Gene Pape

FAWF

For starting one of these snarling beasties, a good one-hand hold positions and steadies crate for flipping. No mistaking how the prop was pulled through—note that long follow-through. Emphatic pull-through avoids bitten finger.

Why did one of the best combat men opt for a foam airplane? He finds it a better machine in many ways, and his dissertation on foam and how to cut it is one of the most interesting and readable we've yet encountered. Combat fliers will dig his rationale in both design and materials—and there are bits of wisdom for you "wireless" guys as well.

MOST construction articles start out, "Here is the ultimate model. It does everything better than any other." You've read that before so I won't insult your intelligence with it. But probably you're wondering, "What kind of a name is FAWF for a combat plane and why should I build one?"

The name FAWF identifies the First Airplane We Flew in a test session that includes six different airplanes. When Rich Brasher's Rotation Station arrived on the scene on the West Coast, everything else suddenly was outdated. While plans for the Rotation Station were available to me, I soon discovered that you had to be dedicated to make them fly right. You couldn't just build one and fly it. The FAWF is a different story. I have built about 20 of them and each one was competitive right off the board. Consistency is a prime factor in winning in combat.

There is much more to having consistent-flying airplanes than building the same design all of the time. You must pay attention to certain details. Each airplane must be balanced the same. You must be very careful that the plane is straight.

Keeping all this in mind, there have been several times in the past three years that I have found myself without airplanes just before a contest, built a couple of FAWFs and brought home some trophies.

Unless you have built foam models before, the construction techniques in the FAWF are probably entirely new to you. It frequently is claimed that foam is faster and easier to build. Wrong! It's a whole new ballgame in which the experienced builder is a beginner. The advantage of foam in combat is that it will grab a string and pop the knot off where wood won't cut a thing.

Before I get into the step-by-step construction procedures, let's discuss some of the different types of combat airplanes now in use and why I chose to do an article on this type of plane. Also I'd like to pass along my experiences with different materials used to build foam combat airplanes.

I started building foam combat models because someone said you could build them in two hours each. They also said tapered wing models were as easy as straight wing models. Someone else said you couldn't get warps in foam wings. All of these ideas proved to be totally false. I kept telling myself there must be some reason to build foam, so I kept plugging away.

My first efforts included the original FAWF, a Flite Line kit, and two partially cored tapered-

wing models, The Flite Line kit flew pretty well, but I didn't like the way it was built. The two taper-wings were warped, turned extremely tight, and even after straightening, liked to flop on the end of the lines. The FAWF, well, it just flew super.

Through the course of the next couple of years I changed almost everything about the airplane. Most of the things I changed, I changed back. At least now I know the merits of other methods.

The biggest area of experimentation was covering. I started out using low-temperature heat-shrink model covering: Solarfilm, EconoKote, etc. This worked the best of everything I have tried and is what I am presently using.

The next thing I tried was gift wrap paper. I used wallpaper paste as adhesive and finished it off with clear polyurethane varnish. This is a pretty cheap way to go. It has the following drawbacks: It is slightly heavier than plastic. It is somewhat brittle and cracks at the leading edge where the foam panels join the root rib. I would recommend this method only if you are going to build a large number of models with a very short life expectancy.

After that I tried tissue paper applied with wallpaper paste. This is Dirty Dan's favorite method. I thought it was plumb awful. It's almost impossible not to tear and makes all kinds of warps that you can't get out.

The last material I tried was adhesive-backed decorator plastic. It is available in variety, hardware and grocery stores. The brand I have used is Kwik Kover II. This material probably is the way to go if cost is important to you. It typically costs less than $2 per roll. A roll will do at least two airplanes. It is slightly heavier than model coverings. It is also very low-temperature material. It shrinks at a setting about one number lower on my MonoKote iron than does Solarfilm.

