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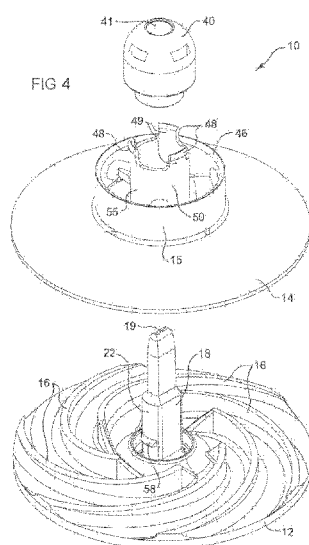
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Published:

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(54) Title: IMPROVED PUMP IMPELLER



(57) Abstract: An impeller (10) suitable for use in a fluid pump, including first and second annular plates (12,14) which are axially spaced. The impeller (10) also includes an angularly spaced array of vanes 16 located between the plates (12,14), and a central hub (18) connected to the first annular plate (12). The hub (18) is within and radially spaced from the inner periphery (24) of the second annular plate (14); and by which the impeller (10) is mountable on a shaft (28) for rotation therewith. The hub (18) includes a shaft-receiving bore (26) for receiving the shaft (28) therein. The bore (26) includes a portion (30) with a non-circular axial cross-section for providing a fit between the hub (18) and the shaft (28) that precludes axial rotation of the shaft (28) relative to the hub (18).

IMPROVED PUMP IMPELLER

The present invention relates to an improved impeller suitable for use in a fluid pump. In one exemplary application, the invention is used in a fluid pump having an electric motor. It will be hereinafter convenient to describe the invention in relation to this
5 exemplary application, although it should be appreciated that the invention is not limited to that application and may be used as an impeller in a variety of different pump types and configurations.

10 INVENTION BACKGROUND

Fluid pumps are suitable for pumping water to the jets of a spa-bath or spa-pool installation, or for meeting the requirements for pumping water for a swimming pool. By way of example, one form of fluid pump used in this application includes a housing assembly having a first sub-housing and having an electric motor therein, which is in
15 line with a second sub-housing within which is provided an impeller. A rotor shaft of the motor is connected to the impeller through a seal between the first and second sub-housings.

Existing fluid pumps typically include an impeller connected to the rotor shaft by way of a screw threaded arrangement. In such an arrangement, the surface of one end of the rotor shaft is provided with a screw thread for mating with an internally threaded bore of the impeller. This type of arrangement provides a generally suitable connection when the motor is operated as intended. However, if the motor is inadvertently operated in the reverse direction of rotation then the impeller will tend to
20 unthread from the rotor shaft. The reverse direction of rotation can occur, for example, in incorrectly wired domestic applications supplied with three phase power. This can have a disastrous effect on a fluid pump, as an impeller unthreading from a rotor shaft axially displaces the impeller relative to the pump motor, in turn potentially smashing the second sub-housing and/or stripping the thread between the impeller and the
25 shaft.
30

One approach to addressing the problem of an impeller unthreading from a rotor shaft is to include an adhesive or bonding agent such as LOCTITE[®], to secure the threaded components together. It is to be appreciated that the adhesive must strong enough to

prevent unintended unscrewing of the threaded components; while at the same time allow the components to be unscrewed, when necessary, to allow for servicing. Undesirably, the use of such products generally adds to the overall time and cost of pump assembly. Also, such products must be carefully and sparingly applied to the specific components in question. It would be most undesirable for adhesive or a bonding agent to be applied, spilt or otherwise come into contact with other pump components. Moreover, adhesives and bonding agents generally only cope with the torsional stress of a limited number of motor starts before eventually failing. As a result, the use of such products for securing an impeller to a rotor shaft is generally not preferred.

It is to be appreciated that pump motors are typically biased to run in one direction. However, unintentional fluid flow in the reverse direction can be sufficient to impart rotation on the impeller overcoming the bias. Another approach to minimizing the potential damage caused by a motor operating in reverse is to provide a check valve in the fluid flow path. The provision of a check valve limits the flow of fluid through the impeller and, in turn, through the second sub-housing, to one desired direction. The inclusion of a check valve, however, adds to the overall cost and complexity of the pump. A check valve, fitted to prevent reverse rotation of the impeller, can cause water hammer. This can generate very high internal pressures within the pump and associated pipework. If a check valve is not fitted, these potentially damaging pressure build-ups cannot occur.

The above discussion of documents, acts, materials, devices, articles and the like is included in this specification solely for the purpose of providing a context for the present invention. It is not suggested or represented that any of these matters formed part of the prior art base or were common general knowledge in Australia or elsewhere in the field relevant to the present invention as it existed before the prior date of each claim of this application.

The present invention relates to an improved impeller for use in the above referred application. It is to be understood, however, that the invention could also be used in other applications.

SUMMARY OF THE INVENTION

According to the present invention, there is provided an impeller suitable for use in a fluid pump, although the impeller may be used in other forms of pump. The impeller includes first and second annular plates which are axially spaced. The impeller also
5 includes an angularly spaced array of vanes located between the plates, and a central hub connected to the first annular plate. The hub is within and radially spaced from the inner periphery of the second annular plate; and by which the impeller is mountable on a shaft for rotation therewith. The hub includes a shaft-receiving bore for receiving the shaft therein, the bore including a portion with a non-circular axial
10 cross-section for providing a fit between the hub and the shaft that precludes axial rotation of the shaft relative to the hub.

As stated, the axial cross-section of the bore portion referred to above would typically be non-circular. However, this need not necessarily be the case, as a circular cross-
15 section is also contemplated. In such an arrangement, an interference fit may, for example, be provided between the hub and shaft to prevent axial rotation of the shaft relative to the hub.

Axial displacement of the hub relative to the shaft may be precluded by way of a
20 suitable engagement therebetween. In one non-limiting form, the hub is made of a suitable stiff material which has sufficient resilience to enable the hub and shaft to be secured together by a snap-fit therebetween. Preferably, the snap-fit arrangement is a releasable snap-fit, enabling the shaft and impeller to be secured together and released, as may be necessary for maintenance, repair or replacement of parts.

