extend along any amount from 0% up to nearly 100% of the threaded length, depending on the specific requirements of a particular application.

[0053] In the region adjacent the high pressure port **6**, the first rotor **3** and second rotor **4** do not contact in the corresponding area, indicated by the arrow in FIG. **11**. When the first rotor **3** rotates counter-clockwise and second rotor **4** rotates clockwise the gap G is formed between one of the concave surfaces **32***a*, **32***b* of the helical lobe **31** and the facing surface of a cooperating flute **41**. It will be appreciated by those skilled in the art that the gap G is defined between the driving surfaces **32***a*, **42** of the rotors **3**, **4**. More particularly, in the expander configuration the second rotor **4** drives the first rotor **3** and the concave surface **32***a* describing part of the gap G is on a trailing, driven side of the lobe **31**. In the compressor configuration, the concave surface **32***a* describing part of the gap G is on a leading, driving side of the lobe **31**.

[0054] In this embodiment, absence of contact between the first rotor **3** and second rotor **4** is achieved by the second rotor **4** having a helical profile that changes gradually along its length, beginning at a location approximately 70% therealong. It twill be appreciated, however, that the change in helical profile may be sudden or abrupt and may occur at any point along its length. The change in helical profile in this embodiment is achieved by increasing the size, more particularly the circumferential width, of the flute **41** of the second rotor **4** in the region adjacent the high pressure port **6** relative to the size of the flute **41** in the region adjacent the low pressure port **7**.

[0055] Referring now to FIG. **12**, there is shown a cross-sectional view of the first rotor **103** and second rotor **104** according to another embodiment, which is more particularly suited to functioning as an expander. The dashed line represents the cross-sectional profile in the region adjacent the low pressure port **7**, while the solid line represents the cross-sectional profile in the region adjacent the high pressure port **6**. The first rotor **103** according to this embodiment differs from the first rotor **3** according to the embodiment described above in that its profile also varies along its length. More particularly, the gap G in this embodiment is created in part by a difference d in the concave surface **132***a* adjacent the high pressure port **6** relative to the concave surface **132***a*' adjacent the low pressure port **7**. Moreover, the second rotor **104** differs from the second rotor **4** according to the embodiment described above in that the profile of the second rotor **104** is inverted as compared to that of the second rotor **4** described previously. The profile of the second rotor **104** according to this embodiment is better suited to the expander configuration due to the profile of the driving surfaces **142'**.

[0056] FIG. **13** illustrates a milling operation for manufacturing the first screw rotor **103** using a cutting tool **8** coupled to a driving means (not shown) configured to rotate the cutting tool **8** about its centre as indicated by the arrow. In use, a solid metal bar (not shown) is mounted such that it is rotated about its longitudinal axis. The cutting tool **8**, while rotating about its centre, makes a pass along the longitudinal axis of the metal bar to create a helical profiled screw rotor **103** through the relative rotation between the cutting tool **8** and metal bar. To make a change to the profile of the screw rotor **103** during the milling process, a small change can be made in the orientation of the rotational axis of the cutting tool **8** relative to the longitudinal axis of the metal bar **9** and/or the cutting path may be changed. Other methods are also envisaged.

[0057] It will be appreciated by those skilled in the art that several variations to the aforementioned embodiments are envisaged without departing from the scope of the invention. For example, although the helical profile change is described as being applied to the second rotor **4** only this need not be the case and the helical profile change may be applied to the first rotor **3** only or both first rotor **3** and second rotor **4**.

[0058] Additionally, the helical profile change of the second rotor **4** may be applied through an increase in the depth of the flutes **41**, an increase in the circumferential width of the flutes **41** or a combination of the two. Additionally or alternatively, the helical profile of the first rotor **3** may be changed by reducing the size of the helical lobes **31**, for example in the region adjacent the high pressure port **6**, such as by reducing their circumferential width or height or a combination of the two.

[0059] The first and second rotors **3**, **4** may have any number of helical lobes **31** and flutes **41** respectively and they may be of any profile shape. Additionally, the contact portion need not extend along 70% (or even most) of the length of the rotors, for example the contact portion may be any other single continuous length of contact or there may be multiple sections of intentional contact and non-contact along the rotor pair **3**, **4**. The contact portion need not be continuous and may extend between 0 and 100% of the length of the rotors.

