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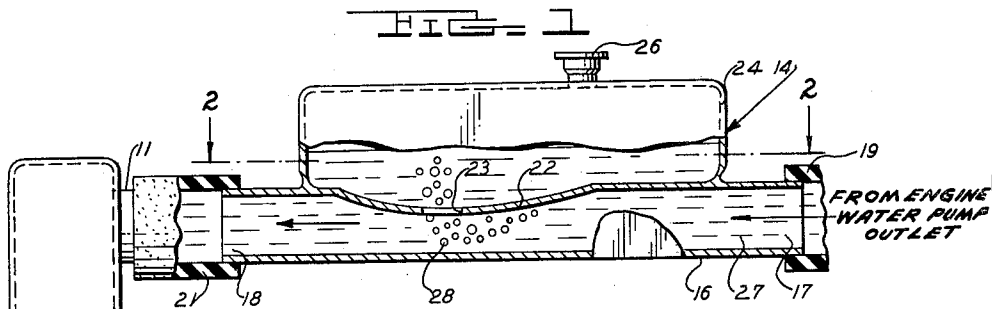
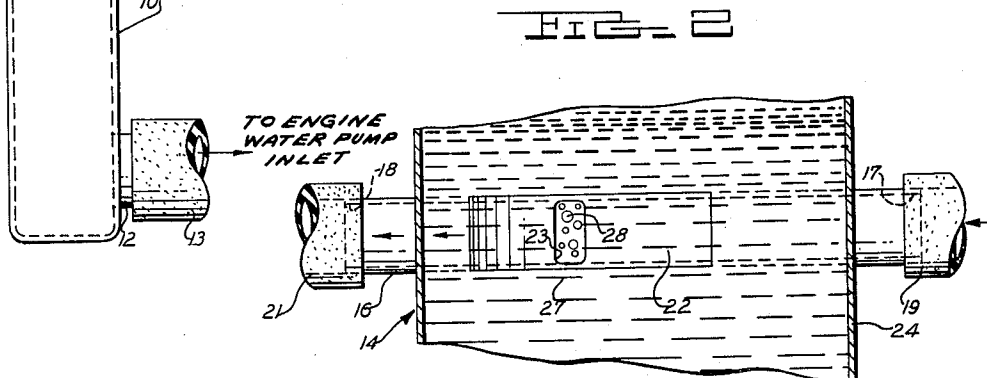
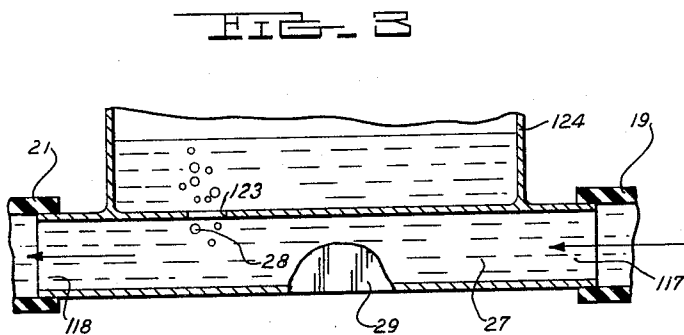
A. VERDURA ET AL

