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TEMPERATURE CONTROLLING APPARATUS FOR INTERNAL COMBUSTION ENGINES.

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1,403,493. Patented Jan. 17, 1922.

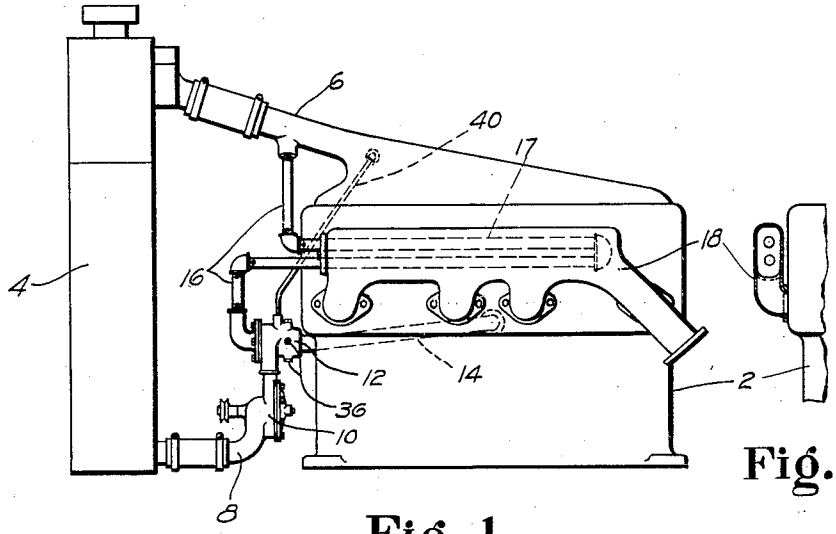


Fig. 1

Fig. 3

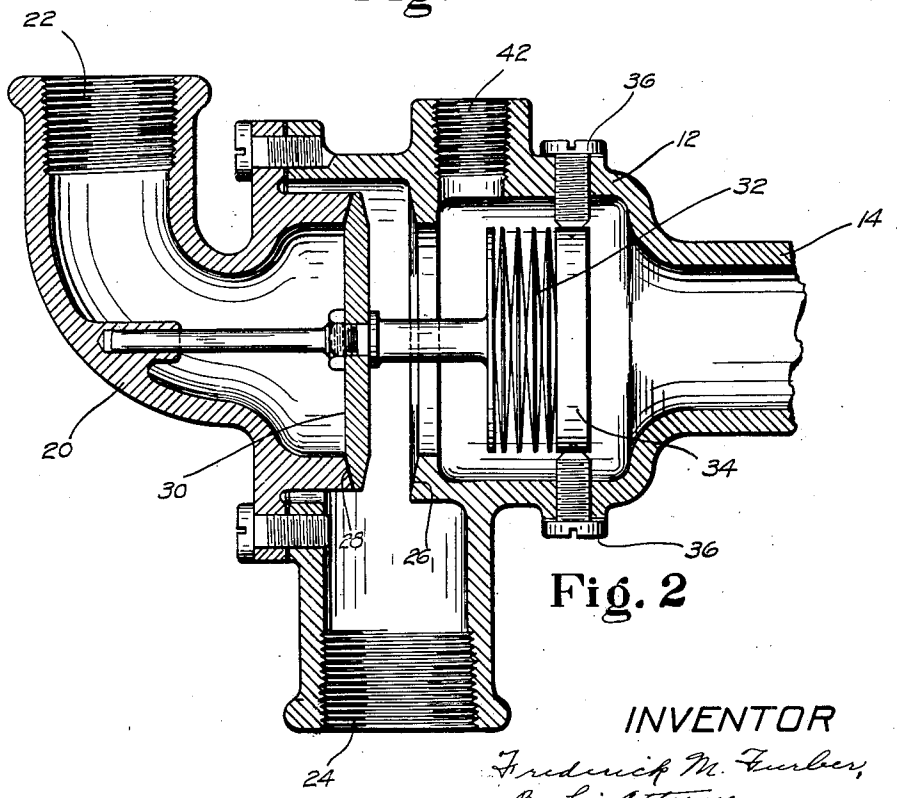


Fig. 2

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TEMPERATURE-CONTROLLING APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

1,403,493. Specification of Letters Patent. Patented Jan. 17, 1922.

