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F. W. BALDWIN

HYDRODROME

Filed May 14, 1921

Fig. 1.

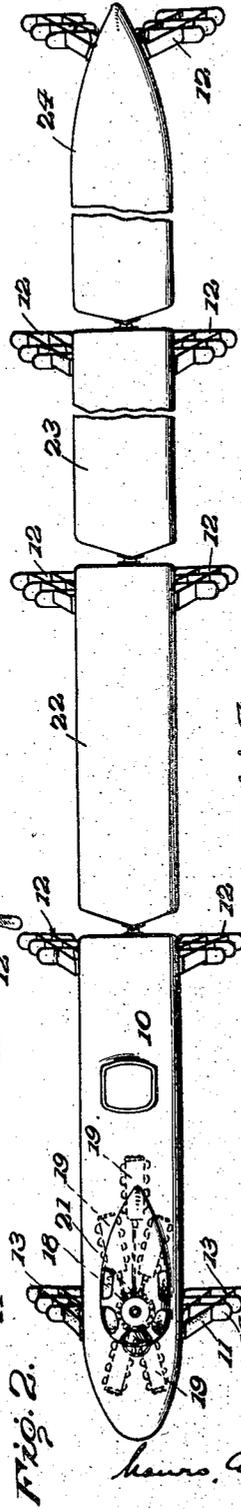
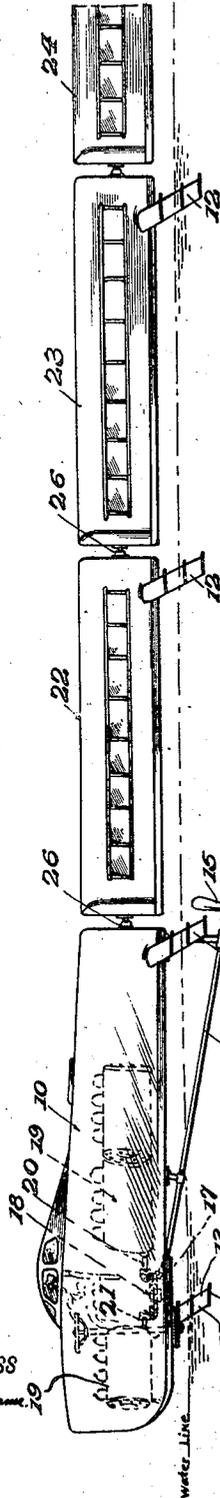


Fig. 4.

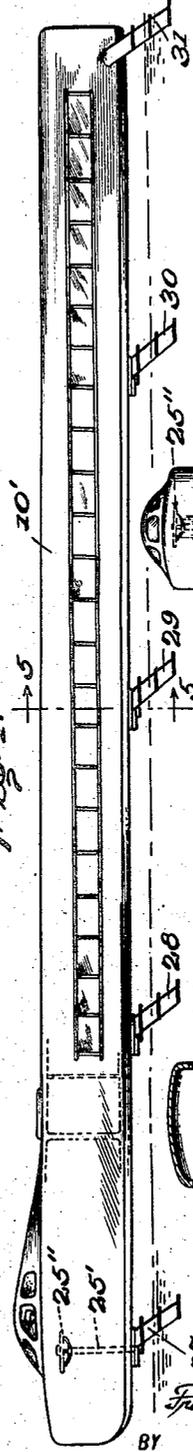


Fig. 3.

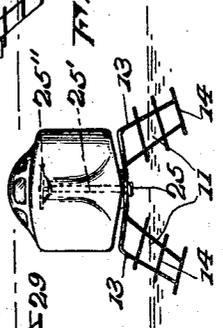
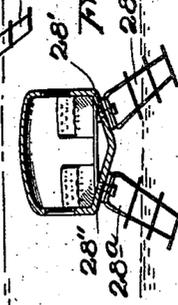


Fig. 5.



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# UNITED STATES PATENT OFFICE.

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## HYDRODROME.

Application filed May 14, 1921. Serial No. 469,725.

*To all whom it may concern:*

Be it known that I, FREDERICK W. BALDWIN, a subject of the King of Great Britain, and a resident of Baddeck, Nova Scotia, Canada, have invented new and useful Improvements in Hydrodromes, which invention is fully set forth in the following specification.

