
TRAILING EDGE STOCK FOR WING
NOTE BEVEL
3/16 BALSA
LEADING EDGE STIFFENER 3/8 x 3/8
SPAR 3/32 SHEET BALSA
1/8 HARD BALSA
HARDWOOD LANDING GEAR MOUNT
3/32 PLYWOOD
HOLLOW TIP BLOCK
AILERON CUT FROM 1/4 x 1 x 36 BALSA
RIBS CUT FROM 3/32 BALSA
ELEVATOR CUT FROM 3/8 SHEET BALSA
LEADING & TRAILING EDGE STOCK FOR STAB
BLOCK SPACING SAME ON THIS SIDE
BACK PIECE (RIGHT)
FRONT PIECE (RIGHT)
FULL SECTION
SCALE 1/8" = 1"
BLOCK MADE OF 3/4" HARDWOOD STOCK
1/4 - 5 PLY PLYWOOD
3/16 DIA.
9/64 DIA.
1/4 BALSA
3/32 PLYWOOD
RUDDER & FIN 1/4 SHEET BALSA
3/4 x 1/2 x 1/4 NYLON
1/4 x 1/2 BALSA
4-40 BLIND NUTS
SPINNER TURNED DOWN FROM 2-1/4 TO 2-1/8 VECO
DU-BRO CANOPY
BALSA TOP BLOCK 5/8 x 3-1/2 x 36
VECO .61 R/C
ENGINE MOUNTED 2-1/2 DEGREES DOWN 2 DEGREES RIGHT
3/4 TRIANGLE STOCK
12 OZ. BARBER BOTTLE
9/16 TRIANGLE STOCK
FUSELAGE STIFFENERS 3/32 x 1/4 BALSA
3/32 PLYWOOD
C/G
TOP FLITE TAURUS MAIN LANDING GEAR USED MAIN WHEELS 2-3/4 IN. DU-BRO
1/4 DOWEL
1/32 PLYWOOD DOUBLER
3/32 BALSA SIDES
3/32 BALSA DOUBLER
3/32 PLYWOOD SADDLE
5-1/2 IN. DIHEDRAL
NOSE WHEEL 2-1/2 IN. DU-BRO
RADIO CONTROL modeler MAGAZINE
CYGNUS
DESIGNED & DRAWN BY
NICK BOZNOS
INKED BY
C. FLORES

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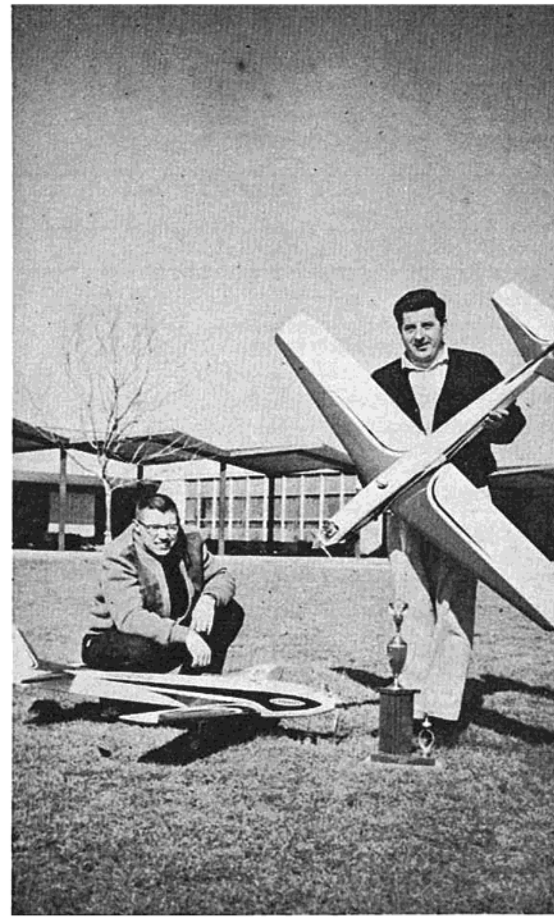
CYGNUS




