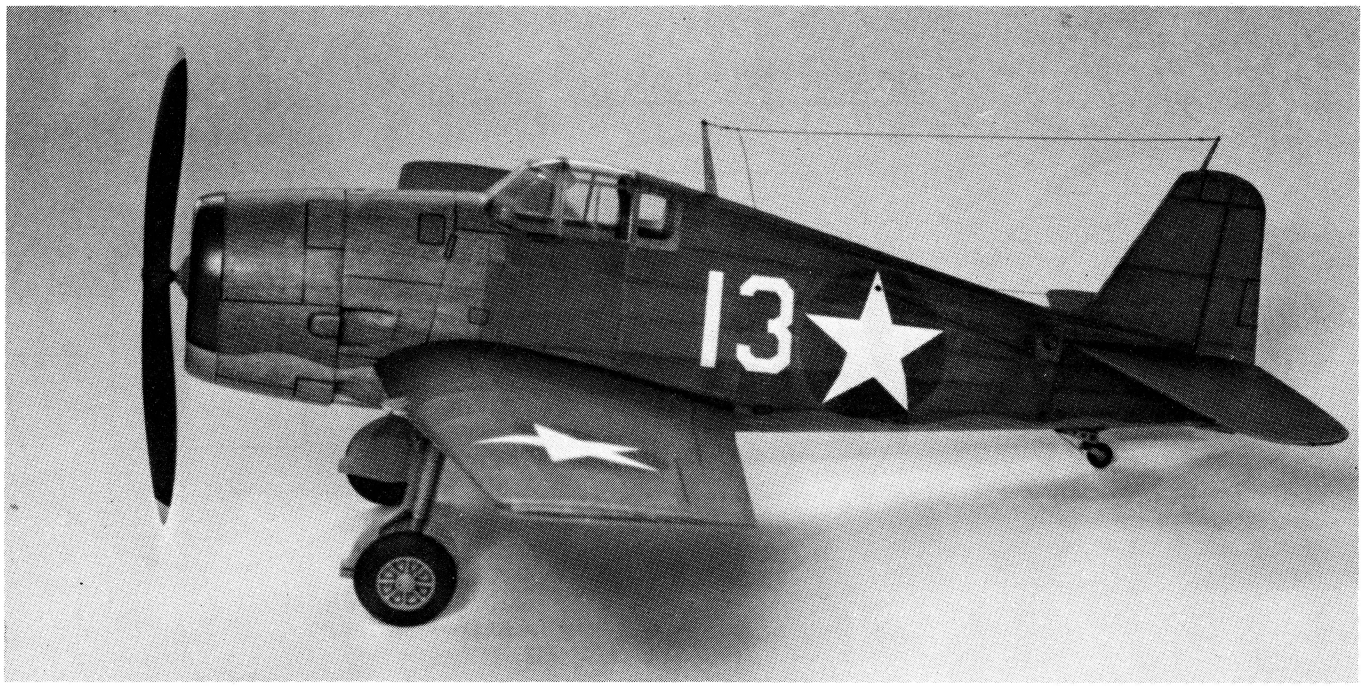


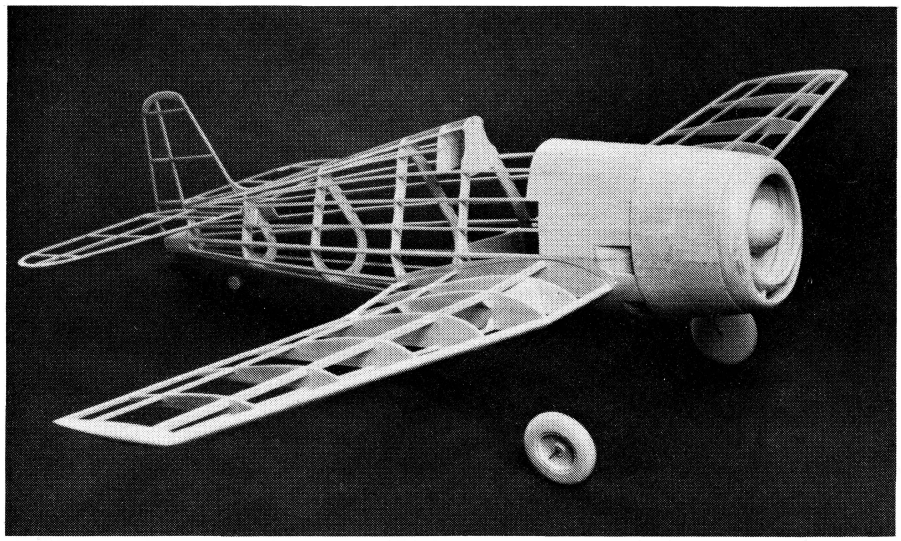
The Hellcat is one of those rare exceptions where downthrust is scale! A 6 inch Kaysun Plastic prop was used for flying.

