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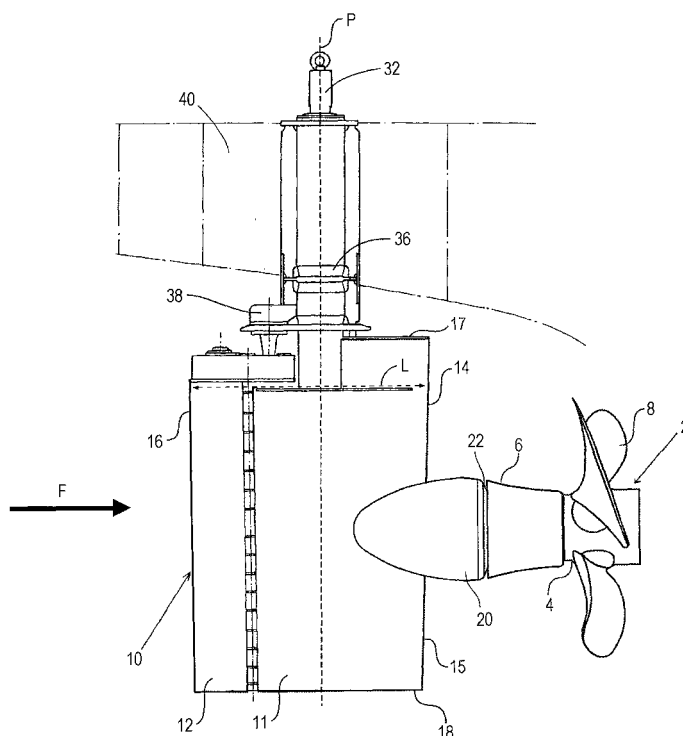
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(54) **Propulsion and steering arrangement**

(57) A propulsion and steering arrangement for a vessel (40) comprises a screw propeller (2) and a rudder (10) arranged behind the propeller (2). A fairing (6) at a tail end of the propeller (2) and a bulb-shaped body (20) provided on a rudder blade (11) of the rudder (10) form

a streamlined body which is continuous except for a narrow gap between the fairing (6) and the bulb-shaped body (20) to allow a swinging movement of the bulb-shaped body (20) relative to the fairing (6) when the rudder blade (11) is turned. A tail end of the rudder blade (11) is provided with a movable flap (12).

Fig. 1



Description

FIELD OF THE PRESENT INVENTION

[0001] The present invention relates to a propulsion and steering arrangement for a vessel. The arrangement is of a kind that comprises a propeller, a rudder arranged behind the propeller, and a bulb-shaped body provided on a rudder blade of the rudder.

BACKGROUND OF THE PRESENT INVENTION

[0002] The most common means for propelling a vessel is a screw propeller which has two or more propeller blades. To reduce fuel consumption and emissions, the propulsive efficiency of the propeller, which is defined as being the ratio between propulsion (also called effective) power and delivered power, should be as high as possible.

[0003] The prediction of the propulsive efficiency for a certain engine power is usually done through model scale tests. The prevailing opinion that was developed more than 100 years ago in the model testing practice of those days suggests that propeller and hull of a vessel can be viewed and assessed separately. In reality, however, the interaction between propeller and hull is a very important aspect. The propeller and the hull should be integrated and tuned to one another if optimal performance is to be achieved. This also holds true for the interaction between propeller and hull appendages such as a rudder.

[0004] In order to improve interaction between a screw propeller and a rudder, GB 762,445 teaches to arrange a bulb-shaped body behind the propeller in extension of the propeller axis. In order to overcome a contraction of the propeller slip stream, it is suggested to push a freely protruding head of the bulb-shaped body closely up to the trailing edge of the propeller blades so as to overlap the propeller hub. In one embodiment, the bulb-shaped body is supported by a rudder blade of a balancing rudder and the propeller hub has a recess engaged by the protruding head of the bulb-shaped body to allow a swinging movement of the bulb-shaped body relative to the propeller hub when the rudder blade is turned.

[0005] WO 2006/112787 A discloses a propulsion and steering arrangement of a vessel, wherein a fairing hubcap which is integral with a hub of a screw propeller forms a continuous streamlined body with a bulb-shaped body supported by a rudder blade of a full spade rudder behind the propeller. The leading end of the bulb-shaped body and the hubcap are designed to keep a narrow gap between the bulb-shaped body and the hubcap constant when the rudder blade is turned.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide a propulsion and steering arrangement having increased propeller efficiency.

[0007] According to a first aspect the present invention, there is provided a propulsion and steering arrangement for a vessel, the arrangement comprising a screw propeller and a rudder arranged behind the propeller, wherein a fairing at a tail end of the propeller and a bulb-shaped body provided on a rudder blade of the rudder form a streamlined body which is continuous except for a narrow gap between the fairing and the bulb-shaped body to allow a swinging movement of the bulb-shaped body relative to the fairing when the rudder blade is turned, and wherein a tail end of the rudder blade is provided with a movable flap.

