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COOLING SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

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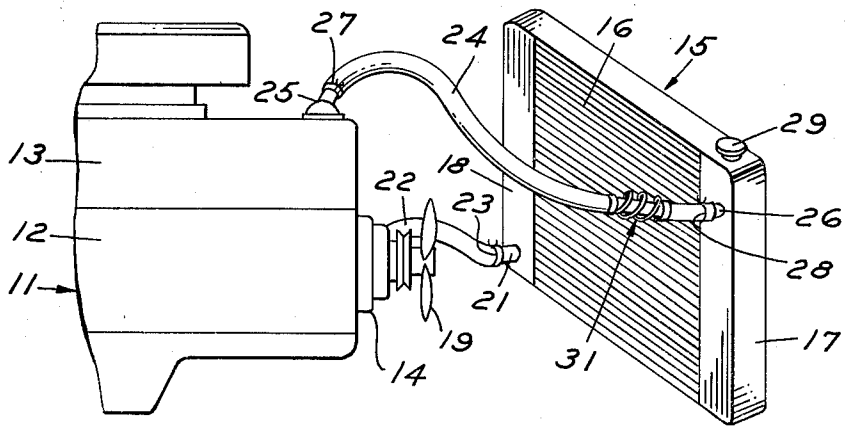


FIG. 1

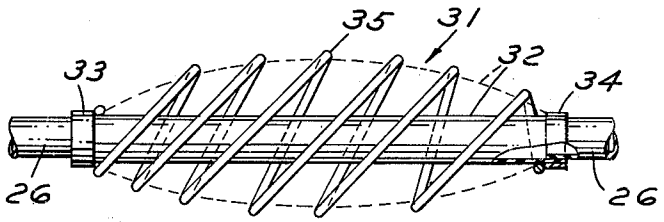


FIG. 2

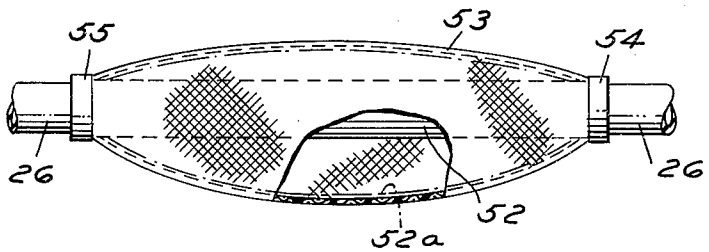


FIG. 3

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COOLING SYSTEM FOR AN INTERNAL COMBUSTION ENGINE

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This invention relates to a liquid cooling system for an internal combustion engine and more particularly to a cooling system embodying an improved expansion device.

In the liquid cooling system of an automotive engine it is now a common practice to use a crossflow type radiator. The crossflow radiator is desirable since it permits a low hood line. A separate, expansion tank, however, must be used with the crossflow radiator to compensate for the increase in volume of the coolant at engine operating temperatures. The separate expansion tank normally employed with crossflow radiators increases the possibility of coolant system leaks since additional conduits and fittings are required to connect the expansion tank into the system.

It is therefore a principal object of this invention to provide an improved expansion device for the cooling system of an internal combustion engine that will not present the possibility of leakage.

The current emphasis upon low maintenance vehicles has also created a demand for sealed engine cooling systems. In addition to requiring premium coolants, the sealed cooling system requires higher quality components. It is essential that the number of conduits and connections be reduced in a sealed system to reduce the number of possible areas of leakage. If a separate expansion device is provided, additional areas of leakage are introduced into this system.

It therefore is a further object of this invention to provide a liquid cooling system that embodies an integral expansion device.

A liquid cooling system for an internal combustion engine embodying this invention includes a cooling jacket for the engine. Means including a flexible conduit are provided for circulating liquid cooling through the system. The flexible conduit includes an expandable section that is resilient in a radial direction. The expandable section expands upon temperature induced increases in the volume of the coolant contained in the system. Expansion limiting means surround the expandable section to limit the degree of expansion.

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

FIGURE 1 is a schematic view of a liquid cooling system for an internal combustion engine embodying this invention.

FIGURE 2 is an enlarged side-elevational view of the expansion device employed in the cooling system shown in FIGURE 1.

FIGURE 3 is a side-elevational view of another form of expansion device.

Referring now in detail to the drawings and in particular to FIGURE 1, a liquid cooled internal combustion engine is identified generally by the reference numeral **11**. The engine **11** includes a cylinder block **12** and cylinder head **13** that are provided with cooling jackets through which a suitable liquid coolant may be circulated. A crankshaft driven coolant pump **14** is positioned at the front of the cylinder block **12** for circulating the liquid coolant.

The crossflow radiator or heat exchanger, indicated

generally by the reference numeral **15**, is positioned at the front of the engine **11**. The radiator **15** has a section **16** made up of a plurality of water tubes and heat exchanger fins. Header tanks **17** and **18** are positioned at each end of the section **16**. An engine driven fan **19** causes air circulation across the radiator **17**.

A coolant outlet fitting **21** is positioned in the lower side of the header tank **18**. One end of a flexible hose **22** is connected to the outlet fitting **21** by a hose clamp **23**. The other end of the flexible hose **22** is affixed to the inlet side of the coolant pump **14**. The coolant pump **14** discharges coolant into the cylinder block **12** and cylinder head **13**. A flexible conduit **24** is provided to convey coolant from an engine coolant outlet fitting **25** positioned upon cylinder head **13**, to a radiator inlet fitting **26** positioned at the upper end of the header tank **17**. Clamps **27** and **28** secure the respective ends of the flexible conduit **24** to their respective fittings.

