Fundamentals of Model Airplane Building

A New Complete Course in Model Airplane Building for Beginners Who Wish to Become Expert

By EDWIN T. HAMILTON

PART NO. 1

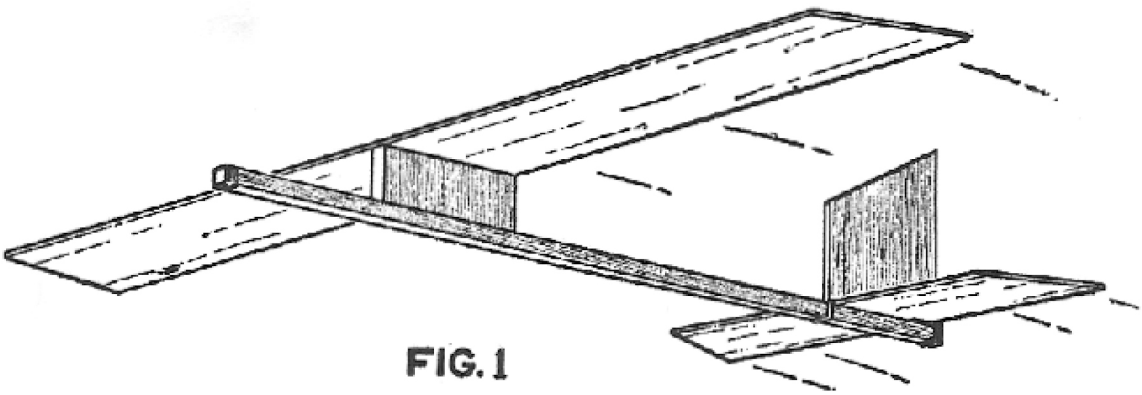


FIG. 1

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.

NOT long ago of friend of mine asked me, "How can I learn to become a model builder?" I have often been asked this question, and my reply invariably is, "By building models." That may seem a most unsatisfying answer, but its worth is to be tested by these articles, for we are going to learn model airplane building by doing just that -- building models.

Each month, a different model will be used to illustrate certain principles in construction. Plans, illustrations, diagrams and step-by-step instruction will accompany each one. In this way the new modeller will not only learn to master each step, but will find himself in possession of a ready worthwhile flying model.

The glider given here has been chosen for its simplicity. It incorporates many important steps in model construction and yet is not too difficult for the beginner who has never handled a piece of balsa wood in his life.

Before starting any actual work, a thorough understanding of what you are going to build is essential. To gain this, read every word of these instructions. Refer constantly to both plans and illustration. Do not proceed with the next step until the first one is understood perfectly.

Note that the plans accompanying this model are not given full-size. It is true that full-size plans are a great convennlence, but they teach nothing except the art of copying. All of us learned to do that in kindergarten, but none of us learned to read plans. Many model builders lack this knowledge but the time is bound to come when they will wish they had it. Those who read these articles are going to learn to read plans exactly the same as the great builders of today who make real planes, raise our great buildings and build our railroads. They do not work from full size plans, although their work is ten times as difficult as ours. We are not going to either. Let's build our models from plans exactly the same as our engineers build the real ships. In this manner we, too, will be able to step into their shoes some day and carry on.

The first step in building anything is to obtain the materials from which to build it. The model given here is of a type called "all balsa," which means exactly what it says -- that all parts are of solid balsa wood. Solid balsa wing, rudder, elevator, motor stick and elevation block. Locate each of these parts on the plan. Study their dimensions, locations and general form. Each appears in the plan under its proper name.

In the advertising section of this magazine will be found a hundred different model airplane supply houses that sell balsa wood. One of the greatest aids to any model builder is to build up a "catalogue library." Write to all the companies offering catalogues. Get them and then sit down and ready study their contents. In them you will find prices, grades, sizes and other important data on balsa wood, rubber, accessories, etc. In this way you will learn which company handles certain materials which you prefer, which prices are the most reasonable and how to obtain execily what you need.

As the work progresses yon will learn to figure from the plans exactly the materials required and how much of each will be needed. For this model we must purchase the following:

(A) 1 piece, 1/16" thick x 5" wide x 15-1/2" long, sheet balsa.
(B) 1 piece, 1/4" thick x 1/4" wide x 11" long, balsa stick.
(C) 1 piece, 1/4" thick x 1" wide x 2 -1/2" long, balsa block.
(D) 1 rubber band.
(E) 1 loot soft wire.
(I) 1 can model airplane cement.
(C) 1 sheet No. 00 sandpaper.
(H) 1 package model pins.

Let us look each item over carefully, see what it's for and how we know how much of each one we need. (A) When balsa wood is purchased in thin sizes or sheets, it is called "sheet balsa," How do we know we need a sheet measuring 1/16" x 5" x 15-1/2"long? Let's turn to the plan and find out. Our main wing measures 1/16" thick, as do the elevator and rudder. Note in each of these pieces on the plan, the notation "1/16" balsa."

As long as all three pieces are of the same thickness, we can order one piece of sheet balsa of that thickness and then cut each part from it. However, to do this we must measure the width and length of each part. When determining anything of this nature, always start with the longest part, which in this case is the wing. Note on the plans that our wing is 15" long on its longest side. As the combined length of the elevator and rudder is less than the length of the wing, we know that a piece of sheet balsa 15" long will prove long enough to cut all the parts from. As the ends of our wing will require cutting and sandpapering, an additional 1/2" is added to the total length for safety, which gives us the length of 15-1/2" for our piece.

We now have the required thickness and length and have only to figure the width of the piece before ordering. The width of the main wing is 2-1/2" wide, while the width of the elevator and rudder is 2". As we know the rudder and elevator must be cut from the same piece as the wing, we add the width of the wing and the width of one of the other parts to gain the total necessary width of the piece.

By adding 2-1/2" and 2" we know our sheet balsa piece must be 4-1/2" wide, and as they must be cut out, shaped and then sandpapered, all of which cause certain waste, we add an additional 1/2" to the width to have plenty of spare wood for these operations. With 4-1/2" of actual width and 1/2" for any waste, we know our board must be 5" wide. Some builders purchase boards considerably wider and longer than necessary so as to have extra material in case of an accident. This is good practice and is heartily recommended. In Fig. 2 will be seen the positions of each part, on this board preparatory to cutting. Note the long wing at the top, the short rudder just below it in the corner and the longer elevator next to it. In the plans at the upper right hand corner will be seen a small block which is used to give the elevator elevation. Note that its thickest portion is
1/16". It too, can be cut from this board of 1/16" balsa and it may be seen in Fig. 2 between the wing, rudder and elevator.

Our next consideration is item "B." This calls for a balsa stick which is known as a "motor stick" in models having rubber motor. For gliders such as this one it actually forms the fuselage to which are attached the wing, elevator and rudder, although the rudder in this case is really cemented to the top-center of the elevator.

As may be seen in the plans, this stick is 1/4" wide, 1/4" thick and 11" long, Very little work is required for finishing, and as sticks may be purchased this size, one should be ordered exactly this size. Lengths often differ and you may find it necessary to cut a longer stick to the required 11", but aside from finishing smooth with sandpaper nothing more is required.

Item "C" is another type of elevation block and in this case is used for the wing. Turn to the plans under "Front View" and you will locate this part under "Block." Its side view is shown under "Side View" in the plans. As it fits and covers the top of the motor stick, it must be 1/4" thick. As it extends the full width of the wing, it must be 2-1/2" long and as it raises the wing 1" above the stick its width must be 1". Be sure to cut it so the grain of the wood runs across the block. These items complete the list of necessary balsa wood.

Item "D" is any ordinary rubber band large enough to stretch at least 2-1/2" long. It is used to hold the elevator in position on the stick. It is shown in the plans under "Side View" and "Plan" by its proper name "Rubber Band." In Fig. 6 is shown how it is applied,

The soft wire (E) is used to wrap around the front end of the stick to make the model balance at its proper center of gravity, which appears in the plans under "C.G." A small can of model airplane clear cement (F) should be purchased, as well as one or more sheets of No. 00 (very fine) sandpaper (G). Tiny model pins (H) are very useful for a hundred different reasons in model building. For this model we use them to hold the block in place on the stick until the cement has hardened, which takes only a second or two. These complete our necessary materials. Gather them together on any empty table and let's get to work!

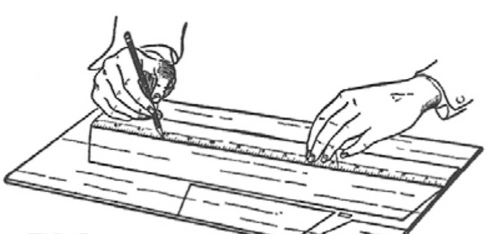


FIG. 2

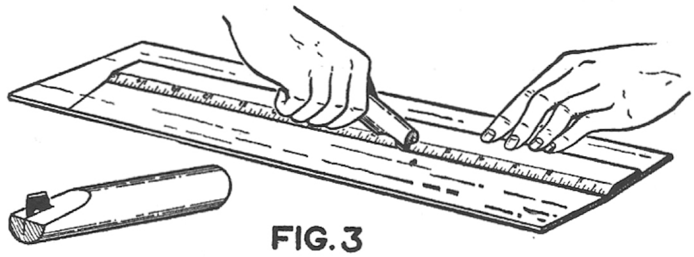


FIG. 3

FIG. 4

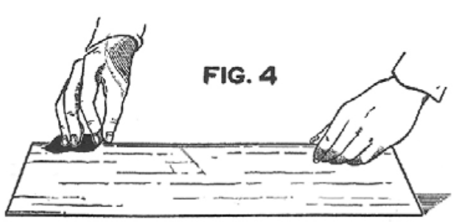
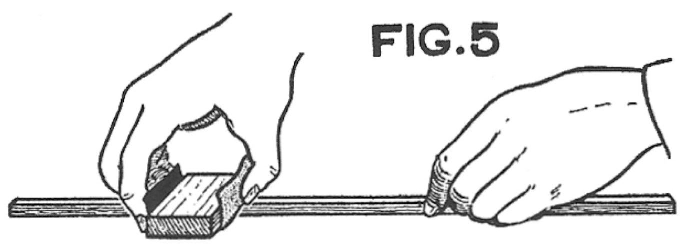


FIG. 5



Our first job is to lay out the wing, rudder, elevator and small elevation block on our sheet balsa piece. Study each part. Note that they have their ends cut at a slight angle. Lay out each of these pieces as shown in Fig. 2. When measuring them, make each a perfect rectangle. Then measure along one long edge of both the wing and elevator and mark points 1/2" in from each end. Join these points with the ends of the other edge, which completes their form. The rudder has a 1" angle on only one end. Measure this and join it with the other end. Test to see that the sides of all pieces are parallel with each other and the proper distance apart.

We are now ready to cut out these parts from the balsa sheet. A razor blade is best for this work, although if you have a sharp knife and cannot locate a razor blade, it may be used. A small cutter can be easily
made, as shown in Fig. 3. It consists of a 6" length of dowel stick or a broom handle, cut at a slant at one end and then slotted to take a safety razor blade. Cement the blade in place.

Whenever cutting balsa wood, use a steel edge school rule to guide your lines, cut very slowly and take care that your cuts are slightly outside the lines. When each piece has been cut out, they should be finished with sandpaper. Whenever using sandpaper, always stroke with the grain of the wood. For rounded edges, such as is required for the wing of our glider, use the sandpaper in the bare hand, as shown in Fig. 4. Note that one hand holds the wing on edge, while the other hand sands the other edge. Lightly sandpaper both faces of all parts, round both edges of the main wing, as shown in the plans under "Side View" and leave the other parts with squared edges. When using sandpaper on fiat surfaces which you wish left flat, always use a small block of wood, as shown in Fig. 5.

Study the form of the small elevation block shown under "Side View" in the plans. Note that it is given the form of a wedge, being the full 1/16" at one end and tapering off to 1/32" at the other. Complete this piece by sandpapering it to proper shape. This completes the wing, rudder, elevator and elevation block.

The wing elevation block requires no work except cutting to exact size, which is 1/4" x l" x 2-1/2" and then sandpapering smooth, Do this lightly so as not to cut down its size.

Cut the 1/4" x 1/4" stick of balsa exactly 11" long and smooth with sandpaper used with a block of wood so as to prevent rounded edges. Note this in Pig. 5. All parts are now finished and we are ready to assemble our glider.

Assembly

When all parts of a model have been correctly and carefully finished, many model builders ruin their good work by hurrying and making a poor assembly. Show me a poorly assembled model and I'll show you a poor flier. If you were ever patient in any work, be so now for it is vitally important to the success of your entire work.

Study the illustration in Fig. 1 showing the completed and assembled model. *Note where each part is located.* Choose one end of the fuselage stick and mark it for the front. From this end, measure 3-11/16" and mark. This point is the center of gravity when the glider has been properly balanced with the wire. Measure 7-1/2" from either end of the wing and mark. This should be its exact center. Draw a line from side to side. Measure from one end of the elevation wing block a distance of 1" and mark. This mark and the center of gravity mark on the stick must be directly in line with each other when the block is in proper place on the stick, as shown in the "Side View" of the plans under "C.G."

Coat the bottom edge of this block with cement, place it in position on the stick so that the mark on the block and the mark on the stick come together, and hold in position with two model pins thrust through the stick and up into the edge of the block. Allow the pins to protrude so that they can he easily removed. The wing is then cemented on top of the block so that its edges match the edges of the block and the center line of the wing comes exactly in the center of the block's upper edge.

Test to see that the wing is level with the stick and at right angles to it. Model pins may hold it in place until the cement has hardened. Allow fifteen minutes before removing the pins. The "tail unit" which consists of the elevator and rudder, is now assembled.

Find the exact center of the elevator by measuring 3" from either of its ends along its longest edge. Mark and then draw a line from side to side. Coat the rudder with cement along its squared end and place along the center line of the elevator so that the rudder is directly centered on it. See that the rudder and elevator form right angles. Hold by pushing model pins through the elevator and up into the edge of the rudder. When thoroughly hardened, the pins are removed and the unit assembled on the stick. This is done with the rubber band and is shown in Fig. 6 in three steps. Pass the rubber band over the end of the stick and work it along until in front of the elevator when in place. Place the elevator in place on the stick so that its trailing edge is about 1/4" in from the end of the stick. This is shown in Fig. 6 "A." The loop of the band is now stretched over the elevator and rudder and brought under the end of the stick, as in "B." In "C" is shown the elevator in place held by the rubber band. In these illustrations, the rudder is purposely left off the elevator to make the picture more dear.

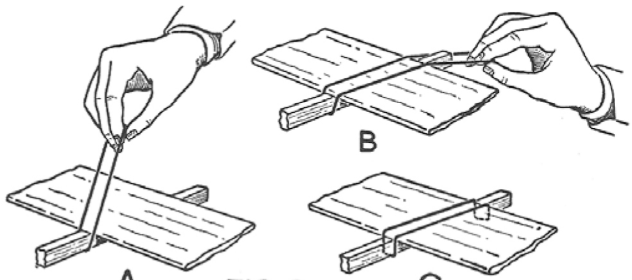


FIG. 6

Balancing

The glider must now be properly balanced. This is done by wrapping soft wire around the end of the stick as shown in the plans. Just enough of the wire should be wrapped around the stick to make the entire model balance evenly on its point of center of gravity. Start wrapping wire around the end of the stick. Balance the model at the exact point marked on the stick as the center of gravity. When the balancing is perfectly even, stop wrapping.

The small elevation block for the elevator is used to obtain angle for this surface, which in turn will regulate the climb of the glider. By pushing the block well under the elevator, the glider will tend to climb. By pulling the block back so that less height is given to the rear portion of the elevator, the climb is lessened. If the glider should still climb too steeply and then tend to stall, this may be corrected by adding a little more weight to its nose, which is done by adding wire around the end of the stick.

The elevator block, when once properly set, should be cemented in place on the stick, but do not cement the elevator to it. This is held with the rubber bands. Launch your model from a hill or high elevation.

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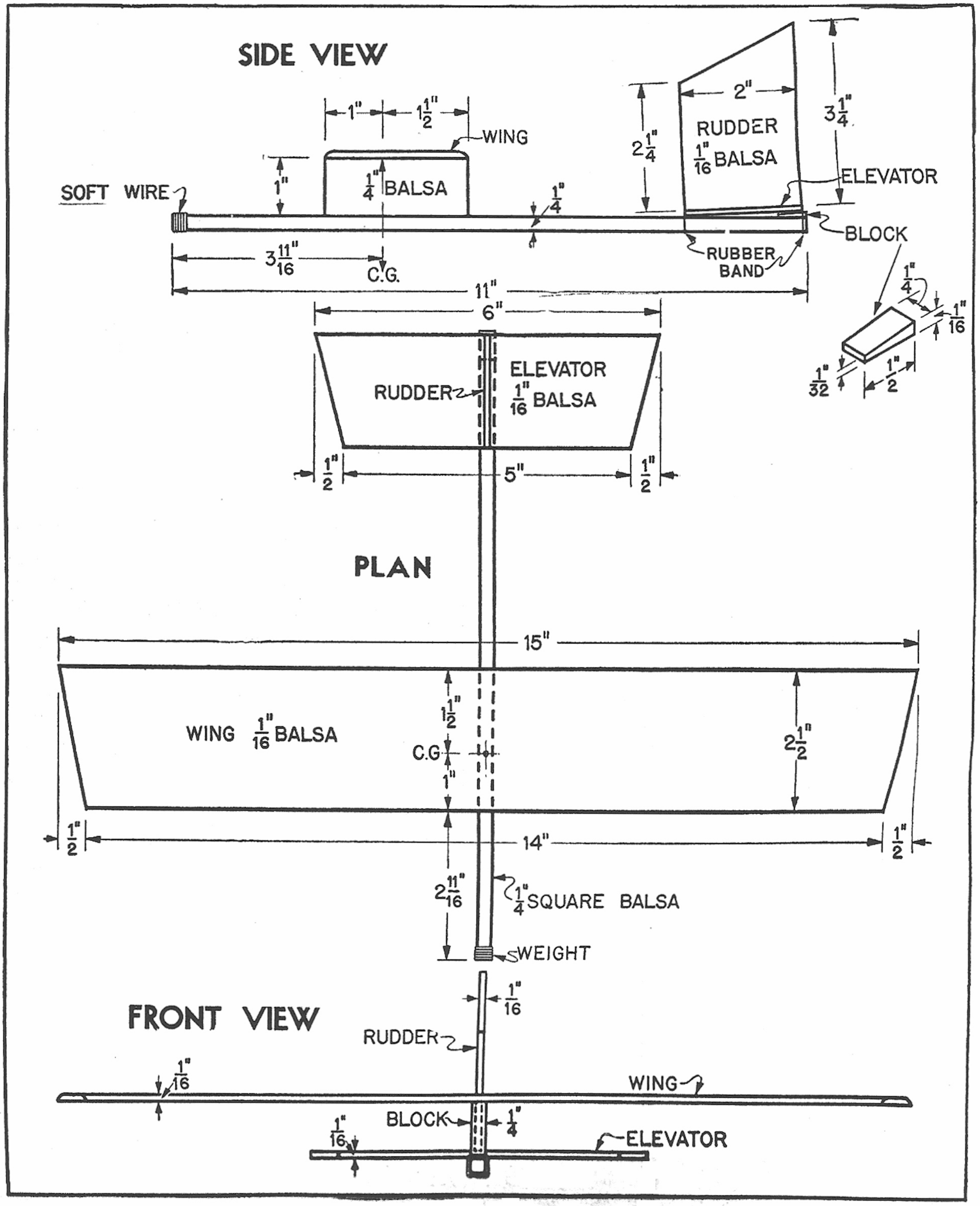
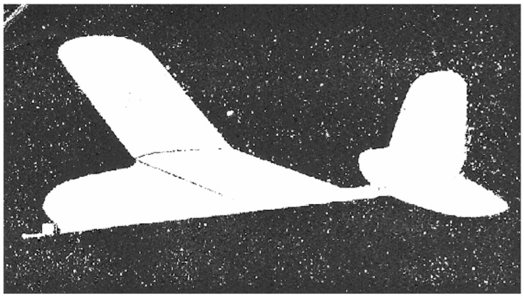
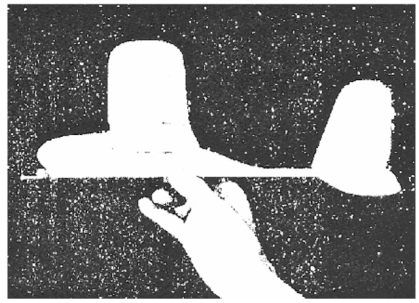


SIDE VIEW
1"
1 1/2"
WING
1"
1/4" BALSA
SOFT WIRE
1/4
3 11/16"
C.G.
11"
2"
RUDDER
1/16" BALSA
2 1/4"
3 1/4"
ELEVATOR
BLOCK
RUBBER BAND
1/4"
1/16"
1/32"
1/2"
6"
ELEVATOR
1/16" BALSA
RUDDER
1/2"
5"
1/2"
PLAN
15"
WING 1/16" BALSA
1 1/2"
C.G.
1"
2 1/2"
1/2"
14"
1/2"
2 11/16"
1/4" SQUARE BALSA
WEIGHT
FRONT VIEW
1/16"
RUDDER
1/16"
WING
BLOCK
1/4"
1/16"
ELEVATOR


The finished glider. Note the balance weight on the nose


To launch the glider, hold it as shown here

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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.

