HAVE you ever fancied an aerobatic model capable of the full F.A.I. schedule, that will also go assembled in the boot of your car? Such is 'Zippy'. Apart from the convenience, I have always had an attraction to small models, the design presented here combining the experience gained with four earlier models of a similar size.

My approach to a new design is to decide the performance criteria and then blend the necessary features into the new craft in an attempt to fulfil these demands. Examination of the new F.A.I. schedule revealed the necessity for a high power to weight ratio to cope with the vertical rolling manoeuvres and again for the hesitation and slow rolling manoeuvres which also demand generous side and rudder area. I also made a point of keeping the rudder's centre of area as close to the thrust line as possible to minimise its rolling component, so that, as shown, full rudder deflection will induce only a slight rolling tendency. But, as only half rudder throw is adequate for the hesitation and slow rolls, the rudder rolling force component becomes negligible and full rudder deflection is reserved for the spin.

At this stage, my sparse collection of motors revealed a redundant Super Tigre G15 originally set aside for Quarter Midget pylon racing. Having thus settled on a powerplant, consideration was given to the wing. Experience had shown that the complete model would weigh about $2\frac{3}{4}$ lb. (44 oz.). All the smoother flying 61 size aerobatic models appear to have a fairly high wing loading of about 30 oz./sq. ft., so my model would need a fairly high wing loading to achieve the required smoothness of flight. For an equivalent performance with a smaller wing, the loading would have to be reduced slightly (Mr. Fredney could explain why), so 24 oz./sq. ft. was selected as a target giving an area of 1.8 sq. ft.

As a swept tapering planform looks attractive, this was adopted and used in conjunction with a wing section which progressively increases towards the wing tip, disguised because the tapering planform still allows a decrease in the actual wing thickness from root to tip. The thicker wing tip will then stall at a lower airspeed than the rest of the wing, allowing slow nose-up landing approaches to be performed with confidence. As an extra safeguard, the ailerons were stopped 2 in. short of the tip and kept narrow to eliminate tip stalling encouragement from the down going aileron. Next on the agenda was wing section. A relatively thin section was selected because the powerplant is a racing unit and will only be happy at speed. The leading edge was kept blunt to enable the model to slow down more quickly when the throttle was closed and the choice of a fully symmetrical section was obvious to minimise changes in trim from upright to inverted flying and enable a zero datum, thrustline, wing and tailplane incidence set-up to be used. 12 per cent thickness ratio is therefore used at the root, increasing to 15 per cent thickness at the tip and thought was now given to aileron shape. Pure strip ailerons tend to cause more drag than effective rolling moment close in against the wing root, so the ailerons were spaced well clear of the fuselage and linked to the aileron servo using torque rods, used because of their positive action and simplicity of installation.

Unlike free flight models, multi channel R/C aircraft can utilise very small tail surfaces but as this model is quite small to start with, a minimum of 20 percent of the wing area was considered desirable and sketched out to match the wing planform. Laying out my radio gear, engine and tank on the drawing board, the fuselage was drawn and the details worked out. Selection of a 6 oz. tank was dictated by the thirsty nature of the ST.15 motor running at high revs on a 7 in. × 6 in. propeller. Tail moment was kept fairly long to reduce elevator sensitivity and 20 percent centre of gravity was chosen, well forward to encourage flight smoothness.

Construction

As this is not a beginner's model and most experienced modellers have their own ideas about construction techniques, I will only outline the main construction points. All the balsa used is of the medium soft grade except for the wing leading edge and $\frac{1}{8}$ in. sheet fuselage sides which are medium hard balsa.

