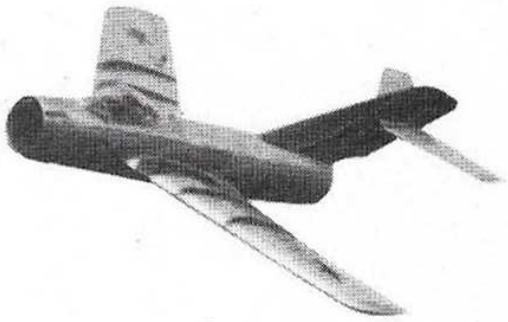

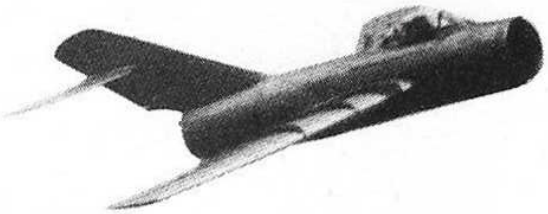

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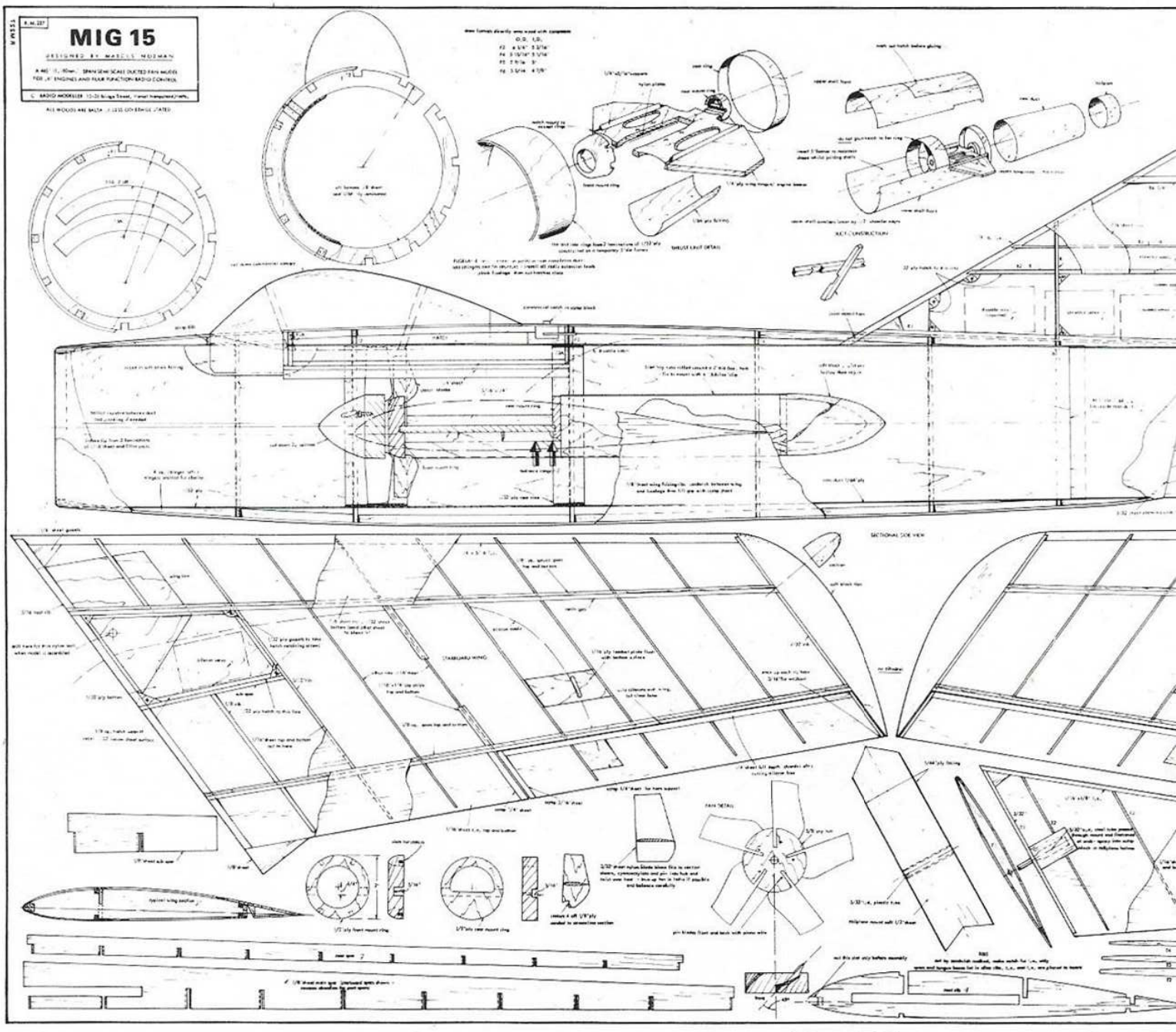

