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Datasheet for the decision of 6 May 2015

Case Number: T 0088/13 - 3.2.01

Application Number: 07251664.4

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IPC: B63H5/125, B63H25/42

Language of the proceedings: EN

Title of invention:
A propulsion and steering unit for a waterborne vessel

Patent Proprietor:
Rolls-Royce Marine AS

Opponent:
Wärtsilä Finland OY

Headword:

Relevant legal provisions:
EPC Art. 54

Keyword:
Novelty (main request; first, second, third auxiliary requests : no)

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Catchword:

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Case Number: T 0088/13 - 3.2.01

D E C I S I O N
of Technical Board of Appeal 3.2.01
of 6 May 2015

Appellant: (Patent Proprietor)	Rolls-Royce Marine AS Dep. Propulsion - Ulstein Sjogt 98 6065 Ulsteinvik (NO)
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Respondent: (Opponent)	Wärtsilä Finland OY John Stenbergin ranta 2 po box 196 00531 Helsinki (FI)
Representative:	TBK Bavariaring 4-6 80336 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 12 December 2012 revoking European patent No. 1847455 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	G. Pricolo
Members:	C. Narcisi
	D. T. Keeling

Summary of Facts and Submissions

I. European patent No. 1 847 455 was revoked by the decision of the Opposition Division posted on 12 December 2012. An appeal was lodged by the Patentee against this decision on 15 January 2013 and the appeal fee was paid on the same day. The statement of grounds of appeal was filed on 11 April 2013.

II. Oral proceedings took place on 6 May 2015. The Appellant (Patentee) requested that the decision under appeal be set aside and the patent maintained on the basis of the claims of the main request, filed by letter of 20 February 2014, or, in the alternative, on the basis of the claims of the first, second or third auxiliary request, all filed with the grounds of appeal on 11 April 2013. The Respondent (Opponent) requested that the appeal be dismissed.

III. Claim 1 of the main request reads as follows:

"A propulsion and steering unit for a waterborne vessel, the propulsion and steering unit comprising a pod (1) having front and rear ends, a fin element (32) extending downwards from the pod (1), a propeller (2) and propeller shaft (4), the propeller (2) being disposed externally at the front of the pod (1) and being rotatable about a longitudinal axis (6) of the propeller shaft (4), the propeller shaft (4) being drivingly connected to drive means, the drive means comprising a driving pinion gear (10) and a driven wheel (8), the unit further comprising steering means for rotating the unit about an axis (18) substantially perpendicular to the longitudinal axis (6) of the propeller(2), the fin element (32) being arranged behind an axis (18) of rotation of the drive shaft (12) and driving pinion gear (10), the axis (18) of rotation of the driving pinion gear (10) further being forward of the driven wheel (8), and the location of the driving pinion gear (10) on the driven wheel being such that, in use, the rotational direction of the driving pinion gear (10) produces a torque, characterized in that said torque acts against a maximum hydrodynamic torque generated by a rotation of the propeller (2) and a rotation of the unit by the steering means."

Claim 1 of the first auxiliary request differs from claim 1 of the main request in that the characterizing portion is replaced by the following wording :
"characterized in that said torque acts against a maximum hydrodynamic torque induced by a slipstream generated by a rotation of the propeller (2) and a rotation of the unit by the steering means."

Claim 1 of the second auxiliary request differs from claim 1 of the main request in that the characterizing portion is replaced by the following wording:
"characterized in that said torque acts against a maximum hydrodynamic torque generated by a rotation of the propeller (2) and a rotation of the unit by the steering means, and in that said propeller (2) is a controllable pitch propeller."

Claim 1 of the third auxiliary request differs from claim 1 of the main request in that the characterizing portion is replaced by the following wording:
"characterized in that said torque acts against a maximum hydrodynamic torque generated by a rotation of the propeller (2) and a rotation of the unit by the steering means, and in that said propeller (2) is a fixed pitch bladed propeller."