CYGNUS
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CYGNUS
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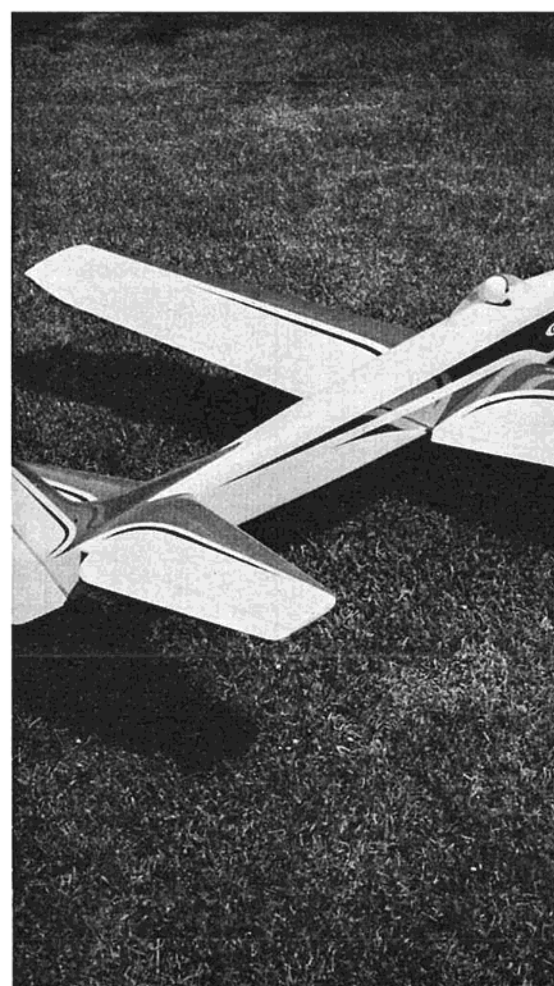
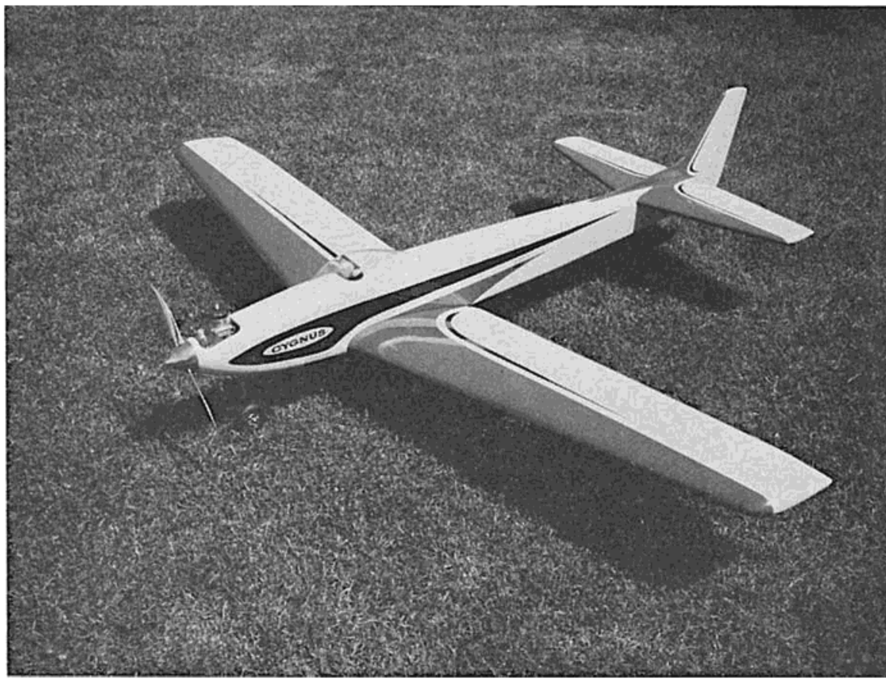
CYGNUS



