Feb. 26, 1963 W. K. CROWDER 3,078,482

SWIMMING ACCESSORY

Filed May 11, 1959

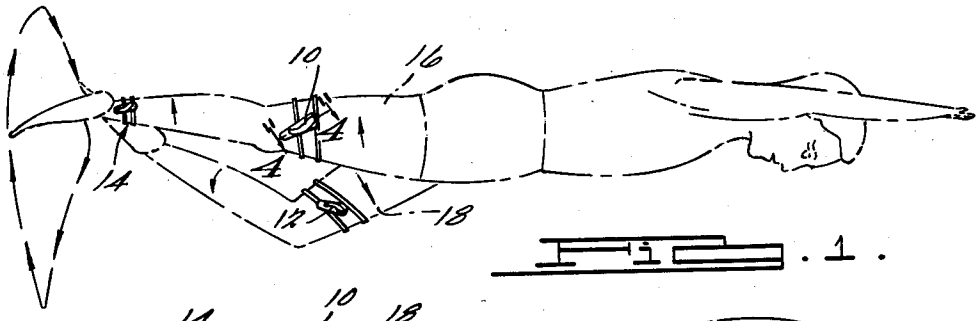


FIG. 1.

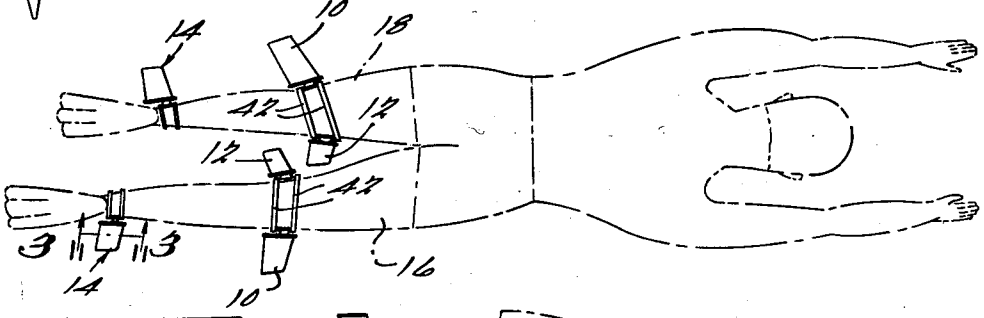


FIG. 2.

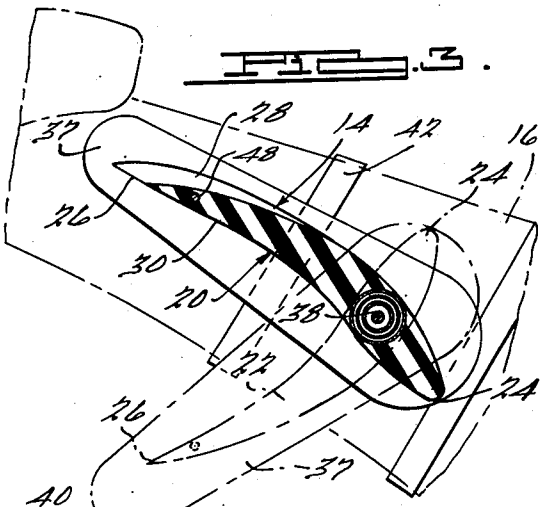


FIG. 3.

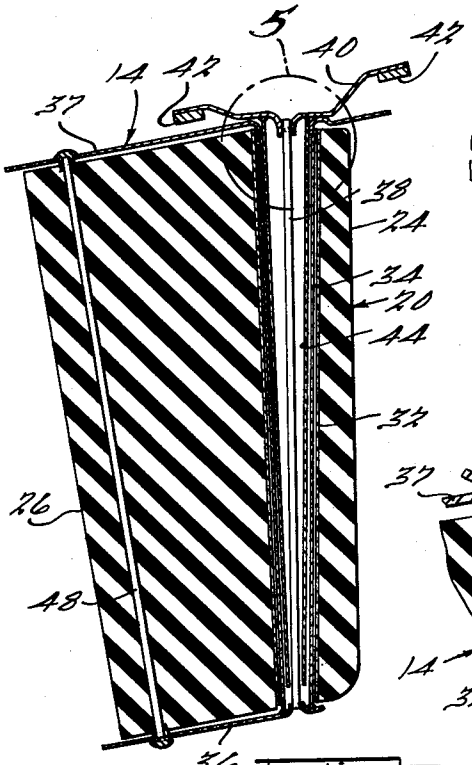


FIG. 4.

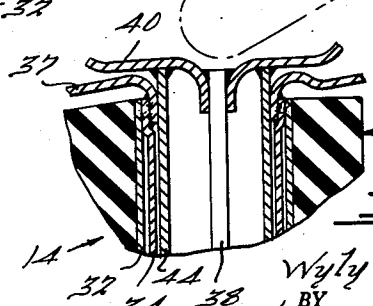


FIG. 5.

