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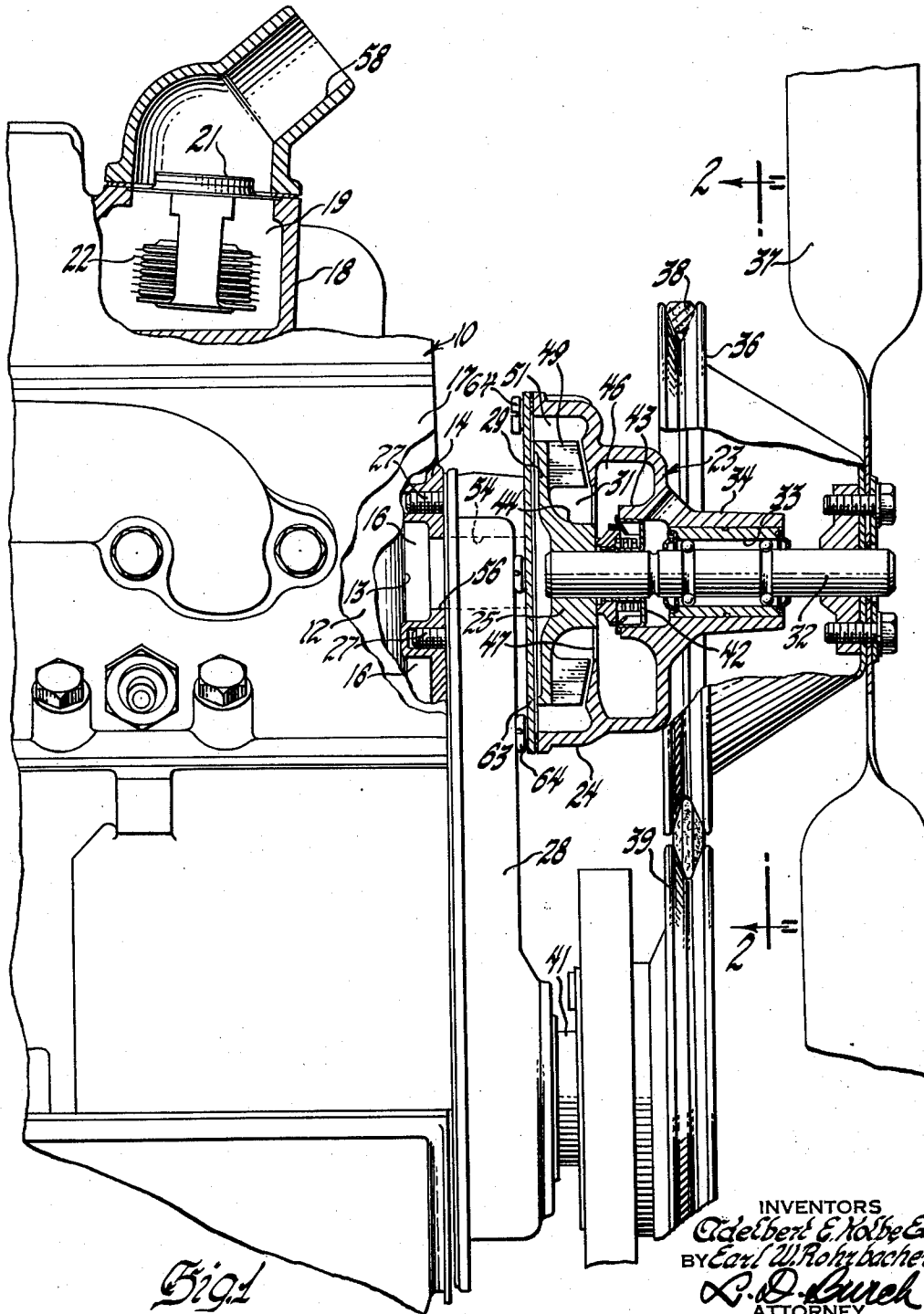
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COOLING LIQUID PUMP FOR ENGINES

