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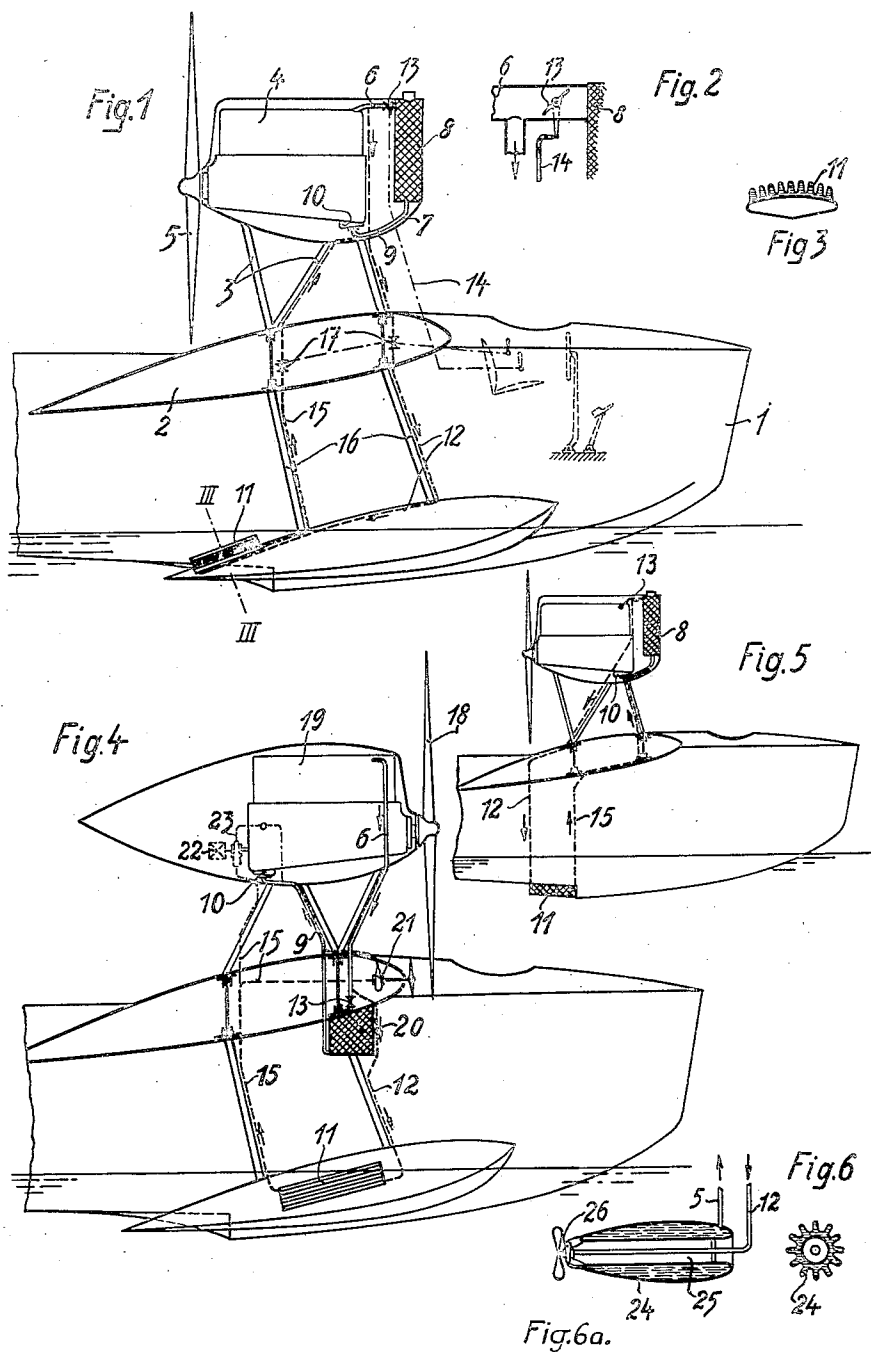
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WATER COOLING APPARATUS FOR SEAPLANE ENGINES