GRUMMAN F6F HELLCAT

By BILL HANNAN

● The Grumman "Hellcat" was one of the most effective aircraft of World War II, and its design parameters were largely dictated by actual combat veterans, as an answer to the "Zero Menace." A descendant of the F4F "Wildcat," the F6F was superior in virtually every respect. Powered by a Pratt and Whitney R-2800 Double Wasp, rated at 2,000 horsepower, the "Hellcat" had a top speed of about 375 miles per hour. The engine was mounted at a noticeable down-thrust angle, which, coupled with the minimum wing incidence, resulted in a distinctive tail-low flight attitude. The structural strength of the machine was exceptional, which contributed greatly to the confidence of its pilots.

There were two basic types of "Hellcat" which were produced in quantity, the F6F-3 and the F6F-5. External differences were minor, and it would be possible to adapt our model to either type. A large quantity of information has been published concerning these machines (see reference list at end of article), and it is suggested that one or more of these publications be acquired before starting the model. In this way, a builder can select coloring and markings of his choice, and incorporate the small external differences found in individual aircraft. It will be noted that F6's have been finished in everything from "Plain Jane" through elaborate "shark-mouth" paint schemes. In fact, the author had difficulty reaching a decision from the many available alternatives.



The nose of the Hellcat was filled in with soft 1/16 balsa sheet. This improves strength where needed and helps obtain proper balance when the model is flown. Note light tail structure.

Our prototype model features 1942 camouflage and markings, based upon an early production F6F-3 used during the Hellcat's aircraft carrier trials. A photograph of this machine appears in the Caler Illustrated Series book "U.S. Navy Markings, W.W. II - Pacific Theater," by Thomas E. Doll. We would like to extend special thanks to Mr. Doll, who also provided us with additional research material relating to this aircraft.

During preparation for the model, a great deal of conflicting information was encountered, particularly in regard to 3-view drawings. Wherever discrepancies were noticed, photographs were used in preference to drawings in reaching conclusions. And, while certain changes were made for practical construction and flight stability reasons, an effort was made to retain the character of the full size Hellcat.

SELECTION OF MATERIALS

Our prototype model was designed primarily for outdoor flying under average weather conditions, and materials were selected accordingly. Light but firm wood was used, with certain exceptions, such as the wing spars, leading and trailing edges, rear motor peg mounts and front three cowling rings, which were made from hard stock. Particular care was taken to keep the rear

of the fuselage and tail surfaces light, to minimize the need for nose ballast.

CONSTRUCTION

The fuselage is constructed in the traditional "half shell" manner. Each basic keel is made from two 1/16 square balsa strips, which are laminated with white or Titebond glue, and pinned to the workboard directly over the plan while drying. Note that the diagonal strip between F-6 and F-7 in the cockpit area is only temporary, and will be removed later. All bulkheads are cut from 1/16 sheet balsa, and two of each half are required. Cement one set of bulkhead halves in respective locations along the upper and lower keels. Use a small triangle to check the vertical alignment of each. Allow to dry thoroughly.

