

SPECIFICATION

Water craft with water jet driving apparatus

- 5 Shallow water craft have a small draught and therefore react in a sensitive way to alterations in weight and displacement, particularly if, for guiding water in the driving apparatus, ducts or tunnels are provided in the hull. There is considerable risk that
- 10 such craft will touch the water bottom; also, these craft should be very manoeuvrable.

- A driving apparatus for water craft of this kind should therefore simultaneously fulfil the following requirements. The driving apparatus should be
- 15 installed in such a way as to afford protection, particularly protection against the vessel touching the water bottom; also the driving apparatus should, on account of the narrow waters which frequently have to be negotiated, be suitable for small
- 20 manoeuvrable vehicles. Accordingly, the driving apparatus must only take up a small space and be relatively lightweight. By reason of the shallow waters which have to be travelled over the drive apparatus must, when the draught is extremely
- 25 small, function with self-suction, and be insensitive, particularly to the influences of sand, stones, ice, and other contaminants, when the water depth and bottom clearance are small. The required good manoeuvrability is best realised with a jet which is
- 30 steplessly directable the whole way round the apparatus.

- Jet driving apparatuses are in existence; however, none fulfils all the above indicated requirements. In particular, they do not satisfy in an optimum way,
- 35 the requirement for a small size, for a small weight, and for good efficiency.

- The present invention provides a water craft having a water jet driving apparatus comprising a flow guide unit mounted in the hull of the craft for
- 40 unlimited rotation of the entire unit about a substantially vertical axis, and a rotary pump in the flow guide unit for sucking water from the bottom of the vessel through a suction opening of the flow guide unit and ejecting this water obliquely,
- 45 downwards from an ejection opening of the flow guide unit, neither of the said openings projecting beneath the bottom of the craft, the pump being eccentric to the axis of rotation of the flow guide unit.

- 50 By the term 'rotary pump' is meant a propeller-pump or radial-pump of axial, semi-axial, or radial construction.

- By 'flow guide unit' is meant any unit which guides a stream of water from one direction into another
- 55 direction, for example including a spiral duct which guides a stream of water flowing axially to the pump into a radial stream of water.

- The efficiency of the jet drive apparatus is increased if the axis of rotation of the pump is
- 60 inclined with respect to the axes of rotation of the flow guide unit, which also affords the advantage that the reaction moment of the pump has a lesser effect on the steering drive.

- With apparatus of heavy and robust construction,
- 65 it may be preferable to drive the pump by a motor

mounted in the hull. However, in the case of forms of construction in which the axis of rotation of the pump is inclined, it may be preferable for the pump to be driven by a motor mounted on the flow guide

70 unit. A particular lightweight, and therefore favourable, form of construction, can be achieved if the flow guide unit has a housing comprising foamed plastics material.

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

Figure 1 is a schematic cross-sectional view through a jet drive apparatus having a pump and a flow guide unit whose axes are parallel;

- 80 *Figure 2* similarly illustrates a jet drive apparatus with a propeller pump having an inclined axis of rotation; and

- Figure 3* similarly illustrates a jet drive apparatus with a centrifugal (radial) pump having an inclined
- 85 axis of rotation.

- Referring first to *Figure 1*, a flow guide unit 2 is mounted for unlimited swivelling motion, about a central vertical axis 3, in the hull 1 of a shallow water craft. The flow guide unit 2 comprises a suction duct
- 90 5 which merges into an ejection duct 6. The ejection duct 6 is shaped as a nozzle. A propeller pump 7 is in the unit 2 where the suction duct 5 merges into the ejection duct, the pump being fixed to the lower end of a propeller shaft 8. The propeller shaft 8 is so
- 95 mounted in the unit 2 that the axis 8' of rotation of the propeller pump 7 is eccentric to and parallel with the axis 3 of rotation of the unit 2. The suction opening 9 of the suction duct 5 is curved in the direction of flow. The ejection duct 6 is obliquely
- 100 downwardly directed, thus applying a driving component to the craft.

