



(51) International Patent Classification:

B63H 1/20 (2006.01) *F04D 29/20* (2006.01)
F04D 29/18 (2006.01) *F04D 29/34* (2006.01)

(21) International Application Number:

PCT/GB2019/052407

(22) International Filing Date:

29 August 2019 (29.08.2019)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1814138.2 30 August 2018 (30.08.2018) GB

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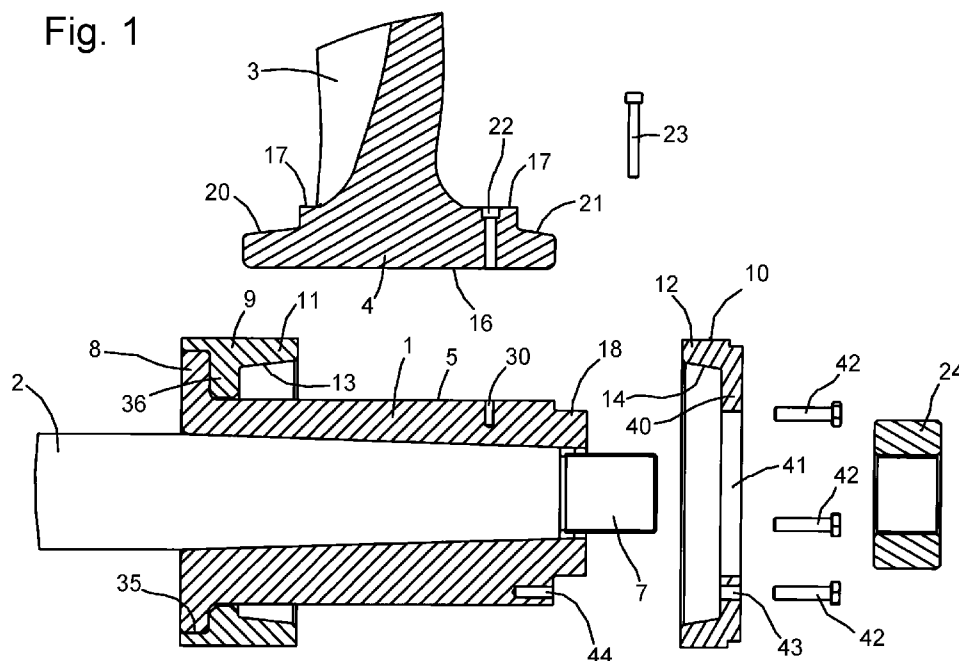
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,

(54) Title: BLADE HUB ASSEMBLY

Fig. 1



(57) Abstract: A propeller has a hub (1) and a plurality of radially-extending propeller blades (3) each having a mounting flange (4) seated on the hub. The blades are held to the hub by first and second axially-spaced clamping rings (9) and (10) which co-operate with inclined shoulders (20, 21) on the mounting plates. The first clamping ring (9) at the fore end includes a locating wall (36) having a circular outer profile and a polygonal aperture. The second clamping ring (10) at the aft end is received on a boss (18) on the hub and is secured to the hub by thrust screws (42) alongside the boss (8). The assembly is secured to a shaft (2) by a propeller nut (24) which bears against the boss (18). The shoulder (21) at the aft end of each mounting plate (4) is shorter than the aft shoulder (20). Sacrificial blades (3) and mounting plates (4) are used, which are formed of softer material than the hub (1) and clamping rings (9,10).



KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

- 1 -

BLADE HUB ASSEMBLY

TECHNICAL FIELD OF THE INVENTION

This invention relates to a blade hub assembly as used in propellers with detachable blades, particularly (but not exclusively) marine propellers.

