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PATENT SPECIFICATION (11) 1 579 155

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(21) Application No. 24882/77 (22) Filed 14 Jun. 1977 (19)
(31) Convention Application No. 7623269 (32) Filed 29 Jul. 1976 in
(33) France (FR)
(44) Complete Specification Published 12 Nov. 1980.
(51) INT. CL. [3] B63H 1/30
(52) Index at Acceptance
B7V BX

(54) IMPROVEMENTS IN OR RELATING TO AN IMPROVED DEVICE FOR PROPELLING SHIPS

(71) We, SOCIETE D'ETUDE ET DE GESTION DES BREVETS de LA ROCHE KERANDRAON ET de SAULCES de FREYCINET "S.E.G.", a Body Corporate organized under the laws of France, of 68 Boulevard Malesherbes - 75008 PARIS, France do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

The present invention relates generally to the propulsion of ships or other water craft and has more particularly for its object an improved propelling device of the type comprising an open-ended casing or housing which in use is mounted in a submerged position and within which is provided a propulsion element in the form of a surface, plate or blade which is reciprocated to-and-fro while at the same time being allowed to oscillate pivotally.

Such propelling devices are known already, e.g. in UK patent No. 1 089 033 which discloses a propelling device of this type.

More specifically, there is described in this earlier patent a propelling device comprising a propulsion element accommodated in a casing or housing which in use is submerged in a fluid, the said casing or housing comprising an inlet port and an outlet port for the said fluid, as well as opposite longitudinally extending walls between which the said element is subjected to a to-and-fro movement while at the same time freely oscillating in the fluid owing to a driving shaft being pivotally connected to the said element.

It is found that such a propelling device is far from providing the performance and advantages that were expected because of the following reasons.

The propulsion element actuated in a reciprocating movement in the fluid is liable to knock against the upper and inner walls of the casing. Consequently one cannot obtain a smooth operation of the propulsion element within the casing especially at high frequency. As a result the known propelling device of the prior art is particularly noisy.

There are also some drawbacks arising especially at large angles of incidence of the element. Thus, when the element flattens out again after moving to an end pivotal position there may occur an effect that forces the fluid forward, i.e. in the direction opposite to the direction of advance of the craft, which of course adversely affects the performance.

According to the present invention, there is provided propelling device for ships or other vessels or water craft and comprising at least one propulsion element accommodated between a forward inlet end and a rearward outlet end of an open-ended casing, at least one actuating member being pivotally connected to said propulsion element to reciprocate it between opposite walls of the casing while allowing it to oscillate pivotally, said element comprising a main hydrodynamically-shaped blade and at least the smaller hydrodynamically-shaped blade connected to the main blade mounted forwardly of a forward or leading edge of the main blade to leave a space between said smaller blade and said leading edge.

In a device according to the invention, said main blade may constitute two thirds of the total length of the element and the said space together with said at least one smaller leading blade constitutes the remaining third of the said total length, whereas said actuating member has a pivot connection with the main blade substantially at that end of the main blade adjacent to said space.

The provision of a free space between the main and smaller blades allows passage of

the fluid during oscillation of the propulsion element, and this minimises the generation of shock forces between the element and said opposite walls.

In alternative forms of the invention, said at least one smaller leading blade may be mounted fixedly or pivotally in relation to the main blade.

In one arrangement, the main blade is rigidly connected to two superposed smaller leading blades braced or tied by rods, bars or the like.

In a device according to the invention, a parallel linkage may be associated with said actuating member for guiding said at least one smaller blade so as to maintain it in substantially the same orientation with respect to said opposite walls of the casing whatever the inclination of the main blade.

According to a preferred feature of the invention, at least those portions of said opposite walls of the casing extending forwards of the main blade have inwardly concave surfaces that extend generally outwardly away from a central longitudinal plane of the casing between said walls, the profiles of said surfaces substantially matching the hydrodynamic shape or profile of said smaller blade.

If said opposite walls of the casing constitute upper and lower walls, at least said lower wall of the casing may be provided with a proximity detector arranged in the region of the said leading blade.

According to another preferred feature of the invention, the or each smaller leading blade may have a profile generally in the shape of an isosceles triangle with a rounded base, which base is located in the inlet end of the casing.

