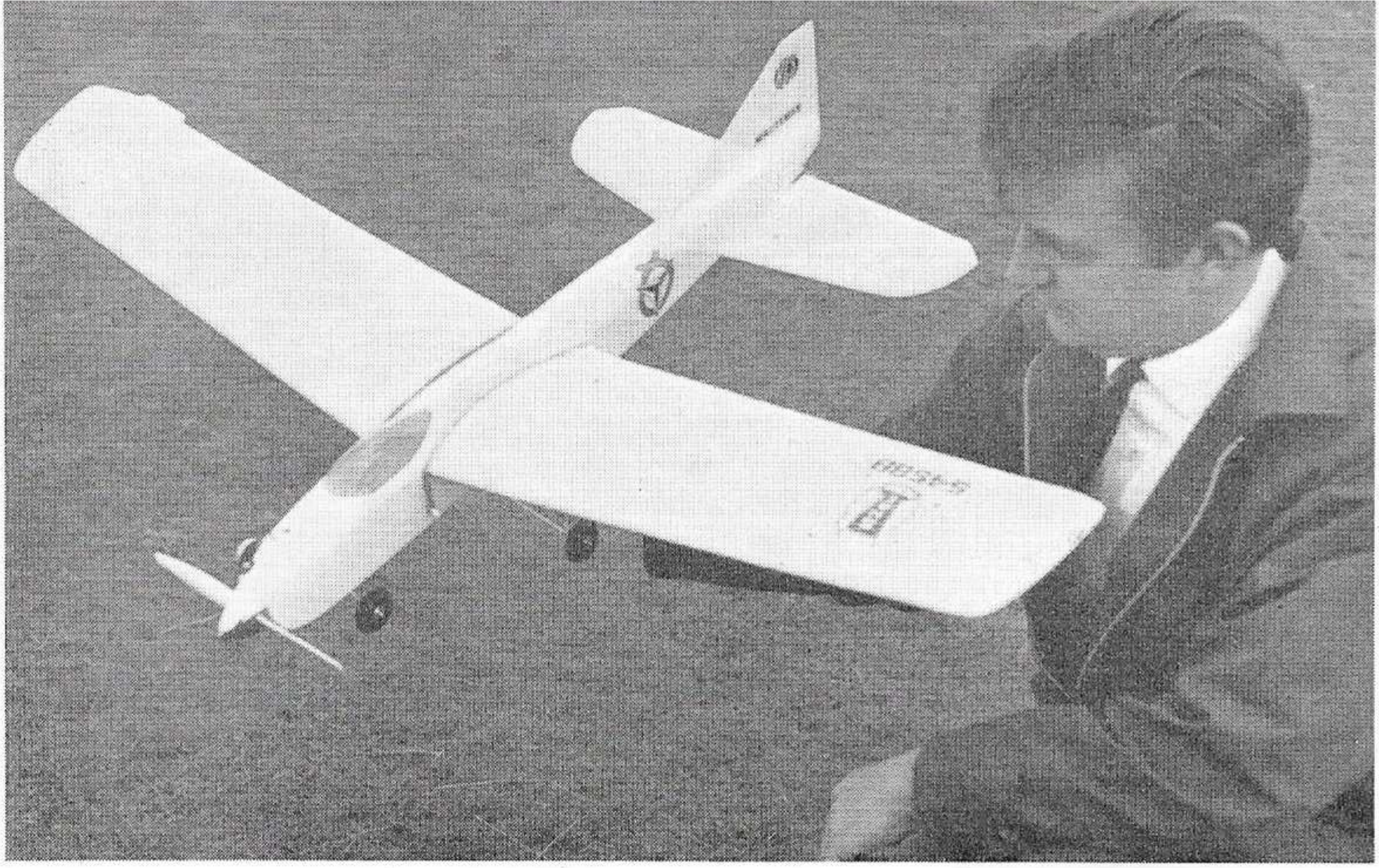


A "single" model with "multi" appearance ....

"MINUTEMAN"

by DAVE APPLEYARD

.... should help to get s/c out of its rut!

