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(54) **WATERCRAFT**

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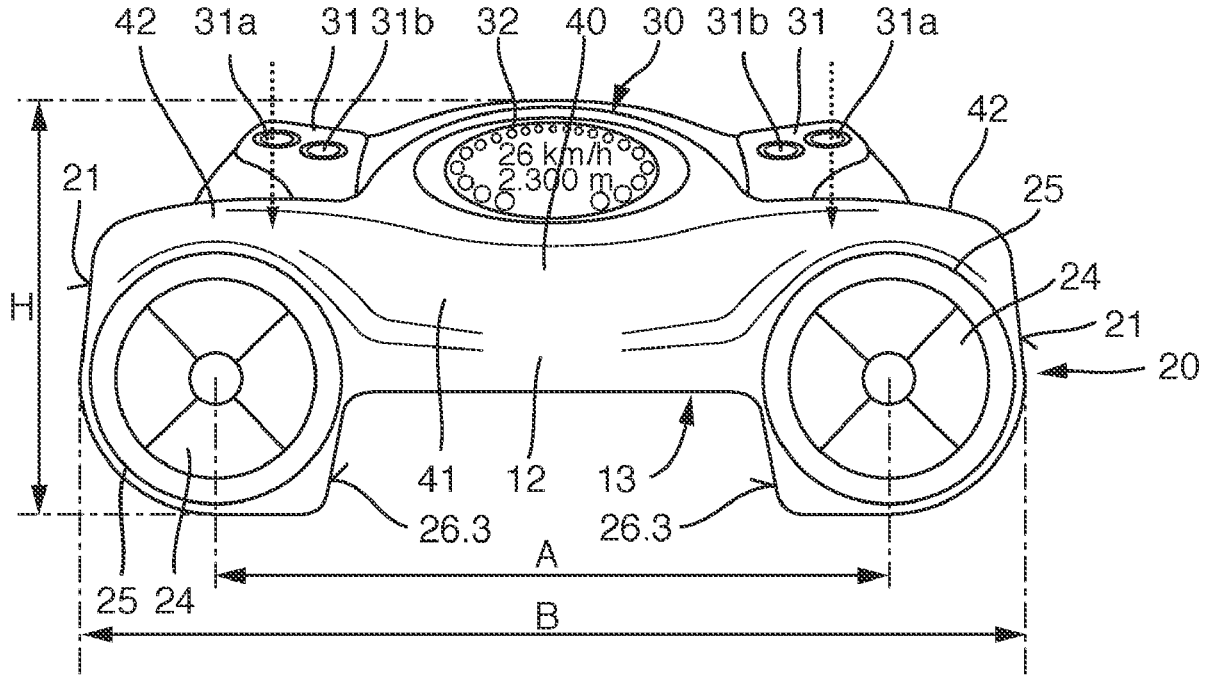
(57) **ABSTRACT**

The invention relates to a watercraft, in particular a swimming and/or diving aid with a hull (**10**) having a stern (**12**) and a bow (**11**), wherein two flow channels (**27**) are provided in the hull (**10**) or on the hull (**10**), which flow channels extend from a water inlet (**22**) to a water outlet (**24**), wherein a water acceleration device (**52**), in particular a propeller or a propelling screw, is arranged in each of the two flow channels (**27**), wherein each water acceleration device (**52**) is driven by a motor (**50**), wherein handles (**31**) a user can hold on to are arranged in the midship area between the bow (**11**) and the stern (**12**) or in the bow area, wherein a support surface (**40**) is provided adjoining the handles (**31**) in the direction of the stern (**12**), on which support surface the user can at least partially rest, and wherein two spaced-apart bulges extending in the longitudinal direction of the hull (**10**) are provided on the underside of the hull (**10**), between which bulges at least one water-sliding surface (**14**, **15**) is arranged. To be able to implement a low flow resistance with a compact structure in such a watercraft, provision is made according to the invention that the flow channels (**27**) extend at least sectionally in the area of the bulges.



