

**A**ny well-versed aviation historian would agree that the Douglas A-20 *Havoc* attack bomber was the most popular, most widely-used, and most effective attack aircraft of the second world war. Only the Douglas A-26 might be considered in contention. However, the A-26 arrived late in the war in fewer numbers and on fewer fronts. The A-36 *Apache*, A-22 *Maryland* and A-30 *Baltimore* did not gain as popular a reputation as did the A-20. The "attack" designation called for low-level strafing and bombing in addition to various other missions "down on the deck". The *Havoc* also performed the role of medium-level bomber.

Over 7000 A-20's of various model designations were manufactured. Export *Havocs*, or *Bostons*, were used by the English, French and Soviets. Almost 400 A-20G-25's were made. American A-20's were used in North Africa, Italy, Northern Europe, and the South Pacific. One variation, the P-70 was developed as a night fighter.

Our version presented here is an A-20G-25. The *La France Libre* completed one hundred missions, including D-Day strikes. It was from the 668th Bombing Squadron of the 416th Bomb Group.

The A-20G had a wingspan of 61 feet, 4 inches and a length of 48 feet. Maximum gross weight was 27,000 pounds. Two 1600 hp 14-cylinder, double-row Wright Cyclone engines gave the machine a top speed in excess of 300 mph. Service ceiling was over 25,000 feet. Landing speed was approximately 100 mph. Its crew usually consisted of two members, the pilot and a gunner. Other versions of the A-20, those with bomber noses, had three man crews; one, of course, would be the bombardier.

Armament consisted of nine .50 caliber machine guns: six in the nose, two in the Martin 250 CE electric turret and one in the ventral (bottom) position. A bomb load of 2,000 pounds could be carried internally, with another 2,000 pounds externally.

The A-20 appealed to me as a good subject to model because of its color, conventional configuration, and its comparative rarity as a model. Its scale is  $\frac{7}{8}$  inch=1 foot. It is not a beginner's model and it is quite demanding on your balsa block supply. A fair amount of carving and planking is required, but this is not too painful for the dedicated builder. I've tried to reduce some of the tedium of building by offering a "pre-planned" scheme of parts sheets.

