

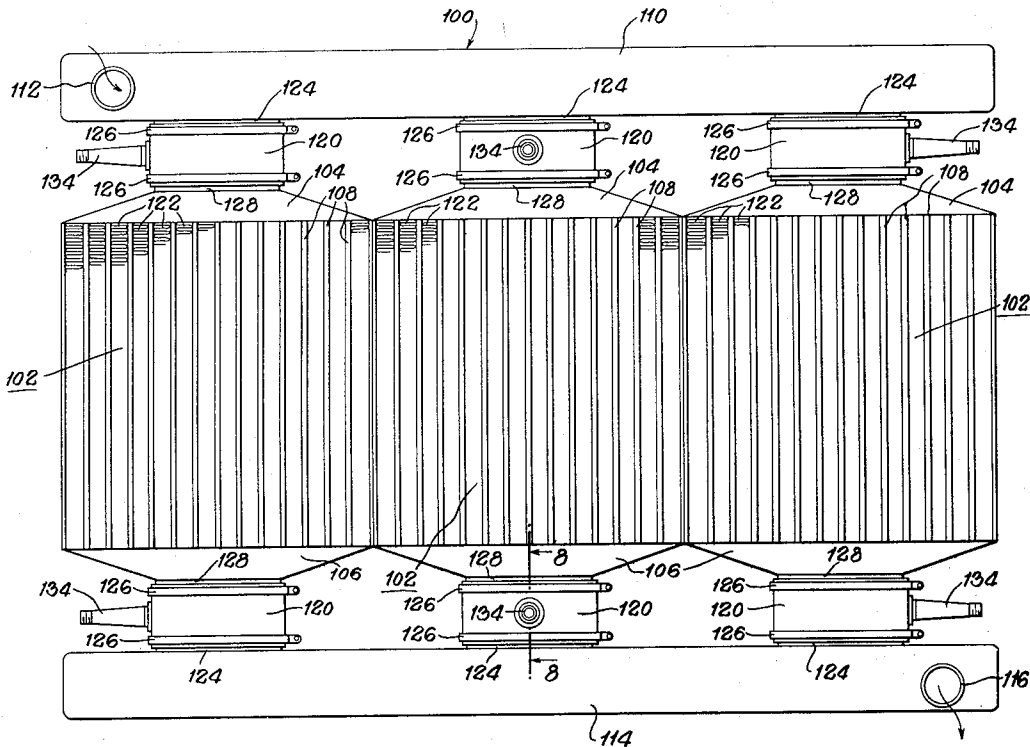
- [54] **COOLING SYSTEM WITH SELECTIVELY
REPLACEABLE RADIATOR SECTIONS**
[76] Inventor: **Frank J. Glorisi**, New Brunswick,
N.J.
[22] Filed: **Apr. 7, 1971**
[21] Appl. No.: **131,993**
[52] U.S. Cl. **165/76, 165/101, 165/144,**
138/93, 137/510
[51] Int. Cl. **F28f 27/02**
[58] Field of Search 165/76, 77, 129-131,
165/101, 144; 138/93; 137/224-227, 510

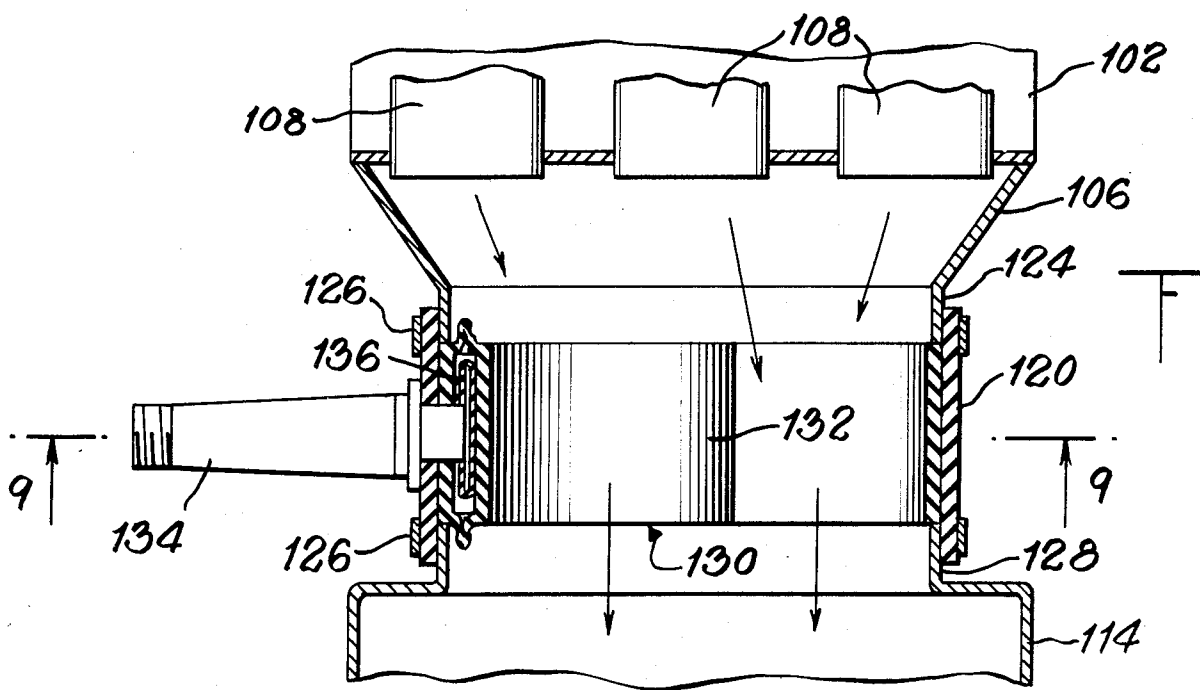
- [56] **References Cited**
UNITED STATES PATENTS
1,827,568 10/1931 Donadio 165/76
2,811,985 11/1957 Wells 138/93

