March 4, 1969 D. W. NICHOLAS 3,430,725

GAS CUSHION VEHICLES OF THE SIDE WALL TYPE

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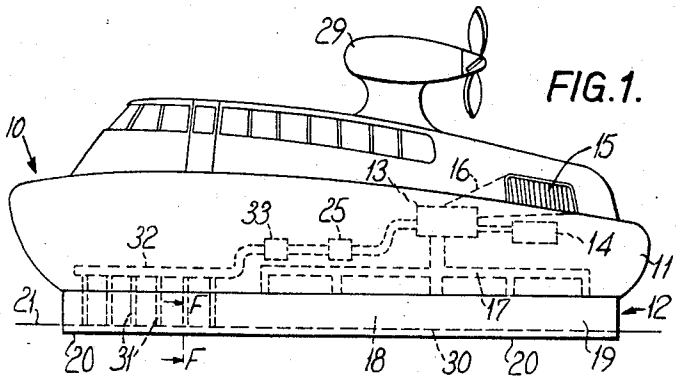



FIG.1.

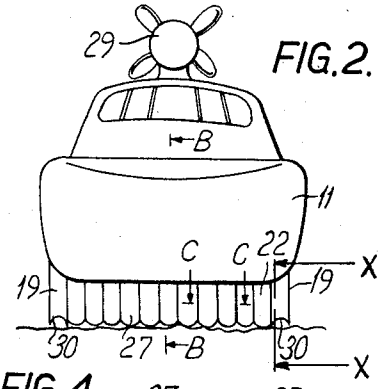



FIG.2.

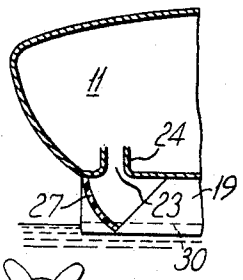



FIG.3.

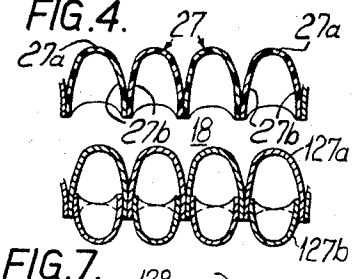



FIG.4.

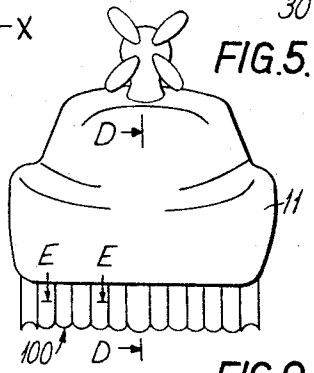



FIG.5.

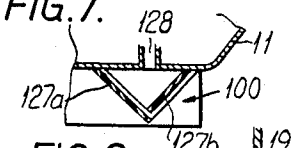



FIG.6.

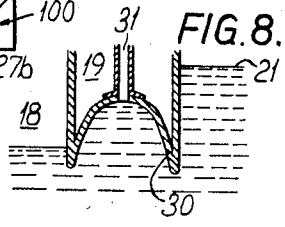



FIG.8.

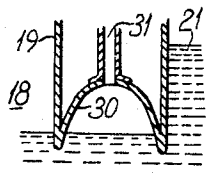



FIG.9.

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FIG. 10.

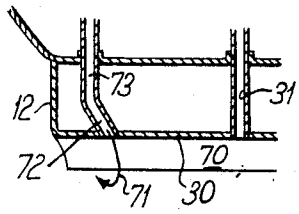



FIG. 11.

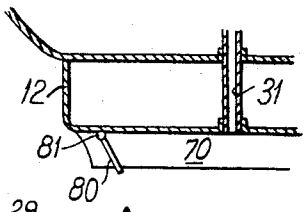



FIG. 12.

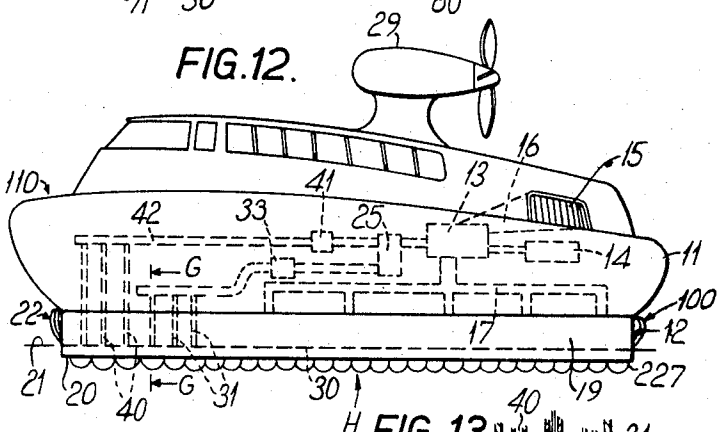



FIG. 13.

