Aug. 15, 1967 R. PONTBRIAND ET AL 3,335,686

ICE-BREAKING SYSTEM

Filed June 22, 1964 3 Sheets-Sheet 1

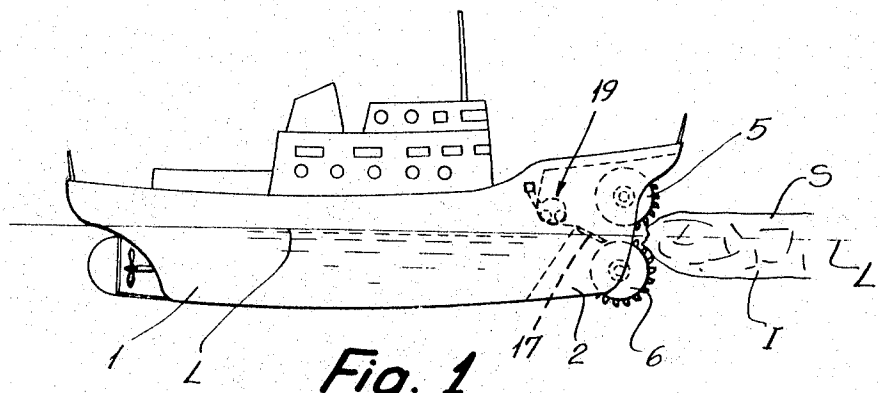


Fig. 1

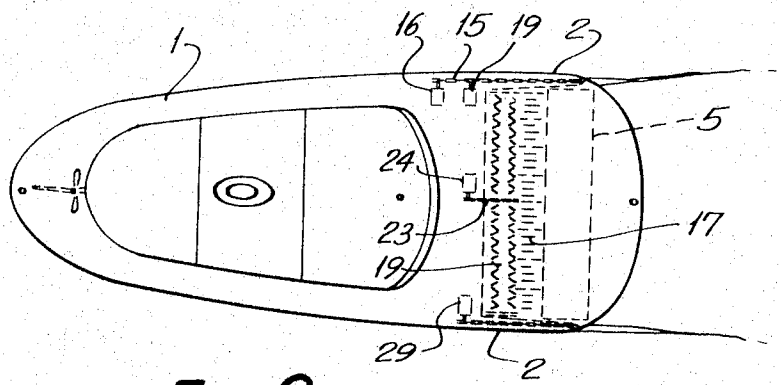


Fig. 2

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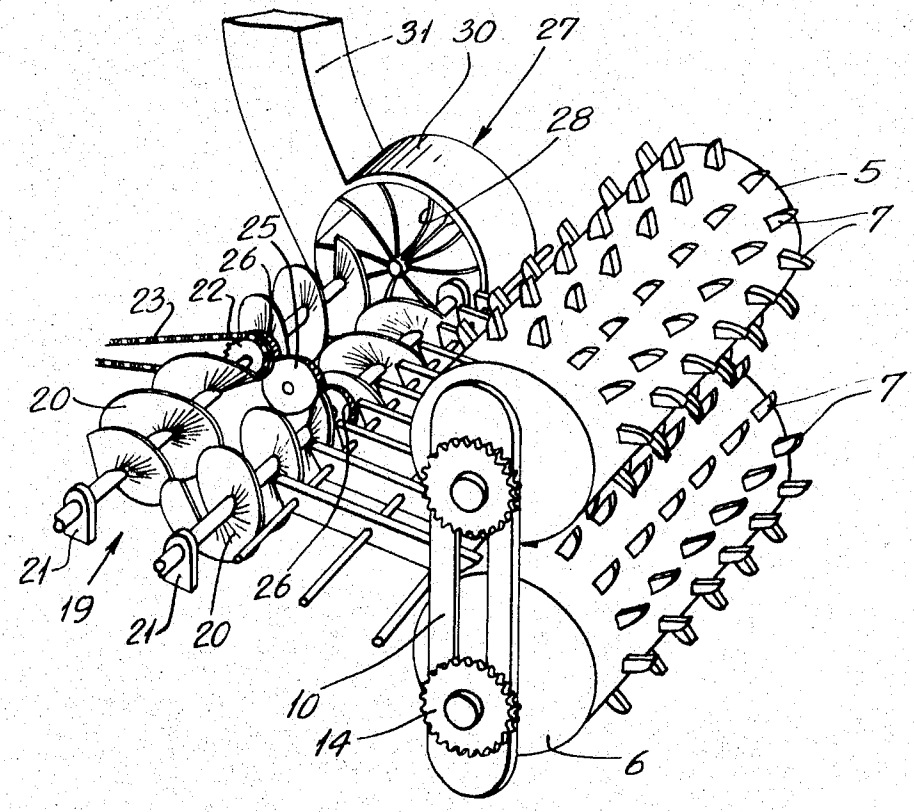