3,195,294

FLUID SEPARATOR

Filed March 20, 1961

2 Sheets-Sheet 1



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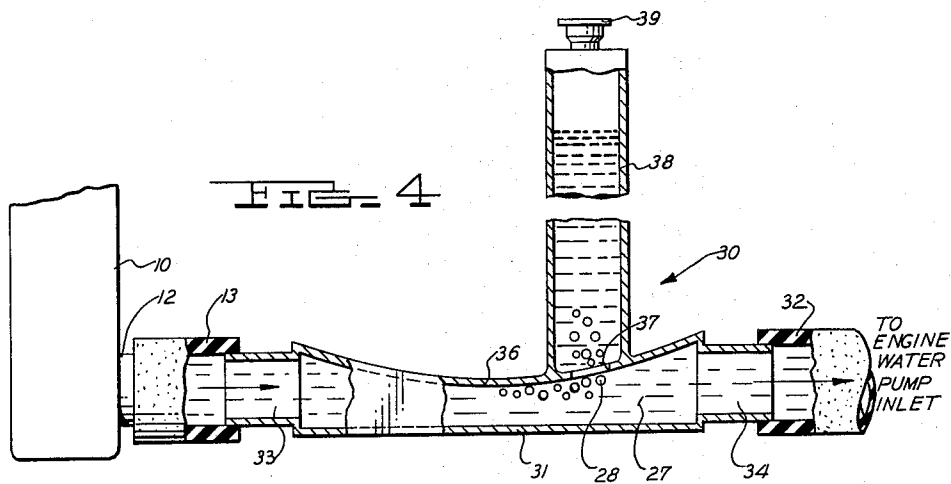
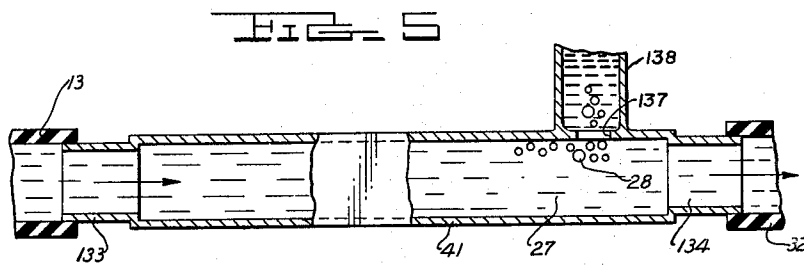
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FLUID SEPARATOR

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FLUID SEPARATOR

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10 Claims. (Cl. 55-159)

This invention is concerned with means for separating or purging gas or air bubbles from a flowing liquid. More particularly it is concerned with a separating device for removing gas bubbles from an automotive cooling system.

Cooling systems having entrained gas bubbles are inefficient. Water pump cavitation, increase in rust formation and corrosion, overheating, foaming of the coolant and overflow loss of the coolant are a few of the most common problems encountered as a result of air contamination.

Present cooling systems generally embody a reservoir and surge tank either as a part of the radiator or as a member separate from the radiator. The reservoir and surge tank provides not only expansion room for the coolant but also acts as a reservoir for the coolant, as a means for filling the cooling system, and for separating entrained air in the coolant. The reservoir portion of the reservoir and surge tank is normally located above a baffle provided in the tank. Air may be drawn into the cooling system when the coolant has reached the level of the baffle. Air may also be drawn into the cooling system by virtue of leaks in the system. Even exhaust gas leakage into the cooling system is possible and does occur adding to the contamination of the coolant. The present systems require considerable time to purge themselves of gas bubbles.

The invention is directed to a fluid separating means for automatically and effectively purging gas bubbles from the coolant. The fluid separating means, furthermore, incorporate a reservoir for surplus coolant as well as a place for the entrained gases to collect and separate from coolant. The invention may be used between the internal combustion engine and the radiator inlet, or between the radiator outlet and the internal combustion engine.

In the preferred embodiment a venturi section is provided in the top of the fluid separating means. An opening is provided in the venturi section downstream of the most restricted part of the venturi which communicates with a liquid containing reservoir.

Another embodiment of the invention provides for the upwardly facing opening to be located in the top of a conduit which does not have a venturi section.

An object of this invention therefore is to provide an effective fluid separating means.

Another object of this invention is to provide a means for automatically deaerating a cooling system.

Still another object of this invention is to provide fluid separating means which has means for separating gas bubbles from a flowing liquid combined with a reservoir of liquid, and means for filling said reservoir.

Still another object is to provide a fluid separating means in combination with a reservoir of liquid which is simple in construction, easy to manufacture, dependable in operation and relatively low in cost.

Other objects and advantages of this invention will become more apparent when considered in connection with the accompanying drawings, wherein:

FIGURE 1 is a fragmentary schematic side elevational view of a cooling system incorporating an embodiment of this invention between the mechanism to be cooled and the inlet of the radiator, and

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FIGURE 2 is a sectional view taken on the plane indicated as 2-2 of FIGURE 1, and

FIGURE 3 is a cross sectional view of an alternate embodiment of the fluid separating means shown in FIGURE 1, and

FIGURE 4 is a fragmentary schematic side elevational view of another embodiment of this invention in which the fluid separating means is located between the radiator outlet and the inlet of the mechanism to be cooled, and

FIGURE 5 is an alternate construction of the fluid separating means used in FIGURE 4.

