United States Patent [19]

Schirtzinger

[11] **3,768,428**

[45] **Oct. 30, 1973**

[54] **SWEEP ICE CUTTER**

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[52] **U.S. Cl.** **114/42**

[51] **Int. Cl.** **B63b 35/12**

[58] **Field of Search** 114/42, 40, 41

[56] **References Cited**

UNITED STATES PATENTS

588,393	8/1897	Brown	114/42
2,883,957	4/1959	Ehinger	114/42
3,521,592	7/1970	Rosner et al.	114/42
2,545,104	3/1951	Musial	114/42

FOREIGN PATENTS OR APPLICATIONS

30,671	7/1965	Germany	114/42

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[57] **ABSTRACT**

There is provided a structure for mounting on the bow of a marine vessel or structure to cut ice into sections which are readily broken or discarded by the vessel or structure. The system comprises a pair of fixed or adjustable end ice cutters positioned ahead of the port and starboard of the vessel or structure. Between the end cutters there is provided at least one movable cutter which traverses the path between the end ice cutters. The traversing action of the movable cutter cuts the ice between the end cutters into sections which are easily broken or discarded by the bow of the vessel or the structure being protected to permit free passage of the vessel through the ice and prevent damage to the structure due to ice flows.

13 Claims, 4 Drawing Figures

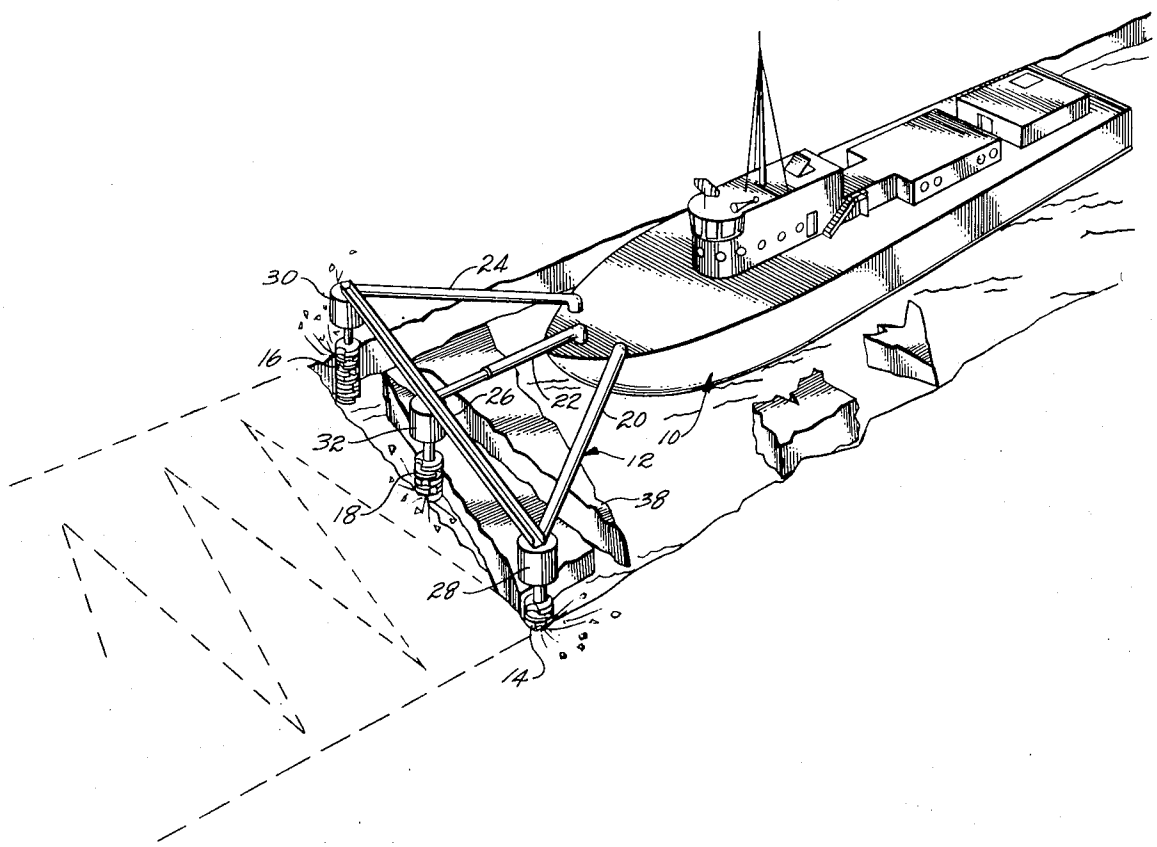

FIG. 1

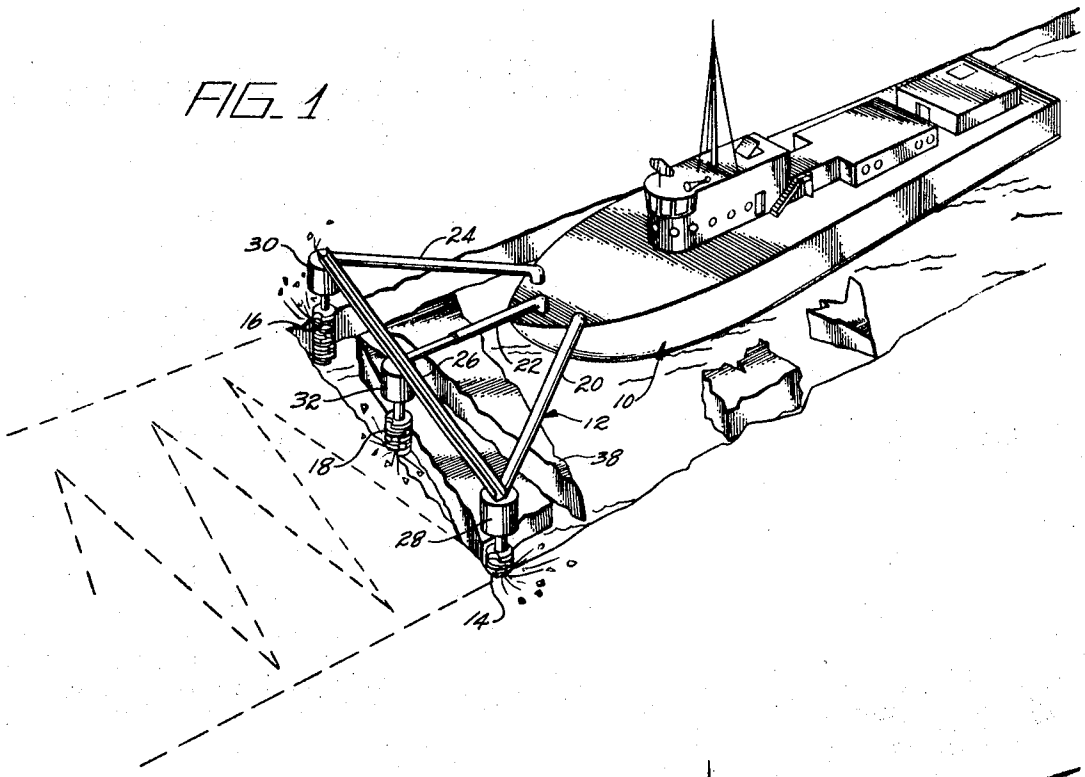

FIG. 2

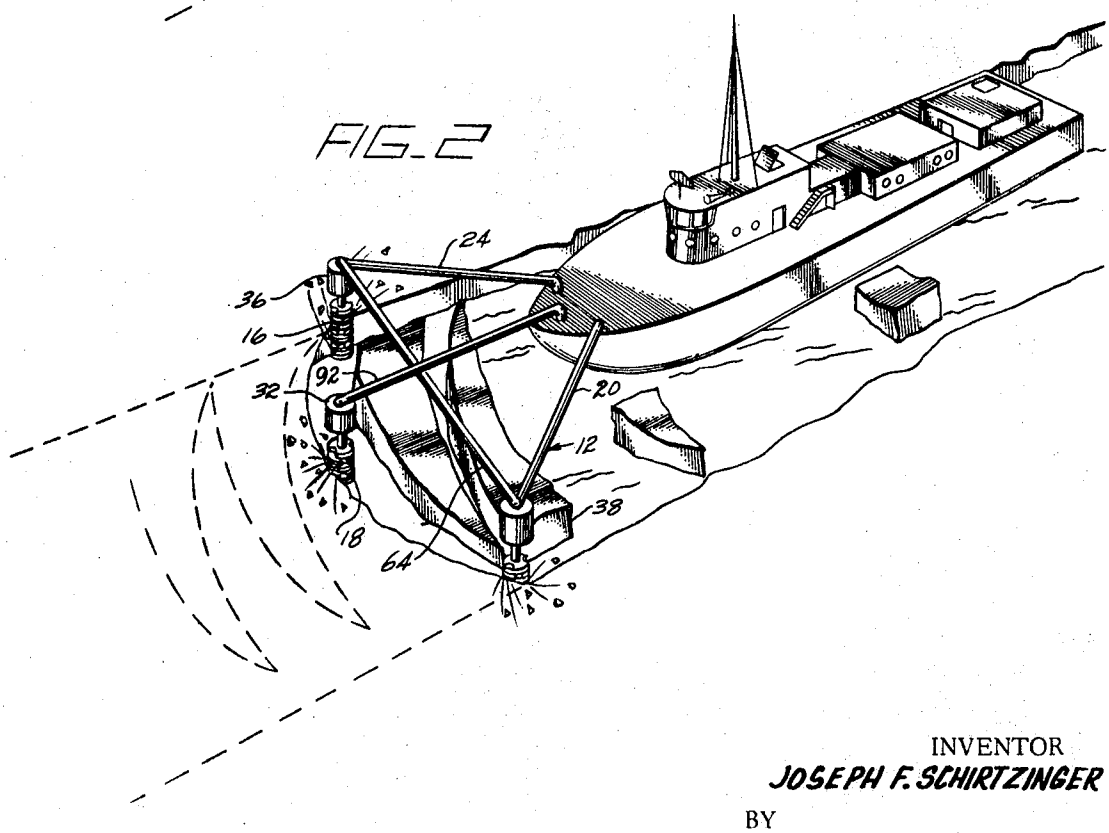

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FIG. 3

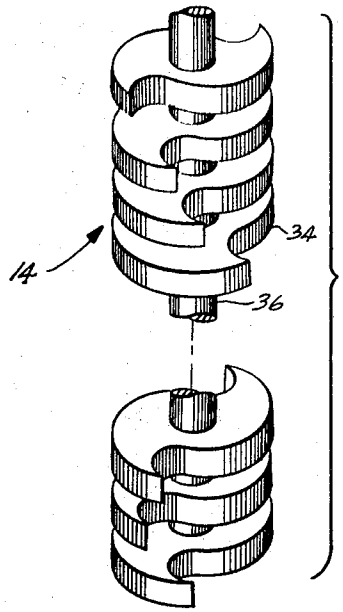
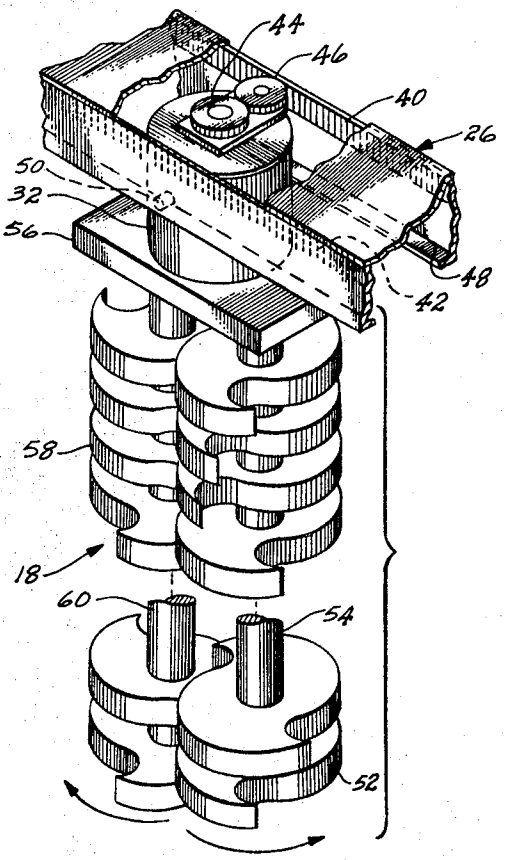