Fig. 3

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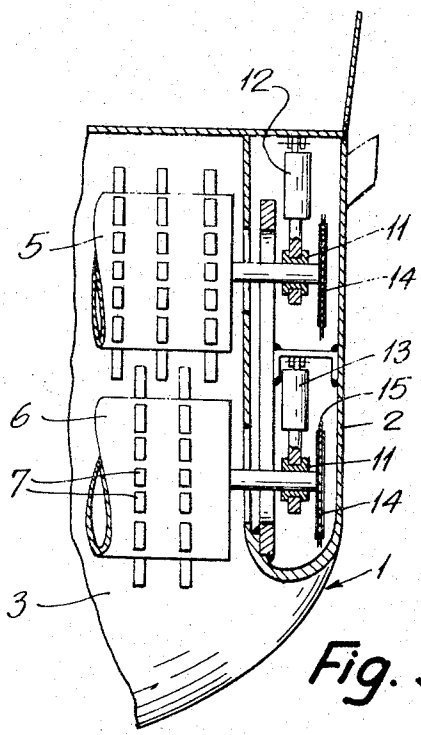


Fig. 5

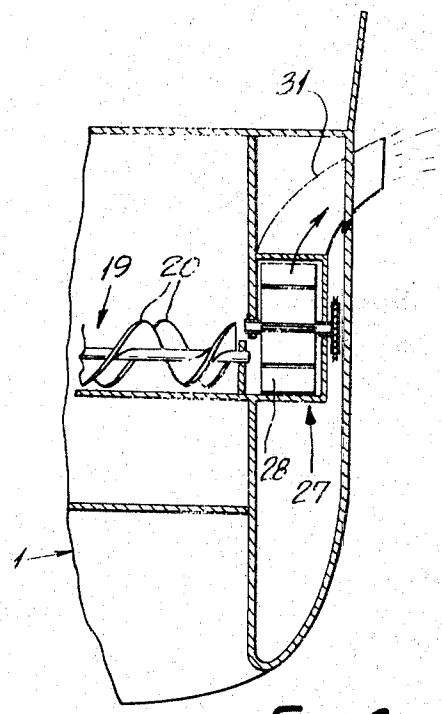


Fig. 6

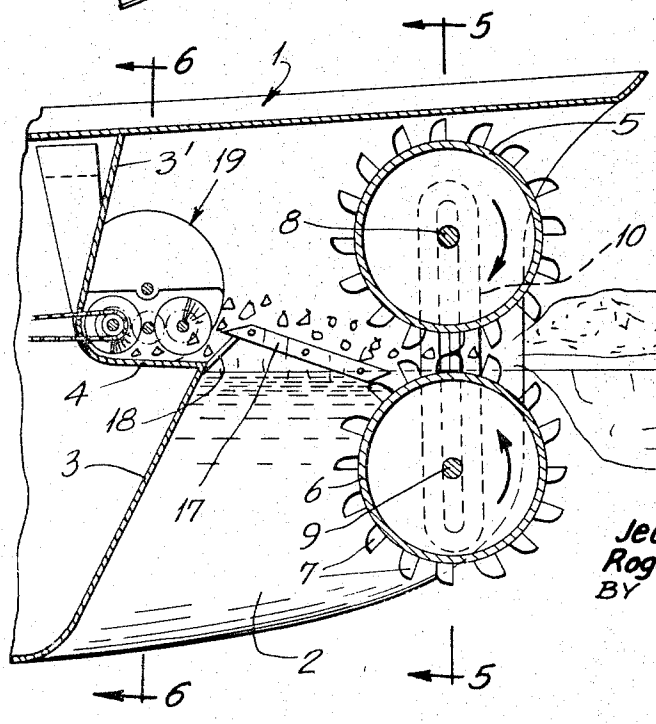


Fig. 4

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ICE-BREAKING SYSTEM

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7 Claims. (Cl. 114—42)

The present invention relates to an ice-breaking system and, more particularly, to means mounted on a ship for breaking the ice to clear a channel and removing said ice from the channel.