The design features two plywood wing



PHOTOGRAPHY: RICHARD A. HALL

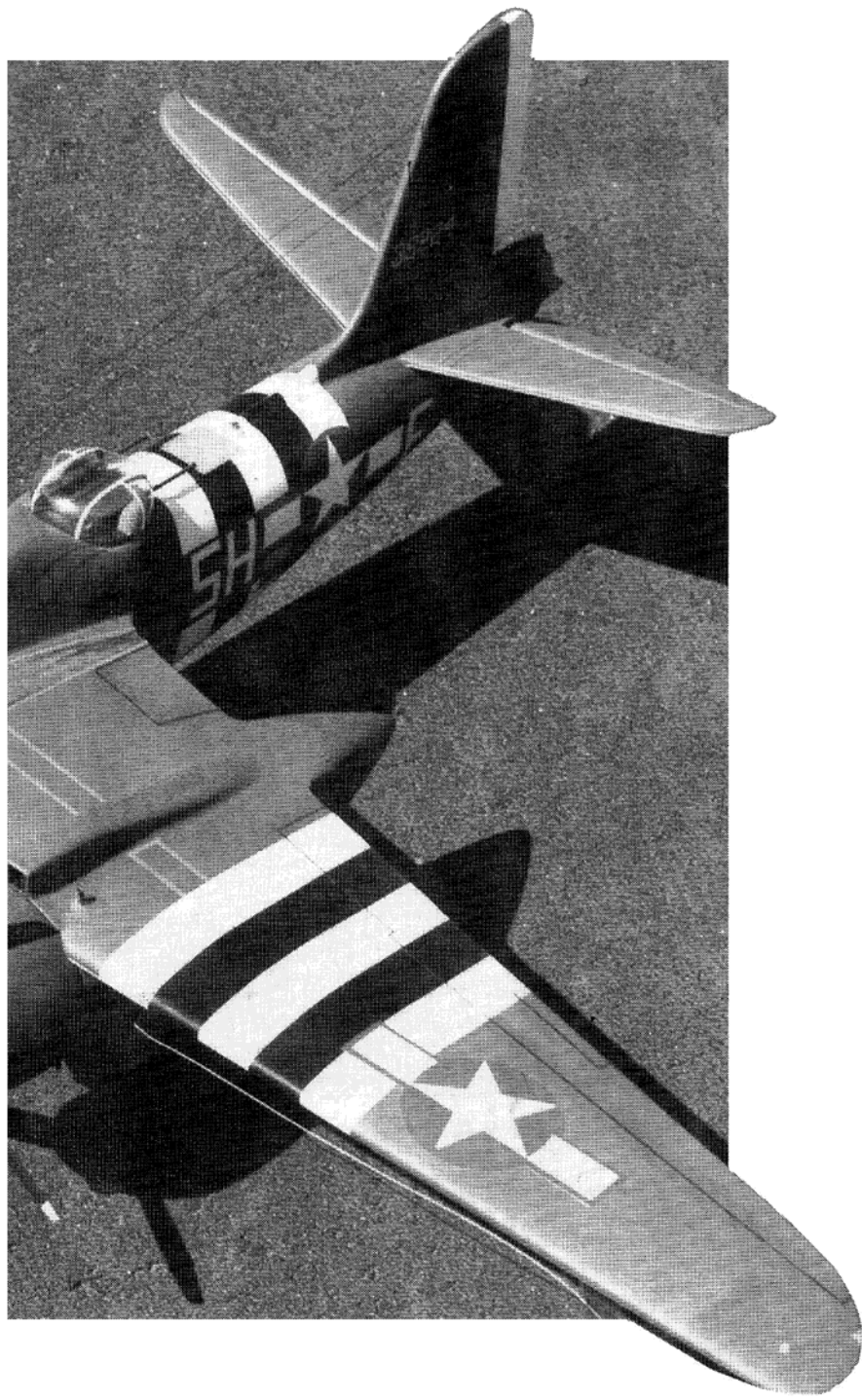
**a C/L Scale Douglas...**

# **A-20G Havoc**

**By Richard Hall**

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For those seeking a classic building project, we present this C/L scale version of a WW II attack aircraft that was widely and very effectively used.



spars. The landing gear mounting former attaches to the rear wing spar and the long motor mounts. In addition, the plywood firewalls are actually embedded in the heavy leading edge. This mutual bonding of major components develops the strength necessary for twin-engine operation.

It is extremely important to keep the tail weight light, otherwise it will be necessary to add quite a bit of nose weight to obtain the proper fore-aft location of the center of gravity. I used steel nails to simulate the six nose guns. Use light weight balsa for tail parts and be sure to hollow out the tail cone block.

## Construction

**Wing construction.** Cut out items shown on parts sheets from  $\frac{1}{8} \times 3 \times 36$ -inch balsa. It should be noted that not all  $\frac{1}{8}$ -inch parts requirements are covered by the parts sheets.

Cut out one W1 wing rib. This is shown in

the partial side view of the fuselage. Two pieces of  $\frac{1}{4}$ -inch thick sheet balsa are needed for the auxiliary leading edge. These should be made slightly over the actual tapered size of  $1\frac{1}{16}$  to  $2\frac{7}{32}$  inch. Any oversize can be cut down after the wing is sheet covered. Leading edges are cut from  $\frac{1}{2}$ -inch thick sheet or laminated from two  $\frac{1}{4}$ -inch thick sheets. Taper as indicated on the plans. Both the wing tips and trailing edges will probably have to be laminated to build up the necessary thickness unless you have some thick planks in your inventory. Accurately notch the trailing edges at the rib locations. Cut out and assemble the plywood wing spars and spar joiners.

Because of the spar arrangement and the airfoil shape, the wing is made "in the air". Center and glue ribs W2 through W10 into the trailing edge notches for left wing panel. Add the spar assemblies and  $\frac{1}{4}$ -inch square spars. Be sure to check alignment during all

stages of construction. Mark off rib locations on the leading edge pieces. Glue leading edge pieces in place followed by wing tip, W11 and W1. Proceed with the right wing panel in a similar manner. Note that it is not necessary to trace out the right panel. The bottom can be sheet covered at this time.