[0060] It will also be appreciated by those skilled in the art that any number of combinations of the aforementioned features and/or those shown in the appended drawings provide clear advantages over the prior art and are therefore within the scope of the invention described herein.

1. A screw rotor device comprising a first rotor having a plurality of helical lobes about its periphery, a second rotor having a plurality of helical flutes about its periphery and a housing with a high pressure port and a low pressure port, the first and second rotors being rotatably mounted within the housing such that the lobes intermesh with the flutes for conveying, in use, a fluid between the high pressure port and the low pressure port, wherein at least one of the rotors has a helical profile that changes along its length such that a gap is described between intermeshing lobes and flutes adjacent the high pressure port which is larger than a gap described between intermeshing lobes and flutes adjacent the low pressure port.

2. Device according to claim **1**, wherein the size of each flute adjacent the high pressure port is greater than its size adjacent the low pressure port.

3. Device according to claim **2**, wherein the circumferential width of each flute adjacent the high pressure port is greater than its circumferential width adjacent the low pressure port.

4. Device according to claim **2**, wherein the size of each lobe of the first rotor adjacent the low pressure port is greater than its size adjacent the high pressure port.

5. Device according to claim **4**, wherein the circumferential width of each lobe adjacent the low pressure port is greater than its circumferential width adjacent the high pressure port.

6. Device according to claim **1**, wherein the gap is described between driving surfaces of the intermeshing lobes and flutes.

7. Device according to claim **1**, wherein the rotors are driven in a first respective direction and the gap is described between a trailing surface of each intermeshing lobe and a facing surface of a cooperating flute.

8. Device according to claim **7**, wherein a further gap is described between a leading surface of each intermeshing lobe and a facing surface of a cooperating flute.

9. Device according to claim **1**, wherein the rotors are driven in a first respective direction and the gap is described between a leading surface of each intermeshing lobe and a facing surface of a cooperating flute.

10. Device according to claim **1**, wherein the at least one rotor has a helical profile that changes either gradually along at least part of its length or as a step transition part way along its length.

11. Device according to claim **1**, wherein the at least one rotor has a helical profile that is constant along part of its length.

12. Device according to claim **1**, wherein the at least one rotor comprises the first rotor.

13. Device according to claim **1**, wherein the at least one rotor comprises the second rotor.

14. Device according to claim **1**, wherein the device is free of lubricating oil.

15. Device according to claim **1**, wherein the device is free of timing gears.

16. Device according to claim **1**, comprising one or more further rotors each having helical lobes about its periphery and/or one or more further rotors each having a plurality of helical flutes, the further rotor or rotors being rotatably mounted within the housing such that the lobes or flutes intermesh with corresponding flutes or Lobes on another of the rotors for conveying, in use, a fluid between the high pressure port and the low pressure port.

17. Device according to claim **1**, further comprising an expander, wherein the high pressure port comprises an inlet of the expander and the low pressure port comprises an outlet of the expander.

18. Device according to claim **1**, further comprising a compressor, wherein the low pressure port comprises an inlet of the compressor and the high pressure port comprises an outlet of the compressor.

19. A steam generator comprising

a screw rotor device comprising a first rotor having a plurality of helical lobes about its periphery, a second rotor having a plurality of helical flutes about its periphery and a housing with a high pressure port,

the first and second rotors being rotatably mounted within the housing such that the lobes intermesh with the flutes for conveying, in use, a fluid between the high pressure port and the low pressure port,

wherein at least one of the rotors has a helical profile that changes along its length such that a gap is described between intermeshing lobes and flutes adjacent the high pressure port which is larger than a gap described between intermeshing lobes and flutes adjacent the low pressure port.

20. A method of manufacturing a screw rotor for a screw rotor device, the method comprising forming at least one helical lobe or flute having a constant depth and a circumferential width that varies along its length.

21. A method according to claim **20** comprising forming the helical lobe or flute with leading and trailing surfaces, wherein only one of the leading and trailing surfaces varies along the length of the rotor.

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