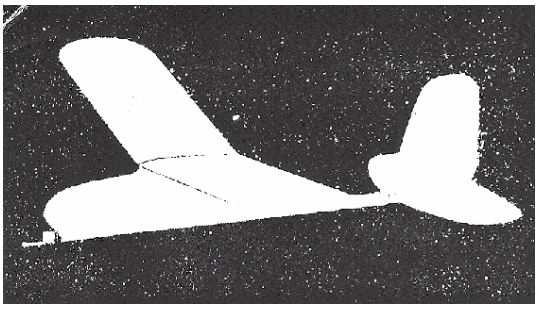
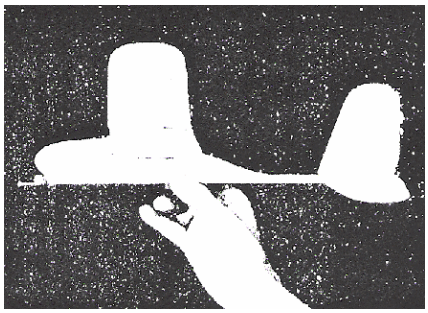


The finished glider. Note the balance weight on the nose



To launch the glider, hold it as shown here

Fundamentals of Model Airplane Building

A New Complete Course in Model
Airplane Building for Beginners
Who Wish to Become Expert
By EDWIN T. HAMILTON

EDITOR'S NOTE

How can I learn to build successful model airplanes and compete with experts? This is the burning question which stares approximately 200,000 model builders in the face every year. Most of the literature on model airplanes has catered to the builder who already knows how to build and fly model planes. Those new to this art have been left to shift for themselves and to pick up haphazard information as best they could.

The function of Universal Model Airplane News is to promote model building and flying universally among novice and expert, and thereby to further knowledge of aeronautics.

We therefore take great pleasure in presenting this valuable course by an expert in the art and a well known author, Mr. Edwin. T. Hamilton. In collaboration with the editor, he will endeavor to make this the greatest course in Model Building ever presented.

These articles are not primarily for the experienced builder but for the novice. Each month an actual model will be built on these pages so that the builder will learn the fundamentals of the art of doing the operations explained.

Complete plans, diagrams, illustrations and step-by-step instructions will accompany each model. With each succeeding article, the models will become more complicated, embrace greater building problems and present the reader with more advanced methods.

In this progressive manner all phases of model airplane design, construction, assembly and operation will be fully covered in such a way as to make its mastery assured. The collection of these articles should prove a valuable treatise on the subject.

THIS is the second article of our series on model airplane construction. While step-by-step instructions will be given in these articles for each model as it is presented, detailed information will not be repeated when it has already been given in a preceding chapter. Because of this progressive method of presentation, it is vitally important that those following the entire series as a course be thoroughly familiar with what has gone before.

Not only should you be familiar with preceding chapters, but each of their details should be mastered through actual constuction. If you have not mastered the details given last month in the May issue, you will find those given here just that much more difficult, as your author assumes in his writing of instructions that you know them.

It will be found helpful to keep all preceding chapters on hand when working on a new one so that they may be quickly consulted if difficulties arise. If you should miss a copy, write immediately to your editor and request the missing one. Copies will be kept on hand for such emergencies.

The model presented this month is another "all balsa" glider, which incorporates four new steps in model work. Designed, built and tested by your editor, Charles Hampson Grant, it has proven itself in every way to be a first class flier. Similar in general construction to the one he designed for you last month, it brings to the reader refined features missing in our first glider.

In this, we find curved tips on wing, elevator and rudder, adding greatly to its graceful appearance in the air. It is also equipped with a nacelle, which is the equivalent of a fuselage or body, of a tractor powered plane. Its wing, instead of being perfectly flat as in the first model, has a "dihedral," while the curvatures of its various parts make the introduction of the "graph" plan necessary. Each of these improvements together with their terms, will be fully explained later.

Before we start any actual work, let's read these instructions all the way through, and as we read them, refer constanty to the plan, illustrations and photographs. Each has a story to tell, so let's find out what it is all about before attempting to master it.

We have already explained last month our reasons for giving plans that are not full size, but you may be wondering how we can hope to give curved sections unless full size. This !s clone by reading and copying "graph" plans. Such a plan is used where the giving of direct dimensions would be difficult, such as the curve of the nacelle's upper edge. Turn to the plan and locate the "Side View."

