

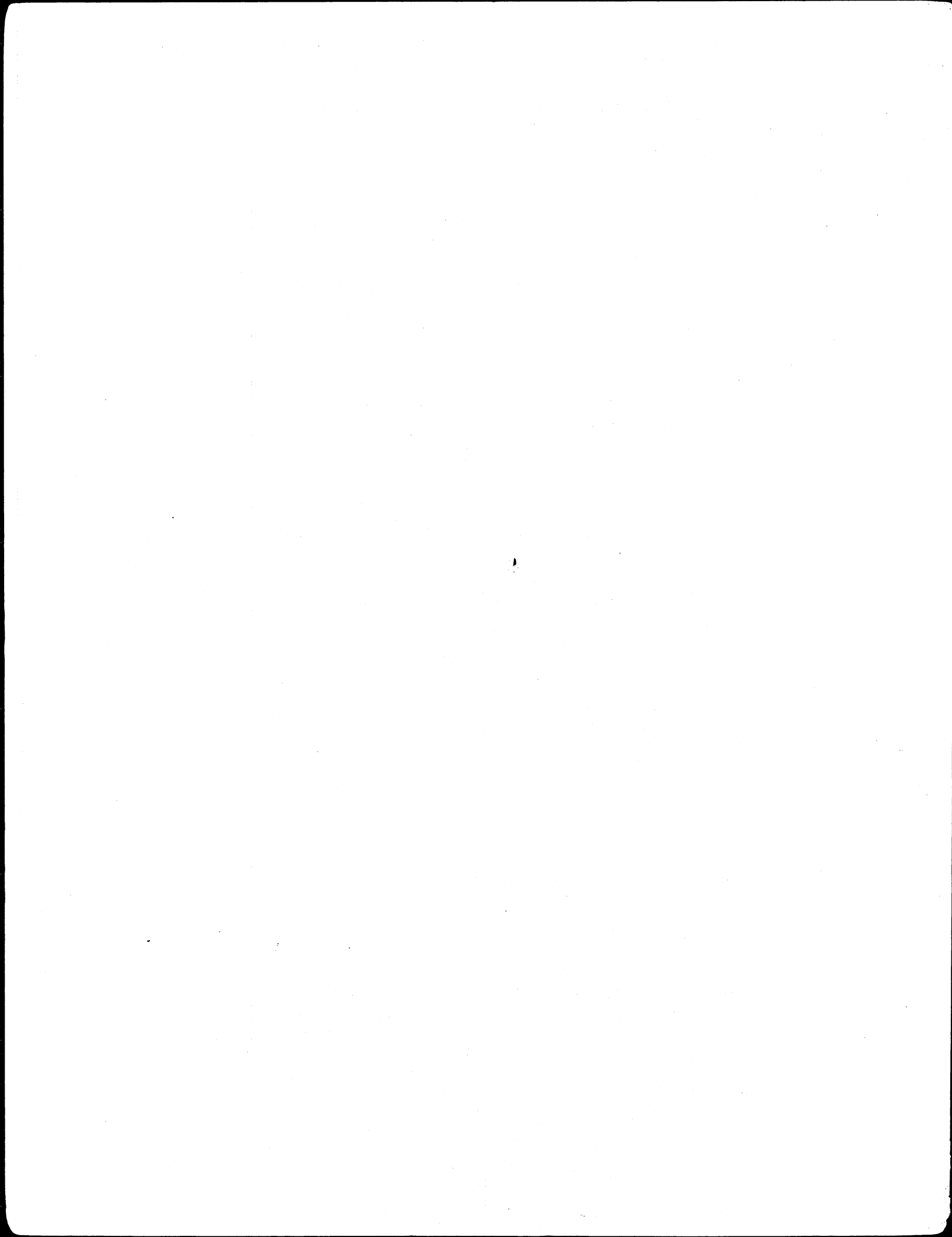
# HOW TO GET STARTED IN **MODEL BUILDING AND FLYING**

**\$2.**

- **ILLUSTRATED METHODS**
- **EXPLANATORY TEXT**
- **PLANS TO BUILD**
- **DETAILS  
AND DATA**
- **FLYING  
INSTRUCTIONS**







# Introduction:



The beginning for each new builder has always been hard. There are too many things to find the answer to, and too few to give the advice that is needed.