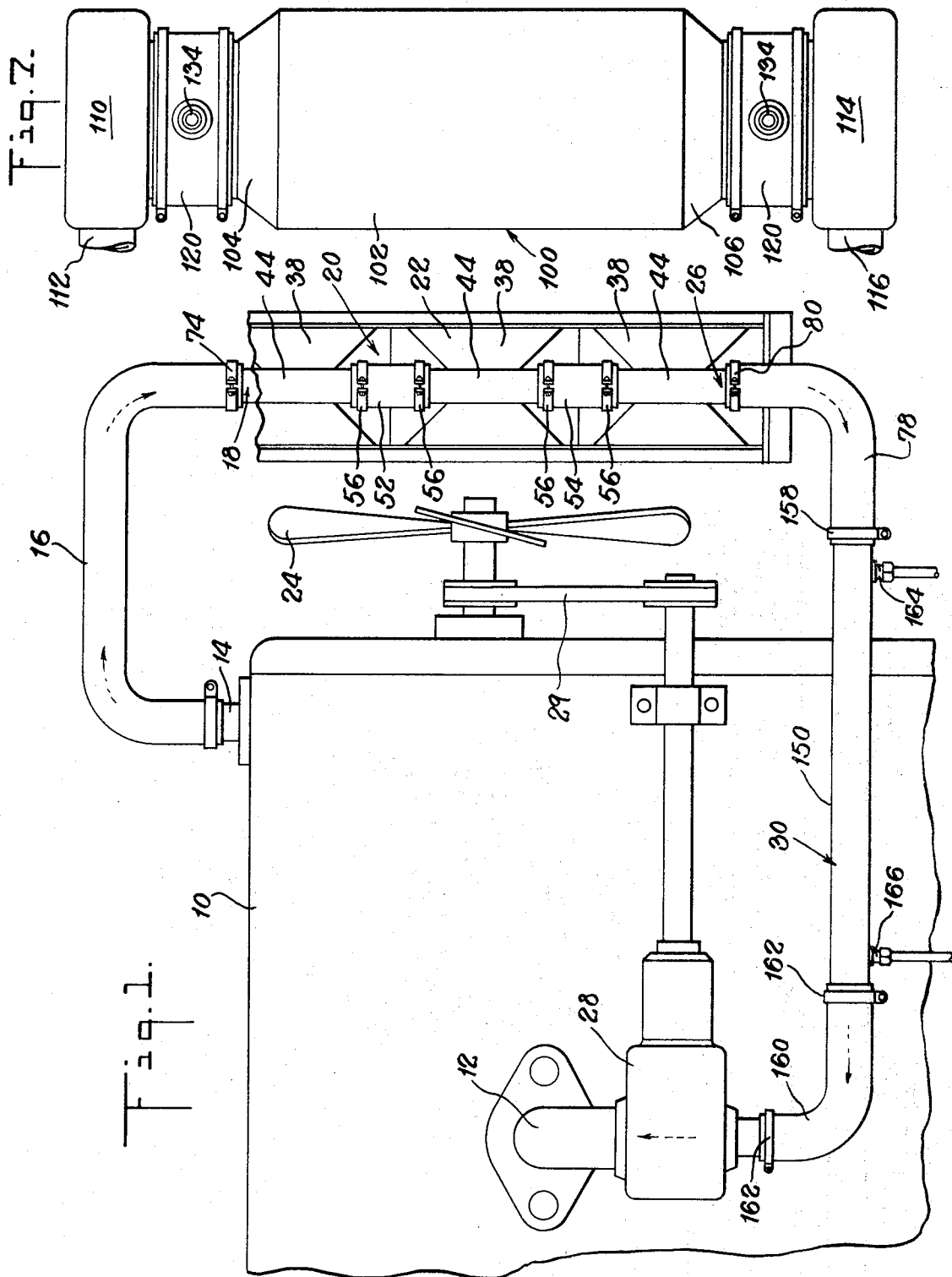
Primary Examiner—Charles J. Myhre
Assistant Examiner—Theophil W. Streule, Jr.
Attorney—Lawrence I. Lerner, Sidney David, Joseph
S. Littenberg and Richard I. Samuel

[57] **ABSTRACT**
A cooling system for an engine including a radiator for cooling a liquid circulated between the engine and the radiator, the radiator having a plurality of sections interconnected through conduits which pass externally between the radiator sections, the conduits thus being accessible for selective closing of a conduit or re-routing thereof to isolate one radiator section from the others and thereby enable continued operation of the remaining portions of the radiator despite the presence of a puncture in that one section. An auxiliary heat exchanger is supplied with cooled liquid passing from the radiator to the engine and includes a continuous annular chamber for receiving fluid to be cooled by the liquid.

4 Claims, 13 Drawing Figures







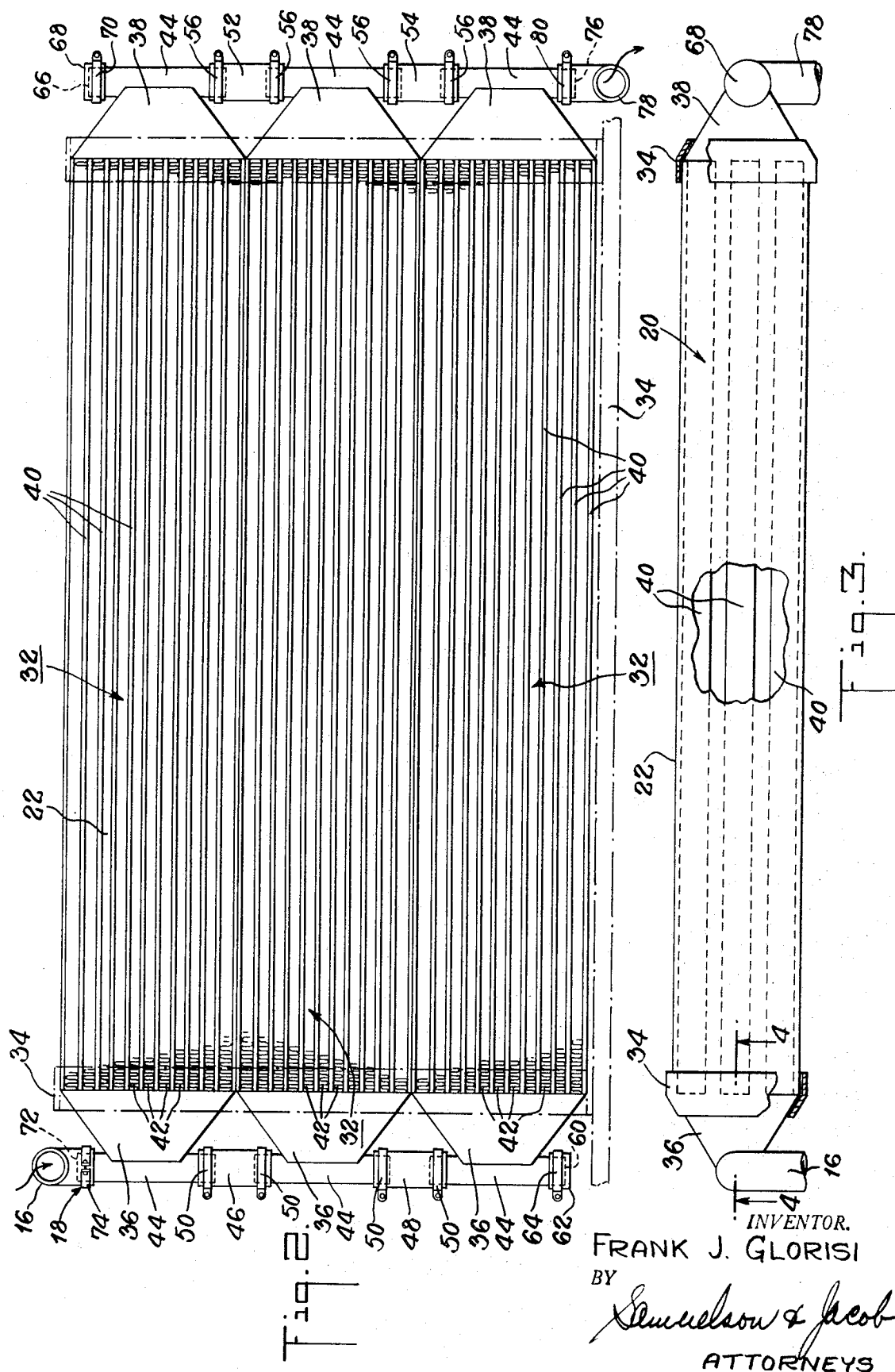
INVENTOR.

