

July 17, 1956

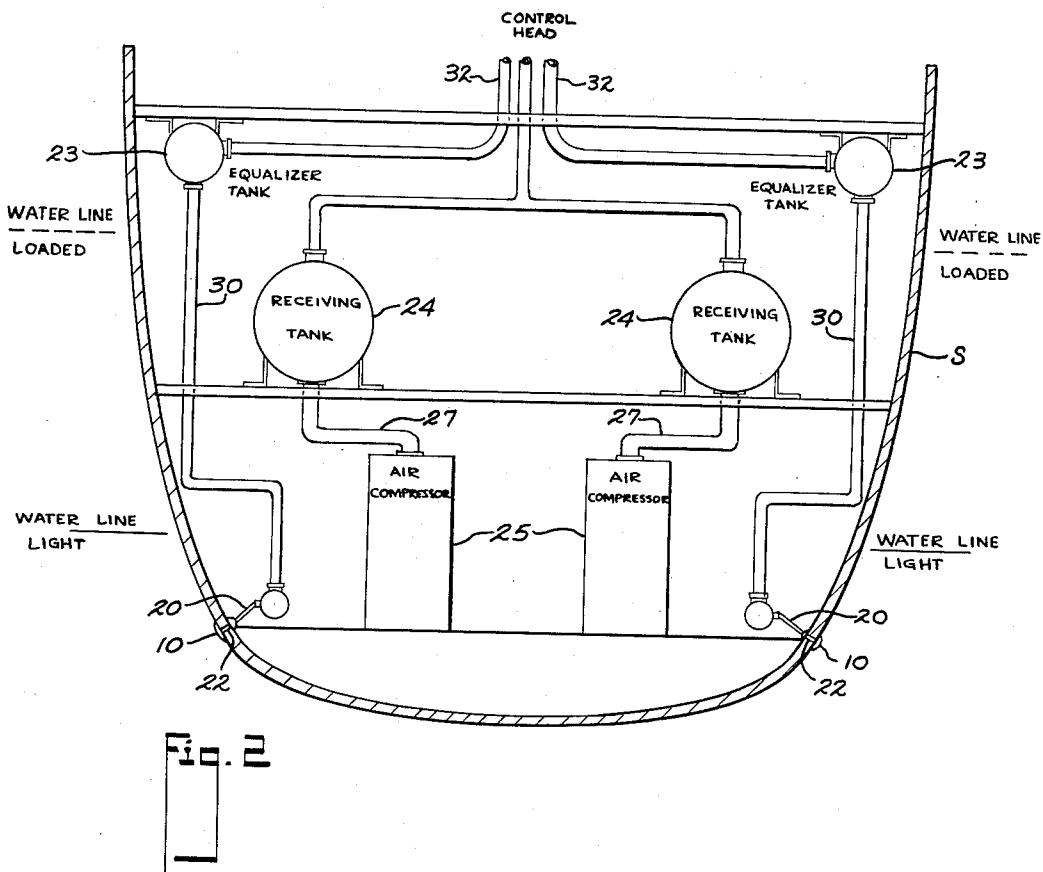
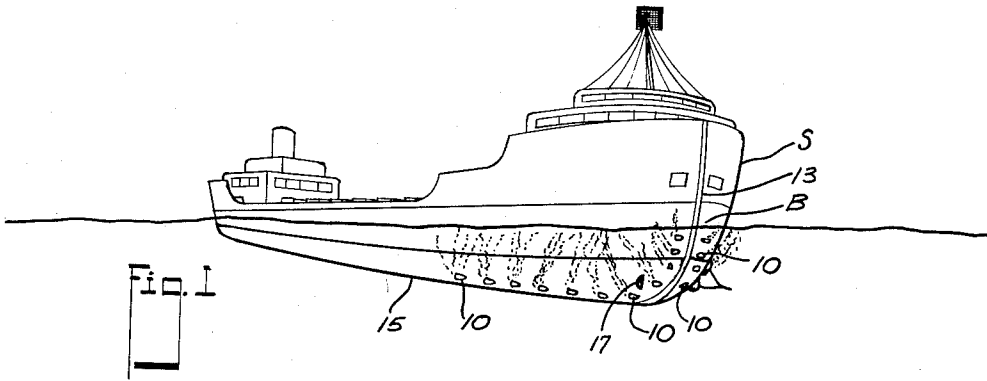
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2,754,791

