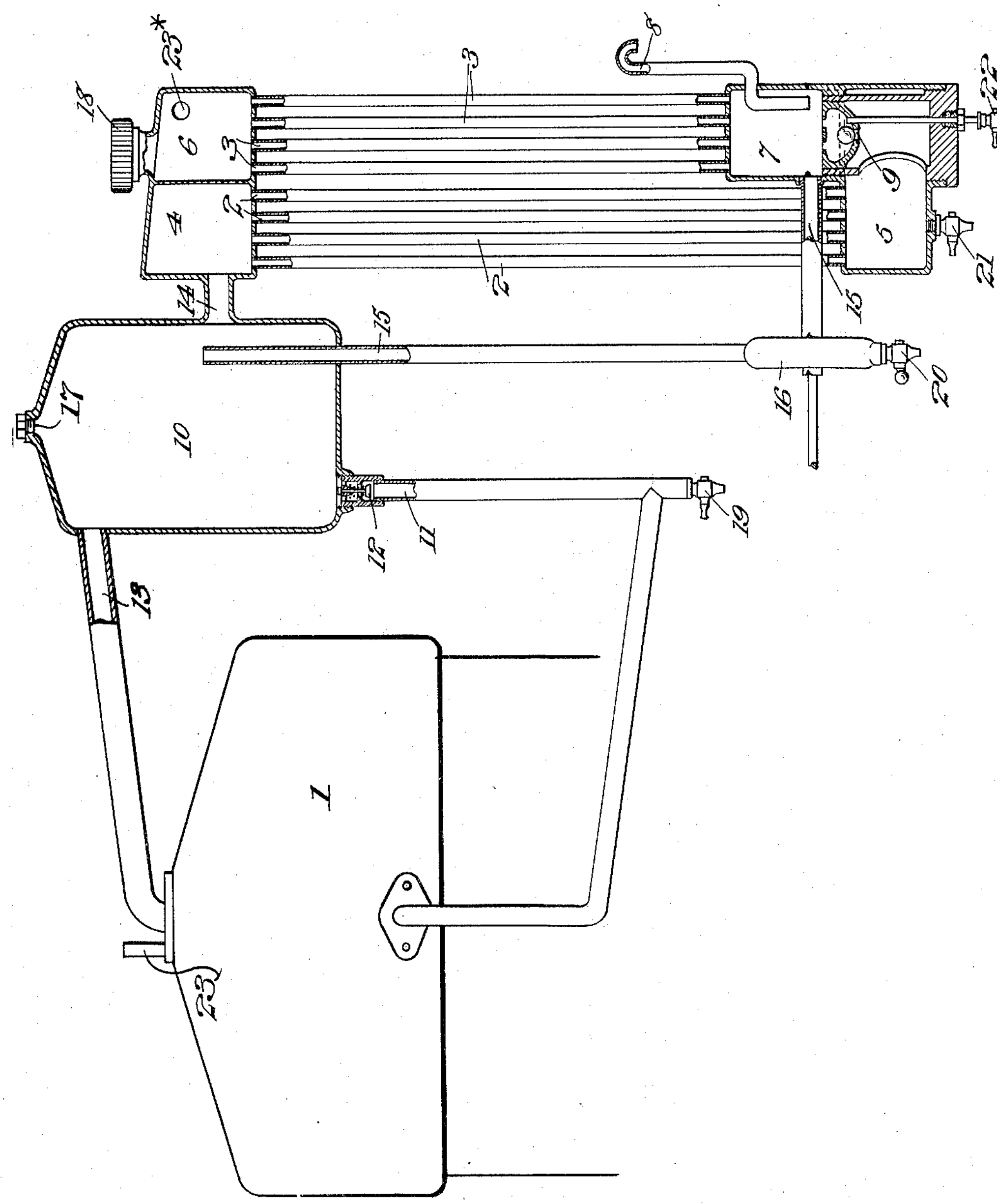
April 15, 1930. I. H. AYRES ET AL 1,754,300

STEAM COOLING SYSTEM FOR INTERNAL COMBUSTION ENGINES

Filed April 13, 1926



INVENTORS

BY

ATTORNEYS

Patented Apr. 15, 1930

1,754,300

UNITED STATES PATENT OFFICE

IRA HUBERT AYRES, OF NEW YORK, N. Y., AND HERBERT RIVINGTON PYNE, OF BERNARDSVILLE, NEW JERSEY

STEAM-COOLING SYSTEM FOR INTERNAL-COMBUSTION ENGINES

Application filed April 13, 1926. Serial No. 101,726.