The first thing to consider when building a foam airplane is how to cut the foam. Over the past several years I have seen all types of exotic devices detailed in various model mags. Most of them require two people to operate. Being too cheap and too lazy to build an elaborate device and not having a body to help me operate it, I decided something simpler was in order. I drilled a ⅛ hole in one end of my workbench and stuck a piece of ⅛ piano wire about 5 in. long in it. Then I drilled a series of ⅛ holes about 25 in. away from the first hole about ¼ in. apart (this allows me to adjust the tension on the hot wire), and stuck another piece of ⅛ piano wire 5 in. long in one of them. I then stretched a piece of .018 flying line between them. Presto: one table-mounted foam cutter.

Right now, you're thinking, "This must be some big dumb dude to pick up his workbench and turn it upside down to use it as a foam cutter."

I'm probably that dumb, but not quite that big, so I decided to hold on to the block of foam and pass it over the hot wire. Cutting foam with this cutter is basically like any other cutter. It requires a bit of practice to get perfect cores. I will go into the details below, but first, a few words about foam.

I have read many articles about the various kinds of foam. All of them say that the kind to use is one-pound-per-cu.-ft. density expanded polystyrene. I hope this is correct. I have never been able to find anything else to experiment with. The brand I use is Zonolite. It seems to be available in all major cities. I doubt if the brand name has much significance. Try to get it in 2-in. thick sheets. You can't laminate it, but thicker sheets can be used if necessary.

The first step in the construction of the cutter is to cut two pieces of ⅛ piano wire 5 in. long. File or grind a notch about 1/32 deep around one end of each piece about ⅛ in. from the end. Now cut a piece of .018 flying line 30½ in. long. Cut two pieces of aluminum or brass tubing ½ in. long. Use one piece of tubing to tie one end of the .018" line to the grooved end of one of the pieces of ⅛ piano wire. Use the other piece of tubing to make up the other end of the .018 line, leaving a loop just large enough to slip over the other piece of ⅛ piano wire.

Now drill two ⅛ holes nearly through the top of your workbench. Drill the holes so that they are angled slightly away from each other. Insert the two pieces of ⅛ piano wire in the drilled holes and string the .018 flying line between them. You may have to move the holes to get the proper tension on the cutter wire. The spacing is correct when the ⅛ piano wire stays slightly bent after the cutter wire is taken back off. Except for the power supply, your one-man cutter is now complete.

The most popular power supply seems to be a heavy-duty electric train transformer. This is what I use. I have read about various other power sources, including tapping various cells in a 12-volt car battery, but I haven't had any contact with them.

Before you can actually use the cutter, you will need to make various templates. Since the quality of your finished product depends largely on the quality of your templates, make them carefully. Templates can be made from various materials. The three that I have tried are ⅛ plywood, aluminum and Formica. Plywood is the most common in the modeler's shop and the easiest to work with. Aluminum is probably the best, but is somewhat difficult to make good templates with using commonly available tools. If you have a jigsaw of some sort, Formica is the thing to use. It's easy to cut using a very fine blade, and leaves a smooth surface for the wire to slide over. Whatever material you use for your templates, sand the edges as smooth as possible. Plywood templates should be waxed with paraffin.

The first templates to make are the square templates for cutting out the blanks. These should be 3 X 3½", with a piece of ¼-sq. spruce Hot Stuffed to one side to position them.

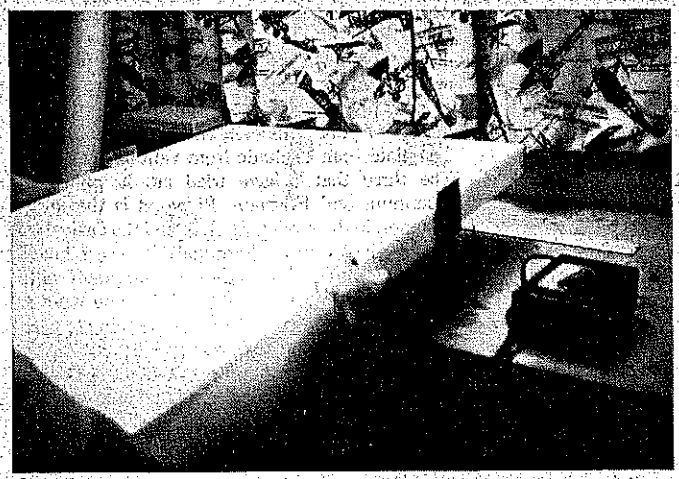
And now that the engine is running, the author maintains the same one-handed grip, left, as he tweaks the needle for a just-so mixture. At the right, he demonstrates the traditional launch. Note the angle of the ship and how both hands have just been lifted free.