BACKGROUND

GB 2 526 302-A discloses a propeller with detachable blades. The propeller includes a hub which is secured to a shaft, and radially-extending propeller blades each having a mounting flange seated on the hub. The blades are held to the hub by first and second axially-spaced clamping rings with axially-extending collars which co-operate with inclined shoulders on the mounting flanges to position and hold the flanges to the hub. The first clamping ring may be located relative to the hub by an abutment or flange, and the second ring is urged axially by a propeller nut which retains the components on the shaft.

In such an assembly there are several important but sometimes conflicting factors which need to be taken into account. On the

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one hand it is essential that the assembly is strong enough to reduce and ideally eliminate the risk of stress failure during the normal service life, but on the other hand, the hub should be as compact as possible to reduce drag. Put simply, the hub needs to be strong but small. The assembly should also be easy to service, and in the event of any impact damage the propeller should be capable of being stripped down and repaired at minimum cost, and put back into service with minimum delay. Although the assembly disclosed in **GB 2 526 302-A** met the primary requirement of being easy to assemble it did not fully address all of the factors identified above.

SU 1 105 388-A1 discloses a propeller assembly with blades which are held to a hub by a pair of rings 8 with axially-extending flanges that engage in grooves 6. The assembly is held together by heat, rather like an iron hoop on a wooden cart wheel. Bores 9 and 11 are used to inject oil to force the assembly apart should it become necessary to replace the blades.

SUMMARY OF THE INVENTION

When viewed from one aspect the present invention proposes a blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5) of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10), and wherein the clamping

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rings (9, 10) and/or the mounting plates (4) have inclined bearing surfaces (13, 14; 20, 21),

characterised in that the hub is formed with a boss (18), the second clamping ring (10) is received on the boss (18), and the second clamping ring (10) is secured to the hub by fixing elements (42) which are inserted through the second clamping ring into the hub alongside the boss (18).

In a preferred embodiment the hub is mounted on a shaft (2) with a threaded end section (7) which projects from the boss (18), and a propeller nut (24) is tightened against the boss (18) to hold the assembly on the shaft.

The invention also provides a blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5) of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10),

wherein the first clamping ring (9) has a locating wall (36) to engage the hub (1), and the locating wall (36) has a polygonal aperture (37).

In a preferred embodiment the polygonal aperture (37) of the locating wall closely conforms to the external profile of the hub (1) which includes the external surfaces (5) on which the mounting plates (4) are seated.

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In a preferred embodiment the locating wall (36) has a substantially circular outer profile (38).

The invention also provides a blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5) of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10), in which the mounting plates have outer bearing surfaces (20, 21) at opposite ends, and the first and second clamping rings (9, 10) have respective collars (11, 12) to engage said outer bearing surfaces (20, 21),

wherein the axial length of the collar (12) of the second clamping ring (10) and the corresponding outer bearing surface (21) is shorter than the axial length of the collar (11) of the first clamping ring (9) and the corresponding outer bearing surface (20).

In a preferred embodiment the axial length of the collar (12) of the second clamping ring (10) and the corresponding outer bearing surface (21) is between 20% and 50% shorter than the axial length of the collar (11) of the first clamping ring (9) and the corresponding outer bearing surface (20).

In a preferred embodiment the collars (11, 12) and the co-operating outer bearing surfaces (20, 21) of the mounting plates are inclined towards the hub in opposite directions.

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In a preferred embodiment the mounting plates (4) are secured to the hub (1) by fixing elements (23) located at one end only of the mounting plates (4).

In a preferred embodiment said fixing elements (23) are located between the respective blade (3) and the second clamping ring (10).

The invention also provides a blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5) of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10),

wherein the propeller blades (3) and mounting plates (4) are of softer material than the hub (1) and the clamping rings (9, 10).

In a preferred embodiment the inclined bearing surfaces (13, 14) of the clamping rings (9, 10) and/or the inclined bearing surfaces (20, 21) of the mounting plates (4) are inclined towards the hub in opposite directions.