- Since the axis 8' is eccentric to the axis 3, only a very small enclosed space is required for the housing 10 of the unit 2, this housing 10 being
- 105 accommodated strictly within the confines of the hull of the craft (thus, the housing 10 does not project downwardly below the bottom 4 or the keel of the craft). The propeller pump 7 lies directly above the suction opening 9. The suction opening may be screened off by a grid or grating (not shown) for the purpose of preventing entry of contaminants. The housing 10 may be completely or partially made of foamed plastics material; in this way a tight seal and a lightweight housing can be achieved. The means
- 110 whereby the housing is mounted is schematically indicated as a bearing 11, but other means could of course be used. A seal 12 is schematically shown and may be combined with a second bearing.

- Pivotal movement of the flow guide unit 2, i.e. of its housing 10, is actuated by a control motor 13,
- 120 which acts on the unit 2 by way of a pinion 14 and a toothed wheel 15. Instead of this gear train it is possible to use a worm gear, or some other suitable gearing system.

- The propeller pump 7 is rotated by means of a drive motor 16, which is mounted in the hull of the vessel. Drive is transmitted from the motor 16 to a bevel gear 20 by way of a clutch 17, a cardan shaft 18, and a bevel gear 19, the gear 20 being fixed on
- 130 the upper end of motion-transmitting shaft 21 which

is rotatably mounted, in the hull of the craft, in alignment with the axis 3. A toothed wheel 22 is arranged on the lower end of the shaft 21 and meshes with a toothed wheel 23 fixed to the upper end of the propeller shaft 8, the diameter of the housing 10 may be kept to a minimum, thanks to the eccentricity of the propeller shaft 8 relative to the axis 3. Also, the weight of the unit 2 is reduced by making the housing 10, completely or partially, of foamed plastics material. The housing 10 may, for example, be realised by foaming out the corresponding space in the hull of the craft.

Figure 2 illustrates an embodiment in which the propeller shaft 30 carrying the propeller pump 33 and the suction duct 31, are inclined in the suction direction. This results in a reduced resistance to suction, particularly if the suction opening is given a hydrodynamically favourable shape. Also, the suction of the propeller pump provides a component in the drive direction. The propeller shaft 30 is coupled to the motion-transmitting shaft 21 by means of a ball joint 32 (or a bevel gear wheel set or a cardan shaft or some other suitable system). Alternatively, the torque may be transmitted by the drive motor 16 driving a hydraulic pump or a generator, an associated hydraulic or electric motor being arranged on the unit 2 so as to drive the propeller shaft 30. In this way there may be realised a very favourable way of distributing the motor and one or more jet driving apparatuses in the craft.

The reaction of the propeller torque on the steering drive is reduced by the obliquity of the propeller shaft 30.

Figure 3 illustrates an embodiment in which the propeller pump is replaced by a centrifugal pump 40, which is so installed, with an inclined pump shaft 41, in the flow guide unit 2, that the centrifugal pump is eccentric to the swivel axis 3 of the unit 2. The drive motor 16 drives the centrifugal pump 40 by way of the above mentioned gearing elements and also by way of a cardan shaft 42 (which in contradistinction to the arrangement illustrated in Figure 3, may be inclined somewhat in the direction of the propeller shaft, so as to uniformly distribute the angle of kink or bend of the cardan shafts or synchronous joints). The suction opening 9 of the suction duct 5 is provided with guide blades 43 for the purpose of facilitating guidance of the incoming water. The water is axially sucked in by the centrifugal pump

and conveyed into a spiral duct 44, which opens out into the ejection duct 6. As in the two embodiments described above, the ejection duct 6 is so inclined that a thrust component for driving the craft forwards is obtained. Also, the suction duct 5 is so inclined, and possibly curved, that the suction imparts a forward-driving component to the craft.

In all the above embodiments, the housing 10 of the flow guide unit 2 is so constructed, and so installed in the craft, that it accurately matches the contour of the hull and is flush with the bottom of the hull. In this way the resistance and the buoyance loss of the vessel are reduced to a minimum.