25 The hub may be connected to the first plate by one or more connectors extending between the first plate and an outer peripheral surface of the hub.

The impeller preferably includes a retainer to prevent disengagement of the hub
30 relative to the shaft during use. In one preferred form, the retainer is receivable about the hub.

Axial displacement of the retainer relative to the hub may be prevented during use by way of a suitable engagement therebetween, or more preferably between the retainer

and a sleeve. The retainer may be in the form of an end cap mounted to an axial end of the hub, with a convex surface for assisting in the guiding of fluid through the impeller. The convex surface may be part-spherical.

- 5 The retainer and sleeve are preferably made of suitable stiff material which has sufficient resilience to enable the retainer to be secured about the hub by a snap-fit arrangement between the retainer and sleeve. In one preferred form, this snap-fit arrangement is a releasable snap fit arrangement, enabling removal of the retainer from the hub and, in turn removal of the impeller from the shaft for maintenance,
10 repair or replacement of parts. The snap-fit arrangement may be provided by way of one or more hooks (or other suitable protrusions) provided on an outer surface of the sleeve, for engagement with an angled surface provided on an inner annular surface of the retainer.
- 15 The sleeve may be radially spaced from and extend about the hub. The sleeve may be connected to the second plate by way of a plurality of connectors extending between an outer peripheral surface of the sleeve and the second plate. An annular array of openings may be provided between an inner edge of the second plate and the sleeve and between successive connectors, enabling fluid to be pumped and be
20 drawn through the space between the plates.

The first plate and the hub are preferably integrally formed as a single component part, and the second plate and sleeve may be integrally formed as another single component part, and with the vanes formed integrally with one of the plates. The
25 vanes provided between the plates may be formed integrally with either plate, and in one form are integrally formed with the first plate.

In such an arrangement, the hub and sleeve are preferably secured together by suitable engagement therebetween to prevent axial displacement between the hub
30 and sleeve and; in turn, to prevent axial displacement between the first and second plates. For example, the hub and sleeve may be made of a suitable stiff material which has sufficient resilience to enable the hub and sleeve to be secured together by a snap-fit. In such an arrangement, the hub and sleeve may be configured to be releasably snap-fitted together, although in a more preferred form the hub and sleeve

are non-releasably snap-fitted together during impeller assembly. In one form, the sleeve is provided with an annular shoulder provided about an inner surface thereof for engagement with one or more hooks provided about or connected to an annular outer surface of hub.

5

Another impeller embodiment is also contemplated, wherein the hub is connected to the second plate and the sleeve is connected to the first plate. In this embodiment, the hub and second plate may be integrally formed as a single component part; and the sleeve and first plate may be integrally formed as another single component part.

10

In a preferred form, the first plate is substantially flat, and the second plate has a generally frusto-conical portion.

The impeller may be made of any suitable material, and preferably a material that is moldable or castable. Suitable materials may include metal or a plastics material.

15

The vanes located between the plates may be arcuate, and outwardly extending in a spiral array. The vanes are provided to enhance the velocity of fluid being pumped outwardly between the outer peripheries of the plates.

20

It is envisaged that the impeller will initially impart an axial movement on the fluid moving between the plates followed by a radial movement of the fluid as the fluid moves towards and between the outer peripheries of the plates.

The present invention has, so far, been described in the context of an impeller, but it should be appreciated that the invention also resides in a fluid pump having an impeller of the above described form.

25

BRIEF DESCRIPTION OF THE DRAWINGS

It will be convenient to hereinafter describe a preferred embodiment of the invention with reference to the accompanying drawings. The particularity of the drawings is to be understood as not limiting the preceding broad description of the invention.

30

Figure 1 illustrates a sectional front view of an impeller according to one embodiment of the present invention.

Figure 2 illustrates a sectional side view of the impeller of Fig. 1.

Figure 3 is a perspective view of the impeller of Fig. 1.

Figure 4 is a perspective exploded view of the impeller of Fig. 1.

Figure 5 is a perspective view of one end of a rotor shaft to which the impeller
5 of Fig. 1 may be connected.

Figure 6 is a perspective view of an impeller according to another embodiment
of the present invention.

Figure 7 is a sectional front view of the impeller of Fig. 6.

Figure 8 is a sectional top view of the impeller of Fig. 6.

10 Figure 9 is another sectional top view of the impeller of Fig. 6.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the Figures 1 to 4, there is illustrated an impeller 10 according to one
form of the present invention. The impeller 10 forms part of a fluid pump (not
15 illustrated).

The impeller 10 includes a first annular plate 12 and a second annular plate 14. The
first plate 12 is substantially flat, and the second plate 14 has a generally frusto-
conical portion. It can be seen that the plates 12, 14 are axially spaced.
20

The inner periphery of the second plate 14 includes an annular skirt 15 which extends
in an axial direction away from the first plate 12. The skirt 15 defines an inlet guide for
fluid being drawn through the impeller 10. The skirt 15 initially imparts an axial
movement A of fluid as it moves through the impeller 10.
25

An angularly spaced array of arcuate vanes 16 is provided, which are located
between the plates 12, 14. The plate 12 and the vanes 16 are integrally formed.
Although not entirely evident from the drawings, the vanes 16 define a spiral array. As
previously stated, the vanes 16 are provided to enhance the velocity of fluid being
30 pumped outwardly between the outer peripheries of the plates 12, 14. The vanes 16
guide a radial movement B of fluid as the fluid moves towards and between the outer
peripheries of the plates 12, 14.

A central, annular hub 18 is connected to the first plate 12. The hub has a closed end 19. The first plate 12 and the hub 18 are integrally formed as a single component part, with the hub 18 being connected to the first plate 12 by two opposed (and integrally formed) connectors 20 (see Fig. 2) extending between the first plate 12 and an outer peripheral surface 22 of the hub 18. The hub 18 is within and radially spaced from the inner periphery 24 of the second plate 14. The hub 18 includes a bore 26 for receiving a rotor shaft 28 (refer to Fig. 5) of an electric motor (not illustrated). Indeed, it is to be appreciated that the impeller 10 is mounted on and rotatable with the shaft 28. Although not illustrated, the lower end of the rotor shaft 28 would form part of and extend from the electric motor.

