June 2, 1942. R. A. B. ALLEN, JR 2,284,938

AIR FLOW CONTROL

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Fig. 1.

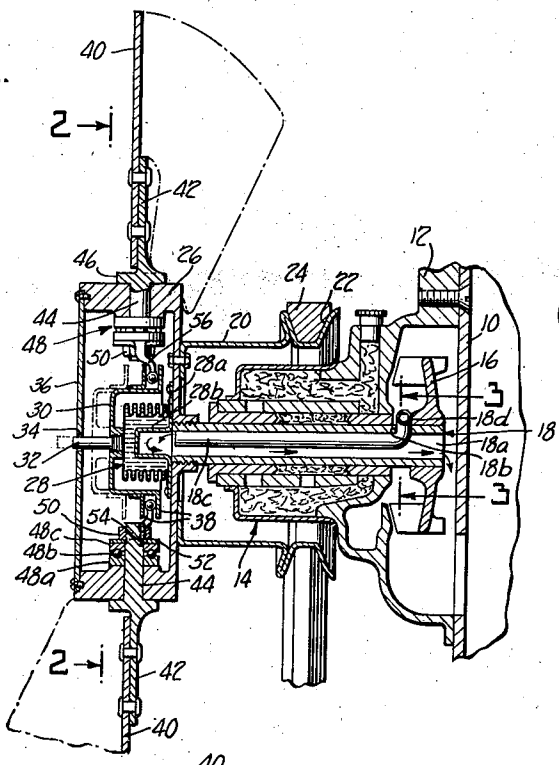


Fig. 3.

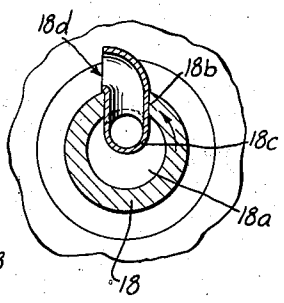
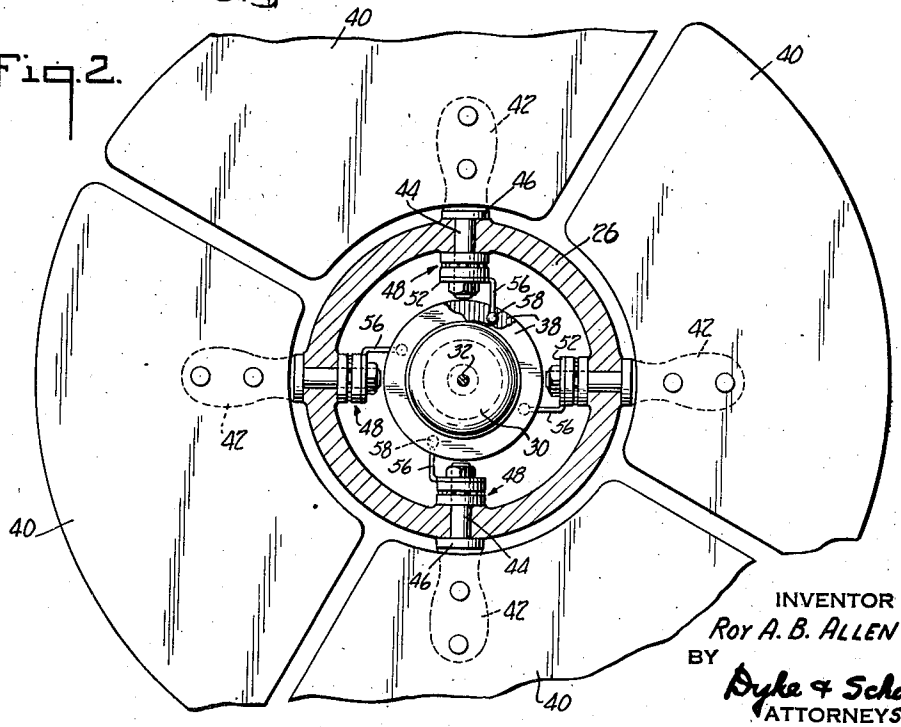


Fig. 2.