CLAIMS

1. A water craft having a water jet driving apparatus comprising a flow guide unit mounted in the hull of the craft for unlimited rotation of the entire unit about a substantially vertical axis, and a rotary pump in the flow guide unit for sucking water from the bottom of the vessel through a suction opening of the flow guide unit and ejecting this water obliquely downwards from an ejection opening of the flow guide unit, neither of the said openings projecting beneath the bottom of the craft, the pump being eccentric to the axis of rotation of the flow guide unit.
2. A craft as claimed in claim 1, in which the axis of rotation of the pump is inclined with respect to the axis of rotation of the flow guide unit.
3. A craft as claimed in claim 1 or 2, in which the pump is a propeller pump.
4. A craft as claimed in claim 1 or 2, in which the pump is a centrifugal pump.
5. A craft as claimed in any of claims 1 to 4, in which the pump is driven by a motor mounted in the hull of the craft.
6. A craft as claimed in any of claims 1 to 4, in which the pump is driven by a motor mounted on the flow guide unit.
7. A craft as claimed in any of claims 1 to 6, in which the flow guide unit has a housing comprising foamed plastics material.
8. A water craft having a water jet driving apparatus substantially as described herein with reference to, and as shown in, any of Figures 1 to 3 of the accompanying drawings.

is rotatably mounted, in the hull of the craft, in alignment with the axis 3. A toothed wheel 22 is arranged on the lower end of the shaft 21 and meshes with a toothed wheel 23 fixed to the upper end of the propeller shaft 8, the diameter of the housing 10 may be kept to a minimum, thanks to the eccentricity of the propeller shaft 8 relative to the axis 3. Also, the weight of the unit 2 is reduced by making the housing 10, completely or partially, of foamed plastics material. The housing 10 may, for example, be realised by foaming out the corresponding space in the hull of the craft.

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The reaction of the propeller torque on the steering drive is reduced by the obliquity of the propeller shaft 30.

Figure 3 illustrates an embodiment in which the propeller pump is replaced by a centrifugal pump 40, which is so installed, with an inclined pump shaft 41, in the flow guide unit 2, that the centrifugal pump is eccentric to the swivel axis 3 of the unit 2. The drive motor 16 drives the centrifugal pump 40 by way of the above mentioned gearing elements and also by way of a cardan shaft 42 (which in contradistinction to the arrangement illustrated in Figure 3, may be inclined somewhat in the direction of the propeller shaft, so as to uniformly distribute the angle of kink or bend of the cardan shafts or synchronous joints). The suction opening 9 of the suction duct 5 is provided with guide blades 43 for the purpose of facilitating guidance of the incoming water. The water is axially sucked in by the centrifugal pump

and conveyed into a spiral duct 44, which opens out into the ejection duct 6. As in the two embodiments described above, the ejection duct 6 is so inclined that a thrust component for driving the craft forwards is obtained. Also, the suction duct 5 is so inclined, and possibly curved, that the suction imparts a forward-driving component to the craft.

In all the above embodiments, the housing 10 of the flow guide unit 2 is so constructed, and so installed in the craft, that it accurately matches the contour of the hull and is flush with the bottom of the hull. In this way the resistance and the buoyance loss of the vessel are reduced to a minimum.

CLAIMS

1. A water craft having a water jet driving apparatus comprising a flow guide unit mounted in the hull of the craft for unlimited rotation of the entire unit about a substantially vertical axis, and a rotary pump in the flow guide unit for sucking water from the bottom of the vessel through a suction opening of the flow guide unit and ejecting this water obliquely downwards from an ejection opening of the flow guide unit, neither of the said openings projecting beneath the bottom of the craft, the pump being eccentric to the axis of rotation of the flow guide unit.

2. A craft as claimed in claim 1, in which the axis of rotation of the pump is inclined with respect to the axis of rotation of the flow guide unit.

3. A craft as claimed in claim 1 or 2, in which the pump is a propeller pump.

4. A craft as claimed in claim 1 or 2, in which the pump is a centrifugal pump.

5. A craft as claimed in any of claims 1 to 4, in which the pump is driven by a motor mounted in the hull of the craft.

6. A craft as claimed in any of claims 1 to 4, in which the pump is driven by a motor mounted on the flow guide unit.

7. A craft as claimed in any of claims 1 to 6, in which the flow guide unit has a housing comprising foamed plastics material.

8. A water craft having a water jet driving apparatus substantially as described herein with reference to, and as shown in, any of Figures 1 to 3 of the accompanying drawings.

