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TEMPERATURE CONTROLLING MECHANISM FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JUNE 8, 1916.

1,327,381. Patented Jan. 6, 1920.

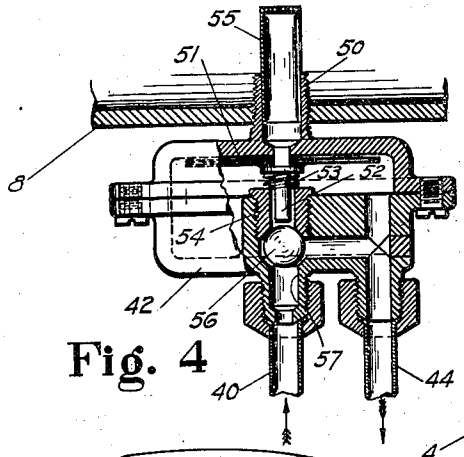


Fig. 4

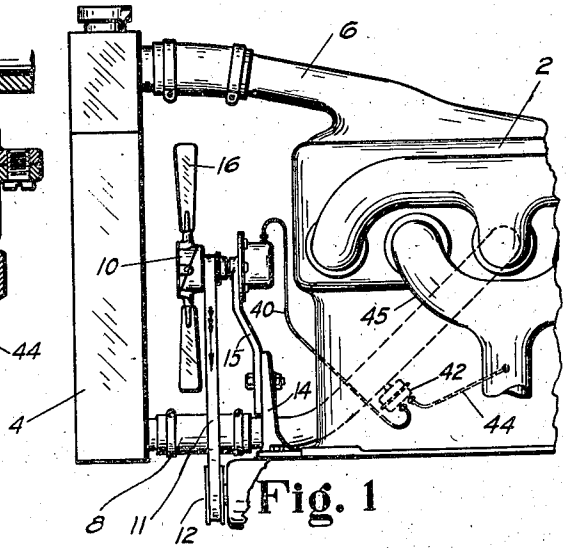


Fig. 1

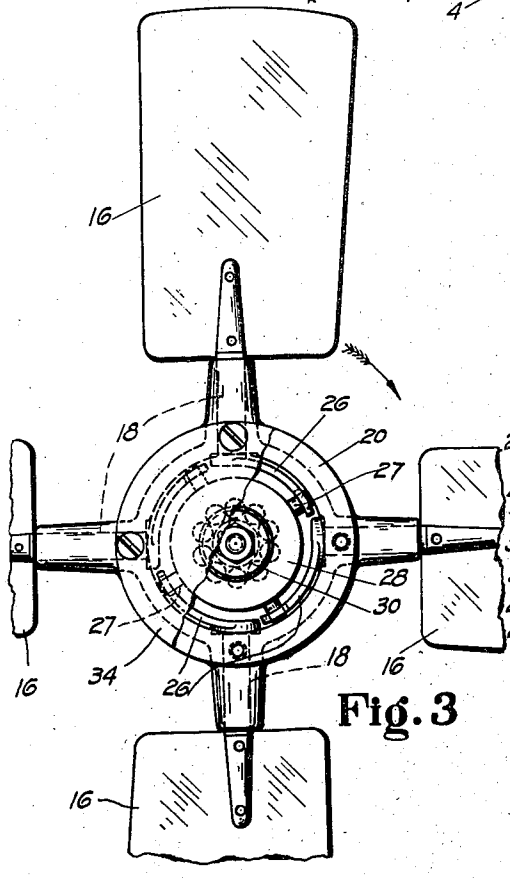


Fig. 3

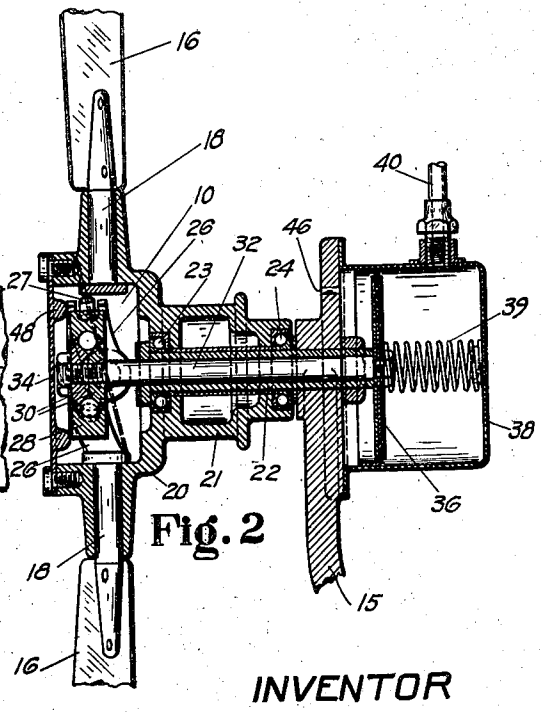


Fig. 2

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TEMPERATURE-CONTROLLING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

1,327,381. Specification of Letters Patent. Patented Jan. 6, 1920.

Application filed June 8, 1916. Serial No. 102,514.

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 Mechanism 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.

This invention relates to the cooling apparatus used with internal combustion engines and is of particular utility as applied to the engines of this type used in automobiles, trucks, tractors and the like.

The heat radiating systems used with engines of this character are designed to conduct heat away from the cylinders of the engine fast enough to keep the engine at an efficiently operative temperature in warm weather. Consequently when these engines are operated in cold weather it is found that the heat is carried away so rapidly that the temperature of the engine is reduced to a point much below that at which it gives its best performance. Most internal combustion engines used in automobiles are equipped with a water cooling system; and it is a common occurrence for the circulating water to freeze in the bottom of the radiator when the car is operated in very cold weather. In order to avoid this difficulty it is a common expedient to cover a part of the radiator so as to reduce the effective radiating area. It has also been proposed to make the radiator in sections and to cut out certain sections in cold weather. But these, and various other expediencies that have been proposed, have proved unsatisfactory for many reasons, sometimes because they did not produce the desired results and at other times because the conditions varied so