March 18, 1941. G. W. WALKER ET AL 2,235,806

LIQUID AND VAPOR HEAT EXCHANGER

Filed April 30, 1938 2 Sheets-Sheet 1

FIG. 1

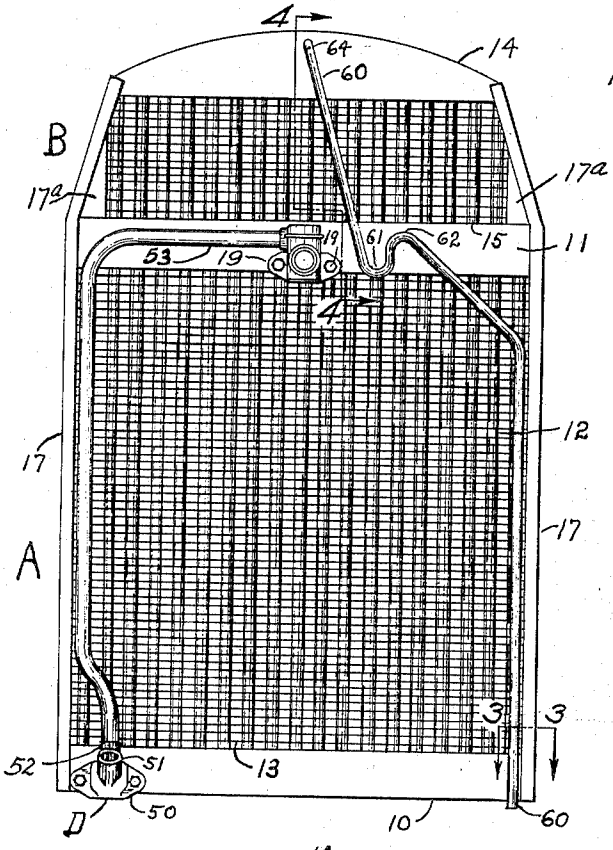
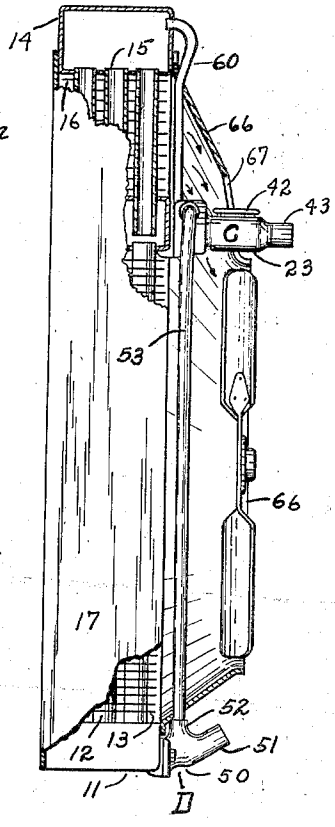


