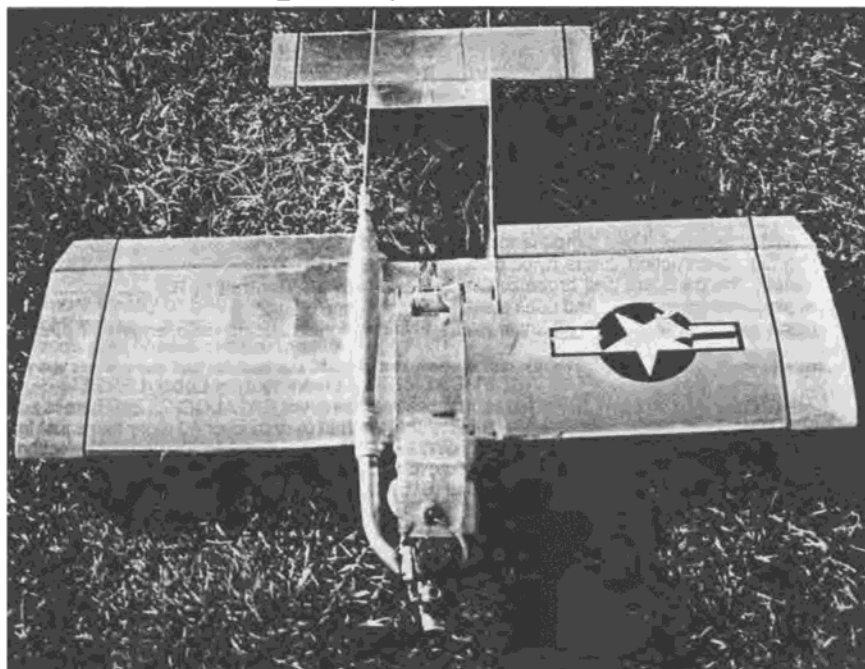




VOODOO

By Scott McMaster
and Jason Falladown

**If You Really Like Hot Sport
Ships, or are Into R/C Combat,
This One Will Provide Plenty
of High Speed Thrills!**



Want something that will get your pulse going a little quicker, but not take you a year to build? Something that will have all your friends beating the door down just to get the plans? Something that goes right where you point it, right now? Then you want a Voodoo.

As anyone who flew (or flies) U Control (U/C) can tell, the Voodoo was inspired by the combat planes that we flew in our U/C days. One of the first types that we built was a Carl Goldberg Voodoo and since the name has always appealed to us, it was only natural that we call our first attempt at an R/C combat plane the "Voodoo." The aircraft in this article is the sixth version of the Voodoo and it is designed to out-fly any .40 powered R/C aircraft we have seen. It is a joy to fly for fun or combat if you have progressed to the point where something like the Hot Shot is old hat, and if you love over-powered, high performance airplanes. It accelerates crisply in the vertical (0-60 mph vertical in 4-5 seconds), has a roll rate of 900+° per second, and has essentially vice-free handling over a wide speed range.

The high speed requires no explanation, a 36" wingspan aircraft weighing 3 lbs. with a .46 and a tuned pipe had better go fast. On the other end of the speed scale, the Voodoo benefits from a very low aspect ratio wing and low wing loading. The low aspect ratio produces large wingtip vortices at high

NAME
VOODOO

Designed by:

Scott McMaster & Jason Falladown

TYPE AIRCRAFT

R/C Combat, Hi Performance Sport

WINGSPAN

36" (39-1/4" w/Optional Tips)

WING CHORD

12 Inches

TOTAL WING AREA

418 Sq. In. (438 Sq. In. w/Tips)

WING LOCATION

Mid-Wing

AIRFOIL

Symmetrical

WING PLANFORM

Constant Chord

OVERALL LENGTH

35 Inches (Approx.)

(depending on engine installation)

RADIO COMPARTMENT SIZE

(W) 7" X (L) 6" X (H) 2"

(height varies with airfoil depth)

STABILIZER SPAN

18 Inches

STABILIZER CHORD

4-3/4 Inches (Avg.)

STABILIZER AREA

86 Sq. In.

STAB AIRFOIL SECTION

Flat

STABILIZER LOCATION

Mid-Boom

VERTICAL FIN HEIGHT

5 Inches

VERTICAL FIN WIDTH

3-3/4 Inches (Avg.)

REC. ENGINE SIZE

.29-.46 2-stroke

FUEL TANK SIZE

10 Oz.

LANDING GEAR

None (Optional Nose Skid)

REC. NO. OF CHANNELS

3

CONTROL FUNCTIONS

Throt., Ail., Elev.

BASIC MATERIALS USED IN CONSTRUCTION

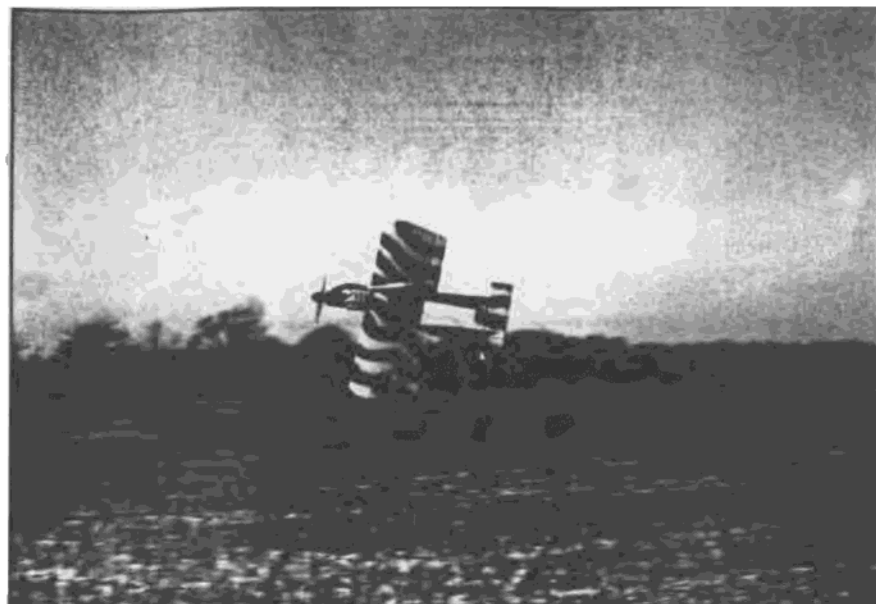
Airframe Balsa & Lite Ply

Engine Mounts Hard Maple

Wt. Ready To Fly 48 Oz. (3 Lbs.)