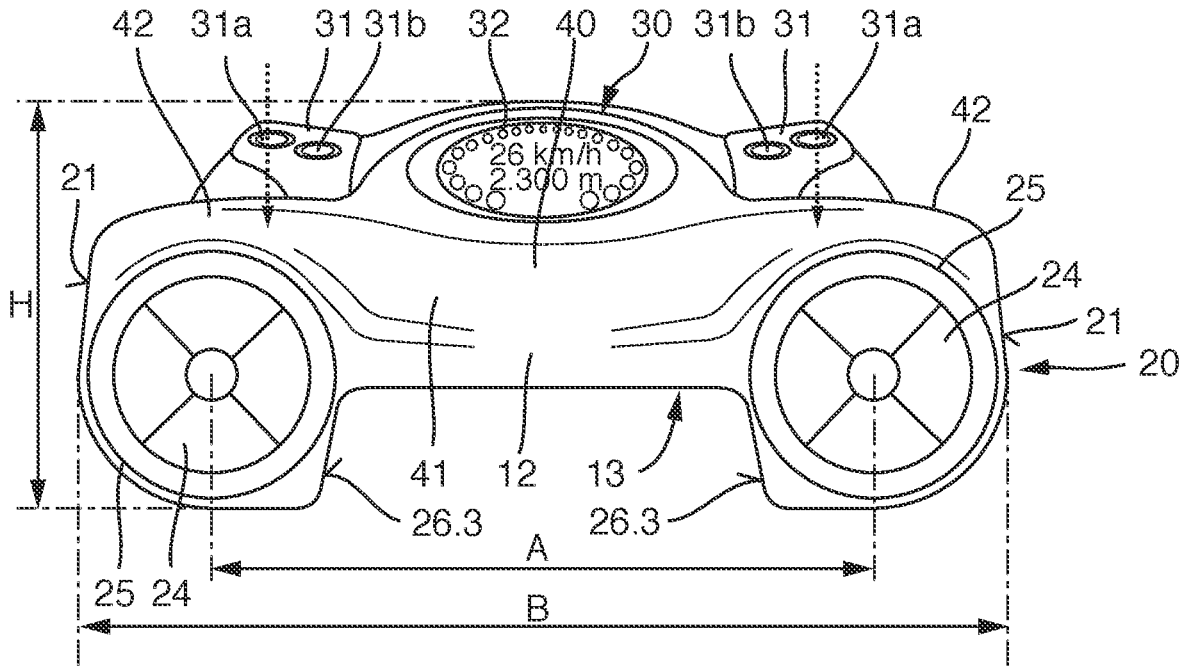

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Fig. 1

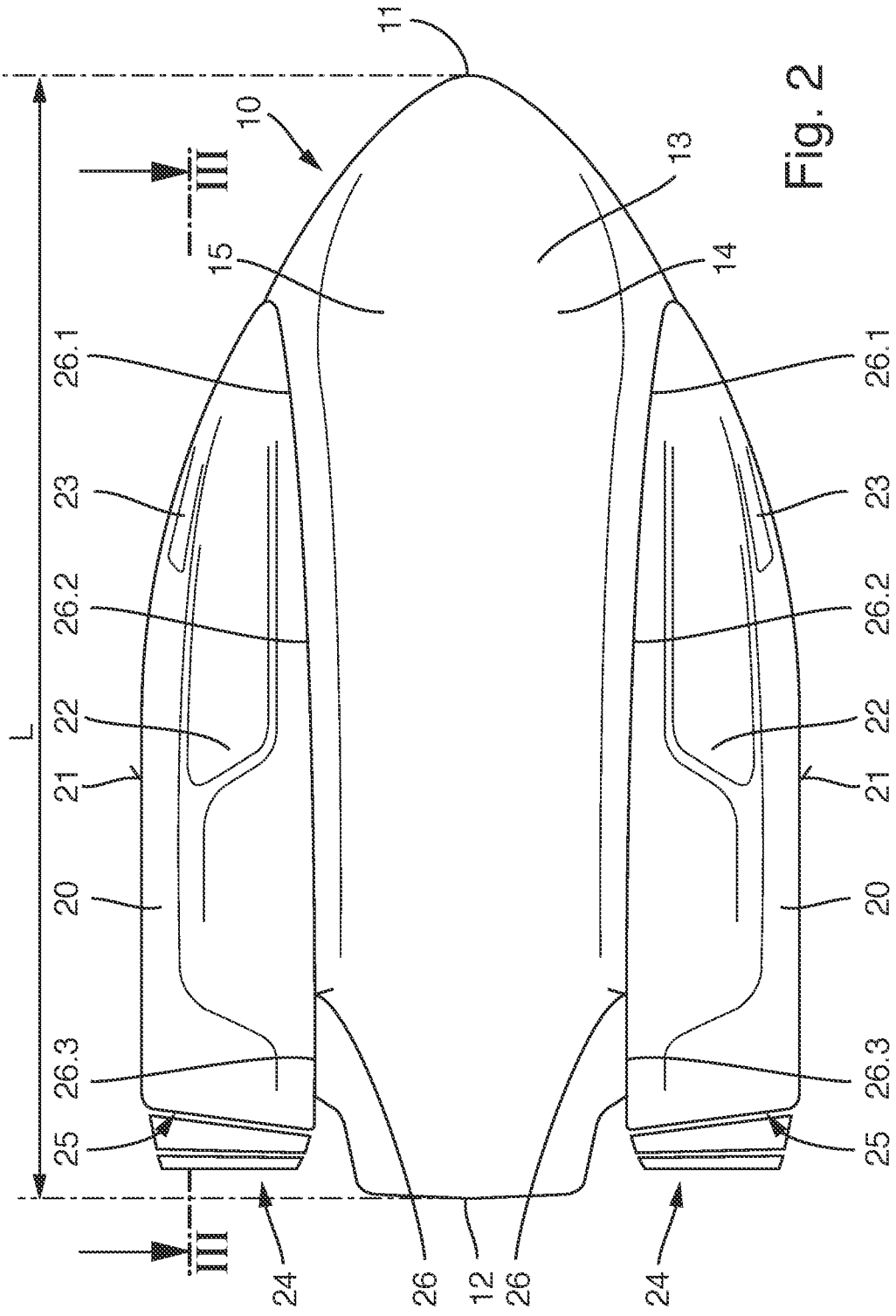
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Fig. 2

