United States Patent [19]

Pickard

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[45] **Nov. 11, 1975**

[54] **ENGINE PREHEATER**

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[73] Assignee: **Bardon Research and Development Limited,** Toronto, Canada

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[21] Appl. No.: **321,455**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 159,816, July 6, 1971, abandoned.

[30] **Foreign Application Priority Data**

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June 30, 1972 Canada 76680

[52] **U.S. Cl.** ..... **219/208;** 123/142.5 E; 165/164; 219/301; 219/540

[51] **Int. Cl.** **F02n 17/04;** F24h 1/10; H05b 1/02

[58] **Field of Search** ..... 219/208, 301, 540; 123/142.5 E

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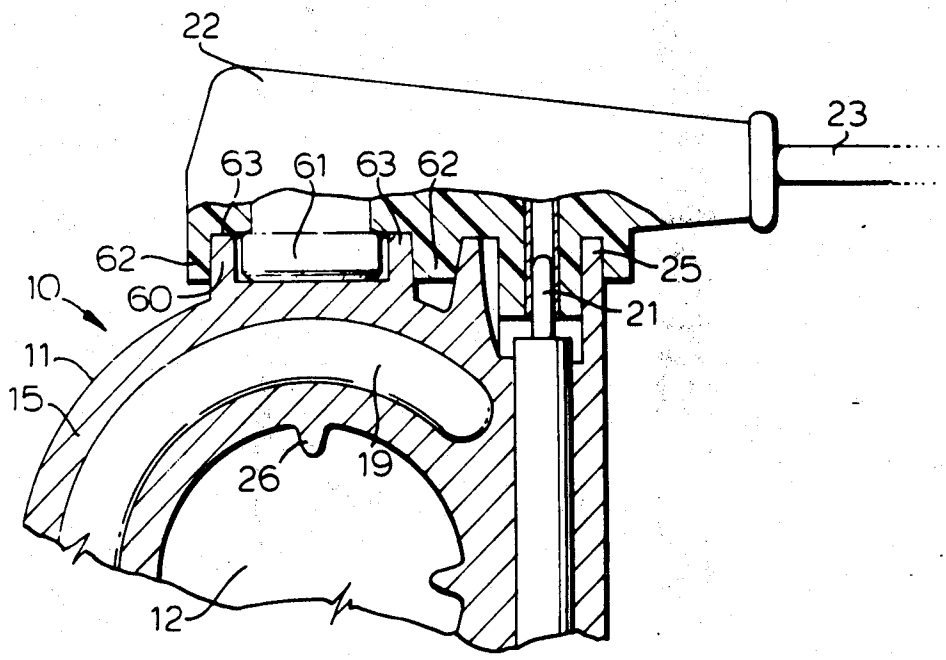
Primary Examiner—Albert W. Davis, Jr.
Attorney, Agent, or Firm—Sim & McBurney

[57] **ABSTRACT**

An engine preheater is of a type that is adapted to be connected in one of the radiator hoses that is connected between a liquid cooled engine and a radiator therefor. The preheater has a housing with a passage extending therethrough for passage of a coolant through the preheater. The housing has two end sections and an intermediate section, the latter being located between the end sections and being fabricated of a heat conductive material. An electric heating element is cast in place and embedded in the intermediate section and is separated from the passage through the housing by a part of the housing so that the heating element does not contact coolant flowing through the passage but heats it indirectly. The end sections are adapted to be connected to the radiator hose.