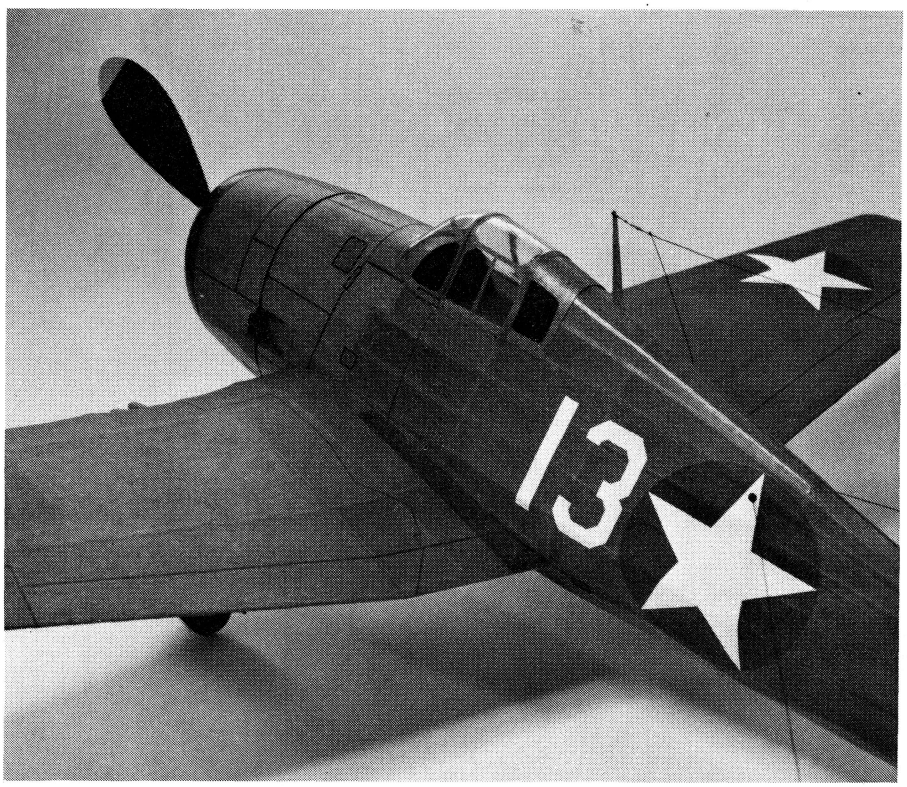
Meanwhile, laminate two side keels, which can be pinned to shape directly over the top view drawing, one at a time. When dry, they may be removed from the board, and one of them installed in the fuselage half shell which is pinned down. When the half shell is dry, remove the assembly from the board and continue construction by carefully gluing the second set of bulkhead halves in position and adding the second side keel. The engine cowling is constructed separately in exactly the same manner as the fuselage.

Install the partial bulkheads F-6 and F-8. Note that the paper instrument panel should be added to F-6, but not until a bit later in the program. Begin installing the fuselage stringers, first giving each a trial installation. Occasionally, owing to drawing inaccuracies, cutting slippages, and "Murphy's Law," a stringer will be found to have a slight "bobble" in it and will not smoothly follow the contour between bulkheads. In this event, it is best to enlarge the offending bulkhead slot as needed to shift the stringer into alignment. Afterwards the oversize notch may be filled in with scrap wood, if desired. Taking the time to make these small corrections will result in a better final product. As each stringer is installed, its opposite number should be next in place. The object, of course, is to avoid pulling the fuselage out of line, which may occur if more than one stringer is added to one side at a time. Once the stringers are in place, the short diagonal keel piece between F-6 and F-7 may be removed, and the instrument panel drawing glued on.

Note that additional stringers may be added between indicated stringers if desired, to obtain smoother contours. The problem is, though, that the weight can increase rather alarmingly if one gets carried away. A flying model of necessity must be a compromise between strict accuracy and practical considerations.

Install the 3/32 sheet balsa wing saddle pieces as indicated on the side view drawing. The balsa ring laminations for the extreme nose are best sanded to shape before gluing to the cowling. A careful look at photographs will help in understanding the contours involved. The two "teeth" are carved and installed by the trial and error method. Note that the nose button is removable for winding, but should be a snug fit. The cowling and forward portion of the fuselage may either be covered with 1/32 sheet balsa or filled in between the stringers with soft 1/16 sheet. The latter method is rather tedious, but results in an exceedingly strong assembly. Again, the balsa covering or fill-in could be extended further aft for greater realism, but consider possible weight penalties carefully!

The cockpit interior may be covered with light green tissue or painted pale green to simulate the zinc chromate primer used inside the real machine. The scrap balsa headrest may be painted black.



Bill's model of the Hellcat was covered with colored transparent tissue. The text explains how he got the two-tone effect of dark blue on top and light grey underneath. Lines are India ink.

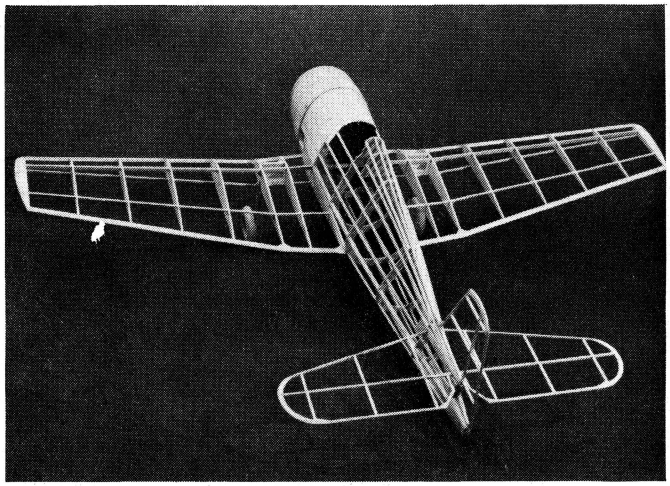
Bill's Hellcat climbs away from a hand launch.