INVENTOR
ROY A. B. ALLEN JR.
BY
Dyke & Schaines
ATTORNEYS

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AIR FLOW CONTROL

Roy Albert Bryan Allen, Jr., Dallas, Tex.

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9 Claims. (Cl. 123—171)

This invention relates to air circulation systems and particularly the air fan system for cooling automobile engines.

The general object of my invention is the provision of improved mechanism whereby the amount of air flow past an engine or a radiator therefor is automatically controlled by the temperature of the cooling water which flows through the engine casing and radiator.

A particular object is the provision of a simple mounting directly on the water pump shaft of a fan blade support with a thermostat in immediate communication with the cooling water and means connecting the thermostat with the fan blades to vary the pitch thereof.

It is an object to provide fan blades which will present an almost entirely closed surface across the path of air flow until a predetermined temperature of the cooling water has been reached, while producing an increasing flow of air as the water temperature rises above that point.

Another object is the direct circulation of water from the neighborhood of the water pump into a recess of the thermostat for effective response to temperature changes.

Another object is the provision of the thermostatically controlled variable pitch fan which can be mounted with the standard water pump as in common use today, without taking up extra space, occasioning any increased friction with attendant problems of wear, power loss, lubrication, or noise, without requiring any extra packing or occasioning any extra possibility of leakage, and which at the same time will be positively and powerfully controlled directly by the temperature of the engine cooling water.

Further objects will become apparent during the course of the detailed specification which follows. In the drawing I have shown an illustrative embodiment of my invention as applied to an automobile engine.

Fig. 1 is a vertical sectional view of my fan mechanism and associated parts;

Fig. 2 is a front view partly in section taken on the line 2—2 of Fig. 1; and

Fig. 3 is a detail section taken on the line 3—3 of Fig. 1.

To a portion of the engine jacket structure 10 is attached the water pump housing 12 carrying usual packed bearing 14.

The centrifugal pump 16 rotates together with shaft 18 in the casing and packed bearing structure 14. A hub member 26 is secured to the shaft 18 for rotation therewith. A cup member 20 is secured to the hub member 26 for rotation therewith and has formed therein trough 22 for the belt 24 which imparts rotation to the water pump and fan. Secured to the hub member 26 opposite the shaft 18 is a thermostat 28 of known type, having a bellows and containing preferably a volatile liquid which causes the bellows to be extended (as shown in dotted lines in Fig. 1) upon rise in temperature of the contained liquid to beyond a predetermined critical point. The rear face of this thermostat is formed as a plate 28a having a central thimble 28b extending into the bellows and forming a recess in the thermostat.

Over the thermostat on the side away from the shaft is secured a metal shield 30 which preferably carries a forwardly extending pin 32 slidably fitting within a hole 34 in a plate 36 which covers and is secured to the front of the hub member 26. Upon expansion and contraction of the thermostat bellows the shield member 30 is forced forwardly or rearwardly, being guided and steadied by the pin fitting within the hole. A double flange 38 is provided on the shield 30 for a purpose which will appear hereinafter.

Fan blades 40 are mounted on radial arms 42 which are journaled in the hub 26 by means of stub shafts 44. Shoulder 46 is provided on each of the arms on the outside of the hub, and ball bearings 48 at the inner side. This ball bearing consists of race plate 48a, steel balls 48b, and race plate 48c which is threaded onto the stub shaft 44. A lock nut 50 firmly secures the ball bearings 48b between race plates 48a and 48c and also a washer member 52 interposed between the lock nut and the ball bearing assembly. This washer member 52, as seen in Fig. 1, is keyed to the tub shaft 44 as at 54, in any suitable manner, and carries an extension arm 56 which extends from the washer in the general direction of the plane of rotation of the fan and is then bent over more or less radially of the fan, terminating in a ball foot 58. This ball foot fits fairly snugly within the double flange 38 but with working clearance.

