"CURRENT" AFFAIRS

by PETER HOLLAND

electric flight developments

A GREAT MANY flight cells have been cycled since the first *Radio Modeller* All-electric Fly-in was held, yet even before then flight motors and systems were discussed in these pages, so I think a brief resumé of what has happened might not come amiss, particularly as more modellers are entering the scene and will want to find out more about electric-powered flight.

"Brush"-up dept.

Motors were discussed in the Sept. '75, April '76, January '77 and Feb. '77 issues. The Fly-in reports were in Dec. '76, Dec. '77 and Sept. '77. Dogged by poor weather, these meetings nevertheless showed the trend of models and choice of motors. It is clear that for duration, the geared folder prop driven by a geared Mabuchi RS54 is tops for the powered-glider type of duration model, and the direct-drive version of the same motor (under various trade names) has become the most popular unit for sport, aerobatic and scale. Few modellers have departed from the standard eight fast recharge 1.2Ah. cell battery-pack for the last three mentioned classes of model. This would seem to be due to the convenience of charging from a 12 volt car battery more than anything else.

The models

In September '76 we published John Fletcher's *Hushabye* (R.M.165), a leader in the field of sport electric from this glider-oriented modeller. This was to be followed by Dennis Tapsfield's exciting twin stand-off scale *Pegasus* (R.M.173) which is a full-house machine capable of aerobatics and without any of the problems associated with i.c. power twins. He followed up the success of this one with a scale Ford Trimotor—the "Tin Goose" (R.M.192) in Feb. '78—also "full house" and using three Mabuchi RS54 motors. It was Jim Slade who, in 1977, showed that an electric-powered model could be designed that would do respectable aileron/elevator aerobatic. His *Voltair* (R.M.180, July '77) would seem to be difficult to beat for capability and simplicity. It proved that electric powered model could be made to really move—that a symmetrical wing could be used efficiently and from the numbers of replicas flown that it is not an experts-only model. Mind you, the wing is quite thin which, according to current trends, is what seems to count. Jeremy Collin's *Mandrake* (R.M.214 in July '79) is a semi-scale machine with all-moving-tail and ailerons, following the same philosophy.

The trend

My "Current Affairs" column has been mainly concerned with model developments, rather than with motor and battery matters, because the average modeller does not seem to want to get involved with the technicalities of volts, ohms and amps. The first was in June '77 and described the development of airframes and gearing and showed that a starting resistance was useful. August '77 saw the findings of experiments with extension drives and variable-camber wings, plus tips on nicad packs. The November '77 issue carried data on power in practice, a list of motors and the basis of speed control. June '78 described Pete Richardson's V.P. folder prop and showed some tips for streamlining models. The February '79 issue contained a test on the M.F.A. *Magicfly* and conclusions drawn from extended use of thin aerofoil sections.

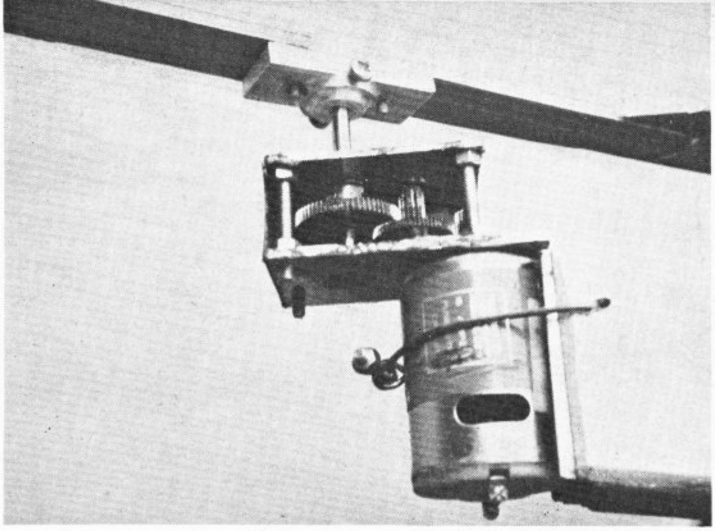
The first ever electric kit review was conducted by Nick Cook on the Graupmer *Mosquito* in the April '76 issue and in May '77 John Crampton wrote about his *Vampere* all-plastic electric model. Useful snippets of information were Paul Channon's duration flight reported in Aug. '76 and some charging tips by David Thomas in 'Matters Marine' of Oct. '77. Roy Yates, also, has contributed material on electrics, in April '76 via his Scale Topics column.

