July 1, 1947. S. C. EARLEY ET AL 2,423,140

COOLING SYSTEM, THERMOSTAT CONTROL

Filed Feb. 7, 1945 2 Sheets-Sheet 1

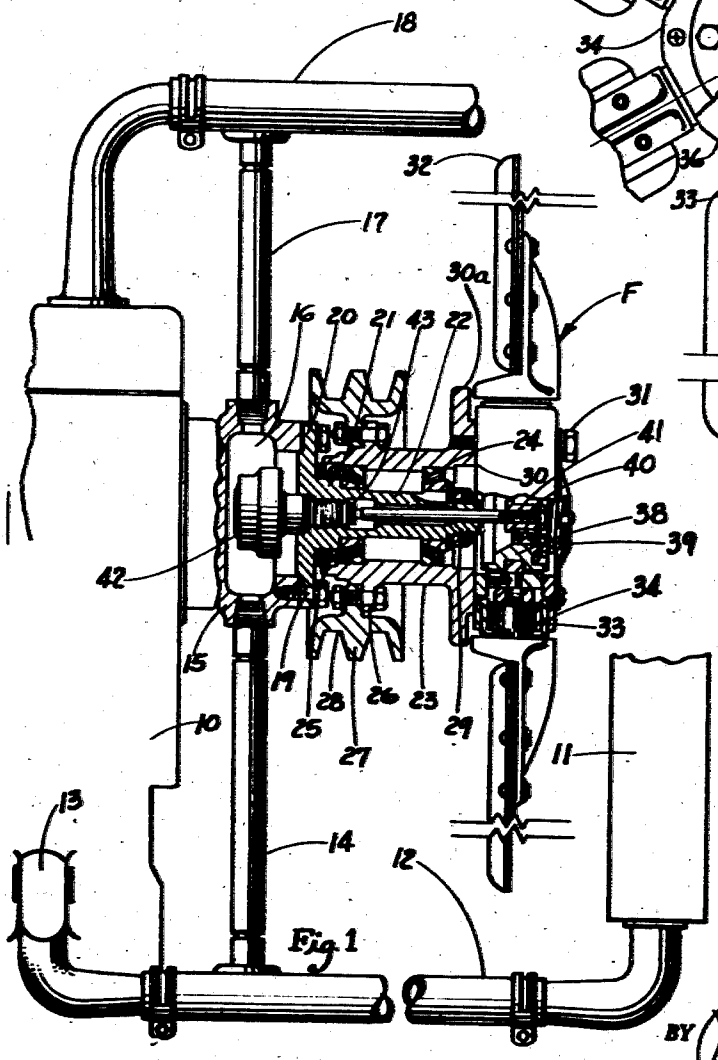


Fig. 1

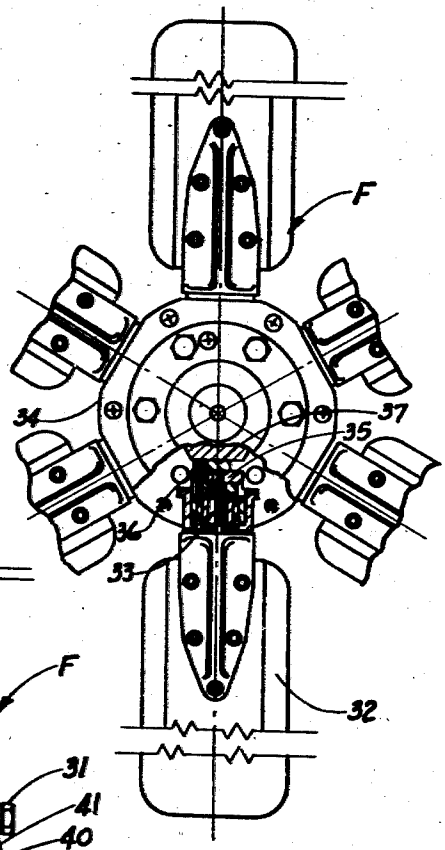


Fig. 2.