Application filed December 28, 1916. Serial No. 139,315.

To all whom it may concern:

Be it known that I, FREDERICK M. FURBER, a citizen of the United States, residing at 52 Bradstreet Ave., Revere, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Temperature-Controlling Apparatus for Internal-Combustion Engines, of which the following description, in connection with the accompanying drawings, is a specification, like reference characters on the drawings indicating like parts in the several figures.

Internal combustion engines, particularly those used in automobiles, are usually equipped with a water cooling system of some type designed to carry away the excess heat from the engine cylinders with sufficient rapidity to maintain the engine at an efficiently operative temperature. These radiating systems are designed with particular reference to the conditions existing in warm weather and much difficulty is experienced in using an engine equipped in this manner in cold weather, due to the fact that the cooling system radiates the heat so rapidly that the cylinder temperature is reduced to a point below that at which the engine can give its best performance. It is also necessary in operating engines equipped with cooling systems of this type to take special precautions to keep the water from freezing at some point in the system. In very severe weather the water sometimes freezes at the bottom of the radiator even while the engine is in operation.

In order to avoid the undesirable reduction of the cylinder temperature due to the conditions just described, it has been proposed heretofore to provide a bypass between the outlet and inlet connections to the water jacket surrounding the cylinders and to provide some means for controlling the distribution of water through this bypass and the radiator, so that when the engine is cold, or its heat is being radiated too rapidly a large part of the water can be short circuited through the bypass and its temperature thus will not be reduced nearly as much as it would be if it were allowed to flow through the radiator. This arrangement has been found objectionable, however, for the reason that it materially reduces the rate of circulation of the water through the radiator and thus increases the danger of freezing the water in the radiator, and also for the reason that when the cylinder temperature has been allowed to build up to the desired point and water from the radiator is again admitted to the jacket, this water is so much colder than that which has been circulating through the jacket that it is liable to crack the cylinders.

The present invention aims to devise a thoroughly practical means for controlling the temperature of the engine and of the water in the circulating system. It aims particularly to overcome the objections above mentioned which have been found to exist in systems previously proposed and it also aims to provide a system that will operate entirely automatically. While the invention described and claimed in my earlier patent, No. 1,168,623, granted Jan. 18, 1916, is also directed to the accomplishment of substantially these objects, the present invention aims to improve the apparatus shown in said patent with a view particularly to devising an arrangement in which the cylinder temperatures can be raised more rapidly when the engine is started into operation than in former systems, and in which also a more accurate control of the temperature in the entire circulating system can be maintained.

The invention also involves certain combinations and arrangements of parts and details of construction which will hereinafter be described and the advantages of which will be obvious to those skilled in this art.

Referring now to the accompanying drawings,

Fig. 1 is a view in side elevation of an apparatus embodying the present invention, various elements of the apparatus being indicated somewhat diagrammatically;

Fig. 2 is a central, vertical, cross sectional view of the automatic valve and the casing therefor which form a part of the apparatus shown in Fig. 1; and

Fig. 3 is a transverse, vertical, cross sectional view through the exhaust manifold.

The apparatus shown in Fig. 1 includes an engine 2 of a type commonly used in automobiles, a radiator 4 for the engine, a pipe 6 that leads the hot water from the upper or discharge end of the engine jacket to the top of the radiator 4 and a return connection that leads the water from the lower end of the radiator back again to the lower or intake end of the jacket. This latter connection includes a pipe 8, a pump 10, a valve casing 12 and a pipe 14 leading

from said casing to the engine jacket. The circulating water or other cooling fluid (hereinafter for convenience referred to as water) flows from the upper end of the jacket through the pipe 6 to the radiator, then descends through the radiator as it is cooled and returns to the jacket again through the pipe 8, pump 10, valve casing 12 and pipe 14.

According to the present invention, a bypass is provided between the connections 6 and 8 so that a part of the water instead of passing through the jacket may be shunted through this bypass. Provision also is made for heating the water as it flows through the bypass. In the form shown this bypass consists of pipe connections 16 leading from the valve casing 12 to the pipe 6, and it includes a U shaped section 17 that lies within the exhaust manifold 18, as clearly shown in Fig. 1. Consequently the water flowing through this bypass will be heated by the exhaust gases as they leave the engine.