15 Claims, 13 Drawing Figures



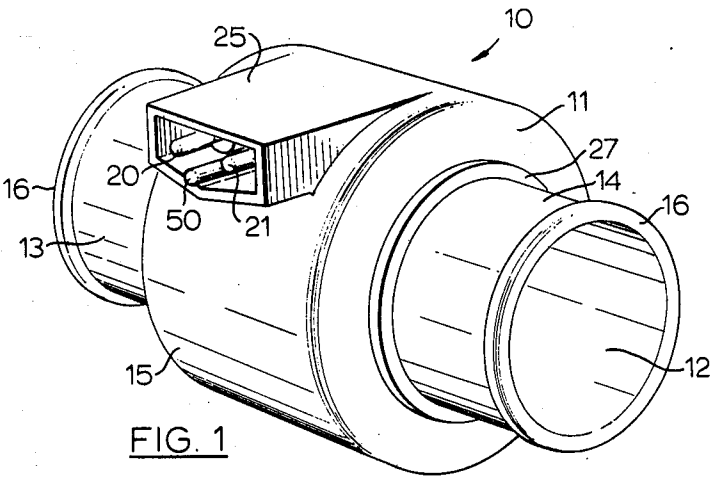


FIG. 1

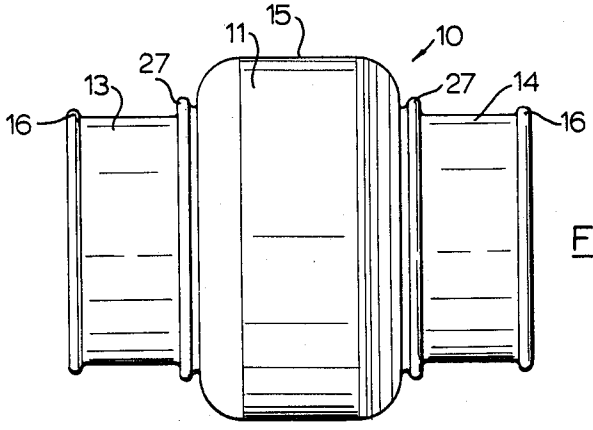


FIG. 2

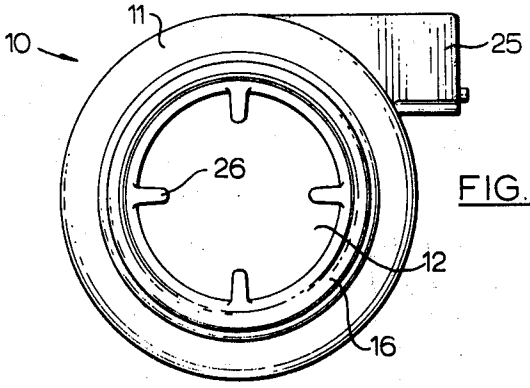


FIG. 3

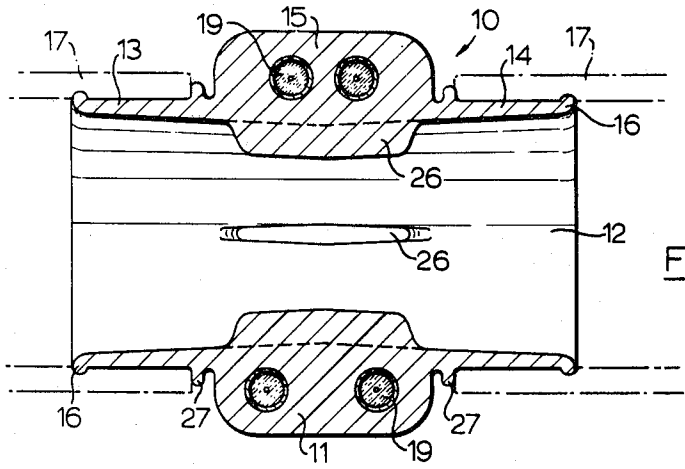


FIG. 4

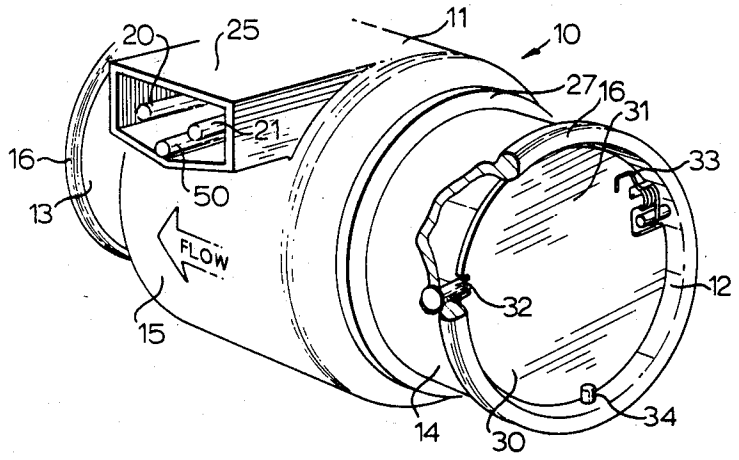


FIG. 6

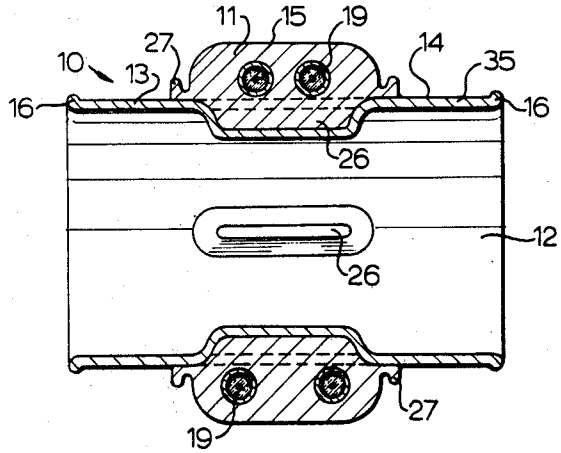


FIG. 5

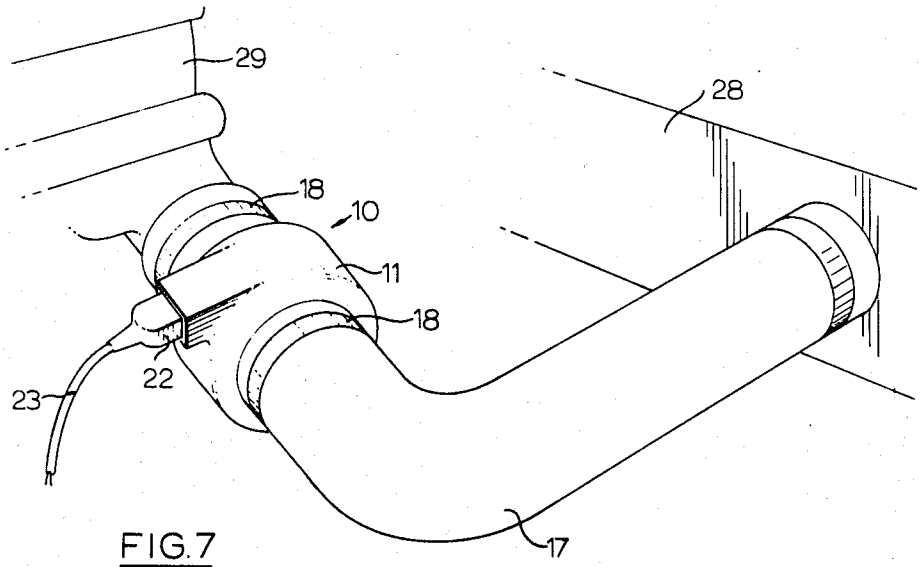


FIG.7

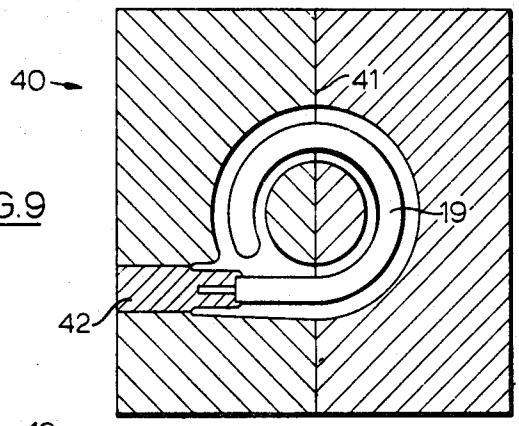


FIG.9

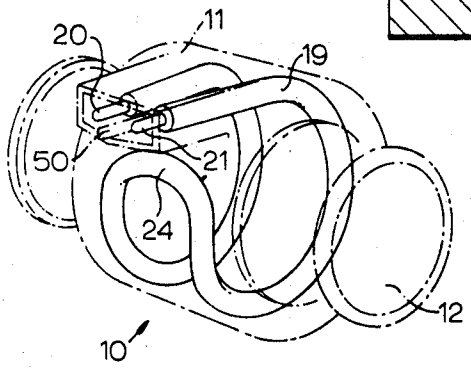


FIG.8

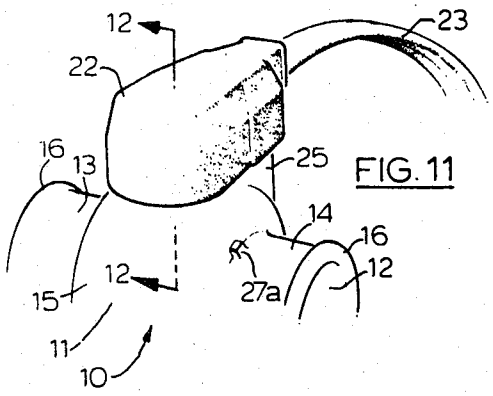


FIG. 11

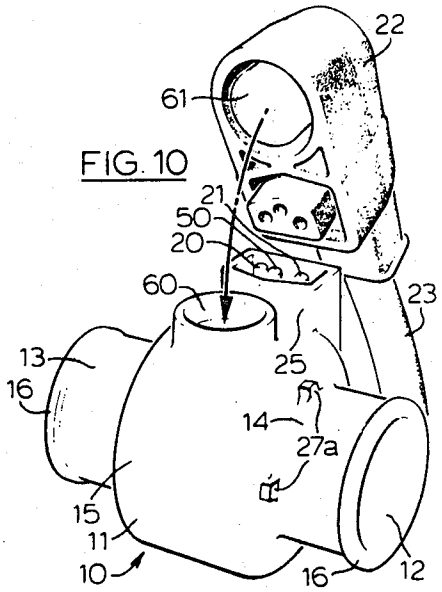


FIG. 10

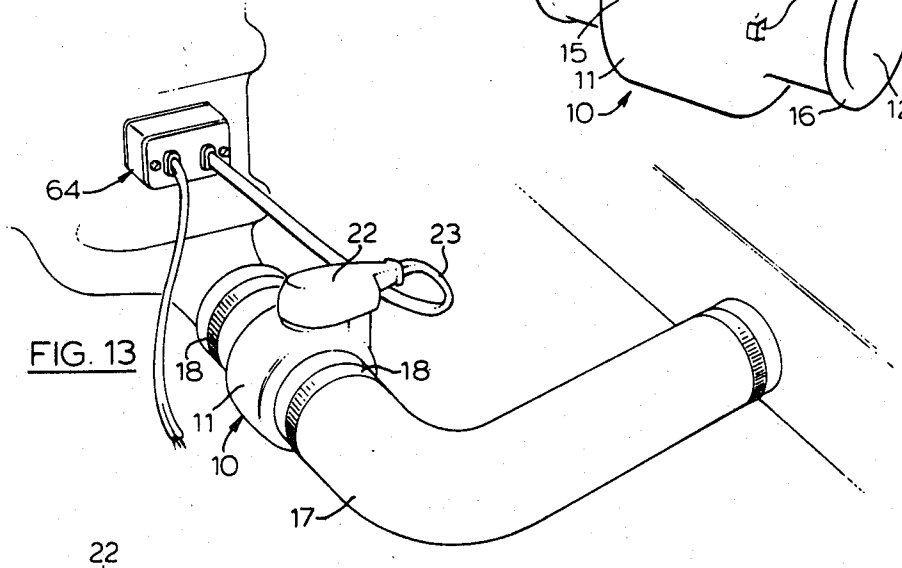


FIG. 13

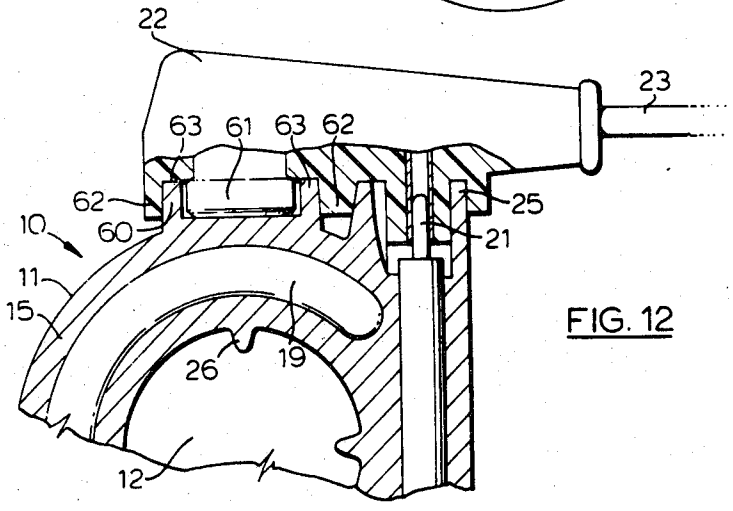


FIG. 12

ENGINE PREHEATER

This application is a continuation-in-part of abandoned application Ser. No. 159,816, filed July 6, 1971 now abandoned.

This invention relates to a preheater for an engine, i.e. to a heater for the coolant of a liquid cooled engine. More particularly, this invention relates to an engine preheater of the lower radiator hose type.

