

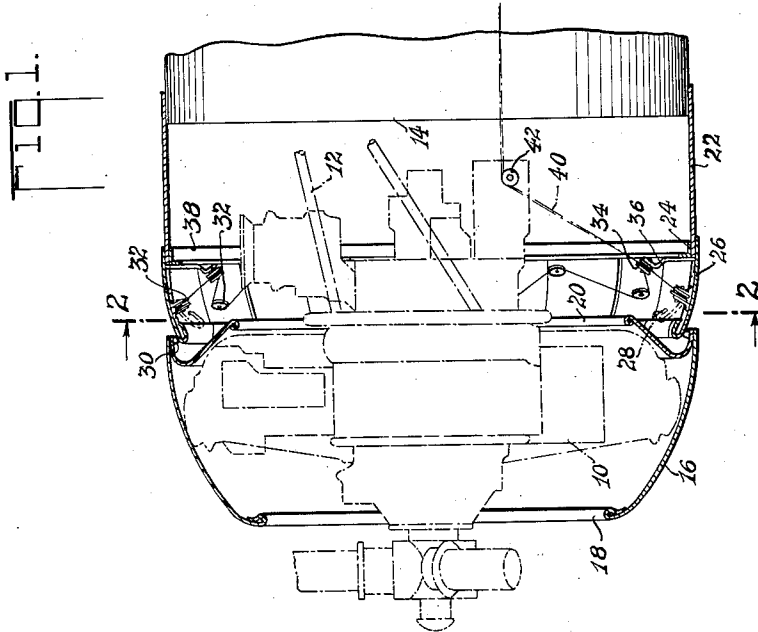
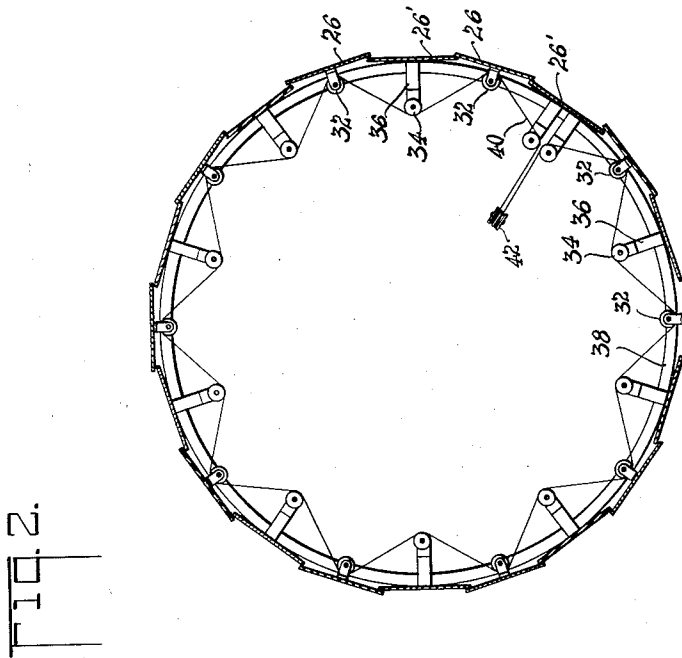
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CONTROLLABLE COWLING

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CONTROLLABLE COWLING

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This invention relates to low-drag cowling for air-cooled aircraft power plants, and has for a primary object the provision of improvements in cooling airflow control for the engine while maintaining optimum cleanness of the power plant to minimize drag.

Other objects of the invention are to provide in combination with a cowl giving optimum cooling air pressure differential at low flight speeds, an improved means for dampering the otherwise excessive cooling air flow resulting at high airplane speeds, and to effect said dampering control without distorting the desired streamline contour of the cowling.

The so-called N. A. C. A. cowl, which is almost universally used on radial air cooled engines, comprises an entering portion curved inwards in front of the engine cylinders and merging to a relatively lengthy cylindrical portion, at the rear of which the air exit slot is located. Pressure measurements over such cowlings indicate that the lowest external pressure occurs around the curved portion and that this depression decreases with the length of straight run so that when the slot is disposed far back of the curved portion, as in current practice, the depression available for educing the exit air is little if any below atmospheric.

It will be understood that these cowlings are used with "pressure baffles" which are closely fitted to the cylinder fins to prevent any wasted air flow i. e., to confine the entire air flow to the fin spaces. The cooling capacity depends on the pressure difference between the cowl entrance and the exit slot. In the prior art, "reversed flow cowlings" have been proposed which bring the exit slot ahead of the engine in the curved nose portion of the cowl where the depression available is a maximum. With such cowlings adequate cooling is aimed at, at low airplane speeds as when climbing.

However, when the exit slot is placed in the zone of high depression, the cooling air flow at normal cruising speed becomes more than necessary (the pressure difference increases as the square of the speed) and since the cooling air drag is proportional to the air flow quantity, excessive drag is induced at the higher speeds. Accordingly, "dampering" whereby the exit slot may be reduced in width to prevent the cooling air flow at high speeds from exceeding the cooling requirements, has been proposed. The present invention comprises in part improved and simplified dampering means whereby the desired air control may be achieved without introducing any

protuberance from the streamline shape of the cowling as a whole.