FIG. 4



SWEEP ICE CUTTER

BACKGROUND OF THE INVENTION

The discovery of valuable minerals in Arctic coastlines such as the north shore of Alaska and the island of Canada has presented a problem of accessibility by sea for the transportation of both personnel and equipment for exploitation of the mineral values present.

Normally, accessibility by sea is less than two months of the year and for the remaining period of time accessibility by airborne cargo carriers is limited by both the size and weight limitations of airborne cargo carriers.

These limitations and high cost per productive hour of labor, due to climatic extremes and long logistic lines, have made installation costs of exploitation equipment prohibitively high and their installation economically questionable.

Ice formations also preclude the transport of cargo and the like in lakes and rivers for many months of each year. Ice breaking vessels have been employed but they have been established to be of limited utility.

After lapse of many years, there has been a resumption of activity in connection with the development systems for cutting ice to permit the passage of vessels into ice-bound areas. Attention has also been focused in developing ice cutting systems as for protecting sea bound marine structures from ice damage due to ice flow.

For instance, in the U.S. Pat. No. 3,468,277 to Rosner et al, there is provided an ice cutting system for a marine vessel in which there is provided at least one ice engaging unit supported on the prow of the vessel. The unit contains a plurality of spaced ice chippers which rotate on what amounts to a plurality of horizontally disposed endless chains secured to and driven by a plurality of spaced gears mounted on parallel shafts. The chippers engage the ice and break the ice into small chunks to clear a path ahead of the vessel.

In U.S. Pat. No. 3,521,592 also to Rosner et al, there is provided an ice channel cutter for mounting on the prow of the vessel which consists of a plurality of parallel spaced vertically mounted ice engaging units each having an array of radially extending ice chopping blades or cutters. The ice choppers rotate simultaneously with the forward motion of the vessel and chop the ice into relatively small chunks which are carried rearwardly around the vessel or downwardly to permit vessel passage.

In working with systems described in the aforementioned patents it has been found that a high degree of energy is required to cut a wide clear passage through ice when all of the ice in the path of travel is chopped into small chunks of say, three to four inches in size.

SUMMARY OF THE INVENTION

According to the present invention there is provided an ice cutting system for mounting on the bow of a vessel to facilitate its movement through ice or on a marine structure to protect it from ice damage due to ice flows.

The system consists in part of at least a pair of end ice chipping cutters positioned ahead of the marine vessel or structure and at least at the outermost port and starboard sides of the vessel or marine structure. Between the end ice chipping cutters there is provided at least one additional ice chipping cutter which traverses a path between the two end cutters. This cuts the ice into fairly large blocks which are readily broken by a vessel passing through ice or structure subjected to the flow of an ice mass. The amount of energy extended to remove ice in this manner is far less than chopping an entire mass of ice into small chunks.

In this system, the cutters may operate in any convenient fashion, both rotating and reciprocating in nature. The intermediate ice cutter or chopper traverses the path between the two end ice cutters by any means such as on a track of a pivoting arm extending from the vessel bow or structure body.

