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F1F FEH F1B7

(56) Documents Cited:
GB 1033454 A **GB 0926495 A**
EP 0687816 A **BE 000371144 A**

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INT CL^7 **F01C, F04C**
Other: **ONLINE: WPI, EPODOC, JAPIO**

(54) Abstract Title: **Rotary single vane pump with simplified vane-and-socket joint**

(57) A rotary single-vane pump 10, comprising a drive unit including an eccentric drive member, and a pump unit 12, including a housing 16, with a cylindrical inner peripheral wall defining a cavity, and a cylindrical rotor 20, disposed eccentrically in the cavity. The rotor 20, is engaged to the eccentric drive member so as to scroll the inner peripheral wall and to define a pump chamber therewith. The housing and the rotor are connected to each other, across the pump chamber, by a vane-and-socket joint. The housing has an inlet port 24, adjacent one side of the joint and an outlet port 26, adjacent the other side of the joint. The joint is designed such that the vane 22, can both slide along the socket 28, and rock in the socket with the joint maintaining fluid tightness. A sealing barrier 35, is disposed between the rotor periphery and the inner peripheral wall, so as to prevent fluid communication between the inlet port 24, and the outlet port 26, when the scroll zone is over the inlet port or the outlet port or between them. The pump unit 12, is attachable to and detachable from the drive unit (14, fig 3) by simple manipulation without tools and is made of material suitable for its usage as a disposable unit.

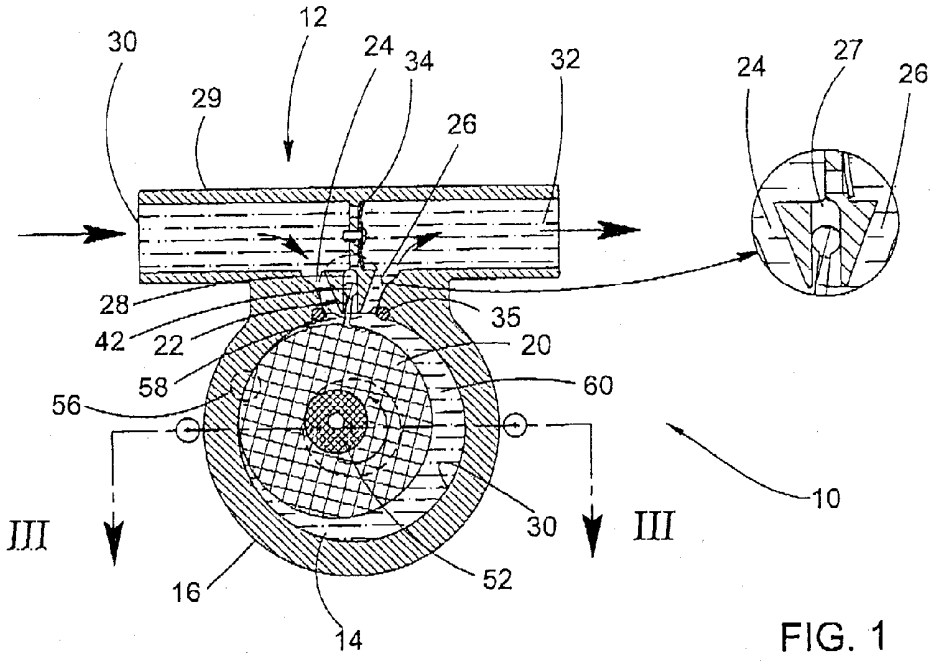

FIG. 1

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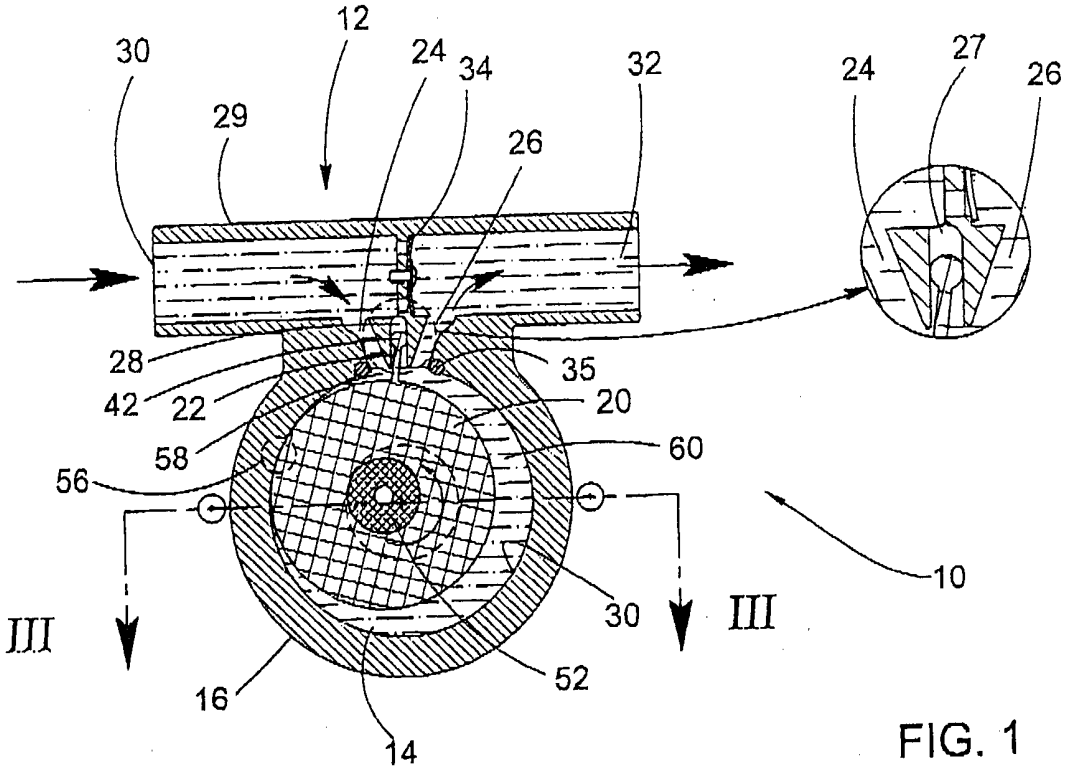
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FIG. 1

