April 6, 1937. R. CHILTON 2,076,225

ENGINE COOLING AND COWLING

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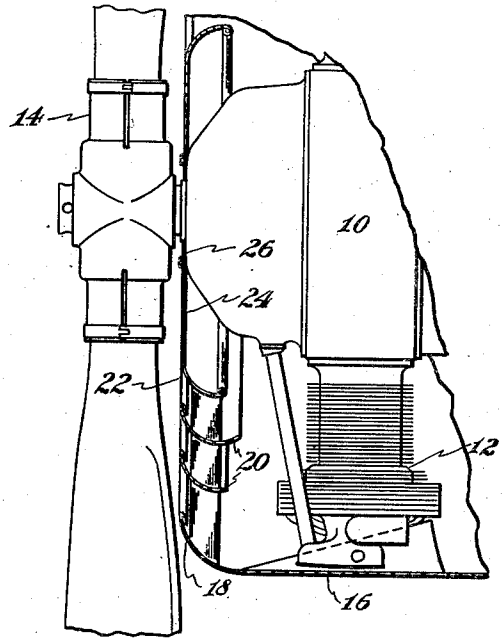


Fig. 1.

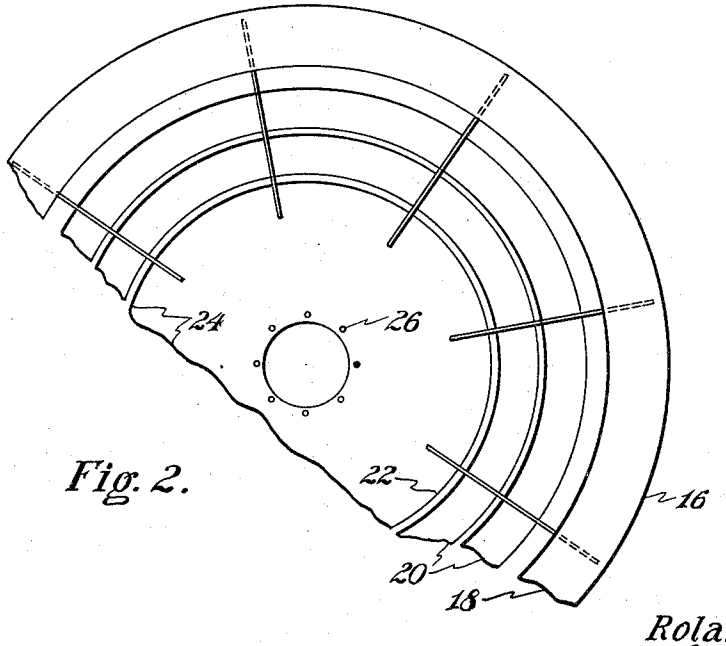


Fig. 2.

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ENGINE COOLING AND COWLING

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Application June 1, 1934, Serial No. 728,480

1 Claim. (Cl. 123—171)

This invention comprises anti-drag means for improving the air flow over engine cooling means, the specific embodiment of the drawing illustrating a construction suitable for use on an air-cooled radial aircraft engine having a tractor propeller.

Such engines are provided with ring cowls in order to reduce the aerodynamic drag of the engine, and unless carefully proportioned such cowls are apt to detract from the cooling air flow.

The spaces between the cylinders are usually baffled to confine the air flow to the finned periphery of the engine so that the total area for flow past the engine under the cowl is a small fraction of the total frontal area. For this reason most of the air flowing towards the engine is deflected outwardly over the outside of the cowl and this radial displacement is augmented by the centrifugal action of the relatively bulky propeller hubs which have circular sockets to hold the circular blade shanks and there is usually very little pitch effect in that part of the propeller which is in front of the cowl entrance. As a result, it has been found that the cooling effectiveness of the cowl is very sensitive to the curvature and proportions of the inturned leading edge. If this fails to receive the incoming air at a small angle of incidence to the divergent flow, turbulence and loss of cooling results.