Original Filed Nov. 3, 1927

2 Sheets-Sheet 1



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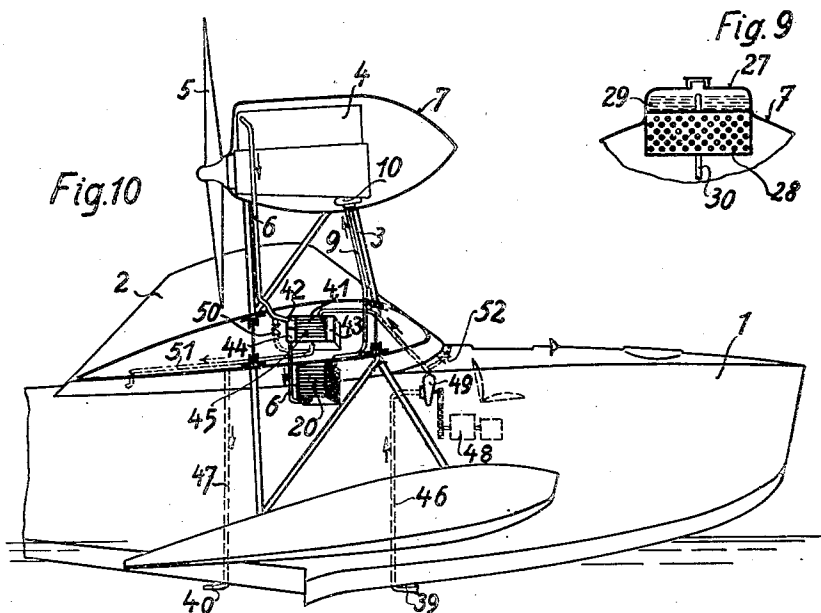
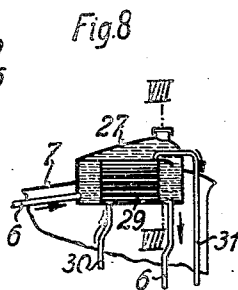
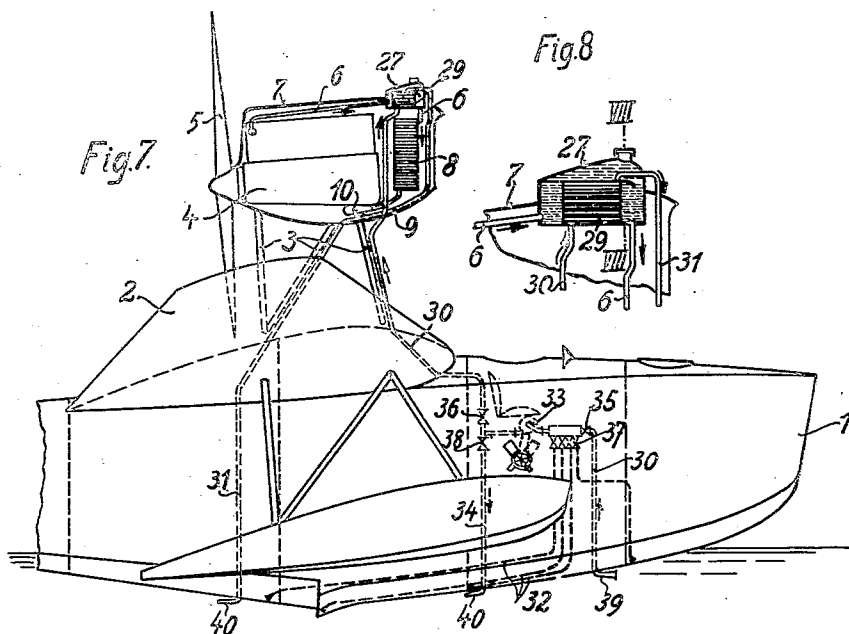
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UNITED STATES PATENT OFFICE

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WATER COOLING APPARATUS FOR SEAPLANE ENGINES

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To enable seaplanes having water-cooled engines to travel on water for a substantial time under their own power it has been the practice to provide them with cooling appliances substantially in excess of that which they require when flying. The excess capacity must be particularly large where pusher propellers are used, because it is then in practice not easy to place the cooling appliance in the path of the propeller stream.