Filed Sept. 29, 1954

2 Sheets-Sheet 1



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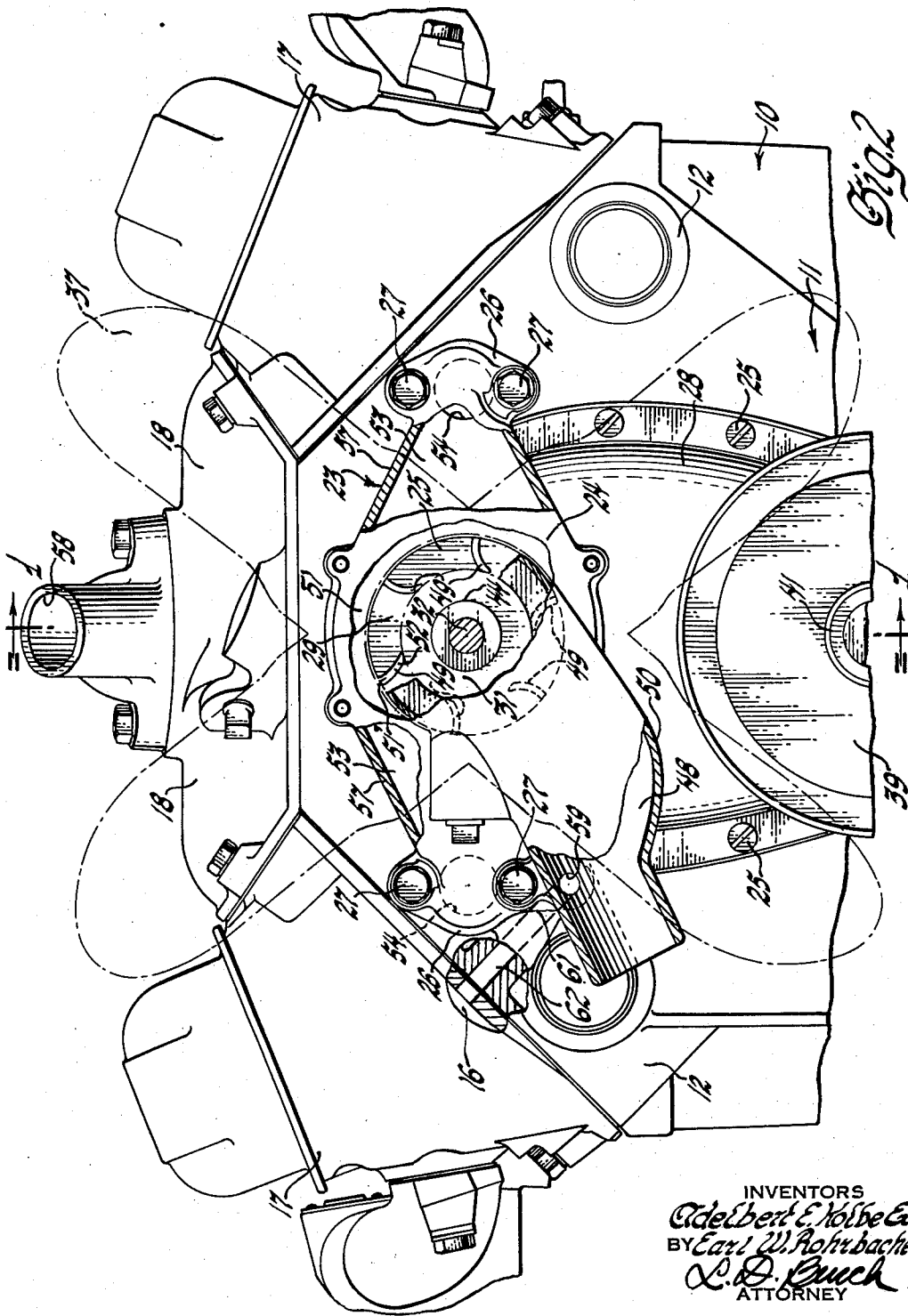
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COOLING LIQUID PUMP FOR ENGINES

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This invention relates to internal combustion engines and particularly to cooling liquid circulating pumps especially applicable for use on V-type internal combustion engines and for other purposes.

