

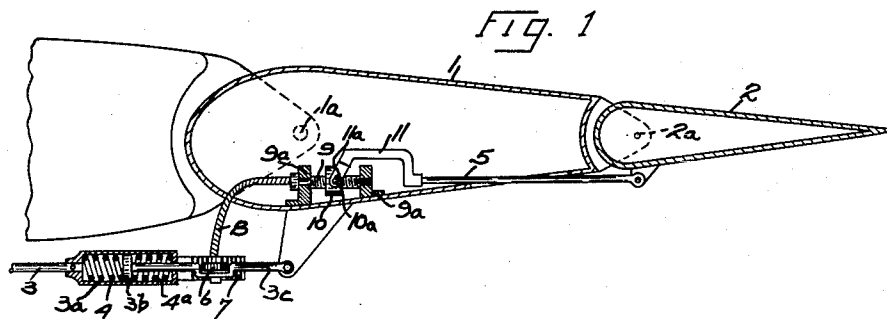
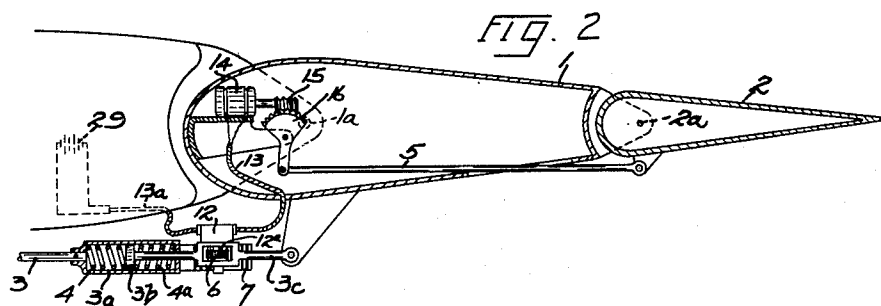
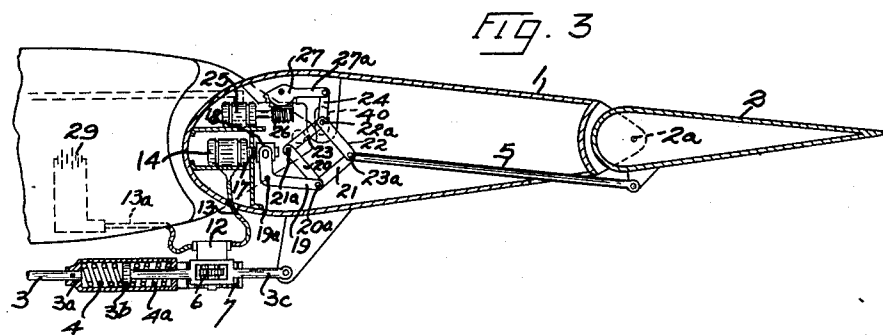
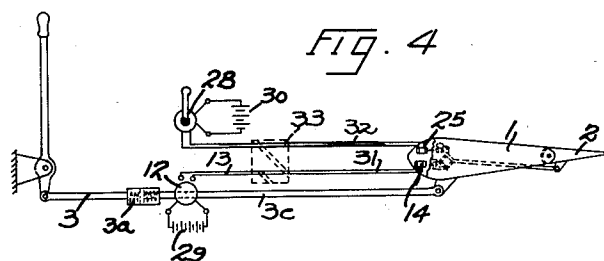
July 27, 1943.

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2,325,548

CONTROL MEANS FOR RUDDERS AND THE FLAPS THEREON

Filed Dec. 7, 1940



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UNITED STATES PATENT OFFICE

2,325,548

CONTROL MEANS FOR RUDDERS AND THE
FLAPS THEREON

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Application December 7, 1940, Serial No. 368,966
In Germany November 20, 1939

6 Claims. (Cl. 244—87)

This invention relates to improvements in control means for rudders and the flaps thereon, and refers to an arrangement whereby a rudder and its flap may be operated through a single actuating rod.

It is an object of the invention to provide a control means for a rudder and its flap including a resilient connection whereby pivotal movement of the flap precedes that of the rudder so that the inclination of the flap, and the air forces acting thereon, may be utilized to assist in moving the rudder. Thus the effort required to move the rudder is materially lessened, particularly in the case of larger airplanes flying at high speeds, though the arrangement is such that perceptible effort is required to move the actuating rod when flying at slower speeds so that the pilot is not deprived of the sense of touch whereby he ascertains that the mechanism is correctly positioned.