[0008] When the rudder blade is turned so much that the bulb-shaped body comes out from the shadow of the fairing, the continuous streamlined body formed by the bulb-shaped body and the hubcap is disrupted, so that flow friction increases and unwanted turbulence is formed. However, by actuating the flap, the vessel can be steered without turning the rudder blade or with a smaller steering angle of the rudder blade. Therefore, the manoeuvring situations where the bulb-shaped body comes out from the shadow of the fairing will be less. Consequently, propulsion efficiency is increased and considerable fuel savings are obtained.

[0009] Preferably, the fairing has a recess which is engaged by a leading end of the bulb-shaped body.

[0010] The rudder may be a full spade rudder. In this case, the rudder blade may have a twisted upper leading edge extending from an upper end of the rudder blade to the bulb-shaped body and a twisted lower leading edge extending from a lower end of the rudder blade to the bulb-shaped body.

[0011] Alternatively, the rudder may be a semi spade rudder having a fixed leading head. In this case, the leading head may have a twisted upper leading edge extending from an upper end of the leading head to a lower end of the leading head, and the rudder blade may have a twisted lower leading edge extending from a lower end of the rudder blade to the bulb-shaped body.

[0012] The twist of the full spade rudder or the semi spade rudder aligns the upper and lower leading edges with the incoming flow from behind the propeller, thus reducing propeller drag and, to a high degree, propeller cavitation.

[0013] Preferably, at least one of the upper and lower leading edges has a constant twist angle. The constant twist angle results in a rugged and easy to manufacture rudder.

[0014] The propulsion efficiency and fuel savings of the propulsion and steering arrangement according to the present invention are the more remarkable the farther the pivot axis of the rudder blade is disposed from the leading edge of the rudder, or the more the bulb-shaped body is displaced from the axis of rotation of the propeller for a given turning angle of the rudder blade. At the same time, the balance of the rudder is improved and the efficiency of the rudder at low ship speeds is increased. For this reason, the pivot axis of the rudder blade is preferably

located at 30 to 50% of a maximum rudder length, more preferably at 35 to 50% of the maximum rudder length, and most preferably at 40 to 50% of the maximum rudder length in aft direction.

[0015] The propulsion efficiency and fuel savings are also improved by at least one of the following measures: The bulb-shaped body is substantially equal or larger in width than the diameter at the tail end of the fairing and has a larger height than width. A tail end of the bulb-shaped body is located above the level of the axis of rotation of the propeller on one side of the rudder blade and below the level of the axis of rotation of the propeller on the other side of the rudder blade. The fairing has a concave shape towards the bulb-shaped body.

[0016] According to a second aspect the present invention, there is provided a vessel having the afore-mentioned propulsion and steering arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1 shows a propulsion and steering arrangement according to a first embodiment of the present invention.

Fig. 2 is a schematic view of the rudder of Fig. 1 with upper and lower cross sections.

Fig. 3 shows the upper cross section of Fig. 2.

Fig. 4 shows the lower cross section of Fig. 2.

Fig. 5 shows a propulsion and steering arrangement according to a second embodiment of the present invention.

DETAILED DISCLOSURE OF THE INVENTION

[0018] The invention is now explained in greater detail with reference to Figs. 1 to 5 which illustrate preferred embodiments of the present invention.

First Embodiment

[0019] Figs. 1 to 4 show a propulsion and steering arrangement according to a first embodiment of the present invention. The propulsion and steering arrangement is mounted on the stern of a vessel. The vessel may be equipped with one or more of the propulsion and steering arrangements.

[0020] As illustrated in Fig. 1, the propulsion and steering arrangement according to the first embodiment comprises a screw propeller 2 mounted on a drive shaft (not shown) of the vessel 40, and a full spade rudder 10 which has a turnable rudder blade 11 mounted at a pivot axis P to a rudder stock 32 of the vessel 40 behind a tail end of the propeller 2 and a movable flap 12 hinged to a tail end of the rudder blade 11 behind the pivot axis P. In this context, the term "behind" refers to the fore direction of the vessel 40 as indicated by arrow F.

[0021] The rudder stock 32 is supported by a main

bearing 36 at the stern of the vessel 40 and is actuated for turning the rudder blade 11 about the pivot axis P to port or starboard so as to manoeuvre the vessel 40. Further, an actuation mechanism 38 is adapted to move the flap 12 relative to the rudder blade 11 to port or starboard so as to manoeuvre the vessel 40. The movement of the flap 12 is independent of the rudder blade 11.

[0022] The pivot axis P of the illustrated rudder 10 is located at about 45% of a maximum rudder length L from the upper leading edge 14 in aft direction. The maximum rudder length L is the maximum distance between the upper and lower leading edges 14, 15 and the trailing edge 16. The pivot axis P can also be located at a different position, but preferably at 35 to 50% of the maximum rudder length L to achieve a superior balance of the rudder 10. The closer the pivot point P to the midsection of the rudder 10 is, the smaller is the steering angle of the rudder blade 11 needed for a given steering effect and the higher is the efficiency of the rudder at low ship speeds such as in harbour conditions.

