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SHUTTER CONTROL FOR AIR COOLED ENGINES

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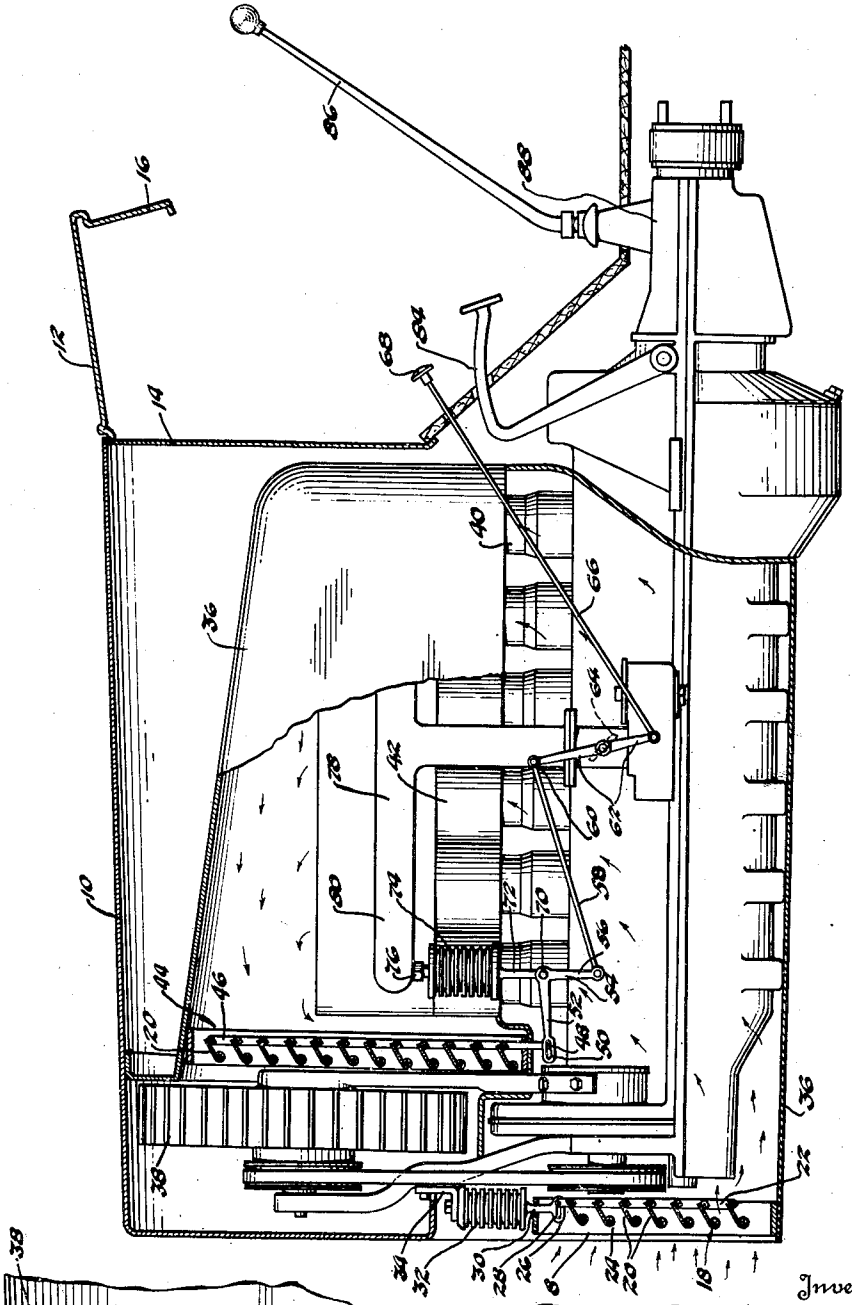


Fig. 1

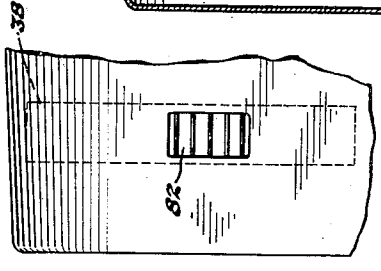


Fig. 2

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SHUTTER CONTROL FOR AIR-COOLED ENGINES

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This invention relates to internal combustion engines, and has particular reference to engines of the air cooled type used on automobiles, airplanes, or other vehicles.