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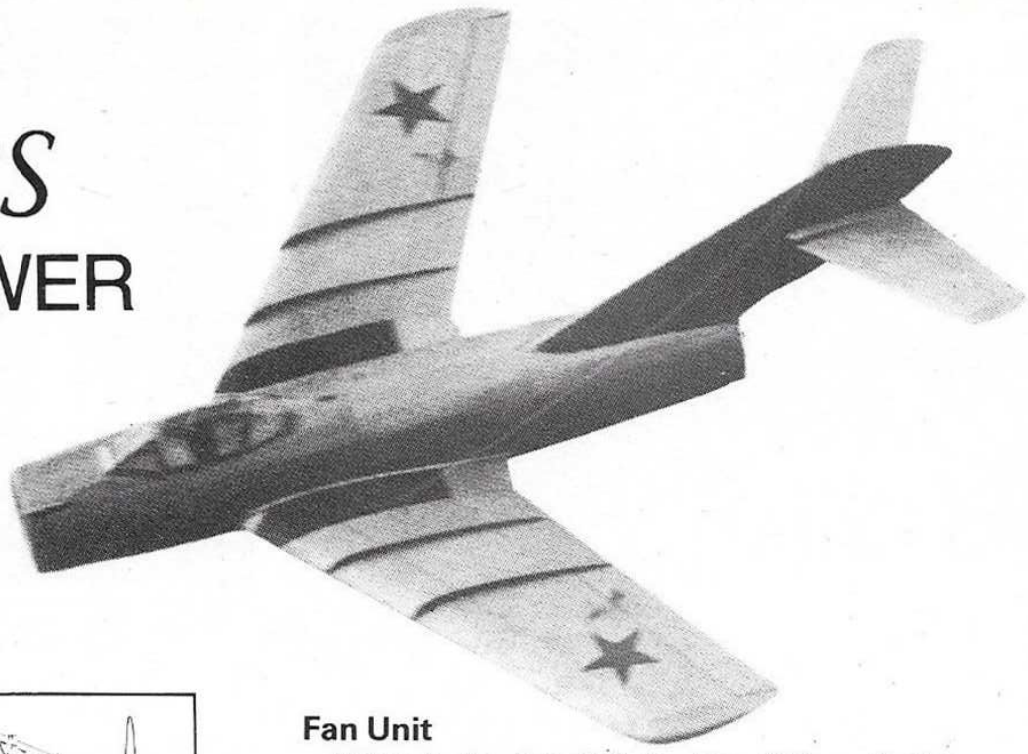
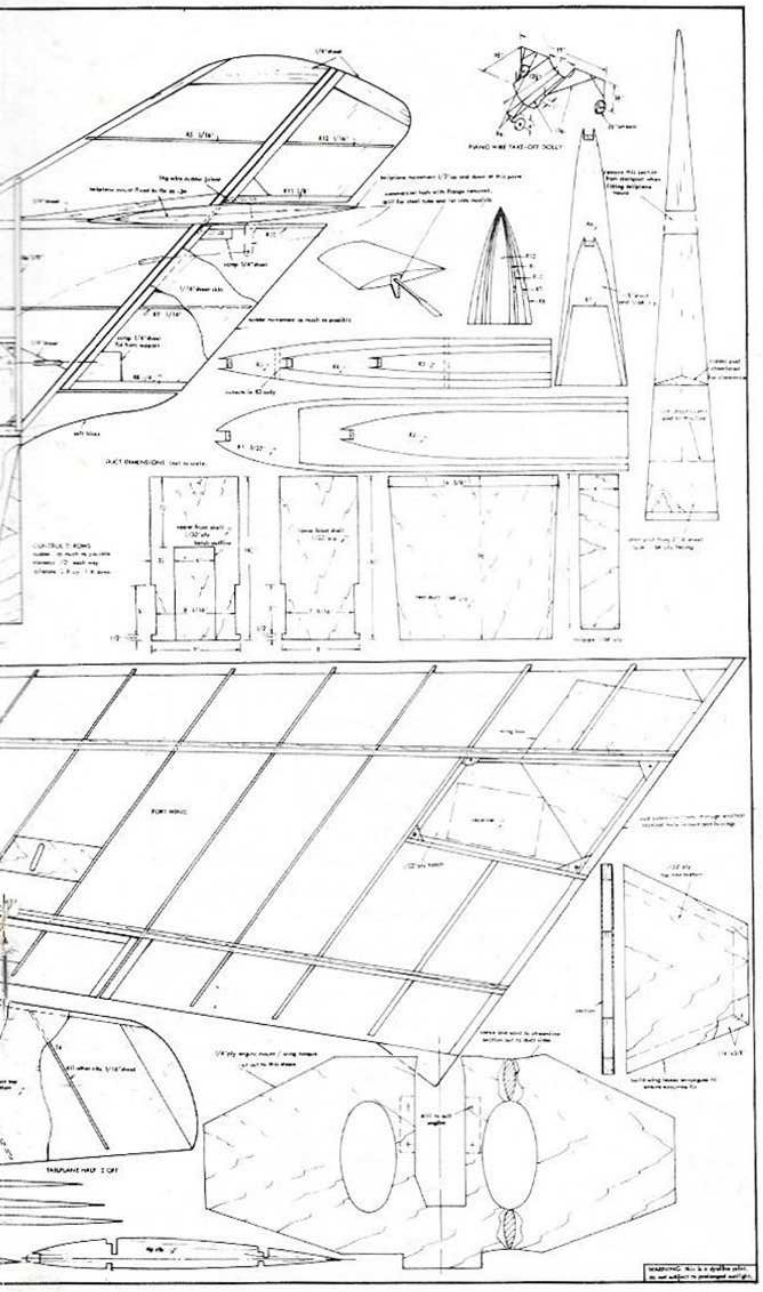