The rotor shaft 28 includes an axial end portion 30 generally defining what could be described as a key for receiving in a complementary receiving portion 32 of the bore 26. The portion 30 of the shaft 28 and the portion 32 of the bore 26 provide a fit (such as a close fit) between the hub 18 and the shaft 28 that precludes axial rotation of the shaft 28 relative to the hub 18. Desirably, with this arrangement the rotor shaft 28 can be rotated in either direction R1, R2 (see Fig. 5) without the possibility of the hub 18 (and hence the impeller 10) being unintentionally disconnected from the shaft 28, as can occur with existing arrangements. It is to be appreciated that the axial cross-section of the receiving portion 32 of the bore 26 is non-circular. The end portion 30 of the shaft 28 includes a tapered end-section 31 to facilitate ease of assembly of the shaft 28 and hub 18.

In use, axial displacement of the hub 18 relative to the shaft 28 is prevented by way of a snap-fit 34 connection therebetween. The snap-fit 34 connection includes complementary first sloping surfaces 36 for snap-fit between the hub 18 and the shaft 28. The snap-fit connection also includes complementary second sloping surfaces 38, thereby enabling the impeller 10 to be released from the shaft 28, as may be required during the operating life of the fluid pump. The hub 18 is manufactured from a material having sufficient resilience to enable the hub 18 and shaft 28 to be snap-fitted together.

The impeller 10 includes a retainer 40 in the form of an end cap mounted to and receivable about the axial end 19 of the hub 18. The retainer 40 is provided for preventing disengagement of the hub 18 relative to the shaft 28 during use.

- 5 Axial displacement of the retainer 40 relative to the hub 18 during use is prevented by way of a snap-fit 44 between the retainer 40 and a sleeve 50.

10 The retainer 40 and/or sleeve 50 are manufactured from of suitable stiff material which has sufficient resilience to facilitate the snap-fit therebetween. This snap-fit arrangement is a releasable snap fit arrangement. The snap-fit arrangement is provided by way of three radially spaced hooks 48 (or other suitable protrusions) mounted on arms 49 extending axially from the sleeve 50. The hooks are provided for engagement with an angled surface 52 provided on an inner annular surface 54 of the retainer 40.

15

The retainer 40 has a part-spherical surface 41 for assisting in the guiding of fluid into the impeller 10 between the retainer 40 and the edge 46 of the second plate 14.

- 20 Openings 42 are provided for receiving the end of a screw driver (or other suitable implement). This potentially assists in the release of the snap-fit between the retainer 40 and sleeve 50, by providing a means for axially leveraging the retainer 40 from the sleeve 50. The openings 42 allow the end of a screw driver to disengage the hooks 48 from the angled surface 52. It is to be appreciated that the retainer 40 must first be removed from the sleeve 50 before the impeller 10 can be removed from the shaft 28.
- 25 With the retainer 40 removed, the sloping surfaces 36,38 are able to deflect radially outwardly, thereby enabling fitment of the impeller 10 to (and removal from) the shaft 28. This action is possible by virtue of the resilience of the hub 18 material, enabling the sloping surfaces to deflect outwardly. It is to be appreciated, however, that when the retainer 40 is fitted to the sleeve 50 it prevents the sloping surfaces 36,38 from
- 30 deflecting radially outwardly, thus securing the impeller 10 to the shaft 28.

The sleeve 50 is radially spaced from and extends about the hub 18. The sleeve 50 is connected to the second plate 14 by way of a plurality of connectors 51 extending between an outer peripheral surface 55 of the sleeve 50 and the second plate 14. An

annular array of openings 56 is provided between the inner periphery 24 of the second plate 14 and the sleeve 50 and between successive connectors 51. This enables fluid to be pumped and be drawn through the space between the plates 12, 14.

5

The second plate 14, the sleeve 50 and connectors 51 are integrally formed as a single component part.

10

The hub 18 and sleeve 50 are secured together by a firm snap-fit. This prevents axial displacement between the hub 18 and sleeve 50 and, in turn, prevents axial displacement between the first and second plates 12, 14. One or both of the hub 18 and sleeve 50 are manufactured from a suitable stiff material having sufficient resilience to enable the snap-fit. The sleeve 50 is provided with an annular shoulder 57 provided about an inner surface thereof for engagement with two radially spaced shoulders (or hooks) 58 connected to and extending outwardly from the surface 22 of the hub 18. This snap-fit is non-releasable, such that the hub 18 and sleeve 50 (and hence the first and second plates 12, 14) are non-releasably snap-fitted together during impeller assembly.

15

20

In a preferred form, the impeller is manufactured from a non-conductive material, for example a plastics material, such that the hub 18 provides an unbroken layer of insulation about the shaft 28. This is desirable because it ensures that a potential current path from the electric motor, via the shaft 28 to the water flowing through the impeller 10 isn't provided.

25

A second possible form of the invention is illustrated in Figures 6 to 9. Many of the components illustrated in Figs 6 to 9 are identical or at least very similar to those illustrated in Figs 1 to 4 and are prefixed by the number "1".

30

One notable difference between the two embodiments relates to that of the retainer 140, which has a second axial opening 141.

It is to be appreciated that the retainer 140 illustrated in Figure 6 is upside down in relation to its normal, in-use, orientation relative to the other components. The

orientation illustrated in Figure 5 can be used when it is desired to remove the hub 118 from the shaft 128 for service, repair or maintenance.

5 The upper end 142 of the hub 118 is sufficiently flexible such that pressing the upturned retainer 140 downwardly over the end of the hub 118 and shaft 128 causes the sloping surfaces 136, 138 of the hub 118 (providing the snap fit with the upper end 143 of the shaft 128) to disengage from undercuts 144 of the shaft 128. Once this occurs, the hub 118 and shaft 128 can then be relatively easily separated without the need to use a screwdriver or similar implement to prise the hub 118 and shaft 128
10 apart.