FIG. 2



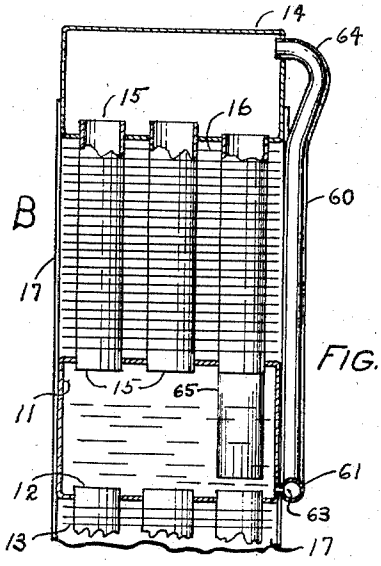


FIG. 4

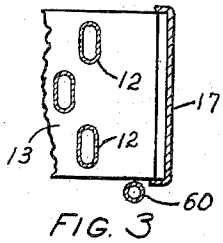


FIG. 3

INVENTORS
GEORGE W. WALKER
HOMER B. MORROW
BY A.S. Krotz
ATTORNEY

March 18, 1941. G. W. WALKER ET AL 2,235,806

LIQUID AND VAPOR HEAT EXCHANGER

Filed April 30, 1938 2 Sheets-Sheet 2

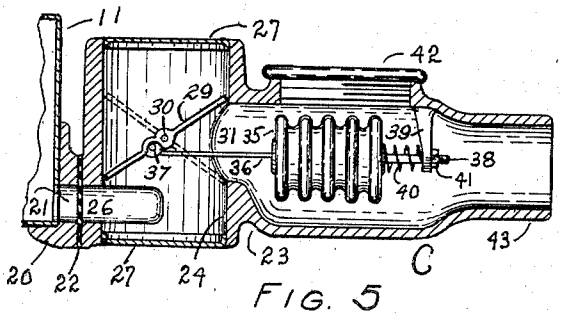


FIG. 5

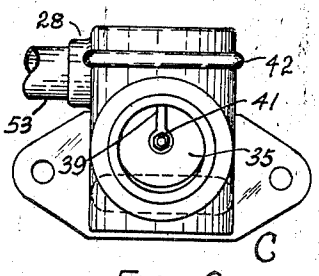


FIG. 6

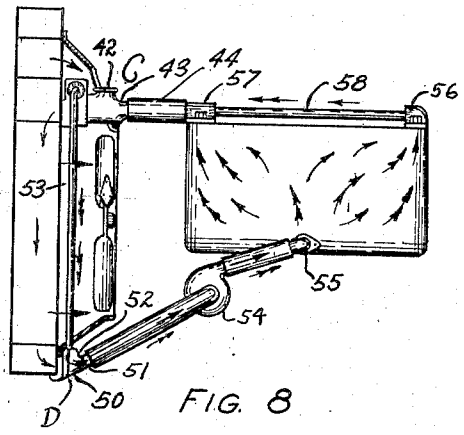


FIG. 8

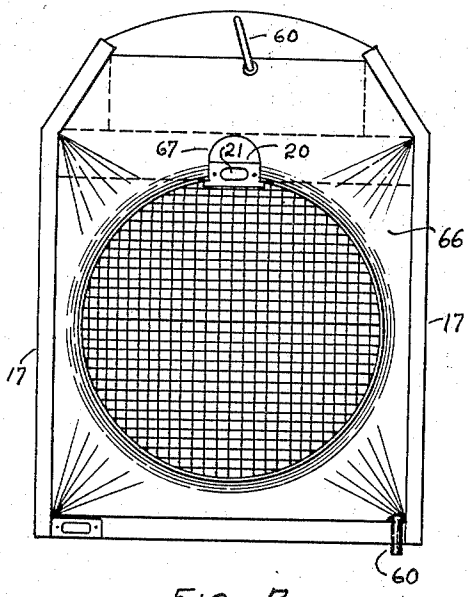


FIG. 7

INVENTORS
GEORGE W. WALKER
HOMER B. MORROW
BY
ATTORNEY

Patented Mar. 18, 1941

2,235,806

UNITED STATES PATENT OFFICE

2,235,806

LIQUID AND VAPOR HEAT EXCHANGER

George W. Walker and Homer B. Morrow,
Platteville, Wis.

Application April 30, 1938, Serial No. 205,162

2 Claims. (Cl. 257—125)

The present invention relates to heat exchangers used principally for the purpose of cooling jacket water or coolants in internal combustion engines and has for its objects to supply a simple, economical and efficient device for cooling the coolant and condensing the vapor and steam therefrom.

Vapor continually escapes from water, alcohol and other coolants at all temperatures from evaporation or boiling temperature to below zero, particularly if in contact with dry air. In conventional radiators there is no means provided for condensing vapor and steam so as to prevent the loss of coolant.

An object of the present invention is to definitely prevent loss of coolant by condensing the vapor or steam formed, thus to avoid the necessity of adding fresh coolant to the system thereby to prevent the collection of lime, salts and minerals in the tubes of the radiator and in the engine jacket.

A further object of the present invention is to automatically, safely and quickly cause the temperature of the coolant to rise to a predetermined point after the engine has been started and then to hold it at this predetermined temperature under all operating conditions of the engine thus to increase the efficiency and life of the engine.