[0023] When the propeller 2 is driven by the drive shaft, the propeller 2 propels the vessel 40 in either the fore direction F or in the opposite aft direction. When the vessel 40 is propelled in the fore direction F by the propeller 2, water that has passed the propeller 2 forms a slip stream of swirling water which travels towards the rudder blade 11.

[0024] The propeller 2 has a hub 4 on which three propeller blades 8 are mounted. It can also have less or more blades. The propeller 2 is shown as a variable pitch propeller, but may also have a fixed pitch.

[0025] The tail end of the propeller 2 is defined by a fairing hubcap 6 which has been screwed on or shrunk on the propeller hub 4 to be integral with the hub 4. The illustrated concave contour of the propeller hub 4 can also be cast in a single piece. The fairing hubcap 6 has a recess. The recess is engaged by a front end 22 of a bulb-shaped body 20 which has been attached to the rudder blade 11 by means of a flange connection to be integral with the rudder blade 11.

[0026] The front end 22 of the bulb-shaped body 20 projects into the recess of the hubcap 6 without contacting the recess. The recess of the hubcap 6 and the front end 22 of the bulb-shaped body 20 are curved to keep a narrow gap between the recess of the hubcap 6 and the front end 22 of the bulb-shaped body 20 constant when the rudder blade 11 is turned. The bulb-shaped body 20 and the hubcap 6 form a continuous streamlined body which is broken only by the narrow gap when the rudder blade 11 is not turned. Additionally, a flexible, non-contacting sealing structure may be provided between the bulb-shaped body 20 and the hubcap 6 to minimize the water flow in the narrow gap. The concave hubcap 6 guides the propeller slip stream away from the narrow gap and around the bulb-shaped body 20 when the rudder blade 11 is not turned, and the bulb-shaped body 20 prevents a contraction of the propeller slip stream behind the propeller hub 4. As a result, separation losses behind

the propeller hub 4 are reduced.

[0027] The bulb-shaped body 20 has roughly the shape of an ellipse in cross-section which is substantially equal or larger in width than the diameter at the tail end of the hubcap 6 and which has a larger height than width. This bulb-shaped body 20 has another effect in that it reduces water velocity through the propeller plane. Consequently, the average wake fraction of the vessel 40 and the hull efficiency are increased.

[0028] The design of the full spade rudder 10 is now explained in more detail. Fig. 2 shows the full spade rudder 10 of Fig. 1 together with an upper cross section at an upper end 17 of the rudder 10 and a lower cross section at a lower end 18 of the rudder 10. Figs. 3 and 4 show the upper and lower cross sections in more detail.

[0029] As shown in Figs. 2 to 4, the rudder 10 has a streamlined profile with an upper leading edge 14 extending from the upper end 17 of the rudder blade 11 to the bulb-shaped body 20, a lower leading edge 15 extending from the lower end 18 of the rudder blade 11 to the bulb-shaped body 20, and a trailing edge 16 extending behind the bulb-shaped body 20 from the upper end 17 to the lower end 18 of the flap 12. The upper leading edge 14 has a constant first twist angle α of 8° with respect to a centreline C of the rudder 10 in port-side direction, while the lower leading edge 15 has a constant twist angle β of 6° with respect to the centreline C of the rudder 10 in starboard direction. The twist angles α , β can have different values, but are preferably less than 15° , more preferably less than 10° , and most preferably between 5° and 10° in each direction.

[0030] The twists of the illustrated upper and lower leading edges 14, 15 decrease in aft direction to 0° within a range defined by the respective leading edge 14, 15 and the pivot axis P of the rudder 10, so that the trailing edge 16 is not twisted and extends in a straight line. The twists can also decrease to 0° within a range defined by the pivot axis P and the trailing edge 16, or the twists can continue up to the trailing edge 16 so that a fishtail rudder is formed.

[0031] When the propeller 2 drives the vessel 40 in the fore direction F, the twisted leading edges 14, 15 meet the swirling water propelled backwards by the propeller 2. The twisted leading edge profile of the rudder 10 improves the propeller slip stream through the rudder area, thereby increasing propeller efficiency.

[0032] The illustrated bulb-shaped body 20 has a symmetric shape. However, similar to the twisted leading edges 14, 15, the bulb-shaped body 20 may be asymmetric in shape. The angle formed between the axis of rotation of the propeller 2 and the tail end of the bulb-shaped body 20 may be such that the tail end of the bulb-shaped body 20 is located above the level of the axis of rotation of the propeller 2 on one side of the rudder blade 11 and below the level of the axis of rotation of the propeller 2 on the other side of the rudder blade 11. The asymmetric shape has the effect of further increasing propeller efficiency.

[0033] As compared with a standard rudder which has no bulb-shaped body 20, the drag produced by the rudder 10 at a small steering angle of 10° or less is higher. However, the produced lift force is also much higher, meaning that smaller steering angles can be used. This trend changes for large steering angles of more than 10° , and this is of course due to the bulb-shaped body 20. However, in general such large steering angles will only be used at slow speed operation, for which the lift force is more of an issue than the rudder drag. All in all, the rudder 10 shows a better lift-to-drag ratio than the standard rudder.