Wing

A centreline is drawn along each rib and also along the $\frac{1}{2}$ in. leading and trailing edges and the two wing panels are built inverted. The leading and trailing edges of each panel are now pinned to the building board and packed up on scrap pieces of $\frac{1}{2}$ in. sheet. The ribs are positioned and alignment of the centre lines checked, the top spar added and finally, the 1/16 in. cover surface sheeting which has previously been joined and sanded is positioned with contact adhesive. The two panels are now removed from the board, the $\frac{3}{8}$ in. balsa root rib is sanded to incorporate the 1 in. total dihedral and the two panels stuck together. The $\frac{1}{2}$ in. balsa false leading edge is now added at the root, and the undercarriage seating, which has previously been prefabricated from 1/16 in. ply and $\frac{1}{8}$ in. × $\frac{1}{4}$ in. spruce can now be laid down and its position marked on and relieved from the lower surface sheeting. At this position, each exposed rib is notched $\frac{1}{8}$ in. deep and the undercarriage seating is stuck in together with the 1/32 in. ply reinforcing pieces. The top $\frac{1}{8}$ in. sq. spruce spar is now added complete with 1/16 in. balsa webbing and the first rib bay at the trailing edge is now filled with scrap block to within $\frac{1}{8}$ in. of the surface of the top 1/16 in. sheeting and the $\frac{1}{8}$ in. gap filled with $\frac{1}{8}$ in. ply to retain the wing fixing bolts. Finally, the 1/16 in. balsa top sheeting is positioned with impact adhesive and the block tips added.

A razor plane is now used to complete the final wing shaping for which a centreline along the leading and trailing edge is an aid to accurate contouring, finishing with sandpaper. Finally, the ailerons are cut out at the trailing edge, the longitudinal cut continuing to the root. The trailing edge off-cut inboard of the aileron line is then channelled out to accommodate the torque rods and tubes and repositioned on to the wing.

Final touches are by addition of the $\frac{1}{4}$ in. dia. dowel location peg and scrap block fuselage fairing.