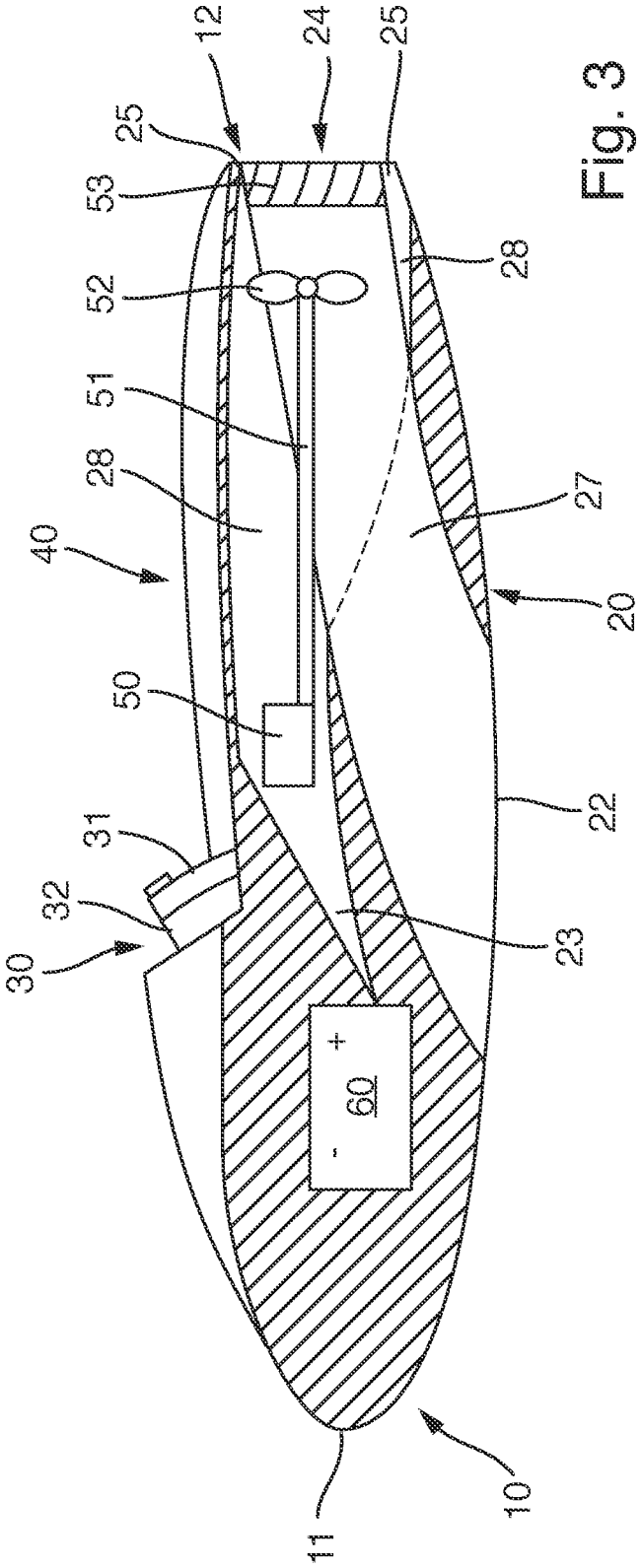

Fig. 3

WATERCRAFT

[0001] The invention relates to a watercraft, in particular a swimming and/or diving aid with a hull having a stern and a bow, wherein two flow channels are provided in the hull or on the hull, which flow channels extend from a water inlet to a water outlet, wherein a water acceleration device, in particular a propeller or propelling screw, is arranged in each of the two flow channels, wherein each water acceleration device is driven by a motor, wherein handles a user can hold on to are arranged in the midship area between the bow and the stern or in the bow area, wherein a support surface is provided adjoining the handles in the direction of the stern, on which support surface the user can at least partially rest, and wherein two spaced-apart bulges extending in the longitudinal direction of the hull are provided on the underside of the hull, between which bulges at least one water-sliding surface is arranged,

[0002] Such watercraft are used as recreational or sports equipment, as rescue equipment and for professional use. They can be used to pull a user across the water's surface. At the same time, the watercraft can also be transitioned from surface travel to submerged travel. In particular, the watercraft can then be used for longer diving trips.

