

Rudder for ships

This invention relates to a rudder for ships comprising a rudder blade which shows a leading edge and a trailing edge, whereby the rudder blade has two superimposed rudder blade sections, the leading edge sections and/or the trailing edge sections of which are offset in such a manner that the one leading edge section and/or the one trailing edge section is offset port or starboard and the other leading edge section and/or trailing edge section starboard or port and that the one leading edge and/or trailing edge section has a port-sided offset surface which projects over the other leading edge section and/or the other trailing edge section and the other leading edge section and/or trailing edge section has a starboard-sided offset surface which protrudes over the one leading edge section and/or trailing edge section.

Such rudders are known by the prior art and are often designated as twisted rudders. Generally, for such rudders, the rudder blade is divided into an upper and a lower half or an upper and a lower rudder blade section along a section plane which is orientated normally substantially horizontally for a mounted rudder. For a few embodiments, for example for twisted rudders with horn, the separating line between the two rudder blade sections can also be configured in a profile view non linearly, for example graded. Both rudder sections are placed adjacent to each other and can be fixedly connected with each other. Each rudder blade section comprises a leading edge section and an trailing edge section. The front leading edge areas (or sections) of both rudder sections are offset to

each other or are placed twisted to each other, whereas both side wall surfaces of the respective rudder blade sections converge into a single continuous trailing edge section. The offset or the twisting of the rudder blade appears for these embodiments only in the front area which is turned to the propeller. Moreover, multiple twisted rudders are known as well for which the leading edge is divided into three sections or more, whereby a section is placed respectively offset to its adjacent sections. Furthermore, there are also known embodiments for which the trailing edge sections of the single rudder blade sections turned to the propeller are placed offset to each other. On the other side, the opposed leading edge sections turned to the propeller merge for this embodiment into a continuous single strip. Furthermore, embodiments are also possible for which the rudder blade sections of the leading edge as well as of the trailing edge are offset to each other, whereby for this embodiment typically the nose and trailing edge of a rudder blade section are offset to different sides, i.e. the one strip to the port side and the other side to the starboard side.

When mounted in a ship, the rudder blade is assigned to a propeller placed on a drivable propeller axis and connected with the hull of the ship, whereby the rudder blade is placed behind the propeller in the direction of motion of the ship and the rudder blade is placed in such a manner that the (front) nose edge is turned to the propeller and that the (rear) strip is turned away from the propeller. Moreover, the rudder comprises normally additionally to the rudder blade a rudder port for the rudder post and a rudder post.

The indication that the rudder blade sections are placed superimposed refers to the mounted state of the rudder blade in which usually a section is placed above the other. Generally speaking, both rudder blade sections are thus placed adjacent to each other. Due to the offset arrangement of the leading edges to each other, an offset surface which protrudes or projects normally laterally respectively beyond the other leading edge is created on each leading edge in the area in which both leading edges are adjacent to each other. Thus, there is a (90°) edge in the transition area between the two leading edges on each side which runs into one of the offset surfaces. A further (90°) edge is created on the inner side of the offset surfaces.

Figures 7 and 8 show examples of twisted rudders known from the prior art with leading edges (sections) offset to each other. The rudder blade 100 has respectively two superimposed rudder blade sections 10, 30, whereby the leading edge sections 11, 21 are offset in such a manner that the one leading edge (or leading edge section) 11 is offset to the port side BB and the other leading edge (or leading edge section) 21 to the starboard side SB. Both side wall surfaces 100a, 100b of the rudder blade 100 or of both rudder blade sections 10, 20 merge into a single continuous trailing edge 30. Since both leading edges 11, 21 are to be placed offset to each other for the twisted rudder, one leading edge has always to be respectively offset to the port side and the other to the starboard side. Due to the offset arrangement, there results respectively an offset surface 18 in the area of the transition between the leading edges 11, 21 on each rudder blade side. The offset surface 18 represented in fig. 8 is formed by the part of the lower side of

the upper leading edge 11 which projects over the lower leading edge 21. The offset surface existing on the opposite side (which is not depicted here) is formed correspondingly by the part of the upper side of the lower leading edge 21 which projects over the upper leading edge 11.

Fig. 9 shows a further example of a twisted rudder known from the prior art for which both rudder blade sections 10, 20 of the rudder blade 100 are offset to each other in the area of their trailing edge sections 30a, 30b. On the other hand, the leading edge 11 turned to the propeller in mounted state is configured continuous. Due to the offset arrangement, there results for this embodiment an offset surface 18 on each rudder side, whereby the offset surfaces 18 are configured between the transitions of the trailing edges (trailing edge sections 30a, 30b). The offset surface 18 depicted in fig. 9 is formed by the part of the upper side of the lower trailing edge 30b which projects laterally over the upper trailing edge 30a.

