THE PERFORMANCE OF SAILPLANES IN CIRCLING FLIGHT

By A. M. LIPPISCH*

Since the time when soaring in thermals was discovered, circling flight has been one of the main attitudes in soaring. Even in the long distance flight, fifty per cent of the time is spent in circling. The usual design of a sailplane is based on the performance calculations in a straight soaring flight. As far as gliding from one thermal to another is concerned, the straight flight performance at higher speeds is an important figure, but the soaring flight attitude, or the flight at a low sinking speed, is never straight flight and our performance calculations should be based on circling flight figures.

There is not only the question of performance, which seems to be of some interest, but we should investigate also the problems of stability in circling. There is, for instance, the question of whether the smaller span sailplane might do better in circling than the high performance large span airplanes. It will, therefore, be of some help to us to investigate these questions and get an understanding of what we should do with respect to a good overall design of a sailplane.

To explain the symbols and expressions used in the following derivations, we have at Figure 1 a sketch of a sailplane in circling flight. While we are interested in soaring, we will assume that the circular flight path is in a horizontal plane, or, in other words, we are investigating a flight attitude where the sailplane is maintaining constant altitude. To maintain circling flight, we have to have a certain bank angle so that the resultant force which is rectangular to the wing span has a radial component towards the center of the circle. To get an equilibrium of the forces acting on the center of gravity of the plane, we put a virtual centrifugal force of equal strength against this radial component of the resultant air force.

While we are considering a steady circling flight condition, all forces acting on the center of gravity must be in a vertical plane through the radius of the circle including the axis of rotation. We will call this plane the "vertical plane." If we consider the flow against the plane and the components of lift and drag under certain conditions, we will regard the different forces within a plane rectanglar to the span axis—the Y-axis—of the plane. This plane is in the direction of the pendulum, if we have an unaccelerated circular motion. We will call this plane, therefore, the "perpendicular plane."

(Continued on Next Page)

* Collins Radio Company, Cedar Rapids, Iowa.

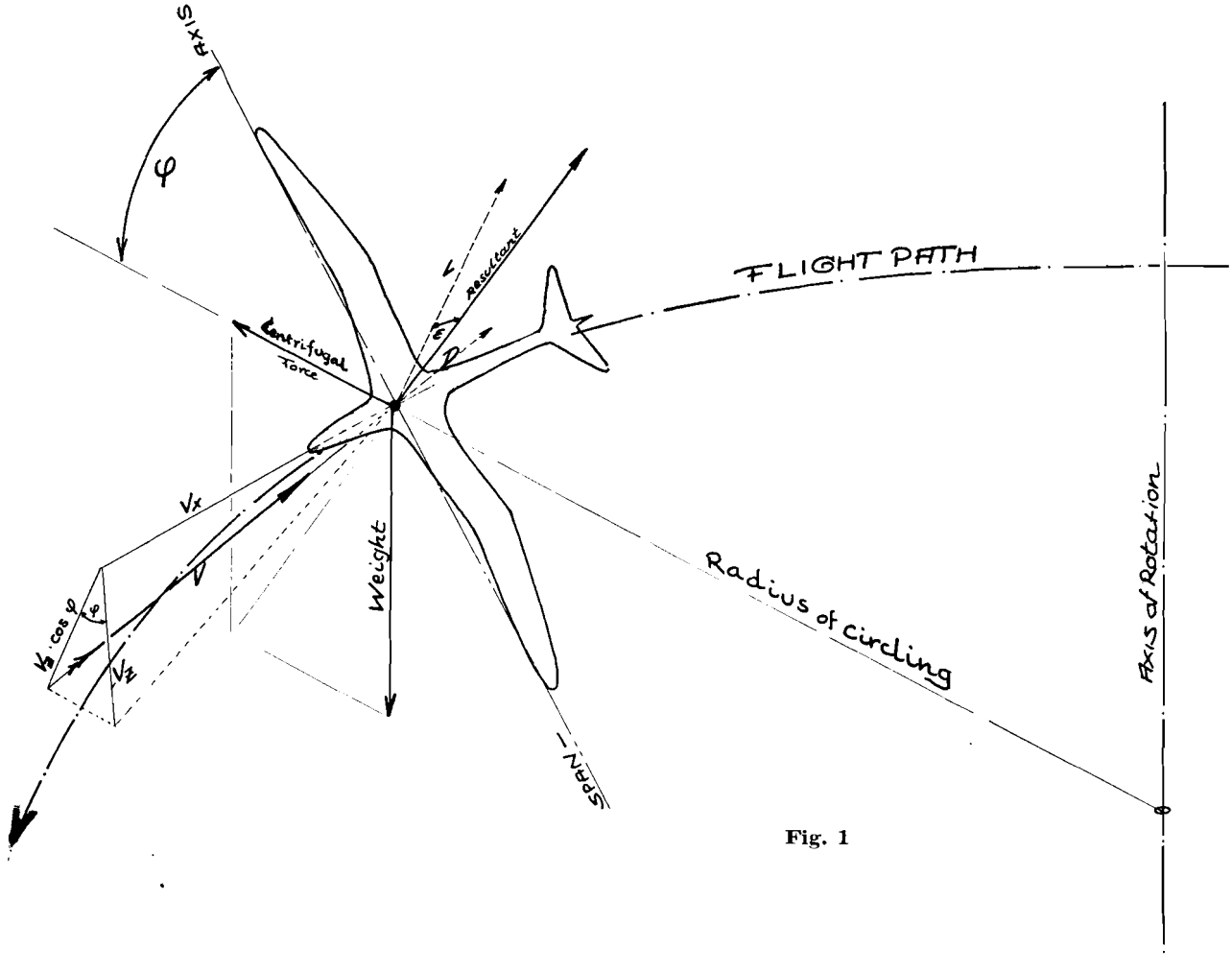

Fig. 1