Mark locations of W3, W4, and W5 on the tops of the leading and the trailing edges. Also mark off the centerlines of the nacelles. Apply the top sheet coverings. Contour the leading and the trailing edges and wing tips. Remember to transfer markings as you complete the wing sanding. Slot the left panel between W4 and W5 behind the rear main spar to receive formers N5PL and N5PR. Slot the right panel to receive N5SR. The slot for N5SL is made between W3 and W4. Install the leadout line guide at W11.

**Nacelle assemblies.** Now that you have cut out all of the items shown on the parts sheets, you have all of the balsa formers ready. Cut out  $\frac{1}{8}$ -inch plywood formers N5SL, N5SR, N5PL, N5PR and splice the plates. These are all shown in nacelle rear views. One word of caution: be sure to drill landing gear "J" bolt holes at this time. You won't be able to drill the holes after the formers are glued to the motor mounts. Cut out and drill the firewalls, N2.

The nacelles are made by assembling the left sides over the plan. The method of numbering formers is shown on the plan. You can lighten motor mounts, if so desired, but any holes should be made aft of former N5.

Assemble the motor mounts over the plan and glue down formers N3PL through N7PL for the port nacelle. Notice the N5 is canted to make it perpendicular to the fuselage centerline. Add one or two pieces of planking to stabilize the formers. After the glue is set, remove the assembly from the workboard and cut N4PL to receive the fuel tank. Glue former N3PR in place. Mount the fuel tank so that it will clear the control leads. Add fuel tank feed, vent, and drain lines. The vent line, which should employ a piece of brass tubing as a stiffener, has to be long enough to project above the nacelle.

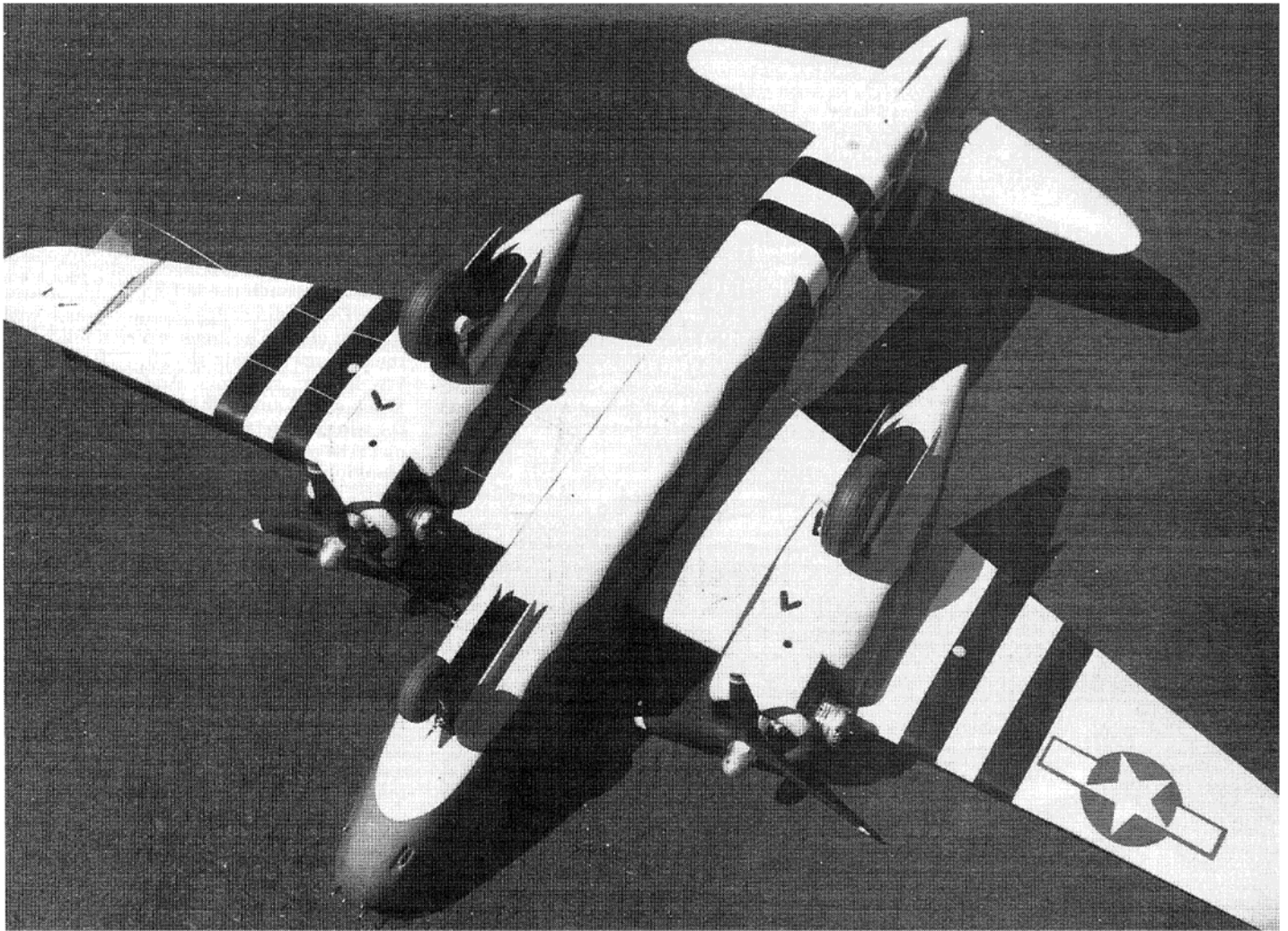
Slide N2 over the motor mounts and glue it to N3 and the mounts. Now trim N4PR to suit the fuel tank. Glue N4PR through N7PR in place. Glue plywood stiffener in place on the back of N5PL and N5PR. The landing gear wire is now bent and bolted to the front of N5. Planking can be completed except for the portion just under the wing. Delay this portion until the nacelle is joined to wing. The starboard nacelle can be made in a similar manner.

