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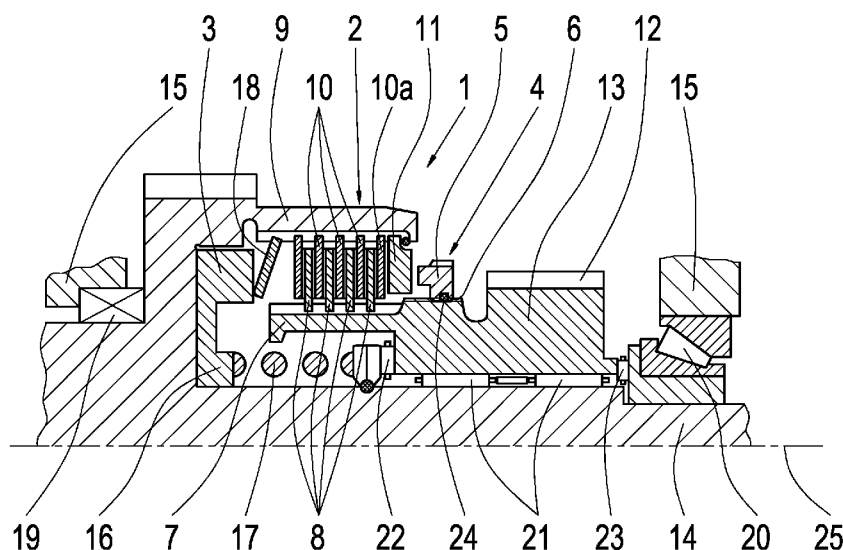


Fig. 1

(57) Abstract: The invention relates to a disk clutch assembly (1) for a marine propulsion device, the disk clutch assembly (1) comprising a disk clutch (2), a powered actuator (3) to engage and disengage the disk clutch (2) during normal operation, and emergency actuating means (4) to manually engage the disk clutch (2) in case of a failure of the powered actuator. The emergency actuating means (4) comprise a ring nut (5, 5a) and a screw thread (6, 6a) which are arranged to interact with each other in a way that the disk clutch (2) may be engaged by rotating the ring nut (5, 5a) on the screw thread (6, 6a).



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Disk Clutch Assembly

The present invention relates to a disk clutch assembly for a marine propulsion device with a powered actuator for normal operation of the clutch and with emergency actuating means for manual operation of the clutch in case of an actuator failure.

There are shiftable friction plate clutches known in the art which are actuated by powered actuators during normal operation. Powered actuators can be pneumatic, hydraulic or electric actuators. Some of the conventional power actuated clutches are equipped with emergency actuating means to enable manual operation in case of a failure of the powered actuator. Such emergency actuating means in marine propulsion devices are also called "bring home" device or "limb home" device. However, the emergency actuating means of conventional friction plate clutches are difficult to handle in an emergency situation. Such shiftable disk clutches are often located inside a gearbox housing and the emergency actuating means have to be operated through a housing window with a tool. That makes the handling even more difficult.

An example of a pressure actuated disk clutch with a mechanical emergency actuating device is described in US 6042436 A. This friction plate clutch can be closed manually by several threaded bolts arranged near the friction plates. When the friction plate clutch has to be closed manually, the clutch together with parts of the power train has to be rotated in order to have access to all threaded bolts with appropriate tools to screw in the threaded bolts.

The aim of the present invention is to avoid the disadvantages of prior art and to provide a disk clutch assembly for a marine propulsion device with a powered actuator and with emergency actuating means which is easy to handle and which has a simple construction.

The invention provides a disk clutch assembly for a power train of a marine propulsion device, the disk clutch assembly comprising a disk clutch, a powered actuator and emergency actuating means. The disk clutch can be a shiftable friction clutch with inner and outer clutch disks, which are arranged adjacent to each other in axial

direction. The axial and radial directions in this document refer to the rotation axis of the disk clutch. The powered actuator is used to engage, i.e. to close and to disengage i.e. to open the disk clutch during normal operation, while the emergency actuating means may be used to manually engage the disk clutch when the powered actuator fails for any reason. The powered actuator can be a pneumatic, hydraulic or electric actuator.

