Nov. 1, 1966 F. J. LUKETA 3,281,980

PROGRESSIVELY FLOODING TRAWL DOORS

Original Filed Aug. 24, 1962 4 Sheets-Sheet 1

Fig. 1

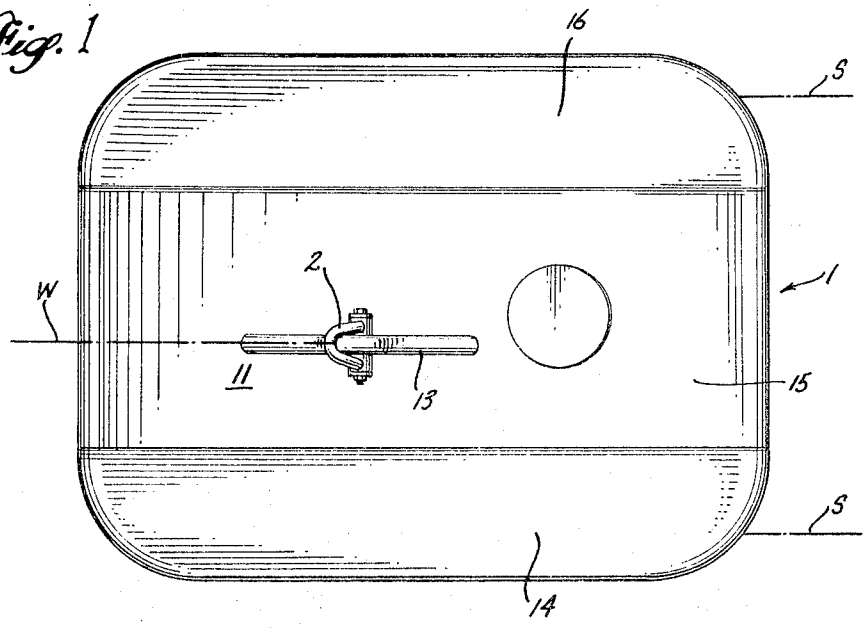

Fig. 2

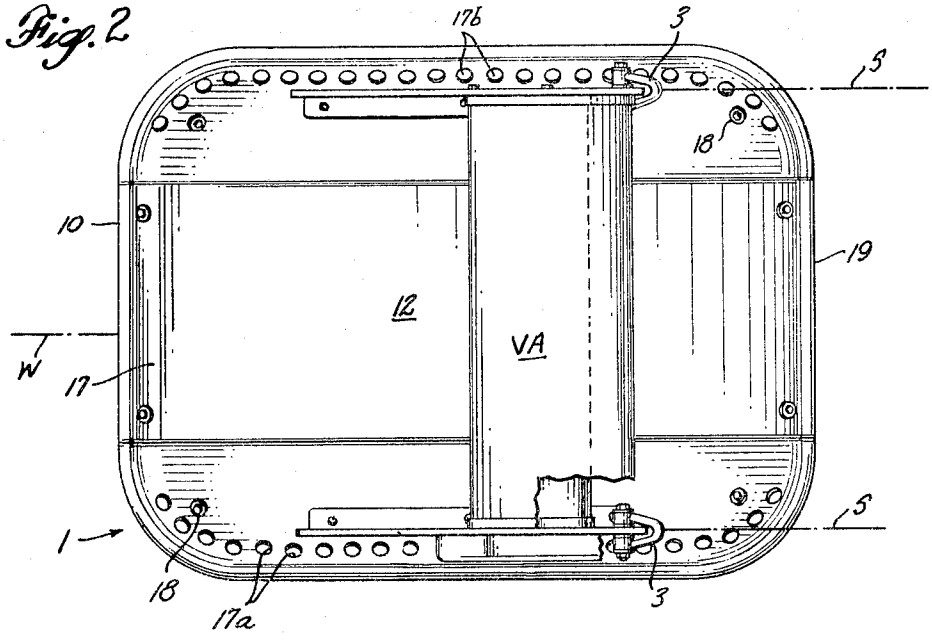