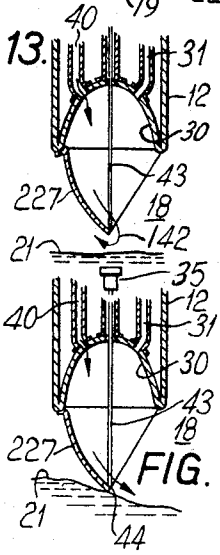



FIG. 14.

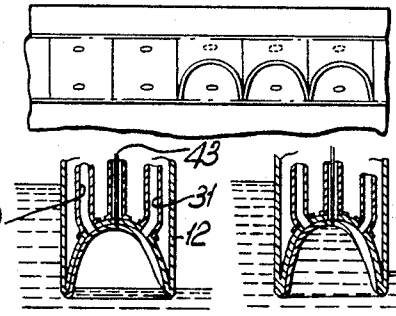



FIG. 15.

FIG. 16.

FIG. 17.

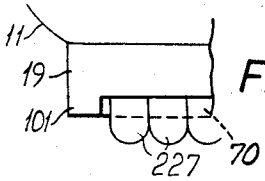



FIG. 18.

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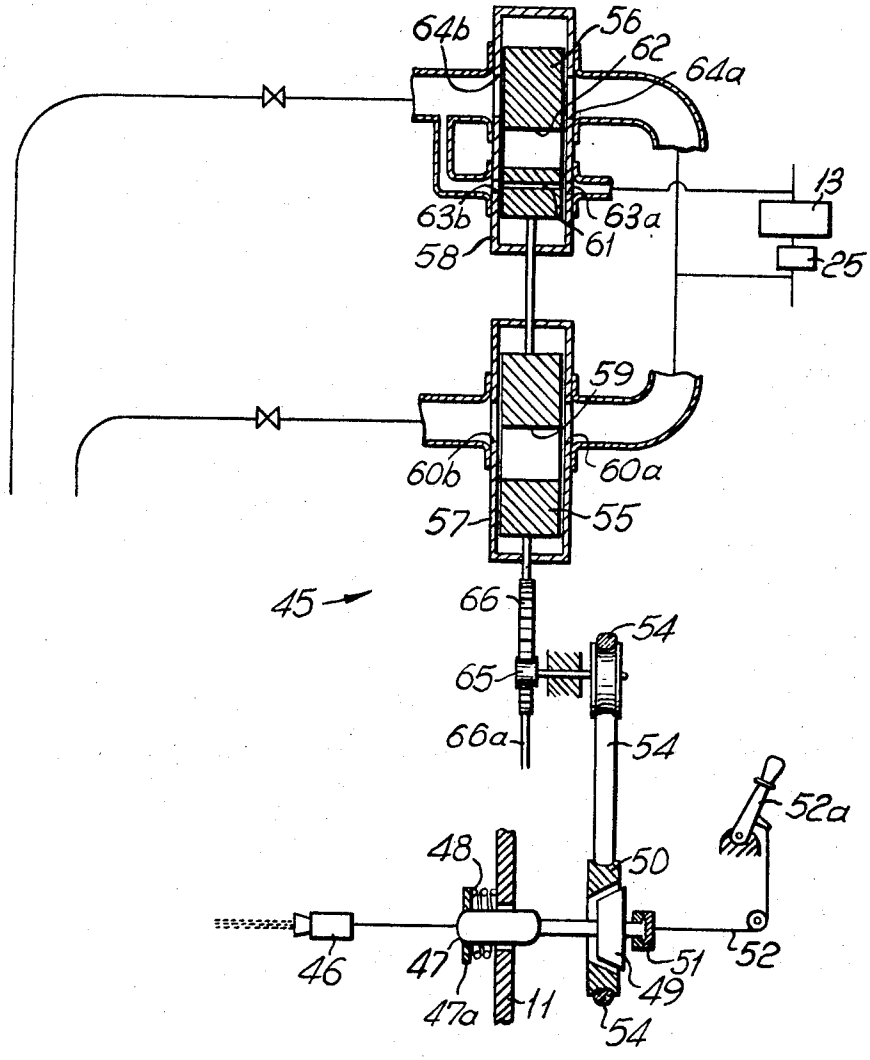



FIG. 19.

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3,430,725

# GAS CUSHION VEHICLES OF THE SIDE WALL TYPE

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Claims priority, application Great Britain, Nov. 11, 1965, 47,963/65
U.S. Cl. 180—126 14 Claims
Int. Cl. B60v 1/04, 1/16, 1/02

## ABSTRACT OF THE DISCLOSURE

A gas cushion vehicle of the side wall type has a downwardly facing, longitudinally extending concavity beneath the rigid portion of each side wall and is provided with means for supplying pressurised gas to each concavity to form gas cushions beneath the sidewalls, and with means at each end of each concavity for restricting the outflow of gas therefrom. Each side wall may be provided with a flexible skirt which is movable between a first position wherein it is disposed within the concavity and a second position wherein it extends downwardly from the side wall to assist in laterally bounding the vehicle-supporting gas cushion. The vehicle may also be provided with means responsive to the speed of the vehicle for regulating the supply of gas to the cushions beneath side walls, and for controlling the position of the flexible skirts.

