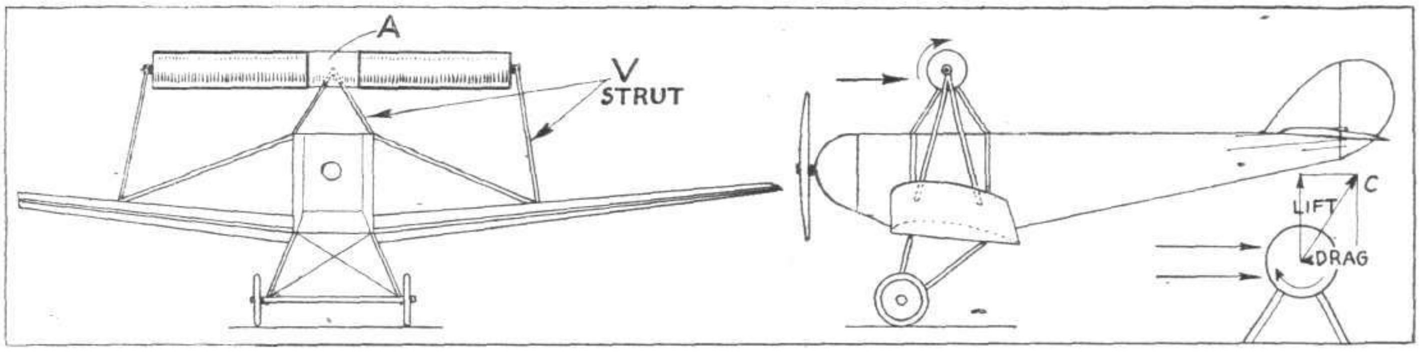
FLIGHT

TESTING THE FLETTNER "ROTOR" IN ACTUAL FLIGHT

A Possible Field for the Light 'Plane

WITH reference to the article appearing in last week's issue of FLIGHT on the subject of the Flettner "Rotor Ship" and the possible application of the principles involved to aircraft work, the aircraft designer who sent us the initial communication (and who, for reasons of his own, desires to "hide his light under a bushel") has forwarded the accompanying sketches to show how the idea might be tested out in actual flight. "For an initial experiment," our correspondent writes, "it would be best to try only a small rotor and to drive it from the engine, in conjunction with a wing of sufficient size to enable a landing to be made if the rotor stopped." The diagrams are, we think, more or less self-explanatory. The rotor is in two halves, supported in the centre by the fixed portion "A" and at the outer ends by inverted V-struts rising from the wing spars. A machine of the low-wing monoplane type would seem to lend itself to the experiment, particularly one in which the wing was braced by struts as in the Parnall "Pixies" or the de Havilland D.H. 53. Thus, we see here an opportunity to use the light 'plane for real research work, a sphere of usefulness to which we have repeatedly called attention. The experiment should cost relatively little, and if handled methodically and carefully should result in no very grave risk to the pilot. "Straights" would naturally be undertaken first, and the presence of the ordinary wing, with its ailerons, should ensure safety and controllability.



Suggested method of testing the Flettner rotor on a light 'plane. The presence of the usual wing should enable a landing to be made safely in case of stoppage of the rotor

Since we published the article last week, certain details of the Flettner rotor have become known, the inventor having read a paper on the subject before the *Schiffbautechnische Gesellschaft*. From Herr Flettner's paper it appears that, as we suspected, there is a definite relationship between translational and rotational speed. This relationship seems to be somewhat unfortunate from the point of view of the application of rotors to aircraft, since experiments at Göttingen have indicated that the best efficiency is attained when the peripheral speed of the rotors is approximately 3½ to 4 times that of the translational speed. In rough-and-ready figures this seems to mean that, suppose the rotor were tested on a light aeroplane and that the rotor itself measured 10 ft. in length by 1 ft. diameter, at 30 m.p.h. the peripheral speed should, for good efficiency, be about four times that, or 120 m.p.h., or 176·6 ft./sec. This would correspond to a rotational speed of 56·2 r.p.s., or 3,370 r.p.m. It is thus quite obvious that for mechanical reasons a limit would soon be reached, and that the rotor does not appear very promising for fast machines. It is not, of course, known what power is required to drive the rotor, but if it be found that no very great power supply is necessary a windmill drive seems to be suggested. In larger machines probably a separate engine might be found to be the solution. At any rate, it is fairly evident that the source of power must be independent of the main engine, since otherwise engine failure would result in the stoppage of the rotors, with consequent loss of lift. One can also visualise the use of rotors as auxiliaries to the normal wing surfaces and used to give extra lift while taking off and alighting, although the problem of streamlining the rotors when not in use would present difficulties. The application to machines of the helicopter type is also indicated, although here the rotor system would suffer from the same drawback as the direct-lift airscrew type, *i.e.*, loss of lift in case of engine stoppage.

From statements made and illustrations shown in Herr Flettner's paper it appears evident that the rotor has an action very similar to that of an aerofoil, as was surmised in FLIGHT last week. The rotation of the rotor, owing to surface friction, causes the air in contact with the cylinder to rotate with it, and over one portion of the rotor there is thus an increase in velocity, while over another there is a decrease.

These changes in velocity naturally result in corresponding changes in pressure, so that we get a portion where there is a small positive pressure, corresponding to the lower surface of an aerofoil, and a portion where the pressure is negative, corresponding to the upper surface of a wing section. As in the case of the aerofoil it was found that in the rotor the negative pressure is the more important of the two.

It is also of interest to note that end losses were considerable, and that the circular plates on top of the rotors in the *Buckau* were intended to reduce these. Thus, it seems obvious that the rotors are subject to the same laws as aerofoils, and that aspect ratio has a similar effect.

As regards actual results, Herr Flettner states that with short cylinders the "lift coefficient" had an "absolute" value of 4 (corresponding to a value of 2 in British "absolute" units), but that this was increased to 9 (4·5 British) by fitting the end plates and reducing losses. Compared with the maximum lift coefficient obtainable with high-lift aerofoils (somewhere in the neighbourhood of 0·8), a lift coefficient of 4·5 is rather astonishing.

The wind-tunnel tests at Göttingen are stated to have been carried out with a cylinder 33 cms. (a little over 13 ins.) long and having a diameter of 7 cms. (2¾ ins.) *i.e.*, with an aspect ratio of 4·72. The end discs were of 14 cms. (5½ ins.) diameter. Doubtless rotors of higher aspect ratio would give still better results.

From curves given by Herr Flettner in his paper it appears that the lift coefficient of the rotor reaches its maximum value when the rotational speed is 3½ to 4 times the translational speed, and then remains at this value as long as this ratio is maintained. Curves showing the pressures on the rotors of the *Buckau* indicate that for the rotor speed employed the force on the towers reaches a maximum at a relative wind speed of about 15 m. per second, and that from then onwards the force remains practically constant. For ship work this is, of course, important, since a sudden gust would exert no extra pressure on the towers and so would not tend to heel the ship over further. In the case of aircraft, presumably the effect would be that once the maximum lift had been attained any further increase in air speed, if unaccompanied by an increase in rotor speed, would not give any extra lift. In other words, once the proper ratio had been reached the lift per square foot would remain constant at higher speeds.

It will be noted that certain assumptions made last week have not proved quite accurate, and that as a result the lift attainable at 30 m.p.h. (assuming a maximum lift coefficient of 4·5) would be 45 lbs./sq. ft., and not, as originally estimated, 95·8 lbs./sq. ft. Even so, however, the lift is sufficiently startling, and in spite of many difficulties in connection with the operation of the rotor, the subject seems to be one very well worth close study.