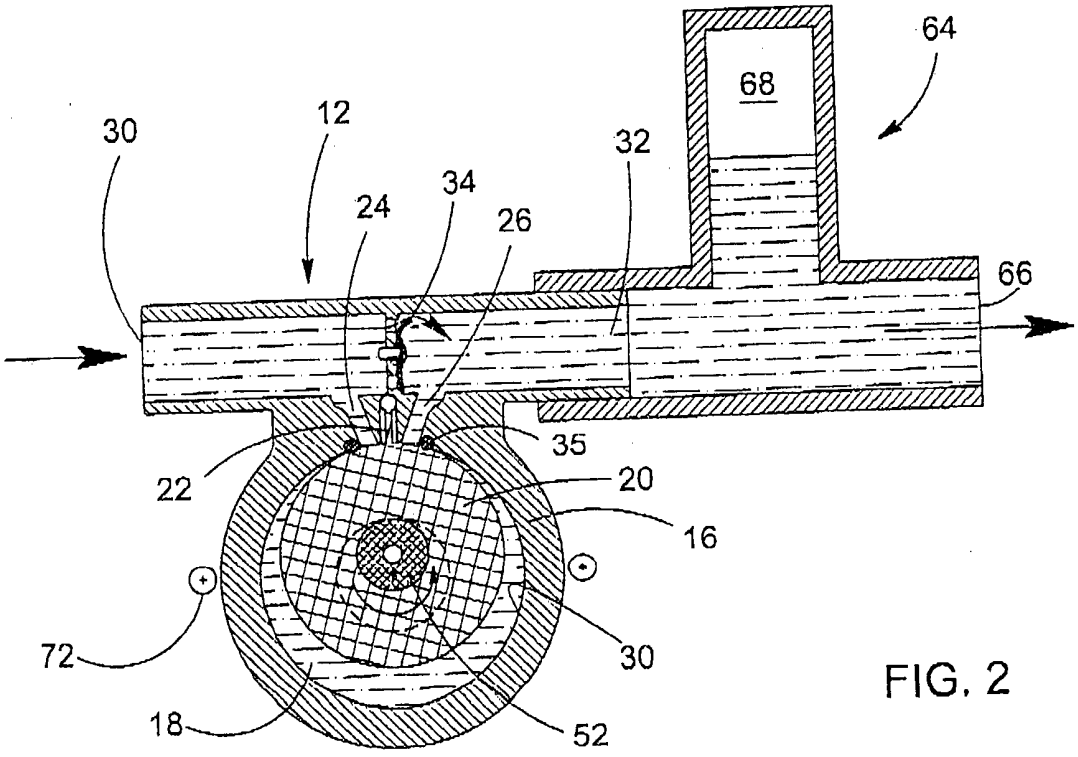
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FIG. 2

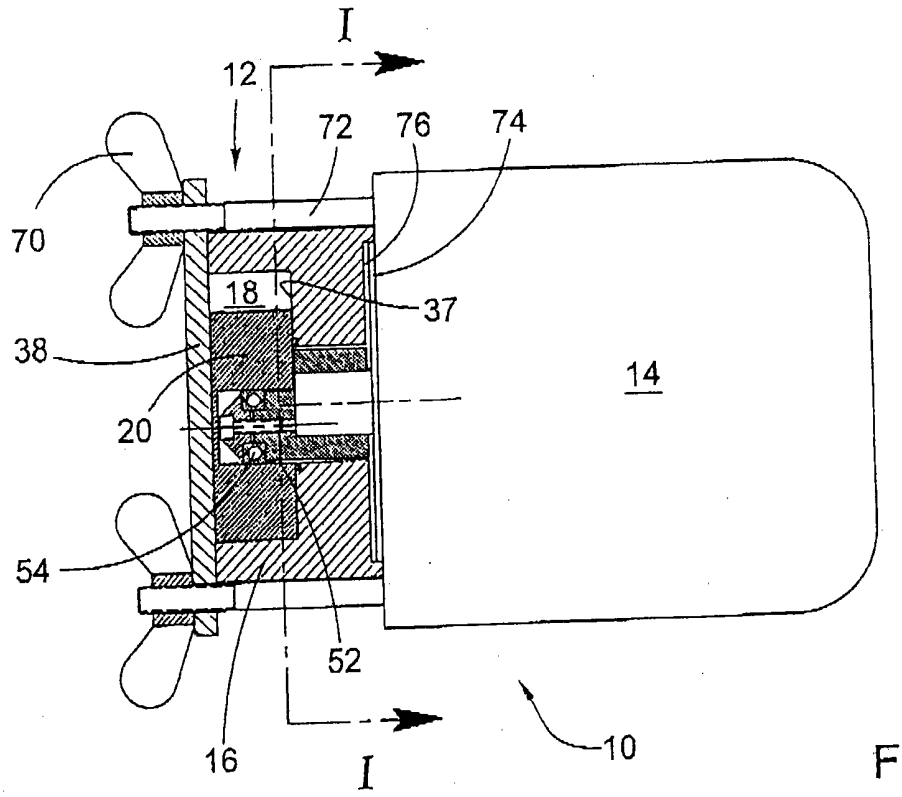
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FIG. 3