According to the invention the emergency actuating means comprise a ring nut and a screw thread which are arranged to interact with each other in a way that the disk clutch may be engaged by rotating the ring nut on the screw thread. The screw thread may be arranged on a driving or on a driven part of the disk clutch assembly. Rotating the ring nut on the screw thread in a first direction moves the ring nut in an axial direction towards the disks of the disk clutch in order to press the clutch disks against each other. This way the disk clutch can be manually engaged. Rotating the ring nut on the screw thread in a second direction moves the ring nut away from the disks and disengages the disk clutch.

This solution enables the manual operation of the disk clutch by rotating only one element, namely the ring nut. Compared to the conventional solution with several threaded bolts this makes the handling of the disk clutch in case of an emergency simpler and faster. With such a disk clutch assembly it is no more necessary to rotate the disk clutch and parts of the power train in order to gain access to the required emergency actuating means. If the disk clutch is located inside a gearbox housing, the ring nut can easily be accessed via a housing window in any rotational position of the power train.

The ring nut may be any ring-shaped element with a thread, which meshes with the related screw thread on the corresponding element of the disk clutch assembly. The ring nut has a form which allows attaching a tool for rotating the ring nut on the screw thread.

The disk clutch assembly may comprise an inner disk carrier carrying several inner disks and an outer disk carrier carrying several outer disks. In a first preferred em-

embodiment the screw thread is arranged on the inner disk carrier. The screw thread may be an external thread on the outer surface of the inner disk carrier. Due to its smaller dimension in radial direction compared to the outer disk carrier the inner disk carrier allows a smaller diameter of the screw thread and of the ring nut. Hence, less force will be necessary to rotate the ring nut manually in an emergency.

Preferably a locking ring for locking the outer disks on the outer disk carrier is arranged between an adjacent outer disk and the ring nut, so that the ring nut presses the locking ring against the adjacent outer disk when the ring nut is rotated in a first direction. The locking ring holds the outer disks on the outer disk carrier. For this the locking ring limits the axial movement of the outer disks in the axial direction towards the ring nut. In the opposite axial direction the locking ring can be moved by rotating the ring nut on the screw thread in the first direction. This way the ring nut can be rotated to press the locking ring in axial direction onto the outer disks and to further press the outer disks and the inner disks against each other, thereby engaging the clutch. The locking ring and the ring nut may be arranged very near to each other in the disk clutch assembly, in order to reduce the necessary number of rotations for closing the disk clutch manually. The distance between the locking ring and the ring nut should be just big enough to allow free rotation between the driving and the driven parts of the disk clutch when the disk clutch is open during normal operation.

Preferably the inner disk carrier and a pinion are integrally formed as a one-piece element. This allows a space-saving and simple layout of the whole assembly. The pinion is arranged to mesh with another gear wheel of the gearbox or power train, for example with a gear wheel which is arranged on an output shaft or on a propeller shaft.

In a second preferred embodiment the disk clutch assembly comprises an inner disk carrier carrying several inner disks and an outer disk carrier carrying several outer disks, and the screw thread is arranged on the outer disk carrier. Advantageously the screw thread can be an internal screw thread at a free end of the outer disk carrier. The free end of the outer disk carrier can be located in axial direction on the opposite side of the powered actuator. A ring nut with a corresponding external thread can be

screwed in the internal screw thread of the outer disk carrier. This way the ring nut serves not only for manual emergency actuation but also as a locking element to lock the outer disks in the outer disk carrier. Such a disk clutch assembly requires less parts and lower costs.

In both embodiments mentioned above the threads of the ring nut and/or the screw thread are preferably screw threads of a self-locking type. There are different self-locking threads known in the art. The self-locking can be effected by the form of the thread, especially by a small pitch.

In order to ensure that the ring nut does not come loose on the screw thread additional locking elements can be used like pretensioned elements at the thread, e.g. elastic or plastic rings or a counter ring nut. Such additional locking element avoids undesired displacement of the ring nut and consequential undesired clutch engagement or disengagement caused for example by sudden changes of the rotation speed.

