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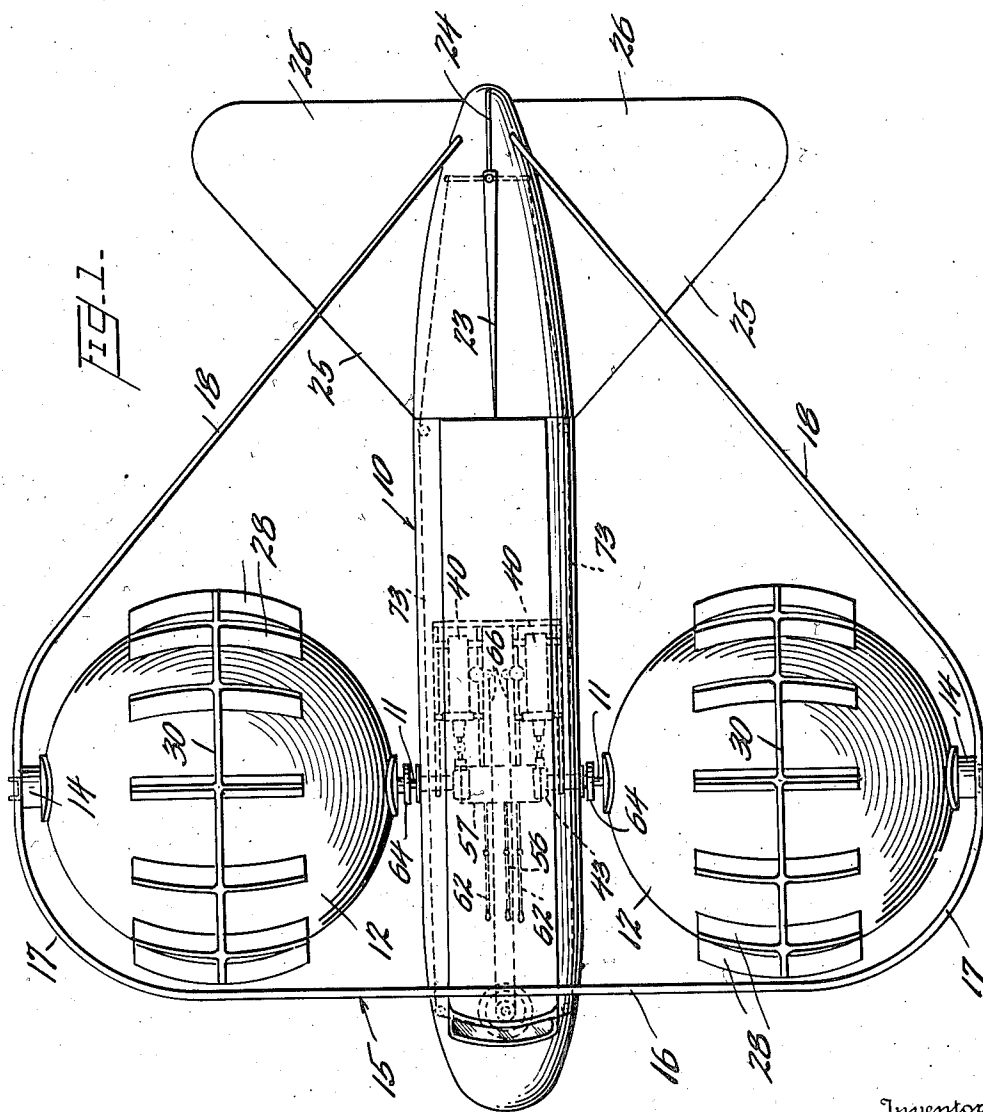
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2,309,875