rapidly that too close attention and too frequent adjustment was required to effect even approximately the results sought. Automatic mechanisms of several types have also been proposed for accomplishing these objects; but they have gone into use to only a very limited extent, due, apparently, to the fact that they only partially accomplished the results desired and also to the fact that they usually have been complicated and very liable to get out of order, leaving a condition as bad, or sometimes worse, than that which originally existed.

The present invention is directed to the solution of the problem presented by the conditions just described. Stated more specifically, the invention aims to devise a thoroughly practical and reliable mechanism for controlling the action of the heat radiating systems of an internal combustion engine, and especially to provide means for preventing the undesirable reduction of temperature in the engine cylinders or in the heat radiating system which is liable to take place when the car is operated during severe weather. It is also an object of the invention to devise an apparatus of this general character which can be economically manufactured, shall not be subject to rapid wear or deterioration, shall not be liable to get out of order, will be substantially automatic in its action and will require a minimum of attention on the part of the operator or attendant.

The manner in which it is here proposed to accomplish these objects will be readily understood from the following description of the embodiment of the invention now preferred by me, reference being made to the accompanying drawings, in which—

Figure 1 is a view in side elevation showing an apparatus constructed in accordance with this invention and applied to an automobile engine;

Fig. 2 is a vertical, central, sectional view of the fan and the adjacent operating mechanism therefor shown in Fig. 1;

Fig. 3 is a front elevation of the fan, certain of the parts being broken away; and

Fig. 4 is a vertical sectional view partly in elevation of the thermostat used in the apparatus shown in Fig. 1.

