

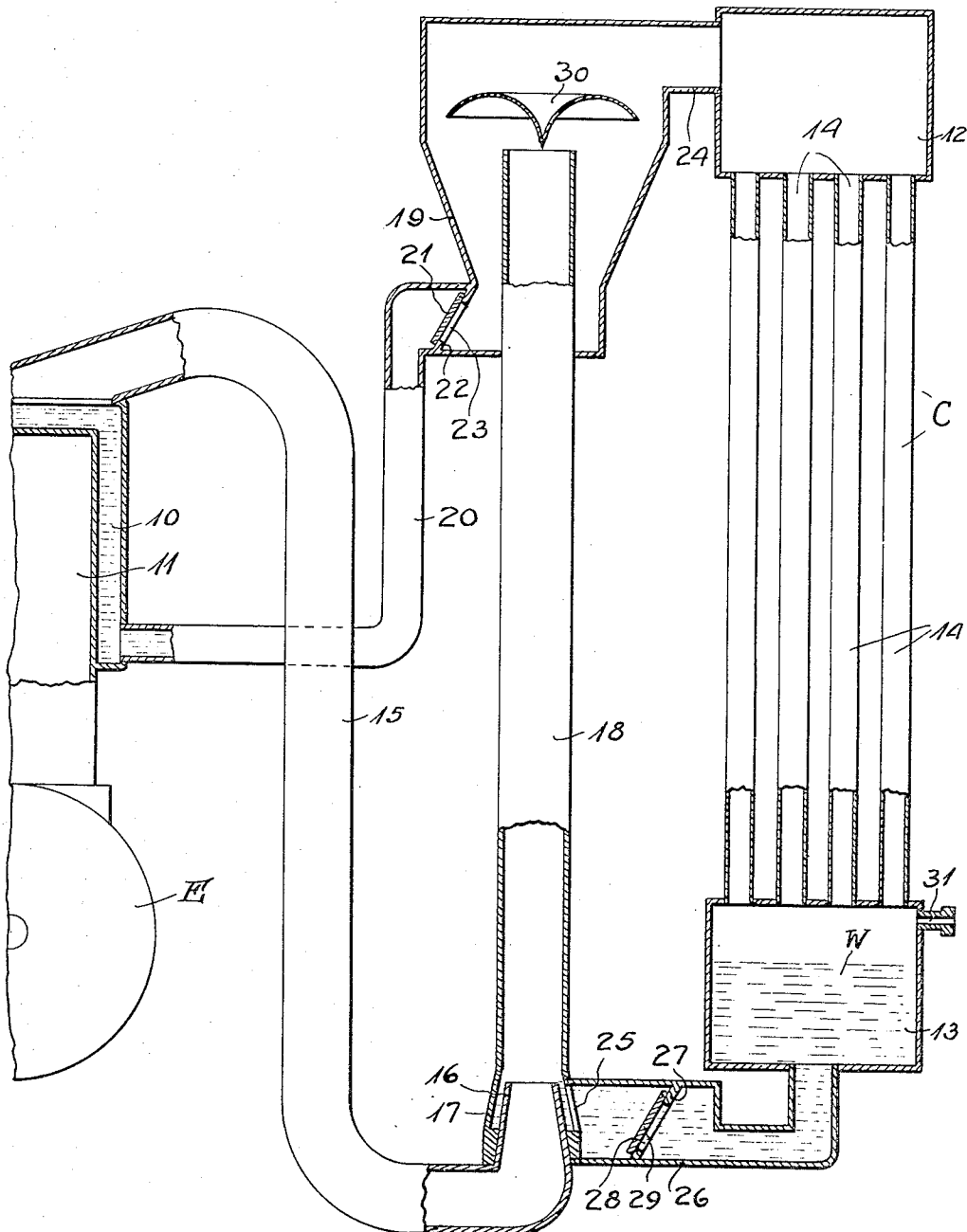
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STEAM COOLING SYSTEM

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STEAM COOLING SYSTEM

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My invention relates to steam cooling systems for internal combustion engines, such systems usually comprising the engine cylinder water jacket, a condenser for receiving and condensing the steam, and some means for returning the water of condensation from the condenser to the water jacket. The object of the invention is to produce a system in which use of a positive delivery pump for returning the condensate is dispensed with and the kinetic energy of the steam utilized for elevating the condensate from the condenser for return to the water jacket, and to accomplish this without the creation of a sub-atmospheric pressure in the steam passage, the normal kinetic energy alone being depended upon to elevate the water.

