United States Patent

Blanchet

[15] **3,636,904**

[45] **Jan. 25, 1972**

[54] ICEBREAKER EQUIPMENT FOR SHIPS

[72] Inventor: **Charles Blanchet**, Grenoble, France

[73] Assignee: **Societe Grenobloise d'Etudes et d'Applications Hydrauliques, (SOGREAH)**, Grenobles, France

[22] Filed: **Jan. 14, 1970**

[21] Appl. No.: **2,893**

[30] **Foreign Application Priority Data**

Jan. 17, 1969 France 6900922

[52] **U.S. Cl.** **114/41**

[51] **Int. Cl.** **B63b 35/08**

[58] **Field of Search** 114/40–42

[56] **References Cited**

UNITED STATES PATENTS

17,209 5/1857 Estlack 114/42

993,440 5/1911 Duplessis 114/41

FOREIGN PATENTS OR APPLICATIONS

2,625 2/1890 Sweden 114/41

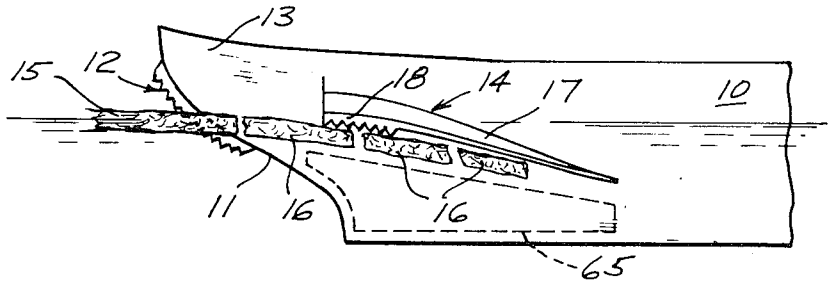
Primary Examiner—Trygve M. Blix

Attorney—Sylvester J. Liddy, John J. Hart, Joe E. Daniels and Charles E. Baxley

[57] **ABSTRACT**

The icebreaker ship herein disclosed has means for cutting a slit in an ice layer mounted on its prow forwardly of the ship's stempost, and set back from such cutting means, are means enabling the ship to bear its weight down on the slit portion of the ice layer so as to break the latter into pieces of ice. Located rearwardly of the bearing means are guiding means for immersing the ice pieces below the ice layer and coacting with the sides of the ship's prow to force the immersed ice pieces laterally so that they are pushed beneath the ice layer.

