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(54) **Variable stern buoyancy in boat hulls**

(57) A planing boat hull having it's transom clear of the waterline or semi-immersed when at rest, in the stern part of which at a horizontal below the waterline there is a chamber 7 that can be flooded to produce various inclinations of stern trim. Within the chamber is located a device or system for expelling water from the chamber thereby removing the acquired stern trim. The device or system may comprise inflatable air bags or bellows, pivoted rigid flotation units 17 or compressed air and the chamber formed as an irregular shape or be divided athwartship.

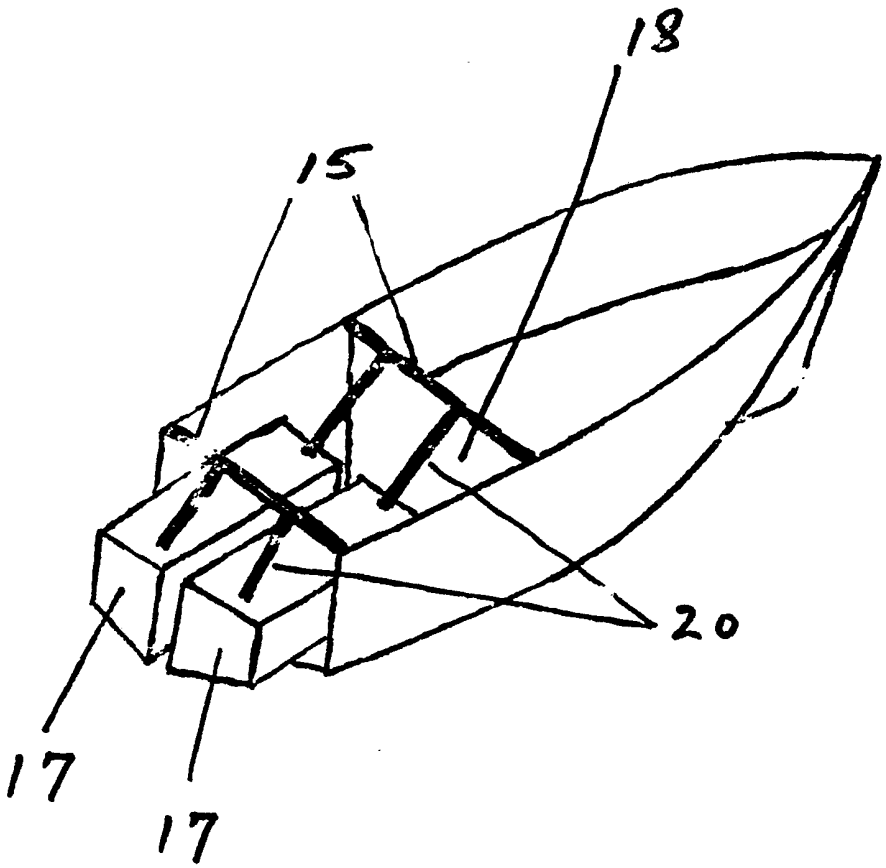

FIG 11

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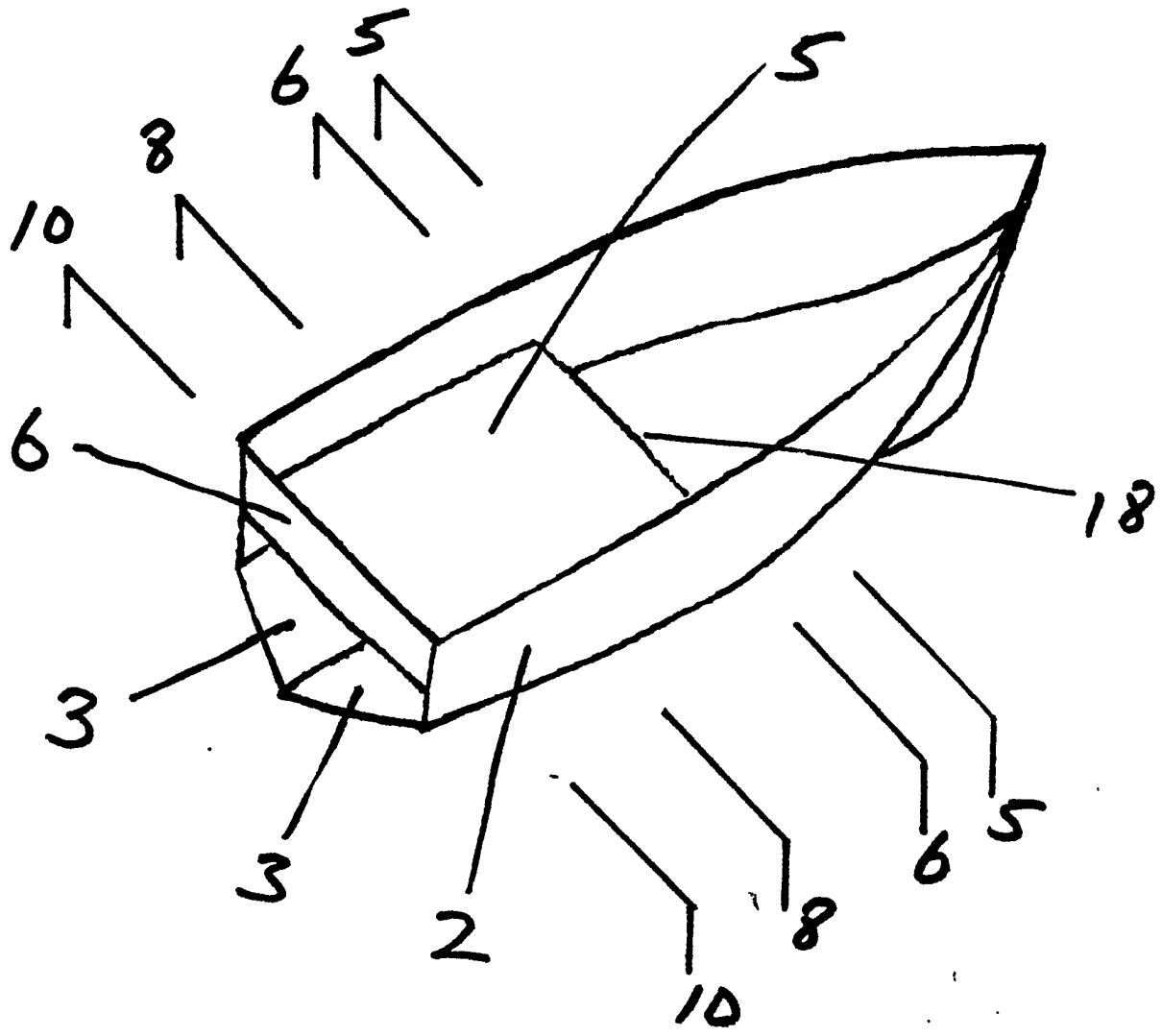