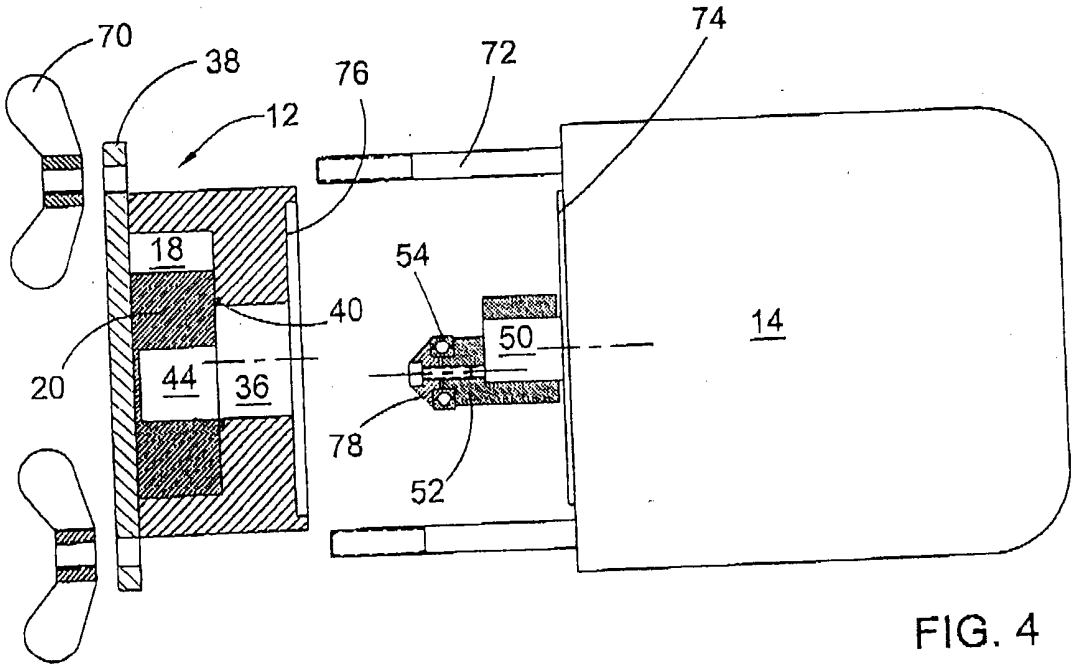
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FIG. 4

