

SPECIFICATION

Heat exchanger

The invention relates to heat exchangers incorporating resilient means for connecting a

5 core to a tank of the heat exchanger or radiator.

Heat exchangers or radiators, and primarily the type of radiators used to cool internal combustion engines either on a moving vehicle or on a fixed stationary frame while usually constructed as

10 single integral units, have been constructed by mounting a plurality of cooling cores between a pair of spaced manifold tanks or by hooking the cooling cores together by hoses. These cooling cores are formed from a tube having fins radiating therefrom and providing means for fluid coolant delivered from the circulating system of the engine to flow from one manifold through the tube into the other manifold. Air flow passes through the radiator to absorb heat from the radiating fins thereby reducing the heat of the fluid coolant flowing through the tubes. The cooling cores may be removed individually after one of the manifolds or hoses is disconnected.

It is essential in such radiators to provide a

25 fluid-tight connection between the manifolds and the cooling cores. Often, the cooling cores are soldered to the manifold tanks. In other constructions the cooling cores are clamped to the manifold or are provided with grommets or O-rings to provide a sealing capability when the cooling cores are plugged into the manifolds. Because of the high number of seals required, some leakage problems are expected, particularly in the case of O-rings which are not adapted to

35 tolerate much relative motion.

In addition, the heat exchangers must be constructed so that thermal expansion of the cooling cores as the coolant heats up is compensated for. Since the cooling cores are

40 normally made from copper or aluminum which expands more rapidly than the steel frame to which the radiator is bolted, the thermal growth of the radiator is much greater than that of the frame. Hence, solid soldered or clamped connections are not desirable, since they do not readily permit relative movement between the connected components.

Recognizing that vehicle frames distort during operation, the radiator cores have in the past been

50 resiliently mounted in some manner to prevent rupture of the radiator cores which might otherwise occur if the cores were rigidly attached between the frame and manifold. These soft suspensions, provide a misalignment mount function, and may frequently lead to resonant vibration of the radiators. To prevent malfunction of the radiator, the radiator must be isolated against shock and vibration. Large radiators have utilized separate snubbers to prevent excessive

55 vibration amplitudes at resonant speeds, but it is expensive to design and manufacture a snubber to provide the desired damping.

In accordance with the present invention we provide a heat exchanger comprising a fluid tank

65 and a cooling core, one of the tank and core having a bore and the other having a protruding tube inserted in the bore; and means for resiliently connecting the core to the tank, the means including an elastomeric grommet having an opening which receives the tube, the grommet being positioned between the tank and the core to seal the tube to the bore, and the means further including an upstanding elastomeric lip portion integral with, and at least partly spaced from and extending around, the grommet, the lip portion being compressed between the core and the tank to seal the connection between the tank and the core and to provide a damped, resilient mount therebetween.

80 Preferably, the one of the tank and the core has a plurality of bores and the other has a corresponding plurality of protruding tubes, each tube being received in a respective bore; and the resilient connecting means comprises a

85 corresponding plurality of elastomeric grommets, each grommet having an opening which receives a respective tube, adjacent grommets being connected together by elastomeric strip portions, and at least a part of the upstanding lip portion being spaced from the grommets and defining a peripheral wall of the resilient connecting means.

Where the cooling core has a protruding tube and the tank has a bore, the grommet may provide a seal between the outer diameter of the cooling core tube and the inner diameter of the bore leading to the interior of the tank. The lip portion is placed in a stressed state by compressing the tank and cooling core together. The resilient means thereby provides a soft resilient mount to

100 compensate for thermal expansion, the lip portion becoming relatively rigid when deflected sufficiently to prevent vibration when the apparatus is operated at some resonant speed.

The heat exchanger may comprise a plurality of

105 cooling cores and the resilient means allows misalignment of the joint between the manifold tanks and the or each cooling core and simultaneously allows the removal, service and/or installation of the or each cooling core module without disturbing the complete core assembly.

An example of a heat exchanger in accordance with the present invention is illustrated in the accompanying drawings, in which:-

Figure 1 is a plan showing an example of a

115 resilient means for connecting a tank and core;

Figure 2 is a side elevation, partially in section, of the resilient means shown in Figure 1;

Figure 3 is a cross-section of part of the resilient means in an unstressed state between a core and a tank;

Figure 4 is a cross-sectional view taken on the line 4—4 in Figure 6, similar to Figure 3 but showing the resilient means in a stressed or compressed state;

Figure 5 is a partial cross-section of the heat exchanger; and,

Figure 6 is a cross-section taken on the line 6—6 in Figure 5.