For many years internal combustion engines, particularly automobile engines, that are called upon to operate at least part of the time in cold weather have been provided with engine preheaters or block heaters of the frost plug type to facilitate starting of the engines. This type of block heater is essentially an immersion heater that is located in a frost plug opening in the block of an engine. The basic problem with frost plug type block heaters is that an extremely wide variety of them now must be manufactured and stocked if one is to be able to provide a block heater for every different automobile on the road. Thus, from 1963 to 1971 the number of different types of block heaters that would have to be provided just for the most popular makes of automobiles on the road has increased from 16 to 30.

Because of this problem a different type of engine preheater known as the lower radiator hose type has been developed. This type of engine preheater, as its name suggests, is connected in the radiator hose, and far fewer heaters of this type are required to be used with different makes of automobiles, since there are only a few standard sizes of radiator hoses.

However, prior art engine preheaters of the lower radiator hose type have in many instances been constructed with the heating element directly in the path of coolant flowing between the radiator and the engine. This can lead to overheating problems, particularly when the engine is operated during the summer months, since it is the practice to leave the engine preheater in the radiator hose at all times. In some designs this problem has been avoided by providing an enlarged peripheral well in the housing of the engine preheater and mounting the heating element in this well so as not to impede the flow of coolant through the device. However, this can lead to the problem of vapour lock. Furthermore, in engine preheaters of this type it has been common to fabricate the heating element itself of copper and the housing of the engine preheater of steel. This has led to problems of galvanic corrosion. There also is the problem of having to solder or braze the element in position.

Other types of engine preheaters are known in which the electric heating element is wrapped around or inserted in an opening in the metal housing of the engine preheater. Devices of this type are expensive to make, and the efficiency of heat transfer from the electric heating element to the housing may not be high leading to a generally inefficient heater from the point of view of the amount of heat that it transmits to the coolant relative to the electrical energy input. Furthermore devices of this type are likely to burn out quickly.

In accordance with this invention there is provided an engine preheater of the lower radiator hose type that avoids all of the foregoing problems of its predecessors.

In brief, in accordance with this invention there is provided a heater for the coolant of a liquid cooled engine in which the heating element is cast in place in the housing of the engine preheater so as, with high efficiency, to indirectly heat coolant passing through the engine preheater and not to impede the flow of coolant through the device.