As engines increase in horsepower and decrease in size it becomes desirable to circulate a larger and larger amount of cooling liquid through engine cooling liquid cavities and passages that become smaller and smaller. This makes it necessary to provide increased capacity in the cooling liquid circulating pumps employed. Also in V-type and other engines where parallel rows of cylinders are employed as the circulation of cooling liquid increases it becomes more difficult to equalize the circulation of liquid between the different rows of cylinders.

It is now proposed to increase the capacity of cooling liquid circulating pumps especially applicable for use with V-type and other engines by increasing the efficiency of the impeller employed, by reducing the turbulence and resistance to flow of liquid throughout the pump casing and improving the supply of liquid to the impeller, thereby increasing the circulation of liquid throughout the engine and equalizing the flow of liquid to the different rows of cylinders of the engine.

In the drawing:

FIGURE 1 is a fragmentary side elevational view of the front end of a V-type internal combustion engine having a cooling liquid circulating pump embracing the principles of the invention. Parts of the structure are broken away and shown in cross-section to better illustrate the principal features of the invention.

FIGURE 2 is a cross-sectional view of the engine taken substantially in the plane of line 2—2 in FIGURE 1 and illustrating particularly a front end elevational view of the engine and the pump with various parts of the structure broken away and shown in cross-section to better illustrate the principal features of the invention.

The engine 10 in which the invention is embodied may be constructed to provide an engine block 11 having obliquely disposed and parallel rows or banks 12 of cylinders 13 formed therein. The cylinders 13 in the banks 12 are surrounded by cooling cavity walls 14 in which cooling liquid is circulated in cavities 16 for cooling the cylinders 13. Each bank 12 of the cylinders 13 is provided with a head 17 for closing the ends of the cylinders and containing the valves, the combustion chambers and the inlet and exhaust passages for each cylinder of the engine. The cooling liquid cavities 16 in the cylinder banks 12 are continued in the head 17 of the engine for cooling the valves and the passages and the combustion chambers for the cylinders of the engine.

The cooling liquid cavities 16 in the heads 17 communicate with a cooling liquid manifold 18 for discharging heated cooling liquid from the engine to the radiator of the engine for cooling the cooling liquid for the engine. The manifold 18 is formed to provide a chamber 19 in which a thermostatically actuated valve 21 is employed for controlling the flow of cooling liquid from the engine to the radiator for the engine. The valve 21 is operated by a thermostat 22 affected by the temperature of the cooling liquid received from the engine for closing the valve 21 when the engine is cold.

In order to supply cooling liquid from the radiator to the engine, the engine is provided with a cooling liquid circulating pump indicated generally at 23. The pump

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23 is formed in a pump casing 24 which is an elongated casing that may extend across the front of the engine and between the cylinder banks 12. The opposite ends of the casing 24 are formed to provide flanges 26 which are secured by bolts 27 to the cooling liquid cavity walls 14 at the front end of each bank of cylinders of the engine. The thickness of the flanges 26 and the somewhat laterally bent ends of the casing 24 permit the casing 24 to be secured to the front of the engine outside of the timing chain cover 28 which is also secured to the front of the engine by screws 25. The casing 24 is independent of the cover 28 so that the pump 23 may be removed from the engine without interfering with the cover 28.