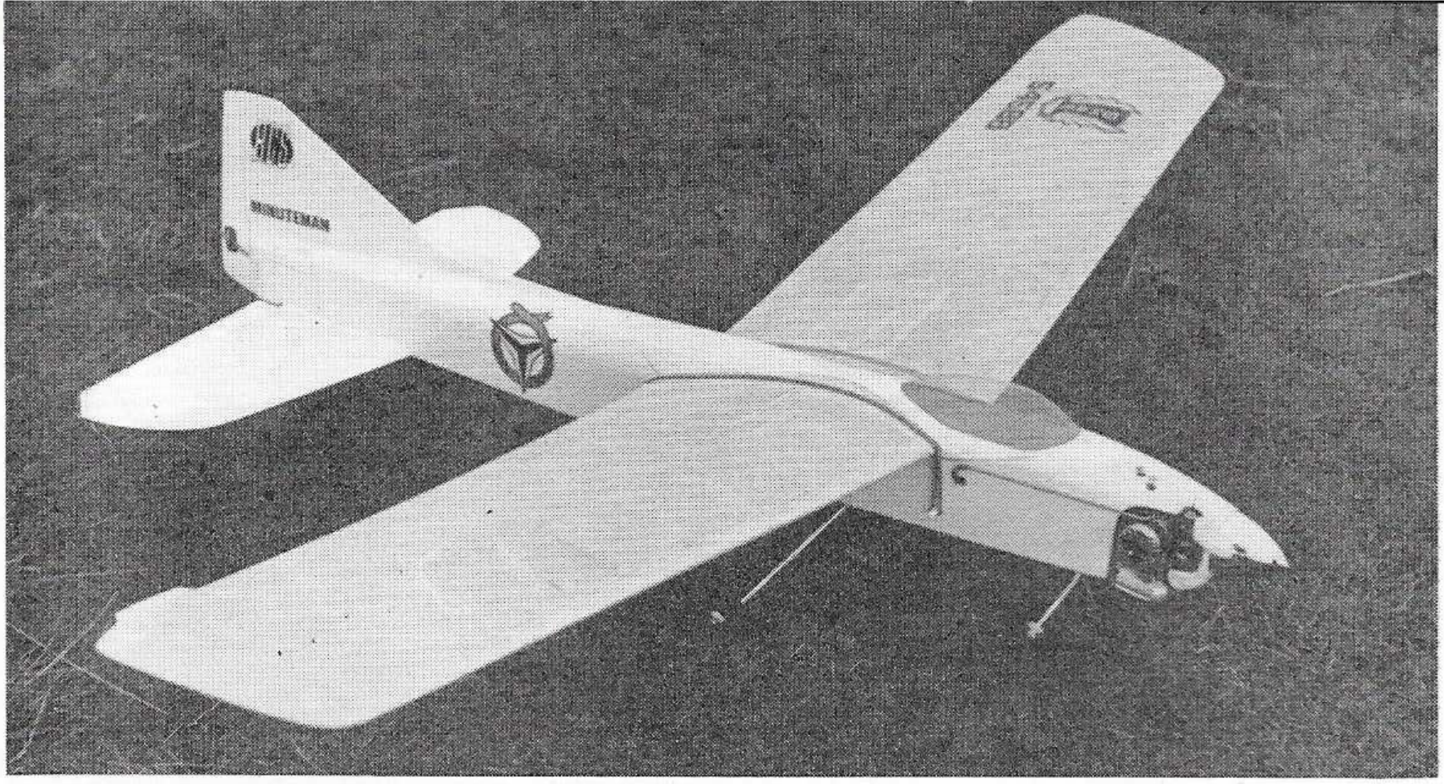
HAVING built most of the standard types of single channel model, I felt like a complete change, and decided to design my own. *Minuteman* is the result. It took four prototypes and eighteen months to get it right but, if you decide to have a go, I'm sure you'll agree it was worth it. *Minuteman* was designed from the start to have "full house" single channel equipment — rudder, throttle and "kick-up" elevator—and that is the way it should be built, if it is to realise its full performance potential.

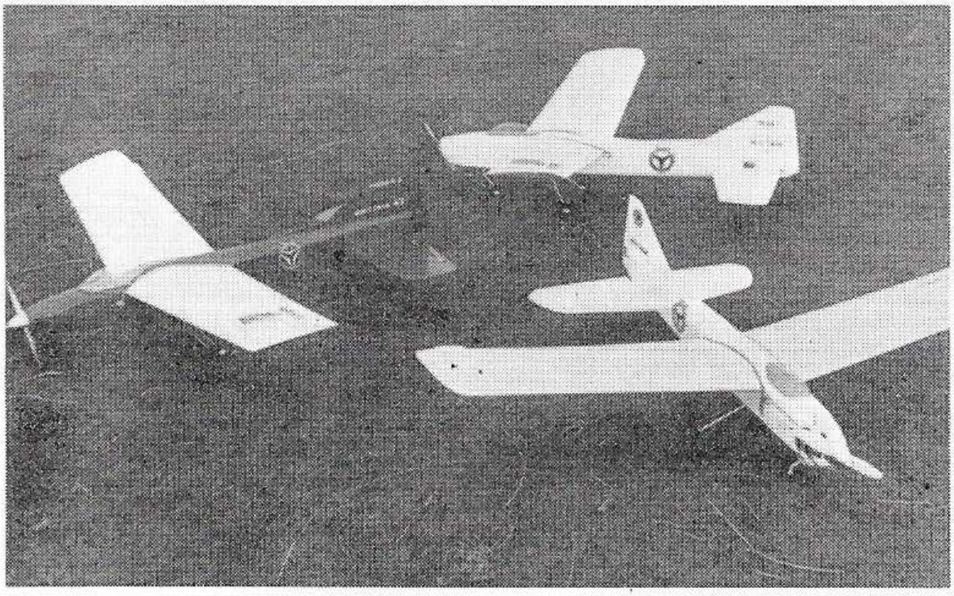
For reliable elevator operation, the tailplane is permanently cemented on, and the tips are rounded off to reduce the possibility of it hooking onto grass, and other natural hazards, when landing. The undercarriage has probably had more development than that on any other s/c model, in an attempt to achieve smooth quick take-offs and bounce free landings, so make the undercarriage just as it is, including the different wire gauge for the front leg. MK $1\frac{1}{2}$in. wheels were used on all prototypes.