7 Claims, 8 Drawing Figures



PATENTED JAN 25 1972

3,636,904

SHEET 1 OF 2

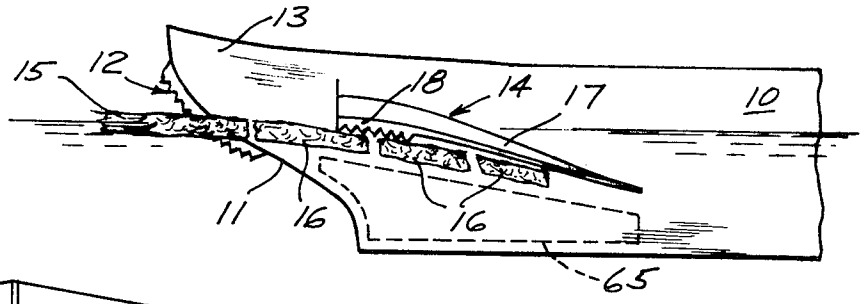


FIG. 1

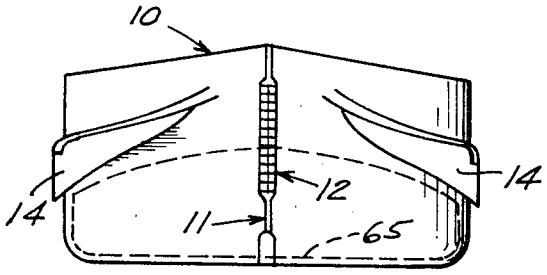


FIG. 2

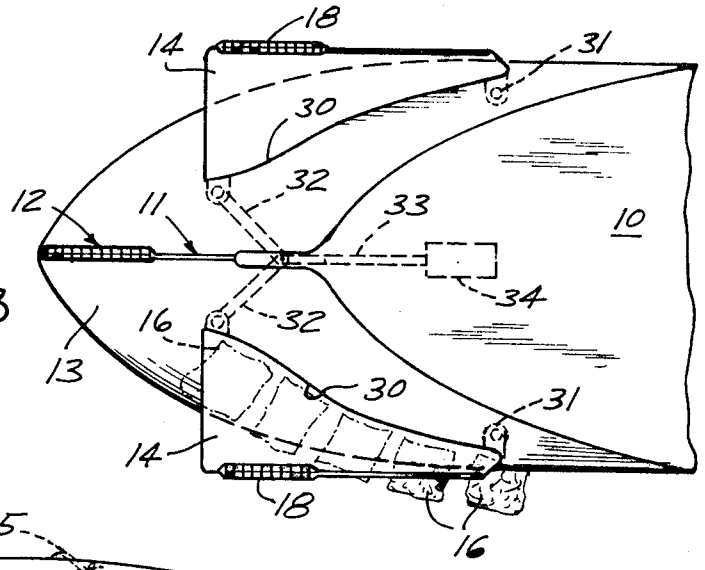


FIG. 3

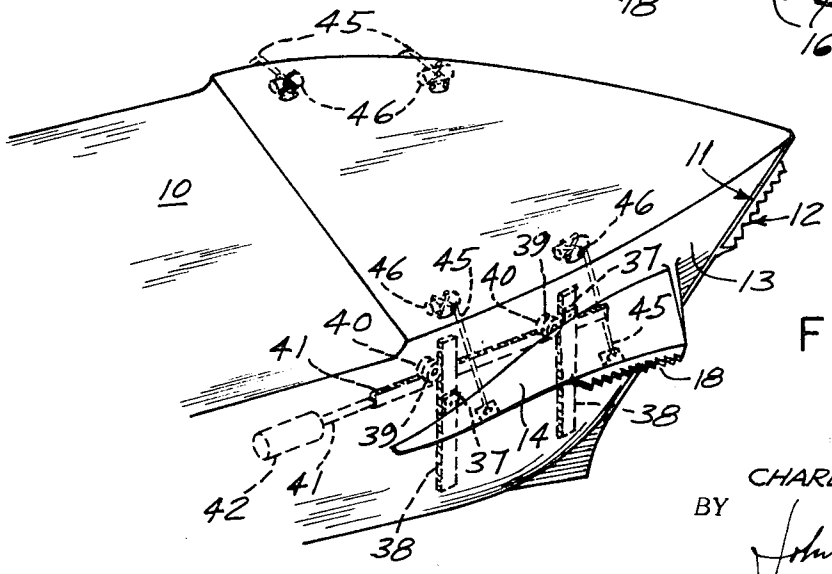


FIG. 4

INVENTOR.
CHARLES BLANCHET
BY
John J. Hart
ATTORNEY