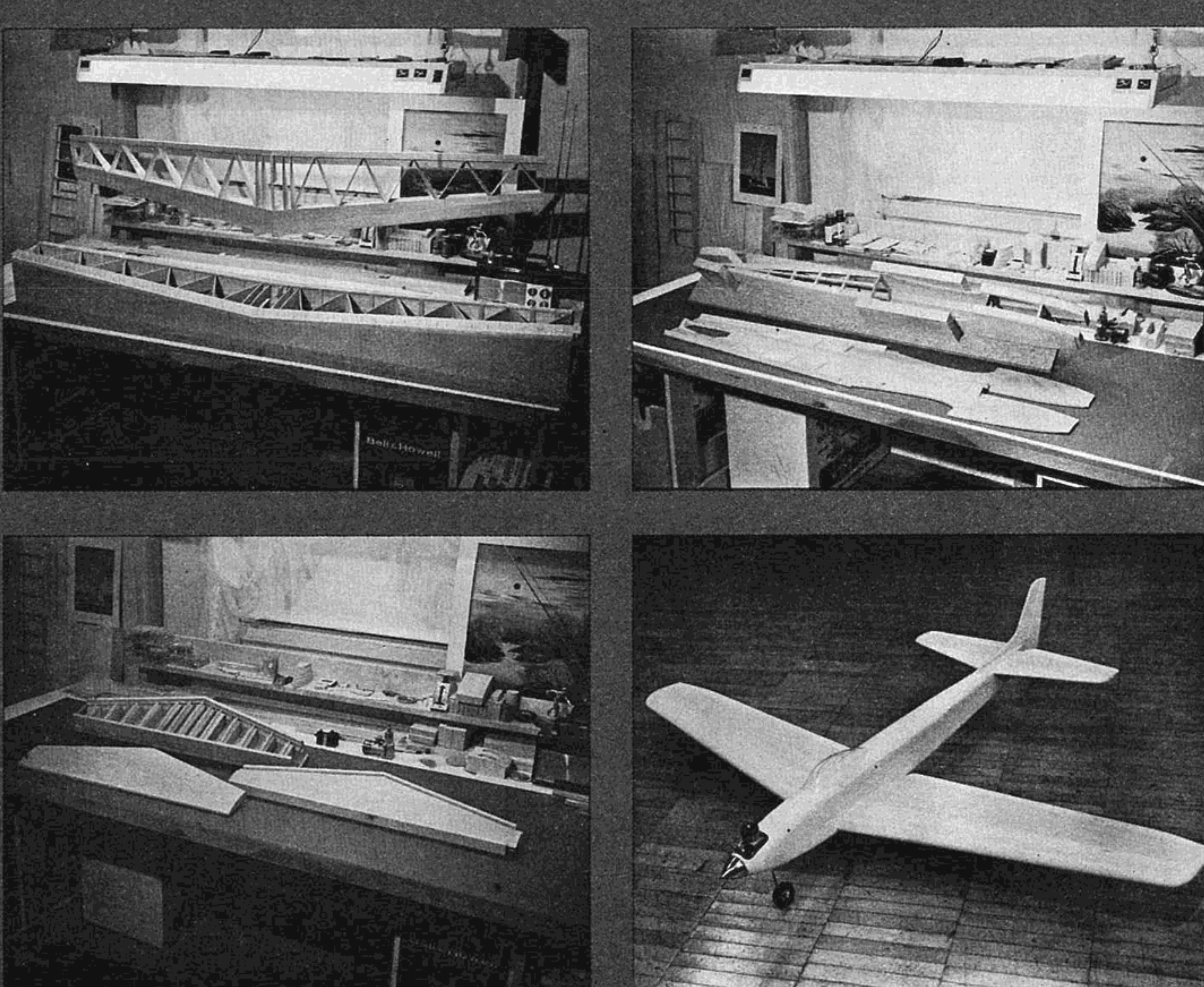
CYGNUS



Winner of the R/C Modeler Editors Trophy at the Toledo Conference, the Cygnus is the remarkable product of its designers' dedication to an ideal of no compromise in R/C design and construction.

Photos And Text By
NICK BOZNOS
and
GORDON BELL

FAR in the back of most every modeler's mind lies a vision of the "perfect plane"; the plane he'd create if he were going to design his concept of the "ideal airplane." This vision had been haunting us for quite some time. On several occasions we discussed the various properties we'd include in each of our respective airplanes, and to our surprise, found that our ideas of what the "perfect plane" should have were basically similar. There were certain characteristics which we both felt were vital to a well-designed model. And soon the temptation to combine our efforts in creating one "ideal" ship could no longer be resisted. We thereby set forth in designing what we thought would be a most attractive airplane. But, devising an attractive plane and a functional one are not necessarily the same thing! Having built numerous kits for Class III multi-stunt ships, we had great respect for the basic aerodynamic principles which these tried and proven, predecessors had successfully utilized. We were not so foolish as to disregard the many good features which these planes had to offer, and we wished to incorporate as many of them as possible in our own design. But there were other desirable features which the available aircraft lacked. In our design we wished to answer some of the common problems of the average modeler which the existing airplanes did not solve. One of these was to devise a sure-fire method of building a warp-free wing and stabilizer. A second feature we wished to include was a quick construction, sheet and block fuselage with clean lines. As you will see, these features and the method of building them are of some value to any modeler building a Class III ship. Another aspect which we wished to incorporate in our design was an attractively cowled upright engine with a spinner. True, engines had been



Top row: Cygnus wing jig assures perfectly true surface. Fuselage sides shown with jig. Quickly built fuselage jig assures true fuselage contours plus rapid assembly. Lower row: Stabilizer shown from jig construction to finished unit. Completed Cygnus prior to finishing steps.

cowled before in an inverted position, but this created operational difficulties in the engine itself, and we wished to avoid this. The engine, therefore, had to be upright. But the problem of symmetrically balancing a fuselage, tapered to spinner, with a cowled upright engine was more difficult than it first appeared. And it was of greatest importance that the engine, propeller, and spinner operate efficiently. After many hours of frustrating trial and error, we hit upon a feasible way to do this.