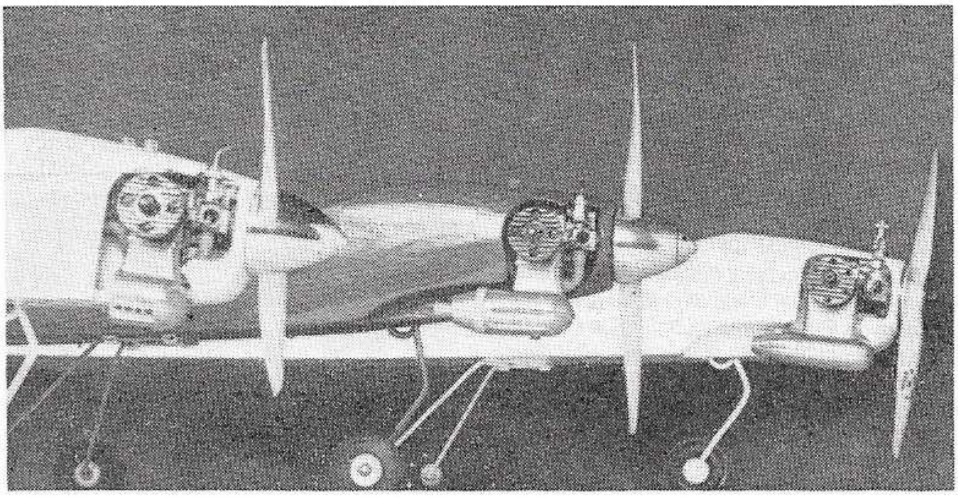
The aerodynamics of *Minuteman* may not be everybody's cup of tea—but they really do work. Let's work right through the design and see what's different and why it was done that way. Starting with the wing, the aspect-ratio will be seen to be higher than with many s/c designs and this is quite intentional. The theory being that the high aspect-ratio leads to less movement of the centre of pressure throughout the range of flying speed, and thereby reduces the "ballooning" or zooming tendency, which many single channel models exhibit after completing a turn. The high aspect-ratio could lead to the model dropping a wing easily in turns, but the unusual wing tips (inverted Höerner?) seem to take care of this point, as prototypes without this feature were rather "dicey." The aerofoil section is also the product of much development (and disagreement, I might add) among fellow club members. I can offer no technical reason as to why it should be good, but it is. The reason for the lower main spars not being carried right through to the wing tips is so that, when the wing is covered with nylon and doped, a degree of washout will automatically be induced in the wing—an absolute

THE DESIGNER — Dave Appleyard has been aeromodelling since about 1938, but temporarily dropped out for a few years in favour of tuning competition sports racing cars. (He says the skills and knowledge an aeromodeller acquires are more useful in motor racing than most people would imagine). His return to the modelling feld has so far been confined to single channel models, mostly of his own design, **Minuteman** being the latest of these.

A lecturer at Hinckley College of Further Education, in motor engineering and welding, he assists part-time with the design of industrial machinery — and still manages to find time for duties as Secretary of Nuneaton Aeromodellers!







"Ground-to-ground" shot of "Minuteman's" starboard side shows side-winder engine installation, and throttle linkage. Left: three of the development prototypes —still flying! Below is close-up of the various noses, looking like a trio of some thing from "War of the Worlds"! Note different silencer arrangements.

must for optimum performance with this design.

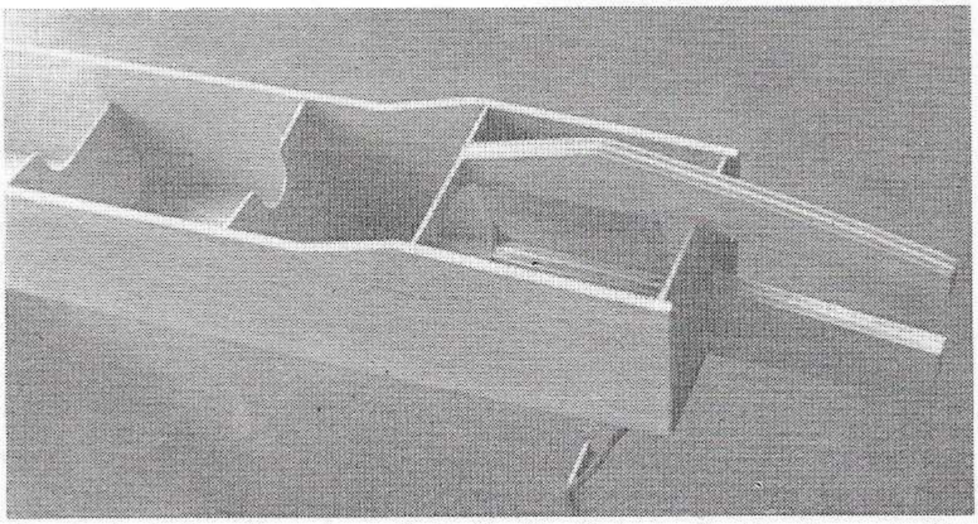
The "multi" inspired looks of the model make the fuselage cross section rather small, which might suggest, to some, that the equipment has to be hacked about to get it in. This is not so. *Minuteman* was, in fact, designed from the outset to accept pre-wired escapement packs of the Elmic Corporal and Compact type, but it is necessary to unsolder the battery box supplied and replace it with a 4.8v., 225 DKZ Deac and a jack plug, so that it may be charged in position. A Fred Rising two pawl clockwork escapement is used on one prototype in place of the Corporal unit and, incidentally, gives the model a much cleaner looking interior layout.