A portion of a heat exchanger, or radiator 10, is

illustrated in Figures 5 and 6. The heat exchanger 10 includes a header or inlet manifold tank 12, a bottom or outlet manifold tank 14, and a plurality of cooling modules or cores 16. Liquid coolant is delivered by a pump (not shown) to the interior of the inlet tank 12 via an inlet (not shown). The liquid coolant, which enters at high temperature, is circulated through the cooling cores 16, so that the temperature of the coolant is reduced. The cooled coolant flows from the cooling cores 16 into the interior of the outlet tank 14 and exits through an outlet conduit 18.

The cooling cores 16 are of conventional design and have through tubes to which a plurality of radiating fins 19 have been attached. Each cooling core 16 has a top collector tank 20 with a top plate 22 and a bottom collector tank 24 with a bottom plate 26 which have, respectively, upwardly and downwardly extending inlet and outlet tubes 28 and 30. The inlet and outlet tubes 28 and 30, in turn, are adapted to fit within the openings 32 formed in the thickened boss portions 34 of the bottom wall 36 of the inlet tank 12 and in the openings 38 formed in the thickened boss portions 40 of the top wall 42 of the outlet tank 14. The tubes 28 and 30 of each cooling core 16 lie along a pair of lines extending between the top and bottom of the core. While a radiator having dual inlet and outlet core tubes is shown herein, each core may have only one inlet tube and one outlet tube, or may have two, or more than two, inlet and outlet tubes depending on flow requirements. As shown in Fig. 6, the cooling cores 16 are angularly oriented relative to one another to present increased surface area to the air flow. The cores 16 could also lie parallel to each other or have a different orientation.

Hot coolant flows into the inlet tank 12 and into the openings 44 of the tubes 28. The heated fluid coolant flows through tubes in the cooling cores 16, where the heat in the coolant is radiated to the radiating fins 19 and is removed by the passage of air over, around and between the tubes and fins.

The coolant, with a reduced temperature, is collected in the outlet tank 14 where it is pumped back to the engine.

A resilient elastomeric element, generally designated 50, is placed between the cooling cores 16 and the respective inlet and outlet tanks 12 and 14 to provide a seal therebetween, to provide a soft mount to isolate against shock and vibration and to provide compensation for thermal expansion of the cores as heat is absorbed. Interchangeable resilient elements are utilized at each end of a cooling core 16.

The resilient element 50 integrally includes a pair of raised grommet portions 52 and 54, a strip portion 56 spanning the grommet portions 52 and 54, and a raised lip 58 extending around the edge of the strip portion 56 and the grommet portions 52 and 54.

The relatively flat strip portion 56 has a centre portion 60 spanning the distance between the pair of grommet portions 52 and 54 and has a pair of end portions 62 and 64 extending longitudinally

beyond the grommet portions 52 and 54, respectively. As seen in Figs. 1 and 2, the strip portion, therefore, assumes an elongate, generally rectangular configuration.

The grommet portions 52 and 54 are annularly formed and define bores therethrough, designated 66 and 68, which are adapted to receive the tubes 28, 28 or 30, 30. The grommet portions 52 and 54 include curved edges 70 at the lower end of the bores 66 and 68 to facilitate insertion of a tube therein. To facilitate insertion of the grommet portions 52 and 54 into the manifold tank bores 32, 32 or 38, 38, the upper end of the outer cylindrical surfaces 72 thereof includes a cammed or chamfered edge 74. The outer surfaces 72 may be circumferentially grooved (not shown) without a reduction in reliability to further facilitate insertion thereof into the manifold tank bores.

The lip portion 58 includes a part 76 formed at the junction between the strip portion and the grommet portion surrounding each of the grommet portions 52 and 54, parts 78 and 80 extending along the edge of the centre strip portion 60, and parts 82 and 84 extending around the end strip portions 62 and 64, respectively. As a result, the resilient element 50 has a flat surface 86 on a bottom wall and a built-up surface on the opposite or upper wall defining recesses 88, one between the grommet portions 52 and 54 and one at each end. This permits sufficient deflection or compression of the lip portion 58 unobtainable with a solid structure not embodying a lip.

