

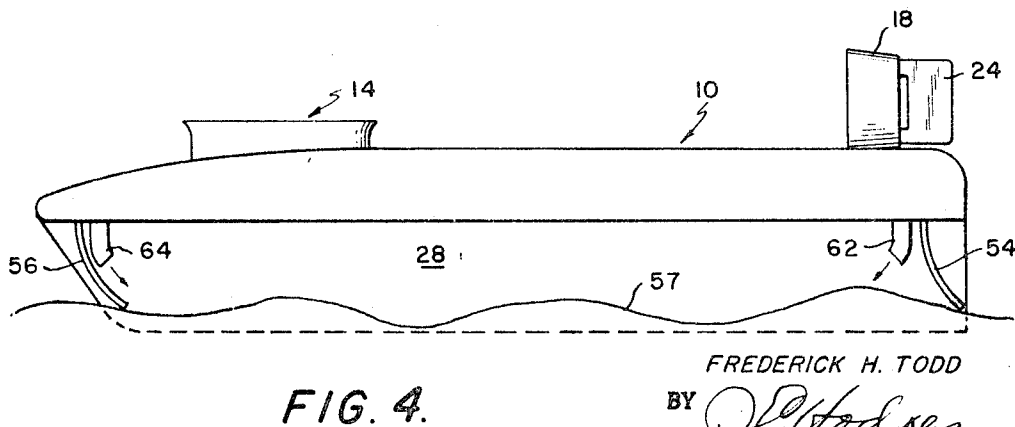
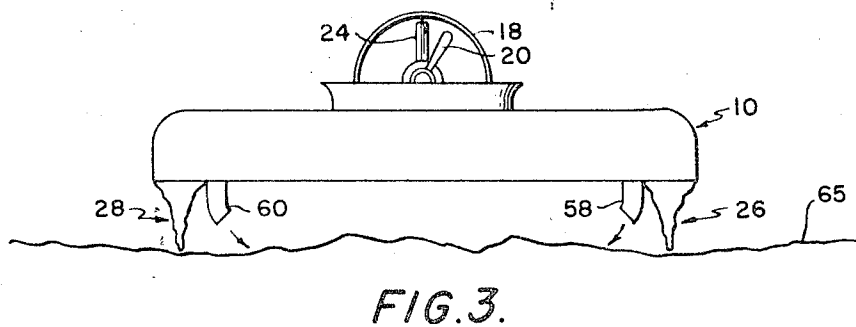
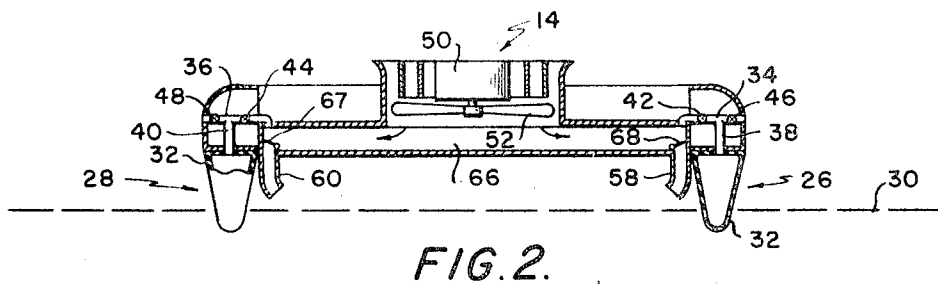
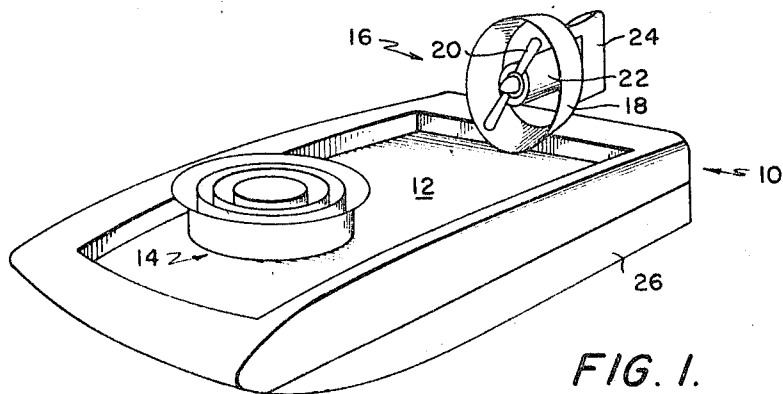
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CAPTURED AIR BUBBLE (CAB) GROUND EFFECT MACHINE