There you will see the word "Nacelle." Study its curved term. Note that no dimensions are given to aid the builder in cutting this form. This is because it would be impossible to do so. Now locate the same part at the bottom of the plan. There is the nacelle drawn on squares each of which represents a 1/4" sqaure.

Let us see how it aids us in cutting the nacelle. Take sheet of white paper and carfully rule it with 1/4" squares. An exact copy of the nacelle is now drawn free-hand on these squares. Care must be taken to see that the line you are drawing on your paper passes through each square in exactly the same location that the corresponding line passes through the same squares on the graph plan, In other words when drawing anything on a graph plan, you are actually drawing square by square so that if your line passes through each square in the correct location the whole drawing will be correct when completed.

While such a plan is absolutely necessary for a cruved piece, such as the nacelle, unless full-size plans are given, one is not required for the elevator and rudder. They are shown on graph simply to give the reader practice in reading and copying such plans. Locate the elevator at the upper right side of the plan under "Plan." Note that full dimensions are given for cutting this piece. This is possible because its form can be obtained by straight cuts and two perfect half circles, which are drawn on the wood itself with a compass, as shown in Fig. 2. The wing and the rudder are also cut in the same manner. However, for practice, draw all the parts shown on graph and set aside for future use. Such a full-size drawing Is called a "pattern."

With this understanding of our plan, we are ready to gather together our required materials, As has already been pointed out, our glider is an "all balsa" model, so the only material for building we will need is "sheet balsa," except for the glider's stick.

(See May issue). At your nearest dealer, purchase the following:

(A) 1 piece 1/16" thick, 3" wide and 11" long - Sheet Balsa
(B) 1 piece 1/8" thick, 3" wide and 18" long - Sheet Balsa
(C) 1 piece 1/4" thick, 1-3/4" wide and 9" long - Sheet Balsa
(D) 1 piece 1/4" thick, 1/4" wide and 13" long - Balsa Stick

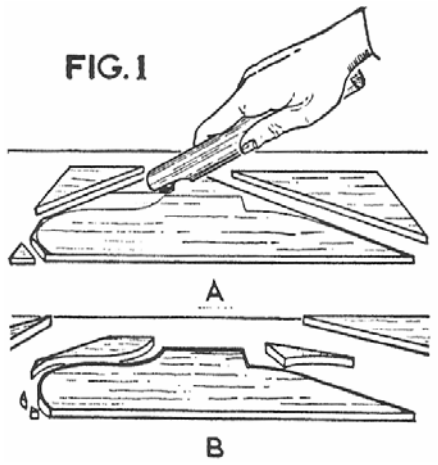
Let us turn to the plans and see what each of these items is for. (A) Turn to the plans and locate the

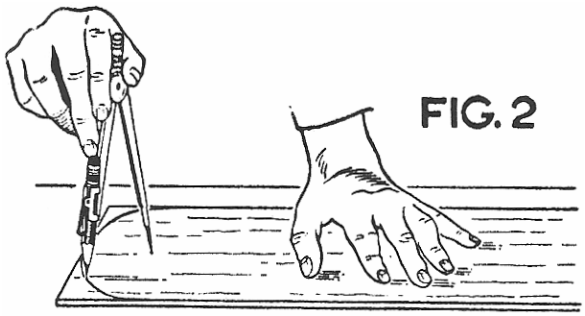
rudder under "Side View" and the elevator under "Plan." (This latter view is often shown in plans as "Top View," which is the same as "Plan"). Note that a dotted line runs around each of these pieces indicating the necessary size of wood required to cut them out. Adding both the rudder and elevator pieces together, both of which are 1/16" thick and 3" wide, we find we need a piece 10-1/2" long. The added 1/2" is for waste, so we need only one piece 1/16" thick, 3" wide and 11" long from which to cut these two pieces.

