

[54] AIR COOLING APPARATUS

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[21] Appl. No.: 204,935

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 1,587, Jan. 9, 1970, abandoned, which is a continuation-in-part of Ser. No. 793,799, Jan. 24, 1969, Pat. No. 3,540,229.

[52] U.S. Cl..... 62/240, 62/506, 62/262,
62/272, 62/280

[51] Int. Cl. B63b 25/26

[58] **Field of Search**..... 62/240, 506, 262,
62/280

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2,042,141 5/1936 Campbell..... 165/122

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2,966,779	1/1961	Lintern	62/160
3,102,397	9/1963	Trucchi.....	62/240
3,111,013	11/1963	Simmons.....	62/317
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Primary Examiner—William J. Wye

Attorney—Arthur H. Seidel, Edward C. Gonda and Joel S. Goldhammer

[57] **ABSTRACT**

Air cooling apparatus for use in boats which is resistant to corrosion, and comprises a unit having a compressor, condenser, evaporator, a positive condensate removal system and a cool air circulating fan and cooling water pump preferably driven by the same motor. The unit is mounted entirely within the boat, and uses the external water for cooling the condenser.

4 Claims, 11 Drawing Figures

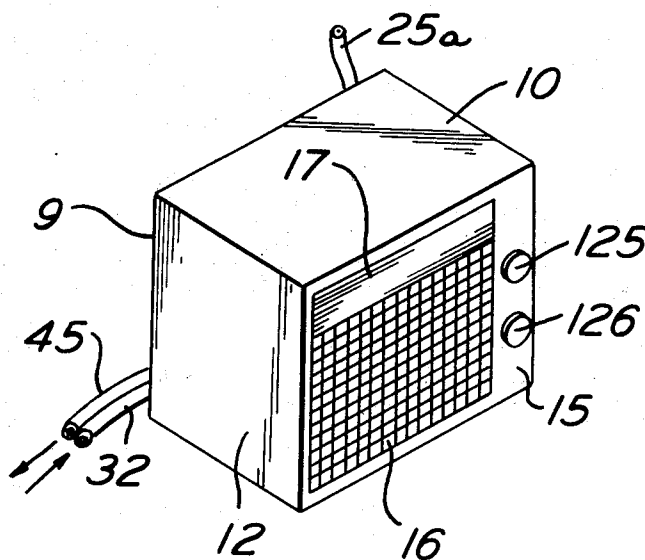


FIG. 1

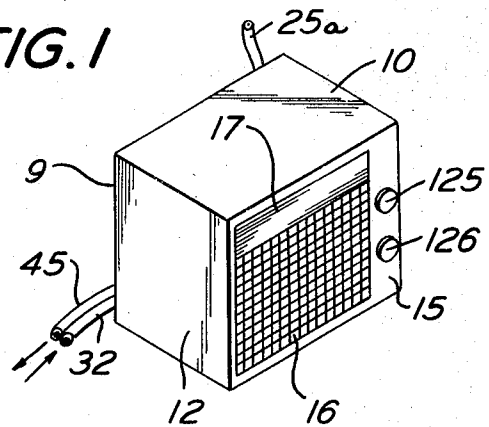


FIG. 7

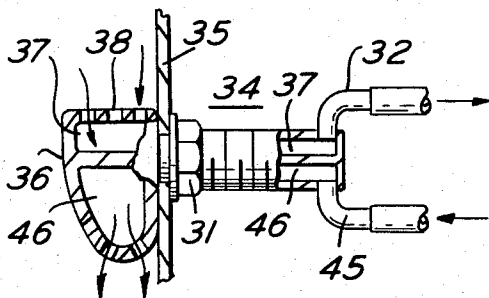


FIG. 8

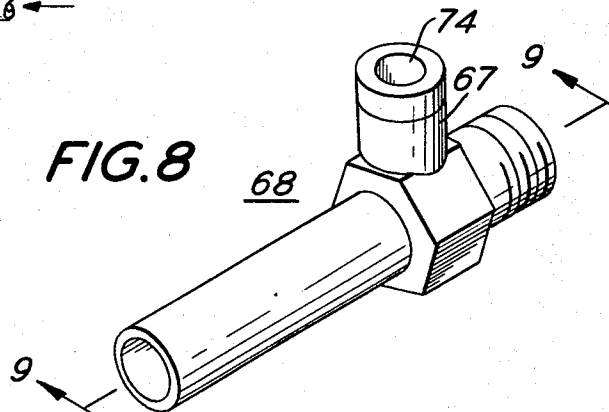


FIG. II

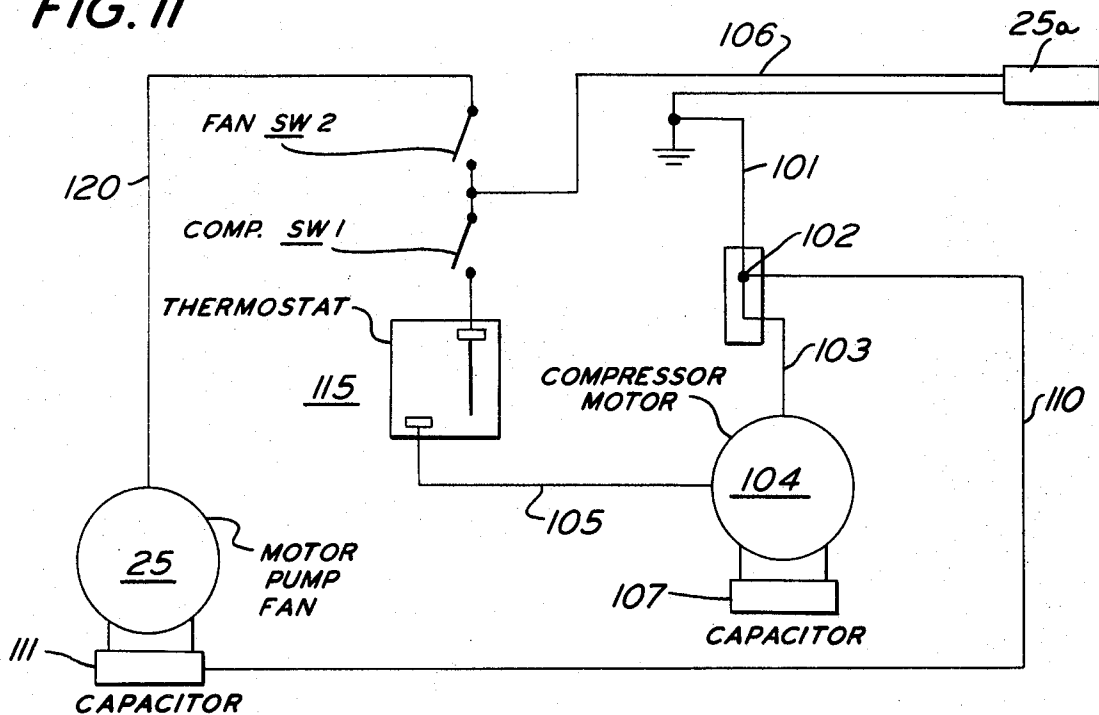


FIG. 2

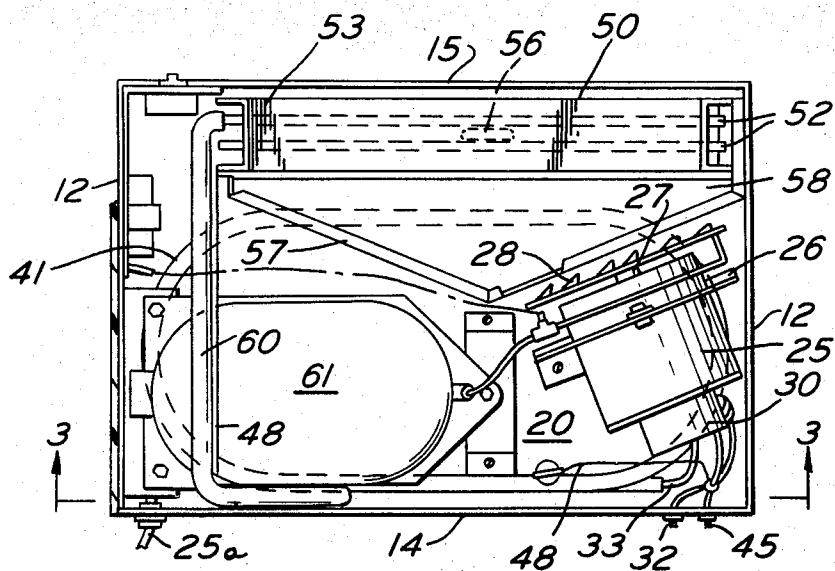
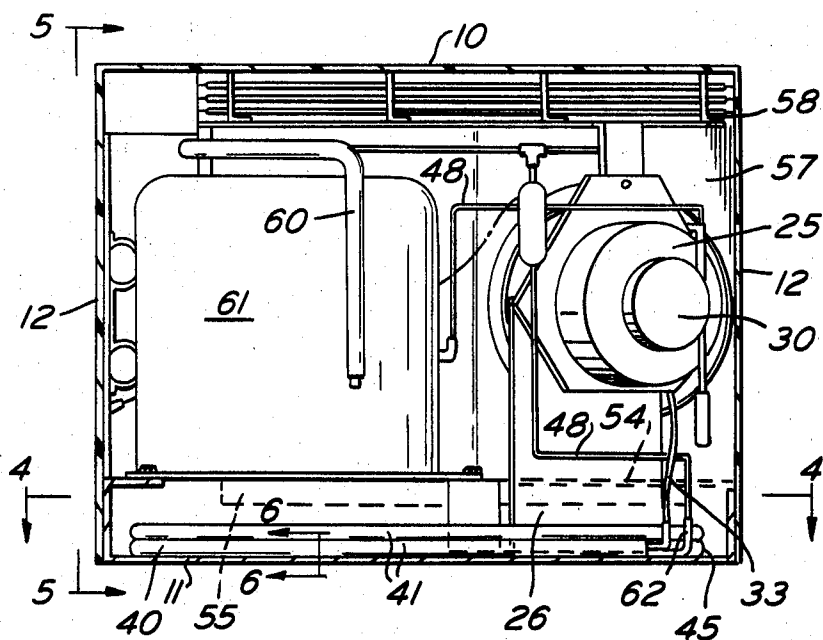


FIG. 3



SHEET 3 OF 3

FIG. 4

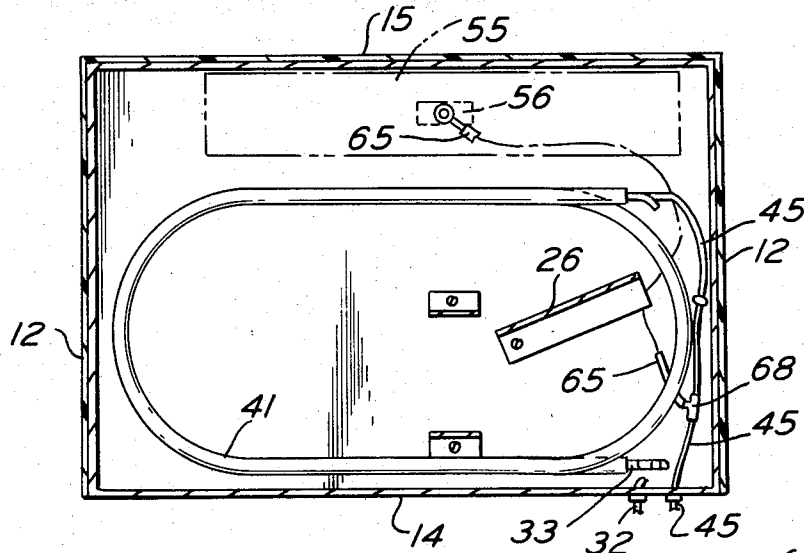


FIG. 10

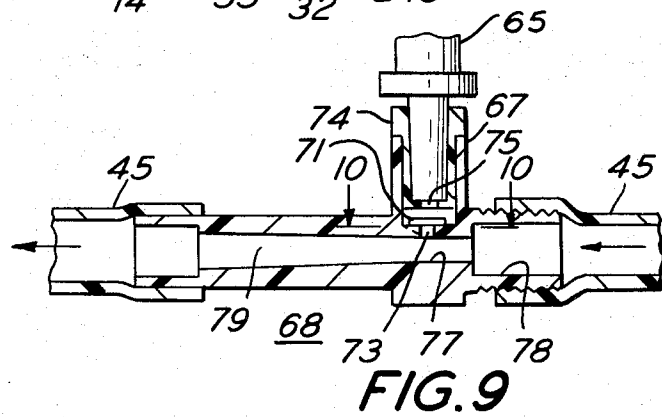
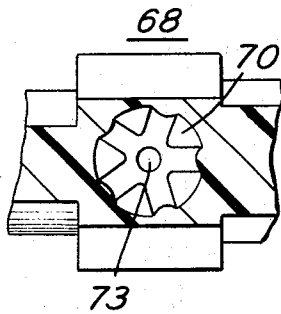