This invention will become more apparent from the following detailed description, taken in conjunction with the appended drawings, in which:

FIG. 1 is a perspective view of an engine preheater embodying this invention;

FIG. 2 is a front elevation of the engine preheater of FIG. 1;

FIG. 3 is an end elevation of the engine preheater of FIG. 1;

FIG. 4 is a section through the engine preheater of FIG. 1;

FIG. 5 is a section through a modified engine preheater embodying this invention;

FIG. 6 is a perspective view similar to FIG. 1 of another embodiment of this invention;

FIG. 7 is a view showing an engine preheater embodying this invention installed in a radiator hose;

FIG. 8 is a view showing the location of the heating element in an engine preheater embodying this invention, the housing thereof being shown in ghost outline in FIG. 8;

FIG. 9 shows a permanent mold that can be used in making an engine preheater embodying this invention;

FIGS. 10 and 11 are perspective views of another embodiment of this invention that is provided with a thermostat to guard against burn out of the electric heating element thereof;

FIG. 12 is a section taken generally along line 12—12 in FIG. 11; and

FIG. 13 is a view similar to that of FIG. 7 but of the embodiment of the invention shown in FIGS. 10–12 further modified by the addition of a thermostat responsive to engine coolant temperature.

Referring to the drawings, particularly FIGS. 1 to 4, there is shown an engine preheater 10 that includes a housing 11 having a passage 12 extending therethrough for passage of coolant through the heater. Housing 11 has end sections 13 and 14 that are separated from each other by an enlarged intermediate section 15.

End sections 13 and 14 are adapted to be connected to a radiator hose in the manner shown in FIG. 4 and, to this end, are provided with lips 16 over which the radiator hose 17 must be stretched. Conventional hose clamps 18 (FIG. 7) may be used for clamping hose 17 to end sections 13 and 14.

Cast in place in and embedded in intermediate section 15 is a heating element 19 of known conventional type. Housing 11 may be cast in a permanent mold, and it is to be understood that heating element 19 is positioned in the mold and housing 11 cast around it, whereby element 19 becomes embedded in the casting. In this manner heating element 19 is kept out of contact with coolant flowing through passage 12 to avoid problems of galvanic corrosion. Details of a permanent mold 40 that may be used in making engine preheaters 10 are shown in FIG. 9. The mold parting line is designated 41. No locating pins are required. An element pick up core 42 is used for holding and locating heating element 19 during the molding operation.

Clearly the casting in place of heating element 19 in housing 11 avoids any problem of the heating element impeding flow of coolant through passage 12, and tests have shown that ample heat can be indirectly applied from heating element 19 via housing 11 to coolant flowing through passage 12. Indeed, the casting in

place of heating element **19** is an important feature from a number of points of view. Heating element **19**, as aforementioned, is of a conventional type consisting of an outer steel tube having its outer surface flashed with copper, a resistance wire centrally located in the tube and magnesium oxide surrounding the resistance wire and filling the remainder of the passage through the tube. When this heating element is cast in place, it is believed that adhesion between the metal of the housing and the tube of the heating element takes place. In any event, perfect or almost perfect heat transfer relationship between the housing and the heating element is established, much more so than ever could be established by wrapping a heating element around the housing or inserting it into a preformed cavity in the housing. Furthermore, the additional expense of these manufacturing steps is avoided.

Intermediate section **15** should be fabricated of heat conductive material and, obviously, if the whole of housing **11** is to be cast at one time, the whole of housing **11** will be fabricated of the same heat conductive material. This material preferably is a metal, a very suitable alloy that can be used being ALCAN (trade mark) 160X, an aluminum alloy composed of copper — 0.1%, iron — 0.6% manganese — 0.3%, silicone — 10 — 13%, zinc — 0.1%, titanium — 0.2%, various other elements — 0.2%, balance aluminum.

As will be seen by reference to FIG. **8**, heating element **19** has two terminals **20** and **21** that may be connected via a plug **22** (FIG. 7) and cord **23** (FIG. 7) to any suitable source of electrical energy. The heating element itself is formed into almost two complete circles joined by a section **24** (FIG. **8**). Such a configuration provides a low watts density and minimizes corrosion problems that increase with increasing watts density.

