

[54] **SHIP CONSTRUCTION**

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[58] Field of Search **114/157; 115/42, 39**

[56] **References Cited**

UNITED STATES PATENTS

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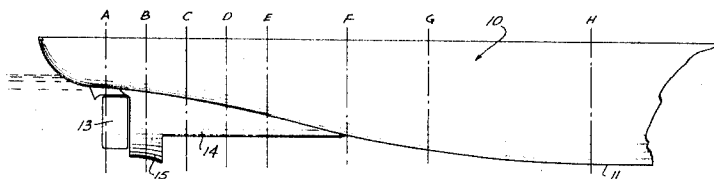
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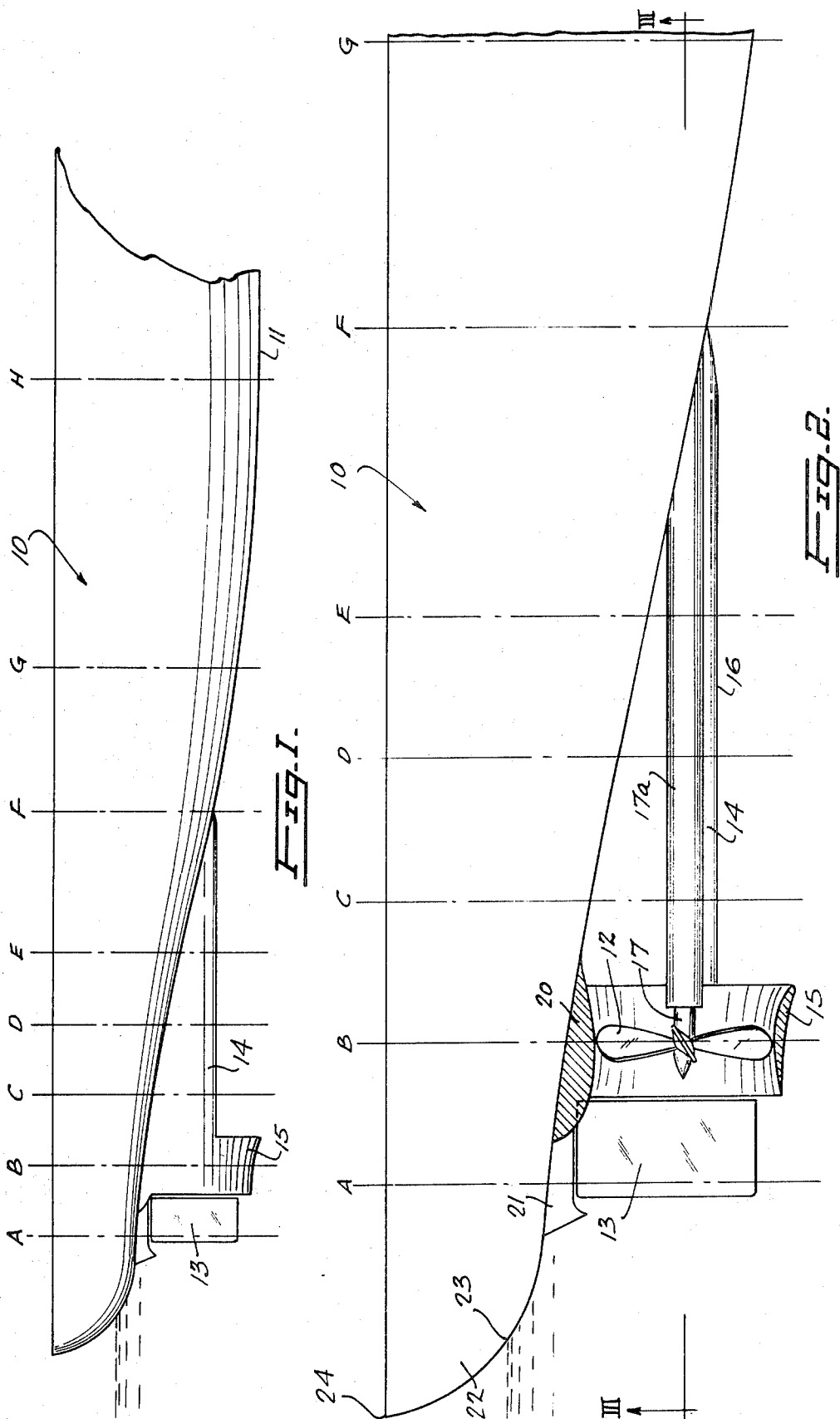
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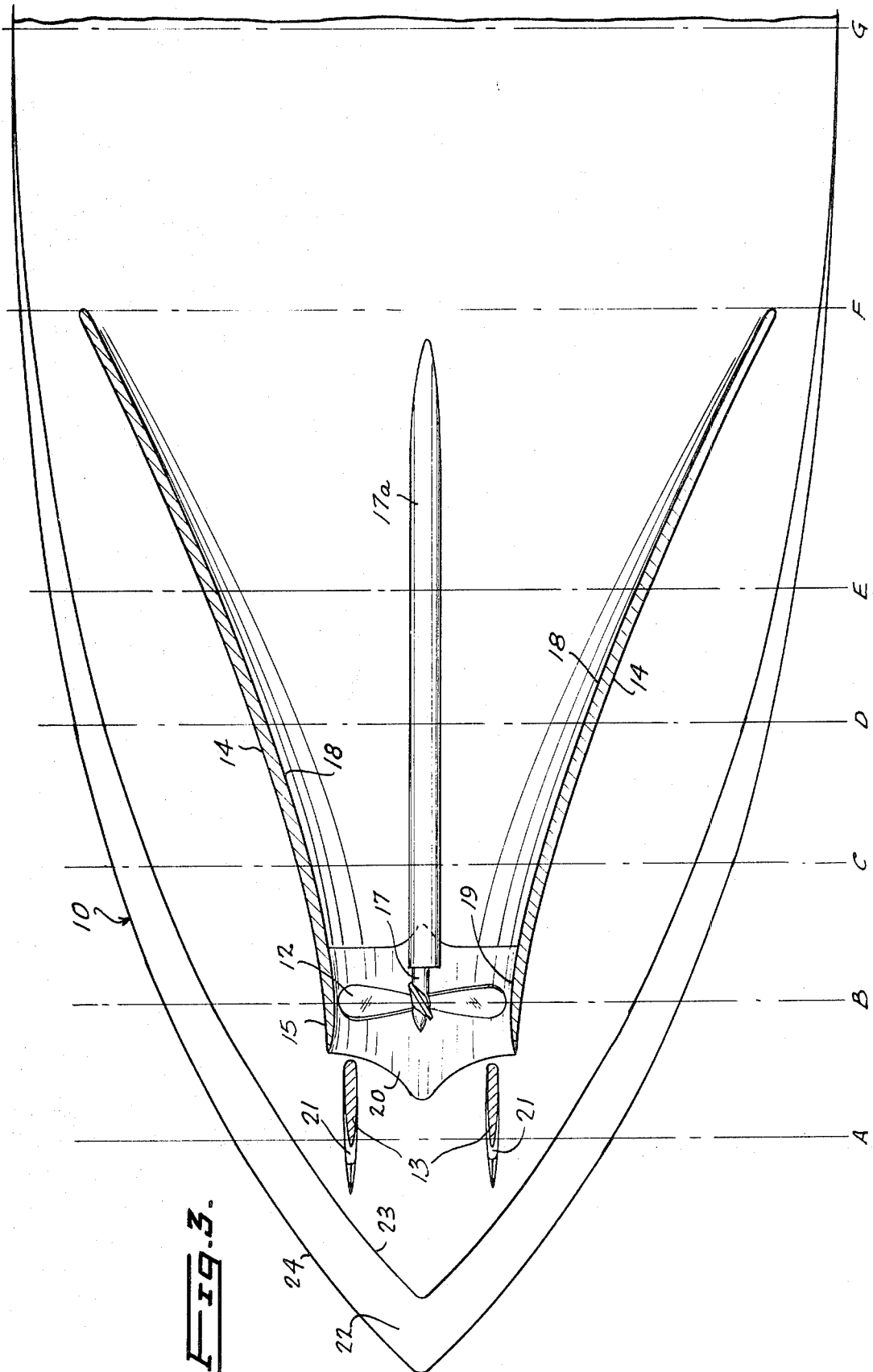
ABSTRACT

