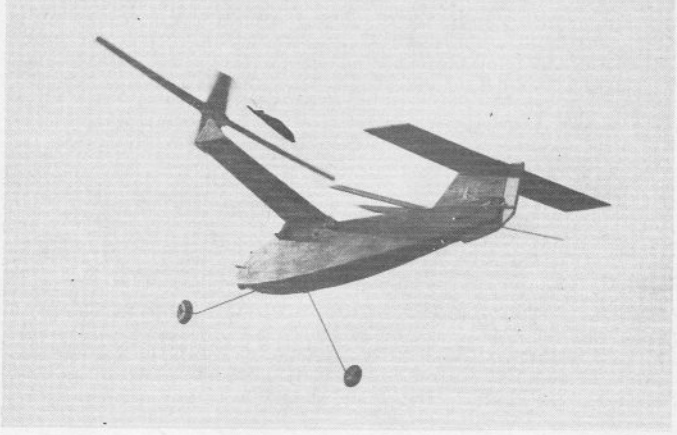
DAVID BODDINGTON

Sport & Single

Vic Bond built this replica of the Bob Brown twin rotor R/C autogyro described in text below. Machine is quite stable, yet remains surprisingly manoeuvrable. Kit for machine should appear soon.

Rotors and Propellors

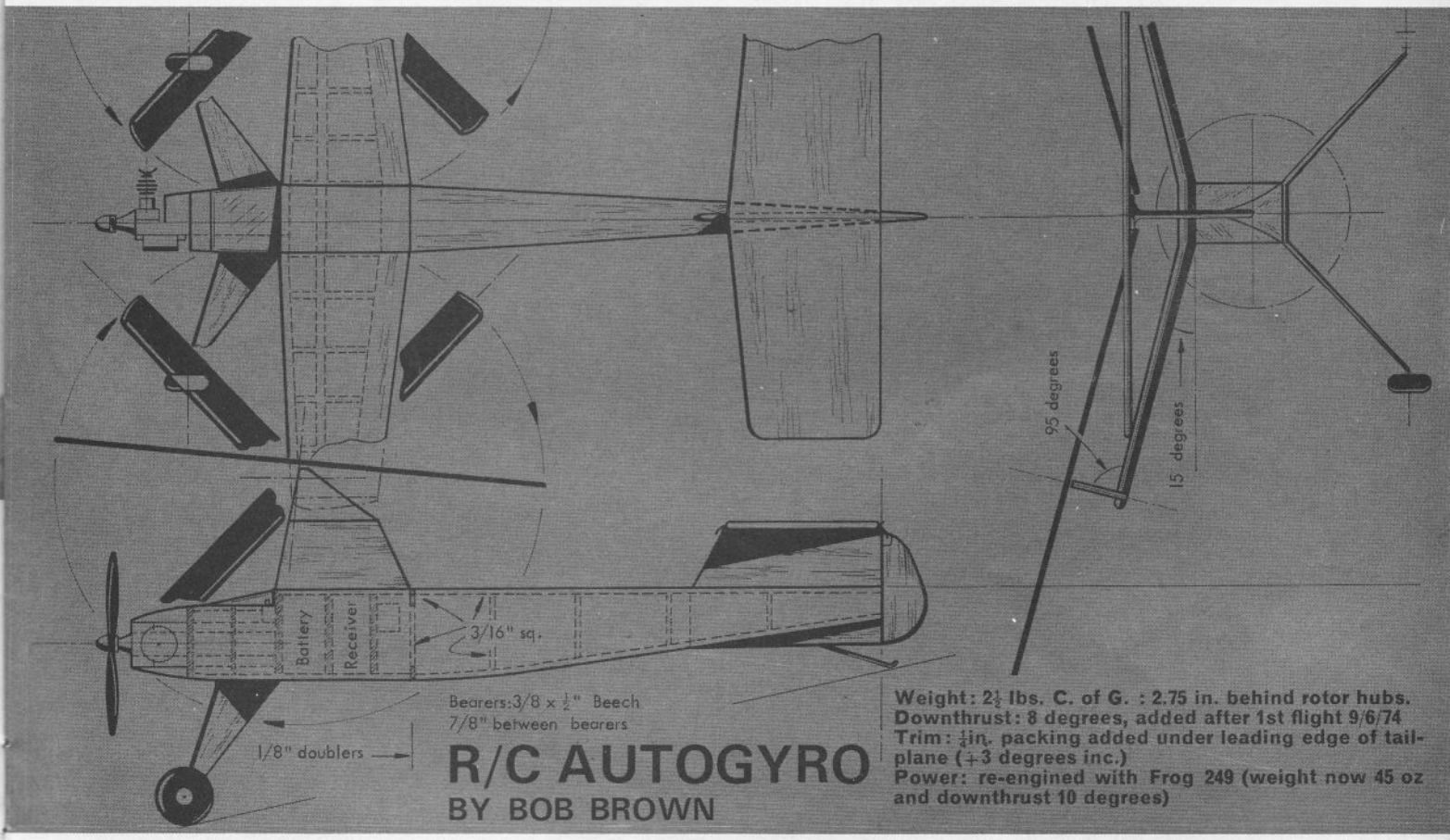
It was an interesting coincidence that the day of receiving the February issue of R.C.M.&E., and reading the *Straight & Level* sage's writings, should also be the day of preparing to fly an R/C Autogyro. A coincidence that is because Mr. Russell had, apparently not seen a successful R/C autogyro and his readings on the subject had suggested that rotor head control might be necessary. As the model we were about to attempt to fly was, theoretically, capable of control by rudder only (although this model featured three function control) it promised to be a very interesting and illuminating experience.