FIG 1

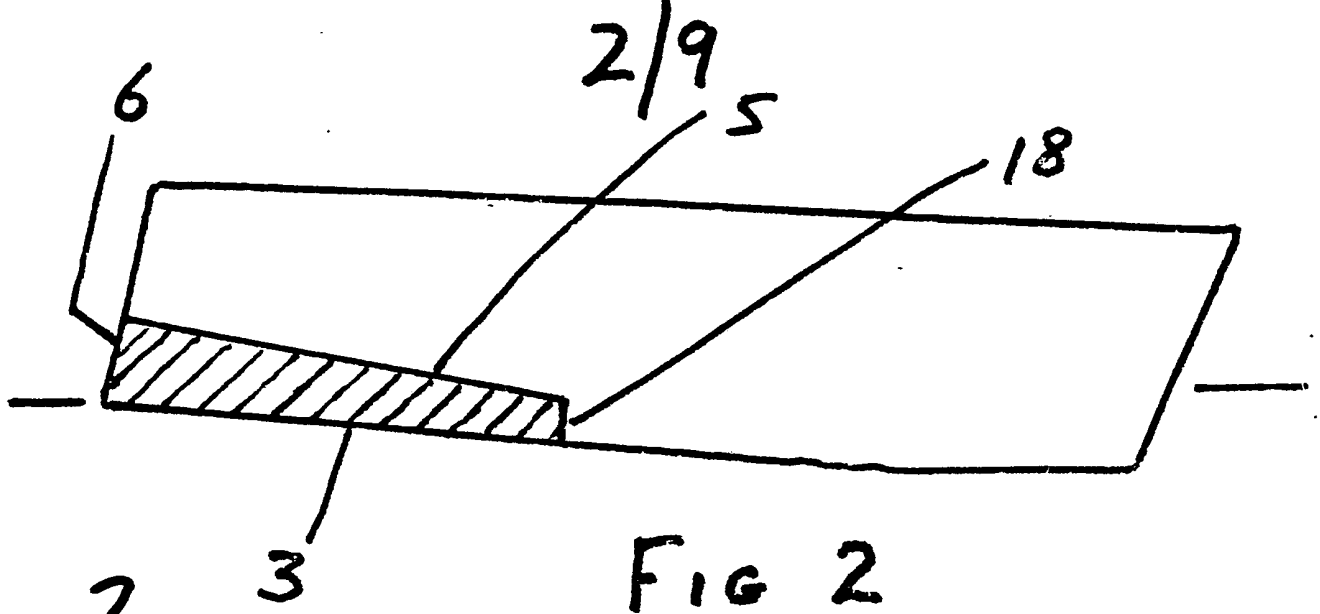

FIG 2

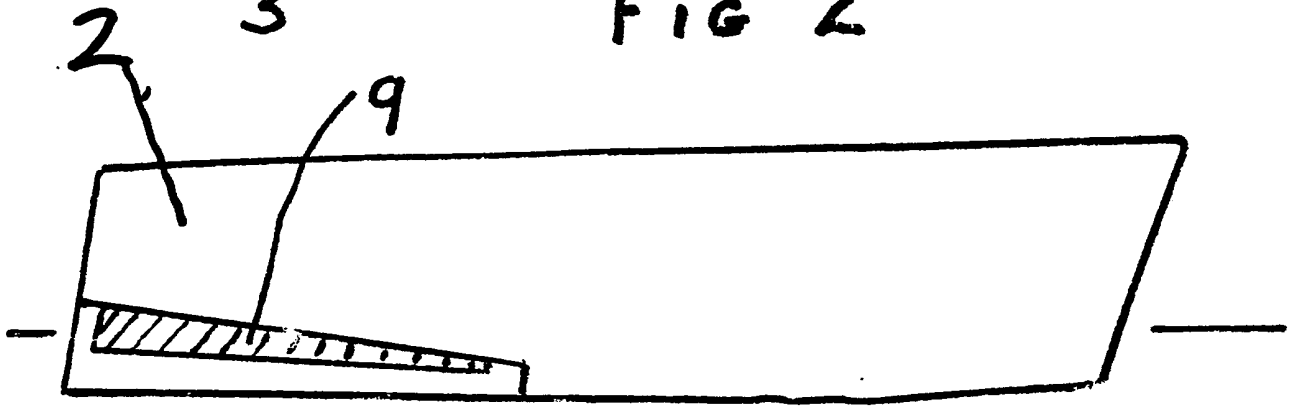

FIG 3

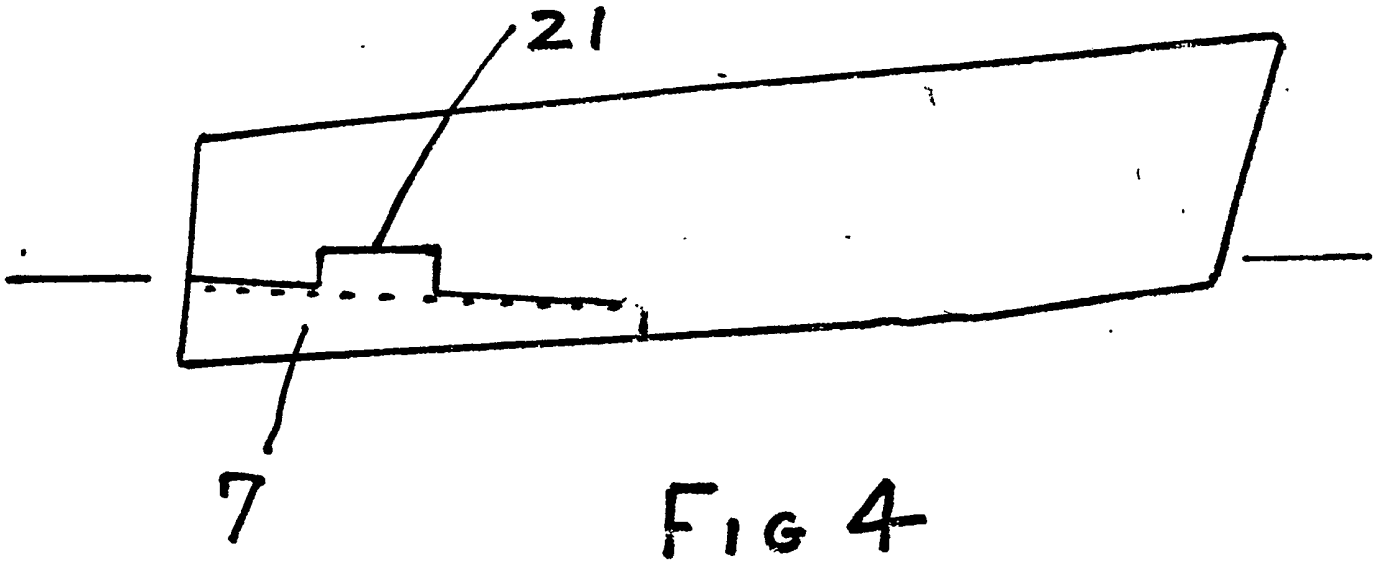

FIG 4