Cut out cowl parts C1, C2 and N1. Glue some temporary pieces of scrap balsa between C1 and N1. Plank the cowls as shown on the fuselage side view. Trim the planking flush with the front of C1, then add C2. Sand the cowlings. A bench mandrel or lathe gives better results. An even better job would be had if aluminum or fiberglass cowlings were used.

Drill the motor mounts to suit your engines, then temporarily mount the engines. Cut cowlings and needle valve openings to suit engine. The cowlings are each mounted by three  $\frac{1}{2}$ -inch wood screws. Remove the cowlings for painting, which will be done later. Remove the engine.

**Fuselage and tail.** Assemble the vertical keel on the side view using  $\frac{1}{4}$ -inch sheet pieces K1 and K2,  $\frac{1}{4}$ -inch square strips and a  $\frac{1}{4} \times 1\frac{5}{32} \times 11\frac{1}{16}$ -inch piece. The top  $\frac{1}{4}$ -inch

# C/L Scale Douglas A-20G Havoc



This bottom view shows not only the paint scheme, but also the vent tubes in the bottom of the nacelles, as well as the small cowl drain holes.

square pieces run from F1 to F5, F5 to F8, and from F7 to F14. Left halves of formers F1 through F6, F7T, F7B, F8T, F8B, and F9 through F14 should be glued and pinned to the keel parts. You will have to add  $\frac{1}{8}$ -inch thick shim pieces under F7B and F8B to maintain their inner edges on the fuselage centerline. Add a  $\frac{1}{4}$ -inch stringer which runs between F6 and F9.

Remove the left side from the workboard after the glue has dried. Add right side formers F1, F2 and F3. Cut out and drill the nose landing gear plate as shown in "Section at F2 Looking Forward". Bend the nose gear and attach it to the landing gear plate with "J" bolts. Carefully cut the bottom keel piece K1, aft of F2, to clear the plate and wire. Trim F2 enough to clear the "J" bolts. Glue the nose landing gear assembly to rear of F2. Glue the cockpit floor in place, followed by two K3 pieces. Add right side formers F4, F5, F6, F7B, F8B, and F9 through F12. Add  $\frac{1}{4}$ -inch stringer (right side) which runs between F6 and F9. Pieces F7T and F8T will be added after the wing is in place. Right side pieces F13 and F14 will be added after the pushrod is installed.

Add the three  $\frac{1}{4}$ -inch square strips which run the width of the fuselage. One is located forward of F5 (see part sheet former F5). One is aft of F6, and one is forward of F7B.

Make and drill the bellcrank mount. Glue the mount in place. Make the pushrod assem-

bly, then connect it to the bellcrank, then connect the bellcrank to the mount. The control assembly can be slipped in place from the tail end. Attach two 27-inch lengths of flexible controline cable to the bellcrank. Do not

form eyes, or install eyelets, on leads until later. The leads have to be threaded through nacelle fairleads and leadout guide later on. Coil leads and tape them to the bellcrank mount.