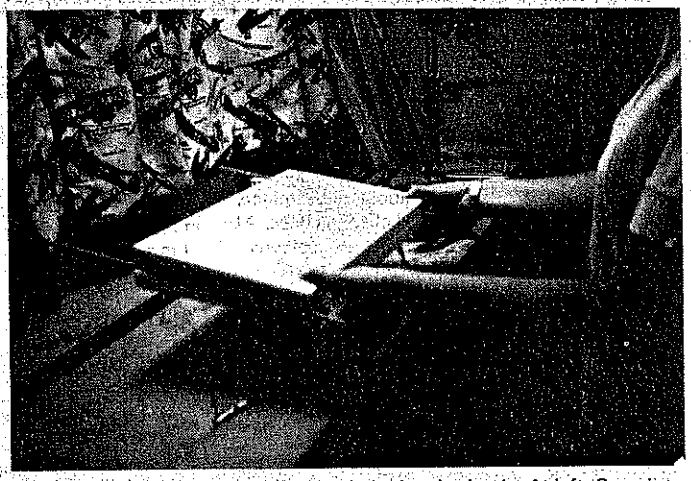
You will need two sets of rib templates. One set is for cutting the wing to shape. The other set is for cutting the spar notches and coring. After the templates are cut to shape, they should be stacked on top of one another to drill the nail holes. Do this on a drill press if possible. Make sure the nail holes are exactly on the airfoil centerline. After the airfoil templates are cut to shape and drilled, you will need to glue on short pieces of 1/16 X 3/16 spruce so that they extend 1 in. from the leading edge and 2 in. from the trailing edge. These pieces must be centered on, and aligned with, the airfoil centerline. These extensions are to guide the wire as it enters and leaves the blank and are an absolute must. I have tried to make them as part of the template, but I always ended up with a small notch that would catch the wire at the start of the cut.

All that's left now before cutting foam is something to hold the templates to the foam. I use 6-penny box nails cut 1½ in. long and sharpened. Two nails in each template should do the job.

The first step in cutting foam cores is cutting the blanks. Using the square templates, cut several blanks 10⅛ X 17-9/16". Plan to scrap some foam before consistent perfection is achieved. Draw centerlines on the ends of the blanks.

Align the airfoil templates with the centerlines on the ends of a blank and secure in place with the





Since quick construction is a way of life with all combat fliers, it follows that Gene's one-man foam cutter would be ingeniously simple. At left, Gene is cutting the blank—note guides to hold accurately in position, and hands, foreground, pulling it through. Right: How the foam blank is drawn across the cutting wire, each hand forming a "G" at the corners. The text deals comprehensively with fine points of technique.

nails. At last you are ready to cut foam.

Hopefully, you got some kind of a feel for how hot to set the wire while cutting the blanks. Wherever you set the temperature for cutting blanks is as good a place to start as any. Position the foam blank so that the extensions from the leading edge of the templates are resting on the cutter wire. Grasp the foam blank at the corners so your thumb and fingers form a "C" around the cutter wire. Turn the cutter on and immediately begin to draw the foam blank across the cutter wire. The beginning is the trickiest part as the leading edge forms nearly a right angle with the template extension and the wire tends to stick in the corner. Once you are moving, continue smoothly and evenly across the templates until the wire is clear of the foam. Turn off the cutter.

