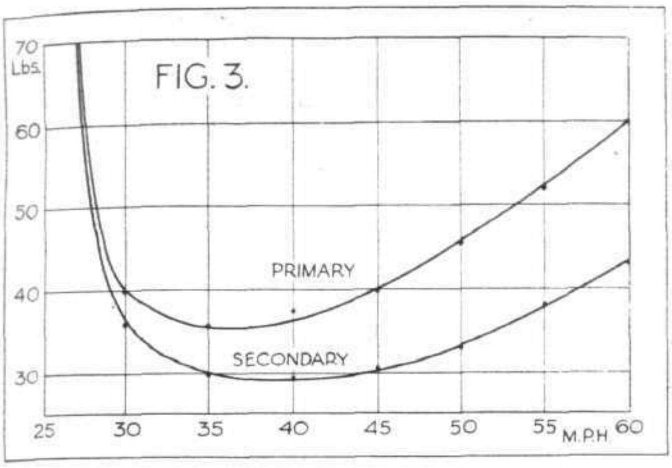

FIG. 3.

(Itford Hill is about 1 in 1 at the more moderate slopes facing north) a primary type glider would attain an air speed of 80 m.p.h., the angle of incidence would be minus 4½ degrees, and the C.P. at 0·94 chord. With the secondary and sail-plane types, the speeds would be 95 and 110 m.p.h. respectively, with the C.P. behind the trailing edge of the wing.

It may be argued that such flying is not good gliding because the high rate of descent precludes any chance of making a good time, nevertheless it is done sometimes, occasionally by good power aircraft pilots. Moreover, if there is a stiff wind, the upward current of air may make the speed appear to be very moderate. If it is done at all then, there should be a load factor of at least 2.

If the assumptions of this curve are correct and the curve does, as it appears to do, represent the true relationship of the variables connected with the flight of gliders, then it is an envelope curve, *i.e.*, it is impossible for the glider to fly at any position which does not lie on the curve, with two exceptions, one below the stall, two when zooming. However, the k.e. of a glider is very low compared with the resistance; consequently the ability to zoom and force the glider from its place on the curve is small, and the departure will be momentary.

If the curve is plotted in three dimensions, then the load factors can be included on the same curve. It would appear to the writer that if Göttingen **549** is used for gliders, then the C.P. back factor should be at least two, with the C.P. at the trailing edge. Such a factor will necessitate a very heavy rear spar. There is much to be said for the tailless glider, though with this there may be considerable torque on the wings.

It seemed desirable to see how these envelope curves would represent a glider with a totally different type of wing. A low-lift wing, with stationary C.P. and large area to give the same stalling speed, because as this is as diametrically opposite a case as can be found, it would test the envelope curve for gliders. Göttingen **445** (N.A.C.A. 797) was chosen, with a wing area of 260 sq. ft. This is a symmetrical double-camber of the type used for very high-speed power aircraft, and has a reverse C.P. movement of 0·35 to 0·22 only. The large area and thin wing would necessitate a biplane structure. Fig 3 shows the performance curves, which indicate a small speed range at useful gliding angles and a very marked stall which woud tend to cause many crashes if used for training purposes. Fig. 4 is the envelope curve for two gliders with these wings. It will be noticed that the curves are of exactly the same form as in Fig. 2, but the high speeds are somewhat increased, the gliding angle is reduced, and the position of the C.P. is such that the C.P. forward and C.P. back positions may be considered as the same, so that a load factor of 6 for the slow speed angles will cover all cases.

A similar set of curves was drawn for a family of gliders loaded 2 lb. per sq. ft. with U.S.A. 27-wing section. The curves are very similar to Fig. 2. In fact, if the stalling speed of 22 m.p.h. is brought to coincide with 25½ m.p.h., the primary and secondary types coincide, but as the wing is more efficient the sail 'plane shows a higher speed. The C.P. position is no worse than for the Göttingen **549**, and as it is possible to use a larger rear spar, the use of this wing section might result in a safer machine.

It has already been noted that the extreme range of wing section as illustrated in Figs. 2 and 4 are similar except for angles of incidence and positions of the C.P. Hence it would appear that the glider is less changed by variations in the aerodynamic characteristics of the wings (provided suitable areas are used) than power-driven aircraft. Doubtless this is due to the fact that gravity is an excellent and elastic motor. Table I shows the net horse-power provided by gravity at different air speeds for the three gliders represented in Figs 1 and 2. For the benefit of gliding readers who may be tempted to put an engine in a glider and are not familiar with power aircraft, it must be noted that the horse-power given is net. About 30 per cent. more power must be supplied for airscrew losses, and the added resistance of the engine and airscrew would reduce the performance of the sail-plane to that of the primary type unless very well streamlined.

