July 19, 1938. E. E. DUFF ET AL 2,124,333

GILL OPENING ADJUSTING MEANS

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Fig. 1

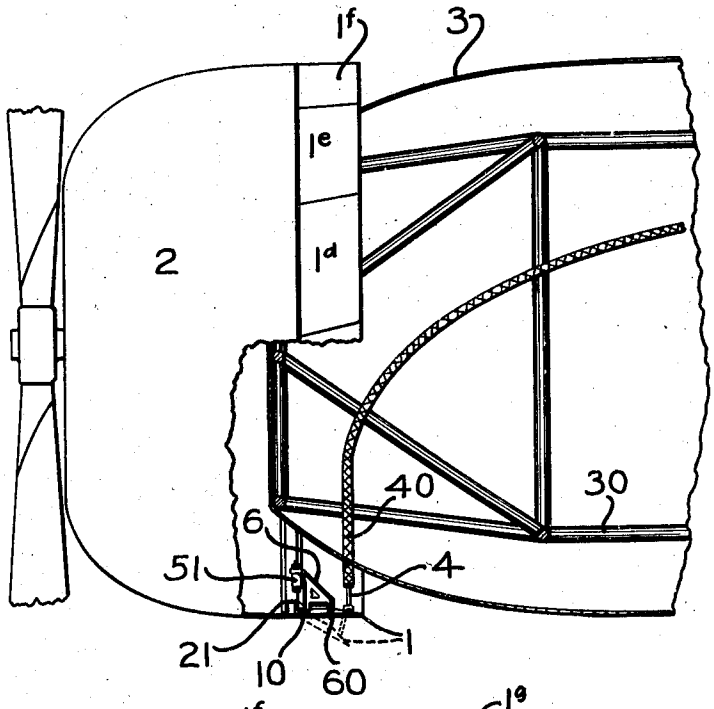
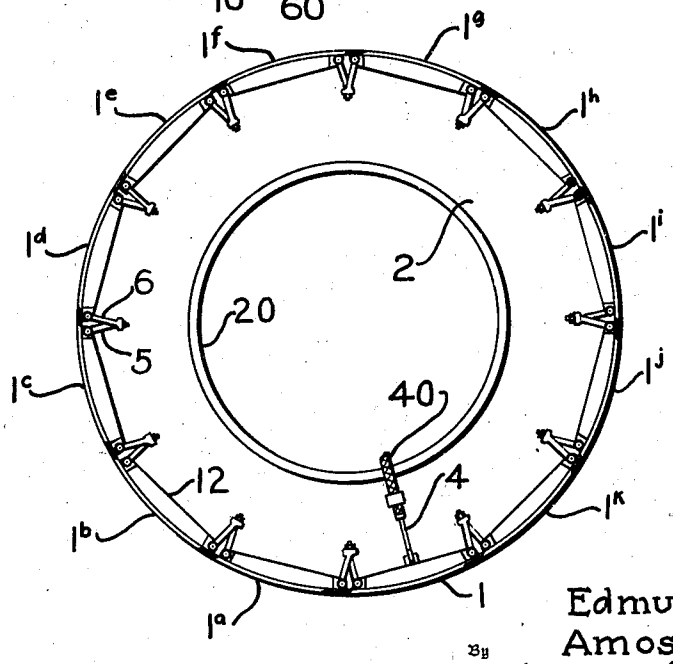


Fig. 2



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Fig. 3

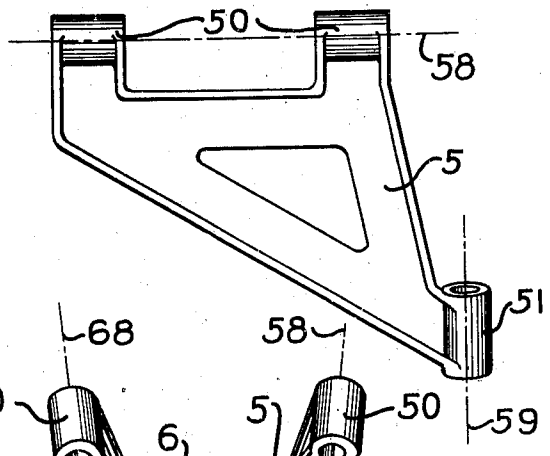


Fig. 4

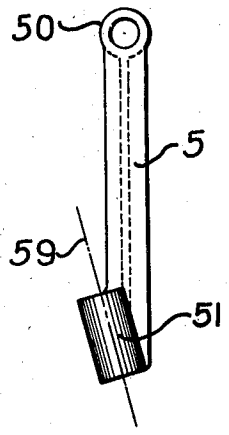
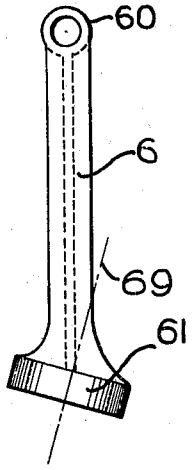