Referring now to the drawings and in particular FIGURES 1 and 2, a radiator is indicated generally at 10 having an inlet 11 and an outlet 12. Outlet 12 is adapted to be connected by a conduit 13 shown in part to the water pump inlet, for example, of an internal combustion engine.

A combined fluid separator and liquid containing reservoir and surge tank is shown at 14 and includes a conduit 16 having an inlet 17 and an outlet 18. Inlet 17 is connected to conduit 19 shown in part, which is adapted to be connected to the water pump outlet of an internal combustion engine. Outlet 18 is connected by conduit 21 to the radiator inlet 11.

The fluid separating means is provided in the conduit 16. A venturi section 22 is provided in the top portion of conduit 16 intermediate of the inlet 17 and outlet 18. An upwardly facing opening 23 is located in the venturi section 22 and extends transversely across the conduit 16 so that it covers a distance which is substantially equal to the widest portion of the conduit 16 at the site of the opening. This insures that all of the liquid indicated at 27 flowing through conduit 16 will pass under the upwardly facing opening 23. The upwardly facing opening 23 is located at a location downstream from the most restricted portion of the venturi 22.

A combined liquid containing reservoir and surge tank 24 is integrally connected to the top of the conduit 16 so that the upwardly facing opening 23 communicates with the inside of the combined liquid containing reservoir and surge tank 24. A filler cap 26 is located in the top of the combined liquid containing reservoir and surge tank 24 for the purpose of filling the system with coolant. The combined liquid containing reservoir and surge tank 24 extends upwardly a distance sufficient to make it the highest part of the cooling system.

In the operation of the device, the liquid 27 containing entrained gas or air bubbles 28 is pumped downstream from the water pump outlet of the internal combustion engine through conduit 19, inlet 17 and into the conduit 16. Once inside conduit 16 it comes in contact with the venturi section 22. All of this time gas bubbles 28 having a density less than the liquid 27 will be rising in the liquid 27. The venturi section 22 permits an accumulation and combining of a number of the gas bubbles 28 adjacent to the surface of the venturi section 22. The gas bubbles 28 will quickly rise through the upwardly facing opening 23 as the liquid 27 flows past the upwardly facing opening 23. Gas bubbles 28 continue to rise and separate gravitationally from the quiescent liquid in the combined liquid containing reservoir and surge tank 24 until they are expelled into the air space above the liquid in the combined liquid containing reservoir and surge tank 24.

Referring now to FIGURE 3, an alternate conduit 29 is provided which has an inlet 117 and an outlet 118 connected to conduits 19 and 21. Conduit 29, however, does not have the venturi section. It does, however, have the upwardly facing opening 123 in the top of the conduit 29 which communicates in the same manner with the liquid 27 in the combined liquid containing reservoir and surge

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tank 124. In this embodiment the gas bubbles 28 simply rise to the top of the conduit 29 and when reaching the opening 123 separate themselves from the liquid in the conduit 29 and are received in the combined liquid containing reservoir and surge tank 124.

Referring now to FIGURE 4, a combined fluid separator and liquid containing reservoir conduit is indicated at 30. The fluid separating means is provided in conduit 31. Conduit 31 is located between the conduit 13 connected to the outlet 12 of the radiator 10 and the conduit 32 shown in part. Conduit 32 is connected to the water pump inlet of the internal combustion engine.

Conduit 31 is also provided with an inlet 33 and an outlet 34. Conduit 31 may be formed with a box-like cross section with the top portion of the conduit 31 including a venturi section 36. An upwardly facing opening 37 is also provided in the venturi section 36 downstream of the most restricted portion of the venturi section 36. Thus, opening 37 is positioned in a portion of conduit 31 where the cross sectional area of conduit 31 varies directly with the distance from the most restricted portion of the conduit.