WINGS

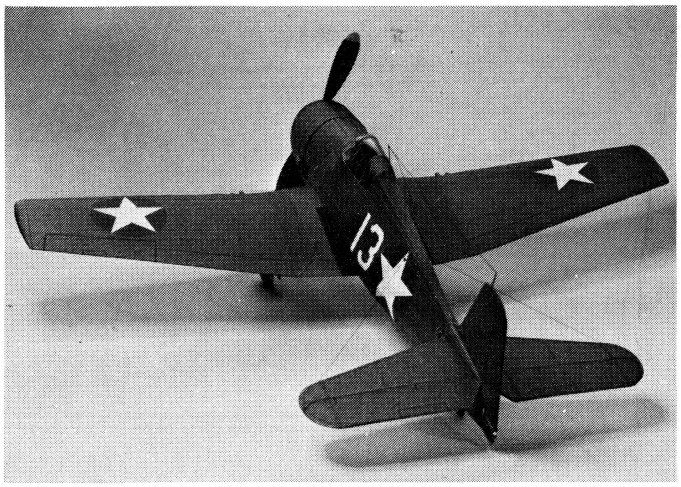
Cut two each of the wing ribs from 1/16 sheet balsa, except for the W-1s, which are 3/32 sheet. Pin the 3/16 x 1/16 trailing edge strips and the 1/16 square lower spar onto the building board directly over the plan. Install each wing rib, trimming slightly if requited for a perfect fit. Next, install the hard 1/8 square leading edge. After allowing plenty of drying time, crack the leading and trailing edges plus lower spar at the W-3 rib positions, and elevate the wing tips for the correct amount of dihedral. Note that the trailing edge tips are elevated an extra 3/32 to provide wash-out, as a stability aid. Add both upper spars, and the gussets at the dihedral breaks. Shape and glue on the light balsa tips. Also install the hard balsa landing gear mounts and gussets. Sandpaper the leading and trailing edges to final contour.

TAILPLANES

The tail surfaces are constructed from 1/16 square balsa strips plus the 1/16 sheet balsa tip members, directly over the drawings. When dry, remove from board, and sand edges to a rounded contour.



Bulkheads are sanded away between stringers to allow covering to flow smoothly fore and aft.



It is important, if you intend to fly the model, to add washout to the tips of the wing for improved stability.

LANDING GEAR

The load absorbing members of the main landing gear are bent from .040 diameter music wire as indicated. These are glued in position and sandwiched with 1/16 hard balsa reinforcement pieces, glued firmly in place. The detailing is best added after the wings are covered with tissue, but will be described here. Build up the main struts from balsa sanded round, then split to permit installation around the landing gear leg wire. Strips of paper are wound and glued on to build up the various areas of different diameters. The landing gear leg covers and doors are thin card stock, with other details of scrap balsa, etc. Again, it is suggested that photos of the real machines be examined by those who may care to add extensive detailing. While it would be possible to construct actual wheel wells, we elected to simply simulate them with black tissue paper.

COVERING

All structure should be carefully sanded to blend the components smoothly together and eliminate surface roughness and any slight misalignments. The bulkhead areas between the fuselage stringers may be scalloped with a round sanding stick, for a smoother covering job. If you intend to duplicate the recessed areas directly behind the cowling (exhaust outlets) this operation should be performed before covering. Alternatively, these areas may be simulated with dark colored tissue.

Apply two coats of clear dope to every portion of the structure which will touch tissue paper, with the following exceptions: Only the outlines, of the wings, the dihedral joint ribs and outlines of the tailplanes are doped. After drying, lightly sand all the doped areas to remove balsa fuzz, and apply two more coats of clear.