The object of our invention is to provide a novel steam cooling system for internal combustion engines, especially automobile engines, which system is capable of quickly obtaining and thereafter maintaining the engine cooling medium at a high temperature in the engine water jacket for ensuring the most efficient and economical operation of the engine. The system includes a water jacket, a condenser, a reservoir and two circuits, one passing through the water jacket and reservoir and the other passing through the reservoir and condenser, means being provided in the last named circuit for returning the water of condensation to the reservoir, said means in the present instance being shown as a pump driven from the engine.

A practical embodiment of our invention is represented in the accompanying drawing which illustrates the system partly in side elevation and partly in section.

The engine water jacket is denoted by 1, the top of which forms a steam space.

The condenser may be of any well known or approved construction. In the present instance we have shown a condenser comprising juxtaposed direct and reflux condensing units. The passages 2 of the direct condensing unit connect the upper and lower chambers 4 and 5 and the passages 3 of the reflux condensing unit connect the upper and lower chambers 6 and 7. The lower chamber 7 may be provided with an overflow passage 8. A valved passage 9 leads from the lower chamber 5 of the direct condensing unit to the lower chamber 7 of the reflux condensing unit.

It will be understood that the passages 2 and 3 of the two condensing units may be of any well known or approved form.

The reservoir for the cooling medium is denoted by 10. A water supply passage 11 leads from the bottom of the reservoir 10 to the bottom of the water jacket 1. A valve 12 is provided in this passage 11 for preventing the steam pressure in the water jacket returning the water to the reservoir. A steam passage 13 leads from the top of the water jacket 1 into the reservoir 10 at a point above its normal water level. A steam passage 14 leads from the reservoir 10 into the upper chamber 4 of the direct condensing unit 2 of the condenser at a point above the normal water level in the reservoir, the reservoir mouth of the said passage 14 being preferably located below the reservoir mouth of the steam passage 13.

Means are provided for returning the water of condensation from the condenser to the reservoir, which means is herein shown as a passage 15 leading from the lower chamber 7 of the reflux condensing unit through an engine driven pump 16 to the reservoir 10 at a point preferably above its normal water level.

The reservoir 10 may be provided with a filling cap 17 and the condenser may be provided with a filling cap 18 for the upper chamber 6 of the reflux condensing unit 3.

The water supply passage 11 may be provided with a drain cock 19, the pump 16 with a drain cock 20, the lower chamber 5 of the direct condensing unit with a drain cock 21 and the lower chamber 7 of the reflux condensing unit with a drain cock 22. The top of the water jacket 1 may be provided with a two-way safety valve denoted conventionally by 23, operable in case of a possible stoppage in any of the passages. The upper chamber 6 of the reflux condensing unit 3 is provided with a vent 23* to external atmosphere.

To put the system in operative condition, the filling plug 17 is removed and the water is poured into the reservoir 10. The water will first fill the water jacket 1, then the reservoir 10 to the passage 14 and then the direct and reflux condensing units of the condenser to the level of the discharge end of the overflow passage 8, thus filling the lower chambers 5 and 7 and partly filling the passages 2 and 3. The filling plug 17 is then replaced. Thereafter when it becomes necessary to add water to take the place of any loss by leakage or evaporation, the water may be supplied by removing the filling cap 18 for the upper chamber 6 of the reflux condensing unit.