A liquid containing reservoir conduit 38 is secured to the top of the venturi section 36 so that the upwardly facing opening 37 communicates with the interior of the liquid containing reservoir conduit 38. The liquid containing reservoir conduit 38 may have its axis substantially perpendicular to the axis of the conduit 31. The liquid containing reservoir conduit 38 may be arranged however at any convenient vertical angle to conduit 31 as long as it rises higher than the other portions of the cooling system, and furthermore that the gas bubbles 28 be permitted to rise to the surface of liquid 27. A filler cap 39 is disposed on top of the liquid containing reservoir conduit 38 so that the liquid 27 may be added as needed by the system. Liquid containing reservoir conduit 38 also acts as an expansion chamber for the liquid 27. The operation of this embodiment is similar to the embodiment of FIGURES 1 and 2.

FIGURE 5 discloses an alternate embodiment to the fluid separating means shown in FIGURE 4. In this embodiment the conduit indicated at 41 has an inlet 133, and outlet 134 and a substantially constant cross section. Conduit 41 does not have a venturi section. Gas bubbles 28 simply rise gravitationally to the top of the conduit 41 and when reaching the upwardly facing opening 137 pass into the confines of the quiescent liquid 27 of the liquid containing reservoir conduit 138. This embodiment is similar in operation to the embodiment of FIGURE 3.

The aforementioned described cooling systems are automatically self-purging of gas bubbles as long as there is a full liquid flow through any of the described conduits 16, 29, 31 or 41. A liquid expansion chamber as well as a reservoir of coolant also is provided. The liquid coolant level may drop substantially without detriment to the cooling system operation as long as it does not drop below the level of the corresponding upwardly facing opening 23 123, 37 or 137.

The invention is adaptable to many and different cooling systems used with many and different forms of mechanisms. It will be understood therefore that the invention is not to be limited to the exact construction shown and described but that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. A device for the separation of a gas from a flowing liquid in which the gas is relatively insoluble comprising a reservoir means and a conduit having an inlet means, an outlet means, a portion of reduced cross sectional area between said inlet means and said outlet means, and an upwardly facing opening located between the most restricted part of said conduit and said outlet means and positioned in a portion of said conduit where the cross

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sectional area of said conduit varies directly with the distance from said most restricted part, said reservoir means communicating with said conduit through said upwardly facing opening, having a portion thereof situated above said conduit and said upwardly facing opening and being positioned in relation to said conduit to admit of gravitational separation of a gas into said portion from a liquid in said conduit.

2. A device for the separation of a gas from a flowing liquid in which the gas is relatively insoluble comprising a reservoir means and a conduit having an inlet means, an outlet means, a portion of reduced cross sectional area between said inlet means and said outlet means, and an upwardly facing opening located between the most restricted part of said conduit and said outlet means and positioned in a portion of said conduit where the cross sectional area of said conduit varies directly with the distance from said most restricted part, said reservoir means being integrally connected to the top of said conduit and communicating with said conduit through said upwardly facing opening so as to admit of uninterrupted ascending flow of gas from said conduit through said opening into said reservoir.

3. A device for the separation of a gas from a flowing liquid in which the gas is relatively insoluble comprising a reservoir means and a conduit having an inlet means, an outlet means, a portion of reduced cross sectional area between said inlet means and said outlet means, and an upwardly facing opening located between the most restricted part of said conduit and said outlet means and positioned in a portion of said conduit where the cross sectional area of said conduit varies directly with the distance from said most restricted part, said reservoir means communicating with said conduit through said upwardly facing opening and being integrally connected to the top of said conduit in a manner such that the resulting connection encompasses said upwardly facing opening and admits of uninterrupted ascending flow of gas from said conduit through said opening into said reservoir.

4. A device for the separation of a gas from a flowing liquid in which the gas is relatively insoluble comprising a reservoir means and a conduit having an inlet means, an outlet means, and an upwardly facing opening located between the most restricted part of said conduit and said outlet means and positioned in a portion of said conduit where the cross sectional area of said conduit varies directly with the distance from said most restricted part and the downstream extremity of said opening is above the upstream extremity of the same, said reservoir means communicating with said conduit through said upwardly facing opening, having at least a portion thereof situated above said conduit and said upwardly facing opening and being positioned to admit of gravitational separation of a gas into said portion from a liquid in said conduit, the area encompassed by said opening being small compared to the average cross sectional area of said reservoir means.