The invention also utilizes a form of cowling wherein the exit slot is brought into the low pressure zone but without the complications of reversed flow. This is achieved by using a somewhat longer curved portion than usual, so that this may terminate closely behind the engine, where the exit slot is located, without the interposition of the usual straight cylindrical portion which is the cause of the poor depression existing at the usual exit slot which is disposed relatively far back from the curved nose portion.

On account of this low depression, it has been found necessary, in many cowling applications having the conventional straight run ahead of the slot, to resort to "flaps" which are projected outwardly just ahead of the slot to create sufficient depression thereat for adequate cooling at slow speeds. Such flaps, of course greatly increase the drag when in out-turned position.

The present invention approaches the problem from the opposite end, i. e., the slot and the curved cowl portions are brought together giving adequate depression for slow speed conditions, while excessive cooling air flow and drag in the high speed condition are avoided by dampering with the novel mechanism of the invention by means of which the dampering is effected without disturbing the smooth streamline blending between the exit air and the slipstream over the cowling.

Further objects will become apparent in reading the annexed specification, in connection with the drawing, in which:

Fig. 1 is an axial section through the aircraft cowling, and

Fig. 2 is a section on the line 2—2 of Fig. 1.

A radial cylinder air-cooled aircraft engine indicated at 10 is mounted on a structure 12 extending forwardly from the firewall of a fuselage or nacelle 14. Embracing the engine proper is an annular cowling 16, intumed from rear to front to define a forward air entrance opening 18 ahead of the engine, and having an inwardly projecting ring baffle 20 attached at its outer edge to the trailing edge of the cowling, which trailing edge is as far forward as possible. Rearwardly of the cowling 16 is a second fixed annular cowling 22 exteriorly profiled as a streamlined continuation of the cowling 16, having its front edge 24 rearwardly spaced from the trailing edge of the cowling 16. In the annular gap between the two cowlings, I provide a plurality of segmental flaps 26 attached at their rear edges to the rear cowling

leading edge 24. These flaps are made from spring material and are so formed initially as to substantially bridge the gap between the cowlings 16 and 22, and to provide a substantially streamlined continuation of the profiles thereof. The flaps 26 may be sprung inwardly, as shown in dotted lines at 28, to provide an air exit slot of greater area, and stops 30 limit the outward movement of the flaps so that there will always be some degree of air exit opening. For any degree of slot opening, it will be seen that the flaps 26 allow for smooth external airflow, without undue drag increase.

In the prior art, flaps have been hinged to the trailing edge of the front cowl, for movement inwardly to decrease the air exit slot area, and for movement outwardly to increase the slot area. Therein, drag is increased respectively if the minimum opening be obtained by pulling the flaps inwardly beyond the normal cowling profile and if the flaps are extended outwardly beyond the normal cowling profile to obtain a large air exit opening as for takeoff, climb and low air speed operation.

As a practical arrangement for controlling the flaps 26, I show alternate flaps 26 overlapping intermediate flaps 26'. Each flap 26 is provided with a sheave 32 close to its inner surface, and radially inwardly disposed fixed sheaves 34 are mounted on struts 36 which are carried by a reinforcing ring 38 attached to the cowling 22, the struts 36 being intermediate the sheaves 32. A cable 40 is reeved through the sheaves 32 and 34, and is carried rearwardly as at 42 to a suitable pilot control. By drawing up the ends of the cable 40, all the flaps 26 are drawn inwardly an equal amount, and the flaps 26, by their overlapping relationship with the flaps 26', draw the latter in also. When the cable 40 is relaxed, the spring of the flaps, augmented by the pressure difference between the inner and outer surfaces, moves the flaps outwardly to reduce the area of the air exit opening.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after under-

standing my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications and changes.

I claim as my invention:

1. In combination, an air-cooled radial engine, axially spaced aligned streamlined annular cowls, one embracing the engine, defining therebetween an annular air exit opening, a plurality of segmental spring flaps fixed about the periphery of one cowl adapted in their relaxed position to substantially close said opening, and means for simultaneously springing all said flaps inwardly to enlarge the effective area of said opening.

2. In a cowling system, in combination, a radial air-cooled engine, a forward cowl annulus embracing the engine, a rearward concentric cowl annulus forming a rearward streamlined prolongation of said forward cowl and spaced therefrom to define therewith an annular air exit opening, and flap means connected to the leading edge of the rear cowl movable from an outward substantially closed position substantially flush with the cowl annuli, inwardly to provide an air exit annulus of larger effective area, whereby, in either open or closed positions, said flaps lie wholly within the streamlined profile of said cowls.

3. In a cowling system for a radial engine, a forward fixed cowl embracing the engine and terminating at its trailing edge closely adjacent a plane through the rearward cylinder portions, a baffle ring extending inwardly from said cowl directing airflow inwardly from the cylinder heads, a rearward fixed cowl spaced from the first, and flaps connected at their trailing edges to the forward edge of the rearward cowl movable substantially radially inwardly from the cowl profile toward the cowl axis, at their leading edges, to vary the size of the annular opening between the flap leading edges and the trailing edge of said forward cowl.

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