A computer came in handy when it came time to create the 100-mission panel on the side of the fuselage. The model recreates an A-20G-25 that served in the European theater and took part in D-Day strikes.

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Not exactly contemporaries, the O-47 in the background served much earlier in the war than the A-20 in the foreground. Note the D-Day invasion stripes and the overall olive drab finish of the *Havoc*.

Add right side formers F13 and F14. Some of F13 will have to be cut away to clear the pushrod. Depending upon the make of bellcrank you use, you may have to cut away just about all of left side former F7B, above the bellcrank mount, to clear the bellcrank and leadouts.

Fabricate the horizontal tail assembly, together with control horns and elevators. Use two modified commercial horns as a substitute for the homemade arrangement shown, if so desired. Use epoxy to insure a strong joint at the stabilizer centerline. Glue the stab to the fuselage, and at the same time, connect elevator horns to the pushrod ends. Check clearance of the controls. Add a few pieces of planking under the stab to attain some rigidity. Note that controls will be hidden from view.

The basic planking size was  $\frac{1}{8} \times \frac{5}{16}$ -inch; however, some areas can be planked with wide sheets. Side sheets,  $\frac{1}{8} \times \frac{3}{4}$  inch can be used below the wing, between F5, and F11. A bottom piece,  $\frac{1}{8} \times 2\frac{1}{4}$  inches, can run from F2 to F9. Add some side planking to gain some rigidity, then glue a bottom sheet between F9 and F13. This piece is  $\frac{1}{8} \times 2\frac{1}{4}$  inches tapered to  $1\frac{1}{4}$  inches. It needs a little bending. Therefore, it is important to get some side planking in place first to avoid distortion. Make the bellcrank leadout fuselage penetrations. Install pushrod guides to suit. Check control clearance and operation. Tape leadouts to the outside of the fuselage. Planking forward of F6, aft of F11, and below wing support stringer can be completed.

The fin and rudder can be made now, but you may wish to delay adding them to the

fuselage until the wing-fuselage-nacelle work is done. It's easier to work on the bottom without the vertical tail in place.

The fin and forward part of the rudder are of hollow, built-up construction. Both fin and rudder are made independently. Leading edges are rounded. The fin trailing edge is left square. Trailing edge of the rudder is tapered to about  $\frac{1}{16}$ -inch width.

## Assembly

Install wing in fuselage by slipping right wing tip through the left-hand side of fuselage. The leading edge should be flush with the rear of F6. The angle of airfoil relative to the fuselage is established by F7B, F8B, and the support stringers. Add the right side formers F7T and F8T. Apply glue wherever the wing contacts stringers or formers. Complete the planking below the wing. Complete planking between F6 and F8T. Add balsa blocks between F8 and F11. Refer to the fuselage side and partial plan views. These blocks will enable you to make a flat surface for the turret. Add any required planking.

Temporarily glue the nose and tail cone blocks in place. Shape the nose, turret area, and tail cone blocks. Remove nose and tail blocks, hollow them out, then glue them in place. Add filler and fillets in, and around, the wing, nose and turret areas. Complete rough sanding in these areas. Add the nose guns.

Join the nacelles to the wing. Refer to the rear views of nacelles. Note that it is necessary to cut away some wing lower sheeting and wing leading edge. Sheeting is trimmed to clear motor mounts. Leading edge is cut to seat former N2.

Establish headout locations through the left nacelle. Add plastic fairleads for leadouts. Thread leadouts and add eyelets to suit. Complete the planking on both nacelles. Add balsa blocks at the ends of the nacelles. Cut and sand nacelle blocks. Add air scoops.

I used modified Robart scale landing gear struts, which had to be shortened from standard. One side of the wire nose strut is a dummy piece, held in place at the bottom by a brass tube. The top is locked in by the scale strut. Add wheels and landing gear doors. Add plywood tail skid.

If you haven't yet mounted the fin and rudder, they should be glued in place. Offset the rudder to the right, about  $\frac{3}{4}$ -inch measured at the bottom of the trailing edge. Add fillets.