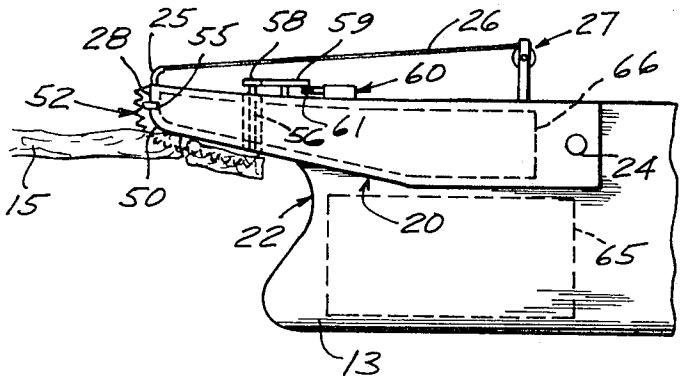


FIG. 5

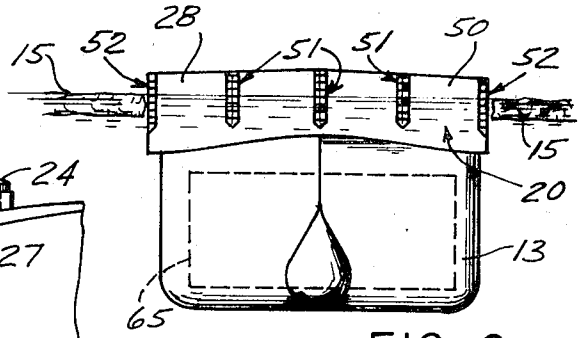


FIG. 6

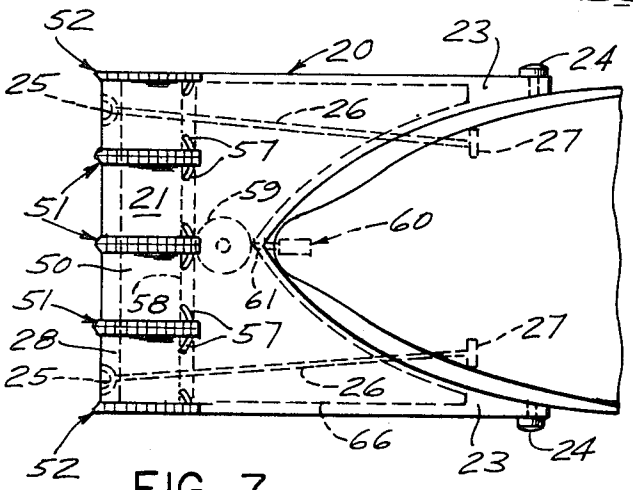


FIG. 7

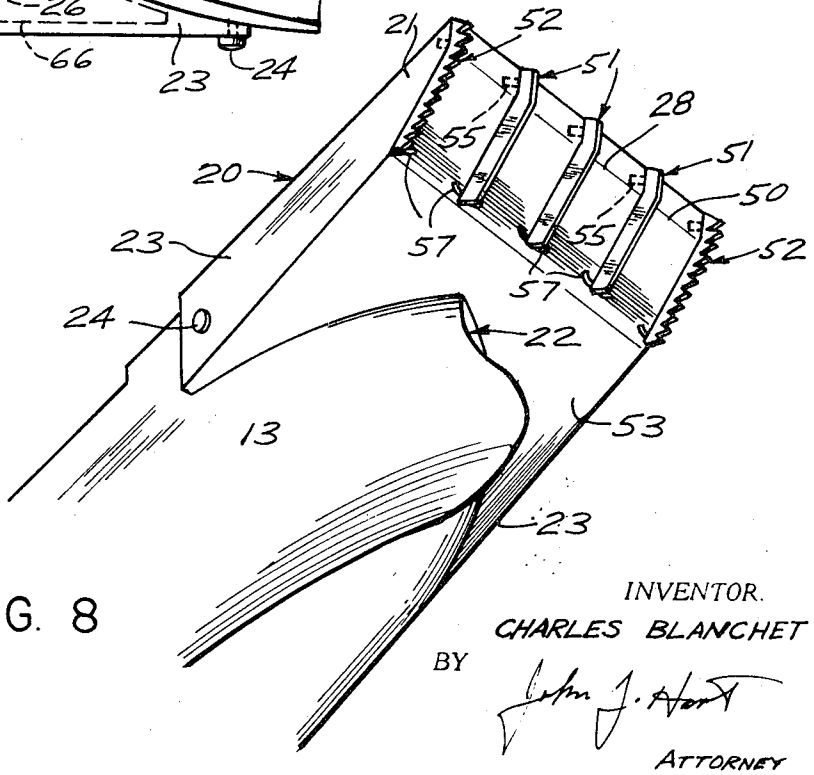


FIG. 8

INVENTOR.
CHARLES BLANCHET
BY
John J. Hart
ATTORNEY

ICEBREAKER EQUIPMENT FOR SHIPS

This invention relates to improvements in icebreaking equipment for ships.