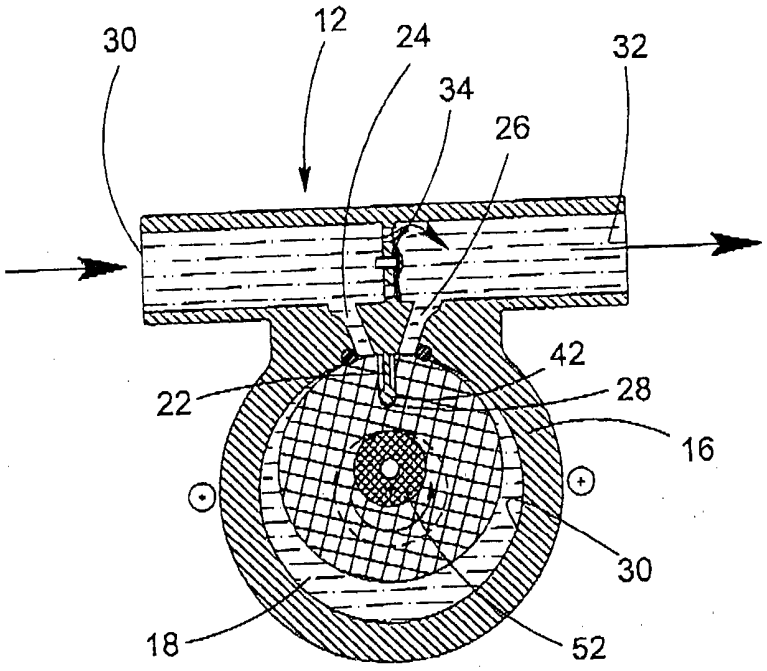

FIG. 5

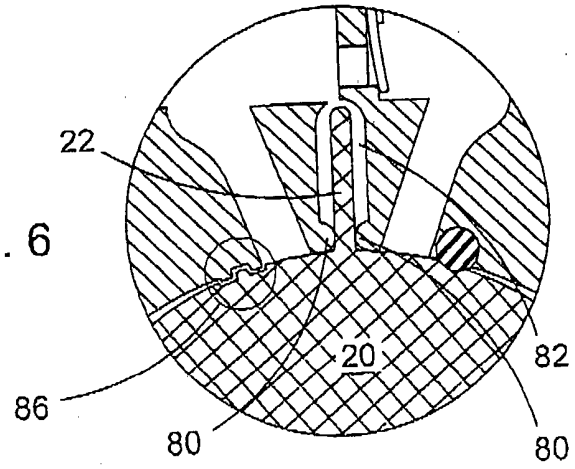

FIG. 6

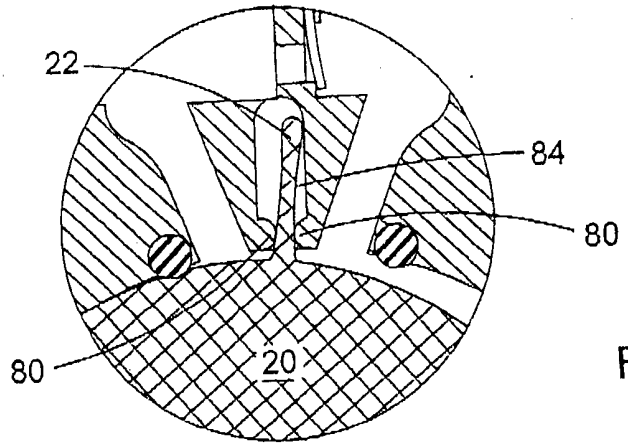

FIG. 7

SINGLE-VANE BARRIER PUMP

FIELD OF THE INVENTION

The present invention relates generally to vane pumps and more particularly, to single-vane pumps used for pumping of fluids in the chemical, medical and food industries, where the required process cleanliness necessitates frequent pump cleaning or replacement.

BACKGROUND OF THE INVENTION

A few examples of single-vane pumps are provided in Japanese publication JP 06-200887. The general layout of the pump includes a housing with a cylindrical cavity and a cylindrical rotor of lesser diameter eccentrically disposed therein. The pump drive, by means of an eccentric crank, causes the rotor to orbit the cavity scrolling the inner peripheral wall of the cavity. A pump chamber with crescent shape is thus defined between the rotor and the housing. The pump has a single vane joined to the rotor and to the housing across the pump chamber and dividing the latter into an expanding chamber and contracting chamber. The pump further has an inlet port at one side of the vane, connected to the expanding chamber, and an outlet port at the other side of the vane, connected to the contracting chamber. In one embodiment, the vane is in a radially sliding joint with the housing and in a hinged joint with the rotor. In a second embodiment, the vane is also in a sliding joint with the housing - however, the vane is not joined to the rotor but is urged to the rotor periphery by a spring in the sliding joint so that a tip of the vane is in sliding contact with the rotor. In a third embodiment, the vane is integral with the rotor, while sliding through a socket which in its turn is rotatably joined to the housing.

In all embodiments, the outlet port is closed by a one-way check valve to prevent backflow of fluid, or pressure loss, when the scrolling zone of the rotor passes over the vane joint, since neither the vane, nor the rotor in that position isolate the inlet port from the outlet port of the pump.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention, there is provided a rotary vane pump comprising a drive unit including an eccentric drive member, and a pump unit including a housing and a rotor. The housing has a cylindrical inner peripheral wall defining a cavity, the rotor has a cylindrical peripheral surface and is disposed eccentrically in the cavity. The rotor is engaged to the eccentric drive member so as to scroll the inner peripheral wall in close proximity thereto. The inner peripheral wall and the rotor surface define a pump chamber between them. The housing and the rotor are connected to each other, across the pump chamber, by a vane-and-socket joint. The housing has an inlet port adjacent one side of the assembly and an outlet port adjacent the other side of the assembly, both ports being open to the inner peripheral wall. A scroll zone of close proximity between the rotor surface and the inner peripheral wall of the housing divides the pump chamber into a first expanding inlet chamber in fluid connection with the inlet port and a second contracting outlet chamber in fluid connection with the outlet port.

The joint is designed such that the vane and the socket make contact in a contact zone substantially shorter than the socket or the vane, and such that the vane can both slide along the socket, and rock in the socket while maintaining predetermined fluid tightness in the contact zone.

In one embodiment, the socket has parallel walls, the vane has a thick rounded tip received in the socket and providing, together with the walls, the contact zone. The vane has a thin base protruding from the socket such that the vane is able to rock in the socket.

In another embodiment, the socket has a mouth defined by two rounded protrusions receiving the vane therebetween and providing therewith the contact

zone. The socket has a wider cavity behind the mouth such that the vane is able to rock in the socket. The vane may have parallel walls providing, at variable angles of rocking, variable fluid tightness in the contact zone. Alternatively, the protrusions may be elastic, or vane thickness may vary along vane length, thereby providing, at variable angles of rocking, approximately uniform fluid tightness in the contact zone.

