

GULFHAWK

By
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At first glance the model cannot be distinguished from the real ship.

THE air-minded youngsters of to-day invariably visualize a trim, speedy plane when associated with Major Al. Williams, who has a most enviable record with fast ships.

The latest Williams Gulfhawk is the Grumman G22, built especially for him. This amazing little ship is powered with a Wright, single-row Cyclone of 1,000 h.p. and has a top speed of 290 m.p.h. The G22 differs only slightly from the navy fighter.

The beautiful color scheme of orange, striped with blue and white, stands out under almost any light condition and can easily be one of the handsomest models to grace your collection.

The model has been designed carefully to preserve the sleek lines and features. It is extremely fast and stable with the proper adjustments made.

FUSELAGE

Cement the two $1\frac{1}{2} \times 3 \times 18$ " soft blocks together, with several drops near the center so they may be separated later. Trace the side view of the fuselage, less cowl, onto one side of the block so that the bottom curve is at the edge. The block will not be quite high enough at the top, so saw along the bottom curve and cement the remaining piece to the top. Then complete the side-view blank. (A larger block combination may be used if desired.) If the top and side views are traced onto thin cardboard and cut out for templates, marking the lines on the soft wood will be made easier. Draw the top view onto the top face, using the joint between the blocks as a center line and saw away the surplus.

Now sand the blank to smooth the irregularities of the saw cuts. Start carving at point C, otherwise the blank is likely to be spoiled. Cut templates of cardboard of A, B, and C to aid in the final shaping. After carving closely as necessary, sand the remainder of the wood away. It is important now to dope and sand the fuselage.

The next step is to hollow the wheel depressions, or landing-gear wells. A cardboard template of the outline will insure getting both sides alike. Carve the wheel wells $\frac{1}{4}$ " deep and the strut wells $\frac{3}{16}$ " deeper. Sand and dope until glossy.

Split the blocks apart and hollow the halves. A spoon-shaped tool (page 56, October AIR TRAILS) is the best for this purpose, or a thin double-edged razor blade,

broken in half lengthwise—the ends of one half bent back and inserted $\frac{3}{8}$ " apart in an improvised handle—will do.

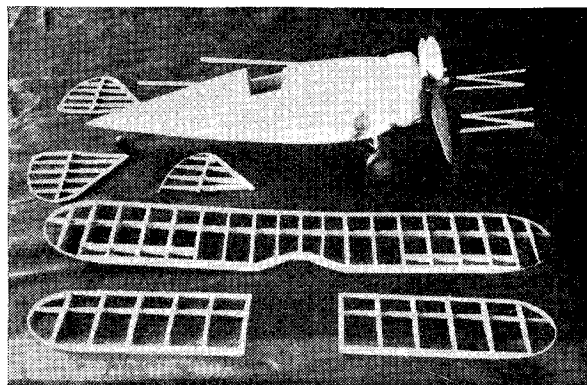
Carve to paper thinness back of the rear hook position and gradually increase the thickness to $\frac{1}{8}$ " at the front. Leave plenty of thickness around the wheel wells. A $\frac{1}{16}$ " sheet bulkhead should be fitted in halves at point C. Insert the snakelike rear hook with plenty of cement just at the time the two halves of the fuselage are being cemented back together.



A greatly enlarged flight photo.

COWL

From the remaining square end of the fuselage block, saw off the necessary length for the cowl. Carve and polish and then hollow it. The motor block is merely a $\frac{1}{4} \times 2$ " disk with the cylinder detail done in base-relief. The 9 cylinders are laid out, carved, sanded, doped and lacquered black. The fin impressions are then made by closely spaced knife cuts. The push (Turn to page 92)



The hollwed balsa fuselage affords the strongest and most realistic construction. The entire job is remarkable for its simplicity.

AIR TRAILS

MODEL DESIGN

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Because of the fact that standard wings have air-tight covering, there is no interchange of air from lower to upper through the wing proper; so we obtain the full benefit of the wing section. The moment we do interchange air—that is puncture the wing full of holes—the efficiency drops very low as the pressure differentials are equalized. We have this exchange of pressure at the tip. It is natural for the compressed air to try to roll around the tip into the rarefied upper portion. There is very little we can do about it except try to make this loss as small as possible. We could sort of fence the areas by tip fins, but they bring in so many other problems that it was found best to forget them and concentrate in shaping the tips so as to cause minimum loss.

It can readily be seen that if the wing was spanned way out into the Milky Way with a very gradual taper, we would have an almost perfect wing. However, under the circumstances, the best we can do is to taper the wing to a fairly small section at the tip, so that the pressure differentials will be small and consequently have a lower tip loss. Designers don't mind very much the lift they lose by having square tips, as they only need to add a few extra square feet to compensate. What they do resent and object to very strongly is the immense disturbance square tips produce. The square tip allows the lower compressed air to whirl around the tip in a big mass into the upper portion. This mass movement naturally messes up the air in the surrounding area, with the result that the ailerons are in shifting air flow, while the power used to pull the airfoil is wasted in churning the air.

There is no reason why square tips should be used on models. Besides having poor aerodynamical efficiency, the structure is also weakened. A rounded tip gives a good base for covering and strengthens the structure. Start to round the tip about two tip chord lengths from the tip. It is hoped that you notice the mention of air-tight covering used on power ships. Be sure to follow suit on models when doping. If the framework is too weak to take regular dope, try to plasticize it with castor oil.