Figure 7 illustrates the retainer 140 in its in-use orientation relative to the other impeller components.

15 Figure 8 illustrates the in-use relationship between the hub 118, shaft 128 and retainer 140; while Figure 9 illustrates the top end of the hub 118 being deformed outwardly when the upturned retainer 140 is forced downwardly upon the hub 118 and shaft 128. It can be seen in Figure 9 that the sloping surfaces 136, 138 are disengaged from the undercut 144, thereby allowing separation of the hub 118 and
20 shaft 128.

Finally, it is to be understood that the various alterations, modifications and/or additions may be introduced into the construction and arrangement of the parts previously described without departing from the spirit or ambit of this invention.

CLAIMS:

1. An impeller for a fluid pump, including:

- first and second annular plates which are axially spaced;

5 - an angularly spaced array of vanes located between the plates;

- a central hub connected to the first annular plate, the hub being within and radially spaced from the inner periphery of the second annular plate, and by which the impeller is mountable on a shaft for rotation therewith;

10 wherein the hub includes a shaft-receiving bore for receiving the shaft therein, the bore including a portion with non-circular axial cross-section for providing a fit between the hub and the shaft that precludes axial rotation of the shaft relative to the hub.

15 2. An impeller according to claim 1, wherein axial displacement of the hub relative to the shaft is precluded by way of a suitable engagement therebetween.

20 3. An impeller according to claim 2, wherein the hub is made of a suitable stiff material which has sufficient resilience to enable the hub and shaft to be secured together by a snap-fit therebetween.

4. An impeller according to claim 2 or 3, including a retainer, the retainer receivable about the hub to preclude disengagement of the hub relative to the shaft.

25 5. An impeller according to claim 4, wherein axial displacement of the retainer relative to the hub is prevented by way of a suitable engagement between the retainer and a sleeve connected to the second plate.

6. An impeller according to claim 4 or 5, wherein the retainer is in the form of an end cap mounted to an axial end of the hub.

30

7. An impeller according to claim 6, wherein the end cap includes an opening on an upper side thereof to facilitate separation of the hub and shaft.

8. An impeller according to claim any one of claims 4 to 7, wherein the retainer and/or sleeve are made of suitable stiff material which has sufficient resilience to enable the retainer to be secured about the hub by a snap-fit between the retainer and the sleeve.

5

9. An impeller according to any one of claims 5, 6, 7 or 8, wherein the sleeve extends about the hub.

10

10. An impeller according to claim 9, wherein the first plate and the hub are integrally formed as a single component part, and the second plate and sleeve are integrally formed as another single component, and with the vanes formed integrally with one of the plates.

15

11. An impeller according to claim 9 or 10, wherein the hub and sleeve are secured together by a suitable engagement therebetween.