AMPHIBIAN

Filed July 14, 1941

3 Sheets-Sheet 1



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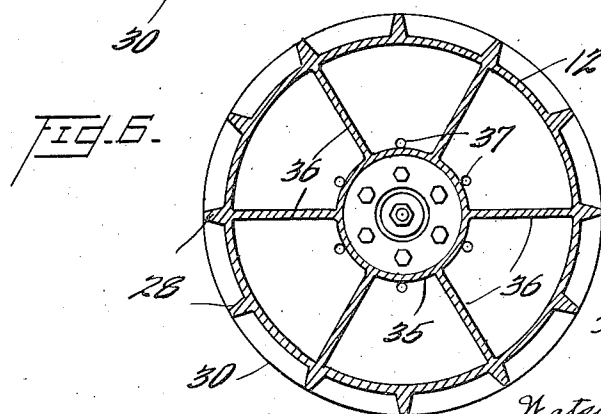
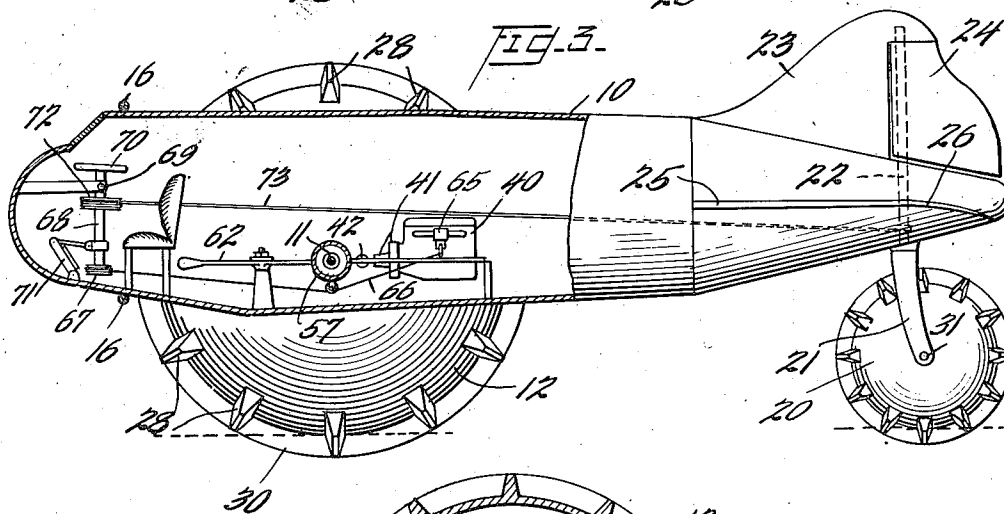
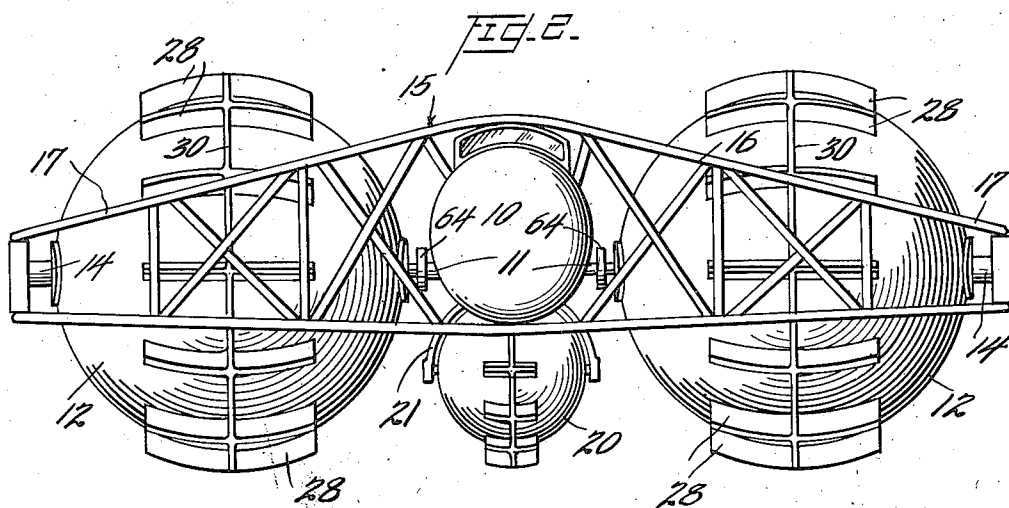
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3 Sheets-Sheet 2