On the drawings the figures, more or less in section, diagrammatically illustrates the structure and operation of my improved system.

The internal combustion engine is represented by E and has the water jacket 10 surrounding the cylinders 11. The condenser is represented by C and comprises the upper header or steam receiving chamber 12, and the lower header or condensation water receiving chamber 13, the heat radiating tubes or flues 14 extending between and communicating with the headers.

The steam generated in the engine water jacket is received by the duct 15 which extends downwardly and terminates in the upwardly extending nozzle 16 which projects into the lower Venturi end 17 of the elevator duct or tube 18. At its upper end the elevator tube extends into the reservoir 19 at a distance above the bottom of the reservoir. A duct 20 extends from the lower end of the reservoir to the lower part of the water jacket 10, a check valve 21 at the upper end of the duct being mounted on the seat 22 to control the flow through the valve passageway 23, the steam pressure in the water jacket tending to keep the valve closed. At its upper end the reservoir 19 is connected by the duct 24 with the upper header 12 of the condenser structure.

The tube 18 at its lower edge is sealed by the nozzle end 16 of the duct 15, and communicating with the tube 18 at the Venturi section by means of the passageway 25 is the duct 26 which is connected with the lower header 13 of the condenser structure which contains the water of condensation W. Extending across the duct 26 is the valve seat 27 having the passageway 28 controlled by the check valve 29, the steam pressure of the steam flowing through the duct 15 and into the tube 18 tending to keep this check valve closed.

Describing now the operation, when the engine is running, the water in the water jacket is heated above the boiling point and steam is generated, this steam flowing from the upper end of the water jacket down through the tube 15 and then upwardly through the nozzle end 16 and being projected into the elevator tube 18, the steam impinging against the concave surface of the separator plate 30 inserted in the reservoir 19, and then flowing into the upper header 12 of the condenser structure and downwardly through the cooling flues 14 to be condensed back to water, which water is gathered in the lower header 13. During operation of the engine, the level of the condensate water is sufficiently high to cause a pressure head against the check valve 29 and to open this valve against the steam pressure and to permit water to flow into the elevator tube 18 adjacent to the upper edge of the nozzle end 16. As the water tends to flow over this edge it is picked up by the steam and the waterdrops and particles are carried upwardly with the steam to be received by the separator plate 30 and deflected against the side walls of the reservoir and to flow to the bottom of the reservoir. As soon as the water in the reservoir attains sufficient head to overcome the steam pressure against the check valve 21, the valve will open and the water will flow from the reservoir thru the duct 20 back into the water jacket. There is thus continuous circulation of steam from the water jacket into the condenser and condensate back to the water jacket from the condenser. An atmosphere vent 31 is provided preferably for the lower header 13 and above the water level therein, such vent per-

mitting flow of the water from the header 13 to the elevator tube 18. This vent is preferably made adjustable so that the air flow can be controlled and thereby the rate of water flow from the condenser to the elevator tube 18 regulated.

The flow of the condensate from the condenser is entirely by gravity, the water as it reaches the nozzle 16 being picked up by the impact of the steam blowing through the nozzle and being thrown or carried up to the top of the elevator tube 18 to be received in the reservoir. When the engine is at rest and there is no steam pressure, the level of the water in the condensate header 13 may drop as the water will flow by gravity through the valve 29, and if there is sufficient water it may flow through the passageway 25 and into the nozzle end of the duct 15. However, as soon as the engine again operates and steam is generated, the steam will pick up the water and carry it up through the tube 18 into the reservoir from where it is returned to the water jacket. This lifting of the water by the steam in the tube 18 will introduce resistance to the steam flow and will consequently cause increase in steam pressure in the engine water jacket. However, such increase in pressure is compensated for by the height of the reservoir 19 above the water jacket.

