

## THE AUTOGYRO ROTOR AS A SAIL

BY

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The idea of navigating a certain type of sailing boat of mine by an autogyro instead of an ordinary sail has long been a desire of mine, in that I always have considered sailors to be very out of date as to rigs.

In conversation with J. Weir this question arose, whereupon he said that he had within his organisation of the Autogyro Company an engineer named O. Reder who had the same desire. We, therefore, got in touch and although the time was very short got out a rig and installed it upon a very small one-design class, well-known in the Solent, namely, the Redwing. These boats are about one ton, and the rules governing their racing are that the hulls are standard and that any rig can be used, but that the sail area must not exceed 200 sq. ft.

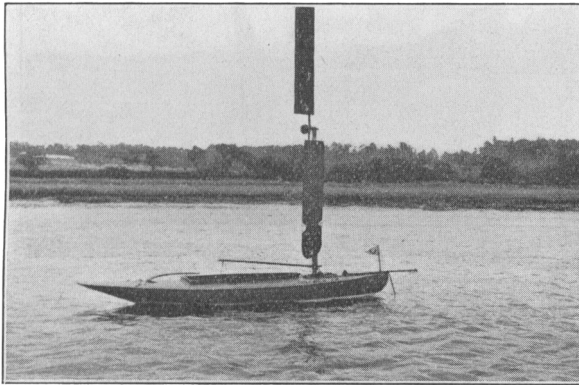


FIG. 1.

*Riding on moorings with rotor tied up.*

To those who are acquainted with yachting, and Solent yachting in particular, the Redwing will appear as being one of the most difficult of boats to adopt to any new rig, in that the mast has to be stepped rather farther forward than in an ordinary boat to get the balance right, and it is a boat where the very latest forms of gadgets and devices are adopted, so the sailing is extremely good and the efficiency of the rig extremely high. To give an impression of the standard of the rig of this class let me say that the mast, the sails and all rigging complete in a first class Redwing weigh only 45 to 50lbs. and we were set the problem of trying to instal an autogyro to compete with this and not to so overload the boat as to make her excessively tender.

Mr. Reder got out a design which redounds to his credit, in that nothing at all actually went wrong or broke upon the sea, and I took the craft out in some pretty stiff winds. We installed a duralumin mast of two sections. It was stepped into the keel in a ball bearing and it traversed the deck also in a ball

bearing. It was 10ft. high and carried a rotor weighing some 45lbs. of 18ft. diameter, the blades being 1ft. 6in. deep. The rotor plane was inclined to the mast  $8^\circ$  in order to clear it. The rotor was set back eight inches from the mast in order to get a slight pull on the boom—had it not been for this the boom would have had to have been pushed out instead of going out of itself. The boom naturally was rigid with the mast and the boat was sailed as if the plane of the rotor was a sail. The rotor had no angle on it at all as it had to rotate in the same direction with the wind coming from either side. It was, I think, the only sailing boat existing in which there were carried no ropes at all. We did, as a matter of fact, later have a rope to the end of the boom, but even that could have been dispensed with.

Our first trials were exceedingly interesting and precarious as no data on the behaviour of such craft or such a rotor was existent. It must be remembered that with the rotor clearing the deck only by a foot, and revving up to 250 revs., it is a dangerous thing in a sea, and any mistake of the crew might lead to very serious disaster.

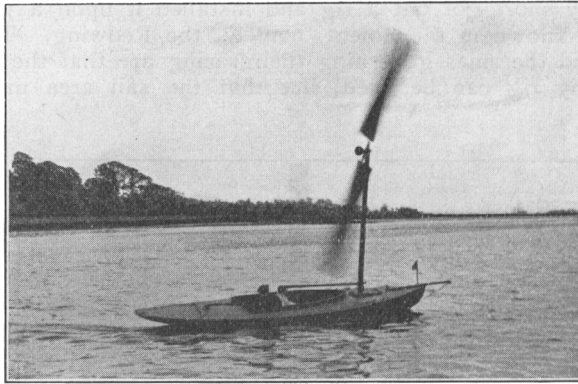


FIG. 2.  
*On a wind.*

In a fairly strong wind of about 30 m.p.h. we made our first sally on the Hamble river. On giving the rotor a push she responded and proceeded to speed up, whereupon a very ugly phenomenon occurred as the series of buffets given to the top advancing blades of the rotor coincided with the natural harmonic of the mast. We thought at the moment that disaster was upon us, but the moment the critical speed was over the rotor settled down quite quietly and nicely and the mast seemed quite happy. It will be appreciated that it was impossible to stay the mast and that the whole of the driving force and thrust came from the top of the mast, giving a sheer on the deck. However, we had allowed for this and the boat did not seem to mind heeling quite naturally.

