

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FOIL BOARDING COMPANY, INC.

Petitioner,

v.

MHL CUSTOM, INC.

Patent Owner

U.S. Patent Nos. 9,359,044 and 9,586,659
IPR Case Nos.: IPR2024-00086 and IPR2024-00085

DECLARATION OF JACOB W. LANGELAAN, PHD

1. My name is Jacob W. Langelaan. I am a professor of aerospace engineering at the Pennsylvania State University. Aerospace engineering is the branch of engineering that deals with the research, development, design, construction, testing, and flight testing of aircraft. I am also the sole inventor of U.S. Patent Nos. 9,359,044 (the '044 Patent) and 9,586,659 (the '659 Patent).

2. I have had an interest in watersports my entire life. I have been involved in the sport of rowing (crew) since my early teens and I have enjoyed canoeing, sailing, windsurfing for decades. When I moved to central Pennsylvania (Penn State is in the town of State College, right in the middle of the state), there was not much of an opportunity for sailing or other watersports so I began thinking of new ways to enjoy the water. I wasn't interested in watercraft such as jet skis and I began thinking about and looking for small, easily portable personal watercraft so that I could engage in a watersport activity on inland bodies of water such as lakes or rivers. I did not find any such product that matched what I was looking for.

3. In approximately 2012, after finishing a large research project on electric-powered aircraft, I began thinking about electric powered surfboards. Unfortunately, the power required to operate a surfboard at the speeds I wanted to go (15 to 20 miles per hour, similar to waterskiing or wake boarding) was too high: I'd need to carry a very large battery to be able to ride for a reasonable amount of

time. The flash of inspiration was incorporating a hydrofoil: the power required to operate a hydrofoil is about a fifth of the power needed to operate a planing-hull watercraft such as a surfboard. This meant that I could ride at “fun” speeds for a reasonable time with a much smaller battery. I also decided it would be fun challenge to try to make this electric powered hydrofoil surfboard rideable using weight shift control: I’d be able to ride it without needing moveable control surfaces. This was a big change from traditional hydrofoils: up to that point, successful powered hydrofoils (ranging from large ocean-going vessels to small single-person boats) had all used control surfaces similar to those found on airplanes to enable stabilization and control. But I really wanted something I could ride like a snowboard or surfboard, and it would be worth the effort to see if it could be done.

4. I started working on the design and performing calculations needed to figure out how much power such a device would take and if the device could be stable and controllable. Initially, these designs and calculations were done using a combination of open source aerodynamic analysis tools (Athena Vortex Lattice, commonly called AVL, as well as XFOIL) and some computer programs that I wrote myself to analyze power, stability, and controllability. After working through these calculations and settling on a hydrofoil design that I thought would work and was mathematically stable, I began working on the full watercraft design.

After finalizing the design, in October 2013, I filed a provisional patent application directed to a weight-shift controlled electrically powered hydrofoil watercraft.

5. As part of the development process, I did extensive research to assess the current state of the art: I wanted to know what else was out there and if this had already been done. This was done through a long series of internet searches using Google, Google Scholar, Google Patents, and later the U.S. Patent and Trademark Office (USPTO) website. I used search terms such as “powered surfboard,” “electric powered surfboard,” “hydrofoil surfboard,” “electric hydrofoil,” “electric powered hydrofoil,” “electric powered hydrofoil surfboard,” and various other search terms, combinations of search terms, and other keywords that came up during my searches. I found a lot of interesting things: numerous surfboards powered by small internal combustion engines (JetSurf was a notable example); electric powered surfboards; electric-augmented surfboards designed to help a surfer paddle out through the break; electric augmented stand-up paddle boards that would help a paddler travel farther or more easily travel upwind; small hydrofoil boats and hydrofoil sailboats; hydrofoils for ocean wave surfing, wind surfing, and kite surfing; a form of waterski with a hydrofoil (marketed as the “Air Chair”); and even an electric powered hydrofoil surfboard that incorporated control surfaces, a steering mechanism, and a stabilization mechanism (the “Chen” patent, US 7,047,901 B2). But none of these matched what I wanted: a self-propelled

hydrofoil surfboard that was inherently passively stable and could be controlled using weight shift, that I could put in the back of my car so I could go ride on the lake a half-hour drive from my house.

6. After speaking with a patent attorney about the provisional patent application, I also searched by classification on the USPTO website. All of the results of my searches were included in my submission to the USPTO, as I believed it was important for the patent examiner to see these in order to know how my invention fit into the broader context of the art, and because of the duty to disclose all information known to be material to patentability.