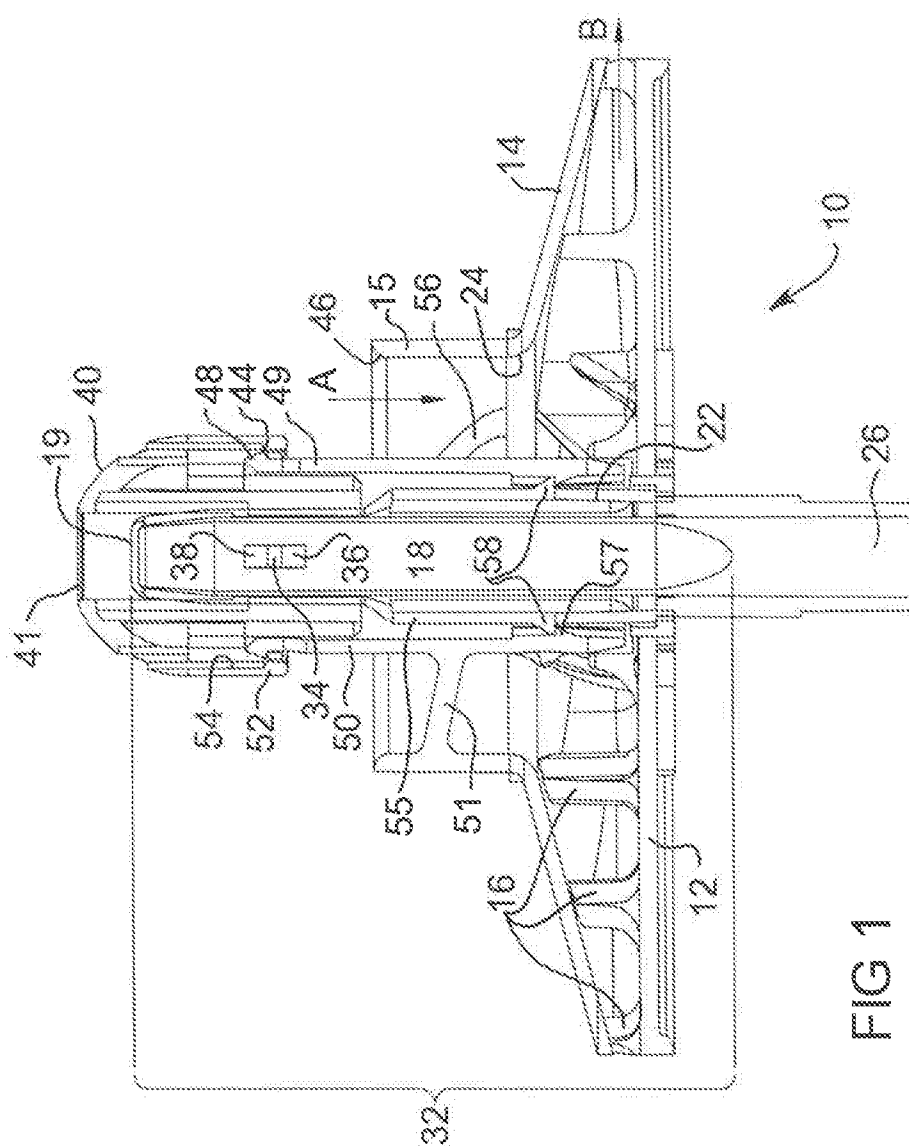
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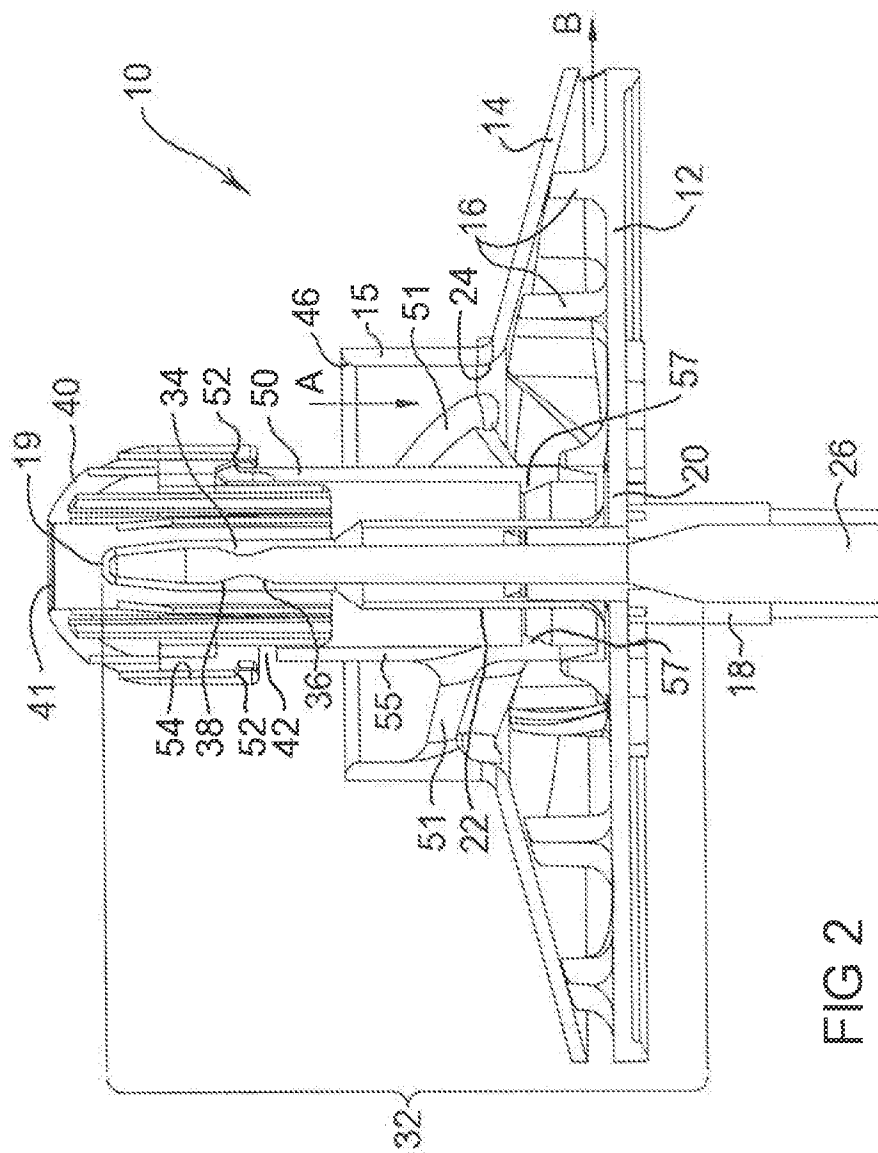
12. An impeller according to claim 11, wherein the hub and sleeve are made of a suitable stiff material which has sufficient resilience to enable the hub and sleeve to be secured together by a snap-fit therebetween.