The present invention is concerned with gas cushion vehicles and relates particularly to gas cushion vehicles of the type in which, in operation, a vehicle-supporting cushion of pressurised gas is formed beneath the body of the vehicle, and is laterally bounded, at least in part, by the wall structure extending downwardly from the body and having at least a part which is rigid and substantially parallel to the intended direction of motion of the vehicle.

Usually, in those vehicles of this type known as "rigid side wall vehicles," the wall structure comprises two rigid parts or rigid side walls which depend from the sides of the body of the vehicle and are parallel to the intended direction of motion (hereinafter termed the "longitudinal direction") of the vehicle. The right side walls from opposite lateral boundaries of the vehicle-supporting cushion. The lateral boundaries of the cushion between the ends of the rigid side walls can be formed by a flexible part of the wall structure and/or by a curtain of fluid downwardly discharged from the body.

In the normal mode of operation of known rigid side wall vehicles over water, the lowest regions of the rigid side walls are immersed in the water so that no, or very little, gas can escape from the cushion between the said rigid side walls and the surface of the water. The immersed rigid side walls also serve in the manner of a keel to resist forces which act on the vehicle with at least a component perpendicular to the intended direction of motion of the vehicle. Such forces are for example, those forces associated with steering the vehicle and the aerodynamic forces due to cross-winds.

Another benefit provided by the immersed rigid side walls during operation over water is that of stability against roll of the vehicle due to the buoyancy of the rigid side walls. If the immersion of one of the side walls should increase during a roll of the vehicle, the immersion of the opposite side wall decreases and the increased buoyancy of the first side wall and the decreased buoyancy of the other wall provide a couple acting to restore the attitude of the vehicle. The magnitude of the restoring



couple which will be available for each angle of roll depends, among other factors, on the displacement volume of the rigid side walls which is immersed in the water at each roll angle. In the interests of roll stability particularly at low speeds, it is advantageous to shape the side walls so that the displacement volume per unit angle of roll is large. At higher speeds, the roll stability of the vehicle improves due to the planning of the rigid side walls over the water surface. However, the advantages of providing a potentially large immersed volume of the side walls for roll stability must be weighed against the drag that the immersed part of the rigid side walls will produce when the vehicle is moving.

While at low speeds the drag of the immersed rigid side walls in the water is relatively low, at higher speeds it becomes one of the more significant power consuming factors, and it is one of the objects of this invention to provide a vehicle of the said type in which the drag of the rigid side walls in the water can be minimized.

According to this invention there is provided a gas cushion vehicle of the type described comprising means for containing a cushion of pressurised gas beneath at least a portion of the rigid part of the wall structure.

The said rigid part may define a concavity which may extend in the longitudinal direction and which, during normal operation of the vehicle, may be presented downwardly for containing the said gas cushion beneath the wall structure. The vehicle may be provided with means for supplying pressurised gas to the concavity for forming the gas cushion therein, and there may be means responsive to the speed of the vehicle for regulating the supply of gas to the concavity. The wall structure may be formed with at least one port for discharging a curtain of fluid transversely across the concavity whereby to contain the gas cushion longitudinally in the concavity, during operation. Alternatively, or in addition, at least one of the longitudinal ends of the concavity may be provided by a flap member hingedly attached to the rigid part of the wall structure transversely across the concavity so as to be capable of pivoted movement in the lengthwise direction of the concavity.

The wall structure may comprise a skirt formed of flexible material which is attached to the said rigid part, and the skirt may be movable between a first position in which it is disposed within the concavity and a second position in which it extends downwardly from the rigid part to provide a lateral boundary below the rigid part, in operation, for the vehicle-supporting gas cushion, there being skirt-extending means operable to cause the skirt to move from the said first position to the said second position, and skirt-retracting means operable to cause the skirt to be retracted from the said second position to the said first position. There may be means for applying suction to the skirt in the said first position thereof whereby to retain the skirt in the said first position. The vehicle may comprise means responsive to the speed of the vehicle for controlling the suction-applying means so that, for example, at speeds below a selected speed, suction is applied to the skirt to maintain the skirt in the said first position, and at speeds exceeding the selected speed, substantially no suction is applied to the skirt whereby the skirt may be moved relatively freely from the said first position to the said second position thereof.