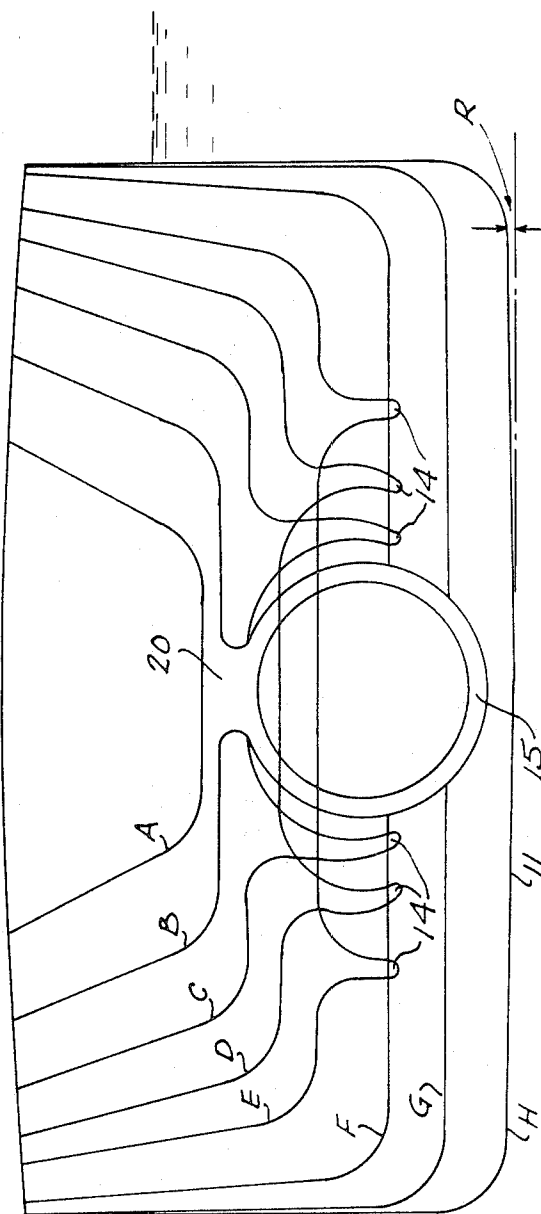
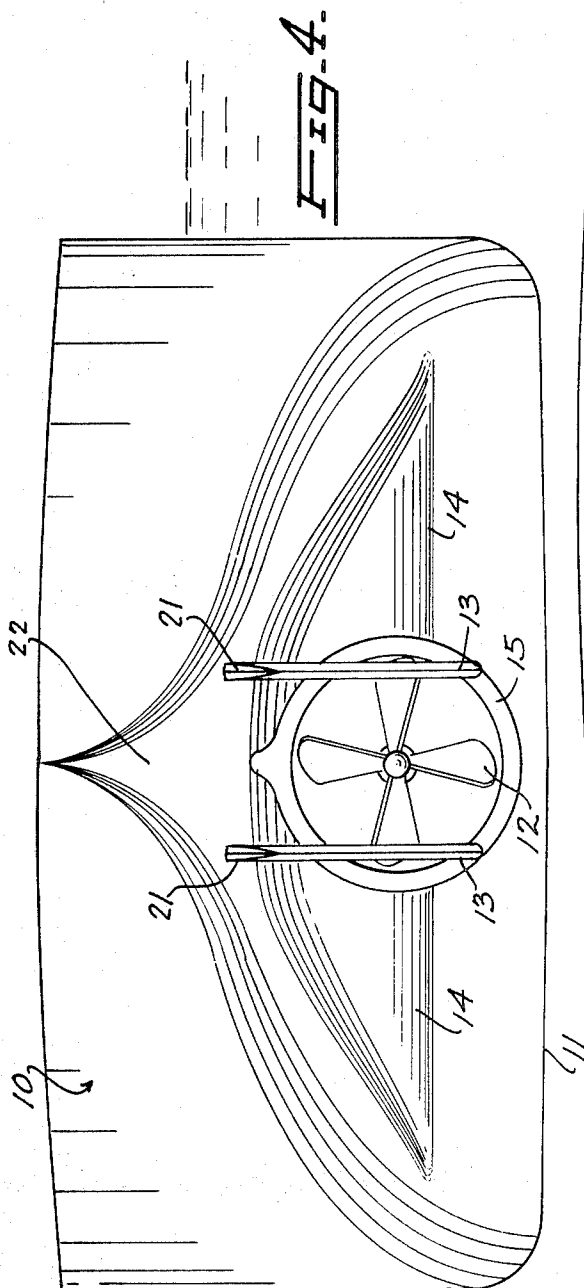
A hull designed to afford additional protection to the ship's screw or screws and rudder or rudders against damage by floating or sheet ice, the hull having a flat bottom midship section and a buttock flow stern section. A closed annular nozzle closely and coaxially surrounds each screw and a skeg projects downwardly on each side of the hull, each skeg being a forwardly extending streamline continuation of an outboard rim of a nozzle.