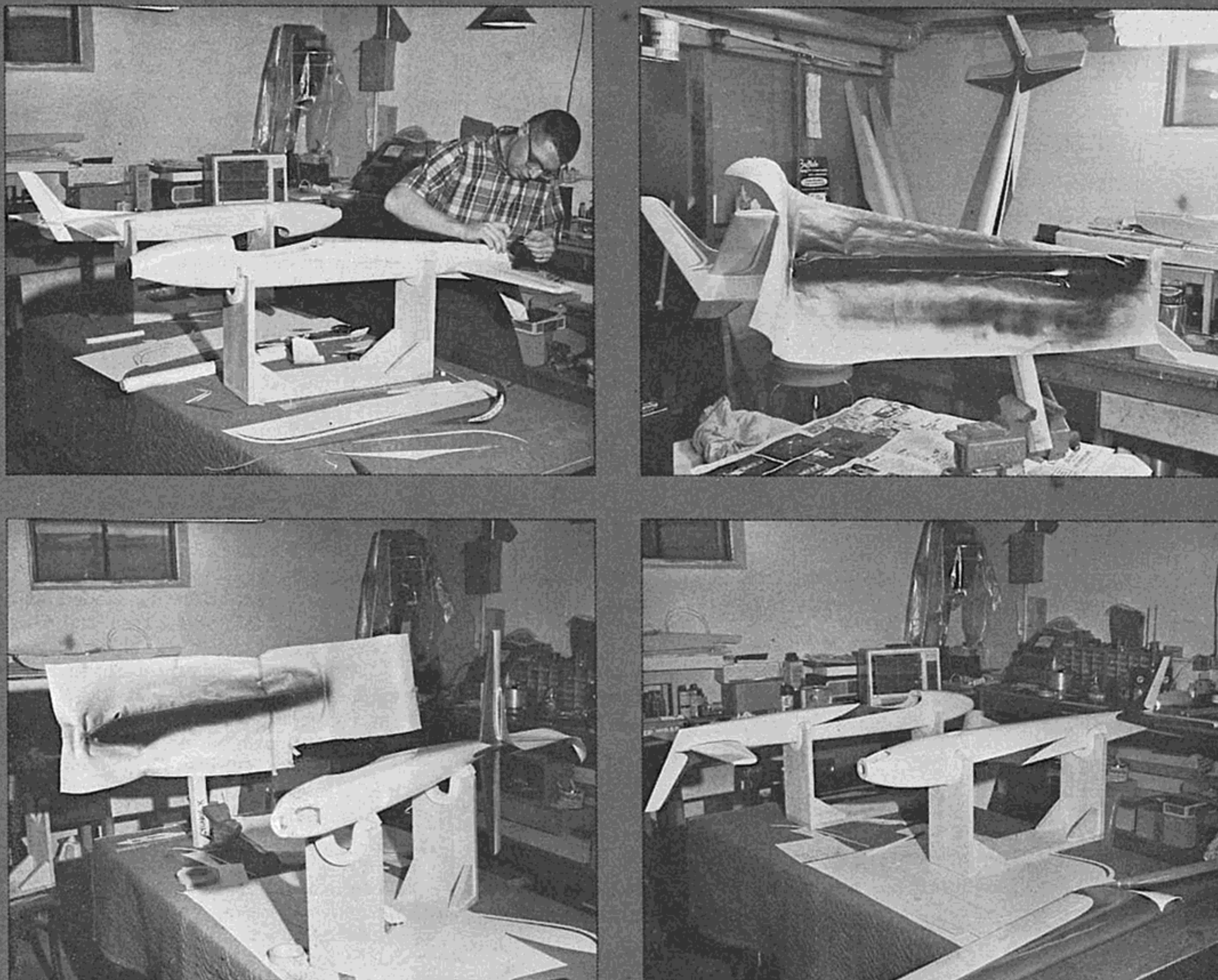
All these features make the CYGNUS more than just another Class III ship, and we hope that our experiences and findings will benefit other modelers like ourselves in building or designing future aircraft.

Wing Construction

Finding the answer to a warp-free wing was not an easy task, but one thing we found invaluable in its construction was the use of a jig (see drawing). This insured a truly straight wing. The true key to the warp-free wing, however, was in the word "Geodetic." It was through Ed Kazmirski that we were first introduced to this concept. He explained how this particular type of wing construction had the advantage of being extremely strong and rigid without adding extra weight. From these ideas, we developed our first swept-back geodetic wing. The most difficult problem we faced in developing this wing was in finding an accurate method of plotting the angular ribs. This same swept-back wing was tested March, 1964, by Ed during his demonstration tour in Japan and was found to be very successful.

The building of this wing is somewhat unconventional, but the final product is well worth the effort. The first step in building is in preparing the 3/32" sheet spars, which must be cut and marked for the rib placement and then pinned to a flat surface. Next, the small angular uprights are glued to a center line in order to keep the ribs standing on the proper angle during the construction. (The rib section, incidently, is a modified NACA 2419-19% section.) The ribs #1S — #12S should then be glued and pinned to the spar and angular uprights where the ribs have been marked. This spar is then transferred to a perfectly flat leading-edge jig in order to complete what will be the leading-edge or "D-tube" of the wing. A 3/8" square piece of soft balsa is used to reinforce the leading edge. When dry, shape the 3/8" square by sanding to conform to the shape of the rib. Next, a pair of Taurus, pre-formed leading-edges are glued to the upright leading-edge on the jig. Securing these tightly with masking tape will insure a good job of gluing on each rib. The upper and lower 3/32" planking is added behind the preformed leading-edges in such a way that it extends about 1/4" past the full depth spar (which acts as a locking device and prevents any further movement in construction). The first and most basic part of the wing, the leading-edge, will now be complete.