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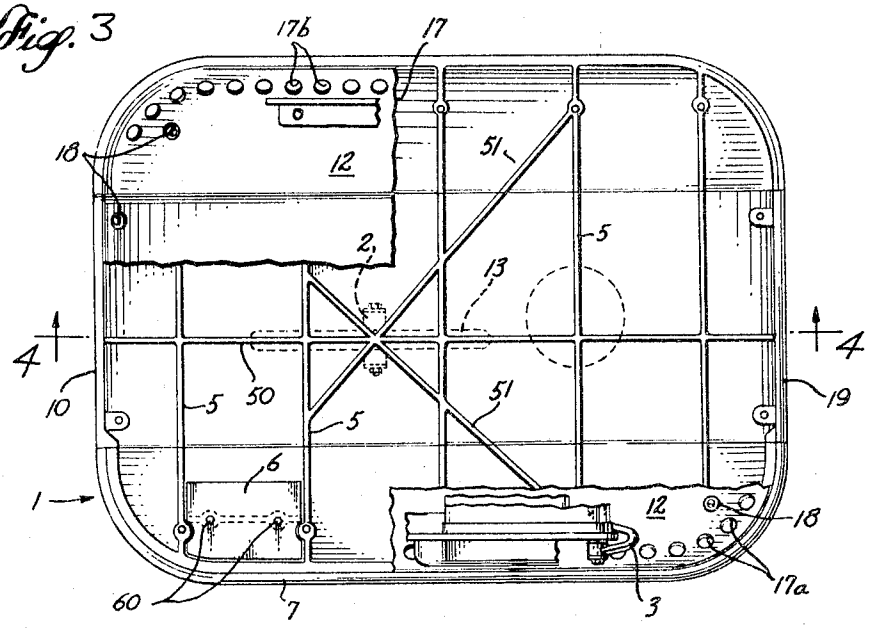
Fig. 3



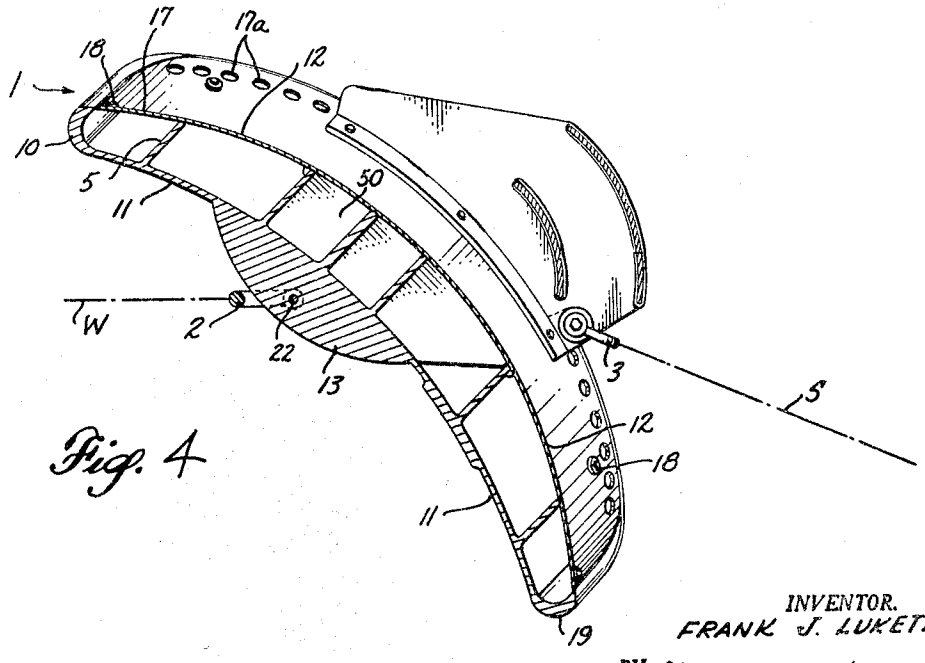


Fig. 4

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PROGRESSIVELY FLOODING TRAWL DOORS

