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(54) Title: A CENTRIFUGAL PUMP AND VOLUTE LINER

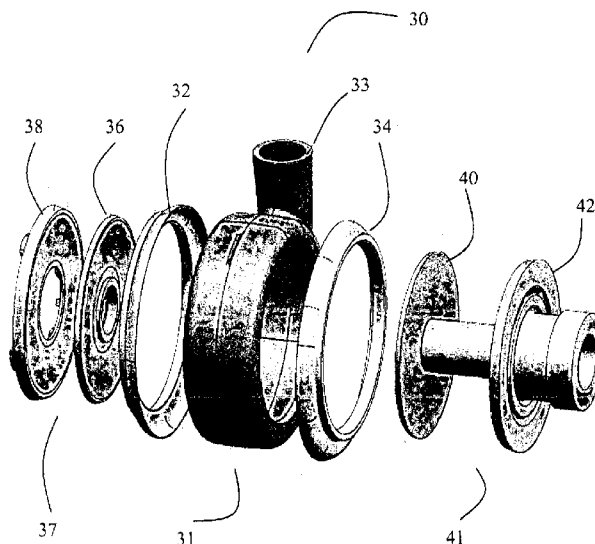


Fig 2

(57) Abstract: A centrifugal pump and liner components for pumps are described, the pump including: two pump casings; a wear resistant ceramic liner is located between the casings; and wherein at least one region of polyurethane is provided between the outside of the liner and the inside of at least one of the pump casings.



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A CENTRIFUGAL PUMP AND VOLUTE LINER

Technical Field

The present invention relates to wet ends for use in centrifugal pumps and particularly relates to wet end arrangements which utilise a combination of ceramic parts and resilient parts.

Background

A known arrangement for a centrifugal pump 10 is shown at Figure 1. The pump 10 includes two pump casings 12, 14. Inside these casings 12, 14 is provided a ceramic liner and a ceramic impeller 17. The ceramic liner is comprised of a volute liner 16, a frame plate liner insert 18 provided on the driveshaft side of the pump 10, and a throatbush liner 20 provided on the inlet side of the pump 10.

Following assembly of the pump parts, the pump is secured together by way of tightening nuts onto a series of bolts 22 which are provided about the periphery of the pump casing 12 and which cooperate with apertures 24 provided about the periphery of the pump casing 14.

Ceramic parts can be quite brittle in nature and it has been found that, when tightening the nuts to secure the pump casings together, cracking of the ceramic liner components can result.

Furthermore, it is not uncommon for ceramic liner components to be damaged by cracking due to shock forces experienced during transit or other handling.

There remains a need to provide improved pump arrangements.

Summary

In one aspect there is provided a centrifugal pump including: two pump casings; a wear resistant ceramic liner is located between the casings; and wherein at least one region of polyurethane is provided between the outside of the liner and the inside of at least one of the pump casings.

In certain embodiments the at least one region of polyurethane is provided between the outside of the liner and the inside of both of the pump casings.

In certain embodiments the at least one region of polyurethane is annular in shape.

In certain embodiments the liner is comprised of a volute liner, a throatbush liner and a frame plate liner.

In certain embodiments the volute liner extends between both pump casings to overlie a join between the pump casings.

In a second aspect there is provided a pump liner component which is formed from a ceramic material and includes at least one region of polyurethane which is bonded
5 to a surface of the ceramic material.

In certain embodiments the at least one region of polyurethane is annular in shape.

In certain embodiments the component is one of a volute liner, a throatbush or a frame plate liner.

In a third aspect there is provided a liner for a centrifugal pump which is
10 comprised of a volute liner, a throatbush and a frame plate liner, all of which are in accordance with the second aspect.

In a fourth aspect there is provided a method of forming a pump liner component including the steps of: forming a ceramic part; and over-moulding the ceramic part with at least one region of polyurethane.

15 In certain embodiments the pump liner component comprises any of a volute liner, a throatbush or a frame plate liner.

In a fifth aspect there is provided a method of retrofitting a centrifugal pump liner including the steps of replacing a component of the existing pump liner with a pump liner component according to the second aspect.

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Brief Description of the Drawings

Notwithstanding any other forms which may fall within the scope of the methods and apparatus as set forth in the Summary, specific embodiments will now be described, by way of example, and with reference to the accompanying drawings in which:

25 Figure 1 is an exploded view of a prior art centrifugal pump arrangement; and

Figure 2 is an exploded view of a centrifugal pump arrangement according to an embodiment of the invention.