This design allows to build a single-vane pump where the single vane and the socket are integral with the housing or with the rotor and the pump is thus easy to manufacture and assemble.

In accordance with another aspect of the present invention, the rotary vane pump comprises a sealing barrier disposed between the rotor periphery and the inner peripheral wall, preferably adjacent to the inlet port or to the outlet port. The barrier is adapted to prevent fluid communication between the inlet port and the outlet port when the scroll zone is over the inlet port or the outlet port or between them. Preferably, a second sealing barrier is disposed adjacent to the other port. The sealing barrier may be made of compliant material and attached to the inner peripheral wall or to the rotor periphery. Alternatively, it may be formed as cooperating teeth on the inner peripheral wall and on the rotor peripheral surface. Thereby, a single-vane pump is provided, which does not utilize any check-valves for the pumping, but rather employs a barrier, to maintain separation between the pump inlet and outlet. Thus, the employment of one-way valves at the outlet is avoided, as such valves cause pressure spikes, as well as excessive wear, due to their high rate of activation.

In accordance with a further aspect of the present invention, the pump unit of the rotary vane pump is attachable to and detachable from the drive unit, the two units being constructed so that attaching the pump unit to the drive unit results in engagement of the rotor to the eccentric drive member. Preferably, the rotary vane pump includes attachment means allowing simple manipulation without tools.

Preferably, the rotor has a concentric socket, the eccentric drive member comprises an eccentric crank adapted to fit rotatably, by a bearing, into the socket

when the pump unit is attached to the drive unit, and the housing has a sealed opening allowing the crank to enter the socket. Preferably, the crank has a tapered head with such diameter and eccentricity that it can enter the socket irrespective of the alignment between the socket and the crank before the attaching.

The pump unit of the rotary vane pump is preferably made of materials suitable for its usage as a disposable unit, such as plastic.

Thus, a single-vane pump constructed of two main components is provided: a permanent drive unit, which contains all the costly components, and a low-cost disposable pump unit, which comes in contact with the pumped media, and is easily and quickly replaceable. The disposable pump unit contains all the pump parts which are subjected to high rate of wear, such that its replacement results in a complete pump assembly which is as good as new with respect to wear and cleanliness.

The rotary vane pump of the present invention may further comprise a bypass channel, preferably integral with the housing, with an inlet in communication with the inlet port, an outlet in communication with the outlet port, and a one-way valve disposed between the inlet and the outlet so as to allow fluid flow bypassing said pump chamber, thereby maintaining a close to steady and uniform flow, while the rotary vane pump is pulsating when pumping. The pump may further comprise a pulsation damper with an air chamber, connected to the outlet, adapted for damping the pressure ripple present at the rotary vane pump outlet.

Other objects and features of the present invention will become apparent when viewed in light of the detailed description of the preferred embodiment when taken in conjunction with the attached drawings and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and its application, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic cross sectional view of a single vane pump in accordance with a preferred embodiment of the present invention;

Fig. 2 is a schematic cross sectional view of the single vane pump of Fig. 1, with the rotor in registration with the vicinity of the fluid inlet and outlet ports, and mounted pulsation damper.

Fig. 3 is a cross sectional view of the single vane pump of Fig. 1, showing the attachment and coupling of the pump unit to the drive unit and the eccentric drive member;

Fig. 4 is a cross sectional view of the single vane pump of Fig. 3, showing the disassembly and decoupling of the pump unit from the drive unit and the eccentric drive member; and

Figs. 5, 6 and 7 are schematic cross sectional views of vane-and-socket joints of the single-vane pump in accordance with alternative embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to Figs. 1 through 4, there is shown a single vane pump 10 in accordance with a preferred embodiment of the present invention. The single vane pump 10 comprises a pump unit 12 and a drive unit 14 detachably attached to each other.

The pump unit 12 includes a housing 16 with a cylindrical cavity, and a cylindrical rotor 20 disposed eccentrically in the cavity of the housing so as to define a pump chamber 18. The housing 16 has an inlet port 24 and an outlet port 26 communicating with the pump chamber 18, and a radial vane socket 28 disposed between the ports 24 and 26. Ports 24, 26 and the socket 28 are opened at the inner peripheral wall 30 of the pump chamber. The distal end of socket 28 is in

communication with the inlet side of the pump via a channel 27. The housing 16 includes a bypass channel 29 with an inlet 30 in communication with the inlet port 24, an outlet 32 in communication with the outlet port 26, and a one-way valve 34 between the inlet and the outlet. Two sealing barriers 35 are disposed at the peripheral wall 30, adjacent the inlet port 24 and the outlet port 26 respectively, at their farthest sides from the vane socket 28. The housing 16 has a central opening 36 at its wall 37 and a cover 38 closing the pump chamber 18.

Rotor 20 is disposed in the housing cavity in sliding contact with the cover 38 and the wall 37, sealing the opening 36 by means of a ring seal 40. Rotor 20 has a radial vane 22 with a thick cylinder tip 42 engaged in the vane socket 28 so that the vane 22 can slide along the radial socket 28. Vane tip 28 contacts the parallel walls of socket 28 in a sealing fit. The base of the vane 22 is thinner than the tip 42 such that the vane can rock in the socket 28 around the thick tip 42, still maintaining the sealing fit. Thus, the vane 22 and the socket 28 constitute a joint providing both sliding and rocking. The rotor 20 further has a central socket 44 facing the opening 36.