[0034] As compared with a standard rudder which has no flap 12, the flap 12 of the rudder 10 has the ability to redirect the propeller slip stream. Consequently, the lift-to-drag ratio is further increased, thereby facilitating small accurate turns at low ship speed.

[0035] The flap 12 of the rudder 10 has advantages at not only low ship speeds and large steering angles, but also high ship speeds and small steering angles of 10° or less. This is for the following reason. When the rudder blade 11 is turned so much that the front end 22 of the bulb-shaped body 20 comes out from the shadow of the hubcap 6, the continuous streamlined body formed by the bulb-shaped body 20 and the hubcap 6 is disrupted, so that flow friction increases and unwanted turbulence is formed. However, by actuating the flap 12, the vessel 40 can be steered without turning the rudder blade 11 or with a smaller steering angle of the rudder blade 11. Therefore, the manoeuvring situations where the front end 22 of the bulb-shaped body 20 comes out from the shadow of the hubcap 6 will be less as compared with the standard rudder which has no flap 12. Consequently, considerable fuel savings are obtained.

[0036] Actually, the flap 12 is so efficient that it is possible to make the front end 22 of the bulb-shaped body 20 which projects from the leading end of the rudder blade 11 longer and the hubcap 6 shorter. With the hubcap 6 being shorter, the rotating parts between the propeller plane and the rudder 10 are smaller in length, which lowers flow friction and further increases efficiency.

[0037] This all makes it possible to reduce the size of the rudder 10, which again lowers the frictional losses and increases overall efficiency.

[0038] The efficiency gains are particularly large for propellers with a relatively large propeller hub, such as highly loaded controllable pitch propeller systems as on RoRo vessels, RoPax ferries, container/multipurpose vessels, or cargo vessels with an ice class notation. Due to the large ratio between propeller and hub diameters, the hub losses would be significant for a conventional combination of propeller and rudder. With the application of the propulsion and steering arrangement according to the first embodiment, these losses can largely be avoided.

[0039] Additionally, the gains for single screw full block ships can be quite significant. The bulb-shaped body 20 causes the wake fraction to become larger and thus also

the hull efficiency to increase. Hence, for single screw vessels with full aft bodies, such as tankers, bulk carriers and small cargo vessels - which may have quite a difficult wake field as well as a high wake fraction - the annual savings could also be well worth the investment.

Second Embodiment

[0040] Fig. 5 shows a propulsion and steering arrangement according to a second embodiment of the present invention mounted on the stern of a vessel 40.

[0041] As illustrated in Fig. 5, the propulsion and steering arrangement according to the second embodiment comprises a screw propeller 2 mounted on a drive shaft 30 of the vessel 40, and a semi spade rudder 10' mounted behind the propeller 2 to the hull of the vessel 40. The semi spade rudder 10' comprises a leading head 34 which is fixed to the hull of the vessel 40, a turnable rudder blade 11 mounted at a pivot point P to a rudder stock 32 of the vessel 40, and a movable flap 12 hinged to a tail end of the rudder blade 12.

[0042] The rudder stock 32 is supported by a main bearing 36 provided in a lower part of the leading head 34 and is actuated for turning the rudder blade 11 about the pivot axis P to port or starboard so as to manoeuvre the vessel 40. Further, an actuation mechanism (not shown) is provided in the inside of the rudder blade 11 for moving the flap 12 relative to the rudder blade 11 to port or starboard so as to manoeuvre the vessel 40. The movement of the flap 12 is independent of the rudder blade 11.

[0043] The illustrated rudder 10' has a constant rudder length in fore and aft direction. The pivot axis P of the rudder blade 11 is located at about 41% to achieve a good balance of the rudder 10'.

[0044] The propeller 2 has a hub 4 on which four propeller blades 8 are mounted. It can also have less or more blades. The propeller 2 is shown as a variable pitch propeller, but may also have a fixed pitch.

[0045] The propeller hub 4 has been cast in a single piece to have the shape of a fairing which is slightly concave towards the tail end thereof. Alternatively, the fairing can be a hubcap which has been screwed on or shrunk on the propeller hub. The hub 4 has a recess which is engaged by a leading end of the bulb-shaped body 20 without contacting the recess. The recess of the hub 4 and the leading end of bulb-shaped body 20 are curved to keep the narrow gap constant when the rudder blade 11 is turned. The bulb-shaped body 20 and the hub 4 form a continuous streamlined body which is broken only by a narrow gap to allow a swinging movement of the bulb-shaped body 20 relative to the hub 4 when the rudder blade 11 is turned. The streamlined body prevents a contraction of the propeller slip stream, thereby reducing separation losses.

[0046] The bulb-shaped body 20 has roughly the shape of an ellipse in cross-section which is substantially equal or larger in width than the diameter at the tail end

of the hubcap 6 and which has a larger height than width. This bulb-shaped body 20 has another effect in that it reduces water velocity through the propeller plane. Consequently, the average wake fraction of the vessel 40 and the hull efficiency are increased.