Midway between the opposite ends of the casing 24 the pump 23 is provided with a rotatable impeller 29 which is mounted in the pump casing 24 in an impeller chamber 31 of circular cylindrical formation. The impeller 29 is mounted on a shaft 32 which is supported between the ends thereof by a bearing 33 mounted within a sleeve 34 projecting from the front of the casing 24. The opposite end of the shaft 32 projects beyond the bearing 33 and is driven by a pulley 36 also employed in driving the fan 37 for the engine. The pulley 36 is driven by a belt 38 which is in turn driven by a pulley 39 mounted on the front end of the crankshaft 41 of the engine. A seal 42 supported by an inwardly projecting flange 43 may be provided between the hub 44 of the impeller 29 and the casing 24 of the pump 23. Surrounding the flange 43 is an annular inlet chamber 46 which is adapted to supply cooling liquid to the impeller 29 through an inlet port 47 communicating with the central part at one end of the impeller chamber 31 and the space within the impeller 29 and surrounding the hub 44. The diameter of the inlet chamber 46 is considerably larger than the diameter of the inlet port 47 to prevent any restriction being formed adjacent the inlet port 47 and to provide for an adequate supply of cooling liquid to the inlet port 47. Cooling liquid is supplied to the inlet chamber 46 by an inlet passage 48 which is formed in a lateral extension 50 projecting from one side of the front of the casing 24. The reduced end of the extension 50 in which the inlet passage 48 is formed may be connected to the engine radiator for supplying water from the engine radiator to the pump 23. The inlet passage 48 is preferably enlarged adjacent the inlet chamber 46 to communicate with the inlet chamber 46 substantially across a diameter of the inlet chamber 46. It will be apparent that the velocity of the liquid supplied to the inlet chamber 46 through the inlet passage 48 will decrease in the enlarged part of the inlet passage 48 so that liquid flowing from the passage to the chamber will not be subject to abrupt changes of velocity and turbulence as the liquid is supplied through the inlet chamber 46 to the inlet port 47.

The impeller 29 is provided with impeller vanes 49 which are adapted to be rotated around the outer annular part of the impeller chamber 31 for projecting cooling liquid supplied to the central part of the impeller chamber radially outwardly. The liquid so projected is received by discharge chamber 51 which is formed in the casing 24 to extend entirely around the impeller chamber 31 and the impeller 29. The vanes 49 are formed to provide substantially radially disposed outer ends 51¹ and forwardly projecting inner ends 52, the vanes between the inner and outer ends being relatively smooth and of relatively uniformly changing curvature. The impeller 29 is adapted to be rotated so that the inner ends 52 of the vanes 49 will lead the outer ends 51¹. With such rotation of the impeller the inner ends 52 of the vanes 49 tend slowly to pick up the liquid in the central part of the impeller chamber 31, to progressively thereafter increase the velocity of the liquid along the outwardly extending

parts of the vanes and thereafter to discharge the liquid outwardly and into the relatively unrestricted cavity surrounding the impeller 29 which forms the discharge chamber 51. The discharge chamber 51 extends in opposite directions throughout the length of the casing 24 and through relatively symmetrical outlet passages 53 which terminate at the opposite ends of the casing 24 in outlet ports 54. The outlet ports 54 extend laterally and rearwardly from the passages 53 and communicate with ports 56 leading to the cooling cavities 16 in each of the cylinder banks 12. The opposite ends of the casing 24 which extend outwardly from the impeller chamber 31 are formed to provide oppositely disposed and converging walls 57 within which the converging outlet passages 53 are formed. The slope of the walls 57 is such that the cross-section area of the outlet passages 53 will decrease at a relatively uniform rate between the impeller chamber 31 and the outlet ports 54. The entire discharge chamber 51 including the outlet passages 53 is formed substantially symmetrically on opposite sides of a middle plane extending through the axis of rotation of the impeller 29 and the geometrical axis of the impeller chamber 31.

It will be apparent when cooling liquid is discharged outwardly by the rotating vanes of the impeller 29 that there will be ample space in the discharge chamber 51 and radially outwardly from the impeller chamber 31 to receive the liquid without excessive losses due to walls that may compel the liquid to flow in one direction and circumferentially around the casing with the impeller vanes to reach outlet passages leading from the impeller and the impeller chamber. It will also be apparent that there will be an equal tendency for the liquid to flow from the impeller in opposite directions along the outlet passages 53 which will tend to collect the liquid and to direct the liquid at relatively uniformly changing velocities and into the outlet ports 54. From the outlet ports 54 the liquid will be received within the cooling liquid cavities 16 in the cylinder banks 12 and the heads 17 and from which the liquid will be collected by the manifold 18 and returned to the radiator of the engine through the manifold outlet 58.