Your hobby dealer tries his best, but as often as not, all he can do is gesture with his hands on how to cover a model, build a wing, or adjust for flight. All this while he has to wait on others too.

We feel the information, data, drawings and designs contained herein, taken from the pages of *Flying Models*, will fill much of the new builder's quest for this needed knowledge, with the answers all bound together in this reference manual, and with projects graduated in complexity.

Fifty five features cover the field, from the most elementary glider and its structural details, to the beginnings of radio control. As many subjects as possible have been covered and profusely illustrated. No one book can cover everything, but we do feel that most of the major trouble spots in each new builder's career, are dealt with in detail. By studying the designs and text, and building those you feel the need for, you will advance rapidly in model building skill, and soon be able to tackle more complex and intriguing designs.

You will find much help along the way. As you progress, so will your new friendships with other model builders. The model magazines too, will become a source of information.

And you will learn to count heavily on the hobby dealer. He will keep you supplied, order for your special needs, and interchange ideas at every opportunity. There is much to learn, but all of it is fun, it is a hobby to take pride in. It will develop your latent skills, excite your mind, give you pride of accomplishment, new friends across the nation, fresh air in abundance, and no end to your future.

Many top notch designers have contributed to the material in this book, and their work reflects also the progress of thousands of other builders who have designed before them, helping to develop the various types of models. Some of these designs are outdated as far as rules and competition are concerned, but each in its way contributes something to the overall picture.

As you become engrossed in the hobby, always remember that there are no limits to what you can design. The perfect model has yet to be built. Can you do it?

*The Editors*



HOW TO GET STARTED IN

# MODEL BUILDING AND FLYING



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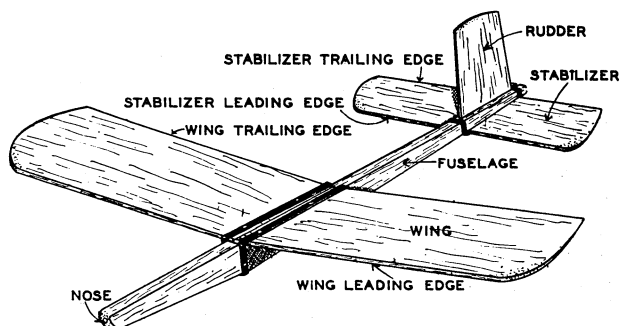
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# GETTING STARTED

## *in model aviation*

● If you're a newcomer to the field of model aviation, you'll be glad to know that building and flying model planes is not complicated. Just begin right, with the simplest types of planes. As you get experience, you'll be able to take in your stride the more intricate details involved in building and flying bigger planes. And, before you know it, you'll be right alongside the experts.

A model airplane consists of five basic sections: (1) The wing; (2) The body, or fuselage; (3) The rudder; (4) The stabilizer; (5) The power plant, or motor.

**KINDS OF MODEL AIRPLANES:** The simple, basic, easy-to-build, hand-launched glider has all of these parts except a power plant. A glider's power comes from the force exerted by your own arm when launching it, and its design uses the air currents to keep it soaring and floating in flight. By building a simple hand-launched glider, you can learn all the rudiments of flight.

Rubber-powered stick models with sheet balsa wings (called R.O.G.'s, since they rise off the ground rather than being hand-launched) are the next step for the new model builder. R.O.G.'s are the simplest models to build which have their own motive power.

These two model types form the basis for all of the larger and

**Presenting the simple, basic data needed for building and flying your own model planes.**

more complicated models that you can build as you progress in the hobby. More advanced models include built-up rubber-powered stick and cabin duration types and flying scale replicas, built-up soaring tow-line gliders, and gas-engine powered free-flight designs.

