Jan. 9, 1940. K. D. McMAHAN 2,186,837

FAN

Filed March 30, 1937

Fig. 1.

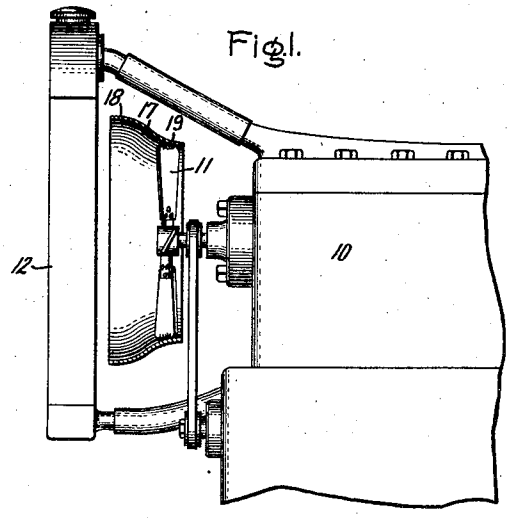


Fig. 2.

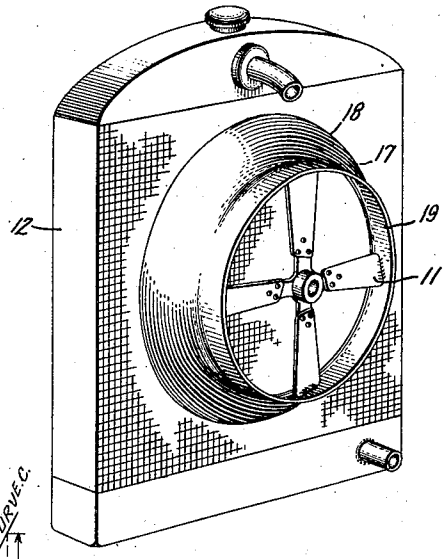
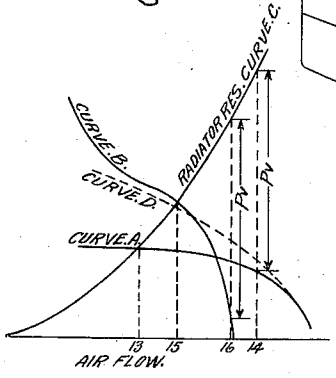


Fig. 3.



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Patented Jan. 9, 1940 2,186,837

UNITED STATES PATENT OFFICE

2,186,837

FAN

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Application March 30, 1937, Serial No. 133,842

6 Claims. (Cl. 257—126)

My invention relates to fans and more particularly to fans for circulating air through a radiator.

An object of my invention is to provide an improved fan of the propeller type adapted to circulate air against a back pressure.

Another object of my invention is to provide a fan which will operate efficiently throughout a range of speeds and against a varying back pressure.

What I consider to be novel and my invention will be better understood by reference to the following specification and appended claims when considered in connection with the accompanying drawing in which Fig. 1 is a side elevation of a fan mounted between an automobile engine and radiator; Fig. 2 is a perspective view of the fan and radiator; and Fig. 3 shows different curves of flow against different static pressure.

Referring to the drawing, 10 indicates an automobile engine on which is mounted a fan 11 adapted to be driven thereby and positioned to circulate air through a radiator 12. In the operation of an automobile the fan is driven by the engine at varying speeds depending upon the speed of the car and the ratio of the gears interconnecting the driving means for the fan and the engine. When the engine is idling the fan is driven at a relatively low speed and the air circulated through the radiator 12 depends upon the radiator resistance and the speed of rotation of the fan.

Referring to Fig. 3, curve A indicates the variation of air flow with the static pressure of a fan circulating air through a radiator. Curve C represents the resistance of the radiator. The intersection of curves A and C indicated by the numeral 13 represents the air flow through the radiator when the car is idling. When the car is moving, the combined action of the motion of the car and the operation of the fan at a higher speed produces a flow of air which is represented in Fig. 3 by the numeral 14. P_v is the pressure head due to the motion of the car. The combined pressure head produced by the fan and the motion of the car must equal the radiator resistance. In order to increase the air flow when the car is standing a cowling has been secured to the radiator shell adjacent the fan. Curve B of Fig. 3 represents the air flow of such a combination. As will be seen from this curve, the intersection of curves B and C indicated by numeral 15 shows a higher air flow when the car is idling. However, when the car is in motion producing a pressure head P_v, the total air flow indicated by the numeral 16 is less than the flow produced by the fan alone. Thus, from these curves it may be seen that a fan alone will produce a greater flow when the car is running and the combination of a fixed cowling and fan will produce a greater flow when the car is standing or idling.