The advantage of such twisted rudders with two mirror-inverted cross section profiles consists on the one hand in avoiding the vapour bubble formation and on the other hand in avoiding erosion phenomena on the rudder which appear due to cavitation formation for high-speed ships with high loaded propellers. Moreover, the special configuration of the rudder blade contributes to a reduction of the fuel consumption. Besides a considerable protection against cavitation, there is thus also an improvement of the degree of efficiency. Furthermore, a considerable saving of weight is achieved. In particular, these improvements can be produced in that, due to

the offset arrangement of the leading edges of both rudder blade sections, an adaptation to the twist in the propeller jet takes place.

For such rudders, because of the offset arrangement of the front leading edges or of the rear trailing edges and the thus caused angular transitions between the strips of the single rudder blade sections, it can come to a swirl of the current so that a.o. the risk of cavitation is increased. Moreover, in spite of the orientation of the single front leading edges or the rear trailing edges with respect to the twist of the propeller jet, in particular in the transition area between the strips, it can come to a separation of flow.

Furthermore, it is known from the state of the art to provide Costa bulbs on rudders. Costa bulbs are relatively big bulb or Zeppelin shaped bodies which are provided on rudder blades. Costa bulbs are fundamentally known and are sometimes also designated as propulsion bulbs. They are provided in prolongation of the propeller (shaft) axis in the area of the rudder blade and clearly protrude from the rudder blade in direction of the propeller and beyond the rudder blade.

In particular, Costa bulbs project so far from the rudder blade that they (nearly) come to rest on the hub of the propeller. The distance between the Costa bulb and the propeller or the propeller hub should generally be the lowest possible so that as much of the water flow as possible produced by the propeller flows on the outside along the Costa bulb and not between the Costa bulb and the propeller hub.

Due to this prolongation of the whole profile of the hub, it is achieved that only a light swirl of the water flowing off develops. This being, it is however disadvantageous that the Costa bulb exerts a strong influence onto the propulsion behaviour of the ship. If it is provided on an existing rudder, the propulsion behaviour is influenced negatively and must be specially adapted to the propulsion behaviour of the ship which causes complicated and expensive tests and trials. If such an adaptation does not take place, due to the provision of the Costa bulb, the fuel consumption of the ship is considerably increased.

Thus, the object of this very invention is to indicate a rudder for ships for which erosion phenomena on the rudder due to cavitation formation, in particular for the use of high-speed ships with high loaded propellers are avoided and with which the fuel consumption is reduced or is held low.

This object is achieved with a rudder according to the characteristics of claim 1.

Accordingly, for a rudder designated at the beginning, a flow body or a moulded body is provided in the area of each offset surface or of the transition area between the two front leading edges and/or trailing edges. Moreover, the flow body is configured on the one hand in such a manner that it is limited with respect to its dimensions or to its physical extent to the area of the offset surfaces or of the transition area between the two leading edges and/or trailing edges. In other words, the flow

body is dimensioned such that it does exist only locally in the area of the offset surfaces and does not or only to a small extent penetrate in other areas of the rudder or projects over the rudder. Thus, the flow body is adapted with respect to its size or shape to the offset surface or to the transition area of the two leading edges and/or trailing edges. In other words, it is configured exactly fitting. In particular, the flow body does not project, such as for example a Costa bulb, to a big extent over the rudder blade. Thus, the rudder according to the invention is formed or produced by excluding a Costa bulb or propulsion bulb. It is thus not a propulsion rudder (rudder with Costa bulb). Thus, in particular the flow body or moulded body must not be on the propeller spindle axis as it is obligatorily necessary for the Costa bulb. In the contrary, the flow body or moulded body can be placed offset with respect to the propeller shaft axis, in particular offset upwards or downwards (the rudder being mounted) without any problem.

The flow body, contrary to the Costa bulb, can also be placed spaced to the propeller hub since it does not, or not substantially, project over the leading edge.

Furthermore, the flow body is configured in such a manner that it substantially covers the offset surfaces or the transition area between the two front leading edges and/or trailing edges. The flow body is thus disposed in the area of the offset surfaces on the rudder blade and covers these surfaces so that the water flows along the flow body instead of on the offset surfaces. The risk of a flow swirl is thus reduced. The flow body or moulded body or the walls of the moulded body thus form a lateral

bridging over or covering of the transition area between the upper and the lower rudder blade section. The term "covering" is to be understood here in such a way that the flow body covers the offset surfaces at least to a substantial extent.

It is advantageous for such a rudder that, due to a flow body which is configured only locally in the area of the offset surfaces and which covers the offset surfaces, the risk of a flow breakaway can be reduced, whereby the flow body simultaneously does not influence the propulsion behaviour of the ship, this being due to the relatively small dimensions thereof. Thus, a "propulsion neutral effect" takes place. Moreover, the flow bodies can be placed without any problem on already existing rudders without complicated tests having to be carried out and without high costs. Thus, this invention is convenient for new constructions as well as for existing rudders for the later equipment thereof. Moreover, the probability of an occurring of swirls or turbulences is reduced in the transition area.

Basically, the flow body can be produced from any material known by the prior art that is suitable for this purpose. Appropriately, the flow body is made of wrought iron.