In operation:—When the engine is started, the pump 16, driven by the engine, will take the water from the chamber 7 through one branch of the passage 15 and force it up through the other branch of the passage into

the reservoir 10. It will be seen that this water does not circulate through the water jacket 1 but passes through the passage 14 into the upper chamber 4 and downwardly through the passages 2 into the lower chamber 5, and from thence through the valved passage 9 into the lower chamber 7. There being no circulation of water through the water jacket 1, the water in the water jacket will become rapidly heated to the boiling point, the steam passing from the top of the water jacket through the passage 13 into the reservoir 10 where some of it is condensed. The uncondensed portion of the steam passes on through the passage 14 into the upper chamber 4 of the direct condensing unit where it is condensed and joins the water in the lower chamber 5 of said unit. As the water jacket 1 and reservoir 10 are directly connected through the passage 13, the pressures in the water jacket and in the reservoir will be nearly equal so that as the steam is lost from the water jacket, water from the reservoir 10 will flow through the passage 11 into the water jacket to take its place. The valve 12 prevents the return of the water from the water jacket in case of a sudden formation of steam therein. Also the valve in the passage 9 between the lower chambers 5 and 7 of the condenser will prevent the sucking of the water up into the reservoir if much steam is suddenly condensed in the reservoir.

Should the engine be working under unusual conditions of load or temperature and generating more steam in the water jacket than can be condensed in the direct condensing unit, the excess steam will pass upwardly into the lower chamber 7 through the water therein (which will assist in the condensation of the steam) and rise through the passages 3 into the upper chamber 6 of the reflux condensing unit until it escapes through the vent 23*. However, the greatest practicable quantity of the steam will be condensed in the reflux condensing unit which is placed in front of the direct condensing unit in the coldest part of the system and the condensed steam will fall into the lower chamber 7.

The air is normally supplied to the system through the vent 23* and overflow passage 8. If any of the passages should become stopped, the two-way safety valve 23 in the top of the water jacket will act.

From the above description it will be seen that two separate circuits are provided in the cooling system, one circuit passing through the reservoir 10 and water jacket 1 and the other circuit passing through the reservoir 10, the condenser, and the pump 16.

While describing this cooling system in connection with water as a cooling medium, it is to be understood that any suitable liquid may be utilized as the cooling medium.

The condenser shown and described, but not claimed herein, forms the subject matter of our copending application, filed of even date herewith, its Serial Number being 101,724.

It is evident that various changes may be resorted to in the construction, form and arrangement of the several parts without departing from the spirit and scope of our invention; hence we do not intend to be limited to the particular embodiment herein shown and described, but

What we claim is:—

1. In a cooling system for internal combustion engines, a water jacket, a condenser, a reservoir, two circuits, one through the jacket and reservoir and the other through the reservoir and condenser, and means in the last named circuit for lifting the water of condensation from the bottom of the condenser into the reservoir.

2. In a cooling system for internal combustion engines, a water jacket, a condenser, a reservoir, passages between the reservoir and the tops of the jacket and condenser respectively, passages between the reservoir and jacket and between the reservoir and bottom of the condenser, and means located in the passage connecting the reservoir with the bottom of the condenser for lifting the water of condensation from the bottom of the condenser into the reservoir, the reservoir mouth of the passage from the bottom of the condenser being located above the normal water level in the reservoir.

3. In a cooling system for internal combustion engines, a water jacket, a condenser, a reservoir, passages between the reservoir and the tops of the jacket and condenser respectively, passages between the reservoir and jacket and between the reservoir and bottom of the condenser, and means located in the passage connecting the reservoir with the bottom of the condenser for lifting the water of condensation from the bottom of the condenser into the reservoir, the reservoir mouth of the passage from the jacket being located at a higher level than the reservoir mouth of the passage to the top of the condenser, the reservoir mouth of the passage from the bottom of the condenser being located above the normal water level in the reservoir.

4. In a cooling system for internal combustion engines, a water jacket, a condenser, a reservoir, a water supply passage leading from the reservoir to the jacket, a steam escape passage leading from the jacket to the reservoir above its water level, a steam escape passage leading from the reservoir above its water level to the top of the condenser, a return passage leading from the bottom of the condenser to the reservoir above its water level, and means for lifting the water of condensation through said return passage into the reservoir before it passes into the water jacket.