I have found that the advantage of a greater flow when the car is running of the fan alone and the greater flow of the combination of the fixed cowling and fan when idling can be obtained by a cowling 17 secured to the periphery of the fan and consisting of a housing portion 18 tapering to an orifice 19 integrally connected thereto. The housing portion 18 determines the portion of the radiator through which the fan alone will circulate air and the orifice 19 produces a smooth flow through the fan and thus increases the amount of air which can be circulated by the fan without turbulence and against a higher back pressure. When the car is standing the amount of air which can be circulated through the radiator depends upon the speed of the fan and the portion of the radiator blocked out by the housing 18. When the car is in motion the air under the influence of the fan and the motion of the car combined will be determined by the portion of the radiator blocked out by the housing 18 and the motion of the car alone will produce an additional flow through the remainder of the radiator. The housing 18, in addition to determining the portion of the radiator through which air will be circulated by the fan also prevents a recirculation of air adjacent the outer periphery of the fan as commonly experienced in the operation of a fan alone due to the great difference in the pressure produced at the tip of the fan and adjacent to the fan. The recirculation of air or eddies produced at this point greatly reduces the flow of air through the radiator especially when the car is standing and also increases the amount of power necessary to drive the fan to produce a desired flow through the radiator. The spacing between the radiator 12 and housing 18 is just sufficient to insure that the vibration of the engine will not produce a contact between the rotating housing 18 and the stationary radiator 12. In Fig. 2 the relation between the portion of the radiator 12 blocked out by the housing 18 is better indicated. The ratio between the blocked out portion and the remainder of the radiator is determined by the diameter of the fan, the size of the radiator and the relation between the flow desired when the car is idling and that necessary when the car is in motion.

Curve D of Fig. 3 shows the air flow of the combination of fan and rotating cowling. As may be seen from this curve, the air flow when the car is standing is substantially the same as the air flow produced by the combination of a fixed cowling and a separate fan and at running speeds the air flow represented by curve D is substantially the same as the air flow of a fan alone operating in combination with a radiator.

The provision of a housing 18 with an enlarged inlet opening tapering inwardly to an orifice 19 directly secured to the periphery of the fan permits the use of a smaller diameter fan as it increases the area of influence of the fan. As pointed out above, a fan operating alone adjacent a radiator is limited by the recirculation of air or eddies produced adjacent the tip of the fan both in the amount of air which it can circulate and the area of the radiator which it can affect. The energy consumed in the operation of the fan is also reduced by eliminating these eddies as it has been found that these eddies consume considerable power and to no purpose. The use of a cowling secured directly to the fan blades has the advantage over the combination of a fixed cowling and fan in that the efficiency of the combination depends upon a minimum spacing between the cowling and fan. Obviously, in automobile operation it is difficult to make such a spacing very small. On the other hand, when the cowling is secured directly to the fan the combination operates efficiently and the spacing between the cowling and the radiator can be made more than sufficient to allow for vibration of the engine without affecting the operation of the combination.

In the above specification I have described the use of a combined fan and cowling with an automobile engine and radiator. My invention is not limited to the use of a fan and cowling secured to the blades in such a combination alone as it may to advantage be used in combination with a fixed mounting and radiator such as in an air conditioning apparatus or for any operation in which the fan must circulate air against a back pressure with a resultant highly efficient and improved operation.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a radiator, a fan positioned adjacent said radiator and adapted to draw a fluid through said radiator, means for driving said fan, and a cowling secured to the periphery of the fan and having an enlarged inlet opening adjacent said radiator.

2. In combination, a radiator, a fan positioned adjacent said radiator and adapted to draw air through the radiator, means to drive said fan, and a housing secured to said fan, adapted to rotate therewith and having an enlarged inlet opening adjacent said radiator.

3. In combination, a radiator and means for circulating air through said radiator comprising a fan, means to rotate said fan and a cowling rotating with said fan and having an enlarged inlet opening tapering to an outlet opening of substantially the same diameter as said fan.

4. In a vehicle, a radiator subject to a pressure head due to the velocity of the vehicle forcing air through the radiator from the front to the rear, and a fan at the rear of the radiator arranged to draw air through the radiator from the front to the rear, said fan comprising a plurality of fan blades and a cowling secured to the periphery of the blades having an enlarged inlet opening adjacent the radiator and tapering to an orifice at the periphery of the blades.

5. In a vehicle, a radiator subject to a pressure head due to the velocity of the vehicle forcing air through the radiator from the front to the rear, and a fan at the rear of the radiator arranged to draw air through the radiator from the front to the rear, said fan comprising a plurality of fan blades and a cowling secured to the periphery of the blades having an enlarged inlet opening adjacent the radiator and an outlet opening of substantially the same diameter as the fan.

6. In a vehicle, a radiator subject to a pressure head due to the velocity of the vehicle forcing air through the radiator from the front to the rear, and a fan at the rear of the radiator arranged to draw air through the radiator from the front to the rear, said fan comprising a plurality of blades, an orifice secured to the periphery of the blades, and a housing connected to said orifice and having an enlarged inlet opening adjacent the radiator.

KENTON D. McMAHAN.