An advantageous space-saving layout of the disk clutch assembly can be achieved, if the inner disk carrier is part of a driven shaft and formed as a hollow shaft which is arranged coaxially to a drive shaft. In such an assembly the drive shaft may be rotationally fixed to the outer disk carrier and arranged to extend through the driven hollow shaft. The driven shaft may further comprise a pinion to drive another gearwheel of the marine propulsion device. Preferably the inner disk carrier and said pinion are integrally formed as a one-piece element.

The disk clutch assembly may be arranged inside a gearbox housing. For manually engaging the disk clutch by rotating the ring nut an appropriate opening can be provided at the gearbox housing.

While the claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, the following detailed description in connection with the accompanying drawings will help to understand the objects, features and advantages of the invention, wherein:

- Fig. 1 shows a disk clutch assembly in a sectional view according to a first embodiment of the invention in a disengaged state of the disk clutch;
- Fig. 2 shows the disk clutch assembly of Fig. 1 in a sectional view in an engaged state of the disk clutch and
- Fig. 3 shows a drawing detail of a disk clutch assembly in a sectional view according to a second embodiment of the invention in a disengaged state of the disk clutch.

For the sake of convenience only the upper part of the symmetric disk clutch assembly 1 is shown in the figures. Fig.1 shows a disk clutch assembly 1 wherein the disk clutch 2 is open. This means that a powered actuator 3 and emergency actuating means 4 are disengaged. The disk clutch 2 is arranged to connect a drive shaft 14 with a driven shaft 13. The drive shaft 14 is supported by two rolling contact bearings 19, 20 in a gearbox housing 15. The driven shaft 13 is formed as a hollow shaft and supported on the drive shaft 14 by needle bearings 21 and by axial roller bearings 22, 23. Both, the drive shaft 14 and the driven shaft 13 may rotate around a central rotation axis 25.

The disk clutch assembly 1 comprises an inner disk carrier 7 carrying several inner disks 8 and an outer disk carrier 9 carrying several outer disks 10, 10a. The inner disks 8 are rotationally fixed to the inner disk carrier 7. The outer disks 10, 10a are rotationally fixed to the outer disk carrier 9. The inner disks 8 and the outer disks 10, 10a are movable in axial direction. The inner disk carrier 7 is part of driven shaft 13 and formed as a hollow shaft which is arranged coaxially to drive shaft 14. Drive shaft 14 extends through the driven shaft 13. The driven shaft 13 further comprises a pinion 12 to drive another gearwheel which is fixed to an output shaft of the corresponding gearbox. The driven shaft 13, the inner disk carrier 7 and pinion 12 are integrally formed as a one-piece element.

A powered actuator 3 in form of a hydraulic piston 16 is provided to engage the disk clutch 2 during normal operation. In the disengaged position piston 16 is pressed by

a helical spring 17 to its retracted position away from friction disks 8, 10 of the disk clutch 2. A cup spring 18 is arranged between piston 16 and the disks 8, 10 in order to enable smooth engagement by the piston 16. As a result harsh engagement of the disk clutch 2 is avoided when actuating pressure acts on piston 16. On the opposite side of the disks 8, 10 there is a locking ring 11 provided to block the clutch disks 8, 10 when they are pushed in this direction by the piston 16. This way the outer disks 10, 10a can be pressed against the inner disks 8 and disk clutch 2 is engaged, i.e. closed.

Emergency actuating means 4 in form of a ring nut 5 and a screw thread 6 are provided for cases when the powered actuator 3 fails. This is for example, if no hydraulic pressure can be supplied by the hydraulic system. Said emergency actuating means 4 comprise a screw thread 6 which is arranged on the inner disk carrier 7 and a ring nut 5 which is screwed onto screw thread 6. The ring nut 7 is equipped with an additional locking element, namely an elastic ring 24. The elastic ring 24 acts on the screw thread 6 in a way to avoid the ring nut 7 from coming loose and rotating on the screw thread 6 during normal operation, especially when the rotation speed of the inner disk carrier 7 or the whole disk clutch assembly 1 is changing quickly.

The locking ring 11 is arranged between an adjacent outer disk 10a and the ring nut 5, in a way that the ring nut 5 presses the locking ring 11 against the adjacent outer disk 10a when the ring nut 5 is rotated in a first direction.