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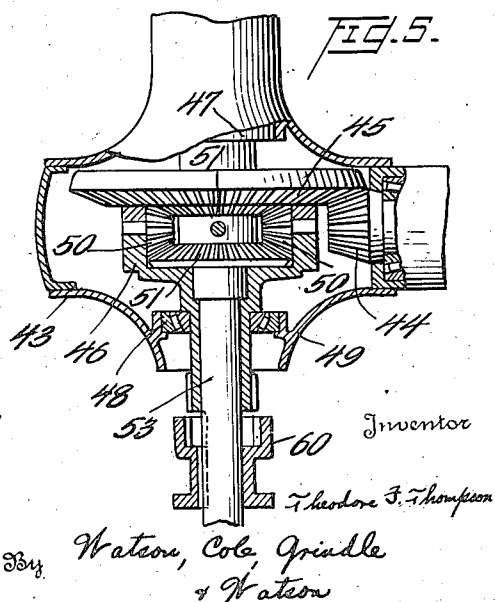
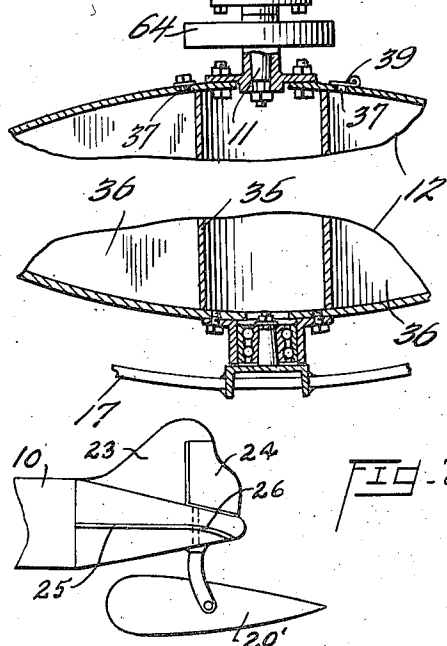
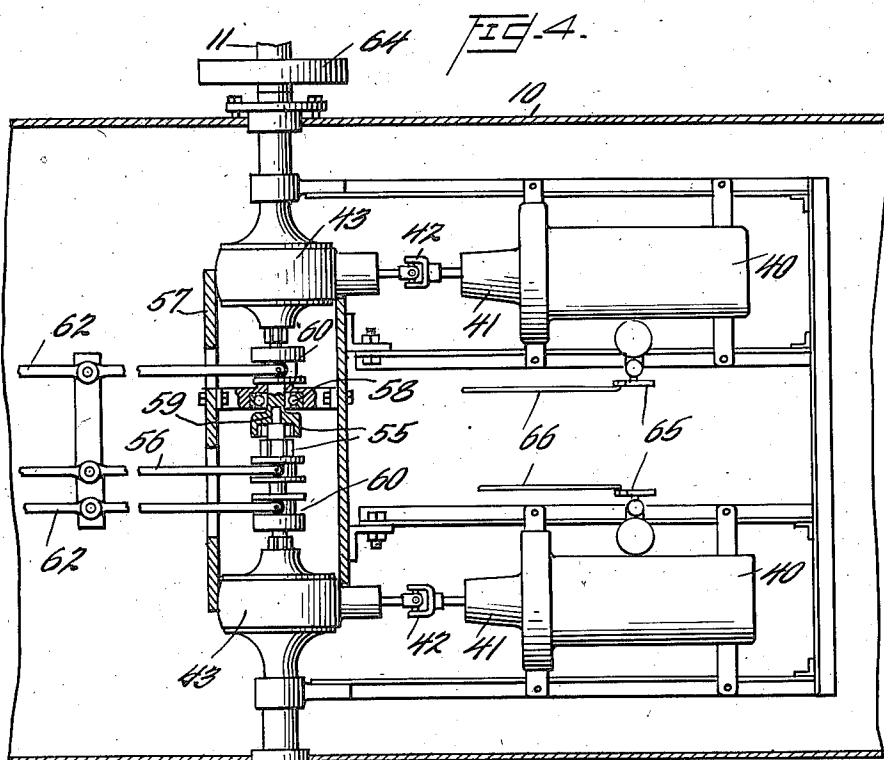
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UNITED STATES PATENT OFFICE

2,309,875

AMPHIBIAN

Theodore F. Thompson, Des Moines, Iowa

Application July 14, 1941, Serial No. 402,338

11 Claims. (Cl. 115—19)

This invention relates to vehicles and more particularly to amphibians intended primarily for high-speed operation on the water but fitted for operation on solid land, over marshes and floating vegetation or the like, and capable of moving from one element to another without hesitation.

It is a general object of the present invention to provide a novel and improved vehicle of the type described.

More particularly it is an object of the present invention to provide an amphibian vehicle adapted to travel at high speeds and incorporating a body or fuselage supported on propulsive pontoons.