Fan Unit

Although the Fan Unit i.e. Fan, Stators, Engine mounting-cum-wing tongue assembly, Fan Ring and Rear Ring are expected to be available commercially from Micro Mold (Micro-Mold are tooling-up for this but it may be a few months before it comes on the market), it may be that some modellers will wish to construct these parts themselves. Consequently, I will describe them in some detail.

Engine Mount & Wing Tongue

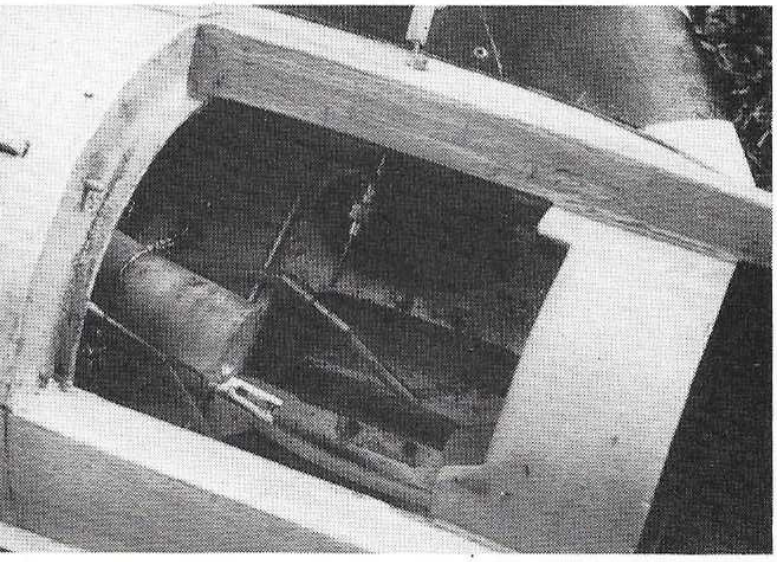
Commence the assembly of this unit by cutting out the engine mount-cum-wing tongue pattern from ¼in. resin bonded plywood as per the plan. (This particular mount is designed to suit the K & B rear exhaust rear induction 6.5 engine with tuned pipe, H.P. rear induction and MAX 40 rear induction motors, but naturally the mount can be changed to suit any engine of the 40 class and all bolt holes drilled accordingly). Carve and sand the streamlined section to shape as illustrated. Glue 1/8in. strips of nylon or suitable hardwood below the engine mounting holes to take the engine self tapping mounting screws. These must be fixed securely as they are not accessible when the ducting has been completed.

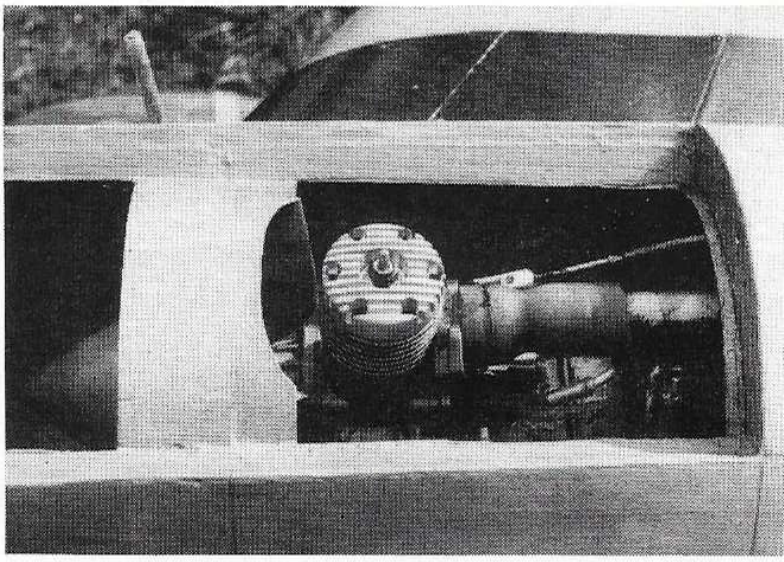
Fan Ring

Cut a 5in. dia. x ½in. plywood disc. Drill the centre to suit the crankshaft of the engine to be used (the importance of this will be seen later). Take a strip of 1/32in. plywood x 2in. wide, bind this upon the disc and mark for a butt joint. Take a second strip of 1/32in. ply x 2in. and bind this over the first piece of ply and again mark and cut for a butt joint. Now, using either a whitewood PVA glue, epoxy, or even a cyanoacrylate glue, form a laminated ring upon the 5in. disc taking care to get no glue between the disc and the ring. Allow to dry. Repeat this process for the rear ring (see plan).