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CAPTURED AIR BUBBLE (CAB) GROUND EFFECT MACHINE

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Continuation of application Ser. No. 505,768, Oct. 29, 1965. This application Dec. 6, 1967, Ser. No. 699,280

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4 Claims

ABSTRACT OF THE DISCLOSURE

A ground effect machine capable of motion over land and water having a first propeller for propulsion, a second propeller supplying compressed air for support, and inflatable side skegs capable of being made rigid for penetrating the surface of the water, or of being made flaccid for use over land to clear obstacles.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Cross-reference to related applications

This application is a continuation of application Ser. No. 505,768 filed Oct. 29, 1965, for Improved Ground Effect Machine and which has since become abandoned.

Background of the invention

The present invention relates to an improved ground effect machine and more particularly to an improved ground effect machine with superior amphibious characteristics.

Ground effect machines (hereinafter referred to as GEM's) are increasingly coming into use because of their versatile nature which allows them to traverse rugged terrain and operate over water. However, GEM's, when in over-water operation, waste a considerable portion of their available power generating their supporting cushion. Even when peripheral jets are employed, the power waste is so high as to make the use of such craft practical only in highly specialized situations. One solution to this power loss problem is an over-water modification of the GEM called a captured air bubble machine (hereinafter referred to as a CAB). CAB's use rigid skegs located along their sides which are designed to penetrate the water surface a short distance as the craft moves across the water. With compliant seals to prevent loss at the forward and rearward ends, very little pressurized air is allowed to escape and consequently the craft is supported nearly clear of the water with greatly reduced power requirements. The primary disadvantage of the rigid skag CAB's is that their ability to operate over-land is greatly reduced if not completely eliminated. This disadvantage results from the protrusion of the rigid skegs which increases air loss, necessitates higher ground clearance, requires additional power, and does not allow the craft to pass over rough terrain.

Summary

The device of the present invention overcomes the defects of the prior art machines by providing an amphibious vehicle with all the attendant advantages of a CAB when operating over-water yet as effective over-land as a GEM.

It is therefore an object of the invention to provide an improved ground effect machine.

It is another object of the invention to provide an improved GEM with superior amphibious characteristics.

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It is a further object of the invention to provide an improved GEM operable in the conventional manner over-land but operable as a CAB over-water.

It is a final object of the invention to provide an improved GEM which is capable of increased speed over-water with reduced cushion power.

Other objects and many of the attendant advantages of the invention will be readily appreciated as the same becomes better understood by reference to the following detailed description of a preferred embodiment thereof when considered in connection with the accompanying drawings wherein:

Brief description of the drawings

FIG. 1 is a perspective view of the GEM of the invention;

FIG. 2 is an end view partly in section of the GEM shown in FIG. 1 with its skegs inflated for over-water use;

FIG. 3 is an end view similar to that of FIG. 2 but showing the skegs deflated for over-land use; and

FIG. 4 is a side view of the GEM of the invention in use over-water. One of the skegs being omitted to more clearly show the understructure and its operative relationship with the water.

Description of the preferred embodiment

The general construction of the preferred embodiment of the invention is best seen in FIG. 1. The GEM of the invention is there shown as consisting of a generally rectangularly shaped body 10 having a recessed deck area 12. Body 10 may be constructed of any suitable material providing the necessary strength while being relatively light in weight. Aircraft alloy aluminum is employed as the body material in this preferred embodiment of the invention and in use has been found to perform most satisfactorily.

On the deck 12 is mounted an inlet baffle 14 for the air cushion generating pressurizing system. At the rear of the deck area 12 is a propulsion means 16 including duct 18, propeller 20 and motor 22. Located to the rear of the propeller and motor is a movable air rudder 24. Along the lower edges of the sides of the body are a pair of skegs 26 and 28, only one skag 26 being shown in FIG. 1. The skegs form an important part of the invention and the construction thereof is best seen by reference to FIGS. 2 and 3 wherein the configuration of the skegs for both over-land and over-water travel is shown. FIG. 2 shows skegs 26 and 28 penetrating the water surface 30. These skegs are comprised of a flexible, water- and airtight material 32 such as rubberized "nylon" and are held rigid by the pressurizing of their sealed interiors. In the preferred embodiment of the invention, pressurization is by air ducted from the supporting supply through control conduits 34 and 36 and connecting conduits 38 and 40. The control conduits 34 and 36 have inlet valves 42 and 44 and outlet valves 46 and 48, respectively therein.