An important object of the invention consists in the arrangement of an amphibian including a fuselage fitted with laterally disposed propulsive pontoons capable of independent rotation about a substantially horizontal axis, each capable of being driven by a separate power unit, together with means for driving both pontoons from either driving unit through a differential, thereby relieving the drive shafts of strains when operating on solid ground in other than a straight line.

One of the noteworthy features of the invention comprises novel steering mechanism for amphibians incorporating independent speed control of the propulsion pontoons together with water and air steering all under the control of a single manually operable control mechanism.

A further feature of the invention resides in the arrangement of two independently operable propelling pontoons and a third or tail supporting pontoon arranged for steering control of the vehicle, together with an air steering rudder and horizontal elevator surfaces capable of lifting the steering pontoon from the surface of the water at high speeds, whereupon steering control is taken over by the air rudder operating alone or in conjunction with relative speed control of the propelling pontoons.

Other and further features and objects of the invention including novel arrangements and constructions of the several parts will be more apparent to those skilled in the art upon a consideration of the accompanying drawings and following specification wherein is disclosed a preferred embodiment of the invention with the understanding, however, that such changes and modifications may be made therein as fall within the scope of the appended claims without departing from the spirit of the invention.

In said drawings:

Figure 1 is a plan view of an amphibian vehicle constructed in accordance with the present invention;

Figure 2 is a front elevation of the same;

Figure 3 is a side elevation partly in vertical longitudinal section showing the steering and speed control mechanism and one of the propulsion motors;

Figure 4 is a fragmentary horizontal section partly in elevation, taken on the axis of rotation of the propulsion pontoons;

Figure 5 is a horizontal section on an enlarged scale of one of the differential units and its associated clutch member;

Figure 6 is a transverse, vertical central section through one of the pontoons; and

Figure 7 is a fragmentary side elevation illustrating a modified form of rear pontoon.

The present invention is intended to fill the need for an amphibian vehicle capable of traveling at high speeds over water and at moderate speeds over all sorts of relatively flat terrain. It is of particular value for operating in marshy country where there are alternate stretches of open water and marsh land heavily overgrown with vegetation and the like. The change from land to water operation or even travel over floating vegetation is made without any change in propelling means, supporting elements or the like and the operation merely consists in driving the vehicle from one area into the other with appropriate changes in speed.

The invention is capable of such operation primarily because the whole vehicle is supported on a plurality of flotation and propelling pontoons each preferably in the form of a sphere rotatable on a horizontal axis and capable of supporting the vehicle in water alone with only about one-fourth of the vertical height of the pontoons submerged. These pontoons may be equipped with suitable traction units of cleat or paddle form so that they are capable of travelling in water, over land, heavy vegetation, marshy soil or the like without the possibility of sinking in or slipping.

Provision is made for several forms of steering, the one intended for use on all land surfaces comprising a pontoon rotatable about a horizontal axis and equipped with a circumferential keel and adapted for adjustment about a vertical axis for steering control. The second steering means consists in an air rudder adapted for rotation coincident and simultaneously with that of the steering pontoon and adapted to take over when the vehicle is running at such high speeds on the water that the tail elevators have lifted the

steering pontoon from the surface. As a third means, and probably the most effective for turning at short radii, the propulsion pontoons are adapted to be independently driven at relatively different speeds and there is provided coordinating means for associating the relative speed control of the several propulsion pontoons and the adjustment of either of the rudders for additive operation.

For a more complete understanding of the invention, reference should be had to the accompanying drawings. Illustrated in these drawings is a fuselage or body 10 lightly constructed in general along the lines of more or less conventional airplane practice. In place, however, of the customary wings the fuselage is equipped with a pair of transverse shafts 11 in axial alignment and each rigidly attached to a hollow flotation element or pontoon 12 preferably spherical in form, although the ends may be flattened if desired in order to reduce the overall width where this is advisable. These elements may have outboard support at the bearings 14 carried by the girder-like frame 15 suitably attached to the fuselage and comprising the transverse forward section 16, the curved parts 17 and the reach sections 18 extending to the tail of the fuselage.

The main or propulsion pontoons are of sufficient size to provide adequate buoyancy so as to support the loaded amphibian vehicle on the water when at rest with the pontoons immersed only about one-fourth of their diameter. They are so positioned that the center of gravity of the fuselage and load is only slightly aft of their axis.