Table I.

Air speed in miles per hour	30	40	50	60	70	80	90	100
Primary type glider, h.p.	2·8	3·7	5·9	9·7	13·2	22·9	—	—
Secondary ,, ,, ,,	2·5	2·9	4·3	6·9	10·9	16·3	23·4	32·2
Sail 'plane ,, ,, ,,	2·2	2·3	3·3	5·1	8	12	17	23·5

Reference to Fig. 2 will give the ground speed in each case.

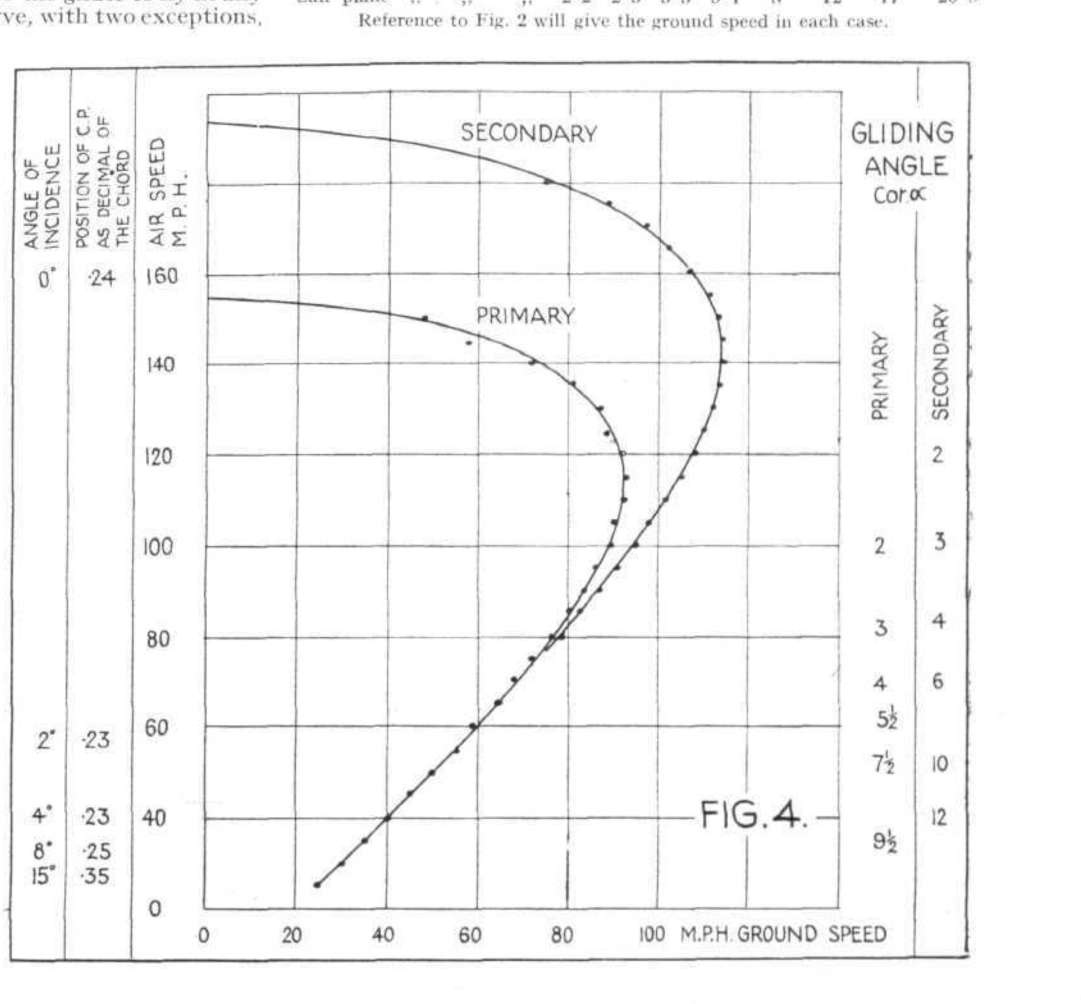

FIG. 4.