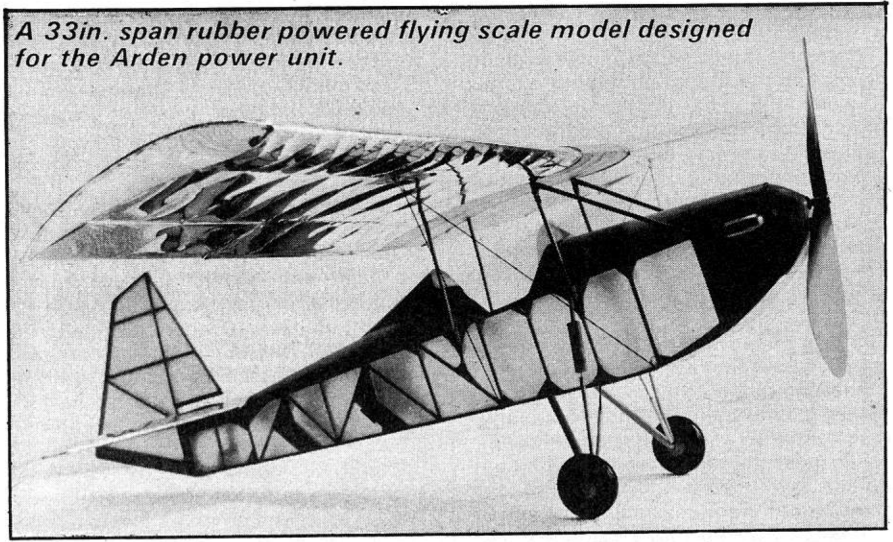
A 33in. span rubber powered flying scale model designed for the Arden power unit.



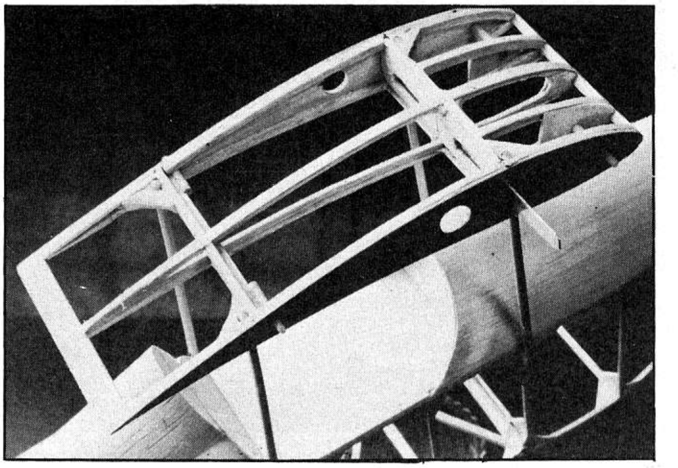
FRED

FRED'S EXISTENCE WAS revealed long ago via the pages of the Aeromodeller annual 1968-69. A 1/72nd scale drawing of the Flying Runabout Experimental Design by Messrs. Clutton and Sherry showed a delightfully pugnacious-looking light plane with a low aspect-ratio/constant chord wing using an undercambered Gottingen section, a large-ish tailplane rather too close to the wing T.E. for (model) comfort, and a simple 'boxy' fuselage with semi-circular top decks front and rear.

I decided to build to a scale which would produce a model of about 36in. span, as the trim adjustments would not be too taxing for my limited skills in that direction. The only other scale model I'd ever built was an own-design *'Kania'* of some ⅔ this size, and this had shown that a reasonable size models could survive my rough handling, a much greater threat to *my* models than their return to terra firma.

Because of the short moment-arm, a decision was made to produce movable control surfaces which could, in theory, provide washout in the mode of a crude flying wing via the ailerons, and a powerful stab section, (i.e. highly cambered), by means of the elevators. As the stabiliser angle was only to be settled after testing. I thought it likely that the variables of camber and incidence would give me considerable latitude when this stage was

Full size copies of the plan reproduced here to 1/5th scale are available as Plan No. FSR 1426



Wing centre section and cabane structure. Before gluing the centre section to the cabane struts, ensure that you have the correct angle of incidence and the wing is square to the fuselage and tailplane assembly.

reached, and, if stability was still suspect, then as much up-aileron (on both sides) as was required would solve the problem.