The next problem is in sanding the two "D-tubes" accurately to fit at the



Top row: Cygnus fuselages in painting jigs. Author applies masking tape to trim areas. Paper is applied to fuselage and trim areas sprayed. Bottom row: Another view of fuselage masked off and first coat of red applied over basic white. Both fuselages in painting jigs with basic color and trim applied.

center of the wing. This can be done best by first building a sanding jig of "Nova-Ply" (see photograph). After having tried to sand three angles simultaneously, we can assure you that the extra time involved in making the jig is well worth the trouble. The jig was made using the basic principle of the miter-gauge on the table saw. This jig can also be made adjustable to suit any wing, whether built on the "D-tube" principle or not.

After sanding the left and right leading-edge, determine the location of the aileron servo on the 3/8" balsa center rib, and cut partially but not completely through. This will insure that the rib will retain its shape during the wing construction. The next step is in gluing the two "D-tubes" and center rib together. After these have been joined, the unit is placed on the jig. Next, the tip ribs must be added. The trailing-edge stock is securely pinned to the back of the jig, and the tip and center ribs are then glued to the trailing-edge. Masking tape should once again be used to hold the "D-tubes" to the front uprights on the jig. The #1S and #2S ribs are now fitted and glued into place. Then fit and glue #1A through #10A into place. Note that ribs #1A - #10A are slightly longer on the plan than necessary. This was done to allow for fitting. Let the entire structure dry overnight.

A perfectly flat sanding block 1" wide by 18" long by 3/4" thick, with #100 sandpaper contact-cemented to one side, is used to lightly touch-up any high points on the ribs. After this is done, a 2" piece of 3/32" sheet is fitted and glued to the trailing-edge stock.

The next step is removing the wing from the jig and cleaning off any of the excess glue which may have dripped through. The gussets are now added to the trailing-edge and center rib. (The center rib gusset also serves as a servo mount.)

Basswood filler blocks should be used between the center rib and #2S as reinforcement for the 8-32 screws used to hold down the wing to the fuselage. The 3/8" square balsa is added between the front of ribs #1S and #2S and the spar as shown in the plan. Next, add the landing gear blocks and 1/8" balsa wedges. Be sure to check the grain direction; this is important. The small landing gear blocks are now glued to ribs #1A in order to anchor the landing gear. Add the 3/32" plywood scabs on either side of the blocks to prevent any movement of these blocks.

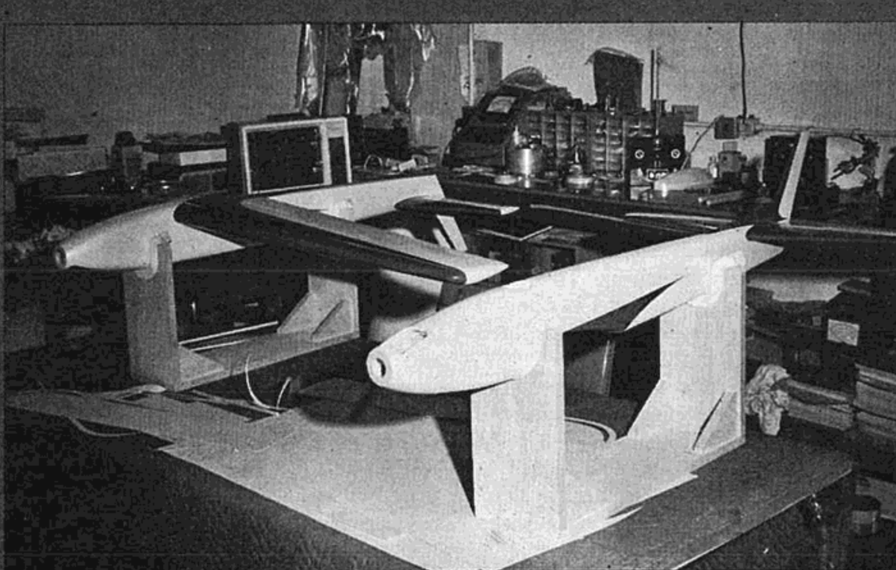
Before adding the final top and bottom 3/32" sheeting, check the rigidity of the wing by holding the center section and twisting one of the tips. This will eliminate any doubts as to the possibility of future warping. If the jig is built accurately, the wing will be true. Finally, add the soft balsa tips and the wing construction will be complete.

Fuselage Construction

For convenience in building the fuselage, the plan has been laid out in such a way as to allow the patterns to be cut while still having the side and top views

Completely painted fuselage and wing. Jig in foreground.

Closeup of nose section of Cygnus.



Two Cygnus prototypes in authors workshop.

intact for reference needs during the construction. The fuselage sides should first be laid out and marked for the former and doubler placement, etc. The top and bottom longerons are then added. The 1/32" plywood doubler underneath the stabilizer saddle is added with contact cement. Next, the 3/32" front doublers are cut and pinned into place on the fuselage sides. The bottom edge should be cut somewhat longer so that the 3/32" plywood wing saddle may be aligned. A line should be scribed along the top of the saddle. Then all the doublers are unpinned and cut along this line for a perfect fit of the wing saddle. Before the saddle is glued, however, the 4-40 blind mounting nuts and nylon blocks for the wing hold-down are installed.