I thus provide a very simple and efficient steam cooling system for internal combustion engines in which positive delivery pumps are dispensed with and the normal kinetic energy of the steam depended upon to elevate the condensate for return to the water jacket without the creation of sub-atmospheric pressure at the nozzle end 16. During operation of the engine the nozzle outlet is below the condensate water level in the condenser and the steam merely elevates the water in the form of drops to the reservoir.

Having described my invention, I claim the following:

1. In a steam cooling system, the combination with the water jacket of an internal combustion engine, of a condenser having a condensate chamber below the level of said water jacket, an elevating tube communication at its lower end with said chamber, a steam pipe extending from the top of said water jacket and discharging into the bottom of said elevating tube to receive the condensate and carry it through said tube, a reservoir at the upper end of said tube for receiving the steam and condensate, said reservoir communicating with the upper part of said condenser for the flow of the steam to the condenser, and a condensate return path from said reservoir to the lower part of said water jacket.

2. In a steam cooling system for internal combustion engines, the combination with the engine water jacket, of a condenser, a

reservoir above the level of the water jacket connected with the condenser for the flow of steam, a steam pipe extending from the top of said water jacket and terminating in said reservoir, a water well for said condenser below the level of the water jacket, a connection for conducting water from said well by gravity into the path of the steam flow through said steam pipe whereby said water will be carried upwardly in said steam pipe and into said reservoir, and a duct for conveying the water from the reservoir back to the water jacket.

3. In a steam cooling system for internal combustion engines, the combination with the engine water jacket, of a condenser having a water well below the level of said water jacket, a water reservoir above the level of the water jacket connecting with the upper part of said condenser, a steam pipe extending from the water jacket into said reservoir, a connection from said water well to the steam pipe for conducting the water into the path of the steam flow to be raised by the steam and delivered to said reservoir, a duct for conveying the water from the reservoir to the water jacket, and a check valve in said duct controlled by the steam pressure to check the flow of water from the reservoir.

4. In a steam cooling system for internal combustion engines, the combination with the water jacket of an engine, of a condenser having a water well below the level of said water jacket, a reservoir above the level of the jacket communicating with the upper part of said condenser, a steam pipe leading from the top of said water jacket into said reservoir, a duct leading from said water well and connected with said steam pipe at a point below the level of the water in said well whereby the water will flow into the path of the steam to be conveyed thereby into the reservoir, a check valve in said duct subjected to the steam pressure to check the flow of water into said steam pipe, a water return pipe from said reservoir to said water jacket, and a check valve in said return pipe subjected to steam pressure to check the flow of water from the reservoir to the water jacket.

5. In a steam cooling system, the combination with the water jacket of an internal combustion engine, of a condenser having a well for condensate below the level of the water jacket, a steam path from the top of the water jacket to the upper part of said condenser, a water trap interposed in said steam path, a connection for conducting water from said well into the flow of the steam through said path whereby the water will be carried through said path and received by said trap, and an outlet from said trap for the flow of water to the water jacket.

6. In a steam cooling system for internal combustion engines, the combination with the water jacket of an engine, of a condenser hav-

ing a well for condensed steam, a water receiver above the level of the water jacket connected by a steam passage with the upper part of the condenser, a steam tube extending upwardly into said receiver, a steam pipe extending from the water jacket and projecting into the lower end of said steam tube to form a nozzle, a duct for conveying water from said well into said steam tube adjacent to said nozzle, the nozzle outlet being below the level of the water in said well, whereby steam flowing from said nozzle and through said steam tube will receive the water and convey it into said water receiver, and a return path from the water receiver to the water jacket.