IV. The Appellant's arguments may be summarized as follows:

Claim 1 relates to a pulling azimuth thruster comprising a pod rotatable by 360° about an azimuth axis. The main advantage of a pulling azimuth thruster, as compared to a pushing azimuth thruster, resides in its undisturbed propeller inflow; its disadvantage resides in a greater torque required to turn the pod around the azimuth axis. The invention aims at alleviating this disadvantage by locating the driving pinion gear on the driven wheel such that the rotational direction of the driving pinion gear produces a torque according to the characterizing features of claim 1 (hereinafter denominated as features (i)), i.e. which "acts against a maximum hydrodynamic torque generated by a rotation of the propeller (2) and a rotation of the unit by the steering means". Thus, according to the present invention it was in essence first recognized that the effect of the hydrodynamic torque, which is asymmetric both in magnitude and direction, can be alleviated by locating the driving pinion gear and choosing its direction of rotation such as to counteract the hydrodynamic torque. The inventor realized that for the pulling azimuth thruster there exists a maximum hydrodynamic torque which acts in an asymmetric way towards port or starboard, which maximum hydrodynamic torque the steering engine needs to be designed to overcome. This makes it possible to reduce the maximum power and torque requirements on the steering motor. However, the direction (and magnitude) of maximum hydrodynamic torque is not known a priori but depends on several factors, such as the specific geometric configuration of the pod (e.g. the position and geometry of the fin and the leg of the pod, the position of the azimuth axis) and the propeller advance number Ja (= V_A (advance velocity of the propeller)/ (N (revolutions per second) x D (propeller diameter)). This is confirmed both by tank tests performed on geometrical scale models of specific thrusters and by computational fluid dynamics methods (CFD methods) performed on such thrusters. The Appellant performed CFD simulations using different thruster configurations (see Appendix B annexed to the grounds of appeal) to calculate the (non dimensional) steering moment coefficient KMz for two possible geometries and two possible positions of the azimuth axis. The results show e.g. (for thruster 1a) that for a left-handed propeller the direction of maximum hydrodynamic torque changes from port (at an azimuth (steering) angle of 35°) to starboard (at an azimuth angle of -35°) if the azimuth axis is moved from position (c) to (d) (see Appendix B, figure 3) and the advance number Ja has a value of 1.1 (see figure 5), or (for thruster 1b) if the advance number Ja changes from 0.72 to 0.9 (Table 1) in position (e) (figure 6) of the azimuth thruster. The application as filed (see published patent application, hereinafter designated as EP-A), and the corresponding passages in the patent specification (hereinafter designated as EP-B), already indicate that maximum hydrodynamic torque may depend on the configuration of the pod (see EP-B, paragraph [0017]). For instance, a given pod without a fin produces at sufficiently high azimuth angles in port direction (positive deflection) a lower hydrodynamic torque than in starboard direction (negative deflections) (see EP-B, figure 5, curves 80 and 81, paragraph [0026]). This stands in marked contrast to the embodiment disclosed in figures 3a, 3b of EP-A where again a pod with a left-handed propeller is shown and the maximum hydrodynamic torque is nonetheless directed towards port (see EP-B, paragraph [0028]). The conclusion is

that there is no unambiguous relationship between the rotational direction of the propeller and the direction of maximum hydrodynamic torque and that it is impossible to derive the direction of maximum hydrodynamic torque from a schematic two-dimensional representation of a thruster. This is also confirmed by Appendix A (expert opinion of professor Abdel-Maksoud, University of Hamburg), annexed to the statement of grounds of appeal.
From the aforesaid it ensues that documents D1, D1a (Excerpt of magazine "The motor ship", pages 2, 3 and 36-39, January 2003; document D1a shows enlarged view of thruster picture extracted from page 38 of D1) cannot take away the novelty of claim 1 of the main request. Indeed, whilst it is not disputed that the features according to the preamble of claim 1 are known from D1 (D1a), this is not so for the characterizing features (features (i)) of the claim. D1 (D1a) merely shows a left-handed propeller, i.e. configured to be rotated in anti-clockwise direction when viewed from astern, and a driving pinion acting in a clockwise direction when viewed from above. However, as discussed above, nothing can be inferred from the picture shown in D1a (and from D1 as a whole) about the direction of maximum hydrodynamic torque, such that features (i) are not known from D1 (D1a).