In order to control the distribution of the circulating water between the bypass and the engine jacket, a thermostatic valve is located in the casing 12. This casing, as clearly shown in Fig. 2, consists of a main body designated by the numeral 12 and a cap 20 bolted to this body and having a threaded outlet 22 into which the bypass 16 is connected. The part 12 also has a threaded inlet opening 24 to which the discharge end of the pump 10 is connected. Water entering the inlet 24 thus may take either of two paths through the casing, one through the pipe 14 to the jacket and the other through the outlet 22 to the bypass. The main body 12 of the casing has a valve seat 26 surrounding a port through which the water must pass in traveling to the pipe 14, and the cap 20 has a similar seat 28 located opposite the seat 26 and surrounding a port through which the water passes in traveling to the bypass 16. These two seats are located relatively close together and a valve 30 mounted on a thermostat 32 is arranged to engage either one of the seats and thus to control the flow of water both through the engine jacket and also through the bypass.

Any suitable construction of thermostat may be employed for operating the valve 30. The construction shown consists of a metallic bellows secured at one end to a plate 34, which is supported centrally in the casing by four clamping screws 36, and has secured to its opposite end the stem on which the valve 30 is mounted. This bellows contains a suitable quantity of some volatile fluid, such for instance as ether. This construction is substantially like that disclosed in my pending application, Ser. No. 73239, filed Jan. 20, 1916.

It is obvious that when the engine is started and the water in the entire system is cold, the bellows 32 will be contracted thus seating the valve 30 on the valve seat 26 and shutting off the flow of water through the pipe 14 to the engine jacket. The temperature of the water in the circulating system is, however, built up very rapidly when the engine is started into operation, the temperature of the water in the jacket being raised by the high temperature created in the cylinders and the temperature of the water flowing through the bypass 16 and through the radiator being raised by the heat from the exhaust gases. It is, of course, desirable that the temperature of the water in the jacket shall be allowed to rise until it reaches the point at which it permits the engine to operate most efficiently and that thereafter it shall be maintained substantially at that temperature. Consequently, in order to subject the thermostat 32 to substantially the temperature of the water in the jacket while the circulation from the pump through the jacket is cut off, a small pipe 40 leading from the upper end of the jacket into an opening 42 provided for it in the casing 12 conducts hot water from the discharge end of the jacket to a point behind the valve seat 26 and thus leads this hot water to the thermostat 32. This water then flows through the pipe 14 to the lower end of the jacket. When, therefore, the temperature of the water in the engine jacket approaches the desired point, the thermostat 32 opens the valve 30 and allows more or less of the water returning from the radiator 4 to flow to the jacket. The thermostat then becomes responsive to changes in the temperature of this current of water which, of course, also varies with the temperature of the engine. If, due to the temperature of the atmosphere, or for any other reason, the temperature of the engine should be raised above the desired point, the bellows 32, of course, will expand far enough to seat the valve 30 on the valve seat 28, thus sending the entire flow of water in the circulating system through the engine jacket and enabling the system to exert its maximum heat radiating effect. The amount of heat supplied to the circulating system at this time by the exhaust will be too small to interfere substantially with the normal action of the water cooling system.

It is obvious that the apparatus may be made to respond to temperature conditions existing at any point in the circulating system desired, as for instance, by locating the thermostat at the point in question or by circulating around the thermostat water taken from the point from which the control is to be effected. I prefer, however, to locate the thermostat in the manner shown

for the reason that it can readily be set to control the temperature of the water in the jacket and also for the reason that this location enables the thermostat to respond also to any dangerous changes in the temperature that may take place in the water in the radiator. The location of the thermostat, however, may be varied to suit individual preferences, as may also the precise temperature at which the thermostat is designed to operate the valves.

When the valve 30 is away from the seat 26, thus allowing the water to flow through the pipe 14, a very small part of the water may also flow around the jacket through the small pipe 40; but this pipe is made so small in comparison with the flow area provided through the jacket that the amount of water discharged through the pipe 40 is negligible.