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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:

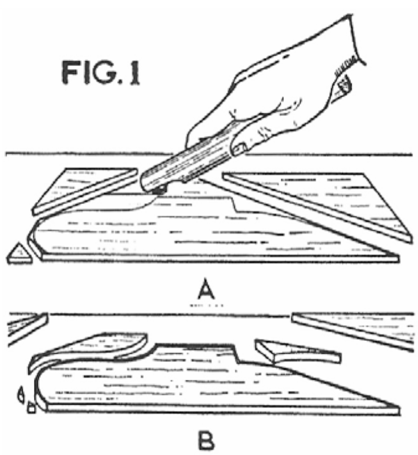
(A) 1 piece 1/16" thick, 3" wide and 11" long - Sheet Balsa
(B) 1 piece 1/8" thick, 3" wide and 18" long - Sheet Balsa
(C) 1 piece 1/4" thick, 1-3/4" wide and 9" long - Sheet Balsa
(D) 1 piece 1/4" thick, 1/4" wide and 13" long - Balsa Stick

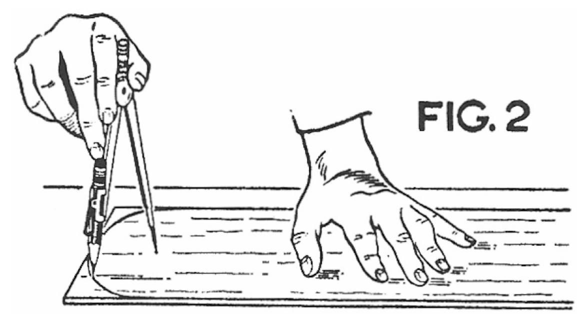
Let us turn to the plans and see what each of these items is for. (A) Turn to the plans and locate the rudder under "Side View" and the elevator under "Plan." (This latter view is often shown in plans as "Top View," which is the same as "Plan"). Note that a dotted line runs around each of these pieces 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.

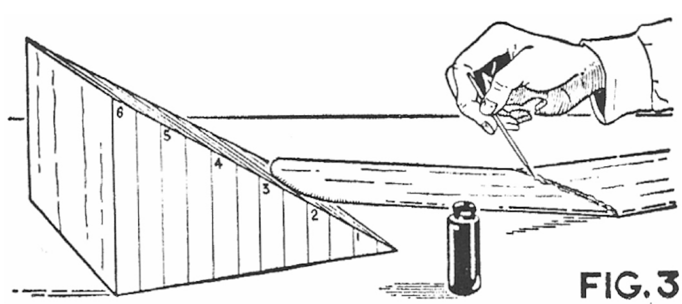
By following the dotted lines around the nacelle, it will be seen that the piece from which this can be cut must be 1/4" thick, 1-3/4" wide and 9" long. Because of its form, no surplus stock need be added to this piece. A glance directly under the nacelle will show the stick with its given dimensions 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.

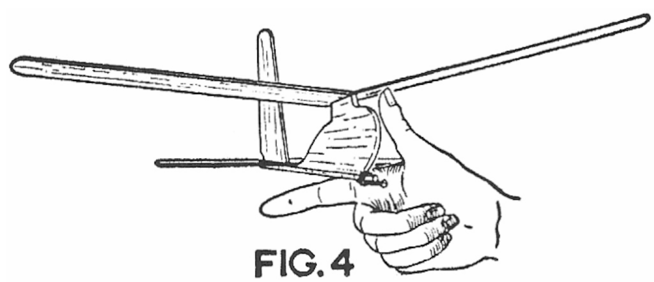
The stick should be carefully sanded with a piece of No. 00 sandpaper. However, do not round the corners where the nacelle is to be cemented to it. The "trailing" (meaning rear, or back) end is then notched, as shown in the plans. Note the large view of this notch at the right of the plans. When completed,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

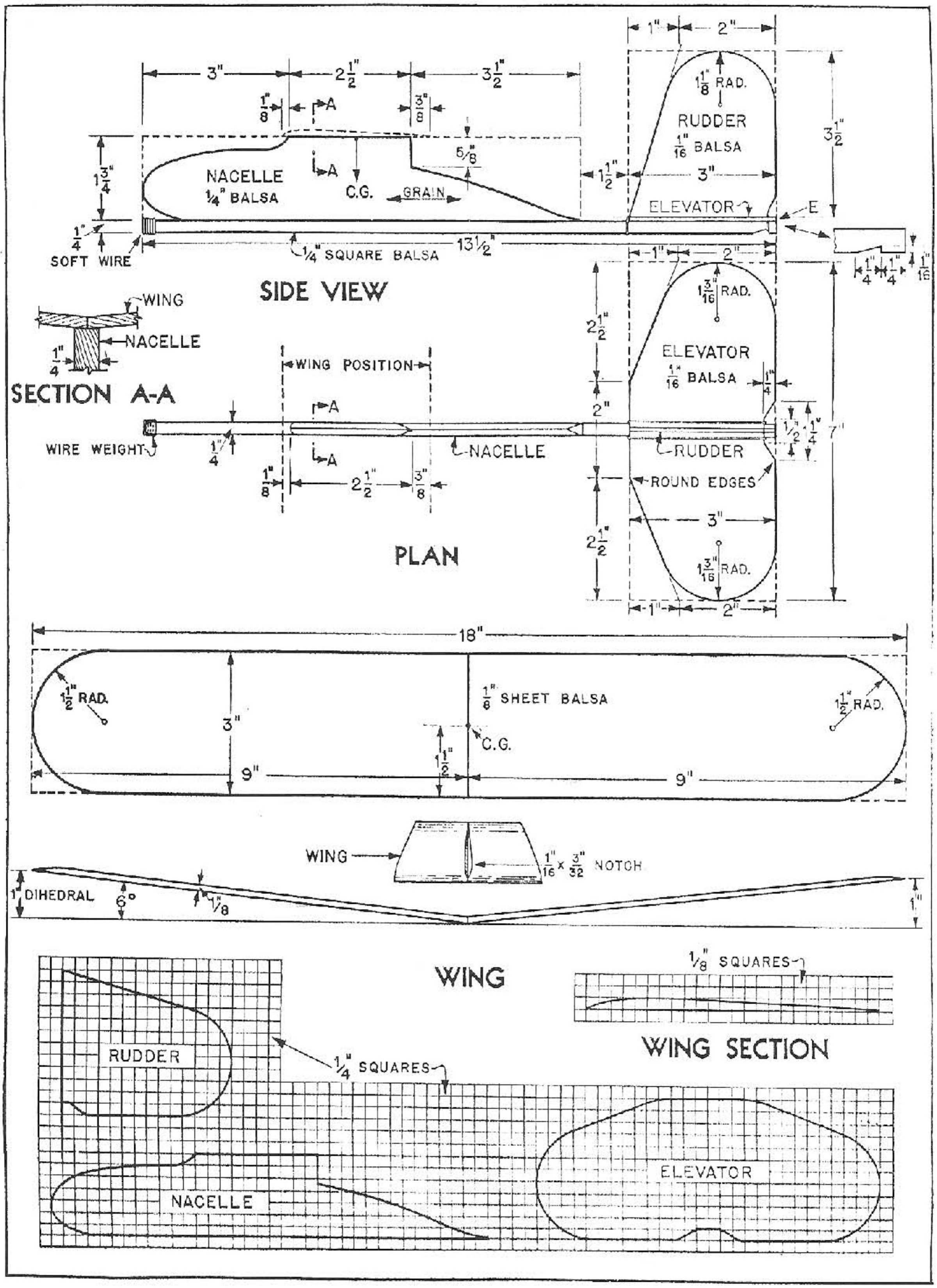
The nose or forward portion of the stick, is now wrapped with soft wire until the glider is properly balanced. As will be seen in the accompanying photographs, as well as in Fig. 4, a common wood screw is held on the stick with rubber bands as another means of gaining necessary weight at the nose of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

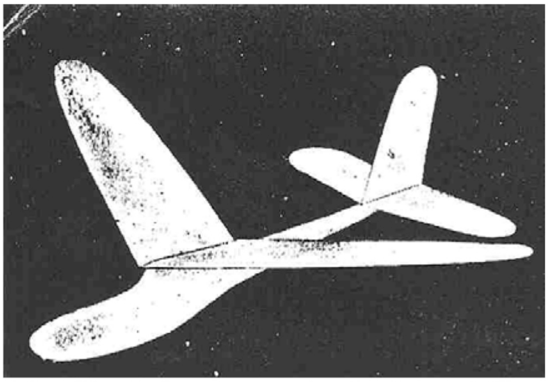
If the glider has a tendency to dive, a small elevation block should be thrust under the elevator at point "E," which is shown in the plans under "Side View." In our first glider which will be found in the May issue of UNIVERSAL MODEL AIRPLANE NEWS, complete instructions for making and using such a block 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.

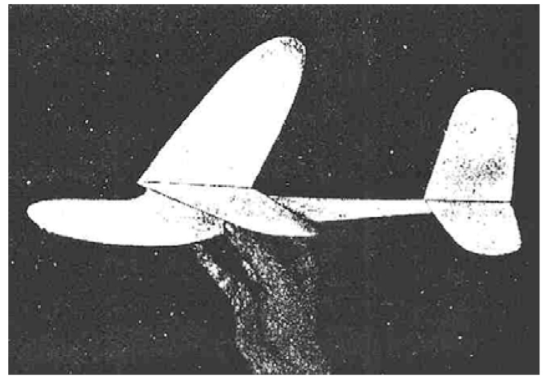
Scanned From June 1934
Universal Model Airplane News



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



The dihedral and sweepback give stability



The finished glider ready to launch

Fundamentals of Model Airplane Building

A Complete Course for Beginners Who Wish to Become Expert. How to Build a Contest Glider-Part No. 3

By EDWIN T. HAMILTON

IN THIS article, we present the third and last "all balsa" glider which will appear in this course. It Is a contest glider designed and perfected by your editor, Charles H. Grant. As this completes such instruction as will be given on this type of model, it may be helpful to quickly review the work covered so far.

In the opening article, an all balsa, stick glider of straight lines was given for obvious reasons. Its simplicity of line, together with its gliding ability, made it a perfect model through which to introduce the newcomer to the fun of model airplane building. In this first article, such steps as layingout, cutting, sandpapering, cementing, general assembly and the reading of simple plans were covered. So much for stick, all-balsa gliders.

In the second article appearing last month, refinements were introduce into the glider design. A nacelle was added to the stick, squared corners were gracefully rounded, while the wing was given a dihedral angle. The cutting of curved sections, cementing the wing in dihedral position, reading and using graph plans, and shaping the nacelle were only a few of the advanced steps covered. So we now come to the contest - and last all-balsa - glider. Through it is brought to the reader his first fuselage, his first sweepback and tapered wing and a stationary tail unit, together with the art of launching a contest glider.

At the same time, we introduce another addition to these articles. This will be an exhaustive, comprehensive and complete model airplane glossary of terms. This feature will appear at the end of each article. It will consist of understandable definitions of all aeronautical or model words used in the article it covers, In this way, the new builder will soon have a model airplane and aeronautical vocabulary second to none.

Fuselage

Turn to the plan and carefully study the fuselage, as shown under "Side View" and "Plan," In the former view, the side of the fuselage is shown, while a top view is seen under the latter. Obtain a piece of light balsa wood measuring at least 1/4" thick 2-1/4" wide and 14-1/4/" long. This piece will allow a 1/4" surplus for waste on the width and length.

Study the graph plan shown just above the fuselage. Rule a sheet of paper with 1/4" squares, and then make a full-size copy of the front part of the fuselage on it, As this must be done free-hand, the squares are given to aid in the work. When copying the plan, make sure that the line you are drawing on your ruled paper passes through each square in exactly the same location as the corresponding line passes through the squares of the graph plan.

Take the piece of balsa and sandpaper one edge perfectly straight and parallel with the grain of the wood. This is called a "working edge" and in this case will become the top of the fuselage. Lay a piece of carbon paper on the wood with the full-size copy over it. Bring the straight top edge of the pattern flush with the straight edge of the wood and at the same time, see that the nose of the pattern is within 1/8" of the edge of the piece of wood. When in this position, trace over the lines of the pattern with a sharp pencil. Remove the pattern and go over the lines with the pencil to make them stand out clearly. Do not press too hard with the pencil as the wood may become marred should the pencil slip.

Measure 3/16" down from the straight edge of the wood and draw a line along its length. If the tracing has been correctly made, this line will meet the upper right end of the pattern outline, Measure along this top line 7" from the end of the pattern line, which will be the trailing, or rear end of the fuselage, This line is the straight upper edge of the fuselage. The bottom edge extends from the lower end of the pattern line out to a point 1/16" under the end point of the fuselage. When these lines have been drawn, the fuselage is cut out in the usual manner. For instructions on this work, see June issue, page 9, Fig, 1.

Both sides of this fuselage piece should he carefully sandpapered smooth and all edges rounded except those holding the wing and elevator. These must be left perfectly flat. Note their position in the side view under "Wing Position" and "Elevator." We are now ready to cut, shape and sand the elevator.

Elevator

The elevator is shaped from a piece of light sheet balsa wood measuring 1/16" thick, 2-1/2" wide and 7" long, as shown by the dotted lines in the plan under "Elevator." Sandpaper one edge straight to serve as the working edge. Sandpaper the opposite edge parallel with the first. Find the exact center of the wood by measuring 3-1/2" from either end and draw a line at right angles to the long side edges. Square up both ends. See that they form right angles with the side edges. Measure 1-1/2" from one side edge at both ends and draw lines from these points to a center point on the opposite side edge. Cut the elevator to the shape shown in the plan with 7/8" radius ends, Complete it by sandpapering both sides and slightly rounding all edges.

Rudder

This requires a piece of light sheet balsa measuring 1/16" thick, 2-1/2" wide and 3-1/2" long. A back or trailing edge of the rudder and one end are sandpapered smooth, straight and at right angles to each other. The opposite end is rounded with a 7/8" radius circle, as shown in the "Side View" under "Rudder" of the plans.

Shape the rudder, as was done with the elevator, slightly round all edges except the straight end, and then sand both sides smooth.

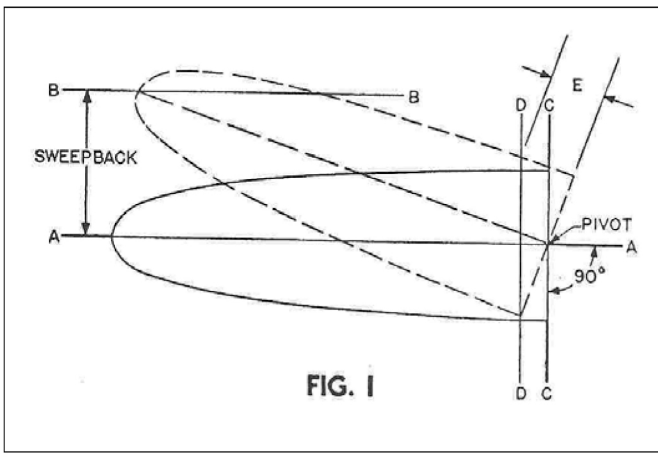


FIG. 1

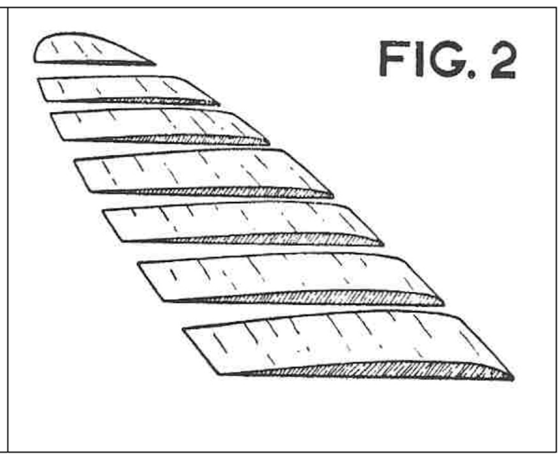


FIG. 2

Wing

The wing used on this glider tapers in width and thickness from its center toward its tips. It is made in two duplicate parts. To simplify the work of the builder, instead of giving a dimension for its sweepback, half the wing is shown on a graph, which includes the necessary slant for the sweepback. A full-size copy of the graph plan is drawn on paper ruled with 1/4" squares, as shown in the plan under

"Wing." The two halves are cut from a piece of very light balsa measuring 1/8" thick, 3" wide and 16-1/2" long.