It is customary to design icebreaking ships so that their prows are enabled to rise over an ice pack and break it solely by the use of their weight. It is the purpose of this invention to enable a ship to break through an ice pack employing a different principle of operation.

In accordance with the invention, means are provided to enable the ship to produce one or more slits in the ice as it moves through the ice pack. The slit ice is then broken into blocks or pieces by flexure under the weight of the vessel which is applied on the edge of the previously slit portion of the ice layer. The application of the weight of the vessel may be exercised directly by the surfaces of the prow of the ship, or through lateral surfaces provided on means mounted on the ship's prow. The blocks of ice formed by such breaking action are forced down so that they become submerged in the water at a level below the bottom of the ice layer. The thus submerged blocks of ice are then moved laterally beneath the surrounding ice pack on both sides of the channel formed by the ship.

For a better understanding of the invention and the means whereby the aforesaid results are accomplished, reference is made to the accompanying drawings which show by way of example specific embodiments of the invention, and in which

FIG. 1 is an elevational view of the forward end of a ship equipped in accordance with the invention;

FIG. 2 is a front view of the forward end or prow of the ship;

FIG. 3 is a bottom view of the ship portion shown in FIGS. 1 and 2, and additionally indicating one method by which the ice block submerging means may be retracted within the ship's hull;

FIG. 4 is a perspective view of the ship portion shown in FIGS. 1–3, but additionally showing another means by which the ice block submerging means may be retracted, the retracting means in this figure being also adjustable to vary the height of the ice block submerging means;

FIGS. 5, 6, 7 and 8 are views similar to FIGS. 1, 2, 3 and 4, respectively, but relating to a modified form of the invention.

Referring now more particularly to FIGS. 1–4 of the drawings, the reference numeral 10 indicates generally the forward end of a ship. Mounted on the stempost 11 of the ship's prow 13 is an ice cutting blade 12, the cutting edge of which protrudes forwardly from the stempost. The cutting edge of the blade 12 may be of any suitable type such as a plain cutting edge as in the blades 51 shown in FIGS. 5–8 of the drawings, or a saw-blade-type of cutting edge such as shown in FIGS. 1–4 of the drawings. The cutting blade 12 is inclined downwardly from front to rear and extends over such a length that though inclined it can cut through the entire thickness of any ice pack that the ship may normally encounter in its travels. It will be noted from FIGS. 1–4 of the drawings, that the upper end of the blade 12 is located adjacently to the top end of the stempost 11 and extends downwardly well below the bottom surface of the ice layer 15 when the ship is in a horizontal position.

Projecting from the sidewalls of the prow 13, in rearwardly spaced relation to the stempost 11 so that they are materially set back with respect to the latter, are two downwardly inclined guide fins 14. In the embodiment shown in FIGS. 1 to 4, the surfaces of the sidewall portions of the prow located between the stempost 11 and the guide fins 14 are the means through which the weight of the ship is utilized to break the portion of the ice layer slit by the cutting blade 12 into blocks or pieces. Such sidewall portions of the prow are of material extent and are so shaped that they can rest on the edge of the layer of ice under the force of the ship's propellers and cause the slitted portion thereof to flex under the weight of the vessel and finally break into blocks or pieces 16. As the ship continues to advance these ice blocks pass under the leading or forward ends of the fins 14.