When at rest on the water or running on land the tail of the fuselage is supported by a third pontoon 20 which may be constructed similarly to the propulsion pontoons and mounted in a fork 21 having a vertical shaft extension 22 rotatably pivoted in the tail structure to permit steering of the vehicle by rotation of the rear pontoon.

The tail of the fuselage also carries above it a large vertical fin 23 to help maintain the vehicle in a straight line when travelling at high speed and the after portion of this fin is constituted by an adjustable vertical rudder 24 attached to the shaft 22 to be steered with the pontoon. A suitable and preferably fixed horizontal air foil or elevating fin 25 is provided at each side of the tail and curved downwardly toward the after end as shown at 26 so as to provide sufficient air lift at high vehicle speeds to raise the tail in the manner of an airplane when in flight, lifting the rear pontoon clear from the water, relieving its drag, and allowing the vehicle to be supported solely by the front pontoons and the elevators 25. The operation of lifting the rear pontoon is assisted by the action of the propulsion pontoons 12 which tend to ride up on the surface of the water when the vehicle is travelling at high speed so that they are only immersed to a slight degree.

To assist the propulsion pontoons, which are positively and mechanically rotated by means subsequently to be described, to obtain a satisfactory grip on the water, some form of transverse or partially transverse fins, cleats, paddles or the like, such as shown at 28, are spaced about the peripheries of the same as clearly shown in Figures 1, 2, and 3. These are connected together and braced by an annular or circumferential keel 30, in a plane at right an-

gles to the pontoon axis, which strengthens the pontoon and provides means to prevent lateral slippage and to assist in the steering. The rear pontoon may be equipped with both the keel and the propulsion fins, although it is preferred that this rotary pontoon not be positively driven. Under some circumstances, however, it may be best to have it driven. Where it is not to be driven, it can be a simple boat-shaped float as shown at 20' in Figure 7 and need not be provided with the axle 31 about which it is shown to rotate in the preferred embodiment. If it is rotatable, however, the circumferential keel is of great service in steering. The shape of the propulsion fins 28 on the main pontoons is preferably such as to assist in elevating the balls to the surface of the water as the vehicle speed increases. These fins are likewise of great assistance in obtaining traction on soft or marshy soil when the vehicle is used out of water, while the central keel or web provides a continuous smooth surface for land travel and eliminates much of the bumpiness which would be present if only the transverse fins or cleats were used. Obviously the pontoons may be equipped with pneumatic tires of appropriate configuration if desired to improve the land riding qualities of the vehicle.

For the sake of safety in the event of puncture, each of the pontoons which are formed of metal is preferably divided into a plurality of watertight compartments. For this purpose a central tube 35 is arranged coaxial to the shaft and outboard bearing and radiating from this are a plurality of plates 36 dividing the space between the central cylindrical water-tight compartment and the periphery into six or more water-tight compartments. Each of these compartments may be provided, closely adjacent the cylindrical surface 35, with a drain aperture 37, from which any water which may leak in may be drained when the compartment is at the top. A removable plug may close each opening. If it is desired, this drainage may be made automatic by means of a flap valve such as shown at 39 which opens outwardly under the pressure of water from inside but which closes to prevent ingress of water.

For the purpose of operating the propulsion pontoons it is preferred to provide a pair of motors 40, shown as positioned with their axes fore and aft and each connected to drive one of the pontoons. Each motor is of the automotive vehicle type equipped with a suitable clutch and multi-speed gear box in the housing 41 and connected by a universal joint 42 to the differential structure 43, again of the automotive type. It may be constructed as best shown in Figure 5, where the pinion 44 is driven from the motor shaft and drives the ring gear 45 which is supported by the differential gear carrier 46, journaled at 47 and 48 in the housing 49. The carrier drives the gears 50 meshing with the gears 51 and 52, the former rigid with the shaft of the pontoon and the latter with an idle shaft 53. The idle shafts of the two propulsion units are in alignment and may be connected together by the spline clutch 55 as shown in Figure 4, upon the operation of lever 56, but normally this clutch is disconnected so that the two pontoons are driven independently each by its own motor. The housings 49 of the two differentials are rigidly connected together by the tube 57 which provides a support for bearing 58 for the inner end of one of the idle shafts 53. A pilot bearing

59 in the end of this shaft provides support for the inner end of the other idle shaft.