Wing Loading 16.5 Oz./Sq. Ft.

angles of attack that tend to eliminate tip stalling problems. Unfortunately, the vortices also produce large amounts of induced drag at high angles of attack (for example in high G corners). Luckily, the high power to



weight ratio goes a long way toward compensating for the drag, and we feel the vice-free handling benefits of the low aspect ratio are worth the induced drag penalty. The light wing loading allows the aircraft to be slowed right down to a walk with the large reserves of control power ensuring full control, even at the stall. (One of our favorite maneuvers is an aileron roll performed just above stall speed on short final. The very low speed and high control effectiveness make the maneuver impressive and, with the Voodoo, it's not nearly as difficult as it looks.) A word of caution is in order here. All the characteristics that make the Voodoo a tremendous combat plane (neutral stability, lightning fast control response, and high speed) also make it a poor choice for all but experienced fliers. These attributes, combined with the small size and overall symmetry of the Voodoo, can make it very difficult to determine its attitude; so if you still require the top of your aircraft to be a different color than the bottom, think twice about building and flying this aircraft!

The other major design objective was to make the Voodoo quick and cheap to build. As many of the main structural elements as possible are stock balsa and plywood sizes to keep the cutting and shaping to a minimum (this is the reason for the 36" wingspan). The Voodoo in this article was

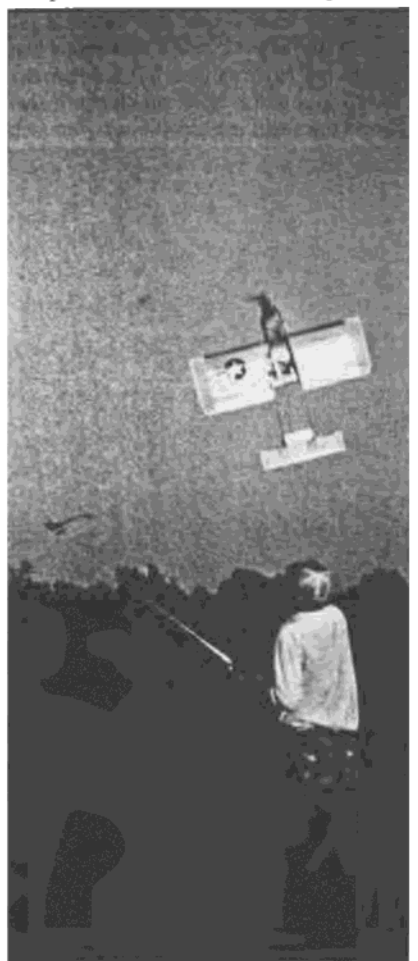
built and test flown in 25 hours at a cost of about \$70.00 Canadian. This price included everything but the engine, pipe, and radio.

CONSTRUCTION

Tail:

We'll start with the easiest part, the tail booms. Take a piece of 1/16" x 6" x 24" plywood and lay out the booms as shown on the plans. Cut the booms out and save the remaining scraps of plywood for use later.

The horizontal stabilizer is almost as easy. Cut a piece of 1/16" x 4" x 36" into two 18" pieces. Take one and CA pieces of



About the Authors

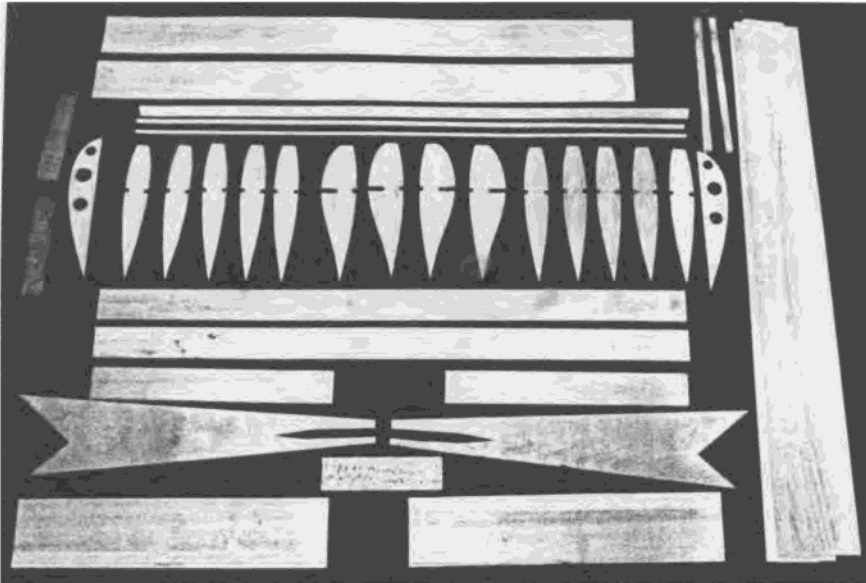
Scott McMaster, P. Eng.:

Age 35, B. Eng. and M. Eng. (Physics) from McMaster University. Currently employed by the Ontario Center for Materials Research at McMaster University, Hamilton, Ontario. Scott flies full scale aircraft, and has both Commercial Pilot and Glider Pilot licenses, and owns a share in a Bellanca Decathlon for aerobatic flying. He has been building and flying radio control aircraft for 20 years, his main interest is pattern flying.