Conventional ice-breakers have an inclined bottom at the bow, whereby the ship breaks the ice under her own weight by climbing over said ice.

In rivers and other areas where the water is flowing, ice-breakers work going upstream. The ice breaks into blocks of various sizes and is carried downstream by the current. However, it very often happens that the blocks of ice pile up in the more stagnant areas of the river to finally form an ice bridge which completely blocks the channel just cleared by the ice-breaker.

Consequently, the general object of the present invention resides in the provision of an ice-breaking system which will obviate the above-noted disadvantage found in conventional ice-breakers.

Yet another important object of the present invention resides in the provision of means mounted on a ship which will crush the ice into small pieces and which will throw the crushed ice at a considerable distance laterally of the ship, to thereby completely clear the channel being produced by the ship of any ice floating downstream.

Another important object of the present invention resides in the provision of a system of the character described, of very efficient means for crushing the ice, said means being adjustable in accordance with the thickness of the ice cover on the water.

Another important object of the present invention resides in the provision in a system of the character described of means for separating the crushed ice as much as possible from the water before feeding said crushed ice to the ice-throwing means.

The foregoing and other important objects of the present invention will become more apparent during the following disclosure and by referring to the drawings, in which:

FIGURE 1 is a side elevation of an icebreaker provided with the means in accordance with the present invention;

FIGURE 2 is a top plan view of the same;

FIGURE 3 is a perspective view of the combined ice-crushing and ice-throwing means;

FIGURE 4 is a longitudinal partial section of the front part of the ship, showing the ice-crushing and ice-throwing means;

FIGURE 5 is a section taken along line 5—5 of FIGURE 4; and

FIGURE 6 is a section taken along line 6—6 of FIGURE 4.

Referring now more particularly to the drawings in which like reference characters indicate like elements throughout, the ice-breaking ship **1** has a bow formed of two laterally spaced wing-like extensions **2**, extending longitudinally forwardly with respect to the long axis of the ship from the front wall **3** which extends transversely between the wings **2**.

Front wall **3** has a rearwardly offset upper portion **3'** defining with the lower portion of the wall a shelf-like part **4** disposed slightly above the water level L.

Wings **2** are of double-wall formation to house the journal means of upper and lower ice-crushing drums **5** and **6**. These drums extend the full extent between the

wings **2** and may have a diameter of as much as **15'** and they are provided with a plurality of ice-crushing teeth **7** spacedly disposed over their entire cylindrical surface. They are rigidly secured to their shafts **8** and **9** respectively, which extend transversely to the long axis of the ship **1** and enter the wings **2**. Said shafts **8** and **9** pass through the elongated vertical slot of a guiding bar **10** rigidly mounted within each wing **2** and are journalled in journal boxes **11** which are carried by the free end of the piston of a cylinder and piston unit **12** and **13**, respectively, said units being pivotally connected at their upper ends to the framework of the ship.

A sprocket gear wheel **14** is secured to the shafts **8** and **9** at the ends thereof and a sprocket chain **15** is trained on the same and is driven by a suitable engine **16** (see FIGURE 2), disposed rearwardly within the ship. Sprocket chain **15** extends longitudinally within wing **2**.

The two drums **5** and **6** may be driven by the same engine or by separate engines. Also, the drums may be driven from both ends by suitable engines.

Cylinder units **12** and **13** serve to adjust the level of each drum **5** and **6** in accordance with the ice thickness and the level of ice. A grate **17** is disposed behind drums **5** and **6**.

The front end of grate **17** is at approximately water level L and the rear end is above shelf **4** and supported by brackets **18**, so as to discharge crushed ice onto said shelf to feed said crushed ice to the ice-throwing means, which are generally indicated at **19**.

Grate **17** generally consists of a plurality of longitudinally extending spaced parallel bars laid on edge and interconnected by transverse rods.

The ice-throwing means **19** may consist of any of the different conventional types of snow blowers used for road clearing.

In the embodiment shown two transversely extending double spiral screws **20** are disposed one behind the other over shelf **4** and their shafts are mounted in journals **21**. The back spiral screw **20** is directly driven by means of a central sprocket gear **22** and sprocket chain **23** and an engine **24**, while the front spiral screw **20** is driven by the back screw through the agency of intermeshing gear wheels **25** and **26**.

A blower **27** is mounted at each end of the spiral screws **20**, each blower **27** comprising an impeller **28** driven by a suitable engine **29** and located in a housing **30** having an ice and snow discharge duct **31** opening on the side of the ship **1**.