In order that proper drive may be had when each motor drives its own pontoon, a spline clutch 60 is provided for each differential, serving to connect together the idle shaft 53 and the differential gear carrier upon the operation of one of the levers 62. This constrains the idle shaft to run at the same speed and in the same direction as the pontoon shaft and solid driving is obtained.

Should either engine be disabled the other may be called upon to drive both pontoons by engaging the clutch 55 between the two idle shafts 53, then connecting together the idle shaft 53 and its differential gear carrier in the differential housing whose motor is disabled, and disconnecting these parts in the housing of the operating motor whereby true differential action is effected. Thus the pontoons may operate at different speeds in accordance with the relative impedances to their operation permitting the vehicle to be steered without breaking any parts. The regular clutch of the inoperative motor permits its drive shaft to rotate freely under the action of the ring gear.

Each of the propulsion pontoons is provided with a brake 64 which may be of conventional form and each operated by a separate pedal (not shown). With this arrangement stopping is effected by the use of both pedals, while steering when under the drive of one motor may be effected by braking the pontoon on the inner side of the desired turn. This is permitted by the differential drive.

It is found convenient to handle a vehicle of this type, particularly when short turns are desired, by driving one pontoon at a different speed than the other and to effect this operation each motor is provided with a throttle control 65 for regulating its speed and a flexible cable 66 connects these two together, the cable first passing about a drum 67 on the vertical steering shaft 68 mounted for rotation about its axis and for swinging about the transverse pivot 69. A steering wheel 70 is mounted on the upper end of the shaft.

When the wheel is rotated the throttle of one motor is opened wider while the other is moved toward closed position and thereby the pontoon which is to be on the outside of the desired turn rotates more rapidly than the one on the inside and the turning is accomplished in a short radius. If the wheel is pulled toward the driver or the lower end moved forward by the use of the foot pedal 71, both reaches of the flexible element 66 are moved forward and the throttles of both motors are opened simultaneously. In this manner the two motors can be controlled both as to actual speed and relative speed by the operation of the single steering element 70.

The shaft 68 on which the wheel 70 is mounted also is equipped, close to the transverse pivot, with a drum 72 for the steering cables 73 leading to the shaft 22 for rotating the steering pontoon 20 and the air rudder 24. Under these conditions the steering, which is primarily effected by the different relative speeds of the propulsion pontoons, is simultaneously effected and assisted by the rear pontoon when in contact with the ground or the air fin 24 when the tail of the fuselage is elevated.

It will be appreciated that the vehicle is capable of important military usages, under which conditions it may be suitably equipped with armor

and armament. Because of its ability to travel at extremely high speeds on the water resulting from the low retardational effects and because it can travel on both water and land, it will be of extreme importance in effecting landings for troops on beaches and the like where the terrain is suitable. It will also be capable of carrying and discharging torpedoes, depth bombs and the like.

A number of the principles of operation of the present craft are identical with those explained in my copending application Serial No. 365,353, filed November 12, 1940 for Water craft, the improvements herein adapting it for amphibian use, achieving more adequate steering control and materially simplifying, strengthening, and improving the device.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a vehicle of the type described, in combination, a body, a pair of laterally disposed flotation and propelling pontoons, laterally disposed aligned shafts each rotatably mounting one of said pontoons, a pair of motors each connected to normally drive one of said pontoons, a differential, and means to drive both said pontoons from one of said motors through said differential.

2. In a vehicle of the type described, in combination, a body, a pair of laterally disposed flotation and propelling pontoons, laterally disposed aligned shafts each rotatably mounting one of said pontoons, a pair of motors each connected to drive one of said pontoons, a steering pontoon disposed longitudinally of said body from said flotation pontoons, a steering wheel in said body, means operatively associating said wheel and steering pontoon, a speed regulating device for each motor, and means associating said devices with the steering wheel in such a manner that the motor for the pontoon on the outside of a desired turn is operated at a higher speed than that for the inside pontoon.

3. In a vehicle of the type described, in combination, a body portion supported by a pair of laterally disposed pontoons, each pontoon being rotatably mounted for propulsive rotation about a horizontal axis and being fitted with traction elements, a separate motor connected to drive each of said pontoons, a speed control device for each motor, a single operator for both said controls comprising a shaft rotatable about its axis for simultaneous adjustment of said controls in an opposite sense and dependent upon the direction of shaft rotation, said shaft being also tiltable to move said controls simultaneously in the same sense.

