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[54] **COOLING RADIATOR**

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[52] **U.S. Cl.** **165/76,** 165/148, 165/175, 165/178

[51] **Int. Cl.** **F28f 9/12**

[58] **Field of Search** 165/178, 175, 173, 165/148, 69, 76

[56] **References Cited**

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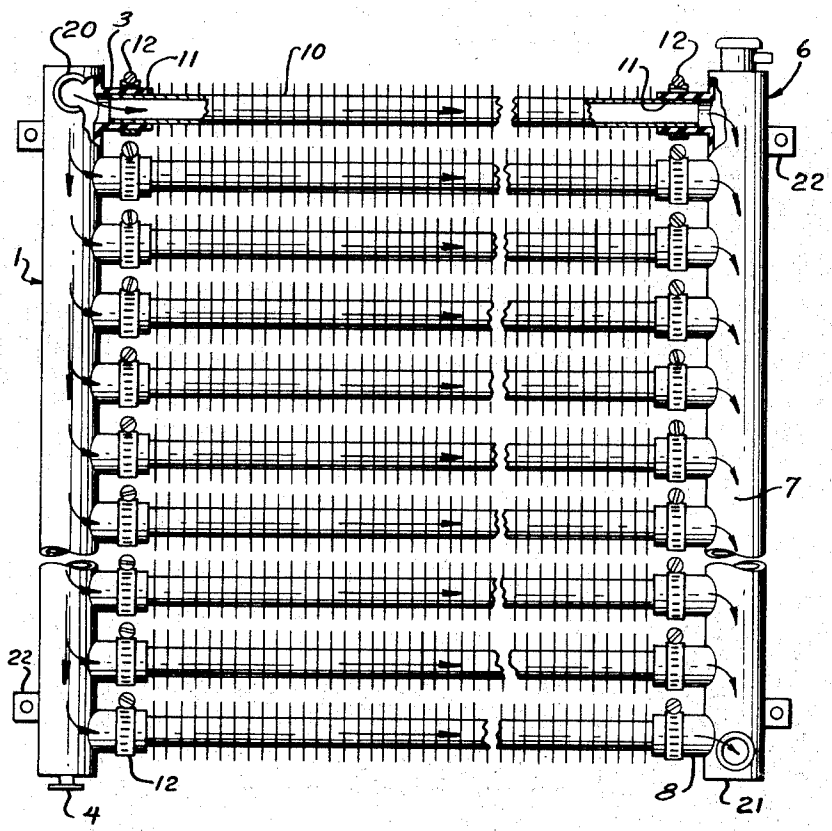
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Attorney—Edward D. Gilhooly

[57] **ABSTRACT**

An improved radiator for use in the cooling system of a vehicle including a plurality of cooling conduits interconnecting an inlet manifold and an outlet manifold. The tubes are horizontally disposed creating efficient cooling of the fluid passing through the radiator by inducing uniform cross flow between the manifolds and the tubes. The manifolds may be constructed of a suitable durable and flexible material such as rubber and are advantageously molded in a one-piece construction.

