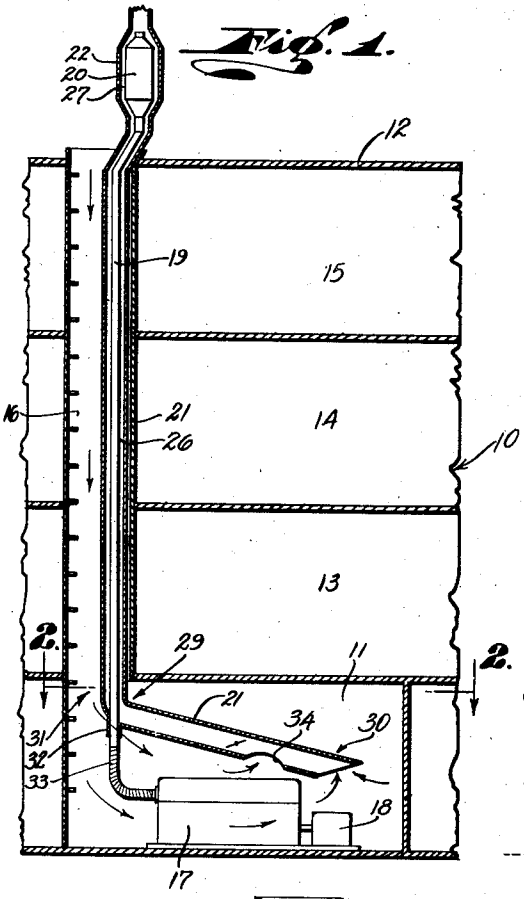
Aug. 22, 1944. P. E. FLUOR 2,356,392

VENTILATION AND EXHAUST PIPE COOLING IN BOATS

Filed July 19, 1943

Fig. 1.



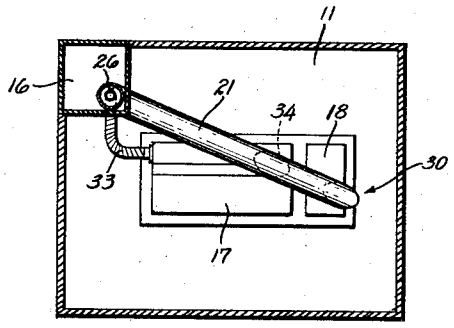


Fig. 2.

Fig. 4.

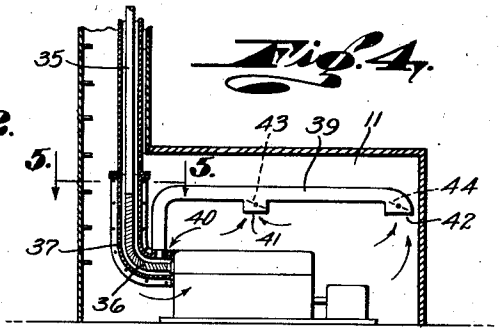


Fig. 3.

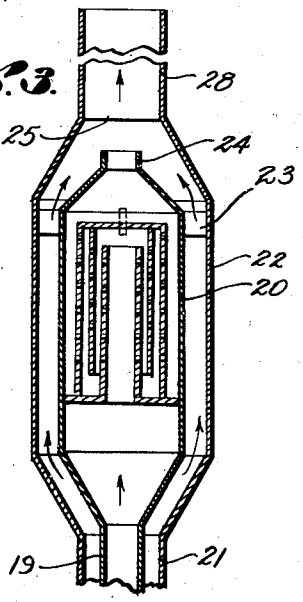
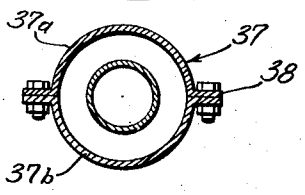


Fig. 5.



PETER E. FLUOR
INVENTOR.

BY H. Calvin White

ATTORNEY

Patented Aug. 22, 1944

2,356,392

UNITED STATES PATENT OFFICE

2,356,392

VENTILATION AND EXHAUST PIPE COOLING IN BOATS

Peter E. Fluor, Santa Ana, Calif., assignor to The Fluor Corporation, Ltd., Los Angeles, Calif., a corporation of California

Application July 19, 1943, Serial No. 495,300

14 Claims. (Cl. 114—211)

This invention has to do with improved systems for the ventilation of compartments in boats, by which term it is intended to include various size boats, vessels or ships having compartments which, by reason of their locations below the decks, present problems of ventilation. More particularly, the invention is concerned with the ventilation of engine rooms, i. e. compartments containing one or more internal combustion engines, wherein effective ventilation is particularly difficult by reason of the quantity of heat developed by the engines, heat radiation from the exhaust pipes, and the problem of effecting ample cool air circulation by reason of the location of the compartment.