Another object of the invention is to provide such a control means including locking means for the flap to prevent fluttering and normally holding it rigid with the rudder. Because without such locking means, due to the resilient connection, there would be a tendency for the flap to flutter at relatively slow speeds and thereby materially reduce the critical speed of the airplane.

A further object of the invention, in its preferred form, is to provide such a control means including power driven means set in motion by movement of the actuating rod for imparting movement to the flap, because the inclusion of such a locking means adds considerably to the effort required to move the flap so that considerable force must be exerted to move the rod if the entire movement is to be obtained by the exertion of manual effort.

Another object of the invention is to provide such a control means for a rudder and its flap including auxiliary means, preferably operated through a second motor, for adjusting the position of the flap independently of the rudder. Such an arrangement materially increases the factor of safety because it prevents pivotal movement of the flap to other positions while the rudder remains stationary, and consequently fine adjustment of the flap may be obtained to produce an exactly balanced condition. It is preferable that such motors be electrical because the wiring and connections therefor are quite light in weight, and again the use of long rods or other parts required in some other forms of installation would result in a springy installation that would permit fluttering of the flap to occur, in addition to which such types of installation would necessitate the inclusion of greater additional weight.

Yet another object of the invention is to provide such a control means including one motor for imparting movement to the flap upon movement of the actuating rod whereby the rudder is

also moved, and a second motor for imparting independent movement to the flap, and to include dual connections and wiring so that either motor may be operated through each switch.

5 Having thus briefly and broadly stated some of the objects and advantages of the invention we will now proceed to describe the latter with the aid of the accompanying drawing, in which:

Figure 1 illustrates the invention including 10 manual means for obtaining the entire movement of the rudder and its flap.

Figure 2 shows a modification of the invention wherein movement of the actuating rod causes movement of the flap through power driven 15 means.

Figure 3 is a further modification wherein a second motor is employed for imparting independent pivotal movement to the flap for purposes of trimming, and

20 Figure 4 is a reduced view of the modification shown in Figure 3 including the dual wiring for the two motors and means for energizing either motor by closing either switch.

Referring first to Figures 1 and 2. 1 designates 25 a rudder pivoted at 1a, and 2 is a flap pivotally mounted on the rudder at 2a. 3 denotes a portion of an actuating rod intended to be moved axially. This rod terminates at one extremity in a cylinder 3a having a piston 3b therein which is normally maintained substantially centrally 30 therein by opposed springs 4 and 4a. Extending from the end of the cylinder 3a remote from the actuating rod 3 and integral with the latter is a rack 7 which meshes with a pinion 6 mounted for rotation on a piston rod 3c extending from the 35 piston 3b.

Referring now to Figure 1, connected to the pinion 6 for rotation therewith is a flexible shaft 8 the opposite extremity of which is connected 40 to a spindle 9 mounted in bearings 9a secured to the rudder 1. This spindle 9 is threaded to engage a nut 10 which is held against rotation in a fork 11 the other extremity of which is secured to a reach rod 5, and the opposite extremity of 45 the said reach rod is connected to the flap 2 to move it about its axis 2a. The fork 11 is provided with opposed slots 11a to receive trunnions 10a extending from the nut 10 to permit the rod 5 to change its longitudinal alignment as it moves 50 to impart rotation to the flap 2 about its pivot axis 2a.

The operation is briefly as follows: When the rod 3 is moved axially in either direction the rack 7 causes rotation of the piston 6 and turns the 55 spindle 9 through the flexible shaft 8. Then the reach rod 5 is moved to turn the flap 2. During the initial portion of the movement of the actuating rod 3 the piston 3b remains stationary due to its arrangement between the opposed springs 4 and 4a. However after the flap has been turned 60 to a predetermined angle and one of the springs

4 or 4a has been sufficiently compressed the piston 3b and its rod 3c commence to move thereby rotating the rudder 1 about its axis 1a. Thus movement of the flap 2 occurs first, and when it has been moved to a predetermined angular position the air forces acting thereon tend to move it and the rudder 1 thereby materially reducing the effort that would otherwise be required to move the said rudder. Again due to the fact that movement of the flap 2 and reach rod 5 is obtained through rotation of the spindle 9 in the nut 10, air forces acting upon the flap cannot change its angular position as the said spindle and nut combination constitute a locking means which precludes any such movement.