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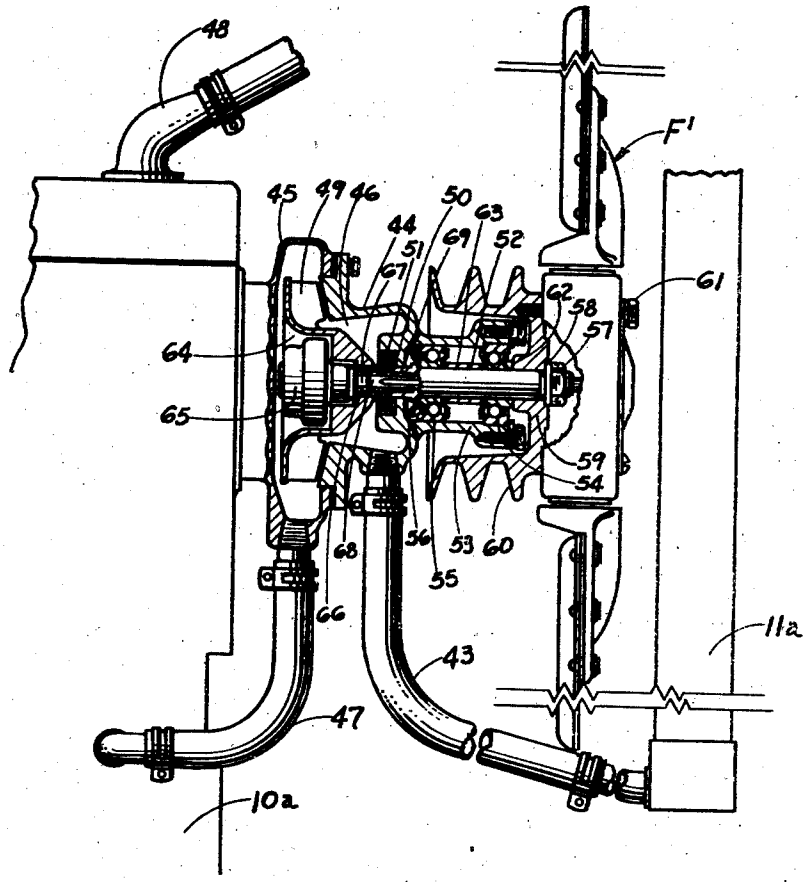


Fig. 3

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2,423,140

COOLING SYSTEM, THERMOSTAT CONTROL

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12 Claims. (Cl. 123—178)

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This invention relates to cooling systems for internal combustion engines but more particularly to systems of this character employing a thermostatically controlled variable pitch fan blade assembly in which the blades are tilted in accordance with the temperature conditions prevailing in the cooling system.

An object is to produce an engine cooling system employing a variable pitch fan blade assembly controlled by a thermostat arranged in the stream of cooling liquid and having the new and improved features of construction, arrangement and operation hereinafter described.

Another object is to provide in combination with a pump impeller in a system of the above character, a thermostat which is compactly arranged for controlling the pitch of the fan blades and in which the impeller is actuated conjointly with the fan blade actuating means, thereby to produce a simple and efficient assembly which occupies a minimum of space and which reliably and efficiently operates to control the pitch of the fan blades.

A further object is to produce an engine cooling system employing circulating liquid and a variable pitch fan blade assembly in which a pump impeller is disposed in the stream of cooling liquid and is connected to be driven conjointly with the fan blade assembly, the thermostat for varying the pitch of the blades being intimately associated with the pump impeller in a novel, compact and efficient manner.

A still further object is to produce a mounting on the engine block for a variable pitch fan blade assembly, its drive, operating thermostat and associated parts in a new and improved manner by which the performance and efficiency of the unit are enhanced and the assembly and maintenance of the parts simplified.

For purposes of illustration but not of limitation, embodiments of the invention are shown in the accompanying drawings in which

Figure 1 is a view in elevation partly in vertical section of a variable pitch fan blade assembly and a mounting therefor on an associated internal combustion engine;

Figure 2 is a face view partly in section with some of the parts broken away, of the variable pitch fan blade assembly; and

Figure 3 is a side elevation partly in section of an alternate form of an internal combustion engine cooling system in which the fan blade controlling thermostat is housed within the pump impeller.

