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(54) A WATER JET PROPULSION SYSTEM FOR PROPULSION AND STEERING OF A WATERBORNE CRAFT

(71) We, SCHOTTEL - WERFT, JOSEF BECKER KG., of 5401 Spay/Rhein, Germany, a German Company, 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 invention relates to a water jet propulsion system arranged for the propulsion and steering of a waterborne craft.

It is known that so-called rudder propellers, being propellers which are swivellable about a vertical axis, may be installed for the propulsion and steering of waterborne craft. Cross-thrust systems are also known, being tunnels passing from one side of the vessel to the other, wherein one or more propellers operate, with which it is possible to exert a lateral thrust on the vessel as an aid in manoeuvring. For their operation, these systems require a definite and relatively great depth of water.

The invention is based on the problem of devising a propulsion system for waterborne craft which is appropriate for shallow-draft vessels.

The invention provides a water jet propulsion system arranged for propulsion and steering of a waterborne craft having an inboard motor, the propulsion system comprising a curved elbow-duct accommodated within a recess in the hull of the craft so as not to project beyond the bottom of the craft, the elbow-duct having a substantially horizontally directed outlet end and an inlet end directed downwardly and substantially vertically, the elbow-duct being swivellable around a substantially vertical axis, the downwardly directed part of the elbow-duct containing a propeller or propellers having a substantially vertical axis of rotation and being drivable by the motor in order to draw water upwards into the inlet end of the elbow-duct and to expel the water substantially horizontally from the outlet end. It may be

advantageous for the swivellable curved duct to be situated between two opposed outlet tunnels which are directed towards opposed sides of the waterborne craft, e.g. towards port and starboard. These non-swivellable tunnels last referred to then act as cross jet rudders. On the other hand, the tunnels may point fore and aft in order to serve the purpose of forward and reverse propulsion. A combination of these structural forms comprising, for example, four non-swivellable tunnels, between which the curved duct is swivellably arranged, is especially advantageous. Although the non-swivellable tunnels are directed towards the side or towards the bow or stern, this does not mean that they must open at the side, or stern, in the case of the directions specified, the outlet may also be situated at the bottom of the waterborne craft, for example.

The efficiency of the propulsion system may be improved by incorporating one or more guide vanes within the elbow duct. The efficiency of the propulsion system is also increased if the elbow duct is produced in the form of a nozzle.

For particular waterborne craft, e.g. work boats, it may be advantageous to incorporate several propulsion systems e.g. forward or aft, or, so to speak, at each corner of the craft or else in another structural arrangement corresponding to the purpose of the craft.

It may be advantageous for the propulsion system, e.g. the propeller or propellers, to be reversible.

If for example, the propulsion system is arranged in bell-like recess at the bottom of the ship, the arrangement can advantageously include a device deflecting the water flow impelled by the propeller pump, so that the flow is directed slopingly in a downward direction.

For the purpose of assembly, it is advantageous to provide a structural unit consisting of a housing equipped with openings

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directly radially outwards, within which is installed the swivellable duct.

It is an advantage of the system of the invention that the efficiency is identically satisfactory in any direction of thrust. By comparison with rudder propellers, the invention also has the advantage that underwater transmission gear is unnecessary. By comparison with the cross-thrust systems, the invention also has the advantage that the system can also be used for forward propulsion. A separate actuation system for valves or the like is unnecessary.

Although it is stated above that a flow of water directed substantially vertically is deflected into a substantially horizontal flow, this should be taken as relating to all forms of embodiment wherein the water is drawn in from the bottom of the ship or through the bottom of the ship, and is deflected in some manner to engender a laterally directed thrust.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 diagrammatically shows a longitudinal cross-section through part of a waterborne craft including a propulsion system;

Figure 2 diagrammatically shows a transverse cross-section through the lowest part of a waterborne craft including a propulsion system; and

Figure 3 on enlarged scale, diagrammatically shows the propulsion system without the craft.

The craft part of which is shown in Figure 1, is a ship 1 which is of hollow draft, i.e. the depth from the waterline 2 to the ship's keel 3 is small. The bottom of the hull is raised at the stern to form a recess 4 in which a propulsion system 5 is installed in such manner that it does not project below the bottom of the ship. The hull is so constructed that a flow of water may issue rearwards and/or towards the sides, if appropriate, in a substantially unimpeded manner. The raised part of the ship's bottom merges into the bottom of the ship in such manner that little resistance is opposed to a flow of water directed towards this side, e.g. forward.

The propulsion system consists of an elbow duct 6 wherein a propeller or a propeller pump, e.g. several propellers, is rotatably mounted with its axis vertical. Water is drawn in substantially vertically is deflected into a substantially horizontal direction by the elbow duct 6. The elbow duct containing the propeller or propellers is rotatably mounted on the ship. An engine 8 drives the propeller through a conventional and known power transmission means, e.g. through a clutch situated in the clutch housing 9 and/or a change-speed gear situated in this housing, a universal joint shaft 10, through an

angle drive 12, 13 (Figure 3) installed with known facilities within a fixed transmission case 11, and through a vertical propeller shaft 14. The propeller shaft 14 carries the propeller 7 at its lower extremity.

Figure 2 shows a cross-section through a ship comprising a similar propulsion system. The elbow duct 6 described above is swivellably arranged within the recess 4. Tunnels 15, 16 which optionally release a flow of water 17 received from the elbow duct in lateral direction, thereby securing a steering action, are situated in either side of the hull beside the recess. The tunnels slope downwards a little in outward direction, to deprive the flow of water of a possibly disturbing action.