Engine-powered control-line models are also well up on the list of the more advanced types. These include flying scale models (which are built with a great deal of emphasis on authentic reproduction of the real aircraft), speed models (which require considerable skill in using the power plant to its utmost advantage), and control-line stunt models (which are quickly assuming a very popular place in model flying since they are capable of almost all the aerial maneuvers that real aircraft can perform).

Finally, you will arrive at the real test of your ability—building and flying original designs.

Another popular type of model which, however, cannot fly, is the solid-scale replica. These are scaled-down versions of real airplanes. Authenticity of solids depends upon the amount of detail designed into them. Some replicas



made by advanced modelers are carbon copies of the full-size plane and, when photographed, can hardly be distinguished from the real plane.

**KITS:** Model airplane manufacturers today cover the field of model aviation in a very thorough manner. You'll find their products advertised in magazines, and at local Hobby Shops. Their planes, available in kit form, range from the extremely simple inexpensive basic models, to the more costly highly developed original designs which have turned in top-flight contest performances.

Many kits are of the flying-scale type. Naturally the more detailed parts in the kit, the more the kit will cost. Scale detail kits are made for the exacting builder—not for the beginner. Keep this in mind when purchasing kits.

**FULL-SIZE PLANS:** Still another source for models are the full-size plans which can be found in Hobby Shops and purchased from publications. These are inexpensive and by working with them a modeler can gain valuable experience, using wood and materials which he purchases separately.

**TOOLS NEEDED:** Building your model, from either a kit or a plan, requires certain tools. For the beginner, who should build the basic, simple type of plane, the tools will match the plane in simplicity.

First, you will need a wood cutting tool. In the choice of this piece of equipment, a little thought as to what is required will help to decide which of several such items available is finally purchased. The knife must have a

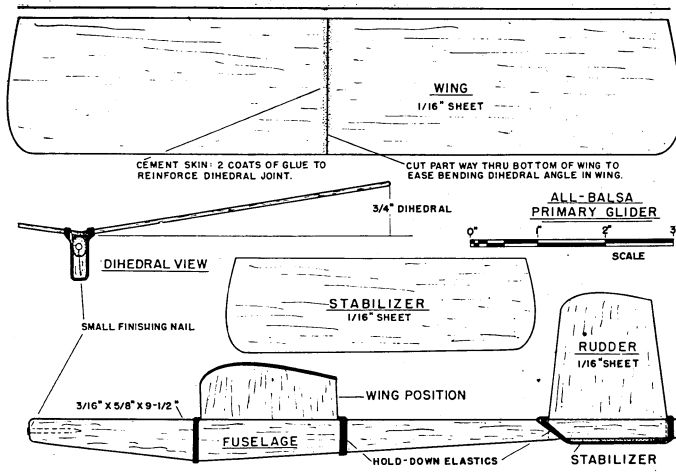
keen edge at all times. It must enable you to make both straight and curved cuts. You will need to do carving with it, and trimming as well.

The benefits derived by using kits are legion. Model airplane kits include plans and necessary construction materials. All irregular parts are printed on the correct size sheet balsa, ready to be cut out or already cut out for you (depending on the price). Covering tissue and building instructions are included and some kits even include the liquids needed to finish the model.

The liquids, such as cement, clear dope, and colored dopes will be found in what are called "wet kits". "Dry kits" do not contain these liquids. Other included items are wire for landing gear (in many cases pre-formed), wheels, nose buttons, hooks which hold the rubber motors, and other miscellaneous hardware items. Deluxe kits contain many items—low-cost kits provide basic materials. As with automobiles, model airplane kits come in price ranges to suit different tastes and pocketbooks.