Stator Blade assembly

Cut a 2in. dia. x ½in. plywood disc. Cut out the centre to allow the propeller boss of the engine to pass through. Notch this front mount ring as per the plan and round off the front edges. Cut four 1/8in. thick plywood





Above left; engine removed to show mounting. Above; engine in position, note silicon tube connection to tuned pipe; also spinner at left, on which can be seen the marks left by the electric starter cone.

stator blades as per the pattern on plan — sand and file these to aerofoil section. (Note that the camber is opposite hand to that of the fan blades). Notch the back of the stator ring to locate onto the mount. Fit the engine in its mount and affix the stator ring using white wood glue or epoxy (the fitting of the engine first ensures that the prop. boss passes through the stator ring centrally). With the engine still in position fit the 5in. dia. disc with the new made fan ring still around it onto the crankshaft of the engine. Mark carefully the points on either side of the mount at which fan ring touches. Remove the ring and disc. Now cut slots into the engine mount at these marked points, to a depth as shown on the plan. Replace the disc and fan ring on the engine crankshaft and glue the ring in position in the slots. Allow to dry. It is most important to keep the fan ring around the 5in. dia. disc whilst this operation takes place as this ensures that the crankshaft of the engine is central in the fan ring, and thus the fan when fitted should run true within the ring. Remove the 5in. disc from the engine crankshaft and remove engine. Replace 5in. disc in ring to hold it true whilst glueing stator blades in position. These are set equidistant around the fan ring with no angle on them. Glue with a good quality epoxy to obtain a very strong bond. When dry, remove the 5in. disc from the ring.

Rear Tank Mount Ring

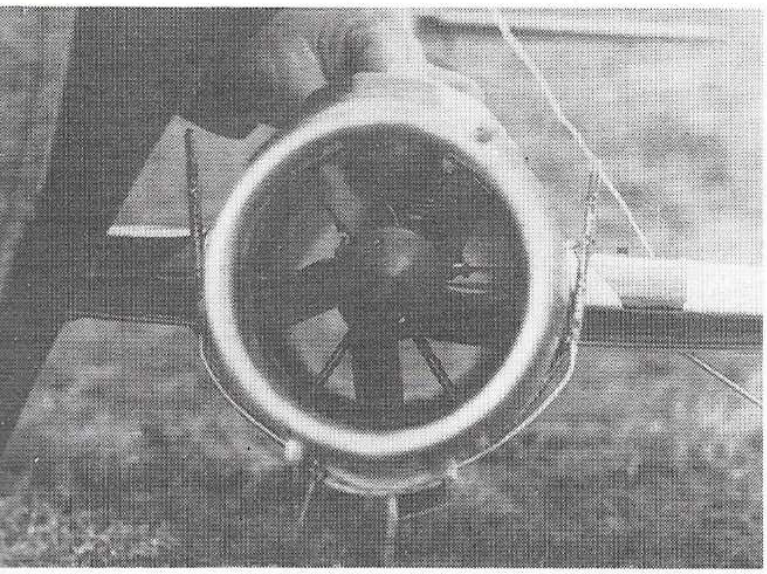
Cut from ½in. ply as per plan. Cut out top half to provide fuel line, pressure feed and filler pipe access to engine when tank cone is mounted later. Fix rear tank mount ring to engine mount as per plan. Take previously made 5in. diameter rear ring, cut a small slot either side of the engine mount at the trailing edge and glue ring centrally in position. Form ¼in. x 5/16in. supports in hard balsa and fit between front fan ring and rear ring either side of engine mount top and bottom; these provide support for the duct shells later in assembly. Make underfairing between front stator ring and rear tank mounting ring from 1/64in. ply and glue in position. Sand the complete 'unit' lightly to a smooth finish; dope thoroughly and paint if desired. Do not paint exterior of fan, rear rings, or balsa support pieces as ducting affixes to these items.