Drive unit 14 has a rotary shaft 50 with an eccentric crank 52 equipped with a bearing 54. When pump unit 12 is attached to drive unit 14, crank 52 is received by central socket 44 and shaft 50 is coaxial with the cylinder pump chamber 18.

The radial geometrical relationship between drive unit 14, eccentric crank 52, rotor 20 and diameter of the cylinder pump chamber 18 is such that rotation of rotary shaft 50, via the crank 52, causes rotor 20 to scroll the inner peripheral wall 30, maintaining contact or near-contact with the wall at a scroll zone 56. Due to the vane-and-socket joint of rotor 20 to the housing 16, where the tip 42 of radial vane 22 is confined to vane socket 28, the rotor performs simultaneously a reciprocating motion parallel to the vane socket, and a transverse rocking motion. The channel 27 facilitates sliding of the tip 42 by letting fluid in and out of the distal end of socket 28.

During this complex motion, rotor 20 and housing 16 define two isolated and variable volumes: an expanding inlet chamber 58 and a contracting outlet

chamber 60. Expanding chamber 58 is defined between the inlet side of the vane 22, a portion of the peripheral wall 30 between vane socket 28 and scroll zone 56, and an adjacent portion of the rotor's periphery. Contracting chamber 60 is defined between outlet side of the vane 22, the remaining portion of the peripheral wall 30 between vane socket 28 and scroll zone 56, and the remaining portion of the rotor's periphery.

When the eccentric crank 52 rotates counterclockwise (see Fig. 1), scroll zone 56 also travels counterclockwise, and the expanding chamber 58 expands, thereby drawing or suctioning fluid from the inlet 30, through the inlet port 24. At the same time, the contracting chamber 60 contracts, forcing the fluid it contains, through the outlet port 26 to the outlet 32. In the position shown in Fig. 2, scroll zone 56 has reached vane socket 28 so that the contracting chamber has vanished while the expanding chamber has attained its maximal volume, after which it starts contracting and becomes the contracting chamber, while at the same time a "new" expanding chamber is born.

In the position of Fig. 2, rotor 20 is in contact with the sealing barriers 35, thereby sealing off possible communication between inlet port 24 and outlet port 26 around rotor 20. Barriers 35 are made of elastic material, such as rubber, such that they are compressed by the rotor 20 as it scrolls by them. In the absence of barriers 35, when the rotor 20 is in the illustrated position, or rather in any position where scroll zone 56 is on inlet port 24 or on outlet port 26, or between them, pressurized fluid from outlet port 26 could flow around rotor 20 back to inlet port 24. This undesirable reverse flow is traditionally prevented by use of a one-way valve at the outlet port. Sealing barriers 35 perform an equivalent function, preventing fluid back flow from the outlet port 26 to the inlet port 24, without the negative effects, which valves introduce.

Notably, fluid back flow may be prevented also by a single sealing barrier 35. In such case, the single barrier should provide the sealing of a slightly wider gap. For example, if the left barrier in Fig. 2 is removed, the remaining right barrier

35 must keep the gap between rotor 20 and the inner wall 30 sealed until scroll zone 56 reaches a point to the left of inlet port 24.

It would be obvious to those skilled in the art that any barrier, suitably disposed between rotor 20 and inner peripheral wall 30, may perform the function of blocking off the back-flow path from outlet port 26 to inlet port 24. For example, the barriers may be disposed on the rotor periphery opposite ports 24 and 26. Alternatively, a labyrinth barrier 86, shown in Fig. 6, may be formed as cooperating teeth on the inner peripheral wall and on the rotor peripheral surface.

The bypass one-way valve 34 is optional. It is made of resilient material, such as rubber, which may deflect under pressure differential applied thereto, permitting fluid to flow from the inlet 30 to the outlet 32. Thus, continuous flow of fluid may be maintained also at the time when expanding chamber 58 and contracting chamber 60 are not displacing fluid.

In the illustrated preferred embodiment of Fig. 2, the single vane pump 10 is shown assembled with an additional pulsation damper 64 which in this embodiment is a trapped air reservoir with fluid outlet 66. The damper 64 absorbs and dampens pressure ripple or fluctuations resultant from the cyclic nature of the fluid displacement in the single vane pump 10. Trapped air 68 expands and contracts in response to pressure fluctuations of the fluid at the outlet 32, enhancing, together with by-pass valve 34, stable and uniform flow and pressure of the pumped fluid at the outlet 66.

Fig. 3 illustrates the pump unit 12 of the single vane pump 10, attached to the drive unit 14, with rotor 20 coupled to eccentric crank 52, via bearing 54. The pump unit is retained in place by wing nuts 70, which are manually screwed and tightened on threaded studs 72 anchored in drive unit 14. Drive unit 14 has a protrusion 74 mated to recess 76 in the housing 16 such that pump unit 12 is keyed in proper relation to drive unit 14.

