FLEXIBLE REENTRY GLIDERS

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For presentation at the
SAE NATIONAL AERONAUTIC MEETING
Hotel Commodore, New York, N.Y.
April 5-8, 1960

Written discussion of this paper will be accepted by SAE until May 1, 1960.
Three double-spaced copies are appreciated.
Discussion is printed if paper is published in SAE Transactions.

SOCIETY of AUTOMOTIVE ENGINEERS, Inc., 485 Lexington Avenue, New York 17, N. Y.

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The NASA is investigating many different kinds of reentry vehicles. This paper will not attempt to compare these different vehicles, but rather to present some results of preliminary investigations of flexible gliders that are thought to have several areas of application in aeronautics and space flight including their possible use as reentry gliders.

An artist's conception of such a glider is shown in fig. 1. The passenger and cargo compartment is suspended on lines beneath the flexible aerodynamic surface, which is an essentially tension structure of very light weight per unit of area. This lifting surface would be kept folded in a compact bundle like a parachute until deployed for reentry.

The reasons for choosing a lifting reentry vehicle for this task can be illustrated by fig. 2. This is a plot of altitude against speed showing different flight regimes. At low speeds and altitudes is the area where aerodynamic lift can be used to support the vehicle. The area at the higher speeds represents the region of extreme aerodynamic heating. Also shown for reference are the speed of sound and the orbital and escape velocities. Two flight paths are plotted on this figure to show the difference between the lifting and nonlifting (capsule) type of reentry. The lifting reentry vehicle flies at lower speeds at the higher altitudes and keeps out of the region of high heating. This reduces the problems regarding high-temperature materials as well as those associated with keeping the astronaut within tolerable heat limits. The lower the wing loading the farther the lifting vehicle curve is from the heat boundary and thus the cooler the structure. For this reason, the vehicle to be discussed has as low a wing loading as possible.

Other advantages of a lifting reentry vehicle are the reduction of reentry accelerations, and the ability to maneuver laterally as well as in the plane of the orbit, as illustrated in fig. 3. A lifting vehicle could land anywhere within the shaded area; three different reentry paths are indicated by the solid lines. The dashed line is for a conventional nonlifting device with its one landing spot. A lightly loaded glider, moreover, would have low landing speeds, so low perhaps that bucking a strong head wind might sometimes be a problem unless some method of reefing is provided.

RESULTS AND DISCUSSION

In view of the foregoing considerations, the NASA undertook an exploratory investigation of flexible reentry gliders, and some of the results obtained so far are presented in figs. 4 to 11. The following standard coefficients and symbols are used:

C_L lift coefficient, L/qS

C_M pitching-moment coefficient, $\dfrac{\text{Moment about confluence point}}{qS\bar{c}}$