Figure 3 shows a section through the propulsion system of Figures 1 and 2. The propeller 7 is installed with its axis vertical, in the vertical part of the elbow duct 6, on the propeller shaft 14, which is housed in a bearing sleeve 18 projecting into the elbow duct 6. The elbow duct has fastened to it, e.g. bolted, a neck 19 which is arranged in a rotatable but not longitudinally displaceable manner in a bearing tube 11a joined to the transmission case 11. On the upper part of the neck 19 is fastened a bevel gear 20 in mesh with a pinion 21 which is installed in approximately horizontal bearings in the transmission case 11. The steering drive coming from the helm is coupled to the pinion, for instance in the manner known from rudder propellers. The elbow duct may thus be turned and the thrust aimed in the direction required for the steering of ship, from the helmsman's post.

The propeller shaft 14 traverses the neck 19. On its extremity situated above the bevel gear 20 is secured a bevel gear 13 of the angle drive referred to above. A bevel driving gear 12 which is installed in horizontal bearings in the transmission case, meshes with the bevel gear 13. The propeller 7 is driven in this manner by the engine 8 through the clutch already referred to and/or the change-speed gear, the universal joint shaft, the angle drive consisting of the bevel driving gear 12 and the bevel gear 13, and the propeller shaft 14.

The elbow duct is of flow-promoting form and appropriately constructed as a nozzle, i.e. the intake opening is larger than the discharge opening. Turbulence is prevented or reduced in the area of curvature by means of one or more guide vanes 22. The intake and/or discharge opening is or are formed with a slightly flared shape. All points of view affecting flow dynamics should thus advantageously be taken into account in designing the elbow duct.

Tunnels appropriately corresponding to Figure 2, are incorporated for the purpose of ducting water after the elbow duct. The water

may also be freely ejected however, as illustrated in Figure 1 for forward and reverse propulsion.

5 The elbow duct is unilaterally journaled in the forms of embodiment shown. An ambilateral journalling system or a support complementing the journalling system illustrated, may be appropriate for greater thrust forces. A journalling (or bearing) system may thus
10 be incorporated for the elbow duct, e.g. close to the intake opening.

If greater thrust forces are required for a water-borne craft, it may be equipped with several propulsive elbow ducts, e.g. one or
15 more elbow ducts at the bow and/or at the stern or else one elbow duct for example "at each corner" of the waterborne craft so to speak.

20 Deviating from the example of the embodiment illustrated, the engine and if appropriate the transmission system, may also be arranged axially or parallel with respect to the propeller shaft.

25 An advantageous embodiment may also consist in that a self-contained attachment unit is formed from the elbow duct with the internal and external attachments, the driving systems for the propeller and if appropriate for the swivelling displacement, and a housing
30 (containing tunnels similar to the one of Figure 2) surrounding the elbow duct.

It may also be advantageous for the blades of the propeller or propellers to be made adjustable, forms of embodiment thereof
35 being known, so that a description referring thereto is superfluous. It may also be advantageous in special cases to drive the propeller through a reversing gear.

WHAT WE CLAIM IS:—

40 1. A water jet propulsion system arranged for propulsion and steering of a waterborne craft having an inboard motor, the propulsion system comprising a curved elbow-duct accommodated within a recess in the hull
45 of the craft so as not to project beyond the bottom of the craft, the elbow-duct having a substantially horizontally directed outlet end

and an inlet end directed downwardly and substantially vertically, the elbow-duct being swivellable around a substantially vertical axis, the downwardly directed part of the elbow-duct containing a propeller or propellers having a substantially vertical axis of rotation and being drivable by the motor in order to draw water upwards into the inlet
50 end of the elbow-duct and to expel the water substantially horizontally from the outlet end.

2. A propulsion system as claimed in claim 1, including at least one guide vane within the elbow-duct. 55

3. A propulsion system as claimed in claim 1 or 2, in which the elbow-duct is constructed as a nozzle. 60

4. A propulsion system as claimed in any of claims 1 to 3, in which the elbow-duct is arranged between at least two opposed outlet tunnels which are directed towards opposed sides of the waterborne craft. 65

5. A propulsion system as claimed in claim 4, in which the elbow-duct is arranged at least four outlet tunnels, which are directed towards opposed sides and towards the bow and stern of the waterborne craft. 70

6. A propulsion system as claimed in any of the preceding claims, in which a device deflecting the flow of water expelled by the elbow-duct is slopingly arranged in a downward direction. 75

7. A propulsion system as claimed in any of the preceding claims, in which the elbow-duct is swivellably mounted in a fixed housing equipped with openings directed radially outwards. 80

8. A propulsion system as claimed in any of the preceding claims, in which driving power from the motor is transmitted to the propeller(s) through a transmission system. 85

9. A propulsion system substantially as described herein with reference to the accompanying drawings. 90

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Deviating from the example of the embodiment illustrated, the engine and if appropriate the transmission system, may also be arranged axially or parallel with respect to the propeller shaft.

An advantageous embodiment may also consist in that a self-contained attachment unit is formed from the elbow duct with the internal and external attachments, the driving systems for the propeller and if appropriate for the swivelling displacement, and a housing (containing tunnels similar to the one of Figure 2) surrounding the elbow duct.

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and an inlet end directed downwardly and substantially vertically, the elbow-duct being swivellable around a substantially vertical axis, the downwardly directed part of the elbow-duct containing a propeller or propellers having a substantially vertical axis of rotation and being drivable by the motor in order to draw water upwards into the inlet end of the elbow-duct and to expel the water substantially horizontally from the outlet end.

2. A propulsion system as claimed in claim 1, including at least one guide vane within the elbow-duct.

3. A propulsion system as claimed in claim 1 or 2, in which the elbow-duct is constructed as a nozzle.

4. A propulsion system as claimed in any of claims 1 to 3, in which the elbow-duct is arranged between at least two opposed outlet tunnels which are directed towards opposed sides of the waterborne craft.

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