Big'uns and little'uns

The large electric-flight motors seem to have declined in popularity due to the high voltage requirement. (The boat enthusiasts seem to have snapped them up though.) There are a few Astro 02 (Mabuchi 360) types around in really small lightweights, where the fast-charge capability of four or six cells is attractive—as George Bushell has shown. Peter Bragg went even further with reworked slot-car motors, but apart from the "20" motors, there do not seem to be any new power units widely available in this country.

Breakthrough

If someone told you to chuck out fixed wings and *all the servos* to go flying, would you think they were kidding? One of our more experimental and innovative readers; John



Heading photo (opposite) gives an idea of the size of John Emmett's electric helicopter. Right: one of the simple lift units with two-stage gearbox and rigid hub.

Emmett of Teddington, who had previously been flying a Graupner *Mosquito*, did just that and he wasn't joking.

Now, electric powered helicopters are not unknown; in fact some attempts have been made in America. These followed the rather cautious trend of swopping electric motors for i.c. engines in well-tried airframes. John started from the "flying bedstead" point of view. He used an RS54 and 12:1 gearbox to drive a rigid hub rotor, and controlled its speed electronically. The lift measurements he obtained from this combination showed the practicability of a four-motor flying machine, which I will leave him to describe in his own words . . .

* * *

"I was working out the amount of power that would be required to fly a model in terms of watts per ounce. What could be deduced from existing information, was that it took about 5 watts per ounce (about 1 horse power for 10lb) for fixed wing models (and full-size for that matter.)

"A typical nicad flight-pack will only produce 6 watts per ounce for five minutes or so, so things did not look too hopeful. On the other hand, full-size helicopters fly at this ratio to obtain fast forward speed, and no-one seems to worry about the power-weight ratio of *model* helicopters.

"In fact, it is quite easy to get down below 1 watt per ounce with reasonable rotor speed, and it is at this ratio that the electric helicopter is definitely possible—with all the advantages of reliability, instant throttle response, and the simplicity of solid-state control in place of servos and mechanical linkages. This makes it more attractive than a traditional i.c. powered machine.

Test rotor

"Let's start with rotors, the amount of lift they produce and the power required to do the work. The lift of a rotor is proportional to the power input times the rotor diameter —all to the power of 2/3. This means that if you *either* double the power input *or* the rotor diameter, you get approximately 1.6 times the lift; $(2)^{\frac{2}{3}}$. "Bigger rotors weigh more and turn more slowly, needing bigger, heavier gearboxes, so there is a practical limit to the lift from limited power. The slower a rotor turns, the more adverse effect the wind will have on the helicopter.

"Experiments with rotors are best done in two stages, so if you want to try some permutations yourself; find the best blade section and planform for a given diameter and lift, then choose the gear ratio to get the best out of the motor. I started with a 42in. dia. rotor which gives 30oz. of lift with 45 watts into the motor. I tried various sections, tapers and tip shapes, washout and aspect ratios before settling on the simplest shown in Fig. 1, which also shows the construction.

"The blades were balanced by applying cellulose putty to the tips, and finished with silver cellulose paint. The motor is a Cyclone-15 and the 12:1 gearbox uses standard metal gears by Moffats and ball races bonded with cyanoacrylate into alloy plates, screwed to the motor. With everything running true and tracking accurately (achieved by packing the blade mount) the "lift unit" was mounted on a crude test rig as shown in Fig. 2. The results obtained were 22oz. lift on 5volts,

Fig 2.