Original Filed Aug. 24, 1962 4 Sheets-Sheet 3

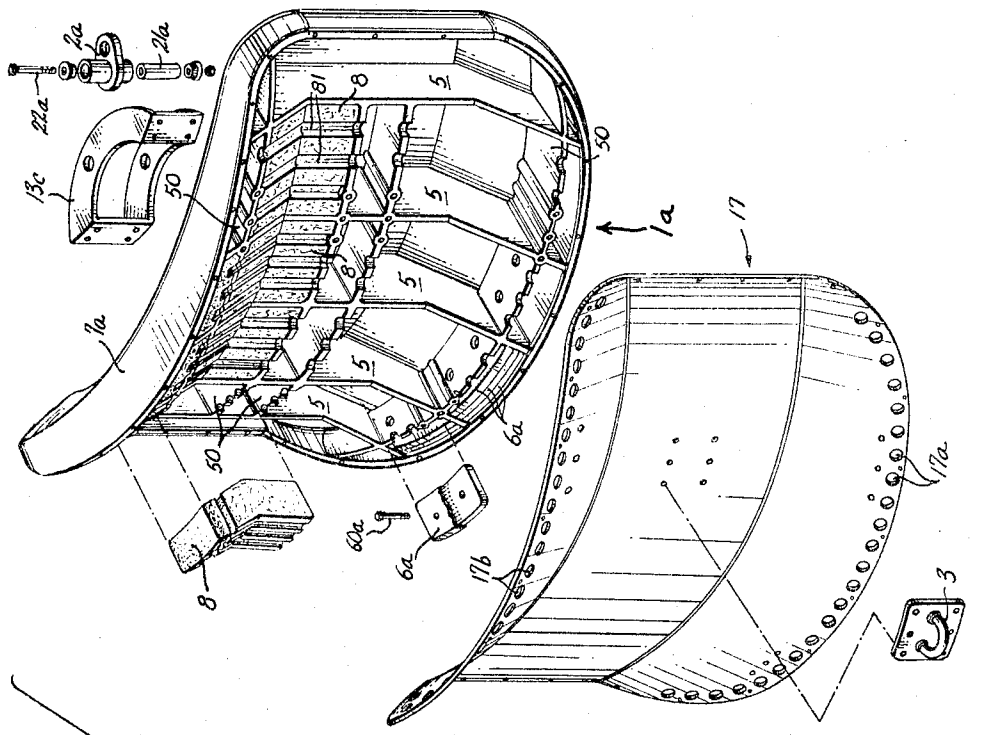

Fig. 6

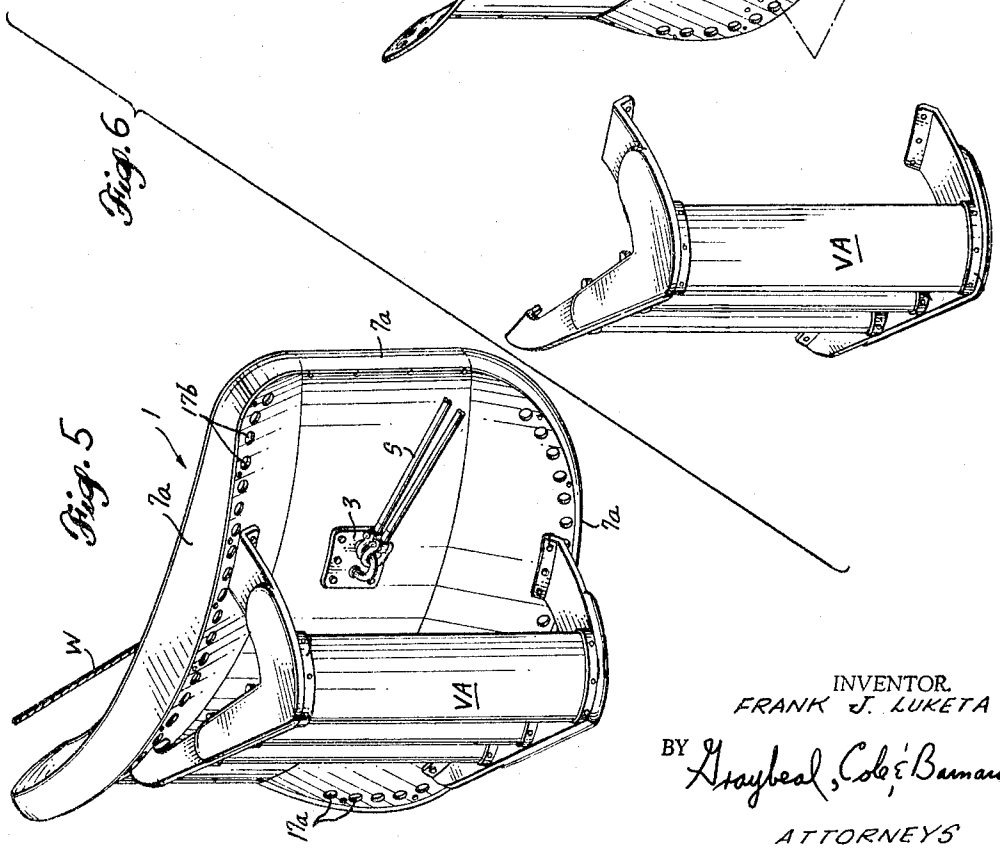

Fig. 5

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PROGRESSIVELY FLOODING TRAWL DOORS

