

Oct. 5, 1971

SEIICHI MABUCHI
WATER WALKING APPARATUS

3,609,782

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2 Sheets-Sheet 1

FIG. 1.

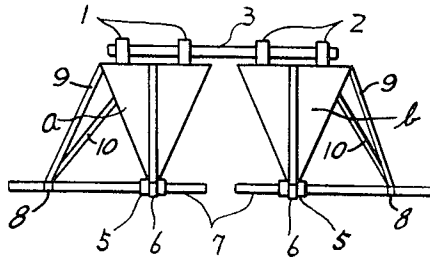


FIG. 2.

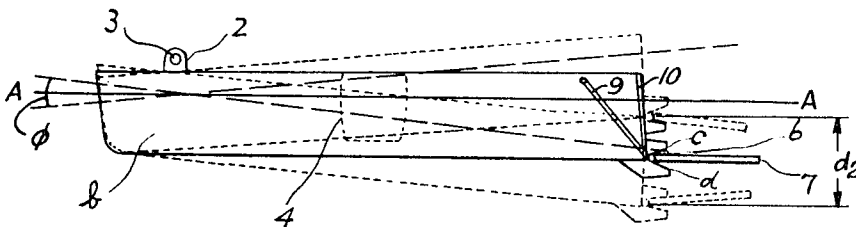
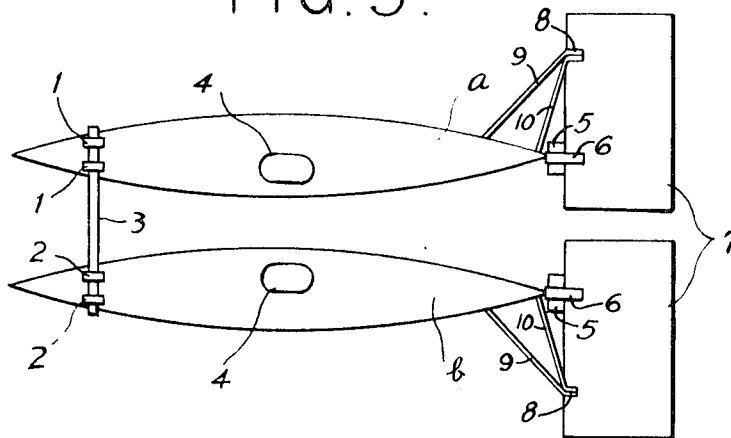


FIG. 3.



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FIG. 4.

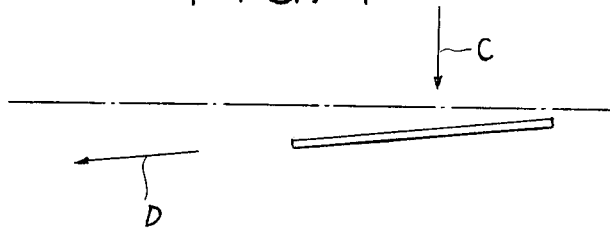


FIG. 5.

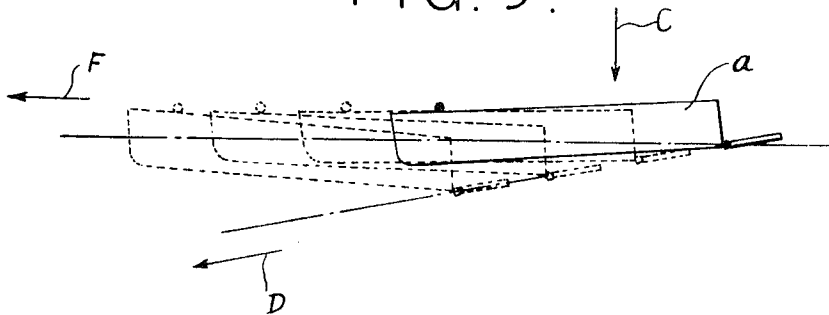
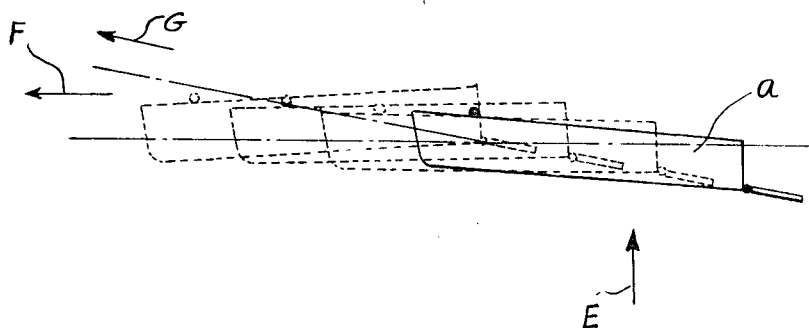


FIG. 6.