13. A fluid pump including an impeller according to any one of the preceding claims.

25

14. An impeller substantially as herein described and illustrated.





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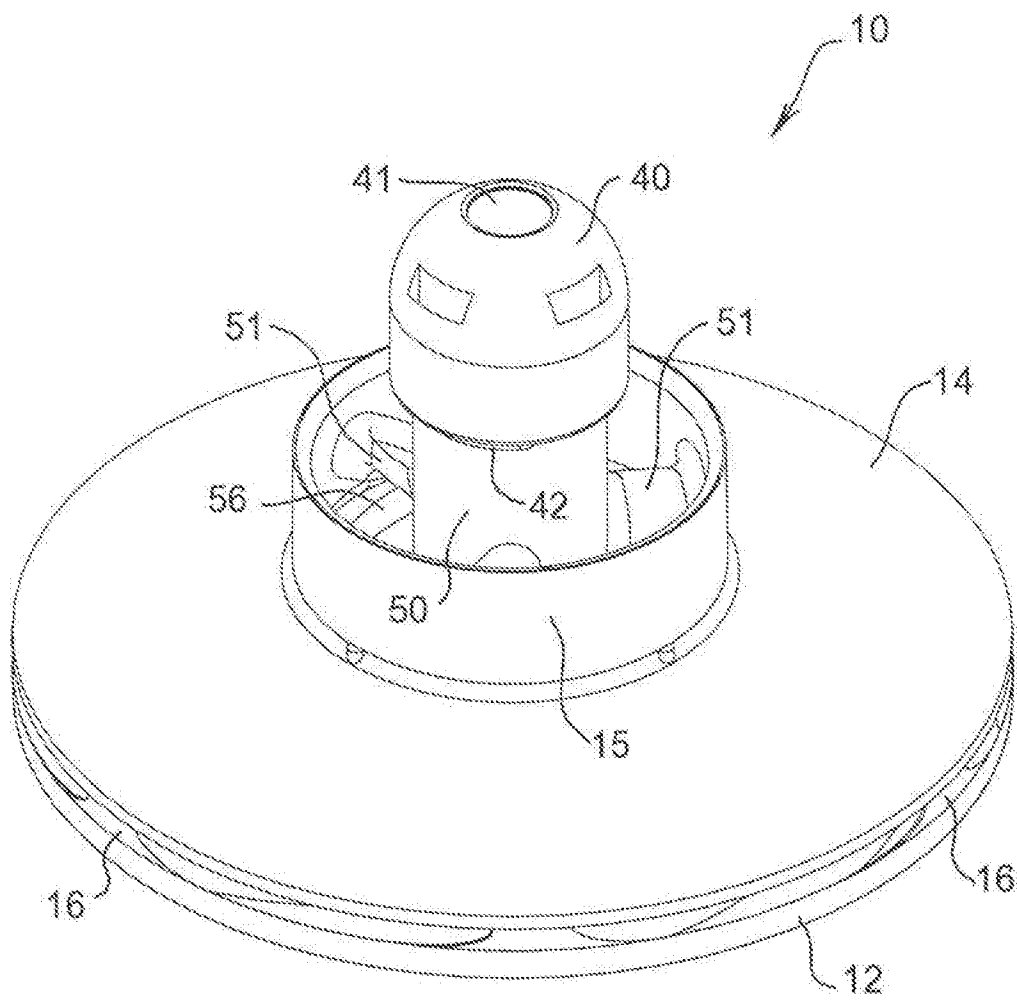
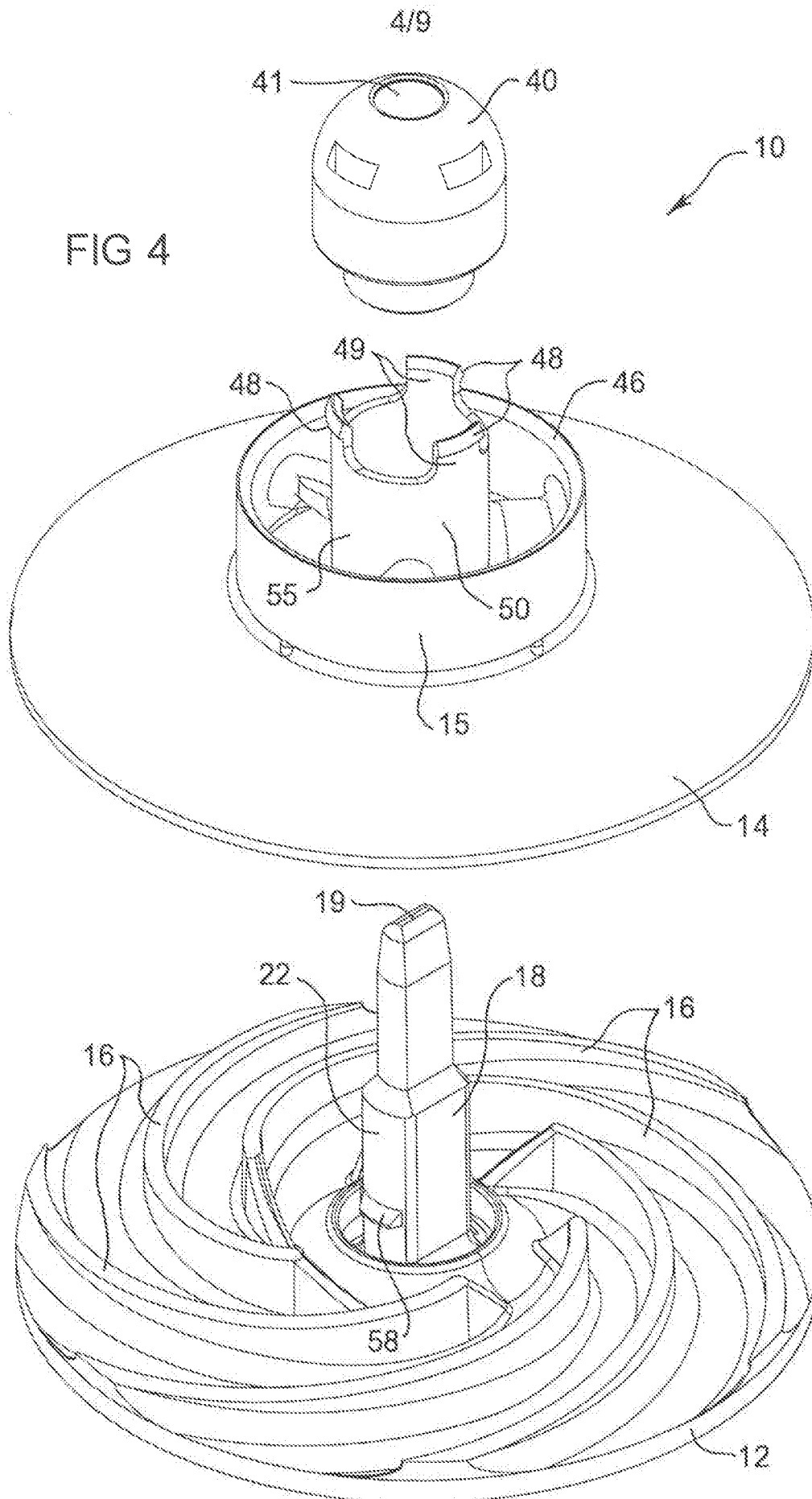
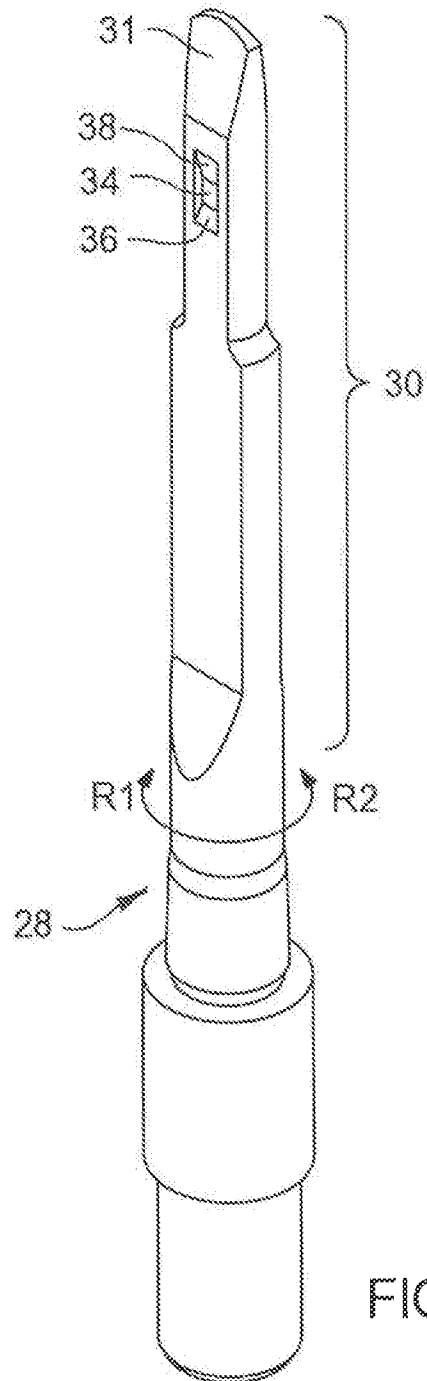