[0003] US 2001/0025594 A1 discloses a watercraft, in which a hull having laterally projecting wings is provided. The hull has a support surface on which the user's upper body can rest. Similar to a motorcycle, the watercraft has a handlebar. The handlebar has two handles. The user can hold on to these. Two flow channels are further provided in the hull, wherein impellers are provided inside the flow channels. The impellers are arranged on a shaft and can be driven by an electric motor. The watercraft has protrusions on its underside that are spaced apart. This well-known watercraft has a relatively large footprint, making it unwieldy. In particular, it cannot be used for water travel where turns along tight curve radii are to be made. In addition, the clear height of the watercraft is great, i.e., it has a relatively high flow resistance.

[0004] Such a watercraft is known from DE 35 23 758 A1, for instance. Similar to a biplane, this watercraft has two wings that are spaced apart. Flow channels are formed between these two wings. Motors are arranged in the flow channels, driving one propeller each. Furthermore, handles are provided between the wings. These handles can be used to individually control the motors.

[0005] Another watercraft having two flow channels and engines associated therewith is known from FR 2 915 172.

[0006] The invention addresses the problem of providing a watercraft of the type mentioned at the beginning, which has a compact structure in aid of a relatively low flow resistance and which is easy to handle in aid of a speedy driving style.

[0007] This problem is solved by the flow channels extending at least sectionally in the area of the bulges.

[0008] According to the invention, the flow channels are integrated into the area of the bulges in a space-saving manner, considerably reducing the overall height of the watercraft compared to known watercraft. This reduces flow resistance. This results in the watercraft having a significantly lower energy consumption and makes for a speedy driving style. In addition, it has been shown that the integration of the flow channels into the bulges results in an improved balance of the watercraft during a dive. When driving on water, an improved water supply to the flow channel is achieved even in rippled waters and the risk of air being drawn into the flow channels is significantly reduced when driving in this manner.

[0009] According to a preferred variant of the invention, provision is made that each of the two flow channels has its own water inlet, which are each introduced into the bulges. On the one hand, this results in an improved directional stability. On the other hand, operation is enhanced in that if one of the two flow channels unintentionally aspirates air, the other flow channel does not. The other flow channel can then continue to provide driving power at the desired thrust.

[0010] According to one conceivable embodiment of the invention, provision can be made that the water inlets are open towards the underside and/or towards the area located between the bulges. If the water inlets are oriented to open towards the underside, an ideal water supply of the flow channels is safeguarded. When the water inlets are oriented to open into the area between the bulges, this improves the driving style because the water is actively drawn over the sliding surface between the bulges into the area between the bulges. If the water inlets are aligned in both directions, i.e. towards the underside and in the area between the bulges, these effects combine and there is no risk of cavitational effects.

[0011] To achieve a maximum thrust effect, provision can be made that the water outlets of both flow channels are open towards the rear of the watercraft.

[0012] A considerable optimization of efficiency can be achieved by arranging a flow stator in each of the flow channels downstream of the water acceleration devices, which flow stator is designed to reduce or eliminate the swirl of the water downstream of the water acceleration device, preferably to straighten the water jet. The water drawn through the flow channels by means of the water acceleration device, for instance the propeller, is twisted at the water acceleration device. This twist results in a decrease in thrust. When the flow stator is used to reduce or eliminate this swirl, the thrust of the water jet and thus the overall performance of the watercraft are significantly increased.

[0013] If provision is made that the motors associated with the two water acceleration devices are located outside of the flow channels in the hull, then the free cross-sectional area of the flow channels remains unaffected by the motor to achieve maximum water flow. Preferably, the engines are located on both sides of the central longitudinal axis of the watercraft. As a result, the weight of the engines contributes to the stabilization of the watercraft during water travel.

[0014] A preferred option of the invention provides that the engines are housed in a joint flooding compartment or in separate flooding compartments, wherein the flooding compartments can be flooded with ambient water. In this way, the engines can be efficiently cooled by means of the ambient water during operation. Ambient water is available for cooling purposes in virtually unlimited quantities.