Original Filed Aug. 24, 1962 4 Sheets-Sheet 4

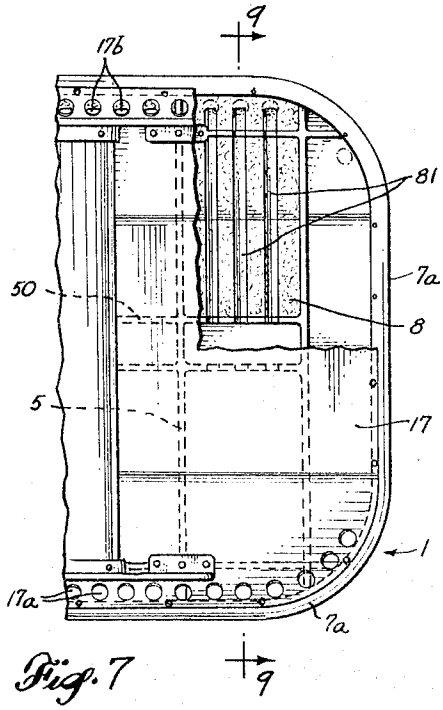

Fig. 7

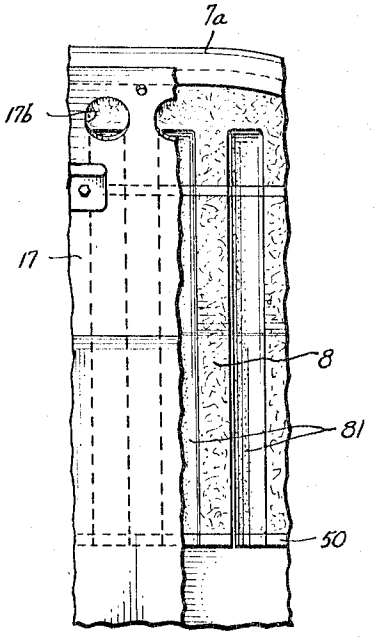

Fig. 8

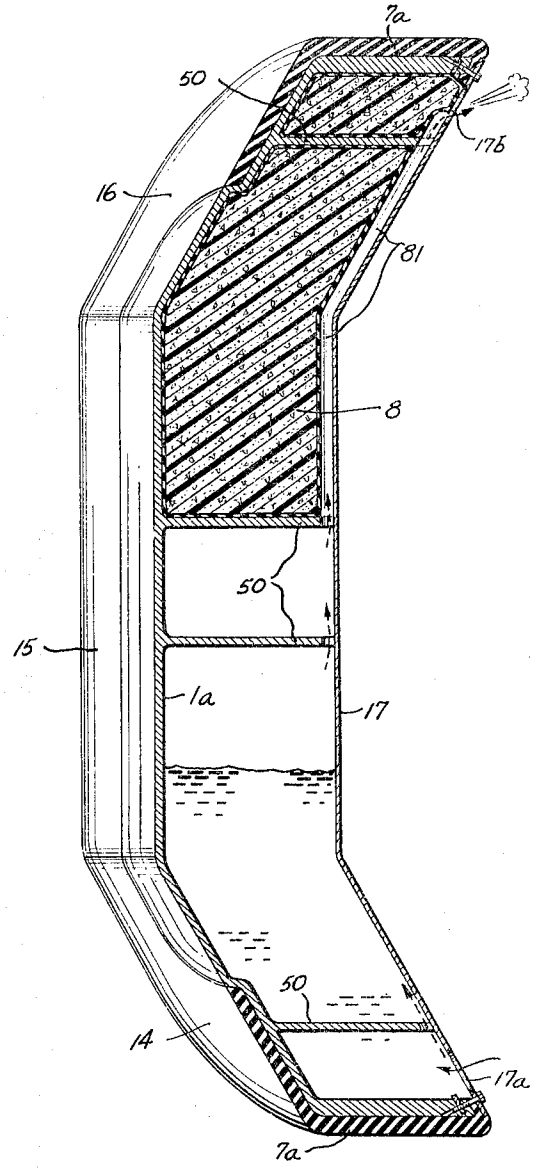

Fig. 9

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PROGRESSIVELY FLOODING TRAWL DOORS

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Original application Aug. 24, 1962, Ser. No. 219,276. Divided and this application Nov. 5, 1964, Ser. No. 409,122

6 Claims. (Cl. 43—9)

This is a division of my pending, now abandoned, application Serial No. 219,276, filed August 24, 1962, and entitled Trawl Doors, which application in turn is a continuation-in-part of my now abandoned application Serial No. 837,025, filed August 31, 1959, and also entitled Trawl Doors.

The present invention relates to trawl doors having a hollow body adapted to afford temporary buoyancy to the door as it sinks in the water, for the purpose of causing the door to assume a correct attitude during setting. The hollow body floods at a slow rate as it descends in the water, resulting in the boyancy being ultimately dispelled. However, by the time that this happens the door will have assumed a proper attitude.

In brief, trawl doors according to the present invention each comprise a hollow body having a ballast weight concentrated adjacent its lower edge, and apertures along its upper and lower edges for restricted communication with its interior. The total area of the upper apertures is substantially less than the total area of the lower apertures. As a result, air entering and entrapped within the door when out of water will tend to buoy up its upper portion while such door is descending in the water, while the ballast weight pulls its lower edge downwardly. As the door sinks the air escapes through the upper edge apertures, and is replaced by water entering through the lower edge apertures. When the door is pulled out of the water after use, the water inside it drains out through the lower edge apertures. As will be evident, the above described arrangement avoids superfluous buoyancy of the door in the water, and superfluous weight when the door is out of the water.

According to the present invention, filler blocks may be disposed in the upper portion of the hollow body and arranged to partially mask the upper edge apertures. Preferably such filler blocks are inherently bouyant.

Preferably, the interior of the hollow door is divided into a plurality of compartments symmetrically related about a horizontal center line, and the door is invertible. These compartments consist of or include ballast weight compartments disposed inboardly adjacent the two edges of the door which are horizontally disposed during use. When the door is rigged for use, one of such edges is chosen to be the lower edge of the door, and the ballast weight means is put into one or more of the compartments disposed adjacent such lower edge. When the door is inverted, the ballast weight means is moved across the center line and put into the compartments which are located adjacent the opposite edge, which then becomes the lower edge. In doors employing filler blocks, compartments are provided for the filler blocks on both sides of the horizontal center line, so that they can also be moved to the opposite side of the center line when the door is inverted.