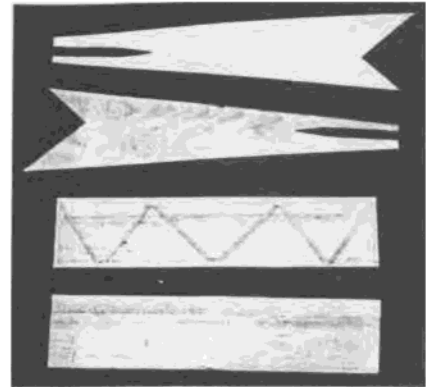
Jason Falladown:

Age 23, Aircraft Maintenance (Avionics) Degree from Canador College. He is currently finishing apprenticeship for Aircraft Maintenance Engineer License in Brantford, Ontario. Jason enjoys fast, overpowered cars, and has been building and flying radio control aircraft for about 10 years.





Voodoo parts kit. With the exception of the wing ribs and the tail booms, everything is just stock sizes.

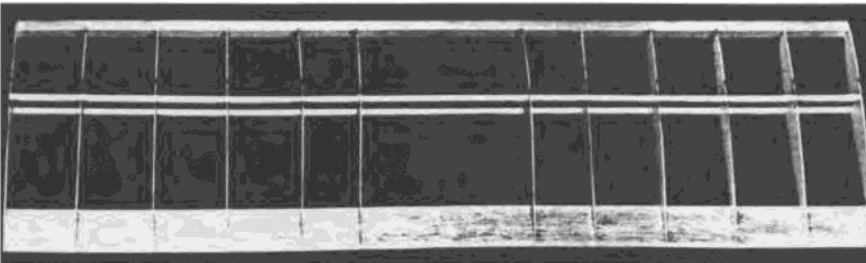


Complete empennage before final sheeting of the horizontal stabilizer.

will work, practice it on scrap balsa first. The last thing to do is to square up the tips and profile the leading and trailing edges with a sanding block. Don't go overboard with the sanding here, the airplane is not aerodynamically clean anyway, and you need the strength, so just round the leading edge and taper the trailing edge a little.

Wing:

The wing is the heart of this aircraft. Make every effort to build it straight, strong, and light. We used CA almost exclusively because of its strength, speed, and light weight. Begin by cutting all the wing ribs out of 1/16" sheet balsa using the templates on the plans. Stack two pieces of 1/4" sq. x 36" balsa on top of each other with some wax paper between them and then pin onto the plans in the location for the bottom spar. **Do not** glue the spars together, the bottom spar is just for jiggging, later it will be the top spar! Pin a 1/16" x 2" x 36" piece of balsa over the position for the lower trailing edge sheet. Place all the ribs except the two center ones on the spars and trailing edge,



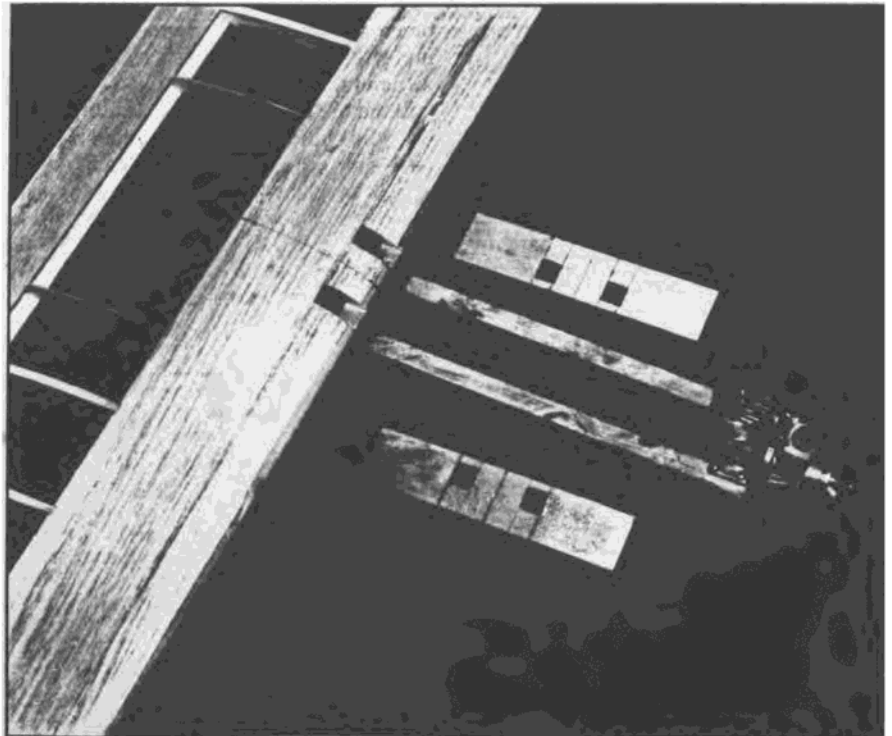
Initial frame-up of wing. L.E., ribs, spars, and T.E. stock are in place.

1/8" x 1/4" balsa to it in the locations shown on the plan. With this done, add the other 18" piece of 1/16" to the top. We have found that a good way to do this with CA is to pin the sheet in place and then prick pin holes through the sheet in a few spots over each

structural piece. Put a drop of thin CA in each hole and the capillary action will draw the CA through the hole and along the rib to bond it to the top sheet. Don't leave more than 1/4" between holes to ensure good bonding. If you are in doubt about how this



Wing with L.E. sheet, lower capstrips, and T.E. filler pieces installed.