The axis of impeller **28** may be arranged parallel to the axes of screw **20**, as shown, or disposed at right angles thereto, in which case the blower **27** will be located behind the screws **20**.

Screws **20**, which are of double spiral arrangement, will direct the snow and ice laterally outwardly with respect to the ship and the ice will be thrown by the respective blowers **27** at a considerable distance transversely of the ship onto the ice field covering the river or other water system.

If desired, screws **20** can have a spiral of the same inclination and be made reversible so as to feed the ice and snow to one or the other of the impellers **27** at both sides of the ship, in accordance with the prevailing wind direction.

The ship when seen in top plan, as in FIGURE 2, will be preferably wider at the bow portion thereof than at the stern thereof, whereby the remainder of the ship will pass freely in the channel cut by the drums **5** and **6**.

Teeth **7**, which may have, for instance, about 1' in length, are preferably removable so as to be replaced when worn out.

Although both drums **5** and **6** are shown as being vertically adjustable for certain applications, the lower drum **6** may be arranged in fixed journals and the level of the bow of the ship may be adjusted by adding ballast to the front portion of the ship.

In practice, the ice cover I and the snow overburden S are attacked by the teeth **7** of the counterrotating drums **5** and **6** and are made to pass between said drums which crush the ice; the crushed ice and snow move rearwardly under the action of drums **5** and **6** along the inclined grate **17** and water drains back into the river, whereby substantially water-free crushed ice and snow enter the throwing means **19**.

The screws **20** of said throwing means move the ice and snow laterally towards the impellers **28**, which throw the ice and snow under centrifugal force through duct **31** at a great distance laterally of the ship. Thus, the ice removed from the channel being cut by the ship is thrown on the ice field on each side of said channel and, therefore, no floating ice or snow remains in the channel and said ice cannot obstruct again the channel being cleared.

The ice-breaker in accordance with the invention can also be used for clearing locks, gates of dams and harbor facilities, and also to disengage ships caught in ice.

While a preferred embodiment in accordance with the present invention has been illustrated and described, it is understood that various modifications may be resorted to without departing from the spirit and scope of the appended claims.

What we claim is:

1. An ice-breaker comprising, in combination, a ship, at least two superposed rotary drums mounted transversely of said ship at the front thereof, power means to drive said drums in opposite directions of rotation, the lower one of said drums being arranged below the waterline of said ship and the upper one of said drums being arranged above said waterline, so that said two drums will engage the bottom and top surface of an ice cover on a body of water and crush the same, and ice- and snow-throwing means arranged within said ship behind the rotary drums and located above the waterline of the ship, power means to actuate said throwing means, said throwing means having a discharge duct directed transversely of the ship for throwing the ice and snow laterally thereof away from the channel being cleared by said ice-breaker, and rearwardly upwardly inclined grate means extending from behind the nip of said drums to said throwing means, its forward end being below said waterline and its rearward end above said waterline, whereby crushed ice and snow moving rearwardly over said grate, will be drained of excess water before being engaged by said throwing means.

2. An ice-breaker as claimed in claim **1**, wherein at least one of said drums is vertically adjustable and power means to adjust the level of said adjustable drum.

3. An ice-breaker as claimed in claim **1**, including journal means for said drums, which are vertically adjustable, and power means to move said journal means vertically and maintain the same in adjusted position with respect to said ship.

4. An ice-breaker as claimed in claim **1**, wherein said throwing means include transversely extending screws, power means to rotate said screws and blower means to receive ice discharged by said screws, said blower means including an impeller and power means to rotate said impeller, a casing for said impeller, said duct being connected to said casing.

5. An ice-breaker as claimed in claim **4**, wherein said screws are disposed above the waterline of said ship.

6. An ice-breaker as claimed in claim **3**, wherein, the hull of said ship includes two forwardly extending lateral wings at the bow thereof, said wings being of double-wall construction, the shafts of said drums entering said wings, said journal means being located within said wings and said drums extending between said wings, the hull of said ship including a transversely extending front wall joining said wings and recessed rearwardly with respect to the front edge of the same, said front wall extending above the waterline of said ship, a rearwardly extending shelf co-extensive with said front wall, disposed above said waterline, said throwing means disposed over said shelf.

7. An ice-breaker as claimed in claim **1**, further including a plurality of ice-engaging and crushing teeth protruding from the cylindrical surface of each of said drums.

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