Detailed Description of Embodiments

30 Referring to Figure 2, a pump liner 30 comprising a volute liner 31, a throatbush 41 and a frame plate liner 37 is shown in an arrangement somewhat similar to that shown in Figure 1. The pump casings are not shown, as these are identical to those shown in Figure 1.

The volute liner 30 is comprised of a ceramic volute liner 33 which is provided

with regions of polyurethane on each side in the form of polyurethane rings 32, 34. When assembled inside a pair of pump casings 12, 14, the rings 32, 34 sit between the outside of the volute liner and the inside faces of the pump casings 12, 14. At the time of assembling the pump, the polyurethane rings 32, 34 alleviate and distribute compressive load applied to the volute liner 30. This reduces the likelihood that the volute liner will crack whilst the fasteners 22, 24 which are used for holding the pump casings 12, 14 together in the assembled position are tightened.

Although shown in exploded view, the rings 32, 34 are affixed to the volute liner 33 using an over-moulding technique at the time of manufacturing the volute liner. Similarly, the ceramic frame plate liner 36 is over-moulded with polyurethane backing 38, and the ceramic throatbush 40 is over-moulded with polyurethane outer ring 42 at the time of manufacture.

To produce the liner, the ceramic components are produced in a known fashion, such as by slip casting, which does not require detailed explanation as it is a technique known in the art. Following production of the ceramic parts, a polyurethane resin is mixed. Liquid isocyanate and polyol resin are combined at a specified stoichiometric ratio along with a catalyst, and are mixed together until a homogeneous blend is obtained which is ready for dispensing as a liquid into a mold.

Each of the ceramic parts are put into molds with voids defining the shape of the desired polyurethane regions. The resin is dispensed into the voids and is allowed to set at room temperature for a period of time. When the resin has set, the finished parts are demolded.

Advantageously, the over-moulding operation is conducted at ambient temperatures, and without the need for high pressures and large amounts of heat energy, as would be the case if attempting to form the resilient portions from a heat-cured elastomer. Furthermore, the costs of the associated molds are greatly reduced as they can be formed of thinner and lighter materials, and require less energy consumption for the production process.

By this process of over-moulding, each polyurethane region becomes tightly bonded to the previously formed ceramic components. Therefore, the volute liner 31 being a combination of the ceramic liner 33 and the polyurethane rings 32, 34 is shipped as one component. Similarly, the throatbush 41, being a combination of the ceramic throatbush 40 and the polyurethane outer ring 42 is shipped as one component, as is the frame plate liner 37, being a combination of the ceramic frame plate liner 36 and a polyurethane

backing 38.

The polyurethane regions 36, 32, 34, 42 protect the liner components from shock loads that may be experienced during transit and handling, such as by being knocked or dropped, thereby reducing the risk of the liner components becoming damaged prior to assembly into a pump.

In further embodiments only some of the components may feature the polyurethane region bonded thereto, for example the volute liner 30 may have the peripheral rings 32, 34 positioned thereon, but the other liner components may not. Thus it may be possible to retrofit various liner components which feature polyurethane regions bonded thereto, at different times into a pump during a maintenance cycle without the need to change all of the liner components at once.

It can be seen that embodiments of the invention provide at least one of the following advantages:

- The ceramic liner components are cushioned against the inside of the pump casings by regions of polyurethane to reduce risk of breakage when assembling pump and tightening pump casings together.
- The ceramic liner components are protected from damage due to dropping or shock loads during transit.

In the foregoing description of preferred embodiments, specific terminology has been resorted to for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar technical purpose. Terms such as "front" and "rear", "inner" and "outer", "above", "below", "upper" and "lower", "horizontal" and "vertical" and the like are used as words of convenience to provide reference points and are not to be construed as limiting terms.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

In this specification, the word "comprising" is to be understood in its "open" sense, that is, in the sense of "including", and thus not limited to its "closed" sense, that is the sense of "consisting only of". A corresponding meaning is to be attributed to the corresponding words "comprise", "comprised" and "comprises" where they appear.

The preceding description is provided in relation to several embodiments which may share common characteristics and features. It is to be understood that one or more features of any one embodiment may be combinable with one or more features of the other embodiments. In addition, any single feature or combination of features in any of the embodiments may constitute additional embodiments.