The fins 14 extend laterally from opposite sides of the ship and have outer longitudinally extending, substantially parallelly disposed edges. The spread of such fins is such that the distance between such outer longitudinal edges is at least slightly greater than the maximum breadth of the ship's hull. The fins 14 project outwardly from the forward convexly formed sides of the ship so that they have a substantially triangular configuration in plan view; the maximum widths of such fins being along the transverse leading ends or edges thereof and the widths thereof progressively reducing toward the rear ends thereof. The fins 14 incline slightly transversely, downwardly and outwardly from the sides of the vessel, as is illustrated in FIGS. 1, 2 and 4. The lengths of the fins 14 and the degree of longitudinal inclination thereof are such that the fins extend in height over a distance at least as great as the thickness of the thickest layer of ice that the ship may encounter in its travels. The outer longitudinal edges of the fins 14 may be provided along the forward sections of such edges with cutting blades 18. The purpose of the blades 18 is to split and break the ice along the edges of the channel formed in the ice pack so as to assure that it will have a width greater than that of the ship.

It will be understood from the foregoing, that when the ship advances into a layer of ice 15, the blade 12 first acts on the ice causing large cracks therein. The front of the ship's prow 13, in the region thereof between the blade 12 and the fins 14, then comes against the ice and enables the weight of the ship to cause, by flexure, the breaking of the thus split and weakened portion of the ice layer into blocks 16 of different shapes and sizes. These ice blocks 16 pass on both sides of the prow and below the leading ends of the advancing fins 14. As the ship continues its advancement, the fins 14 force the ice blocks 16 to submerge so as to cause such blocks to reach, at about the zone of such fins designated 17 in FIG. 1, a depth which is greater than the bottom of the ice layer 15. The ice blocks reaching this zone 17 of the fins 14 are simultaneously pushed laterally outwardly by the convexly curved hull of the ship and start to emerge from below the fins. The ice blocks finally pass outwardly beyond the longitudinal side edges of the fins and beneath the layer of ice lining the channel established by the ship. As the blades 18 on the fins 14 do not extend rearwardly into the zone 17 of the fins 14, the ice blocks 16 pass freely from beneath such fins and under the edges of the ice pack forming the ship channel.

The fins 14 may be fixedly secured, as by welding, to the steel plates of the ship, but may also be mounted on the ship so that they can be raised, or retracted when the vessel is sailing in free waters so as not to interfere with the normal operation of the ship. They also may be made adjustable in height as a function of the draft of the ship which will vary depending on the load being carried. As to the retractableness of the fins 14, this may be accomplished, as in indicated in FIG. 3 of the drawings, by having the fins mounted for pivotal movement through suitably designed slots 30 provided in the prow walls and covered in any suitable manner (not shown) when the fins 14 are retracted within the hull. In the embodiment shown in FIG. 3, the rear ends of the fins 14 are pivotally mounted at their rear reduced ends on vertical pins or shafts 31 located within the hull of the ship. Connected to the inner sides of the leading end portions of the fins 14 are one end of two links 32,32. The links 32,32 extend inwardly and rearwardly and are both movably connected at their other ends to the forward end of a longitudinally extending shaft 33. The shaft 33 may form part of the piston of a hydraulic ram 34 which is suitably controlled in a known manner to move the fins 14 about their pivots 31 to advanced, or retracted positions.

In the mechanism illustrated in FIG. 4 of the drawings, the fins 14 are retracted by raising them to vertical positions against the sides of the prow. The inner longitudinal edges of the fins 14 are each hingedly supported by two hinge blocks 37,37 mounted on a side of the ship's hull. Connected to the outer longitudinal edges of the fins 14,14 are the ends of two ropes 45,45 which extend up to the ship's forward deck and are wrapped around deck cleats 46,46. By pulling upwardly on the ropes 45, the fins 14 will be pivoted upwardly about their

hinged connectors to the blocks 37, and secured in their retracted positions by wrapping the ropes around the deck cleats 46 in a known manner. The hinge blocks 37 are secured to vertical racks 38,38 slidably mounted for vertical movement in a known manner on the sides of the ship. Engaging the teeth in each rack is a gear wheel 39 mounted on a shaft that extends through and is rotatably supported by a bearing provided in the hull of the ship. Secured to the inner end of each such shaft is an interior gear wheel 40, both of which are engaged by a longitudinally disposed rack bar 41 activated by a hydraulic ram 42. The hydraulic ram 42 is suitably controlled in a known manner to reciprocate the rack bar 41, to rotate the gear wheels 39,40 in one direction or another so as to raise or lower the rack bars 38 and consequently the fins 14 to the levels at which they will be most effective for the load that the vessel is carrying.