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WATER WALKING APPARATUS

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Continuation-in-part of application Ser. No. 637,234,
May 9, 1967. This application Nov. 10, 1969,
Ser. No. 875,102

Claims priority, application Japan, Oct. 13, 1966,
41/67,525

Int. Cl. A63c 15/04

U.S. Cl. 9—310 D

24 Claims

ABSTRACT OF THE DISCLOSURE

A water walking apparatus having boat-like bodies arranged parallel to each other. The front portions of said boat-like bodies are interconnected to each other in such a manner that they are capable of moving pivotally up and down alternately; the rear portions of which are provided with submerged, inclinable rigid plates associated with stop means which limits their movement to a small angle.

This is a continuation-in-part of my earlier application Ser. No. 637,234, filed May 9, 1967, now abandoned.

This invention relates to an occupant-propelled water walking apparatus which enables its rider to travel a long distance by exerting approximately the same amount of effort as when walking on land.

Generally, water walking apparatus which uses a rider's foot powder involves the rotation of a propeller or a water wheel or the oscillation of a boat-like body in the shape of an oar as a propulsive means. Another apparatus utilizes a pair of interconnected hulls, each of which has a flexible vane extending rearwardly therefrom.

A characteristic of these various types of water walking devices is that each of them has a mechanism to move the boat-like body forward by exerting a sudden and hard force on the water to push it in a rearward direction. This creates turbulence in the water which, of course, needlessly dissipates the energy exerted by the rider. Consequently the rider becomes tired quickly and is unable to travel for long periods or over substantial distances.

In contrast, the water walking apparatus of the present invention has submerged pivotally movable rigid plates which slide or glide diagonally forward as force is applied to them in a vertical direction. This results in a relatively non-turbulent action which, nevertheless, causes its boat-like body to move forward. The waste of a rider's energy is so negligible that he can, easily and safely, travel over water for a long distance. It may be said, therefore, that the apparatus of the present invention has opened up a new frontier in the field of watercraft.

One embodiment of the present invention is shown in the accompanying drawings.

FIG. 1 is a front view of the water walking apparatus embodying the principles of the invention.

FIG. 2 is a side elevation of one hull of the water walking apparatus in its central position, and showing phantom line representations of the upper and lower positions of the hull bodies when in operation.

FIG. 3 is a plan view of the water walking apparatus.

FIG. 4 is a side view diagrammatically showing a plane sliding operation.

FIGS. 5 and 6 are side elevational views of the water walking apparatus showing the manner in which it moves forward.

The following is a detailed description of one embodiment of the present invention.

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The apparatus preferably has a pair of adjacent parallel buoyant hulls *a* and *b* which are arranged parallel to each other and are provided with holes 4 which receive the feet of a rider. These hulls are pivotally interconnected by a rod 3 which passes through the bearings 1 and 2 which are located at their forward portions. Thus, the boat-like bodies *a* and *b* are capable of moving alternately up and down by relatively rotating about the axle pin 3.

Toward the rear of the hulls *a* and *b*, there are a pair of plates 7 which have exposed forward edges and are pivotally attached to the boat-like bodies *a* and *b* by means of hinged connections 5 and 8. The hinged connections 5 are located in the vertical centerline plane of each respective hull while the connections 8 are located at the outer end of the outriggers 9 and 10.

Pivotal movement of the plates 7 is limited by stop means such as the fittings 6 which provide the inclined stop surfaces *c* and *d* lying above and below the plates 7. The fittings 6 control the pivotal movement of the plates 7 to limit their angular movement.

In operating the apparatus of the present invention, the hulls *a* and *b* are first floated. Then, a rider places his feet into the holes 4 shown in FIG. 3, and steps on the hulls *a* and *b* in an alternate fashion. By so doing, the rider's weight is applied to hulls so that each of the rear portions of boat-like bodies and the pivotal connection of the plates 7 rises toward the water surface and sinks under water alternately.

The pivotal connection of the hulls through the axle pin 3 results in a transferred buoyant force from one hull to the other, as the axle pin 3 maintains at a constant elevation from the water.

When one of the boat-like bodies *a* sinks under a rider's weight, applied in the direction of arrow C, its plate inclines in such a way that its rear portion is slightly higher than its front portion. The plate 7 then glides forwardly as shown in FIG. 4 in the direction of the arrow D to propel the hull. Of course the inclination of the plates with respect to the water surface will change slightly during this downward movement since the stop surface *c* is attached to and inclinable with its respective hull.

When the rider then shifts his weight to the hull *b*, the hull *a* is released so its rises due to its own buoyancy creating a force in the direction of arrow E in FIG. 6. The force of water acting on the plate 7 of the upwardly moving hull *a* changes the position of plate 7 so that it becomes inclined downwardly and rearwardly. In this way, the hulls move forward as the rider shifts his weight to change the effective center of gravity of the system. As the hull continues its upward movement, the associated plate glides in the direction of the arrow D to propel the apparatus in the direction of arrow F.