Because of the radial displacement and disturbance caused by the propeller, it has been found necessary in normal cowls to have the entrance area very much greater than the area for flow between the baffles and cooling fins. Due to this large entrance diameter, serious recirculation has been found to occur within the cowl entrance whereby the air displaced by the propeller and caught by the inturned leading edge of the cowl tends to flow inwardly when it meets the cylinder obstruction, whereupon it is sucked out forwardly by the depression set up near the center of the propeller by the centrifugal action thereof. It has been found that this re-circulation is often responsible for cooling difficulties, and in my co-pending application, Serial No. 720,283, there is shown a nose cowling plate whereby this re-circulation is overcome. The present invention in volves improved means for achieving similar results.

In the drawing:

Fig. 1 is a fragmentary axial sectional view of the device with the engine shown diagrammatically in outside view; and

Fig. 2 is a fragmentary front view of the device.

In these figures, 10 designates an engine having the usual air-cooled cylinders 12, and the usual propeller 14. The ring cowl is seen in section at 16, and has its front edge inturned at 18, so as to conform to the substantially radial entering air flow, as has been found most efficient.

Within the cowl entrance there is disposed a plurality of annular cambered guide vanes 20, the inner vane 22 comprising a continuation of a plate 24 secured, as by bolts 26, to the nose of the engine.

It will be noted that each of the guide vanes 20 is inturned to meet the substantially radial air flow and that the curvature or camber converts this to axial flow, thus enhancing the effect that has already been found beneficial in the case of the leading edge of the cowl itself. The multiplicity of guide vanes also acts to prevent re-circulation by separating the air flow by providing a number of separate cells or ducts therefor.

I am aware that single inner rings of more or less cylindrical form have in the past been inserted in the entrance of ring cowls, but such auxiliary rings have been found relatively ineffective because they have lacked the inturned edge by which the guide vanes of this invention convert the substantially radial flow, present just in front of the cowl, to the axial flow needed for best cooling.

Ring cowls having an inturned front edge are known to develop a substantial forward reaction which is an index of the extent to which they reduce the drag of the engine and of the extent to which they assist in entraining the cooling air. Since these reactions result from the axial deflection of the divergent air flow, the cowl entering edge acts as a deeply cambered airfoil, the "lift" of which has a substantial forward component.

While it is probably well known to those skilled in the art that these effects are lost with straight cylindrical cowls, yet, as far as I am aware, the only annular separator or ring that has been proposed for use in the entrance has had little or no camber and thus presented an excessive angle of attack with respect to the substantially radial incoming air flow whereby they failed to develop forward thrust and thus have not increased either the propulsive efficiency or the cooling effectiveness of the cowl.

It will be seen that the air flows into the

cowl through an annulus of great width compared to the chord of the usual inturned leading edge and that, within this entrance, this relatively thick layer of air has to be deflected from substantially radial to axial flow. Under these conditions best efficiency is obtained by using a multiplicity of curved vanes wherein the gap or spacing is not very much greater than the chordal dimension. I am aware that this theory has already been applied to reduce the resistance to flow in air duct elbows, but I believe that I am the first to teach that a similar effect may be obtained in the apparently non-analogous case of the annular entrance to an engine cowl.

The cooling effect with baffled engines depends upon the pressure differences existing in front and back of the cylinders and it will be obvious that this pressure difference is a large element in the drag of the entire power plant, since it is effective over the entire disc area of the cylinders and baffles. The added guide vanes of this invention may have as great aggregate area, whence the sum of the forward reactions from the guide vanes may offset the cylinder drag which cannot be expected with the single inturned cowl edge which can only have a relatively small "lifting" surface without unduly reducing the entrance diameter.

It will also be seen that by the multiple guide vanes of this invention the incoming air will be well distributed over the heads and barrels of the cylinders.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claim to cover all such modifications and changes.

What is claimed is:

In combination, a radial cylinder engine, a propeller mounted thereon and producing more nearly radial than axial air flow toward the center thereof, a plurality of concentric annular members arranged in coplanar relation between said engine and the propeller, each said member comprising a ring having a leading edge inturned so that a tangent thereto in the axial plane is more nearly radial than axial, said tangent being substantially parallel to the local air flow at the respective leading edges, and a circumscribing ring cowl having an inturned leading edge and a rearward substantially cylindrical portion embracing the engine, the leading edges of said cowl and annular members being coplanar, and said members being axially coextensive with the inturned leading edge portion only of said ring cowl.

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