Contact cement may be used to glue the doublers behind former "C." The front doublers ahead of former "C" are glued with regular airplane glue — a glue which can be easily sanded and feathered as this will either make or break the sanding job on the front end.

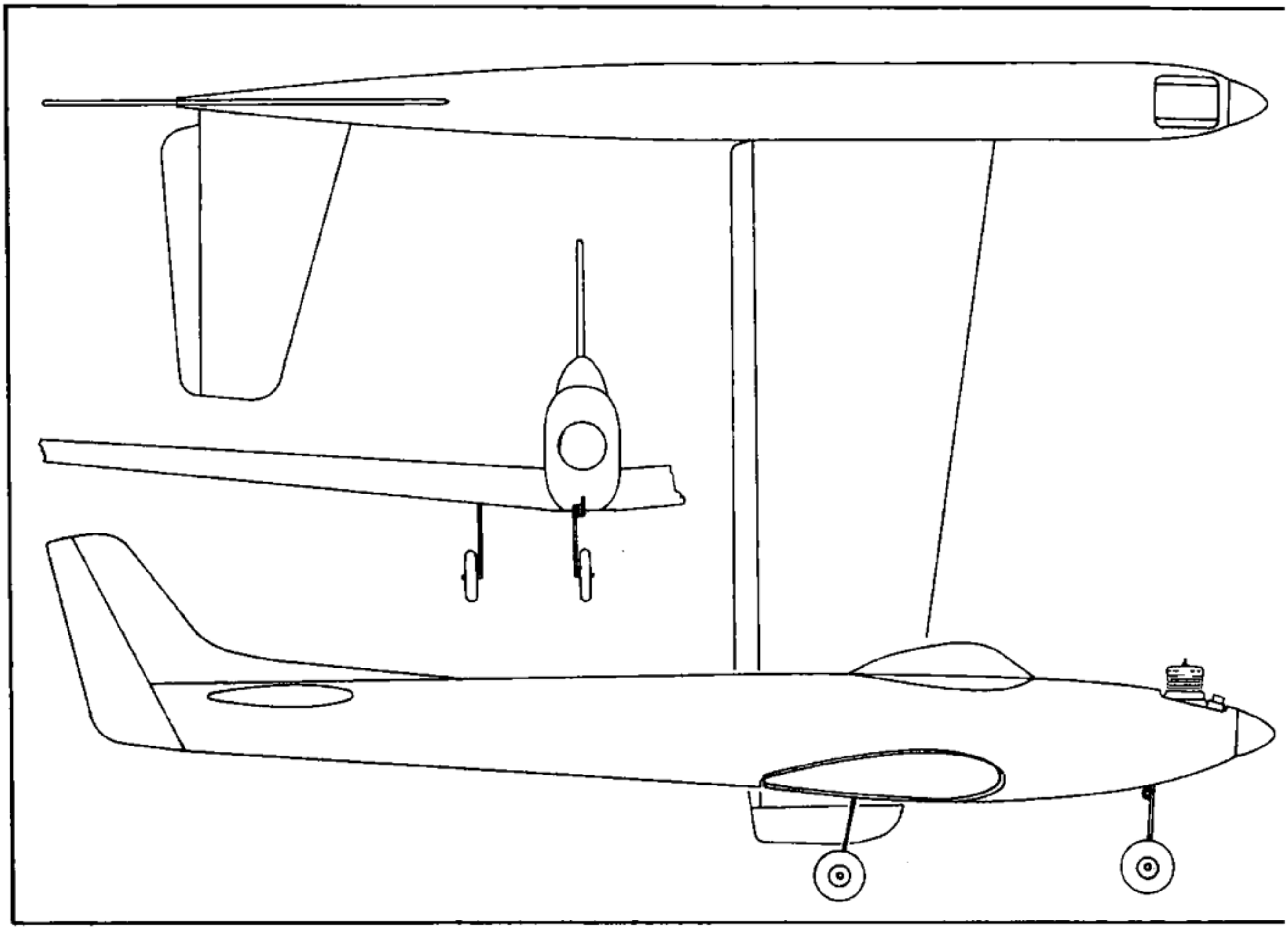
When fairly soft fuselage sides are used, the rear section needs to be stiffened up to avoid having the sides drawn in after the finish has been applied. The fuselage sides behind former "D" are beefed-up somewhat by the 3/32" x 1/4" upright and diagonal braces without adding much additional weight. (See plan.)

The front-end pieces, including nose blocks, doublers, motor mounts, and formers, are fitted separately before any are glued down. This takes a little time but saves a good deal of grief later on. The upper and lower nose blocks and doubler behind former "B" should be cut from one block of wood. This will make sanding much easier and more accurate since all the wood will be the same degree of hardness.