The subject-matter of claim 1 of the first auxiliary request is new over D1 (D1a), for (in addition to what was discussed above) nothing can be derived from this prior art concerning the interaction between the thruster body and the slipstream.

The subject-matter of claim 1 of the second and third auxiliary requests is new over D1 (D1a) since (in addition to what was discussed above) the latter does not disclose which of the possible alternatives for the propeller, namely controllable pitch or fixed pitch, is present in conjunction with the remaining features of the claim.

V. The Respondent's arguments may be summarized as follows:

The subject-matter of claim 1 of the main request lacks novelty over D1 (D1a). It is not disputed that the features according to the preamble of claim 1 are known from D1 (D1a), particularly the location of the fin element relatively to the location of the drive shaft and of the driving pinion gear, the axis of rotation of the driving pinion gear being also located forward of the driven wheel. Further, as visible from D1a, the illustrated propeller is left-handed (as seen from astern) and the driving pinion gear accordingly rotates in a clockwise direction (as seen from above). Consequently, the geometry and functioning of said specific constructional elements is entirely equivalent to the geometry and functioning of the pod as described in figures 1, 2, 3a, 3b, of EP-B. Moreover, comparing these figures of EP-B with D1a it can be inferred that the overall configuration and geometry of the pods is substantially the same in both cases, such that necessarily the same directions will arise for the torque produced by the driving pinion gears and for the maximum hydrodynamic torque respectively. As set out in EP-B (paragraph [0028]), such a configuration gives rise to a maximum hydrodynamic torque directed towards the port side, which conclusion then necessarily holds true for both the embodiment of figures 1, 2, 3a, 3b and prior art D1a. Therefore features (i) of claim 1 are known from D1 (D1a).

The Appellant's contention that the direction of the maximum hydrodynamic torque does not uniquely depend on the direction of rotation of the propeller but also depends on several other factors (e.g. such as specific pod configuration) is not disclosed in the application documents as filed (see EP-A). Therefore these arguments cannot support the novelty of the claimed subject-matter, particularly since none of the specific design features mentioned by the Appellant and allegedly apt to alter the direction of maximum hydrodynamic torque are included in the claim and discussed in EP-B.

The subject-matter of claim 1 of the first auxiliary request is not new over D1 (D1a), given that the features introduced into claim 1 of the main request merely imply a specification (i.e. that the hydrodynamic torque is induced by a slipstream) leading to a subject-matter to which the same arguments apply as for the main request.

The subject-matter of claim 1 of auxiliary requests 2 and 3 is not new over D1 (D1a) since controllable pitch and fixed pitch blade propellers are explicitly mentioned in said prior art.

Reasons for the Decision

1. The appeal is admissible.

2. The question of novelty of the subject-matter of claim 1 of the main request is centered exclusively on whether features (i) (i.e. the characterizing features of the claim) (see point IV above) are known from D1 (D1a), the other features being undisputedly known from

this prior art. Particularly, it is acknowledged by the Appellant that the driving pinion gear illustrated in D1 (D1a) generates a mechanical torque directed towards starboard, the propeller being left-handed. The question which remains to be answered is whether or not the pulling azimuth thruster (or pod) shown in the figure of D1a produces a maximum hydrodynamic torque directed towards port. In this respect the Respondent contends that the similarities between the pods of EP-B (figures 1, 2, 3a, 3b, 6) and of D1a are striking and evident (both also having a left-handed propeller) and thus, the physical configuration and geometry being substantially the same, the two pods will in use both give rise to a maximum hydrodynamic torque directed towards port (see EP-B, paragraph [0028]).