In the past difficulty has been experienced in maintaining air cooled engines at their optimum temperature at all times, and it is the object of the present invention to disclose a system of cooling which is interrelated with the engine and outside atmosphere so as to give the proper amount of cooling at all times.

The idea of the present invention is to maintain this optimum temperature for the metal parts of the power plant, particularly the manifold, regardless of outside temperature, speed or load conditions.

In driving an automobile through a hilly country it is known to be one of the criticisms of engine performance that the engine becomes over-cooled at the bottom of hills, after having been used as a drag on the car to supplement the braking action. This is substantially identically the same condition obtained in connection with the first copper cooled aeroplane engine with which we experimented and which was flown for many hours in both hot and cold weather; that is, the engine over-cooled in a fast glide, an objectionable condition which was very noticeable, and which we have remedied in the present invention.

When the amount of cooling air is a function of speed alone, regardless of load, then the engine is always over-cooled at high speed, light load conditions. With the automobile engine at moderate speeds it is possible to obtain very nearly full torque with only a fraction of total angular movement of the throttle shaft from closed position. Hence it is not possible here to properly control the amount of cooling air handled by linkage alone operated by the throttle.

The rate of heat rejection to the cooling system varies somewhat with the time rate of mixture consumption. The most readily utilized condition occurring in the engine, governed by mixture flow rate, is the manifold vacuum. Hence it is proposed to insert in a linkage control some over-control dependent upon manifold vacuum. The manifold vacuum increases, at any throttle position, with mixture flow rate, although at wide open throttle the rate of increase and total increase are both relatively small. However, at partial throttle the total maximum manifold vacuum can be quite high, and at high speed with closed throttle it may be still higher. However, under this last condition the weight of charge entering the engine is relatively small, consequently the heat rejected to the cooling system is likewise small.

With an uncontrolled cooling system the engine often is over-cooled. Hence if high manifold vacuum can be utilized to throttle or partially throttle the supply of cooling air going through the system, the engine will not be over-cooled to so great an extent. It is recognized that at wide open throttle, high speed, the manifold vacuum may be greater than at wide open low speed. In general this condition occurs at high forward velocities of the car, at which time, with a tight cooling system as disclosed, advantage may be taken of the higher velocity pressure of the air at the entrance of the system to overcome such throttling by the secondary control shutter as may be brought about by the higher manifold vacuum.

To obtain proper control of the cooling effect we make use of two shutters, one subject to control by the outside temperature, and which governs the admission of cooling air to the engine, and the other subject to control by the engine vacuum determining the amount of this air which will be allowed to pass through the system.

The function of the first shutter, controlled by a thermostat subjected to environment temperature, is self-evident. To maintain optimum operating temperatures it is plain that with cooler outside air and a consequent higher available temperature gradient between the cooling air and the parts being cooled, less weight—hence less volume of cooling air—is required. The first shutter will govern the maximum amount of air handled in proportion to outside tempera-

ture. The second shutter will control what proportion of that maximum air will be allowed to go through the system to adequately cool—but not overcool—the power plant.

The object of the invention is accomplished by placing at the front of the engine a shutter which is controlled by a heat sensitive element, which is subject to the outside or atmospheric temperature. This shutter will control the maximum weight or amount of air handable in proportion to the outside temperature.

The air after passing through the shutter is caused to circulate around the cylinders of the engine in a suitable and well known way, and by means of suitable baffles is forced to travel toward the front of the engine where it is sucked by the fan and forced out of openings in the sides, or sides and top of the engine hood.