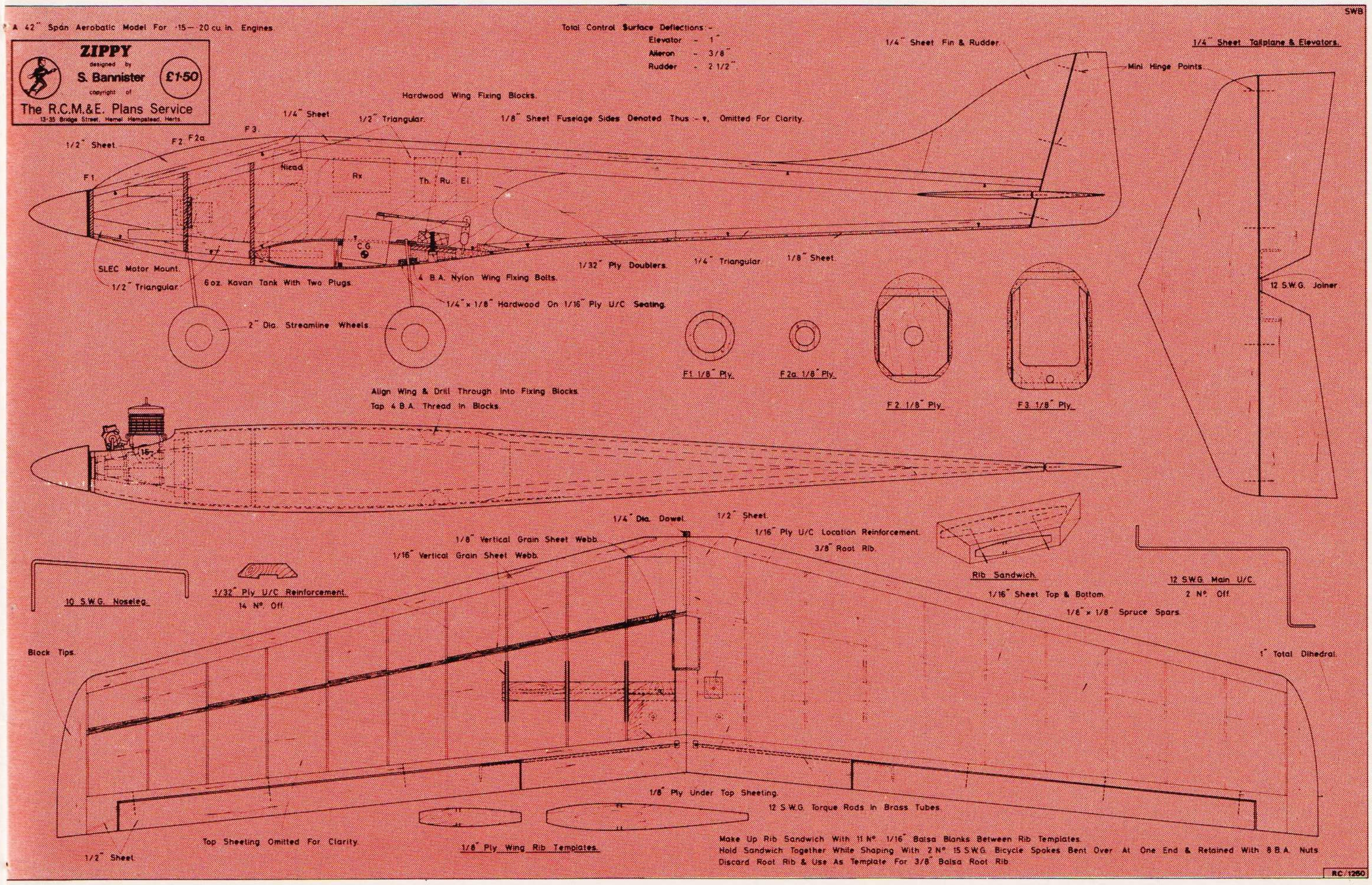
Tail Surfaces

The tail surfaces are all cut from medium soft $\frac{1}{4}$ in. balsa and shaped to a good streamline section.

ZIPPY

by Sean Bannister

If you like aerobatics and like your models small, try this 42in. span swept-wing design for .15-.20 power. Two-functions on ailerons and elevator are all you need— or fly it 'full house' as on the prototype.