By closing valves 46 and 48 and opening valves 42 and 44, the sealed interiors of the skegs 26 and 28 are connected pneumatically to the source of pressurized air supplied by the operation of engine 50 and propeller 52. This pressurized air causes the skegs to inflate and become rigid so as to penetrate the water along the length of the GEM somewhat in the manner of a catamaran thus preventing air loss from either side of the craft. In the inflated condition the skegs assume a tapered cross-sectional form with the broad end thereof attached to the body of the craft.

Air loss from the front and rear of the GEM is almost completely eliminated by the use of compliant seals 54 and 56 shown in FIG. 4. These seals may be of a flexible skirt configuration as shown or may comprise a rigid unit

sprung yieldably into contact with the water surface. In the first mentioned alternative, the skirt may be multi-layered rubberized fabric, metal reinforced rubber sheets, or any other material sufficiently flexible to yield with wave motion without producing excessive hydrodynamic drag, yet sufficiently stiff to maintain constant contact with the passing waves. In the second alternative, the rigid unit may be comprised of a curved plate hinged to the body of said GEM, biased downwardly by springs, and snubbed by shock absorbers.

Considering now the subject GEM's air support system, it should be noted that two such systems may be used. The simplest of systems is the plenum type where pressurized air is forced into a distribution chamber below the baffle structure 14 and allowed to escape relatively unimpeded from under the lower peripheral edges of the machine. The preferred support system is that shown whereby continuous peripheral nozzles or ducts 58, 60, 62 and 64 are used to form an inwardly directed curtain of air and reduce air loss. The nozzles used in this preferred embodiment of the invention are arranged to extend longitudinally along the entire length of both undersides of the craft as shown at 58 and 60 and across both ends as at 62 and 64. The ducts are all supplied with air from a distribution chamber 66. In over-land use, air from the chamber is allowed to pass through and out of all the four continuous nozzles so as to form a continuous curtain of air inboard of the then flexible skegs and the compliant end seals. The air curtain minimizes air loss under the skegs and seals and so allows the GEM to clear larger obstacles on the ground 65 at lower power settings. In the CAB mode of operation, the air loss is greatly reduced from that over-land, the most significant loss being past the end seals. To take full advantage of the reduced air requirements provision is made to direct pressurized air to the nozzles 62 and 64 only, cutting off the supply to the nozzles 58 and 60. This may be accomplished by the use of flapper valves 67 and 68 which are manually actuatable to seal off nozzles 58 and 60, while permitting normal flow to nozzles 62 and 64.

The nozzles themselves may be constructed of any suitable material but flexible construction is preferred to allow them to flex and collapse when the machine is allowed to settle on the ground for loading and unloading. The flexible construction eliminates the need for supporting members to hold the nozzles clear of the ground when the machine is at rest.

Description of the operation

In operation from a land base, the craft is set in motion by first starting the propulsion engine 22 so as to have steerage available, then activating the cushion engine 50 so as to raise the body of the machine clear of the ground. Of course, a single engine could be adapted to power both the cushion and propulsion propellers by suitable gearing and clutching mechanisms, but the use of two engines is preferred because of increased operational flexibility. The power plants themselves would be chosen with special emphasis on weight to horsepower ratios, aircraft-type gas turbine engines being preferred.

As the body of the craft leaves the ground, the skegs, being in a deflated condition, hang from the body and act, in connection with the compliant seals, in the same manner as the conventional flexible skirts used on GEM's to prevent excessive air loss while allowing passage over rough terrain. When the craft, being controlled by rudder 24, approaches a body of water and, operation in the over-water mode is desired, the inflation of skegs 26 and 28 is begun. While in the preferred embodiment, the required inflation is accomplished by bleeding some of the cushion air through valve 42, it is to be understood that any other source of pressurized gas may be used and that liquids such as the kerosene used to fuel the turbines, or seawater, may be used to so inflate the skegs and make them rigid.

