NASA TECH BRIEF

Langley Research Center

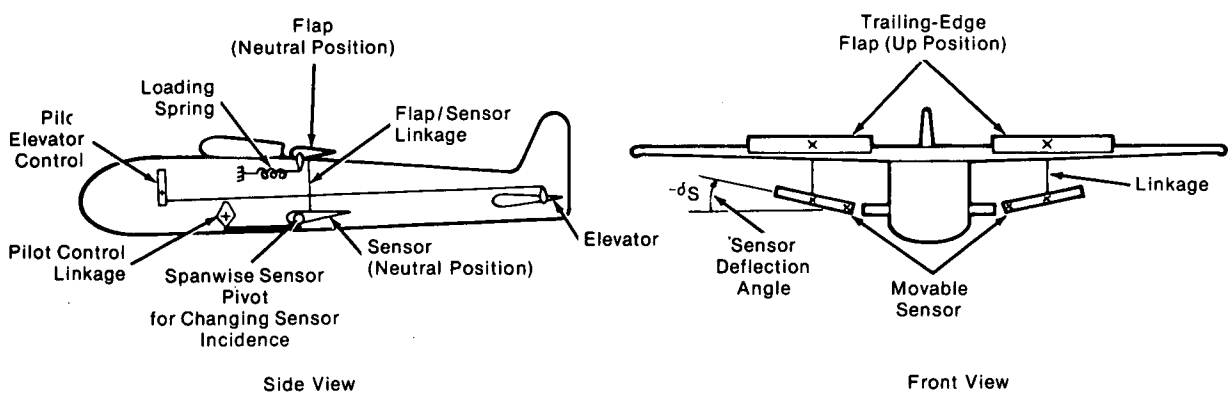
Gust Alleviation System To Improve Ride Comfort of Light Airplanes

A simple all-mechanical gust alleviation system has been developed for light airplanes. This longitudinal gust alleviation system was developed to reduce the normal accelerations of the airplane at cruise conditions. It consists of movable auxiliary aerodynamic surfaces (sensors) mounted on the fuselage and connected to the trailing-edge flaps by rigid mechanical linkages.

The basic components of the system are shown in the illustration. The sensors are hinged about a chordwise axis adjacent to the fuselage and change their dihedral angle in response to gusts. Both sensors and both flaps are interconnected so that all deflect together symmetrically. As the sensors move up in response to an up gust, the flaps are deflected up by the flap/sensor linkage. The flaps decrease lift on the wing by an amount almost equal to the increase in lift on the wing due to the gust which caused the sensor deflection. In this way, the lift on the airplane is maintained relatively constant regardless of the gust encountered by the airplane.

A loading spring is provided to assure that the sensor operates at the most effective angle of attack for a given airplane flight condition. The positive angle of attack is desirable from a performance standpoint, in order that the sensor detract as little as possible from the basic lift-to-drag ratio of the airplane. This positive angle of attack results in the alleviation of horizontal gusts as well as vertical gusts, as the lift on the sensor will change with airspeed. Except for low-speed approaches, horizontal gusts are of much less importance than vertical gusts.

This gust alleviation system achieves its alleviation, essentially, by reducing the lift-curve slope of the airplane to such a small value that gust-induced angles of attack will result in small changes in lift. This low response to changes in angle of attack practically eliminates the ability of the pilot to change the flightpath unless some sort of compensation is provided. The spanwise pivot axis for changing sensor incidence and the pilot's control linkage (see illustration) are provided for this purpose. As the elevator is deflected, the sensor is rotated about its quarter chord so that its angle of attack remains constant as the angle of attack of the airplane changes. Thus, the flap will not respond to changes in angle of attack due to control inputs but will still respond to changes in angle of attack due to gusts.



Longitudinal Gust Alleviation System for Light Airplanes

(continued overleaf)

Data from static wind-tunnel tests and longitudinal short-period analysis revealed that the system required some means of increasing longitudinal short-period damping. A flap/elevator interconnect was installed, because of fewer system design complications, which made the flap pitching moment more negative. This reduced the normal acceleration to about one-half that of the basic airplane, with a resulting ride comfort improvement.

Note:

Requests for further information may be directed to:

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Patent status:

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