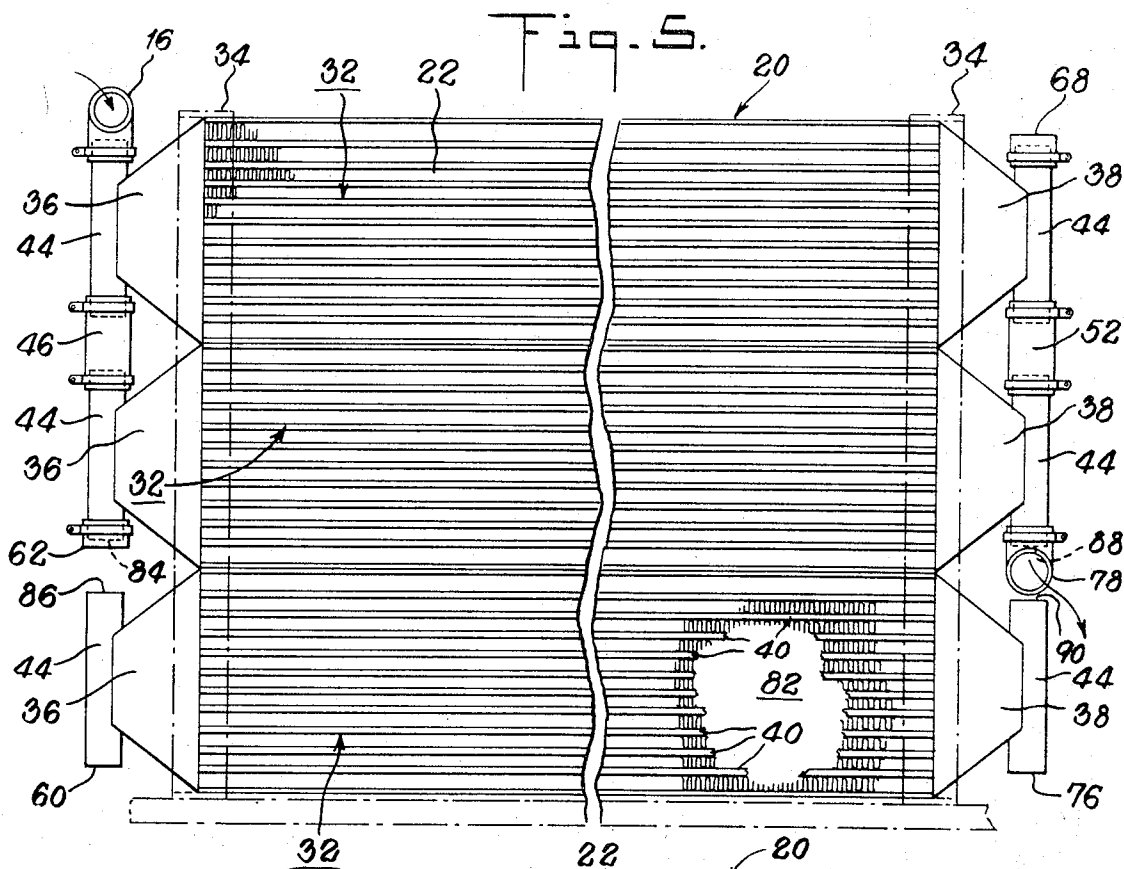
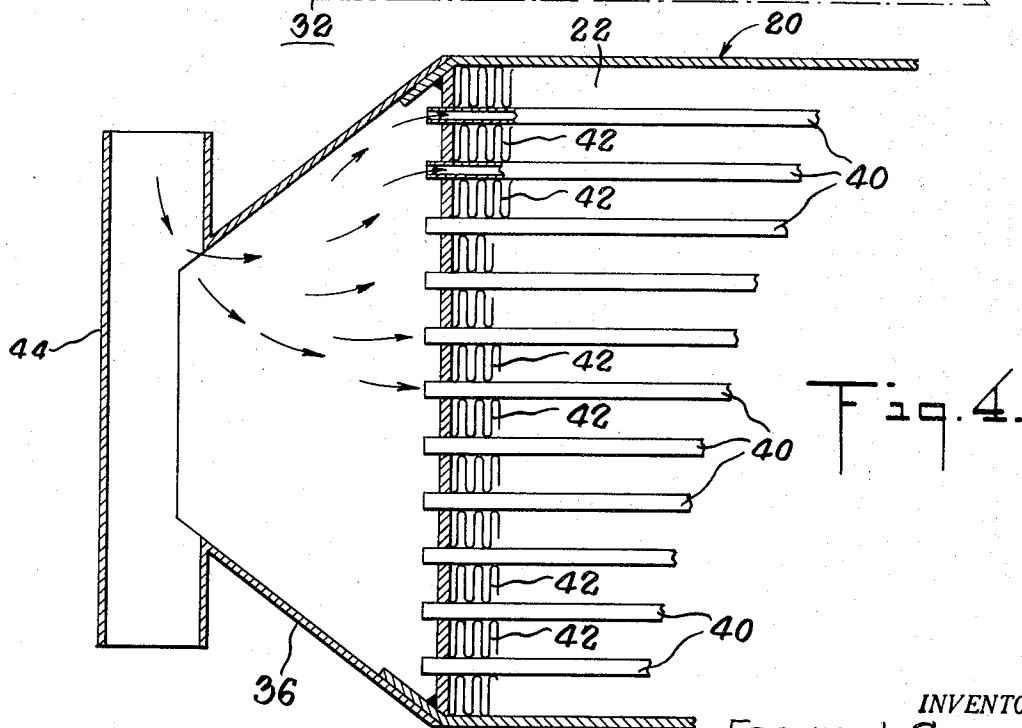
FRANK J. GLORISI