Remember this though—the lower price kits will, if well built, show to greater advantage than high price kits which are poorly constructed. The manufacturer of a model plane kit designs his product to meet a demand for that particular model in a certain price class. He employs experienced designers, draftsmen, and builders to draw the plans and test the completed ship. Everything possible is done to make the plane easy to construct and fly.

**MAGAZINE PLANS:** Another excellent and important source for fine models are magazine plans.



Another basic tool for the model builder is the straight-edge—a metal rule, or scale, which has a perfectly straight edge. For drawing straight lines and cutting along a straight line, this tool cannot be beaten.

You also need a soft pencil, for marking shapes and lines on balsa wood—a hard pencil will dig in and tear the surface. A couple of soft, camel-hair brushes for applying dope to the surfaces of your models are also needed.

A flat soft pine board, Celotex, or a similar soft wall board, makes an ideal working surface. They are soft enough to take a pin and firm enough to withstand a lot of use. You need such a board to protect your worktable top from damage. Also get a roll of wax paper to place over your plans while building on them, to keep cement from adhering to the plans. This will facilitate the removal of the work from the plan after completion. In addition you'll need a coping saw with finely cut teeth to cut curves in heavier and harder balsa.

As you gain experience and skill, you will want to build more intricate models which call for other tools. A small block plane is handy for trimming to finish size, and for smoothing out the curved surfaces of many model plane sections. For cutting wire, diagonal cutting pliers are needed. Needle-nose and round-nose pliers are excellent for wire bending. A small bench vise, a soldering iron, some small clamps, and a pair of dividers also can be used to advantage on more intricate models.

Your workshop probably already includes many of these tools—the rest can be bought at hardware stores, at most Hobby Shops, or by direct mail.

**WHICH WOOD FOR WHAT?** The use of a kit generally eliminates the need for the selection and purchase of balsa wood. But you must know your building materials if you're using magazine plans. Like anything else, care must be taken in their selection. The right kind of wood must be put into the right place if best results are to be obtained.

Because of its natural characteristics, porosity and lightness, balsa wood is the ideal material for building model airplanes. It grows in Central and South America and is noted for its rapid growth. It differs from the harder domestic woods in that its pores are much more numerous and larger. In addition to making the wood light, the numerous pores act as a sponge and absorb cement, creating a strong bond between joined pieces.

For this reason, it is good practice to follow this procedure when cementing parts together: Always apply a coat of cement to each joining part and allow this cement to become absorbed into the wood. Then, apply another coat to act as a strong binder for the parts.

Balsa wood ranges from rock-hard to very soft. Between these extremes are many grades and variations of softness and hardness. All of these grades are useful if utilized properly. Use the following as a guide in your selection.

#### PART OF MODEL

Wing Ribs  
Leading Edge  
Longerons  
Trailing Edge  
Glider Fuselage  
Motor Stick  
Rudder  
Stabilizer  
Wing Tips  
Bulkheads  
Props  
Spars  
Glider Wing

#### TYPE OF WOOD

Soft, straight grain  
Med.-hard, str. grain  
Rock-hard, str. grain  
Med.-hard, str. grain  
Rock-hard, absolute str. gr.  
Rock-hard, absolute str. gr.  
Med.-hard, str. grain  
Med.-hard, str. grain  
Med.-hard, str. grain  
Med.-hard, quarter grain  
Med.-hard, str. grain  
Rock-hard, str. grain  
Med.-hard, str. grain

Balsa wood has its insect enemies, which dig into the tree while it is growing. When selecting your wood, watch out for tiny holes—they are a source of weakness which may pass unseen and show up when it is too late. At the first strain or impact, the wood will give at the weak spot. Get the finest wood and you'll have strong models.

Balsa is cut into many standard sizes for the convenience of the model builder. Sheets are available in the following thicknesses: 1/16", 3/32", 1/8", 5/32", 3/16", 1/4", 5/16", 3/8" and 1/2". All sizes over 1/2" may be considered as a plank or a block.