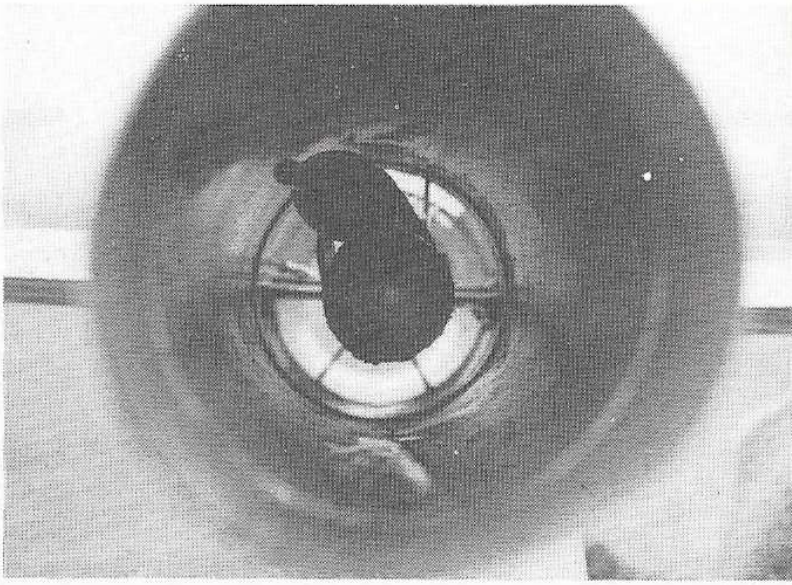
The Fan

This is the most important item in the entire model, but not too difficult to make if the instructions are followed carefully. This particular fan design has been tried and tested in many of my most successful models. (It is this design which is expected to be available from Micro Mold in a few months time — Ed.)

The Hub or Centre Boss

It is preferable to use a wood turning lathe, or employ the services of a friendly joinery firm, to turn up a number of 5/8in. resin bonded ply 2in. dia. hubs. (I personally go to the local Technical College). At the same time the 5 x 45 deg. angled slots can be cut in the hub to the depth shown, and here it is again preferable to get the work done on a machine. Accuracy is important as it reduces vibration levels and consequently allows the fan to turn at higher speeds without tearing the engine apart. Cut 5 blade blanks as per plan in 3/32in. sheet **Nylon 66** (This you will find is obtainable from Nylonic Engineering, Rickmansworth, Herts. I usually buy 1sq.ft. at a time). Place the 5 blanks in a vice and file to outline shape. Remove blades from vice and place them in the 2in. dia. pre-slotted hub ensuring that the leading edges are flush with the front face of the hub. This can be checked by laying the fan face down upon a perfectly flat surface. Having made sure that this has been done accurately use "Hot Stuff" (or similar) cyanoacrylate adhesive, to fix the blades in place. When dry, drill with small diameter drill through hub and blades in positions shown on plan, from front to rear of fan. Use 14 gauge piano wire cut into short lengths as pins and drive these through the holes. Repeat this process from the rear of the fan making sure that the second set of holes are in different positions to the first set. Now for the *hard work!!* Grasping the fan firmly, use a rasp to file an aerofoil shape on the blades as per the plan. Ensure that they are all the same. It is surprisingly that once you get going "a feel" for the job becomes apparent, so if possible, try and do this shaping all in one go. Having aerofoiled all the blades with the rasp finish off with various files and sandpaper until a smooth finish is obtained. Take a pair of round nosed pliers, and, holding each blade in turn over a source of heat for a short while, induce an under camber and a twist toward the tip as indicated on the plan. Do not hold the nylon over the heat for too long, or it will melt completely. It is advisable to try the process on one or two test blades to start with; once again "a feel" for the job will become quite apparent after a little





Above; this photo of the intake clearly shows its aerodynamic shape — the spinner, fan and starter blades are also visible. Above right; a rather unusual shot from the 'rear end' showing the tank cone and tuned pipe.

while. It is interesting to see how accurate one can become at this job even doing it "by eye". The final stage in making the fan will be to take it back to your friendly joiner together with the fan unit you have made and with the engine mounted in position carefully turn the fan down until it fits within the fan ring with as close a clearance as possible. Having done this, paint and finish the fan as required. Finally, balance the fan as accurately as possible. It is surprising how accurately a fan can be made using this method.

The Tank Cone

This is simply made from a rolled piece of 1/64in. ply wrapped around a 6oz. commercial tank which you will find is of approximately 2in. dia. Make the streamlined end of the cone from soft balsa block carved to shape, hollowed out and glued into the end of the 2in. dia. tube. I use a 2in. dia. Jubilee clip to hold this tank cone to the rear tank mount ring; this seems to be a very satisfactory method and enables quick removal of the tank, if required, on the flying field. Paint and fuel-proof the cone as required. This completes the construction of the "Fan Unit".

The Front Ducting

Cut a 5in. dia. former from hardboard. Cut the lower front shell to the dimensions and shape shown upon the plan. Making sure that the 5in. dia. ½in. ply disc is in position in the fan ring, fit the bottom shell of the front duct in place on the fan unit. Glue with white wood glue or epoxy. Mark and cut out the upper front shell of the duct in 1/32in. ply. Make sure the hatch position is marked on this shell and I suggest a small hole be drilled at each corner of this hatch shape. Mask out the position of the hatch on the fan ring to ensure that the glue will not stick the upper shell to the ring at this point. Fix the upper shell in position on the unit inserting the 5in. dia. hardboard former at the intake end to maintain the shape of the duct whilst glueing. The 5in. dia. ½in. ply disc should be in the fan ring whilst this operation takes place. Bind the duct shells whilst glueing with elastic strips, powerful elastic bands and/or string. When glue is dry remove binding.

