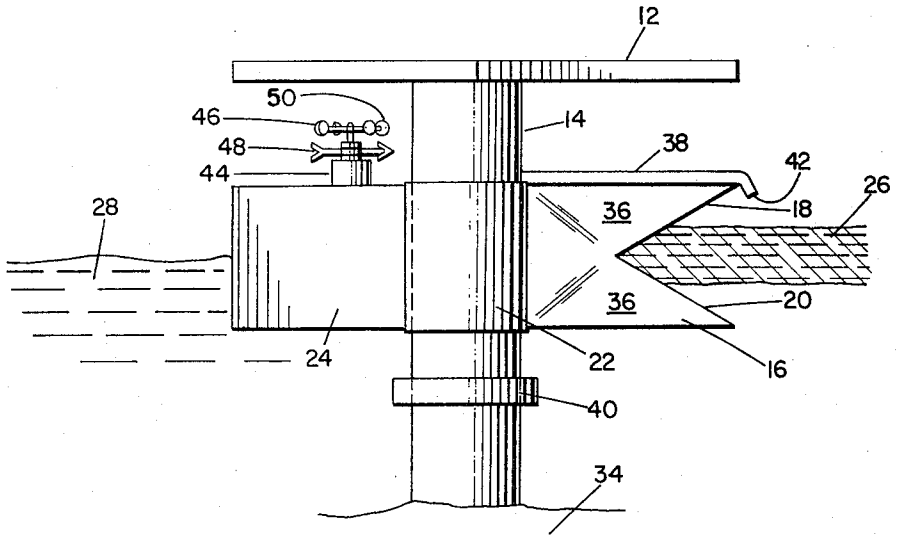


FIG. 1

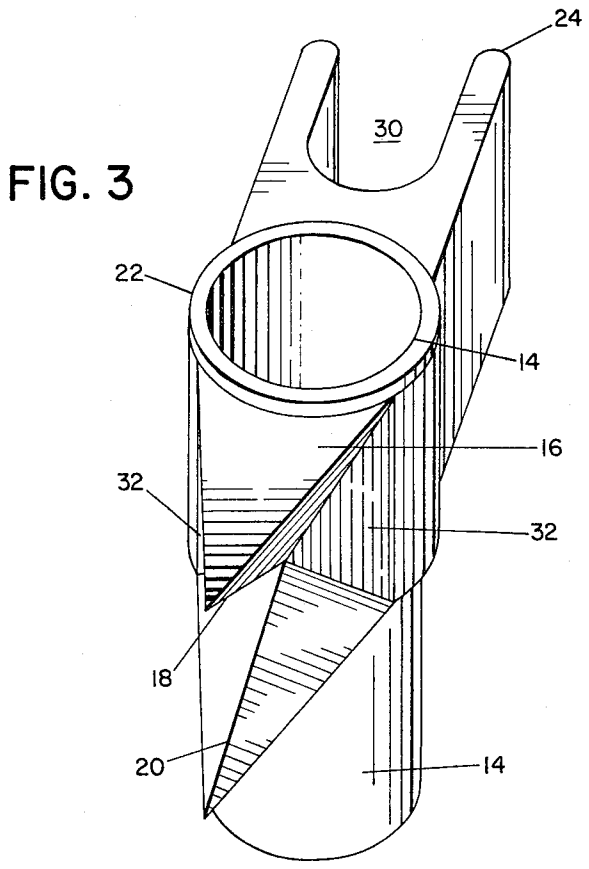


FIG. 3

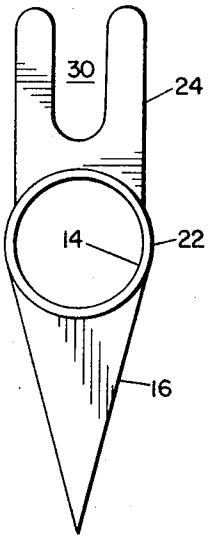


FIG. 2

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[54] ICE CUTTER

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[73] Assignee: **Sun Oil Company,** Dallas, Tex.