According to my invention I provide, in the case of a seaplane having water-cooled engines, in addition to the engine cooling appliance operating when the machine is in flight, a cooling appliance which is used specially when the machine is travelling on the water. With this arrangement a seaplane is able to travel on the water for an indefinite period, and its utility is thus very considerably increased. A fast seaplane is, for example, able to descend and take off at any selected part of the sea, and may travel on the water from the high sea to the river-mouth port. This greatly facilitates the cooperation of seaplanes with warships, in addition to having other important advantages.

The supplementary cooling apparatus provided according to the invention may with advantage be carried below the waterline of the machine, exposed to the sea. Another method is to have it above the waterline, with conduits for passing seawater to and from it, a considerable part of the cooling passages being seawater passages, which can be emptied when flying, with a substantial saving of dead weight, particularly where high-powered engines are used. The water carried in the supplementary cooler, during flight, may be made to take part in the circulation, so that there is no risk of its freezing in cold weather, or at high altitudes. By placing the supplementary apparatus in an elevated position it is in general better protected than when carried low.

Several examples of apparatus according to the invention are shown in the annexed drawings.

Fig. 1 is a side-view of the front part of a seaplane having lateral stabilizing floats and a pusher propeller, Fig. 2 is a view showing

a detail thereof, to a larger scale, and Fig. 3 is a section on the line III—III of Fig. 1. Fig. 4 shows part of a seaplane having a tractor propeller. Fig. 5 shows a modification of a machine similar, in its general aspects, to that shown in Fig. 1. Fig. 6 shows a special embodiment of return-radiator in cross-section. Fig. 6a represents the same part in vertical longitudinal center section. Fig. 7 is a side view, partly in section, showing another modification, Fig. 8 is a section of the supplementary cooler, to a larger scale, and Fig. 9 is a section on the line VIII—VIII of Fig. 8. Fig. 10 shows another modification, partly in section.

Referring first to Figs. 1 to 3, a flying boat is shown having a boat hull 1 and planes 2, with struts 3 supporting above the planes a water-cooled engine 4 driving a pusher propeller 5. Cooling water flows from the engine through a pipe 6 to the forward part of the engine housing 7, where there is a cooler 8 exposed to the wind of the machine, to cool the water, which then flows through a pipe 9 to a pump 10 and is pumped back to the engine. During flight the cooler 8 is adequate for keeping the cooling water adequately cooled. For travelling on water, at a lower speed, there is a supplementary water-cooled cooler 11, shown in section in Fig. 3, which is connected by two pipes to the normal cooling system of the engine and is disposed on one of the floats, below the waterline. Cooling water flows from the pipe 6 through a pipe 12 to the cooler 11, when the latter is in use, there being a throttle valve 13 (Fig. 2) in the pipe 6, between the cooler 8 and the pipe 12, this valve being controlled by a Bowden wire or rod 14 from the pilot's seat. From the supplementary cooler 11 water flows through a pipe 15 to the pump 10. To avoid additional head resistance the pipes 12 and 15 extend along two of the struts 3. The valve 13 can be adjusted so that a greater or less proportion of the water for cooling the engine passes through the supplementary cooler 11, where it gives off much of its heat to the sea water. In the example shown the pressure difference due to the throttle valve 13 is used for causing circula-

tion through the supplementary cooler. At 17, 17 means are provided for entirely closing the branch pipes.

In the modification shown in Fig. 4 the machine has a tractor screw 18. During flight, water for cooling the engine 19 flows through a cooler 20 under the wing 2. Pipes 6 and 9, a pump 10, and a supplementary cooler 11 are provided, as described with reference to Fig. 1, but the pipe 15 leading from the cooler 11 is connected to an additional pump 21, which is shown as being actuated by an air screw, but alternatively there may be used a pump 23 driven by the engine 19, or by an electromotor 22 or the like, as shown in broken lines. The cooler 11 is partly above the waterline of the float which carries it, but is sufficiently submerged and swept by waves, when travelling on water, to cool the water adequately.

It will be understood that a throttle valve for deflecting the water to the supplementary cooler may also be used on a machine having a tractor screw, instead of using a supplementary pump.

In the modification shown in Fig. 5 the supplementary cooler 11 is arranged under the boat body, behind a shoulder or step of the bottom. The return pipe 15 shown joins the circulation system between the cooler 8 and pump 10, but alternatively it may be connected to the pipe leading from the engine to the cooler 8, the connection being made between the valves 13 and the cooler 8.