The illustrated embodiment of the invention

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shown on Figures 1 and 2 comprises an internal combustion engine 10 having the usual cooling fluid jacket. In advance of the engine 10 is the usual radiator 11, from the lower part of which leads a tube 12 to a pump 13. The pump 13 forces the cooling liquid upwardly through the engine cooling jacket and liquid returns to the top portion of the radiator through a tube 18 which leads from the top of the cooling jacket. Branching from the tube 12 is a smaller bypass tube 14 through which cooling liquid passes to a casing 15, which is suitably fixed to the front face of the engine block. The casing 15 has a chamber 16 through which cooling fluid may pass and from the chamber leads a tube 17 which is joined to the tube 18. Secured by screws 19 to the front of the casing 15 is a plate 20 which is formed with a reduced shouldered portion 21 and integral with the shouldered portion 21 and projecting forwardly therefrom, is a sleeve portion 22. Mounted for rotative movement upon the sleeve portion 22 is a hub portion 23, two sets of roller bearings 24 being interposed between the hub 23 and the sleeve 22. Providing a seal between the inner end of the hub 23 and shouldered portion 21 is a sealing gasket 25. The hub 23 is formed with an annular flange 26 and bolted thereto is a sheave ring 27, which is formed with a pair of annular grooves 28 to receive the usual V pulleys, which in turn are secured to pulleys (not shown) driven by the engine as will be readily understood.

Integral with the sleeve 22 is a screw-threaded extension 29, which receives a lock nut 30 bearing against the adjacent roller bearing 24 thereby to secure the hub 23 in place on the sleeve 22, it being understood that the other roller bearing abuts against the shouldered portion 21 of the plate 20. At the outer end of the hub 23 is a flange 30*a* which is secured by a series of stud bolts 31 to the fan blade assembly F.

The fan blade assembly F comprises a series of fan blades 32, each of which carries a stub shaft 33 which is mounted for rotative movement in a fan hub assembly 34. Each stub shaft 33 has fixed to its end a disc 35 which carries an eccentrically disposed pin 36 which engages a block 37 carried in the rim portion of an actuating sleeve 38. The actuating sleeve is adapted to move axially with respect to the fan hub assembly 34. Movement of the sleeve 38 in one direction is effected by a coil spring 39 but movement in the opposite direction is controlled by a shaft 40 which extends through the sleeve 22. The shaft 40 does

not rotate but engages at its outer end a sleeve 41 and between the sleeve 41 and the actuating sleeve 38 is an anti-friction bearing so that the actuating sleeve can rotate relatively to the shaft 40.

Disposed within the chamber 16 in the casing 15 is a thermostat 42 of any suitable structure which in response to changes in the temperature conditions of the liquid passing therethrough, actuates an abutment member 43 which bears directly against the inner end of the shaft 40. Thus, in response to temperature changes, the thermostat 42 imparts longitudinal movement to the shaft 40 in one direction thereby to cause rocking simultaneously of the various fan blades 32 in one direction. Upon return of the temperature of the cooling liquid passing through the chamber 16 allowing the thermostat 42 to return to normal position, the coil spring 39 operates to effect movement of the actuating sleeve 38 and consequently the shaft 40 towards its normal position. The thermostat illustrated is sold under the trade-mark "Vernatherm" by the Detroit Lubricator Company of Detroit, Michigan.

In this manner it will be manifest that the pitch of the several fan blades 32 is automatically changed or varied in accordance with the temperature of the cooling liquid coming in contact with the thermostat 42. Thus when the temperature of the cooling fluid is relatively low, the pitch of the fan blades will be such as to create no or a minimum stream of air toward the engine. This is recognized to be particularly of advantage since it reduces the strain on the motor parts particularly the motive power for driving the fan. Subsequently as the temperature of the cooling liquid increases, the pitch of the fan blades is gradually changed so that a greater and greater volume of air is handled by the fan and directed toward the engine.

Reference is hereby made to our co-pending application Serial No. 564,278, filed November 20, 1944, and entitled "Variable pitch fan blade assembly," wherein more detail illustration and description of the mechanism for varying the pitch of the fan blades, is set forth and further illustration and description in that connection is not considered necessary for a full understanding of this invention.

In the form of the invention shown on Figure 3, the internal combustion engine 10*a* having the usual cooling jacket, has a radiator 11*a* disposed in spaced relation thereto and a variable pitch fan blade assembly F' is interposed between the radiator and engine. The mechanism for varying the pitch of the fan blades is similar to that above described and is in accordance with our co-pending application Serial No. 564,278 above referred to so that detail description and illustration thereof is not considered necessary.

Leading from the lower end of the radiator 11*a* is a tube 43 which leads to a housing section 44 which is secured to the front end of the engine or cylinder block. Within the housing formed by the sections 44 and 45 is a chamber 46 through which cooling liquid passes, and leading from the lower end of the housing section 45 is a tube 47 which communicates with a lower portion of the engine cooling jacket. Leading from the upper end of the engine or cooling jacket is a tube 48 which extends to the upper end of the radiator 11*a*. For creating forced circulation of liquid through the radiator tubes and cooling jacket above mentioned, a blade impeller 49 is disposed within the chamber 46 and is suitably secured

to a tubular shaft 50 which extends forwardly therefrom, a seal 51 being provided in the housing section 44 to militate against leakage along the shaft 50.