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[21] Appl. No.: **77,507**

[52] **U.S. Cl.** **61/46,** 61/1, 114/41, 299/24

[51] **Int. Cl.** **E02b 15/02,** B63b 35/12

[58] **Field of Search** 61/46, 46.5, 1, 5, 6; 114/41, 114/42, 40; 299/24, 25, 26, 27

[56] **References Cited**

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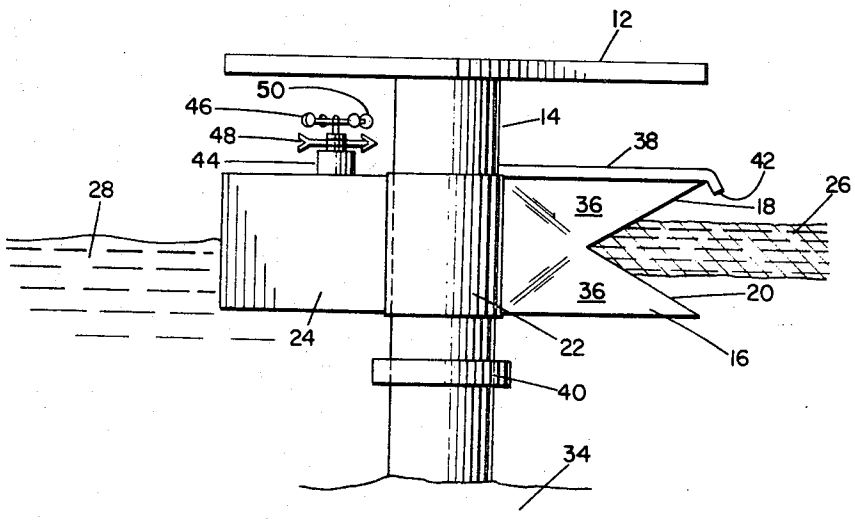
Primary Examiner—Jacob Shapiro

Attorney—George L. Church, Donald R. Johnson, Wilmer E. McCorquodale, Jr. and John E. Holder

[57] **ABSTRACT**

A cutter rotatably mounted on a marine structure for cutting and diverting encroaching ice floes. The cutter has upper and lower cutting edges that are angled from one another and intersect. Sides angle away from the cutting edges, and the trailing edge of the sides flare outwardly to divert the ice around the marine structure. The cutter is attached to a sleeve which rotates around the marine structure in response to a vane member which also acts as a counterweight and is shaped to act as a protected boat dock.

10 Claims, 3 Drawing Figures



ICE CUTTER

BACKGROUND OF THE INVENTION

This application deals with the problem of protecting marine structures from floating ice and is related to an application filed of even date herewith by John D. Bennett, entitled "METHOD AND APPARATUS FOR CUTTING ICE" which describes a jet nozzle for cutting ice with high pressure fluids. Also related hereto is an application by John D. Bennett et al. entitled "METHOD OF BREAKING ICE" which describes stressing ice with gas injected under the ice floe.

There is currently high interest in locating and developing natural resources in the Arctic Islands area. Ordinarily, platforms supported by rigid members attached to the floor of the body of water have been used. The environment to which a platform might be exposed if located in the Arctic region could well resemble that of the Arctic Ocean adjacent the North Slope.

The Arctic Ocean adjacent the North Slope area of Alaska is characterized by its shallow depth and gradual slope to deep water. Air temperatures usually range from −40° to +50° F. The water is very uniform in temperature, from +28° to +30° F. and very saline except in the lagoons opposite the rivers. Winds are predominantly from the East, 10 to 15 mph, with a maximum of 50 to 60 knots. Waves are not usually more than 5 feet high. In the months of November through April, large masses of ice are in continuous movement by the effects of wind in the Arctic Ocean. Ice fields measuring thousands of feet in diameter are propelled in many directions by the winds and are generally unaffected by the minor currents present in the Arctic Ocean.

The main ice form in the Arctic Ocean is the ice sheet, which is generally 6 to 10 feet thick. Another form of ice encountered is "rafted" ice, which is the term used to describe the overlapping of ice sheets as one sheet rides up over another sheet, resulting in an ice floe made up of two or more distinct layers. In open locations, the rafting does not generally take place between sheets of more than 1 or 2 feet in thickness, since thick sheets cannot withstand the deflection necessary for one sheet to ride over the other. Rafted ice has a much smaller surface area than that of the more prevalent ice sheets.

Thus, it can be seen that offshore platforms located in relatively shallow water in the Arctic Ocean will encounter ice sheets from 6 to 10 feet thick, and occasionally rafted or sheet ice up to 15 feet thick. Generally speaking, then, an offshore platform should be able to routinely withstand at least 15 feet thick ice floes having diameters of several thousand feet being moved by winds of 15 miles per hour.