The skirt-extending means may comprise means for discharging pressurised fluid against the skirt whereby to urge the skirt away from the said first position thereof towards the said second position thereof and the vehicle may comprise means responsive to the speed of the vehicle for controlling the rate of discharge of pressurised fluid from the fluid-discharging means, so that, for example, pressurised fluid is discharged against the

skirt only when the vehicle's speed exceeds a selected speed. The skirt-retracting means may comprise resilient means operable in the second position of the skirt to bias the skirt away from the said second position towards the said first position. Alternatively, or in addition, the skirt-retracting means may comprise a member which is drivable for moving the skirt from the said second position to the said first position. The skirt may be so formed that in the said second position thereof, it is inclined inwardly under the vehicle body.

The said skirt may comprise a succession of wall elements disposed side-by-side, each wall element having a wall portion which, in the said second position of the skirt, extends downwardly from the rigid part of the wall structure and longitudinally thereto, and a side portion extending inwardly from each of the longitudinally spaced sides of the wall portion, the adjacent side portions of neighbouring wall elements co-operating with each other in operation, under the inflating action of pressurised gas laterally contained by the wall portion, whereby substantially to prevent the escape of pressurised gas between neighbouring wall elements. Flexible wall elements of this nature are disclosed in British Patent No. 1,043,351.

Embodiments of the invention, given by way of example only, will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a side elevation of a rigid side wall gas cushion vehicle in accordance with the invention,

FIGURE 2 is a front view of the vehicle of FIGURE 1,

FIGURE 3 is a sectional view on the line B—B of FIGURE 2,

FIGURE 4 is a sectional view on the line C—C of FIGURE 2,

FIGURE 5 is a rear view of the vehicle of FIGURE 1,

FIGURE 6 is a sectional view on line D—D of FIGURE 5,

FIGURE 7 is a sectional view on the line E—E of FIGURE 5,

FIGURE 8 is a sectional view on the line F—F of FIGURE 1,

FIGURE 9 is a view similar to FIGURE 8 but with the vehicle of FIGURE 1 progressing at a higher speed,

FIGURES 10 and 11 are longitudinal cross sections of the rigid side walls taken on the line X—X of FIGURE 2 and showing alternative methods of confining a cushion of air beneath the rigid side walls,

FIGURE 12 is a view of another vehicle in accordance with the invention,

FIGURE 13 is a cross sectional view on the line G—G of FIGURE 12,

FIGURE 14 is a view of part of the vehicle of FIGURE 12 looking in the direction of the arrow H, parts being removed to show the manner of construction.

FIGURE 15 is a view corresponding to the view of FIGURE 13 but with the vehicle progressing at a lower speed,

FIGURE 16 is another view corresponding to the view of FIGURE 13, but with the vehicle progressing at a still lower speed, and

FIGURE 17 is a further view corresponding to the view of FIGURE 13 but with the vehicle stationary or progressing at very low speeds,

FIGURE 18 shows in longitudinal vertical cross section a detail of the vehicle of FIGURE 12,

FIGURE 19 is a schematic illustration of an automatic speed responsive control valve.

The vehicle shown in FIGURE 1, generally indicated by reference **10**, comprises a body **11** and a wall structure generally indicated by reference **12** attached to, and extending downwardly from the body **11**. Within the body **11** is a compressor **13** driven by a motor **14**, the compressor inducing air through intake **15** and ducting **16**, compressing the air, and discharging the compressed air through ducting **17** beneath the body **11** through suitable ports (not shown) in the bottom of the body **11**. The



compressed air beneath the body **11** forms a cushion **18** supporting the body **11** above the water and which is laterally contained by the wall structure **12**. The wall structure **12** comprises two spaced apart rigid side walls **19** (only one of which can be seen in FIGURE 1) which are parallel to the longitudinal axis of the vehicle **10** and which depend from the sides of the body **11**, and for low speed operation over water, the lowest sections **20** of the side walls **19** are immersed below the surface **21** of the water. Thus the side walls **19** form a barrier to the escape of compressed air from the cushion **18** under the longitudinal sides of the vehicle.

The cushion **18** is laterally confined at its forward end by a front wall structure, generally indicated by **22** in FIGURE 2, which extends between the opposite rigid walls **19**. As shown in FIGURE 3, the front wall structure **22** comprises a plurality of wall elements **27** which are downwardly dependent from the body **11**. As will be seen from FIGURES 3 and 4, each wall element **27** is formed from a single frusto-triangular piece of flexible sheet material, such as rubber or rubberised fabric, folded about a median line into a downwardly extending chute having a wall portion **27***a* providing the front boundary of the cushion **18** and a side portion **27***b* on each side of the wall portion **27***a*, the side portions **27***b* extending inwardly towards the cushion **18** so that each wall element **27** is substantially U-shaped in horizontal cross section. Each element **27** is attached to the body **11** outwardly (with respect to the cushion **18**) of a respective port **23** formed in the bottom of the body **11**. Port **23** is fed with compressed air from compressor **13** via duct **24** (FIGURE 3) and the air from port **23** is guided downwardly and somewhat inwardly towards the cushion **18** by the U-shaped wall elements **27**. This air serves to separate the side portions **27***b* of each wall element **27** and to press adjacent side portions **27***b* of neighbouring wall elements **27** into co-operation so that substantially no air can escape therebetween. The air leaving the lowest part of the wall elements **27** may form an air curtain which bounds the cushion **18** below the front wall structure **22** if the wall elements **27** do not touch the water surface **21**.

