July 4, 1961 K. G. F. MOELLER 2,990,797

COOLING WATER SYSTEMS FOR CONDENSERS

Filed April 13, 1959 2 Sheets-Sheet 1

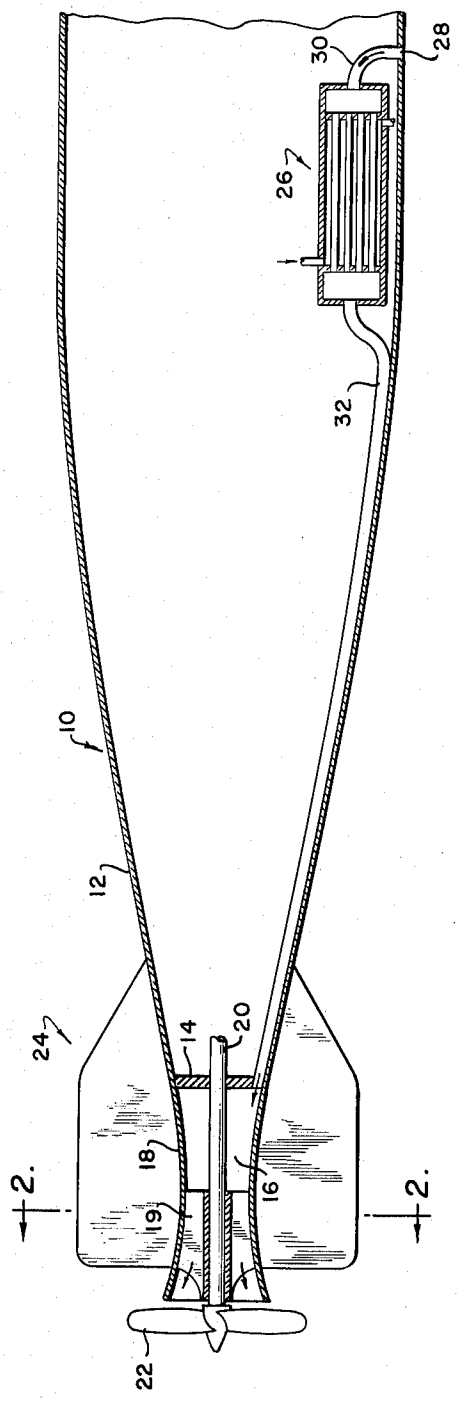

FIG. 1.

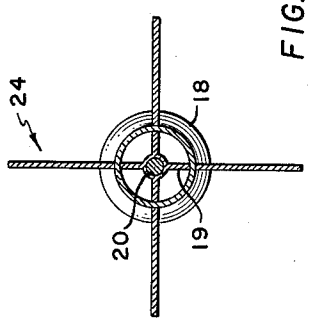

FIG. 2.

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2 Sheets-Sheet 2

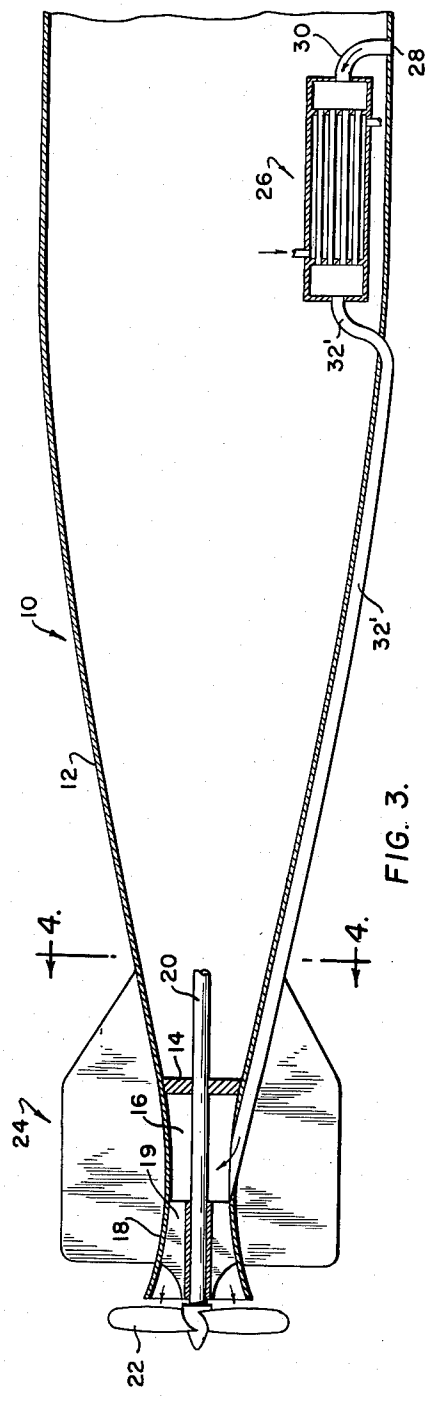

FIG. 3.