The longest edge of a sweepback wing is always the leading edge. It will be noted that while this edge on each half is nearly 8-3/4" long, the sheet balsa piece from which both halves are cut need be only 16-1/2" long. This is because of the slant of the inner straight end of each half, which forms the center dividing line of the wing,

Place a piece of carbon paper on the balsa sheet with the pattern of the wing half over it. See that the wing tip of the pattern is at the end of the wood when making the tracing. The second half is now traced by turning the pattern around until the short or trailing edge, of the wing half just traced, continues into the long edge of the wing on the pattern. At the same time, the leading edge of the traced wing must continue into the trailing edge of the wing on the pattern. The straight inner end of the pattern wing must be directly over the inner end of the tracing,

This process is quite correct when the slant of the inner end is given, as in this case, but when only a dimension is given, another method must be used. For example, let us say that the wing has a 2" sweepback. Half of the wing is cut out, as in Fig. 1. As no slant has been specified for the inner end of the wing, this must he cut square or at right angles to a line drawn through the center of the half wing along its length. Let us say that the half wing is 3" wide and 9" long, Measuring 1-1/2" from either edge at the inner end or center of the entire wing, make a mark. Slide your rule to a point further toward the tip, find the exact center and mark. Draw a line through these two marks, which will split the wing along its center.

Draw a straight line on a piece of paper at least 10" long, as shown in Fig. 1 by "A-A." Draw another straight line at right angles to line "A-A" and passing through it, as shown by "C-C" line, The line "B-B" is drawn 2" above "A-A" and parallel to it, which represents the called for sweepback of the wing.

Place the wing half on line "A-A" so that the line drawn along its length is directly over the line "A-A," as shown by the solid lines of the illustration. At the same time, see that the inner straight end of the wing half is directly over line "C-C." At the point where "A-A" and "C-C" cross, the wing half is pivoted until the end of its center line touches line "B-B". When in this position, as shown by the dotted lines in the illustration, the line "D-D" is drawn. This must be parallel to "C-C" and pass through the corner formed by the inner end of the leading edge and the straight inner end of the wing half. The wing must be cut along this line to form the proper slant for a 2" sweepback. In other words, the distance "E" is removed from the trailing edge, shorter than the leading edge by the distance "E." In our model here, the distance "E" equals 1-1/16", as shown in the graph plan.

The two wing halves are now cut out in the usual manner. The sweepback and taper along the width of the wing has been taken care of through this layout and cutting. The taper in thickness must now be dealt with. This is shown in Fig. 2. The form of the wing is shown in the plans under "Wing Section." Sandpaper must be used to gain this form. Fig. 2 shows several sections of the wing, cut as cross-sections, to enable the reader to picture how his wing should be formed, Note that the thickness of each half slowly decreases as it nears the tip. When doing this work, start sanding at the inner end of each half and work out toward the tip.

When completed, the two halves are cemented together with a 2-1/4" dihedral, as was explained in the June issue, Page 9, (see Fig, 3). When making this joint, lift one tip 4-1/2" off level, while the other is held at level.

Assembly

Cement the elevator in position on the fuselage, as shown in the "Plan View" of the plans. See that its top is at right angles to the side of the fuselage and its trailing edge is at right angles to the edge of the fuselage.

Directly in the center of the elevator and over the center of the top of the fuselage, cement the rudder. Be sure it forms right angles with the elevator. Its sides must be parallel with the sides of the fuse-lage.

The wing is cemented on the fuselage, as shown in the plans. The top of the fuselage, where the wing is located, must be cut in the form of a slight groove to fit the form of the wing at its center. This was shown in detail last month. Turn to the June issue, Page 10, which shows the plans, Note "Section A-A" of the plans, which shows how the nacelle is cut in the form of a shallow "V" to accommodate the wing. The top section of the fuselage of this glider is cut in the same manner,

The proper position of the wing is shown under "Wing Position" in the plans, (see "Side View" and "Plan"). The leading edge of the wing at its center protrudes over the level top of the fuselage a distance of 1/4", which makes the trailing edge come to within 1/16" of the rear of this section. When cementing the wing in place, see that both wing tips are level with each other and an equal distance above the level on which the fuselage rests, when the fuselage is perpendicular to that level,

Go over the entire model with sandpaper. Sand lightly to remove excess glue. The nose of the fuselage is now weighted to obtain the correct center of gravity location. Note that this is given in the "Side View" of the plans and is indicated by the letters "C.G." Balance the model at this point, as explained in the June issue on Page 42, with an illustration on Page 9, under Fig, 4.

Small brads are thrust into the nose of the fuselage until enough weight has been added to balance the glider at the point indicated by "C.G," This is shown in the side view of the plans.

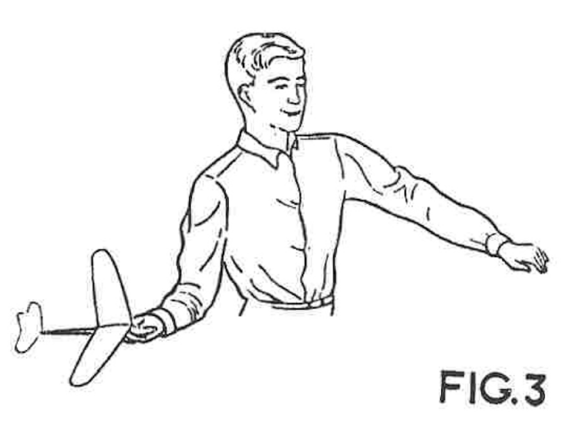


FIG. 3

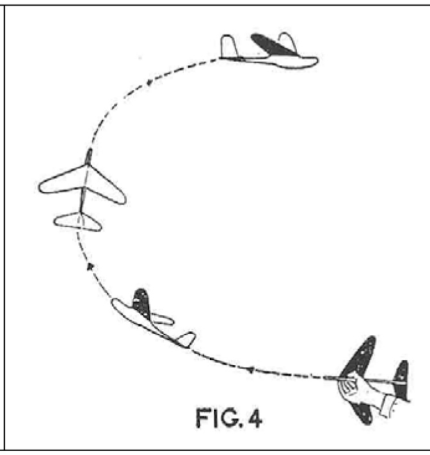


FIG. 4

Launching

In Fig. 3 will be seen an illustration of the correct method of holding a contest glider for launching. The arm is brought well back, swept forward, and the glider released with its nose pointing slightly up and its wing in a vertical bank position. In Fig. 4 the result may be seen. When the glider leaves the hand, it shoots up and out: the upward flight due to the position of its thrust, while the outward circle is the result of the vertical bank position of its wings, which naturally turn it toward the right.

As the model climbs, It slowly rights itself in the air and its soaring flight starts. It may continue to glide in wide circles, which is desirable, or air currents may carry it into other flight courses. The beginner should realize that such launching is not easy and that considerable time and practice must be given the side arm launching before the new enthusiast will master it, but experts agree that it is far best, so keep at until you yourself can get the most from your glider by this method.

Glossary of Terms

BALSA. The lightest wood that grows and widely used in model airplane work.

DIHEDRAL ANGLE. In model airplane construction and designing, refers to the height above center of the wing that the wing tips are set, (Aviation) This is obtained by inclining the main wings of an airplane up from the center of the fuselage so that the tips are higher than any other portion of the wings. This angle is measured from the chord of the wing to a line drawn perpendicular at the intersection of the two wings, if they were elongated equally at the fuselage until they met.

ELEVATOR. A hinged or pivoted auxiliary, horizontal surface or wing which controls the up-and-down direction of the airplane. It is part of the tail unit or assembly.

FUSELAGE. Body. That portion of an airplane to which the wings, tail unit and landing gear are attached. It is streamlined and it contains the power plant, cockpit or cabin for passengers and pilot, cargo, gasoline, etc.

GLIDER. A light, motorless form of aircraft similar to the airplane. One who glides.

LEADING EDGE. The edge that leads. The foremost, or front edge of a wing or a propeller. That part of a wing, elevator, fin or rudder which leads all other parts of the structure to which it is attached.

NACELLE. An enclosure designed to accommodate the passengers or power plant, or both, Usually limited to the pusher type of aircraft, it is shorter than the average fuselage and larger than the average cockpit. When used in reference to balloons, it indicates the passenger basket suspended from the gas bag.

RUDDER. A hinged or pivoted, movable, vertical auxiliary airfoil or surface, designed to steer an aircraft about its vertical axis. A flat or vertical wing, situated on the stern of aircraft, which controls the left to right movement horizontally.

SWEEPBACK. The acute angle between the lateral axis of an airplane and the projection of the axis of the wing on the plane which includes the lateral and longitudinal axes. (Note: The axis of a wing is a line through the centroids of the section of the wing).

TAIL UNIT. The rear portion of an aircraft which includes the rudder, elevators, fin and stabilizers.

TRAILING EDGE. The edge that trails. That part of a wing, elevator, fin or rudder which trails all other parts of the structure to which it is attached.

WING. A general term used to express the main supporting surface of an airplane. Usually designated as the right, left, upper or lower wing.

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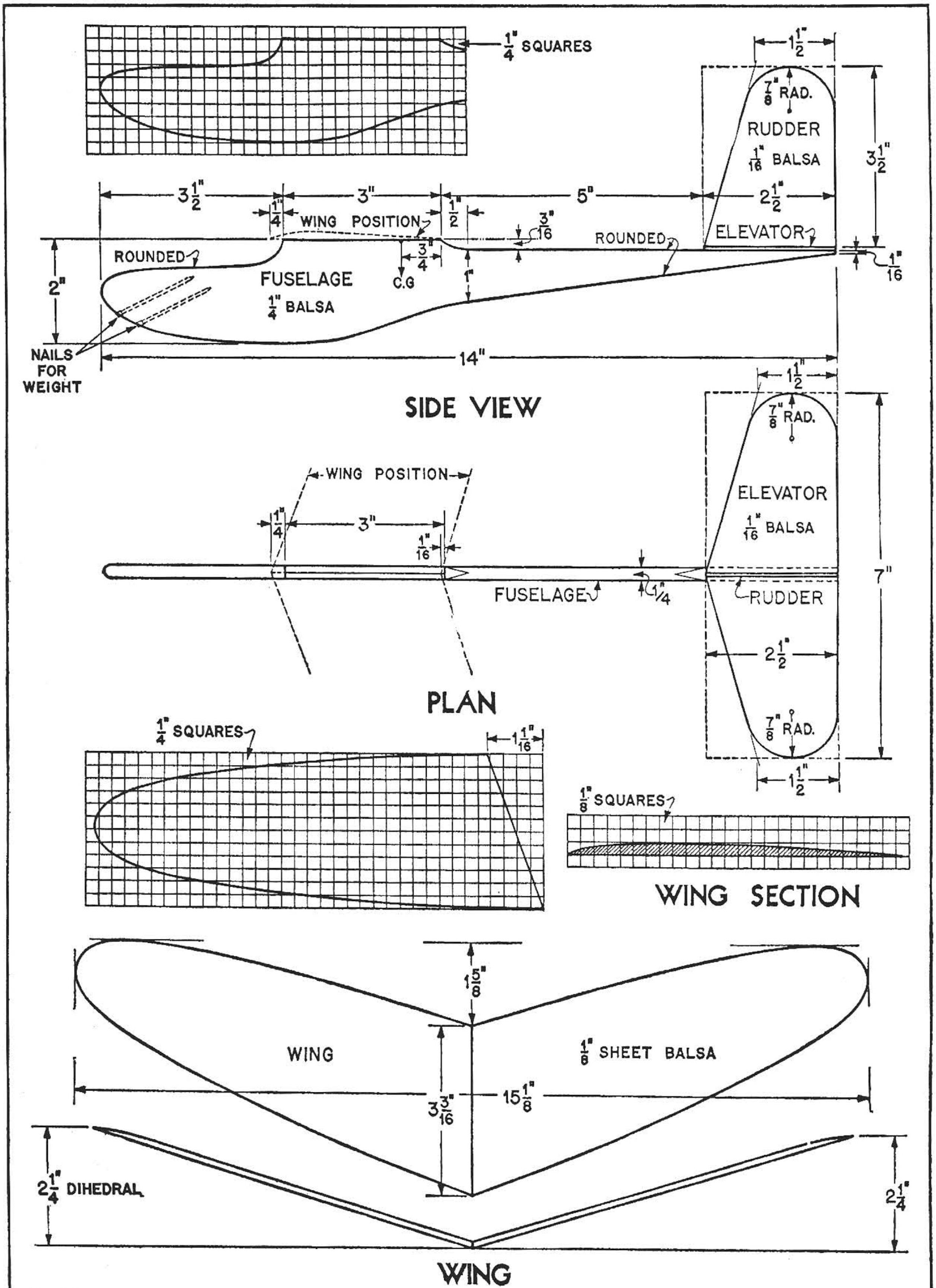
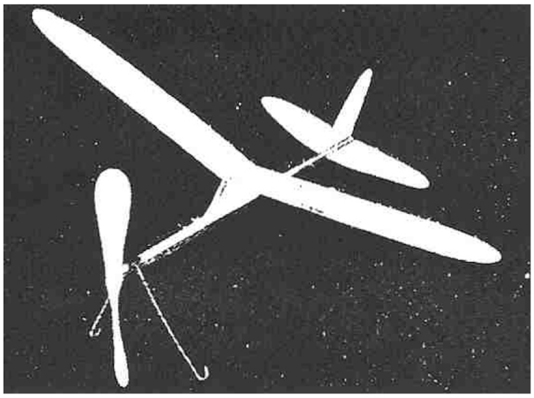
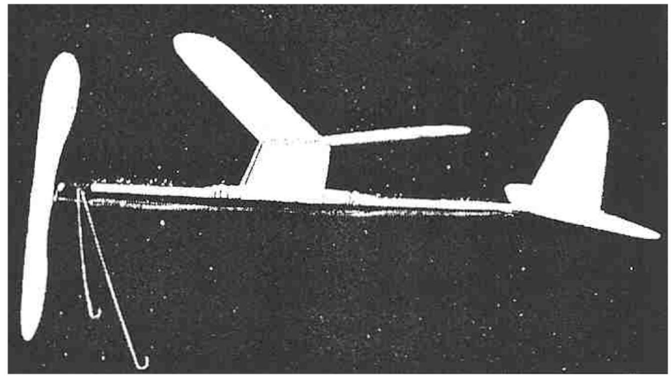

1/4" SQUARES
1 1/2"
7/8" RAD.
RUDDER
1/16" BALSA
3 1/2"
3 1/2"
3"
5"
2 1/2"
1/4"
WING POSITION
1/2"
3/16"
ROUNDED
ELEVATOR
ROUNDED
3/4"
1/16"
2"
FUSELAGE
1/4" BALSA
C.G
1"
NAILS FOR WEIGHT
14"
SIDE VIEW
WING POSITION
ELEVATOR
1/16" BALSA
3"
1/16"
FUSELAGE
1/4
RUDDER
7"
2 1/2"
PLAN
7/8" RAD.
1/4" SQUARES
1 1/16"
1/8" SQUARES
WING SECTION
1 5/8"
WING
1/8" SHEET BALSA
3 3/16"
15 1/8"
2 1/4" DIHEDRAL
2 1/4"
WING



A novice can fly this model 600 feet consistently



This hand-launch model is simple, efficient and stable

Fundamentals of Model Airplane Building

A Complete Course for Beginners Who Wish to Become Expert. How to Build Your First Powered Model -Part No. 4

By EDWIN T. HAMILTON
Models Designed by Charles Hampton Grant

HERE it is! The first power-driven model airplane to appear in this course. When its designer and builder handed me this model, I instantly recognized it as another accomplishment added to an already long list of successes on the part of a man whose name stands above all others in the field of scientific model airplane designing.

Its creation is the result of a year of experimentation with this particular type of plane. It will prove ideally suited for the novice learning the technique of model airplane building and flying. Following the progressive method of presentation, many of its features will be found similar in design to the corresponding features of the three gliders already presented in this course.

Its elevator and rudder follow closely the general lines of those parts of the glider appearing in the July issue. Its wing is similar in form to the glider wing given in the June issue, while the raised position of the wing above the motor stick, as well as the motor stick itself, copy similar features found in our first glider presented in the May issue. So here is a splendid power-driven flying model which might be called a glorified glider, because its various parts as well as its general assembly, have been literally borrowed from the three gliders. already presented.

Test flights proved its stability so remarkable as to bring comment from spectators who knew nothing of model airplane flying. When wound fully with a winder, it is capable of flying for seventy to seventy-five seconds and covering in this time a distance of from one thousand to twelve hundred feet. When the winding is done by hand, it will easily travel for thirty-five seconds and cover a distance of six hundred feet.

Let's get busy and build this modern, up-to-the-minute model. Then we'll find a large open field, wind its motor, launch it and watch our first power-driven plane sail away on its maiden voyage!

Motor Stick

Read all instructions and carefully study the accompanying plan before starting work. Under "Top View" will be seen the line "Motor Stick 3/16" x 1/4" Hard Balsa." Just under this is the dimension line of the stick showing its length to be 17". As the stick must be sandpapered smooth, one should be purchased at least 1/4" thick, 5/16" wide and 17-1/4" long. Lightly sandpaper the stick down to exact size.

In the "Side View" will be seen the form of the stick. Its front end is rounded on the upper side while at a point 4" from its rear end, the stick tapers from its original width of 1/4" to 1/16" at the end. Cut these after laying them out in pencil. Complete the cuts by sandpapering them smooth. This completes the stick except for its wire fittings, which will be discussed under "Wire Fittings."

Elevator

The elevator is cut to form from a piece of balsa wood measuring 1/32" thick, 2-1/2" wide and 8" long. Note its form shown at the bottom of the plan in graph. Make a full-size pattern of the elevator. (See June issue, Page 8). The plan is shown on 1/4" squares so your paper must be ruled with 1/4" inch squares. Place the pattern on your sheet balsa so that the straight, trailing edge of the elevator is running parallel with the grain of the wood, and make the tracing in the usual manner. The elevator is now cut out and then finished by carefully and lightly sandpapering both sides and rounding its edges.

Rudder

A full-size pattern of the rudder is copied from the graph plan in the usual manner. This is traced on a piece of sheet balsa measuring 1/32" thick. 2-1/2" wide and 3-1/2" long. The straight, trailing edge of the rudder must be parallel with the grain of the wood. The rudder is then cut out and finished with sandpaper in the same manner as the elevator.

Tail Skid

This consists of a tapering block of balsa wood, as shown under the elevator in the "Side View" of the plans. It requires a piece 3/16" thick, 1/4" wide and 3/8" long. Its under side is tapered from its original width of 1/4" to a medium sharp edge, as shown in the plan.

Wing

Before making the wing, it will be well to carefully study the instructions given for the wing in the June issue on Pages 9 and 36. Obtain a piece of sheet balsa (soft), measuring 1/8" thick, 2-1/4" wide and 20-1/2" long. Note the pan of the wing shown under "Wing". Its finished size must be 2" wide and 20" long. Square it up and cut to this exact size. Its ends are now finished, as shown in the graph plan under "Wing Tip." Make a full-size copy of this tip, trace it on each end and cut to proper shape. Complete the tips by sandpapering their cut edges smooth.

In the plans under "Wing Assembly" will be seen the shape of the wing, which must now be given it with the aid of sandpaper. Follow the instructions for this work given in, the June issue on Pages 9 and 36. When completed, the wing is given its dihedral angle. Note this in the plans under "Wing." Each tip is given a 2" dihedral. (See June issue, Page 36 Fig. 3).