Fig. 5



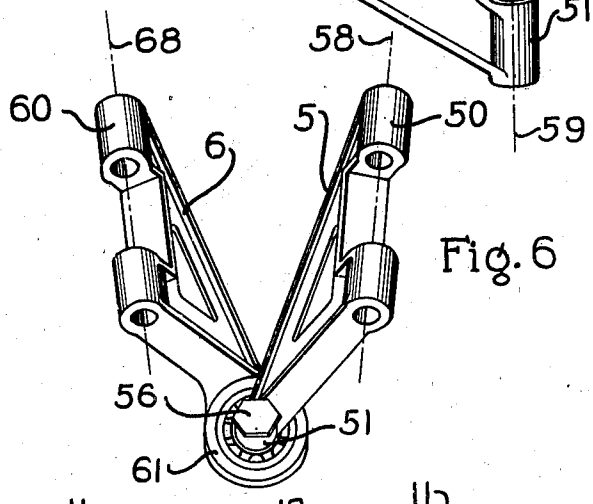


Fig. 6

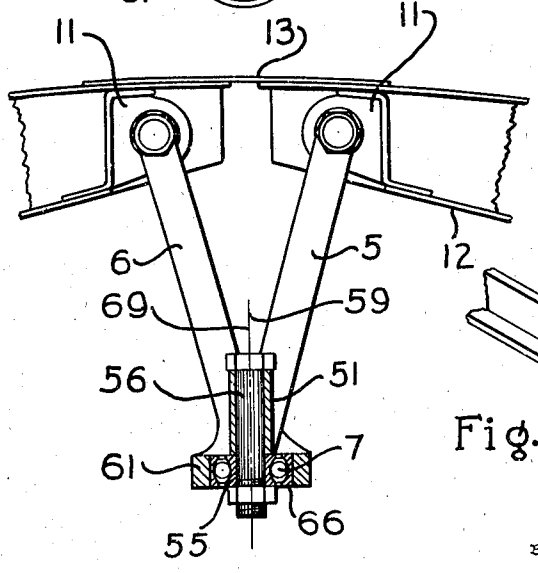


Fig. 7

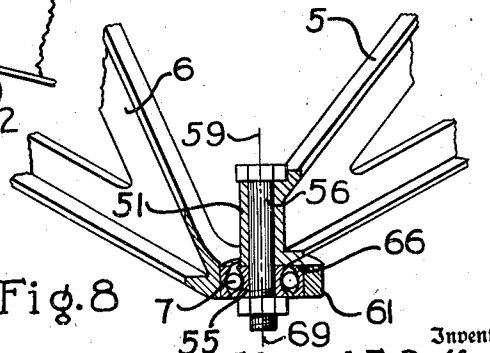


Fig. 8

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UNITED STATES PATENT OFFICE

2,124,333

GILL OPENING ADJUSTING MEANS

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Application August 4, 1937, Serial No. 157,322

5 Claims. (Cl. 123—171)

Our invention relates to the ring cowls used to control the flow of air past a radial aircraft engine, and more specifically to the control or adjustment of the size of the gill opening at the trailing edge of such a ring cowl. Our invention is an improvement on inventions of the general type illustrated by the Shoemaker Patent No. 2,049,751, dated August 4, 1936.

More broadly considered, the present invention has for its object the simultaneous adjustment of a plurality of elements such as flaps, disposed about a circle or other curve, and pivoted for movement about axes disposed in chords of the curve, and such adjustment being preferably accomplished by movement of one only, or less than all, of the flaps through pivoted members mounted only upon these adjustable flaps and interconnected to accomplish simultaneous adjustment of all the flaps by the movement of the one.

Among the objects of the present invention are to simplify and lessen the weight of the members interconnecting the flaps for conjoint movement; to arrange all such elements, so far as possible, in a longitudinal plane, to the end that they will interfere the least with the flow of air through the gill opening; and in general to simplify the interconnecting means and to provide such means which will be strong and rugged, and in particular which will be operable with a minimum of effort, which latter is important when it is remembered that their operation is sometimes opposed by the force of the relative airstream in flight.