SHIP TURBULATOR

Filed Aug. 16, 1954

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

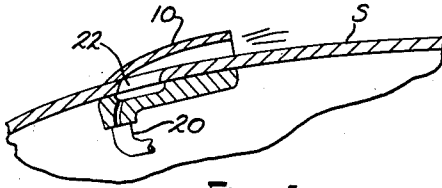


Fig. 6

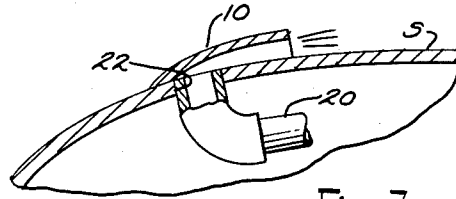


Fig. 7

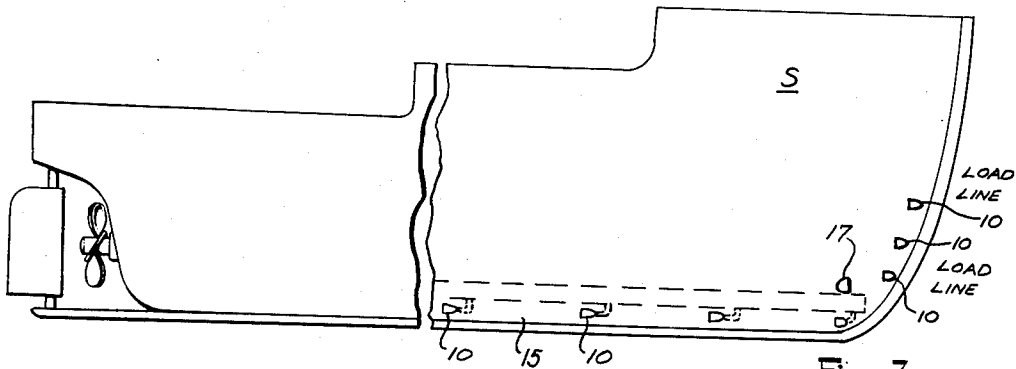


Fig. 3

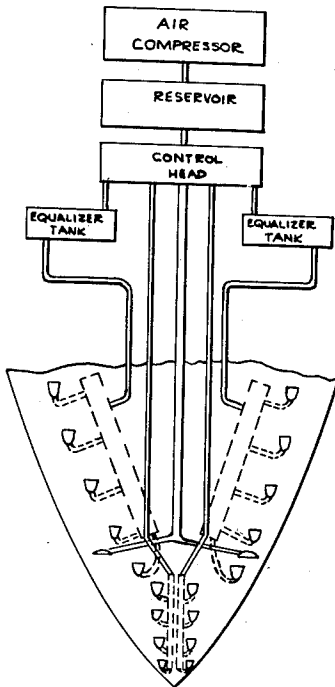


Fig. 4

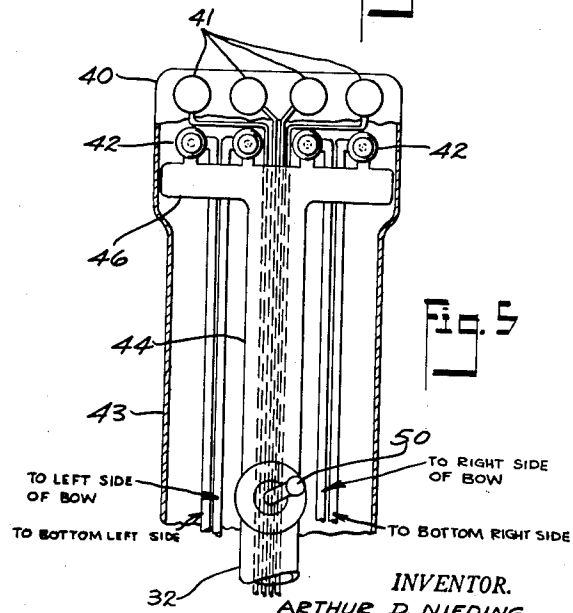


Fig. 5

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## SHIP TURBULATOR

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3 Claims. (Cl. 114-67)

The present invention relates generally to the navigation art and is more particularly concerned with a novel ship propulsion system employing jet nozzles and jet streams and with a jet nozzle element for use in said system.

