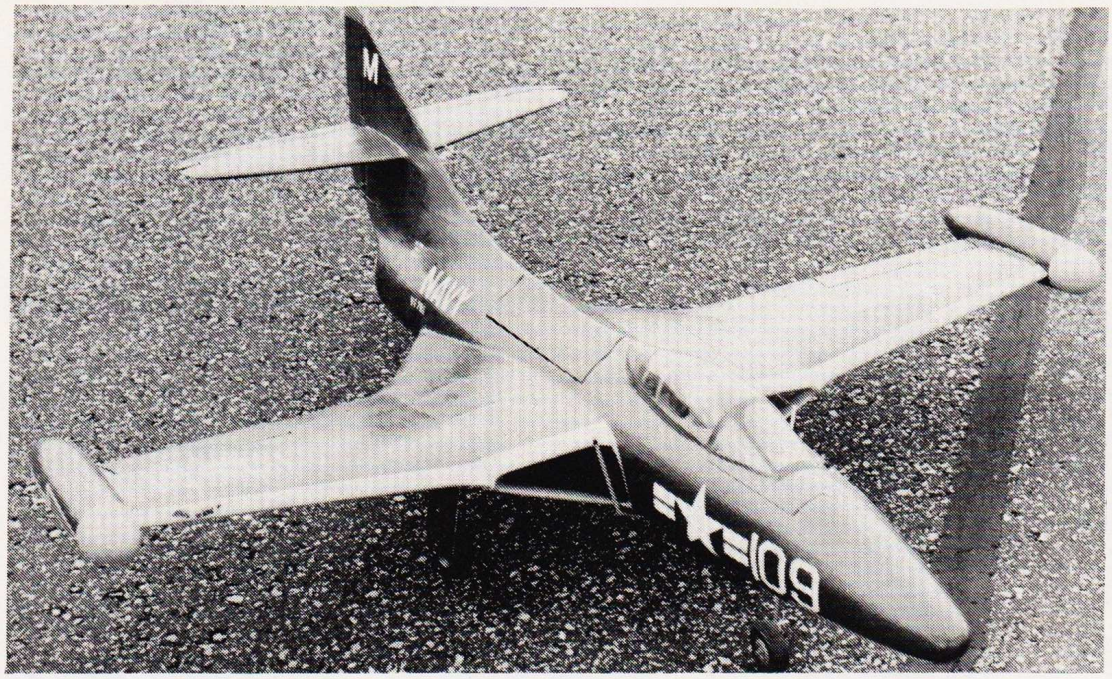
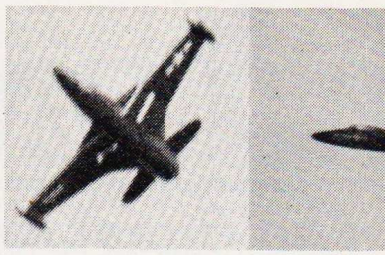


# GRUMM
# PANT
## desig
## MARCUS
**Ducted fan model for .4
function co**

### Fan unit

Although the fan unit, i.e. fan, stators, engine mounting-cum-wing tongue assembly, fan ring and rear wing are to be available commercially from Micro Mold, it may be that some modellers may wish to construct this part themselves. Consequently, I will describe this in some detail.

### Engine mount and 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 plan. (This particular mount is to take the **K&B** rear exhaust rear induction 6.5 engine with tuned pipe). It will be found that this mount will also take the **HP** 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. Below the engine mounting holes glue ⅛in. strips of nylon or suitable hardwood to take self tapping mounting screws of size required ensuring that these are fixed firmly as they are not accessible when ducting is complete.

### Fan ring

Cut a 5in. dia. × ½in. plywood disc. It is upon this that the fan ring is made. Drill the centre to suit crankshaft of engine to be used (the importance of this will be seen later). Take a strip of 1/32in. plywood × 2in. wide, bind this upon the disc and mark, to make a butt joint. Take a second strip of 1/32in. ply × 2in. and bind this over the first piece of ply and again cut and mark 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 (see sketches).