[0015] In order to be able to achieve an efficient flow, provision can be made that the flooding compartment or compartments are connected to the environment via at least one water inlet port and one water outlet port, that the water inlet port and the water outlet port are arranged offset from each other in the longitudinal direction of the hull extending from the bow to the stern, to generate a water flow in the flooding compartment or compartments during the operation of the watercraft.

[0016] It is also conceivable that one or more vents are assigned to the flooding compartment(s). When the watercraft is placed on the water, the air from the flooding compartment(s) can quickly escape through the vent, causing the flooding compartments to fill with water. Preferably, the vent or vents are located in the area of the flooding compartments, which are located at the top, facing away from the bottom hull, to permit venting to the greatest possible extent.

[0017] The flooding compartments can also be used to reduce the buoyancy of the watercraft when it is placed on the water. This results in a reduction in the structural weight of the watercraft, rendering it easy to transport outside the water.

[0018] When two flooding compartments are used, the balance of the watercraft can be further improved during operation.

[0019] According to a conceivable variant of the invention provision can be made that the bulges are part of lateral outriggers, and that preferably a motor and/or a flooding compartment is provided in the area of each outrigger. The outriggers can be directly in contact with or spaced apart from the actual hull body. They can also be integrated into the hull body. If an engine and/or a flooding compartment is located in each outrigger, a stable center position of the watercraft can be achieved during operation.

[0020] It is particularly preferred that each of the two motors can be controlled and/or regulated separately. In this way, improved handling can be achieved when cornering. For instance, when turning, the motor facing the outside radius of the curve can operate at a higher power than the motor facing the inside radius. This makes for fast turning.

[0021] In particular, provision can also be made to assign control elements of a regulating device to each handle, i.e. the control elements of one handle can be used to regulate the power output of the one motor and the control elements of the other handle can be used to regulate the power output of the other motor. In this way, the user can actively influence the cornering behavior during driving, which supports a speedy driving style.

[0022] According to a further variant of the invention, provision can be made that both engines are supplied by a joint power supply. In that case it is advisable to arrange the power supply, which can be designed as an accumulator, centrally amidships or in the bow area of the watercraft, to use the weight of the power supply to counterbalance the load the user applies to the supporting surface. It is also conceivable that each motor is assigned its own power supply. In that case, redundancy us established. If a power supply fails during operation, the user can reach the shore at reduced speed using the power of the second accumulator. It is also conceivable that in that case there is a changeover switch which can be used to supply the remaining power supply to both motors. When two power supplies are used, they can preferably be arranged symmetrically with respect to the central longitudinal axis of the watercraft and on both sides of the central transverse plane of the watercraft passing through the central longitudinal axis, to achieved a good stability of the watercraft.

[0023] When using two power supplies, it is also recommended that the two power supplies for the motors are each located in a flooding compartment or in a joint flooding compartment. In that way, the power supplies can be cooled during operation in the flooding compartments. This ensures a constant power output of the power supplies.

[0024] If provision is made that a regulating device can be used to individually or jointly reverse the direction of rotation of the motors and in that way the thrust direction of the water acceleration device can be reversed. Then, reversing or turning the watercraft can be accomplished in a confined space.

[0025] For solving the problem of the invention, a watercraft can also be of the type having a hull with a stern and a bow, wherein two flow channels are provided in the hull or on the hull, which flow channels extend from a water inlet to a water outlet, wherein a water acceleration device, in particular a propeller or a propelling screw, is arranged in each of the two flow channels, wherein each water acceleration device is driven by a motor, wherein handles a user can hold on to are arranged amidships between the bow and the stern or in the bow area. In such a watercraft, provision can be made that it has a tilt sensor which qualitatively or quantitatively detects the tilt of the watercraft about its central longitudinal axis, that the tilt sensor is connected to a regulating device, and that the control device controls the two motors as a function of the signal from the tilt sensor when the watercraft is inclined in such a way that the motors have a power output differing from one another.

[0026] When the user of such a watercraft wants to initiate a turn, he intuitively tilts the watercraft about its central longitudinal axis. The tilt sensor then detects this tilt. The regulating device thereupon regulates the two motors with regard to their power output. For example, the motor facing the inside of the curve can be operated at a lower power than the motor on the outside. This makes for tight turns, resulting in a speedy driving style. It is conceivable that the tilt sensor qualitatively detects the degree of tilt, in particular the angle of tilt. A functional relationship or a characteristic map is stored in a memory in the regulating device. Depending on the measured tilt angle, the regulating device then takes the assigned control parameters for the two motors from the functional relationship or a characteristic map. This permits optimized turning at maximum driving performance.