12 Claims, 8 Drawing Figures









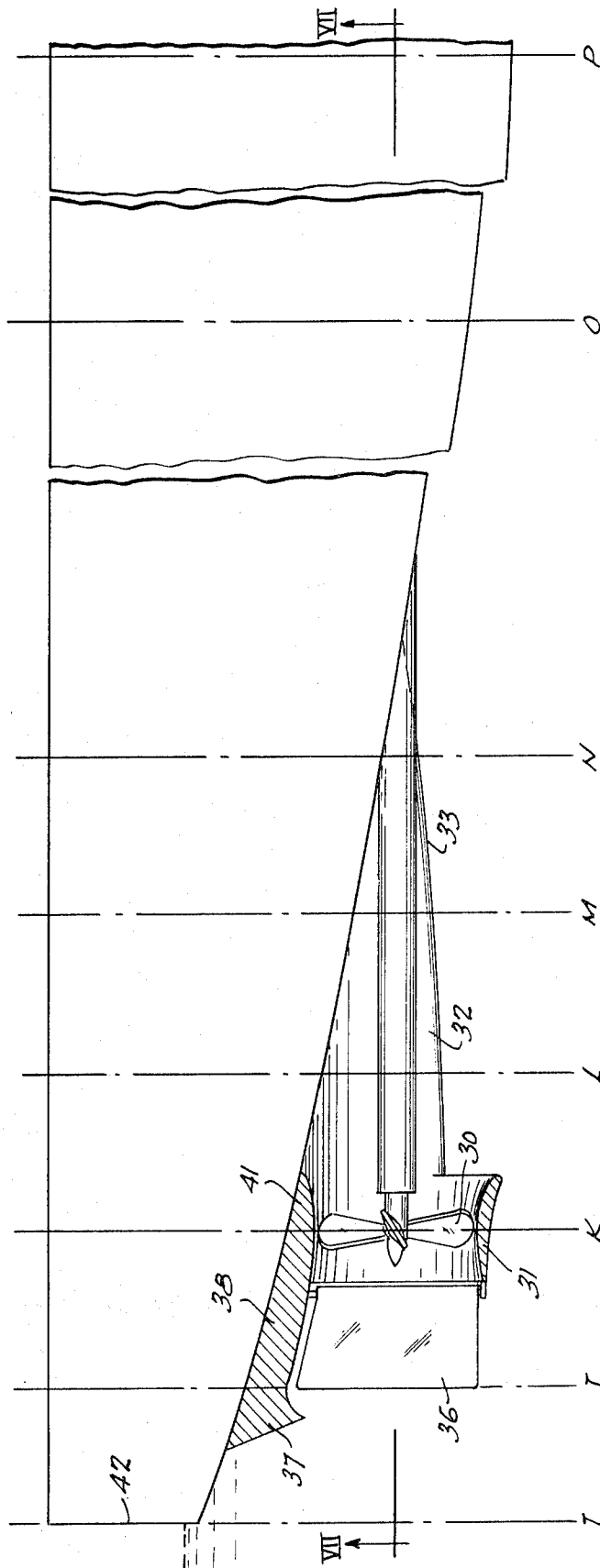


Fig. 6.

SHIP CONSTRUCTION

This invention relates to improvements in ship construction and more particularly to ships designed to negotiate ice fields. Increased navigation in Arctic and Antarctic waters has given rise to a need for improved methods of protecting ships against the destructive effects of floating or sheet ice, and especially the protection of the ships' screws and rudders against damage by ice.

An object of the present invention is to provide improvements in construction that will afford advantages in this respect.

While in northern waters the major hazard to shipping in the form of floating objects can normally be expected to come from pieces of ice, the features of the present invention are equally useful in the avoidance to damage to the screws of vessels that are employed in other environments where heavy flotsam is likely to be encountered, for example the logs and floating tree trunks that are often encountered in inland and confined waterways.