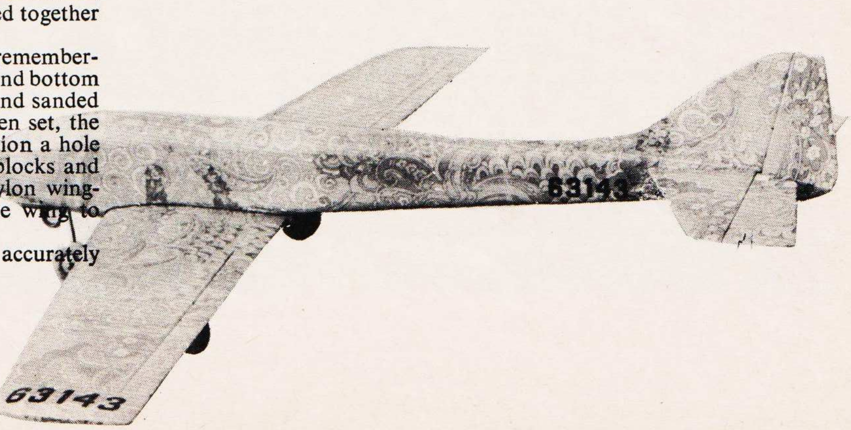


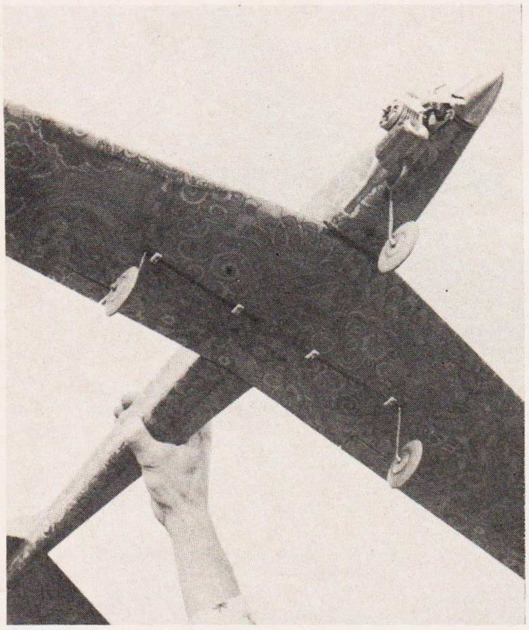
Fuselage

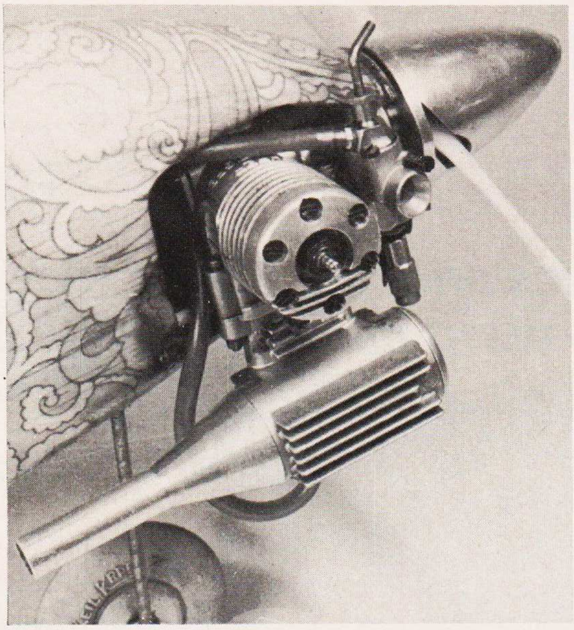
To the $\frac{1}{8}$ in. medium hard balsa sides, add 1/32 in. ply doublers and triangular pieces. Saw cuts are then made through the triangular pieces to enable the sides to bend when added to the formers. The engine mount and the undercarriage leg are now bolted to F2 and the other formers F1, F2a and F3, cut from $\frac{1}{8}$ in. ply. The triangular sections are tapered in plan towards the rear to enable the sides to be glued together at the rear.

The sides and formers are then assembled over the plan, remembering that the engine bay is cut out after final shaping. The top and bottom sheeting are now added and the complete assembly carved and sanded to final shape. Add the wing retaining bolt blocks and, when set, the wing is positioned accurately on the fuselage. In one operation a hole is drilled 4 B.A. tapping size through the wing and into the blocks and the blocks are then tapped to accommodate the 4 B.A. nylon wing-fixing bolts, but do remember to enlarge the holes in the wing to accommodate the 4 B.A. bolts.

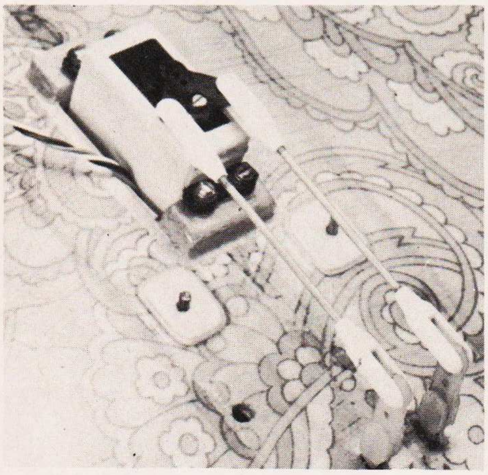
Finally, add the tail surfaces to the fuselage and align accurately with the wing in position.

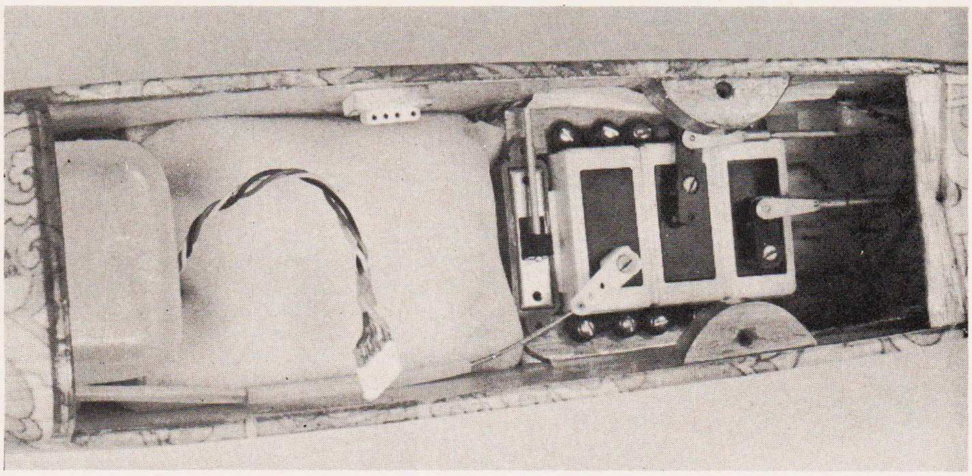






Far left: simple trike undercarriage of prototype uses Keil Kraft streamline wheels to mimise drag – cheap too. Left: motor installation showing Super Tigre G15 with muffler and manifold pressure fuel system. Prototype model has an excellent performance on this motor. 2nd left: detail of aileron servo installation and strip aileron linkage. Note also the wing bolts. Below: fuselage radio compartment showing tidy arrangement of D&R servos of the World Engines radio system.