In the path of the indrawn air and preferably at the front of the engine just to the rear of the fan there is positioned a second shutter which controls the exit of the air. This shutter is interconnected with the throttle of the engine by means of a suitable linkage, which linkage is in turn connected to an element controlled by the induction system of manifold vacuum of the engine. This element is capable of expansion or contraction in response to the suction and will accordingly determine the position of a lever of the connecting linkage. The condition of this element will determine the extent of opening of the exit shutter, the position of the latter therefore, being a direct function of the degree of expansion or contraction of the element or of the suction of the intake manifold.

The throttle is operated as usual, and due to the interrelated linkage the shutter is operated simultaneously with the throttle.

In the drawings:

Figure 1 shows a view through an air cooled engine applied to an automotive vehicle with the hood and other parts in section and parts broken away.

Figure 2 is a side view of the front portion of the engine showing an opening for allowing egress of air from the engine.

Referring to Figure 1, the numeral 10 designates the hood of an automotive vehicle, 12 the cowl, 14 the cowl pan, and 16 the instrument board.

At the front lower portion of the hood 10 there is positioned a shutter 18 comprising a plurality of vanes or blades 20 pivoted to a common link 22 at one end and to the frame 24 of the shutter at their other end. The link 22 has a pin 26 at one end which works in a slot 28 at the end of an arm 30 attached to a heat sensitive element 32, secured by means of a bracket 34 to any suitable part of the engine. It will be noted that this heat sensitive element 32 is subject to the temperature of the outside air, due to the fact that the hood 10 is broken away in front thereof. The shutter 18 will be directly controlled by the extent of expansion or contraction of the heat sensitive element 32 and when it is fully contracted, it will be evident that the shutter is completely closed, while at its full expansion the vanes 20 will be opened to their fullest extent. Intermediate expansions of the member 32 will bring about intermediate positions of the vanes. It is therefore, quite obvious that the temperature of the outside air will directly control the amount of cooling air admitted to the cylinders of the air cooled engine.

The path of the air through the shutter 18 and through the engine is shown by the arrows. The engine is provided with any suitable kind of baffle arrangement 36 for properly directing the air past the cylinders and toward the fan 38, preferably positioned at the front of the engine. The cylinders of the engine are shown at 40 and surrounding each cylinder is the housing 42 containing a plurality of fins (not shown) as is customary, to radiate the heat from the cylinder.

At the front of the engine and hood 10 and preferably at the rear of the fan 38 there is arranged a second shutter 44, the construction of which is similar to the shutter 18. This shutter has a common link 46 connecting all of the vanes or blades 20 and one end of which has a pin 48 which operates in a slot 50 at one end of an arm 52 of a bell crank lever 54, the opposite arm 56 of which is pivoted to a link 58 connected at its opposite end as at 60 to the arm 62 which operates the usual throttle valve 64. The arm 62 is connected by means of a rod 66, which extends through the foot board and terminates in a knob 68. By pulling or pushing on the rod 68 the throttle valve 64 may be operated in either direction.

The bell crank lever is pivoted at 70 to an arm 72 formed on an expansible and contractible member 74, preferably in the form of a bellows, which is connected at 76 to the induction system 78 of the engine. The connection is preferably made to the intake manifold 80, as shown in Figure 1.

The interior of the bellows 74 is subject to the suction of the induction system or intake manifold, and it will, therefore, be obvious that when the suction is high as for instance, at throttle-closed position at high or low speeds, the bellows 74 will contract and move the bell crank lever 54 upwardly. As the suction decreases, such as at full throttle-open position, the suction will be relatively low and there will be little contraction of the bellows 74. This will allow the bell crank lever 54 to assume its lowermost position. The position of the bell

crank lever 54 will therefore, be directly dependent upon the suction in the induction system of the engine.