THE DRAWINGS

FIG. 1 illustrates one sweep ice cutter system provided in accordance with the present invention.

FIG. 2 is an illustration of one alternate sweep ice cutting system provided in accordance with this invention.

FIG. 3 is an illustration of the detail of one ice chipping cutter for the port side of the vessel or structure, its mirror image being employed on the starboard side.

FIG. 4 illustrates one ice chipping cutter which may be employed on the traversing ice chipping cutter including an illustration of its associated traversing mechanism.

DESCRIPTION

According to the present invention there is provided a sweep ice cutter which includes a pair of fixed end ice chipping cutters which cut a path through the ice about the port and starboard of a marine vessel or structure in combination with a traversing ice chipping cutter which continuously traverses the path between the terminal ice chipping cutters to cut the ice ahead of a vessel or marine structure into blocks which may be easily broken or discarded by the vessel or structure. By cutting the ice into blocks as opposed to chipping or cutting the entire zone of ice ahead of the marine vessel structure into small chunks of ice, considerable energy is conserved.

As used herein, the term "ice chipping cutter" is meant a means which functions to cut ice by a chipping and/or cutting action with chipping being preferred and as less energy is required to chip ice into chunks as opposed to cutting into fine pieces.

For purposes of illustration, the ice sweep cutter of this invention will be described in terms of its use in conjunction with a seagoing vessel traveling through icebound waters.

With reference first to FIG. **1**, there is shown mounted on vessel **10** the sweep ice cutting system **12**. It comprises port ice chipping cutter **14**, starboard ice chipping cutter **16**, and traversing ice chipper or cutter **18**. The ice chippers or cutters are mounted ahead of vessel **10** by means of brackets **20**, **22** and **24**. Traversing ice chipper **18** may be mounted on track **26**, which forms part of its support structure.

Port and starboard ice chippers **14** and **16** are positioned at points which extend at least to the port and starboard extremities of the vessel or structure, and preferably beyond that point in order that chipped ice and the like may readily flow along the side of vessel **10** or the marine structure.

The ice chipping cutters may be respectively provided with individual motors **28**, **30** and **32**.

With additional reference to FIG. **3**, counterclockwise oriented chipping discs **34** are mounted on shaft **36** of cutter **14** connected to motor **28** are rotated in

a counterclockwise direction by motor **28** to throw the chipped or cut ice away from the port side of vessel **10.**

Ice chipping cutter **16** is rotated in a clockwise direction by motor **30** to accomplish the same result in the starboard side of the vessel. To achieve this, its chipping discs are the mirror images of blades **34.**

As vessel **10** advances, traversing ice chipping cutter **18** which may have its own motor **32** travels between port ice chipping cutter **14** and starboard ice chipping cutter **16** to cut the ice ahead of vessel **10,** in generally triangular or sinusoidally shaped blocks **38.**

These blocks **38** are small relative to entire mass of ice ahead of the vessel and are severed from the ice mass by combined actions of port, starboard and traversing ice chipping cutters **14, 16** and **18** and are readily broken by the bow of vessel **10** or diverted by the bow to the port and/or starboard paths provided by extended ice chipping cutters **14** and **16.**

With reference now to FIG. **4** in one construction, track **26** may be lined with an inner and outer set of gear trains **40** and **42** and the ice chipper motor **32** provided with an arm mounted driving gear **44** which meshes through driven gear **46** which traverses along one of the gear trains **40** as illustrated, until the opposed end of the track is met and the gear then automatically reversed by conventional mechanical, electrical or hydraulic mechanisms to the opposite train of gears **42** for return travel of the traversing cutter **18.**

Motor **32** of cutter or chipper system **18** may be guided along the rails **48** of track **22** by means of rollers **50** mounted on each side of motor **32.**

FIG. **4** also illustrated opposed rotating cutters which may be used on traversing cutters. Cutters **52** attached to shaft **54** rotate by gears (not shown) coupled to motor **30** in transmission **56** counterclockwise to cut or chip ice when the cutter is transversing portwise. Cutters **58** coupled to gears in transmission **56** by shaft **60** rotate in the opposed direction and cut or chip ice when cutter **18** traverses in a starboard direction.