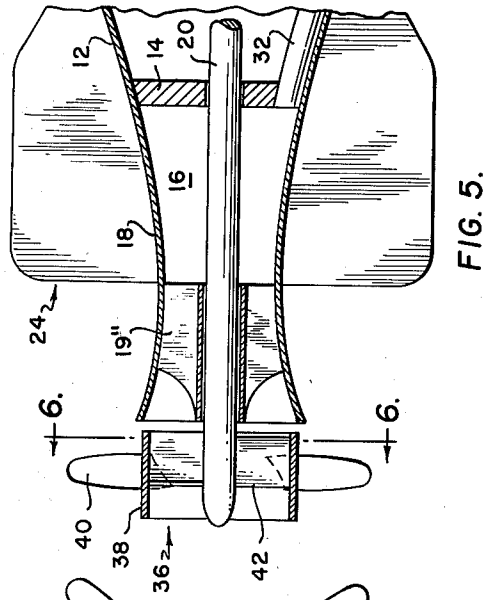

FIG. 5.

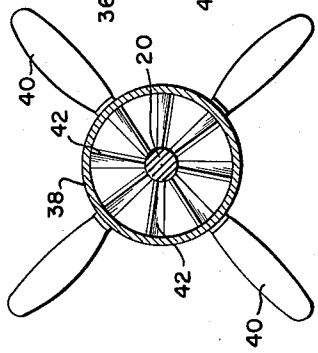

FIG. 6.

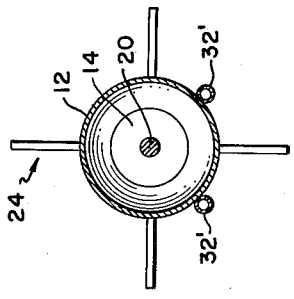

FIG. 4.

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COOLING WATER SYSTEMS FOR CONDENSERS

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Filed Apr. 13, 1959, Ser. No. 806,194
7 Claims. (Cl. 114—.5)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to cooling water systems for ships. More particularly, this invention relates to condenser cooling water systems for submarines.

Steam propelled ships, and in particular steam propelled submarines, need a large amount of cooling water for the condensers. This water is generally pumped from the sea by a separate pump designed for that purpose, it is passed through the condenser or other heat exchanger and is returned to the sea. In some instances scoops are used for picking up the sea water. Scoops of this type operate on the principle of causing flow of sea water by hydrodynamic head produced by the protruding device on the ship's hull moving through the sea.

Both the pump and scoop methods, used heretofore, present noise problems, which can be serious particularly in submarine installations in war times.

An object of the present invention is to provide a cooling water system that eliminates this noise.

A further and more specific object of this invention is to utilize the ship's propeller for supplying cooling water to condensers or other heat exchanges.

The invention, together with the above and other objects and advantages, is set forth in more technical detail in the following description and accompanying drawings in which like reference characters designate like parts throughout the several views and wherein:

FIG. 1 is a vertical, longitudinal sectional view through the stern portion of the hull of a submarine incorporating a first embodiment of the present invention;

FIG. 2 is a transverse section taken on line 2—2 of FIG. 1, with parts omitted;

FIG. 3 is a view similar to FIG. 1, illustrating a second embodiment of the invention;

FIG. 4 is a transverse section taken substantially on lines 4—4 of FIG. 3;

FIG. 5 is a partial longitudinal view similar to FIG. 1 illustrating a third embodiment of the invention; and

FIG. 6 is a transverse section taken on line 6—6 of FIG. 5.

Referring now to the drawing and particularly to FIG. 1, the submarine **10** is of known construction, formed with a pressure hull **12**, which pressure hull is divided into the usual compartments, engine rooms, ballast tanks, fuel storage tanks, etc., not shown. Aft of the last pressure bulkhead **14** is a flooded space **16** formed by a stream lined casing **18** which supports the usual struts **19** that mount the shaft **20** for driving a propeller **22**. A conventional stabilizing-rudder assembly **24** is mounted on the aft end of the hull immediately in front of the propeller. A conventional surface condenser **26** is located in the engine room close to the steam turbine or turbines, not shown.

In accordance with the first embodiment of this invention (FIGS. 1 and 2), cooling water is taken from the sea through an opening **28** in the pressure hull and is led by a conduit **30** into the water tubes of the condenser **26**. As shown, the intake is flush with the hull; there are no protrusions to interfere with streamlining or to generate noise. The discharge side of the condenser is connected

to a pipe **32** which extends along the lower inside of the hull aft through the bulkhead **14** and discharges into the space **16**, which space is normally flooded and is at ambient sea pressure. From space **16**, the condenser cooling water discharges around the strut-bearing openings into the sea at the upstream or negative side of the propeller.