Coming back to the airfoil forces, last month's diagrams showed how the lift was concentrated at the leading edge at high angles and at the trailing edge at low angles. If we were to find the center of all these forces, the place of this point would be as shown on Drawing 4 for different angles. Notice how it moves. The center of these lift forces is known as center of pressure (C.P.).

The airfoils that have considerable C.P. movement are known as unstable sections.

The so-called unstable sections are usually those that have flat or undercambered bottom portion; the greater the undercamber, the greater is the C.P. travel. This can be easily explained by the fact that the downward droop of the trailing edge still produces lift, while the front portion is way below the zero angle.

The stable sections are those whose trailing edges have an upward swing, such as the M-6. Such airfoils are noted for zero lift at zero, or slightly negative angle of attack, as they present a streamlined form to the air flow. The modern airliners use such airfoils because of low drag. However, it is to be remembered that when they land, the flaps down produce a highly undercambered airfoil with resultant tremendous lift.

For model work, the so-called unstable airfoils are best because of their high lift characteristics. This unstable situation is easily remedied by using large stabilizers, which keep the wing within a fixed angle border.

Before the action of the stabilizer is detailed, we must bring in another force which the stabilizer takes care of to a certain extent. To obtain lift, the wing is forced through the air. Consequently, we get an opposition to this forward motion. This is technically known as drag. This drag is overcome by forward pull or thrust of the prop. Although the drag is thus equalized, it still has to be controlled or it will upset the ship. If the prop thrust was right through its center we would have no reason for worry, but since such alignment is rare we must make adjustments to counteract it. A force diagram showing this new addition is shown in Figure 5. Note how the rotation direction changes when wing positions are rearranged.

Combining the drag and lift forces we now have a force diagram as shown in Figure 6. The degree of these forces naturally changes with angles of attack. The diagonal shows the direction of the motion. Although the airfoil does not move into this direction, we can assume the forces take this road and that the direction of the wing would move if it were suddenly cut loose from the ship. This direction is very important to keep in mind, as the whole longitudinal stability treatise depends on knowing just where it is in respect to the center of gravity—C.G. from now on.

With the direction of the force line settled we can see what happens when the angle of attack changes the C.P. (such as in changing incidence). In a normal flight, with no load on the stabilizer, the line projects right through the C.G. as shown. Note how

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rods are broom straws, ignition ring $\frac{1}{16}$ " aluminum tube and the wires thread. After all detail has been added, cement the motor into the cowl. A removable nose plug shaped like the crankcase is then added.

LANDING GEAR

A serviceable landing gear, closely resembling scale, can be made from aluminum tube pinned together, or a less pretentious one of music wire will do. The one on the original model is automatically released, but is too complicated for the average builder to tackle without cussing.

WINGS

Build the wing frames on the drawings laid on a flat surface. Before removing the top frame, crack the frames at the second $\frac{1}{16}$ " ribs, raise the tips $\frac{1}{2}$ " with blocks and cement the cracked

members. Carve a pair of fillet blocks with which to attach the lower wings to the fuselage.

TAIL SURFACES

Assemble the tail surfaces with plain unshaped stock as designated on each member. Then sand to the required streamline shape.

PROPELLERS

Both scale- and flying-propeller designs are included on the drawing. Cement three blocks together, with the center lines 120 degrees apart. Then blank and carve in the usual manner.

FINISHING

Cover the wing and tail frames with orange tissue and attach them to the fuselage. Attach the top wing first by using a $\frac{1}{8}$ " sheet block shaped like the space between the fuselage and the center section. Pin the block to the fuselage and then the wing to the block. In this manner the center struts can be accurately fitted so the wing will have zero incidence. With the top wing in

place, it is an easy job to fit the N struts and the bamboo rigging wires. Spray the tissue lightly with water and when dry, apply thin model dope.

FLYING THE MODEL

Power the model with 3 loops of $\frac{1}{8}$ " flat lubricated rubber. Make the first flight tests in tall grass until a fully wound flight has been made. Stretching and winding the motor will give improved endurance.

LIST OF MATERIALS

Blocks	Miscellaneous
2 $1\frac{1}{2} \times 3 \times 18$ "	1 oz. cement
3 $\frac{3}{4} \times 1 \times 3$ "	2 oz. clear dope
1 $\frac{1}{32} \times 2 \times 18$ "	1 oz. orange lacquer
1 $\frac{1}{16} \times 2 \times 6$ "	2 dm. blue lacquer
1 $\frac{1}{8} \times 2 \times 9$ "	4 dm. white lacquer
1 $\frac{1}{4} \times 2 \times 2$ "	1 sheet orange tissue
	3x4" sheet celluloid
	12x $\frac{1}{16}$ " alum. tube
	6x $\frac{1}{8}$ " alum. tube
1 $\frac{1}{16} \times 3 \times 18$ "	1 $\frac{1}{16} \times 1\frac{1}{4} \times 10$ " bamboo
2 $\frac{1}{16} \times 1\frac{1}{8} \times 18$ "	12" #12 music wire
1 $\frac{3}{32} \times 3 \times 18$ "	60" $\frac{1}{8}$ " flat rubber
2 $\frac{1}{8} \times 1\frac{1}{8} \times 18$ "	