In addition to providing protection for the screws (and often also the rudders) of ships likely to be exposed to dangerous flotsam, the present invention is also concerned with the provision of a hull structure that affords improved thrust characteristics at slow speeds, i.e., when ice breaking or towing, in combination with the improved protective aspects.

Various features of the invention are illustrated by way of example in the accompanying drawings. The broad scope of the invention is not limited by the many specific features described and shown but is defined in the appended claims.

In the drawing:

FIG. 1 is a side view of the stern portion of a single-screw ship's hull constructed according to the invention;

FIG. 2 is a central vertical section on the ship of FIG. 1;

FIG. 3 is a horizontal section taken on the line III—III in FIG. 2;

FIG. 4 is a rear, end-on view of the ship of FIGS. 1 to 3;

FIG. 5 is a rear multiple-section view of the ship of FIGS. 1 to 4 taken on various transverse vertical planes and with the screw and rudders omitted;

FIG. 6 is a longitudinal vertical section of a twin-screw ship constructed according to the invention, and taken on the line VI—VI in FIG. 7;

FIG. 7 is one half of a horizontal section taken on the line VII—VII in FIG. 6, the other half being the same in mirror-image; and

FIG. 8 is a rear multiple-section view of the ship of FIGS. 7 and 8.

Reference will first be made to the single-screw ship 10 of FIGS. 5 to 5, which will be seen to comprise a "buttock flow stern," that is to say a stern construction in which a substantially flat ship's bottom (there may be some slight dead rise) is gradually and smoothly inclined upwardly from the maximum draft 11 (section H) to the location of the screw 12 (section B) and that of a single rudder or the twin rudders 13 (section A). When a single rudder is used it will be located on the ship's center line. A buttock flow stern has the characteristic that water will tend to flow from beneath the vessel to the propeller (or propellers), rather more than it will tend to be drawn in from the sides of the vessel. The adoption of a buttock flow stern thus contributes to the avoidance of damage to the screw by pieces of broken ice that may be moving rearwardly along the sides of the ship and which would otherwise tend to be subjected to strong inward suction.

It is not considered, however, that reliance on the buttock flow stern would be sufficient in itself to ensure positively that no broken ice reaches the screw, and consequently the ship is fitted with a pair of skegs 14 that project from the hull structure and taper inwardly towards each other (as best seen in FIG. 3) to merge into the sides of a closed annular nozzle 15 surrounding the screw 12. It will be noted from FIG. 2 that the bottom edges 16 of the skegs 14 project downwardly at least as far as the shaft centerline, and preferably somewhat below the lower edge of the shaft 17 or, when fitted, the shaft bossing 17a.

The nozzle 15 which is a constructional feature known per se will have its surfaces aerodynamically designed in the conventional manner to provide increased thrust at slow and zero vessel speeds, a characteristic that is very desirable in ice fields, particularly if the ship is itself fitted with an ice-breaking bow the operation of which absorbs substantial amounts of power. Nozzles of the so-called decelerating flow and accelerating flow type can be used in the present invention. While the characteristics of these two types differ somewhat from each other, they both provide the necessary high thrust at low speed, while at the same time providing good performance and full power when running free at high speeds.

As FIG. 3 demonstrates the inner surfaces 18 of the skegs 14 are curved and form smooth continuations of the aerodynamically designed inner surface 19 of the outboard rims of the nozzle 15. The outer surfaces of these parts similarly form a smooth continuation of one another, at least when considered in the horizontal plane of FIG. 3. The skegs 14 serve a triple purpose: to funnel a streamline flow of water from beneath the vessel into the nozzle; to inhibit the sucking in of water from the sides of the vessel, particularly near the water line, with the attendant reduction of the risk of sucking in floating ice or other solid objects such as floating logs; and finally to strengthen the nozzles 15 structurally.

The upper portion 20 of the nozzle 15 is faired into the hull, as best seen in FIG. 2, and above each rudder 13 there is provided an ice knife 21 to protect the rudder stocks when backing into ice. The extreme stern construction, i.e., the hull portion 22, is a so-called canoe stern which is desirable but not essential when backing into ice.