These and other objects, features, characteristics and advantages pertaining to and inherent in the present invention will be apparent from the following description of certain typical and therefore non-limitive embodiments thereof, as illustrated in the accompanying drawings, wherein like letter designations and numerals refer to like parts and wherein:

FIG 1 is a front elevational view of a typical embodiment of trawl doors according to the present invention, such view looking toward the longitudinally concave anterior surface of such door;

FIG. 2 is a rear elevational view of the door in FIG. 1, such view clearly showing the openings in the lower edge portion of the door for admitting and discharging water, and the openings in the upper edge portion of the door for admitting and dispelling air;

FIG. 3 is a view similar to FIG. 2, but with the cover and other portions of the door considerably broken back to illustrate the interior construction;

FIG. 4 is a longitudinal sectional view taken through the same door, substantially along line 4—4 of FIG. 3;

FIG. 5 is a perspective view of a modified form of door according to the present invention, such view being taken from above and looking toward the posterior side and after end of such door;

FIG. 6 is an exploded perspective view of the door shown in FIG. 5, such view showing the compartmented interior of the door, including identical compartments in the upper and lower regions of the door, so that the buoyant filler blocks and the ballast weights may be changed to opposite sides of the door's longitudinal center line when the door is to be inverted, and such view also showing the invertible nature of the towing warp connector on the anterior side of the door;

FIG. 7 is a rear elevational view of an end portion of the door of FIGS. 5 and 6, with a part of the posterior cover cut away;

FIG. 8 is an enlarged scale fragmentary view of the upper centeral portion of FIG. 7; and

FIG. 9 is an enlarged scale transverse sectional view taken substantially along line 9—9 of FIG. 7.

Two trawl doors are used, so shaped and oriented as to cause the curtains of the net (corresponding somewhat to the wings of a standard trawl net, but much longer, and open of mesh) to diverge widely apart and forwardly, so as to sweep the maximum bottom area. Each such door is towed by a towing wrap W from the trawling vessel, and is connected to a net trailing behind the door by net lines including a sweep line and a curtain line (both designated S in the drawing), which net lines transmit the drag to the net. The doors themselves are generally upright in use, and during bottom trawling their lower edges ride evenly upon the bottom, and so the door must be nonbuoyant, and usually is weighted, not only to hold it down but to maintain it in a generally upright disposition as it is set and while it sinks to the bottom, and later to assure that it rides evenly on the bottom.

The door illustrated in FIGS. 1–4 comprises a body generally designated by the numeral **1**, which in the form shown, as viewed from one side or the other, is generally rectangular, though with rounded corners. It may sometimes be rounded at its forward end. The door shown, as viewed in plan (see FIGURE 4) is curved or cambered from its forward end **10** progressively toward its after end **19**, although the cambered form is not strictly essential to other novel features. In other words, the body **1** has a concave anterior surface **11** and a complementally convex posterior surface **12**, and the door has anchorage means for the lines mentioned above so located as to produce a moment tending to incline the general plane of the door at a desired fairly large angle of attack with relation to the direction of drag. For instance, a shackle **2** (FIG. 1) for attachment of a towing wrap W is itself pivotally mounted upon a fore and aft rib **13** outstanding from but close to the anterior surface **11** of the door aft of its leading end **10**, but only slightly ahead of the door's midpoint. Other shackles **3** (FIG. 2) are mounted at the posterior surface of the door, these being for connection to sweep and curtain lines indicated,

for instance, at S in FIG. 4. Preferably the shackle **2** for the towing wrap W is mounted slightly below the longitudinal center line of the door; see FIGS. 1 and 3.

The door, whether cambered or not, is preferably formed with rearwardly inclined lower and upper edge portions or band **14** and **16**, respectively, of equal area. These might adjoin one another, at opposite sides of a longitudinal apex line midway between the upper and lower edges, or, as shown, may be separated by an intervening central portion or band **15**, which while the door is in use is generally upright. All such bands **14**, **15**, **16** are shown to be of hydrofoil shape longitudinally. The dihedrally related bands **14** and **16**, in cooperation with the below-center location of the anchorage of the towing warp W to the door, already mentioned, afford stability to the door in a manner explained below.

