

PATENT SPECIFICATION

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(54) TRANSVERSE JET STEERING SYSTEM FOR WATER CRAFT

(71) We, **SCHOTTEL-WERFT, JOSEF BECKER K.G.**, a German company of 5401 Spay/Rhein, Germany, 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:—

This invention relates to a transverse jet steering system, and is a modification or improvement of the system in Patent Specification No. 1 293 738.

The purpose of a transverse jet steering system is to exert a transverse force on the ship by means of a thrust generator (usually a propeller) in a tunnel directed athwartship, in order thereby to increase the manoeuvrability of the water craft. The inventor has observed that, during forward or astern travel and simultaneous transverse thrust, an underpressure area is engendered at one side of the ship and an overpressure area on the other side, behind the transverse tunnel, the pressures being oppositely directed to the transverse thrust, whereby the effectiveness of the transverse jet steering system is reduced.

A way of eliminating the troublesome pressure areas is described in Patent Specification No. 1 293 738: at least one pressure equalisation duct leads from one side of the ship to the other and interconnects the areas of unequal pressure. This arrangement has proved to be the most effective in practice, the purpose being the destruction of the pressure areas. Beyond this, a pressure equalisation duct causes less deflection of the emergent jet and complementary impulsion by means of the existing passive flow, which is equidirectional with the jet of the transverse jet steering system. It is thus possible, for example, to incorporate one or more ducts, which connect the troublesome pressure areas with another area of opposed pressure differential.

The aim is to render the transverse jet

steering system described above more effective, in particular providing the possibility of concentrating the required power in the space available, for example, when draught limitation would imply the risk of air entry if a large diameter were used for the transverse jet steering system. Individual systems of high capacity require the use of high tension, which is not available in many cases, or appears to be inappropriate for various reasons. It may also happen that the use of a high tension is not desirable.

The present invention provides a transverse jet steering system for water craft, comprising a group of at least two associated tunnels directed athwartship and leading from one side of the ship to the opposite side, each tunnel containing a thrust generator, and one or more pressure equalisation ducts associated with the tunnels and leading from one side of the ship to the opposite side, the duct or ducts connecting overpressure and underpressure areas during motion of the water craft, in which the group comprises at least two tunnels arranged one abaft the other, there being at least one pressure equalisation duct between adjacent tunnels.

With a pair of tunnels, the tunnels may be used conjointly or individually to provide transverse thrust in both directions of travel. One tunnel of the pair may be used as a reverse system in case of possible failure of the other tunnels. In this connection, it must be pointed out again that what is of importance is not the form and extent of the equalisation duct(s), but that deleterious pressure areas are largely eliminated.

In a preferred embodiment, having a pair of tunnels one abaft the other, at least one equalisation duct is situated ahead of, between, and abaft the tunnels. The ducts ahead of and abaft the pair having means for shutting off the ends of the ducts by remote control. All the tunnel and duct apertures may evidently be constructed so as to be

closable, e.g. in order to reduce drag during normal forward or astern travel.

A compact form of construction is obtained by bringing the tunnels closer together and off-setting at least one duct from the centre line of the tunnels.

An optimum system from the point of view of the effectiveness and cost may be achieved if the or each duct is between the tunnels. The or each equalisation duct then always has its pressure equalisation effect for the tunnel which is leading in the direction of travel, notwithstanding the direction of travel, whereas the tunnel situated behind it in the direction of travel provides complementary power or may serve as a standby system.

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

Figure 1 diagrammatically shows an elevation of part of a water craft with a transverse jet steering system;

Figure 2 is a cross-section along the line II—II in Figure 1;

Figure 3 is an elevation of another transverse jet steering system; and

Figure 4 is an elevation of a third transverse jet steering system.

The drawings are not intended to indicate any dimensional proportions with respect to the water craft.