The apparatus shown includes an engine 2 of the type commonly used in automobiles, having a water cooling or heat radiating system which includes a radiator 4 and connections 6 and 8 by which the water or other cooling fluid (hereinafter for convenience referred to as water) is conducted from the engine jacket to the radiator and back again to the jacket. In the arrangement shown the water flows from the top of the engine jacket through the pipe 6 to the radiator 4 and returns again to the jacket through the

pipe 8 after it has been cooled by flowing through the radiator. This system is known as the "thermo siphon" system, although the invention is equally applicable to systems in which the circulation of water is produced by a pump or in some other manner. As is well known, the radiators used for this purpose have a very large heat radiating surface so that the heat given to the circulating water by the engine cylinders is dissipated very rapidly from the walls of the radiator.

In order to facilitate this radiation or dissipation of heat from the radiating system a fan usually is employed to force a current of air against the radiator. In the construction shown this fan is indicated at 10 and it is arranged to be driven by a belt 11 running over a pulley 12 that is driven by the engine shaft. A pedestal 14 secured to the engine base has a bracket 15 bolted thereto which supports the fan, and this bracket is vertically adjustable relatively to this pedestal so that the belt 11 may be tightened more or less as desired.

It will be noted that the fan is positioned between the radiator and the engine; and in the present construction this fan is made reversible so that it will force air through the radiator 4 either in a direction toward or from the engine. This reversal of the fan may be effected either by reversing its direction of rotation or by reversing the angle of the blades with reference to their plane of rotation. In order to avoid complicating the driving mechanism I prefer the latter arrangement.

The fan shown has four blades each indicated at 16, and the blades are supported respectively in blade holders 18 which are mounted to have a rotative movement in sleeves that project radially from the fan hub 20. In the present construction this hub is formed integrally with a pulley 21 over which the belt 11 runs; and the pulley and the fan are both supported for rotative movement on a bushing 22 that is clamped securely in the bracket 15, as best shown in Fig. 2. Two sets of ball bearings 23 and 24, respectively, are provided between the bushing 22 and the pulley 21 to enable the pulley and the fan to rotate freely.

It will now be evident, that assuming the fan blades to be in the position in which they are shown in Fig. 1 and the belt 11 to be driven in the direction indicated by the arrow in said figure, the fan will force air through the radiator 4 toward the engine 2. This is the normal action of a fan in automobiles as now constructed and the cooling effect of the air thus will, at this time, be that which normally takes place. It will be evident, however, that the air under the engine hood and around the engine has a temperature considerably higher than that of the outside atmosphere, due to the waste heat that radiates from the engine parts, and especially from the exhaust connections. Advantage is taken of this fact to modify the rate at which the heat will be dissipated from the radiator when the temperature of the engine drops below a desired point. It is for this purpose that the fan is made reversible, as above stated; since, when it is reversed it will direct through the radiator a current of this warm air taken from around the engine. In order to effect the reversal of the fan automatically and make the apparatus respond to changes in the engine temperature, a thermostat is connected into the heat radiating system, and connections are provided between this thermostat and the fan whereby the thermostat is enabled to control the action of the fan.

Referring more particularly to Figs. 2 and 3, it will be noted that each of the blade holders 18 has an arm 26 secured to its inner end, all of these arms being curved about the axis of the hub of the fan and all extending in the same direction. Each of these arms 26 is slotted at its free end to receive one of a series of pins or studs 27, which project radially from an annular collar 28 that is located within the inclosure formed by the arms. This collar has a groove formed in its inner wall to receive a series of balls which are confined between this collar and two cone bearing collars 30 that are screwed on the end of a shaft 32, which is supported in the bushing 22. This construction enables the collar 28 to rotate freely relatively to the cones 30 and the shaft 32, under the driving action of the arms 26 which is transmitted to the collar 28 through the pins 27. At the same time it enables the reversal of the fan blade 16 to be effected by moving the shaft 32 axially through the bushing 22, this movement of the shaft being transmitted to the blades through the collar 28, pins 27, arms 26 and the blade holders 18. A cover plate 34 closes the chamber in the fan hub.