Thus, the flow of cooling water to and from the condenser is effected by the negative head caused by the sucking action of the rotating propeller. The amount of cooling water per unit time changes automatically with the speed of rotation of the propeller. For dockside operation and for very low speed a small auxiliary pump, not shown, may be used for flowing cooling water to and from the condenser. The noise level of such a pump is negligible.

In situations where the installation of large pipes in the stern section of a submarine is too difficult regarding space, the discharge pipe or pipes are arranged on the outside of the pressure hull, as shown in FIG. 3.

Referring now to FIGS. 3 and 4, in accordance with this second embodiment of the invention, the discharge pipes **32'** are welded to the outside of the pressure hull and, as shown in FIG. 4, these pipes are shaped so as to function as bilge keels. With this second embodiment, where a single discharge pipe is used it is welded along the bottom centerline of the hull and is so shaped as to function as a keel. The pipes **32'** discharge cooling water into the space **16** from whence it is discharged into the sea by the rotating propeller in the same manner as in the FIG. 1 embodiment. In installations where the hub of the propeller is too large in diameter to warrant sufficient pumping action by the center portion of the propeller a different arrangement, such as shown in FIGS. 5 and 6, is designed to do the job.

Referring now to FIGS. 5 and 6, with this third embodiment of the invention the discharge of cooling water from the condenser to the space **16** is substantially the same as with the first embodiment, FIG. 1. However, with this third embodiment of the invention an especially designed propeller is used. This propeller, indicated generally by reference numeral **36**, comprises a hollow cylindrical hub **38** having propeller blades **40** on the outer surface and pump blades **42** on the inner surface. The pump blades converge toward the center of the hub and are connected to the propeller shaft. If desired, the struts **19''** may be formed to function as stator blades for directing discharge condenser water into the pump blades.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A surface-condenser cooling system in a ship having a stern propeller, said system comprising a sea water inlet in the hull of the ship below the normal waterline thereof, a first conduit connecting said inlet with an inlet side of the surface condenser, a second conduit having one end thereof connected to an outlet side of the condenser and an opposite end thereof discharging in the immediate vicinity of the propeller on the suction-side thereof, whereby flow of cooling sea water through the surface condenser is effected by the negative head caused by the sucking action of the rotating propeller, said ship being a submarine having a streamlined stern mounting the propeller and having a flood-space immediately in front of the propeller, and the opposite end of the second conduit discharging into said flood-space.

2. A surface-condenser cooling system as set forth in

claim 2 wherein the said second conduit is welded to the exterior of the hull of the submarine and is so shaped and located as to form a keel for such hull.

3. A surface-condenser cooling system as set forth in claim 2 wherein the said second conduit is divided into two parallel conduits each welded to the exterior of the hull of the submarine on opposite sides thereof and said parallel conduits being so shaped and located as to form bilge keels for such hull.

4. A cooling system of a type described for a ship having a stern propeller and a shaft for driving said propeller, a plurality of pump blades carried by said shaft at the stern of the ship, a cooling pipe system comprising a sea water inlet in the hull of the ship below the waterline thereof and a sea water outlet at the region of the suction side of said pump blades, whereby flow of cooling sea water is affected by the negative head caused by the sucking action of the pump blades when they rotate.

5. A cooling system as set forth in claim 4 wherein said ship has a flood-space immediately in front of the pump blades on the suction side thereof, and wherein said outlet is at said flood-space.

6. The cooling system as set forth in claim 4 but characterized by said cooling pipe system comprising a heat-exchange unit in which said cooling pipe system comprises a first water-path, said heat-exchange unit including a second water-path in heat-exchange relation to said first water-path, said second water-path having an inlet and outlet inside of the ship.

7. A surface-condenser cooling system in a ship having a stern propeller, said system comprising a sea water inlet in the hull of the ship below the waterline thereof, a first conduit connecting said inlet with an inlet side of the surface condenser, a second conduit having one end thereof connected to an outlet side of the condenser and an opposite discharging end, said stern propeller comprising a hollow cylindrical hub, a plurality of propeller blades having inner ends thereof attached to an outer surface of said cylindrical hub and radiating outward therefrom and a plurality of pump blades attached to an inner surface of said cylindrical hub, said opposite end of the said second circuit discharging cooling sea water in the region of the suction side of said pump blades, whereby flow of cooling sea water through the surface condenser is effected by the negative head caused by the sucking action of the rotating propeller.

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