Gears

Sharp eyed readers will probably note that a number of changes in the structure are visible. These were the result of correspondence with the designers of the full size FRED, and their great help concerning details. For one thing, thrust-lines on FRED replicas tended to vary a bit according to the power plants employed. As I'm very keen on the use of gear-boxes for scale models because they help to avoid excessively large props, two gear-boxes were built from old clock gears; then a casual visit to the local hobby store revealed the existence of a nicely made, pre-packaged unit with nice gears, prop and an instruction sheet which demonstrated that the manufacturer had more than a rubbing contact with model aircraft. This unit, (the Arden), had a 5:1 ratio gear. In other words, for one revolution of the rubber motor, the prop turned five times. It also offered the possibility of using other prop sizes, but data did state that it was suitable for models up to 26in. span. FRED's 33in. did seem rather reminiscent of my local council's rate increase by comparison with the Arden's recommendation, but the soundness of the unit's fabrication encouraged me to take the risk. After all, two other more conventional gear units had been produced and could be employed if required.

A $9\frac{1}{2}$in. dia. plastic prop was bought as an alternative to the 7in. job in the Arden pack simply as an insurance against under-propping, a considerable snag with rubber scale as past experience had indicated. (Prop-swaps are easy on the Arden unit, by the way.)

I discovered that the Arden unit would fit very neatly into the nose block of the model; (a smaller FRED wouldn't have provided the required clearance), but the design now meant that the original intention of building a radial engine version wasn't feasible. The nose was modified to suit, and the motor-peg moved forward in anticipation of a reduced nose weight with the abandonment of the heavy brass gears.

Construction

Wings. These are three-piece, consisting of outboard panels and a centre section. It would be easier and lighter to make them as a single unit, but my intention was to allow for variations in dihedral by alternative wing-joiners with altered geometry. A knock-off system was planned, but a conventional 'banded-on' system can be used with slight alterations to the cabane unit.

Sliced ribs are employed as being more economical with balsa, and are much closer to scale. The original rib spacing is followed, but half-ribs are used rather than a sheeted leading edge to minimise weight.

Sliced ribs are very easy to cut. The sheet must be accurately marked to give constant depth, and a smooth template prepared. I always use a nose gusset at the leading edge for greater gluing area, and core template which, together with profile templates, allows the made-up ribs to be sanded as a block in the conventional manner.

Spars must be very accurately marked and cut as they act as an assembly jig into which the ribs are slotted. Main and rear spars should be matched for congruence by comparing the slots. With the three-piece wing, the wing-joiner boxes must now be built. They can be a loose fit front to rear on the joiners, but should be only 'easy' top to bottom. (This will permit the joiners to bend or break in the event of striking an obstacle, thus saving the wing). Note the vertical grain of the joiners.

Laminated tips are formed round a piece of shaped polystyrene tile from $\frac{1}{32}$in. strips and white glue.

To assemble the ribs and spars, all ribs for a panel are slipped along the main spar, fitted into matching slots and lined up to admit the rear spar. This is positioned and engaged with the ribs, and adjusted so that the whole assembly is warp-free before being glued with PVA 'White' adhesive. Aileron sub-spars are similarly fitted, and the end ribs for these units cemented in place with a small clearance at each side.

At this stage, neither LE nor TE have been fitted. The entire component should be allowed to dry thoroughly using blocking strips underneath each of the spars, these strips and the component then conforming to the plane of the building board.

Trailing edge slots are marked, checked against their opposite numbers on each spar, and assembled with the wing panel UPSIDE DOWN on the board. (Because of the under camber, there is no support for the ribs if assembly is attempted 'right way up'). Finally, leading edge slots are checked for alignment by sighting from one end. Correct slight deviations by easing with a razor blade, marking each treated rib to indicate the need for a sliver of packing when gluing up.

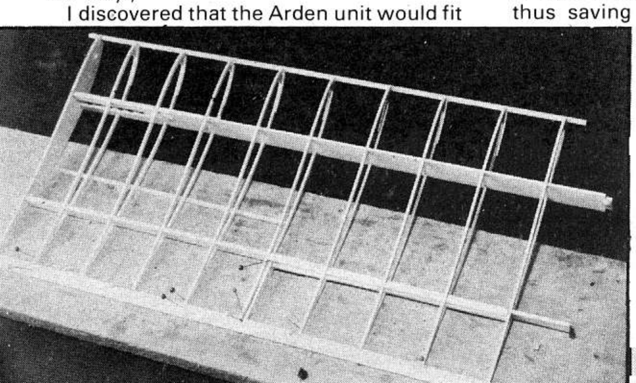
When everything is dry and true, (and if it isn't true, steam the frame and pin down as before to cure), the cross bracing may be fitted. Take care not to induce strains into the frame at this point. If the wings are on a flat base, the upper layer of braces can be fitted with the assurance that all will remain true. Then the lower set can be added with the component free of the board, only being returned for final drying. *Use PVA (white) glue for all wing assembly work.*