A group of two associated tunnels 11, 12 leading athwartship one side 13 to the opposite side 14 is arranged in a water craft 10 (Figures 1 and 2). Thrust generators in the form of drivable propellers 11a, 12a are situated in the respective tunnels 11, 12. The tunnel apertures are preferably rounded off or chamfered so as to merge into the external surface. The tunnels may optionally be closable by shut-off devices (not shown). Behind the tunnels, as seen in the direction of travel, an overpressure area is formed at the jet inflow side and an underpressure area at the jet outflow side, which act against the transverse thrust, as explained above. The locations and the form of the pressure areas depend on the shape of the water craft.

Pressure equalisation ducts 15, 16, 17 are incorporated respectively in front, between, and behind the tunnels, that is to say at the most advantageous points with regard to the pressure areas. Like the tunnels, these ducts lead from one side 13 to the opposite side 14. Several ducts may also be incorporated in each case, instead of one pressure equalisation duct in each case. Their cross-sectional form depends on the form and location of the pressure areas. At least the two outer ducts 15 and 17 are equipped with remotely controllable respective shut-off device 18 and 19, which may also have another appropriate configuration than that illustrated, according to

requirements. The pressure equalisation duct which is behind the tunnels with respect to the direction of travel is opened upon actuation of the transverse jet steering system.

Figure 3 shows a transverse jet steering system wherein the associated thrust generating tunnels 20, 21 of a group or pairs are brought closer to each other. For this reason, the pressure equalisation ducts 22, 23, 24 are upwardly and downwardly offset with respect to the centre line 25 extending through the centres of the tunnels. The pressure equalisation ducts 22, 24 which lie on either side of the pair of tunnels are equipped with respective shut-off devices 26, 27. The pressure equalisation ducts may obviously also be positioned at both sides of the centre line. If the tunnels are not brought extremely close to each other, the middle duct 23 may also be slot-shaped and positioned symmetrically with respect to the centre line.

Figure 4 shows a transverse jet steering system which may be considered as being particularly advantageous, upon assessing its effectiveness and cost. The two associated thrust generating tunnels 28, 29 are situated just far enough apart that a pressure equalisation duct 30, having an optimum action for both directions of travel, may be situated between them. Outer pressure equalisation ducts, which would have to be equipped with shut-off devices, are not provided. The central duct performs the pressure equalisation for the tunnel which is situated in the leading position in the direction of travel, whereas the tunnel situated in the trailing position in each case, operates without pressure equalisation. This form of construction is not as effective from the point of view of pressure equalisation as, for example, that according to Figure 1, but if cost and space requirements are taken into account, the form of construction according to Figure 4 is very advantageous.

WHAT WE CLAIM IS:—

1. A transverse jet steering system for water craft, comprising a group of at least two associated tunnels directed athwartship and leading from one side of the ship to the opposite side, each tunnel containing a thrust generator, and one or more pressure equalisation ducts associated with the tunnels and leading from one side of the ship to the opposite side, the duct or ducts connecting overpressure and underpressure areas during motion of the water craft, in which the group comprises at least two tunnels arranged one abaft the other, there being at least one pressure equalisation duct between adjacent tunnels.

2. A system as claimed in claim 1, in which there is at least one pressure



closable, e.g. in order to reduce drag during normal forward or astern travel.

A compact form of construction is obtained by bringing the tunnels closer together and off-setting at least one duct from the centre line of the tunnels.

An optimum system from the point of view of the effectiveness and cost may be achieved if the or each duct is between the tunnels. The or each equalisation duct then always has its pressure equalisation effect for the tunnel which is leading in the direction of travel, notwithstanding the direction of travel, whereas the tunnel situated behind it in the direction of travel provides complementary power or may serve as a standby system.

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

Figure 1 diagrammatically shows an elevation of part of a water craft with a transverse jet steering system;

Figure 2 is a cross-section along the line II—II in Figure 1;

Figure 3 is an elevation of another transverse jet steering system; and

Figure 4 is an elevation of a third transverse jet steering system.