The concept of this invention provides a solution to a problem of long standing because it not only enables the elimination of that problem, but also does not raise, create, or involve any new or additional problem or have any other offsetting disadvantage. In fact, the present invention affords advantages in addition to those stated above. In particular, a ship equipped with apparatus of this invention is more readily kept on course due to the counter action of drift effects due to waves, currents or winds. In addition, such a ship has auxiliary steering means not found in prior installations. Furthermore, such a ship does not have the tendency toward panting, rolling or squatting characteristic of certain types of vessels such as Great Lakes cargo ships of recent design and high power rating. Still further, a ship equipped with the system or apparatus of this invention has novel facilities for ungrounding itself and it is much better suited to ice-breaking operations than heretofore conventional ships.

The present invention is centered to a substantial degree in the concept of delivering gas in the form of a plurality of jet streams into water through which the ship is travelling or is to travel. The principal effect of such jet streams is to aerate the water adjacent to the bow and to reduce the resistance to forward motion of the ship through the water. Another important result of these streams is to develop a certain amount of reaction force to the jet for action in the direction in which the ship is to travel, thus urging the ship forward on the travel course. Other novel results and objectives of this invention will become apparent on consideration of the detailed description set out below, reference being had to the drawings accompanying and forming a part of this specification, in which:

Fig. 1 is a perspective view of a Great Lakes-type cargo carrier equipped with apparatus embodying this invention in a preferred form;

Fig. 2 is a transverse, sectional view of the ship Fig. 1, illustrating the internal arrangement of the elements comprising part of a system of this invention;

Fig. 3 is a fragmentary, side-elevational view of the Fig. 1 vessel, showing the relationship and arrangement of the external elements in the aforesaid system of this invention;

Fig. 4 is semi-diagrammatic view of the said system of this invention, illustrating the relationship of various components of the system inside and outside the hull;

Fig. 5 is a fragmentary, perspective view of a control panel of the said system;

Fig. 6 is a fragmentary, sectional view taken through the ship's hull and showing the details of nozzle structure including a novel nozzle element of this invention; and,

Fig. 7 is a view similar to Fig. 6, illustrating an alter-

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native form of nozzle construction embodying this invention.

In general, this invention comprises in a surface ship, the combination of a plurality of jet nozzles opening through the ship's hull and arranged in vertical rows adjacent to and on each side of the bow stem and extending from a point above the bottom of the ship to a point below the loaded water-line of the ship. In addition, the apparatus of this invention comprises means including a source of gas under pressure which communicates with the nozzles to deliver a plurality of gas jet streams through the nozzles into the water through which the ship is to travel, thus aerating the water and reducing the resistance to the forward motion of the ship.

In another of its aspects, the present invention, broadly speaking, comprises a jet nozzle element for a ship propulsion system, this element comprising a shell to cooperate with the hull to define a jet orifice and a passageway for delivering gas under pressure to that orifice. Furthermore, this shell has a peripheral portion conforming in shape to a portion of the hull so that the said peripheral portion can be substantially fluid-tightly engaged with the hull with the intermediate end portions of the shell spaced from areas of the hull bounded by the said peripheral portions.