[0047] Similar to the full spade rudder 10 according to the first embodiment, the semi spade rudder 10' according to the second embodiment has a streamlined profile with a twisted upper leading edge 14, a twisted lower leading edge 15, and a trailing edge 16 which is not twisted and extends in a straight line. The upper leading edge 14 extends from an upper end of the leading head 34 to a lower end of the leading head 34. The lower leading edge 15 extends from a lower end 18 of the rudder blade 11 to the bulb-shaped body 20. The upper leading edge 14 has a constant first twist angle with respect to a centreline of the rudder 10' in starboard direction, while the lower leading edge 15 has a constant twist angle with respect to the centreline in port-side direction. The twist angles have values less than 15°, more preferably less than 10°, and most preferably between 5° and 10° in each direction. The twist of the upper leading edge 14 decreases to 0° in aft direction towards the rudder stock 32. The twist of the lower leading edge 15 decreases to 0° in aft direction within a range defined by the lower leading edge 15 and the pivot axis P of the rudder 10'. The range between the pivot axis P and the trailing edge 16 can also be twisted.

[0048] When the propeller 2 drives the vessel 40 in the fore direction, the twisted leading edges 14, 15 meet the swirling water propelled backwards by the propeller 2. The twisted leading edge profile of the rudder 10' improves the propeller slip stream through the rudder area, thereby increasing propeller efficiency.

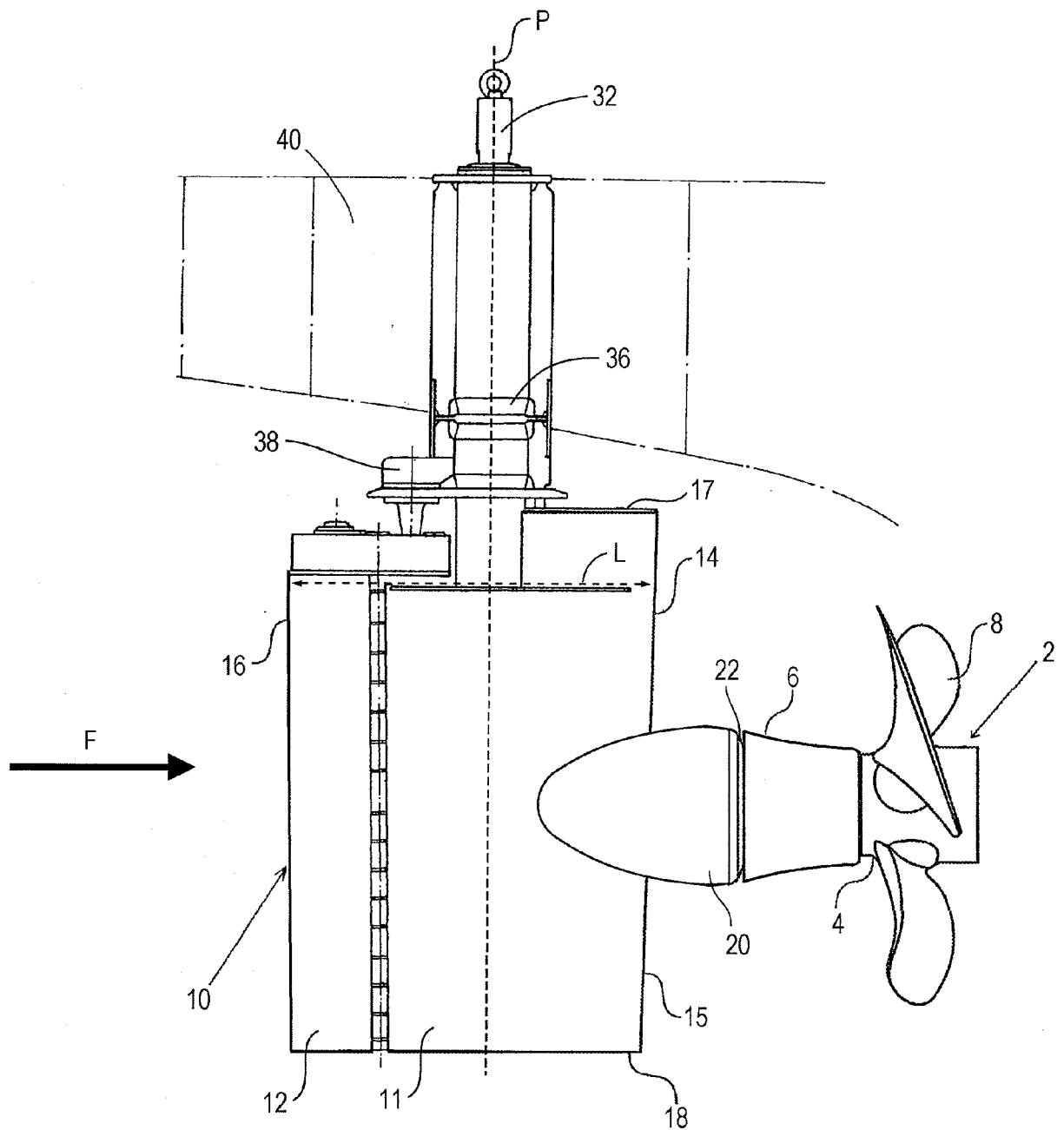
[0049] Similar to the propulsion and steering arrangement according to the first embodiment, the lift-to-drag ratio of the rudder 10' is better than a standard rudder which has no bulb-shaped body 20. The flap 12 of the rudder 10' further increases the lift-to-drag ratio at low ship speeds, thereby facilitating small accurate turns at low ship speed. Additionally, by actuating the flap 12, the vessel 40 can be steered without turning the rudder blade 11 or with a smaller steering angle of the rudder blade 11. Therefore, the manoeuvring situations where the front end 22 of the bulb-shaped body 20 comes out from the shadow of the hub 4 will be less as compared with a standard rudder which has no flap 12. Consequently, considerable fuel savings are obtained. The flap 12 is so efficient that it is possible to make the front end 22 of the bulb-shaped body 20 which projects from the leading end of the rudder blade 11 longer and the hub 4 shorter or reduce the size of the rudder 10', so that efficiency is further improved.