BRIEF DESCRIPTION OF THE DRAWINGS

The following description and the accompanying drawings referred to therein are included by way of non-limiting example in order to

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illustrate how the invention may be put into practice. In the drawings:

Figure 1 is an exploded axial section through a blade hub assembly of a marine propeller;

Figure 2 is an end view of the hub of the assembly looking from the right in Fig. 1, the position of the Fig. 1 section being indicated at I-I; and

Figure 3 is an end view of a first clamping ring of the assembly as viewed from the right in Fig. 1.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring firstly to **Fig. 1**, the marine propeller which is shown in the drawing is arranged to be mounted at the stern of a ship with the fore end of the propeller at the left of the drawing and the aft end on the right. It will be appreciated however that the terms "fore" and "aft" are only used herein for descriptive convenience and are not intended to limit the scope and application of the invention.

The blade hub assembly includes a hub 1 secured to a propeller shaft 2 and a plurality of propeller blades 3 which project radially of the shaft. The hub 1 may be secured to the shaft 2 in various ways. It would be possible for the hub to be integrally formed with

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the shaft, or the hub and shaft may be splined or similarly keyed to each other. In the present example the hub 1 has a tapered bore, the shaft 2 has a corresponding external taper, narrowing towards the aft end, so that the hub is a hydraulic interference fit on the shaft. The aft end of the shaft 2 is provided with an externally screw-threaded end section 7 which projects from the hub.

The present propeller has five blades, although only part of one blade is shown in the drawing. Each blade 3 has a mounting plate 4 at its the radially inner root end, which in use is seated on an external surface of the hub. Considering **Fig.s 1 and 2** together, the external surface of the hub 1 has five flat conjoined facets 5, matching the number of blades, but the number of blades and facets may vary. The fore end of the hub has an external annular flange 8 to axially locate a first clamping ring 9 which is received on the hub. The aft end of the hub is formed with a circular boss 18 to receive a second clamping ring 10. The clamping rings 9 and 10 are provided with opposing axially-extending retaining collars 11 and 12 having inclined undersurfaces 13 and 14 respectively.

Referring again to **Fig. 1**, the mounting plate 4 at the root of each propeller blade 3 is of generally rectangular shape, corresponding to the external profile of one external facet 5 of the hub 1. The bottom face 16 of the plate 4 is flat, the opposing top face 17 is part-cylindrical, and the two longitudinal edges extend substantially radially of the propeller shaft 2. The top face of the mounting plate 4 is provided with sloping shoulders 20 and 21, at

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opposite ends of the mounting plate, for co-operation with the inclined undersurfaces 13 and 14 of the clamping rings 9 and 10, the sloping surfaces of the two shoulders being inclined towards the hub in opposite directions. The shoulder 21 at the aft end of the mounting plate 4, together with the corresponding collar 12 of the second clamping ring 10, is about 40% shorter in the axial direction (preferably anywhere between 20% and 50% shorter) compared with the shoulder 20 and corresponding collar 11 of the clamping ring 9 at the fore end. The reduced length of the shoulder 21 at the aft end relative to the shoulder 20 at the fore end gives a better stress profile within the mounting plate and allows the overall length of the hub to be reduced. The aft end of the mounting plate 4 also contains one or more holes 22 located between the blade 3 and the shoulder 21 which enables fixing elements in the form of bolts 23 to be inserted into corresponding threaded holes 30 in the hub 1. These bolts are only used to hold the blades in position on the hub during assembly and dis-assembly; in use, the load on the blades is transferred to the hub 1 via the clamping rings 9 and 10. Since the bolts are only provided at the aft end of the blades, the assembly time is significantly shortened and drag is reduced.