7. In a steam cooling system for internal combustion engines, the combination with the water jacket of an engine, of a condenser having a water well below the level of the water jacket, a water receiver above the level of the water jacket connected with the upper part of the condenser for the flow of steam, a steam tube extending upwardly into said water receiver and having a Venturi lower end, a steam pipe extending from the water jacket and projecting into the Venturi end of said steam tube, a water passageway from said well terminating at said steam tube adjacent to the Venturi end thereof whereby steam flowing into said tube will receive the water and convey it through the tube into said water receiver, and a duct for conveying the water from said receiver to the water jacket.

8. In a steam cooling system for internal combustion engines, the combination with the water jacket of an engine, of a condenser having a water well below the level of the water jacket, a water receiver above the level of the water jacket, a steam tube extending upwardly into said receiver, a connection between the lower end of said steam tube and said water well, a steam pipe extending from the top of said water jacket and discharging axially into the lower end of said steam tube whereby water received in the tube will be taken up by the steam and conveyed to the water receiver, the upper end of said receiver being connected with the upper part of the condenser, and a duct for conveying water from the receiver to the water jacket.

9. In a steam cooling system, the combination with the water jacket of an internal combustion engine, of a condenser having a condensate well below the level of the water jacket, a steam path from said water jacket to said condenser, and means controlled by the direct and positive kinetic energy of the steam flowing to the condenser for returning the condensate to the water jacket.

10. In a steam cooling system, the combination with the water jacket of an internal combustion engine, of a condenser having a con-

densate well below the level of the water jacket, a steam path from said water jacket to said condenser, a reservoir above the level of said water jacket, means for elevating the condensate from said well to said reservoir by the direct and positive kinetic energy of the steam flowing to the condenser, and means for conducting the condensate from said reservoir to said water jacket.

11. In combination, steam generating means, a condenser connected to the generating means, and means for returning the condensate from said condenser to the generating means by the steam flowing from the generating means to the condenser and gravity, and without the creation of sub-atmospheric pressure.

12. In combination in a steam cooling system for internal combustion engines, steam generating means, a condenser connected to the generating means, a reservoir above and discharging into the generating means, and means for returning the condensate from said condenser to the reservoir by the direct and positive kinetic energy of the steam flowing from the generating means to the condenser.

13. In combination in a steam cooling system for internal combustion engines, steam generating means, a condenser connected to the generating means, a reservoir above and discharging into the generating means, and gravity means for introducing the condensate from the condenser into the flow path of the steam to be entrained thereby, the steam flowing into the reservoir and thence to the condenser.

14. In combination in a steam cooling system for internal combustion engines, steam generating means, a condenser, a reservoir above and discharging into the generating means and in series therewith and with the condenser, and gravity means for introducing the condensate into the flow path of the steam to be entrained thereby and discharged into the reservoir.

15. In combination in a steam cooling system for internal combustion engines, steam generating means, a condenser, a reservoir in series with the generating means and the condenser and discharging into the generating means, and means for returning the condensate from the condenser to the generating means by the kinetic energy of the steam and by way of the reservoir, said returning means operating without the creation of sub-atmospheric pressure.

16. In combination, in a steam cooling system for internal combustion engines, steam generating means, a condenser, a reservoir in series with the generating means and the condenser and discharging into the generating means, and means for introducing the condensate into the flow path of the steam to be entrained thereby and without the creation of sub-atmospheric pressure.

17. In combination, steam generating means, a condenser connected to the generating means, and means for returning the condensate from said condenser to the generating means by the kinetic energy of the steam flowing from the generating means to the condenser and by gravity, said condensate returning means operating at pressure above atmospheric pressure.
18. In combination, steam generating means, a condenser connected to the generating means, and means for returning the condensate from said condenser to the generating means by the direct action of the steam flowing from the generating means to the condenser and by gravity, said returning means operating at pressure above atmospheric pressure.

In witness whereof, I hereunto subscribe my name this 1st day of October, 1926.

ARTHUR W. POPE, JR.