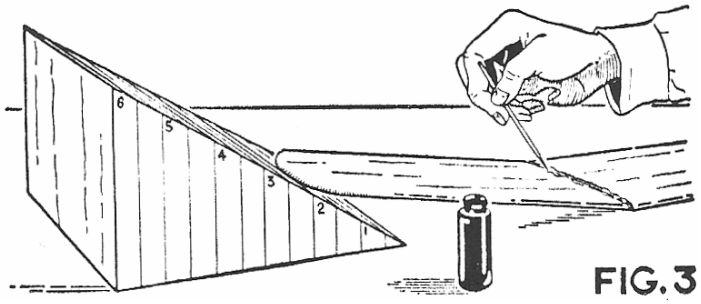
By following the dotted lines around the nacelle, it will be seen that the piece from which this can be cut must be 1/4" thick, 1-3/4" wide and 9" long. Because of its form, no surplus stock need be added to this piece. A glance directly under the nacelle will show the stick with its given dimensions of 1/4" square and 13-1/2" long. In the plan under "Wing" two views may be seen, The lower one shows its front edge head on, or as it would look if you were standing directly in front of it on the same level. The upper view shows a top picture of the wing or how it would look if you stood directly over it looking down in this view can be seen the dotted lines indicating the squared board from which it must be cut. It also gives the 3" width and 18" length of the wing, while its edge view shown just under it shows the thickness of 1/8". These dotted lines are not practical in most plans but are added here as an aid to the beginner. Hereafter, they will be left out and the builder will be made to figure his own overall dimensions.

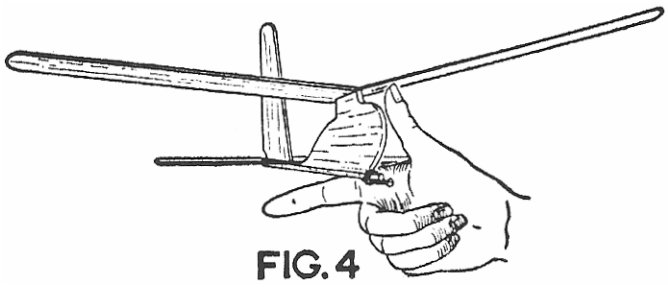
The stick should be carefully sanded with a piece of No. 00 sandpaper. However, do not round the corners where the nacelle is to be cemented to it. The "trailing" (meaning rear, or back) end is then notched, as shown in the plans. Note the large view of this notch at the right of the plans. When completed, the nacelle pattern must be traced on its piece of wood and cut out.

Place a piece of carbon paper shiny side down on the wood with the pattern over it. Line up the straight bottom edge of the pattern with the bottom edge of the wood and then go over the outline of the pattern with a sharp pencil. If carbon paper cannot he obtained, shade the back of your pattern paper with heavy pencil marks, turn the marks over on the wood, line it up and trace over your original lines.









When tracing has been finished, remove the pattern and go over the lines carefully with the pencil on the bare wood. The nacelle is now cut out. Two important steps are used in this work, as shown under "A" and "B" of Fig. 1. When cutting pieces with various curves, cut away all excess large stock with straight cuts, as shown at "A." This makes the cutting of the curves considerably easier, as there remains little stock to remove. The curves are then cut just outside the lines so that the edges may be sanded smooth without fear of passing the outline, as shown at "B." When cut out, sand both sides of the nacelle slightly round the top of its front portion, but keep the top straight part, which holds the wing and the lower edge which is to be cemented to the stick later, with sharp edges. The back portion is sanded to a sharp edge.

With rule and pencil, lay out the elevator and rudder, as shown in the plans, on their wood. Make the end curves with a compass, as shown in Fig. 2. The radius, or width the compass is spread, is shown for each end, such as "1-1/8" RAD.," etc. These pieces are then cut out, as was the nacelle, sanded smooth on both sides and their edges rounded. The wing is laid out with 1-1/2" radius ends on the wood and cut, as in Fig, 2. If you wish added protection before cutting the elevator and rudder, lay their patterns over your pencil lines and test to see that the pattern and your lay-out work are exactly alike. The wing is shaped and given its necessary "dihedral" at this time. In the plans under "Wing Section" will be seen a graph of the Wing's section, Such a section is really a picture of how the wing would look if cut all the way through at any point. Make a full-size copy of this section on paper ruled With 1/8" squares, as shown. Note that the underside of the wing is left straight and flat, while its top side is curved. A "template" of this curve is now made. Trace the curve of the wing on heavy cardboard, Cut this cardboard in a square with the concave side of the curve for a bottom edge. This piece of cardboard is then used to determine when the wing has been properly formed. Sandpaper the top of the wing until it approaches the desired curve. Place the bottom edge of the template on the wing and test to see if the curve of the cardboard and the curve of the wing are alike. When both match each other all along the wing, it has been properly shaped. At the same time, sand its curved ends and taper the top side of the wing down to meet these edges, as shown in the edge view of the wing in the plans.