A still further object of the present invention is to provide an automatic over-flow and safety device and an efficient thermal control having means for conveniently filling the device but adapted to prevent the addition of more coolant than is necessary.

In conventional radiators the primary object is to prevent boiling and when boiling does take place the vapor and steam escape through the over-flow with corresponding loss of the coolant.

It is an object of our invention to prevent boiling temperatures by efficiently condensing the rising vapor before boiling temperature is reached and in the event boiling temperature is reached to efficiently condense the steam or vapor.

We provide means for condensing the vapor and steam generated and returning the condensate in a manner which does not add to the cost of the equipment but does add greatly to its efficiency.

To these and other useful ends our invention consists of parts and combinations thereof or their equivalents and mode of operation, as hereinafter described and claimed and shown in the accompanying drawings in which:

Fig. 1 is a rear elevational view of our complete improved device less the fan shroud.

Fig. 2 is a fractionally sectioned view of the device shown in Figure 1 but including a sectional view of the fan shroud and illustrating the fan in position.

Fig. 3 is an enlarged fractional view of the device taken on line 3—3 of Figure 1.

Fig. 4 is an enlarged sectional view of the condenser and upper header taken on lines 4—4 of Figure 1.

Fig. 5 is a full section shown in a vertical position of our thermally controlled inlet valve.

Fig. 6 is a rear end view of the thermal control valve.

Fig. 7 is a rear view of the device shown in Figure 1, less the valve and its connections but including the fan shroud.

Fig. 8 is a diagrammatic drawing of the device illustrating its connections to the jacket of an internal combustion engine.

As thus illustrated, the device consists of a conventional radiator or heat exchanger which in its entirety is designated by reference character A. Reference character B designates in its entirety the condenser and C designates in its entirety the thermally controlled device. Reference character D designates in its entirety the outlet connection to the lower header of unit A which also acts as a by-pass connection to unit C.

As thus illustrated, the radiator proper comprises a lower header 10 and an upper header 11 being operatively connected together by means of tubes 12, these tubes having the conventional closely spaced fins 13.

Condenser unit B comprises an upper or supplemental header 14 being operatively connected to header 11 by means of a number of tubes 15 having a multiplicity of closely spaced fins 16 through which the tubes extend. Header 14 is made somewhat shorter than headers 10 and 11 so as to provide the proper shape to accommodate the framework into which the device is supported.

We provide preferably end channels 17—17 which are adapted to be secured to the ends of the headers of units A and B as clearly illustrated in Figures 1, 2 and 7 thus the tubes, headers and fins will be protected against undue strain or injury.

On the rear face of header 11 as shown in Figure 5 we provide a suitable plate 20 having an opening 21 which registers with a corresponding opening in the header. This plate is bonded to the header and forms a base to which unit C is secured by means of bolts 19—19. The ad-

jacent faces of unit C and member 20 are machined true and adapted to form a suitable surface for gasket 22. Member C comprises a suitably shaped housing 23 having a vertically positioned uniform chamber 24. This chamber is provided with an outlet opening 26 which registers with opening 21, the ends of the chamber being sealed or closed by means of caps 27—27 which are suitably bonded to the ends of chamber 24.

Near the top of chamber 24 we provide a side outlet flange 28. We pivotally mount a butterfly valve 29 on shaft 30 which, when in the position shown in Figure 5, will form direct connection between inlet 31 and outlet 26. When this valve is in the position shown by dotted lines, inlet opening 31 will then be directly connected to the chamber above valve 29 whereby the coolant will flow into a pipe connection leading from flange 28, as will hereinafter appear.

It will be seen that valve 29 may act to direct the coolant either into header 11 or into a connection made to flange 28. We provide means for thermally controlling this valve as follows:

A Sylphon 35 is provided with a rod 36 having a pivotal connection to valve 29 as at 37. The rear end of Sylphon 35 is provided with a rod 38 which is loosely supported in bracket 39. Bracket 39 is spaced a distance from the Sylphon providing room for a spring 40. Member 38 is screw threaded and provided with a nut 41 whereby the Sylphon may be adjusted to operate valve 29 at different temperatures.