From the construction just described it will be evident that as the rod 66 is moved to move the arm 62 of the throttle valve 64, it will at the same time move the link 58 and cause the bell crank 54 to swing on its pivot 70 to thereby open or close the shutter. The extent of opening of the shutter will therefore, be dependent in the first place upon the extent of opening of the throttle valve 64. The link 58 it will be seen from Figure 1, forms an angle with the arm 62 and the degree of swing on the bell crank lever will depend upon the position of the arm 58 with reference to the arm 62. As the bellows 74 contracts and draws the bell crank lever as a whole upwardly, it will cause the link 58 to assume more and more a horizontal position, inasmuch as the arm 62 is now stationary. The upward swing of the link 58 will cause the arm 56 of the bell crank to be moved toward the left, which will swing the second arm 52 of the bell crank 54 in an upward direction and cause a closing of the shutter 44. This condition will maintain when the suction in the intake manifold is operating and the degree of movement of the bell crank will depend directly upon the amount of suction. It is therefore to be seen that the width of opening of the shutter 44 is dependent on the degree of suction in the manifold.

The extent of opening of the shutter 44 is therefore dependent upon two conditions:

First: The extent of movement of the throttle valve 64.

Second: The degree of suction in the induction system.

The amount of air admitted to the engine will therefore, be controlled:

First: By the amount of air admitted by the shutter 18, which is subject to control of the outside atmosphere.

Second: By the amount of air which is allowed to pass through the shutter 44.

And this latter condition is in turn governed by the aforementioned two conditions. It will, therefore, be seen that we have a number of controls to give the proper amount of air to the engine and therefore determine our optimum temperature.

When the air is relatively cold, there will be a corresponding contraction of the element 32, and a less amount of air will be admitted through the shutter 18. This is desirable for the reason that the relatively colder air will give a much quicker cooling of the cylinders 40. As the outside air temperature rises the shutter will open and admit a greater quantity of air in order that proper cooling may be effected.

After the air is admitted it will be drawn by the fan toward the shutter 44, and after the throttle of the engine is closed, which is the usual condition when idling or when going down hills, the suction in the induction system will be relatively high, which will contract the bellows 74 to substantially its fullest extent and bring about the greatest upward position of the bell crank 54. At this time the arm 62 will also be in its extreme left hand position or the position of closing of the shutter 44. This position of the arm and bellows will bring about a substantially complete shutting of the shutter 44, only sufficient air being allowed to pass through so that the engines does not over heat.

When driving uphill at full throttle open position the throttle valve 64 will be swung to be substantially in line with the intake pipe of the manifold or will give an extreme right hand position for the arm 62, a position corresponding to open position of the shutter 44. At full throttle open position the suction in the manifold and in the induction system is considerably less than in the case of throttle closed position and the degree of contraction of the bellows 74 will therefore be considerably less and bring about a relatively much lower position of the bell crank 54. This lesser upward movement of the bell crank 54 will give a relatively lower position to the pivot point between the arms 56 and 58 and will cause the arm 58 to swing on a radius on the pivot 60. This will cause the arm 56 to be swung to the right and the arm 52 to be swung downwardly thereby producing a greater opening of the shutter 44.

These movements of the bell crank 54 to move the shutter 44 will be allowed because of the lost motion connection between the arm 52 and the link 46 caused by the pin and slot construction 48, 50.

Degrees of suction in the induction system intermediate the two extremes will bring about a corresponding relative degree of opening of the shutter 44.

From an inspection of Figure 2, it will be seen that suitable openings 82 are provided at both sides of the hood, which openings are to allow for the egress of the air. As many of these openings as desired may be used or if desired only one large opening at either side may suffice. It is also within the scope of the invention to provide openings in the top of the hood about the fan 38.

The usual brake pedal is shown at 84, while 86 indicates the gear shift lever for the transmission 88.

We claim:

1. In combination with an engine, heat sensitive means for controlling the flow of air to the engine, and means connected with the controlling parts of the engine for controlling the flow of air from the engine.