R.C.S. Guidance System equipment was used with excellent reliability on three of the prototypes, and Staveley "Tone Lock" on the fourth, this latter being good if one's button pushing technique is not so hot.

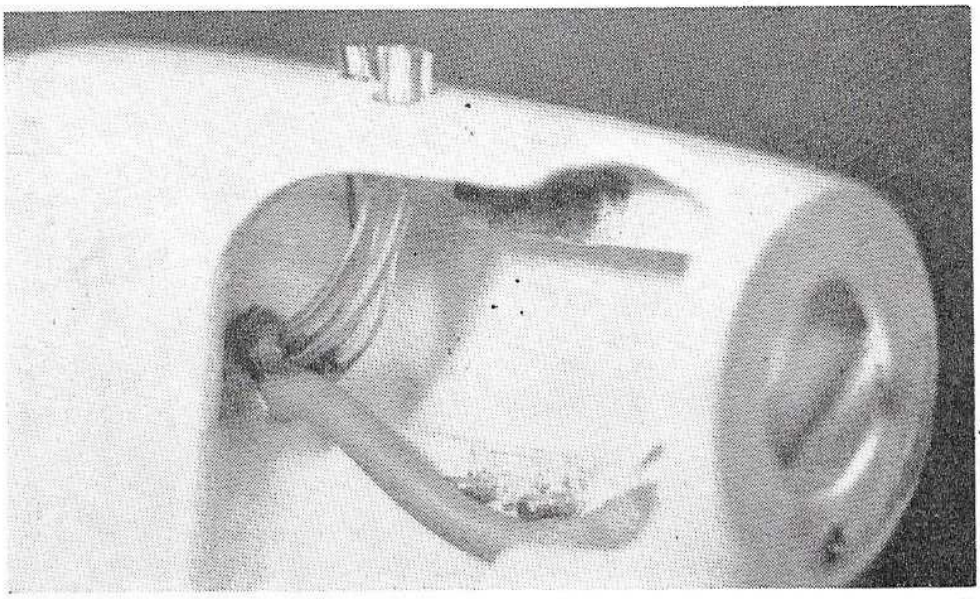
The plywood backbone of the fuselage adds considerably to its strength, by providing short load paths between all the heavy components. Super Models clunk tanks are used because they are so leakproof but, for *Minuteman*, they require $\frac{3}{16}$in. carefully shaving off the top of the bottle, and the same amount off the bottom of the screw cap, to reduce their overall length slightly. M.G. $1\frac{1}{2}$in. spinners are used, because their shape is ideal for this model, but the chromed nylon from which they are made, does discolour rather easily with glo fuel. A suitable cockpit canopy was a problem for a while, until I located a suitable type at the R.C.S. shop at Leicester. It needed only a little stretching in width to be virtually ideal.

Escapement operation must be completely reliable and tested on the ground with the engine running until this is achieved. A well balanced propeller helps considerably to ensure this.

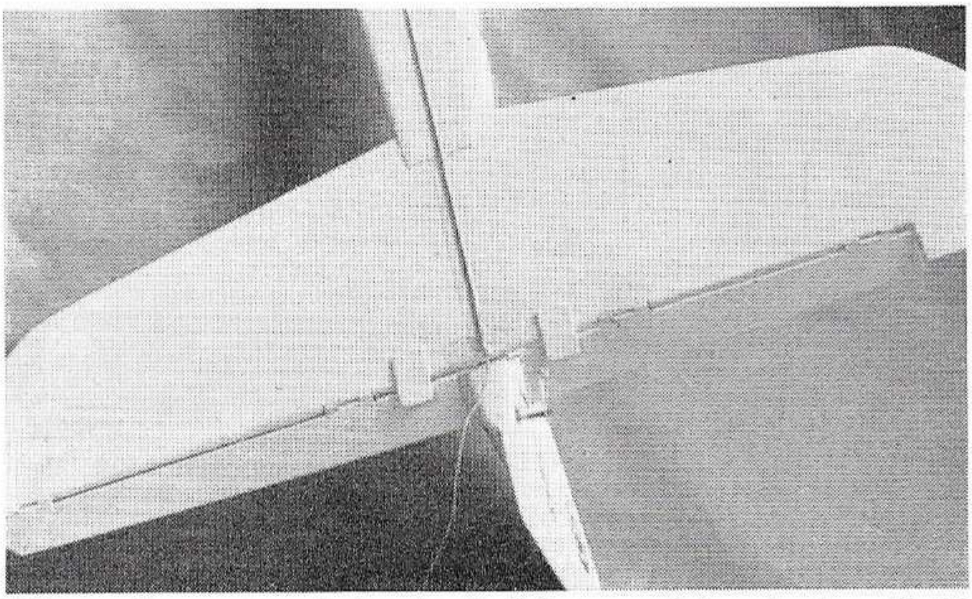
Minuteman should be about one's third model, provided the first two were really mastered, as



Constructional shot above shows clearly the $\frac{1}{4}$in. birch ply "backbone" cum bearers, assembled to front formers. The 10swg nose-leg has also been attached at this stage. Fuselage bottom is from 2mm. ply at nose section.