The wing mounting is now made. This is shown under "Wing Assembly." It consists of two sides, a mounting stick and a separator. The sides are made first. Both may be cut from a single piece of sheet balsa measuring 1/32" thick, 2-1/2" wide and 4" long. Their grain must run up and down when assembled under the wing, as shown in the plan. As the wing is set with its leading edge 3/32" higher than its trailing edge, these pieces forming the wing mount must be 3/32" longer, or higher, at the front than at the back. Note that their top width is only 2" while they are 2-1/2" along the bottom. Cut one of these side pieces perfectly and then make a second duplicate piece. Test them by placing one on top of the other and seeing if all sides of both match perfectly.

A 3/16" square balsa stick is cut 5" long, as shown in the plans. Both of its ends are tapered along the top from its original thickness of 3/16" to 1/16". The front taper begins 1-1/8" back from the front end and the rear tapering begins l-3/8" back from the back end. A second stick is cut of the same size balsa stick, but is only 2" long. This is used to separate the side pieces at the top and is shown in dotted lines, Its ends are beveled, as shown.

The entire mounting is now assembled. Cement the long balsa stick between the side pieces with its bottom edge parallel with the bottom edges of the sides. Note that it extends out 1-1/8" at the front of the side pieces and 1-3/8" at the rear, and that it is located 1/4" above the bottom edges of the sides. The short stick is cemented between the sides along their top edges, so that the top edge of the stick and those of the sides are flush. The wing is mounted on this assembly, as shown in the plans under "Wing" and "Wing Assembly." The top of the sides and their separating stick must be slightly grooved to fit the slant of the wing's center joint. (See June issue, Page 10, under "Wing").

Cement the wing in place so that its center joint comes in the exact center of the sides of the elevation assembly, as shown by the front view of the "Wing." See that both wing tips are exactly the same height above the center assembly.

Metal Fittings

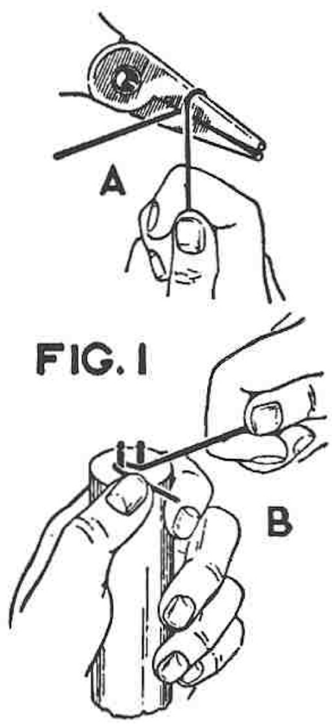


FIG. 1

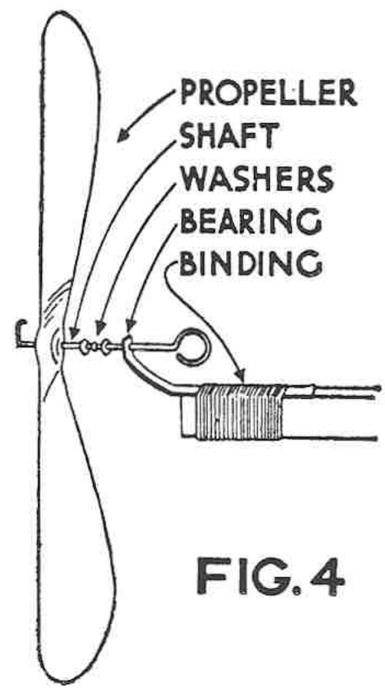


FIG. 4

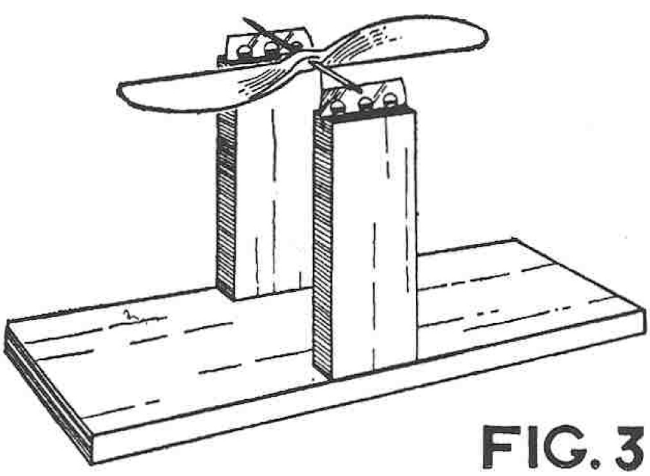


FIG. 3

FIG. 5

All power-driven model airplanes require a certain number of metal fittings. Most of these are bent from wire. While the majority of model supply houses carry a full line of "standard" shapes in metal fittings, every builder should learn how to bend his own from straight wire so as not to be dependent on the manufactured article,

As weight is one of the most important factors in model work, a very thin wire must be used to keep it at a minimum. At the same time, it must possess the required strength. Piano wire has been found to produce the greatest strength with the least weight and is universally used by model builders. It may be purchased at any model supply store.

The size or diameter of wire is measured with a wire gauge. Each diameter is specified by a number and when ordering wire, the purchaser should not only order "piano wire" but must name the desired number. As it is well for the beginner to know something of wire diameters and their numbers, a few of the most commonly used are given here:

Gauge No.	Wire Diam.	Gauge No.	Wire Diam.
5	....0.014"	11	...0.026"
6	....0.016"	12	..0.0283"
7	....0.018"	13	...0.031"
8	...0.0197"	14	...0.033"
9	....0.022"	15	...0.035"
10	....0.0236"	16	...0.037"

While only about 6" of wire is necessary for this model, surplus wire of various sizes should be kept on hand. The fittings of this model are bent from No. 14 piano wire. Bending wire requires time and practice, Do not feel discouraged if your first attempts should fail because when once mastered, any fittings may be made with ease.

Special wire cutters should be purchased, as piano wire will ruin an ordinary pair of pliers in a short time. Round-nosed pliers should be used for bending this wire, and two pairs will be found useful. While one holds the end of the wire, the second can do the bend in. Note Fig. 1-"A." This shows the usual method of bending wire. The pliers hold the wire while the other hand or a second pair of pliers brings the wire over for the bend, Small circles can be made in this manner. A simple wire bender is shown in Fig. 1-"B."

It consists of a short length of I" dowel, or a piece of broomhandle, into the end of which two small brads have been driven. The heads of the brads tend to keep the wire in place during bending. Handles may be 6" or 8" long and several such benders may be made with nails of varying diameters for bends of different sizes.

We will need a propeller bearing, propeller shaft, landing skids, two wing clips and an end hook for this model. While the making of propeller bearings will be given at a later date, the one for this model should be purchased, but all other fittings are made. At the top of the plan will be seen how the end hook, wing clips and propeller shaft are bent. Make the under bend in the end hook as shown, thrust it through the center of the motor stick 3" from its trailing end, or 1/2" in front of the elevator location, and then bend over the protruding end. A drop of cement on this end will hold it in place. Note this in the plans under "Side View" Just in front of the rudder.

Bend two wing clips, as shown in the plan, but do not assemble them in place on the stick at this time, The propeller shaft is bent after the propeller has been carved, but the landing gear skid is made now. Note how this is formed in the plans under "Side View" and "Top View." The bend of the skid fits around the end of the motor stick and its ends then slant out and back, as shown. Cement this and the purchased propeller bearing in place. The latter fits on the under side of the stick at its front end. When both fittings have been cemented in place, reinforce them by wrapping silk thread around the stick and the fittings. When the wrapping has been completed, a coat of cement will add strength and cement the thread in place.

Propeller

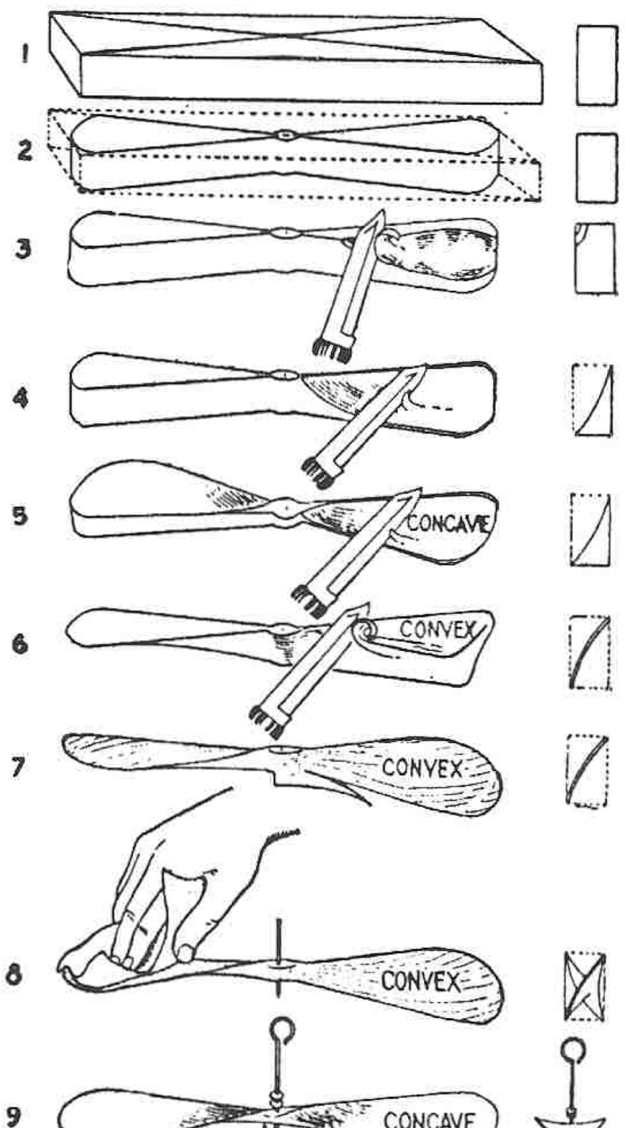


FIG. 2

The propeller for this model is carved from a block of hard balsa wood measuring 3/4" thick, 1-1/4" wide and 8" long. As propeller carving is a step requiring considerable practice, several such blocks should be purchased by the beginner, so as to allow for mistakes and the spoiling of propellers in the process of carving.

Diagonal lines are now drawn across the face of the block, as shown in Fig, 2, Step 1. The general shape of the propeller is drawn on this same face with these diagonal lines acting as edge guides, as shown in Step 2. Step 3 shows the first cutting operation. A sharp pocket knife may be used for this work but a regulation propeller knife will he found best. Such a knife is shown in the illustration and can be purchased at any model supply house. In this first cutting step, the blade attacks the right top edge with a scooping motion to give the cuts a concave form. At Step 4, we see the same operation near the finish, as the knife removes the wood in a concave form which slants from the rear top edge to the front bottom edge. Note the end views of each operation at the right of the illustration.

The blank is now swung around and the knife makes a duplicate concave cut on the other, side, or the original left side of the blank, as shown in Step 5. All cutting must be done from the hub (center) of the propeller toward the tips to eliminate false cuts or possible splitting, The hub is left its original thickness while the carving is being done.

At this point both concave cuts have been made, and when the blank is viewed from on top of the hub, both these cut sides must appear on the side of the blank, while the untouched sides will not be seen or will appear on the opposite side.

The blank is now turned over and the convex sides are cut. The start of the first cut is shown in Step 6. These cuts must run parallel with the concave cuts on the opposite side and should be continued until the blade is 1/8" thick, gradually increasing toward the hub. Both sides are cut in the same manner. Following the carving of the blades, the hub of the propeller should be cut away, as this is its most inefficient part. While experts cut their hubs down to 1/8" thickness, the beginner should leave his not less than 1/4". Step 7 shows this being done. As the shaft of a tractor propeller, such as this one, extends out from the concave side of the blades, it therefore follows that the excess hub material is cut away from that side. Round the blade tips as shown.

Step 8 shows the final sandpapering of the blades. This is an important step. The propeller is now tested for proper balance. To insure even rotation of a propeller, the blades must be exactly the same weight. As it is obviously impossible to weigh each blade, the balance method is used.

A simple balancing block is shown In Fig. 3. It consists of a platform with two uprights of the same length. Into the ends of each a razor blade has been inserted. Piano wire of the same diameter as the intended shaft is thrust through the center of the hub. Make sure that this hole is directly on the cross marks of the two diagonal lines, and that it is inserted perfectly straight. Remove the wire and insert in its place a needle of smaller diameter, so that the propeller will turn easily on it.

File small notches in the exposed edges of the razor blades and then place the protruding ends of the needle in these notches. The propeller should now rotate easily on the needle when blown on, If both blades are of equal weight, the propeller will stay at whatever angle it is stopped in. If not, the heavier of the two will drop down. This blade must then be sandpapered until both are equal.

Step 9 shows the final assembly of the propeller. Bend your propeller shaft, as shown in the plans at the top under "Propeller Shaft." The end opposite the hook is thrust through the hub so that the hook is on the concave side of the blades. Bend the straight end of the shaft around, as shown, and carefully pull it back until the point of the shaft buries itself in the wood of the hub, where a drop of cement will hold it in place.

Assembly

Center the elevator on the under side of the motor stick and cement it in place, as shown in the plans under "Top View," See that the trailing edge of it is at right angles to the stick. The tail skid is now cemented to the under side of the elevator, directly under the motor stick and flush with the trailing edge of the elevator, as shown.

The rudder Is cemented to the right side of the motor stick when sighting it from the rear. Its bottom edge rests on the top of the elevator and its leading and trailing edges are flush with those of the elevator. Apply a fiber washer to the propeller shaft, and thrust its hook through the hole of the propeller bearing. Steel washers may be used, but the fiber is recommended.

The final assembly of a propeller is shown in Fig. 4. While this shows the motor on top of the stick, and ours is on the bottom, as shown in the plans under "Side View," the assembly in both cases is the same.

Motor Power

Our "motor" consists of a high grade of rubber strand which, when unwinding, turns the propeller, We will need about 51" of 1/8" x 1/30" pure Para rubber, which can be purchased at any model supply store. Loop the rubber length and tie its ends together in a square knot, as shown in Fig. 5. Loop this into four strands and place one end of double loops over the hook of the propeller shaft. The opposite end loops are fastened or looped over the end hook, as shown in Fig. 5. A slight "play" will be found in the rubber, which is allowed for surplus winding.

The wing is now assembled on the top of the motor stick. The mounting stick is placed on top of the motor stick with the two sides of the mounting assembly fitting over the sides of the stick. The two wing clips are now placed around the under side of the stick, so that their small hooks come above the top of the stick. They are placed in front and back of the mounting stick, as shown in the side view of the plans.

Two small rubber bands are used to hold the mounting stick in place on the motor stick. Loop them between the hooks of the clips until tight. In the plans under "Wing" is shown the proper center of gravity point by the letters "C.G." The wing with its mounting and clips must he moved forward or backward along the stick until the model balances evenly on this point. This completes the model.

Flying

The usual right-hand propeller, such as this model is equipped with, turns counterclockwise when viewed from in front, and must be wound therefore in the opposite direction or clockwise. Hold the model in your left hand so that the propeller is facing you and with your right hand wind the propeller clockwise. Give it about two hundred turns to start with.

Holding the propeller with the left hand to prevent it from turning, place the right fingers around the stick just below the wing. Place it above your head, level with the ground and release it with a slight push dropping both hands away at the same time.

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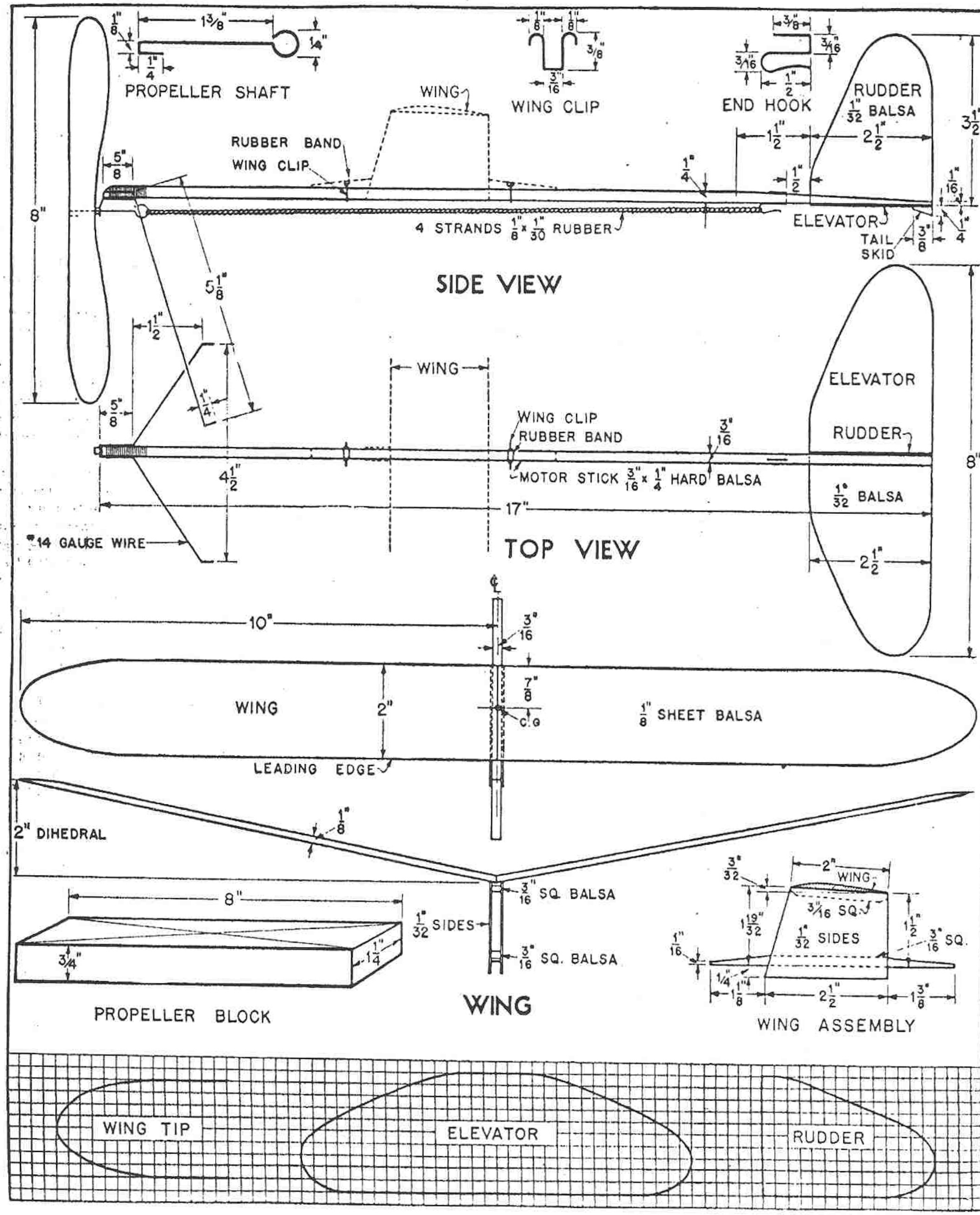
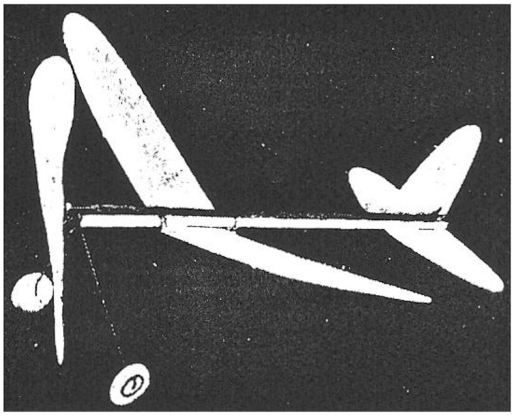
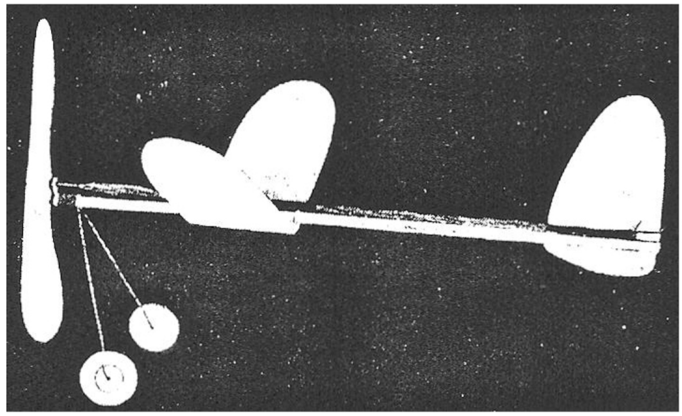


PROPELLER SHAFT
WING CLIP
END HOOK
RUDDER 1/32" BALSA
WING
RUBBER BAND
WING CLIP
4 STRANDS 1/8" x 1/30" RUBBER
ELEVATOR
TAIL SKID
SIDE VIEW
WING
ELEVATOR
WING CLIP
RUBBER BAND
RUDDER
MOTOR STICK 3/16" x 1/4" HARD BALSA
1/32" BALSA
17"
#14 GAUGE WIRE
TOP VIEW
10"
WING
2"
1/8" SHEET BALSA
C.G
LEADING EDGE
2" DIHEDRAL
3/16" SQ BALSA
1/32" SIDES
3/16" SQ. BALSA
8"
PROPELLER BLOCK
WING
WING
3/16 SQ.
1/32" SIDES
3/16" SQ.
WING ASSEMBLY
WING TIP
ELEVATOR
RUDDER



The finished model ready for a flight



The design of this model is perfect for stability

Fundamentals of Model Airplane Building

A Complete Course for Beginners Who Wish to Become Expert.
How to Build a Fine Flying Practice Model-Part No. 5

By EDWIN T. HAMILTON
Models Designed By Charles Hampson Grant

WE PRESENT here our fifth article on model airplane construction. This little model typifies the principles of design which your editor, Charles H. Grant, has been advocating in his popular series of articles "The Aerodynamic Design of the Model Plane." Freak tests with this model have proved beyond doubt the soundness of Mr. Grant's designing principles.