Now the motor mounts should be made, and then the 4-40 blind mounting nuts added in place for the specific engine being used. The corners of the mounts should be cut on an angle to allow balsa fillers to be added. This will eliminate the problem of sanding hard wood next to balsa block which makes it almost impossible to sand evenly. By adding these balsa fillers, sanding becomes a pleasure. Now former "B" is cut and drilled and the blind mounting nuts for the nose gear are added. Pieces of balsa filler are also added to the corners of former "B."

The 3/32" plywood former "C" should now be cut, with holes for battery pack, gas tank, engine control, and nose gear linkage. The balsa fillers should also be added to its lower corners. The motor mounts and formers "B" and "C" are placed over the plan, and the doublers between formers "B" and "C" are then sanded and fit into place. Next, the left and right, upper and lower nose blocks are cut and fit into place. The engine is

CYGNUS DATA SHEET



MATERIAL LIST

Fuselage:

2 — sides — 3/32 x 4 x 48
1 — top block — 5/8 x 3½ x 36
2 — top longerons — ¾ x 48 (45 degrees)
2 — bottom longerons — 9/16 x 22 (45 degrees)
2 — doubler — 3/32 x 3 x 36
2 — saddles — 3/32 x 3 x 16 (plywood)
1 — bottom stringer — ¼ x ½ x 46
2 — fuse stiffeners — 3/32 x ¼ x 36
2 — formers — 3/32 x 3⅛ x 5
1 — former — ¼ x 3⅛ x 4
1 — front doubler — ¾ x 3 x 24
1 — fuse bottom — 3/32 x 3 x 36
2 — 1/32 ply doublers — 1/32 x 2½ x 10
2 — motor mount, hardwood — ⅜ x 1 x 10
1 — fuse bottom front — ¾ x 2¼ x 10

Wing:

1 — spars — 3/32 x 4 x 36
2 — trailing edge — ½ x 9/16 x 36
2 — leading-edge stiffener — ⅜ x ⅜ x 36
2 — forward leading-edge — 3/32 x 4 x 36
4 — planking — 3/32 x 3 x 36
4 — planking — 3/32 x 4 x 36
2 — ailerons — ¼ x 1 x 36
3 — tips and blocks — 1½ x 1¾ x 7
2 — rib angle supports — 3/32 x 1¼ x 12

Tail Group:

1 — rudder — ¼ x 4 x 36
2 — leading and trailing edge — ½ x 1⅛ x 26
2 — planking — 3/32 x 4 x 36
1 — planking — 3/32 x 3 x 36
1 — 3/32 rib stock — 3/32 x 4 x 36
1 — elevators — ⅜ x 3 x 36

screwed down to mounts, and all the parts are then placed into position to assure a proper fit.

The doublers must now be marked to allow for the proper downthrust. (Check this carefully against the plan.) Then, glue down one motor mount, formers "B," "C," and "D," and the doubler between formers "B" and "C" to one fuselage side. On the other fuselage side, glue the other mount and doubler. Allow this much of the construction to dry thoroughly overnight.

Now you can take up the fuselage side with the mount and doubler and fit it to the other side with the formers. Add the tail block to the fuselage side with the formers and weight-down for a tight fit.

A simple jig was made to insure a straight fuselage when gluing the tail cone together. This is shown in the fuselage construction photo. When the fuselage is in the jig, glue in the bottom $\frac{1}{4}$" by $\frac{1}{2}$" cross-pieces. Allow this to dry. Then sand the stringer and add the bottom $\frac{3}{32}$" sheet while still in the jig. This way the fuselage will remain straight after it is taken out of the jig.

After removing the fuselage from the jig, add the upper and lower nose blocks and the $\frac{1}{4}$" upper doubler between formers "B" and "C" above the motor mounts. Then add the short longerons to these doublers and to the upper-back of former "B." These are important when the sanding and shaping operation is started. They will be utilized since the top block is very tapered. Next, the $\frac{1}{4}$" sheet should be fitted and glued into place over the fuel tank. After this has been done, fit the bottom $\frac{1}{2}$" balsa blocks under the engine and battery pack.

Before gluing on the top block, the engine should be screwed down to the mounts, and the plywood piece behind the spinner should be fitted. A hole the same diameter as the crankshaft must first be drilled in the center of a $2\frac{1}{2}$" square piece of $\frac{1}{8}$" plywood. This piece is then slipped over the shaft and pushed snugly against the mount. Next, the spinner backing plate is put on the shaft. The spinner used is a Veco $2\frac{1}{4}$" which has been turned down to $2\frac{1}{8}$" as shown on the plan. The spinner is assembled on the engine, and a line is carefully drawn around the spinner. Another line $\frac{1}{16}$" outside the outline of the spinner is drawn to allow for contour when the final sanding and shaping is done.