Considering each of the clamping rings in greater detail, the first clamping ring 9, located at the fore end, has an annular recess 35 to receive the flange 8 of hub 1. Recess 35 is separated from the inclined undersurface 13 of collar 11 by an internal locating wall 36 to axially abut the flange 8 - see **Fig. 3** also. In the original design the wall 36 had a circular central aperture (an annular wall

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being easy to machine) but the locating wall needed to be of substantial width to ensure that the clamping ring was able to withstand the considerable loads which were experienced in use. In the present propeller hub assembly the locating wall 36 has an aperture 37 with a polygonal profile to match the external profile of the faceted hub 1 as shown in **Fig. 3** (in this case pentagonal) and the outer profile 38 of the locating wall 36 is substantially circular. By using a locating wall 36 with a circular outer profile and a polygonal aperture, the external dimensions of the locating wall, and hence of the clamping ring 9, can be significantly reduced. Detailed stress analysis shows that a locating wall with a polygonal aperture has a reduced risk of stress failure in use compared with a circular flange of similar dimensions.

Referring back to **Fig. 1**, the second clamping ring 10, located at the aft end, has a locating wall 40 which is formed with a circular aperture 41 to locate over the circular boss 18 of the hub 1. The clamping ring 10 is secured to the hub 1 by thrust screws 42 (only three of which are shown) which are inserted through holes 43 in the wall 40 and screwed into threaded holes 44 in the hub alongside the boss 18 - see **Fig. 2** also. A propeller nut 24 is screwed onto the threaded end section 7 of shaft 2 and tightened to bear against the boss 18 of the hub 1 and retain the hub on the shaft. With the aft clamping ring 10 configured as described the blade and hub assembly is held together independently of the propeller nut, forming a compact and rigid assembly. The propeller nut 24 can therefore be tightened up to the torque required to hydraulically secure the propeller onto the propeller

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shaft without affecting the torque of the propeller assembly. Furthermore, the complete blade and hub assembly can be removed from the shaft 2 by removing the propeller nut 24. This allows for rapid change-over of the complete assembly, eliminating the need to assemble and torque the whole hub assembly *in situ*.

In the present assembly the blades 3 and mounting plates 4 are integrally formed from a metal which is softer than the materials from which the hub 1, clamping rings 9, 10 and the associated hub components are formed. A figure of 0.2% proof strength is generally sufficient. A typical propeller assembly would use 245 MPa for aluminium bronze (AB2) and 410 MPa for Duplex Stainless Steel (Temet 25). In the event of an impact which results in propeller damage this substantially reduces the risk that the shock of the impact will result in damage to the hub components. Thus, the blades and mounting plates act as sacrificial components, which reduces repair time and cuts maintenance costs.

To assemble the propeller the first clamping ring 9 is located on the hub against the flange 8. The clamping ring is preferably secured on the hub, e.g. by creating an interference fit using freezing or other suitable means. A propeller blade 3 is placed against the hub 2 so that the flat bottom face 16 of the plate 4 lies against one of the facets 5. The blade is centralised and slid along the hub until the sloping shoulder 20 engages beneath the sloping underside of collar 11. At this point a retaining screw, or screws, 23 may be inserted to hold the blade on the hub. The remaining

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blades are mounted on the hub in a similar manner. The second clamping ring 10 is placed onto the hub so that the retaining collar 12 locates over the sloping shoulders 21. The clamping ring is secured to the hub 1 using the thrust screws 42 which are tightened to the required torque to hold the assembly together.

The complete assembled propeller can be slid onto the aft end of the shaft 2 and a hydraulic interference fit with the shaft completed by fitting the propeller nut 24 tightened to the required torque for a good hydraulic connection. Fitting of the propeller may be completed by securing a nose cone over the propeller nut to ensure non-turbulent flow.

The performance and characteristics of the assembled propeller at least equals that of a monobloc propeller with all the advantages of a built-up propeller. The propeller also has additional advantages over known detachable blade propellers since the hub can be smaller resulting in less frictional drag and increased performance and efficiency. The long blade base allows a longer cord length at the blade root, which again reduces frictional drag and reduces the likelihood of root section cavitation. The hub assembly is smaller and the propeller is more efficient in addition to being easier and quicker to install and service.