The invention will now be described by way of example with reference to the appended drawings, wherein:-

Figure 1 is a diagrammatic cross-sectional view of a propelling device according to one embodiment of the invention;

Figure 2 is a top view of the oscillating propulsion element in the device of Figure 1;

Figure 3 is a diagrammatic elevational view of the oscillating propulsion element shown in Figure 2, equipped with actuating means in the form of a parallel linkage;

Figure 4 is an elevational view identical with that of Figure 3 but showing the propulsion element at a certain angle of incidence within the casing;

Figure 5 is a diagrammatic cross-sectional view of an alternative propelling device according to the invention comprising two propulsion elements, each of the form shown in Figure 2;

Figure 6 is a diagrammatic elevational view of another form of propulsion element for a device according to the invention; and

Figure 7 is a diagrammatic cross-sectional view of the propulsion element of Figure 6 mounted within a casing or housing of appropriate form.

The propulsion element represented in Figure 1 comprises a hydrodynamically shaped surface 1 which undergoes a reciprocating motion within a casing or housing 2. The casing 2 is of rectangular parallelepiped shape and, comprises an upper wall 3, a lower wall 4 and two side walls 5. The casing 2 is open at both ends 6 and 7 so as to provide an inlet and an outlet respectively. The element 1 is connected by a pivot joint 9 to the end of an actuating shaft or rod 10 which undergoes a vertical reciprocatng motion as shown by the double arrow F. The shaft 10 is for example slidingly mounted in a bearing 11 located in a sleeve 12 secured, e.g. welded, on the upper wall 3 of the casing or housing 2. The reciprocating movement of the shaft 10 may be caused by an appropriate device (not shown) such as for example an eccentric rotary device driven by a motor as is described in UK patent No. 1 089 033. Of course the reciprocating movement imparted to the shaft 10 can be obtained in a great number of other known ways.

The arrangement as described so far forms part of the prior art and needs no detailed description.

The element 1 as appears clearly from the drawings is constituted by a main blade 13 actuated by the shaft 10, the said main blade 13 being rigidly connected by rods, side straps or the like 14 to a smaller leading blade 15, the main blade thus being nearer to outlet 7 and the leading blade being nearer the inlet 6.

As appears clearly from Figure 2, a free space 16 is left between the forward or leading edge of the main blade 13 and the smaller leading blade 15. Preferably the length AB of the main blade 13 represents two thirds of the total length BC of the element 1, the free space 16 together with the leading blade 15 constituting of course the remaining third of the said length. According to a preferred arrangement the shaft 10 has a pivot connection 9 with the main blade at that end of the main blade 13 which is adjacent to the free space 16, as seen clearly in Figure 2. The whole active area of the main blade is thus located rearwards of the point at which the actuating force is applied to it.

The smaller leading blade 15, according to the form of the invention, may be mounted rigidly to the side straps 14. In another form of the invention, the smaller blade 15 may be pivotably mounted, between the said side straps, which means that, in this case, the blade 15 can rotate freely about the axis of rotation X, X'

indicated in Figure 2.

In a preferred form of the invention, as shown in Figure 3 the smaller blade 15 may be kinematically controlled by a linkage system 10*a* constituting a parallel linkage the sides of which are formed respectively by the side straps or links 14, a portion of the shaft 10, a rod or the like 17 connected by a rotary joint D to the shaft 10 and another rod 18 connected on the one hand at E to the rod 17 and on the other hand to the smaller blade 15. Such a parallel linkage offers the advantage of maintaining the blade 15 in substantially parallel relationship to the lower wall 4 and the upper wall 3 of the casing whatever the inclination of the main blade 13, as appears clearly from Figure 4.

It is possible to couple, preferably in series, two like propulsion elements 1 such as described previously within one and the same casing or housing 2, as appears in Figure 5. In such an arrangement there are advantageously provided, in the region of each small blade 15, proximity detectors 19 mounted on the opposite walls 3 and 4 of the casing 2 between which the element reciprocates. Thus, as seen in Figure 5, when the small blade 15 associated with the left-hand blade 1 is close to the lower wall 4, the detector causes the shaft 10 to stop and simultaneously causes the actuating shaft of the right-hand elements 1 to start. The right-hand element therefore rises within the casing, whereas the left-hand blade assumes a substantially horizontal position, and the left-hand blade may re-start when the leading blade is associated with the right-hand element reaches a point in proximity of a detector such as 19 arranged in the upper wall 3 of the casing 2. Of course the detectors 19 control appropriate logic means ensuring the desired synchronisation of the operation of the two elements within the casing. It will be noted that the device according to Figure 5 can operate in a particularly quiet manner, since the selected distances at which the stopping action of the detectors 19 takes place can be sufficiently great to avoid any noise which would otherwise be caused by the impact of either element 1 on the lower and upper walls.