The general object of the invention is to provide a boat ventilating system whereby highly effective air circulation within the engine compartment is accomplished by normally waste energy of the heat producing source itself, that is, the engine. In accordance with the invention, the exhaust gas discharge from the engine is utilized to create air displacement from the engine compartment in a manner causing cool fresh air to be drawn into the compartment at one location, and warm air to be withdrawn therefrom through a conduit at another location, all in a manner maintaining air circulation within the atmosphere of the compartment at a rate sufficiently high to reduce considerably the compartment temperature.

Since the principal purpose to be served is proper ventilation within the engine compartment, the invention is more directly concerned with the method or means whereby induction of air through the conduit is caused to maintain effective circulation of cool air within the compartment. As an illustration, the present system is particularly applicable to situations where the engine compartment is in communication with the atmosphere through a vertically extended passage or cool air duct through which the exhaust pipe is brought to a location above the main deck. By discharging the exhaust gases into an ejector throat or passage communicating with the conduit, the exhaust gas discharge is caused to create an upward withdrawal of warm air from the compartment through the conduit, and a replacement flow of cool air through the duct into the compartment. A particularly important feature is the extension of the conduit from the exhaust pipe by way of a branch having a warm air inlet at a location within the compartment distant from the location at which the cooler air enters the compartment. As illustrative, the conduit branch may extend in overlying relation to the engine and to a side of the compartment opposite the side at which the cool air enters. By this arrangement, heat from the engine is effectively absorbed and removed by a cross flow of the cooler air being drawn toward the inlet of the conduit branch.

Further details and objects of the invention will be apparent from the following description of specific embodiments, throughout which reference is had to the accompanying drawing, in which:

Fig. 1 is a sectional view illustrating diagrammatically a typical embodiment of the invention;

Fig. 2 is a cross-section on line 2—2 of Fig. 1;

Fig. 3 is an enlarged sectional view of the muffler and the surrounding stack section of the air conduit;

Fig. 4 is a view similar to Fig. 1 illustrating a variational embodiment of the invention; and

Fig. 5 is an enlarged section on line 5—5 of Fig. 4.

Referring first to Fig. 1, the hull 10 of the boat is shown to contain an engine compartment 11 below the main deck 12 of the boat. As will be understood, the depth or location otherwise of the compartment 11 within the hull of the boat may vary in different situations, as in accordance with the type and construction of the boat, and the purpose of the engine-driven equipment. To illustrate a situation encountered in medium or larger size vessels, the engine compartment 11 is shown to be located rather deep in the hull, below other compartments 13, 14, and 15, at a distance of say 40 feet below the main deck 12. Access is had to the compartment through a relatively small cross-sectional area trunk or passage 16, which also serves as a duct through which fresh air is drawn into the compartment, as will presently appear.

The compartment 11 contains one or more internal combustion engines, diagrammatically indicated at 17, serving as the prime mover for any suitable purpose, as to drive auxiliary equipment such as a pump or generator 18. In other instances, the engine or engines may be used to drive the boat. Combustion gases are discharged from the engine through an exhaust pipe 19 extending upwardly within the duct 16 to a muffler 20 positioned at or above the deck 12. It will be understood that except where otherwise qualified or distinguished, the muffler may be regarded as a portion or extension of the exhaust pipe.

The development of heat by the engine 17 during its operation within the compartment 11 results in excessive temperatures and the existence of a ventilating problem which heretofore has not satisfactorily been solved, or at least without relatively expensive equipment which itself may be heat-generating. The invention presents a highly practicable and extremely simple solution by utilizing the exhaust gas discharge to induce air flow into and out of the duct 16, without necessity for any additional equipment other than a simple form of air conduit arranged with relation to the exhaust pipe to cause induced draft of warm air through it from the proper location within the engine compartment.