This very invention can also be used for multiple twisted rudders, whereby then at least one flow body is respectively to be provided in each transition area between the single sections of the front leading edge and/or the rear trailing edge.

Preferred embodiments of the invention are characterized in the subclaims.

Preferably, the shape of the flow body is configured in such a manner that the flow body closes the rudder profile fluidically in the area of the offset surfaces. In other words, the flow body forms a transition which guides the flow from one leading edge or trailing edge to the other. Thus, the flow body offers a flow guiding surface for a flowing of the flow without breakaway from the one leading edge or trailing edge to the other.

The flow body set on the rudder in the area of the offset surfaces forms a transition for the flow between the two front leading edges or trailing edges which are offset with respect to each other. In particular, it is preferred that the transition is configured edgeless or continuous. In this context, under the term "edgeless" it is understood that the transition does not have any projecting strong marked edges as it is the case for a normal twisted rudder without flow body in the area of the offset surfaces. On the border of the offset surfaces of normal twisted rudders, there are respectively (90°) edges. A substantially edgeless transition can be achieved for example by a rounded-off configured flow body or by a rounded-off transition between the rudder blade sections. The flow body could also be configured as a substantially oblique guiding surface which runs from the outer edge of an offset surface to the other leading edge or to the rear trailing edge so that the edge areas between the rudder blade and the flow body are less strongly marked. The probability of the occurrence of swirls is thus further reduced.

According to a further preferred embodiment of the invention, the flow body ends substantially at flush level with at least one of the front leading edges or rear trailing edges. The closed configuration of the rudder profile is thus further improved and it is ensured that the flow body does not influence negatively the propulsion system or the propulsion behaviour of the ship. "Substantially at flush level" means in this context for example that the flow body encompasses the front strip or the trailing edge on its side turned to the propeller, however, it only slightly projects over the edges or not at all.

It is also preferred that the flow body projects over the leading edge or the trailing edge by maximally 10%, preferably by maximally 7%, particularly preferably by maximally 5% of the mean profile length of the rudder blade. It is thus achieved that the flow body has only a slight projection with respect to the rudder blade and thus does not influence negatively the propulsion behaviour like a Costa bulb. Costa bulbs project with a much longer length with respect to the rudder blade, generally with a length of 20% and more of the mean profile length of the rudder blade.

Similarly, it is also preferred that the (maximal) length of the flow body substantially corresponds to the length of the offset surface and/or that the maximal width of the flow body substantially corresponds to the biggest profile thickness of the rudder, in particular the biggest profile thickness of the rudder in the transition area between the two rudder sections. The length of the flow body is thus approximately of the same length as the

offset surfaces and the width of the flow body is smaller than or the same as the biggest profile thickness of the rudder. It is thus achieved that the flow body does not project or just only slightly projects over the proper rudder profile as it is the case, for example, for a Costa bulb and the propulsion behaviour is not negatively influenced. Preferably, the length of the flow body is $1/5$ to $1/2$, particularly preferably $1/4$ to $1/3$ of the length of the rudder blade. Furthermore, the height of a flow body is preferably $1/10$ to $1/4$, particularly preferably $1/8$ to $1/6$ of the height of the rudder blade.

For creating an optimal flow transition between the two offset edges, it is preferred to configure rounded-off flow bodies. For this purpose, the flow body can have, for example, a spherical or a hemispherical shape or only a slightly rounded-off shape. Basically, only one single flow body can be provided as well which forms a flow guiding surface for both offset surface areas and/or which covers both offset surface areas. Thus, for this embodiment, the flow body is configured in such a manner that it is placed in both offset surface areas or in both side areas of the transition area between the two leading edges or trailing edges. This being, the flow body can be provided in one piece as well as in several pieces. It is particularly preferred that the flow body for this embodiment is configured spherically, drop-shaped, lentiform, cylindrical or torpedo-shaped. Basically, a combination of different basic shapes, for example a cylindrical basic body with a hemispherical end area, is possible. Advantageously, a flow body with such a shape is made of at least two single parts which are placed respectively on a rudder blade side in the area of an offset surface area and which form

together a closed flow body. The overall shape of the body, for example cylindrical, drop-shaped, etc., results from the two single parts together with the intercalated rudder blade area. Such flow profiles are particularly optimal fluidically.

In another alternative embodiment, two flow bodies are provided, whereby each one is placed in respectively one offset surface area. Preferably, such flow bodies are arranged with an inclined plane or surface with respect to the rudder blade side wall, wherein they run obliquely from the outer edge of the offset surface of a leading edge or a trailing edge to the other leading edge or trailing edge. The flow body can eventually be configured rounded-off in the transition areas to the rudder blade. Such flow bodies or moulded bodies can be configured in particular as a rounded-off side sheet metal.

In a further preferred embodiment of the invention, the size of the cross-sectional surface of the rudder blade diminishes from the upper area of the rudder blade to the lower area of the rudder blade.