When the engine thermostat 22 closes the valve 21, as when a cold engine is being started, it is desirable to provide a limited circulation of cooling liquid in the engine so that the thermostat 22 will open the valve 21 when the cooling liquid in the engine has been sufficiently heated. To accomplish this end it is proposed to provide a by-pass passage 59 between the cooling liquid cavity 16 in one of the cylinder heads 17 and the inlet passage 48 leading to the inlet chamber 46. In order to provide the by-pass passage 59 at the least possible expense it is proposed to extend the extension 50 laterally and somewhat downwardly so that one edge of the casing overlaps and is formed integrally with a downward extension 61 of the flange 26 at the adjacent end of the casing 24. Under such circumstances the by-pass passage 59 may be formed through the wall of the inlet casing 50 which merges with the extension 61. The by-pass passage 59 may communicate with the cooling liquid cavity 16 in the head 17 through a port 62 extending inwardly and upwardly through the front wall of one of the cylinder banks and the lower wall of the head. It will be noted that the passage 59 is parallel to the holes for the bolts 27 and may be drilled in the same operation.

When the valve 21 controlled by the engine thermostat 22 is closed it will be apparent that the passage 59 will supply a limited amount of cooling liquid to the inlet chamber 46 from a part of the cooling liquid cavity 16 in one of the heads 17. This liquid will be discharged by the impeller 29 into the cooling liquid cavities 16 in both of the cylinder banks 12, thereby permitting the cooling liquid first heated by the combustion chambers and exhaust passages for the cylinders of the engine to be circulated upwardly and into the manifold 18 and the

chamber 19 surrounding the thermostatic element 22. This will cause the thermostatic element 22 to open the valve 21 without excessively heating the cooling liquid in the engine after the engine commences to operate from a cold start.

The impeller casing 24 is provided with a circular opening in the back wall of the casing in directly opposed relation to the impeller chamber 31. The opening is somewhat larger than the diameter of the impeller chamber 31 to extend entirely across the middle of the discharge chamber 51, the cavity of greatest width within the casing 24. This opening provides means whereby the impeller 29 and the impeller shaft 32 may be installed in and removed from the casing 24 for convenient assembly and service. The opening is adapted to be closed by a plate 63 which may be secured to the casing 24 by screws 64.

We claim:

1. A cooling liquid pump for engines having parallel rows of liquid cooled cylinders and comprising an elongated pump casing adapted to extend between said rows of cylinders and to be secured at the opposite ends thereof to the liquid cooling cavity walls of said rows of cylinders, said casing being formed to provide a cylindrical impeller chamber extending transversely of said casing and between said ends and an inlet chamber at one end of said impeller chamber and a discharge chamber outwardly of said impeller chamber, said discharge chamber being an elongated chamber surrounding said impeller chamber and communicating with said impeller chamber throughout the peripheral extent of said impeller chamber and extending in opposite directions toward said ends and within oppositely disposed walls of said casing extending to and converging toward and about said ends of said casing, said casing ends being formed to provide outlet ports opening laterally of said casing through one of the side walls of said casing and being adapted to provide communication between said discharge chamber and the cooling liquid cavities within said cavity walls of said rows of cylinders, said one of the side walls of said casing being formed to provide a removable cover for said casing, said impeller chamber and said discharge chamber being open and accessible across the width thereof through an opening in said one side wall of said casing when said cover is removed from said casing.

2. A cooling liquid pump for engines as defined by claim 1 and in which the outlet ends of said impeller chamber are substantially symmetrical passages decreasing in cross-sectional area from said impeller chamber to said outlet ports at substantially a uniform rate.

3. A cooling liquid pump for engines as defined by claim 1 and in which the outlet ends of said impeller chamber communicate with one another substantially in a plane extending along a diameter of said impeller chamber and through the axis of said impeller chamber.

4. A liquid cooling pump for engines as defined by claim 1 and in which said casing is provided with an arcuately formed opening therein at the end of said impeller chamber opposite said inlet chamber said opening being concentric with respect to said impeller chamber and having a diameter as great as the width of said discharge chamber, said opening being closed by a removable wall of said casing.

