APPLIANCE FOR PRACTICING AQUATIC SPORTS

18 Claims, 10 Drawing Figs.

ABSTRACT: An appliance for practicing within a reduced area of aquatic sports such as surf-riding and water-skiing, said appliance including a vat the bottom of which is sloping and has a longitudinal section which shows a concavity facing upwards while a stream of water is caused to flow upslope over said bottom as produced by a nozzle discharging water onto the surface of the lower end of said bottom.
APPLIANCE FOR PRACTICING AQUATIC SPORTS

My invention covers an appliance for practicing nautical sports, said appliance comprising a vat closed at its lower end by a bottom over which water is constrained to flow as a stream showing a free upper surface along which it is possible to practice an aquatic sport within the restricted space constituted by the vat. A number of appliances are known, which allow for instance practicing swimming and sometimes, with a more speedy flow of water, water-skiing. They do not allow, in contradistinction, practicing a novel sport which is now increasingly popular and which is known as surf-riding. Such a sport is practiced in the vicinity of a reduced number of beaches where billows of an adequate shape have been devotedly sent along a board or the like part sliding over the slope of the billows in a manner such that the sliding movement of the board combined with the substantially vertical movement of said board due to the surge finally results in a shifting of the surf-riding in parallelism with the free surface of the water. All such known arrangements have furthermore a reduced efficiency by reason of the fact that the major part of the kinetic energy of the water which has not been made use of by the water skier or the like is lost.

SUMMARY AND OBJECTS OF THE INVENTION

My invention has for its object to afford means for practicing in all seasons within a reduced space and in an economical manner, not only swimming or water-skiing, but also surf-riding and a further sport which has not been practiced hitherto and consisting in being carried by two boards as in the case of water-skiing while maintaining one's balance in accordance with the principle of surf-riding, this corresponding to water-skiing with one's hands free. My invention has also for its object to allow gradually turning from the comparatively easy practicing of water-skiing under control of a pulling cable to the more difficult practicing of water-skiing with one's hands free or of surf-riding, so as to further under conditions readily available for the general public physical development and individual skill.

According to my invention, the bottom of the vat inside which an aquatic sport is to be practiced slopes with reference to a horizontal plane in a manner such that water may flow over said bottom in an upward direction, that is in an upward direction. Such an arrangement shows firstly the advantage of allowing the practicing of surf-riding and other similar sports, as the sloping of the vat bottom results in the possibility for the water skier to keep his balance is an equilibrium position depending, on the one hand, on an upwardly directed force ascribable to the drag or resistance of the carrier board or boards dipped into the stream of water and, on the other hand, on a downwardly directed force produced by the component of the weight of the water skier in a direction parallel with the vat bottom. My invention shows also the advantage of allowing the recovery as potential energy of the major fraction of the kinetic energy applied to the stream of water and which, in fact, is finally not used by the water skier. Said water being generally recirculated for instance by a pump system, the power required for recirculating the water is considerably reduced.

According to a preferred embodiment, the sloping bottom of the vat is not flat, but incurved in longitudinal section, with concavity facing upwards. A theoretical and experimental investigation of the appliance has shown as a matter of fact that the position of equilibrium of the user as referred to hereinafore may, under certain conditions, lack stability. It may occur, during operation, that the user changes suddenly the position of the board or boards carrying him with reference to the water surface, for instance when he simulates sudden movements such as turns, side slips, snow ploughs or the like. This may lead to a substantial alteration of the upwardly directed force referred to hereinafore and thereby either to a sudden sinking of the water skier whose weight has thus become suddenly predominant down to the lower end of the bottom or else in the opposite case, to a rising of the water skier into immediate proximity with the upper end of said bottom.