3 Claims, 5 Drawing Figures



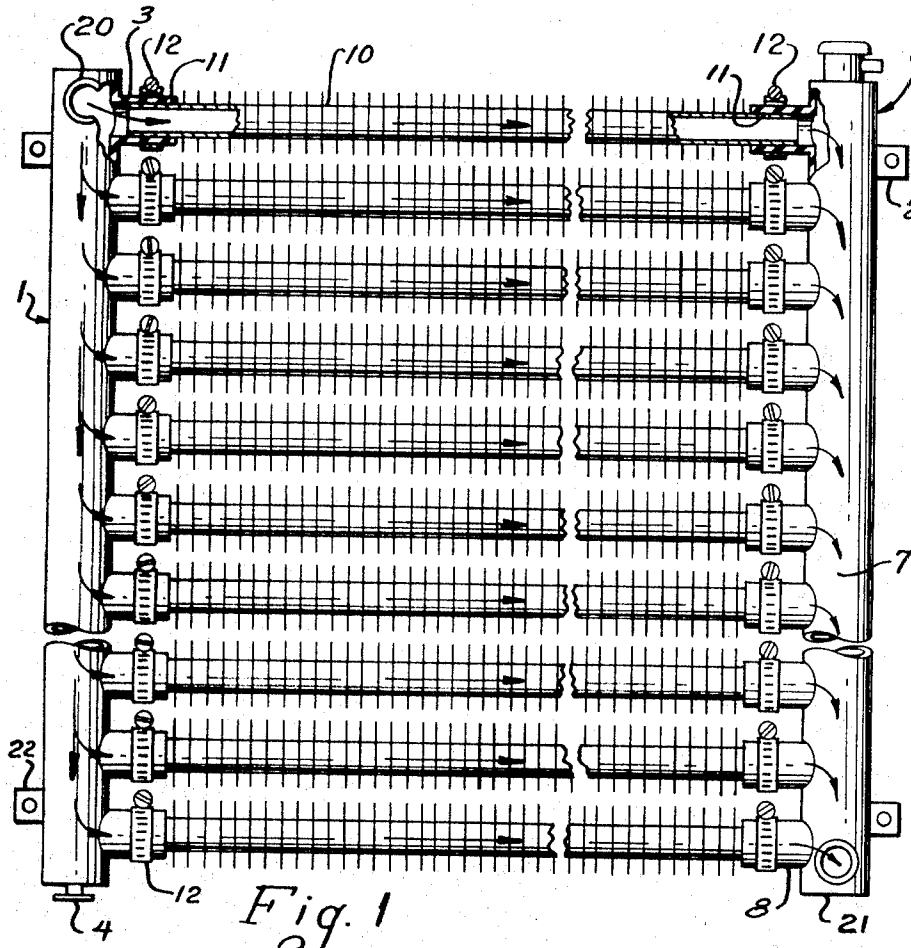


Fig. 1

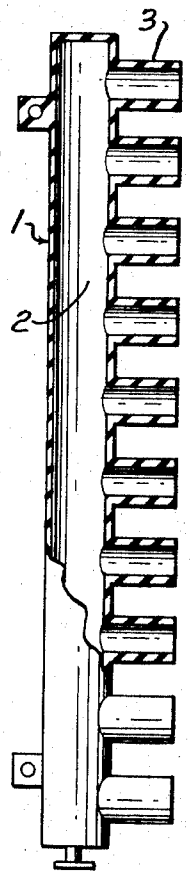


Fig. 2

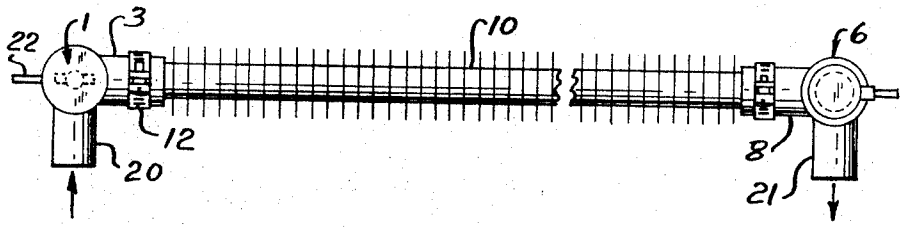


Fig. 3

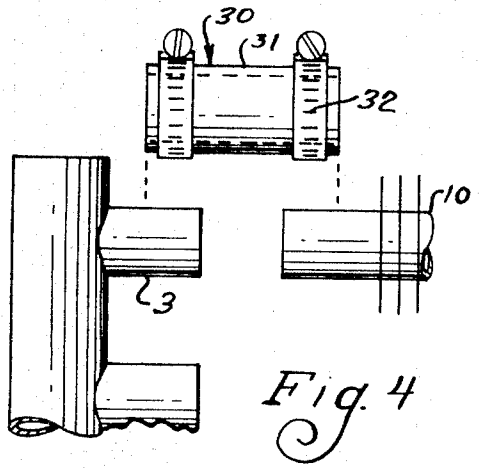


Fig. 4

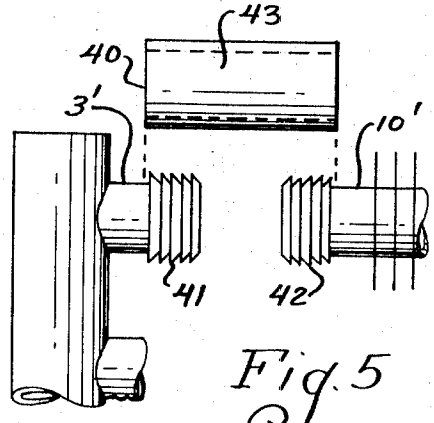


Fig. 5

COOLING RADIATOR

BACKGROUND OF THE INVENTION

This invention relates in general to cooling systems and in particular to an improved radiator for use in the cooling system of a vehicle.

More specifically, the invention relates to a radiator having a plurality of thin cooling tubes or conduits which interconnect an inlet and outlet manifold in a manner that any selected conduit may be readily inserted or removed from the radiator as required. In one embodiment of the invention, the tubes lie with their longitudinal axes extending in a horizontal orientation wherein improved cooling effects have been found to be achieved due to the uniform cross flow of the coolant. The radiator of the invention provides an inexpensive and easily serviced device which may include a pair of molded one-piece manifolds.

As is well known, a radiator is utilized in a vehicle to reduce the heat of the coolant fluid in the circulating system of the engine. Generally, air flow created by a fan or movement of a vehicle passes through the radiator to reduce the heat of the coolant flowing therethrough. The radiators most frequently utilized in the vehicles at present comprise a structure having a single continuous tube which acts as a cooling conduit. The cooling tube within these conventional radiators generally is a convolution or the like of a single length of tube which when leaking or damaged can cause loss of all the fluid in the cooling system. It is extremely troublesome to repair a conventional radiator since the entire device generally must be removed from the vehicle for service. The necessity of removal increases the difficulty and cost of repairing the radiator and does not permit a vehicle to be conveniently fixed at a roadside breakdown location.

Attempts have been made in the prior art to construct radiators with a plurality of tubes interconnecting a pair of inlet and outlet chambers. The designs of such prior art radiators have been deficient since efficient cooling has often not been achieved and the construction of these devices are expensive to manufacture due to their design. In addition, the cooling tubes of the radiators are vertically oriented and it has been found that an efficient flow of