As an alternative and as shown in FIGS. **1** and **2,** there may be employed a single ice cutter or chipper as illustrated in FIG. **3.**

In the alternative, power to each of the port and starboard ice chipping cutters **14** and **16** may be delivered directly through supports **20** and **24** to supplant motors **28** and **30.**

The gear train described above, for instance, may also be supplanted by a cable system driven separately from a motor in vessel **10,** the cable being fed through inner channel **22** or end channels **20** and **24.** The motor **32** for chipper **18** is mounted on the cable and traverses the path between ice chipping cutters **14** and **16** by reciprocating movement of the cable with the chiper **18** and motor **20** being supported by the cable and rail **48** of track **26** as shown in FIG. **4.**

With reference now to FIG. **2,** there is shown an alternative embodiment in which ice chipper or cutter **18** and its motor **32** are mounted on reciprocating arm **62** pivotably secured to the vessel and which may be supported by spacing arm **64.** There is also provided within vessel **10** means to control the degree of swing of arm **62.**

When pivoting arm **62** is employed, motor **32** may be eliminated by providing through the pivoting arm **62** a source of power for ice chipper **18** such as motor driven flexible cable which may be rotated clockwise and counterclockwise depending on the path being traversed by ice chipper **18.**

With respect to stationary marine structures, identical apparatus as shown in FIGS. **1** and **2,** may be used except that the structure is positioned on the fixed marine structure in the direction of the flow of ice towards the structure in order to, again, cut the ice into small blocks relatively easily broken or discarded by the marine structure as compared to the force to be overcome if the entire mass of ice is to be met. Where ice flow occurs in many directions the sweep arm may be mounted on many sides of the marine structure.

The chipping action, as opposed to cutting action, is preferred since the energy required to chip ice into fairly small chunks is much less than required to cut a path through ice.

It will be understood, however, that ice cutting blades may also be used.

In the alternative, to the ice chipping systems depicted in FIGS. **3** and **4,** there may be employed reciprocative ice chippers for end ice chippers or cutters **14** and **16** which operate in a vertical direction much like the action of an icepick which chips and crazes the ice surface to form blocks in cooperation with traversing ice chipper **18.**

While there has been illustrated in FIG. **1** and FIG. **2** the use of only one traversing ice chipper **18** there may be used two or more ice chippers which operate between the end paths in a cooperating action to cut the blocks between the paths made by port and starboard chippers **14** and **18.** The use of more than one ice chipper **18** is usually preferred where the vessel is to travel at fairly high rates of speed in order that ice block cutting may be kept up with the desired rate of advancement vessel **10.**

What is claimed is:

1. A sweep ice cutter for mounting on marine vessels and structures which comprises:

a. a support structural member adapted to be secured to and ahead of said marine vessel or structure;

b. port and starboard ice chipping means secured to said support structural member and respectively positioned at at least the port and starboard extremities of said marine vessel or structure;

c. guide means secured to said marine vessel or structure and containing traversing ice chipping means adapted to move back and forth between said port and starboard ice chipping means to cut a traversing path through ice between said port and starboard ice chipping means while said port and starboard ice chipping means simultaneously cut a path through ice along the port and starboard sides of said marine structure or vessel to cut ice into generally triangularly shaped blocks defined by the position of said port and starboard ice chipping means and said traversing ice chipping means.

2. A sweep ice cutter as claimed in claim **1** in which said guide means for said traversing ice chipping means is secured to said support structure.

3. A sweep ice cutter as claimed in claim **1** in which said guide means for said traversing ice chipping means is pivotably positioned on said marine vessel or structure.