I might also add that the test flights were commenced with some marked degree of doubt and foreboding. That the flights were highly successful – beyond anyone's most colourful dreams – filled me with a certain inner satisfaction and delight. However, to start at the beginning.

Before Christmas I had a letter, with photographs, from Bob Brown of Newbury, Berks giving details of some models that he had designed, built and flown. The three models that he described were an R/C glider, a powered R/C flying wing and an R/C autogyro – not a bad range of subjects! The model that really caught my imagination was of course the autogyro, particularly as it was fairly obvious that Bob had flown the model with some degree of success. Following a request for further information, Bob sent on a ¼ scale drawing together with some informative notes on the subject. I will quote from the relative portions.

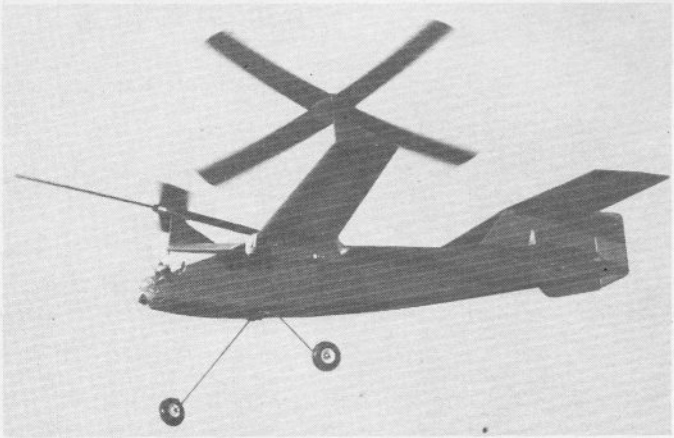
> The autogyro was built by scaling direct from the ¼ scale plan on to the sheet fuselage sides, sheet undersurface of the stub wings, etc.
>
> The blades are of ⅛ in. × 2 in. med.-hard balsa with the leading edge and trailing edge just rounded off. I have doubts about there being any advantage in using a proper airfoil section on such a small scale (Reynolds Number is low and varies along the span and from blade to blade in flight). However, perhaps I will get around to some practical experiments to check on this one day! The resultant rotor is however, quite effective, very easy to build (I always keep a spare set by me on the flying field for this model) and surprisingly strong. The blades, being relatively thin, flex rather than break on a nose-over landing. I have used this system on a number of models, there are at present ten autogyros of