A wall structure of this type is described in British Patent No. 1,043,351.

The cushion **18** is laterally confined at its aft end by a rear wall structure generally indicated by reference **100** in FIGURES 5, 6 and 7. The wall structure **100** is formed from a number of wall elements **127**, similar to the wall elements **27** of FIGURES 3 and 4, but arranged in pairs with side portions of the inner (with respect to cushion **18**) wall element **127***a* of each pair embracing the associated outer wall element **127***b*, as shown in the horizontal sectional plan view of FIGURE 7. A port **128** (FIGURE 6) for each pair of associated wall elements **127***a*, **127***b* is provided in the body **11** of the vehicle **10** and is supplied with compressed air, which may be for example air from the compressor **13**. The wall elements **127***a*, **127***b* in each pair are urged into co-operation with each other by the compressed air to form a conical bag, and the plurality of conical bags forming the rear wall structure **100** co-operate with each other to form the aft lateral boundary of the cushion **18**. A wall structure of the nature of aft wall structure **100** is described in British Patent No. 1,109,562.

The vehicle **10** is propelled by a propeller unit **29**.

Referring now to FIGURE 8, it will be seen that the lowest section **20** of the rigid walls **19** has a longitudinal concavity in the form of a groove **30** formed in the bottom thereof. One or more bores **31** in each of the walls **19** communicates at one end with the concave groove **30** and at the other end as shown in FIGURE 1, with a conduit **32** connected to the output side of an auxiliary compressor **25**: the passage of air from the auxiliary compressor **25** into the conduit **32** is regulated by a valve **33** under the control of the pilot.

The difference in level between the water surface beneath cushion **18** and the free water surface **21** is due to the pressure of cushion **18**.

For low speed operation of vehicle **10**, when the drag of the immersed sections **20** of the rigid walls **19** is relatively small, the auxiliary compressor **25** is not operated and valve **33** is closed.

Water will fill, or tend to fill, the concave groove **30** as shown in FIGURE 8. As the speed of the vehicle **10** is increased and drag becomes more significant, the auxiliary compressor **25** is started and valve **33** opened, to permit compressed air to flow from the auxiliary compressor **25** through the conduit **32** and the bores **31** to the concave groove **30**, where it depresses the water level in the concave groove **30** as shown in FIGURE 9, thus reducing the area of rigid wall **19** in contact with the water and forming a cushion of pressurized air in the groove **30**. Accordingly, the drag resulting from the contact of wall **19** with the water is reduced and this mode of operation is particularly suited for cruising speed operation.

The cushion is pressurised air which is formed in the concave groove **30** is confined at the forward and aft ends of the groove **30** either by a curtain of air which is downwardly discharged from ports in the walls of the groove **30** or by hinged flaps resembling the mud-flaps which are attached to the mudguards of automobiles. FIGURE 10 shows, by way of example, the forward ends of the concave groove **30** in the side walls **19**, in which a cushion **70** of pressurised gas is confined by a curtain **71** of air downwardly discharged into the groove from a slit-like port **72** receiving air from the auxiliary compressor **25** via conduit **73**. The after end (not shown) of cushion **70** may be similarly confined. The air curtain **71**, in addition to containing the gas cushion **70**, also may supply pressurised air to maintain the cushion **70**, at least partly.

FIGURE 11 shows an alternative way of confining the air cushion **70** by the use of a flap **80** attached to the walls of concave groove **30** by means of suitable hinges **81** which permit the flap member **80** to pivot longitudinally. Both the curtain **71** of FIGURE 10 and the flap **80** of FIGURE 11 take up positions determined by the difference between the total pressure head of the water and the total pressure head of the cushion **70**.