The invention relates to hydroplane boats of the submerged hydrofoil type.

Vessels of the submerged hydrofoil type are more comparable to heavier-than-air flying machines than to balloons and are sharply differentiated from displacement vessels by the fact that, when in motion, they are heavier than the water they displace. They have the same sort of advantage over the ordinary displacement vessel (the lighter-than-water craft) that the heavier-than-air flying machine has over the ordinary balloon (the lighter-than-air vessel). Ordinary displacement vessels displace their own weight of the medium through which they move, whereas vessels of the present type weigh a great deal more than the water displaced by the submerged hydrofoils. The greater the weight supported by the submerged hydrofoils and the less the weight of water displaced by these hydrofoils, the less the retarding effect of a wave on the whole machine and the greater the uniform speed that can be maintained and the smoother the motion of the machine.

While machines of this character have proved very successful on sufficiently large scale to be highly desirable for naval and other purposes, there is a demand for increased transportational capacity greater than any machine that has heretofore been built is capable of meeting.

The heavier-than-air and heavier-than-water machines both present the same engineering difficulties as the size of the machine is increased. The lift of the supporting surfaces in both types increases only as the second power of the linear dimensions, whereas the weight increases as the third power of linear dimensions.

This fundamental law imposes a limit on the size of the machine with a given weight per unit of motive power, whether of the heavier-than-air or heavier-than-water type, which, while it can be avoided to a certain

extent by more complicated construction or a reduced factor of safety, cannot be overcome.

The object of the present invention is to provide a device the effectiveness of which will not be diminished as its size is increased; and particularly to provide a device of the character described which may be readily enlarged to any desired size in much the same way as additional coaches are added to a train.

With this object in view, the preferred embodiment of the inventive idea is to provide a hydrodrome car comparable to a locomotive which is supported when in motion by a plurality of sets of hydrofoils. This locomotive carries the motor which is preferably of a type for a water-drive. To the locomotive there is coupled one or more hydrodrome cars, each of which is supported by a plurality of sets of hydrofoils. On the forward or locomotive car, there is provided a hydrofoil set, mounted on a vertical axis, which is utilized as a rudder. It has been found from actual tests that the several hydrodrome cars which are drawn by the locomotive track perfectly; and this is particularly apparent and of importance when a turn is being made. By the mounting of these cars on hydrofoil sets, there is no tendency of the cars to swing; and the device of the present invention tracks as perfectly as does a railroad train on its rails.

A large number of these cars may be connected in series to attain these desirable ends, with the result that head resistance, structural strength and weight may be cut down to a minimum without any sacrifice of efficiency or safety. Further, the cars are of such size that they may be readily transported overland by railroad, placed on the waters of an inland river and sent on their journey without delay. This is of importance in connection with troop transport, for example, inasmuch as by the use of the present device troops or merchandise can be moved by water at a speed of sixty or more miles per hour. The minimizing of head resistance and the fact that only the lowermost of the hydrofoil blades are submerged make it possible to transport great weights at high speeds with the expenditure of only a fraction of the power that would be necessary in

displacement craft. Further, the connection between the cars being of the universal type, the individual cars have a freedom of movement in a lateral and vertical direction.

5 The hydrofoil blades are only about six inches in extent in a fore and aft direction and may be spaced at a ratio of 80-1, though this ratio may be materially decreased so long as the necessary support is provided.

10 This avoids interference between successive hydrofoil sets.

With the present device, the carrying capacity is directly proportional to the increased length and, therefore, the expenditure of power required is in direct proportion to the useful load-carrying capacity. As a matter of fact, with the present invention, there is a gain by increased length because no more head resistance is involved, and therefore the total resistance is less than directly proportional to the load carried.

The invention will be better understood by reference to the accompanying drawings, wherein are shown two expressions of the

25 inventive idea, and wherein—

Fig. 1 is a side view of the complete train made up of a series of connected cars;

Fig. 2 is a plan view of the same;

Fig. 3 is a front elevation;

30 Fig. 4 illustrates a modification;

Fig. 5 is a cross-section on the line 5-5 of Fig. 4.