The engine mount rails, 1/16" plywood shear webs, and the L.E. notches for the rails. The notches should be to the centerline of the L.E. so that the top of the engine mounting rails are on the aircraft centerline.

the center ribs will be added later with the engine mounts. Make sure the ribs are perpendicular to the spar (especially the ribs that the booms glue to) and CA them to the trailing edge sheet and the bottom spar. Take the leading edge stock and make small locating notches in the locations for each rib using a razor saw, then CA it to the front of the ribs. Carefully lift the wing off the plans, remove the extra spar you used as a jig, and CA it in place as the top spar. Use a piece of 1/16" x 4" x 36" balsa for the bottom leading edge sheeting. With the wing upside down, CA the rear edge of the bottom leading edge sheeting to the bottom main spar. Flip the wing over and CA the sheet to the ribs, starting at the spar and moving forwards. Be careful here to keep the wing straight. Finish by wrapping the sheet around the leading edge stock so that you glue the sheet to within 1/4" of the front of the wing.

Once the bottom leading edge sheet is in place, add the bottom capstrips to all but the boom ribs. Add the 1/16" balsa trailing edge fillers to the inside of the trailing edge sheet as shown on the plans. These serve the dual purpose of keeping the trailing edge even and giving you somewhere to glue the hinges for the ailerons. Now add the 1/16" x 2" x 36" upper trailing edge sheeting.

Now is the time to add the engine mounts. Cut the two hardwood engine mounting rails about 1/2" longer than called for on the plans. Take the engine you plan to use on the Voodoo and mount it to the rails using the largest machine bolts, flat washers, and locking nuts that the holes in your engine mounting flanges will allow. Take care to keep the rails parallel. Using the width of the rails as a guide, cut the center section shear web out of 1/16"

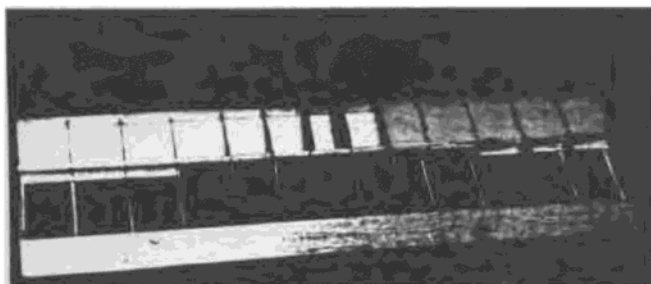


The engine mounts and plywood shear webs installed. Note the fuel tank temporarily installed to ensure adequate clearance. Be careful installing the rear halves of the center ribs to get the bottoms flush with the lower spar. This will allow the lower sheeting to fit properly.

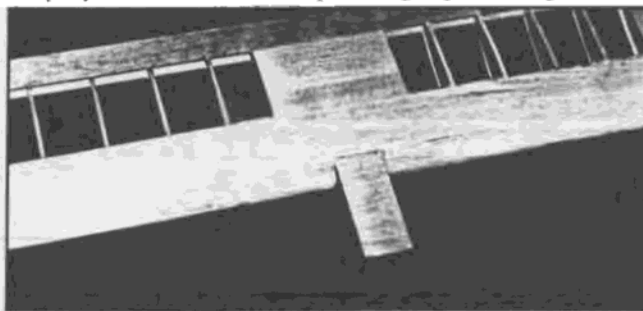
plywood using the template on the plans. Carefully cut notches in the leading edge and bottom sheet to accept the rails. If you are using a .40 or .46, mount the fuel tank on the rails in the proper location and then insert the rails into the leading edge slot until the tank just touches the leading edge. Mark and cut off the rails so that they protrude about 1/8" past the back of the spars. If you plan to use an engine smaller than a .40, leave the rails at their original length to avoid needing nose weight later. Now epoxy the rails to the leading edge and spars, then add the plywood shear webs as shown. Don't be bashful with the epoxy and make

sure everything is square and true before the epoxy sets. Add the two center ribs.

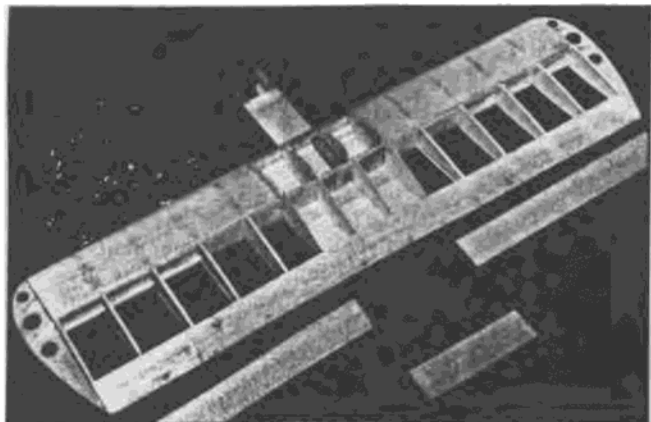
Next in line is the shear webbing. Notice the direction of the grain shown on the plans. This is important to get right, as a lot of the wing's strength comes from the ability of these webs to resist the shearing and compressive loads between the spars, and at 15 g's you'll want all the help you can get! Glue 1/16" balsa webs to the front of the spars between all the ribs outboard of the boom ribs. Repeat on the rear side of the spar but leave the outer three bays on each side with only the front webbed. Next in line is the top leading edge sheeting. Add this



Balsa shear webbing completely installed and one wing with L.E. sheet. Note the dark patches from the CA used to fix the L.E. sheeting to the ribs.