Another form of propulsion element according to the invention appears in Figures 6 and 7, in which the main blade 13 is rigidly connected to two superposed smaller blades 15*a*, 15*b* braced or tied by bars or the like 20 in spaced relation to each other. At 21 are shown bars or rods connecting the end of the main blade 13 to the smaller blades 15*a*, 15*b* which, in this embodiment are fixed relative to the main blade. As seen in Figure 7, there is provided a casing 2 having a particular shape adapted to the element represented in Figure 6. Indeed, the end portions of the lower and upper walls 4 and 3 towards the inlet end of the casing each have a forwardly divergent portion 22 having an inwardly concave profile that matches the profiles of the smaller blades 15*a*, 15*b*. In this manner each smaller blade 15*a*, or 15*b* is always tangential to the internal surface of the walls. Moreover, it will be observed that when the blade 1 is in an extreme position as shown in Figure 7, the smaller blade adjacent the wall surface follows closely the incoming water flow direction (indicated by arrow A) and therefore offers little resistance or reaction against the flow. As a result, the element 1 represented in Figure 6 can operate at a high frequency without any risk of damage due to impact on the casing walls.

The smaller blades 15 in the various forms of embodiment illustrated have a teardrop shape in cross section, i.e. generally in the shape of an isosceles triangle with a rounded base, which base is directed towards the inlet end 6 of the casing 2.

The invention is able to provide a propelling device, with considerable improvements in performance and quietness of operation. More specifically, such a device can offer the advantage that impacts of the leading edge of the propolsion element on the walls of the casing are reduced to a minimum and even completely avoided. Consequently, there is obtained a very smooth operation of the propulsion element even at a high frequency of reciprocation.

Of course the invention is by no means limited to the forms described and illustrated which have been given by way of example only. Thus, there can be provided on the main blade various means such as fins or the like subjecting the said blade to self-sustained secondary oscillations that add to the primary oscillations imparted by the actuating shaft or rod.

WHAT WE CLAIM IS:-

1. Propelling device for ships or other vessels or water craft and comprising at least one propulsion element accommodated between a forward inlet end and a rearward outlet end of an open-ended casing, at least one actuating member being pivotally connected to said propulsion element to reciprocate it between opposite walls of the casing while allowing it to oscillate pivotally, said element comprising a main hydrodynamically-shaped blade and at least one smaller hydrodynamically-shaped blade connected to the main blade mounted forwardly of a forward or leading edge of the main blade to leave a space between said smaller blade and said leading edge.

2. A device according to claim 1 wherein said main blade constitutes two thirds of the total length of the said element and said space together with said at least one smaller

indicated in Figure 2.

In a preferred form of the invention, as shown in Figure 3 the smaller blade 15 may be kinematically controlled by a linkage system 10*a* constituting a parallel linkage the sides of which are formed respectively by the side straps or links 14, a portion of the shaft 10, a rod or the like 17 connected by a rotary joint D to the shaft 10 and another rod 18 connected on the one hand at E to the rod 17 and on the other hand to the smaller blade 15. Such a parallel linkage offers the advantage of maintaining the blade 15 in substantially parallel relationship to the lower wall 4 and the upper wall 3 of the casing whatever the inclination of the main blade 13, as appears clearly from Figure 4.

It is possible to couple, preferably in series, two like propulsion elements 1 such as described previously within one and the same casing or housing 2, as appears in Figure 5. In such an arrangement there are advantageously provided, in the region of each small blade 15, proximity detectors 19 mounted on the opposite walls 3 and 4 of the casing 2 between which the element reciprocates. Thus, as seen in Figure 5, when the small blade 15 associated with the left-hand blade 1 is close to the lower wall 4, the detector causes the shaft 10 to stop and simultaneously causes the actuating shaft of the right-hand elements 1 to start. The right-hand element therefore rises within the casing, whereas the left-hand blade assumes a substantially horizontal position, and the left-hand blade may re-start when the leading blade is associated with the right-hand element reaches a point in proximity of a detector such as 19 arranged in the upper wall 3 of the casing 2. Of course the detectors 19 control appropriate logic means ensuring the desired synchronisation of the operation of the two elements within the casing. It will be noted that the device according to Figure 5 can operate in a particularly quiet manner, since the selected distances at which the stopping action of the detectors 19 takes place can be sufficiently great to avoid any noise which would otherwise be caused by the impact of either element 1 on the lower and upper walls.