BY

Emmelson & Jacob

ATTORNEYS





INVENTOR.
FRANK J. GLORISI
BY *Samuelson & Jacob*
ATTORNEYS

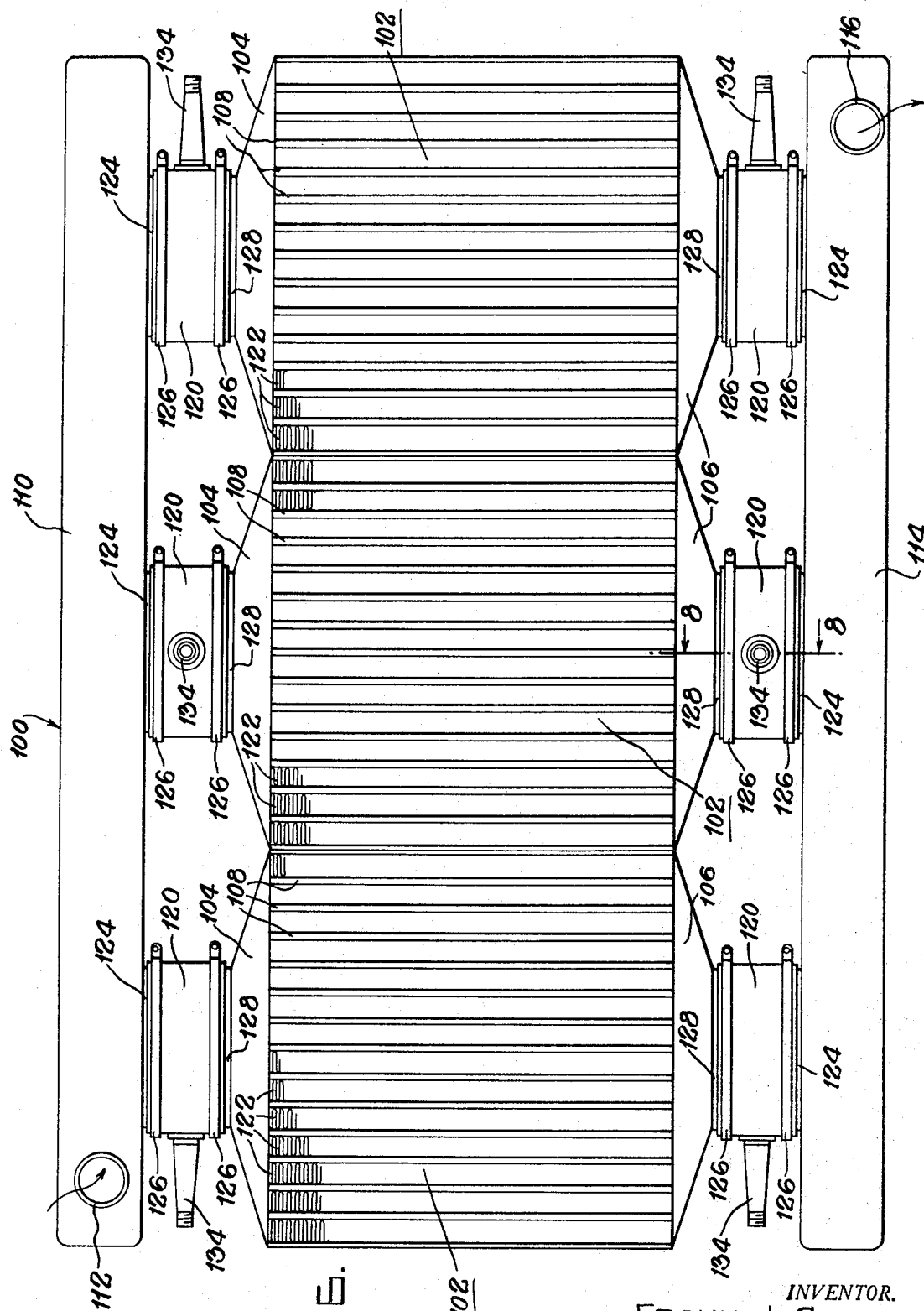
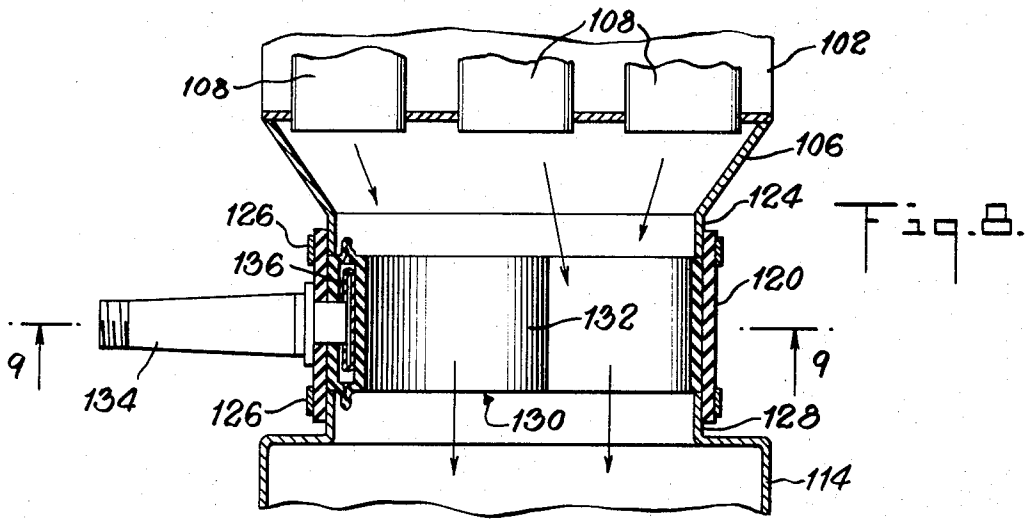
