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OUTBOARD ENGINE COOLING DEVICE

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The present invention relates to improvements in outboard engine cooling device, and constitutes certain improvements over my prior invention as disclosed in my prior Patent No. 2,268,526, granted October 7, 1941.

The present invention has for its purposes and objects, those set forth in my prior patent aforesaid, in addition to those hereinafter set forth.

It is an object of the present invention to increase the cooling capacity of the prior device and thereby to enhance the effectiveness of the device as a heat exchanger in cooling the engine jacket water; this to the end of preventing overheating of the engine and the incidental damage and disasters resulting therefrom.

In outboard motor coolers the problem of increasing heat exchange capacity cannot be directly and immediately solved by mathematical enlargement of the volume capacity of the cooler, for the reason that the external placement of the cooler with respect to the boat hull interposes a drag element and an increase in skin friction which cannot be enlarged in area without proportionately reducing speed and maneuverability performance factors of the boat at such a ratio that the material enlargement of the cooler area is prohibited.

A further object of the invention is to overcome and solve this problem in the production of an external cooling assembly which will possess the necessary volumetric capacity but which is so constructed and arranged relatively to the hull and keel of the boat and to the various members of the cooler assembly as to retain the drag and skin friction factors within a minimum so as not to interfere in any substantial way with the effective speed of the boat and its maneuverability.

A further object of the invention is to provide an improved cooler unit and assembly in combination with an improved inlet and outlet assembly which results in the delivery of the incoming water simultaneously to a plurality of small diameter tubes, the inlet and outlet unit also being so constructed and arranged as to accommodate the coolant by withdrawing the same simultaneously from a plurality of such tubes.

A still further object of the invention resides in providing an improved form of terminal header fitting in which the rate of flow of the water to and from all of the cooling tubes will be substantially uniform, thus avoiding stagnation zones which interfere with the uniformity of flow rate and correspondingly decrease the cooling effect of the unit as a whole.

With the foregoing and other objects in view, the invention will be more fully described hereinafter, and will be more particularly pointed out in the claim appended hereto.

In the drawings, wherein like symbols refer to like or corresponding parts throughout the several views,

Figure 1 is a side elevation, with parts broken away and parts shown in section of an improved outboard engine cooling device constructed in accordance with the present invention, and shown as applied to a boat hull or keel indicated in broken lines.

Figure 2 is a horizontal section taken on the line 2—2 in Figure 1 with the intermediate portions of the tubes broken away and with the inlet and outlet unit omitted.

Figure 3 is a bottom plan view, with parts broken away and parts shown in section of the device of Figure 1.

Figure 4 is a vertical section taken on the line 4—4 in Figure 2.

Figure 5 is also a vertical section taken on the line 5—5 in Figure 2.

Figure 6 is a perspective view, partly broken away and partly shown in section, of one of the improved terminal header fittings.

Figure 7 is a similar view taken through another chamber of the terminal header fitting.

Figure 7a is a horizontal cross-section taken through the left header of Figure 2 through the lower passage.

Figure 7b is a longitudinal section through the header.

Figure 8 is a vertical transverse section taken on the line 8—8 in Figure 1.

Figure 9 is a top plan view of the inlet and outlet thermostatic cap.

Figure 10 is a view similar to Figure 1 but showing a modification.

Figure 11 is a bottom plan view of the device shown in Figure 10.

Figure 12 is a transverse vertical section taken on the line 12—12 in Figure 10, and

Figure 13 is a top plan view of the inlet and outlet cap, partly broken away and partly shown in section.

Referring more particularly to the drawings, and for the present to Figures 1 to 9 inclusive, 15 shows in broken lines the hull or keel of a boat to which the device may be secured in any suitable manner, as for instance shown and described in my prior patent aforesaid.

The external unit or cooler assembly is, in this particular embodiment of the invention, made up of four copper or other tubes 16, 17, 18 and
19 of relatively small diameter so as to be susceptible of close grouping with respect to one another and of fitting close against the external skin of the keel or hull 15 to avoid a bulky enlargement. The opposite ends of the four tubes are fitted in the terminal header fittings 20 and 21. These headers 20 and 21 are secured to the hull or keel 15 by means of end clamps 22 and 23. Intermediate clamps 24 and 25 serve to support the tubes. Bolts 26 secure the clamps to the hull or keel 15; or any other fastenings may be employed for the purpose.