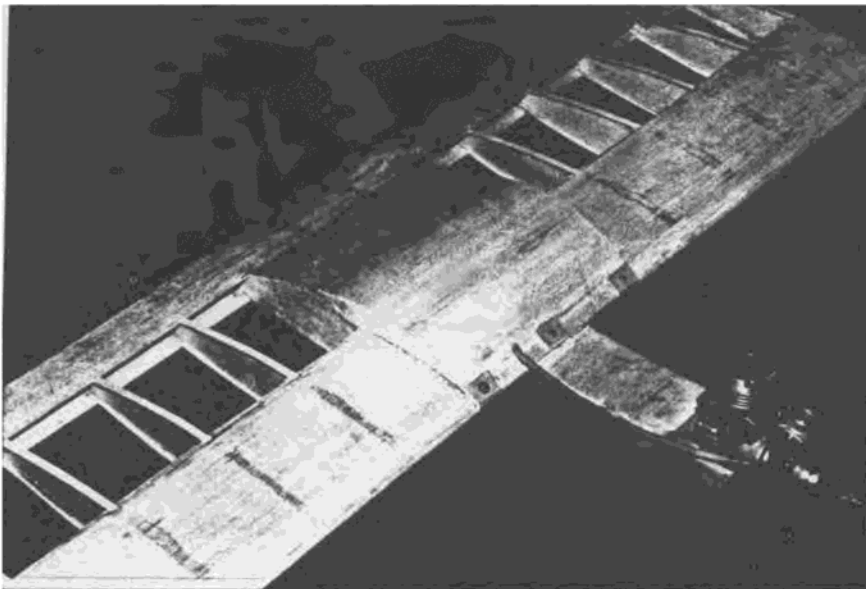
Bottom view of Voodoo ready for radio installation. Wing is sheeted and capstripped and the engine mount is sheeted in.



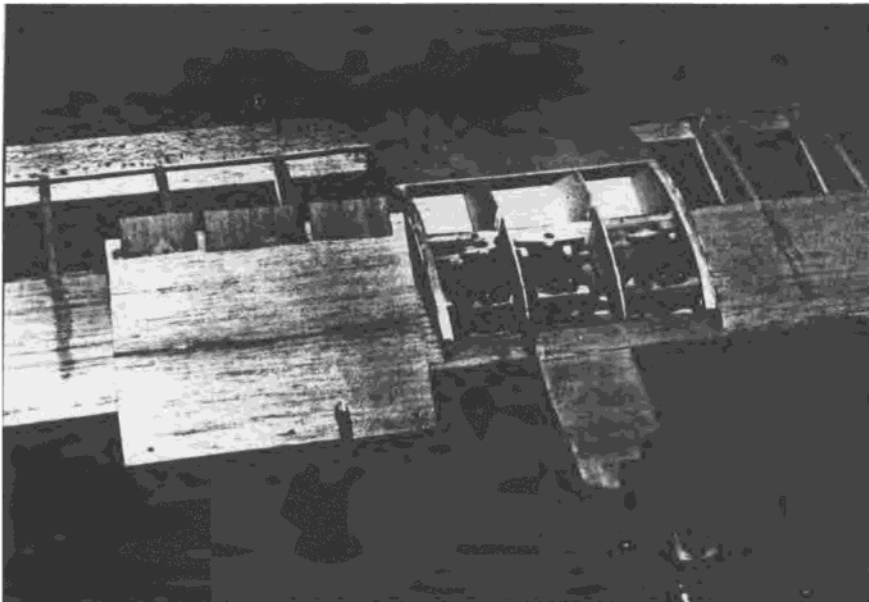
Top view of Voodoo ready for radio installation.



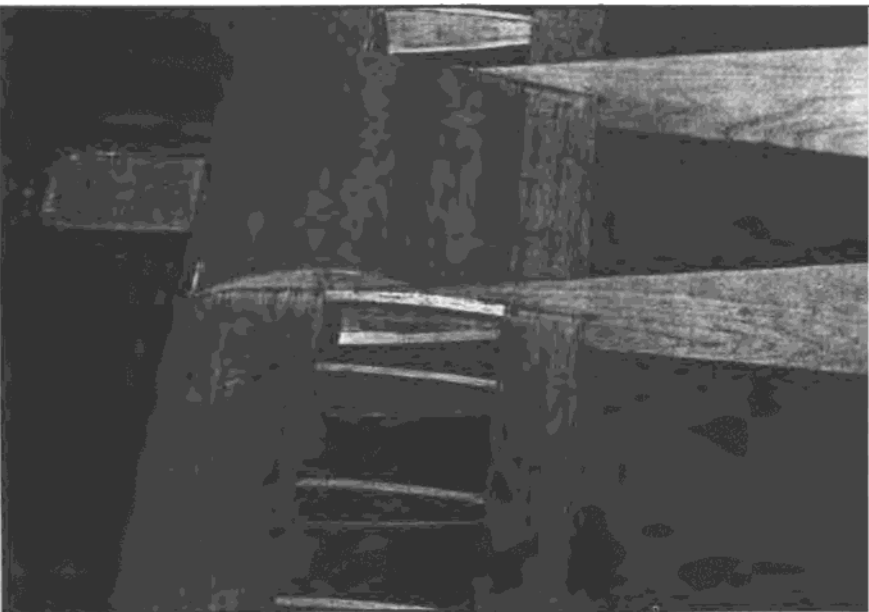
Servos and linkages installed and the receiver and battery set in place to check fit. Leave the aileron pushrods and torque arms free until after finishing. The elevator pushrod is installed after the tail booms are on.



Radio cover completed and installed. The hole for the switch will be cut after covering.



Radio cover off to show the cover supports on the boom ribs and the 1/16" balsa mounting tabs.



Booms installed with false capstripping in place. Don't be bashful with the epoxy when gluing the booms to the T.E.

using the pinhole and CA method described in the horizontal stabilizer section.

Finish the wing by adding the capstrips to the top of all but the four center ribs, and cut the ailerons out of 2" balsa aileron stock. Save the leftover 7" piece of aileron stock for the separator piece between the tail booms. Add the lower center section 1/16" balsa sheeting.