Now examine the cut you have just made. If it is smooth and even, consider yourself very lucky. If it is not, you will have to change the rate of speed at which you move, the temperature of the wire, or both. The only way to determine the temperature and rate of speed that is best for you is practice. Here are a few things to look for. Gentle ripples usually mean the wire is not hot enough and you are moving it too fast. Notches mean the wire is too hot, and/or you may have rough spots on your templates. Cores that are thin in the middle can be caused by too much heat or moving the wire too fast, causing it to sag in the middle. Trailing edges that are thin in the middle can be caused by not holding on to the piece of foam that is being cut from the bottom. Practice is the key to good cores.

Now that you have that part down pat, it's time to cut spar notches. Practice on some of the bad cores from the first operation. Secure the templates on the already-cut cores. Rest the core on the cutter wire with the wire against the front of the spar notches. Turn the cutter to the minimum heat that will make it cut. Allow the core to fall with its own weight to cut the front edge of the spar notch. Allow the wire to dwell in the corner for a few seconds. Slowly move the core toward you to cut the bottom of the spar notch. When you reach the back corner, again allow the wire to dwell for a few seconds. Now gently raise up on the core to cut the back side of the spar notch. Repeat the procedure for the other spar notch. Check to make sure the spars fit snugly in the

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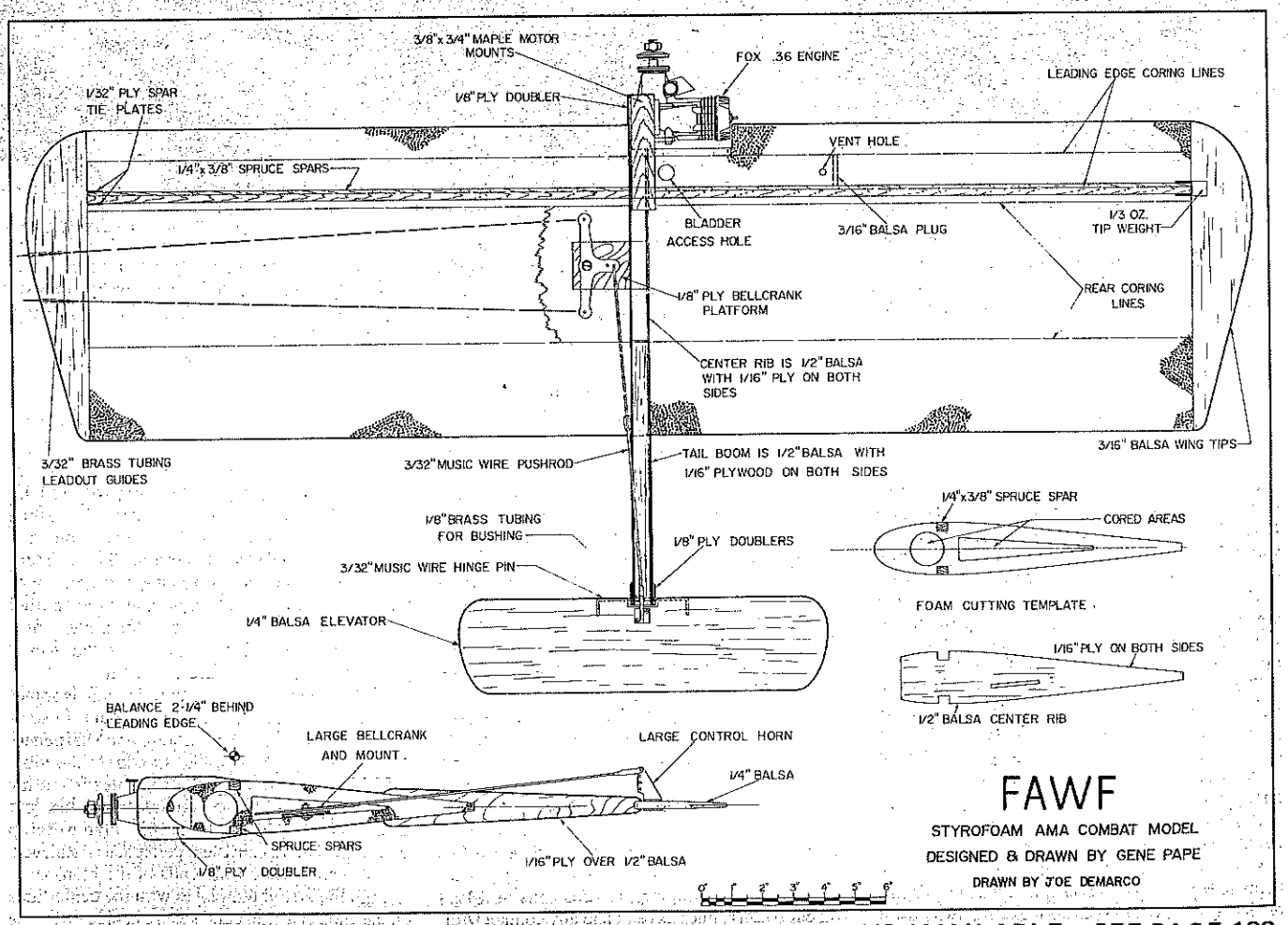