4. A sweep ice cutter as claimed in claim **1** in which the port and starboard ice chipping means mounted on the support structure are positioned beyond the port

and starboard extremities of said marine vessel or structure.

5. A sweep ice cutter as claimed in claim **4** in which said guide means for said traversing ice chipping means is secured to said support structure.

6. A sweep ice cutter as claimed in claim **4** in which said guide means for said traversing ice chipping means is pivotably positioned on said marine vessel or structure.

7. A sweep ice cutter as claimed in claim **1** in which each of said ice chipping means comprises shaft mounted generally horizontally disposed ice chipping blades, the shaft mounted ice chipping blades on the port side of said structure adapted to be rotated counterclockwise and the shaft mounted ice chipping blades on said starboard side adapted to be rotated clockwise, each shaft having means for rotating said shaft in a clockwise or counterclockwise direction.

8. An ice chipping cutter as claimed in claim **7** in which said traversing ice chipping means comprises a pair of parallel shafts each containing a plurality of generally horizontally disposed ice chipping blades the portside directed ice chipping blades adapted to rotate counterclockwise and starboard directed ice chipping blades adapted to rotate clockwise, said shafts having means for independently rotating said shafts in a clockwise or counterclockwise direction.

9. A sweep ice cutter as claimed in claim **2** in which each of said ice chipping means comprises shaft mounted generally horizontally disposed ice chipping blades, the shaft mounted ice chipping blades on the port side of said structure adapted to be rotated counterclockwise and the shaft mounted ice chipping blades on said starboard side adapted to be rotated clockwise, each shaft having means for rotating said shaft in a clockwise or counterclockwise direction.

10. An ice chipping cutter as claimed in claim **9** in which said traversing ice chipping means comprises a pair of parallel shafts each containing a plurality of generally horizontally disposed ice chipping blades the portside directed ice chipping blades adapted to rotate counterclockwise and starboard directed ice chipping blades adapted to rotate clockwise, each shaft having means for rotating said shaft in a clockwise or counterclockwise direction.

11. A sweep ice cutter as claimed in claim **3** in which each of said ice chipping means comprises shaft mounted generally horizontally disposed ice chipping blades, the ice chipping blades mounted on the port side of said structure adapted to be rotated counterclockwise and the ice chipping blades mounted on said starboard side adapted to be rotated clockwise, each shaft having means for rotating said shaft in a clockwise or counterclockwise direction.

12. An ice chipping cutter as claimed in claim **1** in which said traversing ice chipping means comprises a pair or parallel shafts each containing a plurality of generally horizontally disposed ice chipping blades the portside directed ice chipping blades adapted to rotate counterclockwise and starboard directed ice chipping blades adapted to rotate clockwise, each shaft having means for rotating said shaft in a clockwise or counterclockwise direction.

13. A sweep ice cutter for mounting on marine vessels and structures which comprises:

a. a support adapted to be secured to and ahead of said marine structure or vessel;

b. ice chipping means comprising shaft mounted generally horizontally disposed ice chipping blades, the ice chipping blades mounted on the port side of said structure adapted to be rotated counterclockwise and the ice chipping blades mounted on said starboard side adapted to be rotated clockwise, each shaft having means for rotating said shaft in a clockwise or counterclockwise direction.

c. guide means secured to said support structure, said guide means containing traversing ice chipping means comprised of a pair of parallel shafts, each containing a plurality of generally horizontally disposed ice chipping blades, the portside directed ice chipping blades adapted to rotate counterclockwise and the starboard directed ice chipping blades adapted to rotate clockwise and including means to rotate said shafts in clockwise and counterclockwise directions, said traversing ice chipping means adapted to move back and forth between said port and starboard ice chipping means to cut a traversing path through ice between said port and starboard ice chipping means while simultaneously said port and starboard ice chipping means cut paths through ice along the port and starboard sides of said marine structure or vessel to cut ice into generally triangularly shaped blocks defined by the position of said port and starboard ice chipping means on said support structure.

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