Complete this step by sheeting the engine rails with scrap 1/16" balsa. This gives them a little more torsional stiffness. There are gaps at the front of the mount between the engine rails and the balsa and at the rear between the mount and the leading edge that you should fill with scrap balsa as shown on the plans. This prevents fuel residue build-up inside the mount. Add a control horn to the front of the engine mount to prevent the tank from sliding forward. If you prefer, a piece of wood will work as well as the horn does.

The aircraft shown in the photos has the optional wingtips installed, as shown on the plans. They slow the roll rate about 10%, but they look nice. If you want to add them, now is a good time. Cut scrap balsa to the shapes shown on the plans, CA it in place, and then add triangular braces cut from 1/16" or 1/8" balsa scrap.

Radio Installation:

This is the hardest part. The compact design of the Voodoo makes each installation a tailor fit job to ensure maximum performance. The installation we are describing here is for a JR 6-channel radio, but it will give you the idea even if your radio is different. Don't be afraid to modify the procedures listed here to optimize for your radio, just be sure to keep the control linkages tight and straight to avoid any potential flutter problems. Also, if you are planning to fly combat, don't use your new \$2000.00, FM, PCM wonder box. All you need is your cheapest **reliable** radio, anything more and you'll just be afraid to get in and mix it up during combat.

Mount the throttle servo in the right-hand rib bay between the spar and the leading edge using small pieces of hardwood as mounting rails. After cutting the rails out, epoxy them in as far back as possible to get the servo into the deepest part of the wing. This will minimize the height of the radio compartment. The elevator and aileron servos are mounted the same way and go in the left and center rib bays respectively, with the elevator servo as close to the left boom as possible to reduce the amount of bending in the Gold-N-Rod to the elevator. In our installation, the battery went in the right rib bay behind the spar and the receiver was placed behind the spar in the left rib bay. The switch was mounted on the radio cover, near the back. If the size and shape of your components makes another configuration better, by all means use it (Voodoo V has a completely different installation that works just fine) but try to keep the receiver behind most of the heavy components and leave room for foam, you will crash this airplane if you use it for combat and you want to protect the radio as

much as possible. Use Gold-N-Rod to hook up the throttle linkages. Bend up music wire to serve as aileron torque tubes, not forgetting to put the bearing block on before the last bend is made, and temporarily put them in place (they will be secured after finishing). Use Gold-N-Rod (as shown on the plans) or straight threaded rod to hook up the ailerons. If you use threaded rod, make sure to use jam nuts on the aileron clevises to avoid having them work loose and fall out, the Voodoo does fine on one aileron (experience talking here) but won't do well with none. The elevator pushrod will be installed after the tail booms are in place.

Once all the radio is installed, trim away as much of the four center rib tops as possible while still leaving adequate clearance for all the servo arms and pushrods. Sheet the rear section of the upper center section with 1/16" balsa sheet. CA capstrips to the inside of the boom ribs to act as hatch supports. Make the radio hatch by "CA"ing 1/16" balsa together and then cutting to fit. Add the 1/16" plywood reinforcing plates and 1/16" balsa hold-down tabs as shown on the plans. Finally, drill holes in the reinforcing plates to clear the wood screws used to hold the cover down, then attach the cover with wood screws and washers.