FULL SIZE PLANS AVAILABLE . SEE PAGE 128

that is that the fear a dive would actuate the pendulums and increase the hazard. In answer to that, let me say that if the aircraft is in that steep of a dive, you already have your hands full on a model that is clearly out of trim. In any case, the ailerons will still operate to bring a wing up and at least try to keep a spiral dive from developing.

The model in this dive is in effect trying to run away from the pendulums, and this would tend to keep them in neutral until a wing dropped, whereon they would operate in picking up that wing; however, they would have no effect on the dive and you would still have a crash on your hands.

A word on installation. I loosely use the word "horizontally" mounted pendulum, as you can see from Figs. 4 & 5, the pendulum is hanging at least 15° to 20° down from its pivot, so that it can accommodate the glide angle (any glide steeper than that and you're in trouble on your own). This angle is necessarily restricted if you mount your pendulum in the wing by the depth of the ribs themselves, but in large models such as the Bellanca this should pose no problem. If it does, then simply use Jack's system and mount it in the fuselage where there is ample room.

A word of caution. Be sure to use heavy enough wire for all the parts in the mechanical system itself, That is to say, use heavy wire for your connecting piece from the pendulum to the bellcrank, for there is a lot of pressure exerted on it between the pendulum and the aileron. If you try to save weight here, you are, in effect, adding weight uselessly, for a light or small connecting wire will work fine when you tilt it in your hand, but under flight loads it will flex or bend rather than operate the aileron. Heavy wire should also be used on the pendulum itself to permit it to carry the weight, and also to prevent flexing under load. The bellcrank should also be sturdily made. I made the mistake of using a clear plastic for the first ones and had to replace them as they broke under the slightest impact. Access panels over the cranks proved extremely valuable at this time, allowing for small openings in the wing for easy replacement of parts.

Be sure there is no "slop" in the system, for just a little of it in the first bearing, a smidge more in the rod connecting the crank, etc., keeps multiplying until the whole system is rendered next to useless by all the play in it.

On elevator systems I use an RC-type clevis which allows me to adjust the amount of up or down in the elevator. This really works great, allowing you to crank in the amount of elevator needed for flying from an ROG. With pendulum elevators it is almost mandatory to ROG, since on running and launching it by hand, the pendulum is thrown to the back, thus giving down elevator and sending your pride and joy into the ground. I suppose if one were super careful and let the model fly out of his hands, he could get away with it, but I doubt it, since most of the modelers that I see hand-launch tend to throw the model at the last moment.

One must make sure that there is no binding of the hinges on the ailerons or the elevators and that they move very freely. I have used a system that I consider both easy to install and absolutely free of any binding. I use small cotter pins, obtained from the hardware store, and insert them in the wing aileron spar, spreading them out on the back side through a small piece of light plywood. You then have the small heads protruding from the spar, do the same on the ailerons themselves, so that when the ailerons are put on the wing the cotter pin heads are next to each other. Then all that remains to be done is to take a long thin wire and run it through the aligned holes, bend over the end of the wire that protrudes at the wing tip or elevator tip, and fasten it with a piece of Scotch tape, thus making them easily removable if necessary. I have never had one bind, or had the hinge wire fall out using this system. Also they are next to invisible.