The Rear Duct

Cut out 4¾in. dia. hardboard former. Mark and cut out shape of duct on 1/64in. ply as per plan. It may be necessary to make this in two pieces with a strip joint as 1/64in. ply is usually only available in narrow strips i.e. 12in. wide. Form the duct around the 5in. rear ring affixed to the engine mount and insert the 4¾in. dia. hardboard former at the opposite end to give a slight taper to the duct toward the rear end. Glue the tapered pipe to the rear 5in. dia. ring. Form a 1/64in. ply short tail pipe and insert in the duct end, having first removed the 4¾in. dia. former. This completes the ducting and fan unit for the fuselage. All template discs can be removed once all glues are dry.

Fuselage shaping

I suggest that at this point the hatch be almost scored through as this will make it easier to cut out later. Mark and cut out formers F1 to F6. All are of a circular section and can be scribed with a compass directly onto 1/64in. ply. Take care to measure F3, 4, 5 and 6 accurately off the plan. Mark and cut out at the same time 2 x F2A and 2 x F3A. Place formers in position over the duct and glue with white wood glue. Cut stringers from ¼in. x ¼in. and glue in position on formers. Take care at hatch position that glue does not get between the two ¼in. sheet stringers around hatch. (I usually leave a 1/16in. gap around hatch at this stage to allow for final cutting out with sharp steel kitchen knife). Lightly sand stringers and formers to make sure there are no unwanted projections evident. *At this stage all extension leads must be installed.* Three from the fin position to the port side wing tongue (the RX goes in the port wing). One from the battery pack position to the port side and one from the starboard side of the fuselage (aileron servo in starboard wing) to the port RX side. Insert also the throttle cable as per plan. 3/32in. planking of fuselage can now take place. Use white wood glue and dampen the wood as this will help to get a decent curvature. Do not plank where fin is to be fitted. Plank the hatch position separately leaving a gap around it. When all glue is dry, very carefully finish cutting the hatch out. I use an old steel bladed kitchen knife, which is very sharp, to finally cut through the already heavily scored 1/32in. ply shell.

Providing the fan ring has been adequately masked (as previously mentioned) the hatch will come away fairly easily. Clean up with sandpaper any rough edges around hatch sides. Hatch fitting is with a short dowel at the front and a commercial spring loaded catch to the rear (see plan). Build up the intake lips as shown on the

plan and sand to shape carefully. The shaping of the intake lips is fairly important as a reasonably thick aerofoiled section is better than a sharp edged lip. Cut away duct in position shown to form hatch for power pack to be used (Skyleader R.C. equipment was used on prototypes). Form a soft balsa block fairing inside duct and hollow out to take the power pack. The cockpit canopy should be fixed to the engine access hatch and will also cover the power pack area. To ensure an airtight fit to the front of the cockpit canopy a fairing is formed at the front end which is fixed to the fuselage into which the canopy can slide when the engine hatch is replaced after starting.

Fill all crevices with a suitable filler and sand entire fuselage to circular section. Cover in lightweight nylon and dope thoroughly.

Fin, Rudder & Tail construction and fitting

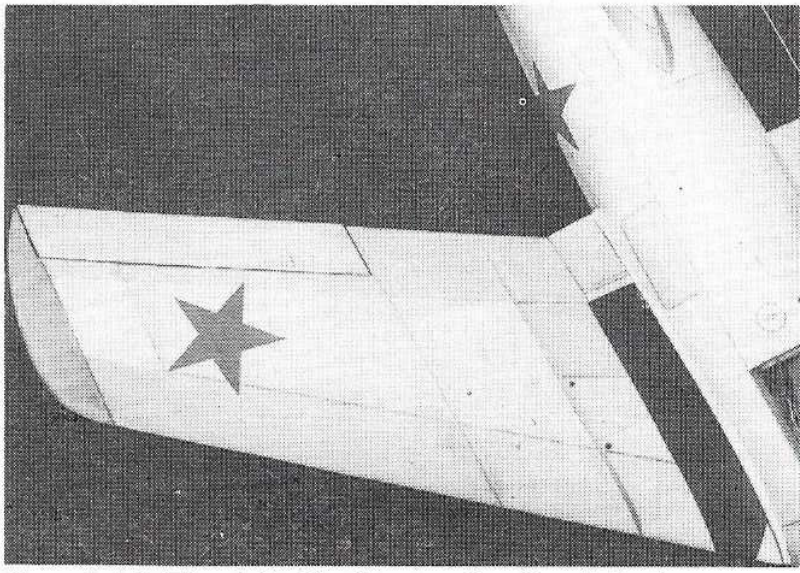
Fin: Cut out all ribs for fin as per plan. Place and glue in position on the R.6 and R.7. Cut leading edge of fin in ¼in. sq. medium hard balsa and glue in position. Cut stern fuselage post and chamfer as per plan then glue in position. Join to leading edge with ¼in. sheet tip as per plan. (Do not remove section from stern post for tailplane mount at this stage). Build up the remainder of the fin with ribs R.1 to R.5. These fit between R.6 and R.7 and the stern post. Glue securely. Now cut out the tailplane mount from ½in. soft balsa and add 1/64in. ply doublers either side. Insert 5/32in. dia. plastic tube in position shown through block. Cut away stern post as indicated on plan and place tailplane block in position with —3 deg. incidence. Glue in position. Sheet the fin with 1/16in. soft balsa. Cut out the servo box area. Insert servo fixing points and make 1/32in. ply hatch.