In the form of the invention shown in Figs. 1 and 2, the exhaust pipe 19 is surrounded by a jacket or air conduit 21 extending upwardly through the duct 16 to connect with a stack section 22 of the conduit surrounding the muffler 20. As illustrated in Fig. 3, the muffler, which may be of any suitable internal design and construction, is rigidly attached to the stack 22, as by means of spiders 23, to position the muffler outlet 24 in predetermined relation to the throat 25 of the stack, so that the discharge of exhaust gases induces a high velocity flow of air through the conduit spaces 26 and 27 to be discharged with the exhaust gases through the outlet 28. In view of the cooling effected by the high velocity air flow through the space 26, insulation of the conduit 21 may be a matter of choice.

Figs. 1 and 2 show the conduit 26 to depart at 29 from the exhaust pipe and to extend above the engine 17 to a location 30 distant from the location 31 at which fresh air enters the compartment through the duct 16. Suitable provision is made for permitting longitudinal expansion and contraction of the exhaust pipe, while maintaining at all times the proper fixed relationship between the muffler outlet 24 and the throat 25. As illustrative, the exhaust pipe may leave the conduit 21 through an opening 32 within which the exhaust pipe is free to expand or contract, and is connected with the engine through a flexible section 33 permitting such movement. The lower end portion of the exhaust pipe within the compartment and outside the air conduit 21, preferably is insulated.

The discharge of combustion gases from the muffler acts to draw warm air upwardly from the compartment through the conduit 21, and to effectively cool that portion of the exhaust pipe jacketed by the conduit. Since it effects a withdrawal of warm air from the compartment, this same induced draft produces a downward flow of cool fresh air through the duct 16 into the compartment. The lower branch of the conduit 21 is positioned and extended with the view of obtaining most effective air circulation within the compartment atmosphere, and efficient withdrawal of heat from the compartment. As illustrated in Fig. 2, the conduit 21 may be extended directly over the engine 17 to a location 30 at the side of the compartment opposite the duct 16. The induction of warm air into the end of the conduit creates within the compartment a cross flow of cool air entering through the duct 16, to effectively remove heat from the vicinity of the engine. If desired, a second air inlet 34 may be provided to cause warm air to be drawn from directly above the engine, and thereby immediately remove from the engine heat less quickly taken into the conduit by the cross air flow.

The variational form of the invention shown in Figs. 4 and 5 differs from the described embodiment with respect to the extent of the exhaust pipe jacketed by the warm air conduit, and the provision of means for controlling the air intake to the conduit. Here the exhaust pipe 35, including the lower flexible section 36, is jacketed substantially to the engine by the bottom length 37 of the conduit, which desirably may be of sectional form to facilitate access to the exhaust pipe. Accordingly, as shown in Fig. 5, the jacket length 37 may be made in sections 37*a* and 37*b* bolted together at 38.

The conduit branch 39 may connect with the exhaust pipe jacket at any point along its length, and is shown typically to extend upwardly and then above the engine to the far side of the compartment, from a location at 40 near the engine. The withdrawal of air through inlets 41 and 42 in the conduit branch 39, is controllable by suitable means, such as the manually adjustable butterfly valves 43 and 44. Ordinarily the atmosphere of the compartment will tend to become overheated, and consequently valves 43 and 44 will be set to permit a high rate of warm air withdrawal from the compartment. In installations where at times heating of the compartment may be desirable, the valves may be closed to whatever extent necessary to maintain the desired compartment temperature by reason of the engine heat.

I claim:

1. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and an air duct leading from said compartment to the deck; the combination comprising an exhaust pipe extending from the engine, an air discharge conduit leading from said compartment, and means creating a flow of warm air through said conduit from the compartment atmosphere and a replacement flow of cool air into the compartment through said duct, by virtue of the engine exhaust gas discharge through said pipe.

2. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended duct leading from said compartment to the deck; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, an air discharge conduit leading from said compartment, and means creating a flow of warm air through said conduit from the compartment atmosphere and a replacement flow of cool air through said duct into a location in the compartment distant from the location of air withdrawal therefrom through said conduit, by virtue of the engine exhaust gas discharge through said pipe.

3. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a duct through which cool air is supplied to said compartment; the combination comprising an exhaust pipe extending from the engine, an air discharge conduit leading from said compartment, and means creating a flow of warm air through said conduit from a location in the compartment directly above the engine and a replacement flow of cool air into the compartment through said duct, by virtue of the engine exhaust gas discharge through said pipe.

4. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended duct leading from said compartment to the deck; the combination comprising an exhaust pipe extending from the engine upwardly through said duct,

an air discharge conduit leading from said compartment through said duct in spaced relation about the exhaust pipe, and means creating a flow of warm air upwardly through said conduit from the compartment atmosphere and a replacement flow of cool air into the compartment through said duct, by virtue of the engine exhaust gas discharge through said pipe.

5. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended duct leading from said compartment to the deck; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, an air discharge conduit surrounding the exhaust pipe within said duct and leading from a location in the compartment distant from the location of air entry thereto through said duct, and means creating a flow of air upwardly through said conduit from the compartment and a replacement flow of cool air into the compartment through said duct, by virtue of the exhaust gas discharge through said pipe.

6. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended duct leading from said compartment to the deck; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, an air discharge conduit surrounding the exhaust pipe within said duct and extending from the exhaust pipe at a location near the engine to take in air from a location in the compartment distant from the location of air entry thereto through said duct.

7. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended duct leading from said compartment to the deck; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, an air discharge conduit surrounding the exhaust pipe within said duct and extending from the exhaust pipe at a location near the engine to take in air from a location in the compartment directly above the engine distant from the location of air air entry thereto through said duct.

8. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended duct leading from said compartment to the deck; the combination comprising an exhaust pipe extending from one side of the engine upwardly through said conduit, an air discharge conduit surrounding the exhaust pipe within said duct and extending from the exhaust pipe to take air from a location in the compartment at the opposite side of the engine and thereby create cross-circulation of air in the compartment past the engine, and means creating a flow of warm air upwardly through said conduit from the compartment and a replacement flow of cool air into the compartment through said duct, by virtue of the exhaust gas discharge through said pipe.

9. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended manway duct leading from the deck into said compartment; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, a muffler connected to said exhaust pipe, an air discharge conduit surrounding said muffler and exhaust pipe and extending downwardly into the compartment, said conduit having a branch extending away from the exhaust pipe to a location within the compartment distant from the location of air entry thereto through said duct, the discharge of exhaust gas from said muffler creating a flow of warm air upwardly through said conduit from the compartment and a cross-flow of cool air from said duct within the compartment into said branch of the conduit.

10. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended manway duct leading from the deck into one side of said compartment; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, a muffler connected to said exhaust pipe, an air discharge conduit surrounding said muffler and exhaust pipe and extending downwardly into the compartment, said conduit having a branch extending away from the exhaust pipe to a location within the compartment at the side opposite the side communicating with said duct, the discharge of exhaust gas beyond said muffler creating a flow of warm air upwardly through said conduit from the compartment and a cross-flow of cool air from said duct within the compartment past the engine into said branch of the conduit.

11. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended manway duct leading from the deck into one side of said compartment; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, a muffler above the deck and connected to said exhaust pipe, an air discharge conduit surrounding said muffler and exhaust pipe and extending downwardly into the compartment, said conduit having a branch extending away from the exhaust pipe to a location above the engine, the discharge of exhaust gas from said muffler creating a flow of warm air upwardly through said conduit branch from a location in the compartment directly above the engine and a replacement flow of cool air into the compartment at a location distant from the location of air withdrawal therefrom through said conduit branch.

12. In a boat containing a compartment below the boat deck, an internal combustion engine in said compartment, and a vertically extended manway duct leading from the deck into one side of said compartment; the combination comprising an exhaust pipe extending from the engine upwardly through said duct, a muffler above the deck and connected to said exhaust pipe, an air discharge conduit surrounding said muffler and exhaust pipe and extending downwardly into the compartment, said conduit having a branch extending away from the exhaust pipe over the engine to an inlet at the side of the compartment opposite the side thereof into which said duct leads, the discharge of exhaust gas from said muffler creating a flow of warm air from said compartment into said conduit branch inlet and also into an opening in said branch directly above the engine.

13. In a boat containing a compartment below the boat deck, and an internal combustion engine in said compartment; the combination comprising means forming a duct through which fresh air is supplied to the compartment, a warm air discharge conduit leading from the compartment, and means creating by virtue of the engine exhaust gas discharge a flow of warm air from the compartment through said conduit, and there-

fore a replacement flow of cool air through said duct into the compartment.

14. In a boat containing a compartment below the boat deck, and an internal combustion engine in said compartment; the combination comprising means forming a duct through which fresh air is supplied to one location in the compartment, a warm air discharge conduit leading from another location in the compartment, and means creating by virtue of the engine exhaust gas discharge a flow of warm air from the compartment through said conduit, and therefore a replacement flow of cool air through said duct into the compartment.

PETER E. FLUOR.