Fig. 2 shows the same disk clutch assembly as Fig. 1. The same elements in Fig. 2 have the same reference signs as in Fig. 1 and their function will not be described once more. In contrast to Fig. 1, Fig. 2 shows disk clutch 2 in its engaged position, wherein the engagement is effected by the emergency actuation means 4.

The piston of the powered actuator 3 stays in its retracted position in both figures 1 and 2. In Fig. 1 the ring nut 5 is positioned on the right handside of screw thread 6 and there is a gap between the ring nut 5 and locking ring 11. Hence, disk clutch 2 is disengaged. In Fig. 2 the ring nut 5 has been rotated on screw thread 6 to be displaced in the direction towards the locking ring 11 and the disks 8, 10, so that the

locking ring 11 and the disks 8, 10 are pressed against each other. By this the disk clutch 2 is engaged and the drive shaft 14 is connected to driven shaft 13, so as to transmit a drive torque from an engine or motor to an output shaft and/or a propeller shaft.

Fig. 3 shows a second embodiment of the disk clutch assembly 1. The powered actuator 3 (not shown in Fig. 3) and emergency actuating means 4 are disengaged, so that the disk clutch 2 is open.

The disk clutch assemblies 1 of above described first embodiment and the second embodiment of Fig. 3 have a similar layout. That is why the same elements have the same reference sign in all figures. The main difference of the second embodiment is the arrangement of screw thread 6a and ring nut 5a on the outer disk carrier 9. In this case screw thread 6a is an internal thread at a free end of the outer disk carrier 9. Ring nut 5a is equipped with a corresponding external thread and is screwed in the internal screw thread 6a of the outer disk carrier 9. This way the ring nut 5a serves as an emergency actuation element and to block the outer disks 10, 10a in the outer disk carrier 9.

The ring nut 5a has at least one hole 26 on its outer surface. Preferably the ring nut 5a has several holes 26 which serve to insert a pin spanner wrench or another appropriate tool. With such a tool the ring nut 5a may be manually rotated for engaging or disengaging disk clutch 2.

The ring nut 5a in this second embodiment may as well be equipped with an additional locking element, e.g. an elastic ring, in order to avoid the ring nut 5a from coming loose and rotating on the screw thread 6a during normal operation.

Reference Numeral

1	disk clutch assembly
2	disk clutch
3	powered actuator
4	emergency actuating means
5	ring nut
5a	ring nut
6	screw thread
6a	screw thread
7	inner disk carrier
8	inner disks
9	outer disk carrier
10	outer disks
10a	adjacent outer disk
11	locking ring
12	pinion
13	driven shaft
14	drive shaft
15	gearbox housing
16	hydraulic piston
17	helical spring
18	cup spring
19	rolling contact bearing
20	rolling contact bearing
21	needle bearing
22	axial roller bearing
23	axial roller bearing
24	elastic ring
25	rotation axis
26	hole

Claims

1. Disk clutch assembly (1) for a marine propulsion device, the disk clutch assembly (1) comprising a disk clutch (2), a powered actuator (3) to engage and disengage the disk clutch (2) during normal operation, and emergency actuating means (4) to manually engage the disk clutch (2) in case of a failure of the powered actuator, wherein the emergency actuating means (4) comprise a ring nut (5, 5a) and a screw thread (6, 6a) which are arranged to interact with each other in a way that the disk clutch (2) may be engaged by rotating the ring nut (5, 5a) on the screw thread (6, 6a).
2. Disk clutch assembly according to claim 1, wherein the disk clutch assembly (1) comprises an inner disk carrier (7) carrying several inner disks (8) and an outer disk carrier (9) carrying several outer disks (10), and wherein the screw thread (6) is arranged on the inner disk carrier (7).
3. Disk clutch assembly according to claim 2, wherein a locking ring (11) for locking the outer disks (10) on the outer disk carrier (9) is arranged between an adjacent outer disk (10a) and the ring nut (5), so that the ring nut (5) presses the locking ring (11) against the adjacent outer disk (10a) when the ring nut (5) is rotated in a first direction.
4. Disk clutch assembly according to claim 3, wherein the inner disk carrier (7) and a pinion (12) are integrally formed as a one-piece element.
5. Disk clutch assembly according to claim 1, wherein the disk clutch assembly (1) comprises an inner disk carrier (7) carrying several inner disks (8) and an outer disk carrier (9) carrying several outer disks (10), and wherein the screw thread (6a) is arranged on the outer disk carrier (9).
6. Disk clutch assembly according to claim 5, wherein the screw thread (6a) is an internal thread at a free end of the outer disk carrier (9) and the ring nut (5a) has a corresponding external thread to be screwed into the internal screw thread (6a).