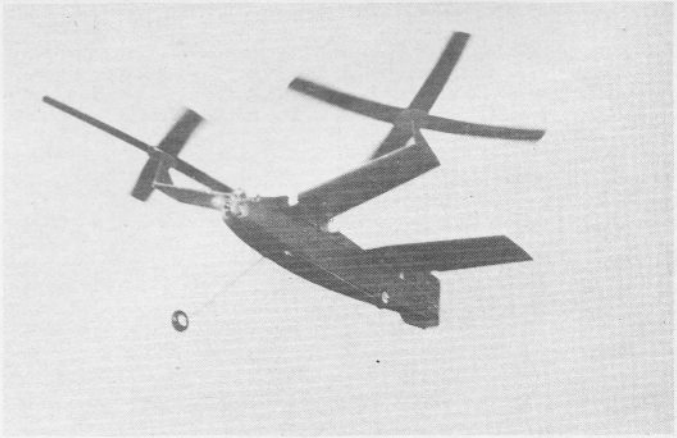


R/C AUTOGYRO

BY BOB BROWN

Weight: 2½ lbs. C. of G. : 2.75 in. behind rotor hubs.
Downthrust: 8 degrees, added after 1st flight 9/6/74
Trim: ¼in. packing added under leading edge of tail-plane (+3 degrees inc.)
Power: re-engined with Frog 249 (weight now 45 oz and downthrust 10 degrees)





various types hanging on the wall of the spare bedroom, all but the one under discussion are free-flight, single rotor, twin rotor, twin rotor coaxial, with stub wings and without wings at all! In fact I know from my free flight experiments that I could have used a cantilever boom or a system of struts on this model in place of stub-wings, but felt it better to play safe with a *first R/C* autogyro as I wanted a perfectly rigid support for the rotors (I have experienced trouble with bearing vibration and engine resonance on a free-flight model).

Having proved the basic twin-rotor system for radio control, there are all sorts of things I want to try when I get time, like motor speed control, elevators, or better still rotor-tilt (I foresee engineering problems here) and an increase in the ratio of rotor dia. to fuselage length (this should reduce disc loading for even slower flight) etc., etc.

One of the great advantages of the side-by-side twin-rotor system is that both the gyroscopic reaction forces and the asymetric lift problems of a near rigid rotor system cancel out with contra-rotating rotors, thus making the model much easier to control in flight.

I should be most interested to hear from anyone who cares to build from my plan, I think it is quite self-explanatory, but perhaps I had better run over a few of the constructional details just in case.

Fuselage

Draw outline and former/upright positions on $^1/_{16}$ sheet. Add $\frac{1}{8}$ in. doubler from nose to rear of servo compartment. Add $^3/_{16}$ in. sq. longerons, uprights and formers, join sides with formers, pull in and cement nose and tail, planking top and bottom with $^1/_{16}$ in. sheet grain running crossways. Add $\frac{1}{8}$ in. balsa bottom to radio and battery compartment, leave section under wing open. Engine bearers slide through rectangular holes in front two formers and butt against heavy bulkhead in front of battery compartment. Build up nose with block.

Fin and Rudder

Med.-hard $^3/_{16}$ in. sheet, slot through fuselage and glue tongue to former. $^1/_{16}$ in. ply platform on top of fin for tailplane – This makes it easy to adjust incidence of tailplane without disturbing rudder installation, etc.

Tailplane

Soft $^3/_{16}$ in. sheet. Re-inforce loosely to prevent holding bands cutting into leading edge and trailing edge.

Stub Wings

Conventional wing construction – "Clark Y type" $^3/_{32}$ in. ribs, shaped L.E. and T.E. say $\frac{1}{4}$ in. sq. main-spars top and bottom, I'm not absolutely sure of the size now. Cover with $^1/_{16}$ in. sheet (nice rigid base). Rotor pylons on tips are from hard $^3/_{16}$ in. sheet with 10 s.w.g. tubes for rotor spindles bandaged and epoxied to front edge. (The use of tubes instead of fixing spindles direct to the pylons allow the spindles to be replaced if they should be bent). Retain rotors with wheel collets or electrical fittings.
N.B. The inward tilt of rotor spindles is important, this acts as dihedral in a conventional model. The spindles should also tilt *back* at an angle of 5°.