5. A device for the separation of a gas from a flowing liquid in which the gas is relatively insoluble comprising a reservoir means and a conduit having a first end section of predetermined cross sectional area, an intermediate section of lesser cross sectional area, a second end section of greater cross sectional area than said intermediate section having a tapered portion adjacent said intermediate section the cross sectional area of which varies directly with the distance from said intermediate section, inlet means associated with said first end section adapted to admit liquid to flow into said conduit, outlet means associated with said second end section adapted to admit liquid to flow from said conduit, and an upwardly facing opening positioned within said tapered portion, said reservoir means communicating with said conduit through said upwardly facing opening, having a portion thereof situated above said conduit and said upwardly facing opening and being positioned to admit of gravitational separation of a gas from a liquid in said conduit.

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tion of a gas into said portion from a liquid in said conduit.

6. A device for the separation of a gas from a flowing liquid in which the gas is relatively insoluble comprising a conduit and a reservoir above and connected to the top of said conduit, said conduit having an inlet and an outlet and a venturi section intermediate of said inlet and outlet, said venturi section being provided with at least one upwardly facing opening which communicates with said reservoir and is located downstream from the most restricted portion thereof, said reservoir being positioned in relation to said conduit so as to admit of uninterrupted ascending flow of gas from said conduit through said opening into said reservoir.

7. A device for the separation of air bubbles from a flowing stream of water comprising a conduit and a combined reservoir and surge tank connected to the top of said conduit, said conduit having an inlet and an outlet and a venturi section intermediate of said inlet and outlet, said venturi section being provided with at least one upwardly facing opening which communicates with said reservoir and is located downstream from the most restricted portion thereof, said opening extending transversely across said conduit for a major portion of the distance across the widest portion of said conduit at the position of said opening, said reservoir being positioned in relation to said conduit so as to admit of uninterrupted ascending flow of air from said conduit through said opening into said reservoir.

8. A device for the separation of air bubbles from a flowing stream of water comprising a conduit and a combined reservoir and surge tank directly above and integrally connected to the top of said conduit, said conduit having an inlet and an outlet and a venturi section intermediate of said inlet and outlet, said venturi section being provided with at least one upwardly facing opening which communicates with said reservoir and is located downstream from the most restricted portion thereof, said opening extending transversely across said conduit for a distance substantially equal to the widest portion of said conduit at the position of said opening, said reservoir being positioned in relation to said conduit so as to admit of uninterrupted ascending flow of air from said conduit through said opening into said reservoir.

9. In a cooling system the combination of a radiator inlet; a conduit having outlet means connected to and communicating with said radiator inlet, an inlet means adapted to admit a flow of liquid and gas into said conduit, a section of reduced cross sectional area between said

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inlet means and said outlet means and an upwardly facing opening between the most restricted part of said conduit and said outlet means and positioned in a portion of said conduit where the cross sectional area of said conduit varies directly with the distance from said most restricted part so that the downstream extremity of said opening is above the upstream extremity of the same; and a combined reservoir and surge tank communicating with said conduit through said upwardly facing opening and positioned in relation to said conduit so as to admit of uninterrupted ascending flow of gas from said conduit through said opening into said reservoir, said combined liquid containing reservoir and surge tank having a removable filler cap remote from the upwardly facing opening.

10. In a cooling system the combination of a radiator outlet; a conduit having an inlet means adapted to admit a flow of liquid and gas into said conduit and communicating with said radiator outlet, an outlet means, a section of reduced cross sectional area between said inlet means and said outlet means and an upwardly facing opening between the most restricted part of said conduit and said outlet means and positioned in a portion of said conduit where the cross sectional area of said conduit varies directly with the distance from said most restricted part so that the downstream extremity of said opening is above the upstream extremity of the same; and a combined reservoir and surge tank communicating with said conduit through said upwardly facing opening and positioned in relation to said conduit so as to admit of uninterrupted ascending flow of gas from said conduit through said opening into said reservoir.

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