Finishing

Traditional dope and nylon was used on the prototype and the complete finish only added a total of 4 oz. in weight, this low figure achieved by using patterned Nylon Chiffon which eliminated the need to use paint. Although nylon will add strength to the structure, plastic film could also be used on the rigid all sheet structure.

Radio Installation

All the servos are mounted on rails using the manufacturers' rubber grommets. Cut a hole in the centre section of the wing to accommodate the aileron servo and box out with 1/16 in. balsa. Hardwood servo rails are then positioned on the top sheeting to suit the servo used. World Engines rotary mini-micro servos were used on the original, but any servo of an equivalent size or slightly bigger can be accommodated. The throttle, elevator and rudder servos are mounted in a transverse fashion across the fuselage on two servo rails fixed to the fuselage sides. The receiver is loosely packed in foam in front of the servos and the 225 mAH power pack above the fuel tank. Although the prototype has the Nicad about 4 in. behind the wing trailing edge in the fuselage to bring the centre of gravity to the required position and the nose has been shortened on the plan by ½ in. to avoid this nose heavy tendency. I always build in an internal aerial for safety and neatness. Thin bowden cable is used in P.T.F.E. tubing for the throttle linkage and 3/16 in. dowel for the elevator and rudder pushrods. For the sake of rigidity, endeavour to keep the pushrod linkages as straight as possible.

Engine and Tank Installation

If a racing '15' is to be used, a 6 oz tank will be necessary for flights of a decent length, but a 4 oz. tank will be adequate if a .20 is used with an 8 in. × 6 in. prop. The Super Tigre .15 was mounted on a SLEC nylon mount, drilled and tapped 6 B.A. to the engine mounting bolts. The large circular hole at the rear of the mount enables the double plug from the Kavan tank to be inserted from the engine bay through F2 into the tank. The purpose of F2a will now become evident, it keeps the plastic tank clear of the undercarriage and motor mount retaining bolts. Also, the purpose of the double plug will emerge making up for the plug length of ¼ in. lost through the formers F2 and F2a. This installation enables servicing of the tank but also ensures a complete fuel seal between the tank and fuselage without the necessity for a separate tank bay. Don't forget to tighten the plug centre bolt up! A two line system is used from the tank with silicone rubber tubing easily threaded from behind the backplate of the engine. The vent is connected directly to the silencer pressure nipple with the carburettor lead used for filling the tank.

Flying

Set control surface deflections as indicated on the plan and the model will be fairly insensitive in comparison with other small models. This is deliberate and is an endeavour to promote smooth flying.

A small amount of right rudder and up elevator is necessary for take off. Allow good speed to build up, at which stage the small amount of up elevator will lift the model off when good flying speed has been obtained.

Large inside and outside loops can be performed with ease and for the four point and eight point rolls, half top rudder is adequate at the appropriate points with a small amount of down elevator in the inverted position. A small amount of down elevator is also used in the consecutive rolls, and these may be extended into a rolling circle with appropriate up and down elevator movements. Probably the models' best formal manoeuvre is the slow roll and here again half rudder is applied in the knife edge position but slowly in and out as the model rolls, and again with a small amount of down in the inverted position. If required, Zippy will also knife edge indefinitely and actually climb in the knife edge position with full rudder applied. The Figure M manoeuvre, complete with half rolls presents no problem, nor does the Top Hat with complete rolls (F.A.I. now reverts to half rolls – Ed.). The only manoeuvre requiring full rudder is the spin and because of the forward centre of gravity, full aileron as well as full up elevator has to be applied. Spin recovery is quick and positive though upon neutralising of all surfaces, and again a product of the forward centre of gravity. Try a flick roll by building up good speed in a shallow dive and gently pull the nose up and at an attitude of 45° pull in full up elevator, aileron and rudder. It flicks quite rapidly, but do not attempt this manoeuvre unless your radio is firmly installed! Landing approach can be made quite slowly with the ailerons' response reducing as the speed falls off with the rear wheels touching down just before the noseleg.

For a sparkling performance, a racing '15' or good Club 20 type .19 or .20 motor is necessary and be careful with wood selection to keep the weight down to 2¾ lb. It's well worth the effort. Have fun.