As shown in the drawings, ship S is provided in its bow portion B with a plurality of jet nozzle units 10 disposed in four separate rows, two of which extend lengthwise of the ship on opposite sides of the keel and along the ship's bottom, while the other two rows are disposed more or less vertically on opposite sides of stem 13. A total of eight jet units 10 are disposed in two rows adjacent to the stem, beginning below the light-water line of ship S and extending downwardly to a point above the bottommost portion of bow B. Twelve jet units 10 are disposed in two rows of six extending from adjacent to stem 13 to a point forward of the hull central portion 15, where the sides of the ship are disposed substantially vertically as the curvature of bow B is blended into the ship's waist portion.

A pair of jet units 17 are disposed on opposite sides of bow B below the light-water line of the hull. Jet units 17 in contrast to jet units 10, are directed forwardly instead of toward the stern of the ship for a purpose to be described.

Air under pressure is supplied to units 10 as desired and preferably continuously during movement of the ship forwardly through water by means of conduits 20 which communicate with units 10 through openings 22 in the hull provided for this purpose and with equalizer tanks 23. Receiving tanks 24 are connected to air compressors 25 by means of pipes 27 and to tanks 23 by tubes 28. Two equalizer tanks 23 are provided to serve units 10 and jet units 17 are supplied with compressed air for their operation by means of conduits 30, opening into these units through apertures in the hull and communicating with main air supply line 32 (Fig. 5) suitable control means being provided as described below. As illustrated in Fig. 2, air compressors 25 are mounted in the lower portion of the bow section of the vessel, while equalizer tanks 23 are suspended from an upper deck and receiving tanks 24 are disposed within the bow section at an intermediate level between compressors 25 and an upper deck being anchored in place in any suitable manner and located for minimum interference with the normal use of bow space. The conduits connecting the various elements into the operating system of this invention are likewise situated with a view to avoiding interference with the chain lockers and the like and at the same time to accessibility for repair and replacement.

It will be understood in view of the foregoing description and Figs. 2 and 4, particularly, that apparatus com-

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prising this system and embodying this invention is readily installed on existing ships as well as in new ships. Furthermore, it will be understood that there is considerable flexibility about the location and arrangement of the various elements in this system so that purposes of the individual operator may be served to a large degree without, in any way, impairing the effectiveness and utility of the apparatus of this invention, assuming strict adherence to the basic invention concept and the requirement that the jet elements be situated in a particular manner with respect to the bow of the ship. In other words, the arrangement of the piping, the compressors and other equipment and controls is a matter of choice with the builder or operator of the vessel, but the location of jet units 10 is critical within narrow limits in accordance with the illustrations and descriptions set forth herein.

A control head 40, including pressure gauges 41 and valves 42 for remote control of the operation of the system of this invention, is located in pilot house P together with the usual control means for the ship in the interest of convenience. Control head 40 comprises a pedestal 43 of suitable height for easy reading of gauge 41 and manipulation of valves 42 mounted on its panel. Substantially all the conduits, pipes and tubes in this system required for control are contained inside the shell of the pedestal and thus are hidden from view to provide a neat appearance to the assembly. Main air supply line 44 extends upwardly within the pedestal shell, terminating in a manifold section 46, conduits running to the four separate rows of jet units are separately connected to manifold 46 within the control head and valve 42 regulate air flow from the manifold to the various jet units. Near the base of pedestal 43, a conduit of enlarged diameter approximating the diameter of line 44 projects through the side wall of the pedestal and downwardly through the pilot house deck to a branching point where the line is divided into two leads running to the jet engines 17. A valve lever 50 is provided for controlling the flow of air from line 44 to units 17 through this enlarged diameter line, this valve lever being effective to shut off manifold 46 completely for maximum jet effect through units 17.

Gauges 41 are provided for the convenience of the pilot in determining and controlling the air pressure in each of the equalizer tanks. Additional controls (not shown) may be provided for automatically regulating the pressure in various parts of the system such as the equalizer tanks, receiving tanks and conduits connecting them as those skilled in the art will understand. In addition, manual control means may be provided for overriding these automatic controls and will preferably be located on these control panel or adjacent thereto on the pedestal.