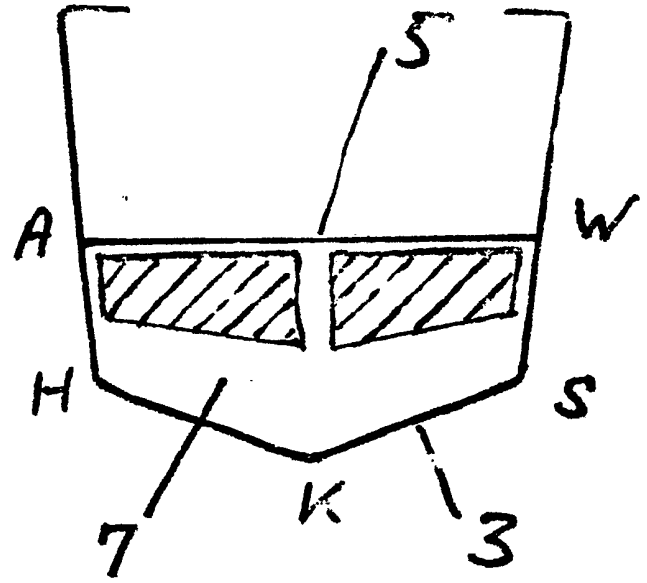

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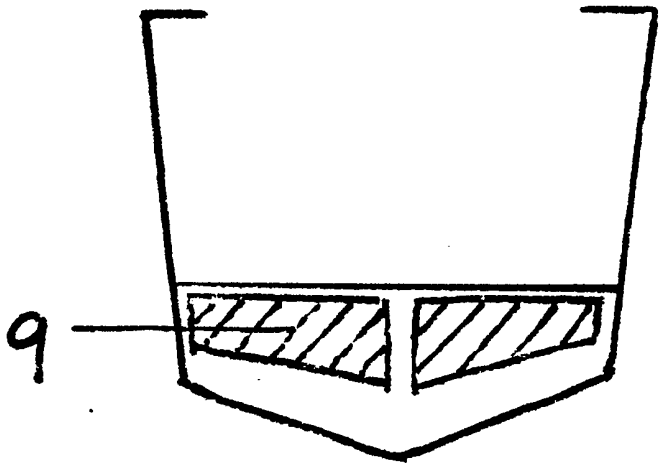
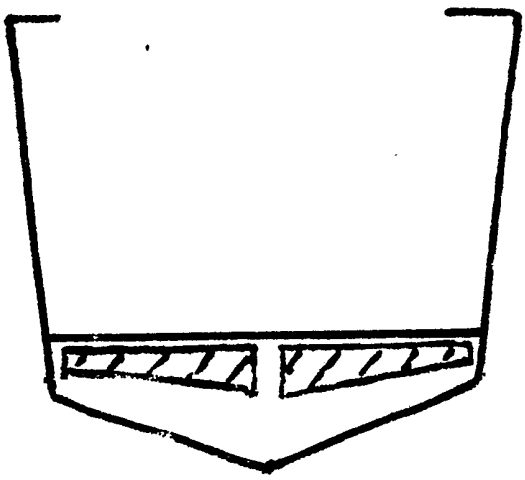
FIG 5