### Stator blade assembly

Cut a 2in. dia. × ½in. ply disc. Cut out centre to allow propeller boss of the engine being used to pass through. Notch this front mount ring as per plan and round off front edges. Cut four ⅛in. thick ply stator blades as per pattern on plan and sand and file 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 engine in mount and affix the stator ring.

Use white wood glue or epoxy of good quality (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 newly made fan ring still around it onto the crankshaft of the engine. Mark carefully the points on either side of the mark 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 (side elevation of fuselage and accompanying sketches). Replace the disc and fan ring on the engine crankshaft and glue 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 5in. disc from crankshaft of engine and remove engine. Replace the disc in the ring to hold it true whilst gluing stator blades in position. These are set equidistant around the fan ring with no angle on them. Glue with 'Araldite' epoxy as this gives a very strong bond. When dry, remove the disc from the ring.

### Rear tank mount ring

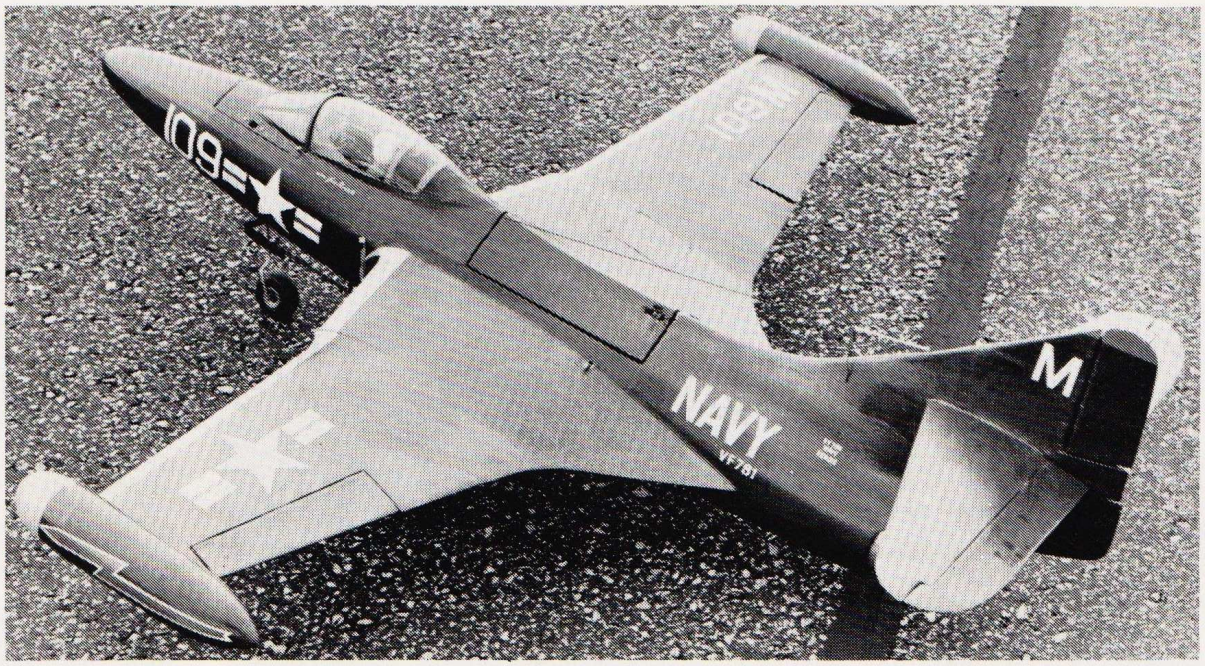
Cut from ½in. ply as per plan. Cut out top half to provide fuel line, pressure feed and filler pipe access to engine when tank cone is mounted later. Fix rear tank mount ring to engine mount as per plan. Take previously made 5in. dia. rear ring, cut a small slot either side of the engine mount at the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

### The fan

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 will be available from Micro Mold.