The general sailing of the boat was an interesting and difficult problem. The most interesting point of sailing was "on a wind" and here a new technique was required, as it will be appreciated that the angle that a boom in an ordinary sailing boat subtends to a wind is not the angle which the sail is making to the wind as the sail pays off so very much the higher you look at it until actually the top is but a flag. In our case the angle of the boom to the boat was the angle of the rotor and naturally was somewhat coarser than that of an ordinary boom. There was the secondary consideration that the speed of the rotor had to be maintained and this was greatest when squarish to the wind rather than at an angle to the wind. It will be seen, therefore, that the two points one

was striving for were rotor speed and sufficient angle to drive the boat, and at first these two were difficult to get going efficiently and smoothly. "Putting about" involved also the greatest technique, quite a different procedure, as the moment the boat shot up into the wind the rotor speed would fall, and in starting on the other tack, just when you wanted the maximum power and a coarse angle on the rotor, the rotor speed had gone down and you were tempted to pull the boom in to make the rotor spin at a time when from the point of view of the propulsion of the boat drive alone was wanted. We did, however, get the technique of this fairly satisfactorily, but the changing of the plane of rotation of the rotor certainly set up some alarming vibrations and jars, but after a time we got used to this and did not become so alarmed as we were at first, in fact we became quite callous to the astonishing whips arising. In this connection it is interesting to note that "jybing" was not more difficult than "putting about," as there was no surface like a sail to fill with a bang, and I would as soon "jybe" in the boat as "put about." On a "reach" the rotor spun at a most satisfactory speed and in a wind of, say, 20 miles per hour the progress made was quite astonishing. In "reaching" there was a danger in a short

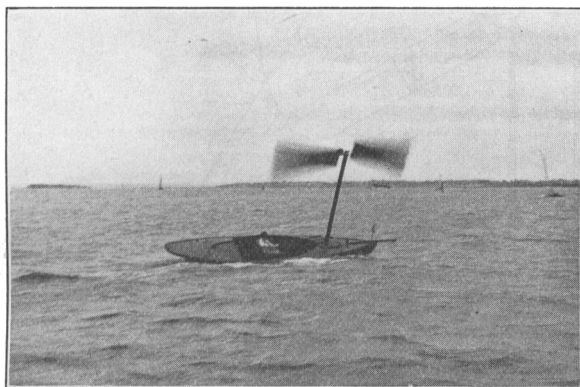


FIG. 3.  
*Reaching.*

sea of the rotor blade touching the sea which would have led to disaster, and one always had that fear in mind, causing us often to have to luff up to avoid it. We had also fitted on the rotor an internal expanding brake, operated from the cockpit by a long bowden wire and lever. This delayed the speed of the rotor considerably when coming up to moorings and had a certain effect when the rotor was inclined to go too fast, but was not so powerful as to be able ever actually to stop it when being driven by a wind. In this connection I hope the difficulty of getting up to one's moorings will be appreciated by sailors as the crew had to keep their heads down if they wanted to avoid having them cut off, the rotor had to be stopped by the brake and the mooring picked up aft instead of forward. Although this is not a very seamanlike practice, it did not matter with us as there was no sail, once the rotor had stopped, to fill and introduce sailing again.

The general behaviour of the boat, in that it had only 35 sq. ft. of surface against the 200 allowed by other craft, was interesting. In light winds up to 7 m.p.h. I do not think the boat could compete against the ordinary marconi-rigged Redwing, as on a light wind the rotor first of all did not go fast enough, and in light puffy air, after the wind had dropped, the inertia of rotation stored up in the rotor did not give one much drive. On the arrival of a new puff the energy

of the wind had to be used entirely to get speed on the rotor. There were, therefore, unpleasant delays. If, however, the wind was over 15 m.p.h. and fairly constant, and the sea not too short and high, then the performance was, I consider, very remarkable. I never actually raced against other boats for reasons I will explain later, but experienced yachtsmen expressed the opinion that they had never seen a boat go so near the wind, and under certain conditions, after a great deal of experience of sailing small boats, I think that was the case.