Furthermore, an advantageous embodiment of the invention provides that the upper rudder blade section has a cross-sectional profile which is formed by a front surface which extends from the front leading edge to the rear trailing edge and which widens conically to a biggest profile thickness as well as by a rear surface which follows the front surface and tapers conically to the rear trailing edge, whereby both front surface sections which are formed by a middle line extending in longitudinal direction of the rudder blade have different sizes,

the bigger surface section of which is situated on the port side and the smaller surface section is situated on the starboard side, whereby both surface sections formed by the middle line in the rear area of the cross-sectional profile are configured alike and that the lower rudder blade section of the rudder blade has a cross-sectional profile which is formed by a front surface extending from the front leading edge to the rear trailing edge and widening conically to a biggest profile thickness as well as by a rear surface following the front surface and extending to the rear surface, whereby both front surface sections formed by a middle line extending in longitudinal direction of the rudder blade have different sizes, the bigger surface section of which is situated on the starboard side and the smaller surface section is situated on the port side, whereby both surface sections formed by the middle line in the rear area of the cross-sectional profile are configured alike so that the leading edge of the upper rudder blade section which is assigned to the propeller is situated on the port side of the middle line and the leading edge of the lower rudder blade section is situated on the starboard side of the middle line.

Moreover, it is preferred that both cross-sectional surface sections turned to the propeller of the cross-sectional profile of the upper rudder blade section have edge areas with a flat curved course and with a strongly vaulted curved course and both cross-sectional surface sections turned away from the propeller of the cross-sectional profile of the upper rudder blade section have tangentially extending edge areas, whereby the cross-sectional surface section is situated with its edge area with a strongly vaulted curved course on the port side and both

propeller-sided cross-section surface sections of the cross-sectional profile of the lower rudder blade section have edge areas with a flat curved course and with a strongly vaulted curved course, whereby both cross-sectional surface sections turned off the propeller of the cross-sectional profile of the lower rudder blade section have tangentially extending edge areas, whereby the cross-sectional surface section with its edge area with a strongly vaulted curved course is situated on the port side so that on the port side and on the starboard side the edge areas on both sides of the upper rudder blade section and of the lower rudder blade section have, in the area of the biggest profile thicknesses, a convexly outwards vaulted curved course with different arc radii so that conically tapering edge areas of the cross-sectional profiles are configured in direction of the leading edges.

Moreover, it is appropriate that the leading edges turned to the propeller have a rounded-off profile. It is further preferred that the flow body is configured rounded-off too at least in the area of the front rudder side turned to the propeller.

According to a further preferred embodiment, the rudder is configured in such a manner that a rudder trunk is provided as a cantilever with a central inner longitudinal bore for receiving the rudder post for the rudder blade and is configured penetrating into the rudder blade which is connected with the rudder end, whereby a bearing is placed in the inner longitudinal bore of the rudder for supporting the rudder post, this bearing penetrating with its free end into a recess, taper or the like in the rudder blade, whereby the rudder post is guided

in its end area with a section out of the rudder trunk and is connected with the end of this section with the rudder blade, whereby no bearing is provided between the rudder blade and the rudder trunk and whereby the connection of the rudder post with the rudder blade is situated above the propeller shaft middle, whereby the inner bearing for supporting the rudder post in the rudder trunk is placed in the end area of the rudder trunk.

The advantage which results for such a rudder configured according to the invention for which the rudder post is positioned in the end area of the rudder trunk by means of one bearing, whereby the connection of the rudder post with the rudder blade is situated above the propeller shaft middle, without a further bearing being here necessary for the rudder blade on the outer wall surface of the rudder trunk, consists in that, for replacing the propeller shaft, the rudder post does not need any longer to be pulled out of the rudder trunk after having removed the rudder blade since the connection of the rudder post with the rudder blade is situated above the propeller shaft middle. Add to this that the rudder blade of the rudder can have a very slim profile.

Embodiments of the invention will be explained below with more details with reference to the drawings.

Fig. 1a to 1d show schematically different perspective views of a first embodiment of the invention.

Fig. 2a to 2d show schematically different perspective views of a second embodiment of the invention.

Fig. 3 shows schematically a rudder blade according to one of fig. 1a to 1d or to fig. 2a to 2d with figured cross-sectional shapes in the upper and in the lower rudder blade section.

Fig. 3a shows schematically a top view of the cross-sectional profile of the upper rudder blade section in the upper and in the lower rudder blade section.

Fig. 3b shows schematically a top view of the cross-sectional profile of the lower rudder blade section of the rudder of fig. 3.

Fig. 4 shows schematically the rudder arrangement with a rudder post positioned in a rudder trunk and a fixing point of the rudder post with the rudder blade which is situated above the propeller shaft middle.

Fig. 5 shows schematically a vertical section through the arrangement of fig. 4.

Fig. 6 shows a schematic representation of a bearing arrangement between the rudder post and the rudder trunk.

Fig. 7 shows a schematic perspective view of a twisted rudder of the prior art.