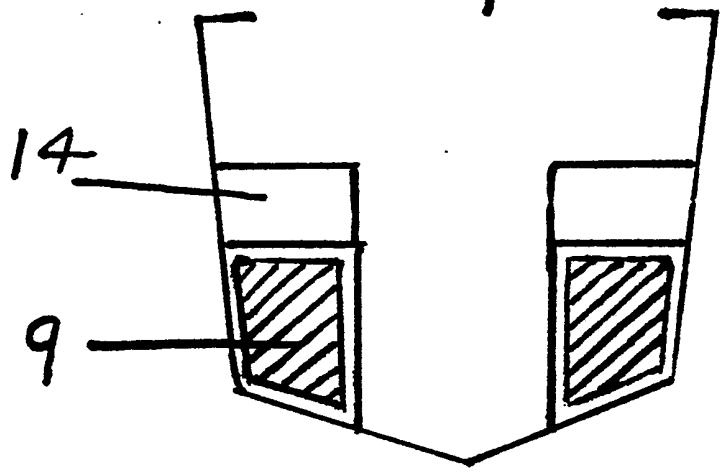
AT 8

FIG 6



AT 6

FIG 7



AT 10

FIG 8

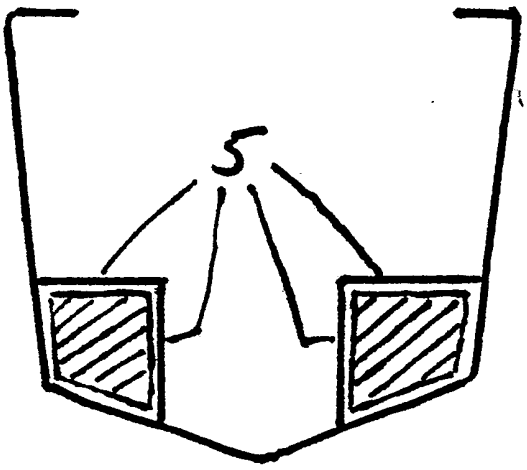


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FIG 9

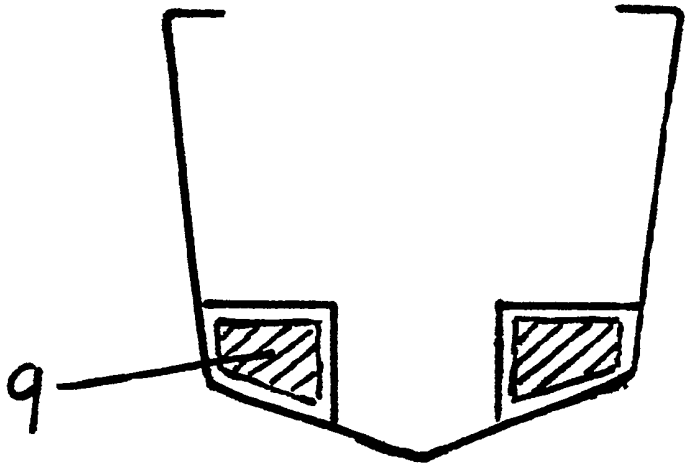

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FIG 10

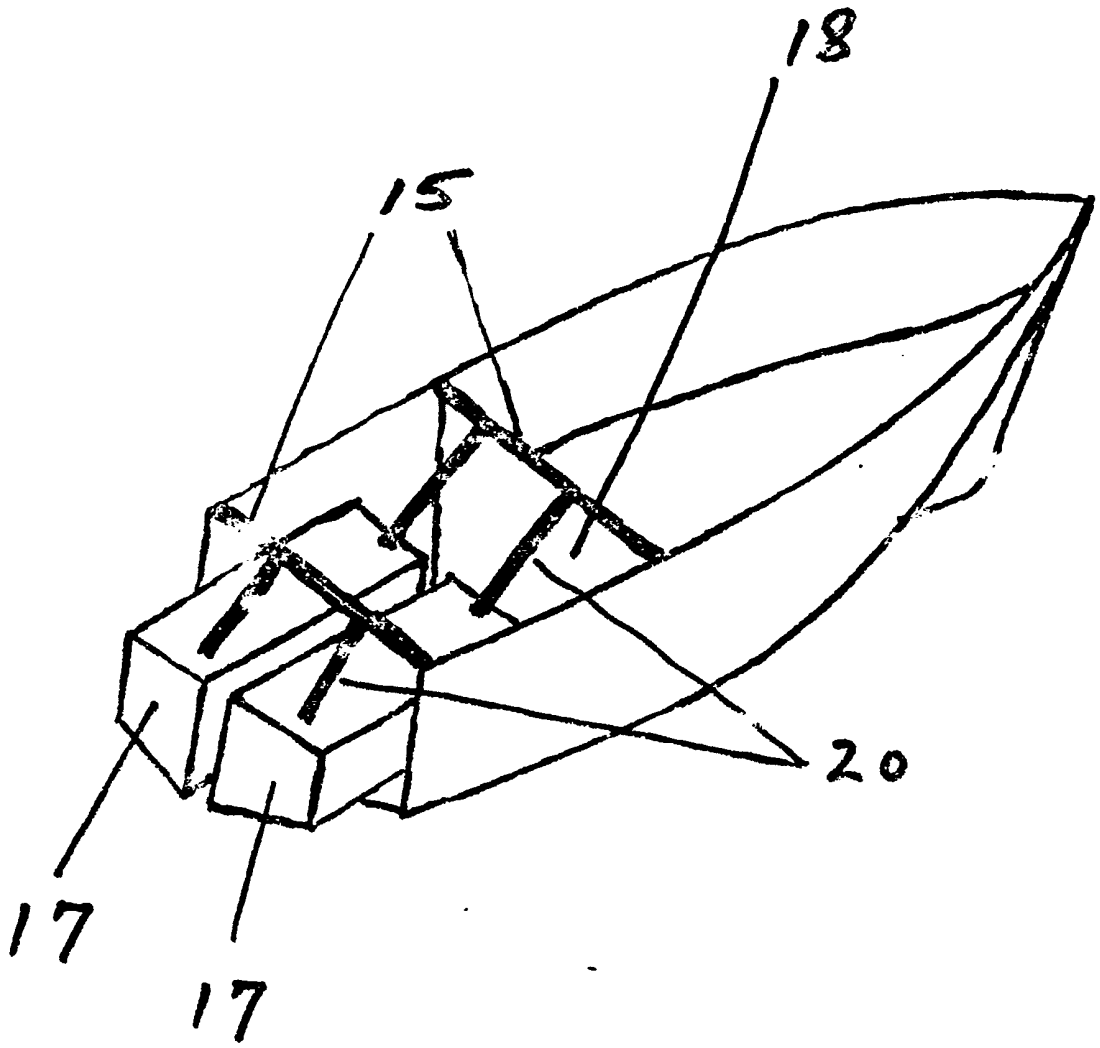

FIG 11

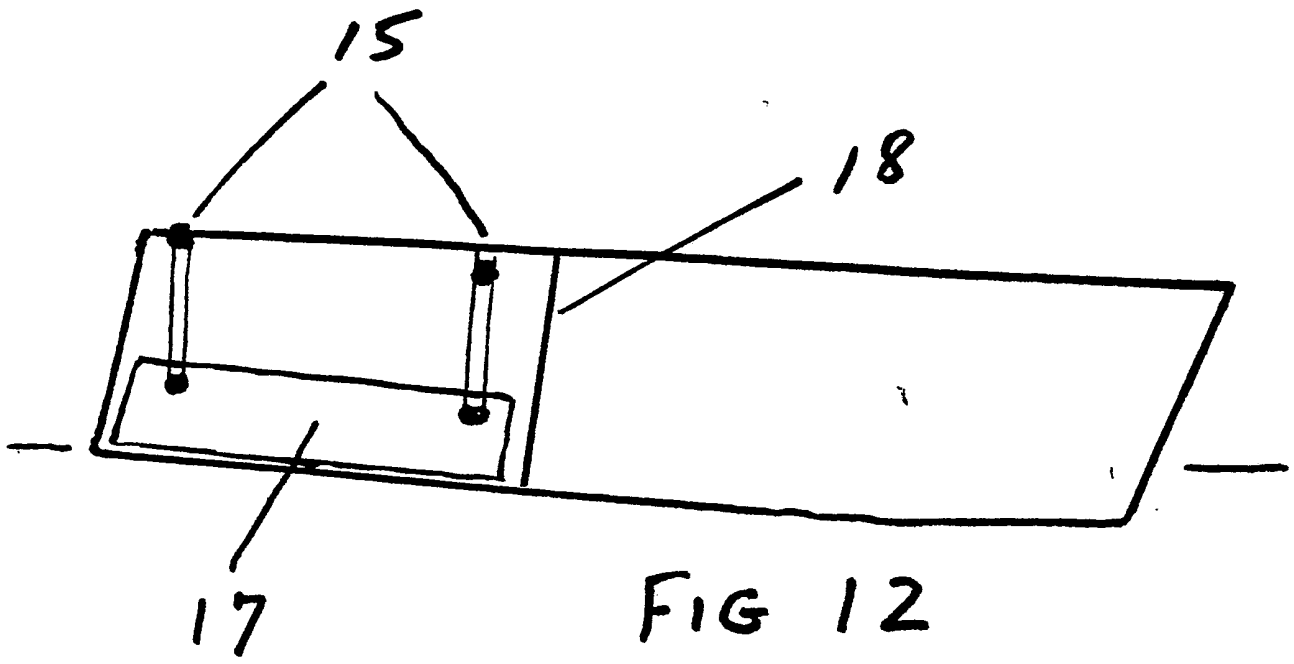

FIG 12

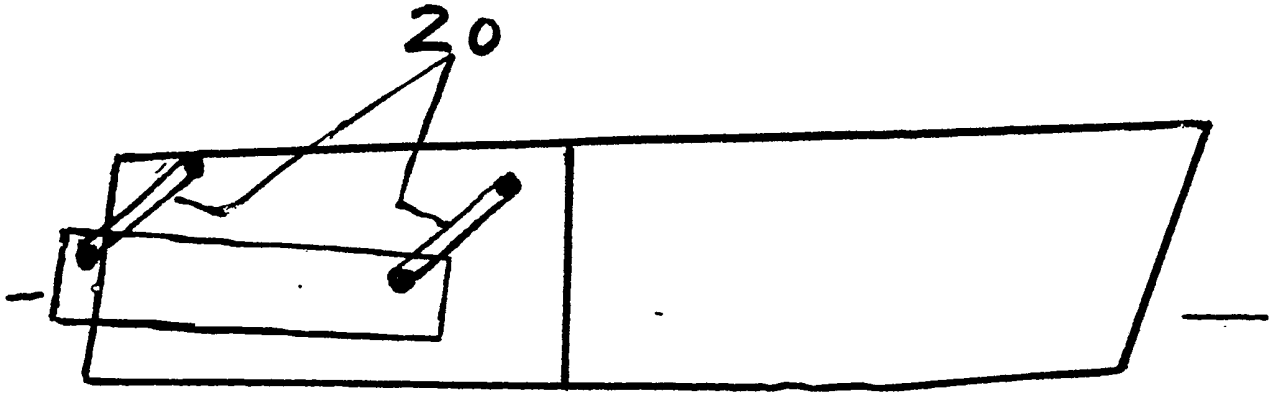

FIG 13

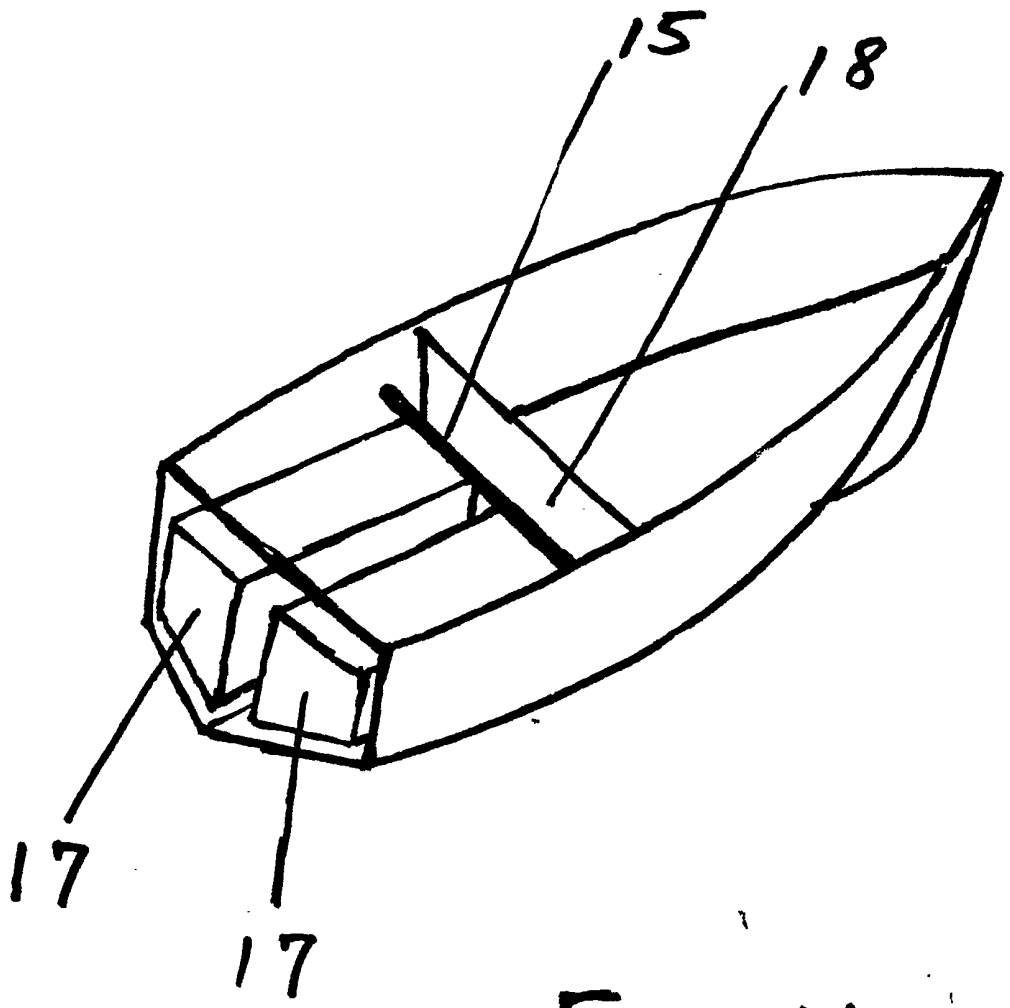

FIG 14

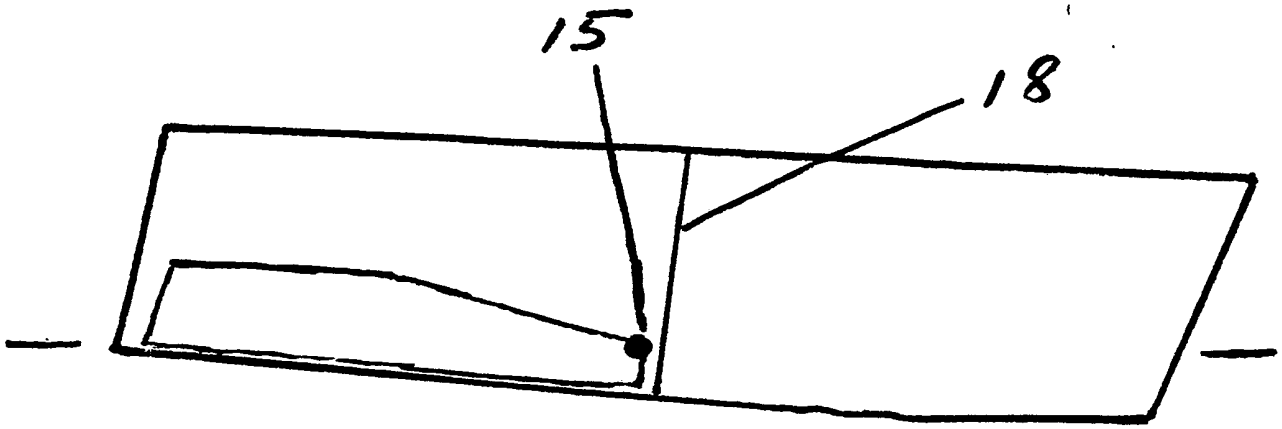

FIG 15

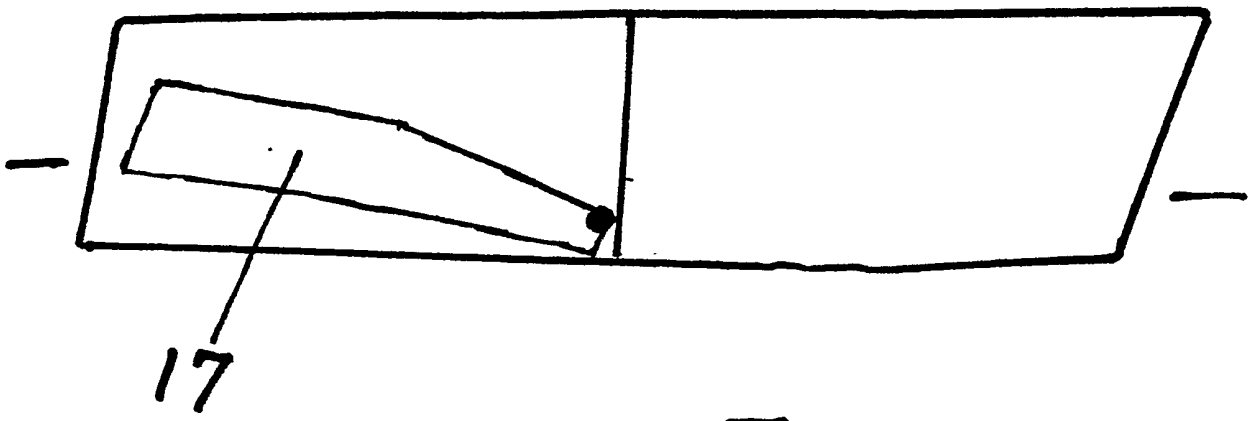

FIG 16

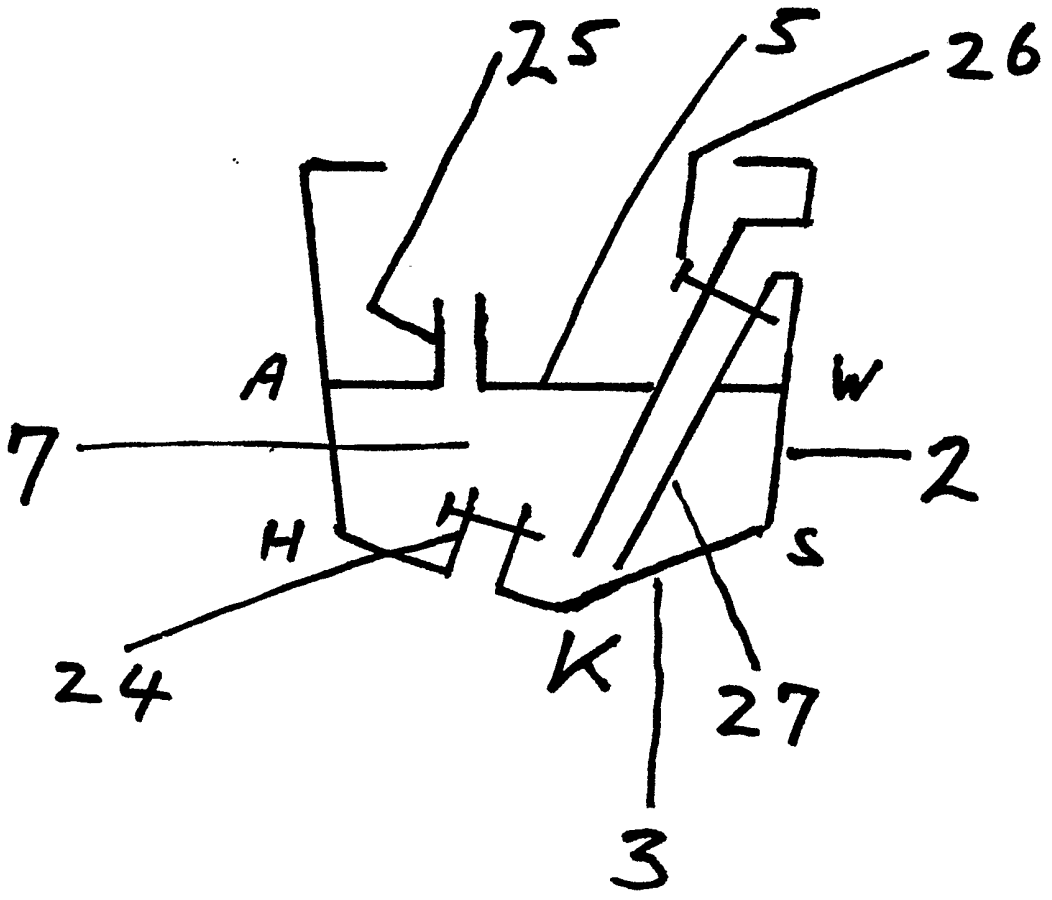

FIG 17

VARIABLE STERN BOUYANCY IN BOAT HULLS

This invention relates to boat hulls of the planing type, in which the transom or it's position if absent, is clear of the waterline or semi-immersed when afloat at rest and without stern trim.

Planing hulls of the type that when not planing require low hydrodynamic drag must alter their longitudinal trim to facilitate planing. The origin of the force necessary to bring about this change in trim may be dynamic or an aftward movement in the location of the centre of gravity of the hull or a combination of the two aforesaid. In small craft of the dinghy type where the weight of moveable cargo in comparison to the hull displacement is large, longitudinal relocation aftward does not incur an expenditure of energy that would otherwise promote an increase in speed. With increasing hull displacement this method of changing the location