### 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 ⅝in. resin bonded ply hub laminations 2in. in diameter. (I go to the local technical college). At the same time the 5 × 45° angled shots can be cut in the hub to 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 five blade blanks as per plan in 1/16in. sheet Nylon 66 (this you will find is obtainable from Nylonic Engineering, Rickmansworth, Herts. or Visitar Laboratories,



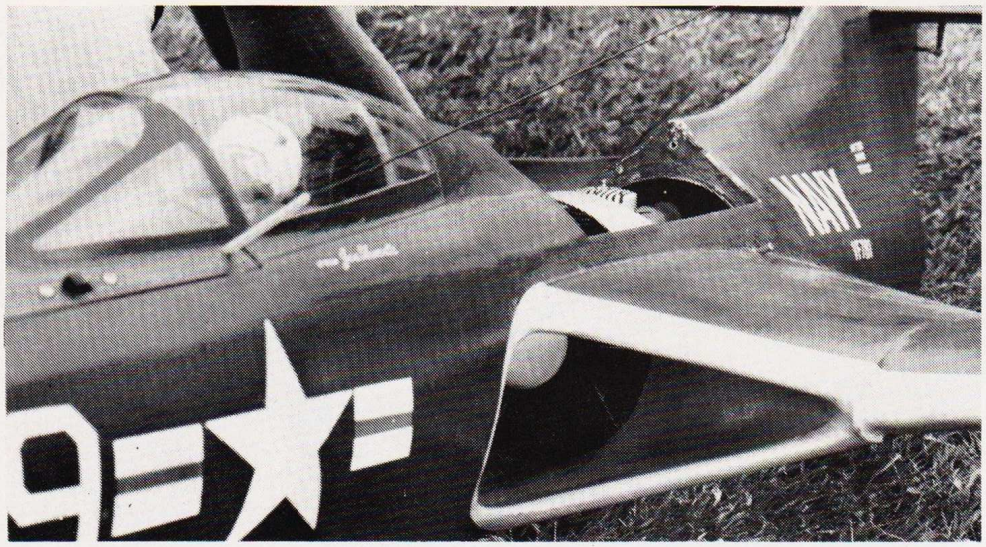

## F9-F2

# HER

## by RMAN

### motors and four stems

Imperial Way, Croydon Airport, Croydon. They are very obliging but there is a minimum charge of approximately £5. I usually buy 1sq. ft. at a time). Place the five blanks in a vice and file to outline shape. Remove blades from vice and place them in the 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' cyanoacrylate glue or 'Araldite' to fix 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 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 plan. Ensure that they are all the same. Actually it is surprising 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 a twist toward the tip as indicated on the plan. Aim for 36° at centre blade chord at 27½° at tip. Do not hold the nylon over the heat for too long, as it will melt completely. It is advisable to do one or two test blades to start with; once again 'a feel' for the job will become quite apparent after a little 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 is 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 1/16in. ply wrapped around a 6oz commercial tank which you will find is of 2in. dia. Make the streamlined end of the cone from the 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 and this seems to be a very satisfactory method and enables removal of the tank, if required, upon the flying field. Paint and fuel-proof the cone as required. This completes the construction of the fan unit. If you have one of the commercial units you start building here.

## Fuselage construction

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. 1/2in. ply disc is in position in the fan ring, fit the bottom shell of the front duct in place on the fan unit, (see sketch). 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. Mark out the position of the hatch on the fan ring so that no glue will stick the upper shell to the ring at this point. Fix the upper shell in position on the unit inserting the 5in. dia. hardboard at the intake end to maintain the shape of duct whilst gluing. The 5in. dia. 1/2in. 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 4 1/2in. dia. hardboard former. Mark and cut out shape of duct in 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 hardboard former at the opposite end to give a slight taper to the duct toward the efflux. Glue the tapered pipe to the rear ring. 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 at this point that the hatch be almost scored through as this will make it easier to cut out later. Mark and cut out formers F1 to F6. Cut out at the same time 2×F2A and 2×F3A. Place formers in position over the duct and glue with white wood glue. Cut stringers from 1/4 × 1/8in. and glue in position on formers. Take care at hatch position that glue does not get between the two 1/2in. 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 any extension leads must be installed.* (Aileron servo in starboard wing to the port nose). Insert the throttle cable as per plan. Planking the fuselage with 3/32in. sheet can now take place. Use white wood glue and dampen the wood as this will help to get a decent curvature. 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). Cut away two rectangular holes forward of the fan ring as indicated on the plan. These will become the air entry inlets to the fan from the wing root intakes when the latter are formed. Cover in lightweight nylon and dope thoroughly.