Fig. 8 shows schematically a perspective view of a further twisted rudder known by the prior art.

Fig. 9 shows schematically a perspective view of still another twisted rudder known by the prior art.

For the different embodiments of the invention represented below, the same components are provided with the same reference numerals.

Fig. 1a to 1d show perspective views of an embodiment of the rudder according to the invention obliquely from the front, from the front, from the side as well as from below. The figures show respectively a rudder 100 which is made of an upper and of a lower rudder blade section 10, 20. The upper rudder blade section 10 has respectively an upper front leading edge 11 and the lower rudder blade section a lower front leading edge 21, whereby the leading edges 11, 21 are offset or twisted with respect to each other. In particular, this can be seen in fig. 1b. This being, the upper leading edge 11 is offset to the port side and the lower leading edge 21 is offset to the starboard side. A flow body 41 is provided in the transition area 40 between the upper leading edge 11 and the lower leading edge 21. The flow body 41 is made of wrought iron and is substantially configured drop-shaped, whereby it is substantially arranged at flush level with the upper leading edge 11 with respect to the side of the rudder 10 which is turned to the propeller. The drop-shaped flow body 41 which covers the offset surfaces created by the offset of the two leading edges 11, 21 is provided on these offset surfaces. Thus, a rounded-off transition is created in the transition area 40 between the two leading edges 11, 21 and the rudder profile is closed fluidically. The gradual angular

transition between the two profiles 11, 21 in the area of the offset surfaces is covered by the flow body 41 so that the offset surfaces cannot be seen in fig. 1a to 1d. In fig. 1b, it can be furthermore recognized that the width of the flow body 41 is somewhat smaller than the maximal width of the rudder blade 100.

The flow can flow along the rounded-off transition or the flow guiding surface made available by the flow body 41 without swirls, flow breakaway or the like arising. The drop-shaped flow body 41 has a front hemispherical area which covers or encompasses both leading edges 11, 21 in their area turned to the propeller. This being, it does not project or only a little over the leading edges 11, 21. The rear part of the flow body 41 converges similarly to a truncated cone.

Fig. 2a to 2d shows similar illustrations of a further embodiment of the invention. Contrary to the embodiment in fig. 1a to d, two flow bodies 41a, 41b are placed in the transition area 40, whereby each flow body is assigned respectively to an offset surface of a leading edge 11, 21. The flow bodies 41a, 41b constitute guiding surfaces which extend obliquely with respect to a vertical axis from the outer edge of a front leading edge to the other front leading edge. They are configured rounded-off in the front area turned to the propeller. The flow bodies 41a, 41b can consist for example of several layers of wrought iron which are disposed in the transition area 40 on the rudder blade 100. Due to the flow bodies 41a, 41b, the profile of the rudder blade 100 is fluidically closed.

Fig. 3 shows a further side view of a rudder according to the invention, whereby an upper, a lower as well as a central cross-sectional surface which is situated in the transition area between the two rudder blade sections 20, 21 are charted. The flow bodies 41 which are placed in the transition area between the leading edges 11, 21 are omitted in fig. 3, 3a and 3b for reasons of clarity. The upper leading edge 11 is offset to the port side and the other lower leading edge 21 is offset to the starboard side. Both side wall surfaces 100a, 100b of the rudder blade 100 converge in an trailing edge 30 turned away from the propeller. This being, the upper and the lower rudder blade section 10, 20 of the rudder blade 100 are configured as follows.

The upper rudder blade section 10 has, according to fig. 3a, a cross-sectional profile 12 which is formed by a front surface 14 conically widening from the front leading edge 11 to a biggest profile thickness 13. A rear surface 15 which extends to the trailing edge 30 and tapers to the trailing edge 30 follows this front surface 14. The front surface 14 is divided by a middle line M1 in longitudinal direction of the rudder blade 100 into two surface sections 14a, 14b which have different sizes.

This being, the bigger surface section 14a is situated on the port side and the smaller surface section 14b is turned to the starboard side. The rear surface 15 is also divided by the middle line M1 into two surface sections 15a, 15b. Both surface sections 15a, 15b have here the same size and the same shapes.

Both propeller-sided surface sections 14a, 14b of the cross-sectional profile 12 of the upper rudder blade section 10 have edge areas 16, 16a with a flat course 16a, whereby both surfaces 15a, 15b of the cross-sectional profile 12 of the upper rudder blade section 10 which are turned off the propeller 220 have tangentially extending edge areas 17, 17a.

The surface section 14b with the edge area 16a with a strong vaulted curved course 16'a is situated on the starboard side. The side walls 100a, 100b in the areas of the biggest profile thickness 13, 23 have a convexly-shaped bent course on the port side as well as the starboard side.