of the centre of gravity is impractical and unseamanlike. The upper limit in moveable cargo weight normally being restricted to small craft of the dinghy type. By the use of dynamic forces acting along the bottom of the hull, the energy employed to create stern trim represents a considerable proportion of the total energy input to attain a particular speed/length ratio for a specific hull displacement.

It is considered that a more efficient means of locomotion for boat hulls is attainable by moving the near total dependance upon hydrodynamic forces to create stern trim in craft larger than dinghies, to a mixed force of hydrostatic and dynamic.

According to the present invention there is provided a boat hull whose outermost shape is of a planing form having it's transom clear of the waterline or semi-immersed when afloat at rest without stern trim, in which the stern part on each side of the keel line comprises an outer and inner watertight hull wall and is characterised by the chamber 7 created between these two aforesaid walls being at least in part at a horizontal below the waterline at least of a size and shape that when moving forward the stern may be trimmed aftwardly downward as the result of flooding of this aforesaid chamber 7 maintaining the condition that at any moment the sum of hydrostatic and hydrodynamic forces acting upon the moving hull remain approximately vertically co-planar with the hulls centre of gravity in the athwartships direction, within the aforesaid chamber 7 is located a device or system for causeing the removal of water from that chamber overboard, operable from within the main hull.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings.

Fig. 1 shows the boat hull diagrammatically in perspective with athwartships sectional numbers.

Fig. 2,3 and 4 being side views about the keel line at various angles of stern trim.

Fig. 5,6 and 7 are sectional views of Fig. 1, at specific sectional numbers.

Fig. 8,9 and 10 are sectional views of Fig. 1, at specific sectional numbers.

Fig. 11 and 14 are perspective views of the hull employing two rigid flotation units.

Fig. 12 and 13 are side views along the keel line of Fig. 11.

Fig. 15 and 16 are side views of fig. 14.

Fig. 17 is an athwartship sectional view part way along the stern of Fig. 1.

Referring to the drawings, the planing hull Fig.1. comprises an outer hull wall 2 at the sides and 3 along the bottom.

A transom 6 is required in some embodiments. Aperatures not shown, maybe present in the outer walls 2,3 and 6. The inner hull wall 5 maybe integral with an athwartships bulkhead 18 that forms the forward part of the chamber 7. The space indecated in Fig. 2, 3 and 4 between the outer wall2,3 and 6 and inner wall 5 and 18 is the chamber 7. Fig. 5,6 and 7 schmatically outline chamber 7 by the letters A H K S W. Fig. 12 and 14 do not show the inner wall 5 but it would be located above the rigid floatation units 17. Flexible, collapsible and inflatable air bags 9 are located within chamber 7. Bellows that can be inflated by compressed air maybe substituted for air bags 9.

In a preferred embodiment of the invention, shown in Fig. 17 compressed air passes into chamber 7 via pipe 25 thereby causeing water within chamber 7 to leave through pipe 27 whose open inner end is situated low in the bilge with the opposite end

overboard and having a controll device 26 along it's length. The inlet pipe 24 to also have a controll device along it's length. The pipe 24 may protrude from the outer surface of the hull facing in a forwardly direction to use the dynamic pressure should the need be to fill part of chamber 7 or an additional tank 14 that is situated at horizontal height above the water surface outside the hull. This condition would exist when the hull is heeled. In this embodiment the transom is an integral part of the outer hull. As in all embodiments the longitudinal distribution of the volume of the chamber 7 is undefined. Except in this example for safety reasons the inner hull 5 and 18 should provide reserve bouyancy commencing near to an angle of stern trim of five degrees positive incidence of the hulls bottom surface 3 as shown in Fig. 4. The chamber 7 maybe continuous across the keel line,or divided parallel with the keel line into two or more parts symmetrically arranged adjacent the keel Fig 5, 6 and 7 or two or more symmetrically arranged parts outward of the keel Fig. 8, 9 and 10 with each having the option of it's own inlet and outlet pipes. Anyway pipe interconnection also being an option.