We used colored tissue for all covering, and applied it by brushing dope thinner directly through the tissue from the top side, which softens the dope on the framework to provide adhesion. Additional clear dope can be brushed along the edges for a firm seal. In the case of stiffer "art store" type domestic tissues, extra attention may be required to ensure complete adhesion. For the fuselage, it is perhaps easiest to apply many small sections, rather than to wrap on larger portions. The tissue is also applied over the sheet balsa areas for uniform appearance. Compound areas will require tissue application in small pieces. Alternatively these areas may be painted, although it is difficult to achieve a good match with the tissue. Again, it is sometimes a matter of compromise between optimum visual effect and practical considerations.

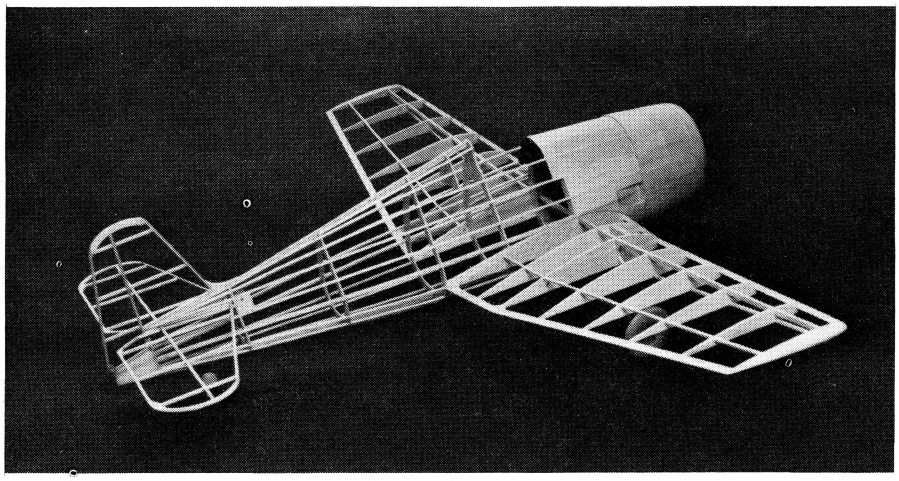
The top of each wing panel can be covered in two sections, and the bottoms similarly treated. Extra strips will be needed for the tips, however. We use alcohol rather than water to shrink our tissue, as it seems to have a milder action, less apt to cause warps. It is, however, best to pin or weight the surfaces to some sort of a jig during shrinking and subsequent doping, to retard warpage. Plasticized dopes such as Sig Litecoat are suggested. We generally settle for two thinned coats, but in moist geographical locations, more may be required.

The two-tone color scheme of our Hellcat required some extra steps. The wavy separation between the two fuselage colors may be achieved in either of two ways (other than painting). If you are using fairly opaque tissue, you may be able to simply apply the wavy blue section of tissue directly over the grey tissue. If, on the other hand, your tissue is quite transparent, a muddy effect may occur if you overlap large areas. The approach then is as follows: Two layers of grey and two layers of blue tissue are taped onto a sheet of cardboard. Next, a tracing of the wavy separation line is made on this paper, such as draftsman's vellum. This is taped over the previously mentioned tissue. Using a very sharp pointed modeling knife, a cut is made clear through the tracing paper and 4 layers of tissue along the wavy color line. Next, a thick coat of clear dope is carefully applied along each wavy edge of each sheet of tissue, in a strip about 1/16" wide. A sheet of transparent plastic wrap is then taped down to the working area. Align the wavy edge of a blue tissue sheet with the corresponding edge of a grey sheet with a slight overlap, say a little over 1/32 inch. Now flow some thinner from a pointed brush THROUGH the two layers of tissue along the previously clear doped area, causing the two sheets to adhere to each other. Now the tissue may be cut into the required strips for application to the model.

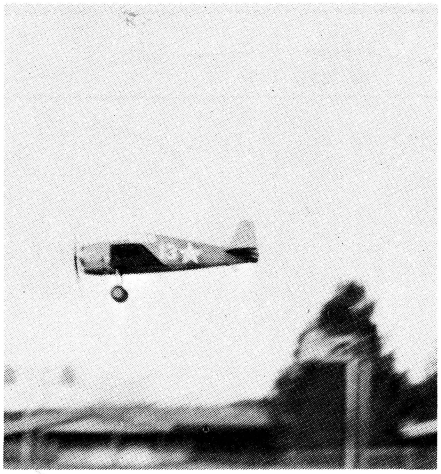
All of the various details and markings are applied before assembling the model, for ease of handling. These items take extra time, but make the difference between a so-so model and an outstanding one. The one deviation from tissue for our markings concerns the white areas of the numbers and stars. Tissue is too transparent for this purpose, as the underlying color shows through. While it would be possible to inlay white tissue in the same manner as the wavy line was created, it is much easier to simply employ opaque white paper. The thin lines such as aileron outlines, cowl flaps, etc., may be made from black tissue, ruled on with india ink, or applied with chart tape.