3. The Board concurs with the Respondent's view and notes, in the first place, that in EP-B only the pod configuration of figures 1, 2, 3a, 3b, 6 is discussed, having a maximum hydrodynamic torque directed towards port and not towards starboard. In effect, the aspects of figure 5 of EP-B relating to curve 80 and to the direction of maximum hydrodynamic torque, as discussed by the Appellant during oral proceedings, are not discussed at all in the description of EP-B. Moreover, curve 80 relates to a pod without a fin, thus having a very different configuration from that of the case in point, and even so the effect mentioned by the Appellant (i.e. maximum hydrodynamic torque directed towards starboard) is minor and clearly visible only for azimuth angles in the vicinity of 30° and above. Likewise, contrary to the Appellant's view, the disclosure of EP-B (in particular paragraph [0017]) does not include any hint that a variation of the pod configuration illustrated in figures 1, 2, 3a, 3b may lead to a maximum hydrodynamic torque directed towards

starboard. On the contrary, the discussion in paragraphs [0018] to [0021] of EP-B explains in detail which physical effects lead, on the bases of the pod of figures 1, 2, 3a, 3b to a maximum hydrodynamic torque directed towards port, as stated in paragraph [0028]. The physical effects are due to the inherent asymmetry of the (left-handed propeller) whose rotation produces a slipstream generating essentially two kinds of hydrodynamic moments. One of these, directed towards port, arises from the slipstream impinging on the pod housing (see figures 2, 3, 3a, 3b, arrows 20, 24; 42, 44; 53, 56), the other, directed towards starboard, arises when the pod is steered towards starboard (figure 3b) since the blades on the left side of the propeller then have a greater angle of attack (higher lift) with respect to the incoming fluid flow than those on the right side (seen from astern). These two opposed hydrodynamic effects on the starboard side result in hydrodynamic torque increasing with increasing azimuth angle in starboard direction (larger negative deflections), as said angle of attack of the propeller blades on the left hand side increases. This explains why, at higher negative azimuth angles (turn towards starboard) said second physical effect (due to asymmetric propeller load, as is well known to the skilled person from propeller theory and fluid dynamics) is larger than said first effect and eventually tends to produce a maximum hydrodynamic torque directed towards starboard. Similarly, this may occur at high advance number Ja, since this analogously further increases asymmetric propeller load. This reversal in the direction of maximum hydrodynamic torque, arises only at high azimuth angles or high advance numbers Ja (see point IV, results obtained by the Appellant in Appendix B), and in particular for pods having no fin (see figure 5, curve 80; figure 4, curves 64, 74). The hydrodynamic torque induced by the fin reduces hydrodynamic torque in both directions (port and starboard) in an upper-value region of the azimuth angle and of the advance number Ja (see EP-B; figure 4, 5; paragraph [0023]). Nonetheless this does not essentially alter the mentioned qualitative behaviour of the maximum hydrodynamic torque as determined by the aforesaid two physical effects occurring for both the claimed propulsion unit and that of D1 (D1a).

Consequently, it is physically at least qualitatively understood and corroborated by all the data submitted by the Appellant (derived from experimental and computational tests and presented in EP-B or Appendix B) that (at least for pods having a fin to which the bulk of data refers) there exists a widely and significantly extended region of values of the azimuth angle and of the advance number Ja (two dimensional region including the origin) where the two aforesaid physical effects produce a maximum hydrodynamic torque directed towards port. It is emphasized that this holds true also for the data presented by the Appellant in Appendix B (see in particular figure 5 and table I), which exhibit a maximum hydrodynamic torque directed towards starboard only at high values of the azimuth angle and of the advance number Ja (respectively 35° and 1.1 or 0.9).
Thus, the qualitative behaviour of maximum hydrodynamic torque as produced by said above two physical effects will be substantially the same (i.e. the magnitude of their opposed torques will not vary considerably) if the configuration, geometry and dimensions of the pod are affected solely by minor changes. It is concluded (as amply demonstrated by the available data) that for a specific pod having a physically meaningful

configuration such as shown in EP-B (figures 2, 3a, 3b, 6) or equivalently in document D1 (D1a) (comprising a fin (contributing to course stability and the reduction of yaw) and exhibiting a geometrical disposition of driving pinion gear, driven wheel and fin element as claimed), there exists a region of said parameters where said feature (i) is fulfilled. In particular, the driving pinion gear produces a torque in starboard direction (see point 2) and thus "acts against a maximum hydrodynamic torque generated by a rotation of the propeller (2) and a rotation of the unit by the steering means".