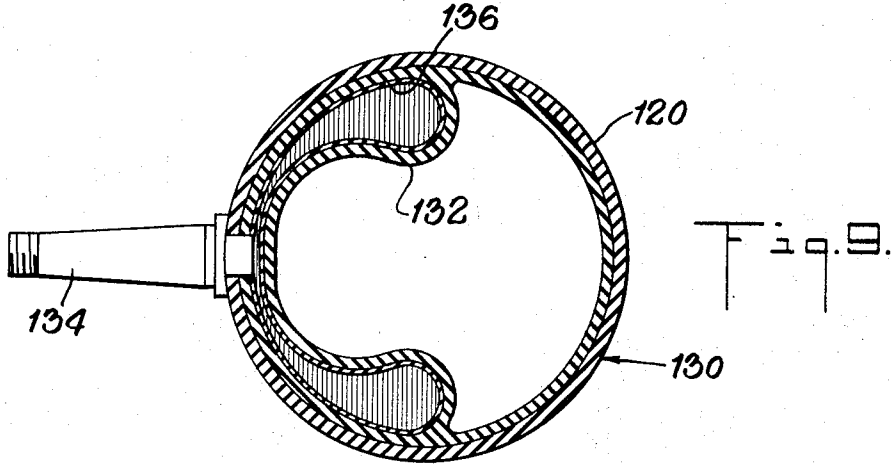
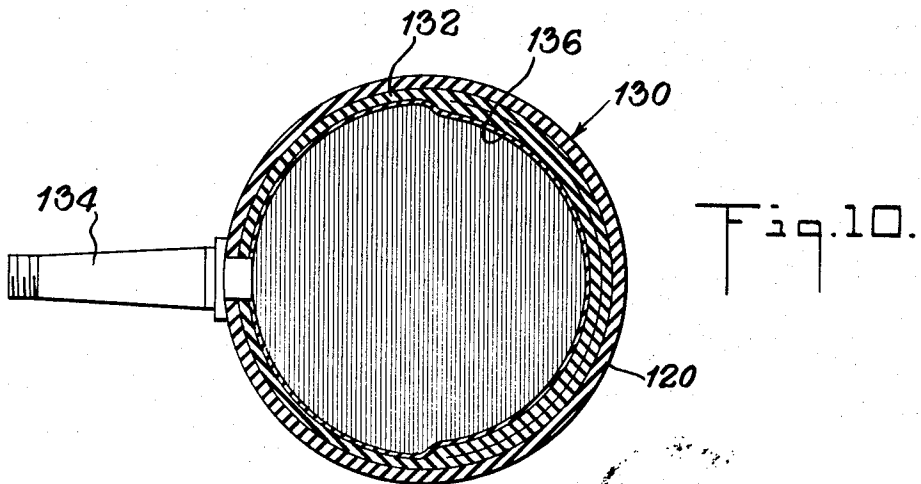
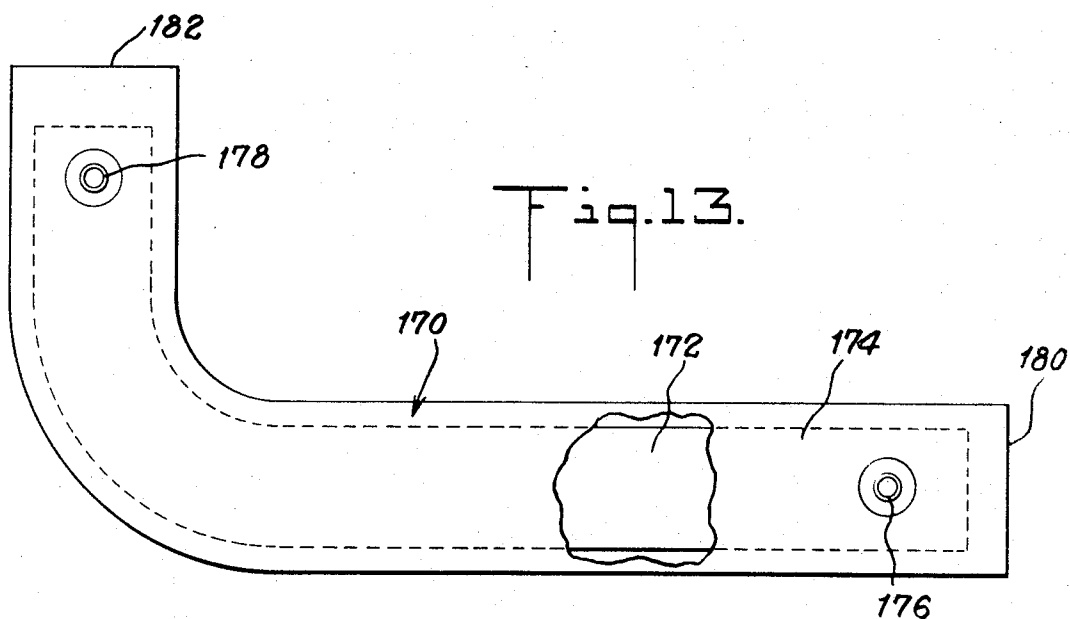
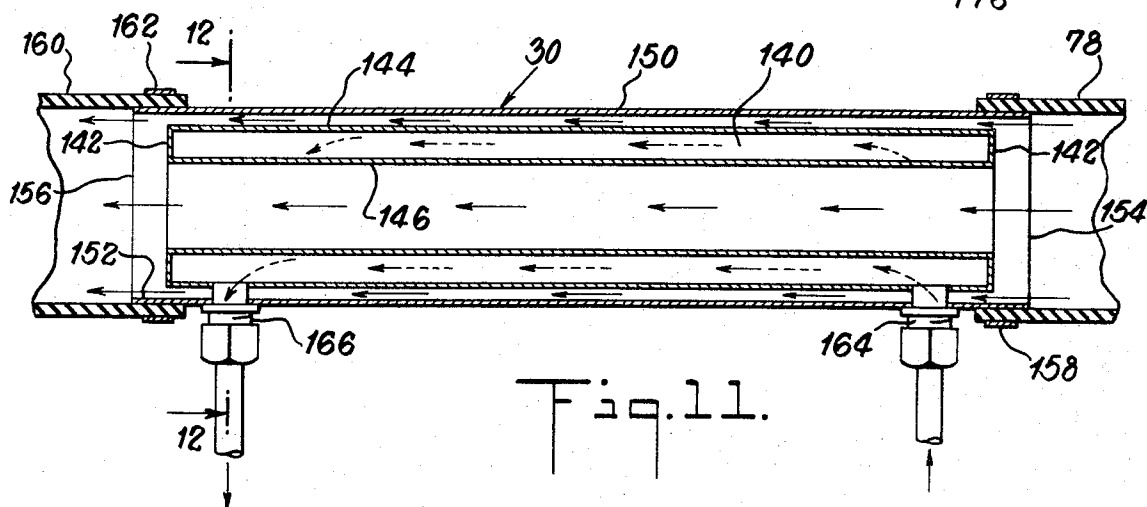
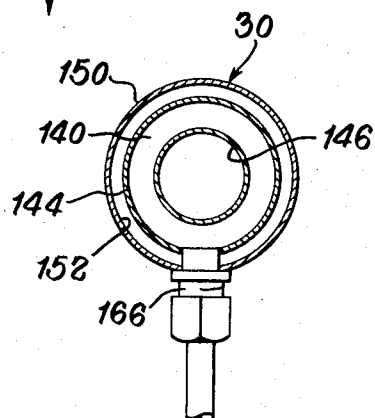