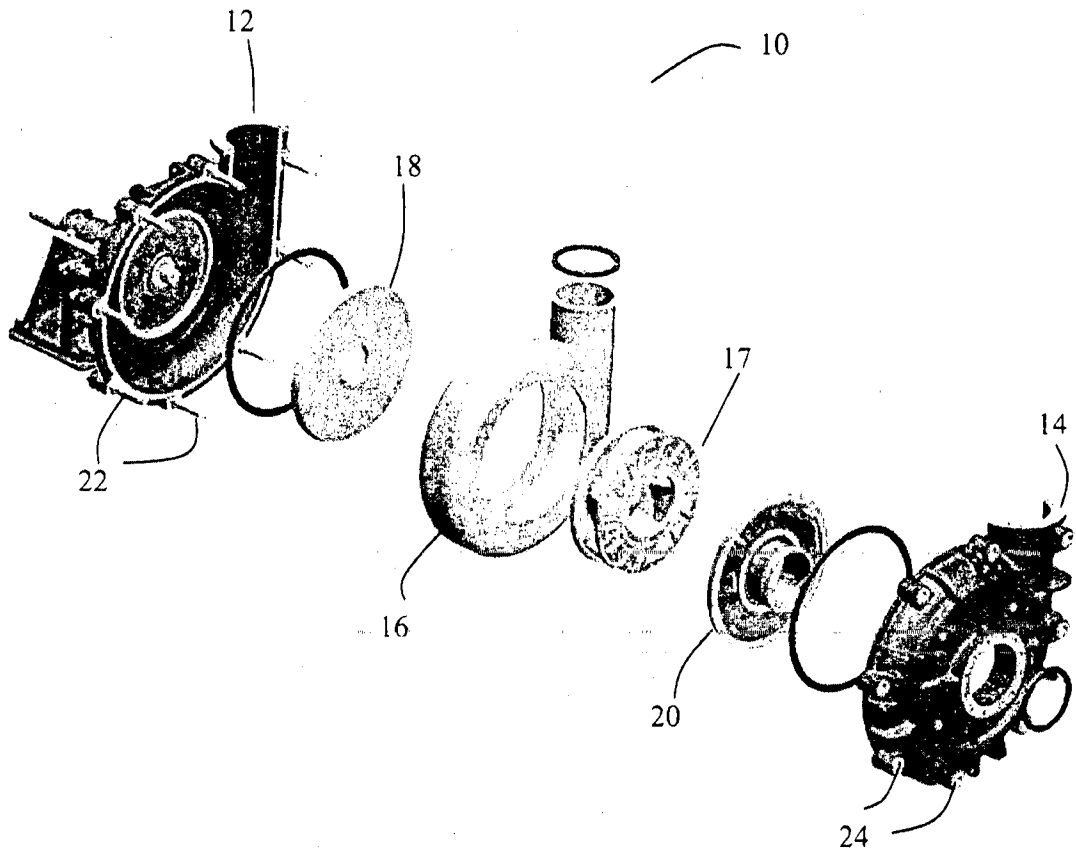
Any inventions which have described in connection with what are presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the inventions. Also, the various embodiments described above may be implemented in conjunction with other embodiments, e.g., aspects of one embodiment may be combined with aspects of another embodiment to realize yet other embodiments. Further, each independent feature or component of any given assembly may constitute an additional embodiment.

CLAIMS:

1. A centrifugal pump including:
two pump casings;
a wear resistant ceramic liner is located between the casings;
and wherein at least one region of polyurethane is provided between the outside of the liner and the inside of at least one of the pump casings.
2. A centrifugal pump according to claim 1, wherein at least one region of polyurethane is provided between the outside of the liner and the inside of both of the pump casings.
3. A centrifugal pump according to any one of the preceding claims, wherein the at least one region of polyurethane is annular in shape.
4. A centrifugal pump according to any one of the preceding claims, wherein the liner is comprised of a volute liner, a throatbush liner and a frame plate liner.
5. A centrifugal pump according to claim 4 wherein the volute liner extends between both pump casings to overlies a joint between the pump casings.
6. A pump liner component which is formed from a ceramic material and includes at least one region of polyurethane which is bonded to a surface of the ceramic material.
7. A pump liner component according to claim 6, wherein the at least one region of polyurethane is annular in shape.
8. A pump liner component according to either of claims 6 or 7, wherein the component is one of a volute liner, a throatbush or a frame plate liner.
9. A liner for a centrifugal pump which is comprised of a volute liner, a throatbush and a frame plate liner, all of which are in accordance with either of claims 6 or 7.
10. A method of forming a pump liner component, the method including the steps of:
forming a ceramic part; and
over-moulding the ceramic part with at least one region of polyurethane.
11. A method according to claim 10, wherein the pump liner component comprises any of a volute liner, a throatbush or a frame plate liner.
12. A method of retrofitting a centrifugal pump liner, the method including the

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steps of replacing a component of the existing pump liner with a pump liner component according to any one of claims 6 to 8.