Drilling platforms may also be located in the lagoons and among the islands. Here pile-up can occur from the ice sheets impinging on long vertical surfaces. Thus, in order to locate platforms in these areas special equipment other than the equipment disclosed herein may be necessary.

It is desirable to use offshore platforms rather than subsea systems because of their availability and low cost. It is therefore an object of the present invention to provide a method and apparatus for equipping offshore platforms for use in areas where ice floes are encountered.

SUMMARY OF THE INVENTION

With these and other objects in view, the present invention contemplates rotatably mounting a cutting member on a marine structure support member. The cutting member has an upper and lower cutting edge angled in opposite directions from horizontal such that the cutting edges intersect and face each other. Sides angle away from each cutting edge with the trailing end of the sides flaring outwardly to divert the cut ice around the marine structure support member.

The cutting member is attached to a sleeve which fits over the platform support member. Located opposite the cutting member and also attached to the sleeve is a counterweight which acts as a vane member for orienting the cutting member as well as a protected area to dock vessels servicing the marine structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of an offshore platform equipped with a cutting member and counterweight;

FIG. 2 is a plan view of the cutting member and counterweight shown in FIG. 1; and

FIG. 3 is a perspective view of the cutting member and counterweight shown in FIGS. 1 and 2 where the cutting member has been modified slightly.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates an offshore platform 12 resting atop rigid hollow support member 14 which extends to the floor 34 of a body of water having water surface 28, with an ice floe 26 floating thereon. Mounted on support member 14 of platform 12 is a sleeve 22 which completely encircles the support member 14 and has attached thereto a cutting member 16 which is counterbalanced by a counterweight 24. The cutting member 16 has an upper cutting edge 18 and a lower cutting edge 20 which face each other and extend outwardly from the support member 14. These cutting edges 18 and 20 are angled from horizontal with the ends of the cutting edges nearest the platform support member 14 converging. These converging cutting edges 18 and 20 describe a V-shaped notch whose opening is directed outwardly from the platform support member 14. The cutting member 16 also includes flared concave sides 36 which start at the cutting edges 18 and 20 and flare outward such that the upper and lower portions of the cutting member describe plows, with the upper plow portion being inverted.

Counterweight 24 and cutting member 16 contain buoyancy compartments which are hollow watertight areas. These buoyancy compartments have not been shown in the drawings. Stop 40 is a flange attached to and extending around the support member 14, which is located beneath the sleeve 22. This flange can be welded to the support member or attached in any other conventional fashion. Located directly above cutting member 16 is a high pressure jet nozzle assembly 38 having nozzle 42 which extends past the leading edge of cutting member 16. Mounted atop the counterweight 24 is wind direction and velocity indicator means 44. This indicator means 44 is comprised of a vane member 48 for determining wind direction and wind gauge 46 comprising a plurality of cups 50 for determining wind velocity. This indicator means is capable of transmitting an actuating signal to means for rotating cutting member 16. This means for rotating cutting member 16 may be of any conventional design such as a pinion and shaft.

In the operation of the apparatus described above, as ice floe 26 moves toward the platform support member 14, it contacts cutting member 16. Upon such contact, cutting edges 18 and 20 commence simultaneously cutting the ice floe 26 from the top and the bottom. Upon reaching the rear of a V-shaped notch described by cutting edges 18 and 20 of cutting member 16, the ice floe 26 has been completely cut. At this point, each portion of the cut ice floe 26 is diverted to the side by the concave sides 36, which forces the ice around the platform support member 14. The cutting member is maintained in position by buoyancy from the chambers in the cutting member 16 and counterweight 24. Because of the nature of the cutting member 16, the ice floe will tend to center itself between the upper cutting edge 18 and the lower cutting edge 20, thereby placing only a minor amount of weight upon the cutting member 16. The stop 40 is located below the sleeve 22 in the event that the buoyancy chambers in the cutting member 16 fail because of a rupture. Stop 40 prevents passage of sleeve 22 and thus the cutting member 16 and related counterweight 24 will not sink to the floor 34 of the body of water. Alternatively, cables attached to and extending between the platform 12 and cutting member 16 could be used to prevent loss of the ice cutting apparatus.