Fig. 5.

INVENTOR.
FRANK J. GLORISI
BY *Samuelson & Jacob*
ATTORNEYS



INVENTOR.
FRANK J. GLORISI
BY *Samuelson & Jacob*
ATTORNEYS



INVENTOR.
FRANK J. GLORISI
BY *Samuelson & Jacob*
ATTORNEYS

COOLING SYSTEM WITH SELECTIVELY REPLACEABLE RADIATOR SECTIONS

The present invention relates generally to cooling systems for liquid cooled engines and pertains, more specifically, to a radiator construction capable of functioning despite the presence of a puncture in the radiator.

With the exception of some engines which are air cooled, most of the engines now in use in automobiles, trucks and like vehicles employ liquid cooling systems which include a radiator for dissipating engine heat to the ambient atmosphere through a liquid heat exchange medium. In addition, a great many modern vehicles carry an additional heat exchanger for cooling the fluid present in automotive transmissions used in connection with these liquid-cooled engines, and some vehicles employ oil coolers for cooling the engine oil. These supplemental heat exchangers and oil coolers utilize the coolant which passes through the radiator of the engine cooling system for cooling the transmission fluid or engine oil.

In order to transfer heat effectively from the liquid coolant to the surrounding air, radiator cores are generally constructed of relatively thin, heat conductive materials and are placed in a vehicle in a location where they will be exposed to cooling air. As a result of such a relatively delicate construction and the exposed location of radiators, the radiator cores are vulnerable to damage from a variety of road hazards such as flying stones, gravel and other debris, as well as being vulnerable to accidental damage as a result of collision. Additionally, radiator cores are susceptible to damage from corrosion, extreme heat, or extreme cold. Very often such damage results in puncture of the radiator core with a resultant loss of coolant and complete failure of the cooling system.

It is therefore an important object of the invention to provide a cooling system which will continue to function despite the presence of a puncture in the radiator core.

Another object of the invention is to provide a vehicle engine cooling system having a radiator which, if damaged by a puncture, can be temporarily repaired on the road in a relatively simple manner for enabling continued operation until the radiator can be more permanently repaired.

Still another object of the invention is to provide a radiator having at least two radiator sections interconnected by external connections which are easily accessible for selective isolation of a punctured section to enable the undamaged portions of the radiator to continue to operate.

A further object of the invention is to provide a sectional radiator wherein a damaged section may be replaced with relative ease so that the cost of repair is reduced in that only a damaged section of the radiator need be replaced rather than an entire radiator, should damage occur.

A still further object of the invention is to provide a sectional radiator as described above in which a damaged section of the radiator may be isolated by re-routing external connections between adjacent sections.

Another object of the invention is to provide a sectional radiator as described above in which a damaged section of the radiator may be isolated by actuating

pneumatic valves utilizing air pressure readily available in most vehicles.

The above objects, as well as still further objects and advantages, are attained by the invention which may be described briefly as a cooling system for an engine including a radiator for cooling a liquid coolant passed from the engine through the radiator and capable of functioning despite the presence of a puncture in the radiator, the radiator comprising at least two radiator sections, each radiator having opposite headers and liquid-conducting tubes extending between the opposite headers, means interconnecting corresponding headers of adjacent sections, the means including liquid-conducting conduits extending externally of the adjacent sections, and means associated with at least some of the external conduits for selectively diverting liquid coolant from at least one of the sections to selectively isolate that one section from the remainder of the radiator such that the radiator will function despite the presence of a puncture in that one section.

The invention will be more fully understood, while still further objects and advantages will become apparent, in the following detailed description of preferred embodiments of the invention illustrated in the accompanying drawing, in which:

FIG. 1 is a diagrammatic illustration of an engine cooling system employing a radiator and an auxiliary heat exchanger constructed in accordance with the invention;

FIG. 2 is an elevational view of the radiator of FIG. 1;

FIG. 3 is a top plan view of the radiator;

FIG. 4 is an enlarged, fragmentary cross-sectional view taken along line 4—4 of FIG. 3.

FIG. 5 is an elevational view similar to FIG. 2, but illustrating a damaged radiator;

FIG. 6 is a front elevational view of another radiator constructed in accordance with the invention;

FIG. 7 is a side elevational view of the radiator of FIG. 6;

FIG. 8 is an enlarged, fragmentary cross-sectional view taken along line 8—8 of FIG. 6;

FIG. 9 is a cross-sectional view taken along line 9—9 of FIG. 8;

FIG. 10 is a cross-sectional view similar to FIG. 9, but with the operating parts in a different operating position;

FIG. 11 is an enlarged longitudinal cross-sectional view of the auxiliary heat exchanger of FIG. 1;

FIG. 12 is a cross-sectional view taken along line 12—12 of FIG. 11; and

FIG. 13 is a plan view of another auxiliary heat exchanger constructed in accordance with the invention.

Referring now to the drawing, and especially to FIG. 1 thereof, a liquid cooled internal combustion engine is illustrated diagrammatically at 10. As in the scheme used in most modern vehicles, engine 10 is mounted in the front of a vehicle (not shown) and, during operation, is cooled by circulating a liquid coolant, usually water, from an inlet 12 through internal passages in the engine 10 to an outlet 14. The outlet 14 of the engine is connected by means of a radiator hose 16 to the inlet 18 of a radiator assembly 20. As the liquid coolant passes through the radiator assembly 20 air is drawn from the front of the vehicle through the radiator core 22 by means of a fan 24 which is rotated by the engine 10. The cooled liquid passes through the outlet 26 of

the radiator assembly 20 and follows a return path to the engine inlet 12. A pump 28, also operated by the engine 10 through a drive belt 29, forces the liquid coolant to circulate in the described manner.

In the arrangement illustrated in FIG. 1, an auxiliary heat exchanger 30 is installed in the return path of the liquid coolant for cooling fluid employed in the transmission of engine 10. Both the radiator 20 and the heat exchanger 30 are constructed in accordance with the invention and will be described in more detail below.

Turning now to FIGS. 2 through 4, radiator 20 is seen to be made up of three radiator sections 32 held in place in the vehicle by means of a frame 34. Each radiator section 32 has a pair of opposite headers 36 and 38 and a plurality of liquid-conducting tubes 40 extending between the headers. Cooling fins 42 are employed in connection with the tubes 40 in a now well-known manner. The radiator sections 32 are placed side-by-side, and generally in the same plane, in the radiator assembly and, in this instance, are placed in a vertical stack to establish a cross-flow radiator assembly wherein the liquid coolant will pass from each header 36 through tubes 40 to an opposite header 38. Each header is provided with a tubular fitting 44, all of which fittings 44 are preferably identical.

As best seen in FIG. 2, the fittings 44 of adjacent corresponding headers 36 are aligned vertically with one another and are interconnected by means of conduits extending externally of the headers, in this instance the conduits being provided by tubular members 46 and 48 affixed to adjacent fittings 44 by clamping means, here shown in the form of clamps 50. Likewise, the fittings 44 of corresponding headers 38 are interconnected by external conduits provided by tubular members 52 and 54 affixed to the vertically aligned fittings 44 by means of clamps 56. The tubular members 46, 48, 52 and 54 are preferably fabricated of ordinary flexible radiator hose, in which case clamps 50 and 56 would be ordinary hose clamps.