7. Disk clutch assembly according to one of the preceding claims, wherein a thread of the ring nut (5, 5a) and/or the screw thread (6, 6a) are of a self-locking type.
8. Disk clutch assembly according to one of the claims 2 to 7, wherein the inner disk carrier (7) is part of a driven shaft (13) and formed as a hollow shaft which is arranged coaxially to a drive shaft (14) which extends through the driven shaft (13), and wherein the driven shaft (13) comprises a pinion (12) to drive another gearwheel of the marine propulsion device.
9. Marine propulsion device comprising a disk clutch assembly (1) according to one of the preceding claims.

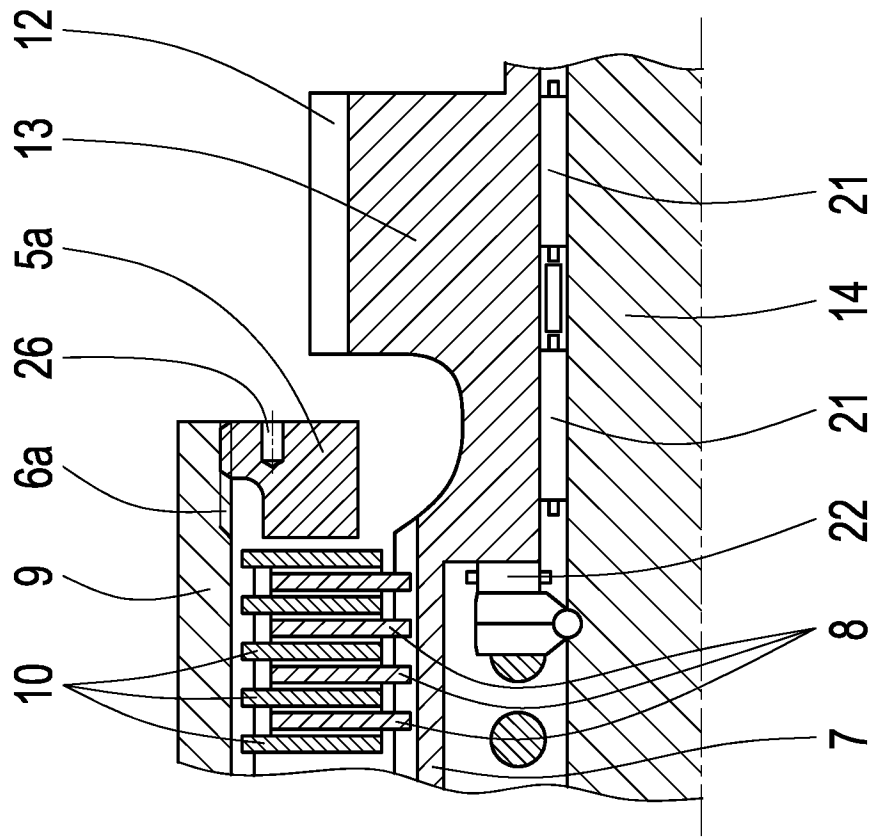


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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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)
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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)

EPO-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	DE 20 2010 017461 U1 (STROMAG AG [DE]) 16 November 2011 (2011-11-16)	1,2,7,9
A	paragraph [0019] - paragraph [0023]; figures 1,2	3-6,8
X	----- US 9 416 827 B1 (LOGAN W ANDREW [US] ET AL) 16 August 2016 (2016-08-16)	1
	column 22, line 19 - column 23, line 55; figures 26,27,31	
A	----- DE 10 2014 210846 A1 (ZAHNRADFABRIK FRIEDRICHSHAFEN [DE])	1
	17 December 2015 (2015-12-17) paragraph [0026] - paragraph [0029]; figures 2,3	



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 202010017461 U1	16-11-2011	NONE	
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