A stand pipe 27 passes through the single opening 28 made in the hull 15 and this stand pipe rises from a base fitting 29. Within the base fitting and stand pipe 27 is a partition 30 (Figure 3), and in this respect the stand pipe is similar in all respects to that illustrated and described in my prior patent aforesaid, with the exception that, as shown in Figure 3, the two chambers of the stand pipe 27 at opposite sides of the partition 30 have cross-sectional capacity substantially equal to that of two of the tubes of the cooling unit so that the inlet chamber 39 may communicate simultaneously with two of the tubes, for instance, the tubes 16 and 17 for the simultaneous delivery thereto of the incoming hot water from the water jacket of the engine installed to drive the boat. This engine is not shown herein but its relative connection with the stand pipe is fully disclosed in my prior patent aforesaid. In a similar way the outlet chamber 40 at the other side of the partition 30 communicates simultaneously with the two tubes 16 and 17 at the other side of the base fitting 29.

A plate 41 of the base fitting 29 engages the hull 15 and is formed with openings 42 to receive the bolts 32 through an inside plate 31 which is perforated to surround the stand pipe 27. A washer and nut assembly 33 is fitted to the externally threaded stand pipe 27 and bears upon the inside plate 31. The stand pipe and its base fitting 29 constitute a combined inlet and outlet fitting coordinated in one element which therefore requires only the one opening 28 through the hull 15 to set up communication with the external cooler and the internal engine water jacket.

The outlet cap or thermostat head 34 may be similar to that shown and described in my prior patent aforesaid and may be held onto the stand pipe by bolts 43 according to the construction more particularly shown in such prior patent.

Referring more particularly to Figures 2, 4, 5, 6 and 7, the improved terminal header 20 may conveniently be made from a casting of metal or other suitable material in which 35 designates the top wall, 36 the bottom wall and 37 and 38 the front and rear walls respectively. This casting is cored out to provide passages for receiving and reversing the flow of the water.

As shown in Figure 2 an end wall 44 cooperates with a septum or partition 45 in the form of an U-shaped passage or chamber 46 placing the left ends of tubes 16 and 18 in communication. In other words water flowing as indicated by the arrow in Figure 2 toward the left in end tube 16 will enter passage 46, wherein its direction of flow will be reversed, and directed outward through intermediate tube 18, through which the water will traverse the full length of the cooler and emerge at the opposite header 21. The inside surface of end wall 44 is shown in Figure 2 with a curvilinear section 47 where the end wall 44 merges with the back wall 38. In a similar way a curvilinear section 48 is made between back wall 38 and the partition 45. Opposed to the curvilinear sections 41 and 48, which are concave, are the mutually and complementarily curved convex surfaces 45 and 46 which are located between the external surfaces of the partition walls 51 and 52 and the connecting partition web 53. Thus the passage 48 is free of all angles, corners or obstructions which would tend to interfere with the free flow of the stream from the one tube to the other.

As shown in Figure 4 the passage 46 is in the upper half of the casting and is separated by a horizontal septum or partition 54 from a bottom passage 55 which connects tubes 17 and 19, as indicated in Figure 2. Reverting to Figure 4, the rear end of the horizontal partition 54 merges with the back wall 38 of the casting. The front wall 20 of the horizontal partition 54 merges with the lower end of the vertical partition 53. The upper edge of the vertical partition 53 merges with the roof 36 of the casing.

Again referring to Figure 2 and to Figure 7a, the lower passage 56 is shown as setting up communication between the intermediate tube 17 and the end tube 19. The end wall 56 forms part of this passage together with the rear wall 38 and an intermediate partition 57 shown in dotted lines in Figure 2 and in full lines in Figure 7a. This intermediate partition 57 as to height extends up from the bottom 36 only as high as the horizontal partition 54 with which its upper edge merges. Curvilinear sections 58 and 59 are formed in the partitions 58 and curved convex surfaces 60 and 62 are made opposite these sections on the corner portions of the partition 62. The partition 62 is shown in dotted lines in Figure 2 and in full lines in Figures 5 and 7a.

The resultant of this construction is that cross-over passages 45 and 55 are provided in the header 20 in which passage 45 is in the upper half of the casting and passage 55 in the lower half; passage 46 establishing communication between the ends of an end tube 16 and an intermediate tube 18, and passage 56 establishing communication between an intermediate tube 17 (companion of tube 16) and an end tube 19 (companion of tube 18).

In this way two tubes 16 and 17 carry the volume flow in one direction and two tubes 18 and 19 carry the volume flow in the opposite direction; in contrast to the single tube in the prior patented device for carrying the flow in each direction. In this way volumetric capacity may be greatly increased without increasing tube diameter sizes. The tubes may be retained of small diameter to lie closely against the hull thus forming minimum obstruction.