## Fin, rudder and tail.

The shape of the *fin* is determined by the formers. Cut leading edge of fin in 3/32in. medium hard balsa and glue in position. Cut stern post as per plan. Place and glue in position. Join to leading edge with 1/4in. sheet tip as per plan. Build up the remainder of the fin with halved ribs to suit. Glue securely. Now cut out the tailplane mount as per plan from 1/8in. medium soft balsa. Place tailplane block in position as shown. Glue in position. Sheet fin in 1/16in. soft balsa below tailplane fixing.

*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 halves 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 halves.

*Tailplane:* (make in two halves). Cut tailplane ribs as per plan. Cut 1/4 × 1/8in. leading edge. Cut out shape of elevator in 1/16in. sheet balsa and lay and glue ribs to this, fitting and gluing leading edge in position at the same time. Glue the two halves together firmly with epoxy and sheet tailplane and elevators with 1/32in. sheet. Use 14in. swg wire joiner. Hinge elevators to tailplane. Glue in position and allow to set. Cover remaining fin with 1/16in. balsa.

## Wing construction and fitting

Cut out main spars and rear spar as shown starboard and port. Do not notch out at this point.

Leading edges and trailing edges are as per plan. Cut out root ribs and tip ribs for both starboard and port side wings. 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 set out leading edge, trailing edge (with 3/16in.) washout packing), root ribs and tip rib as per plan. Lay out and glue all other ribs in position. Now take the mainspar for the appropriate wing 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.

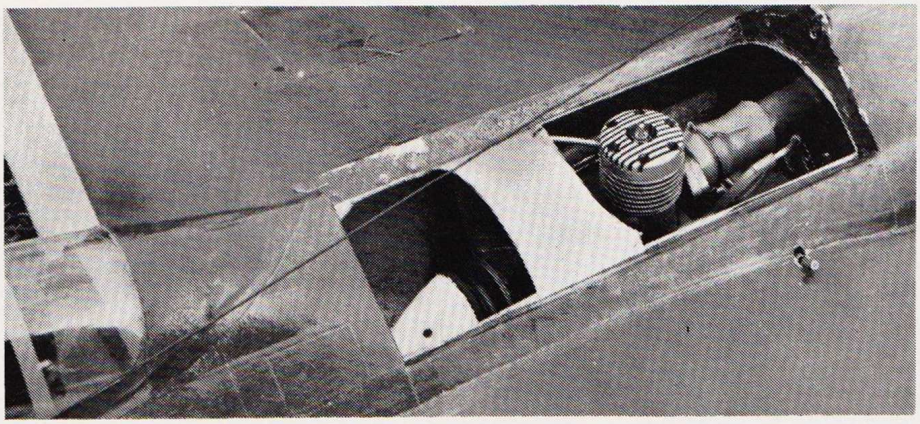
Repeat the process for the rear spar assembly. Make up the aileron as shown on plan. Do not cut out ailerons yet. Notch in to top of ribs the spars and the aileron. Place the sub. spars in position using the same method as with the mainspar. Remove the wing panel from the board and turn it over to complete the aileron. Sand the wing panel to final shape using large sanding block. Sheet the leading edges top and bottom 1/16in. balsa. Sheet the trailing edge top as far as rear spar. Place 1/16in. ply lead out for cable runs in position. Repeat entire process for other wing panel. Wing tip tanks can be made up at this stage.

Mark carefully the position of the lugholes on the wing ribs and cut. Make sure that both wing panels are lined up at dihedral and incidence as per plan.

Glue with white wood glue. Fit cable runs. Repeat the process for both wing panels. The bottom of the servo hatch is made from 1/32in. ply glued securely in position.