7. It wasn't until Fall 2017 that I first learned of a student project at KTH Royal Institute of Technology, Sweden called Evolo. I did not find anything related to the Evolo project, for example the Evolo Report, Evolo videos, articles, or anything else related to the Evolo project during my extensive searching.

8. The provisional patent application filed in October 2013 ultimately became the '044 Patent, which issued on June 7, 2016. A continuation application was also filed (on March 8, 2016) that ultimately became the '659 Patent, which issued on March 7, 2017. At a high level the '044 and '659 Patents cover a passively stable weight-shift controlled electrically-powered hydrofoil personal watercraft. In other words, an entire hydrofoil watercraft. In this context a hydrofoil is essentially an aircraft wing that flies under water, and in the case of the

‘044 and ‘659 Patents, the hydrofoil is sized to support the weight of a rider located on a surfboard-like floatation device. The hydrofoil is attached, via a strut, to the flotation device on which a user can lay, kneel, or stand. Once moving, a user can control the device using only the shifting of their weight (e.g., by leaning forward, backward, right, or left). The ease of use, stability, and ability to control the device by only weight shift has been what has made MHL’s commercial embodiments of the ‘044 and ‘659 Patents so popular.

9. After receiving funding from the Ben Franklin Organization (a state of Pennsylvania organization), I was able to fund building a prototype. I began prototyping and testing the watercraft in spring of 2014 (once the local lake had thawed).

10. Below is an image of me riding the first prototype of my invention in July of 2014. As you can see, the prototype was developed using a variety of commercially available parts, including a styrofoam, Costco surfboard, a waterproof case from Cabela’s to house the battery, and a small push button throttle. There is also a leash, which you can see in the picture, that was there to make sure I did not accidentally yank the throttle cable out from the surfboard. You can also see in this image that there is a strut that extends from the surfboard to under the water. This strut is connected to a motor and the hydrofoil wing (that is under the water).



11. With this prototype, I was able to fly on the hydrofoil over the water; it was the first time I flew a hydrofoil. Even though I had done the mathematical testing and analysis, and knew that the hydrofoil wing was mathematically stable, I was surprised as to how easy the board was to ride. Even on my first attempt I was able to successfully ride the device for several minutes. This confirmed my mathematical analyses that the hydrofoil watercraft was stable: had the hydrofoil not been stable, I would not have been able to ride it. Without the passive stability described in the '044 and '659 Patents the electrically-powered hydrofoil watercraft described therein would not be easy to ride. In fact, if the hydrofoil was not stable it would have crashed almost immediately.

12. My invention was unlike anything I had ever seen in the watersports or watercraft world. For instance, as compared to traditional surf boards, paddle boards, or hydrofoil kiteboards, the invention described in the '044 and '659 patents is self-powered. Unlike other smaller, personal watercraft such as small boats, jet skis or waverunners, my invention does not use active controls such as steering mechanisms or rudders controlled with tillers. My invention is controlled solely by the weight-shift of the individual user: using active controls would make the invention less practical, less portable, more expensive and more difficult to produce. Unlike personal watercraft that require the craft be towed by rope from another craft (such as the Air Chair), the invention described in the '044 and '659 Patents is self-powered and not reliant on other towing watercraft or acts of nature to generate power. Unlike the electric powered surfboards or paddleboards, my invention has a hydrofoil, which allows a user to go at a faster speed and travel longer distances for a comparatively low energy cost. And finally, unlike internal combustion engine-powered surf boards or other ICE-powered watercraft, my invention is more efficient, is less noisy, and does not smell like gasoline.

13. A key insight in the development of the invention was the requirement for the hydrofoil to be passively stable and the means to ensure passive stability even though several factors work to destabilize the craft. First, the rider is positioned far above the hydrofoil. Balancing the rider is thus similar in some ways

to balancing a broomstick upright on the palm of your hand: it is inherently unstable and you have to work hard to keep balancing the broom stick. Second, the propulsive force (propeller or pump jet) is located in the water, far below the rider. The propulsive force thus also tends to destabilize the craft by causing a nose-up moment (think of getting pulled along while wearing roller skates: you'd rather hold the rope in your hands than have it tied around your ankles). The hydrofoil must therefore be designed to overcome these destabilizing influences without needing an active stabilization mechanism. Up to that point, self-powered hydrofoils had all used a mechanical or electronic system to actively stabilize the craft: I developed a self-powered hydrofoil that was passively stable (meaning, inherently stable without needing an active control system).