On both systems, elevator and aileron, notice the stops put in to restrict the movement of the pendulum. I use, as you can see by the pictures, balsa blocks, and if more movement is required, I can just slice off a piece of block or, conversely, glue another piece on to restrict it further. As for bearings, or tubing used as bearings, where your connecting wire passes through the wing ribs or fuselage formers, I prefer to put large holes in the respective parts, making sure that the wire does not touch anything between the pendulum and the bellcrank or the elevator horn. That is another reason that I recommend using a heavy wire between these points.

If you use the bearings you must make sure that they are in a direct line, for if just one is out of line it will tend to bind up the entire system; hence, I use the lazy method and use the large holes as previously mentioned. Besides, I can kid myself into thinking that I'm following the advice of the famous designer Bill Stout whose axiom was "Simplicate and add more lightness." You must concede that is sound advice for all scale modelers.

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notches. The only problem I have run into with this procedure is having the notches much deeper in the center than at the ends. This is caused by having the wire too hot.

It is time now to poke holes through the wing panels so you can pass the cutter wire through them to core them out. To do this you need a piece of ⅛ piano wire, a propane torch to heat the end of it red hot, and something to guide it with. A simple way to make a guide is to drill a 5/32 hole lengthwise through a 1½-in.-long piece of 2 X 2, 1 in. from one side. Insert a 1½-in.-long piece of 5/32 o.d. brass tubing in the hole, and Hot Stuff it in place. Check to see that when the ⅛ piano wire is sticking out 18 in. from this guide, the end of it is still about 1 in. off the table.

Mount the wing panel in one of the pieces that was cut off when it was first cut out. This should but the wing centerline 1 in. above the table. Carve and shim as necessary. Now, with the end of the ⅛ wire sticking out about 2 in. from the guide, heat the end red hot. Moving quickly, set the guide on the table and slide it up to the end of the core with the wire entering the core at the center of the part that is to be cored from the

leading edge. Slowly push the wire the rest of the way through the wing panel. You may have to stop and reheat the wire in the middle of the pass. If you have trouble with the wire wandering, it probably is because you were trying to push it through too fast.

Repeat the procedure, this time putting the hole about ½ in. back from the front of the rear cored area.

You are now ready to core the wing panels. Remove one end of the cutter wire from its post, pass it through the front hole in the wing panel (the templates must be in place at this time) and hook it back up. Turn the cutter on and pull the wing panel straight toward you. Use the same temperature you used to cut out the panels. When you feel the wire make contact with both templates, carefully feed the wing panel around the hole in the template. Stop when you feel the cutter come free when it gets to the starting point. Turn the cutter off. Take the wire loose from one post and pull it out of the wing. The core should come with it. Take care while you are coring not to twist the wing panel. This can cause the cutter to come out through the surface of the panel.

Now that the front is cored out, put the wire through the hole for the rear core and hook it up. Turn the cutter on and allow the wing to fall of its own weight until the wire contacts both templates. Run around the rear core as with the front one. You should now have one good wing panel. When you have two good ones, it's time to read on.

With some experimentation, these methods can be used to cut tapered wing panels. I say this for the benefit of the stunt and RC fliers who may be reading this. For combat fliers, tapered wings open up a whole new can of worms. They can end up flying better, but for the most part the extra performance is not worth the investment.

Now for the easy part, the wood. Start by laminating 1/16 plywood on both sides of a sheet of medium hard ½" balsa. If you only plan to build one model, cut a 6 X 12 sheet of plywood in half and glue it to a piece of ½ X 3 X 12 balsa. Use contact cement. Cut the center rib and the tail boom from this.

There aren't many parts, so you might as well cut the rest of them out while you're at it. The engine mount doubler, bellcrank mount and elevator bearing doublers are cut from ⅛ plywood. The tips are 3/16 medium C-grain balsa. The motor mounts are ⅜ X ¾ maple. The spar webs are 1/32 plywood. And the elevator is ¼" hard C-grain balsa. (I use Sig ¼ X 3 taper-cut sheet because, with it, half of the carving is already done.)