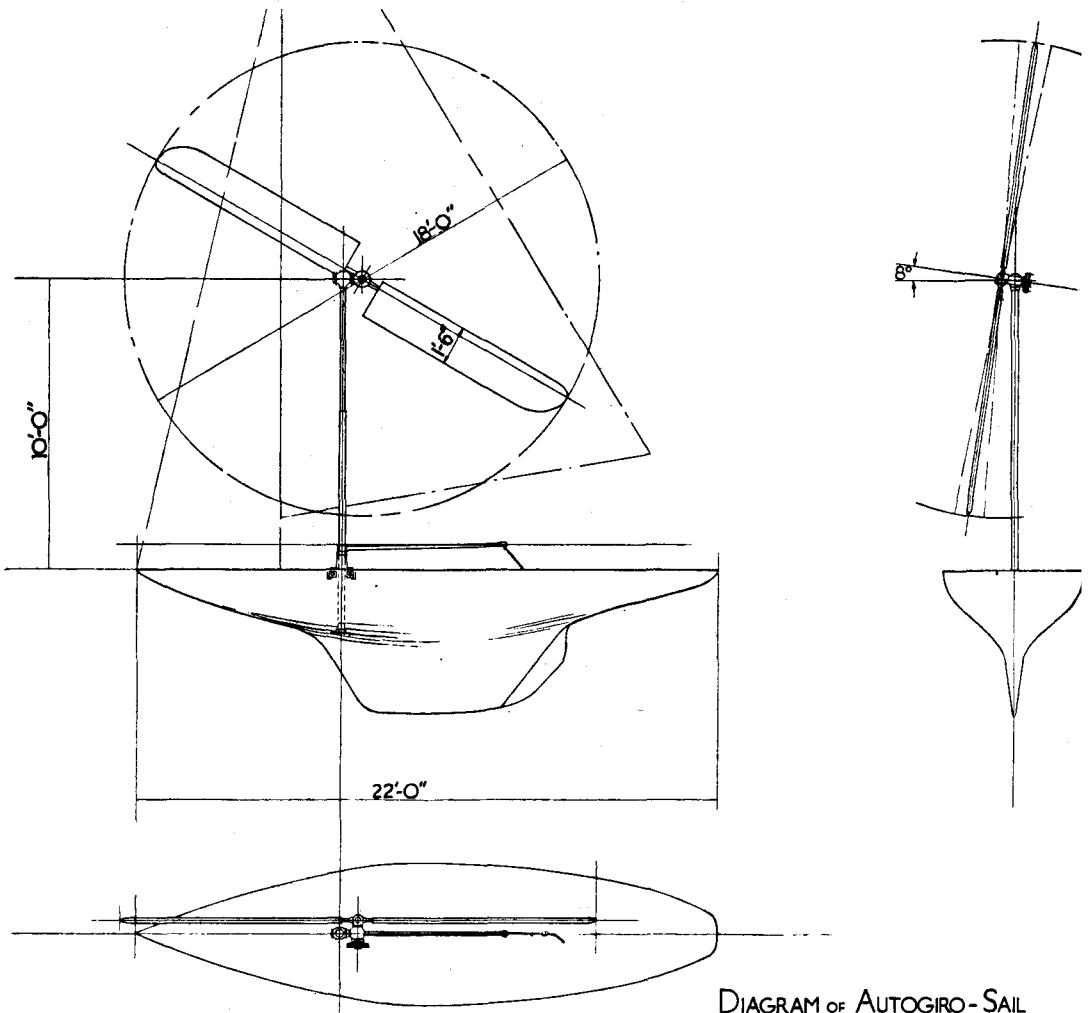


DIAGRAM OF AUTOGIRO-SAIL

O. REDER 2.6.34

It was my desire to race in the Redwing class during Cowes week, but so familiar did we get with the craft, and so self-confident were we, that we suffered one of the most childish of accidents which completely stopped further experiments. When on our moorings one day, in trying to get off instead of being towed off, we started up the rotor before we had got way on, we could not stop it and before we could do anything we drifted on to a dinghy with the most disastrous results to ourselves and the dinghy. This ended the experiment which was extremely novel and extremely interesting.

I have in my time fitted many new rigs to boats, as I like to approach the problem of harnessing the wind from an aeronautical point of view rather than that of the old-fashioned sailor, but many of one's best laid schemes go overboard in a blow. In this particular rig, however, providing one can avoid the rotor striking the water, I believe a smart blow would show satisfactory results. Everyone thought that the boat was motor-propelled, due to the fact that the rotor going up to hit the wind in its revolutions made a slight puffing noise which gave one the impression that there was an exhaust somewhere about. It was, however, satisfactory in view of my experiences not to be told, as I have often been told, that a rig exactly similar had been tried thirty years ago!

I do not consider the general adoption of a rotor instead of a sail a possibility as it is dangerous and impracticable, but racing craft and cruising craft are two very different things, and I believe in the autogyro there is a germ for a better way of getting efficiency out of a wind in a boat than in any other device so far tried, that is always under certain conditions, and although I have been beaten this year I intend to have another try later on.