5. A liquid cooling pump for engines as defined by claim 1 and in which one end of said casing is provided with a passage adapted to provide a by-pass between the liquid cooling cavity in one of said rows of cylinders and the inlet passage in said casing leading to said inlet chamber.

6. A cooling liquid pump for engines having parallel rows of liquid cooled cylinders and comprising a pump casing adapted to extend between said rows of cylinders and to be secured at the opposite ends thereof to the liquid cooling cavity walls of said rows of cylinders, said

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casing being formed to provide a cylindrical impeller chamber between said ends and an inlet chamber at one end of said impeller chamber and a discharge chamber outwardly of said impeller chamber, said discharge chamber being an elongated chamber and at the central part thereof extending radially outwardly from and entirely around and beyond said impeller chamber and being formed in said casing to include outlet passages disposed on opposite sides of said impeller chamber and within oppositely disposed and converging walls extending to outlet ports formed in said ends of said casing and being adapted to communicate through said outlet ports with the cooling liquid cavities within said cavity walls of said rows of cylinders, and an impeller in said impeller chamber, said impeller being formed to provide vanes thereon having inner and outer ends, the outer ends of said vanes being disposed substantially radially with respect to said impeller; the inner ends of said vanes being disposed obliquely to the said outer ends and extending around said impeller in the direction of rotation of said impeller, said vanes between said inner and outer ends being formed to change in slope at a relatively uniform rate.

7. A cooling liquid pump for engines having cooling liquid circulation thermostats and having parallel rows of liquid cooled cylinders and comprising a pump casing adapted to extend between said rows of cylinders and to be secured at the opposite ends thereof to the liquid cooling cavity walls of said rows of cylinders, said casing being formed to provide a cylindrical impeller chamber between said ends and an inlet chamber at one end of said impeller chamber and a discharge chamber outwardly of said impeller chamber, said discharge chamber being an elongated chamber extending radially outwardly from and entirely and continuously around and beyond said impeller chamber and being formed in said casing to include outlet passages disposed on opposite sides of said impeller chamber and within oppositely disposed and converging walls extending to and including outlet ports formed in said ends of said casing and being adapted to communicate through said outlet ports with the cooling liquid cavities within said cavity walls of said rows of cylinders, said casing being also formed to provide an

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inlet passage leading to said inlet chamber and extending across the front of said casing and adjacent one of the opposite ends thereof, said casing being further formed to provide a by-pass passage in said one end of said casing and extending to said inlet passage substantially in parallel relation to the outlet port in said one end of said casing and being adapted to supply cooling liquid from a cooling liquid cavity in one of said rows of cylinders to said pump to be discharged through said outlet ports and into the cooling liquid cavities in said rows of cylinders when the thermostat controlling the circulation of cooling liquid from said cooling liquid cavities in said rows of cylinders is closed.

8. A cooling liquid pump for engines as defined by claim 7 and in which said by-pass passage formed in said casing is below the outlet port in said one end of said casing for supplying to said pump the relatively cool cooling liquid from one of said cooling liquid cavities so that the cooling liquid in the upper part of said cooling liquid cavities may be moved upwardly in said cavities to the chamber in which said engine thermostat is located for heating said engine thermostat for opening said engine thermostat when said engine is operated after a cold start.

9. A cooling liquid pump for engines as defined by claim 7 and in which said inlet chamber extends radially outwardly beyond the inlet port leading to the central part of said impeller chamber and in which said inlet passage has an enlarged end leading to said inlet chamber and communicating with said inlet chamber substantially across the entire width of said inlet chamber to provide for the relatively uniform distribution of cooling liquid throughout said inlet chamber for supplying said cooling liquid to said impeller chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,366,149	Applin	Jan. 18, 1921
1,386,816	Vincent	Aug. 9, 1921
1,461,711	Bull	July 10, 1923
1,848,987	Anibal	Mar. 8, 1932
2,434,038	Ford	Jan. 6, 1948