It has been found that the concavity in the longitudinal section of the bottom of the vat cooperates in a positive manner in ensuring stability by introducing into the equation defining the position of equilibrium referred to hereinafore a stabilizing factor constituted by the gradual variation along said longitudinal section of the component of the weight of the water skier along a parallel to the surface of said bottom. According to a particularly advantageous feature of my invention the vat bottom is pivotally mounted around substantially horizontal axis, so that its slope may be adjusted. This pivotal fitting allows, as will be readily ascertained, adjusting within a broad range the conditions of flow of the water over the bottom and in particular its speed and depth, so that the appliance may be adjusted for that sport which has been selected for practice. It is possible, for instance, to practise ordinary water-skiing by selecting a reduced slope for the bottom. For the practicing of water skiing with one's hands free or of surf-riding, in contradistinction, a steep slope should be used.

The stream of water used should generally be of the so-called torrential type, except for swimming purposes. It will be reminded that the expression "torrential flow" is opposed to the so-called river flow as well known for anyone studying the flow of water under free surface conditions. In the case of a torrential flow, the speed $V$ of the water is higher than a critical speed $V_c$ which is equal to the celerity of propagation in the flow of an infinitely small wave termed sometimes a translational wave. The value of $V_c$ for a flow over a depth $e$ is equal to $\sqrt{g/e}$ being the constant of gravity acceleration.

It is possible to use in practice a nozzle discharging onto the sloping bottom of the vat a stream of water having a reduced depth $e$ at a speed $V$ which is clearly higher than the critical value $V_c$ referred to and showing consequently the properties of a torrential flow; the operation of the appliance can be started with a reduced slope of the bottom, which slope is then gradually increased. The starting may also be performed through a sudden opening of the nozzle.

As a modification, it is possible to bring about a stream of a comparatively large depth of the so-called river type which allows practicing swimming, the speed of said stream being lower than the critical value $V_c$ referred to and being selected in conformity with the speed of the swimmer.

The following description and corresponding accompanying drawings are given by way of an example and in a nonlimiting sense so as to afford a proper understanding of the invention.

In said drawings:

DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates cross-sectionally through line I-I of FIG. 2 an appliance for practicing aquatic sports according to my invention;

FIGS. 2a and 2b shows the arrangement illustrated in FIG. 1, respectively as seen from above and cross-sectionally through line II-II of FIG. 1;

FIG. 3 is a plan view of a board or similar sliding support;

FIG. 4 is a cross section of FIG. 3 through line IV-IV of the latter;

FIG. 5 illustrates diagrammatically a further embodiment of an appliance according to my invention;

FIG. 6 illustrates the appliance according to FIG. 5 when assuming a sloping position;

FIG. 7 is a cross-sectional view of a third embodiment of my invention;

FIG. 7b is a diagrammatic explanatory view of a portion of FIG. 7;
FIG. 8 is a diagrammatic sectional view of a modification of the means feeding water into an appliance according to my invention.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Turning now to FIGS. 1, 2a and 2b, my improved arrangement includes a vat with a bottom 1 adapted to pivot round a transverse axis 12 and a nozzle 2 adapted to discharge water only the surface of said bottom 1, so as to form a stream having a depth a, the line carrying the reference number 3 defining the free surface of the stream.

The speed of the stream of water thus produced is sufficiently high, taking into account the depth a, for the flow to be of the toroidal type referred to hereinabove. As may be ascertained from inspection of FIG. 1, the upper surface of the bottom 1 slopes with reference to a horizontal plane and consequently the speed of the stream of water diminishes as the water rises along said bottom surface, so that the depth a of the stream of water increases gradually as it is considered further from the nozzle 2.

The depth of water may also be caused to increase suddenly in the vicinity of the upper section of the vat bottom, thereby forming a jump beyond which the flow becomes a river-type flow, the level of the free surface of the water in said downstream area being illustrated by the line 4.

It should also be remarked that the longitudinal section of the bottom 1 is incurved and has its concavity facing upwards.