CANOPY

The original model canopy was formed over a carved balsa block with the aid of a Mattel Vac-U-Form toy. The mold should be primered and sandpapered to minimize the grain of the wood. The various "window frames" may be achieved on the mold with strips of tape, or if desired, applied to the finished canopy in any of several possible manners. Chart tape can be used for the frame outlines, as can colored tissue paper. Alternatively, the canopy can be suitably masked and the line sprayed on. The poorest approach, in our opinion, is to paint the lines on



Note high position of the rear rubber peg. This helps maintain the downthrust which is so important for smooth, steady flights.



The Hellcat glides in to land after another successful flight. Ship flies quite well.

with a brush, which is almost bound to produce unsatisfactory results, not to mention frustration!

A duplicate vacuum-formed canopy may be ordered from Sig Mfg. Co., Montezuma, Iowa.

ASSEMBLY

Trial fit the wing panels to be certain of alignment, and if necessary, trim for a perfect fit. When both panels fit properly, glue them in place. Be generous with the adhesive, since the wings must absorb not only flight loads, but the landing-gear shocks as well. A 1/8 x 1/16 hard balsa strip glued across the intersection of the main wing spars will add strength to the assembly.

Cut the small section from the rear fuselage vertical keel member to allow the stabilizer to be installed. Check the alignment of the stab carefully, and glue in position. Cut a small piece of 1/16 sheet balsa to serve as a filler behind the stabilizer, cover the exposed edges with appropriate color tissue, and glue in place. Check the fit of the vertical tail, and if satisfactory glue into position.

Add the various remaining details such as antenna masts, landing gear doors, tail wheel details, etc. It is suggested that the antenna wires be left off until test flying has been completed, since they tend to interfere with handling of the model. Now is the time to carefully examine your reference photographs for differences in markings and details. For example, the F6F-5 versions featured slightly simplified canopy struts, and many of them did not have the rearmost side windows. The fairing over the side exhaust stacks was also eliminated (even on some F6F-3s) and other changes were made in the cowling, inspection panels, etc. The fairings around the wing guns were eliminated on later F6F-3s and all of the F6F-5s.

A simple, yet effective engine can be simulated with Williams Brothers 3/4 inch scale dummy cylinders. These can be cut in half, shortened as required, and fastened to the inside cowl face with contact cement.

PROPELLER

Our test model was flown with a 6 inch diameter Kaysun Plastic prop, which worked quite well. Our drawing includes a scale 3-blade type which could be fabricated for display purposes if desired.

POWER

We used a single loop of 4mm Pirelli rubber, or two loops of 1/8 inch brown rubber. Heavier models might require additional power, while a very light model might need less. Experimentation seems the only answer to this question.

FLYING

Check model carefully for warped surfaces. If any are detected, the offending part may be held over a steaming teakettle, and the warped part twisted the opposite way. Upon cooling the warp should be absent. Check again later though, as some warps seem to return with changes of temperature or humidity.

Although we are seldom able to find both, we must suggest the traditional tall grass field and calm day for test flying. Assuming the model balances close to the point shown on the side view drawing, try a few gentle hand glides. Remember to release the model smoothly and not too fast, in a slight nose down attitude. The addition of ballast to the nose (most likely) or tail should correct any stalling or diving tendencies. If the model persists in falling off on one wing, add a small lump of clay ballast to the opposite wing. When the glide appears satisfactory, try a few turns in the rubber motor. The flight path should be smooth, with no strong tendencies in any direction. If stalling under power occurs, add a downthrust shim at the top of the thrust button. If the flight circle is too tight, or there is sufficient turn, correct with a side thrust adjustment shim. More turns are added to the rubber motor, and any needed readjustments performed. Sometimes a little bit of tail surface "tweaking" can be helpful, but should not be overdone. When all is in order, stretch wind with a mechanical winder for best performance.

This model would also be a "natural" for Brown Jr. CO_2 engine power.

SCALE REFERENCES:

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NOTE: Several plastic kits are on the market, and may prove helpful in visualizing various parts. Bear in mind, however, that they too are based upon human research and conclusions.

Special thanks to the following individuals for research aid: Mr. Thomas E. Doll, and Mr. Russ Barrera, of the Russ-Craft Model Museum. ●