**Turret and canopy.** If you don't feel very ambitious, you can make these items from balsa blocks painted silver. I made the canopy and turret by vacuum-forming. The turret form shape can be seen in the side view and partial top view. The canopy shape can be determined by the side view, shape of former F5, and view shown as "Section at F4". Paint the area under the turret with flat black dope. Paint the cockpit interior chromate-green. Now mount the turret and canopy.

**Details and painting.** Fill in any dents. Sand to a smooth finish, then apply two or more coats of sanding sealer. Sand between coats. I used SIG Supercat or Flat-coat butyrate dope throughout. The first color coats should be white for the "invasion" stripes and white rudder stripe. The bottom was done with polar gray. The top was olive drab.

Apply two, or more, color coats. In addition, the olive drab had a final coat of Flat-coat clear. Mask white "invasion" stripes then apply the black stripes. Paint the wheel wells black.

Make wing walks from extra fine sandpaper painted a flat black. Use MonoKote trim sheets, or equal, to make national insignia, wing walk outlines, numerals, control outlines, and miscellaneous details.

Add gunsight, radio compass loop, antenna mast and antenna.

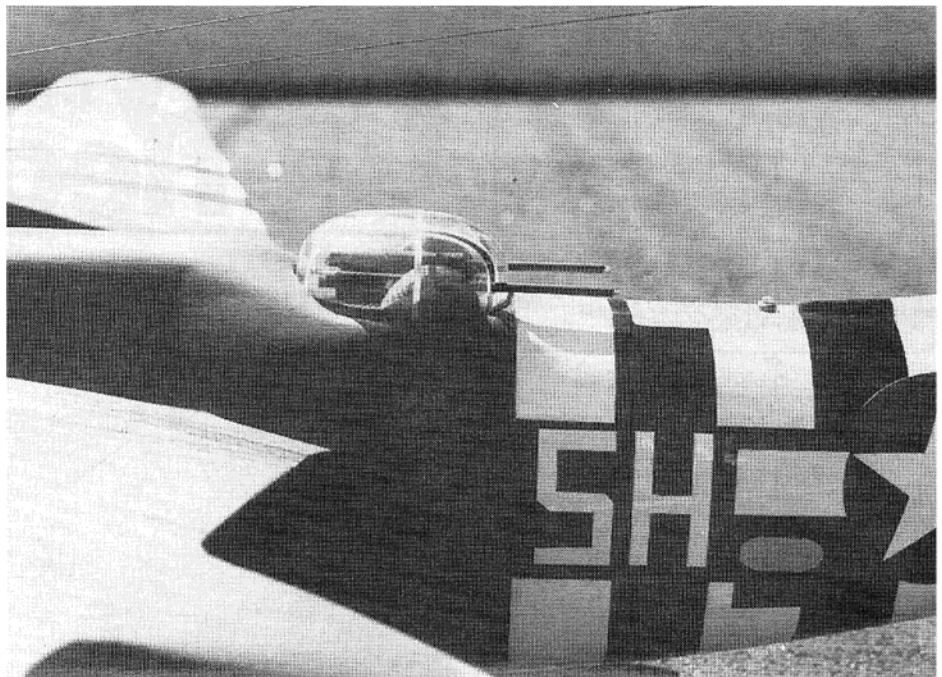
### Balance and flying

Install engines, cowlings and props, then check the balance point. Remember, I told you to keep the tail light! Proper location of fore-aft balance point is in a range between bellcrank centerline and forward main spar. More than likely, you will have to add nose weight. The area forward of F1 offers plenty of room for nose ballast. Heavy prop hubs, made by Harry B. Higley, help to correct a tail heavy condition.

Side-mounted engines will tend to make the right wing heavy. Check to make sure that the plane will roll to the outside of the flight circle. Add right wing weight if necessary, and don't forget to do a pull test on the controls.

Check wheel tracking to assure straight-line rolling or very slight right turn rolling.