Our invention comprises the novel interconnecting members and the novel combination and arrangement thereof in conjunction with a ring cowl and the flaps thereof, all as shown in the accompanying drawings, as described in this specification, and as will be more particularly defined by the claims.

In the accompanying drawings our invention is shown in a form and arrangement which is at present preferred by us, it being understood that various changes may be made in the form of the parts and in their arrangement without departing from the spirit of our invention.

Figure 1 is a general elevation, with parts broken away, of the ring cowl and its flaps.

Figure 2 is a rear elevation of the ring cowl.

Figure 3 is an elevation of one of the companion members intended to be mounted upon a flap, and Figure 4 is an edge view of the same.

Figure 5 is an edge view of the other companion member.

Figure 6 is a view of the two companion members assembled, in perspective, the viewpoint being from the outside of the ring cowl looking nearly radially inward.

Figure 7 is an axial section through the interconnected members, showing them in assembled relationship and in relation to the two adjoining flaps whereon the respective members are mounted, and Figure 8 is a similar view showing the parts exaggeratedly in another position of adjustment.

The ring cowl 2 surrounds a radial engine (not shown) and has a nose opening 20 for entrance of air, and at its trailing edge it lies close to cowling 3 carried upon the airplane structure 30, and cooperates with this cowling 3 to control the flow of air through and past the engine. Under some conditions it is desirable to reduce the area of the gill opening between the trailing edge of the ring cowl and the cowling 3, and under other conditions it is desirable to increase the area of this opening, thus to control the flow of air through this gill opening, and past the engine. To accomplish this adjustment flaps are provided, which are or may be all alike, and which are designated by the numerals 1, 1^a, 1^b, 1^c, etc. At its forward edge, as indicated at 10 in Figure 1, this pivot axis 10, in each instance, is arranged on a chord of the circle about which the flaps are arranged, and the flaps may be supported from a ring 21 which is formed at the trailing edge of the ring cowl 2. Thus the trailing edge of each flap swings inward and outward, or towards and from the cowling 3.

To one of these flaps, for instance the flap 1, is secured a suitable means to swing the flap, consisting, in the form shown, of a Bowden wire 4 within its tubular housing 40, extending between a connection to the flap 1 and a point convenient for operation by the pilot. Since such operating means are common in the art, and any suitable means may be employed, the arrangement shown in deemed to be sufficient to illustrate a mechanism for controlled operation by the pilot. Further, while the operating means 4 is shown as connected only to one flap, it might be connected to additional flaps, although this is not considered necessary, the flaps being interconnected, by means which we will now describe, to accomplish movement of all the flaps when any one of them is moved.

To this end companion members 5 and 6 are employed, these being generally alike and preferably somewhat triangular in shape. Each is formed at its base with pivot ears 50 and 60, defining pivot axes 58 and 68, respectively, by means of which the members 5 and 6 are pivoted to the adjacent ends of two adjoining flaps. Thus each flap may be provided with a pivot bracket 11 (see Figure 7), and the pivot axes 58 and 68 are disposed generally longitudinally of the cowl ring, so that they are transverse to the chordal pivot axes 10 of the respective flaps. At the apex of the triangular member 5 is a boss 51, defining a pivot axis 59, and a similar boss 61, defining a pivot axis 69, is provided at the apex of the triangular member 6. The pivot

boss 61 receives a pivot pin 56, whereby there is mounted the inner race 55 of a self-aligning ball bearing, the outer race 66 of this bearing being received in the larger socket 61 of the member 6, and with the balls 7 interposed between the two races. The axis 59 of the pivot pin 56 is generally transverse to the axes 58 and 68 of the ears 50 and 60, and transverse also to the pivot axis 10. The axis 69 of the boss 61 is similarly disposed, and in one position, as illustrated in Figure 7, coincides with the axis 59, but in other positions does not. The axis 59 of the pin 56 should be directed towards the pivot axis 10, to intersect the latter, for the best results.

It will be noted that the members 5 and 6 are mounted only upon the flaps themselves, and have no connection with the ring cowl or the ring 21. They are disposed in planes generally longitudinal of the ring cowl, and therefore interfere the minimum with the flow of air through the gill opening. They are simple and light in character, and by their use it is possible to reduce the weight of the mechanism to accomplish opening or closing of the flaps.