It has been found that the efficiency of this apparatus is materially affected by the extent to which the propulsion plates 7 are vertically movable about their pivot axes. If their movement is too small or too great, their ability to propel the apparatus is significantly diminished. Some of the factors to be considered in designing water walking apparatus of this type may best be understood by referring to FIG. 2 where the line A—A represents a plane conveniently referred to as a "reference plane," the location of which is established by the waterline of the respective hull when a rider distributes his weight evenly on both of the hulls *a* and *b*. For purposes of illustration, the ordinary rider may be assumed to have a weight of 150 pounds so that 75 pounds will be supported by each of the hulls. The reference plane is by definition inclinable with its respective hull so that its angular displacement as it moves from its lower inclined position

to its upper inclined position, both of which are shown in broken lines in FIG. 2, will be an angle ϕ . Satisfactory models have been constructed wherein the angle ϕ is approximately 10° .

Each of the plates 7 is movable from a first position where it extends upwardly and rearwardly at an acute angle to the reference plane of its respective hull to a second position where it extends downwardly and rearwardly at an acute angle to the reference plane of its respective hull. In FIG. 2, the plate is shown in its first position when the hull at its lower inclined position, and the plate is shown in its second position when the hull is in its upper inclined position. Preferably, the sum of the two acute angles described above, which is also its total angular movement with respect to the hull as it moves from the stop *c* to the stop *d* is no greater than the total angular movement of its hull which is represented by the angle ϕ . However, it has been found that when the angle ϕ is approximately 10° , the angular movement of the respective plate, i.e. the sum of the acute angles, is from 8° to 17° so that when the acute angles are equal, they range from about 4° to 8° . Another way of expressing the angular movement of the plates is to state that the total angular movement represented by the sum of the two acute angles is from -3° to $+8^\circ$.

Furthermore, it has been found that the vertical movement of the center of the plate area has a bearing on the operation of the apparatus. The vertical distance through which the center of the plate area moves with respect to its associated hull is preferably no greater than one-half the vertical movement of the plate pivot axis which is represented in FIG. 2 as the distance *d2*. In the event that some portion of the plate lies forwardly of the plate pivot axis, the forward portion is to be disregarded when analyzing this relationship. For this reason, this aspect of the invention may be described by stating that *d1* is no greater than $0.25 d2$ when *d1* is the maximum vertical distance between the reference plane and the center of the plate area lying rearwardly of the plate pivot axis, and *d2* is the vertical movement of the plate pivot axis as the reference plane moves from its lower inclined position to its upper position.

Experimentation with this apparatus has also shown that the plates contribute to the stability of the apparatus by virtue of the substantial area of each of the plates since each plate preferably has dimensions of 40 by 60 cm. to furnish a surface area of at least 350 square inches. This size also provides a substantial amount of resistance to vertical movement, thereby slowing the vertical movement, minimizing turbulence and promoting the important water gliding action.

Although the hulls may assume various shapes within the spirit of the invention, the preferred and illustrated shape has been found to be especially suitable. Each of the hulls is generally V-shaped in transverse cross section and that portion which lies below the respective reference plane has a transverse cross section which is greater in height than in width. The disclosed shape cuts easily through the water and does not displace a significant amount of water in forward and rearward directions as the hull moves from its upper inclined position to its lower inclined position. A transverse cross section having a greater height than width is desirable in that it promotes a maximization of the vertical movement of the plate pivot axis.

In further explanation, the water gliding action utilized in this invention is similar in character to the gliding action of a glider in the air. It may be explained by visualizing a horizontally oriented iron plate being placed under water and released. It will sink in a vertical direction. However, if this plate is supported under water at a slight inclination and then released, the gravitational effect on the iron plate, coupled with the resistance to vertical movement, will cause it to slide in a direction

of its inclination. The resulting horizontal movement is called the "water gliding action" in this specification.

To further illustrate this principle, suppose a buoyant board-like body is immersed in a horizontal orientation and then released. If the board remains horizontal, it will rise vertically and no horizontal sliding action results. But if the buoyant board is supported under water at a slight inclination and then released, the board will move horizontally and slightly upwardly in a direction of its inclination. This is its gliding action.

This invention is of particular significance since it utilizes the same water gliding action described above to enable an average man to cover a distance of about 30 km. or 40 km. without any appreciable fatigue.