With a view to effecting the reversal of the fan blades as simply as possibly, a pneumatic mechanism is provided in which the fluid pressure conditions created in the engine are utilized. This mechanism includes a piston 36 secured to the rear end of the shaft 32 and working in a cylinder 38 which is bolted to the rear face of the bracket 15. A spring 39 is positioned between the piston 36 and the end of the cylinder 38 tends to force the shaft 32 outward and thus to maintain the fan blades in the positions in which they are shown in Figs. 1 and 2. A small pipe 40 connects the cylinder 38 with a valve casing 42 which is connected by another pipe 44 with the intake manifold 45 of the engine. A relatively high vacuum is created in this manifold during the normal operation of the engine, and when the valve in the casing 42 is open to afford free com-

munication between the cylinder 38 and the manifold, the vacuum thus created enables the atmosphere air pressure to force the piston 36 inwardly against the pressure of the spring 39 and thus to reverse the blades. Air is admitted to the cylinder 38 on the side of the piston opposite the spring 39 through a hole 46.

In order to eliminate, so far as possible, the wear on the parts that effect the reversal of the fan blades, the blade area of each blade is so disposed that the pressure of the air on it tends to maintain it in either of its operative positions to which it is moved or adjusted. That is, the blade area is unbalanced or unsymmetrically disposed with reference to the axis about which the blade turns, the greater part of the area of each blade being on the forward or "leading" side of the axis of the blade. It will be obvious from an inspection of Fig. 3 that this is the case, the dotted line across the blade indicating substantially the axis on which the blade turns and the arrow showing the direction in which the fan rotates. Accordingly in reversing the blades it is merely necessary for the collar 28 to move far enough to swing the blades past the neutral point, and the pressure of the air on them then, due to the direction of rotation, will tend to complete the reversing movement and to maintain them in the positions into which they have just been moved. In order to limit the swinging movement of the blades, an annular boss 48 is formed on the inner face of the cover plate 34. The arms 26 engage this boss when the blades are in the positions in which they are shown in Figs. 1 and 2 and are thus held in these positions; and when they are reversed the arms 26 strike the inner wall of the hub 20 which limits their swinging movement in this direction. Since the hub 20 and the cover plate 34 rotate with the fan there is no wear on the arms 26 or the parts with which they contact. The reciprocating movement of the shaft 32 and the collar 28 is limited by the engagement of the inner cone 30 with one end of the bushing 22, and by the contact of the piston 36 with the opposite end of bushing 22; and the travel of the shaft 32 and the collar 28 is such that the pins 27 on the collar move into the centers of the slots in the arms 26, after they have reversed the blades in either direction, and thus eliminate any side thrusts on the balls between the cones 30 and the collar 28.

As above stated, the mechanism that effects the reversal of the blades is under the control of a thermostat. Any suitable type of thermostat may be used for this purpose, that shown being like that disclosed in my pending application Ser. No. 73,239, filed Jan. 20, 1916. Briefly stated this thermostat comprises a casing 42, which also forms the valve casing, and which is provided with a threaded nipple 50 by means of which it is secured in the return pipe 8. Within this casing is a flexible metallic bellows 51, the upper end of which is secured directly to the casing and the lower or free end of which carries a plunger 52. A spring 53 located between a collar formed on this plunger and a threaded part 54 of the valve tends to maintain the bellows in a collapsed condition. The interior of this bellows communicates with a container 55 which is threaded or otherwise secured fast in the nipple 50, and a suitable quantity of some highly volatile material, such, for instance, as ether is confined in the chamber formed by the bellows 51 and the container 55. Since this container projects into the interior of the pipe 8 it is subjected to the temperature of the water circulating around it, and thus causes the volatile material that it contains to respond very quickly to changes in the temperature of the circulating water. This temperature, of course, varies with the engine temperature so that the apparatus also responds to changes in the temperature of the engine cylinders. It will be evident from an inspection of Fig. 4 that when the bellows is expanded, the plunger 52 will press the ball 56 into its seat formed in the part 57 of the casing 42 and thus will close the communication between the air pipes 40 and 44; but that when the bellows is collapsed the ball 56 will be free to move away from its seat and allow air to flow through the pipe 40 to the pipe 44.