The lower edge of the door drags over the bottom, and should bear thereon evenly throughout its length. The towing warp W is anchored to the door's anterior or concave face at the shackle **2**. This shackle **2**, as already explained, is located close into and slightly ahead of the door's longitudinal center line of the door. Such a below-center location produces a tendency for the upward component of the pull of the towing warp to tilt the door backwardly about its lower edge, and so counters the drag of the bottom against such lower edge. As a result the door tends to remain upright as it advances, and desirably can be so arranged as to tilt rearwardly slightly. The small longitudinal moment arm from the anchorage **2** rearwardly to the midpoint of the door's length tends to prevent uptilting of the door's forward end **10** off the bottom, especially when assisted by the location of ballast weights forwardly, as will be explained later. The upper dihedral band **16**, when the door is tilted somewhat backwardly, causes the door, by water reaction, to be strongly urged downwardly, and therefore it will stay on the bottom more surely with a minimum of ballast.

Thus there are forces arising from the dihedral disposition of bands **16**, **14**, from the below-center location of anchorage **2**, from the latter's short spacing ahead of the longitudinal midpoint of the door, and from the longitudinal disposition of the ballast weights, which cooperate to maintain the door at the proper angle of attack, yet held down to and bearing evenly along the lower edge upon the bottom, and approximately upright as it advances.

Inasmuch as the lower edge bears upon and drags over the bottom, wear occurs there, and should be absorbed by a protective element. For example, a pad **7** of wear-resistant rubber is vulcanized or otherwise held in place upon the door's lower edge, and can be renewed when worn, or as shown in FIGS. 5, 6 and 9, and as is preferable, a complete ring **7***a* encircles all the edges of the door, and is removably secured in place, so that it is replaceable when worn at both horizontal edges, in the manner disclosed in my aforementioned application Serial No. 219,276.

When the protective edging **7***a* is employed, the trawler can carry a spare, and whenever one becomes unduly worn, it can be replaced with little loss of time, whereas with shoes or the like that are bonded in place, the door as a whole must be shipped to a repair station, and replacement is bound to be expensive, and a cause of delay.

The door is ballasted at its lower edge. While the location of ballast weight longitudinally would be governed by the door's balance, and by any tendency to tilt upwardly its forward end—the aim being to have it bear equally upon the bottom along its lower edge—the towing warp anchored at **2** produces some upward component, especially when wave action or the like tends to jerk and pull the warp taut. Accordingly, it is preferred that the ballast be concentrated towards the forward end **10** of the door's lower edge. Ballast weight or weight blocks **6** or **6***a* are shown, so located.

Referring specifically to FIGS. 5–9, it is preferred that the door be formed as a hollow nonbuoyant body **1***a*, for instance of cast aluminum, covered by a lightweight back plate or cover **17** held in place by the bolts **18**. It must, however, be drainable, and is so shown. Preferably, it is provided with transverse or upright ribs **5** and a longitudinal rib or ribs **50**. In the form of FIGS. 1–4 it is also provided with angularly disposed bracing ribs **51**, which interconnect the anchorage point for the shackle **2** with the anchorage points for the shackles **3**. The two latter points are interconnected again by a transverse rib or spreader **5**, so that stresses are transmitted between the points of maximum stress in a most direct manner, and are strongly resisted.

The rubber-coated ballast weight **6** shown in FIG. 3 is mounted within a cell or cells within the hollow structure of the door, by bolts **60** or the like, and may be removed and shifted in location, as found necessary, upon removal of cover **17**.

The door of FIGS. 1–4 is not intended to be reversible top for bottom, whereas the door of FIGS. 5–9 is thus reversible. The ballast weights **6***a* in the latter form are received alternatively in cells within the hollow door structure along the upper and lower edges (whichever edge is then the lower one), and are secured therein by the bolts **60***a*, see FIG. 6.

Buoyance is afforded, at least temporarily, to the upper portion of the door body in any of a number of ways. In the form of FIGS. 1–4 the cells defined by interior dividers **5** and **50** are open, at least restrictedly, to the atmosphere when the door is out of water, by way of holes **17***b* along the upper margin of the body **1***a* or its cover **17**. Along the lower margin of the same, drainage holes **17***a* communicate with the interior. When setting the net the initial few moments in the launching of the door are critical, because unless it automatically assumes its upright disposition and positive angle of attack it may veer inboard and foul gear at the opposite side. This will require that it be hauled in, cleared, and reset, with consequent labor and loss of time. The location of the ballast weight at the lower edge, and the buoyance afforded the upper edge by air temporarily trapped there, because it cannot at once escape through holes **17***b*, which holes must be regulated as to size, to provide the intended lag in escape of air, which, being replaced by water, causes the door to assume its correct orientation as it sinks in the water. Air escapes somewhat slowly through holes **17***b*, for reasons already given, and the temporary buoyance is dispelled. In consequence there is no residual buoyance which must be overcome all during use by providing extra ballast weights, as must be permanently buoyant means usually provided along a door's upper edge.