The lower rudder blade section 20 has, according to fig. 3b, a mirror-inverted cross-sectional profile 22. This cross-sectional profile 22 extends from a surface which conically widens in the direction from the front leading edge 21 to the trailing edge 30, namely to a biggest profile thickness 23. A surface 25 which extends to the trailing edge 30 and which tapers to the trailing edge 30 follows this front surface 24. The front surface 24 is divided by a middle line M2 running in longitudinal direction of the rudder blade 100 into two surface sections 24a, 24b which have different sizes. This being, the bigger surface section 24b is situated on the starboard side and the smaller surface section 24a is turned to the port side. The rear surface 25 is also divided by the middle line M2 into two surface sections 25a, 25b. Here both surface sections 25a, 25b have the same size and the same shapes.

Both propeller-sided surface sections 24a, 24b of the cross-sectional profile 22 of the upper rudder blade section 20 have edge areas 26, 26a with a flat course 26' and a vaulted curved course 26'a, whereby both surfaces 25a, 25b of the cross-sectional profile 22 of the lower rudder blade section 20 which are turned away from the propeller 220 have tangentially running edge areas 27, 27a.

The surface section 24b with the edge area 26'a with a strongly vaulted curved course 26'a is situated on the port side.

The configuration and arrangement of both rudder blade sections 10, 20 results in that the leading edge 11 assigned to the propeller 220 of the upper rudder blade section 10 is situated on the port side to the middle line M1 and the leading edge 21 of the lower rudder blade section 20 is situated on the starboard side to the middle line M2, whereby both rudder blade sections 10, 20 are joined in the rear area of the rudder blade 100 in an trailing edge 30.

According to the fig. 3, 3a and 3b, both rudder blade sections 10, 20 of the rudder blade 100 with their cross-sectional profiles 12, 22 are arranged in such a manner that the side wall sections of the rudder blade which are situated in the area of the strongly bent curved courses 16'a and 26'a of the surface sections 14b and 24b on the port side and on the starboard side are then turned to the surface section 14b of the cross-sectional profile 12 of the starboard side and to the surface section 24b of the cross-sectional profile 22 to the port side so that the leading

edges 11, 21 of both rudder blade sections 10, 20 are situated on the port side and on the starboard side.

The rudder can also be configured in such a manner that both rudder blade sections 10, 20 of the rudder blade 100 with their cross-sectional profiles 12, 22 are placed in such a manner that the side wall sections of the rudder blade which are situated in the area of the strongly bent curved courses 16'a and 26'a of the surface sections 14b and 24b on the port side and on the starboard side, whereby the surface section 14b of the cross-sectional profile 12 is turned to the port side and the surface section 24b of the cross-sectional profile 22 to the starboard side so that the leading edges 11, 21 of both rudder blade sections 10, 20 are situated on the starboard and port side.

For the rudder configuration represented in fig. 4, 110 designates a hull, 120 a rudder trunk, 100 a rudder blade and 140 a rudder post. A propeller 220 is assigned to the rudder blade 100. The rudder blade depicted in fig. 4 is also twisted which cannot be seen in the side view. Moreover, the flow body between the offset front leading edges is omitted in the representation of fig. 4 for reasons of clarity.

Fig. 5 shows a section through the bearing arrangement of the rudder bearing of fig. 4 and fig. 6 shows a schematic illustration of a bearing arrangement between the rudder post and the rudder trunk. The rudder trunk 120 is provided as a cantilever with a central inner longitudinal bore 125 for receiving the rudder post 140 for the rudder blade 100. Moreover, the rudder trunk 120 is configured protruding into the rudder blade 100

which is connected with the rudder post end. In its inner bore 125, the rudder trunk 120 has a bearing 150 for bearing the rudder post 140, whereby preferably this bearing 150 is placed in the lower end area 120b of the rudder trunk 120. The rudder post 140 is guided with its end 140b with its free section 145 out of the rudder trunk 120. This free section 145 of the rudder post 140 is fixedly connected with the rudder blade 100 by means of a press fit and a security nut 170, whereby, however, a connection is also provided which makes possible a loosening of the rudder blade 100 from the rudder post 140 when the propeller shaft has to be replaced. The connection of the rudder post 140 with the rudder blade 100 is situated above the propeller shaft middle 200 so that, for disassembling the propeller shaft, only the rudder blade 100 must be removed from the rudder post 140 while on the other hand a pulling out of the rudder post 140 out of the rudder trunk 120 is not necessary since the free lower end 120b of the rudder trunk 120 as well as the free lower end of the rudder post 140 are situated above the propeller shaft middle. For the embodiments shown in fig. 4 to 6, only a single inner bearing 150 is provided for supporting the rudder post 140 in the rudder trunk 120; a further bearing for the rudder blade 100 on the outer wall of the rudder trunk 120 is not necessary. For receiving the free lower end 120b of the rudder trunk 120, the rudder blade 100 is provided with a taper or recess indicated by 160.