## Wing roots intake formation

Cut away the portions of the leading edge wing roots as shown on the plan. The




Above: the main fuselage hatch is removed for starting. Note the large access area to the starting pulley fixed between the spinner and the fan. Marcus is shown starting the model in the right photo. The very short lead on the glow plug clip is a notable safety feature. Marcus is holding on to the cylinder head of the engine as the starting cord is pulled, as the fan centre would only have to deflected a few thousandths of an inch for the blades to strike the duct wall.

Correctly formed air intakes (facing page) are an important feature of the design. The air must be delivered to the fan as smoothly as possible and a large and clear tail duct must be provided, as in the photo below. The nose high attitude of the *Panther* on its take-off dolly is shown in the photo at the bottom of the facing page. This dolly is formed from wire and the model merely rests on it during the take-off run, no mechanical release mechanisms or catches being employed. Dummy wheel bay doors attached to the dolly improve the static appearance considerably.

rectangular holes on the sides of the fuselage have, of course, been cut away. Now very carefully build up the 'V' shape which will form the actual entrance lips to the intakes.

The air entry to the fan should be as gradual as possible. This is shown on the plan view of the *Panther* drawings. Using the sketch drawings and the plan views carefully build the intake ducting. Although this looks difficult it is really quite simple if the plan is followed and care and time are taken. Sheet the inside of the intakes with 1/16in. balsa. Cover in lightweight tissue and dope thoroughly. Build the root ribs up as shown on the plan. Infill the other ribs and main and rear spars with scrap balsa to form the thickened wing root section which is a feature of this particular aeroplane. Sheet the entire wing with 1/16in. balsa sheet. A very interesting shape is formed as this sheeting proceeds and this part of the building is very satisfying. The ailerons should now be cut out and chamfered ready for hinging. Both wing panels should be covered in Model Span. Dope thoroughly. Make the 1/32in. ply hatch cover. Hinge ailerons in position. Glue wing tip tanks in position. The finishing of the model can now be done.

Form the cockpit fitting. Install any instrumentation required and glue the cockpit in position. Note the plan shows the front part of the cockpit removeable. This part is attached to the removeable hatch which gives access to the radio gear in the nose.

The paint scheme of the aeroplane is, of course, a personal choice i.e. either the dark blue US Navy colours or the gull grey and white colours used by the US Marine Corps. Details of the colouring of the *Panther* can be found in many publications.

Having finished your decor and painting the model can now have the gear installed. Feed the bowden cable drive through both wings and fuselage as one. All my servos are mounted on the upright wing mounts available from Skyleader. However, the installation technique will be down to each individual. 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 approximately 3/8in. up and 1/4in. down.

## Engine tank and fan installation

Place 6oz 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. Screw engine firmly in position on 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 a small fixing hook will have to be made to secure the rear end of the pipe if used.

The fan is placed in position on the engine with a commercial spinner fitted. To do this cut away the rear part of a 2 1/4in. dia. spinner leaving the 2in. dia. backplate. It will be found that the spinner can be screwed directly to the face of the hub (with the Micro Mold unit this will all be provided). Make sure that the screws do not coincide with a blade, as this will weaken the root fixing.

The CG positions have been marked on the plan. I would recommend that the forward position be used for initial flight testing as the model is distinctly hairy if tail heavy. Ballast can be added to the nose. I had to add approximately 8oz to bring the CG to the forward position. The all up weight of the model should be approximately 6.5lb. At this weight the aeroplane performs exceptionally well. In fact mine is 7.25lb (my heavy building again.

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 CG and the model, when sitting on the dolly, has a distinct tail down appearance as on the real *Panther*.

## Flying

The model should be tanked up with the engine hatch removed. Ensure that the pressure feeds are connected properly (if used) and that the filler vent is closed. Switch on RC gear. The model can be started with the old cord method wound around the pulley part of the spinner or with a commercial starter and belt.

Make sure that the starter is held firmly. Start the engine — tune as required. Throttle back to replace engine hatch as there is a good deal of suction from the fan which can 'snatch' 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 much easier if you have a helper).

The acceleration with the nose up attitude on the dolly is quite quick especially on tarmac. Rotation will happen very quickly so be careful of the stall. 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. Do not try to prolong the glide by pulling the stick back too far. 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.