While a single rudder can be employed, the use of twin rudders increases maneuverability when navigating in leads through ice and also helps to protect the screw from direct impact with ice when going astern. In FIG. 3, the line 23 represents the water line, and the line 24 represents the extreme periphery of the hull.

In the twin-screw hull construction shown in FIGS. 6 to 8, each screw 30 is provided with a nozzle 31 and the outboard rim only of each nozzle 31 is extended in the form of a skeg 32 which is generally similar to one of the skegs 14, except that the bottom edge 33 of the skegs 32 are inclined upwardly slightly in the forward direction, the tendency to suck in floating ice from the sides being less at the more forward locations (e.g., from section N forward). As before the ship has a buttock flow stern sloping gradually upwardly from the maximum draft at section P. In FIG. 7 the lines 34 and 35 represent the waterline and the deck line respectively.

One rudder 36 is associated with each screw, being located slightly inwardly of the centerline of the shaft of the screw. Each rudder 36 is protected when going astern by an ice knife 37 faired into the hull above the rudder, the fairing portion 38 of this knife diverging along lines 39 and 40 to join a fairing portion 41 that constitutes the upper part of the nozzle 31. The hull terminates in a desirable but not essential destroyer-type stern 42.

The adoption of a hull of an essentially flat bottom type having a full midship section (e.g., section H or P) is essential to the invention. By "essentially flat bottom" it is not intended to exclude a normal amount of dead rise, i.e., some sloping upwardly of the bottom towards the sides, as shown at R in FIG. 5. On the other hand, the term "essentially flat bottom" is intended to exclude the double or multiple hull type of constructions that provide channels for ice to be drawn in at the bow and conveyed longitudinally beneath the ship. The present ship will exhibit no tendency for ice to be directed towards the screw or screws in this way. On the contrary any ice forced downwardly by the bow will tend to be urged outwardly towards the sides of the vessel before it could reach the buttock flow stern, an action that some measure of dead rise will encourage. This requirement could be expressed in other words by saying that the bottom of the main midship section of the vessel may well be structured so as to slope gently upwardly towards the sides, provided that such upward slope is

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not reversed at any time so as to form a channel in which piece of ice might become trapped.

I claim:

1. A ship comprising
 - a. a hull having an essentially flat bottom midship section and a buttock flow stern section sloping gradually upwardly and rearwardly from such midship section,
 - b. at least one screw and shaft connected thereto,
 - c. a closed annular nozzle secured to said stern section of the hull closely and coaxially surrounding each said screw,
 - d. and a skeg projecting downwardly from said stern section on each side of the hull, said skeg forming a forwardly extending streamline continuation of an outboard rim of a said nozzle.
2. A ship according to claim 1, wherein at least the portion of the lower edge of each skeg adjacent a nozzle rim projects to a depth below the centerline of the shaft of the screw located in such nozzle.
3. A ship according to claim 1, wherein said skegs diverge from each other in the forward direction.
4. A ship according to claim 3, wherein said skegs diverge from each other throughout their entire length extending from a said nozzle to a location at which they merge into the hull.
5. A ship according to claim 4, wherein said location is situated in the buttock flow stern section rearward of the midship section.
6. A single-screw ship according to claim 1, wherein the two

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skegs form continuations of opposite rims of a single nozzle surrounding a single screw and located on the centerline of the ship, said skegs continuously diverging from each other in the forward direction to merge into the buttock flow stern section.

7. A ship according to claim 6, wherein the lower edge of each skeg projects to a depth below the lower edge of the shaft connected to said screw.

8. A ship according to claim 6, including a pair of rudders located rearwardly beyond said nozzle, each rudder being displaced to a respective side of the centerline of the screw within said nozzle while remaining within the slip-stream propelled rearwardly by said screw.

9. A ship according to claim 8, including an ice knife secured to the hull above each said rudder.

10. A twin-screw ship according to claim 1, wherein the two skegs form continuations of the outboard rims of a pair of said nozzles, each of which surrounds a screw, said skegs continuously diverging from each other in the forward direction to merge into the buttock flow stern section.

11. A ship according to claim 10, including a rudder located rearwardly beyond each said nozzle, each said rudder being displaced slightly inwardly of the centerline of the screw located within the associated nozzle while remaining within the slip-stream propelled rearwardly by the screw within such nozzle.

12. A ship according to claim 11, including an ice knife secured to the hull above each such rudder.

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