The shaft 18 which carries both the water pump and the fan, all rotating unitarily together, has a hollow central bore 18a and a radial opening 18b adjacent the pump. A tube 18c is secured within the bore of the shaft 18 with one open end terminating adjacent the thermostat 28. The interiorly directed thimble 28b in the plate 28a forms the rear side of the thermostat so that water coming through the tube 18c will flow into the thimble 28a and have intimate

association with the thermostat for heat exchange. The water has a return flow through the remaining portion of the bore 18a which communicates with the open chamber of the water pump. The other end of the tube 18c projects through the hole 18b and is bent over to form an open scoop 18d alongside the water pump and rotating therewith inside the pump casing. This scoop picks up water in the casing and forces it through the tube 18c and out into the thimble recess in the thermostat, from whence it returns to the water pump chamber.

Operation

When the water in the engine jacket is completely cold, the thermostat 28 has its bellows completely contracted and hence the shield member 30 pulled to the right to the limit of its motion as shown in full lines in Fig. 1. The double flange 38 rocks the arms 56 and thereby rotates the arms 42 to position where the fan blades 40 lie flat in a common plane. In this position the whirling fan draws no air through but merely acts as a whirling disc, which is the substantial equivalent of a stationary solid disc for the purpose of blocking passage of the air through the system, while using very little power for its rotation. As the engine continues to run and receives little air circulation with the fan in this position, it will begin to warm up. As it grows warmer the circulating water passing through the pump will circulate past the thermostat. The thermostat, containing volatile liquid, is made so it will not expand until a predetermined temperature is reached, after which it gradually expands with increase in temperature until it reaches its maximum expansion. This expansion will rock the arms 56 and rotate the arms 42 to open the fan blades to a pitch depending upon the temperature of the water within the thermostat's variable range. The hotter the water gets the more the pitch of the fan blade will be increased and the more air will be circulated past the cooling system, until the thermostat reaches maximum expansion, at which point or above maximum pitch and maximum air flow result. Thus the initial warming up period will be shorter because of the blocking off of the air, and after such period there will be a strong tendency for the engine to remain at or very near a constant operating temperature.

For any automobile engine there will be an optimum water temperature for operation of the engine. For example, if this temperature is 180°, this thermostat of the critical variety will be so proportioned that expansion of the bellows does not start until a given temperature is reached, say 175° F., and the expansion of the bellows will take place completely over the range up to 185° F., at which temperature and above the expansion of the thermostat bellows is at its maximum. Thus the fan blades will be held closed to form a flat disc resisting flow of the air past the radiator and engine until the water in the engine has reached the temperature of 175° F. Then the fan blades will gradually open and force more and more air past the radiator and engine as the temperature rises from 175 toward 185° F., at which last temperature a maximum flow of air would be passed and would tend to bring the water temperature down to below 185° F. Thus a constant operating temperature at some point between 175 and 185° F. will tend to be reached and kept. While this constant temperature will vary somewhat with outside air temperature and engine load, the tendency will nevertheless keep the engine operating temperature very close to the predetermined operating optimum.

The semi-balanced arrangement of the fan blades 40 (shown in Fig. 2, where each blade is seen to extend to both sides of its supporting arm, but by unequal amounts) allows them to exert a considerable pressure, either in blocking off the incoming air when the thermostat is cold, or in propelling a swift stream of air when the thermostat is hot, without requiring any strong mechanical force to be exerted by the thermostat.

It is to be observed particularly that my entire fan mechanism is mounted on the rotary shaft, which also mounts the water pump, and all of the parts involved in varying the pitch of the fan blades rotate as a whole with the fan. There is no additional packed joint or extra possibility of leakage, nor is there any additional friction resistance, nor is contact between rotary and stationary parts required, other than the water pump shaft which is already present. The water circulating system is marked by simplicity and short travel, the ordinary solid shaft for the water pump simply being bored and provided with the tube 18c. The water is taken at a point where very little increased travel on its part is involved and the flow of the entire stream of water is not blocked, a by-pass portion only being used for regulating the thermostat.