Figs. 6 and 6a show a supplementary cooler 24 consisting of a vessel having hollow ribs and having the general shape of a falling drop of water, with a central passage 25, for seawater to flow through, there being at one end of this passage a pump 26 driven by a water-actuated propeller. Combining the cooler with the water-driven pump, in the form of a structural unit, greatly simplifies the appliance.

I may arrange the supplementary cooler to be cooled solely by the wind of the machine. In this case I preferably adopt the known practice of pivoting it, so that when not in use it can be swung into some protected position where it does not add to the head resistance.

It will of course be understood that under suitable conditions I may provide that when travelling on water the cooling of the engine water is performed by means of the supplementary cooler alone. It will also be understood that there may be any number of engines, and that each engine may have one, two or more supplementary coolers. Where a supplementary cooler common to two or more engine cooling systems is used, cocks may be provided enabling any selected unit to be cut off, to prevent loss of water in case of a pipe fracture.

The invention is applicable also to land

aeroplanes, for use where occasion for travelling for long stretches on the ground exists.

In the modification shown in Figs. 7 to 9 the main cooler 8 is air-cooled, and is disposed near the open front of the engine housing 7. The pipe 6 feeding water to the cooler 8 is in two parts, leading respectively into, and out of, a stream-lined water container 27 above the cooler 8, this container having an equalizing effect, compensating for loss of cooling water, should such loss occur. Water flows from the cooler 8 through a pipe 9 to the pump 10. The container 27 has within it a closed box 29, with tubes 28 extending therethrough, and to this box are connected a seawater supply pipe 30 and a discharge pipe 31. Engine cooling water flows freely through the tubes in the box. The pipe 30 supplying sea water to the box 29 is connected to a bilge pump system controlled by the crew, comprising a pump 33, suction pump 32 and delivery pipe 34, this system serving for pumping water from the compartments of the hull, separately or collectively. The bilge pump motor is preferably driven by an auxiliary engine. There are stop valves 35, 36 in the pipe 30, in front of, and behind, the pump 33, and there are also stop valves 37, 38 in the pipes 32, 34. The intake end 39 of the pipe 30, below the waterline, is flared and faces forwards, so that the travel of the boat on the water forces water into the pipe. To utilize the speed of the boat for assisting the outflow of the water the outlets 40 of the pipes 31 and 34 are in the form of suction nozzles.

During flight engine cooling water is circulated through pipe 6, box 29, main cooler 8, pipe 9, pump 10 and engine, the cooling of the water itself being effected solely by the air to which the cooler 8 is exposed. On descent of the machine, and travelling on the water, the cocks 37, 38 are closed, and the cocks 35, 36 opened, and the pump 33 is caused to propel a continuous stream of sea water through the pipe 30 and box 29 where the water cools the tubes 28, through which the engine cooling water is flowing. When the machine rises again the pipes 30 and 31, and box 29, empty themselves of sea water. To allow of emptying them also when the machine is afloat an aircock may be provided; the cock 38 may, for example, be a combined stop cock and aircock. For pumping water from the hull the cocks 35, 36 are closed, and the cocks 37, 38 opened.

In the modification shown in Fig. 10 the main cooler 20 is suspended below the wing 2. The supplementary cooler 41 is a box having 4 compartments, and is inside the wing, offering no head resistance. Cooling water from the engine flows through pipe 6 to the top left-hand compartment 42 of the cooler 41, through tubes to the right hand chamber 43, through tubes to the left hand top

chamber 44, and thence to the main cooler 20, from which it is pumped through pipe 9 to the engine. The large compartment 45 of the supplementary cooler is traversed by tubes and connected to seawater pipes 46, 47, fed through a pipe 46 by means of a pump 49 driven by some auxiliary motor, say the starter or the motor driving the lighting dynamo. The intake and discharge openings 39, 40 are constructed and arranged substantially as described with reference to Fig. 7. A pipe 50, with a cock, enables engine cooling water to be taken directly to the main cooler, without flowing through the supplementary cooler. A pipe 51 is indicated by broken lines, showing that the seawater used for cooling may be discharged above sea level. When the supplementary cooler is required, the machine travelling on the water, the pump 49 is started, and propels cold sea water through the compartment 45 of the supplementary cooler 41, where it absorbs a substantial proportion of the heat of the engine cooling water. During flight the sea water pipes are empty; 52 is an aircock.