The water stream is circulated back to the nozzle 2 in a closed circuit which in the example illustrated includes elongated slots 5 formed longitudinally at the upper end of the sloping bottom, bellows 6 underneath said slot, a chamber 7 and a return channel 8. The water flows in said circuit under the action of a pumping system constituted in the case illustrated by two propellers 9 driven by one or more power units 13.

Sidewalls 10 which are preferably inflatable are associated with the bottom 1 to form a complete vat adapted to be adjustably tilted round the pivotal axis 12. To this end, a jack 11 engages on the one hand the sloping bottom 1 and on the other hand a stationary frame. As illustrated in FIG. 1, the sloping bottom 1 is in its medial position while the extreme position of the sloping bottom are illustrated by the short lines a and a'.

The reference number 14 designates the anchoring means for skier-retaining cables 18 and the reference number 15 designates instruments giving out the speed of the stream of water at the outlet of the nozzle 2 and the actual position of the sloping bottom.

One or two sliding surfaces constituted for instance by boards 16 which are well known per se and are illustrated in FIGS. 3 and 4 allow simulating all the stages of water-skiing between low speed and full speed, upon setting of the sloping bottom 1 in a position lying between the horizontal position a and the position illustrated at b. The water skier is then held in position by the cables 18.

Steep or moderate slopes, lying between the position a illustrated and the position defined by the line c provide a transition towards water-skiing with one's hands free or towards surf-riding. The sliding surface or surfaces 16 are preferably provided with lateral walls 20 also known per se but of a larger size than hitherto so as to bound between the vat bottom 1 and the sliding surface 16 a water cushion according to the ground effect principles.

It is then possible for the water skier not only to keep his balance without resorting to the retaining cables 18 and by relying solely on the movements of his center of gravity, but furthermore he can modify the slope of the board or boards or the like sliding surfaces 16 so as to find those points near the nozzle where the speed of the water is higher or else water levels located further from the nozzle 2 and where the speed of the water is lower and the depth is larger.

FIG. 7bis shows how the surf-rider lying over a sliding board may, by engaging his feet more or less deep into the water, vary his own drag or resistance in the stream, whereby he may change his position to a large extent and simulate thus the practicing of a sport similar to tobogganing.

One or more transverse cables 19 serve as safety means prevent the water skier or surf-rider from coming too near the nozzle 2.

In the arrangement illustrated for the practice of surf-riding or water-skiing, the speed of the stream of water is higher than the speed Ve = ge as defined hereinabove so that the flow is actually of the toroidal type.

The appliance according to the invention allows also practicing swimming. To this end, the swimmer sets the bottom 1 into a slightly sloping position i.e. that illustrated at a and he fills the vat almost up to its upper edge. He resorts then to low speeds for the water stream, which stream is smoothed out by one or more grids 17 constituted for instance by perforated plates, nets or the like.

The speed of the stream of water may be adjusted, so as to match the speed of the swimmer, by acting on said grids or on the power unit 13 or again by acting on said grids or on the power unit 13 or again by partly covering or uncovering the slots 5 or by varying the depth of the stream or again by simultaneously acting on two or more of such adjusting means; in such a case the speed of the stream beyond the grids 17 drops underneath the critical speed Ve, the stream being then of the river flow type.

In the embodiment illustrated diagrammatically in FIGS. 5 and 6 those parts which are the same as those already described and illustrated in the preceding FIGS. are designated by the same reference numbers. The slope of the bottom surface may be controlled by tilting the entire appliance round axis 12a by means of jacks 11a; in this position founded by the sidewalks 10, storage compartments 21 may be formed, which compartments communicate with the vat proper through a channel 23, a pump 22 and a stopcock 24.

The arrangement includes as in the preceding embodiment a return channel 8, safety cables 19 and a nozzle 2. The position of the appliance as illustrated in FIG. 5 is that which may be used for swimming. The bottom is substantially horizontal, while the grids 17 are operatively positioned. The water is pumped out of the storage compartments 21 by the pump 22 and sent into the circuit, which produces a rising of the water level in the vat. It is also possible to use instead of the pump 22 the recirculation pump 9 provided the channel 23 is connected with a point of the circuit where the speed of flow is high.