The vehicle **110** depicted in FIGURE 12 resembles the vehicle **10** of FIGURE 1 in most respects. However, in addition, to the bores **31** for supplying compressed air to the concave groove **30**, there are other bores **40** disposed outwardly (with respect to the cushion **18**) of the bores **31** which can be connected as desired to the input side or the output side of an auxiliary compressor **25** by means of valve **41** in line **42**, so that the pressure in the bores **40** can be reduced or increased. The valve **41** is under the control of the pilot. A number of wall elements **227** resembling the wall elements **27** and **127** of previous embodiments, are attached by their upper regions to the walls of the concave groove **30** in such manner, as shown in FIGURES 13 and 14, that when valve **41** is adjusted to allow compressed air to be discharged from the bores **40**, the adjacent side portions or limbs of successive wall elements **227** are inflated into co-operation with each other and the elements **227** are downwardly extended so that each element **227** has the shape of a downwardly extending chute which is U-shaped in horizontal cross-section. The compressed air is directed downwardly and somewhat inwardly towards the vehicle-supporting cushion **18** by the wall elements **227**, and forms an air curtain **42** serving to bound the cushion **18** below the wall elements **227**, and to feed the cushion **18** with air. In this mode of operation, the subsidiary cushion in groove **30** becomes continuous with the vehicle-supporting cushion. This mode of operation of the vehicle **110** with a curtain **142** of air discharged from the fully extended wall elements **227** is best suited for the highest operational speeds, since the power required to generate the compressed air used to form the curtain **142** in addition to the power required to form and maintain the cushion **18** is more than offset by the reduced power of the drag forces between the water surface **21** and the vehicle **110**.

For lower speed travel, the valve **41** can be slightly shut off so that the flow of compressed from the bores **40** is sufficient to maintain the chute like configuration of the elements **227**, but insufficient to form a curtain **142**. This mode of operation is represented in FIGURE 15. Accordingly, the wall elements **227** will contact the water surface **21** to act as the lateral boundary of the cushion **18**, and the air from bores **40** will pass directly to the cushion **18**. The increased power of the drag forces due to contact between the wall elements **227** and the water surface **21** will be smaller, for the said lower speed travel, than the power which would otherwise be required to maintain the curtain **142**.

At cruising speeds below the speed for which the configuration of FIGURE 15 would be appropriate, the drag forces can be so small, that the power required to maintain the wall elements **227** extended (by means of the compressed air from port **40**) is greater than the power of the drag forces which would prevail in the total absence of the wall elements **227** and with the rigid side walls **19** partly immersed in the water as shown in FIGURE 12.

Accordingly, as the speed of the vehicle **110** is reduced, valve **41** is first adjusted to shut off the supply of compressed air to bore **40**, and each wall element is upwardly withdrawn into the concave groove **30** by a cable **43** attached at one end to an eyelet **44** on each wall element **227**, and at the other end to suitable resilient means, such as a light spring **35**. Alternatively, the cable **43** can be pulled upwardly when required by a retracting or winding drum (not shown) driven by an electric motor under the control of the driver. The arrangement of the upwardly withdrawn wall elements **227** is illustrated in FIGURE 16.

When each wall element **227** has been completely withdrawn into the concave groove **30**, it may be retained against the walls of the groove **30** by suction applied from bore **40** by suitable adjustment of valve **41**. However, the speed may still be sufficiently high to make it desirable to maintain compressed air in the concave groove **30** to reduce the area of the rigid wall **19** in contact with the water. The necessary compressed air is supplied from bores **31**. The power required to provide the suction in bores **40** is very small.

At very low speeds, the drag forces become so insignificant that the provision of compressed air from bores **31** in groove **30** becomes superfluous. Accordingly, valve **33** can be closed, and the area of contact between the rigid wall **19** and the water becomes maximal, as shown in FIGURE 17. Since there would be some power advantage in maintaining the wall elements **227** firmly against the walls of groove **30** to avoid damage or excess drag due to a wall element **227** which is "floating" in the concave groove **30**, the suction in the bores **40** is continued.

In FIGURE 18, which shows in longitudinal vertical cross section a detail of the rigid wall **19** of the vehicle of FIGURE 12, the concave groove **30** does not extend the whole length of the rigid walls **19**, there being short portions **101** at the forward and aft ends of the rigid walls **19** which are not provided with a concave groove **30**. The wall elements **227** are disposed between these portions **101** so as to be retractable into the concave grooves **30** as previously described. When they are so retracted, the wall elements **227** at the forward and aft ends of the concave groove **30** are protected against being pulled downwards due to turbulence in the water by the forward and aft portions **101** which act as fairings. The forward and aft portions **101** can also serve to confine the cushion **70** of gas beneath the rigid side walls

19 when the vehicle 10 is operating in the mode depicted in FIGURE 9. The front wall structure 22 and aft rear structure 100 preferably (although not essentially) extend across the forward and aft boundaries of the cushion 18 between opposite grooved portions of the rigid walls 19 so that substantially no air escapes between the transverse ends of the wall structures 22 and 100 and the longitudinal ends of the rigid side walls 19 from the vehicle-supporting cushion 18 when the vehicle is operating with the wall elements 227 extended as shown in FIGURE 10.

Thus there are four modes of operation of the vehicle 110 as represented by FIGURES 13, 15, 16 and 17. The transition between the four modes, by the adjustment of valves 33 and 41 and the regulation of cables 43, can be under the control of the pilot, as previously mentioned. Alternatively, or in addition, the transition may proceed automatically from a speed responsive mechanism, an example of one of which is shown in FIGURE 19.