Another form of propulsion element according to the invention appears in Figures 6 and 7, in which the main blade 13 is rigidly connected to two superposed smaller blades 15*a*, 15*b* braced or tied by bars or the like 20 in spaced relation to each other. At 21 are shown bars or rods connecting the end of the main blade 13 to the smaller blades 15*a*, 15*b* which, in this embodiment are fixed relative to the main blade. As seen in Figure 7, there is provided a casing 2 having a particular shape adapted to the element represented in Figure 6. Indeed, the end portions of the lower and upper walls 4 and 3 towards the inlet end of the casing each have a forwardly divergent portion 22 having an inwardly concave profile that matches the profiles of the smaller blades 15*a*, 15*b*. In this manner each smaller blade 15*a*, or 15*b* is always tangential to the internal surface of the walls. Moreover, it will be observed that when the blade 1 is in an extreme position as shown in Figure 7, the smaller blade adjacent the wall surface follows closely the incoming water flow direction (indicated by arrow A) and therefore offers little resistance or reaction against the flow. As a result, the element 1 represented in Figure 6 can operate at a high frequency without any risk of damage due to impact on the casing walls.

The smaller blades 15 in the various forms of embodiment illustrated have a teardrop shape in cross section, i.e. generally in the shape of an isosceles triangle with a rounded base, which base is directed towards the inlet end 6 of the casing 2.

The invention is able to provide a propelling device, with considerable improvements in performance and quietness of operation. More specifically, such a device can offer the advantage that impacts of the leading edge of the propolsion element on the walls of the casing are reduced to a minimum and even completely avoided. Consequently, there is obtained a very smooth operation of the propulsion element even at a high frequency of reciprocation.

Of course the invention is by no means limited to the forms described and illustrated which have been given by way of example only. Thus, there can be provided on the main blade various means such as fins or the like subjecting the said blade to self-sustained secondary oscillations that add to the primary oscillations imparted by the actuating shaft or rod.

WHAT WE CLAIM IS:-

1. Propelling device for ships or other vessels or water craft and comprising at least one propulsion element accommodated between a forward inlet end and a rearward outlet end of an open-ended casing, at least one actuating member being pivotally connected to said propulsion element to reciprocate it between opposite walls of the casing while allowing it to oscillate pivotally, said element comprising a main hydrodynamically-shaped blade and at least one smaller hydrodynamically-shaped blade connected to the main blade mounted forwardly of a forward or leading edge of the main blade to leave a space between said smaller blade and said leading edge.

2. A device according to claim 1 wherein said main blade constitutes two thirds of the total length of the said element and said space together with said at least one smaller

blade constitutes the remaining third of the said total length and said member is pivotally attached to the main blade adjacent its leading edge.

3. A device according to claim 1 or 2 wherein said at least one smaller blade is mounted at a fixed orientation relative to the main blade.

4. A device according to claim 1 or 2, wherein said at least one smaller blade is pivotally mounted relative to the said main blade.

5. A device according to one of claims 1, 2 or 4, wherein said actuating member is associated with a parallel linkage for guiding said at least one smaller blade so as to maintain it in substantially the same orientation relative to said casing independently of the inclination of the main blade.

6. A device according to one of claims 1 to 3, wherein in that said main blade is connected to two superposed smaller blades braced or tied together.

7. A device according to any one of claims 1, 2, 3 or 6, wherein in a region forwards of said main blade said opposite walls of the casing having inwardly concave surfaces that extend generally outwardly away from a central longitudinal plane of the casing between said walls, the profiles of said surfaces matching the hydrodynamic shape or profile of said smaller blade.

8. A device according to any one of the preceding claims, wherein said opposite walls constitute upper and lower walls of the casing and at least said lower wall is provided with a proximity detector arranged in the region of the said smaller blade.

9. A device according to any one of the preceding claims having a plurality of said propulsion elements disposed in tandem in the casing.

10. A device according to claim 9 wherein successive propulsion elements are arranged to be reciprocated out of phase with each other.

11. A device according to claim 8 together with claim 10 wherein respective proximity detectors co-operate with the individual propulsion elements for co-ordination of the movement of the elements.

12. A device according to any one of the preceding claims wherein the said at least one smaller blade has a profile generally in the shape of an isosceles triangle with a rounded base that is directed towards the inlet end of the casing.

13. a propelling device constructed and arranged for use and operation substantially as described herein with reference to any of the examples in the appended drawings.

14. A ship, vessel or like water craft equipped with a propelling device according to one of the preceding claims.

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Printed for Her Majesty's Stationery Office,
by Croydon Printing Company Limited, Croydon, Surrey, 1980.
Published by The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