Study this edge view of the wing. Note that at the left appears the dimension 1" with the word "Dihedral" following. This means that the wing is given a 1" dihedral or if given in degrees, as shown in the plan also, it indicates that each wing is set at a 6 degree dihedral angle. This means that the tips of the wing are 1" above its center, or that the angle formed by raising the tip is a 6 degree angle. This is done to promote stability. Dihedral angles are usually given in inches for models, as such dimensions are easier to work from.

To obtain such an angle in the wing, it must be cut in the center to permit the tips to be raised. Find the exact center of your wing, and draw a line from edge to edge at right angles to the front (leading) edge or rear (trailing) edge. A knife cut is now made along this line, sinking about two-thirds through the thickness of the wing. Care must be taken not to cut all the way through. This cut is then widened into a V with sandpaper. Note the enlarged view of this in the plan just above the edge view of the wing. This V permits the tips to be raised and will slowly close the slot as they are brought into position.

The easiest method of obtaining a dehedral in a wing is to hold one side flat on a table and raise the other until its tip is twice the required dihedral above the surface. For example, our wing calls for a 1" dihedral meaning that both its lips must be raised 1" above its center. By holding one tip on the table and lifting the other until it is 2" off the table, both tips will have the required 1" dihedral when the wing is in level flight position.

As it is often difficult to hold a wing in such a position while the cement binding it is drying, the author has designed the small dihedral block shown in Fig, 3. Cut a block of wood 6" square and saw along a diagonal line drawn from one corner to another. Lines are then ruled along its tapering top to indicate 1", 2", 3", 4", 3" and 6" heights with other lines drawn between these one inch lines to indicate halfinches. To obtain the dihedral of our wing, place the wing flat on a table, hold one side flat in place and push the dihedral block under the tip of the other until the tip rests at the 2" line, as shown in Fig. 3.

Cement is then applied along the V-shaped cut in the center of the wing and the wing left in place until dry. The cement may be applied with a sharpened match stick in this case. In the plans under "Section A'-A," a front view of the joint formed by the wing and the top of the nacelle is shown. The straight top portion of the nacelle must be cut in the form of a shallow V to fit the shape of the wing. This is done with sandpaper.

The model is now assembled. Cement the nacelle in place on the stick. The foremost tip of the nacelle must be in line with the front end of the stick, as shown in the plans under "Side View." In the same view, note the position of the wing on top of the nacelle, which is shown in dotted lines. The groove in the top of the

nacelle is coated with cement and the center cemented portion of the wing placed in the exact center of the nacelle with 1/8" of the wing protruding beyond the front of the grooved section. This is also shown under "Wing Position" of "Plan." When the cement is thoroughly dry sand the whole assembly with No. 00 sandpaper. The rudder is now cemented in the exact center of the elevator and should be tested to see that it and the elevator form right angles. Then this tail assembly (the elevator and rudder) is held in position with a rubber band. The notch made in the trailing end of the stick is to accommodate the rear end of' tile rubber band. If you do not know how such a band is attached, refer to the May article in which this is described.