FIG. 2 illustrates the cutting member 16 and counterweight 24 shown in FIG. 1 from a top view. As in FIG. 1, cutting member 16 is attached to sleeve 22 which encircles platform support member 14 located opposite cutting member 16. Also attached to sleeve member 22 is counterweight 24. Counterweight 24 as shown here serves both as a vane member and a vessel docking area. Docking area 30 is protected from three sides by counterweight 24 and provides sufficient room to position a vessel therein. It is contemplated that wind and current directional indicators linked with cutting member rotating means may be necessary in the event that the described vane is not sufficiently responsive. For example, because winds are often the main ice propelling force in the Arctic Ocean area, an actuating signal from wind direction and velocity indicator means 44 can be used to initiate appropriate means for rotating cutting member 16.

FIG. 3 illustrates a cutting member 16 and counterweight 24 similar to the ones shown in FIGS. 1 and 2. Here cutting member 16 also has upper cutting edge 18 and lower cutting edge 20; however, instead of concave sides as shown at 36 in FIG. 1, the cutting member 16 has flat angular sides 32 for diverting the ice floe around the platform support member 14. The flat sides allow for easier and therefore cheaper construction. As in FIGS. 1 and 2, the cutting member 16 is mounted on sleeve 22 which encircles platform support member 14. Located opposite cutting member 16 and also attached to sleeve 22 is counterweight 24 which operates as a vane member and defines a vessel docking area 30. As ice moves into contact with the cutting member 16, it is cut from top and bottom by cutting edges 18 and 20 and upon reaching the intersection of the cutting edges it is completely severed. At that point the flare of the flat angular sides 32 forces the separated ice sections to the side and thus around the platform support member 14. To facilitate such sideward movement, the cutting member axis can be rotated slightly from vertical so that one separated section of ice is forced upward and the other separated section if forced downward. If the stress thus put in the ice causes portions to break from the ice mass, the sections will move above or below the remaining ice mass.

This ice cutter can also be used with the apparatus described in the John D. Bennett application entitled "METHOD AND APPARATUS FOR CUTTING ICE," assigned to Sun Oil Company filed of even date with this application. This invention describes in part, jet nozzles for cutting ice with high pressure fluids. They could be used herein to at least partially cut the ice prior to reaching the cutting member described herein. Only a single nozzle is necessary and such a nozzle has been shown as 38 in FIG. 1.

Additionally, the method of breaking ice described in the John D. Bennett et al. application entitled "METHOD OF BREAKING ICE" assigned to Sun Oil Company could also be used in conjunction with the cutting member described herein. That application discloses injecting gas beneath the ice floe to create a stress in the ice. Such stressed ice, upon contacting the cutting member 16, allows easier cutting of the ice.

While particular embodiments of the present invention have been shown and described, it is apparent that changes and modifications may be made without departing from this invention in its broader aspects, and therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. Apparatus for shearing ice floes floating in a body of water and encroaching a marine structure comprising: a cutting member rotatably mounted on the marine structure, said cutting member having upper and lower cutting edges facing each other which are substantially equal in length and converge at a point near the ice level.

2. The apparatus of claim 1 wherein the cutting member has upper and lower wedge shaped portions having concave sides and wherein the upper cutting edge is formed on the upper wedge shaped portion and the lower cutting edge is formed on the lower wedge shaped portion.

3. The apparatus of claim 1 wherein the portion of the cutting member having the upper and lower cutting edges is shaped in the form of a pair of plow members, one of which is inverted and positioned above the other plow member in such a manner that the end of the cutting edges facing the ice floe are vertically spaced.

4. The apparatus of claim 1 wherein a vertical section of the cutting member taken at the intersection of the upper and lower cutting edges describes two isosceles triangles.

5. The apparatus of claim 1 including nozzle means for directing a liquid at high pressure against the ice so as to cut the ice at a point prior to the ice reaching the cutting member.

6. The apparatus of claim 1 including means responsive to elements directing the movement of ice for orienting the cutting member relative to direction of movement of the ice.

7. The apparatus of claim 1 including a sleeve member for mounting the cutting member and including a counterweight attached to the sleeve member opposite the cutting member.

8. The apparatus of claim 7 wherein the counterweight is shaped to provide a cove-like area for docking vessels servicing the marine structure to protect said vessels against the ice floes being diverted around the marine structure.

9. The apparatus of claim 7 wherein the counterweight is shaped similar to a vane member to align the cutting member with the direction of movement of the water.

10. The apparatus of claim 2 wherein the wedge shaped cutting member is titled so that the concave sides thereof divert one portion of the ice floe above the normal level of the ice floe and another portion is diverted below the normal level of the ice floe to minimize the amount of crushing of the ice floe as the ice floe by-passes the marine structure.

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