The speed responsive mechanism, generally indicated by reference 45, comprises a Doppler-type speed measuring device 46 of known type which operates to generate a speed indicative signal. The speed indicative signal is supplied to a reversible fractional horsepower electric motor 47 which is slidably mounted in the vehicle body 11. The motor 47 has an annular flange 47*a* towards one end and a compression spring 48 acting on the flange 47*a* urges the motor 47 to the left, as seen in FIGURE 19. The driveshaft of the motor 47 protrudes from the opposite side of the motor 47 to the flange 47*a*, and is connected to an externally coned wheel 49 forming the inner member of a clutch. The outer member of the clutch takes the form of an internally coned wheel 50. The spring 48 serves to maintain the externally coned wheel 49 in cooperation with the internally coned wheel 50. On the opposite side of the externally coned wheel 49 from the spring 48, there is provided a shaft having a collar bearing 51 to which is connected a control cable 52 actuable by a control lever 52*a*. By suitably moving the control lever 52*a*, the wheels 49, 50 may be declutched.

The internally coned wheel 50 is externally grooved so as to receive an endless belt 54 which transmits motion from the wheel 50 via a pulley wheel to a pinion wheel 65 which meshes with a rack 66. The rack 66 is connected to the lower end of a lower valve slide 55 which in turn is connected to the lower end of an upper valve slide 56. Each valve slide 55, 56 is vertically movable in a corresponding valve sleeve 57, 58 respectively. The lower valve slide 55 is formed with a single diametric bore 59 which can provide a connection between a port 60*a* formed on one side of the valve sleeve 57 and a port 60*b* formed diametrically opposite. The port 60*a* is connected to the output side of the auxiliary compressor 25 (shown in FIGURE 12) and the port 60*b* is connected to the bores 31 (shown in FIGURES 13 to 15). When the bore 59 and the ports 60*a* and 60*b* are in register, compressed air from the compressor 25 is supplied to the bores 31 in the rigid walls 19 so that a cushion of pressurised air is formed in the grooves 30 in the bottom thereof.

The upper valve slide 56 is furnished with two bores 61 and 62 which can register with respective pairs of diametrically opposed ports 63*a*, 63*b* and 64*a*, 64*b* provided in the upper valve sleeve 56. The bore 61 is of smaller diameter than the bore 62 and the ports 63*a*, 63*b* are longer, vertically, than the diameter of the bore 61. The port 63*a* is connected to the input side of compressor 13 (shown in FIGURE 12) while the port 63*b* is connected to the bores 40 in the rigid side walls 19. The port 64*a* is connected to the output side of the auxiliary compressor 25 and the port 64*b* to the bores 40.

The operation of the speed responsive mechanism 45 during passage of the vehicle 110 over water is as follows: the Doppler device 46 furnishes a speed indicative signal to the electric motor 47 which rotates the clutch 49, 50 (when operative) in accordance with the signal. The rotation of the clutch 49, 50 causes movement of the rack 66 due to the movement of the belt 54 and its pulley and the pinion wheel 65. As the rack 66 moves, for instance, in an upward direction, as seen in FIGURE 19, the valve slides 55, 56 are displaced upwardly. The higher the speed of the vehicle 110 relative to the surface, the greater will be this upward displacement of the valve slides 55, 56. The speed responsive mechanism 45 is so arranged that at zero speed, the valve slides 55, 56 will be in their lowest positions in their respective sleeves 57, 58. At these lowest positions, the bores 61, 62 in the slide 56 are arranged not to be in register with the corresponding pairs of ports. However, the bore 61 in the upper valve slide 56 connects the vertically elongated ports 63*a*, 63*b* so that suction is applied from the input side of the compressor 13 to the bores 40 and hence to the wall elements 227 so that the wall elements 227 are retained in the groove 30. As the vehicle speed increases, the signal from the Doppler device 46 will cause the motor 47 to drive the clutch 49, 50, the belt 54 and pinion wheel 65 so that the rack 66 will be displaced upwardly and the bore 59 in slide 55 will now connect the ports 60*a* and 60*b*. Accordingly, there will be a flow of compressed air from the auxiliary compressor 25 via the bores 31 to the grooves 30 under the side walls 19 so that a cushion of air is formed in the grooves 30 as depicted in FIGURE 16. If the vehicle speed should increase still further, the correspondingly further upward displacement of the upper valve slide 56 will cause the bore 61 to pass out of register with the ports 63*a*, 63*b* and the bore 62 to pass into register with the ports 64*a* and 64*b*. Compressed air will now be supplied from the auxiliary compressor 25 to the bores 40 in the side walls 19 causing the wall elements 227 to assume the configuration depicted in FIGURE 15. According to whether or not the ports 60*a*, 60*b*, are vertically longer than the bore 59, compressed air may or may not continue to pass to the grooves 30 via the bores 31. When the vehicle 110 slows down, the corresponding speed signals from the Doppler device 46 operate on the motor 47 to cause the valve slides 55, 56 to return to their initial lowest position in their respective valve sleeves 57, 58.