Rudder: Cut out ribs and rudder post as per plan. Assemble rudder in two pieces. At this stage the 14 gauge piano wire joiner should be made and passed through the tailplane mount at position shown. The two parts of the rudder are sheeted and covered, then hinged and fitted in position to the fin. The joiner must be glued firmly in position in the rudder parts.

Tailplane (make in two halves): Cut tailplane ribs as per plan. Cut 1/16in. x 1/8in. leading edge. Cut out shape of tailplane in 1/16in. sheet balsa and lay and glue ribs to this, fitting and glueing leading edge in position at the same time. Insert soft block for pivot mounting. Sheet the top of the tailplane. Repeat process on left hand tailplane. Take a piece of 4 3/8in. x 5/32in. dia. steel tube of correct length (section of old Tx aerial may suit) and flatten one end. Push into balsa block in tailplane half and glue firmly with epoxy. Cut a commercial horn down as described on plan and drill to slip over the tubing. Push onto tube and glue into recess in root rib on left hand tailplane side. Allow to set. Pass the non-flattened end through tube in tailplane mount. Place a thin washer over tube. Flatten the end of the tube and push into the soft balsa block in the right hand tailplane; glue in position and allow to set. Form and shape the soft balsa block at base of the rudder and fin above the end of tail pipe and glue in position. Cover entire fin, rudder and tail in heavyweight modelspan. Dope thoroughly.

Wing construction and fitting

Cut out main spars and rear spars as shown for both panels. Do not notch out at this point. Cut out 2 sub-

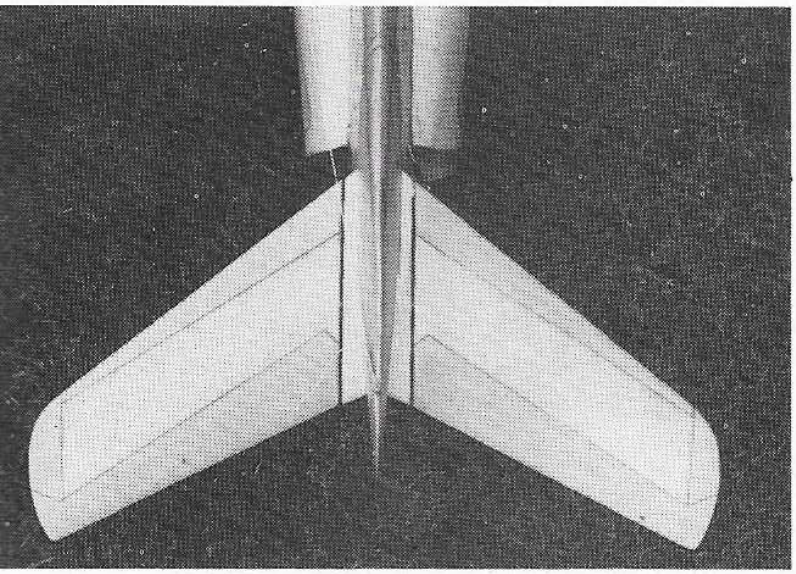


Above; shot of starboard wing. The aileron servo is positioned below the hatch cover which can be seen at the wing root. Above right; shot from above of the all-moving tailplane.

spars, 1 port and 1 starboard. Do not notch at this point. Cut out 2 tip blocks, leading edges and trailing edges as per plan. Cut out root ribs and tip ribs for both starboard and port side wing panels. Do not cut out any slots at this stage. Make up a set of ribs for each wing using the sandwich method. Lay tracing or greaseproof paper over plan and lay out leading edge, trailing edge (with 3/16in. washout packing), root rib and tip rib as per plan. Lay out and glue all other ribs in position. Now take the mainspar for the appropriate panel and mark on it all the notch positions checking it against each rib position. Cut notches in spar. Offer spar onto ribs in position shown. Mark each rib for the spar position. Remove spar and cut all notches in ribs. Place mainspar in position ensuring a snug fit to the ribs. If satisfactory, glue in place. Repeat the process for the rear spar assembly. Make up the aileron as shown on plan. Do not cut out aileron yet. Notch in to top of ribs beside spars the 1/8in. sq. spruce spars. Place the sub. spars in position using the same method as with the mainspar. The position of this will vary slightly depending on the size of servo and Rx used in each particular model. Remove the wing panel from the board and turning it over, notch the ribs to take the 1/8in. spruce spars on the bottom of the wings. Glue the soft balsa wing tip in position. Sand the wing panel to final shape using a large sanding block. Sheet the leading edges top and bottom with 1/16in. balsa. Sheet the trailing edge top as far as the rear spar. Place 1/16in. ply lead out plate for cable runs in position. Repeat entire process for other wing panel.