PRIOR ART

Fig 1

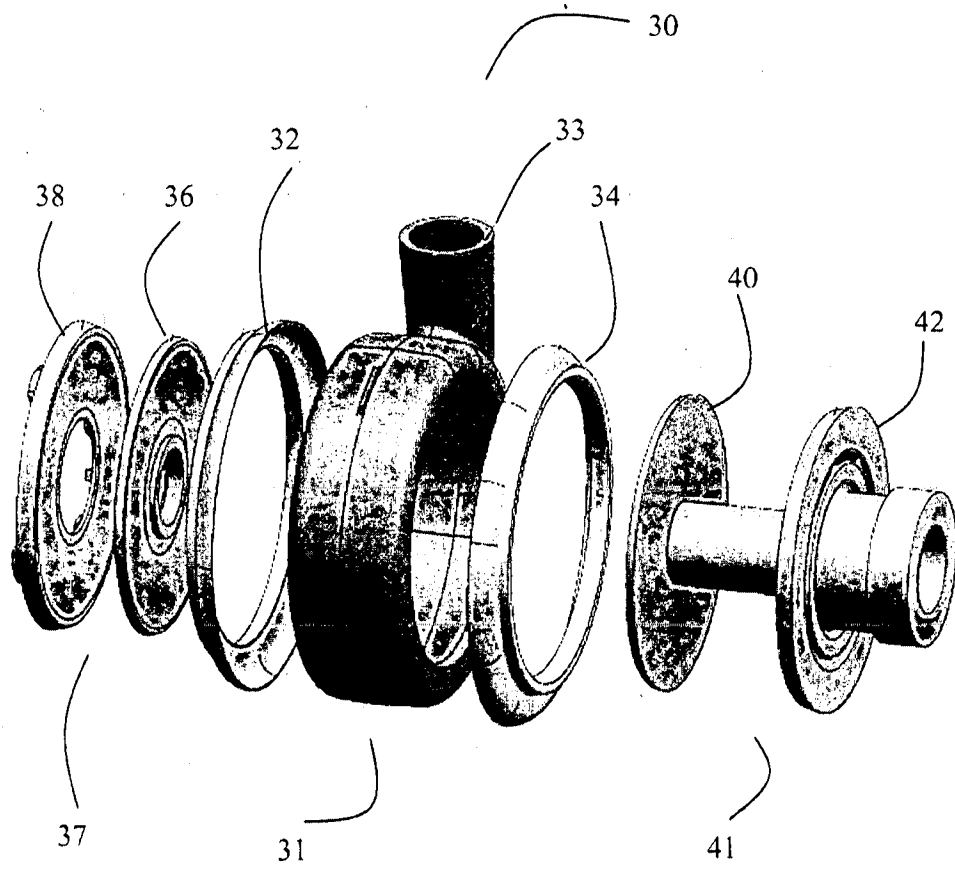


Fig 2

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/40 (2006.01) F04D 29/02 (2006.01) F04D 1/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

WPI, EPODOC: IPC, ECLA: F04D29, F04D1 & Keywords (centrifugal, volute, rotary, pump, ceramic, liner, casing, resilient, cushion, ring, wear, resist) and like terms

Google Patent: pump, liner, ceramic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

 Further documents are listed in the continuation of Box C See patent family annex

* Special categories of cited documents:

"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
12 October 2012Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2012/000776
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2009/0068002 A1 (BURGESS) 12 March 2009 Figure 1	
A	US 3115099 A (CLAY) 24 December 1963 Figures 1, 3	
A	US 4099890 A (MURAKAMI et al.) 11 July 1978 Figures 2, 5	
A	US 4974998 A (HEINEMAN) 04 December 1990 Figures 1-2	
A	US 1585669 A (HANSEN) 25 May 1926 Figure 1	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2012/000776

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2012/000776

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Patent Document/s Cited in Search Report		Patent Family Member/s	
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End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

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