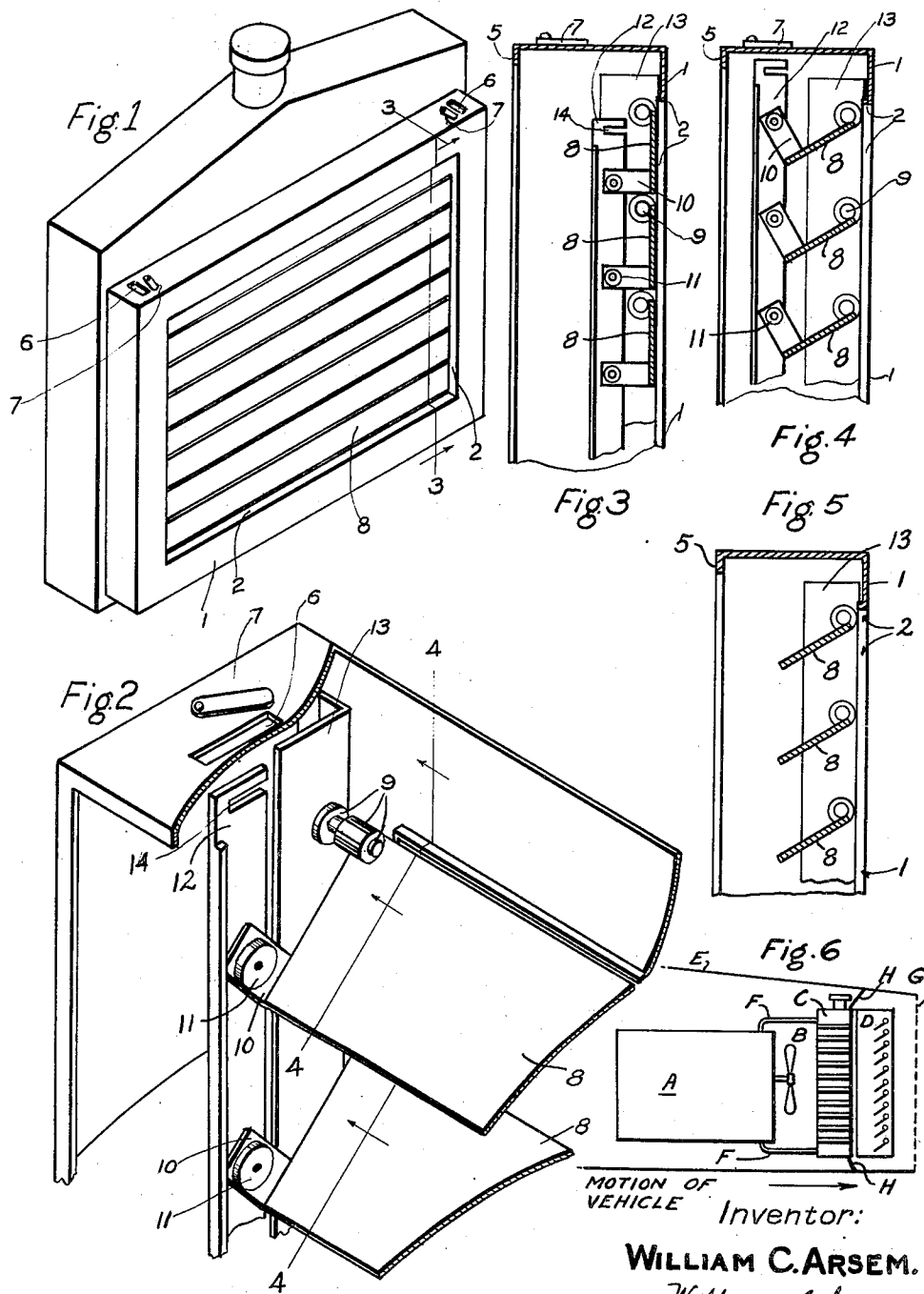


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AUTOMATIC RADIATOR SHUTTER

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AUTOMATIC RADIATOR SHUTTER

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2 Claims. (Cl. 123—41.04)

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This invention relates to automatic radiator shutters especially radiator shutters for internal combustion engines.

One object of the present invention is to control automatically the supply of air which passes through the radiator in order to maintain the temperature of the circulating liquid in a range conducive to high engine efficiency and fuel conservation.

Another object of the invention is to stop the flow of air through the radiator when the engine stops running, so that heat will be conserved and the temperature of the engine maintained during non-operating intervals.