The sub-assemblies are next. Epoxy the bellcrank mount through the center rib. Shape the elevator bearing doublers and glue them to the tail boom. Epoxy the motor mounts to the plywood doubler.

While this is drying, make up the control system. Note that it really works better to have the pushrod pass under the bellcrank. This makes the pushrod exit the wing nearer the trailing edge which helps reduce pushrod flex on outside maneuvers.

Make up a round balsa plug from scrap 3/16 balsa and glue it in place about 6 in. from the root end of the leading edge cored hole in the outboard wing panel. This becomes the bladder tube.

Mount the bellcrank assembly to the bellcrank mount. Use a dummy pushrod, at this time, which is only long enough to reach to the trailing edge. Hold the inboard panel up to the center rib, and mark where the pushrod will pass through the wing. Use a razor saw to cut a slot for the pushrod about 1 in. into the wing panel. Assemble the inboard wing panel to the center rib and check for clearance. If necessary, carve the foam as required for clearance.

When everything else clears, align the pushrod as it will be when the controls are hooked up. Heat the end of a piece of ⅛ o.d. brass tubing red hot and slide it down over the pushrod to the bellcrank. This will give you a clean pushrod hole in the wing. Disassemble and mount the pushrod you intend to use for flying.

Coat the surfaces of the center rib and the wing panels with water-based contact cement where they will join together, and set them aside to dry. If you don't have much experience with water-based contact cement, Goldberg's Glue Goo works well.

While this is setting, you will need to make an alignment jig for putting these pieces together. This is made by finding two of the pieces that were cut from the outside of the wing panels that are the same thickness front and back. Line these up side by side on a flat table and you have your jig.

Once the contact cement has set, carefully assemble the inboard wing panel to the center rib. Be very careful with alignment. You must do this right the first time. You won't get a second chance. Lay the inboard panel with center rib attached and the outboard panel on the jig. Now just slide them together. Once the outboard panel contacts the center rib, the basic wing is complete.

Assemble the spars to the wing without glue. Use a razor saw to make the slots for the 1/32 plywood spar tie plates. Glue the spars and tie plates in place with white glue or Titebond. Sight down the leading and trailing edges to make sure the wing is straight.

Mark the leadout hole locations on the inboard wing tip and drill holes through the tip for the 3/32 o.d. brass tubing leadout guides. Round the inboard tip where the leadouts will come out (you won't be able to after the leadouts are in place). Thread the leadouts through the inboard tip and glue it in place with five-minute epoxy. Pins are used to hold it in place while the epoxy sets. Epoxy the outboard tip in place. Slip the leadout guides in the holes. A couple of drops of Hot Stuff will hold them in place. Epoxy the ½-oz. tip weight to the outboard tip. Finish the leadout ends.

After the glue has dried thoroughly on the spars, sand the wing all over. Trim the trailing edge even with the end of the center rib. Cover the wing using one of the previously-discussed materials.

After covering, cut the notch for the engine with a *very sharp* knife. Cover the bare foam in this area with a scrap of plastic covering.

Shape the elevator and cover it with plastic covering. Shape the tail boom and cover it with plastic covering. Drill the hole for the ⅛ brass tubing hinge bearing. Be very careful to get this hole straight. Push the brass tubing through the tail boom and secure it with Hot Stuff. Finish the rest of the hinge the same way as any other combat model.

Remove the covering from the center rib where the tail goes on and epoxy the tail assembly to the wing. When this is dry, mount the horn and finish the control assembly.

Cut the motor mount assembly to shape. Cut the covering away from the center rib where the motor mount goes. Install the motor mount temporarily. Put the engine you plan to use, complete with prop, in place in the motor mount to check the balance point, holding it on with rubber bands. Slide the motor back and forth until the plane balances properly. Mark the motor mount hole locations. Remove the motor mount and drill the engine mounting holes. Epoxy the motor