This close-up of the engine bay shows clearly the fuel feed and tank-vent lines, as well as the pre-fixed bolts for engine mounting. Note how fuselage shell is cut away to fair round individual engine-shape.



"Minuteman" empennage—showing the ply limit-stops used in conjunction with the "kick-up" elevator control, from Elmic Compact escapement. Note moulded nylon hinges used, which give a very free-moving control surface—vital for proper operation of the kick-up system. The aerial may be seen, in this picture, taped to the underside of the fuselage and tailplane, and "trailing" out at the rear.

it has to some small extent to be flown rather than just left in the sky to find its own way around.

CONSTRUCTION

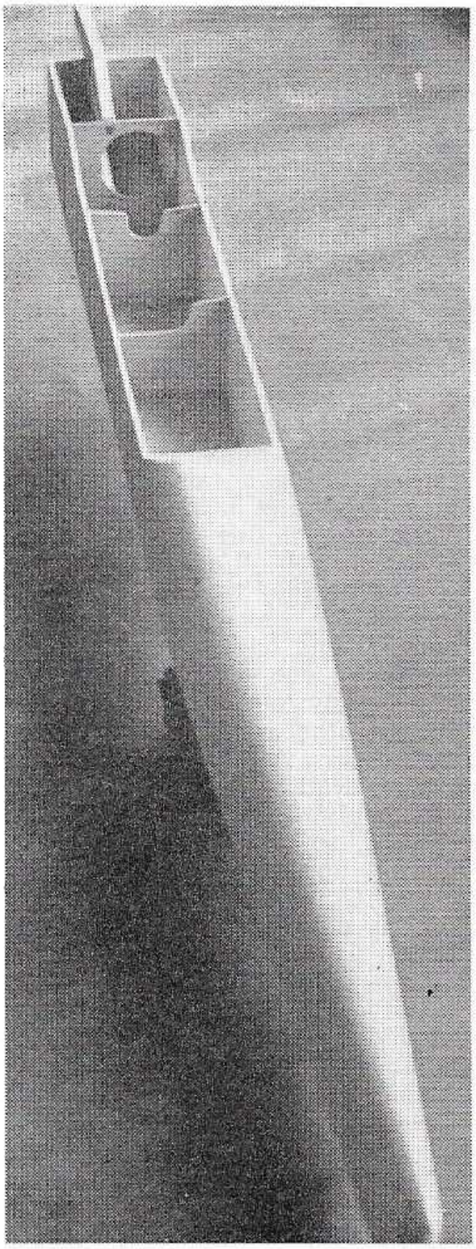
Wings

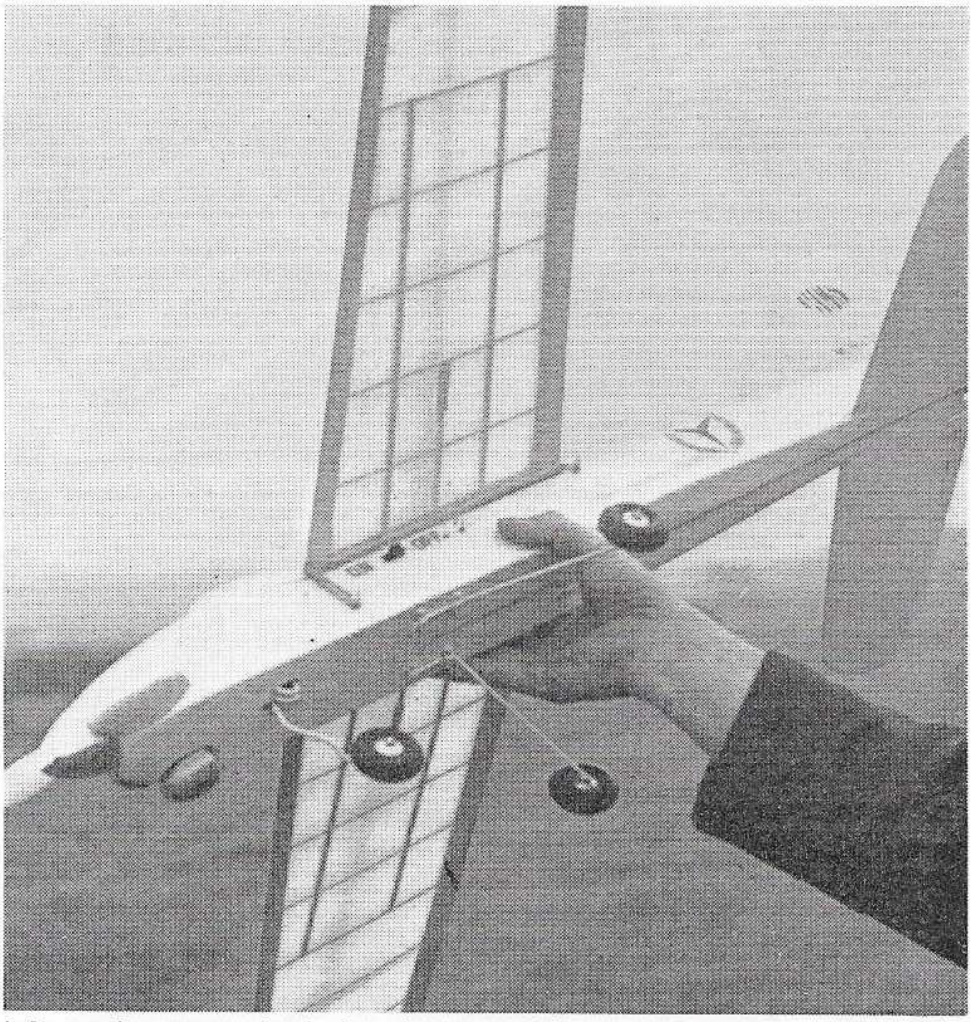
Commence the wing by cutting out all ribs and spars. Pin down the leading and trailing edge spars on the plan, and cement all ribs in position except the R 1's. Fit the tapered upper main spar in position and, when dry, place a suitable 4in. block under one wing tip, and join the wing halves together, cementing all joints. Add $\frac{1}{16}$in. ply dihedral braces to the spars, remembering that a small balsa filler-piece is required behind the leading edge spar before the ply brace can be fitted. Cement the R 1 ribs together in pairs and fit them in position. Invert the wing and fit the lower $\frac{3}{16}$in. sq. spars and cover the centre-section with $\frac{1}{16}$in. medium grade sheet. The $\frac{1}{8}$in. scrap balsa gussets can now be fitted to the outer ends of the wings. The wing-tips are made by carving the soft balsa block to plan form shape, and then to the aerofoil section of R 10. A 12° angle is then planed on the inner face, i.e. the abutment face to R 10. The tips are then fitted and finally sanded to shape. $\frac{3}{16} \times \frac{3}{32}$in. hard balsa strips are fitted under the centre-section to locate the wing squarely with the fuselage and these complete the construction of the wing.

Fuselage