Assuming now that the engine has just been started, the water in the circulating system of course will be cold, and consequently the thermostat will not be able to hold the valve ball 56 in its closed position. The suction created in the manifold 45 will partially exhaust the air from behind the piston 36, this air traveling through the pipe 40, valve casing 42 and pipe 44 to the manifold, thus shifting the blades of the fan into the angular positions in which they are operative to force air outwardly away from the engine 2 through the radiator 4. If the engine is used in an automobile the motion of the car will, of course, tend to cause a flow of air through the radiator 4 toward the engine, but the fan is rotated at a high speed, and under all ordinary conditions easily overcomes this tendency of the air to flow through the radiator toward the engine. Accordingly the fan is effective at this time to force through the radiator a current of air at a higher temperature than that of the outside atmosphere, and thus substantially reduces the rate at which the heat is dissipated by the radiator 4. The temperature of the water in the circulating system thus rises rapidly and when it has reached a predetermined point, say for in-

stance 170 degrees F., which point is determined by the construction and setting of the thermostat, the plunger 52 then presses the ball 56 into its seat, thus closing the valve. Enough air will leak into the cylinder 38 behind the piston 36 to reduce the vacuum previously existing therein, thus allowing the spring 39 to shift the blades 16 back into the positions in which they are shown in Fig. 1, and in which condition the fan becomes effective to force a current of air inwardly through the radiator toward the engine. This current of air, of course, is at a lower temperature than that which has been flowing through the radiator, and consequently the rate of radiation of heat from the radiator will be increased and the temperature of the water in the circulating system will be correspondingly reduced.

The type of thermostat shown is adapted to effect a very substantial movement of the plunger 52 upon a relatively small change in temperature and accordingly the action above described will be repeated, the fan being shifted from one operative position to the other as the temperature of the water varies between certain predetermined limits, in a manner which will tend to maintain the temperature of this water substantially constant. This mechanism thus operates, not only to prevent the freezing of water in the circulating system during severe weather, but also tends to maintain the engine cylinders at substantially the temperature at which the engine can operate at its maximum efficiency. At the same time the apparatus is entirely automatic in its action and requires no attention on the part of the driver.

The point at which the thermostat is connected into the system will, of course, depend very largely on the point in the system at which it is desired to control the temperature most accurately. If the temperature of the water as it issues from the engine jacket is regarded as the important thing to control, then obviously the thermostat will be connected into the circulating system at this point. There is some danger, however, that in operating a car in very cold weather there may be enough difference in the extreme temperatures between this point and that of the coolest point in the system so that the water will freeze at the latter point. This is particularly liable to occur in a thermo siphon system. Accordingly I prefer, for general purposes and certainly when operating a car in very cold weather, to connect the thermostat into the return pipe 8 where it will control the minimum temperature in the heat radiating system. This location obviously will be controlled largely by the particular conditions under which the engine is operated.

It is obvious that this invention is applicable, because of its ability to control the temperature of the cooling medium employed, whether water or air, to cars in which a heat radiating system very different from that shown is employed.

Obviously the thermostat can readily be made adjustable in a manner similar to that disclosed in my pending application above designated; that is, by making the plunger 52 in two sections and threading one on to the other, or by making the valve seat adjustable toward and from the plunger. This, however, is not always desirable since the thermostat can be properly set when the apparatus is installed and the absence of an adjustment prevents any tinkering with the thermostat, which would be more liable to interfere with the desired operation of the mechanism than to improve that operation.