I claim:

1. Water walking apparatus including a pair of buoyant hull means pivotally interconnected for relative movement about a transverse hull pivot axis, each of said hull means being constructed to float in water when a rider's weight is equally shared by both hull means at a depth and orientation where its waterline defines a reference plane which passes through and is inclinable with the hull means, each of said hull means having means spaced from the hull pivot axis for supporting a rider so that a rider placing his entire weight on either of the hull means will cause movement of the reference plane of one hull means to a lower inclined position and movement of the reference plane of the other hull means to an upper inclined position, an angle ϕ lying between the reference plane of each hull means when in its upper and lower inclined positions, each of said hull means having a submerged rigid propulsion plate connected thereto at a location spaced from the hull pivot axis, each said plate being supported for inclination about a transverse plate pivot axis and having an exposed leading edge, means for limiting the inclination of each said plate from a first position where it extends upwardly and rearwardly at an acute angle to the reference plane of its respective hull means to a second position where it extends downwardly and rearwardly at an acute angle to the reference plane of its respective hull means, each said plate being freely movable from its first position to its second position so that it will assume its first position when its associated hull means is moved downwardly under the influence of a rider's weight, and the plate will move to its second position upon upward movement of its hull means under the influence of buoyant forces when a rider's weight is released from the associated hull means.

2. Apparatus according to claim 1 wherein the sum of the acute angles of each plate is between about $\phi-3^\circ$ and $\phi+8^\circ$.

3. Apparatus according to claim 1 wherein the means for limiting the inclination of each said plate is constructed to limit said acute angles to from about 4° to 8° .

4. Apparatus according to claim 3 wherein *d1* is no greater than $0.25 d2$, when *d1* is the maximum vertical distance between the reference plane and the center of the plate area lying rearwardly of the plate pivot axis, and *d2* is the vertical movement of the plate pivot axis as the reference plane moves from its lower inclined position to its upper inclined position.

5. Apparatus according to claim 3 wherein the portions of each of said hull means lying below the respective reference plane has a transverse cross section which is greater in height than width.

6. Apparatus according to claim 3 wherein each of the hull means is generally V-shaped in transverse cross section.

7. Apparatus according to claim 3 having two spaced apart pivotal supports for each of said plates, one of said pivotal supports being located on an outrigger which projects laterally from the respective hull means.

8. Apparatus according to claim 3 wherein each of the plates has a surface area of at least 350 square inches.

9. Apparatus according to claim 3 wherein the means

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for limiting the inclination of each plate is an abutment member attached to and inclinable with the associated hull means.

10. Apparatus according to claim 1 wherein the means for limiting the inclination of each said plate is an abutment attached to and inclinable with the associated hull means, and the angle ϕ is no greater than the sum of said acute angles assumed by the associated plate.

11. Apparatus according to claim 10 wherein $d1$ is no greater than $0.25 d2$, when $d1$ is the maximum vertical distance between the reference plane and the center of the plate area lying rearwardly of the plate pivot axis, and $d2$ is the vertical movement of the plate pivot axis as the reference plane moves from its lower inclined position to its upper inclined position.

12. Apparatus according to claim 10 wherein the portions of each of said hull means lying below the respective reference plane has a transverse cross section which is greater in height than width.

13. Apparatus according to claim 10 wherein each of the hull means is generally V-shaped in transverse cross section.

14. Apparatus according to claim 10 having two spaced apart pivotal supports for each of said plates, one of said pivotal supports being located on an outrigger which projects laterally from the respective hull means.

15. Apparatus according to claim 10 wherein each of the plates has a surface area of at least 350 square inches.

16. Apparatus according to claim 1 wherein $d1$ is no greater than $0.25 d2$, when $d1$ is the maximum vertical distance between the reference plane and the center of the plate area lying rearwardly of the plate pivot axis, and $d2$ is the vertical movement of the plate pivot axis as the reference plane moves from its lower inclined position to its upper inclined position.

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17. Apparatus according to claim 16 wherein the means for limiting the inclination of each said plate is constructed to limit said acute angles to from about 4° to 8° .

18. Apparatus according to claim 16 wherein the means for limiting the inclination of each said plate is an abutment attached to an inclinable with the associated hull means, and the angle ϕ is no greater than the sum of said acute angles assumed by the associated plate.

19. Apparatus according to claim 16 wherein the sum of the angles of each plate is between about $\phi-3^\circ$ and $\phi+8^\circ$.

20. Apparatus according to claim 16 wherein the portions of each of said hull means lying below the respective reference plane has a transverse cross section which is greater in height than width.

21. Apparatus according to claim 16 wherein each of the hull means is generally V-shaped in transverse cross section.

22. Apparatus according to claim 16 having two spaced apart pivotal supports for each of said plates, one of said pivotal supports being located on an outrigger which projects laterally from the respective hull means.

23. Apparatus according to claim 16 wherein each of the plates has a surface area of at least 350 square inches.

24. Apparatus according to claim 16 wherein the means for limiting the inclination of each said plate is an abutment member attached to and inclinable with the associated hull means.

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