Commence the fuselage by cutting out the birch ply backbone and all formers. Fit formers F 1 and F 2 to the ply backbone, using white P.V.A. glue, (Evo-stik Resin "W") and form the front u/c leg out of 10 s.w.g. wire, by wrapping it around a piece of $\frac{7}{16}$in. steel bar held in a vice. Do not forget to wrap the wire in rag while bending, to avoid injury, or wear leather gloves. *(Better still use the very effective M.F.A. wire-bender!—Eds.)* The nose leg is the toughest job on the model, but it is well worth the effort. When formed, sew it to the backbone with multi-strand control-line wire and cover the joint area in Araldite or Britfix-88 epoxy-resin glue.

Make the bottom of the fuselage from 2 mm ply up to the point shown on the plan, and rearward from that point in $\frac{3}{32}$in. balsa—cross-grain (across the width of the fuselage). Draw a centre-line





Left: another constructional shot showing assembly of fuselage formers. Above: the undercarriage arrangement can be seen in this underside view.

right down the length of the completed bottom to assist with alignment of the formers and backbone. Fit the ply backbone assembly to the fuselage floor in the position shown—again with P.V.A. glue. Fit formers F 4 and F 5 to the ply floor and make up a $\frac{3}{32} \times \frac{1}{4}$in. hard balsa bulkhead and fit in position as shown on the plan. Cut out the fuselage sides as accurately as possible, and add 1 mm ply doublers in the dotted area. Cement $\frac{1}{8}$in. sq. strips along the edges of the sides in the position shown on the plan. Drill holes in the sides for wing dowels, and then fix the sides in position on the fuselage using P.V.A. glue; pin in position until set and add the hard balsa block in the rear end of the fuselage.

Carve a piece of soft balsa to the shape of the main coaming and hollow out, as shown on the plan, to approximately $\frac{3}{16}$in. wall-thickness. Sand to final shape after fitting to the fuselage. Fit suitable blocks of soft balsa around the nose of the fuselage and carve to shape. Accurately cut the ends of a block of soft balsa to form the shape of the wing coaming, and add the $\frac{1}{16}$in. ply facing to the front end. Lightly cement the coaming in position over the wing cutout of the fuselage, and carve to correct shape, lightly sanding the full length of the fuselage to give a smooth profile.