The bottom end 60 of the fitting 44 of the lowermost header 36 is closed by a cap 62 affixed to the fitting by another clamp 64. In the same manner, the top end 66 of the fitting 44 of the uppermost header 38 is closed by a similar cap 68 held in place with still another clamp 70. The top end 72 of the fitting 44 of the uppermost header 36 serves as the inlet to the radiator assembly 20; hence, the radiator hose 16 which connects the outlet 14 of the engine 10 to the inlet 18 of the radiator serves as an inlet member and is clamped to the top end 72 of the fitting 44 of the uppermost header 36 by means of a hose clamp 74. In a similar manner, the bottom end 76 of the fitting 44 of the lowermost header 38 is connected to the return path of the cooling system by an outlet hose 78 which serves as an outlet member and is affixed to the fitting 44 by another hose clamp 80. Thus, radiator assembly 20 provides a complete cross-flow radiator in the cooling system illustrated in FIG. 1.

Turning now to FIG. 5, radiator 20 is seen to have suffered damage in the form of a hole 82 passing through the lowermost radiator section 32 thereof. The hole 82 has punctured several of the radiator tubes 40 of that section. Ordinarily, such damage would render a radiator inoperative since the liquid coolant could drain out through the hole 82 and render the entire cooling system useless. However, radiator 20 is capable of functioning despite the puncture of the tubes 40 re-

sulting from the illustrated damage. To this end, the lowermost radiator section 32 has been isolated from the middle and uppermost radiator sections by manually removing the tubular members 48 and 54 (FIG. 2) which had previously interconnected the opposed, spaced-apart ends 84 and 86 of the fittings 44 of the corresponding headers 36 and the opposed, spaced-apart ends 88 and 90 of corresponding headers 38. The cap 62 which originally was located at the bottom end 60 of the fitting 44 of the lowermost header 36 has been removed and placed on the bottom end 84 of the fitting 44 of the middle header 36 and the outlet hose 78 has likewise been removed from the bottom end 76 of the fitting 44 of the lowermost header 38 and has been affixed to the bottom end 88 of the fitting 44 of the middle header 38, as shown in FIG. 5. Thus, the lowermost radiator section 32 has been selectively isolated from the remaining portions of the radiator 20 and the flow of liquid coolant has been diverted to the remaining portions of the radiator which are able to function adequately to keep the cooling system in operation until more permanent repairs can be accomplished.

The temporary repairs provided by the ability to manipulate the interconnections between the fittings 44 of the headers 36 and 38 enables emergency repairs to be performed on the road with ease. Since all of the fittings 44 are identical, the various tubular members, caps and inlet and outlet hoses may be arranged to isolate any given section 32 from the remaining sections, thereby enabling operation of the cooling system in spite of the presence of a damaged section. By locating the fittings 44 and the tubular members 46, 48, 52 and 54 at the opposite horizontal extremities of the radiator sections 32, the tubular members, caps and inlet and outlet hoses are rendered more accessible for on-the-road repairs. Since each of the foregoing elements are clamped in place by ordinary hose clamps, repairs are facilitated. In addition, employment of ordinary radiator hose for the tubular members facilitates re-routing of the liquid coolant from section to section, as desired, to avoid a damaged section.

In order to assure that the radiator 20 will have an adequate cooling capacity even through one section 32 may be disabled, all of the sections 32 are provided with a greater number of tubes 40 than would ordinarily be found in a conventional radiator of comparable size. Thus, as seen in FIG. 3, each section 32 is provided with three rows of tubes 40 rather than the single row found in comparable conventional radiators. Hence, the loss in cooling capacity sustained by the damage to the lowermost section 32, as shown in FIG. 5, is compensated for by the use of a greater number of tubes 40 in the remaining sections 32. It will be seen, then, that the number of sections 32 may be multiplied and any number of sections may be isolated in the manner illustrated, as long as the remaining sections are provided with sufficient tubes to attain adequate cooling capacity in the remaining undamaged operating sections.

When it is desired to permanently repair radiator 20, the damaged section 32 is merely removed from the stack of sections 32 in the frame 34 and replaced with an undamaged section. Thus, permanent repairs are effected rapidly and inexpensively since the entire radiator need not be replaced and the individual sections are relatively easy to manipulate.

Referring now to FIGS. 6 and 7, another radiator constructed in accordance with the invention is illustrated at 100. Radiator 100 is also made up of an assembly of three radiator sections 102 located in side-by-side arrangement. In this instance, however, the radiator sections 102 are oriented such that the opposite headers 104 and 106 of each section 102 are vertically spaced from one another and the tubes 108 which conduct the liquid coolant between the headers extend vertically between each pair of opposite upper and lower headers. An upper manifold 110 has an inlet 112 which can be connected to the outlet 14 of the engine 10 while a lower manifold 114 has an outlet 116 which can be connected to the return path to the inlet 12 of the engine. A plurality of external conduits, shown in the form of tubular members 120 interconnect the upper manifold 110 with the upper headers 104 and interconnect the lower manifold 114 with the lower headers 106. Thus, liquid coolant may flow through the radiator 100 by entering the upper manifold 110 at the inlet 112 thereof, then passing through the upper tubular members 120 into the headers 104, then through the radiator cores provided by the tubes 108, which again carry cooling fins 122, to enter headers 106 and pass through lower tubular members 120 to the lower manifold 114 and out through the outlet 116.

Each tubular member 120 is affixed at one end thereof to a fitting 124 (also see FIG. 8), which extends from a corresponding header, by means of a clamp 126. Likewise, the other end of each tubular member 120 is affixed to a complementary fitting 128 on one of the manifolds 110 or 114 by means of another clamp 126.

As best seen in FIGS. 8, 9, and 10, each tubular member 120 houses a valve 130 which is ordinarily open to enable the liquid coolant to pass through the tubular member 120 from a header to the corresponding manifold. However, should any one radiator section 102 become damaged, that section may be isolated from the remaining sections by merely closing the valves 130 at each end of the section.

Each valve 130 is capable of being actuated by pneumatic pressure so that a source of compressed air, such as the air reservoir of an air brake system in trucks or a spare tire in automobiles, may be utilized quickly and effectively to close off the valves necessary to isolate a damaged section from the remainder of the radiator. Thus, each valve 130 includes a flexible, bag-like inflatable gate member 132 affixed to the tubular member 120. Preferably, the tubular member 120 is constructed of rubber or a similar elastomeric material and the gate member 132 is vulcanized or otherwise adhered directly to the tubular member. An ordinary air valve stem 134 passes through the tubular member 120 and the gate member 132 and communicates with a bladder 136 lying within the gate member. Ordinarily, the bladder 136 is collapsed and the gate member 132 is in an open position as shown in FIGS. 8 and 9, so that the liquid coolant may pass through the tubular member 120 and past the gate member. However, upon passing air through the air valve stem 134 to inflate the bladder 136, the gate member is actuated to a closed position 120, as illustrated in FIG. 10, thereby closing off the tubular member 120 to the passage of liquid coolant. By thus closing the valves 130 at each end of a particular section 102, that section may be isolated from the remainder of the radiator and the remaining portion of

the radiator 100 may continue to function despite a puncture in the isolated section.