4. In a vehicle of the type described, in combination, a body portion supported by a pair of laterally disposed pontoons, each pontoon being rotatably mounted for propulsive rotation about a horizontal axis and being fitted with traction elements, a separate motor connected to drive each of said pontoons, a speed control device for each motor, a single operator for both said controls comprising a shaft rotatable about its axis for simultaneous adjustment of said controls in an opposite sense and dependent upon the direction of shaft rotation, said shaft being also tiltable to move said controls simultaneously in the same sense, a steering element for said vehicle, and means operatively associating said element and said single operator so that steering by said

element and by relative speed control of the propulsion pontoons is additive.

5. In an amphibian, in combination, a fuselage having a vertical tail fin and an adjustable air rudder, a fixed horizontal tail fin constructed to elevate the tail at high speeds, a pair of laterally disposed propelling pontoons supporting said fuselage, a rotatable pontoon for supporting the rear of said fuselage on land and at low water speeds, and means to steer said air rudder and rear pontoon simultaneously.

6. In an amphibian, in combination, a fuselage having a vertical tail fin and an adjustable air rudder, a fixed horizontal tail fin constructed to elevate the tail at high speeds, a pair of laterally disposed propelling pontoons supporting said fuselage, a pontoon for supporting the rear of said fuselage on land and at low water speeds, means to steer said air rudder and rear pontoon simultaneously, a separate motor for each propelling pontoon, a speed control device for each motor, and means associating said devices with the steering means to adjust the motor speeds inversely with the rudder adjustment, whereby the outer pontoon on a desired turn is given a preponderance of speed.

7. In an amphibian, in combination, an elongated fuselage, a shaft extending laterally from each side of the fuselage, a flotation pontoon of generally spherical form secured to each shaft to support the fuselage, a circumferential keel and propulsion fins on each pontoon, a separate motor to drive each shaft, a vertical air rudder at the rear of the fuselage, a keeled rotary flotation pontoon beneath the rudder and mounted for simultaneous steering adjustment therewith, means to elevate the rear of the fuselage at high speed to lift the rear pontoon from the surface of the water, and means actuated by the steering adjustment for controlling said motors to cause them to drive the pontoons at different relative speeds only when turning.

8. In an amphibian, in combination, an elongated fuselage, a shaft extending laterally from each side of the fuselage, a flotation pontoon of generally spherical form secured to each shaft to support the fuselage, a circumferential keel and

propulsion fins on each pontoon, a separate motor to drive each shaft, a vertical air rudder at the rear of the fuselage, a keeled rotary flotation pontoon beneath the rudder and mounted for simultaneous steering adjustment therewith, means to elevate the rear of the fuselage at high speed to lift the rear pontoon from the surface of the water, and means independent of the steerable rudder and pontoon to steer the vehicle on land or water.

9. In an amphibian, in combination, an elongated fuselage, a shaft extending laterally from each side of the fuselage, a flotation pontoon of generally spherical form secured to each shaft to support the fuselage, a circumferential keel and propulsion fins on each pontoon, a separate motor for each pontoon shaft, a differential connecting each motor to its pontoon shaft and to an idle shaft, means to lock the idle shaft to the differential carriage for normal operation, and means to connect the idle shafts together to drive both pontoons from one motor.

10. In an amphibian, in combination, an elongated fuselage, a shaft extending laterally from each side of the fuselage, a flotation pontoon of generally spherical form secured to each shaft to support the fuselage, propulsion cleats on each pontoon, a separate motor associated with each pontoon to drive the same, a supporting and steering pontoon spaced from the propulsion pontoons, each of said pontoons having a plurality of water-tight compartments, automatic means to drain said compartments while running, and means to elevate the said supporting pontoon while running at high speed.

11. In an amphibian vehicle, in combination, an elongated fuselage, a pair of ball-like rotatable propulsion pontoons disposed one on each side thereof just forward of the center of gravity of the fuselage and its normal load, a rear flotation pontoon to support the fuselage tail when at rest, an airfoil to lift the tail to clear the rear pontoon at high speeds, and means to drive the propulsion pontoons by rotation to propel the vehicle.

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