Referring to the drawings, wherein like reference numerals indicate like parts, 10 indicates a hydrodrome, or "locomotive car" as herein designated, supported by two sets of hydrofoils 11 and 12. Each set of hydrofoils is composed of a plurality of struts 13 suitably connected to the car body, these

40 struts having the hydrofoil blades 14 connected thereto in any usual or desired manner. Preferably, the struts on each side of the car are inclined rearwardly and outwardly from the car body, so that the hydro-

45 foil blades on one side of the car will be arranged at a dihedral angle with respect to those on the other side.

The car 10 carries the power equipment for driving the device. Any suitable or

50 desired drive may be employed, but I prefer to use a water-propeller 15 mounted on the lower end of a rearwardly and downwardly inclined shaft 16 suitably supported from the under side of the car. The upper end

55 of this shaft is provided with a suitable pinion 17 which meshes with the under face of a large horizontal gear 18. This horizontal gear is preferably carried by a series of ball or roller bearings. Power is applied to the horizontal gear from a series of

60 motors 19 of which any desired number may be employed. As here shown, five motors 19 are provided. On the end of each motor shaft 20 is mounted a bevel gear 21 that

65 meshes with teeth on the upper face of

the horizontal gear 18. It will thus be seen that the power of the motors is readily and simply transmitted to the propellers through this connection.

Connected to the locomotive car 10 by 70 any suitable connection is a series of trailer cars 22, 23, 24. As here shown, three trailers are provided but it will be understood that more or less may be used dependent upon the particular needs of the occasion. 75 Each of the trailers is supported by a plurality of hydrofoil sets such as the sets with which the locomotive car is provided, with the distinction, however, that the hydrofoil sets of the trailer cars are fixed in position 80 whereas the forward sets 11 of the locomotive car are pivoted on a vertical axis 25, so that they may be used as a steering device. Steering rod 25' and steering wheel 25'' are preferably utilized. 85

The preferred connection between the locomotive car 10 and the trailer 22, and between the several trailer cars, is a universal joint 26, so that the cars may have some independent freedom of lateral and vertical 90 movement.

The arrangement of the hydrofoil sets beneath the several cars is such as to provide the necessary support for the load to be carried, and the fore and aft spacing of the 95 successive sets is such as to avoid all hydrodynamical interference.

It has been experienced that a device of this character will track as perfectly as a railroad train on its rails, due to the resistance to lateral displacement which is afforded by the struts and the inclination of the hydrofoil blades. This is of primary importance and is particularly noticeable when the device is making a turn in the 105 bends of a river.

In Fig. 4 there is shown a modification of the inventive idea, wherein a single elongated car 10' is employed, this single car being used to carry not only the motor 110 equipment but the passengers, cargo, and the like. In this device, the car is supported by a plurality of hydrofoil sets 27, 28, 29, 30 and 31, suitably spaced in a fore and aft direction. Preferably, in this construction, 115 the steering is effected by means of the bow sets of hydrofoils 27 and the rear sets 31 are fixed. It will, however, be understood that the steering might be effected by means of the rear sets 31, in which event the bow sets 120 would be fixed and the rear sets pivoted. The intermediate sets 28, 29 and 30 are each pivoted on a vertical axis and are entirely free to move on their axes which are preferably in advance of the center of resistance of the hydrofoil sets which normally preserves their fore and aft direction with respect to the line of advance of the machine. Preferably, each set 28, 29 and 125 30 is independently pivoted as shown in 130

Fig. 5. As there shown, set 28 is pivoted at 28' and set 28<sup>a</sup> at 28''. Unless these intermediate sets were free to move in this manner, it would be practically impossible to steer the craft.

In addition to this advantage of a freely pivoted hydrofoil set, it is pointed out that such a freely pivoted set may be effectively used as a landing device for a flying machine. It frequently happens that, in landing, the machine in the air will be moving bodily in a certain direction, but (on account of the wind) will be headed away from its general direction of travel relative to the water. Under these conditions, when the machine alights the tendency of the water (if the hydrofoils are fixed) will be to overturn the machine. By equipping the machine with a freely pivoted hydrofoil set, when the machine alights this set will turn in the direction in which the craft is moving on the water, with the result that the craft will be permitted to safely skid and not overturn. Preferably, with such a construction I employ a light tension-spring to normally hold the set in the fore and aft direction, but leaving it free to move under pressure.