Fuselage

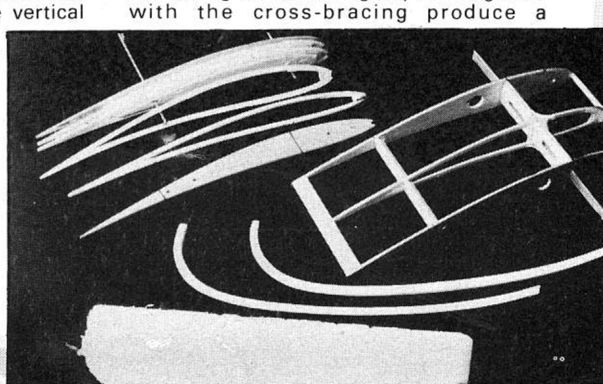
This is very conventional with the exception of the cabane assembly. Each $\frac{3}{32}$in. dowel passing from fuselage to the centre section is secured outside the longerons by means of two ply projections which sandwich the appropriate vertical spaced and cross-member. (As these are all $\frac{3}{32}$in. stock, the ply acts as a sug 'clip' on the dowels and allows dry assembly, adjustment and marking before they are glued in place). This assembly is left until all covering is completed: there is then no problem of fitting tissue panels around awkward bits of the structure.

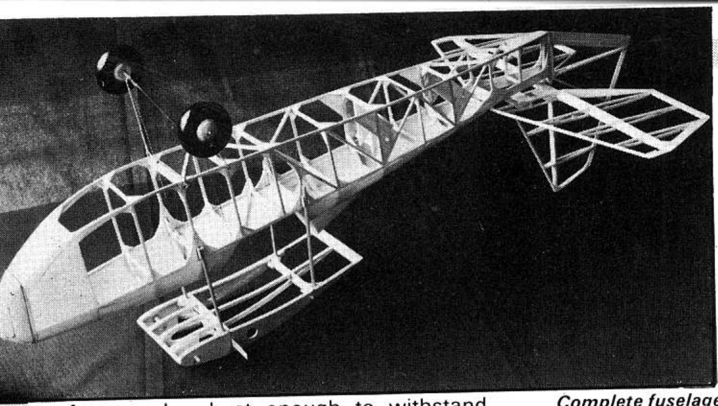
The front dowel braces are bound to wires projecting from a supplementary cross-member, and are also assembled after covering.

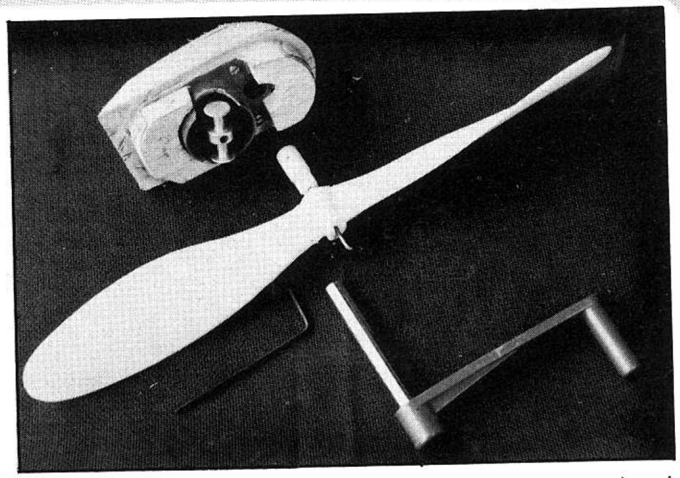
The gussets shown are very helpful in increasing structural rigidity and together with the cross-bracing produce a



Right: wing ribs and laminated ribs. In the foreground, polystyrene former for laminating the 1/32nd tips around. Left: pin the trailing edge down on the building board while gluing ribs and ensure leading edge is parallel to the trailing edge.







Complete fuselage and tail structure. Right: front end of the Arden power unit mounted in nose block, with prop, locking key and winding handle in the foreground.

framework robust enough to withstand motor and handling stresses.

Tailplane

The stabiliser is an easier version of the wing; its lack of undercamber means that it can be completed on the board.

The rudder unit can be built 'in the air', glued and then allowed to set after blocking and pinning to a board.

Undercarriage

Wheels are made by producing a sandwich of discs to which a length of alloy tube is epoxied. A wire is passed into the tube, and the projecting tube and wire held firmly in the chuck of an electric drill. The drill is clamped in a vise, and allows the wheels to be 'turned' faceplate-fashion using sandpaper as the cutting tool. After doping, the excess tube is removed.

The undercart is clipped into the tube which is cemented and sewn to the cross-member, and held in place at its front with the small band which passes through the paper tube. The 'shock absorbers' are non-working, simply hiding the ends of the floating struts from the axles, and pivoting on the small wire hinge below the strut attachment projections. The undercarriage should move backwards under impact, the rubber band needs only to hold the unit up to the fuselage sufficiently firmly to prevent its yielding excessively.