14. In 2015, Nick Leason, the CEO of MHL Custom, Inc., emailed me indicating he had seen my patent application and wanted to speak with me. Mr. Leason mentioned that he was a hydrofoil builder and had been building hydrofoils for kitesurfing for a couple of years. He also indicated that he was interested in a powered hydrofoil surfboard and had begun development of a powered hydrofoil himself. Mr. Leason and I had a call and we agreed to cooperate with respect to my invention. On March 4th, 2016, I entered into an exclusive licensing agreement with MHL to allow MHL to manufacture and sell commercial embodiments of my patented invention.

15. The initial payment for this license agreement was \$15,000 with ongoing royalties of two-and-a-half percent of net sales of the licensed products in the U.S. These amounts were decided upon because MHL was a small family-owned business and at that time there was no market for powered hydrofoils. I did not want the licensing rates to impede MHL's ability to create and grow a market for these products.

16. Following the execution of the agreement with MHL and the issuance of the '044 Patent, I received several additional inquiries about licensing the patent. One such example was a company named Fliteboard (which ultimately ended up licensing the technology as well); other examples included an individual from North Sails and another from Hobie Cat. For each licensing inquiry I received, I responded that MHL had an exclusive license and that they should speak with Mr. Leason regarding any sub-licensing.

17. There were multiple amendments to the original March 4th, 2016 licensing agreement, but on July 16, 2020 I ultimately assigned all of my rights, title, and interest in the '044 Patent and '659 Patent to MHL. I have not collected any further royalties from MHL as of that date.

18. Since Fall 2017, I have had the opportunity to study the Evolo Report and videos in detail. Based on my review of that report and in watching the videos, the students who were involved in the Evolo project were trying to create a

self-powered (electric), personal hydrofoil watercraft based upon a boat and not a surfboard. Their intent was that the watercraft should be stable, but in their case this meant stable when the boat (or flotation device) was on the water and providing buoyancy for the occupant, not a device wherein the hydrofoil provides passive stability as taught in the '044 Patent and '659 Patent. Ultimately, based on my review of the Evolo Report and the videos, the Evolo project failed to teach or create a passively stable (or usable), personal hydrofoil watercraft as disclosed and claimed in the '044 Patent and '659 Patent. Note also that the watercraft described in the Evolo Report incorporated a handle to assist in the control of the craft and to help the occupant stay on board while attempting to operate the craft.

19. I also am familiar with the patents naming Woolley as an inventor, including U.S. Patent No. 6,443,786. Unlike the inventions disclosed in the '044 Patent and '659 Patent, Woolley discloses a waterski-like device (sold commercially as the Air Chair) that you sit on. Woolley is fundamentally different from my invention in three key respects. First, propulsion is provided by a tow rope held by the rider and connected at the other end to a motorboat. Second, in addition to being a source of propulsion, the tow rope is used to aid in control: the rider can move the tow handle up/down and left/right to provide steering and control moments. Third, the propulsive force provided by the tow rope goes roughly through the center of gravity of the rider and craft, hence it does not

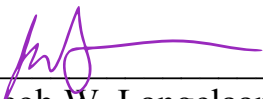
destabilize the watercraft the way a propulsion system located far below the center of gravity would destabilize a watercraft such as a powered hydrofoil.

20. It is my opinion that the hydrofoil of Woolley would not inherently provide passive stability if implemented in the Evolo device. One cannot simply put hydrodynamic surfaces such as hydrofoils on a watercraft with an expectation of success: the specific implementation details must be considered. To give an example: as mentioned earlier, the propulsive force of Woolley is provided by a tow rope held by the rider well above the water surface, near the center of gravity of the craft. The propulsive force of Evolo is well below the water surface and far away from the center of gravity, giving a significant destabilizing moment. Further, to enable weight shift control as well as stability, the hydrofoil must be designed so that the rider can exert control in both speed and direction while remaining stable: this means that the rider should be able to operate the vehicle at different speeds and the craft should be stable at those different speeds. In reviewing the Evolo Report and Woolley, it is my opinion that given already unstable nature of Evolo as well as Woolley having a tow rope that provides both a propulsive force near the center of gravity as well as a means to provide control by moving the tow handle up/down and left/right, one would naturally conclude that an active stabilization system (such as flaps or other control surfaces) would be required to provide stability and control on a self-propelled hydrofoil watercraft.

This was in fact done by Chen (as disclosed in US Patent 7,047,901 B2, referenced in both the '044 and '569 patents). This is crucially different from the invention in the '044 Patent and '659 Patent wherein the hydrofoil provides for passive stability as well as control via weight shift (i.e., there is no active stabilization system and there are no moveable control surfaces).

I declare under penalty of perjury that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both (18 U.S.C. § 1001).

Dated: February 27, 2024



Jacob W. Langelaan, PhD