It will be observed that, in this modification, the matter of distributed support is the primary consideration as is the case with the embodiment shown in the other figures. It will also be noted that the length of span between the supporting hydrofoils is not increased as the length of the craft is made greater.

The preferred form of the device, as heretofore indicated, is that shown in Figs. 1-3 inclusive, in which, in addition to the advantages enumerated, there is—from the point of view of the passengers—an absence of vibration, safety from fire, sinking and collision. Further, as a commercial proposition, this form has the advantage that only as many cars may be used on any particular occasion as the number of passengers or load to be carried requires.

While, for the purpose of clearness, two embodiments of the inventive idea have been herein shown and described in considerable detail, it is to be understood that the invention is not limited to this construction but that the inventive idea is susceptible of other expressions within the limits of the appended claims.

What is claimed is:—

1. A device of the class described comprising, in combination, a locomotive hydrodrome car, one or more trailer cars connected in series to said hydrodrome car, and a hydrofoil set adjacent one end only of each of said trailer cars for supporting the latter when in motion.

2. A device of the class described comprising, in combination, a locomotive hydro-

drome car, one or more trailer cars connected in series to said hydrodrome car, and a hydrofoil set adjacent the rear end only of each of said trailer cars for supporting the latter when in motion.

3. A device of the class described comprising, in combination, a locomotive hydrodrome car, a plurality of trailer cars, universal joint means for connecting said trailer cars in series to said hydrodrome car, and a plurality of hydrofoil sets secured to the train of cars at substantially equal longitudinally spaced intervals for supporting said cars when in motion.

4. A device of the class described comprising, in combination, a locomotive car, one or more trailer cars, universal joint means for connecting said trailer cars in series to said locomotive car, a plurality of hydrofoil sets rigidly secured to the train of cars at substantially equal longitudinally spaced intervals, and a hydrofoil set pivotally secured to said locomotive car.

5. A device of the class described comprising, in combination, a locomotive hydrodrome car, a plurality of trailer cars connected in series to said locomotive car, and hydrofoil sets for supporting said cars when in motion, the forward end of each trailer car being supported by its connection with the forwardly adjacent car.

6. A device of the class described comprising, in combination, a locomotive hydrodrome car, a plurality of trailer cars, means connecting said trailer cars in series to said locomotive cars, and hydrofoil sets for supporting said cars when in motion, said sets being longitudinally spaced at substantially equal intervals to avoid hydrodynamical interference.

7. A device of the class described comprising, in combination, a locomotive hydrodrome car, hydrofoil sets for supporting said car when in motion, one of said sets being pivotally mounted for steering purposes, one or more trailer cars connected in series to said locomotive car, hydrofoil sets secured to said trailer cars, the longitudinal distance between any two adjacent sets of hydrofoils being substantially equal to the distance between the hydrofoil sets of the locomotive car.

8. A device of the class described comprising, in combination, a locomotive hydrodrome car including a water drive mounted thereon, one or more trailer cars connected in series to said locomotive car, hydrofoil sets for supporting said cars when in motion, the fore and aft spacing of the successive sets being such as to avoid hydrodynamical interference.

9. A device of the character described comprising, in combination, a locomotive hydrodrome car, one or more trailer cars connected in series to said locomotive car, and

hydrofoil sets for supporting said cars when in motion, the fore and aft spacing of the successive sets being such as to avoid hydrodynamical interference, and each of said sets comprising two series of superimposed blades arranged at a dihedral angle.

10 In a device of the character described, the combination of a float body, three or more sets of hydrofoils for supporting the same when in motion, said sets being arranged in

series one behind the other and longitudinally spaced at equal intervals to avoid hydrodynamical interference, a hydrofoil set pivoted to said body adjacent one end thereof for steering purposes, and a water-drive for propelling the device. 15

In testimony whereof I have signed this specification.

FREDERICK W. BALDWIN.