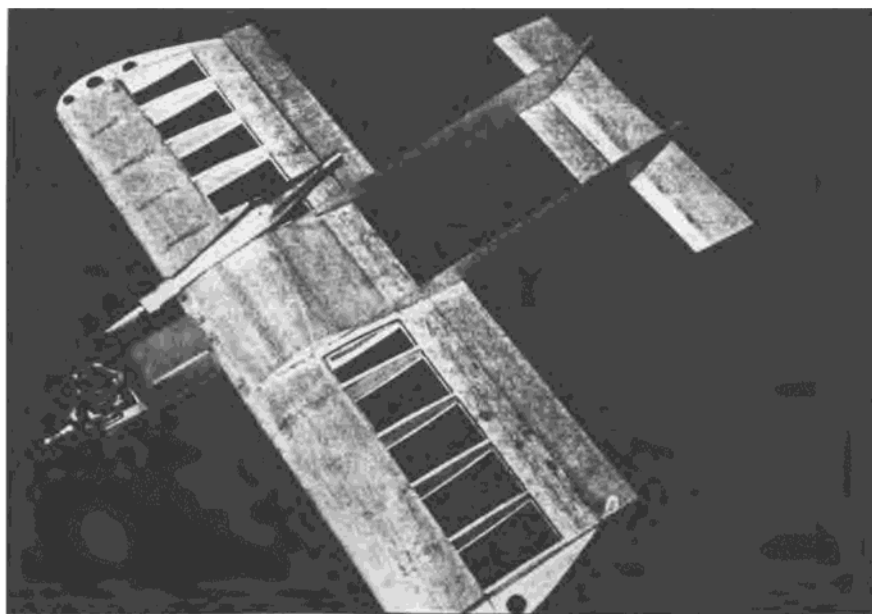
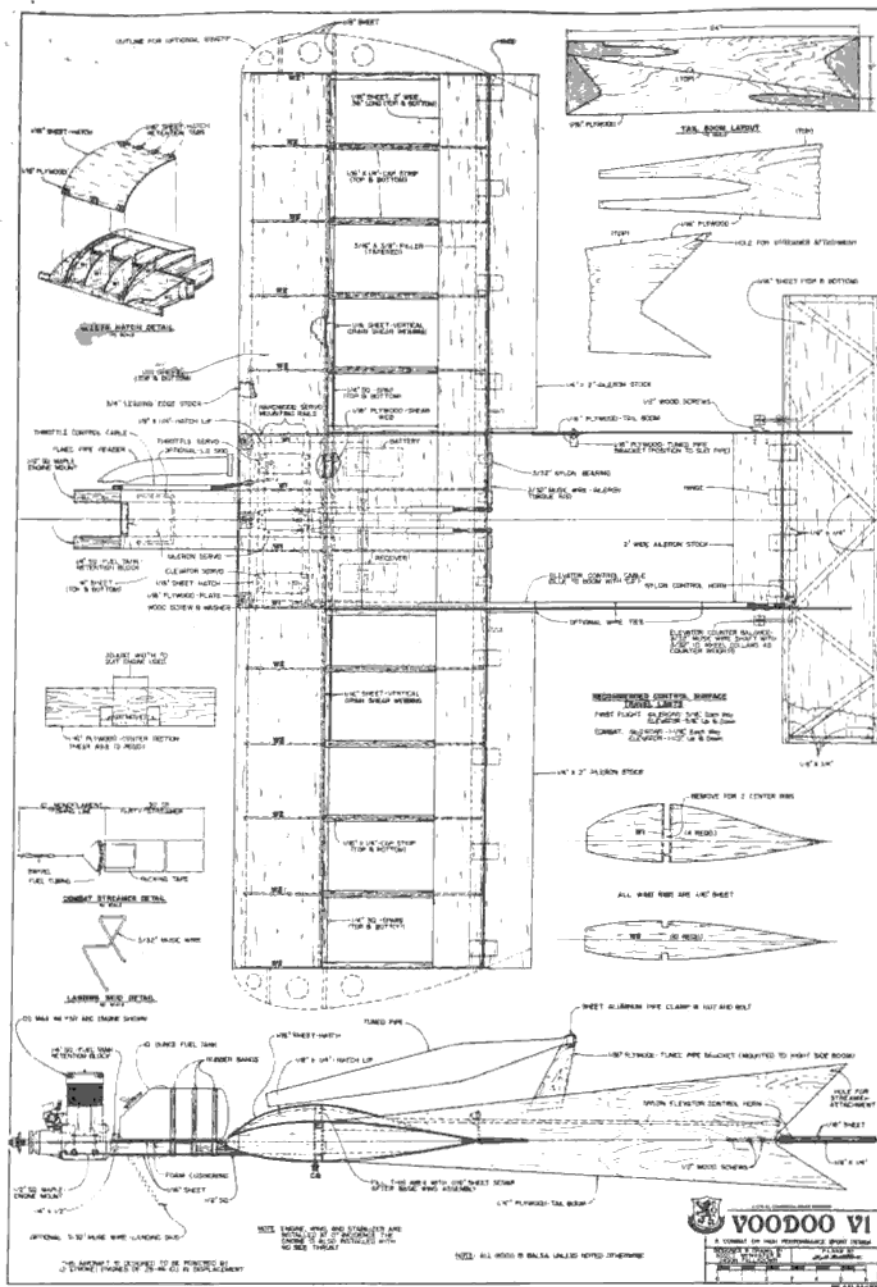
Final Assembly:

Trial fit the tail booms in place and make any corrections to the cut-outs that are required. At this point, the booms will look awfully flimsy and may have a bend in them, don't worry. As long as they are even when viewed in side profile, and the section to be attached to the boom ribs is true, the rest will work out okay. When you are satisfied with the fit of the booms, epoxy them in place. Add the false rib capstrip to the outside of the booms as shown on the plans. This facilitates covering the joint between the booms and the wing. Check the fit of the 7" piece of aileron stock that you will use for the boom spacer and adjust its width as necessary, then hinge the horizontal stabilizer. Don't glue anything together yet, this is just a trial fit. The Voodoo with all equipment trial fitted is now ready for covering.

Covering:

Use your favorite plastic film covering on the wings, ailerons, radio cover, booms, elevator, and boom spacer. If you want to paint the Voodoo, you can just paint over the covering. We painted Voodoo VI with Perfect Paint applied with an airbrush and it works great, but watch the weight, paint will add about 5 oz. even if you are careful with it. Once the covering is finished, take the aileron stock spacer and position it between the booms. Drill pilot holes for the reinforcing screws and remove the covering where the glue goes. Put the screws in, making sure everything stays straight. Once it's all aligned, remove the screws, epoxy the aileron stock to the booms, and put the screws back in before the epoxy sets. Make any final alignment adjustments and then put the assembly aside to set hard.

The engine mounts should be painted with whatever fuelproof paint you have



Final trial fit of all components before covering.

handy (again we used Perfect Paint). Add the control horns and the hinges, then install the elevator and ailerons. Using nuts and bolts as shown on the plans, construct the mass balances for the elevator and glue them in place. If you want to add any decals, add them now, but remember to clear coat them to protect against fuel.

If you plan to use a tuned pipe, make a pipe holder out of scrap 1/16" plywood and epoxy it to the right boom at a location suitable for your pipe. Mount the engine and pipe on the aircraft and secure the pipe to the holder using a strap of aluminum cut from a pop can (be careful to dress the edges with a file, they are sharp). To avoid fuel foaming, place a piece of foam rubber between the engine mounts and the fuel tank, then strap the fuel tank to the engine bearers using at least four rubber bands. If you prefer a different method to hold the tank in, an alternate method is to use straps cut from a plastic bottle and screwed into the engine mounting rails. If you will operate off of pavement, fashion a front skid by bending a piece of 5/32" music wire and mount it to an engine mount rail using landing gear straps. Connect the fuel line and you are finished.