Possibly the most interesting test made with this model, and by far the most important one to the average model airplane builder, was the poor launching test. The model was released with its wings at a ninety-degree angle to the horizontal. While this would spell ruin to the flight of the majority of models, it immediately righted itself and flew perfectly upon being launched.

Many other severe tests were given it, both in the method of launching and the weather in which it was flown, but in all cases perfect flights resulted. Its performance and stability are exceptional. Out of some ten flights it averaged, when hand wound, 30 seconds duration covering an average distance of 450 feet. For the beginner who has not yet developed the technique of model plane flying, it will prove especially adaptable.

Here is a model guaranteed to be a "sure fire" flyer under all conditions. It will prove a splendid practice model for every beginner, whether he is building his first model, or for the expert wishing to test the aerodynamic designing principles upon which it has been created.

Motor Stick

The motor stick of this model consists of a single stick of balsa wood. When sandpapered smooth, it must measure 3/16" thick, 3/16" wide and 14" long, as shown in the plans under "Top View." Do this sanding with the aid of a block, as shown in the May issue under Fig. 5 on Page 9.

Elevator

The elevator requires a piece of sheet balsa measuring 1/32" thick, 2-3/4" wide and 7-1/4" long. A graph plan of its form is shown at the bottom of the plan under "Elevator." Make a copy of this on paper ruled with 1/4" squares. (See the June issue, Page 8 for instructions in this work).

The elevator is then cut to its proper form. Make all cuts just outside the lines so that its edges may be sandpapered smooth down to the lines. When completed, it should be 1/32" thick, 2-1/2" wide and 7" long, as shown in the top view of the plans under "Elevator."

Rudder

As shown in the graph plan, the rudder is the exact size and shape of one-half of the elevator. Divide the pattern of the elevator in half, as shown by the dotted line in the graph, trace it on 1/32" sheet balsa and cut out. Sandpaper its edges smooth and down to exact size. Test for exact form by placing it on one-half of the elevator and seeing that it is a perfect duplicate of the elevator half.

Wing

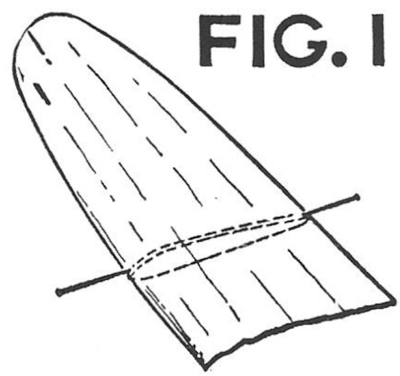


FIG. I

Obtain a piece of sheet balsa measuring at least 1/32" thick, 2-5/8" wide and 17-3/4" long. Study the top view of the wing in the plans under "Wing." This shows the wing as it looks after being bent around its two ribs, as shown under "Wing Section." The width of the wing after bending is 2-1/2", but the original width must be 1/16" wider to allow for its bend. In this manner, the wing must be cut and its edge sandpapered down to 2-9/16" wide.

The tips of the wing should he cut from a pattern made from the graph plan under "Wing Tip." Cut and sandpaper the wing to exact width, trace and cut one tip and finish this by sandpapering down to the pattern line. The length of the wing is then measured exactly 17-1/2", the second tip braced, cut out and sanded smooth.

Locate the exact center of the wing, draw a line from side-to-side at right angles to the sides, and then crease along this line on the upper surface of the wing. This permits it to be bent for the required dihedral without severing the halves.

Cut a dihedral block 1/8" thick, 5/8" wide and 2-1/2" long. This is shown in the plans under "Wing," "Top View" and "Side View." Shape the block in the form of a triangle, as shown in the front, or edge view of the wing, so that it can be fitted and cemented directly over the center creased line of the wing.

The wing is now given its required 2-5/8" dihedral at each wing tip. Place one side of the wing flat on the table and carefully raise its other half until the tip is 5-1/4" above the table surface. When in this position, test to see that the dihedral block fits the angle of the two halves formed at their center. Hold in position, coat with cement and press the dihedral block into the center groove formed by the two wing halves. Small model pins may be driven through the underside of the wing into the block until the cement has dried. They are then removed.

After the cement has thoroughly hardened, the wing ribs are cut and cemented into place. These are carved from 1/8" thick, 5/16" wide or high, and 2-1/2" long balsa wood pieces. Note their exact form in the graph plan under "Wing Section." Two of these will be needed. Carve until exactly like the full-size pattern and finish smooth with sandpaper. They are now cemented in place on the underside of the wing. Locate their position from the plan under "Wing."

Each of these two ribs are attached 3-3/4" from the center line of the wing. Coat the top of one with cement, press it into place at the leading edge and force a model pin into it through the wing at the angle shown in Fig. 1. The wing is then carefully bent around the top curve of the rib and its trailing half held with a pin as shown. The second half of the wing is bent and the rib attached in the same manner. Note that these ribs extend slightly below the leading and trailing edges of the bent wing. Complete the wing by cutting a small elevation block. This is shown at the trailing edge of the wing in the plans under "Side View." It must be cut 3/32" thick 1/4" wide and 5/8" long. Cut this to size and sand all sides smooth. This elevation block is now cemented on top of the dihedral block at the trailing edge of the wing, as shown in the plans under "Side View."

Propeller

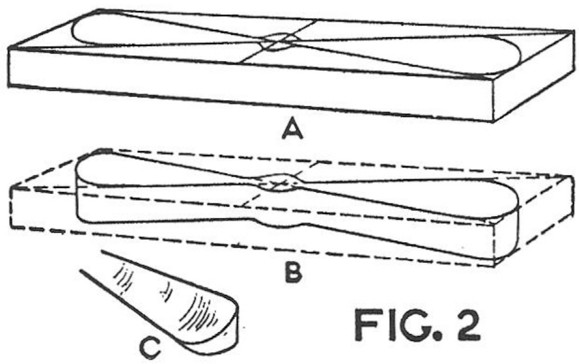
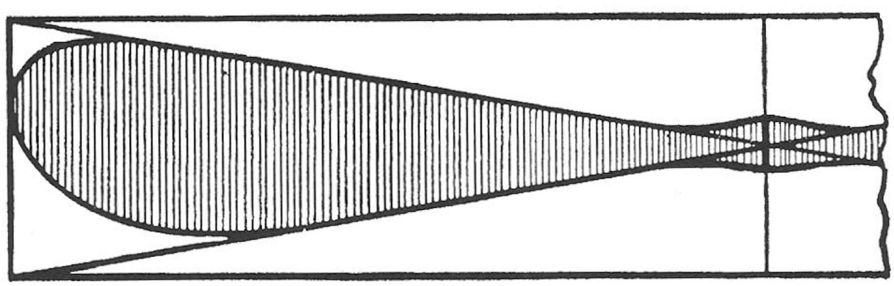


FIG. 2

The propeller is carved from a blank cut from a 11/16" thick, 1-3/8" wide and 8" long balsa propeller block, The propeller given last month was carved direct from the block but this one has its blank cut out first and the carving done from this blank.



PROPELLER PATTERN

The form shown for this model is known as a "U. S. Navy" type propeller. It is the most popular type of propeller for such models. Study the full-size pattern of the propeller. Draw two diagonal lines across your block and then draw within these lines the form of the blades, as shown, The block is now ready to be cut out. The steps of this work are shown in Fig. 2, Your block will look like the one shown at "A" when the blade design has been drawn on it.

This block is then cut along the blade outlines, which makes the block into what is known as a "blank." At each end, the blank is marked with a curve to indicate the cuts to be made when carving. The blank cut out is shown at "B," while "C" shows the end marked. From this point on, the propeller is carved, exactly as was the one described in the August article. Finish by sandpapering both blades perfectly smooth and cutting the hub down to 1/4" thick.

Metal Fittings

All metal fittings with the exception of the propeller bearing, are bent from No. 14 piano wire, as discussed in the August Issue. We require four such fittings. The usual combination rear-hook and tail-skid is bent from one length, as shown at the top of the plans. One wing clip is required, as well as a propeller shaft. As these are practically duplicates of those given last month, no further instruction on bending them to form will be given. The landing gear is also similar to the one shown last month. It is bent from a single length of wire, as shown in the plans under "Landing Gear." Complete the list of necessary metal parts by purchasing a light propeller bearing.

Wheels

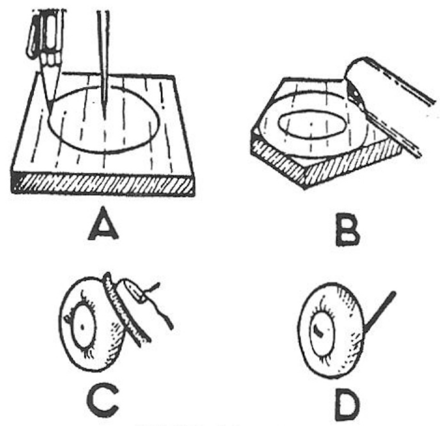


FIG. 3

The two wheels are of the solid balsa, carved type. Two pieces of balsa measuring 1/4" thick and 1" square will he needed for them. Set a compass at 1/2" and scribe a 1" diameter circle, as shown in Fig. 3, "A." This is then cut out with the cutter, as shown at "B." The circle is sandpapered into the form of a wheel with No. 00 sandpaper as shown at "C." Complete the second wheel in the same manner. A center axle hole is now made through each by forcing a common pin through the center of them. Make sure that this hole is slightly larger than the wire landing gear, so as to permit it to turn easily when in place.

Assembly

All parts having been completed, the model is now ready for assembly. Cement the elevator to the underside of the motor stick. Center the elevator with its trailing edge at right angles to the stick and cement in place, as shown in the plans under "Top View." Follow this by cementing the combination rear-book and tail-skid around the end of the stick and over the underside of the elevator, as shown in the plans under "Side View."

The rudder is cemented to the left side of the stick on top of the elevator, when looking straight at the model from the front. See that its leading and trailing edges are flush with those of the elevator.

Cement the propeller bearing to the top center of the motor stick at its leading end with the bent lip of the landing gear cemented directly under it. When both are in place, silk thread is wound around them and then coated with cement for additional strength. The wheels are slipped over the turned up axles of the landing gear and their ends turned up to prevent the wheels from rolling off.

Attach the propeller shaft, as described last month, and then slip its hook through the hole of the propeller hearing. Place the wing clip around the underside of the motor stick just in front of the wing position. Place the wing with its elevation block toward the rear on the underside of the motor stick, as shown in the side view of the plans. The wing is held in place with a single rubber band, Hook one loop over one of the hooks of the wing clip. Bring the two strands of the rubber band under the wing, up and over the stick, back under the wing and hook the other loop over the second hook of the clip.

Note the position of the center of grayitv, as shown in the plans under "Wing" and "Side View" and designated by the letters "C.G." Balance the model at this point under the stick and move the wing backward and forward until perfectly balanced at this point.

Four strands of 1/8" x 1/30" flat rubber are used for motive power. Measure the distance between the hook of the propeller shaft and the rear hook. Multiply this distance by four, add 1/2" to this total and cut a single strand this length. Tie the ends together and loop it twice between the two hooks.

Flying

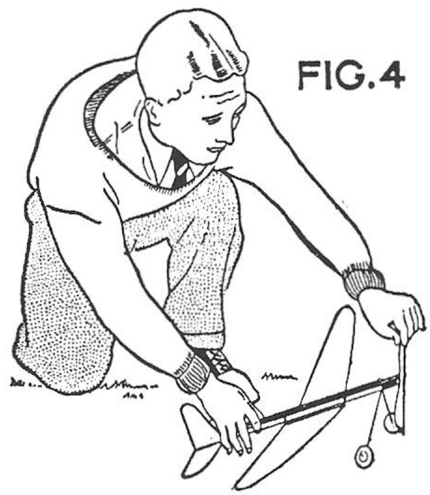


FIG.4

This model will take off the ground without any assistance from the launcher with one row of knots wound up into the rubber motor. No pushing is necessary. Simply place it on the ground and release it. The proper way to hold the model for launching is shown in Fig. 4. Fully wound, it will jump immediately into the air, 275 turns may be put into the motor wound by hand. When stretched and wound with a winder, it may be wound to 550 turns.

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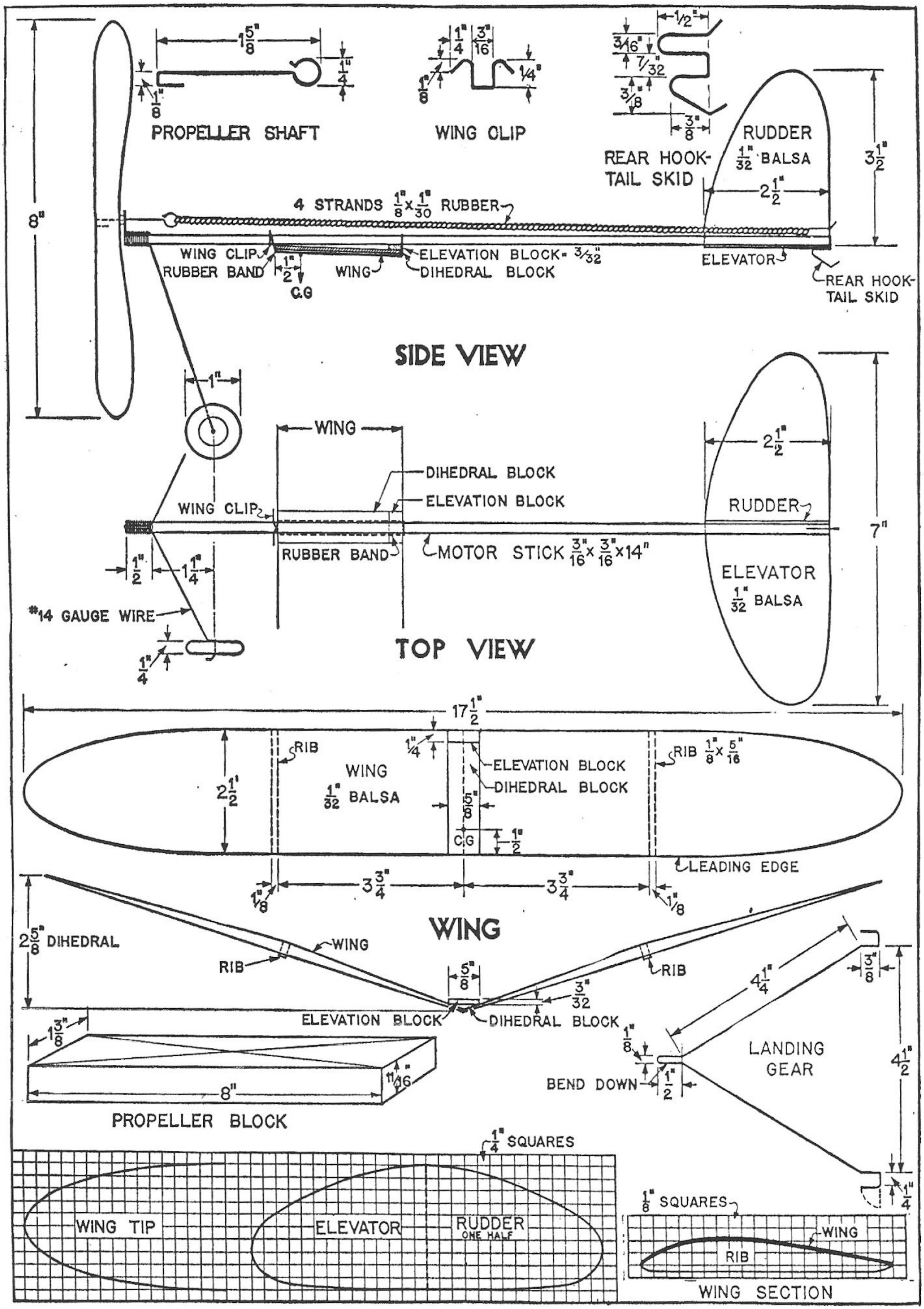
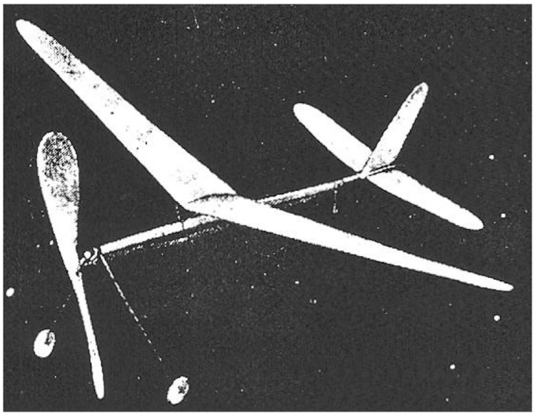
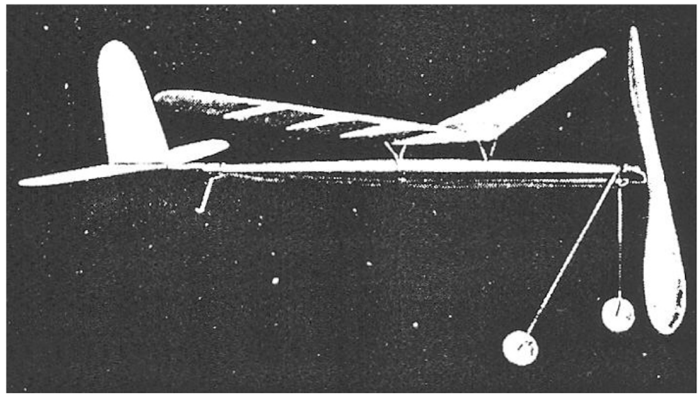
Universal Model Airplane News