It should be noted that the collars 9, 10 and the mounting flanges 20, 21 do not necessarily both need to have inclined faces.

Whilst the above description places emphasis on the areas which

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are believed to be new and addresses specific problems which have been identified, it is intended that the features disclosed herein may be used in any combination which is capable of providing a new and useful advance in the art.

CLAIMS

1. A blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5) of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10), and wherein the clamping rings (9, 10) and/or the mounting plates (4) have inclined bearing surfaces (13, 14; 20, 21),

characterised in that the hub is formed with a boss (18), the second clamping ring (10) is received on the boss (18), and the second clamping ring (10) is secured to the hub by fixing elements (42) which are inserted through the second clamping ring into the hub alongside the boss (18).

2. A blade hub assembly according to Claim 1 wherein the hub is mounted on a shaft (2) with a threaded end section (7) which projects from the boss (18), and a propeller nut (24) is tightened against the boss (18) to hold the assembly on the shaft.

3. A blade hub assembly according to Claim 1 wherein the first clamping ring (9) has a locating wall (36) to engage the hub (1), and the locating wall (36) has a polygonal aperture (37).

4. A blade hub assembly according to Claim 3 wherein the polygonal aperture (37) of the locating wall closely conforms to the external profile of the hub (1) which includes the external

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surfaces (5) on which the mounting plates (4) are seated.

5. A blade hub assembly according to Claim 3 wherein the locating wall (36) has a substantially circular outer profile (38).

6. A blade hub assembly according to Claim 1 wherein the mounting plates have outer bearing surfaces (20, 21) at opposite ends, the first and second clamping rings (9, 10) have respective collars (11, 12) to engage said outer bearing surfaces (20, 21), and wherein the axial length of the collar (12) of the second clamping ring (10) and the corresponding outer bearing surface (21) is shorter than the axial length of the collar (11) of the first clamping ring (9) and the corresponding outer bearing surface (20).

7. A blade hub assembly according to Claim 6 wherein the axial length of the collar (12) of the second clamping ring (10) and the corresponding outer bearing surface (21) is between 20% and 50% shorter than the axial length of the collar (11) of the first clamping ring (9) and the corresponding outer bearing surface (20).

8. A blade hub assembly according to Claim 6 wherein the collars (11, 12) and the co-operating outer bearing surfaces (20, 21) of the mounting plates are inclined towards the hub in opposite directions.

9. A blade hub assembly according to Claim 1 wherein the

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mounting plates (4) are secured to the hub (1) by fixing elements (23) located at one end only of the mounting plates (4).

10. A blade hub assembly according to Claim 9 wherein said fixing elements (23) are located between the respective blade (3) and the second clamping ring (10).

11. A blade hub assembly according to Claim 1 wherein the propeller blades (3) and mounting plates (4) are of softer material than the hub (1) and the clamping rings (9, 10).

12. A blade hub assembly according to Claim 1 wherein the inclined bearing surfaces (13, 14) of the clamping rings (9, 10) and/or the inclined bearing surfaces (20, 21) of the mounting plates (4) are inclined towards the hub in opposite directions.

13. A blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5) of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10),

wherein the first clamping ring (9) has a locating wall (36) to engage the hub (1), and the locating wall (36) has a polygonal aperture (37).

14. A blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5)

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of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10), in which the mounting plates have outer bearing surfaces (20, 21) at opposite ends, and the first and second clamping rings (9, 10) have respective collars (11, 12) to engage said outer bearing surfaces (20, 21),

wherein the axial length of the collar (12) of the second clamping ring (10) and the corresponding outer bearing surface (21) is shorter than the axial length of the collar (11) of the first clamping ring (9) and the corresponding outer bearing surface (20).