Wing boxes

Make up wing boxes as per plan ensuring that they fit fairly tightly over the wing tongues. Place boxes on tongues and pin wing panels in position over them. Mark carefully the position of the boxes on the bottom of the wing ribs upon the wing panels. Now from the underside of the wing carefully cut in (to the depth shown on plan) the wing box positions. Set the wing panels back over the boxes and glue in position. Make sure that both wing panels are lined up. There is no dihedral or incidence to the wings of this model. When glue is dry the wing panels may be removed from the



building board and the underside of the mainspar, ribs and sheeting can be made good below the wing boxes. A wing fairing rib, cut as per plan and slipped over the wing tongue, is then glued in position to the fuselage side and filled with scrap. The wing panel can be slipped over the tongue and a hole drilled through the box and tongue to take a nylon bolt to secure the panel to the fuselage. Repeat the process for both wing panels.

The bottoms of the servo and Rx hatches are made from 1/32in. ply glued securely in position. At this stage the two wing panels should be placed on the model and the cable runs fitted. When these have been aligned the Bowden cable can be removed and the casing cut to allow the removal of the panels for covering and finishing. The ailerons should now be cut out and chamfered ready for hingeing. Both wing panels should next be covered in lightweight nylon. It is essential to use nylon and not iron-on film as the structure of these wings gains part of its' strength from the nylon covering. Dope the nylon thoroughly. Next make the 1/32in. ply hatch covers. Wing fences can be fitted after covering if required. Now hinge the ailerons in position.

Finishing

The model is now ready for finishing. My MiG is painted silver overall with the Russian 5-pointed star in red outlined in white on the fuselage, fin and wing panels. The Russian Air Force did have an aerobatic team with the MiG painted all red on its upper surface and silver underneath. However, the various colour schemes and markings are readily available in many publications.

Having finished your decor and paint, the model can now be assembled, and the R/C gear installed. Replace the wing panels on the fuselage and bolt in position. Feed the Bowden cable through both wings and fuselage as one. The model is effectively one-piece as there is no break in the cable only to connect with the servo. All my servos are mounted on the upright wing mounts available from Skyleader. The movement of the tail surfaces has been indicated and it is quite important to get this correct. The rudder movement should be as much as possible. Ailerons approx. 3/8in. up and ¼in. down.

Engine, Tank and Fan installation

Place 6 oz. tank in ply cone and mount on rear mount ring ensuring that the feed pipe, pressure pipe and filler pipe are through the access hole. Fix the engine firmly in position on its mount. I used the K & B 6.5 rear induction motor (If a front induction motor is to be used then the rear edges of the top stator blades will have to be trimmed away to allow for carburettor clearance). It will be found that a tuned quiet pipe goes nicely along the top of the tank cone and, if used, a small fixing hook will have to be made to secure the rear end of the pipe. The fan is placed in position on the engine and a commercial spinner fitted. To do this, cut away the rear part of a 2¼in. dia. spinner, leaving the 2in. dia. back plate. It will be found that the spinner can be screwed directly to the face of the hub (the Micro-Mold unit will include a spinner). Make sure that the screws do not coincide with a blade, as this will weaken the root fixing.

Balancing

The C.G. positions have been marked on the plan. I would recommend that the forward position be used for initial flight testing. Ballast can be added to the nose between the duct and the outer skins. I had to add approx. 8 oz. to bring the C.G. to the forward position. The all-up weight of the model should be approximately 6 lbs. At this weight the aeroplane performs exceptionally well.

Dolly undercarriage

The 'Dolly' is made up as per the plan sketches — it is fairly simple to construct; the upright prongs rising just in front of the wing root leading edges. The main wheels are just behind the C.G. and the model, when sitting on the dolly, has a distinct tail down appearance as on the real MiG-15.

Flying

The model should be fuelled with the engine hatch removed. Ensure that the pressure feeds are connected correctly (if used) and that the filler vent is closed. Switch on R/C gear. The model can be started by placing a commercial starter on the spinner through the intake. Make sure that the starter is held firmly. Start the engine and adjust the needle valve. Throttle back to replace the engine hatch as there is a good deal of suction from the fan which can "grasp" the hatch from your hands before you know what's happening. Having replaced the hatch, check the tuning again. Place the model on the dolly. Check wind direction (always take off directly into wind). Check that control surfaces are working the correct way. Open the throttle wide and let the model go (it is preferable if you have a helper). The acceleration with the nose up attitude on the dolly is quite phenomenal especially on tarmac. Rotation will happen very quickly so be careful of the stall. It will be found however that the climb angle of the MiG can be pretty steep, but be careful for the first few flights. The model is very quick and responsive, so have your wits about you. If the engine does cut in flight, no difficulty should be experienced with the glide. It is fairly fast however and the rate of descent quite high.

Most aerobatic manoeuvres can be performed with this model, and it is very exciting to watch and fly. I think anyone building it will be more than rewarded by its' performance and so . . . Welcome to the Jet Set!!