PROPELLER SHAFT
WING CLIP
REAR HOOK-TAIL SKID
RUDDER 1/32" BALSA
4 STRANDS 1/8" x 1/30" RUBBER
WING CLIP
RUBBER BAND
C.G
WING
ELEVATION BLOCK = 3/32
DIHEDRAL BLOCK
ELEVATOR
REAR HOOK-TAIL SKID
SIDE VIEW
WING
DIHEDRAL BLOCK
ELEVATION BLOCK
WING CLIP
RUDDER
RUBBER BAND
MOTOR STICK 3/16" x 3/16" x 14"
ELEVATOR 1/32" BALSA
#14 GAUGE WIRE
TOP VIEW
RIB
WING 1/32" BALSA
ELEVATION BLOCK
DIHEDRAL BLOCK
RIB 1/8" x 5/16"
LEADING EDGE
WING
2 5/8" DIHEDRAL
RIB
ELEVATION BLOCK
DIHEDRAL BLOCK
LANDING GEAR
BEND DOWN
PROPELLER BLOCK
1/4" SQUARES
WING TIP
ELEVATOR
RUDDER ONE HALF
1/8" SQUARES
RIB
WING SECTION



A stable all-balsa model with contest performance



The finished model. It will fly for 100 seconds or more, consistently

Fundamentals of Model Airplane Building

A Complete Course for Beginners Who Wish to Become Expert. How to Build an All Balsa Endurance Model-Part No. 6

By EDWIN T. HAMILTON

HERE is the sixth model of this series. Mr. Grant has designed, built and tested it with two major considerations in mind, The first of these is to bring the reader additional building steps, as has been done with the preceding five. In this progressive manner, the reader will gradually master all construction details and operations in the building of model airplanes.

The second consideration is to give the reader as fine a model as possible. In this all-balsa, R.O.G. (rise-off-ground) tractor, Mr. Grant has produced one guaranteed to out-fly any others so far designed in this particular class. How well he has accomplished his task will become evident to all who build and fly the model presented here.

On actual flight tests, its behavior was remarkable. With its motor only two-thirds wound by hand, it rose to an altitude of some two hundred feet and covered a distance of eight hundred feet. Without the aid of air currents, but wound with a winder, it is capable of a flight distance of over twelve hundred feet and a total duration of from ninety to one hundred seconds!

Given a slight up-draft, it will fly in. definitely to give a performance similar to the finest of outdoor contest models. Its large stabilizer; long stabilizer moment arm, and the combination of dihedral, sweep-back and low center of gravity, gives to this model a stability second to none. Rising from the ground in a beautiful sweep, it will quickly adjust itself to existing air conditions, although it is not advisable to fly it in extremely rough and windy weather, as it weighs only 1-1/8 oz.

So let's get busy and build this latest creation of a designer who is not afraid to guarantee his product to beginners and experts alike.

Motor Stick

The motor stick is shaped from a stick of medium hard or hard balsa wood. It should measure 3/16" thick, 3/8" wide and 18" long after being cut and sandpapered smooth. As will be seen in the plans under "Top View," it retains its original thickness along its entire length, but its width varies from 3/8" to 3/16". This is shown in the plans under "Side View,"

Note that this variation in width is obtained by shaping the upper edge of the stick only, while the bottom edge remains perfectly straight. It is in the form of a taper and is now ready for laying out. Choose either end as the front or leading end of the stick and so mark. From this end, measure a distance of 7" along the stick. From this point, the stick is tapered from its original width of 3/8" to a width of only 3/16" at the front end. Cut this taper and sandpaper smooth,

A distance of 8" is now measured from the rear or trailing end of the stick. From this point the stick tapers from its original width of 3/8" to a width of 3/16" at the trailing end, The remaining 3" between these front and rear tapers remains 3/8" wide. Cut this second taper and sand smooth.

The upper front edge of the stick is now rounded, as shown in the plans under "Side View."

Tail Boom

The tail boom is of the same grade of balsa wood and when sandpapered smooth, should measure 1/8" thick, 3/16" wide and 6" long. Choose either end as the front and so mark. From the front end, the boom retains its original 1/8" thickness for a distance of 2-5/8". Lay this out and mark. From this point to the rear end of the boom, the thickness is tapered from 1/8" to 1/16". Note that this taper is cut on one edge only, which becomes the bottom edge, while the other edge which becomes the top edge of the boom, remains perfectly straight. Cut this taper and sandpaper smooth. The upper front edge of the boom is now rounded, as shown in the plans.

Two small balsa blocks measuring 1/8" x 1/8" x 3/4" long are now cut and cemented on both sides of the boom 2-1/4" from its front end, as shown in the plans under "Top View." These are to add strength to the boom at its weakest point, as well as to steady the elevator. Shape their bottom edges to match the taper of the boom.

The boom is attached to the stick at its rear end with cement reinforced with thread binding. Note that its 3/16" width continues the 3/16" thickness of the motor stick. Care must be taken to cut away the top edge of the motor stick, so that when the boom is attached in place, its straight top edge will be parallel with the straight bottom edge of the motor stick. At the same time, the sides of the boom must be in a straight continued line with those of the stick. The front end of the boom overlaps the rear end of the stick l" as shown in the plans under "Top View."

Cut the top of the stick as required. Before the boom is attached, however, the combination rear hook and tail skid must be bent, as these three parts - the stick, boom and this metal fitting are all cemented and bound together.

The combination rear hook and tail skid is bent from No. 13 piano wire. As it is shown in the plans full size, it should be bent to match the one given at the top of the plan perfectly. Cut a small groove along the top-center of the boom slot in the motor stick, so that the top bend of the skid will fit into it perfectly. When in place, coat the slot with cement and place the boom in position on the stick. Now coat both the stick and the boom with cement and then wrap with thread until all three parts are held tightly. When completed, the thread may be given an outside coat of cement to further strengthen it.

Elevator

The elevator is cut from a piece of 1/32" sheet balsa measuring 3" wide and 11" long. Note the elevator shown in graph at the bottom of the plan. Rule paper with 1/4" squares, copy the elevator, fullsize on this paper, trace it on the balsa sheet and cut out. Slightly round and smooth all edges and then carefully sandpaper the piece until slightly thinner than its original thickness.

Rudder

The rudder is cut from a piece of 1/32" sheet balsa measuring 3" wide and 4-1/4" long. It is shown in graph at the bottom of the plan, Proceed to cut this piece in the same manner as was the elevator. Finish with sandpaper in the same manner. As the rudder is cemented to the elevator, it may be assembled at this time.

Two sheet balsa strips are added to the sides of the rudder to increase the thickness of its edge for cementing purposes. These are shown in the plans under "Side View." Each should be cut to measure 1/32" x 3/16" x 3" long. Sandpaper them smooth and then cement them on each side of the rudder along its straight bottom edge.

This assembly is then cemented to the center of the elevator, as shown in the plans. The trailing edge of the rudder must be flush with that of the elevator, the rudder must bisect the elevator, and the trailing edge of the elevator must form right angles with the rudder.

Wing

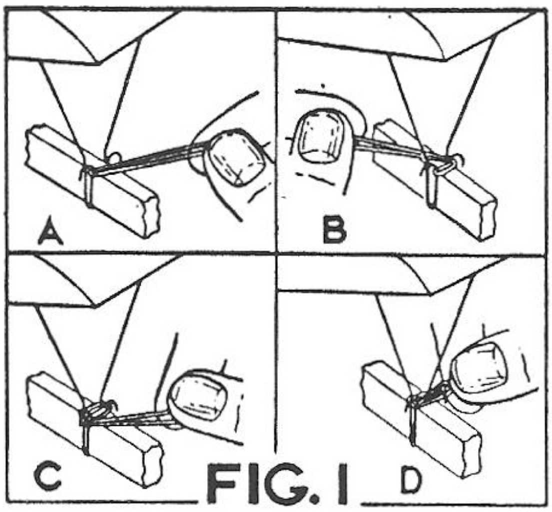


FIG. 1

Study the plan of the wing. Note that it is cut from two, pieces of 1/32" sheet balsa measuring 4' wide and 13-5/16" long. Cut these two pieces to exact size. Note that one of them is shown on the left side of the wing in the plans by dotted lines. Measure 2" in from one edge and then draw a line along the center of the wing board bisecting it. All measurements are laid out on each side of this line. At the tip of the piece, measure 1" on each side of the line, Lay out the trailing edge of the wing by drawing a line from the trailing end of the inner end of the board to this 1" point.

Draw a second line across the width of the board at right angles to the trailing edge line so that its forward end meets the inner front corner of the board. This line forms the inner edge of one wing half.

From the leading end of this inner edge, measure 1/2" along the leading edge of the board. Now draw a line from this point to the 1" point at the wing tip. This forms the leading edge of the wing, Make a graph of the wing tip, trace it on the board and cut out the wing half. The second wing half is cut out in the same manner. Finish smooth with sandpaper.

Both halves should now be tested to see that when placed together they form a perfectly straight trailing edge. If not, their inner edges must he sanded until a perfect fit is obtained. At the same time, the entire wing span must measure exactly 26".

Each wing half requires four wing ribs, which are shown full-size in the accompanying drawing. Trace these on thin paper, transfer two of each rib on 1/16" sheet balsa and cut out. Finish carefully with sandpaper.

Assemble the ribs on each wing half before joining the halves together. Note their positions as shown in the plan under "Wing." Rib No. 1 which is the largest, is placed 1/2" in from the inner edge and parallel to it. Rib No. 2, the second largest, is placed 3-1/4" in from the inner edge or 2-3/4" in from rib No, 1. The third rib is placed 2-7/8" from rib No. 2, while the smallest and last rib, (No. 4), is cemented 3-7/8" from the wing tip or 3" from rib No. 3.

Apply cement to both the ribs and the underside of the wing half and carefully bend the wing around the ribs. Hold with pins until dry. The second half is assembled in the same manner.

Balsa sheeting, measuring 1/32" thick and 5/16" wide, is cemented between ribs No. 1 and No. 2 on the leading and trailing undersides of each wing half for added strength. The inner edges of each wing are now beveled to match each other perfectly when the wing is given a 2-1/8" dihedral at each tip.

Obtain this dihedral in the usual manner and then cement the halves together. Two additional balsa sheetings are now added along the underside of the wing at the leading and trailing edges between the No. 1 ribs of each half. Like the others, these must measure 1/32" thick and 5/16" wide. They must be cut 1" long, bent to fit the dihedral angle and cemented.

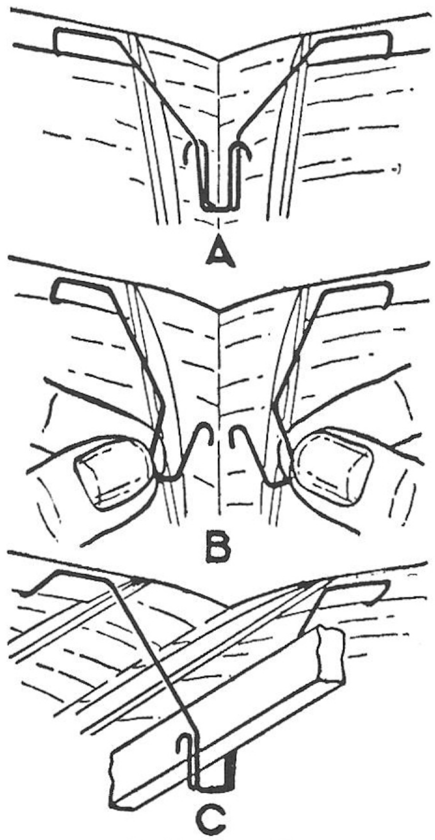


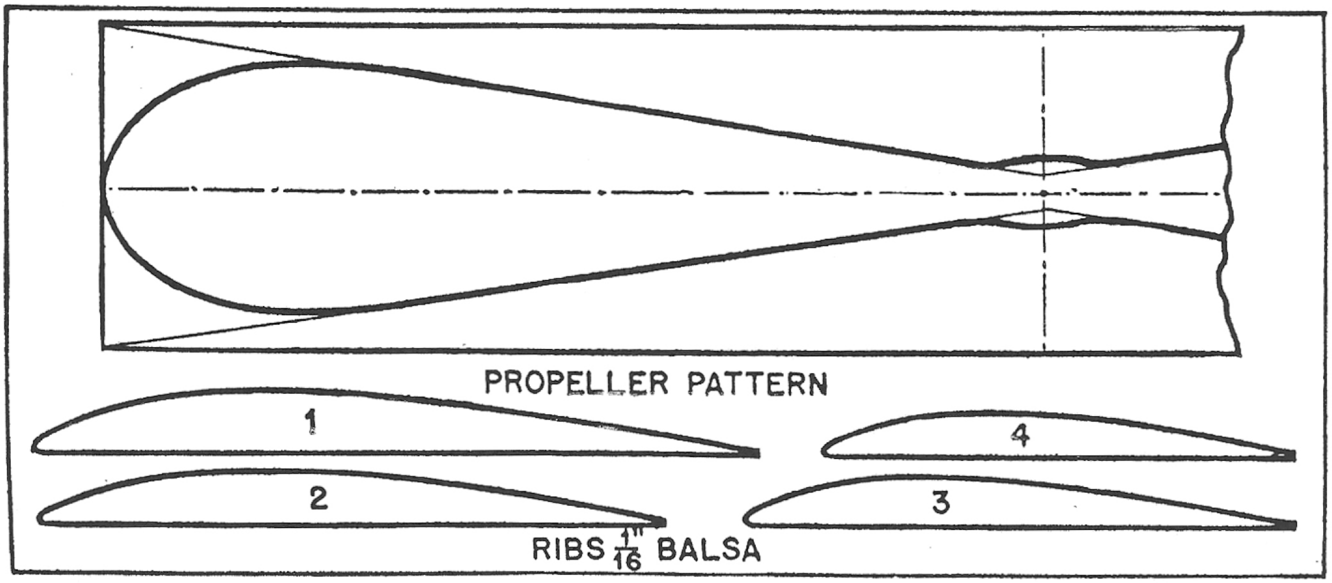
FIG. 3

Mr. Grant has developed a new type of wing clip for this model. It consists of four pieces of wire, two of them forming the leading edge clip and two the trailing edge clip. Note their full-size form at the top of the plan. They are bent from No. 6 piano wire. Bend two front clips and two rear clips. Instead of going directly into the wing structure, these clips have a bent lip on them which extends inward on the underside of the wing before they are bent up to enter its wood surface. These bends are shown at "A" and "B". The former is for the leading clips, while "B" is for the trailing ones.

These clips come up to the edge of the wing, extend along the edge, turn in at right angles, extend toward the center of the wing and are then bent up and inserted into it. Note this in the illustration showing the clip on the wing, marked Fig. 3. Test your bends to see that the trailing clips are exactly 1/8" shorter than the leading clips.

The wing is attached to the motor stick by spreading the hooks of each clip apart, passing them over the stick and bringing them together under it, where they are held together with short 1/2-inch long rubber bands. The attaching of these bands is shown in Fig. 1.

Propeller



The propeller is carved from a medium hard balsa block measuring 7/8" thick, 1-3/4" wide and 10" long. Lay out the pattern as shown full size in the drawing, and then carve in the usual manner. Its hub is cut away on the inner side or on the side from which the propeller shaft protrudes.

Bend a propeller shaft from No. 13 piano wire to the exact size shown in the plans. Insert it through the hub from the inner side, bend it around as shown, pull it back so that the end enters the hub wood and acid cement for strength.

Landing Gear

The landing gear is bent from a single piece of No. 13 piano wire, as shown in the plans, Note that this piece extends up to the stick, goes forward along its bottom edges and then forms a bend around the motor stick. In this way, it must be placed over the motor stick from the stick's upper side, as shown in the small drawing of it. However, before it is attached to the stick, wheels must be cut and the propeller bearing must be bent.

The wheels may be of hard wood and if this is used, they may be 1-1/4" in diameter and 3/16" thick. If balsa wood is used, they should be 1-1/2" in diameter and 1/4" thick. Cut these out, sand to perfect circles and attach to the landing gear.

A regulation propeller bearing is cemented to the underside of the motor stick. Slip the landing gear over the stick, apply cement and then bind both the gear and the hearing with thread. Apply a coat of cement over the finished binding for added strength. Note that the landing gear wire at the lower end extends back a distance of 1-3/47".

Motor Power

The motor consists of six strands of black or brown rubber and is attached to the combination rear hook and tail skid by a second hook, known as an "S" hook because of its shape. Note this at the top of the plan. It is also bent from No. 13 piano wire. Such a hook permits the motor to be wound with a hand winder, such as is shown in Fig. 2.

Tie the length of rubber together into one loop and then pass it between the "S" hook at one end and the propeller shaft at the other. For proper sag in the motor, a length of 100" should be used.

If you wish more power, another strand may be added making seven in all. In this case, one end is tied to the propeller shaft hook, wound hack and forth between this hook and the "S" hook, and then the free end tied to the "S" hook.