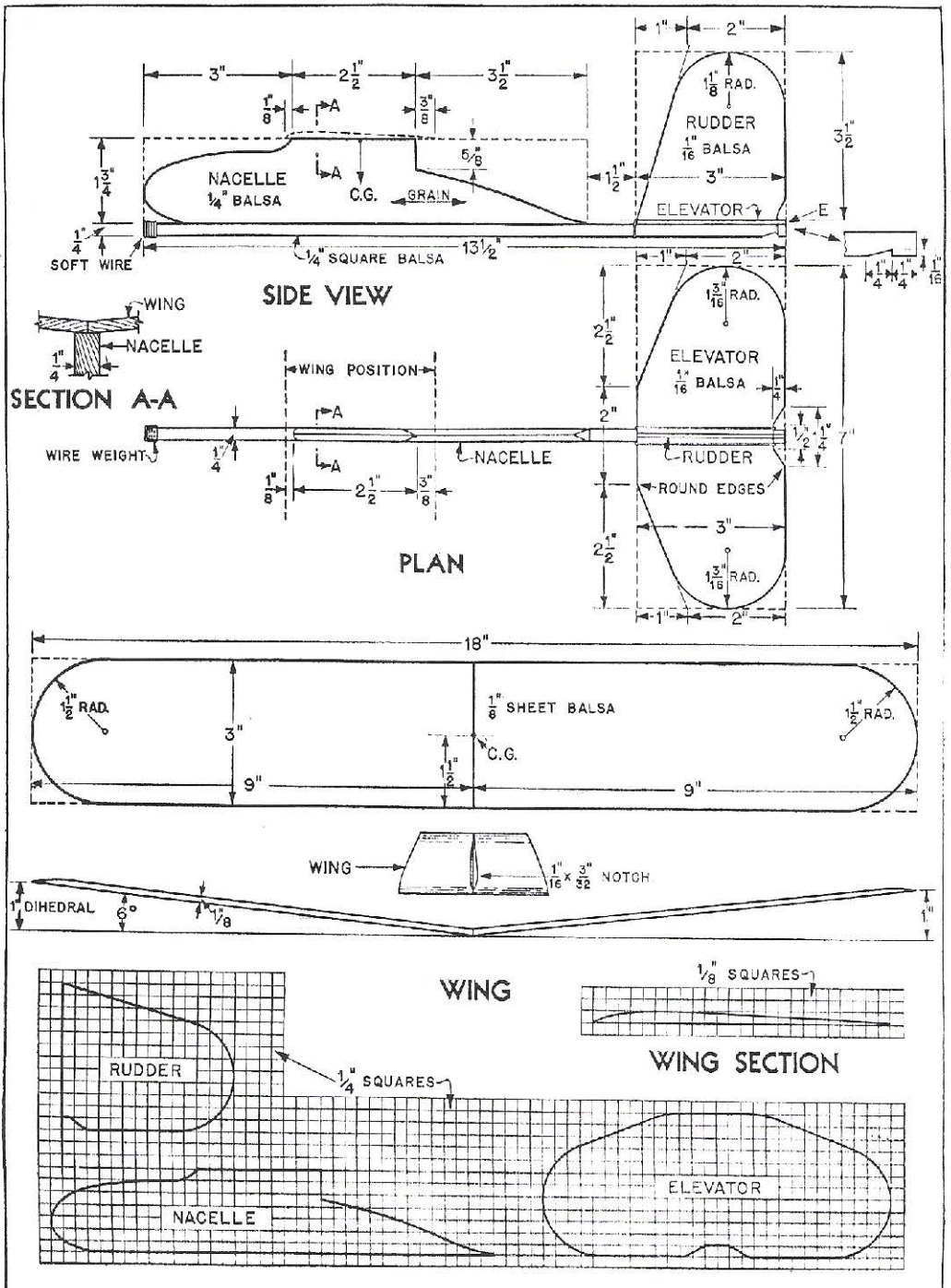
In the "Side View" of the plans, the letters "C.G." appear with an arrow pointing down the side of the nacelle. These stand for "center of gravity," or in other words, the glider must be made to balance evenly at this point. This center of gravity comes in the exact center of the wing, as shown in the top plan view of the wing.

The nose or forward portion of the stick, is now wrapped with soft wire until the glider is properly balanced. As will be seen in the accompanying photographs, as well as in Fig. 4, a common wood screw is held on the stick with rubber bands as another means of gaining necessary weight at the nose of the glider. Either method may be used.

In Fig. 4 is shown how the glider is tested for balance. Place the finger on the exact point (marked "C.G." in the plans) on the underside of the stick. Place the thumb under one wing to aid in balancing. When the model stands level at this balancing point, enough weight has been added to the nose.

If the glider has a tendency to dive, a small elevation block should be thrust under the elevator at point "E," which is shown in the plans under "Side View." In our first glider which will be found in the May issue of UNIVERSAL MODEL AIRPLANE NEWS, complete instructions for making and using such a block will be found on Page 43 under "Balancing." This completes our second model and the builder will find it well worth the time and effort used in its building.

Next month Mr. Hamilton will give instructions and plans for building a Contest Glider.


SIDE VIEW
NACELLE
1/4" BALSA
C.G.
GRAIN
RUDDER
1/16" BALSA
1/8" RAD.
ELEVATOR
SOFT WIRE
1/4" SQUARE BALSA
13 1/2"
SECTION A-A
WING
NACELLE
PLAN
WING POSITION
WIRE WEIGHT
ELEVATOR
1/16" BALSA
RUDDER
ROUND EDGES
1 3/16" RAD.
18"
1/8" SHEET BALSA
1 1/2" RAD.
3"
9"
C.G.
WING
1/16" x 3/32" NOTCH
DIHEDRAL
6°
1/8
WING
1/8" SQUARES
WING SECTION
1/4" SQUARES
RUDDER
NACELLE
ELEVATOR