It will be noted that in the embodiment of FIGS. 1–4, the ice layer splitting blade 12 is mounted on the stempost 11 of the ship, and the portion of the ship's hull between the blade 12 and the fins 14 is utilized to break the cracked or split portion of the ice layer 15 into blocks, which are then guided by the separate fins 14 under the sides of the ice pack forming the channel which the vessel has created for itself. In the form of the invention shown in FIGS. 5–8 of the drawings, the ice splitting blade or blades, the means enabling the vessel to bear its weight down on the cracked ice layer portion to break the latter into individual ice blocks, and the guiding means are provided on a single structure carried by the prow of the ship. As is shown in FIGS. 5–8, the structure embodying the aforesaid combined features and generally designated 20, has a forward transverse body portion 21 which extends transversely across the ship's stem 22 for a distance at least equal to the total width of the ship. Preferably, the overall width of the structure or device 20 is slightly greater than that of the ship in order to assure the formation of a channel through which the ship can readily pass. Integral with the body portion 21 are two rearwardly disposed portions 23 which extend over both sides of the prow 13 of the ship and which are pivotally supported at their rear ends on pins or stub shafts 24 secured to the ship's hull in any suitable fashion. The forward or leading end of the body portion 21 is provided with a pair of anchoring members 25 to which one end of two ropes or cables 26 are connected. The ropes 26 extend rearwardly to two power winches 27 of any suitable construction mounted on the forward deck of the ship. It will thus be seen that by controlling the operation of the winches 27, the structure 20 may be held raised in retracted position when the vessel is sailing in free waters, and may be lowered to any desired position dependent on the load the vessel is carrying or the thickness of the ice field encountered.

The forward end of the body portion 21 has a first inclined bottom surface 50 on which are mounted a plurality of cutting members for cracking or splitting the ice layer 15. The bottom surface 50 is inclined downwardly from front to rear and its forward end reaches a height above the ice layer 15. The cutting members mounted thereon may be of the cutting-blade-type 51 or the saw-blade-type 52, or a combination of both, as illustrated. It will be noted that the cutting members 51,52 protrude forwardly a sufficient distance from the front edge surface 28 of the structure 20 so that the layer of ice 15 is split before the surface 50 rests against the edge of the fractured portion of such layer. The remaining bottom surface 53 is also provided with a rearwardly and downwardly extending incline which extends throughout the length of the two structure extensions 23 and is comparable to the bottom inclined surfaces of the fins 14.

It will be understood that the method of operation of the structure or device 20 of FIGS. 5–8 is substantially the same as the construction shown in FIGS. 1–4, with the difference that in the case of the device 20, the breaking of the layer of ice 15 which has been previously split by the blades 51,52 is caused by the part of the inclined surface 53 on the bottom of the body portion 21 resting on the edge of the fractured ice layer portion and not by the prow of the ship. The inclinations of the surfaces 50 and 53 on the body portion 21 are such that the surface 53 is enabled to rest on the ice to break it under the weight of the ship without running the risk of the stem 22 of the advancing ship striking against the front of the ice layer before it is broken. As in the case of the fins 14, the rear end extensions of the bottom surface 53 throughout the length of the extensions 23 of the device 20, reach such a depth below the layer of ice that the broken blocks formed therefrom are submerged below the ice layer 15 and as a result of the inclination of such extensions of surface 53, the convex portions of the ship's hull, and the speed of displacement of the ship, the submerged ice blocks are released laterally below the edges of the layer of ice forming the channel for the ship. The device of course, will be designed and constructed in accordance with the rules of the art so as to assure it the mechanical strength required to overcome the considerable forces encountered during the operation thereof.