As may be seen from FIG. **1**, terminals **20** and **21** are located in a receptacle **25** formed integral with and constituting a part of intermediate section **15**. Also located in the receptacle and connected thereto is a grounding pin **50**.

In a preferred embodiment of the invention a number of heat transfer fins **26** extend inwardly from housing **11** into passage **12** to increase the rate of heat transfer to coolant flowing through the passage **12**. Four such fins **26** are shown in FIG. **3**, and it will be seen from FIG. **4** that these fins are substantially longer than they are wide, and that the length dimension of the fins is parallel to the flow of coolant through passage **12**, whereby fins **26** do not appreciably impede the flow of coolant through passage **12**.

Since heating element **19** is cast in place in and embedded in intermediate section **15**, intermediate section **15** will be hotter than end sections **13** and **14**. The end sections are provided with stops **27** in the form of annular flanges that are located adjacent intermediate section **15** but spaced therefrom. As shown in FIG. **4**, radiator hose **17** abuts against flanges **27** and is prevented thereby from coming into contact with intermediate section **15** so as to reduce deterioration of the hose due to heat.

As shown in FIG. **10**, such deterioration can be reduced even further by making the stops in the form of spaced apart projections **27***a* so as to reduce the amount of metal in contact with radiator hose **17**. In either case the stops are air cooled and function like heat transfer fins.

It is, of course, undesirable for coolant heated by the engine preheater to flow back into the radiator **28** (FIG. 7) rather than into the engine block **29** (FIG. 7). This can be avoided by proper installation of the unit as close to engine block **29** as possible and in a portion of hose **17** that slopes upwardly towards engine block **29**. However, to positively ensure against this eventuality, an embodiment of the invention that is illustrated in FIG. **6** may be employed. In this embodiment there is a one way valve **30** located in end section **14**. This valve consists of a circular disk **31** mounted for rotation in end section **14** by means of a pivot pin **32** and biased by a spring **33** to a normal closed position against a stop **34**. When the engine is operating in its normal manner, the pressure of coolant downstream from passage **12** is sufficient to open one way valve **30** against the pressure of spring **33**.

While it is preferred to cast housing **11** as a unitary structure, it is possible for housing **11** to consist of a tube **35**, as shown in FIG. **5**, provided with ribs **26** and an intermediate section **15** cast about the central portion of tube **35**. With such a construction the materials of tube **35** and the casting should be selected to have approximately the same temperature coefficient of expansion.

Aside from the other advantages of the engine preheater of this invention that have been enumerated herein, only a few sizes are required to meet the demands of virtually all of the automobiles having liquid cooled engines presently marketed. The sizes in which the device can be provided to meet these requirements are as follows:

Wattage	Size
500	1
800	1
800	1
800	2

The embodiment of the invention shown in FIGS. **10–12** differs from the previously described engine preheaters in that housing **11** is provided with an integrally formed well **60** while plug **22** has a thermostat **61** built into it, this thermostat fitting into well **60**, as best shown in FIG. **12**, when the plug is connected to the terminals of the heating element. As shown in FIG. **12**, plug **22** has a skirt portion **62** that completely surrounds thermostat **61** and that engages the annular wall **63** that defines well **60** to weatherproof the thermostat and seal it in the well.

Heating element **19** is interposed between coolant passage **12** and well **60**, so thermostat **61** senses and is responsive to the temperature of element **19** rather than the temperature of the coolant flowing through passage **12**. The thermostat is set and connected to interrupt the supply of power to element **19** when it becomes too hot, as would occur, for example, if there is no coolant present in the preheater, so as to prevent element **19** from burning out. Such an arrangement is not possible in prior art lower radiator hose preheaters of the type where the heating element is in the coolant passage because, when such a preheater runs dry, the heating element is surrounded by air and transmits very little heat to the housing.

In the embodiment of the invention shown in FIG. **13** another thermostat **64** is provided. This thermostat is mounted on engine block **29** and is responsive to coolant temperature. It is set and connected to interrupt the

supply of power to element **19** when the coolant has reached a desired temperature. It will be appreciated, of course, that thermostat **64** can perform this same function when located at other points in the engine coolant system.