In this last embodiment, the slope of a flap 25 closing the upper end of the nozzle 2 is adjustable so as to allow a sufficient flow-rate of water to flow under low speed conditions.

The position of the appliance as illustrated in FIG. 6 is that which is suitable for water-skiing or surf-riding. In this case, the compartments 21 are filled with water in a manner such that the depth of the stream of water may be reduced while the bottom is caused to slope by a tilting of the whole appliance and the grids 17 are dismantled.

In the embodiments illustrated in FIGS. 1 to 6, the means 9—13 urging the water into circulation require a comparatively low power which may even not be sufficient for the starting of said circulation when the bottom 1 is in a steeply sloping position. In such a case, the starting is performed by giving first a reduced slope to the bottom 1, for setting the water in motion, the water continuing its circulation when the slope of the bottom is gradually increased.

The embodiment illustrated in FIG. 7 relates more particularly to a large-scale appliance adapted for instance to be used in public baths. This arrangement includes a stationary vat 27 bounded by sidewalks 10 and by a sloping bottom 1; as in the preceding embodiments said bottom is concave upward.

A discharge nozzle 2 may be closed by a pivoting flap 25 the closed position of which is illustrated in FIG. 7 in dotted lines.
The vat 27 is adjacent a tank 36 lying at a higher level than said vat and filled with water up to a level 31. Said tank may be constructed for instance by a swimming pool directed flow of the pump 9, the flap valve 26 opens and the water is started circulating.

The appliance is started operating as follows:

The vat 27 is assumed to have been drained by means disclosed hereinafter, and the channel 8 is supposed to be closed by a flap valve 26 as illustrated in dotted lines. The motor 13 then starts, so as to drive the pump 9, and the nozzle 2 is speedily opened. A powerful stream of water flows during a short time out of the tank 36 and enters the slots 5. Under the head of water thus built up in addition to that supplied by the pump 9, the flap valve 26 opens and the water is started circulating.

As to skilled water skiers and the like, difficult and varied programs may be proposed to them, involving the use of small sliding boards, together with great water speeds and steeply sloping bottom surfaces for the vat, while the opening of the nozzle 2 may be subjected to speedy modifications and the retaining cables may be done away with and so on.

The appliance may be readily fitted in a house so as to allow practicing aquatic sports throughout the year. Beginners may be given all possible facilities such as large sliding boards, reduced water speed and low slope of the bottom, retaining cables and the like. Skilled water skiers and the like, difficult and varied programs may be proposed to them, involving the use of small sliding boards, together with great water speeds and steeply sloping bottom surfaces for the vat, while the opening of the nozzle 2 may be subjected to speedy modifications and the retaining cables may be done away with and so on.

Obviously the embodiments described have been given out solely by way of examples and it is possible to modify them chiefly by substituting technical equivalents for the parts disclosed, without widening thereby the scope of the invention as defined by the accompanying claims.

1. A surf-riding and water-skiing simulating and training appliance, comprising:
   an enclosure including a fixed bottom surface which slopes upwardly with reference to a horizontal plane for accommodating a surf-riding or water-skiing trainee wearing a surfboard or water skis, and
   means for constraining a shallow stream of water to flow up-slope over said bottom surface under steady flow conditions and at a velocity higher than \( v_{ge} \), \( g \) being the depth of the stream and \( g \) the constant of gravity acceleration for supporting the trainee facing downslope in a surf-riding or water-skiing stance on said board or skis, whereby to enable said trainee to retain a stable equilibrium position under the influence of a first force ascribable to the drag of said board or skis dipped in said high-velocity stream, and of a second, downslope-directed force ascribable to the component of the weight of the trainee in a direction parallel to said sloping bottom surface.