I claim:

1. In an air flow control system for an engine, a fan having variable pitch blades, a thermostat mounted on the rotary structure of said fan for rotation therewith and operatively connected to vary the pitch of said blades, and a hollow shaft on which said fan is mounted communicating with the engine jacket and the thermostat for flow of water through the hollow shaft.

2. In an air flow control system for an engine having a water pump, a hollow shaft for the water pump impeller, said hollow shaft also mounting an air fan having thermostatically controlled variable pitch blades, and an offset scoop on said shaft adjacent the water pump impeller for causing flow of water through said hollow shaft for controlling the thermostatic action.

3. In a variable pitch blade fan for controlling the flow of air for a water-cooled engine, a closed-chamber, volatile-liquid-containing thermostat mounted on the rotary structure of said fan for rotation therewith, and connected to vary the pitch of said blades and having a central recess formed in its enclosing walls accessible to the engine water.

4. An air flow control system for a water-cooled engine, including an air circulation fan and a water pump mounted on a common shaft for unitary rotation, said fan having variable pitch blades, an extensible bellows type thermostat mounted on the rotary fan structure for rotation therewith and at the center thereof and adjacent said shaft, and means moved by said thermostat and connected with the fan blades for varying their pitch when moved, the aforementioned shaft being hollow and providing direct communication of cooling system water from the water pump chamber to the thermostat.

5. In an automobile cooling system, a fan and a water pump mounted on a common shaft for unitary rotation, said fan including an extensible bellows type thermostat mounted at the center of said fan for rotation therewith and directly adjacent said shaft, said shaft being provided with

a hollow bore open at both ends and said thermostat being of the enclosed chamber type and provided with a thimble extending thereinto and constituting an extension of the bore of the hollow shaft, said thermostat being connected with the blades of said fan for varying their pitch upon variation of temperature of water circulating within the hollow shaft and thimble.

6. In an engine cooling system, a hollow shaft, a fan and a water pump mounted on the ends of said shaft for unitary rotation therewith, a thermostat in said fan at the center thereof adjacent said hollow shaft, means connecting the thermostat with the blades of said fan for varying their pitch upon variations in the temperature of the engine cooling water, the bore of said hollow shaft being partitioned into channels for the flow and counter-flow of water from the neighborhood of the water pump for producing flow and counter-flow of the cooling water through said channels.

7. In an engine cooling system, a hollow shaft, a fan and a water pump mounted on the ends of said shaft for unitary rotation therewith, a thermostat in said fan at the center thereof adjacent said hollow shaft, means connecting the thermostat with the blades of said fan for varying their pitch upon variations in the temperature of the engine cooling water, the bore of said hollow shaft being partitioned into channels for the flow and counter-flow of water from the neighborhood of the water pump, and a scoop communicating with one of said channels and extending out from the axis of said shaft within the water pump chamber and facing in the direction of rotation of said shaft for picking up engine cooling water and circulating same through said channels and past said thermostat.

8. In an engine temperature control system, a fan operatively connected with said engine for rotation therewith, said fan being provided with a plurality of substantially flat blades forming when in co-planar relation a substantially entirely closed flat disk, a thermostat positioned within said fan for rotation therewith and having contact with the cooling water for said engine and being connected with said blades for varying the pitch thereof upon variations of the temperature of said cooling water, said thermostat being arranged to hold said fan blades flat in a single plane until the temperature of the cooling water reaches a pre-determined point whereby up to such point relatively little power is required to rotate said fan and the blades of said fan together act as a closed front to said engine to obstruct the passage of air.

9. In an engine cooling system, a hollow shaft open at both ends, a water pump impeller mounted on one end of said shaft and a fan mounted on the other end of said shaft for unitary rotation together, variable pitch blades mounted on said fan, an extension type bellows thermostat mounted at the center of said fan directly adjacent the open end of said hollow shaft and carrying an annular grooved structure, rocker arms secured to said fan blades and their ends engaging in said groove for varying the pitch of said blades upon movement of said thermostat, and means for positively circulating engine cooling water from the engine pump chamber through said hollow shaft into contact with said thermostat and back through said hollow shaft.

ROY ALBERT BRYAN ALLEN, JR.