Devices previously proposed for controlling the temperature of the cooling liquid for an internal combustion engine do not offer the advantages of the present invention for the following reasons: Manually controlled radiator shutters can be operated only with fixed settings of shutter openings. Thermostatically controlled shutters remain open when the engine stops running and do not close until the liquid has cooled. Thermostatic valves in the liquid circulating system of an automotive vehicle control only the temperature of the liquid and do not control the flow of air through the radiator and around the engine, so that when the vehicle is moving, the air-stream cools the engine itself, and when the vehicle is standing still and the engine is not operating, the air-stream through the radiator rapidly cools the system to a point of low operating efficiency.

The automatic radiator shutter which is the subject of this invention is adapted for installation in front of the radiator of an automotive vehicle. It may be fastened directly to the radiator or mounted in combination with a partition or baffle so that all the air passing through the radiator must first pass through the shutter. It consists of a framework having substantially the same configuration as the front of the radiator, said framework having in its front surface a rectangular opening of substantially the same size as the core section of the radiator, there being mounted immediately behind the opening a system of vanes each pivoted about a horizontal axis coincident with its upper edge, the vanes being arranged one above another in a vertical plane so that they entirely close the opening when brought to a position of rest by the action of gravity and not being subjected to the pressure of a moving current of air.

When there is a difference of air pressure between the front and back of the vane system,

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whether brought about through the operation of the cooling fan behind the radiator or by the forward motion of the vehicle, or by both causes, the vanes are deflected from their normal vertical position through an angle which depends upon the difference of air pressure on the two faces of the vane system and on the weight of the vane system per unit area of the vanes, and air passes through the spaces thus opened up between the vanes and then through the radiator core.

If the wind pressure due to the forward motion of the vehicle in pounds per square foot be represented by P , and the weight of the vane system in pounds per square foot of vane surface be represented by G , then the angle of deflection θ of the vanes from the vertical plane is theoretically given by the equation $P/G = \tan \theta$. If the vehicle is moving forward with the velocity V miles per hour, the pressure on the vane system is proportional to the square of the velocity, and the equation is $P = .0042 V^2$. From these two equations, $\tan \theta = .0042 V^2/G$. Hence, the tangent of the angle of deflection of the vanes from their resting position is proportional to the square of the wind velocity (or the square of the vehicle velocity), and inversely proportional to the effective weight per unit area of the vane surfaces.

For a particular model of vehicle and cooling system, there will be a specific relation between the speed of the vehicle and the angular deflection of the vanes required to admit just sufficient air to maintain the best operating temperature in the cooling system at that speed. In designing the shutter for a particular vehicle, the proper range of angular deflection of the vanes in relation to the range of vehicle speeds can be fixed by making the vanes of material having appropriate specific gravity and thickness so that the effective weight per square foot of vane surface shall have the desired value. The effective weight per square foot of vane surface is defined as the weight of the moving parts of the vane assembly divided by the total area of the vane surfaces exposed to wind pressure.

In one form of this invention, the vanes are independent of each other and are not connected together. In another form of this invention the vanes are connected by vertical articulated link bars so that they move as a unit in response to wind pressure due to vehicle velocity. In still another form of the invention,

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the angular displacement of the vanes in relation to wind pressure may be controlled by a spring the tension of which is determined by a thermostatic element responsive to air temperature; or, alternatively by a movable weight. This method of control is, in effect, a means of adjusting the value of G in the equations given above, and its purpose is to provide means of compensating for extreme variations in temperature.

The following is a description of the invention as shown on the accompanying sheet of drawings:

Figure 1 is an isometric view of one form of automatic shutter shown mounted on the front of a radiator.

Figure 2 is an isometric view in partial section showing one of the upper corner portions of the shutter as seen from the rear.

Figures 3 and 4 are sectional views taken on the plane 3—3 of Figures 1 and 2. Figure 5 is a sectional view, corresponding to the section lines 4—4 of Figure 2, of a form of shutter having no link bar connecting the vanes. Figure 6 is an assembly diagram showing the combination of an engine, a radiator, a cooling fan for the radiator and a shutter in front of the radiator as set forth in claim 2.

Referring to Figs. 1 to 5, the names and functions of the parts are as follows:

1. Framework of shutter.
2. Flanged edge of front opening in framework.
5. Flanged edge at back of shutter.
6. Slots in top of framework to permit passage of upper end of link-bar.
7. Catch to engage link-bar notch.
8. Vanes.
9. Journals for vanes.
10. Ears on vanes carrying bearings for link-bar.
11. Bearings connecting vanes with link-bar.
12. Link-bar, connecting vanes into an assembly.
13. Support for vane journals.
14. Notch in link-bar.