In the case of a machine having several engines, each may have a supplementary cooler, or there may be a supplementary cooler serving them all. If this cooler is placed low, and the machine has a high speed on the water it may not be necessary to use a seawater pump, the rush of the machine through the water being sufficient to drive the water through the cooler.

Another modification consists in so constructing the main cooler that it incorporates also the supplementary cooler, there being, for example, in front of the main cooler a spraying device or the like served with seawater, or seawater being when required driven through tubes which are cooled solely by air when the supplementary cooler is out of action.

With flying machines operating on rivers or fresh-water lakes, mixture cooling of the engine water may be used, instead of surface cooling, the supplementary cooler being, for example, a plain vessel through which the engine water flows, the vessel having a discharge pipe, and fresh water being pumped into it. The arrangement may also be such, that the conduits for circulation of the engine cooling water can be connected directly with the fresh-water pipes, by means of suitable valves.

I claim:—

1. In an engine cooling system for hydro-aeroplanes the combination of an aircooled radiator and a water cooled radiator, the latter being adapted to be cooled by sea water, with means for circulating the engine cooling fluid through said radiators.

2. In an engine cooling system for hydro-aeroplanes, the combination of an air cooled radiator and connections for normally circu-

lating the engine cooling fluid through said radiator, with a water cooled radiator subjected to the cooling influence of sea water and means for circulating the engine cooling fluid through said water cooled radiator.

3. In an engine cooling system of the character set forth in claim 1, wherein the water cooled radiator is disposed below the water line of the aeroplane floats.

4. In an engine cooling system of the character set forth in claim 1, wherein the water cooled radiator is disposed below the water line of the aeroplane floats and is connected with the engine cooling fluid system and means for circulating the engine cooling fluid through the water cooled radiator.

5. In an engine cooling system of the character set forth in claim 1, wherein the water cooled radiator is disposed below the water line of the aeroplane floats and is connected with the engine cooling fluid system, with a pump arranged below the water line of the aeroplane and driven by means of a water driven screw for circulating the engine cooling fluid through the water cooled radiator.

6. In an engine cooling system of the character set forth in claim 1, wherein the water cooled radiator is disposed below the water line of the aeroplane floats and is connected with the engine cooling fluid system with a pump arranged below the water line of the aeroplane and driven by means of a water driven screw for circulating the engine cooling fluid through the water cooled radiator, said pump, the water screw and water cooled radiator being formed into a streamlined structural unit, which unit is provided with elongated corrugations on its surface and an axial channel for the flow of the sea water therethrough, with the water driven screw disposed at one end of the said channel.

7. In an engine cooling system of the character set forth in claim 2, wherein means are provided for deflecting the engine cooling fluid from the air cooled radiator and circulating it through the water cooled radiator at the will of the operator.

8. In an engine cooling system for hydro-aeroplanes, in combination, an air cooled radiator adapted to cool the engine cooling fluid during flight, said radiator being connected on one side with the engine fluid outlet by means of a pipe connection including a throttle valve and on the other side to a circulating pump through another pipe connection, said pump being connected with the engine cooling fluid inlet, a water cooled radiator adapted to participate in the re-cooling of the engine cooling fluid when the plane is afloat on the water, said water cooled radiator forming a body to be cooled by means of sea water and being provided with circulating connections leading to a point in front of said throttle valve with its outlet

discharging in front of said circulating pump.

9. In an engine cooling system for hydro-aeroplanes the combination of means for normally cooling the engine by air washed radiator elements, with water cooling means operable when the craft is floating to cool the engine, and means operable at the will of the operator for rendering said water cooled means operative.

10. In an engine cooling system for hydro-aeroplanes the combination of an air cooled radiator adapted to cool the engine during flight, means and connections for circulating the engine cooling fluid through said radiator, a water cooled radiator which is adapted to be cooled by the sea water when the craft is floating and means operable at the will of the operator while the craft is floating for deflecting and circulating the engine cooling fluid through said water cooled radiator.

Dated this 20th day of October 1927.

In testimony whereof, I have signed my name to this specification.

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ADOLF ROHRBACH.