In a second preferred embodiment flexible collapsible and inflatable air bags 9 or inflatable bellows 9 are located within chamber 7. When inflated fully the bags 9 or bellows 9 displace water that occupied the chamber 7 prior to their inflation. Where the air bags 9 or bellows 9 extend above the waterline with the hull at rest without stern trim, then when inflated there is a continuous reserve of bouyancy to include the main watertight hull, as shown in Fig. 2. When semi-deflated air bags 9 or bellows 9 partly collapse and water enters the chamber 7, see Fig. 3. The division of chamber 7 into muliple chambers as described in the first embodiment is an option.

Within each chamber is located an air bag 9. Each chamber may be flooded independantly, or all maybe inter-connected. It is preferred that the air bags 9 be secured within the chamber 7. Aperatures in the outer wall and transom may have a controll device operable from within the hull. A watertight inspection hatch 21 maybe positioned in the inner hull wall 5.

In another preferred embodiment, rigid flotation units 17, one on each side of the keel line are arranged symmetrically adjacent the keel line as seen in Fig 11 and 14. These same units hinge at pivot 15. Perspective views of two different arrangements are shown in Fig 11 and 14. In Fig 11 two pivot hinges are

provided with arms 15, so that when lifted from their lowermost position in chamber 7, when there is a reduction of bouyancy required, the units 17 lift more horizontally than where only one pivot hinge 15 is provided see Fig. 14. With the arrangement as shown in Fig. 14, a transom stern is possible. (Not Shown). The configuration of the hull in Fig. 2 shows the hull having longitudinal bouyant stability that is maintained throughout the low speed/length range. Whilst in this trim there is no appreciable amount of water within the chamber 7. As the speed/length ratio increases, stern trim becomes neccessary to maintain minimum resistance. In the first preferred embodiment described the pressure of the air within the chamber 7 is reduced, to permit an inflow of water into chamber 7. In the second preferred embodiment described partial deflation and collapse of the air bag 9 or bellows 9 will permit an inflow of water into chamber 7. In the third preferred embodiment as described one or both rigid floatation units are lifted above their lowermost position in chamber 7, thereby allowing an inflow of water into chamber 7. The water now occupying chamber 7 causes stern trim and a new configuration is established that is longitudinally bouyantly stable. This is shown in Fig. 3. Further stern trim is obtainable by progressively flooding the chamber until a maximum trim angle of 5 degrees positive incidence of the planing surface 3 as shown by Fig. 4. The aforesaid changes in reducing bouyancy are reversible.

With increasing speed/length ratio above 1.4 the presence of water at the transom is reducing. To reduce resistance further it is neccessary to lift the hulls centre of gravity upward. This is achieved by the progressive removal of water from within the chamber 7 overboard. At speeds where the dynamic pressure developed about the whole bow, It is expected that by counter balancing this aforesaid dynamically induced force in the stern part obtained by the removal of at least part of the water in chamber 7, the result will be a lifting of the hulls centre of gravity. The aforesaid process maybe achieved without recourse to a manual controll of the outflow is neccessary. This aforesaid process is reversible.

In another option it maybe desired to relocate part of the water in chamber 7 to a more aftwardly located tank that maybe a part of chamber 7.

In another option a water ballasted sailing hull may wish to relocate part of the water content of chamber 7 to a more windward tank that maybe a part of chamber 7.

Any of the three preferred embodiments described maybe arranged side by side and secured one to the other to create a boat of Catamaran or Trimaran form

CLAIM 1.

A boat hull whose outermost shape is of planing form having it's transom clear of the water line or semi-immersed when afloat at rest without stern trim, in which the stern part on each side of the keel line comprises an outer and inner watertight hull wall, and is characterized by the chamber created between these two aforesaid hull walls being in part at a horizontal below the waterline of the hull at rest and at least of a size and shape that when moving forward the stern maybe trimmed aftwardly downward as a result of flooding of this aforesaid chamber, maintaining the condition that at any moment the sum of hydrostatic and hydrdynamic forces acting upon the moving hull remain approximately vertically co-planar with the hulls centre of gravity in an athwarship direction and within the aforesaid chamber is located a device or system for causing the removal of water from that chamber overboard, operable from within the main hull if neccessary.

CLAIM 2.

As claimed in claim 1. where additionally the chamber is water-tight and in which the system for removing the water from this chamber is by the use of compressed air displacing the water from the chamber through pipes or ducts that would restrict accidential loss of air due to rolloing or other hull movements expected in a seaway. The compressed air within this chamber balancing the hydrostatic pressure of the water outside the hull wall when the inlet control device is open.

CLAIM 3.

As claimed in claim 1. in which the device for removing water from chamber is one or more flexible collapsible and inflatable air bags located within chamber.

CLAIM 4.

As claimed in claim 1. in which the device for removing water from chamber is one or more collapsible and air inflatable bellows located within chamber.

CLAIM 5.

As claimed in claim 1. in which the device for expelling or removing water from chamber is by the downward movement of one or more rigid flotation units located within the chamber to it's lowermost position in the chamber.

CLAIM 6.

As claimed in claim 1. to 4. where the chamber is symmetrically arranged adjacent the keel on each side.

CLAIM 7.

As claimed in claim 1.and 4. where the chamber is symmetrically arranged outward of the keel on each side.

CLAIM 8.

As claimed in claim 1.to 4. where the chamber maybe divided athwartship into more than one chamber.

CLAIM 9.

As claimed in claim 1. to 8. where the chamber is of progressively increasing volume aftwardly.

CLAIM 10.

As claimed in claim 1. to 9. where the chamber is of discontinuous irregular shape.

CLAIM 11.

As claimed in claim 1. to 10. where an inspection hatch is provided to chamber from inner watertight hull.

CLAIM 12.

As claimed in claim 1. to 11. where there is a plu arty of such boats joined integrally or otherwise to create a Catamaran or Trimaran.

CLAIM 13.

As claimed in claim 1. to 12. where there are aperatures in the outer hull wall, with or without control devices to restrict the flow of water inward or outward.

CLAIM 14.

As claimed in claim 1. to 13. where there are aperatures in the transom to allow the inflow and outflow of water.

CLAIM 15.

As claimed in claim 1. to 14. where the [illegible]er and outer hull walls are an integral part of the boat.

CLAIM 16.

As claimed in claim 15. substantially as described herein with reference to the Fig.1. to 17m of the accompanying drawing'.

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