The external portion of jet elements 11 as illustrated in Figs. 6 and 7 comprises a tapering shell-like body which is designed to fit fluid-tightly against the boat hull along the leading edge portions of the shell and to define with the hull a jet opening directed toward the stern of the ship and a passageway leading from an aperture in the hull to the opening. The shell body is attached to the hull in any suitable manner, as by welds, being situated so that the leading edge portion of the shell is disposed just forwardly of the hull opening to be served by the nozzle element, as these views illustrate. Depending upon the relative location of the jet element and the accessibility of the location within the bow, either the Fig. 6 or the Fig. 7 form of delivery means may be employed to serve the jet element and connect it to a source of air under pressure within the ship. The Fig. 6 assembly thereof includes an elongated body having a passageway formed with an enlarged end portion and a recessed portion extending from the enlarged end portion toward the central section of the body. This body is mounted within the bow with its

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passageway in register with the leading end of the opening in the hull and with the recessed portion being subsequently co-extensive with the said opening. The body is suitably secured to the bow by means of welds so that there is no tendency for the compressed air delivered through the passageway to leak around the body and into the ship.

The Fig. 7 assembly is of essentially tubular construction within the ship, an elbow being provided to deliver compressed air through the hull opening. The elbow is disposed partially within the opening and is welded to the walls defining it, and a conduit serving the assembly is secured in any suitable way fluid-tightly to the elbow at its other end.

The external construction of the jet elements 20 may be of the general nature of elements 10 described above. Likewise, the internal construction of these units may be, as illustrated in Figs. 6 and 7, of similar form.

In the operation of the system of this invention, air is compressed by the air compressors, which are powered in any suitable manner as by means of electric motors, internal combustion engines, or turbines (not shown). The air is delivered under pressure from the compressors to the receiving tanks, where it is stored for use and the compressors are shut off when these tanks have reached a predetermined pressure by suitable automatic means presently in general use and known to those skilled in the art for this purpose. When it is desired to employ air for any purpose in the form of jets using the jet elements described above or some of them, appropriate valves are manipulated by the pilot working at the control panel and compressed air is delivered into the equalizer tanks and into the lines and manifolds for the jet units to be used. Air flows rapidly through the delivery lines to the jets and emerges in bubble form in the water surrounding the bow. The result is that a certain buoyancy is imparted to the vessel. The bubbles released by the jets acting adjacent to the stern along the forepart of the bow rise and aerate the water in that region, breaking up the water and making it less resistant to the passage of the hull through it. On the other hand, the bubbles formed by the actual jets entering along the bottom portion of the ship tend to stay along the wetted side of the ship, where they have the greatest effect in aerating and breaking up the water. These bubbles, however, do not tend to travel sternward beyond the middle section of the ship and the turbulence due to the bubbling action is restricted to the forepart of the ship, particularly the bow section where it is of the utmost effect. Consequently, unaerated water is present at all times around the stern for maximum efficiency. In screw propeller operation, cavitation is eliminated by virtue of the reduced power output requirements.

When it is desired to reduce the speed of the vessel, one or more things may be done with the system of this invention independently of the other propulsion means of the ship. Some or all of the jets may be shut off or reduced in power. Alternatively or additionally, jet units 17 may be employed in the delivery of powerful jets of compressed air forward of the ship to produce, as a jet reaction, a certain braking effect on the ship's forward motion.

It will be understood, also, that the system of this invention may be used in part at different times to effect a change of course through the reaction force of the jets, as well as through the water aerating effects produced by the release of compressed air into the water at the bow of the ship. Thus, by shutting off the jets on one side, a relatively sharp turn may be effected by the aid of the jets operating on the opposite side. It is clear from the foregoing description that in operating a ship in water covered with ice, breaking up of the ice is materially assisted through the use of the system of this invention by the lifting force which would be delivered

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on the underside of the ice sheet by the bubbles issuing from the jet streams. The ice adjacent to the ship thus is upheaved and then through the action of the ship wedging through the ice sheet, is forced under ice farther away to produce, in effect, an action which is opposite that of the conventional snow plow. An important advantage of this unique effect is that the channel formed in this manner is left clear for the stern portion of the ship to pass through and the rudder and screw propeller are free from ice interference.