coolant in all cooling tubes is not achieved. Moreover, the prior art devices utilizing a plurality of tubes are not efficiently repaired because, as is the case with conventionally used vehicle radiators, it is necessary to remove the radiators from the vehicle to remove a damaged or leaking tube. Another problem presented by the prior art devices is that the interconnection between the cooling tubes and the chambers interconnected by the tubes have been subject to leaking problems due to vibration and poor design of the coupling of the elements.

SUMMARY OF THE INVENTION

It is, therefore, an object of the invention to improve radiators for use in a cooling system of power plants or engine.

Another object of this invention is to improve the thermal control of the coolant of a power plant or engine through the use of a plurality of tubes interconnecting a pair of manifolds.

A further object of this invention is to facilitate the removal or insertion of a respective tube to the radiator.

Still another object of this invention is to reduce the complexity of and cost of manufacturing a radiator.

A still further object of this invention is to increase the efficiency of cooling of a radiator.

These and other objects are attained in accordance with the present invention wherein there is provided an improved radiator for use in the cooling system of engines used in vehicles and the like. A plurality of thin cooling tubes or conduits interconnect an inlet manifold and an outlet manifold which may be of a one-piece molded construction formed from rubber or other suitable durable and resilient substance. The use of a material such as rubber is advantageous since it offers an inexpensive material which resiliently supports the ends of the plurality of cooling tubes and is resistant to corrosion.

The radiator of the invention also employs the use of horizontally disposed cooling tubes or conduits which have been found to increase the efficiency of heat transfer due to the uniform cross-flow of coolant. The novel design of the radiator herein disclosed also permits radiators to inexpensively be manufactured or modified for a variety of different cooling capabilities depending on encountered operational characteristics of the engine in which the radiators are intended to be installed and other conditions. Simple modifications of the radiator, such as varying the number and size of the cooling tubes and size of the manifold provide an unlimited range of operational capabilities.