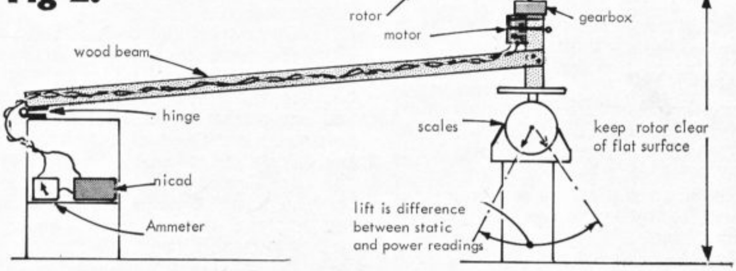
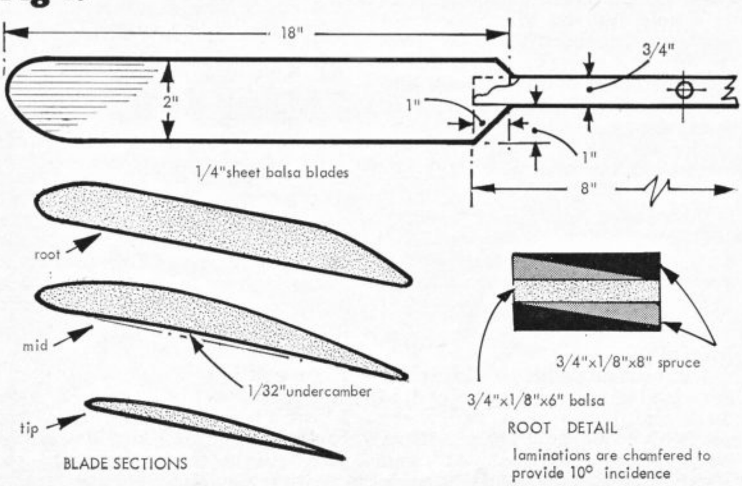
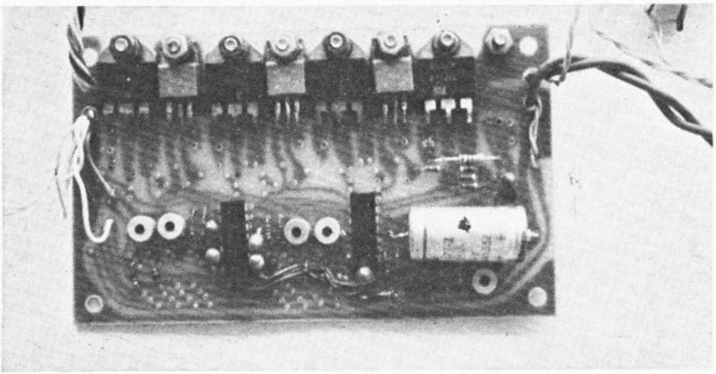


Fig I.





This four-output speed controller connects to the receiver outputs and combines them in various clever mixes Photographed during construction, it has a very high output rate.

drawing 7amps and 38oz. lift on 6 volts, drawing 10 amps. The test arm needed to be heavier than the lift, less the weight of the lift unit, to prevent the scales taking off!

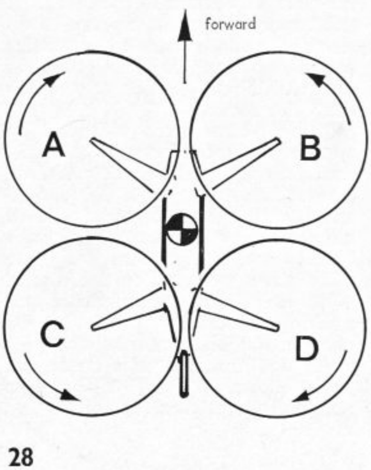
The model

"The fuselage has a pair of outriggers at each end to carry four lift units, each of which has a 2 oz. rotor and 8½oz. motor/gearbox unit. The plan view of the system is shown in Fig. 3, which indicates which rotors have to be speeded up to apply control for fore and aft, or sideways flight and yaw.