FIG. 9

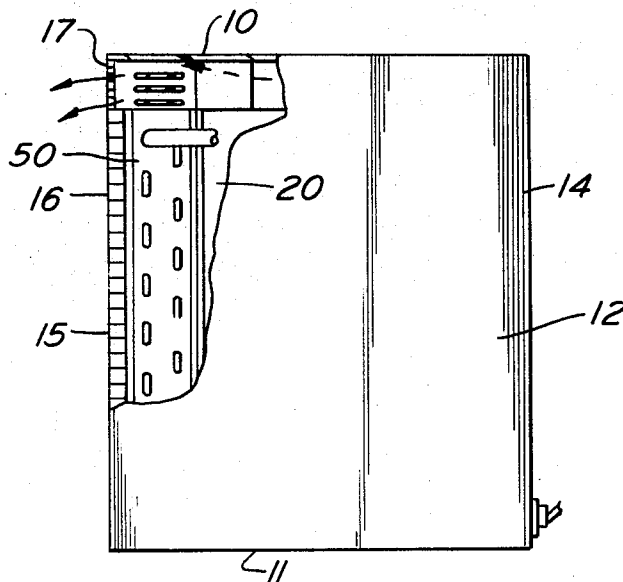
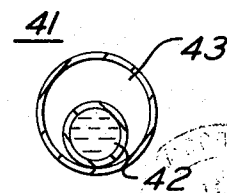


FIG. 5

FIG. 6



AIR COOLING APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation in part of my prior application for air cooling apparatus, filed Jan. 9, 1970 Ser. No. 1,587, now abandoned, which was a continuation in part of my prior application for air cooling apparatus, filed Jan. 24, 1969, Ser. No. 793,799 now U.S. Pat. No. 3,540,299, issued Nov. 17, 1970.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to air cooling apparatus particularly for boats which is constructed of corrosion resistant material, is internally mounted within the boat and uses water from that surrounding the boat for cooling.

2. Description of the Prior Art

The use of air coolers or conditioners for the cooling of air in homes and cars has grown considerably in recent years and demand for a satisfactory air cooler has now spread to the boating industry.

Air coolers or conditioners as used in homes are not satisfactory for use in boats for several reasons, one of which is that the materials of which they are constructed are subject to corrosion and the resultant service life in boats is usually but a few weeks.

In addition the units available use excessive amounts of electricity which is often not present on the boats or dockside.

The air cooled window mounted or through the wall air conditioners now available for room air conditioning are wholly unsuited for marine use because of the necessity for external exposure, the carpentry required for installation together with possible hazards to the structure of the boat.

Air cooled air conditioners depend on removing the heat from the condenser but the varied and changing wind conditions encountered in sailing as well as dockwise present serious problems.

Furthermore, while air cooling units can be installed in large boats, the requirements for boats thirty five feet and under have not heretofore been met. No water cooled air cooling unit capable of being installed by the boat owner or personnel available at a boat yard or marina has been available.

Carpenter, in U.S. Pat. No. 2,746,272 shows a refrigerating system, particularly for keeping fish and like perishables, installed in a fishing vessel but does not show a self-contained unit suitable for installation in a pleasure boat with a minimum of difficulty to the boat owner or installer.

Ammons, in U.S. Pat. No. 3,111,013 shows air conditioning apparatus for yachts and the like which includes a cabinet having a compressor, condenser and air circulating fan therein. Water cooling of the condenser is disclosed but a separate external pump connected to one of the flexible hose connections would be required, together with external wiring for the pump. No provision is made for condensate collection or removal.