The drawings are not intended to indicate any dimensional proportions with respect to the water craft.

A group of two associated tunnels 11, 12 leading athwartship one side 13 to the opposite side 14 is arranged in a water craft 10 (Figures 1 and 2). Thrust generators in the form of drivable propellers 11a, 12a are situated in the respective tunnels 11, 12. The tunnel apertures are preferably rounded off or chamfered so as to merge into the external surface. The tunnels may optionally be closable by shut-off devices (not shown). Behind the tunnels, as seen in the direction of travel, an overpressure area is formed at the jet inflow side and an underpressure are at the jet outflow side, which act against the transverse thrust, as explained above. The locations and the form of the pressure areas depend on the shape of the water craft.

Pressure equalisation ducts 15, 16, 17 are incorporated respectively in front, between, and behind the tunnels, that is to say at the most advantageous points with regard to the pressure areas. Like the tunnels, these ducts lead from one side 13 to the opposite side 14. Several ducts may also be incorporated in each case, instead of one pressure equalisation duct in each case. Their cross-sectional form depends on the form and location of the pressure areas. At least the two outer ducts 15 and 17 are equipped with remotely controllable respective shut-off device 18 and 19, which may also have another appropriate configuration than that illustrated, according to

requirements. The pressure equalisation duct which is behind the tunnels with respect to the direction of travel is opened upon actuation of the transverse jet steering system.

Figure 3 shows a transverse jet steering system wherein the associated thrust generating tunnels 20, 21 of a group or pairs are brought closer to each other. For this reason, the pressure equalisation ducts 22, 23, 24 are upwardly and downwardly offset with respect to the centre line 25 extending through the centres of the tunnels. The pressure equalisation ducts 22, 24 which lie on either side of the pair of tunnels are equipped with respective shut-off devices 26, 27. The pressure equalisation ducts may obviously also be positioned at both sides of the centre line. If the tunnels are not brought extremely close to each other, the middle duct 23 may also be slot-shaped and positioned symmetrically with respect to the centre line.

Figure 4 shows a transverse jet steering system which may be considered as being particularly advantageous, upon assessing its effectiveness and cost. The two associated thrust generating tunnels 28, 29 are situated just far enough apart that a pressure equalisation duct 30, having an optimum action for both directions of travel, may be situated between them. Outer pressure equalisation ducts, which would have to be equipped with shut-off devices, are not provided. The central duct performs the pressure equalisation for the tunnel which is situated in the leading position in the direction of travel, whereas the tunnel situated in the trailing position in each case, operates without pressure equalisation. This form of construction is not as effective from the point of view of pressure equalisation as, for example, that according to Figure 1, but if cost and space requirements are taken into account, the form of construction according to Figure 4 is very advantageous.

WHAT WE CLAIM IS:—

1. A transverse jet steering system for water craft, comprising a group of at least two associated tunnels directed athwartship and leading from one side of the ship to the opposite side, each tunnel containing a thrust generator, and one or more pressure equalisation ducts associated with the tunnels and leading from one side of the ship to the opposite side, the duct or ducts connecting overpressure and underpressure areas during motion of the water craft, in which the group comprises at least two tunnels arranged one abaft the other, there being at least one pressure equalisation duct between adjacent tunnels.

2. A system as claimed in claim 1, in which there is at least one pressure

equalisation duct ahead of and abaft the group.

3. A system as claimed in claim 2, in which the ducts ahead of and abaft the group have means for shutting off the apertures at the ends of the ducts.

4. A system as claimed in any of claims 1 to 3, in which at least one pressure

equalisation duct is situated off a centre line extending through the centre of the tunnels. 10

5. A transverse jet steering system for a water craft, substantially as described herein with reference to and as shown in Figures 1 and 2, Figure 3, or Figure 4 of the accompanying drawings. 15

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