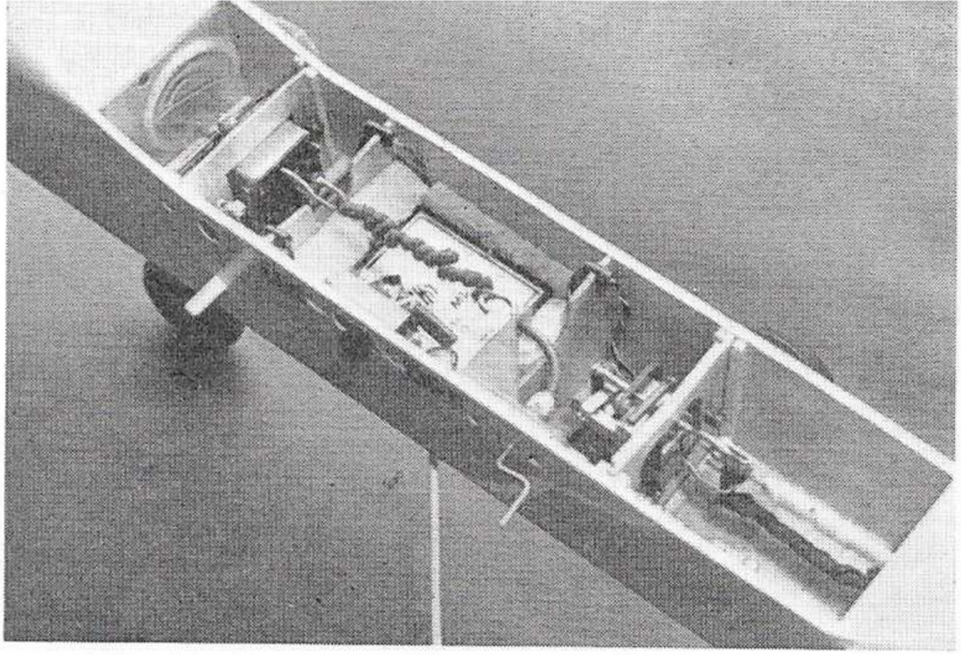
Cut the wing coaming free of the fuselage, hollow out as shown on the plan, place the wing on the fuselage and cut away the sides of the wing coaming to suit the wing shape. Now cement the coaming in position on the wing. This is the most tedious part of the construction, as the wing coaming is very thin in the centre, so patience is required.

Make the fin from $\frac{1}{8}$in. hard balsa sheet, remembering that the $\frac{1}{2}$in. deep top strip of the fin has longitudinal grain to prevent the fin warping. The main fin is slightly inset in the fuselage to improve the joint strength. The tailplane and elevator unit can now be made up as per plan and fitted by cutting away the completed fuselage in the area shown on the plan, making sure that the 16 s.w.g. wire elevator link does not foul the fuselage.

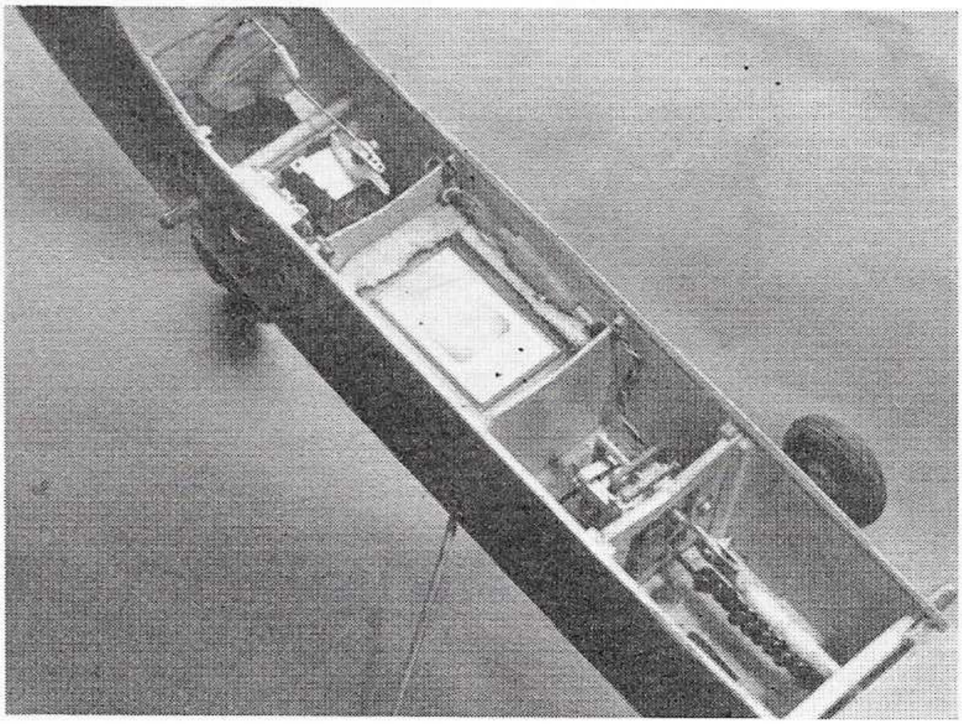
The main undercarriage is now fitted, using 10 B.A. bolts and Micromold mini saddle-clamps. Cutouts for jack-plug, on/off switch and "sidewinder" engine can now be made, and these items fitted. Sliding runners to carry bulkheads F 3 and F 6 can now be cemented in position.