[0027] The invention is explained in greater detail below based on an exemplary embodiment shown in the drawings. In the Figures:

[0028] FIG. **1** shows rear view of the stern section of a watercraft,

[0029] FIG. **2** shows a bottom view of the watercraft of FIG. **1** and

[0030] FIG. **3** shows a side view and a sectional view of the watercraft of FIGS. **1** and **2**.

[0031] FIGS. **1** and **2** show a watercraft having a hull **10**, wherein the hull **10** has a bow **11** and a stern **12**. A cockpit **30** is provided in the area of the bow **11**, which cockpit has a display **32**. The display **32** can be used to display certain operating parameters of the watercraft. For example, the state of charge of power supplies **60**, diving depth, or speed may be indicated on this display **32**.

[0032] Handles **31** are provided on both sides of the cockpit **30**. The user can use these handles to hold on to the watercraft. The handles **31** may have control elements **31**A, **31**B.

[0033] A support surface **40** adjoins the cockpit **30** in the direction of the stern **12**. A user can partially rest on this support surface **40**, for example, supporting his arms and/or

a part of his upper body. Preferably, the support surface **40** is provided amidships in the form of a trough-shaped recess, as shown in FIG. **1**. However, it is also conceivable that no recess is provided, but rather an outwardly curved midship area or a flat midship area.

[0034] The midship area is adjoined by outriggers **20** on both sides of the center longitudinal axis of the watercraft. The outriggers **20** have a rounded transition areas **42**. These rounded transition areas **42** are convexly curved outwards. Of course, other transition areas can also be provided here. The rounded transition areas **42** form part of the support surface and merge into the midship area of the support surface **40**. The outwardly adjoining upper sides of the outriggers **20** form support surfaces for the user's arms. Side walls **21** terminate the longitudinal ends of the outriggers **20**. The side walls **21** are convex to the underside of the watercraft to optimize the flow. There, the side walls **21** merge into inner boundary walls **26**. The boundary walls **26** are also part of the outriggers **20**. As FIG. **2** shows, the boundary walls **26** are each divided into a front part **26.1**, a center part **26.2** and a rear part **26.3**.

[0035] The front parts **26.1** of the boundary walls **26** diverge in the outward direction and are thus arranged to optimize flow.

[0036] The outriggers **20** form protrusions directed towards the underside of the watercraft. These bulges run in the direction of the longitudinal axis of the watercraft, as shown in FIG. **2**. The protrusions are formed by the side walls **21** and boundary walls **26**, wherein the boundary wall **26** adjoins the side walls **21**. The protrusions are spaced apart from each other. At least one, in the present exemplary embodiment two, deflection surfaces **14**, **15** are present between the bulges on the bottom hull **13**. The sliding surface **14**, **15** or the sliding surfaces **14**, **15** and the boundary walls **26** form a water duct. This water duct is open to the underside of the watercraft. Furthermore, the water duct is also open in the area of the stern and the bow. This is clearly shown in FIG. **2**.

[0037] FIG. **3** shows a section through one of the outriggers **20** along the sectional path outlined in FIG. **2** as III-III. As can be seen from this embodiment, the outriggers **20** have a flow channel **27** extending at least sectionally through the outrigger **20**. The flow channel **27** has a water inlet **22** and a water outlet **24**. The water inlet **22** is open towards the underside of the watercraft, and as FIG. **2** indicates, also towards the area located between the two outriggers **20**. It is also conceivable that the water inlet **22** is only open towards the underside or only towards the area between the two outriggers **20**.

[0038] A water acceleration device **52** is located in the flow channel **27**. It is designed as a propeller. The water acceleration device **52** is supported by a drive shaft **51**. The drive shaft **51** is preferably made of a carbon fiber reinforced plastic. It thus has a low weight. On the one hand, this results in a reduction in the overall weight of the watercraft. On the other hand, it decreases mass inertia to achieve a fast response.

[0039] The drive shaft **51** is connected to a motor **50**. The motor **50** can be designed as an internal-rotor motor or as an external-rotor motor. To achieve a high available torque and thus high thrust, preferably an external rotor motor is used.

[0040] The drive motor **50** is housed in a flooding compartment **28**. At least a part of the flooding compartment **28** is located in the area of the outrigger **20**. A water inlet port **23** and a water outlet port **25** are assigned to the flooding compartment **28**. In this case, the water inlet port **23** and the water outlet port **25** are arranged offset from each other in the longitudinal direction of the watercraft. As FIG. **2** shows, the water inlet port **23** ends in the area of the bow. The water outlet port **25** is arranged in the area of the stern **25**.