Flying

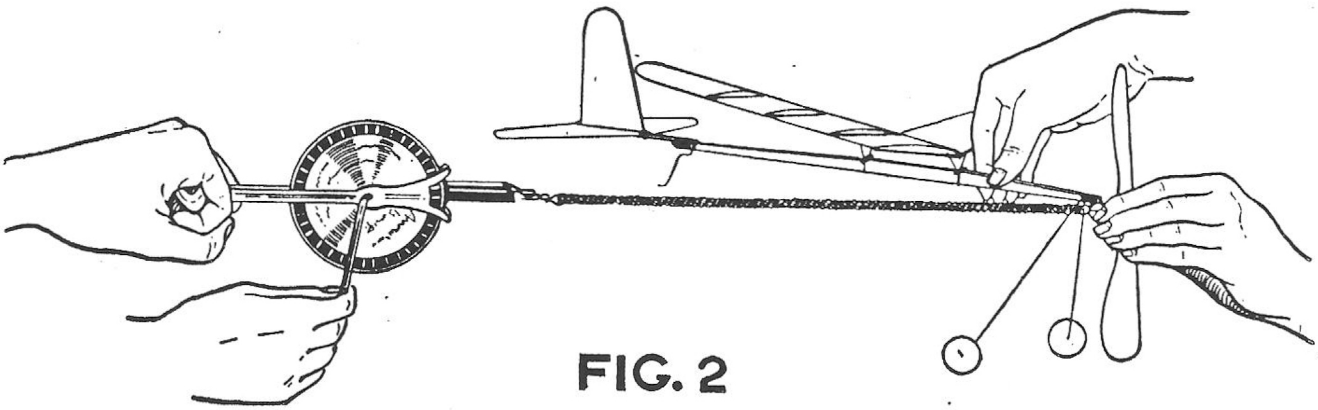


FIG. 2

For all strong motors a winder should be used. These may be purchased at any model airplane supply store and are used as shown in Fig. 2. While one holds the propeller shaft away from the bearing, the other attaches the hook of the winder over the "S" hook, stretches the rubber motor about four or five times the length of one strand and begins to wind, While the winding proceeds, the one doing the winding should slowly walk toward the model.

With such a winder, this motor can be given about 550 to 600 turns when a lubricant is used. Such lubricants can be purchased, applied before winding and then carefully washed off before the model is stored away between flights.

If the winder is not used, a hand-winding can he given the motor of about 300 turns. Through the balance method, locate the center of gravity, as shown on the plan by "C. G." in the side view. The location of the wing is determined from this point of gravity. Note that the leading edge of the wing is set exactly 1-3/4" in front of this point.

Set the wing at this position, wind the motor and launch the plane on its maiden voyage!

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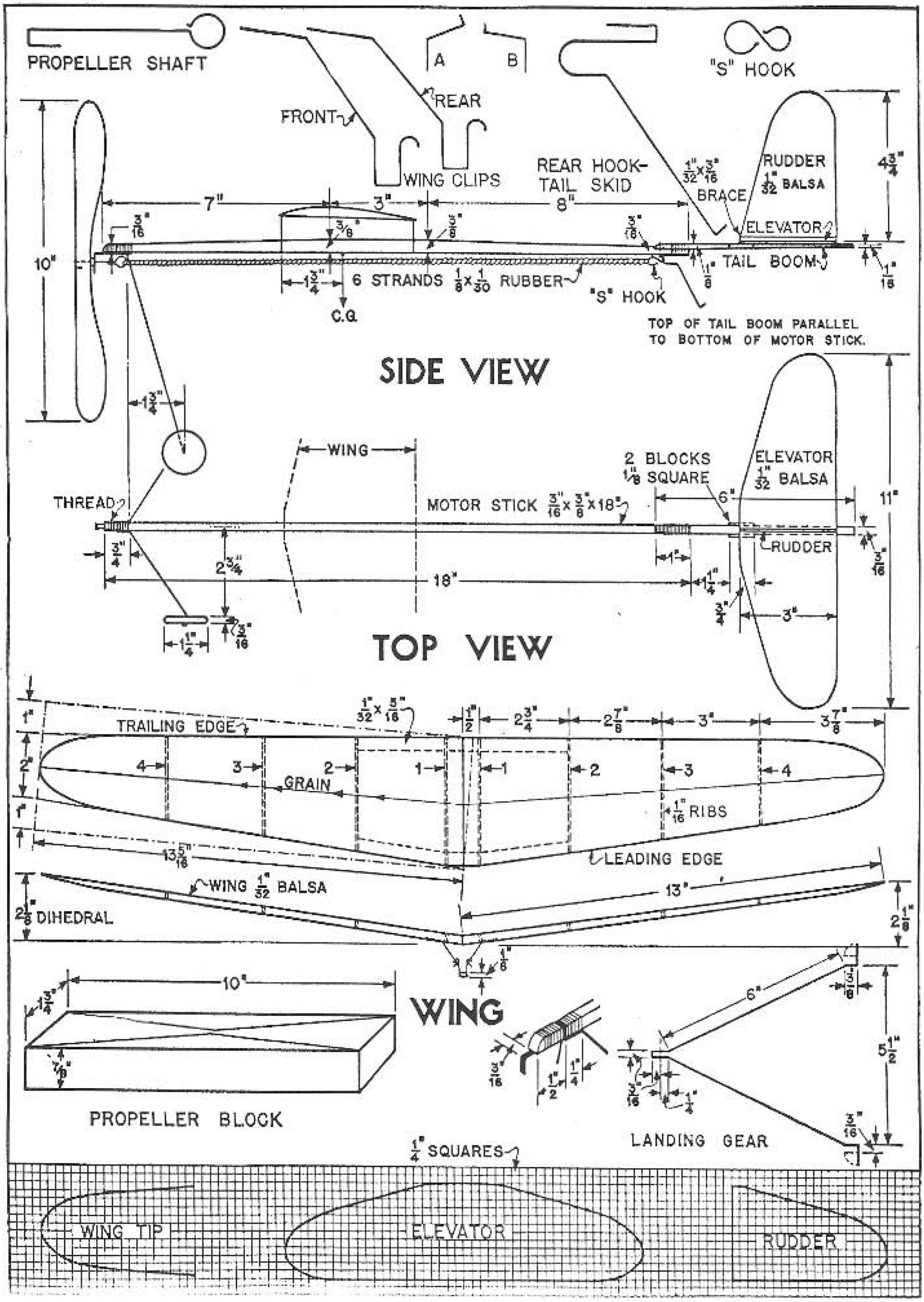
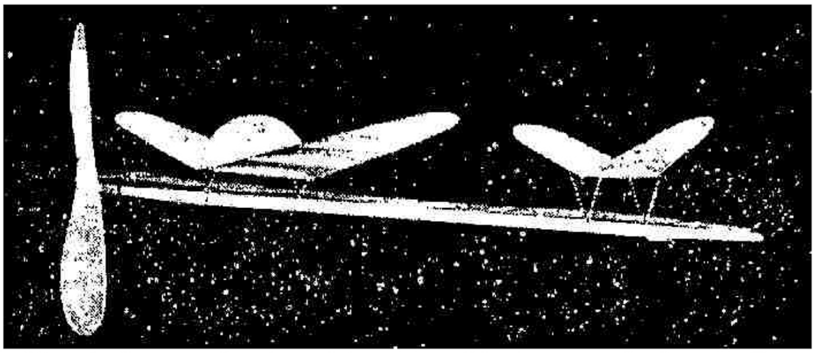

PROPELLER SHAFT
"S" HOOK
A
B
FRONT
REAR
WING CLIPS
REAR HOOK-TAIL SKID
1/32"x3/16" BRACE
RUDDER 1/32" BALSA
ELEVATOR
4 3/4"
7"
3"
8"
3/16"
3/8"
10"
TAIL BOOM
1/8"
1/16"
1 3/4"
6 STRANDS 1/8 x 1/30 RUBBER
"S" HOOK
C.G.
TOP OF TAIL BOOM PARALLEL TO BOTTOM OF MOTOR STICK.
SIDE VIEW
WING
2 BLOCKS 1/8" SQUARE
ELEVATOR 1/32" BALSA
THREAD
MOTOR STICK 3/16"x3/8"x18"
6"
11"
RUDDER
3/4"
2 3/4"
18"
1"
1 1/4"
3"
1 1/4"
TOP VIEW
1"
2"
TRAILING EDGE
1/32"x5/16"
1/2"
2 3/4"
2 7/8"
3"
3 7/8"
GRAIN
1/16" RIBS
LEADING EDGE
13 5/16"
WING 1/32" BALSA
13"
2 1/8" DIHEDRAL
2 1/8"
10"
1 3/4"
7/8"
WING
PROPELLER BLOCK
6"
3/8"
5 1/2"
1/2"
1/4"
1/4"
LANDING GEAR
1/4" SQUARES
WING TIP
ELEVATOR
RUDDER

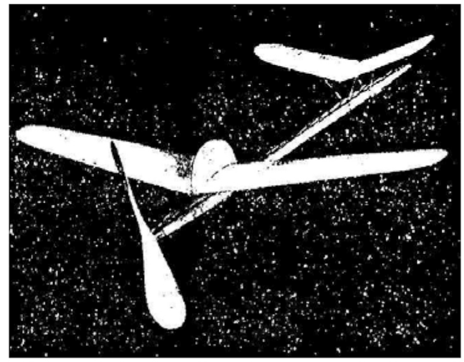
Fundamentals of Model Airplane Building

A Complete Course for Beginners Who Wish to Become Expert. How to Build Your First Single Propeller Pusher. Part 7

By EDWIN T. HAMILTON



Here is the completed model, more stable than any single propeller pushers you have ever flown



The high front wing improves its lateral stability. Note the left hand propeller, turning opposite from tractor propeller

IN THE seventh model to be presented in this series, Mr. Grant brings to the reader the first single propeller pusher. It has proved to be a remarkable performer for an all-balsa plane. The difference between a "pusher" and "tractor" plane lies in the position of the propeller. If the propeller is in front of the main supporting surface, it is called a tractor because the propeller tends to pull the plane, If the propeller should be located behind the main supporting surface, the plane is called a pusher because the propeller tends to "push" the plane.

As the propeller of this model is behind the wing or "main supporting surface," it is a pusher. It is likewise known as a "single propeller pusher" because it has only one propeller which is located behind the wing. Next month, we will give a "twin propeller pusher," which is so-called because it has two or "twin" propellers, both located behind the main wing. These models are often spoken of as "single-stick pushers" or "twin stick pushers,"

The chief problem of a single propeller pusher has been one of stability. This is because the twist of the motor stick and the torque of the propeller both act to make the model turn to one side. This fault has been overcome by raising the elevator well above the motor stick and giving it considerable dihedral. It will be found to fly in a stable circular path.

Its climbing ability has proved remarkable. Under ordinary conditions, flights of two minutes or more can be easily obtained over a distance of from 1000 to 1500 feet, With six strands of 1/8" rubber, the motor may be wound 475 to 500 turns by hand. If lubricated and wound by a winder, this can be increased to 900 or 1000 turns.

With a winding of 900 turns by the latter method, the model has a pitch distance of 1500 feet. Pitch distance equals the number of turns stored in the motor multiplied by the pitch of the propeller, which in this case is 16". This estimate of distance will prove a conservative one.

The model is simple to build; will glide well at a steady, flat angle, and will turn in performances equal to the best of contest models. Under ordinary conditions, it will reach an altitude of 200 feet and make a splendid appearance in the air,

Here's your chance to build and fly an all-balsa, single-propeller pusher second to none! Let's get busy, build this clever plane and know the thrill of flying the best.

The building instructions for this model will not be as detailed as most of the preceding, ones because its lines so closely follow those of the endurance model given last month. It might be well to turn to your October issue (Page 9), and again read the instructions given there. You will find both building operations considerably the same for that plane and the one given here. However, there are several points quite different, which will be fully explained here.

Motor Stick

The motor stick is a single piece of balsa measuring 1/4" thick, 3/8" wide or deep, and 26" long. The top of the stick is left perfectly flat, as shown in the plans under "Side View," while the bottom has both ends tapered. At the front, this taper is started 3-3/4" back, it tapers from the original depth of the slick to 3/16" at the front. (Note that the "front" of the motor stick of this model is exactly opposite from the front of all the other models given so far, as this is a pusher plane and therefore has its propeller at the trailing or back end of the stick).

At the rear end of the stick, the taper starts back 3" and is beveled from the original depth of 3/8" to 3/16" at the end. At this same end on its upper side, the usual propeller bearing is cemented and silk bound to the stick, as shown in the plans,

A nose hook is bent from No. 13 piano wire to the form shown in the plans tinder "Nose Hook." This is shown full size. It is then cemented around the front end of the stick, as shown in the "Side View." On the underside of the motor stick, 3-3/4" back from its front end, a small 1/16" x 1/4" x 2" long block is cemented in place. This offers less elevation for the leading edge of the elevator should this prove necessary, The front clips of the elevator fitted over this block, which in turn pulls the leading edge lower.

Elevator

Make the elevator in two duplicate halves. Cut these to shape from two 1/32" thick, 2-7/8" wide and 6-1/4" sheet balsa, as shown in the plans under "Elevator." The grain of the wood should run parallel to the center line of each half wing. Turn to the ribs in the plan, which are shown full size. These are of 1/16" balsa. Four are required for the elevator; two No. 4 and two No. 3.

Cement the ribs in place, as shown in the plans and hold the sheet balsa to them with model pins until dry. Join the halves together with a 2" dihedral. Flatten the underside of the leading and trailing edges between ribs No, 3, as shown in the edge view. Two pieces of No. 6 piano wire from each of the two necessary elevator clips. Note these in the plans under "Elevator Clips." These are bent and attached exactly the same as the wing clips of last month's model. Cement them in place on the elevator, which completes this part.

Wing

The wing, like the elevator, is made in two duplicate halves. Its basic construction is the same as the elevator. Each half is cut from sheet balsa measuring 1/32" thick, 4" wide and 13-1/4" long, Note that both the leading and trailing edges are tapered in toward the center of the wing at its tips an equal distance. Each half requires four ribs, which are shown in the plans under "Ribs" as Nos. 1, 2, 3 and 4. Cut the halves to shape, cement the ribs in their proper positions and hold with model pins until dry. The two halves are then cemented together at a 2-1/4" dihedral for each wing tip. A small fin is attached to the center-top of the wing to lend stability. This is shown in the plans under "Fin." Note that it is cut to shape from 1/16" sheet balsa and that its bottom edge must be shaped to fit the curvature of the wing made by the rib No. 1. When completed, cement this fin over the joint formed by the two halves.

Wing clips are bent from No, 6 piano wire, as shown in the plans under "Wing Clip." These are the same construction as those of the elevator and are held in place on the stick as described in the October issue. (See October issue, Pages 9 and 11, Figs. 3 and 1).

Propeller

FIG. 1

Mr. Grant has elected to use a left hand propeller on this pusher model. Usually when only one propeller is used on a model, it is a right hand propeller. This means that the propeller turns clockwise when viewed from the rear or concave side of the blades. In other words, it is wound in a counter-clockwise direction and when released, it travels in the same direction the hands of a clock turn.

When a propeller turns counter-clockwise, when viewed from the rear or concave side of its blades, it is known as a. left hand propeller. In other words, it is wound in the same direction as that in which the hands of a clock turn, but when released, it travels in the opposite direction to those of a clock.

This explains the left and right hand propeller, but has nothing to do with a pusher or tractor propeller. As far as the actual propeller is concerned, there is no difference whatever between a pusher and tractor. Both are carved in exactly the same way. Both are mounted with the concave side of the blades trailing. In other words, when viewing the propeller from behind the model, you will always see the concave sides of the blades,

The only difference between a tractor and pusher propeller is that the hook of the propeller shaft extends out from the hub of the propeller on different sides. The shaft of a tractor propeller extends out from the hub on the concave side of the blades. The shaft of a pusher propeller extends out from the hub on the opposite or convex side of the blades. A tractor propeller can be changed into a pusher propeller by simply changing the propeller shaft so that the hook of the shaft is on the other side.

The carving of a left hand propeller is not a necessity for this model. A right hand propeller will serve quite as well if the shaft is inserted from the opposite side. However, a left hand propeller should be carved for this model, in order to be able to wind it by hand clockwise the same as right hand tractor propeller is wound clock wise.

The carving of such a propeller is exactly opposite to that of a right hand propeller. This is shown in the illustration Fig. I, which shows the start of carving one. The first cuts are made along the left top edge of the blank, as shown at "A," while a right hand propeller would be started at the right top edge, as shown at "B." All actual carving steps are the same, after the blades have once been started as at "A."

Bend a propeller shaft from No. 13 piano wire and insert it as you would a right hand propeller so that the hook is on the concave side, and the job is finished.

Assembly

Study the plan under "Side View." Bend an "S" hook from No. 13 piano wire. Six strands of 1/8" flat rubber are used for the motor. Obtain a piece about twelve feet long, tie its ends together and loop it into six strands between the "S" hook at the end having the nose hook and the hook of the propeller shaft. The clips of the elevator and wing are then placed around the stick and held with rubber bands, as explained in the last article in the October issue. Place both these surfaces exactly as shown in the plans.

Hand wind the motor for trial flights and launch it as shown in the illustration Fig. 2

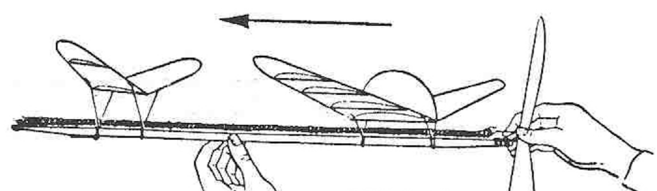


FIG. 2

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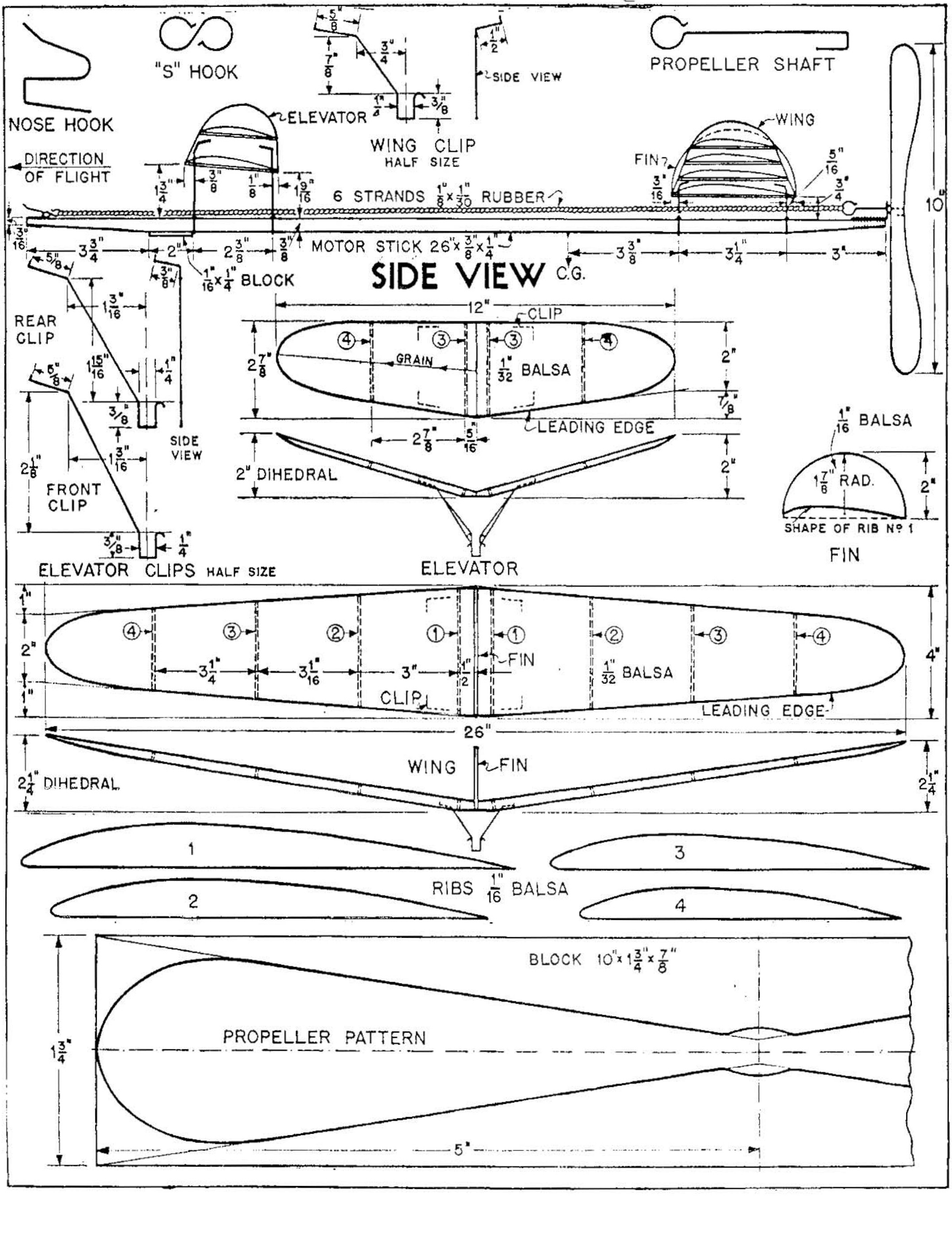
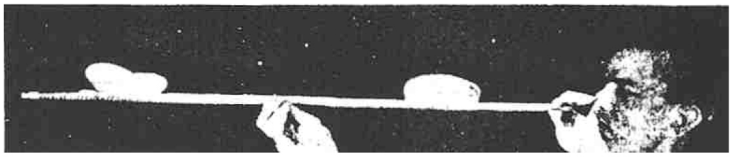