Installation

The fitting-out of the fuselage can now be done, starting with the Compact escapement being fitted with "kick-up" elevator arm as per Elmic instructions, and the making up of the torque rods from $\frac{3}{16}$in. dia. hardwood dowel. The ends of the torque rods are made up of 16 s.w.g. wire, bent to a "U" shape, one bent end being inserted through the control rod and bound, the other being soldered to a piece of doubled-over tinplate, which is clamped to the sides of the escapement "hook"



Upper photo shows the RCS Guidance System installation, with Elmic Compact plus Corporal for throttle. Lower picture shows Staveley Tone-Lock installation, with Elmic Compact plus Rising 2-pawl clockwork throttle actuator.



with an 8 B.A. bolt. A $\frac{5}{8}$in. length of small diameter brass tubing is slipped over the rudder operating arm before the wire is bent to shape, to form the support bush in the hard balsa block in the rear of the fuselage. The same procedure is carried out for the "kick-up" elevator rod, a small split block being wedged in the bottom rear corner of the fuselage and then cemented.

The Corporal escapement is mounted as high as possible on F 3, and the wire bridle re-formed to suit the fuselage. Very short lengths of small bore tubing are soldered onto the ends of the bridle arm, and the external cranked arm which operates the throttle. A short length of bicycle valve tubing is pushed over the two ends of these rods to form a simple universal joint. Balsa packing is used to secure the Deac after the harness has been soldered to it. The Compact escapement rubber motor is a 26in. single loop of $\frac{1}{4}$in. flat rubber strip. A double loop of $\frac{1}{8}$in. flat rubber strip may be used as an alternative. *No other sizes of rubber are any use at all on this model.*

Covering and finishing

The fuselage is given one coat of sanding sealer and covered with medium weight nylon, followed by two coats of clear dope.

The wing is covered in nylon, followed by two coats of clear dope, the whole model then being finished in two coats of polyurethane finish.

Trimming and flying

Check that the centre of balance is in the correct position. If the model is tail-heavy, add lead ballast to the bottom of the clunk-tank compartment, well cementing it in position. If the top coaming block, covering the rear half of the fuselage, is well hollowed out this situation is unlikely to arise. Nose-heaviness can be cured by adding lead ballast to the rear of the fuselage, or moving the receiver compartment bulkheads slightly to the rear. This latter is more tedious, but a much better way of doing it.

Check that the flying surfaces are free from warps, except the slight amount of built-in washout on the wings, which must, of course, be equal on both wings. Test glide the model over a grassy surface, using a fairly fast hand launch, aiming it slightly downward, and noting its behaviour. Slight veering off a straight course can be rectified by gently bending the rudder linkage, or carefully twisting one half-elevator up and the other one down, taking care that the plywood limit stops under the elevator are not damaged in the process. Any tendency to dive can be dealt with by gently bending the plywood limit stops slightly upward, so giving the elevator a slightly upward set. If the model tends to stall when launched slightly downward, add more lead ballast to the nose—this condition cannot be tolerated.

With glide-tests completed and all due regard given to equipment reliability and button pushing technique, the model may be fuelled up and launched—with the radio switch on! The hand launch should be *slightly* upward and reasonably fast. The climb should be fairly gentle and there should be no button-pushing unless a severe banking tendency starts to develop. At about 250 feet try some gentle turns. Only a few seconds on the button is necessary to achieve this—the turn continuing after the button is released until opposite rudder is applied. This means it is possible to complete turns without constantly pressing the button and twitching the aircraft.

Aerobatics

Loops are achieved in the usual way by allowing the model to climb high and then applying rudder to produce a spiral dive, releasing the button, near the bottom of the dive allowing the model to straighten out and, as it starts to go into its first loop, signal "kick-up" elevator on the button, and multiple loops are all yours. If the loops tend to fall over

—concluded on page 35

"MINUTEMAN"

(continued from page 24)

sideways—until, in fact, they are horizontal—the left-hand or port elevator—the cutaway one—should be slightly shortened or lengthened, as the case may be, to rectify this interesting but unintended manoeuvre.

Stall turns are possible, provided they are carried out at a sensible height. Make the model spiral dive as for a loop then, as it straightens out at the bottom due to button release and starts its climb into a loop, tap the button to give engine idle. The model will come to a halt, nose-up. Press on left or right rudder and over it will go—sideways—until it is nose-down. Tap engine-on again, followed by three presses for "kick-up" elevator and it's completed. It needs practice, but is very worthwhile.

If one gets the model into a knot, always apply engine idle, and it will usually sort itself out on its own and, even if it doesn't, which is rare, you certainly have more time. "Engine-on" landings are also possible on engine idle, cutting out the long recovery trek. If the model develops the dreaded "blow away" downwind, apply engine idle to bring it slowly back again—with the odd burst of full power if height is being lost too rapidly, the idling setting being adjusted fairly high, say, about 4,000 r.p.m.

Take-offs from the ground are possible "hands off," if sufficient tarmac is available, but even if this is not so, *Minuteman* will unstick, when heading into a light breeze in about 50 to 60 ft., if a quick touch of elevator is applied and released as soon as it is clear of the ground.

Now the rest is up to you. I hope that all manoeuvres you attempt are completed above ground level!—with practice I'm sure they will be.