15. A blade hub assembly comprising a hub (1) to mount on a shaft (2) and a plurality of radially-extending propeller blades (3) each having a mounting plate (4) seated on an external surface (5) of the hub, wherein the blades are held to the hub by first and second axially-spaced clamping rings (9, 10),

wherein the propeller blades (3) and mounting plates (4) are of softer material than the hub (1) and the clamping rings (9, 10).

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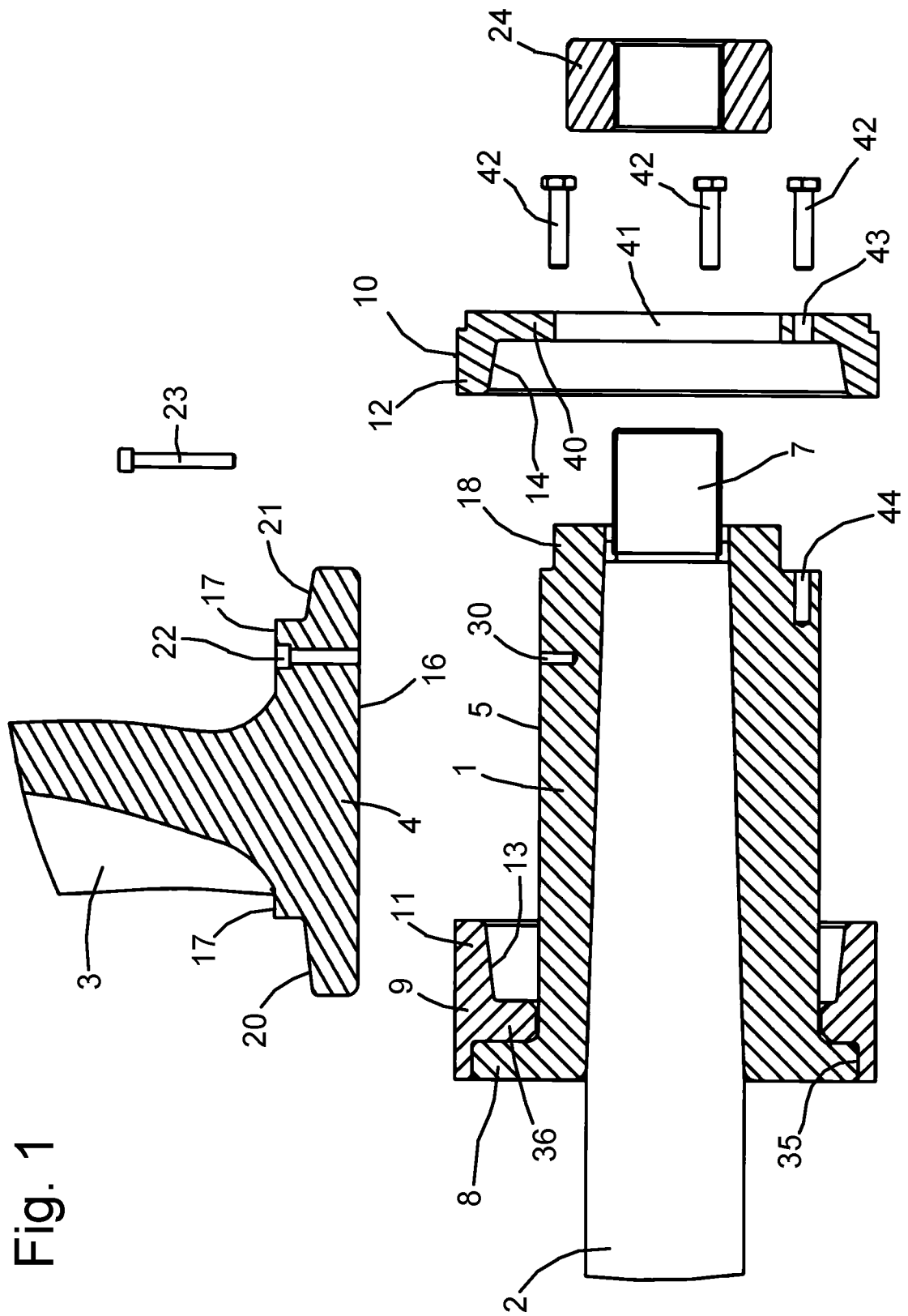
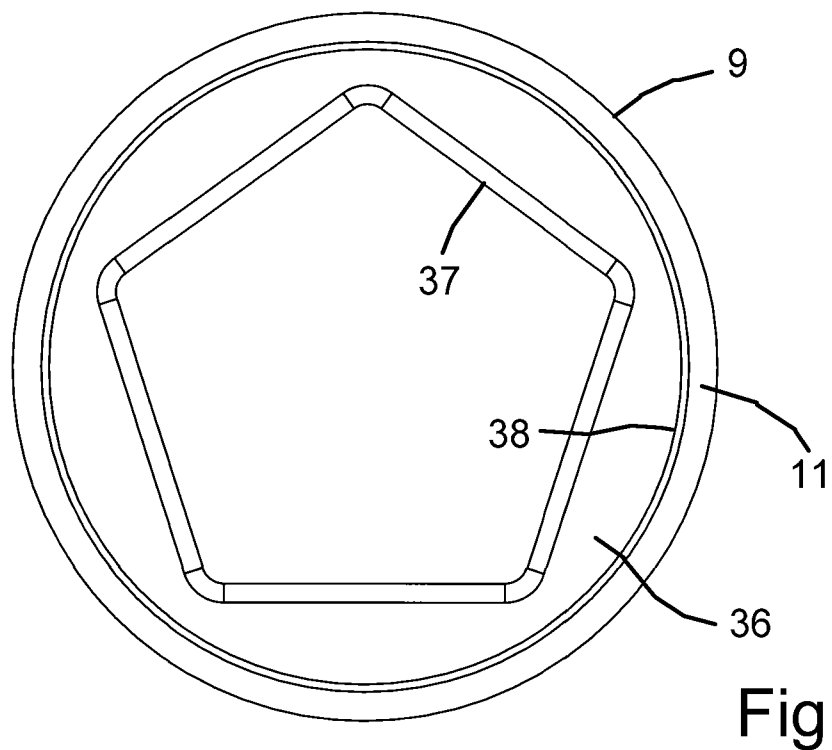
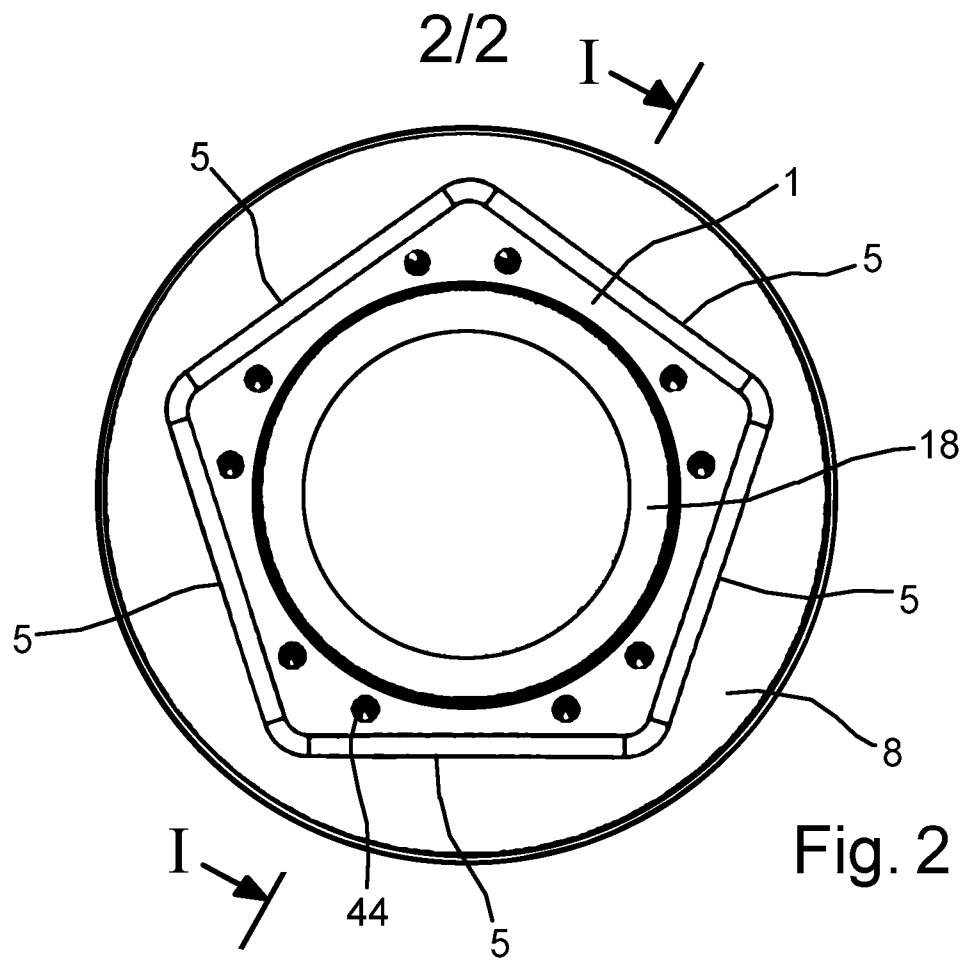