Fig. 4 illustrates pump unit 12 detached from drive unit 14, with wing nuts 70 removed from threaded studs 72. Cover 38 may be an integral part of pump unit 12 permanently attached to housing 16, or it may be separate from housing 16. In

the illustrated embodiment, it functions both as a cover for the housing 16 as well as a retaining plate for retaining pump unit 12 engaged to drive unit 14. It will be appreciated that there are other simple and fast means for manual attaching the pump unit to the drive unit, for example, a bayonet lock or a threaded collar.

Eccentric crank 52 has a tapered head 78 facilitating the insertion of the crank 52 into the socket 44 of rotor 20. The diameter of tapered head 78 and eccentricity of the crank 52 are selected so that tapered head 78 can enter into crank socket 44 while the pump unit is being attached to the drive unit, irrespective of the alignment of the socket 44 and crank 52. For this purpose, the crank eccentricity is preferably less than one-fourth of the crank head diameter (the latter is presumed equal to the socket 44 diameter).

The rotary vane pump of the present invention can be easily adapted for disposable use in the chemical, medical and food industries, where the required process cleanliness necessitates frequent pump cleaning or replacement. For this purpose, the pump unit is made of low-cost materials suitable for its usage as a disposable unit, such as plastic. The unique construction of the vane-and-socket connection allows manufacturing of integral rotor and integral housing, without additional assembly of a vane or socket. Thus, the pump parts which come in contact with the pumped media are cheap, and easily and quickly replaceable by a simple manipulation without using any tools. The disposable pump unit advantageously contains all the pump parts that are subject to high rate of wear and contamination, while the permanent drive unit, including the eccentric crank with the bearing, contains all costly components. Thus, the replacement of the pump unit results in a complete pump assembly which is as good as new with respect to wear and cleanliness.

While particular embodiments of the invention have been shown and described, numerous variations and alternate embodiments will occur to those skilled in the art. Accordingly, it is intended that the invention be limited only in terms of the appended claims.

For example, the vane-and-socket joint in the pump of the present invention may be designed in a number of various ways, as shown in Figs. 5, 6 and 7. In an alternative embodiment of Fig. 5, the vane 22 is made integral with housing 16, while vane socket 28 is formed within rotor 20. As shown in Fig. 6, the vane 22 may be made flat while the socket 28 may be formed with a mouth confined by two protrusions 80 and a wider inner part 82. It would be appreciated that in this simplified design, the fluid tightness of the contact between the vane and the socket protrusions may vary with the angle of rocking. One possibility to ensure uniform tightness is to make the protrusions 80 elastic. Another possibility is shown in Fig. 7, where walls 84 of the vane 22 are slightly concave so that the vane will have uniformly tight contact with the protrusions 80 at all variations of the rocking angle.

CLAIMS:

1. A rotary vane pump comprising a drive unit including an eccentric drive member, and a pump unit including a housing with a cylindrical inner peripheral wall defining a cavity, a rotor with a cylindrical peripheral surface, said rotor being disposed eccentrically in said cavity and being engaged to said eccentric drive member so as to scroll said inner peripheral wall in close proximity thereto when the drive member rotates the rotor, said inner peripheral wall and the rotor peripheral surface defining between them a pump chamber, said housing and said rotor being connected to each other, across said pump chamber, by a vane-and-socket joint comprising a vane and a vane socket, said housing having an inlet port adjacent to one side of said assembly and an outlet port adjacent to the other side of said assembly, both ports being open to said inner peripheral wall, wherein

said joint is designed such that said vane and said socket contact in a narrow contact zone substantially shorter than said socket or said vane, and such that said vane can both slide along said socket, and rock in said socket with respect to said contact zone, with said joint maintaining predetermined fluid tightness in said contact zone.

2. The rotary vane pump according to Claim 1, wherein said socket has parallel walls, said vane has a thick rounded tip received in said socket and providing, in cooperation with said walls, said contact zone, said vane further having a thin base protruding from said socket such that said vane is able to rock in said socket.

3. The rotary vane pump according to Claim 1, wherein said socket has a mouth defined by two protrusions receiving said vane therebetween and providing therewith said contact zone, said socket further having a wider cavity behind said mouth such that said vane is able to rock in said socket.

4. The rotary vane pump according to Claim 3, wherein said vane has parallel walls providing, at variable angles of rocking, variable fluid tightness in said contact zone.

5. The rotary vane pump according to Claim 3, wherein said vane has parallel walls while said protrusions are elastic, thereby providing, at variable angles of rocking, approximately uniform fluid tightness in said contact zone.

6. The rotary vane pump according to Claim 3, wherein said vane has variable thickness along its length such that, at variable angles of rocking, approximately uniform fluid tightness is provided in said contact zone.

7. The rotary vane pump according to Claim 1, wherein said base of said vane is integral with one of said rotor and said housing while said vane socket is integrally formed within the other of said rotor and said housing.

8. The rotary vane pump according to Claim 7, wherein said vane extends along a radius of the rotor or the housing with which said base is integral, and said vane socket extends along a radius of the rotor or the housing within which said socket is formed.