Another advantage of the radiator of the invention is derived from the fact that the plurality of tubes are readily removed from or inserted into coupling with the manifolds thereby permitting rapid and efficient repair of a damaged tube. For example, when a radiator fails or is damaged at a roadside location, it is possible to remove the leaking tube and plug the ports to the manifold whereby the vehicle may be driven to a place where service can be rendered. Alternatively, a damaged tube can be serviced readily at the roadside location by removal of the tube and replacing it with an operative tube. Therefore, the radiator of the invention provides an inexpensive and efficient radiator which significantly improves the devices of the prior art.

DESCRIPTION OF THE DRAWINGS

Further objects of the invention, together with additional features contributing thereto and advantages accruing therefrom, will be apparent from the following description of several embodiments of the invention when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a front schematic illustration of one embodiment of the radiator of the vehicle;

FIG. 2 is a front schematic illustration with parts broken away of a manifold of the radiator of FIG. 1;

FIG. 3 is a top schematic illustration of the radiator of FIG. 1;

FIG. 4 is an exploded partial schematic illustration of another embodiment of the radiator of the invention;

FIG. 5 is an exploded partial schematic illustration of still another embodiment of the radiator of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIGS. 1, 2, and 3, there is illustrated an embodiment of the improved radiator of the invention for use in a cooling system of power plants or en-

gines of vehicles and the like. The radiator is adapted to be interconnected in the cooling system of a power plant or engine in a manner that air passing through the radiator reduces the heat of the circulating coolant fluid utilized to cool the engine. The flow of coolant from the cooling system entering the radiator is directed into an inlet manifold **1** formed as a hollow elongated tubular member which is constructed of a suitable resilient and corrosive-resistant material such as rubber. It is within the scope of the invention to utilize a variety of other materials to construct the inlet manifold such as metal, plastic and the like and the manifold may be constructed in other configurations other than a tubular shape herein disclosed for purposes of illustration. Inlet manifold **1** creates an inlet chamber **2** which receives the fluid being circulated in the cooling system and directs the fluid to a plurality of ports formed by egress or outlet projections **3** which lie in spaced relationship along the longitudinal length of inlet manifold **1**.

It has been found that the inlet manifold advantageously is constructed a one-piece body to enable the element to be inexpensively manufactured by suitable techniques such as molding and the like. Also, the use of rubber is desirable in the invention herein disclosed since rubber provides a non-corrosive body which readily absorbs shocks or jarring effects produced by the movement of the vehicle upon which the radiator is utilized to prevent leakage at connection points. The bottom of the radiator of inlet manifold **1** is constructed with a removable plug or stop cock **4** which can be used to drain fluid from the radiator as desired.

An outlet manifold **6** is positioned on the opposite side of the radiator from inlet manifold **1** and is generally of an identical construction as inlet manifold **1**. Outlet manifold **6** includes an outlet manifold chamber **7** which receives the fluid circulating in the system from a plurality of spaced inlet ports created by inlet projections **8** which lie in spaced relationship along the longitudinal axis of the outlet manifold in substantial corresponding horizontal alignment with outlet projections **3** of inlet manifold **1**.

The outlet ports **3** of inlet manifold **1** and inlet ports **8** of outlet manifold **7** are interconnected by a series of cooling tubes **10** through which the coolant fluid passes therebetween. Cooling tubes **10** includes a plurality of thin elements **10'** integrally connected to the exterior thereof to aid in the cooling of the fluid passing through each of the tubes. The tubes generally are constructed from a suitable heat-dissipating material such as aluminum, copper, and the like. Cooling of the fluid passing through the plurality of tubes is produced by air flow being created by either the fan of the vehicle or the movement of the vehicle being directed adjacent the exterior of the tubes.