It will be evident that the arrangement herein disclosed adds very little apparatus which is not ordinarily required in the equipment of an engine. Also that the automatic control provided is so arranged that if it fails to work for any reason, the spring 39 will maintain the fan in the position in which it forces an inward current of air through the radiator; thus the conditions obtaining under these circumstances will be no worse than they would be if a fan of the ordinary type was used and it was operated in the usual manner.

It is obvious that this invention is susceptible of much change and modification without departing from its spirit or scope. For instance, a great variety of mechanisms may be used for effecting a reversal of the fan which would differ specifically from that shown but would not alter the essential characteristics of the invention. Accordingly it should be understood that the invention is not limited to the details of construction shown.

The present invention while broadly resembling those disclosed in my Patents No. 1,114,246, granted October 20, 1914, and No. 1,168,623, granted January 18, 1916, both covering improvements in temperature controlling apparatus for internal combustion engines, differ substantially from these earlier arrangements. In the construction shown in the earlier patent, the rate of radiation of heat from the water cooling system is controlled by obstructing the flow of air through the radiator and adjusting the degree of this obstruction, while in the construction shown in the present application no obstruction is opposed to the free flow of air through the radiator, but the direction of that flow is controlled, and advantage is taken of the fact that two supplies of air differing in temperature are available, either one of which can be used to effect a cooling action on the radiator, the rate of radiation being substantially varied, of course, by the

difference in temperature of these two air supplies. In the construction shown in the later patent, the temperature is controlled by supplying to the water in the cooling system, from some source additional to the engine jacket, the amount of heat required to maintain the water at substantially the desired temperature. This action, of course, is essentially different from that of the apparatus disclosed in the present application.

While I have shown in the accompanying drawings a controlling apparatus for effecting the reversal of the fan which operates pneumatically, it is obvious that this reversal might be effected mechanically or by electrical means. The pneumatic arrangement has been shown herein because I believe that this arrangement is more reliable and requires less care and attention than the other arrangements that could be used for this purpose.

Some features of the construction of the fan and the controlling mechanism therefor are of general application, and these features are not claimed in this application but applicant reserves the right to cover them in a divisional application.

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 and a heat radiating system therefor constructed to radiate heat into the surrounding atmosphere, of means coöperating with said system to facilitate the dissipation of heat therefrom, said means being constructed and arranged to direct waste heat from the engine on to said system to modify the rate at which the heat will be dissipated by said system, and mechanism responsive automatically to changes of temperature in said system for controlling said means.

2. In an automobile, the combination with an internal combustion engine and a heat radiating system for said engine including a radiator, of means constructed and arranged to direct air at a temperature higher than that of the outside atmosphere against said radiator while the automobile is running, and automatic temperature responsive controlling mechanism for said means.

3. The combination with an internal combustion engine and a heat radiating system for said engine including a radiator, of a fan, means coöperating with said fan to cause it to direct either an inward or outward current of air through said radiator, and mechanism responsive to changes in the temperature conditions in said system for controlling said means.

4. The combination with an internal combustion engine and a water cooling system therefor including a radiator, of means coöperating with said radiator to facilitate the dissipation of heat therefrom, said means being constructed and arranged to deliver waste heat from the engine to said radiator to modify the rate of radiation of heat from said radiator, and mechanism responsive automatically to changes in the temperature of the water in said system for controlling said means.

5. The combination with an internal combustion engine and a heat radiating means for said engine including a radiator, of a fan arranged to urge air against said radiator, and automatic mechanism for controlling said fan in response to temperature changes in the engine, said mechanism being constructed and arranged to utilize the fluid pressure conditions created in the engine in effecting said control.

6. In an automobile, the combination with an internal combustion engine and a water cooling system for said engine including a radiator, of a fan constructed and arranged to direct air at a temperature higher than that of the outside atmosphere against said radiator, means for driving said fan, and mechanism responsive to changes in the temperature of the water in said system arranged to control automatically the action of said fan.