NOSE HOOK
"S" HOOK
WING CLIP
HALF SIZE
SIDE VIEW
PROPELLER SHAFT
ELEVATOR
WING
FIN
DIRECTION OF FLIGHT
6 STRANDS 1/8" x 1/30" RUBBER
MOTOR STICK 26" x 3/8" x 1/4"
1/16" x 1/4" BLOCK
SIDE VIEW
C.G.
10"
REAR CLIP
FRONT CLIP
SIDE VIEW
ELEVATOR CLIPS HALF SIZE
12"
CLIP
GRAIN
1/32" BALSA
LEADING EDGE
2" DIHEDRAL
ELEVATOR
1/16" BALSA
1 7/8" RAD.
SHAPE OF RIB No 1
FIN
FIN
1/32" BALSA
CLIP
LEADING EDGE
26"
WING
FIN
2 1/4" DIHEDRAL
RIBS 1/16" BALSA
BLOCK 10" x 1 3/4" x 7/8"
PROPELLER PATTERN
5"

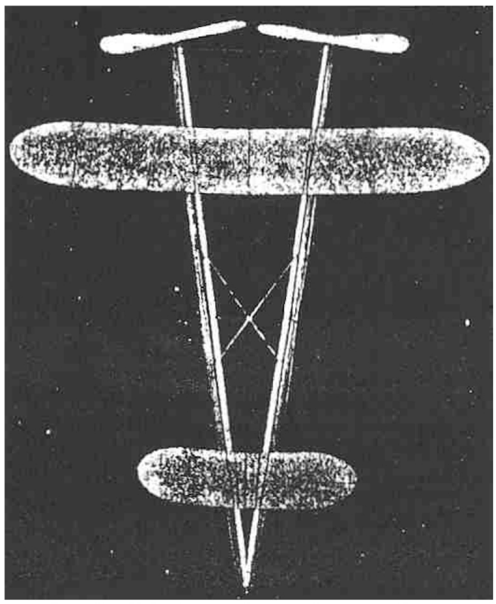
Fundamentals of Model Airplane Building

A Complete Course for Beginners Who Wish to Become Expert. How to Build an All Balsa Twin-Propeller Pusher Model—Part No. 8

By EDWIN T. HAMILTON



This is the best way to launch the twin pusher



The completed all-balsa twin pusher ready to go places

AS OUR eighth airplane model of this series, Mr. Grant has designed the first twin-propeller pusher to appear in this course. As will be noted, we have kept solely to all-balsa models to date and so the one shown here continues that type of plane. This is done as part of a set program, to fully acquaint the beginner with all types of flying models of solid construction before taking him into the more difficult field of built-up construction.

One of the most outstanding features of this model is its exceptional soaring ability which permits it to continue in flight long after normal propulsion by motor has ceased. On test flights, it has remained in the air over two minutes and flown a distance of two thousand feet.

With these unusual flying qualities, it nevertheless is of such simple construction that the amateur can easily build it. The use of solid balsa wings eliminates the tedious operations of built-up framework, which necessitates a large number of ribs, intricate assembly and the covering of the structure with tissue.

It represents the logical step toward contest models of like type and the beginner should find it a stimulating and interesting building problem without the usual expert workmanship being required. Flying the model will bring its builder experience which will prove not only valuable but absolutely necessary when tackling the launching, flying and handling of contest planes.

It must be kept in mind that the whole worth of this course is to develop the rank amateur into a well grounded, well informed expert. The entire course has been laid out by your editor, Mr. Grant and the writer on this basis. Don't shirk ... don't "skip," and you'll find that we have lived up to the usual standards of UNIVERSAL MODEL AIRPLANE NEWS in giving its readers only the best.

A-Frame

In a twin-propeller model of this type, the fuselage is known as the "A-Frame." This is because it is built to the general lines of a capital "A." Such models are often referred to as "twin-stick pushers." They are essentially outdoor models and have set up some of the finest flight records known in the model airplane field.

Two balsa sticks, measuring 1/4" square and 36" long, form the framework of the fuselage. These are joined together at the front end and spread apart at the rear or trailing end, by wire. Cut two sticks to this size, sandpaper each carefully and test to see that both are exact duplicates.

A miter joint is cut at one end of the sticks, so that when they fit together, the trailing or opposite ends will be exactly 10" apart when measured from outside to outside of the sticks. This can be seen in the plans under "Top View." Lay both sticks in proper position and then cement their front ends together. Before applying the cement, squeeze the front beveled ends together and then measure the distance the rear ends are apart. If they are 10" from outside to outside,- or 9-1/2" from inside to inside, the beveled ends may be cemented together. Hold them in place with a model pin or a rubber band until the cement dries.

Four piano wire braces are used to hold the frame in proper form. The two cross braces and the combination cans and center brace are all bent from 1/32" diameter wire, which is approximately a No. 13 piano wire. The trailing end brace because of added stress, should be bent from 3/64" wire. This is about a No. 21 gauge. If you cannot purchase wire of this diameter, do not use any of less diameter than a No. 16, which is .037".

Bend the two cross braces, as shown in the plan under "Cross Braces." This plan is given full-size except for its length which had to be cut down. It is 7-1/2" long from bend to bend, as shown.

The third bracing wire which is bent to form a "can" on each end is shown under "Cans" in the plans. This is full-size. Cans are used to keep the rubber in place against the sticks and Mr. Grant has designed this combination brace and can to cut down operations and weight.

The last brace is located at the trailing ends of the sticks. It is bent from a 10-1/4" long piece of 3/64" diameter wire. Both of its ends are bent for a distance of 3/8" which leaves 9-1/2" of its length straight. This is shown in the magnifying-glass view in the plans under "Top View."

When all these wires have been bent to shape, they are assembled on the A-frame. The trailing brace should be attached first. As a thread binding is used around its bent ends and the propeller bearings of the model, the latter should be attached at the same time.

Obtain two propeller bearings of good size. These are cemented to the outer sides of the sticks, while the bent ends of the brace are cemented to the inner sides. When all are in place, bind the bearings and the ends together with thread and apply a thin coat of the cement over the thread for added strength. Note this assembly in the magnified view of the plan under "Top View."

The two cross braces are now cemented in place. Note that their bent trailing ends are lashed to the inner side of the sticks 14-1/2" from the trailing end of the A-frame. Cement and lash the four bent ends of these two braces in place. The brace having the cans on its ends, is located 18" from the trailing end of the assembly and crosses the two cross braces at the point where they cross each other. Mark a point 18" from the trailing end on each stick, pass the bent notch on each end of the brace over the sticks, cement and then bind with thread. Cement is applied over all thread bindings for added strength. Complete the brace assembly by binding all three of these center braces together at the point where they pass each other in the center of the frame.

A nose hook, which is shown in the plans full-size under "Nose Hook," is bent from No. 13 piano wire. This holds the "S" hooks of the motor and at the same time strengthens the nose joint formed by the two sticks. After bending to proper shape, slip it over the joint of the two sticks and cement firmly in place. It is then bound with thread, which is given a thin coat of cement over its top to add strength.

Up to this point we have not spoken of the top or bottom of the stick. As the curved bends in the cans are to hold the rubber strands of the motor, the opened side of these cans must be the upper side of the frame. The frame is completed by cementing two small blocks on the side of each stick.

These blocks are shown in the plans under "Top View" in the upper left-hand corner. Cut two blocks measuring 1/8" thick, 1/4" wide and 2-1/2 long. Cut two additional blocks 1/16" thick, 1/4" wide and 1" long. The long blocks are cemented on top of the sticks 4" from their leading, or "nose" end. The smaller blocks are then cemented on top of these long ones with the leading ends of both flush with each other. This completes the A-frame.

Elevator

The elevator consists of a single sheet of 1/16" balsa with four ribs of the same thickness. Square up a sheet of the balsa to measure 1/16" thick, 3-1/2" wide and 14" long. From each end, measure in 3-1/2" and lay out the curves of the tips. Cut these to proper shape. Finish smooth with sandpaper.

The elevator is now cut through its center into two halves of equal length. Cut four ribs from 1/16" sheet balsa, as shown full-size in the plans under "Elevator Rib." Note their location in the plan under "Elevator." Apply cement to the ribs, bend the elevator carefully to fit their curves and attach them in place. Hold with model pins until the cement has hardened.

The two completed halves are now cemented together with a 1-3/4" dihedral at each tip. When perfectly dry, complete the elevator by carefully sandpapering its entire surface. As rubber bands are used to hold it in place on the A-frame, no metal fittings are required.

Wing

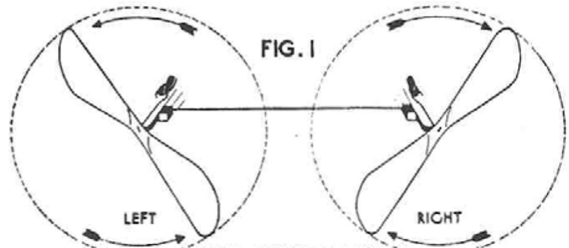
The wing is of the same construction as the elevator. It differs very little from other all-balsa wings given for other models in this course. It is made of two pieces of 1/16" sheet balsa. Square up two pieces to measure 1/16" thick, 4-1/2" wide and 16-1/2" long. Measure 4-3/4" from one end of each piece and lay out the curve of the wing tip, as shown in the plans. Cut these to shape.

Cut to proper form eight wing ribs from 1/16" sheet balsa. The rib is shown in the plan full-size under "Wing Rib." Note the location of these ribs in the plan under "Wing." Apply cement to the ribs' curves, carefully bend the sheeting around each, and hold with model pins until dry and hard.

The two halves are now cemented together to give a 1-3/4" dihedral at each wing tip. When hard, reinforce the joint by cementing leading and trailing edge pieces to the underside of the wing. These measure 1/32" thick, 3/8" wide and 7/8" long, or the distance between the two center ribs, Bend them slightly at their centers and cement them in place between the ribs on the underside of the wing at its leading and trailing edges.

Finish the wing by carefully sandpapering its entire surface to a satin finish. As the wing also, is held by rubber bands to the A-frame, no metal fittings are required in its construction.

Propellers



TWIN PROPELLERS

In the November issue, our first pusher model called for a left-hand propeller, the use, carving and difference of which was fully explained, When two propellers are used on a model, they must be so made as to turn in opposite directions, so that the directional pull of the one will offset that of the other. For this reason, twin propeller units are always made up of one right and one left propeller. On twin - propeller pushers such as the one we are building, the propellers are so mounted that each will turn up and out, as shown in Fig. 1. In this view the eye rests on the concave side of the propeller's blades.

All the models having propellers in this course have had right-hand propellers with the exception of last month's model, which was a left-hand propeller. It will not be necessary, therefore, to repeat carving instructions for the propellers required for this model. From blocks measuring 1" thick, 1-3/4" wide and 10" long, carve one right-hand and one left-hand propeller. Equip them with propeller shafts bent from 1/32" piano wire, (No. 13). These shafts are shown in the plan full-size under "Propeller Shaft." Complete the assembly by adding two shaft washers to the propeller shafts and then place them in position on their bearings.

Motor

Twin motors for the twin propellers are used on such models as this. Each of these consist of eight strands of 1/8" x 1/30" rubber. As considerable "play" should be allowed for added power, the original length of each motor should be at least 288" long or 24 feet. Tie the ends of each piece together to form a single loop.

From No. 13 piano wire, bend two "S" hooks to shape, as shown in the full-size pattern, in the plans under "S" Hook. Hook one end of each over the nose hook and then pass four loops of the rubber motor over the other ends. Weave the rubber strands through the cans and loop their other ends over the propeller shaft hooks, which completes the motor assembly.

Assembly

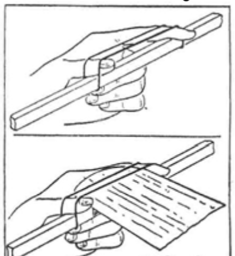


FIG. 2

With the assembly of the motors completed, we have only to add the wing and elevator to our A-frame to complete the job. Both these units are held with rubber bands. Two bands are used for each. Note how this is done in Fig, 2. Locate the trailing edge of the wing 6" from the trailing ends of the sticks and fasten in place on top of the frame with the bands,

The elevator has its leading edge resting on the lower of the two frame blocks, 4-1/2" back from the nose. Attach in this position with two bands as shown.

When flying the model, launch it in the manner shown in the photograph. It will be found best to hold the propellers with one hand and steady the model with the other rather than using the old method of "pushing" the model from you with both hands on the propellers.

If more elevation is required the elevator may be thrust forward until its leading edge is on top of the second and higher elevation blocks.

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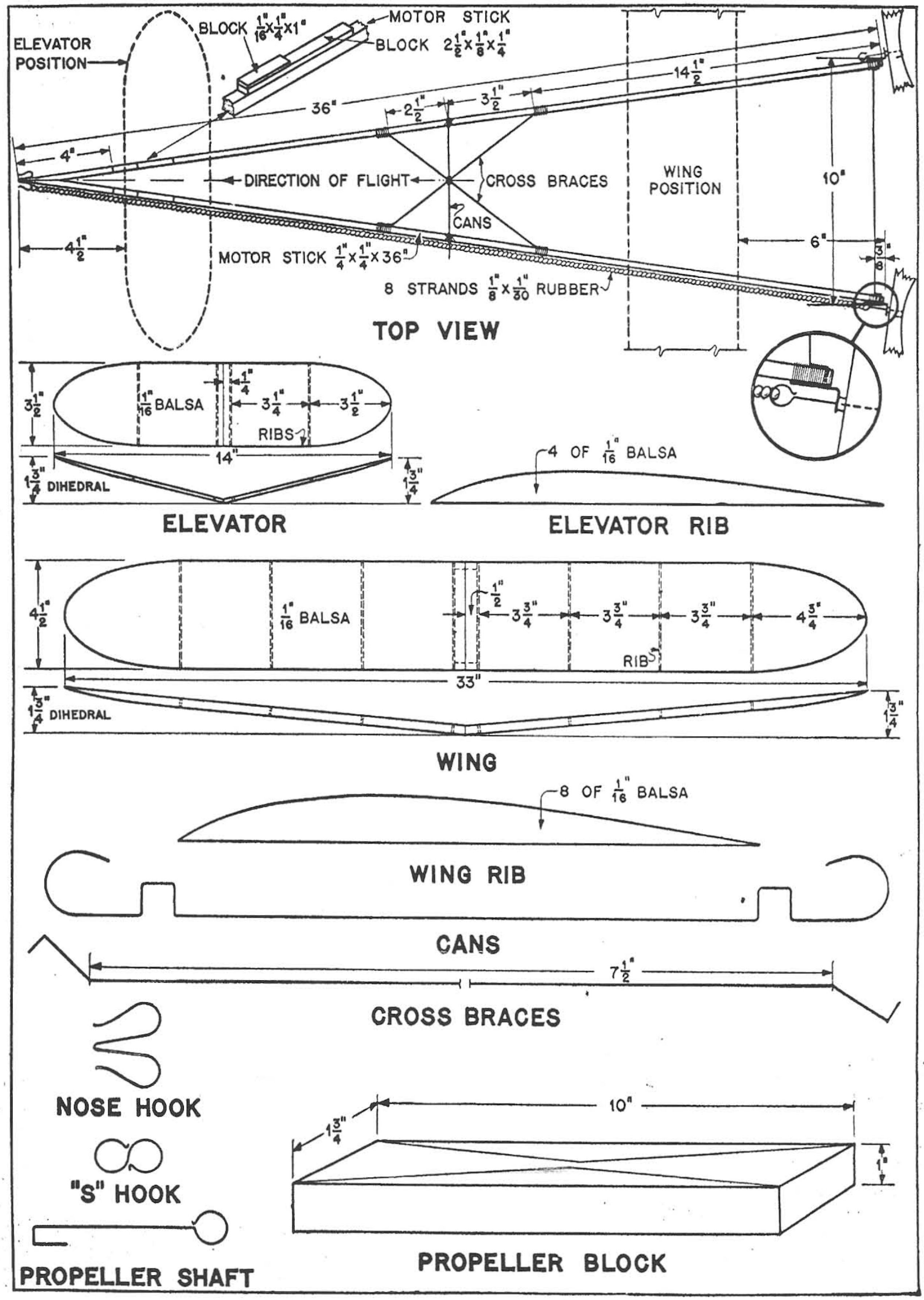
Universal Model Airplane News


ELEVATOR POSITION
BLOCK 1/16"x1/4"x1"
MOTOR STICK
BLOCK 2 1/2"x1/8"x1/4"
36"
14 1/2"
4"
2 1/2"
3 1/2"
DIRECTION OF FLIGHT
CROSS BRACES
CANS
WING POSITION
10"
6"
3/8"
4 1/2"
MOTOR STICK 1/4"x1/4"x36"
8 STRANDS 1/8"x1/30" RUBBER
TOP VIEW
3 1/2"
1/16" BALSA
1/4"
3 1/4"
3 1/2"
RIBS
14"
1 3/4" DIHEDRAL
1 3/4"
ELEVATOR
4 OF 1/16" BALSA
ELEVATOR RIB
4 1/2"
1/16" BALSA
1/2"
3 3/4"
3 3/4"
3 3/4"
4 3/4"
RIB
33"
1 3/4" DIHEDRAL
1 3/4"
WING
8 OF 1/16" BALSA
WING RIB
CANS
7 1/2"
CROSS BRACES
NOSE HOOK
"S" HOOK
PROPELLER SHAFT
10"
1 3/4"
1"
PROPELLER BLOCK