[0050] Similar to the to the propulsion and steering arrangement according to the first embodiment, the efficiency gains of the rudder 10' are particularly large for propellers with a relatively large propeller hub and for single screw full block ships.

Claims

1. A propulsion and steering arrangement for a vessel (40), the arrangement comprising a screw propeller (2) and a rudder (10; 10') arranged behind the propeller (2), wherein a fairing (4; 6) at a tail end of the propeller (2) and a bulb-shaped body (20) provided on a rudder blade (11) of the rudder (10; 10') form a streamlined body which is continuous except for a narrow gap between the fairing (4; 6) and the bulb-shaped body (20) to allow a swinging movement of the bulb-shaped body (20) relative to the fairing (4; 6) when the rudder blade (11) is turned,
characterized in that
a tail end of the rudder blade (11) is provided with a movable flap (14). 5
2. A propulsion and steering arrangement according to claim 1, wherein the fairing (4; 6) has a recess which is engaged by a leading end (22) of the bulb-shaped body (20). 10
3. A propulsion and steering arrangement according to claim 1 or 2, wherein the rudder (10; 10') is a full spade rudder. 15
4. A propulsion and steering arrangement according to claim 3, wherein the rudder blade (11) has a twisted upper leading edge (14) extending from an upper end (17) of the rudder blade (11) to the bulb-shaped body (20) and a twisted lower leading edge (15) extending from a lower end (18) of the rudder blade (11) to the bulb-shaped body (20). 20 30
5. A propulsion and steering arrangement according to claim 1 or 2, wherein the rudder (10') is a semi spade rudder having a fixed leading head (34). 35
6. A propulsion and steering arrangement according to claim 5, wherein the leading head (34) has a twisted upper leading edge (14) extending from an upper end (17) of the leading head (34) to a lower end of the leading head (34), and the rudder blade (11) has a twisted lower leading edge (15) extending from a lower end (18) of the rudder blade (11) to the bulb-shaped body (20). 40 45
7. A propulsion and steering arrangement according to claim 4 or 6, wherein at least one of the upper leading edge (14) and the lower leading edge (15) has a constant twist angle (α , β). 50
8. A propulsion and steering arrangement according to any one of the preceding claims, wherein a pivot axis (P) of the rudder blade (11) is located at 30 to 50% of a maximum rudder length (L), preferably at 35 to 50% of the maximum rudder length (L), and more preferably at 40 to 50% of the maximum rudder length (L) in aft direction. 55
9. A propulsion and steering arrangement according to any one of the preceding claims, wherein the bulb-shaped body (20) is substantially equal or larger in width than the diameter at the tail end of the fairing (4; 6) and has a larger height than width.
10. A propulsion and steering arrangement according to any one of the preceding claims, wherein a tail end of the bulb-shaped body (20) is located above the level of an axis of rotation of the propeller (2) on one side of the rudder blade (11) and below the level of the axis of rotation of the propeller (2) on the other side of the rudder blade (11).
11. A propulsion and steering arrangement according to any one of the preceding claims, wherein the fairing (4; 6) has a concave shape towards the bulb-shaped body (20).
12. A vessel (40) having a propulsion and steering arrangement according to any one of the preceding claims.