How it works

"A single speed control unit is connected to the receiver and gives four outputs, in various mixes. One output goes to each motor, and adjacent pairs of rotors turn in opposite directions. For climb; all rotors are speeded up, to fly forward rotors C and D speed up; to go back, A and B speed up. Sideways flight is controlled to the left by speeding up B and D, and to the right by speeding up A and C. Yaw control is effected by speeding up A and D to turn left and C and B to go right.

Fig 3.



"The mixer circuit in the speed controller is adjustable to match up the lift units for trimming the model. During this process, pieces of curtain tape with lead weights in them were attached to each outrigger so that if the model tilted too far it was restrained. Trimmed out, it does not like gusty weather, so a Mk.11 is to have smaller overlapping rotors all tilted inward to provide inherent stability. 30in. rotors were overlapped with a vertical clearance of 2in. to test the idea and they don't clash—it would be a different matter if they had teeter heads though!

Power/weight

"The prototype weighs 111oz., 25oz. of which is accounted for by three nicad packs, each of 7 cells with 1.2Ah. capacity. The fuselage is 26oz. and unnecessarily heavy for it is practically empty—the batteries are outside in the cool and below to aid stability. Nevertheless, it lifts off at between 5 and 6 amps on 27 volts and that level of drain keeps it going for a respectable time. The beauty of the thing is that it is so mechanically simple and the balsa rotors are easily replaceable. They do need brightly painted tips because it is so quiet and it is easy to walk into them. From the modeller's point of view, the gearboxes and speed controller are the only parts that are not orthodox aeromodelling."

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That's what I call clever! It must be another "First" in the history of R/C . . . thinks . . . "thanks to electric power". Let's hope he brings it to the Fly-in. P.H.

Fair play

I've been doing practically *nothing but* electric flight since the end of 1975 and during that time have received some "kick backs" from people who have "dabbled" and given up. Perhaps they tried electric for kicks, not knowing that it could kick back, by waiting to give of its best until the user had dived in and learned to think electric, to accept a lower power/weight ratio in exchange for the convenience of being ready to fly at the drop of a hat, in the lunch hour or on the way home from the office ("late conference, dear") without the flyer having to change into traditional modelling "clobber" or clean up after. Also to be able to fly where and when the noisy 'uns were restricted, not to have to climb a hill, stake out a bungee or un-tangle a towline.

It is the nature of nicads to improve with constant use; motor brushes have to bed in. Would you expect full power from an un-run-in i.c. engine? It's using, using, *using* that gets the best of them. I've only had a few individual cells fail in all this time, and thinking that mine were not typical, I checked up with a car club who use the same type. They give their cells much rougher treatment, charge them at a higher rate and get a year to 18 months' really competitive use out of them. A car puts sudden high loads on a battery, but an airscrew is steady and there's cooling in plenty.

I'm not a fanatic or an electrical genius; I have more fun than frustration and I keep on doing it. Like most modellers who keep up electric flight, I learnt new flying techniques to get the best out of the systems and I expect that if my latest models were flown by anyone who flies gliders and nothing else, he would do even better. I know for certain that if a "power" modeller had a go, it would take a number of flights before the pattern stopped looking mushy—but the important point is that those same models, which use standard motors and nicads, have the capability of giving a pleasing performance.

At the risk of being repetitive, I must say that I cannot help feeling that flying the electric systems at every available opportunity is the best of getting high performance out of the batteries. Yes, I've worn out a motor or two in the process, but above all I have endless enjoyment from electric flight.

Rejuvenation

Last year's Fly-In winner Alan Litchfield sent me the following battery tip. One cell in his battery pack was shown to be down on capacity; this limited the output and