In the modification shown in Figure 2 the pinion 6, which is again in mesh with the rack 7, is secured to a rotary contact member 12a which intermittently closes connections between leads 13 and 13a in a switch mechanism 12. The leads 13 terminate in an electric motor 14, and the leads 13a are connected to a source of power 29. Thus when the pinion 6 is turned through movement of the actuating rod 3 the motor 14 is intermittently energized. Connected to the shaft of the motor 14 is a worm 15 which meshes with a segmental gear 16 mounted for rotation upon the rudder 1. Connected also to the gear 16 is one extremity of the reach rod 5 the other end of which is again connected to the flap 2 to turn the latter about its axis. Consequently in this embodiment less manual effort is required to turn the flap 2 because it is merely necessary to turn the rotary contact member 12a and thereby energize the motor 14 by which power is supplied to move the flap through the segmental gear 16 and reach rod 5. In this case again air forces cannot cause movement of the flap upon the rudder because the segmental gear 16 is positively held against rotation by the worm 15 unless the latter is turned by the motor 14.

In the modification shown in Figures 3 and 4 the actuating rod 3 is again provided with a cylinder 3a having an integral rack 3c, and a piston 3b in the cylinder having opposed springs 4 and 4a exerting pressure in opposite directions against it. Movement of the rod 3, in the manner already described rotates an intermittent rotary contact member in a switch mechanism 12 to operate the motor 14 through leads 13 and in Figure 4 also through other leads 31 normally connected thereto by a switching means 33. In this instance the second motor 25 is also provided for trimming the flap 2 and moving it entirely independently of the rudder 1.

Extending from the motor 14 is a threaded shaft 17 having a nut 18 thereon from which a double-armed lever 19 pivoted in the rudder at 19a is actuated. Pivotally connected to the lever 19 by a pin 20a are two arms 20 and 21, which are in turn pivotally connected to other arms 22 and 23 by pins 21a and 23a respectively, while the arms 22 and 23 are also pivoted to one another by a pin 22a. Thus the arms 20, 21, 22 and 23 are disposed in the form of a parallelogram and together make a toggle-like connection.

The shaft of the motor 25 has a worm 26 thereon which meshes with a segmental gear 27 pivoted on the rudder 1 and having an integral lever 27a. Pivoted on the latter is a link 24 the opposite extremity of which is connected to the pin 22a. The adjacent extremity of the reach rod 5 is also pivoted on the pin 23a, and the pin 22a is vertically movable in a slide 40 mounted upon the rudder 1.

When the motor 14 is intermittently rotated the nut 18 and shifter yoke 19 are moved thereby moving the toggle-like connection 20, 21, 22 and 23 and the rod 5 to cause movement of the flap 2. Then the pin 22a is held stationary by the lever 27a. On the other hand when the motor 25 is energized the worm 26 is turned thereby moving the lever 27a and causing movement of the reach rod 5 through the arms 20, 21, 22 and 23. During that time the pin 20a is held stationary by the shifter yoke 19. It will be noted that due to the drive imparted from the motors 14 and 25 through the threaded shaft 17 and nut 18, and worm 26 and segmental gear 27 respectively, that the flap 2 is positively held against pivotal movement until and unless either the shaft 17 or the worm 26 is turned.

In Figure 4 leads 32 and 32a connected to a switching means 33 normally connect the motor 25 with a manually operable intermittent rotary switch 28. But so that either motor 14 or 25 can be operated through either switch 12 or 28, the leads 32a from a source of power 30, or the leads 13 from the source of power 29, can, through the means 33 be selectively connected to either set of leads 32 or 31.

While in the foregoing the preferred embodiments of the invention have been described and shown, it is understood that the control means is susceptible to such further alterations and modifications as fall within the scope of the appended claims.

What we claim is:

1. A control means of the character described comprising a rudder mounted for movement and having a flap pivoted thereon, an actuating rod yieldingly connected to the rudder for moving the latter, and means cooperable with the rod on initial movement thereof for imparting pivotal movement to the flap prior to movement of the rudder when the rod is moved, said means including coacting elements preventing movement of the flap by air forces exerted thereon.

2. A control means comprising the combination set forth in claim 1, wherein the means for imparting movement to the flap includes a motor set in motion by movement of the rod.

3. A control means comprising the combination set forth in claim 1, including a second means for moving the flap pivotally while the actuating rod and coacting elements remain stationary.

4. A control means comprising the combination set forth in claim 1, wherein means for imparting movement to the flap include a motor set in motion by movement of the actuating rod, and a second independently operated motor for moving the flap pivotally while the rod and coacting elements remain stationary.

5. A control means of the character described comprising a rudder mounted for pivotal movement and having a flap pivoted thereon, an actuating rod, a motor, means setting the motor in operation upon initial movement of the rod, and means operated by the motor for moving the flap, said rod being connected to the rudder through a lost motion connection to impart movement thereto.

6. A control means comprising the combination set forth in claim 5, wherein the means for setting the motor in operation includes means for intermittently operating the motor during continued movement of the actuating rod.

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