[0041] FIG. **1** shows that the water outlet port **25** can be open, for instance having an annular shape, around the water outlet **24**. As FIG. **3** further shows, a motor **50** can be arranged in the flooding compartment **28**. A wall element is arranged between the flooding compartment **28** and the flow channel **27**. The shaft **51** penetrates this wall element at a suitable point.

[0042] The two outriggers **20** are structurally identical, i.e. the above explanations apply to both outriggers **20**, preferably the two outriggers **20** are of mirror symmetrical construction.

[0043] Both motors **50** can be supplied centrally from one power supply **60**. The power supply **60** is housed in the hull **10** of the watercraft. Preferably, the power supply **60** is located in the area of the bow **11** of the watercraft, as can be seen in FIG. **3**. However, it is also conceivable that the power supply **60** is arranged amidships.

[0044] It is further conceivable that two separate power supplies **60** are used. In that case, each of the power supplies **60** then preferably supplies one of the two motors **50** in the outriggers **20**. For example, the power supplies **60** may be disposed on either side of the center transverse plane extending in the longitudinal direction of the watercraft. In this way, the load is distributed. Preferably, the power supplies **60** are of identical design, resulting in a reduction of the number of required parts and also in a uniform weight distribution. Further preferably, the two power supplies **60** are arranged symmetrically with respect to the center transverse plane.

[0045] It is also conceivable that the one power supply **60** or both power supplies **60** are located in the area of the flooding compartments **28**. In that way, the power supply during operation can be cooled.

[0046] In the exemplary embodiment shown, the flooding compartments **28** are supplied via separate water inlet ports **23**. However, it is also possible that one joint water inlet port **23** is provided for both flooding compartments and/or one joint water outlet port **25** is provided for both flooding compartments **28**.

[0047] Furthermore, it is conceivable that one joint flooding compartment **28** is provided, in which both motors **50** and/or the power supply **60** is/are arranged. It is also conceivable that for cooling purposes an electrical regulating unit for the watercraft may be housed in the one or more flooding compartments **28**. The regulating unit can of course also be located at another suitable place on the watercraft

[0048] For instance, the regulating unit may be used to individually control the power output of the two motors **50** connected to the power supply **60** or power supplies **60**. In this exemplary embodiment, the handles **31** have control elements **31**A, **31**B as described above. The control elements **31**A, **31**B are connected in such a way that the left handle **31** can be used to control one motor and the right handle **31** can be used to control the other motor **50**. In particular, the user can in that way control the power output of the motors **50** individually. This makes for an improved turning behavior. For instance, if the starboard side motor **50**

is operated at a higher power than the port side motor **50**, cornering in the port direction is supported.

[0049] In addition or alternatively to this control option of the motors **50**, it may also be provided that a tilt sensor is arranged in the hull **10** or on the hull **10**. This tilt sensor detects the tilt of the watercraft about its central longitudinal axis. The tilt sensor can be used to qualitatively or quantitatively measure the tilt of the watercraft about its central longitudinal axis. The tilt sensor is connected to a regulating device. The regulating device is designed to control the two motors **50** as a function of the signal from the tilt sensor when the watercraft is tilted in such a way that the motors **50** have a differing power outputs. In this way, turning behavior can be influenced solely by the tilt of the watercraft.

[0050] When the watercraft is placed in the water, water flows through the water inlet ports **23** and the water outlet ports **25** into the flooding compartment **28** to fill the latter.

[0051] For a complete filling with water or an almost complete filling with water, provision can be made that one or more vents are assigned to the flooding compartments **28**, preferably in the upper area.

[0052] Furthermore, the water inlets **22** and the water outlets **24** are also used to fill the flow channels **27**.

[0053] Now the watercraft can be put into operation. For this purpose, the user activates the motors **50** using the controls **31**A, **31** B on the handles **31**. Owing to the activation of the motors **50**, the drive shafts **51** and with them the water acceleration devices **52** are operated. The water acceleration device **52** draws water through the water inlets **22** to accelerate it in the flow channel **27**. Downstream of the water acceleration devices **52**, the accelerated water has a swirl the water acceleration devices **52** have imprinted thereon. Therefore, as can be seen in FIG. **3**, flow stators **53** are provided downstream of the water acceleration devices **52**. These flow stators **53** have water guide vanes, which are arranged in the opposite direction to the swirl of the water jet and reduce the swirl of the water jet, preferably eliminating it completely. Downstream of the flow stators **53**, the water jet exits the watercraft and develops its thrust effect.

[0054] During travel in/on water, the water is routed between the bulges and the sliding surfaces **14**, **15**. The sliding surfaces **14**, **15** can be designed as convex or concave surfaces. The water is drawn into the water duct between the bulges and the sliding surfaces **14**, **15** and accelerated, resulting in improved driving characteristics.