When it is desired to move the flaps, the flap 1 is moved by the control 4. Let us say the flap is swung outwardly. The members 5 and 6, one secured at one end of the flap 1 and one at the other end, pull outwardly, acting through the self-aligning ball bearing upon the companion members which are connected to these two members at the adjacent ends of adjoining flaps, drawing the latter outwardly, the companion members in each assembly pivoting on their axes 58 and 68, and effecting a relative angular displacement of these axes 58 and 68, due to swinging of the two flaps about non-coincident axes 10. This causes their flaps to swing outwardly, and again, because of the angular relationships, the axes 59 and 69 depart from coincidence, and tilt to define a plane, seen in edge view in Figure 8. There is also a twisting or relative rotational movement between the companion members 5 and 6, which, with the tilting action just referred to, is taken up in the universal connection provided by the self-aligning ball bearings, the members 51 and 61 of which twist relatively to each other. Since now the flaps 1^a and 1^k have been swung outwardly by their connections to the flap 1, and by the same amount as the flap 1, it will be obvious that the same motion has been communicated through the companion members of each two adjoining flaps to all the other flaps, and that all the flaps have been opened simultaneously and by the same amount.

The flaps may be formed in any convenient manner. As shown they are stiffened and reinforced as indicated at 12, and are provided with an overlap 13 at their adjoining ends. Since such matters are purely matters of choice, and are old in the art, it is not deemed necessary to refer to them in greater detail. The same principles, however, may be employed in any case where it is desired to swing similar members, arranged about a curve, simultaneously inwardly or outwardly, and while our invention is particularly intended for the operation of flaps controlling the gill opening at the trailing edge of a ring cowl, it will be understood that it may be applied to other purposes.

What we claim as our invention is:

1. In combination, a plurality of flaps circularly disposed and each pivotally mounted upon a chordal axis to swing towards and from the axis of the circle, a member pivotally mounted only upon each flap, adjacent each end thereof, each upon a generally longitudinal axis, a pivot pin carried by one such member of each flap, directed transversely to the axis of swing of its flap, a self-aligning ball bearing connecting the companion member, upon the adjacent end of the adjoining flap, to said pivot pin for rotational movement thereabout and for tilting angularly relative to said pivot pin, and means to swing one flap, thereby, through said connected members, to swing all other flaps.

2. In combination, a plurality of flaps disposed about a curve, and each pivotally mounted to swing about a chordal axis, a pair of members disposed at and mounted only upon the adjacent ends of each pair of adjoining flaps, and connected for relative rotational movement about an axis which is disposed transversely to the axes of such flaps and also transversely of the general surface of the flaps, and for relative tilting movement to effect approach or recession of said connected members, one of said members being connected to an end of one such adjoining flap, to swing about an axis transverse to such flap's axis, and the other in like manner being connected to the end of the adjoining flap, and means to swing one flap, thereby to swing all other flaps, through the connected members.

3. In combination, a plurality of flaps circularly disposed and each swingably mounted upon a chordal axis, a generally triangular member pivotally mounted only upon each flap, adjacent a corresponding end in each case, along an axis in its base extending generally transverse to such chordal axes, a pivot pin carried at the apex of said member, directed transversely of the axis of swing of its flap and of the axis of swing of the member, a companion member, generally triangular, similarly pivotally mounted only upon the adjacent end of each adjoining flap, and having a socket at its apex, and a self-aligning ball bearing having its outer race fixed in said socket and its inner race fixed to said pivot pin, and means to swing one flap, thereby, through said connected members, to swing all the flaps in the same direction and by the same amount.

4. In combination, a plurality of flaps disposed about a substantially circular curve, and each pivotally mounted upon a chordal axis to swing towards and from the axis of such curve, and means for controlling the movement of said flaps simultaneously, said means comprising a member pivotally mounted only upon each flap, adjacent each end thereof, each upon an axis transverse to the flap's chordal axis, a pivot pin carried by one such member of each flap, defining an axis disposed transversely of the flap's axis and also transversely of the member's pivot axis, means connecting the companion member, upon the adjacent end of the adjoining flap, to said pivot pin for pivotal movement thereabout and for tilting angularly relative to said pivot pin, and means to swing one flap, thereby, through the connected members, to swing all other flaps.

5. The combination of claim 4, wherein the axis of each pivot pin intersects the axis of swing of the flaps connected through such pivot pin.

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AMOS L. WOOD.