While preferred embodiments of this invention have been disclosed herein, those skilled in the art will appreciate that changes and modifications may be made therein without departing from the spirit and scope of this invention as defined in the appended claims.

I claim:

1. A heater for the coolant of a liquid cooled engine, said heater being of a type adapted to be connected in a hose between a liquid cooled engine and a radiator, said heater comprising a housing having a passage extending therethrough for passage of coolant through said heater, said housing having first and second end sections and an intermediate section, said intermediate section being cast of heat conductive material and being located between said end sections, said end sections being adapted to be connected to a radiator hose, an electric heating element cast in place in and embedded in said intermediate section and separated from the passage through said housing by a part of said housing, whereby coolant flowing through the passage in said housing is inhibited from direct contact with said heating element but indirectly is heated thereby, a thermostat located in heat transfer relationship with said housing on the side of said heating element remote from said passage, said thermostat being responsive to the temperature of said heating element for interrupting the supply of power thereto when the temperature sensed by said thermostat exceeds a predetermined upper limit, and a plug adapted for electrical connection to said heating element, said thermostat being incorporated in said plug.

2. A heater according to claim **1** wherein the whole of said housing is a cast member.

3. A heater according to claim **2** wherein said housing is cast of a heat conductive metal.

4. A heater according to claim **1** wherein said housing is a metal tube having a heat conductive metal casting cast about said tube intermediate the ends of said tube, said heater element being cast in place in said metal casting.

5. A heater according to claim **1** including a one-way valve located in the passage extending through said housing.

6. A heater according to claim **1** including a plurality of heat transfer fins extending inwardly from said housing into the passage extending therethrough.

7. A heater according to claim **6** wherein said fins are substantially longer than they are wide, the length dimension of said fins being parallel to the flow of coolant through the passage extending through said housing.

8. A heater according to claim **1** wherein said end sections include stop means located adjacent said intermediate section but spaced therefrom and adapted to abut against radiator hose connected to said end sections to prevent the radiator hose from contacting said intermediate section.

9. A heater according to claim **2** including a plurality of heat transfer fins extending inwardly from said housing into the passage extending therethrough.

10. A heater according to claim **9** wherein said end sections include stop means located adjacent said intermediate section but spaced therefrom and adapted to abut against radiator hose connected to said end sections to prevent the radiator hose from contacting said intermediate section.

11. A heater according to claim **10** including a one-way valve located in the passage extending through said housing.

12. A heater according to claim **1** including a second thermostat responsive to the temperature of coolant heated by said heater for interrupting the supply of power to said heating element when the temperature sensed by said second thermostat exceeds a predetermined upper limit.

13. A heater for the coolant of a liquid cooled engine, said heater being of a type adapted to be connected in a hose between a liquid cooled engine and a radiator, said heater comprising a housing having a passage extending therethrough for passage of coolant through said heater, said housing having first and second end sections and an intermediate section, said intermediate section being cast of heat conductive material and being located between said end sections, said end sections being adapted to be connected to a radiator hose, an electric heating element cast in place in and embedded in said intermediate section and separated from the passage through said housing by a part of said housing, whereby coolant flowing through the passage in said housing is inhibited from direct contact with said heating element but indirectly is heated thereby, a well formed in said intermediate section, said well being located on the side of said heating element remote from said passage, a thermostat located in said well and responsive to the temperature of said heating element for interrupting the supply of power threto when the temperature sensed by said thermostat exceeds a predetermined upper limit, and a plug adapted for electrical connection to said heating element, said thermostat being incorporated in said plug.

14. A heater according to claim **13** wherein said well is defined by upstanding walls formed integral with and upstanding from said intermediate section and said plug has a skirt portion surroudning said thermostat, said skirt portion surrounding and engaging said upstanding walls to seal said thermostat within said well.

15. A heater according to claim **13** including a second thermostat responsive to the temperature of coolant heated by said heater for interrupting the supply of power to said heating element when the temperature sensed by said second thermostat exceeds a predetermined upper limit.

* * * * *