Lintern, in U.S. Pat. No. 2,966,799, shows a heat pump for motor yachts which includes, in a diagrammatic showing, both an air cooled condenser for picking up heat from the air for a heating cycle and a water cooled condenser for obtaining better cooling. There is no suggestion of a self contained unit such as that of applicant, nor of condensate removal.

Gould et al. in U.S. Pat. No. 2,945,362 show an air conditioner with an air cooled system having the condenser air fan 84 and the evaporator fan 90, both driven by a common motor. The Gould et al. disclosure does not suggest a self contained water cooled unit nor does it have any provisions for condensate removal related to the water cooling.

Trucchi, in U.S. Pat. No. 3,102,397, shows an air cooling and aeration system for ships cabins and the like in which condensed air moisture drops into suitable collecting trays and may be evacuated from time to time but nothing is stated as to how the evacuation is to be accomplished. The motion of a boat with Trucchi's apparatus carried thereon would involve serious difficulties if condensate were permitted to build up as it could slop over with damage to the apparatus and to the furnishings of the ship.

The build up of condensate is also objectionable from another viewpoint, that is, the potential for algae growth in the trays.

Campbell, in U.S. Pat. No. 2,042,141 shows air conditioning apparatus with one part for installation to extend through a floor and ceiling below with a compressor connected by piping but separated therefrom and condenser unit also connected by piping and separated therefrom. A condensate collector is provided with provisions for evacuation by piping to a jet nozzle through which cooling water is directed. The Campbell structure is not self contained, but has separated pipe connected components and requires installation of a cooling water circulating pump and motor and wiring for the motor for installation.

The apparatus of the present invention is self contained, compact, easily installed, is mounted entirely within the boat, and does not require undesirable openings in the cabin wall, can be mounted at a convenient interior location and does not extend to the outside, has very low electrical demands, is water cooled in an effective manner and is not affected by the rise in ambient air temperature which occurs during the daytime. Removal of condensate is simply but effectively accomplished.

SUMMARY OF THE INVENTION

In accordance with the invention air cooling apparatus for boats is provided which is water cooled, internally mounted within the boat, totally self-contained, operates economically and is constructed of corrosion resistant materials.

The principal object of the invention is to provide air cooling apparatus, which is particularly suitable for use on boats.

A further object of the invention is to provide air cooling apparatus that is water cooled, with its own self contained water pumping system and with provisions for automatic condensate removal.

A further object of the invention is to provide air cooling apparatus with low electricity consumption and suitable for operation from the power supply of a boat, or from dockside power supplies.

A further object of the invention is to provide air cooling apparatus totally self contained with its own controls and its own cooling water pumping system, and that is capable of being mounted anywhere within the boat.

A further object of the invention is to provide air cooling apparatus that is resistant to corrosion.

A further object of the invention is to provide air cooling apparatus for boats which in addition to the cooling unit requires for permanent installation, only through the hull fittings and plastic tubing of well known and readily available type.

A further object of the invention is to provide portable air cooling apparatus for boats that preferably uses a single electric motor, to pump the coolant water, to remove condensate and to move the air through the apparatus.

A further object of the invention is to provide for condenser cooling and for condensate removal with only one discharge line required for this purpose by withdrawing the condensate with the discharging coolant water.

Other objects and advantageous features of the invention will be apparent from the description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature and characteristic features of the invention will be more readily understood from the following description taken in connection with the accompanying drawings forming part thereof, in which:

FIG. 1 is a view in perspective of the air cooling apparatus of the present invention for installation in the boat;

FIG. 2 is a top view of the air cooling apparatus as shown in FIG. 1 with the top cover removed;

FIG. 3 is a vertical sectional view, taken approximately on the line 3—3 of FIG. 2;

FIG. 4 is a horizontal sectional view, taken approximately on the line 4—4 of FIG. 3;

FIG. 5 is an end elevational view, as seen from the line 5—5 of FIG. 3, parts being broken away to show the interior;

FIG. 6 is a vertical sectional view, enlarged, taken approximately on the line 6—6 of FIG. 3;

FIG. 7 is an enlarged cutaway view of the through the hull water exchange portion of the air cooling apparatus;

FIG. 8 is a view in perspective of the condensate removal valve used with the apparatus of the present invention;

FIG. 9 is a vertical sectional view on a reduced scale taken approximately on the line 9—9 of FIG. 8;

FIG. 10 is a fragmentary horizontal sectional view, enlarged, taken approximately on the line 10—10 of FIG. 9; and

FIG. 11 is a schematic view of the electrical circuit used with the apparatus of the invention.