7. The combination with an internal combustion engine and a heat radiating system therefor including a radiator, of a reversible fan arranged to force either an inward or outward current of air through said radiator, means for driving said fan, a thermostat responsive to temperature changes in said system, means controlled by said thermostat for causing the fan to force a current of air outwardly through the radiator, and a spring opposing said means and tending to maintain the fan in a condition in which it forces an inward current of air through the radiator.

8. In an automobile, the combination with an internal combustion engine and heat radiating means therefor including a radiator, of a reversible fan arranged to urge air against said radiator, means for reversing said fan, said fan being constructed and arranged to maintain itself while running in either operative position in which it is adjusted, and means for driving said fan.

9. In an automobile, the combination with an internal combustion engine and heat radiating means therefor, of a fan arranged to direct air against said means and having reversible blades, said blades having unbalanced blade areas, means for reversing said blades, and means for driving said fan.

10. The combination with an internal combustion engine and a water cooling system therefor including a radiator, of a fan arranged to urge a current of air through said radiator, means for driving said fan, and means for controlling the direction of

effort of the fan on the air in accordance with the temperature of the water in said system.

11. In an automobile, the combination with an internal combustion engine and a water cooling system therefor including a radiator, of a reversible driven fan arranged to force air through said radiator, and a thermostat arranged to control the reversal of said fan in response to changes in the temperature of the water in said system.

12. In an automobile, the combination with an internal combustion engine and a water cooling system therefor including a radiator, of a fan having reversible blades, said fan being arranged to force air through said radiator, means for driving said fan, mechanism operative to effect a reversal of the blades of said fan, and a thermostat responsive to changes in temperature of the water in said cooling systems arranged to control the action of said mechanism.

13. In an automobile, the combination with an internal combustion engine and a water cooling system therefor including a radiator, of a fan arranged between said radiator and engine, means for driving said fan, said fan being reversible to force air through the radiator either toward or from the engine, a thermostat responsive to changes in the temperature of the water in said system, and connections between said thermostat and said fan whereby the thermostat is enabled to effect the reversal of the fan.

14. In an automobile, the combination with an internal combustion engine and a water cooling system therefor including a radiator, of a reversible fan arranged to force air through said radiator, means for driving said fan, mechanism constructed to utilize the fluid pressure conditions created in the engine to effect a reversal of said fan, said mechanism including a thermostat responsive to changes in the temperature of the water in said cooling system and a valve operated by said thermostat and controlling the application of pressure from the engine to the fan.

15. In an automobile, the combination with an internal combustion engine and heat radiating means for said engine, of a fan arranged to urge a current of air against said heat radiating means, and controlling means for said fan arranged to modify the direction of effort of the fan on the air.

16. The combination with an internal combustion engine and heat radiating means for said engine including a radiator, of mechanism constructed and arranged to direct a current of air against said radiator, and means constructed and arranged to utilize the fluid pressure conditions created in said engine to control said mechanism.

17. In an automobile, the combination with an internal combustion engine and a water cooling system therefor including a radiator, of a fan positioned between the engine and the radiator, driving mechanism for said fan constructed and arranged to cause the fan normally to urge a current of air through the radiator toward the engine, and controlling mechanism for said fan constructed and arranged to modify its direction of effort on the air.

18. The combination with an internal combustion engine and heat radiating means for said engine, of mechanism for directing a current of air against said means, temperature responsive means for controlling said mechanism, and pneumatic means through which said temperature responsive means effects said control.

19. In an automobile, the combination with an internal combustion engine and a water cooling system therefor including a radiator, of a reversible fan arranged to force air through said radiator, means for driving said fan, mechanism for utilizing fluid pressure conditions created in the engine to effect a reversal of said fan, said mechanism including a thermostat responsive to changes in the engine temperature and a valve operated by said thermostat and controlling the application of said fluid pressure to said mechanism, and a spring opposing the action of said reversing mechanism.

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

FREDERICK M. FURBER.