For this rudder, the rudder trunk 120 is provided as a cantilever girder with a central inner longitudinal bore 125 for receiving the rudder post 140 for the rudder blade 100. Moreover, the rudder trunk 120 is configured penetrating into the rudder blade 100

connected with the rudder post end and has in its inner bore 125 a bearing 150 for supporting the rudder post 140 in the rudder trunk 120. With its free end 120b, the rudder trunk 120 is reaching into a recess or taper 160 in the rudder blade 100, whereby the rudder post 140 is guided in its end area 140b with a section 145 out of the rudder trunk 120. With this section 145, the rudder post 140 is connected with the rudder blade 100, whereby the connection of the rudder post 140 with the rudder blade 100 is situated above the propeller shaft middle 225. The inner bearing 150 is preferably provided in the end area 120b of the rudder trunk 120.

List of reference numerals

100	Rudder blade
100a, 100b	Side wall surface
10	Upper rudder blade section
11	Upper leading edge leading edge section
12	cross-sectional profile
13	Biggest profile thickness
14	Front surface
15	Rear surface
14a, 14b	Surface sections
15a, 15b	Surface sections
16, 16a	Edge area
17, 17a	Edge area
18	Offset surface
20	Lower rudder blade section
21	Lower leading edge leading edge section
22	cross-sectional profile
23	Biggest profile thickness
24	Front surface
24a, 24b	Surface sections
25	Rear surface
25a, 25b	Surface sections
26, 26a	Edge area
27, 27a	Edge area

30	Trailing edge
30a, 30b	Trailing edge section
40	Transition area
41	Flow body
110	Hull
120	Rudder trunk
120b	Free end
125	Inner longitudinal bore
135	Flap
140	Rudder post
140b	End of rudder post
145	Section of rudder post
150	Bearing
155	Taper
170	Security nut
220	Propellers
225	Propeller shaft middle
BB	Port
SB	Starboard
M1, M2	Middle line

Claims

1. Rudder for ships comprising a rudder blade (100) which has a leading edge (11, 21) and a trailing edge, whereby the rudder blade (100) has two superimposed rudder blade sections (10, 20), the leading edge sections (11, 21) and/or the trailing edge sections (30a, 30b) of which are offset in such a manner that the one leading edge section (11) and/or the one trailing edge section (30a) is offset port or starboard and the other leading edge section (21) and/or the other trailing edge section (30b) is offset starboard or port and that the one leading edge section (11) and/or the one trailing edge section (30a) has a port-sided offset surface (18) which projects over the other leading edge section (21) and/or the other trailing edge section (30b) and the other leading edge section (21) and/or the other trailing edge section (30b) has a starboard-sided offset surface (18) which projects over the one leading edge section (11) and/or the one trailing edge section (30a),
characterized in
that a flow body (41), which covers the offset surfaces (18) and which is configured, with respect to its dimensions, adapted to the dimensions of the offset surfaces (18), is provided in the area of each offset surface (18).
2. Rudder according to claim 1,
characterized in
that the flow body (41) is configured in such a manner that it forms a flow guiding surface for the flow.

3. Rudder according to claim 1 or 2,
characterized in
that the flow body (41) is configured in such a manner that
it forms a substantially edgeless transition between the two
leading edge sections (11, 21) and/or trailing edge sections
in the area of the offset surfaces (18).
4. Rudder according to any of the preceding claims,
characterized in
that the flow body (41) ends substantially at flush level with
at least one of the leading edge sections (11, 21) and/or
trailing edge sections (30a, 30b).
5. Rudder according to any of the preceding claims,
characterized in
that the maximal projection of the flow body (41) over the
leading edge (11, 1) and/or trailing edge (30) amounts to
10%, preferably to 7%, particularly preferable to 5% of the
mean profile length of the rudder blade (100).
6. Rudder according to any of the preceding claims,
characterized in
that the length of the flow body (41) substantially
corresponds to the length of the offset surfaces (18).
7. Rudder according to any of the preceding claims,
characterized in
that the maximal width of the flow body (41) corresponds to
the biggest profile thickness of the rudder, in particular to
the biggest profile thickness (13) of the rudder in the

transition area (40) between the two rudder sections (10, 20).

8. Rudder according to any of the preceding claims, characterized in that the flow body (41) is configured rounded-off.
9. Rudder according to any of the preceding claims, characterized in that one flow body (41) is provided which forms a flow guiding surface for both offset surface sections.
10. Rudder according to claim 9, characterized in that the flow body (41) is configured spherical, drop-shaped and/or torpedo-shaped.
11. Rudder according to any of the claims 1 to 8, characterized in that a flow body (41) is respectively provided in the area of each offset surface (18).
12. Rudder according to claim 11, characterized in that the flow body (41) is configured in the manner of an inclined plane and extends obliquely from the outer edge of the offset surface (18) of a leading edge (11, 21) and/or trailing edge (30a, 30b) to the other leading edge (11, 21) and/or trailing edge (30a, 30b).