Preflight:

Ensure that the Voodoo is straight and true, all incidences and angles are 0°. Check the Center of Gravity (C.G.) against the plans. It is absolutely imperative that the aircraft not be tail heavy! A tail heavy Voodoo is an unhappy Voodoo, and it can be so unstable that you will not even be able to control where it's going to crash (experience talking again). So set the C.G. in the right place. It's okay to be a little nose heavy for the first couple of flights (you can move the C.G. progressively back as you get used to the aircraft) but don't over do it. The Voodoo has a small tail volume and if it is too nose heavy, the elevator response is reduced and the amount of energy that bleeds off in a high G maneuver is increased, so stay close to the position on the plans for best results!

Set the control throws as shown for the initial flight. If you have dual rates, set the low rates for the initial flight throws and the high rates on combat throws, but fly it on low rates initially. **Do not** trim in a "little" up on the elevator, set neutral trim at neutral elevator, this should be about right.

Tune the engine as you normally would and you are ready to fly.

Flying:

A word of caution. The controls are very powerful. Do not check the elevator with the engine wide open if you are only holding the aircraft with one hand. The pitching force generated by combat control throws is strong enough to rotate the airplane out of your hand with disastrous results. Check the radio with the engine at idle and then throttle up for launch.

Have a friend hand-launch for you the first couple of times. Grasp the Voodoo by the engine mount, just in front of the leading edge, and throw slightly nose up. The airplane will accelerate rapidly and, with a

touch of up elevator, will climb to a safe attitude in seconds. At altitude, throttle back and feel the airplane out. It will fly in just about any attitude you can imagine with little trim change and is all but indestructible (unless you hit the ground). If you have dual rates and you are feeling comfortable, try the combat high rates. Be careful with the ailerons, at high speed the Voodoo can roll at around 1000° per second and it is very easy to be upside down before you know it. Especially watch this in combat when you are close to the ground, you can easily roll past the vertical as you initiate a turn and the subsequent pull on the elevator can be very exciting. As you get used to the airplane, you will realize that it goes exactly where you point it and with a .40 and a pipe it virtually ignores gravity. The slow speed range is a joy to behold, with excellent control authority and little tendency to tip stall. A high-speed, low level pass followed by a low-speed pass with a vertical departure, rolling all the way, is very impressive. Watch the torque when you apply power rapidly at low airspeed.

Landing is simple because of the good

low-speed handling. The powerful elevator lets you get the nose very high at touchdown and, with the prop set so that it is horizontal as the engine comes up on compression, you should never break a composite prop.

If your Voodoo is in the 3 lb. range and you are using a strong .40, you can do drop launches once you are comfortable with the aircraft. Hold the airplane in your left hand and with the engine wide open, point the nose up about 30°, wings level, and let go. A small push helps a little but is not required. The airplane will cut left a little due to torque, but even with a streamer on it will accelerate away on the climb. About 10' out of your hand, you can transition to a vertical climb to altitude. Most people are impressed.

Combat:

This is the reason we built the Voodoo. These are our rules, not official at all, but we have had a lot of fun with them. Make streamer holders by tying about 10' of monofilament fishing line to a fishing swivel. On the other end make a yoke with a section of fuel line as shown on the plans. Use tape (we use 1" packing tape but a

Materials List

- 1 — 3/4" x 36" L.E. Stock Balsa, Leading edge
- 2 — 1/4" x 1/4" x 36" Balsa, spars
- 3 — 1/16" x 4" x 36" Balsa, leading edge sheet, horizontal stabilizer sheet
- 6 — 1/16" x 3" x 36" Balsa, general use
- 2 — 1/16" x 2" x 36" Balsa, trailing edge sheeting
- 1 — 1/16" x 6" x 24" Ply, tail booms
- 4 — 1/16" x 1/4" x 36" Balsa, capstrips
- 1 — 1/8" x 2" x 36" Balsa, horizontal stabilizer, general
- 1 — 2" x 36" Aileron stock, Balsa, ailerons, boom spacer
- 2 — 1/2" x 1/2" x 12" Maple, engine mounts
- 12 — Heavy duty hinges
- 1 — Heavy duty control Horn
- 46" — Blue Golden-N-Rod
- 8 — Clevises
- 1 — 3/32" x 20" Music wire for aileron horns and stabilizer mass balances
- 4 — 3/32" Wheel collars, mass balances
- 2 — Aileron horns, for 3/32" wire
- 4 — 3/32" Aileron bearings

couple of pieces of Scotch tape will do fine) to attach a crepe paper party streamer to the yoke and then cut it about 30' long to give a total length of 40'. This will look huge on the ground but it shrinks a lot at 90 mph in the air. One thing to note is that if you make the streamers too short, the aircraft can fly fast enough to start shredding them. So if you are shredding streamers, initially make them longer, not shorter, and see if this solves the problem. A real telltale sign that this is happening is a little trail of streamer bits left behind the airplane after a high-speed, low altitude pass. Attach the streamer to the airplane by drilling a small hole in the left top tail boom and inserting a paper clip into it. Attach the swivel on the streamer to the clip and you are ready to go.

Our rules of engagement are to separate to opposite ends of the field and then when ready, fly simultaneously to the middle of the field. Once the aircraft have started to the middle, it's anything goes, but always remember that mid-air is part of the game, as is losing control at low altitude and high-speeds, so **always** knock it off and restart if you are getting anywhere near the crowd lines.

The fight only ends when: (1) all of the streamer is cut off both aircraft or (2) one of the aircraft is on the ground. The other guy running out of gas is no reason to let up on him, and although we have never made a streamer cut on a dead stick Voodoo, we always make the other guy's life miserable as he glides home. Luckily the Voodoo glides like a waxed brick (especially towing a streamer) so the window of opportunity for the guy who is still running is short.

A final note: If you have trouble getting that first kill, take heart, it takes time, but with practice you should average about one kill every two or three flights between evenly matched pilots.

That's the Voodoo, we hope you have as much fun with it as we do, and if you are ever around the Cambridge Model Flying Club in Ontario, Canada, look us up.