It should, of course, be understood that the description and drawings herein are illustrative merely, and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Like numerals refer to like parts throughout the several views.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, the air cooling apparatus is of rectangular box like shape having an outer cabinet 9 comprised of top and bottom walls 10 and 11, side walls 12, rear wall 14 and front wall 15.

The front wall 15 is provided with two grill portions 16 and 17. The grill portion 16 is the inlet grill and has a plurality of large openings 18 to permit warm air to be cooled to flow into the interior 20 of the cabinet 9. The grill portion 17 is the outlet grill through which the cooled air flows from interior 20 and is preferably composed of any desired material.

The bottom wall 11 has a motor 25 mounted thereto by vertical mounting plate 26. The motor 25 is connected to an electrical source (not shown) by power leads 25a through the circuit shown in FIG. 8 to be described below.

The motor 25 for a specific embodiment is a one twelfth horsepower 120 volt motor of very high starting torque design, with a double ended shaft 27, and which, at the forward end of the shaft 27 as shown in FIG. 2, carries a fan 28 of a type to provide positive pressure within the cabinet 9 and thereby cool the compressor 61 and for drawing warm air through grill 16 into and through the interior 20 of the cabinet 9 and over the evaporator 50 and out through the grill 17 as cooled air. The fan 28 combines the desirable characteristics of both the squirrel cage and the propeller types with reduced noise and compactness.

At the rear end of the shaft 27 of the motor 25 a water pump 30 is provided attached to the motor 25. The pump 30 is of conventional positive displacement self priming type, and constructed of corrosion resistant material so that it can be used with both salt and fresh water.

The pump 30 has an inlet pipe 32 and an outlet pipe 33 attached to it. The inlet pipe 32 extends to a water scoop and return member 34 of conventional type which is mounted through the hull 35 of a boat (not shown) below the water line. The scoop and return member 34, as shown in FIG. 7, is of cylindrical shape retained to the hull 35 by nut 31 and with a head portion 36 which is external to the hull 35 and has an inlet passage 37 therein with a screen 38.

The passage 37 extends through the hull 35 and connects to the pipe 32 to supply filtered cool water to the pump 30. The outlet pipe 33 extends from the pump 30 to a condenser 40.

The condenser 40 is comprised of a plurality of coils of pipe 41 and, as shown in FIG. 6, is of double wall construction with an interior passageway 42 carrying the water from the pipe 33 and an outer passageway 43 carrying the refrigerant material.

An outlet pipe 45 connects to the condenser 40 to carry hot water to the head 36 of member 34 wherein it is discharged through passageway 46 to the body of water surrounding the boat (not shown).

The refrigerant utilized in the condenser 40 and elsewhere may be of any suitable type such as refrigerant 22 or other desired refrigerant.

The condenser 40 which contains the heated refrigerant in the outer passageway 43 causes the refrigerant to be reduced to a low temperature by the cool water passing through the passageway 42 and condenses the refrigerant so that it is in a liquid state. The condenser 40 has a capillary tube expansion device 48 connecting it to one side of an evaporator 50.

The evaporator 50 is composed of a plurality of coils of pipe 52 which extend across the front wall 15 in back of the grill 17 and are mounted within a plurality of fins 53 which permits a greater surface area for cooling. The evaporator 50 is supported on a lower baffle plate

54 with a condensate collecting pan 55 therebelow, an opening 56 in the plate 54 permitting discharge of condensate from the outside of the evaporator coils 52 to the pan 55.

Extending upwardly from the baffle plate 54 an angled fan housing 57 is provided to guide the air to be cooled in through the grill 16 and the evaporator 50 for cooling by contact with the coils 52 and fins 53, delivery into the interior space 20 and then for movement outwardly through the grill 17. The housing 57 is closed at the top by an upper baffle plate 58.

The liquid refrigerant under pressure when introduced into the evaporator 50 expands into a gaseous state, the process thereby absorbing large quantities of heat and cooling the coils of pipe 52 and the fins 53, and the air passing in contact therewith.