Flush fuel tanks and lines, then fill the tanks for a test run. Check operation of both

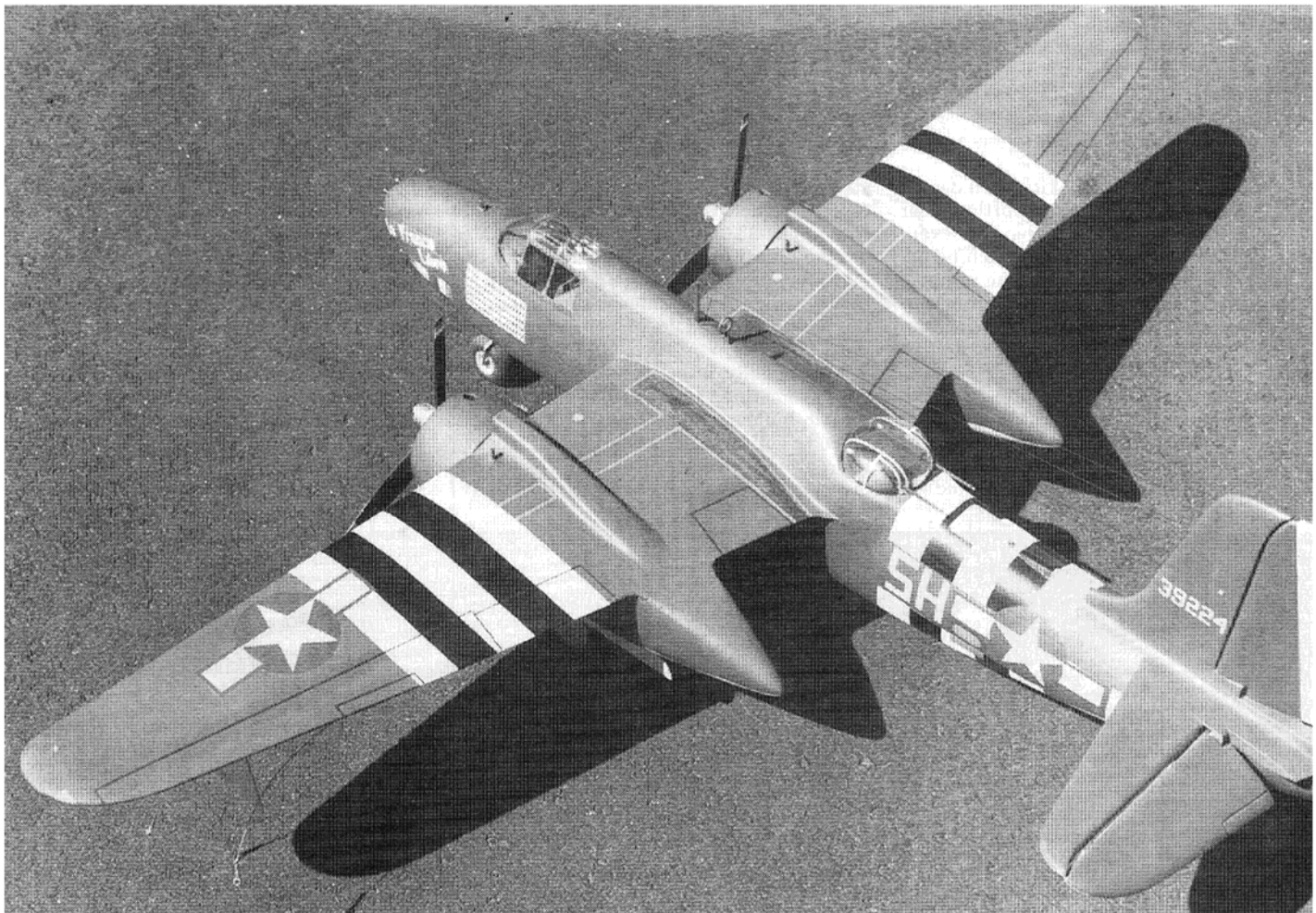


The gun turret canopy was vacuum formed and thin strips of masking tape applied inside to simulate the clear plastic stiffeners used. The author spent time in a turret like this during his WW II stint.

engines. Start the left engine first, then the right engine. Top off the left with fuel to assure that the left will run as long as, if not longer than, the right engine.

Let the plane fly itself off. It will be more realistic that way. Because it is relatively

heavy, it will not "leap off" like a stunt model. Hold low altitudes and avoid the temptation to try stunts. It lands hot, not like a stunt "floater". Reward for your effort will be a realistic, sport-scale model that flies like its big brother did.



This is a true scale project that adds plenty of detail. You'll use a lot of soft balsa blocks to create this plane and it is definitely not a beginner's project.