FIG 3

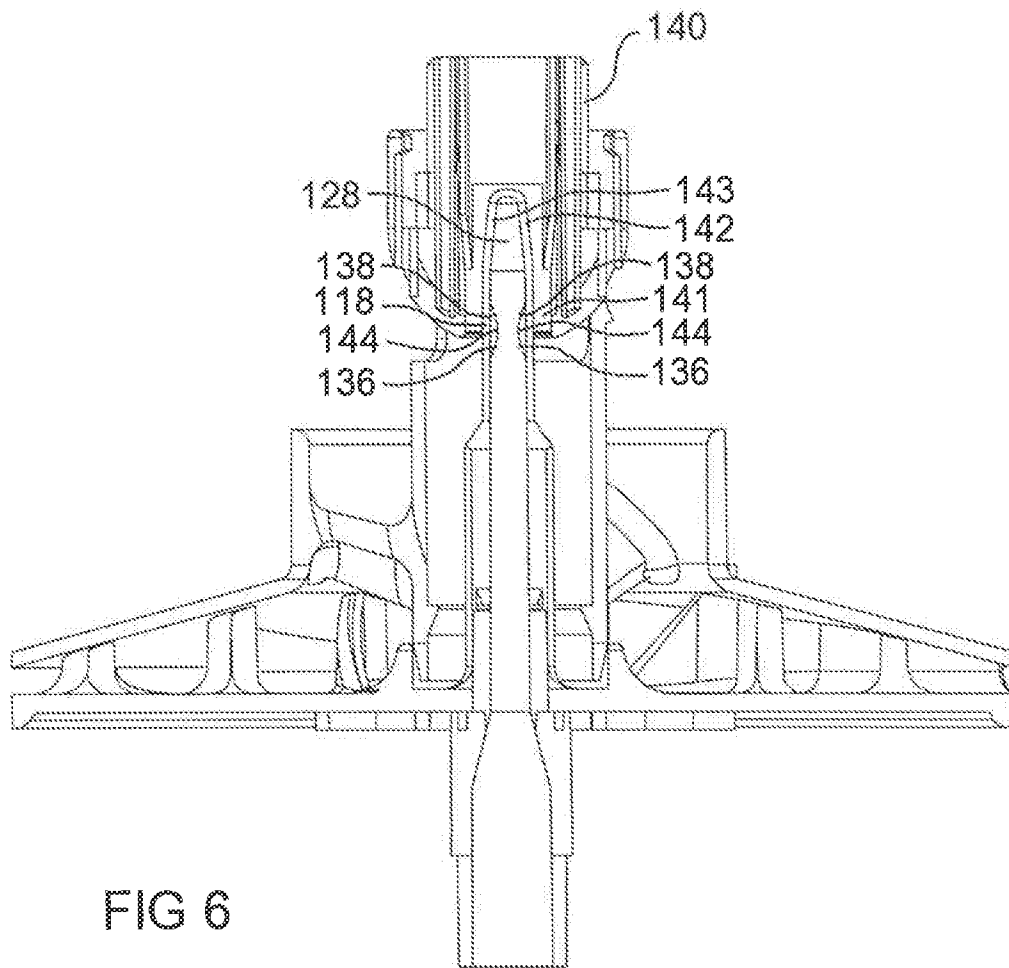
FIG 4



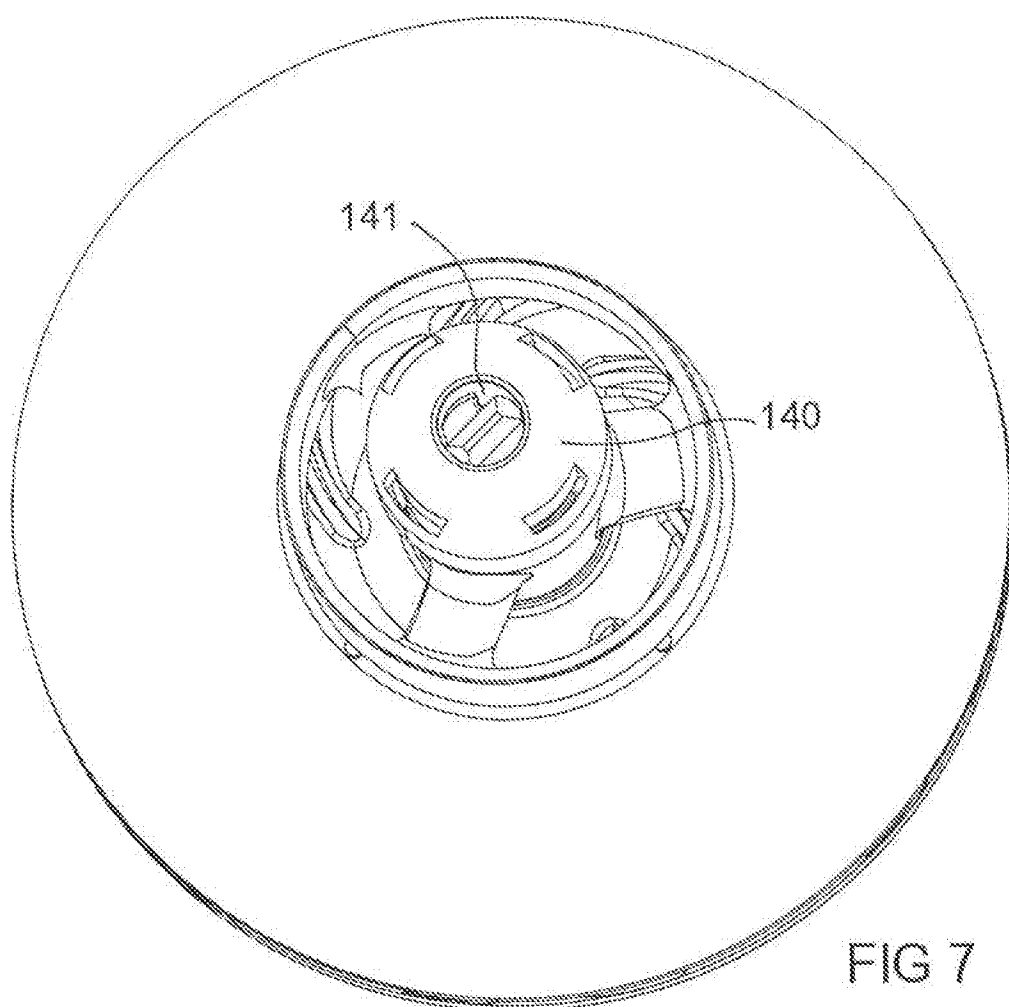
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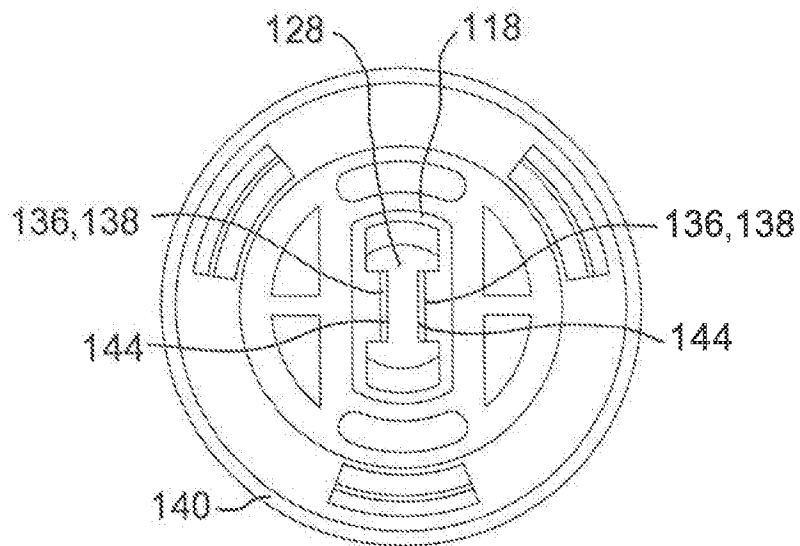


FIG 8

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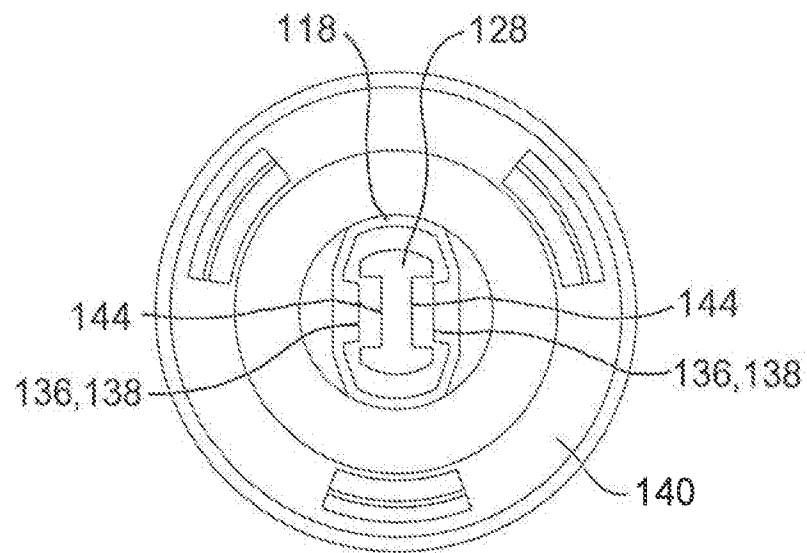


FIG 9

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2010/000772

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

F04D 29/20 (2006.01)

F04D 29/22 (2006.01)

F04D 29/18 (2006.01)

F04D 29/26 (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)

EPODOC, WPI, IPC F04D 29/20, F04D, F04D 29/22, F04D29/18, F04D29/26. Keywords: shaft, spindle, attach, retain, secure, join, fix, fit, hold, snap, clip, key, index, detent, first, second, part, upper, lower, rear, front, plate, disc, shroud, conical, collar, tubular, cylindrical, plastic, elastomer, polymer, resin, rubber, composite, non metallic, impeller and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3779668 A (EKEY) 18 December 1973 See figures 1-4	1,2,13
Y	See figures 1-4	3,4,6
Y	US 4890982 A (RIBACK) 02 January 1990 See figures 1-4, abstract and column 2 line 57 to column 4 line 2	3,4,6



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
19 August 201009 September 2010

Date of mailing of the international search report 14 SEP 2010

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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 14
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
The claim does not comply with Rule 6.2(a) because it relies on references to the description and/or drawings.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2010/000772

This Annex lists the known "A" publication level 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.

Patent Document Cited in Search Report		Patent Family Member	
US	3779668	CA	978421
US	4890982	NONE	
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
END OF ANNEX			