In order to effect a permanent repair to the radiator 100, the damaged section 102 need merely be removed and replaced with an undamaged section without disturbing the remaining sections. Removal of a damaged section is accomplished with ease since all that is required is the loosening of the clamps 126 which hold the tubular members 120 in place between a manifold and a corresponding header. Such loosening of clamps 126 enables quick and easy removal of the damaged radiator sections.

Where tubular members 120 are fabricated of an elastomeric material, clamps 126 may be common hose clamps, thereby facilitating repair. Because the tubular members 120 extend externally of the headers 104 and 106, the tubular members are readily accessible for removal. Additionally, since the conduits provided by the tubular members 120 extend externally of the radiator sections 102 and the headers thereof, the valves 130 are readily accessible for actuation to divert the flow of coolant as desired.

Many modern vehicles include auxiliary heat exchangers within their cooling systems for the purpose of cooling transmission fluid or engine oil. Ordinarily, such an auxiliary heat exchanger is placed within the radiator assembly in such a manner that the cooled liquid coolant passes over the heat exchanger and the fluid within the heat exchanger is thus cooled by the same liquid coolant which cools the engine.

In the cooling system illustrated in FIG. 1, however, the radiator assembly 20 does not lend itself readily to the use of such conventional auxiliary heat exchangers since it cannot be predicted which section 32 of the radiator assembly 20 might become damaged. Hence, it becomes impractical to locate an auxiliary heat exchanger in any particular radiator section 32. In order to alleviate such difficulties, the cooling system includes an external auxiliary heat exchanger 30 in the return path connected to the outlet hose 78. Since the outlet hose 78 is selectively connected to any radiator section 32 and thus always carries cooled liquid coolant from the radiator 20 to the engine 10, the auxiliary heat exchanger 30 will always be provided with the necessary coolant.

As best seen in FIGS. 11 and 12, as well as in FIG. 1, the auxiliary heat exchanger 30 includes an elongate chamber 140 having a continuous annular configuration extending longitudinally and closed at each end to provide outer surfaces 142 and 144 along the end and the outer diameter of the annular configuration, respectively, and an inner surface 146 along the inner diameter of the annular configuration.

An outer jacket 150 surrounds the annular chamber 140 and has a generally tubular configuration providing an internal passage 152 having a diameter great enough so that the jacket 150 is spaced radially from the outer surface 144 of the annular chamber 140. The outer jacket 150 extends longitudinally beyond the ends of the annular chamber 140 and includes an inlet 154 spaced longitudinally from one end of the annular chamber 140 and an outlet 156 spaced longitudinally from the other end of the annular chamber. The outer surface of the inlet 154 receives the outlet hose 78, which is affixed thereto by a clamp 158 while the outer surface of the outlet 156 receives another radiator hose

segment 160, held in place by clamps 162 between the outer jacket 150 and pump 28.

Since the diameter of internal passage 152 is greater than the diameter of the outer surface 144 of the annular chamber 140 and since the inlet and outlet of the outer jacket 150 are spaced from the ends of the annular chamber, liquid coolant will pass along both the outer and inner surfaces 144 and 146 of the annular configuration of the chamber 140 as the liquid coolant is circulated between the radiator 20 and the engine 10. An inlet fitting 164 at one end of the chamber 140 and an outlet fitting 166 at the other end of the chamber serve to support the chamber 140 within the outer jacket 150 while enabling transmission fluid to be passed into the chamber at the inlet fitting and out of the chamber at the outlet fitting.

The continuous annular configuration of the chamber 140 coupled with the tubular configuration of the outer jacket 150 is economical to fabricate, easy to install and provides adequate cooling for the transmission fluid while minimizing any obstruction to the passage of liquid coolant between the radiator 20 and the engine 10.

Turning now to FIG. 13, an alternate heat exchanger for transmission fluid or engine oil is illustrated at 170. Heat exchanger 170 is similar to the earlier described heat exchanger 30 in that an annular chamber 172 is supported within a tubular outer jacket 174 and includes an inlet fitting 176 and an outlet fitting 178 for the fluid to be cooled. Outer jacket 174 has an inlet end 180 and an outlet end 182. In the embodiment of FIG. 13, however, both the chamber 172 and the outer jacket 174 are in the form of complementary elbows so that both the fluid in the chamber 172 and the liquid coolant in the jacket 174 follow a 90° bend as these liquids travel from their respective inlets to their respective outlets. Such a configuration provides an extended length in the auxiliary heat exchanger 170 where the return path of liquid coolant must follow a right angle bend along its course from the radiator to the engine.

It will be seen, then, that the overall configuration of the auxiliary heat exchangers 30 and 170 follows the configuration of a radiator hose which might otherwise connect a radiator with the coolant inlet of an engine in a conventional cooling system. Hence, auxiliary heat exchangers are readily installed within current cooling systems of conventional layout. Thus, the substitution of a radiator assembly, such as radiator 20, for a conventional radiator in an existing cooling system may be accompanied by the installation of an auxiliary heat ex-

changer 30 or 170.

It is to be understood that the above detailed description of preferred embodiments of the invention is provided by way of example only. Various details of design and construction may be modified without departing from the true spirit and scope of the invention as set forth in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A cooling system for an engine including a radiator for cooling a liquid coolant passed from the engine through the radiator and capable of functioning despite the presence of a puncture in the radiator, said radiator comprising:

at least two radiator sections, each radiator section having opposite headers and liquid-conducting tubes extending between said opposite headers; means interconnecting corresponding headers of adjacent sections, said means including a common flow path and a plurality of liquid-conducting conduits, one end of each of which is connected to each of said adjacent sections, respectively; and the other end of each of which is connected to the common flow path; and

diverting means interposed between said headers and said common flow path for selectively diverting liquid coolant from at least one of said sections to selectively isolate that one section from the remainder of the radiator such that the radiator will function despite the presence of a puncture in said one section, said diverting means including a valve forming a conduit, said valve comprising a normally collapsed inflatable gate member within said conduit and means for admitting air under pressure into said gate member to inflate said member and close-off said conduit to the passage of liquid coolant.

2. The invention of claim 1 wherein said external conduits are selectively disconnectable from said respective headers to enable selective removal and replacement of a section within the radiator.

3. The invention of claim 1 wherein said normally collapsed inflatable gate member comprises a bladder disposed within said gate member.

4. The invention of claim 1 wherein each of said valves is in communication with a plurality of liquid-conducting tubes via said headers.

* * * * *