5. In a cooling system for internal combus-

tion engines, a water jacket, a condenser, two circuits, a reservoir common to the two circuits, one circuit including passages for bringing the reservoir into communication with the water jacket at different levels and the other circuit including passages for bringing the reservoir into communication with the top and bottom of the condenser, and means arranged to lift the water of condensation from the bottom of the condenser into the reservoir before it passes into the water jacket.

6. In a cooling system for internal combustion engines, a water jacket, a condenser, two circuits, a reservoir common to the two circuits, one of said circuits including a steam passage leading from the top of the water jacket to the reservoir and a water passage leading from the reservoir to the water jacket, and the other circuit including a steam passage leading from the reservoir to the top of the condenser and a water passage leading from the bottom of the condenser to the reservoir, and means located in the last named water passage for lifting the water of condensation from the bottom of the condenser into the reservoir before it passes into the water jacket.

7. In a cooling system for internal combustion engines, a water jacket, a condenser, two circuits, a reservoir common to the two circuits, one of said circuits including a steam passage leading from the top of the water jacket to the reservoir and a water passage leading from the reservoir to the water jacket, and the other circuit including a steam passage leading from the reservoir to the top of the condenser and a water passage leading from the bottom of the condenser to the reservoir, and a pump located in the last named water passage for lifting the water of condensation from the bottom of the condenser into the reservoir before it passes into the water jacket.

8. In a cooling system for internal combustion engines, a water jacket, a condenser, two circuits, a reservoir common to the two circuits, one of said circuits including a steam passage leading from the top of the water jacket to the reservoir and a water passage leading from the reservoir to the water jacket, and the other circuit including a steam passage leading from the reservoir to the top of the condenser and a water passage leading from the bottom of the condenser to the reservoir, the reservoir mouth of the steam passage from the top of the water jacket being located at a higher level than the reservoir mouth of the steam passage leading to the top of the condenser, and means located in the last named water passage for lifting the water of condensation from the bottom of the condenser into the reservoir before it passes into the water jacket.

9. An arrangement for cooling internal combustion engines by evaporation, comprising a main circuit for the liquid cooling medium, an auxiliary circuit for the vaporized medium separated from said liquid, said auxiliary circuit including a condenser in permanent communication with a pressure gas through an opening arranged at a point in the condenser out of reach of the vapors, and means to return the condensate from the condenser to the main circuit.

10. An arrangement for cooling internal combustion engines by evaporation, comprising a main circuit for the liquid cooling medium, an evaporator in said circuit, an auxiliary circuit including a condenser for condensing the vapor separated from said liquid, said condenser communicating at one end with the evaporator above the liquid therein, and communicating at its other end with the atmosphere and the upper portion of the evaporator.

11. An arrangement for cooling internal combustion engines by evaporation, comprising a main circuit for the liquid cooling medium, an evaporator in said circuit, an auxiliary circuit including a condenser for condensing the vapor separated from said liquid, said condenser communicating at one end with the evaporator above the liquid therein, and communicating at its other end with the atmosphere and the upper portion of the evaporator, and a pump in the auxiliary circuit for returning the condensate from the condenser to the evaporator above the liquid in the latter.

12. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket in intercommunication, said condenser having upper and lower chambers and their connecting condensing passages, and means including a reservoir liquid overflow outlet leading to the upper condenser chamber for maintaining the liquid in the reservoir at a predetermined level.

13. In a cooling system for internal combustion engines, a liquid reservoir, a condenser in communication therewith, said condenser having upper and lower chambers and their connecting condensing passages, a cylinder jacket in communication with the reservoir and condenser, and means for maintaining the liquid at a predetermined level in the reservoir including a reservoir liquid overflow outlet leading to the upper condenser chamber.

14. In a cooling system for internal combustion engines, a liquid reservoir, a condenser in communication therewith, said condenser having upper and lower chambers and their connecting condensing passages, a cylinder jacket in communication with the reservoir and condenser, and means for maintaining the cooling liquid at a predetermined level in the reservoir including a reservoir liquid overflow outlet leading to the upper

condenser, chamber, and means for raising the overflow and condensed liquid back into the reservoir.

15. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket, said condenser having upper and lower chambers and their connecting condensing passages, the reservoir having a liquid overflow outlet leading to the upper condenser chamber and a liquid supply outlet in communication with the cylinder jacket, the cylinder jacket having a vapor outlet in communication with the condenser and the condenser having a liquid outlet in communication with the reservoir, and means for replenishing the liquid supply in the reservoir.

16. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket, the reservoir having a liquid overflow outlet in communication with the condenser and a liquid supply outlet in communication with the cylinder jacket, the cylinder jacket having a vapor outlet in communication with the condenser and the condenser having a liquid outlet in communication with the reservoir, and means for replenishing the liquid supply in the reservoir, the said reservoir and its overflow outlet being so located with respect to the cylinder jacket as to prevent the passage of liquid from the cylinder jacket through its vapor outlet.

17. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket, said condenser having upper and lower connecting condensing passages, the reservoir having a liquid return passage leading from the condenser, a liquid overflow passage leading to the upper condenser chamber and a liquid supply passage leading to the cylinder jacket, the cylinder jacket having a vapor escape passage leading to the condenser, and means for replenishing the liquid supply in the reservoir.

18. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket, the reservoir having a liquid return passage leading from the condenser, a liquid overflow passage communicating with the condenser and a liquid supply passage leading to the cylinder jacket, the cylinder jacket having a vapor escape passage leading to the condenser, and means for replenishing the liquid supply in the reservoir, the said reservoir and its overflow passage being so located with respect to the cylinder jacket as to prevent the passage of liquid from the cylinder jacket through its vapor escape passage, to the condenser.

19. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket, a liquid return passage leading from the condenser to the reservoir, a vapor escape passage leading from the cylinder jacket to the condenser, a liquid supply passage leading from the bottom of the reservoir to the cylinder jacket, a liquid overflow passage bringing the reservoir into communication with the condenser, and means for raising the liquid into the reservoir through the first named passage.

20. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket in intercommunication, means for replenishing the liquid supply in the reservoir, and means for maintaining the liquid at a predetermined level in the reservoir whereby the liquid will, by the action of gravity, be maintained at about a predetermined level in the cylinder jacket under normal operating conditions, said means including a cylinder jacket, a liquid supply passage leading from the bottom of the reservoir and a reservoir liquid overflow passage located at a predetermined height above the bottom of the reservoir.

21. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket in intercommunication, the cylinder jacket having a vapor escape passage leading to the condenser, and the reservoir having a liquid supply passage leading to the cylinder jacket, a liquid overflow passage leading from the reservoir and a liquid return passage, and means in the last named passage for raising the overflow and condensed liquid back into the reservoir, whereby the liquid in the reservoir may be maintained at a predetermined level to thereby cause the liquid in the cylinder jacket to be maintained by gravity at substantially a predetermined level under normal operating conditions.

22. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket in intercommunication, the cylinder jacket having a vapor escape passage leading to the condenser, and the reservoir having a liquid supply passage leading to the cylinder jacket, a liquid overflow passage leading from the reservoir to the condenser and a liquid return passage leading from the condenser, and means in the last named passage for raising the overflow and condensed liquid back into the reservoir whereby the liquid in the reservoir may be maintained at a predetermined level to thereby cause the liquid in the cylinder jacket to be maintained by gravity at substantially a predetermined level under normal operating conditions.

23. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket in intercommunication, the cylinder jacket having a vapor escape passage in communication with the condenser, and the reservoir having a liquid overflow outlet, the said reservoir and its overflow outlet being so located with respect to the cylinder jacket as to prevent the cir-

culation of liquid through the cylinder jacket.

24. In a cooling system for internal combustion engines, a liquid reservoir, a condenser and a cylinder jacket in intercommunication, the cylinder jacket having a vapor escape passage, the outlet of which is in communication with the condenser, and the reservoir having a liquid overflow outlet located below the vapor escape passage outlet, the said reservoir and its overflow outlet being so located with respect to the cylinder jacket as to prevent the circulation of liquid through the cylinder jacket.

In testimony, that we claim the foregoing as our joint invention, we have signed our names this 30th day of March, 1926.

IRA HUBERT AYRES.
HERBERT RIVINGTON PYNE.