Cooling tubes **10** are coupled in fluid-tight relationship to the inlet and outlet manifolds by being inserted at their ends into the outlet projections **3** of the inlet manifold and the inlet projections **8** of the outlet manifold, respectively. The tube and projections of the manifold are maintained in a secure and fluid-tight relationship by coupling means **11** including a conventional clamp member **12** which embraces the exterior of the projections of the manifold to effect the required frictional contact between the manifolds and the cooling tubes. If any of the cooling tubes **10** are subjected to damage or leakage, the utilization of coupling **11** permits easy removal of a damaged tube since the clamp and tube may be readily removed from the manifold. The easy removal of tube allows repair of the radiator without its removal from the vehicle.

The horizontal orientation of the cooling tubes has been found to greatly increase the cooling characteristics of the radiator since the cross flow created by the horizontally disposed tubes **10** effect uniform and efficient cooling. The increased cooling is produced because the inlet manifold is substantially filled with fluid during operation and directs uniform and positive flow to each of the respective tubes.

Fluid is introduced into the inlet manifold **1** through a coolant inlet port **20** which is in the form of a projected element located adjacent the top of the element. Inlet port **20** generally is in fluid communication with a fluid pump (not shown) which circulates the necessary flow of coolant through the cooling system of the vehicle. Inlet port **20** may be coupled to a hose or line of the cooling system in any conventional manner. Similarly, outlet manifold **6** is provided adjacent its bottom portion an outlet port **21** which directs the fluid from the radiator to the engine which heat level is being controlled.

The radiator assembly is mounted to the vehicle by means of bracket members **22** which receive retaining means such as bolts and the like. As stated previously, although it is desirable to utilize rubber one-piece manifolds, it is also within the scope of the invention to utilize other materials such as aluminum, metal, steel, tin, plastic and the like. When using other types of more rigid material other than rubber and the like for the manifold, it is sometimes desirable to utilize different coupling techniques for connecting cooling tubes **10** to the manifolds.

Referring now to FIG. **4**, there is illustrated another embodiment of an alternative coupling means **30** for attaching the cooling tubes. Coupling means **30** includes a sleeve member **31** constructed of rubber or other suitable material which is slipped over the exterior of the end portions of the outlet projections **3** and the end of the cooling tubes **10** wherein a pair of clamps **32** secure the sleeve to each of the members. It should be apparent that the other end of cooling tube **10** is similarly attached to the inlet projection **8** of manifold **6**.

Referring now to FIG. **5**, there is illustrated still another embodiment of the radiator in which a different coupling means **40** is utilized to connect the manifold to the cooling tube. The exterior end portion of cooling tubes **10'** and outlet projection **3'** are formed with a series of serrated elements **41** and **42** respectively which retain in fluid-tight relationship a sleeve **43** which is positioned on the end of both members for secure coupling of the elements. The cooling tubes are similarly attached to outlet manifold **6**.

In the above description, there has been disclosed an improved radiator for cooling the fluid circulating in the cooling system of an engine. Although the cooling tubes have been disclosed as being oriented in a horizontal direction for advantageous cooling, it is within the scope of the invention orient the tubes in other directions such as vertical, if desired. Moreover, the tubes may be interconnected with the inlet and outlet manifold by other conventional techniques if advantageous.

While the invention has been described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that this invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A radiator comprising

an molded inlet manifold for receiving fluid being circulated in a cooling system,

said inlet manifold including a plurality of hollow projections forming outlet ports

a plurality of cooling tubes removably coupled at one end to the hollow projections to receive fluid being circulated and reduce the temperature thereof,

an outlet manifold for receiving fluid from the cooling tubes,

said outlet manifold including a plurality of hollow projections forming inlet ports to the manifold and being coupled to the other end of the cooling tubes,

said inlet manifold and outlet manifold are constructed from a one-piece resilient material,

clamp means for retaining the ends of the cooling tubes partially within the respective hollow projections of the inlet manifold and the outlet manifold, and

said clamp means being positioned in surrounding relationship to each of the hollow projections to effect frictional contact between a respective tube and the interior of a respective projection.

2. The radiator of claim **1** wherein the cooling tubes are horizontally disposed.

3. The radiator of claim **2** wherein the clamp means is constructed of rubber.

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