[0055] After the travel in/on water has terminated, the user can lift the watercraft out of the water. In the process, both the flooding compartment **28** and the flow channels **27** empty through the water inlets **22**, the water outlets **24**, the water inlet ports **23**, and the water outlet ports **25**. This significantly reduces the weight of the watercraft and makes it easy to transport.

1-16 (canceled)

17. A watercraft, comprising:

a hull including a stern and a bow defining a longitudinal direction between the stern and the bow, the hull including an underside including two laterally spaced-apart bulges extending in the longitudinal direction, and the hull including at least one water-sliding surface between the two bulges;

two flow channels, one of the flow channels being provided at least partially in each of the two bulges, each of the flow channels extending from a water inlet to a water outlet;

two water acceleration devices each including a propeller or a propelling screw, one of the water acceleration devices being arranged in each of the two flow channels;

two motors, one of the motors driving each of the two water acceleration devices;

two handles arranged on the hull on a midship area between the bow and the stern or in a bow area; and

a support surface defined on the hull aft of the handles such that a user can hold onto the handles and at least partially rest on the support surface.

18. The watercraft of claim **17**, wherein:

each of the two flow channels includes its own water inlet located in its associated one of the two bulges.

19. The watercraft of claim **18**, wherein:

each of the water inlets is open towards an underside of its associated one of the two bulges and/or towards a space between the two bulges.

20. The watercraft of claim **17**, wherein:

each of the two flow channels includes its own water outlet open towards a rear of the watercraft.

21. The watercraft of claim **17**, further comprising:

two flow stators, one of the flow stators being arranged in each of the two flow channels downstream of a respective water acceleration device in a direction of flow, the flow stators being configured to reduce or eliminate a swirl of the water downstream of the respective water acceleration devices.

22. The watercraft of claim **21**, wherein:

each of the motors is arranged in the hull outside of the respective flow channel in which its associated water acceleration device is arranged, the two motors being arranged on opposite sides of a central longitudinal axis of the watercraft.

23. The watercraft of claim **22**, wherein:

the two motors are housed in one joint flooding compartment or in separate flooding compartments configured to be flooded with ambient water when the watercraft is placed in a body of water.

24. The watercraft of claim **23**, wherein:

the flooding compartment or compartments are connected to an exterior environment through at least one water inlet port and at least one water outlet port, the at least one water inlet port and the at least one water outlet port being arranged offset from each other in the longitudinal direction of the hull to generate a water flow through the flooding compartment or compartments during operation of the watercraft.

25. The watercraft of claim **17**, wherein:

the hull includes two lateral outriggers and each of the two bulges is a part of a respective one of the two lateral outriggers.

26. The watercraft of claim **25**, wherein:

the two motors are housing in separate flooding compartments, one of the flooding compartments being provided in each of the two lateral outriggers, the flooding compartments being configured to be flooded with ambient water when the watercraft is placed in a body of water.

27. The watercraft of claim **17**, wherein:
each of the motors is configured to be controlled and/or regulated separately.
28. The watercraft of claim **17**, wherein:
each of the two handles includes control elements associated with a respective one of the two motors such that the control elements of one of the handles can be used to regulate a power output of one of the motors, and the control elements of the other of the handles can be used to regulate a power output of the other of the motors.
29. The watercraft of claim **17**, further comprising:
a joint power supply configured to supply power to both of the motors.
30. The watercraft of claim **17**, further comprising:
two power supplies, each of the power supplies being configured to supply power to a respective one of the motors.
31. The watercraft of claim **30**, wherein:
the two power supplies are housed in one joint flooding compartment or in separate flooding compartments configured to be flooded with ambient water when the watercraft is placed in a body of water.
32. The watercraft of claim **17**, wherein:
the motors are configured such that a direction of rotation of the motors can be individually or jointly reversed such that a thrust direction of each of the associated water acceleration devices can be reversed.
33. A watercraft, comprising:
a hull including a stern and a bow defining a longitudinal direction between the stern and the bow;
two flow channels provided in or on the hull, each of the flow channels extending from a water inlet to a water outlet;
two water acceleration devices each including a propeller or a propelling screw, one of the water acceleration devices being arranged in each of the two flow channels;
two motors, one of the motors driving each of the two water acceleration devices;
two handles arranged on the hull on a midship area between the bow and the stern or in a bow area;
a tilt sensor configured to qualitatively or quantitatively detect a tilt of the watercraft about a central longitudinal axis of the watercraft, the tilt sensor being configured to generate a signal representative of the tilt; and
a regulating device configured to control the two motors as a function of the signal from the tilt sensor such that the motors have a power output differing from one another when the watercraft is tilted.

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