The shaft 50 has an integral tubular extension 52 and interposed between the extension 52 and a forwardly extending hub portion 53 forming a part of the housing section 44 are laterally spaced anti-friction bearings 54 and 55. Abutting against the inner side of the anti-friction bearing 55 is an annular flange 56 integral with the sleeve extension 52. The outer end of the tubular shaft extension 52 is screw-threaded to receive a nut 57, which holds a washer 58 in abutment with the outer end wall of a sheave 59. The sheave 59 is formed with a pair of tapered grooves 60 to receive the usual V belts, which are adapted to be suitably driven from the engine. The sheave 59 is secured to the fan blade assembly F' by a series of stud bolts 61 so that the fan assembly and sheave rotate together, the fan being driven by the sheave. Projecting inwardly from the end wall of the sheave 59 is a hub portion 62, which is fixed as by a key to the tubular shaft extension 52, thereby to drive the pump impeller 49 concomitantly with and by the sheave. The hub portion 62 abuts against the outer side of the anti-friction bearing 54 and interposed between the bearings 54 and 55 is a spacer sleeve 63, which surrounds a portion of the extension sleeve 52.

It will be observed that the pump impeller 49 is formed with a concentric cavity or recess 64 and disposed therein is a thermostat 65 similar to the thermostat 42 above mentioned. The thermostat 65 has a forwardly extending sleeve 66, which has external screw threads to engage internal screw threads on the pump impeller shaft 50. Slidable within the sleeve 66 is an actuating member 67 which is operated by the thermostat 65 in accordance with the temperature conditions of the cooling liquid passing through the chamber 46. The actuating member 67 operates against a socketed member 68 into which the end portion of an actuating shaft 69 extends. The shaft 69 corresponds to the shaft 40 above described and is operatively connected to parts of the variable fan blade assembly F' so that upon movement thereof in one direction, the fan blades are tilted one way and upon movement in the opposite direction, the fan blades are tilted in the opposite direction, the thermostat imparting movement in one direction and a coil spring similar to the spring 39 above described, imparting movement in the opposite direction. Further description of that mechanism is not considered necessary in view of that given above.

An outstanding feature of the structure according to Figure 3 is the housing of the thermostat within the pump impeller, the conjoint drive for the impeller and fan blade assembly, and the compact arrangement of parts by which a minimum of space is occupied and the number of parts is reduced to a minimum.

It is to be understood that numerous changes in details of construction, operation and arrangement may be effected without departing from the spirit of the invention especially as defined in the appended claims.

What we claim is:

1. In a cooling system for an internal combustion engine, the combination of a liquid cooling jacket for the engine, a radiator, tube connections between said cooling jacket and radiator, a liquid circulating pump, a variable pitch fan

assembly interposed between said radiator and engine and including a longitudinally movable shaft operatively connected to the assembly to vary the pitch of the fan blades, a casing interposed in one of said tube connections and through which cooling liquid passes, a thermostat within said casing and directly connected to said shaft for imparting movements thereto in response to changes in the temperature of the cooling liquid, rigid mounting means for said casing, and means on said casing providing a mounting for said fan assembly.

2. A variable pitch fan control as claimed in claim 1, in which said pump comprises a rotating vane arranged within said casing, said vane having a cavity therein for receiving said thermostat.

3. In a cooling system for an internal combustion engine, the combination of a liquid cooling jacket for the engine, a liquid cooling radiator at one end of the engine, duct means between the upper and lower portions of the radiator and cooling jacket respectively, means providing a housing intermediate the engine and radiator and communicating with the duct means leading from the lower portion of the radiator to the lower portion of the cooling jacket, a variable pitch fan blade assembly between said housing and radiator, a sheave fixed to said assembly for rotation therewith, a tubular extension rigid with said housing, and means within said extension providing a bearing support for said sheave and fan assembly, a pump impeller within said housing, an operative connection between said impeller and said sheave thereby to impart rotation to said impeller, a thermostat housed within said pump impeller, and an operative connection between said thermostat and said variable pitch fan blade assembly for operating the latter in response to temperature changes of the cooling liquid passing through said housing.

4. A variable pitch fan control as claimed in claim 3, in which said pump comprises a rotating impeller arranged within said casing and having an axially disposed cavity, said thermostat being disposed within said cavity, and driving means common to said variable pitch fan assembly and said pump impeller.