13. Rudder according to any of the preceding claims,
characterized in
that the size of the cross-sectional surface decreases from
the upper area of the rudder blade (100) to the lower area
of the rudder blade (100).
14. Rudder according to any of preceding claims,
characterized in
that the upper rudder blade section (10) has a cross-
sectional profile (12) which
 - a) is formed by a cross-sectional surface (14) which is
turned to the propeller (220) which extends from the
leading edge (11) turned to the propeller (220) in
direction of the rear trailing edge (30) and which
widens conically to a biggest profile thickness (13)
as well as
 - a1) by a cross-sectional surface (15) which follows the
cross-sectional surface (14) and tapers conically to
the rear trailing edge (30), wherein
 - a2) both cross-sectional surface sections (14a; 14b),
turned to the propeller (220), which are formed by a
middle line (M1) extending in longitudinal direction of
the rudder blade (100), have different sizes,
 - a3) the bigger cross-sectional surface section (14a) of
which is situated on the port side
 - a4) and the smaller cross-sectional surface section (14b)
of which is situated on the starboard side,
 - a5) wherein both cross-sectional surface sections (15a,
15b) formed by the middle line (M1) in the area of

the cross-sectional profile (12) turned away from the propeller (220) are configured alike,

and that the lower rudder blade section (20) has a cross-sectional profile which

- b) is formed by a cross-sectional surface (24) turned to the propeller (220) extending from the leading edge (21) turned to the propeller (220) in direction of the trailing edge (30) and widening conically to a biggest profile thickness (23) as well as
 - b1) by a cross-sectional surface (25) which follows the cross-sectional surface (24) and tapers conically to the rear trailing edge (30), wherein
 - b2) both front cross-sectional surface sections (24a; 24b), which are formed by a middle line (M2) extending in longitudinal direction of the rudder blade (100), have different sizes,
 - b3) the bigger cross-sectional surface (24a) of which is situated on the starboard side and
 - b4) and the smaller cross-sectional surface (24b) of which is situated on the port side, wherein
 - b5) both cross-sectional surface sections (25a, 25b) formed by the middle line (M2) in the area of the cross-sectional profile (22) turned away from the propeller (220) are configured alike, wherein the cross-sectional surface (14a, 14b, 15a, 15b) of the upper rudder blade section (10) is bigger than the cross-sectional surface (24a, 24b, 25a, 25b) of the lower rudder blade section (20).

15. Rudder according to claim 14,

characterized in

that both cross-sectional surface sections (14a, 14b) turned to the propeller (220) of the cross-sectional profile (12) of the upper rudder blade section (10) have edge areas (16, 16a) with a flat curved course (16') and with a strongly vaulted curved course (16'a) and both cross-sectional surface sections (15a, 15b) turned away from the propeller (220) of the cross-sectional profile (12) of the upper rudder blade section (10) have tangentially extending edge areas (17, 17a), wherein the cross-sectional surface section (14b) is situated with its edge area (16a) with a strongly vaulted curved course (16'a) on the starboard side and both propeller-sided cross-sectional surface sections (24a, 24b) of the cross-sectional profile (22) of the lower rudder blade section (20) have edge areas (26, 26a) with a flat curved course (26') and with a strongly vaulted curved course (26'a), wherein both cross-sectional surface sections (25a, 25b) turned away from the propeller (220) of the cross-sectional profile (22) of the lower rudder blade section (20) have tangentially extending edge areas (27, 27a), wherein the cross-sectional surface portion (24b) with its edge area (26a) with a strongly vaulted curved course (26'a) is situated on the port side so that on the port side and on the starboard side the edge areas on both sides (16', 17, 16'a, 17a, 26a, 27a, 26', 27) of the upper rudder blade section (10) and of the lower rudder blade section (20) have, in the area of the biggest profile thicknesses (13; 23), a convex outwards vaulted curved course with different arc radii so

that conically tapering edge areas (16, 17; 16a, 17a and 26, 27; 26a, 27a) of the cross-sectional profiles are configured in direction of the leading edges (11; 21; 30).

16. Rudder according to any of the preceding claims, characterized in

that the leading edge sections (11, 21) turned to the propeller (220) have a rounded-off profile.

17. Rudder according to any of the preceding claims, characterized in

that a rudder trunk (120) is provided as a cantilever with a central inner longitudinal bore (125) for receiving a rudder post (140) for the rudder blade (100) and is configured penetrating into the rudder blade (100) which is connected with the rudder post end, wherein a bearing (150) is disposed in the inner longitudinal bore (125) of the rudder trunk (120) for supporting the rudder post (140), this bearing penetrating with its free end (120b) into a recess, taper or the like (160) in the rudder blade (100), wherein the rudder post (140) is guided in its end area (140b) with a section (145) out of the rudder trunk (120), and is connected with the end of this section (145) with the rudder blade (100), wherein no bearing is provided between the rudder blade (100) and the rudder trunk (120) and wherein the connection of the rudder post (140) with the rudder blade (100) is situated above the propeller shaft middle (200), wherein the inner bearing (150) for supporting the rudder post (140) in the rudder trunk (120) is disposed in the end area of the rudder trunk (120).

18. Ship,
characterized in
that it comprises a rudder according to any of the preceding
claims.