The other end of evaporator 50 is connected by pipe 60 to compressor 61. The compressor 61 is of conventional sealed type and is designed to compress the gaseous refrigerant from the evaporator 50 and deliver it to the condenser 40 through the discharge tube 49.

The condensate collecting pan 55 has a pipe 65 connected to it extending to an inlet connection 67 of a T-shaped valve assembly 68 in the pipe 45. The valve 68 has a recess 69 in the inlet 67 with a ribbed valve seat 70 and a non-return or check valve member 71 in the recess 69 and free to move to or away from the seat 70 to permit flow of condensate downstream but prevent backflow of cooling water from pipe 45 to passageway 77 through bore 73 to recess 69. The valve member 71 is retained in recess 69 by a tapered plug 74 and has a central passageway 75 therein to permit condensate to flow into recess 69 and past valve member 71 when the valve member 71 is seated on seat 70.

The valve assembly 68 preferably has an interior passageway 77 with which the bore 73 is in communication. The passageway 77 is of smaller diameter than the passageway 78 immediately upstream thereof to provide a Venturi action and to induce flow through the bore 73. The passageway 77 has a recovery passageway 79 downstream thereof.

The water circulating in the condenser 40 cools the refrigerant so that it is liquified and then flows into the evaporator 50 as previously described.

The electrical circuit is shown in FIG. 11 and includes an electrical power source (not shown) with a two wire cord 25a connected thereto and by lead 106 to a common junction 108.

The junction 108 is connected through a compressor control switch SW1 and thermostat 115 to the compressor motor 104 which operates the compressor 61. The compressor motor 104 has a capacitor 107 attached thereto to aid in starting. The compressor 104 is connected by a conductor 103 to a common junction 102 and thereto to a grounded return conductor 101.

The junction 108 is also connected through a fan control switch SW2 by a conductor 120 to the motor 25 which has a capacitor 111 connected thereto to facilitate starting. The motor 25 is connected by a conductor 110 to the common junction 102 and return conductor 101. The thermostat 115 is of well known type connected to normally open switch SW1 and con-

nected by lead 105 to compressor 104. As shown in FIG. 1 switch SW1 is provided with a knob 125 on wall 15. The switches SW1 and SW2 are combined in a three position switch (not shown) with knob 126 and which provides an off position, a fan only position and a combined fan and cooling position.

It will be noted that by the use of the outlet pipe 45 for discharge of the coolant water and for discharge of the condensate no separate discharge of the condensate is necessary nor is additional piping required for condensate removal.

It is thus apparent that structure has been provided with which the objects of the invention are attained.

I claim:

1. Air conditioning apparatus for use in boats comprising an outer cabinet with air inlet and outlet openings, a motor driven compressor within the cabinet for compressing the gaseous refrigerant, a condenser for condensing the gaseous refrigerant to a liquid, an evaporator for causing the refrigerant to expand from a liquid to a gas, said evaporator and condenser being connected together to form a closed circuit for the refrigerant in said cabinet and in series with the compressor, water cooling means for said condenser including a discharge conduit for discharging water overboard, a pump in said cabinet for circulating water from the discharge side of the pump through said water cooling means to said discharge conduit, a fan in said cabinet for delivering air from said air inlet opening and through said air outlet opening in contact therewith with said evaporator, driving means in said cabinet for said pump and fan, said evaporator having a condensate collecting member therebelow in said cabinet, and means in said cabinet including a fluid connection with said discharge conduit for effecting continuous removal of condensate from said collecting member for discharge overboard by way of said discharge conduit, said pump having an inlet conduit which has one end constructed and arranged for communication with water below the water line of a boat.

2. Air conditioning apparatus in accordance with claim 1 wherein said last-mentioned means includes an aspirating member in said discharge conduit with said collecting member being connected adjacent the throat of said aspirating member by way of a flow passage having a non-return valve member so that condensate may flow only from said collecting member to said discharge conduit.

3. Air conditioning apparatus in accordance with claim 2 wherein said condensate collecting member for said evaporator includes a condensate collecting pan below the evaporator and at an elevation which is above the elevation of the condenser, and a pipe extending from said aspirating member to said condensate collecting pan.

4. Air conditioning apparatus in accordance with claim 1 including a common member to accommodate said discharge conduit as well as the inlet conduit for said pump, and means for mounting said common member in the hull of a boat below the water line.

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