It will be understood that the device 20 can be secured in fixed relation to the hull of the ship as well as movably mounted thereon in the manner indicated in FIGS. 5–8. So also, the cutting members 51,52 may be secured in fixed relation on the device 20, or they may be movably mounted thereon so that they may be oriented or staggered with respect to each other to enable the ship to advance more readily along a curved path. This feature may be accomplished, as shown in FIGS. 5–8, by pivotally mounting the forward ends of the cutting members 51,52 on the forward edge of the device 20, as by pins 55 receivable in and keyed in a known manner to recesses provided in such forward edge. Connected to the rear ends of the blades 51,52 are rods 56 which extend vertically upwardly through arcuately-shaped slots 57 in the body portion 20 and are movably connected at their upper ends to a transverse rack bar 58 slidably mounted on the top of body portion 20. Engaging the teeth of rack bar 58 is a gear wheel 59 rotatably mounted on a vertical stub shaft provided on the body portion 20 and driven by a reversible electric motor 60 through a gear 61 mounted on the shaft of such motor. The motor is suitably controlled by an electric switch means operable to rotate it on one direction or the other to cause the blades 51,52 through the aforesaid means, to be pivoted in one direction or the other about their pins 55 dependent upon the direction in which the ship is to be turned.

As is shown in FIGS. 1, 2, 5 and 6 of the drawings, ballast tanks 65 may be provided in the prow 13 of the ship so that when they are filled with sea water in the usual manner the forward end of the ships will be pushed down in order to position the ice breaker structures in proper relation to the ice layer 15, and when they are emptied the prow will be enabled to straighten up so as to cause the ice breaker structures to come as far as possible out of the water so as not to decrease the performance of the ship when sailing in free waters. These ballast tanks are of especial advantage when the ice breaker structures are mounted in fixed relation on the ships. This effect may be heightened in the type of device shown in FIGS. 5–8 of the drawings by providing a ballast tank or tanks 66 in the ice breaker structure 20 thereof as is indicated in FIGS. 5 and 7 of the drawings.

What is claimed is:

1. A ship comprising ice cutting means mounted on the forward end thereof for initially engaging an ice layer on the water and cracking the same as the ship advances, means associated with said cutting means enabling the ship to bear its weight down on the cracked portion of the ice layer so as to break the latter into pieces of ice and form a channel through the ice layer, and guiding means for immersing such ice pieces to a level below the underside of the ice layer, said guiding means comprising two guiding elements extending longitudinally along the sides of the ship's prow and having bottom surfaces inclining rearwardly downwardly, said two guiding elements being constructed and arranged to coact with convex portions of the ship's prow to thrust the ice pieces immersed thereby laterally beneath the sides of the channel made by the ship through the ice layer.

2. A ship as defined in claim 1, in which said guiding elements have a substantially triangular configuration in plan view and are progressively reduced rearwardly.

3. A ship as defined in claim 1, in which the bottom surfaces of said guiding elements incline rearwardly downwardly through a longitudinal distance having a height of inclination at least as great as the thickness of the layer of ice, and in which the outer side edges of said bottom surfaces are spaced apart a distance at least as great as the overall width of the ship's hull.

4. A ship as defined in claim 1, including cutting means mounted on the outer side edges of said guiding elements and having downwardly projecting cutting edges adapted to cut the ice along the sides of a channel made by the ship in the ice layer, said cutting means being mounted on the forward end portions of said outer side edges so as not to interfere with the lateral discharge of the ice pieces from beneath said guiding elements.

5. A ship as defined in claim 1, in which said cutting means is mounted on the ship's stem, in which said guiding elements are a pair of fins extending laterally from opposite sides of the ship's prow, and in which said weight applying means in constituted of the prow's bottom intermediate said cutting means and said fins.

6. A ship as defined in claim 1, in which said cutting means, weight applying means and guiding elements are provided on unitary means mounted on and projecting from the ship's prow.

7. A ship as defined in 1, including means movably supporting said cutting means to enable the latter to be oriented in direction, and means operable to change the direction of operation of said cutting means.

* * * * *