2. An appliance as claimed in claim 1, wherein the longitudinal section, with reference to the general direction of the stream of water, of said bottom surface is a curve having a concavity facing upwards at least over the major part of its length.

3. An appliance as claimed in claim 1, further comprising means hingedly supporting said fixed bottom surface about a substantially horizontal axis transversely directed, with reference to the general direction of flow of the stream of water, and means for tilting said bottom surface about said axis to an adjustable extent, whereby to adjust the slope of said fixed bottom surface to a predetermined value.

4. An appliance as claimed in claim 1, wherein the means constraining a stream of water to flow under steady flow conditions over said upwardly sloping fixed bottom surface include at least one nozzle means adapted to steadily discharges a jet of water onto said bottom surface in the vicinity of a lower region of said surface and in the direction of a higher region of said surface.

5. An appliance as claimed in claim 4, further comprising means for adjusting the cross-sectional area of said nozzle means to a predetermined value.

6. An appliance as claimed in claim 1 wherein said enclosure, further comprises sidewall means bounding a vat means the bottom of which is formed by said bottom surface.

7. An appliance as claimed in claim 6, wherein the means constraining a stream of water to flow under steady flow conditions over said upwardly sloping bottom surface of said vat means include a return pipe means and means for bringing about a steady recirculation of water through a circuit including said bottom surface and said return pipe means.

8. An appliance as claimed in claim 7, wherein said return pipe means form with said vat means an integral unit including said circuit, said appliance further comprising means hingedly supporting said unit about a substantially horizontal transverse axis, and means for tilting said unit about said axis to an adjustable extent, whereby to adjust the slope of the fixed bottom surface of said vat means, to a predetermined value.

9. An appliance as claimed in claim 7, further comprising water storage means integral with said vat means, means connecting said storage means with said circuit, said connecting means comprising valve means and pump means, whereby
water may be pumped from said storage means and sent into the circuit, and conversely.

10. An appliance as claimed in claim 1, wherein the means constraining a stream of water to flow under steady flow conditions over said upwardly sloping bottom surface include a return pipe means and means for bringing about a steady recirculation of water through a circuit including said bottom surface and said return pipe means.

11. An appliance as claimed in claim 10, wherein the means for bringing about a steady recirculation of water comprise a pump means and a power unit for driving said pump means.

12. An appliance as claimed in claim 11, wherein said power unit comprises a hydraulic engine.

13. An appliance as claimed in claim 11, wherein said power unit comprises a heat engine, said appliance further comprising heat exchanger means for transferring the lost heat from said engine to the water of said circuit.

14. An appliance as claimed in claim 10, erected near a waterfall, wherein the means for bringing about a steady recirculation of water comprise a pump means, a hydraulic engine for driving said pump, and means whereby the hydraulic engine is driven by the head of water corresponding to said waterfall.

15. An appliance as claimed in claim 10, wherein the means for bringing about a steady recirculation of water comprise an ejector pump means, and means for supplying said ejector pump means with an inducing stream of water.

16. An appliance as claimed in claim 10, erected near a waterfall, wherein the means for bringing about a steady recirculation of water comprise an ejector pump means, and means for supplying said ejector pump means with an inducing stream of water with a head corresponding to said waterfall.

17. An appliance as claimed in claim 1, wherein the means constraining a stream of water to flow under steady flow conditions over said upwardly sloping fixed bottom surface include a body of water having a water level which is higher than the upper end of said bottom surface, and means continuously connecting said body of water with a lower region of said bottom surface.

18. An appliance as claimed in claim 1, erected near a waterfall which extends between a first body of water with a relatively higher water level and a second body of water with a relatively lower water level, wherein the means constraining a stream of water to flow under steady flow conditions over said upwardly sloping fixed bottom surface comprise means continuously connecting said first body of water with a lower region of said bottom surface, and means continuously connecting said second body of water with an upper region of said bottom surface.