Sylphon 35 is provided with a desired quantity of thermally sensitive liquid and the device is made suitable whereby valve 29 may be moved to either position shown according to the temperature of the coolant flowing past the Sylphon. It will be understood that the pivotal connection 37 will be made a suitable distance from shaft 30 whereby the valve will be moved to its opposite position by a change in the temperature of the coolant of not over 10°. Clearly, therefore, it will be seen that the valve may direct the coolant to either outlet.

It will be seen that when the temperature is below the predetermined point, valve 29 will be moved into the position indicated by dotted lines and the coolant will then be shunted directly into the engine jacket as will hereinafter appear; and after the coolant has reached the desired maximum temperature, valve 29 will be in position to direct all of the coolant into header 11.

In the present invention it is desired to preserve a water level somewhat below the top of header 11. We therefore provide a filler cap 42 which is preferably screw threaded into member 23 as illustrated in Figure 5 and being positioned somewhat below the top of header 11; thus the operator will be able to supply the necessary amount of coolant but will be prevented from supplying more than the desired amount.

The rear end of member 23 is provided with a reduced portion 43 to which the conventional rubber hose 44 may be secured (see Figure 8).

Member D comprises an outlet bracket 50 which is secured to the lower header somewhat similar to the manner in which member C is secured to the upper header. This bracket is provided with a hose connection extension 51 and a flange 52 into which tube 53 is secured, tube 53 extending to and being secured to flange 28 as illustrated in Figures 1 and 8.

It will be seen by scrutinizing Figures 1, 6 and 8 that after the temperature has reached a predetermined point, all of the coolant will be caused to pass into the top header 11, down through tubes 12, into header 10 and out through member D from whence it will be conducted to the jacket of the engine by means of hose connections and pump 54 as illustrated in Figure 8.

We have illustrated in Figure 8, diagrammatically the jacket portion of an internal combustion engine wherein the coolant enters the jacket as at 55 and will leave as at 56 and 57. These members 56 and 57 are connected by tube 58 as illustrated, tube 44 forming an outlet connection to member 43 of unit C. Thus to provide a complete path for the coolant through the radiator core and the jacket and also a complete path for the coolant through pipe 53, the radiator being inoperative when valve 29 is in the position shown by dotted lines in Figure 5.

It will be understood, of course, that the connections to the jacket may be differently arranged. The ones shown are for purposes of illustration.

In Figure 8 we have illustrated the course of the coolant when directed through the radiator by means of single pointed arrows. We have also illustrated by means of double pointed arrows the course of the coolant when the temperature is below normal or when the valve is in the position shown by dotted lines in Figure 5.

It will be seen that the temperature of the coolant is thermally controlled, that all of the coolant passes through the radiator core when the temperature is above the predetermined point and that all of the coolant is shunted around the core when the temperature is below a predetermined point.

Thus there is provided full coolant circulation through the jacket at all times. The advantage of this arrangement is that the coolant is actively circulated through the jacket at all temperatures and every part of the jacket will at all times have a uniform temperature. Clearly, therefore, unequal expansion and contraction will be avoided.

Referring now to Figure 1. We provide a novel overflow and pressure releasing device for the system in the following manner:

A tube 60 is bent in the form shown in Figure 1, being secured preferably to the top of header 14 as clearly illustrated in the various figures and having reverse bends as at 61 and 62, extending outwardly and downwardly from 62 as clearly illustrated. At the bottom of loop 61 (see Figure 4), we provide a small orifice 63 which extends into header 11.

It will be seen that coolant will flow through this small orifice from header 11 into loop 61, which will then act as a trap to thereby close the vapor outlet of header 14. Loop 62 is positioned whereby when the coolant level reaches maximum height any excess will escape through the outlet end of tube 60.

If, for some unusual reason, pressure should suddenly accumulate in header 14, it may escape through the loop by forcing the coolant therefrom, but as soon as the pressure has been released, sufficient coolant will flow into the loop through orifice 63 to again form a seal; thus the system will at all times be normally sealed and protected against harmful pressure, and further, in case of a vacuum in the system, it may be released by atmospheric pressure which will discharge the liquid from loop 61 and thereby prevent harm as a result of the vacuum.