Rotors

As already described. Add a $^1/_{16}$ in. ply disc top and bottom, drill for a 10 s.w.g. bush. Don't forget they rotate in opposite directions!

Radio Installation

Quite conventional.

Flying

For a hand launch, trot into wind until both rotors are rotating at the same speed and fast enough to generate adequate lift, lower nose to normal attitude and allow the model to lift itself out of your hand. *Do not throw* as it is possible the rotor r.p.m. will not then match the forward speed and the blades may temporarily stall and not pick up in the height available.

Take offs should be perfectly satisfactory. I have achieved many with similar free-flight models, but as my local field has no hard surface I have not yet tried one with this model. It helps to spin up the rotors by hand in the correct direction just before release, but this is not absolutely necessary with a longer run and a bit of wind.

From all of this information I drew up some full size plans, basically the same as Bob's $\frac{1}{8}$ in. scale sketch and incorporating his own mods. I handed a set of the drawings over to club member Vic Bond and impatiently awaited the appearance of the model. Occasional 'phone calls came through commencing at the "I don't think it will fly" moving on to "It probably won't fly" and, at the time of completion, "It can't possibly fly". Having completed a model and fitted radio and engine though, there is little more that one can do apart from taking it to the field and at least attempting to fly it. Vic was unsure whether to attempt to launch the model (so that he could judge the lift) and fly it as well. In view of the unknown control responses it was decided to let David Toyer look after the launch and for Vic to be at the immediate ready with the sticks. I was poised – in a sort of no man's land – with my camera hoping to get at least one shot with the model actually in the air. As it happened I got a whole reel of film taken in the space of three flights. The decision to have a separate launcher was a wise one as the first twenty seconds proved to be fairly hectic and the familiar red Horizon transmitter was seeing plenty of activity. Nevertheless, the model was certainly airborne and when the degree of oversensitivity of rudder control was realised – greatly exaggerated by some Dutch rolling – it was possible to maintain it on a reasonable course. The amazing thing – to us ignorant peasants – was the fact that the model would roll, albeit too easily. Eventually the model was landed, in a reasonable imitation of helicopter descent, to cheers from the disbelieving club members. (What little faith we have in the miracles of modern science!). The general consensus of opinion was that a larger fin area was required to overcome the Dutch rolling and a more forward C. of G. to calm the model down a little. The latter remedial action was contemplated with a certain 'try and hope' attitude as we were by no means certain that this would act in a 'conventional' manner. With a further half an hour to go before lunch – and the modifications carried out – a further two flights were attempted and the conclusions of the first flight reinforced.

Vic managed to find time to construct, cover and dope an additional top fin, and fix it in position, plus changing the balance points in between his Yorkshire pudding and meat course (we always have them separate in this area – Culinary note). The afternoon's flying proved the wisdom, or luck, of our diagnostic remedies and the '*Tyro Gyro*' performed excellently. It is all the more surprising that the performance was so consistently good as little trouble had been taken to balance the rotor blades and the port blade was much more free in rotation than the starboard blade. With a light breeze (increasing later) the autogyro could be made to ascend and descend vertically, in relation to the ground, and to fly backwards – again, relative to the ground. On one practice low motor descent the engine quit completely and Vic let the model continue its descent, slightly backwards and turning to the right, until it landed, horizontal, on the ground. It was certainly not a soft landing but light considering the method of descent. Naturally, when the model is descending near the vertical, in light wind conditions, there is virtually no airflow over the fin and rudder (in the normal direction) and they become ineffective. That says a lot for the stability of the 'Tyro Gyro'. A safer way to bring the model down, following an engine failure, would be to maintain the forward penetration by applying down elevator and maintaining the forward speed until reasonably close to the ground. The round-out should not be over critical and, if it is on the high side, will only result in a slightly higher vertical touch down speed.

During the afternoon four or five of us had a go with this new form of flying machine and everyone agreed that it was both easy and interesting to fly. It certainly will not take the place of helicopters, but it offers a tremendous potential for fun flying with a very limited outlay. I will keep you informed on progress, but rest assured that there should be some plans and kit available by the time this article is published.