2. The combination of claim 1, said first

named means including a shutter and a heat responsive element.

3. The combination of claim 1, said first named means including a shutter and a heat responsive element subject to outside or atmospheric temperature.

4. The combination of claim 1, said second named means including a shutter and said controlling part including the throttle valve of the carburetor.

5. The combination of claim 1, said engine having a manifold and said second named means subject to control from the manifold.

6. In combination with an internal combustion engine having a throttle associated therewith, means for controlling the flow of air to the engine, and means interconnected with the throttle and engine induction system for controlling the flow of air from the engine.

7. The combination of claim 6, said first named means comprising a temperature controlled shutter.

8. The combination of claim 6, said second named means including a shutter.

9. In combination with an internal combustion engine, means for controlling the flow of air from the engine including a shutter, a throttle, a controlling means interconnecting said throttle and shutter, and means interconnected with said controlling means for varying the extent of opening of the shutter.

10. The combination of claim 9, said last named means including an element operated from the induction system of the engine.

11. The combination of claim 9, said controlling means including a plurality of levers interconnecting the throttle and shutter.

12. The combination of claim 9, said controlling means including a bell crank lever.

13. The combination of claim 9, said controlling means including a bell crank lever and said last named means being connected to the bell crank lever.

14. The combination of claim 9, said last named means including a bell crank lever having a lost motion connection with said shutter.

15. The combination of claim 9, said last named means including a lever having a lost motion connection with said shutter, and said last named means being connected to said lever.

16. In combination with an automotive vehicle having an engine, controlled means for admitting air to said engine, controlled means for allowing exit of the air from the engine and interconnected with a controlling member of the engine, and means for operating the controlling member from a remote point.

17. The combination of claim 16, said first named means comprising a heat sensitive element subject to outside or atmospheric temperature and a shutter.

18. The combination of claim 16, said second named means including a shutter, a connection between the shutter and the controlling member, and a member connected to said connection and subject to control by the engine induction system.

19. The combination of claim 16, said engine having a fan positioned in front of said second named means.

20. In combination with an air cooled internal combustion engine, a shutter for allowing access of air to said engine, a heat sensitive element subject to outside or atmospheric temperature connected to said shutter to control the same, a second shutter to control the exit of air from the engine, a throttle associated with said engine, a linkage including a bell crank lever connecting said throttle and exit shutter, a lost motion connection between said bell crank and shutter, means pivoted to said bell crank and subject to the induction system of the engine for controlling said exit shutter by causing movement of the bell crank lever, and means for simultaneously operating said throttle and shutter.

21. In combination with an engine, means for controlling the flow of air to the engine, heat sensitive means for controlling said first named means, a throttle, and means interconnected with the throttle to control the air flow admitted by said first named means.

22. In combination with an engine, a throttle, means for controlling the flow of air for cooling the engine, means controlled by the pressure in the intake manifold for controlling the position of said means, and means interconnecting the throttle and said first named means to cause the operation of the latter simultaneously with the former.

23. In combination with an engine, a throttle, means for controlling the flow of air for cooling the engine, means including a bell crank lever interconnecting the throttle and said means whereby the latter is operated simultaneously with the former, and expandible and contractible means connected to the pivot of the bell crank lever to control the position of the bell crank lever and of the first named means.

24. In combination with an engine, a throttle, means for controlling the flow of air for cooling the engine, means including a bell crank lever interconnecting the throttle and said means whereby the latter is operated simultaneously with the former, and a bellows open to intake manifold pressure and secured to the pivot of the bell crank lever to control the position of the lever and of said first named means.

25. In combination with an engine, a throttle, a shutter for controlling the flow of

air for cooling the engine, a bellows open to intake manifold pressure, a bell crank pivoted to said bellows to move therewith and having its arms connected to said shutter and said throttle so as to cause the simultaneous operation of the shutter with the throttle and subject to control by the bellows.

In testimony whereof we affix our signatures.

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