Gearbox/Noseblock

The Arden unit gearbox assembly is used without the motor tube supplied. Some slight individual modifications to the noseblock shown could allow the part to be attached forward of the ply noseblock former. Where it is joined to the rear of this part, (as shown), small bolts should be passed through the former, and secured with washers and nuts to prevent the tension in the motor pulling the gearbox away from the block. DO NOT RELY ON WOODSCREWS FOR THIS. The small pinion is adjusted on the propshaft to give the clearance recommended in the instruction sheet, (sufficient for the free-wheel action to operate). The Allen screw must be tightened with care, enough to prevent the pinion slipping on the shaft, but not so as to strip its thread.

The shrouding flange of the unit which is designed to engage with the discarded motor tube is cut away to allow easier access to the double-bobbin arrangement. (If individual models with highly detailed finishes and increased weight are produced, it would be best to use a conventional plastic bobbin with a double hook bent for the reverse rotational direction of the motor by comparison with normal 'direct drive' models. This is because the nose of the model must be held securely when using the winding crank).

Prototype weights	
Fuselage and centre section	2.00oz.
Undercart	0.50oz.
Noseblock and prop	0.75oz.
Rubber	0.75oz.
Wing panels	1.20oz.
Stab. rudder	0.30oz.
Total	5.50oz.

The prototype is covered in aluminised Melinex on flying surfaces, with light Jap tissue on fuselage and rudder. Not quite like Eric's prototype in WWI German colours (Aeromodeller May 1976 Cover) but lozenge camouflage is hard to paint.

Flying

The model was balanced at the main spar as the scale areas and short tail nose-moment were assumed to be rather marginal in their stabilising effect. In addition, the elevators were both bent slightly 'down', thus giving a highly cambered section to the stab. (Measured at the T.E. this checked out at ¼in. down elevator).

The left aileron was given $^3/_{16}$in. 'up', the right set at $^1/_{16}$in. 'up'. The thinking behind this was that the washout so induced would further aid stability, the differential between the two helping to keep the right wing up on the right hand turn which it was anticipated would be the normal trim.

After a few test glides, the rudder/fin unit, (all-moving on the model as on the prototype), was set to give a hint of a 'lean' into a right turn. The nose-block was packed to give $^3/_{32}$in. right side thrust at the edge of the nose former.

First flights with the right/right trim looked promising. The stab. seemed extremely efficient in the way it tended to lift the tail whenever the stall threatened. On 100 turns on the Arden unit, (equal to 500 on the prop), the model was flying round me in right hand circles of some 20 yards diameter. The only snag was that at the end of the power run, with the prop free wheeling the glide was tightening, and, although nowhere near a spiral, just wasn't nice to look at.

An attempt to fly right/left by moving the fin/rudder unit produced an absolutely straight flight under power with a hint of left glide; this had eliminated the tight glide, but the power run was now off key. By degrees, the nose packing was reduced, $^1/_{32}$in. at a time. This got the result that I had been seeking, even though I'd never flown left/left before. On 120 winder turns, (equal to 600 on the prop) she was away, no hint of transition problems, easy landing with the prop free-wheeling, and a spot of realistic flare-out as the ground effect came in. The maximum turns, (stretch-wound) are in the region of 200-220. On 120 turns the model averages 35 seconds very easily.

One very significant point came to mind regarding the Arden unit. I have never flow a rubber-powered model with so little paraphernalia in my life! All I carried was the winding crank, and though this did not allow any form of stretch winding, the ease with which the model was prepared for each flight was remarkable. The motor used was 12 strands as against the Arden's designed eight. The prop. was far larger than that for which the system was designed, and yet there were no problems with gear slip. this indicates that the unit is more than adequately robust for its designed use in much smaller models. I found that the driving 'step' on the Peck Polymer airscrew was not as positive as I liked when some bench tests were carried out. The prop. was modified by fitting a small wire clutch of the type commonly used in P-30 models. This locks the prop positively on 'drive', and freewheels reliably.

The dihedral brace/wing fixing system also works well, remaining secure in flight, but displacing easily with any impact. My only criticism of the model is that because of the forward CG and related wheel position, surface resistance in the form of tufts of grass and other obstructions will cause it to nose over gracefully. On the credit side, ROG is facilitated so long as the surface is smooth.

Finally, I can recommend FRED as a model likely to respond to careful trimming, but capable of being made to fly by the relatively inexperienced. The expert will be able to reduce the weight of the model by at least 30% I feel sure, as the model shown was built of very ordinary 'off the shelf' balsa. The Melinex covering is a little heavier than Jap. tissue, and the alternative rear motor anchorage shown in the photographs (but not in the drawing) is unnecessary. As ¾oz. of nose weight was added to give the CG shownm a reduction in total weight should give an even better performance.