Consequently the arrangement of tubes and headers forms a multiple flow keel cooling system. The tube sockets of the header 20 are shown at 63, 64, 65 and 66, such sockets receiving respectively the tubes 16, 17, 18 and 19. The header 21 at the opposite end of the cooler is formed precisely like the header 20 but is faced in the opposite directions so that its corresponding tube sockets 63a, 64a, 65a and 66a are reversed. The arrangement of the passages is the same in both headers 20 and 21. The upper cross-over passage 46a in header 21 connects tubes 19 and 17; while the lower cross-over passage 56a connects the tubes 18 and 16.

Screw clean-out plugs 67 and 69 are provided in the end wall 38 of each header at such spaced
points that one plug will communicate with an upper passage 45 and the other with a lower passage 55.

In operation, hot water entering the cap 34 from the water jacket of the boat’s engine descends through the duct 36 at one side of the partition 30 in the stand pipe 27 and is directed by this duct 36 to the tubes 16 and 17, part of this incoming volume being absorbed by each of the two relatively small diameter tubes 16 and 17. These tubes also have greater external cooling surface exposed to the sea water than would one large tube of equal capacity. The divided hot fresh water thus flows in parallel masses in tubes 16 and 17 in the direction of the arrows shown in Figure 2 until reaching left header 23 by which the direction of flow is reversed and the stream re-circulated in the opposite direction through tubes 18 and 19 completely across the device to the other header 21. In this header 21 the direction of flow is again reversed through 180° and the water circulated back through the other halves of tubes 16 and 17 to the base fitting 20 and thence to the ascending or riser duct 40 to the right side of partition 30 in stand pipe 27.

Then the cooled water ascends into the cap 31 and is by this cap directed to the engine water jacket in a manner more fully described and shown in my prior patent previously referred to.

The device constitutes the multiple flow cooling system in which the mass of water to be cooled is split up and carried in two or more tubes in order to properly handle the volume.

In the multiple flow system, the velocity of the water which is carried through the tubes and which is guided to reverse directions by the terminal header fittings, assumes a parabolic action and flows much faster in the outer tubes, thereby defeating the efficiency of the inner tubes. In other words the water in the inner tubes flows too lazily, with the result that the efficiency of the complete cooling system is upset.

Because of this uneven flow a greater amount of tubing than would otherwise be required is necessitated.

The terminal header fittings constitute the mixing arrangement which has been developed in conjunction with the improved multiple flow cooling system by which the efficiency of the entire system is maintained at a maximum and the rate of flow of the water in the various tubes and headers is constant and uniform. The passages in the headers are split in such a way that the water from an outside tube is diverted to an inside tube. Through this arrangement, the momentum or parabolic action of the water is broken up, and its tendency to crowd the outer passages is overcome. All of the tubes therefore carry an even flow of water, which is very important in estimating their capacity of heat dissipation.

Thus the return or terminal fitting is cored in such a way that the water from an outer tube passes through a cored section over the water from an inner tube and is diverted to the inner tube on the return side. Working from the outer end this situation reverses itself.

In order to handle the large amount of circulating water it is absolutely necessary that the water be carried in two or more tubes in each direction, spreading out and converging at the inlet and outlet fitting. The terminal headers, due to their novel arrangement thoroughly mix the circulating water, thus achieving a substantially equal flow in all tubes which is of utmost importance for efficient operation.

Referring more particularly to Figures 10 to 13 inclusive, eight tubes are shown as against the four of the first form of the device. These eight tubes are arranged in parallel relation. Part of the tubes marked 70 carry the water from the origin and terminal header 71 to the aft header 72 in which the direction of current flow is reversed and the water circulated back to header 71 through the four tubes marked 73.

In this instance the stand pipe 74 rises from the central portion of the origin and terminal header 71 and its partition 75 diverts the incoming hot water to the tubes 70 and separates the same from the cooled effluent which is recirculated to the engine water jacket. The cap 71 also has partition 77 forming a continuation of the partition 75. In Figure 12 the arrows show the incoming and outgoing water.

Figure 12 also shows the partition 78 extending outwardly as a prolongation of partitions 75 and 77 into the base fitting 76 which in this instance is or may be a part of the origin and terminal header 71.

It is obvious that various changes and modifications may be made in the details of construction and design of the above specifically described embodiment of this invention without departing from the spirit thereof, such changes and modifications being restricted only by the scope of the following claim.

What is claimed is:

A cooling device comprising four tubes and headers connected to the ends of the tubes, each header comprising a casting cored out to provide rounded passages of approximately equal length, said passages overlapping vertically, a horizontal partition separating the passages, vertical partitions, one vertical partition extending from the top of the casting down to said horizontal partition, another vertical partition extending from the bottom of the casting up to said horizontal partition, tube sockets in the casting, the vertical partitions being in alignment with the intermediate tube sockets and being approximately one-half the cross-sections of the sockets, and other vertical partitions at substantially right angles to the first-named vertical partitions.

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