The components shown in Figure 6 are: A, engine; B, fan; C, radiator; D, shutter; E, hood; F,F, pipes for cooling fluid; G, grille; H,H, baffles to confine the air stream to the radiator.

The framework 1, of the shutter is preferably made of metal. The flanged edge 2, at the front opening of the shutter, forms a rigid window frame against which the vanes can lie flat in order substantially to seal the window opening against passage of air when the vanes are in a resting position with no air pressure against them. The flanged edge 5, at the back of the shutter framework, provides a contact surface against the front of the radiator. A washer of resilient material, not shown, may be employed between the rear flange of the shutter and the front surface of the radiator. Slots 6, are provided in the upper surface of the framework to permit passage of the upper ends of the link-bars 12, so that the catches 7 may be swung over to engage the link-bar notches 14 in order to hold the vanes wide open when limitation of air flow is not desired. The vanes 8 are hung vertically from horizontal journals 9 carried on the supports 13. The vanes may be made of metal or any other suitable material, and are connected by the link-bar 12 through bearings 11 mounted on ears 10 extending from the edges of the vanes. The journals 9 and link-bar bearings 11 may be of the types indicated in Figures 2, 3 and 4, or of any type adapted for performing the same functions. Oil-less type bearings may be used.

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The shutter may be attached to the front of the radiator by welding at one or more points; by bolts or screws engaging with suitable flanges or projections on the shutter or radiator or both; or by means of clamps or other attaching devices which may be integral with the radiator or the shutter or may be entirely separate.

The operation of the automatic radiator shutter when installed in an automotive vehicle is as follows: When the vehicle is moving at a given speed, the vanes of the shutter remain in equilibrium at a fixed angle from the vertical, floating on the air stream, and permitting the continuous flow of air through the radiator at a rate which will maintain the temperature of the circulating cooling liquid within a range favoring the most efficient performance of the engine. If the speed of the vehicle is increased the vanes open further to widen the gaps between the vanes, thus permitting a greater flow of air corresponding to the increased cooling requirements of the engine. If the vehicle is brought to a standstill and the engine continues running at idling speed, the operation of the fan will maintain a small deflection of the vanes which will permit the flow of a small but adequate supply of air. When the engine is shut off, the vanes will drop to their resting position under the influence of gravity, entirely closing the shutter window, so that free circulation of air through the radiator and around the engine ceases and the liquid in the cooling system remains at a favorable operating temperature for an extended period during which the engine can readily be started and does not require warming up. Fuel is thus saved which would be wasted in the inefficient operation of a cold engine. Excessive use of the choke is avoided and the carbonization of cylinders, rings and valves and the fouling of sparkplugs are greatly lessened.

When the automatic shutter is installed on the radiator of a stationary power plant, the operation of the shutter is coordinated with the speed of the cooling fan and hence with the speed of the engine, so that the supply of air increases when the engine speed increases and is shut off entirely when the engine stops.

I claim:

1. A radiator shutter for a vehicle consisting of a framework with a front opening and a series of horizontally journaled vanes arranged in the same plane behind the opening, with the axis of rotation of each vane substantially coincident with its top edge, said vanes being freely rotatable from their normal position in the plane such that the system of vanes entirely closes the front opening, to a limiting position at right angles to the plane leaving the front entirely open, whereby the shutter vanes are actuated by the air pressure induced by the forward speed of the vehicle on which the shutter is mounted, so as to permit air flow through the radiator as a function of the speed of the vehicle.

2. In a vehicle, the combination of an engine, a radiator, a cooling fan for the radiator between the radiator and engine and a shutter in front of the radiator consisting of a framework with a front opening and a series of horizontally journaled vanes arranged in the same plane behind the opening, with the axis of rotation of each vane substantially coincident with its top edge, said vanes being freely rotatable from their normal position in the plane such that the system of vanes entirely closes the front opening, to a limiting position at right angles to the plane,

leaving the front entirely open whereby the shutter vanes are actuated by the air pressure induced by the forward speed of the vehicle on which the shutter is mounted, so as to permit air flow through the radiator as a function of the speed of the vehicle, the operation of the fan maintaining a small deflection of the vanes when the vehicle is at a standstill and the engine is idling.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,310,870	Mapson	July 22, 1919
1,335,356	Vaughan	Mar. 30, 1920
1,369,228	Evers	Feb. 22, 1921
1,482,398	Ilg	Feb. 5, 1924
1,711,215	Workman	Apr. 30, 1929
2,299,832	Mader	Oct. 27, 1942