As seen in Figs. 3 and 4, the grommet portion 54 of the resilient element 50 is placed over the tube 28 of a cooling core 16 to place the flat surface 86 against the plate 22 thereof. Then, the grommet portion 54 is inserted into the opening 32 in the inlet tank 12 so that the upper edge 90 of the lip portion 58 seats against the wall 36 of the inlet tank 12. When the tank 12 is moved forcibly against the cooling core 16 in the direction of the axis of the tube 28, the resilient element 50 is placed in a compressed condition, whereupon the lip part 76 will deform to define a seat for the tank bore edge and the grommet portion 54 will be deformed to provide a tight seal against coolant leaks.

The lip portion 58 around the perimeter of the strip portion 56 and the lip part 76 around the grommet portion 54 will also deform as seen in Fig. 4 to act as a simple compression mount. The height and width of the lip portion 58 (height-to-width ratio as well as the absolute dimension) and the total length of the lip portion 58 determine the spring rate and the relative travel between the cooling core 16 and the inlet tank 12. Such a mounting becomes quite rigid when deflected sufficiently, thereby preventing excessive vibration. This type of mounting provides the damping necessary to prevent build-up of excessive vibration amplitudes during operation at resonant speeds.

There may be a plurality of such resilient members, e.g., one for each tube. In contrast, there need only be a single element for mounting

all of the cores to one manifold tank. The function of the resilient mounting and sealing element is the same regardless. In addition, it is noted that the cooling cores can be formed with relatively short inlet and outlet tubes and that the manifold tanks need not be soldered or otherwise rigidly fixed to the cooling cores.

Hence, this design and construction of a heat exchanger is suitably adapted for use with a liquid-cooled internal combustion engine of a land vehicle, the engine of a stationary installation or the like where air is forced or drawn over the cooling cores. If one of the cores becomes defective or leaks, it is only necessary to unclamp the top tank 12, raise it from the cores, remove and replace the defective core and reclamp the unit, all in a relatively short time and in a simple fashion.

CLAIMS

1. A heat exchanger comprising a fluid tank and a cooling core, one of the tank and the core having a bore and the other having a protruding tube inserted in the bore; and means for resiliently connecting the core to the tank, the means including an elastomeric grommet having an opening which receives the tube, the grommet being positioned between the tank and the core to seal the tube to the bore, and the means further including an upstanding elastomeric lip portion integral with, and at least partly spaced from and extending around, the grommet, the lip portion being compressed between the core and the tank to seal the connection between the tank and the core and to provide a damped, resilient mount therebetween.

2. A heat exchanger according to claim 1, wherein the one of the tank and the core has a plurality of bores and the other has a corresponding plurality of protruding tubes, each tube being received in a respective bore; and wherein the resilient connecting means comprises a corresponding plurality of elastomeric grommets, each grommet having an opening which receives a respective tube, adjacent grommets being connected together by elastomeric strip portions, and at least a part of the upstanding lip portion being spaced from the grommets and defining a peripheral wall of the resilient connecting means.

3. A heat exchanger according to claim 1 or claim 2, wherein the or each grommet is positioned between the outer surface of a respective tube and the inner surface of the bore

in which the tube is received, to provide a seal therebetween.

4. A heat exchanger according to any of the preceding claims, further comprising a second fluid tank connected to the end of the cooling core remote from the first tank, one of the second tank and the core having a bore and the other having a protruding tube inserted in the bore; and means for resiliently connecting the core to the second tank, the means including an elastomeric grommet having an opening which receives the tube, the grommet being positioned between the second tank and the core to seal the tube to the bore and the means further including an upstanding elastomeric lip portion integral with, and at least partly spaced from and extending around, the grommet, the lip portion being compressed between the respective core and tank to seal the connection between the tank and the core and to provide a damped resilient mount therebetween.

5. A heat exchanger according to claim 4, wherein the one of the second tank and the core has a plurality of bores and the other has a corresponding plurality of protruding tubes, each tube being received in a respective bore; and wherein the resilient means connecting the core to the second tank comprises a corresponding plurality of elastomeric grommets, each grommet having an opening which receives a respective tube, adjacent grommets being connected together by elastomeric strip portions, and at least a part of the upstanding lip portion being spaced from the grommets and defining a peripheral wall of the resilient connecting means.