The door in the form of FIGS. 5–9, which is reversible top for bottom, accomplishes a like result in a somewhat different manner. Buoyant blocks **8** fit within cellules in the upper portion of the door's interior, and are held in place by the cover **17**. Apertures in the horizontal dividers **50***a* afford communication between drain holes **17***a* and air exit holes **17***b*, in cooperation with channels **81** in blocks **8**. Such communication is restricted, since the blocks partially mask the holes **17***b*. When the door is let into the water the ballast weights and the buoyant upper space causes it to assume the correct attitude, and as the water slowly displaces the air within the hollow door, it gradually loses its buoyance, which now is not needed, and if present would be detrimental, in that it would require added ballast; see FIG. 23.

The reversible door of FIGS. 5–9 employes a modified form of anchorage for the towing warp W. Whichever horizontal edge is uppermost, the shackle **2***a* should be below the longitudinal center line. It must be shifted when the door in inverted. As seen in FIG. 6, the shackle **2***a* is formed with a pivot sleeve **20***a* that has a bushing **21***a* held by a pin **22***a* between ears **13***b* of a bracket **13***c* secured to the anterior face of the door body. The shackle

2*a* is located nearer one end of the pivot sleeve **20***a* than the other end. In the full line position of FIG. 20 the shackle **2***a* is well below the center line C of the door, whereas if the shackle and pivot sleeve are inverted to the dot-dash line position, and the door too is inverted, the shackle is again in the correct below-center location.

Some of the figures of the drawing show an after vane assembly VA attached to the posterior side of the door. This assembly in part forms the subject matter of my forementioned parent application Serial No. 219,276. To the extent that it may be desirable to a clearer understanding of the present invention, the disclosure of said application Serial No. 219,276 is hereby incorporated herein by specific reference.

From the foregoing, further modifications, adaptations, and variations of trawl doors according to the present invention will be apparent to those skilled in the trawling art, within the scope of the following claims.

What is claimed is:

1. A hollow trawl door disposed generally upright in its position of use, a weight concentrated adjacent its lower edge, said door having apertures along its upper and lower edges for restricted communication with its interior, with the total area of the upper apertures being substantially less than the total area of the lower apertures, whereby air entering and entrapped within the door when out of water will tend to buoy up its upper edge when it is dropped into the water, while the weight pulls its lower edge downwardly, until the air escapes through such upper edge apertures, and is replaced by water entering through the lower edge apertures.

2. A hollow trawl door formed with lower holes for admission of water, and upper holes for escape of air adjacent its upper edge with lesser total area than the total area of said lower holes and communicating with said lower holes, whereby the air escapes from the hollow interior of the door at a limited rate when the door is first submerged.

3. A trawl door comprising a hollow body, said body having open air vent means admitting to its interior along its upper edge, and open water drain means also admitting to its interior along its lower edge and communicating with said open air vent means, the said water drain means being of substantially larger total area than the total area of said air vent means whereby the air escapes from said hollow body at a limited rate when the door is first submerged in the water.

4. A trawl door as in claim **3**, and a ballast weight supported adjacent the lower edge of the door, to maintain its lower edge lowermost.

5. A trawl door comprising a hollow, nonbuoyant body having holes admitting to its interior at its top and bottom edges, filler blocks disposed within the upper part of said body and and arranged to mask the holes there, partially, for restricted communication between the holes and the interior space below such filler blocks, and a weight mass supported adjacent the bottom edge of the door.

6. A trawl door as in claim **5**, wherein the filler blocks are inherently buoyant.

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