Whatever method of inflation is used, when the skegs become rigid, the power to engine 50 is reduced to allow the craft to settle closer to the water's surface and the skegs to penetrate the surface. When this penetration takes place the power to engine 50 may be reduced still further since the skegs and compliant end seals have now minimized air loss. Flapper valves 67 and 68 may also be closed at this point so as to provide an air curtain at the ends of the craft where what little air loss that does take place, occurs. Power and fuel consumption are thus drastically reduced and cruising range is extended. As land is again approached, deflation of the skegs and increasing of cushion power will be commenced. Deflation in the preferred embodiment is a simple matter of the opening of valves 46 and 48 so as to exhaust the skeg interiors to the atmosphere. If liquid filled skegs are to be employed suitable pumps would transfer the liquid to tanks or expel it overboard.

Flapper valves 67 and 68 are opened to maintain a full peripheral air cushion and the craft is ready for over-land operation.

In conclusion, what has been provided is a ground effect machine of superior amphibious characteristics capable of high speed operation over water and land and capable of traversing rough terrain.

Ground effect machines embodying the instant invention would be useful, for example, in transferring troops from ships located many miles from a combat zone, at high speeds over water, and then carrying the troops any required distance beyond the beaches. It is also contemplated that machines embodying the concepts of the present invention would be capable of serving as freighters to carry cargo over water great distances, and at high speeds, with good fuel economy, and then carrying the cargo directly to areas on land without reliance on docking or other support facilities of any kind.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An amphibious ground effect machine comprising:
 - a first propeller mounted horizontally in a duct to support said machine above the earth's surface on a cushion of air;
 - a second propeller mounted vertically to propel said machine along the earth's surface on said air cushion;
 - said first and second propellers being powered by at least one engine operatively connected to said first and second propellers;
 - an inflatable skeg mounted along the underside of each side of said machine near the outer edge thereof usable in two conditions to impede the loss of air from said air cushion, the first of said conditions impeding the loss of air from said air cushion when said machine is being operated over land, and the second of said conditions impeding the loss of air from said air cushion when said vehicle is being operated over water;
 - a source of pressurized fluid;
 - control means operatively connected between said pressurized gas and said inflatable skegs to selectively inflate said skegs for selecting one of said conditions;
 - a plurality of nozzles located near the periphery of the underside of said machine pneumatically connected to said duct; and
 - nozzle control means selectively operable to vary the flow of air to the nozzles located along the sides of said machine where said skegs are located.
2. An improved captured air bubble vehicle of substantially rectangular configuration having fore and aft compliant end-seals and flexible nozzle means located along the underneath periphery of said vehicle, the nozzle

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means disposed at each side of the vehicle intermediate said end seals being provided with means for the selective opening and closing thereof, said vehicle having propeller means mounted in a duct and constituting a source for supplying air under pressure via said nozzle means for developing beneath said vehicle a cushion of air supporting said vehicle above the earth's surface, said vehicle including propulsion means arranged to provide movement of said vehicle along the earth's surface on said air cushion, said improvement comprising:

skeg means mounted along the underside of each side of the vehicle and extending downwardly therefrom and outboard of said nozzle means, each of said skeg means comprising an elongated hollow body of flexible fluid tight material which when filled with fluid are rigid and when not so filled are flexible, deflectable and compliant, the transverse cross-sectional shape of each of said skeg means when filled with fluid being tapered whereby the upper dimension is greater than its lower dimension, the lower dimension of each skeg means at least approaching the configuration of a point; and

means for providing said skeg means with fluid under pressure, and selectively controllable valve means fluidly coupling each of said skeg means to said source of fluid under pressure whereby each of said skeg means may be filled with fluid, whereby when said vehicle is in operation over water and when said skeg means are filled with fluid, the lower ends thereof pierce the surface of the water preventing escape

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of air therepast, and said skeg means when not filled with fluid enabling escape of some of the air from the air cushion therepast and passage of the vehicle over both land and water without damage to the then compliant and deflectable skegs.

3. The vehicle of claim 2 further characterized by: an air distribution chamber connecting said source for supplying air under pressure with said skeg means; said distribution chamber forming, in part, a fluid path for said pressurized air; and said selectively controllable valve means being interposed in said fluid path for variably controlling the flow of air under pressure to said skeg means whereby said skeg means may be inflated or deflated.
4. The vehicle of claim 2, wherein said flexible fluid tight material for said skeg means is rubberized fabric.

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U.S. Cl. X.R.

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