Fig. 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/052407

A. CLASSIFICATION OF SUBJECT MATTER

INV. B63H1/20 F04D29/18 F04D29/20 F04D29/34
ADD.

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)

B63H F04D F03D B64C

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 352 782 A (EUGEN REINTJES) 16 July 1931 (1931-07-16)	1,2,12
Y	figure 1 page 1, lines 37-69	3-5
X	GB 2 526 302 A (TEIGNBRIDGE PROPELLERS INTERNAT LTD [GB]) 25 November 2015 (2015-11-25) cited in the application	13
Y	figures 1,2	3-5
X	EP 2 484 583 A1 (GONZALEZ ABAL PABLO ALFONSO [ES]) 8 August 2012 (2012-08-08) figure 2 paragraphs [0020] - [0030]	1,12
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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

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

3 December 2019

Date of mailing of the international search report

30/01/2020

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2019/052407

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.:
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:
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:

see additional sheet

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 an 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.:

2-5, 12, 13(completely); 1(partially)

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 2-5, 12, 13(completely); 1(partially)

A blade hub assembly with a first clamping ring which has a locating wall to engage a hub, and the locating wall has a polygonal aperture.

2. claims: 6-8, 14(completely); 1(partially)

A blade hub assembly with mounting plates having outer bearing surfaces at opposite ends, first and second clamping rings having respective collars to engage the outer bearing surfaces, and wherein the axial length of the collar of the second clamping ring and the corresponding outer bearing surface is shorter than the axial length of the collar of the first clamping ring and the corresponding outer bearing surface.

3. claims: 9, 10(completely); 1(partially)

A blade hub assembly wherein mounting plates are secured to the hub by fixing elements located at one end only of the mounting plates.

4. claims: 11, 15(completely); 1(partially)

A blade hub assembly wherein propeller blades and mounting plates are of softer material than a hub and clamping rings.

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2019/052407

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10 2015 117520 B3 (SCHOTTEL HYDRO GMBH [DE]) 2 March 2017 (2017-03-02) figures 2,3 -----	1
A	US 6 139 277 A (LOPATINSKY EDWARD [US]) 31 October 2000 (2000-10-31) figures 6-9 -----	1
A	DE 298 11 554 U1 (LIN YEUN JUNN [TW]) 24 September 1998 (1998-09-24) figures 1-3 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2019/052407

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 352782	A	16-07-1931	NONE
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