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SWIMMING ACCESSORY

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The present invention relates to an improved swimming accessory for attachment to the legs of a swimmer to achieve improved utilization of leg muscles in propulsion of a swimmer through the water.

One important object of the present invention is to provide an improved propulsion device for attachment to a swimmer's legs.

Other objects of the invention are: to provide an improved device of this character whereby normal flexing of the swimmer's leg as in walking is translated into an effective forward propulsion in a direction generally longitudinally along the swimmer's body; to provide a propulsion device of this character which is effective to produce a forward propulsion force on each stroke of the swimmer's leg with a relatively high degree of efficiency; to provide an improved device of this character which is constructed in the form of a variable hydrofoil having an automatically reversible camber so that it is equally effective on both the up and the down leg strokes; to provide an improved swimming propulsion device for attachment to a swimmer's leg which is effective to create a relatively strong forward propulsive force in response to relatively easy flexing motion of the leg in a vertical direction; and in general to provide an improved device of this character which is relatively simple and inexpensive in construction, and which is easy and comfortable to use, permitting the swimmer to propel himself with an easy, natural leg motion.

The foregoing and other objects and advantages of the invention will become apparent from the following detailed description of a preferred embodiment thereof, taken in conjunction with the drawing, wherein:

FIGURE 1 is a side elevational view of a swimmer equipped with propulsion devices according to the invention;

FIGURE 2 is a plan view of the swimmer shown in FIGURE 1;

FIGURE 3 is a sectional view of one of the propulsion devices according to the invention, the view being taken along the line 3—3 of FIGURE 2;

FIGURE 4 is a horizontal sectional view of the device shown in FIGURE 3; and,

FIGURE 5 is an enlarged view of the portion of FIGURE 4 within the circle 4 thereof.

The muscles in the human leg are naturally highly developed for walking and running. They also adapt readily to bicycle riding. Bicycle riders use hip, knee and ankle muscles much in the same manner as they are used in walking or running. In swimming, however, the general instruction is to "stiffen the knees and kick from the hips." Even with the popular "webbed foot" attachment, the same instruction still applies. A considerable amount of effort is required to keep the swimmer's legs relatively stiff, effort which does not do any work and does not produce a forward thrust. The propulsion device of the present invention permits a swimmer to avoid the strain of keeping his legs stiff, and permits him to use his already developed walking and running muscles in their natural action to produce a forward propulsion force.

Broadly, the device of the present invention consists of a flexible hydrofoil mounted for limited angular oscillation on a supporting structure which may be strapped to the swimmer's leg. The hydrofoil is spring urged toward a neutral position and is rotatably deflectable against the urging of the spring away from its neutral position in either direction, depending upon the direction of the leg movement. In its unstressed condition, the hydrofoil has no camber, but it flexes in response to water resistance to a cambered shape, with the camber in one direction during the upstroke of the leg, and in the opposite direction during the downstroke. This camber action is an important feature of the present invention since it achieves smooth acceleration of the water in the rearward direction as the water passes along the hydrofoil.

Referring now to the drawing, a set of propulsion devices **10**, **12**, and **14** are illustrated therein attached to the legs **16** and **18** of a swimmer. The devices **10**, **12**, and **14** are essentially similar to each other except for differences in size. Preferably, the devices **10** and **12**, which are attached to the swimmer's thighs just above the knee, are relatively large since the muscles which operate the thigh are relatively large and strong. The devices **10** on the outer sides of the legs may be relatively long, and to allow adequate clearance, the devices **12** mounted on the inner sides of the legs are relatively short. The devices **14** which are attached at the ankles may be smaller than the thigh-attached devices **10** and **12** in view of the difference in muscle strength for driving them. Since the devices **10**, **12**, and **14** are all exactly similar to each other, except for differences in size, their construction and operation may be fully appreciated by a consideration of the device **14** which is shown in detail in FIGS. 3, 4, and 5.

The propulsion device **14** includes a hydrofoil **20**, which is made of a resiliently yieldable material such as molded rubber, and is formed in a shape generally similar to that of an airplane wing of symmetrical cross section. When the hydrofoil **20** is in its normal, unstressed condition, its upper and lower surfaces **28** and **30** are symmetrically disposed relative to each other on opposite sides of a median plane, and the hydrofoil has no camber. The hydrofoil **20** is mounted so that it flexes automatically to a cambered form during use, as shown in FIG. 3. The hydrofoil **20** is fixed to a camber pitch tube **32**, which extends longitudinally through the hydrofoil near its leading edge **24**, and forward of its longitudinal center line. The camber pitch tube **32** is rotatable on a main pitch tube **34**, which extends coaxially within the camber pitch tube and is rigidly secured as by welding to outer and inner plates or shields **36** and **37**, respectively. The outer shield **36** is rigidly secured to the outer end of an elongated torsion spring **38**, which extends coaxially within the main pitch tube **34**, and which is anchored at its inner end upon the support bracket **40**. In this manner the wing **20** is mounted for limited angular oscillation about the axis of the torsion spring **38**. The support bracket **40** may be of any desired shape to conform to the swimmer's leg and may be attached thereto by an convenient means such as the straps **42**, illustrated. A support tube **44** is also rigidly secured to the mount **40** and extends within the main pitch tube **34** and around the torsion spring **38** to maintain the torsion spring in proper alignment and support it against lateral deflection. A camber pitch bar **48** extends between the inner and outer shields **36** and **37**, respectively, passing through the hydrofoil **20** near the trailing edge **26** thereof. The bar **48** is a slip fit within the hydrofoil **20**.