Fig. 1



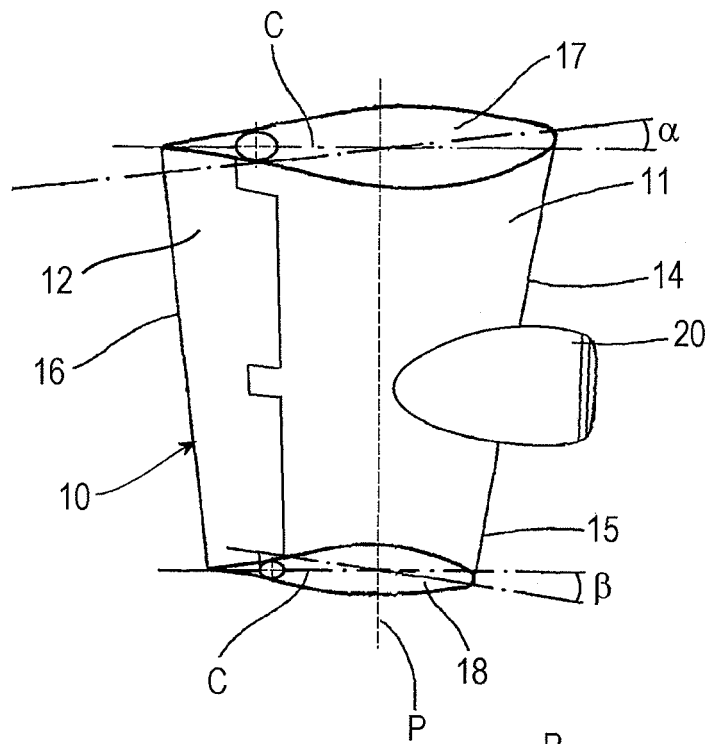


Fig. 2

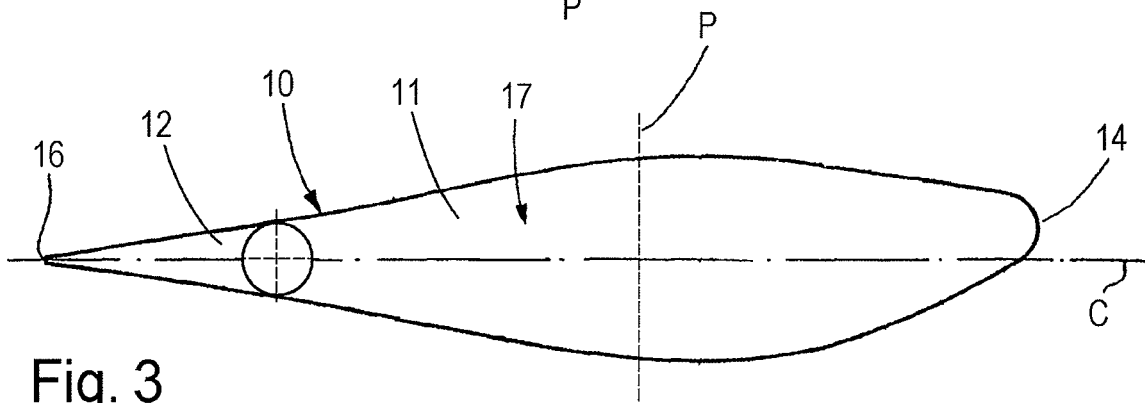


Fig. 3

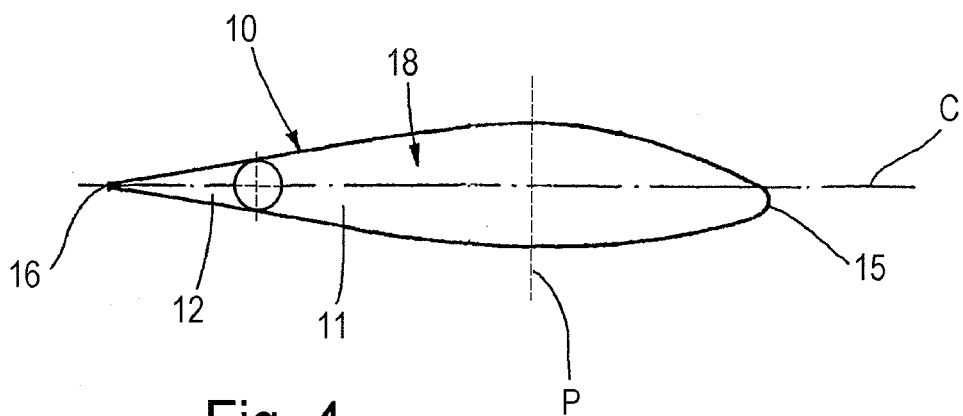
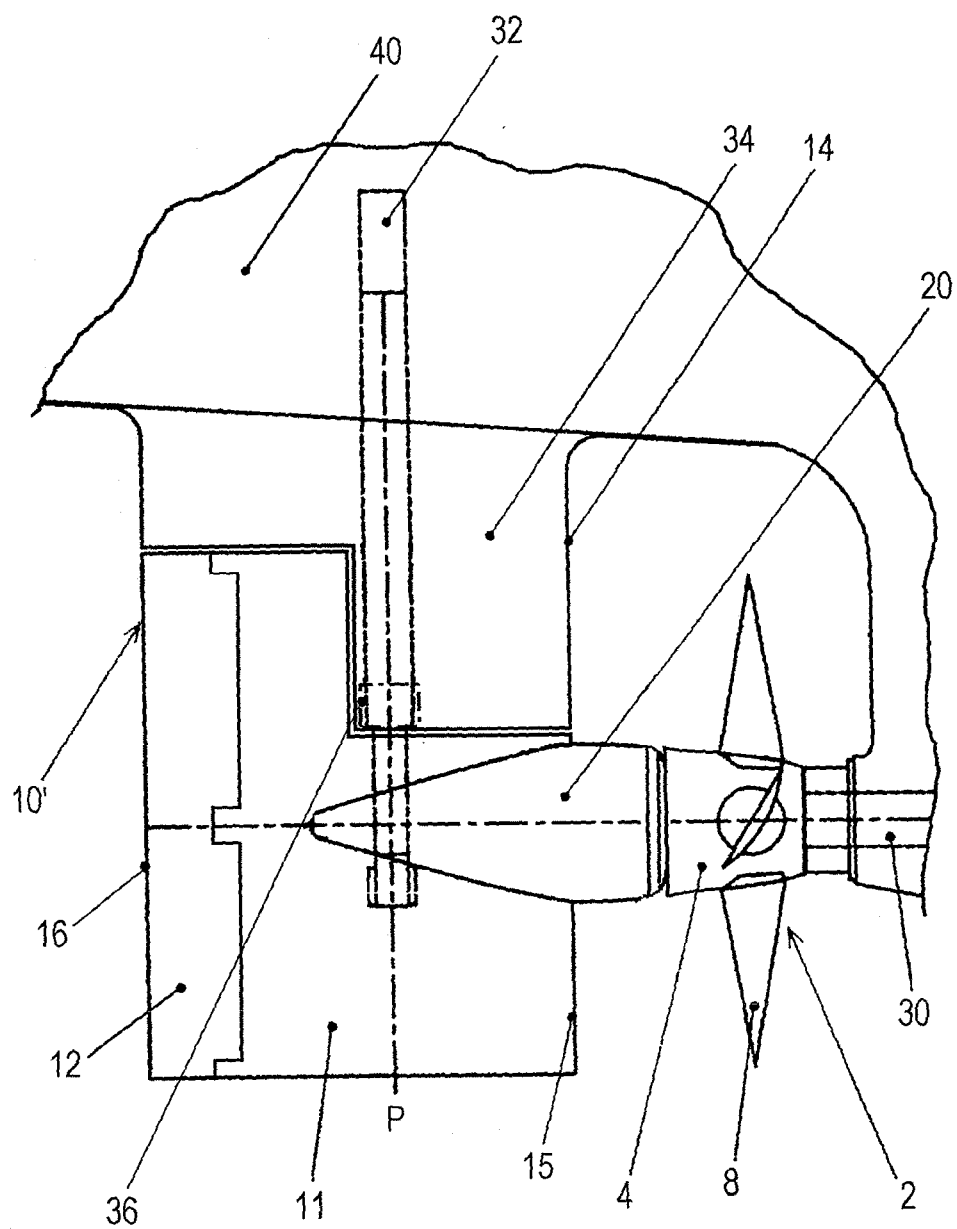