To insure a proper fit when gluing the top block to the fuselage, a very large sanding block of "Nova-Ply," 6" wide by 48" long, with #100 sandpaper contact-cemented to it, should be made. This sanding block is put on the floor or clamped to a bench, and the top of the fuselage is then sanded perfectly flat on this block. The top block is also sanded perfectly flat before gluing. This will make a perfect joint between the longerons and block. The top block may also be hollowed slightly to reduce the weight of the fuselage. When gluing the top block to the fuselage, masking tape should be wrapped all around to assure a tight fit. Allow this to dry 24 to 36 hours. There is nothing more frustrating than to begin shaping the fuselage with a razor plane and have the top block come up because the glue has not yet thoroughly dried.

Sanding the fuselage is best done by holding the fuselage between your legs and using the old "shoe-shine" technique. This should make it entirely symmetrical. Check to see that the spinner fits properly while the final sanding on the nose is being done.

Stabilizer Construction

A flat surface is all that is required in building the stabilizer. The leading and

(Continued on Page 85)

CYGNUS

(Continued from Page 22)

trailing edges are cut according to the cross section on the plan, as shown. The ribs are now cut, pinned, and glued to the trailing-edge stock in place over the plan. Next, the leading edge is added. Sheet the top with 3/32" sheeting. Then the excess trailing and leading edge stock is trimmed down. Sand and shape the contours before adding the tips. This completes the actual stabilizer construction.

The fuselage jig is used again to properly align the stabilizer and rudder to the fuselage. After the fuselage is replaced in the jig, top side up, center lines are lightly drawn on the leading and trailing edges of the stabilizer. The stabilizer is then fitted to the saddle. As it is fitted, it should be checked for alignment by using a square to measure the distance between the flat surface of the bench and the lines on the stabilizer. When an accurate fit has been achieved, glue the stabilizer to the fuselage, rechecking for alignment during the process. Allow the glue to dry overnight.

While the fuselage is still in the jig, draw a light center line on the top block to determine the proper placement of the rudder. Once this is done, the slot may be cut. Glue in the rudder-fin and stabilizer and sand to shape. The wing fillet is added after the wing has been fitted to the fuselage. This fillet has the 1/4" dowel rods which align and hold the wing to the fuselage. The 8-32 2" oval-head screws are used to hold the rear of the wing to the fuselage. The entire structure should be sanded lightly with very fine sandpaper as the last step in the construction.

Finishing Procedure

Although your own individual taste will guide you in trimming the airplane, you may find some of our suggestions helpful in obtaining a durable and lustrous finish.

Once again, special fixtures were made for holding the wing and fuselage during the finishing operation. (See photograph.) It may seem to you that the numerous jigs and devices, used throughout the various steps of building and finishing, are too much work to build for just one plane. Remember, however, that they can be used again, with some modifications, on other airplanes. The painting fixtures enabled us to rotate the entire wing or fuselage in one hand, leaving the other hand free to spray-paint. A second advantage was that after the painting was done, the fixture still holding the wing or fuselage was clamped in a vise, allowing the wing or fuselage to dry untouched.

The procedure outlined here is basically the one we followed in finishing our planes for the Toledo Conference. Naturally, special care and effort went into this finishing project. If you are more familiar with the use of dopes than with acrylic lacquers, dope may be substituted. As stated, finishing the airplane is purely a matter of personal preference.

The first step in finishing the airplane is in applying several coats of "Hobbypoxy" glue, with sanding and scraping between coats. When the "Hobbypoxy" has completely cured, fiberglass tape is resined to the center portion of the wing and feather-sanded. Now, several coats of acrylic primer are applied and wet-sanded between coats to obtain a smooth finish. White acrylic lacquer is then sprayed over the entire model as an under-base for the pearl. When this has dried, the pearl is then evenly sprayed over the entire airplane. Immediately after the pearl has been applied, several coats of acrylic clear are sprayed on. This layer of clear will give added depth to the pearl.

To avoid marking or denting the finish, the paint should be allowed to dry for several days (or until hard) before the taping for the trim colors is done. After all the trim painting is completed, it is again most important that adequate time be allowed for all paint solvents to thoroughly dry before a final coat of clear is applied. This final coat is applied because when dry, the acrylic clear is a hard material that can be readily polished to a high luster. To achieve a beautiful finish, however, patience is very important.

We designed the canopy used on the CYGNUS; it was manufactured by Du-Bro Products, and is available through them. The wheels used are Du-Bro's low-bounce wheels. The nose wheel is 2½" and the main gear wheels are 2¾".

The most difficult step in completing our plane was choosing the right name. In case you're curious about the name we gave our design, Webster defines **CYGNUS** as, "A northern constellation . . . in the Milky Way," and also as "a young swan." (We hope that this trivial bit of information does not lead you to conclude that the CYGNUS is our "swan-song" in the area of designing.)

We felt very honored to have received the "Radio Control Modeler Award" for best finish at the Toledo Conference last February. This, plus the satisfaction of seeing a completed airplane from that which had started out as a thought in the back of our minds, made all the effort worthwhile. In conclusion, we hope that our experience will encourage and assist other modelers like ourselves to create new and better designs.