The system of this invention has another use as indicated above, namely, to assist in dislodging the ship from a mud bank or sand bar grounding in which case, some or all of the units 10 may be employed, depending upon the location of the difficulty. Also, units 17 may be used during or throughout the dislodging operation and as an alternative means.

By virtue of the fact that the tubes, pipes, conduits and lines serving the various jet units are led upwardly to a point well above the loaded water line for connection to the equalizing chambers, etc., there is no tendency for the water to run into the main air supply system when the jets are not in use. However, it may be desired to provide some check valves in these lines, as diagrammatically indicated at 60 in the drawings.

Having thus described the present invention so that those skilled in the art may be able to understand and practice the same, I state that what I desire to secure by Letters Patent is defined in what is claimed.

What is claimed is:

1. In a surface ship having a bow stem and propulsion means including a screw propeller located at the stern, the combination of a plurality of jet nozzles opening through the hull and arranged in a vertical row on each side of the stem and adjacent to said stem and extending from a point above the bottom of the ship to a point below the hull loaded-water line, a plurality of jet nozzles opening through the hull and arranged in substantially parallel rows on opposite sides of the keel below the hull light-water line and extending from adjacent to the stem to a point forward of the hull central portion, a plurality of separate sources of gas under pressure within the hull, first conduit means separately connecting a plurality of jets in a series to one of said sources and second conduit means separately connecting the other jets in a series to another of the sources, said first conduit means having portions disposed adjacent to portions of said second conduit means, and central control means for regulating the flow of gas from said sources through said first and second conduit means to and through said nozzles, including a plurality of juxtaposed valves operatively associated with said adjacent portions of the first and second conduit means.

2. In a surface ship having a bow stem and propulsion means including a screw propeller located at the

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stern, the combination of a plurality of first jet nozzles opening through the hull and arranged in a vertical row on each side of the stem and adjacent to said stem and extending from a point above the bottom of the ship to a point below the hull loaded-water line, said first nozzles all being directed generally toward the stern, a pair of second nozzles disposed below the hull light-water line and directed generally forwardly of the ship, one of said second nozzles being located on one side of the stem and the other second nozzle being disposed on the other side of said stem, means including separate sources of gas under pressure communicating with the first jet nozzles on opposite sides of the stem, a conduit connecting said second jet nozzles to a source of gas under pressure within the hull, and valve means for connecting the said second jet nozzles to said separate sources of gas under pressure and disconnecting the said first jet nozzles from the said sources.

3. In a surface ship having a bow stem and propulsion means including a screw propeller located at the stern, the combination of a plurality of first jet nozzles opening through the hull and arranged in substantially parallel rows on opposite sides of the keel and stem and extending from a point forward of the hull central portion and below the hull light-water line and upward adjacent to the stem to a point below the hull loaded-water line, said first nozzles being directed generally toward the stern, a pair of second nozzles disposed below the hull light-water line and directed generally forwardly of the ship, one of said second nozzles being located on one side of the stem and the other second nozzle being disposed on the other side of said stem, means including separate sources of gas under pressure communicating with the first jet nozzles on opposite sides of the keel and the stem for delivering a plurality of gas jet streams through said first nozzles in water through which the ship is traveling thereby aerating the water and reducing the resistance to forward motion of the ship, a conduit connecting said second jet nozzles to a source of gas under pressure within the hull, and valve means for connecting the said second jet nozzles to said separate sources of gas under pressure and disconnecting the said first jet nozzles from the said sources.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |           |               |
|-----------|-----------|---------------|
| 829,077   | Del Lungo | Aug. 21, 1906 |
| 917,935   | Elniff    | Apr. 13, 1909 |
| 1,398,246 | Trask     | Nov. 29, 1921 |
| 1,445,839 | Mahoney   | Feb. 20, 1923 |
| 1,702,222 | Paxton    | Feb. 12, 1929 |

##### FOREIGN PATENTS

|         |         |               |
|---------|---------|---------------|
| 519,505 | Germany | Feb. 28, 1931 |
| 849,471 | France  | Aug. 21, 1939 |