Fig. 4

Fig. 5





EUROPEAN SEARCH REPORT

Application Number
EP 08 16 4276

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,Y	WO 2006/112787 A (ROLLS ROYCE AKTIEBOLAG [SE]; PETERSSON GOERAN [SE]; KROEVEL NERLAND K) 26 October 2006 (2006-10-26) * figures *	1-9,11, 12	INV. B63H25/38 B63H25/42
Y	WO 89/05262 A (KAMEWA AB [SE]) 15 June 1989 (1989-06-15) * page 7, lines 20-23; figures *	1-9,11, 12	
D,Y	GB 762 445 A (LEO COSTA; ERICH RICHARD FRIEDRICH MAIER) 28 November 1956 (1956-11-28) * figure 6 *	5,6	
Y	US 2008/110386 A1 (KLUGE MATTHIAS [DE] ET AL) 15 May 2008 (2008-05-15) * page 2, paragraph 39 *	7	
A	EP 0 144 860 A (LICENTIA GMBH [DE]) 19 June 1985 (1985-06-19) * figures 2,3 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B63H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 27 March 2009	Examiner van Rooij, Michael
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 16 4276

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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27-03-2009

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 2006112787	A	26-10-2006	EP 1871659 A1	02-01-2008
			JP 2008536761 T	11-09-2008
			KR 20080005560 A	14-01-2008

WO 8905262	A	15-06-1989	AU 2821789 A	05-07-1989
			DE 3885105 D1	25-11-1993
			DE 3885105 T2	05-05-1994
			DK 140990 A	08-06-1990
			EP 0394320 A1	31-10-1990
			FI 96757 B	15-05-1996
			JP 2657422 B2	24-09-1997
			JP 3501714 T	18-04-1991
			SE 459249 B	19-06-1989

GB 762445	A	28-11-1956	NONE	

US 2008110386	A1	15-05-2008	AT 414012 T	15-11-2008
			CN 101181930 A	21-05-2008
			DE 202006017370 U1	20-03-2008
			DK 1921005 T3	02-02-2009
			EP 1921005 A1	14-05-2008
			ES 2313690 T3	01-03-2009
			HR 20080636 T3	31-01-2009
			JP 2008120370 A	29-05-2008
			KR 20080043200 A	16-05-2008
			SG 143109 A1	27-06-2008

EP 0144860	A	19-06-1985	DE 3344017 A1	20-06-1985
			FI 844759 A	07-06-1985

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 762445 A [0004]
- WO 2006112787 A [0005]