We may elect to supply a very small orifice 64 in the top of tube 60 which will act to maintain atmospheric pressure in the system.

Tubes 15 and fins 16 act as a condenser for any vapor that may be released in header 11, the vapor rising in the tubes. By referring to Figure 2 it will be noted that the fan shroud is shaped to thereby provide means for pulling air through the condenser core as illustrated by arrows.

Clearly there will be no loss of vapor and as a result no loss of coolant in our device and in view of orifice 63 the system will be caused to operate in a state of balance at all times and the vapor will be condensed as it rises in tubes 15.

It is desirable to provide a liquid drain from the bottom of header 14 into header 11; this drain however, should be sealed so the downward passage of condensate will not be interfered with by an upward flow of vapor.

We preferably extend two or three of the tubes 15 as at 65 within a short distance of the bottom of header 11, thus the bottom end of these extensions 65 will be sealed by the coolant. The upper ends of the other tubes extend a short distance above the upper ends of these drain tubes thus to provide adequate drainage for condensate to prevent back-flow of liquid in tubes 15.

The fan shroud 66 is provided with a cut-away portion 67 adapted to expose filler cap 42, the cut-away portion being made large enough so the operator will be able to observe the level of the liquid before it reaches the top of the filler opening when cap 42 is removed.

A special advantage of the present invention is that when alcohol is used as a non-freezing means, the vapor from the alcohol will not be lost but will be condensed and returned to the system; therefore the thermostat may be set to maintain a temperature quite close to the boiling point of the alcohol.

Our device is adapted to maintain a uniform temperature throughout the engine jackets by causing rapid circulation therethrough immediately after the engine is started, and means are provided whereby the temperature will be quickly raised to the predetermined point thus to insure increased economy.

One of the advantages of our invention is that when the system is once filled with coolant, whether it is water, alcohol or the like, it will operate for an indefinite period without loss of coolant. Another novel feature of our invention is that it is automatic throughout without the use of gadgets, floats, pressure release valves, etc. The only mechanically operated feature is the thermally controlled valve.

Clearly many minor detail changes may be made without departing from the spirit and scope of the present invention as recited in the appended claims.

Having thus shown and described the preferred form of our invention, we claim:

1. A device of the class described, comprising a radiator core having upper and lower headers, the upper header having a cover lid adapted to form a tube plate for a condenser, a coolant inlet in said upper header positioned near the transverse center thereof, a filler cap in said inlet being spaced a short distance from and below the top of said upper header, a supplemental header positioned a distance above and being somewhat shorter than said upper header, a multiplicity of finned tubes forming an operating connection between said supplemental header and said upper header, frame bars secured to the ends of said radiator headers the upper ends converging and being secured to the ends of said supplemental header, a fan shroud having a fan opening, the upper edge being positioned below the top of said upper header and having a cut away portion to thereby form an access opening to said filler cap, the sides and bottom of said shroud extending forwardly and outwardly terminating adjacent said frame bars and bottom header, the top extending upwardly and forwardly the edges terminating adjacent said converging frame bar ends and said supplemental header.

2. A device of the class described, comprising in combination upper and lower headers having coolant passageways therebetween forming a radiator, coolant inlet and outlet connections in said upper and lower headers, a supplemental header positioned a distance above said upper header, a multiplicity of tubes having their ends operatively connected to the adjacent walls of said upper and supplemental headers forming a vapor passageway therebetween, means for maintaining the coolant level a distance below the top of said upper header, means for releasing excessive vapor pressure in said supplemental header, said pressure releasing means comprising a tube forming a vapor outlet from said supplemental header and depending downwardly and having an S-shaped loop positioned adjacent said upper header, the lower loop having a relatively small aperture at its bottom which leads into the bottom of said upper header, the upper loop being positioned a distance below the top of said upper header to thereby form a surplus coolant overflow and a self-sealing trap and the means for permitting the escape of excessive vapor pressure.

GEORGE W. WALKER.
HOMER B. MORROW.