9. The rotary van e pump according to Claim 7, wherein said base of said vane is integral with said housing.

10. The rotary vane pump according to Claim 7, wherein said base of said vane is integral with said rotor.

11. The rotary vane pump according to Claim 1, further comprising a sealing barrier disposed between said rotor surface and said inner peripheral wall and adapted to prevent fluid communication between said inlet port and said outlet port when said rotor is in said close proximity opposite one of said inlet port and outlet port or between them.

12. The rotary vane pump according to Claim 11, wherein said sealing barrier is disposed adjacent to one of said inlet or outlet ports.

13. The rotary vane pump according to Claim 12, wherein a second sealing barrier is disposed adjacent to the other of said inlet or outlet ports.

14. The rotary vane pump according to Claim 11, wherein said sealing barrier is attached to said housing.

15. The rotary vane pump according to Claim 11, wherein said sealing barrier is attached to said rotor.

16. The rotary vane pump according to Claim 11, wherein said sealing barrier is made of elastically deformable material.

17. The rotary vane pump according to Claim 11, wherein said sealing barrier is formed as cooperating teeth on said inner peripheral wall and on said rotor peripheral surface.

18. The rotary vane pump according to Claim 1, further comprising a bypass channel with an inlet in communication with said inlet port, an outlet in communication with said outlet port, and a one-way valve disposed between said inlet and said outlet so as to allow fluid flow from said inlet to said outlet bypassing said pump chamber.

19. The rotary vane pump according to Claim 18, wherein said bypass channel is integral with said housing.

20. The rotary vane pump according to Claim 1, further comprising a pulsation damper connected to said outlet port.

21. A pump unit for usage with the rotary vane pump of Claim 1.

22. The pump unit according to Claim 21, wherein said pump unit is attachable to and detachable from said drive unit.

23. The pump unit according to Claim 22, wherein said pump unit and said drive unit are constructed so that attaching said pump unit to said drive unit results in engagement of the rotor to the eccentric drive member.

24. The pump unit according to Claim 23, including attachment means allowing for said attaching by simple manipulation without tools.

25. The pump unit according to Claim 23, wherein said rotor has a concentric socket, said eccentric drive member comprises an eccentric crank adapted to fit rotatably into said concentric socket when said pump unit is attached to said drive

unit thereby providing said engagement, and said housing has an opening allowing said crank to enter said socket.

26. The pump unit according to Claim 25, wherein said crank comprises a bearing permanently affixed thereto, said bearing providing the rotatable fit of said crank to said socket.

27. The pump unit according to Claim 26, wherein said crank has a tapered head and has such diameter and eccentricity that said tapered head will enter said socket during said attaching irrespective of the alignment between said socket and said crank before said attaching.

28. The pump unit according to Claim 22, wherein said pump unit is made of materials suitable for its usage as a disposable unit.

29. A rotary vane pump comprising a drive unit including an eccentric drive member, and a pump unit including a housing with a cylindrical inner peripheral wall defining a cavity, a rotor with a cylindrical peripheral surface, said rotor being disposed eccentrically in said cavity and being engaged to said eccentric drive member so as to scroll said inner peripheral wall in close proximity thereto when the drive member rotates the rotor, said inner peripheral wall and the rotor surface defining between them a pump chamber, said housing and said rotor being connected to each other, across said pump chamber, by a vane-and-socket joint comprising a vane and a vane socket, said housing having an inlet port adjacent one side of said assembly and an outlet port adjacent the other side of said assembly, both ports being open to said inner peripheral wall, wherein

said rotary vane pump further comprises a sealing barrier disposed between said rotor surface and said inner peripheral wall and adapted to prevent fluid communication between said inlet port and said outlet port when said rotor is in said close proximity opposite one of said inlet port and outlet port or between them.

30. The rotary vane pump according to Claim 29, wherein said joint is designed such that said vane and said socket contact in a narrow contact zone substantially shorter than said socket or said vane, and such that said vane can both

slide along said socket, and rock in said socket while maintaining predetermined fluid tightness in said contact zone.

31. The rotary vane pump according to Claim 30, wherein said vane is integral with one of said rotor and said housing while said vane socket is integrally formed within the other of said rotor and said housing.

32. The rotary vane pump according to Claim 29, wherein said sealing barrier is made of elastically deformable material.

33. The rotary vane pump according to Claim 29, wherein said sealing barrier is formed as cooperating teeth on said inner peripheral wall and on said rotor peripheral surface.

34. A pump unit for usage with the rotary vane pump of Claim 29.

35. The pump unit according to Claim 34, wherein said pump unit is attachable to and detachable from said drive unit.

36. The pump unit according to Claim 35, wherein said pump unit is made of materials suitable for its usage as a disposable unit.

37. A rotary vane pump constructed and arranged substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.

38. A pump unit constructed and arranged substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.

Application No:	GB 0314231.2	**Examiner:**	Peter Middleton
Claims searched:	1-28, 37-38	**Date of search:**	18 November 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1-2, 7-8, 10, 21-25, 28	GB 926495 A	(BERNARD) whole document
A	1, 21	BE 371144 A	(WEBER) see figures
A		GB 1033454 A	(INPACO)
A		EP 0687816 A	(YASUI)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

F1F

Worldwide search of patent documents classified in the following areas of the IPC[7]:

F01C
F04C

The following online and other databases have been used in the preparation of this search report:

EPODOC, WPI, JAPIO