6. A heat exchanger according to claim 4 or claim 5, wherein the first and the second fluid tanks are axially movable one relative to the other, the core being removable from between the first and the second tanks when the axial distance between the tanks exceeds a preselected value.

7. A heat exchanger according to claim 6, wherein the core is removable from between the first and second tanks without removing the resilient connecting means.

8. A heat exchanger according to any of the preceding claims, comprising a plurality of cooling cores.

9. A heat exchanger according to any of the preceding claims, wherein the or each grommet is closely surrounded by a part of the lip portion.

10. A heat exchanger according to claim 1, substantially as described with reference to the accompanying drawings.



all of the cores to one manifold tank. The function of the resilient mounting and sealing element is the same regardless. In addition, it is noted that the cooling cores can be formed with relatively short inlet and outlet tubes and that the manifold tanks need not be soldered or otherwise rigidly fixed to the cooling cores.

Hence, this design and construction of a heat exchanger is suitably adapted for use with a liquid-cooled internal combustion engine of a land vehicle, the engine of a stationary installation or the like where air is forced or drawn over the cooling cores. If one of the cores becomes defective or leaks, it is only necessary to unclamp the top tank 12, raise it from the cores, remove and replace the defective core and reclamp the unit, all in a relatively short time and in a simple fashion.

CLAIMS

1. A heat exchanger comprising a fluid tank and a cooling core, one of the tank and the core having a bore and the other having a protruding tube inserted in the bore; and means for resiliently connecting the core to the tank, the means including an elastomeric grommet having an opening which receives the tube, the grommet being positioned between the tank and the core to seal the tube to the bore, and the means further including an upstanding elastomeric lip portion integral with, and at least partly spaced from and extending around, the grommet, the lip portion being compressed between the core and the tank to seal the connection between the tank and the core and to provide a damped, resilient mount therebetween.

2. A heat exchanger according to claim 1, wherein the one of the tank and the core has a plurality of bores and the other has a corresponding plurality of protruding tubes, each tube being received in a respective bore; and wherein the resilient connecting means comprises a corresponding plurality of elastomeric grommets, each grommet having an opening which receives a respective tube, adjacent grommets being connected together by elastomeric strip portions, and at least a part of the upstanding lip portion being spaced from the grommets and defining a peripheral wall of the resilient connecting means.

3. A heat exchanger according to claim 1 or claim 2, wherein the or each grommet is positioned between the outer surface of a respective tube and the inner surface of the bore

in which the tube is received, to provide a seal therebetween.

4. A heat exchanger according to any of the preceding claims, further comprising a second fluid tank connected to the end of the cooling core remote from the first tank, one of the second tank and the core having a bore and the other having a protruding tube inserted in the bore; and means for resiliently connecting the core to the second tank, the means including an elastomeric grommet having an opening which receives the tube, the grommet being positioned between the second tank and the core to seal the tube to the bore and the means further including an upstanding elastomeric lip portion integral with, and at least partly spaced from and extending around, the grommet, the lip portion being compressed between the respective core and tank to seal the connection between the tank and the core and to provide a damped resilient mount therebetween.

5. A heat exchanger according to claim 4, wherein the one of the second tank and the core has a plurality of bores and the other has a corresponding plurality of protruding tubes, each tube being received in a respective bore; and wherein the resilient means connecting the core to the second tank comprises a corresponding plurality of elastomeric grommets, each grommet having an opening which receives a respective tube, adjacent grommets being connected together by elastomeric strip portions, and at least a part of the upstanding lip portion being spaced from the grommets and defining a peripheral wall of the resilient connecting means.

6. A heat exchanger according to claim 4 or claim 5, wherein the first and the second fluid tanks are axially movable one relative to the other, the core being removable from between the first and the second tanks when the axial distance between the tanks exceeds a preselected value.

7. A heat exchanger according to claim 6, wherein the core is removable from between the first and second tanks without removing the resilient connecting means.

8. A heat exchanger according to any of the preceding claims, comprising a plurality of cooling cores.

9. A heat exchanger according to any of the preceding claims, wherein the or each grommet is closely surrounded by a part of the lip portion.

10. A heat exchanger according to claim 1, substantially as described with reference to the accompanying drawings.