In operation, the angle of incidence of the hydrofoil **20** is determined by the resilience of the torsion spring **38** and the velocity and direction of the device through the water. The axis of support is forward of the center line of the hydrofoil **20** so that the hydrofoil tilts responsively to the force exerted upon its upper and lower surfaces **28** and **30**, respectively, producing an inclined plane effect to convert the vertical leg movement into a forward thrust.

The inclined plane effect is augmented by the camber action of the hydrofoil **20**, which flexes during use to a cambered form concave in the direction of its motion. The hydrofoil **20** is made of a flexible and resilient material such as molded rubber, and is supported forward of its center line upon the main pitch tube **34** and aft of its center line upon the pitch bar **48**. This construction permits the hydrofoil **20** to flex in the manner illustrated in FIGURE 3 in response to loading in either direction. The camber action contributes to the efficiency of the hydrofoil **20**, causing the water to be uniformly accelerated rearwardly as it passes across the hydrofoil from the leading edge **24** toward the trailing edge **26**, so that the entire surface area of the hydrofoil **20** is effective to develop forward thrust. The camber action, and the streamlined shape of the hydrofoil **20** minimize drag. The device is thus effective to assist the swimmer to gain maximum forward thrust with a minimum expenditure of effort.

In use, the devices **10**, **12**, and **14** are secured to the swimmer's legs, and the swimmer uses a natural leg motion, permitting his legs to flex moderately as in walking. Excessive flexing is not desirable because of drag due to the legs themselves. As the legs move up and down, the hydrofoils tilt back and forth to adjust their angles of incidence in accordance with the direction of leg motion, and also flex as hereinabove described in response to the water pressure to a cambered shape concave in the direction of the leg motion to produce maximum forward thrust.

What is claimed is:

1. A water propulsion device for translating an oscillating driving motion into a thrust in a direction generally transverse to the driving motion comprising a flexible hydrofoil, means for mounting said hydrofoil for limited angular oscillation about an axis generally perpendicular to both the desired direction of thrust and to the direction of the oscillating driving motion, and means supporting said hydrofoil for flexing into an arcuate form concave in the instantaneous direction of the driving motion.

2. A water propulsion device adapted to be worn by a swimmer comprising a flexible wing-like member, means for mounting said member for oscillation about an axis generally parallel to and forward of a line midway between the leading and trailing edges of said member and constituting the sole connection of said member to said swimmer, and means for restricting flexing of the trailing edge of said member relative to said means, whereby surface loading of said member causes it to flex into arcuate form concave toward the loading force.

3. A swimming accessory for attachment to a swimmer's leg to produce a forward thrust in response to flexing of the leg comprising a flexible hydrofoil, and means for attaching said hydrofoil to a swimmer's leg, said attaching means including a pivot for pivotally mounting said hydrofoil, means for fixing said pivot upon the swimmer's leg in a position projecting laterally therefrom, a spring for resiliently urging said hydrofoil about said pivot toward a predetermined angular position relative to the swimmer's leg, and rigid means connecting portions of said hydrofoil adjacent the leading and trailing edges thereof so that said hydrofoil flexes in response to surface loading into arcuate form concave toward the loading force.

4. A swimming accessory for attachment to a swimmer's leg to produce a forward thrust in response to flexing of the leg comprising a flexible hydrofoil, and mounting means for mounting said hydrofoil upon a swimmer's leg, said mounting means including an elongated torsion spring, attaching means for attaching said spring at one end thereof in fixed position upon a swimmer's leg and projecting therefrom, a pivot fixed to the end of said spring opposite from said one end and extending through said hydrofoil, a pair of rigid shields mounted at opposite ends of said pivot and fixed relative thereto, means journaling said hydrofoil upon said pivot between said shields along a line forward of the center line of said hydrofoil, and means connecting said shields to said hydrofoil adjacent to the trailing edge of said hydrofoil, whereby the yieldability of said torsion spring permits tilting of said hydrofoil in a direction to provide a forward thrust in response to a transverse leg motion and said hydrofoil is caused by the water resistance to flex into arcuate form concave in the direction of the leg motion thereby to accelerate the water rearwardly as it passes over the working surface of the hydrofoil.

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