The speed responsive mechanism 45 may be over-ridden by the driver of the vehicle 110 by pulling the control lever 52*a* (anti-clockwise, in FIGURE 19) so that the control cable 52 pulls through the collar bearing 51 to cause the externally coned wheel 49 to move relative to the internally coned wheel 50 so that no drive is transmitted via the clutch 49, 50. A manually controllable link 66*a* attached to the lower end of the rack 66 enables the driver of the vehicle 110 to move the rack 66 manually so as to regulate the flow of compressed air through the bores 59, 61, 62.

Manually controllable valves, which may be the valves 33, 41 of FIGURE 12, may also be provided for use when the speed responsive mechanism 45 has been over-ridden or is inoperative.

Various combinations of the features described above may be employed without departing from the invention.

I claim:

1. A gas cushion vehicle comprising a pair of spaced wall structures, at least the lower part of each wall structure being rigid, extending downwardly from the vehicle and substantially parallel to the fore-and-aft axis thereof so as to laterally bound a space for containing a vehicle-supporting cushion of pressurised gas beneath the vehicle, means for supplying pressurised gas to said space to form said cushion, the rigid part of each wall structure being formed with a downwardly facing longitudinally extending concavity, and means for supplying pressurised gas to said concavity to form a cushion of pressurised gas beneath the rigid part of each wall structure.

2. A vehicle according to claim 1, comprising means responsive to the speed of the vehicle for regulating the supply of gas to the concavity.

3. A vehicle according to claim 1 in which each wall structure defines at least one port which is transverse to the length of the concavity in said wall structure, and means for discharging from said port a curtain of fluid flowing transversely across the concavity so as to contain one lengthwise end of the gas cushion in the concavity.

4. A vehicle according to claim 1 including at least one flap member hingedly attached to the rigid part of the wall structure transversely across the lengthwise concavity so as to be capable of pivotal movement in the lengthwise direction, the flap member serving to define one of the longitudinal ends of the concavity.

5. A vehicle according to claim 1 including a skirt formed of flexible sheet material which is attached to the rigid part of each wall structure, the skirt being movable between a first position in which it is disposed substantially within the concavity and a second position in which it extends downwardly from the rigid part to provide a lateral boundary below the rigid part for the vehicle-supporting gas cushion, skirt-extending means operable to cause the skirt to move from the said first position to the said second position, and skirt-retracting means operable to cause the skirt to be retracted from the said second position to the said first position.

6. A vehicle according to claim 5 in which the skirt-retracting means comprises resilient means operable to bias the skirt from its second position to its first position.

7. A vehicle as claimed in claim 5 in which the skirt-retracting means comprises a retractable cable for moving the skirt from its second position to its first position.

8. A vehicle according to claim 5 including means for applying suction to the skirt in the said first position thereof so as to retain the skirt in the said first position.

9. A vehicle according to claim 8, comprising means responsive to the speed of the vehicle for controlling the suction-applying means.

10. A vehicle according to claim 5 in which the said skirt-extending means comprises means for discharging pressurised fluid against the skirt so as to urge the skirt from the said first position thereof to the said second position thereof.

11. A vehicle according to claim 10 comprising means responsive to the speed of the vehicle for controlling the discharge of pressurised fluid from the said pressurised fluid discharging means.

12. A vehicle according to claim 5 in which the skirt in its second position, it is inclined inwardly relative to the vehicle body.



13. A vehicle according to claim 5 in which the skirt comprises a succession of wall elements disposed side-by-side lengthwise of the concavity, each wall element having a wall portion which, in the second position of the skirt extends downwardly from the rigid part of the wall structure and longitudinally thereof, and a side portion extending inwardly from each of the longitudinally spaced sides of the wall portion, the adjacent side portions of neighbouring wall elements co-operating with each other, in operation, under the inflating action of pressurised gas laterally contained by the wall portion, so as substantially to prevent the escape of pressurised gas between neighbouring wall elements.

14. A gas cushion vehicle comprising a pair of spaced wall structures, at least a lower part of each wall structure being rigid, extending downwardly from the vehicle and substantially parallel to the fore-and-aft axis thereof so as to laterally bound a space for containing a vehicle-supporting cushion of pressurised gas formed beneath the vehicle, means for supplying pressurised gas to said space to form said cushion, the rigid part of each wall structure being formed with a downwardly facing longitudinally extending concavity, a plurality of ports opening into the said concavity at longitudinally spaced intervals therealong, means for supplying gas under pressure to the said ports, and means at each end of the concavity for restricting the outflow of gas therefrom so that a cushion of pressurised gas may be formed and contained beneath said rigid part of each wall structure.


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