4. In view of the above conclusions the subject-matter of claim 1 is not new over D1 (D1a). In effect, claim 1 does not mention or define any range of physical parameters, let alone the parameters themselves, where said feature (i) for the maximum hydrodynamic torque has to be fulfilled. Whether said maximum torque should be determined in an hypothetical operating range (as certified by the manufacturer or as adopted in use on the vessel) whose definition is anyway omitted is likewise not stated in the claim or in the patent specification (EP-B). Moreover, no specific indication of parameters in terms of which an operating range could possibly be defined is contained in EP-B. Under these circumstances it ensues that the subject-matter of claim 1 lacks novelty over D1 (D1a), taking into account said parameter range discussed above (see point 3) fulfilling feature (i) and the remaining features known from D1 (D1a) (see preamble of claim 1) (Article 54 EPC).

5. It follows from the above discussion that the Appellant's argument that according to the present invention "it was discovered that the hydrodynamic

forces produced a hydrodynamic torque which displayed a port-starboard asymmetry" could not be followed by the Board. Regardless of whether or not said asymmetry was first realized by the present invention, the mentioned physical effect was already inherently present in the known azimuth thruster of D1 (D1a), as clearly demonstrated above. Hence, the known azimuth thruster, having the same technical features (and essentially the same configuration) and producing the same technical effect as the azimuth thruster of claim 1, deprives the claimed subject-matter of novelty (see above). The Board agrees with the further arguments that there there is no unambiguous relation between the rotational direction of the propeller and the direction of maximum hydrodynamic torque, given that the configuration and geometry of the propulsion unit (or pod) also clearly play a role. However, the subject-matter of claim 1 is not limited, as demonstrated above, exclusively to such specific configurations and geometries of the pod producing a maximum hydrodynamic torque pointing in a direction different from that disclosed in prior art D1 (D1a). Moreover, as shown by the data submitted by the Appellant (see EP-B or Appendix B), these specific configurations produce a direction of maximum hydrodynamic torque differing from the known direction only at specific values of some relevant parameters, which again are not indicated in the claim.
The Board notes that the above discussion and conclusions are restricted to the case of a pod having a fin element, given that the case of a pod without a fin is immaterial and irrelevant to claim 1.

6. The subject-matter of claim 1 of the first auxiliary request lacks novelty over D1 (D1a). Indeed, the physical effects induced by the "slipstream", as already discussed above (see point 3), are also

inherent to the known propulsion unit, such that the amendment including said "slipstream" cannot confer novelty on the claimed subject-matter.

7. The subject-matter of claim 1 of the second and third auxiliary requests is not new over D1 (D1a), for this document explicitly states that the Azipull thruster (i.e. the propulsion unit disclosed in D1 (D1a) "is a mechanical azimuth thruster equipped with a pulling propeller which may be either controllable pitch or fixed pitch depending on the choices made in the rest of the propulsion system" D1 (D1a) (page 36. left column). Further, it is stated that "one of the thruster's attractions is its mechanical design with bevel gear transmission. This means that it is not restricted to diesel electric or gas turbine electric systems, but can also use straightforward mechanical drive from the prime mover" (D1 (D1a), page 37, central column). Finally, it is indicated that (when using a diesel electric or gas turbine electric propulsion) "the choice is between using a constant speed propulsion motor with a CP propeller to give speed control, or a fixed pitch propeller and variable rev/ min motor" (D1 (D1a), page 37 , right column). These passages altogether demonstrate that the Azipull thruster described in text passages of D1 (D1a) has only one embodiment having a mechanical design as shown in figure D1a (or on page 38 of D1) ("mechanical design having a bevel gear") and this same embodiment allows the use of a controllable pitch or fixed pitch propeller in conjunction with a gas turbine or diesel turbine electric motor. Therefore, obviously the same Azipull's mechanical design (having the features mentioned in the preamble of claim 1) is employed for both the controllable pitch and the fixed pitch propeller, thus depriving the subject-matter of claim 1

of the second and third auxiliary requests of novelty.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Vottner G. Pricolo

Decision electronically authenticated