It will now be understood that this arrangement provides a system in which the engine, when started into operation, is required to heat up only a relatively small percentage of the entire body of water in the circulating system, and that the quantity of water thereafter admitted to the jacket is only that which is required to maintain the engine cylinders at substantially their most efficient temperature condition. This arrangement produces the advantage of bringing the engine quickly to the point at which it gives a satisfactory performance, so far as temperature conditions are responsible for its action, and thus avoids the protracted period of unsatisfactory operation that usually is experienced in starting up a cold engine. It will also be observed that while the thermostatic valve is maintaining the cylinders at the required temperature by reducing the circulation of water through the jacket, it is also diverting the water not required in the jacket through the bypass 16 where it is heated by the exhaust gases, thus supplying to the water circulating through the radiator the heat that is required to keep it from freezing. Since these operations take place without reducing the circulation of water through the system, it is evident that the entire system is under accurate control, and that both the needs of the engine and also those of the circulating system are cared for.

While the arrangement herein described and shown is the best embodiment of the invention of which I am at present aware, it is obvious that the invention may be embodied in many other forms without departing from the spirit or scope of the invention. It is obvious also that the bypass may be arranged very differently from the form shown in the accompanying drawings, it being merely necessary that it be so arranged that the water not required in the jacket can be diverted through this bypass, thus allowing only the amount of water to pass through the jacket that is required to maintain the cylinders at the desired temperature. It is also preferable, of course, to heat the water in the bypass to supply to the circulating system the heat required to keep the water from freezing at some point in the system.

The invention is herein disclosed as applied to a circulating system in which a pump is used, but it is obvious that the invention is equally applicable to other systems such, for instance, as the "thermo-siphon" system.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from the jacket to the radiator and returning it to the jacket again, of a by-pass between said connections arranged to cause the water flowing therethrough to be heated by the exhaust from the engine, and a single valve means for controlling the flow of water both through the by-pass and said jacket.

2. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from the jacket to the radiator and returning it to the jacket again, of a bypass around the jacket, means for heating the water flowing through said bypass and a single valve controlling the flow of water both through the bypass and through said jacket.

3. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from the jacket to the radiator and returning it to the jacket again, of a bypass around the jacket, means for heating the water flowing through said bypass, and a thermostatic valve controlling the distribution of the water between said bypass and said jacket.

4. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from the jacket to the radiator and returning it to the jacket again, of a bypass around the jacket, means for heating the water flowing through said bypass, and valve means operative automatically in response to changes in the engine temperature to control the distribution of the water between said bypass and said jacket.

5. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from the jacket to the radiator and returning it to the jacket again, of a bypass around the jacket, means for heating the water flowing through said bypass, and a thermostatic

valve operative automatically in response to changes in the temperature of the circulating water to divert more or less of the water from said jacket into said bypass while the temperature of the water remains below a predetermined point, and to increase the flow through said jacket again as the temperature of the water rises above said point.

6. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from the jacket to the radiator and returning it to the jacket again, of a bypass around the jacket, means for heating the water flowing through said bypass and valve means operative automatically in response to changes in the temperature of the engine cylinders to reduce the circulation of the water through the engine jacket as the cylinder temperature drops below a predetermined point and to correspondingly increase the flow of water through said bypass.

7. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from said jacket to the radiator and returning it to the jacket again, of a bypass around the jacket, means for heating the water flowing through said bypass, valve means arranged to control the distribution of the water between said bypass and said jacket and a thermostat controlling the action of said valve means and arranged to be subjected substantially to the temperature of the water in said jacket.

8. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from said jacket to the radiator and returning it to the jacket again, of a bypass around the jacket, means for heating the water flowing through said bypass, valve means arranged to control the distribution of the water between said bypass and said jacket, a thermostat for operating said valve means and connections for causing hot water leaving the engine jacket to circulate around said thermostat.

9. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from said jacket to the radiator and returning it to the jacket again, said return connections including a valve casing, of a bypass leading from said casing to the discharge connection from said jacket, two valve ports in said casing, one admitting water to said jacket and the other to said bypass, a valve controlling the flow of water through both of said ports, and a thermostat responsive to changes in the temperature of the circulating water and connected with said valve to operate it, said by-pass being arranged to cause the water flowing therethrough to be heated by the exhaust from the engine.

10. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from said jacket to the radiator and returning it to the jacket again, said return connection including a valve casing, of a bypass leading from said casing to the discharge connection from said jacket, two valve ports in said casing, one admitting water to said jacket and the other to said bypass, a valve controlling the flow of water through both of said ports, a thermostat in said casing connected with said valve to operate it, said thermostat being located in the path of the water flowing to said jacket, and a connection for conducting water directly from the discharge end of said jacket to a point in said casing adjacent to said thermostat and behind the valve.

11. The combination with an internal combustion engine and a water cooling system therefor including a radiator and connections for leading water from said jacket to said radiator and returning it again to the radiator and including also a bypass around said jacket arranged to be heated by the exhaust from the engine, of thermostatically controlled valve means operative automatically to vary the distribution of the water between said jacket and said bypass in response to changes in the temperature of the circulating water.

12. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from said jacket to the radiator and returning it to the jacket again, of a bypass through which the water may be diverted from said jacket, said bypass being arranged to be heated by the exhaust from the engine, and thermostatic valve means operative in response to changes in the temperature of the circulating water to control the distribution of the water between said bypass and said jacket.

13. The combination with an internal combustion engine having a water jacket, a radiator and connections for leading the water from the jacket to the radiator and returning it to the jacket again, of a by pass between said connections, arranged to be heated by the exhaust from the engine, a single valve controlling the flow of water both through said by pass and also through said jacket, a thermostat for operating said valve, and a pump between said radiator and said valve whereby the valve is operative to vary the distribution of water between said by pass and said jacket while maintaining the circulation through the radiator substantially undisturbed.

14. In a cooling system for internal combustion engines equipped with water-jack-

ets, a source of supply of a cooling liquid, means other than the water-jacket of the cylinders for heating the said liquid, means for effecting circulation of the liquid through the water-jacket, and in heat absorbing relation to said heating means, and thermally controlled means for shutting off the circulation of liquid through one or the other of said means or effecting circulation thereof partly through both in accordance with variations in temperature of said liquid.

15. A cooling system for internal combustion engines including water-jackets for the engine cylinders, a water conduit associated with the exhaust manifold for heating water by means of the hot products of combustion, a source of supply of a liquid adapted to circulate through said jackets and said conduit, and thermally controlled means for causing the water to circulate either through said conduit or said jackets or simultaneously through both.

16. A cooling system for internal combustion engines including water-jackets for the engine cylinders, a water conduit associated with the exhaust manifold for heating water by means of the hot products of combustion, a source of supply of a liquid adapted to circulate through said jackets and said conduit, and means controlled by the temperature of the liquid contained in said jackets for causing the water to circulate either through said conduit or said jackets or simultaneously through both.

17. In a cooling system for internal combustion engines, a source of supply of a cooling medium, means for effecting circulation thereof in contact with the cylinders for absorbing heat from the latter, a conduit for said liquid disposed to heat the latter by the products of combustion exhausted from the cylinders, a valve for controlling the circulation of said liquid to confine the same to either of the said two sources of heat, and thermally actuated means for automatically operating said valve.

18. In a cooling system for internal combustion engines, a source of supply of a cooling medium, means for effecting circulation thereof in contact with the cylinders for absorbing heat from the latter, a conduit for said liquid disposed to heat the latter by the products of combustion exhausted from the cylinders, a valve for controlling the circulation of said liquid to confine the same to either of the said two sources of heat, and means actuated by variations in temperature of the liquid for automatically operating said valve.

19. A cooling system for internal combustion engines including water-jackets for the engine cylinders, a water conduit associated with the exhaust manifold for heating water by means of the hot products of combustion, a radiator connected with said jackets and conduit for normally causing the cooling liquid to circulate through said parts, and a valve controlled by the variations in temperature of the liquid for cutting off circulation through the jackets or the conduit or partially from each.

20. In a cooling system for water-jacketed engines, a water conduit disposed in heat absorbing relation to the products of combustion exhausted from the engine, a radiator, means for effecting forced passage of water from the said radiator to the said conduit and the water jacket of the engine, return connection from the latter to said radiator, a valve for causing a flow from one of said water-heating parts to the exclusion of the other, and a temperature responsive element associated with said valve for actuating the same.

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

FREDERICK M. FURBER.