5. In an internal combustion engine, the combination of a liquid cooling system for the engine, a variable pitch fan blade assembly, a sheave adapted to be driven by the engine and connected for rotation with said fan blade assembly, a pump impeller for circulating liquid through said cooling system, an operative connection between said impeller and said sheave, means for mounting said fan blade assembly, pump impeller and sheave for rotation about a common axis and means responsive to the temperature of the liquid in said cooling system for varying the pitch of the blades of said fan blade assembly.

6. In an internal combustion engine, the combination of a liquid cooling system for the engine, a variable pitch fan blade assembly, a sheave adapted to be driven by the engine and connected for rotation with said fan blade assembly, a pump impeller for circulating liquid through said cooling system, an operative connection between said impeller and said sheave, said impeller having an axially arranged cavity, a thermostat housed in said cavity, and an operative connection between said thermostat and said fan blade assembly for varying the pitch of the blades thereof in accordance with changes in the temperature conditions of the cooling liquid.

7. In an internal combustion engine, the combination of a liquid cooling system therefor, a variable pitch fan blade assembly, means secured to said fan blade assembly and adapted to be driven by the engine for rotating same, said cooling system including a housing through which cooling liquid flows, a pump impeller in said housing, an operative connection between said impeller and said rotating means whereby the latter imparts rotation to both the fan blade assembly and said impeller, bearing means on said housing for said rotating means, said pump impeller having a central cavity, a thermostat housed in said cavity, and an operative connection between said thermostat and said variable pitch fan blade assembly disposed concentric of said pump impeller and said rotating means.

8. In a cooling system for an internal combustion engine, the combination of a liquid cooling jacket for the engine, a radiator, tube connections between said cooling jacket and radiator, a liquid circulating pump, a variable pitch fan assembly interposed between said radiator and engine and including a longitudinally movable shaft operatively connected to the assembly to vary the pitch of the fan blades, a casing interposed in one of said tube connections and through which cooling liquid passes, a thermostat within said casing and directly connected to said shaft for imparting movements thereto in response to changes in the temperature of the cooling liquid, means for mounting said casing on the engine, and means on said casing providing a mounting for said fan assembly.

9. In a cooling system for an internal combustion engine, the combination of a liquid cooling jacket for the engine, a radiator, tube connections between said cooling jacket and radiator, a variable pitch fan assembly interposed between said radiator and engine and including a longitudinally movable shaft operatively connected to the assembly to vary the pitch of the fan blades, a casing interposed in one of said tube connections and through which cooling liquid passes, a liquid circulating pump arranged in said casing and conjoined for rotation with said fan blade assembly, a thermostat within said casing and directly connected to said shaft for imparting movements thereto in response to changes in the temperature of the cooling liquid.

10. In a cooling system for an internal combustion engine, the combination of a liquid cooling jacket for the engine, a radiator, tube connections between said cooling jacket and radiator, a variable pitch fan assembly interposed between said radiator and engine and including a longitudinally movable shaft operatively connected to the assembly to vary the pitch of the fan blades, a casing interposed in one of said tube connections and through which cooling liquid passes, a thermostat within said casing and directly connected to said shaft for imparting movements thereto in response to changes in the temperature of the cooling liquid, a liquid circulating pump arranged in said casing, and said thermostat being concentric to and housed within said pump.

11. In a cooling system for internal combustion engines, tubular support means adapted to be rigidly mounted on the engine, a rotatable sheave concentric with said tubular support, antifriction means between said sheave and said support, a variable pitch fan blade assembly directly fixed to said sheave, a housing through which cooling liquid passes, an expansible thermostat stationary within said housing, and shaft means

shiftable longitudinally within said tubular support and providing an operative connection between said thermostat and the variable pitch fan blade assembly thereby to vary the pitch of the fan blades in response to changes in liquid temperature.

12. In a cooling system for internal combustion engines, a housing adapted to be rigidly mounted on the engine, a rotatable tubular member within a portion of said housing, anti-friction means between said tubular member and said housing, a motor operated sheave concentric with said tubular member, a variable pitch fan blade assembly connected to one end of said tubular member and directly fixed to said sheave, impeller blades secured to the other end of said tubular member and disposed within a portion of said housing having cooling liquid passing therethrough, expansible means in the latter housing portion, and shaft means shiftable longitudinally within said tubular member and providing an operative connection between said expansible means and the variable pitch fan blade assembly

thereby to vary the pitch of the fan blades in response to changes in liquid temperature.

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