The coolant system illustrated is of the sealed type. That is, a long-life liquid coolant having a low freezing point and a high boiling point is contained within the system. A filler cap **29** may be positioned upon the header tank **17** to permit topping up of the system. The filler cap **29** may also include a pressure relief valve of any known type (not shown).

If the system is completely filled with coolant when the engine is at normal ambient temperatures, the coolant will expand when it reaches the normal engine operating temperature. It is additionally desirable to permit a certain degree of pressurization in the system to raise the boiling point of the coolant. The changes in coolant volume are accommodated by an expansion device indicated generally by the reference numeral **31** and shown in greater detail in FIGURE 2. The expansion device **31** comprises an expandable section **32** that may be integral with the conduit **24** or may be a separate portion secured at each end to the conduit **26**, as by clamps **33** and **34**. The expandable section **32** is more resilient in a radial direction than the conduit **26** so that the increased pressure in the coolant system generated by the expansion of the coolant may readily deform the outer diameter of the section **32** as shown in the dotted line view of FIGURE 2.

It is essential that some means is provided to limit the radial expansion of the section **32**. For this purpose a barrel-shaped coiled steel wire **35** encircles the section **32**. When the section **32** expands to the diameter shown in the dotted line view it will be contacted by the internal diameter of the barrel-shaped wire **35** and further radial expansion will be limited.

Another form of expansion limiting device is shown in FIGURE 3. In this figure the conduit **26** is continuous. A radially expandable section **52** is provided, however, by forming the section **52** with a thinner wall or with less internal reinforcing than the remaining portion of the conduit **26** or both. Upon increases in the volume of the coolant within the system, the section **52** will increase in diameter to the shape shown by the dotted line **52***a*. A woven wire or cloth expansion limiting element **53** encircles the section **52** and is affixed axially thereto by the clamps **54** and **55**.

The internal volume of the expansion limiting element **53** is greater than the volume displaced by the expandable section **52** at normal, ambient coolant temperatures. The volume of the woven expansion limiting element **53** is sufficient, however, to permit normal expansion of the coolant and expandable section **52** at engine operating temperatures. Further expansion is limited by the contact of the outer surface of the section **52** with the inner surface of the expansion limiting element **53**.

It is to be understood that this invention is not limited to the exact construction shown and described. As has

been noted, the expandable section may be a separate or integral element of one of the cooling system conduits. The conduit that embodies the expansion device can be any conduit in the cooling system that carries the liquid coolant. In addition to being one of the conduits that interconnects the engine cooling jacket to the radiator, the conduit may connect the engine cooling jacket to a vehicle heater or an induction system heating device. Other changes and modifications may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A liquid cooling system for an internal combustion engine comprising a cooling jacket for said engine, means including a flexible conduit for circulating coolant through said system, said flexible conduit comprising an expandable section, said section being resilient in a radial direction for expansion upon changes in the volume of the coolant contained in said system, and expansion limiting means surrounding said expandable section for engagement with said section upon a predetermined expansion for limiting further expansion.

2. A liquid cooling system as defined by claim 1 wherein the expansion limiting means comprises a coiled steel wire.

3. A liquid cooling system as defined by claim 1 wherein the expansion limiting means comprises a woven element surrounding the expandable section.

4. A liquid cooling system for an internal combustion engine comprising a cooling jacket for said engine, a heat exchanger, conduit means for circulating liquid coolant between said heat exchanger and said cooling jacket, said conduit means including an expandable section, said expandable section being resilient in a radial direction for expansion from a normal diameter to an increased diameter upon a temperature induced increase in the volume of the coolant contained in said system, and expansion limiting means surrounding said expandable section for engagement with said section upon a predetermined expansion for limiting further expansion.

5. A liquid cooling system as defined by claim 4 wherein the expansion limiting means comprises a substantially rigid coiled wire encircling the expandable section, the inside diameter of said coiled wire being greater than the normal external diameter of said expandable section.

6. A liquid cooling system as defined by claim 4 wherein the expansion limiting means comprises a woven element surrounding the expandable section, the internal volume of said woven element being greater than the volume displaced by said expandable section in its normal diameter.

7. A liquid cooling system for an internal combustion engine comprising a cooling jacket for said engine, a crossflow heat exchanger, first conduit means interconnecting the outlet of said cooling jacket with one side of said heat exchanger, second conduit means interconnecting the inlet of said cooling jacket with the other side of said heat exchanger, at least one of said conduits comprising an expandable section, said section being resilient in a radial direction for expansion in the diameter of said section upon temperature induced changes in the volume of the coolant contained in said system, and expansion limiting means surrounding said expandable section for engagement with the external diameter of said section upon a predetermined expansion for limiting further expansion.

8. A liquid cooling system as defined by claim 7 wherein the expansion limiting means comprises a barrel-shaped coiled wire surrounding the expandable section.

9. A liquid cooling system as defined by claim 7 wherein the expansion limiting means comprises a substantially rigid woven element surrounding the expandable section.

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KARL J. ALBRECHT, *Primary Examiner.*