These sheets are cut into strips—squares, such as 1/16" x 1/16", 1/4" x 1/4", etc., or rectangular strips like 1/8" x 1/4", 1/4" x 1/2", and so on. All are available at your local Hobby Shop or through magazine advertisers.

#### BUILDING YOUR FIRST PLANE:

Now to get started building model airplanes—to apply the knowledge gained so far from this article and, with just a little care and attention to details, build a basic plane which will fly well.

Study our half-size plan of an All-Balsa Primary Glider and familiarize yourself with every detail of its make-up. Note that the fuselage is 3/16" x 5/8" x 9 1/2" balsa. The outline is completely angular and these lines can be laid out with ruler and pencil. The top of the fuselage is absolutely straight. This will allow the wing to be mounted on a smooth platform.

If you find that the rock-hard balsa used for the fuselage is difficult to manage with your cutting tool, your coping saw will ease the operation for you. Cut outside of the outline and use a sanding block with No. 1 sandpaper to finish down to the line.

Now is the time to make yourself a good sanding block. Use a 1/2" balsa plank, 2" wide by 4" long. Round off one edge of the plank and leave the other three edges at right angles (see Figure 1). The rounded-off part of the block is

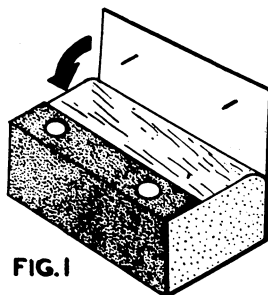


FIG. 1

used for sanding any concave surfaces and the procedure is to hold the block at an acute angle and sand with the rounded surface.

When the block is finished, fold the sandpaper around it. Do not overlap the ends. Just have the paper even at both ends of the block. A couple of thumb tacks will hold it firmly on the block and paper changes can be made easily.

After the fuselage outline has been sanded, use your knife to remove the outer corners, as shown in Figure 2. Many model builders use single-edge razor blades for this job. Leave square the portions of the fuselage where the wing and stabilizer rest.

After trimming the corners, use the sanding block with 2/0 sandpaper, and finish all four corners of the fuselage to a smooth radius. Then form the nose of the fuselage to a nice even contour.

To complete the fuselage, use your coping saw to cut the rudder slot in the tail end. This slot (shown in Figure 3)

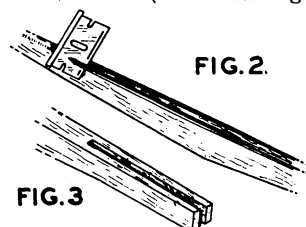


FIG. 2

FIG. 3

should be about 1/8" longer than the base of the rudder. The additional length is needed to receive a rubber band to hold down the stabilizer. The same rubber band will keep the rudder firmly in place.

Use tracing or wax paper to mark the outlines of the wing, rudder, and stabilizer onto a piece of 1/16" x 2" sheet balsa. Use the wood requirement chart in this article to select the right grade of wood.

Trace wing in one piece. Cut from the sheet and sand all edges, as well as the top and bottom of the wing. The leading edge and the wing-tip outlines should be nicely rounded. Use 3/0 sandpaper on your block.

After sanding, draw a center line across the bottom of the wing and cut along this line with a razor blade. Use the straight-edge as a guide and cut only half way through the wood. Now make a dihedral block from scrap balsa

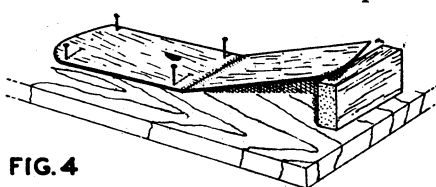


FIG. 4

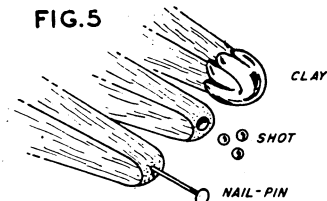
(Dihedral is the upward slant of the wing panels outward from the fuselage. Its purpose is to furnish stability in flight). The length of this dihedral block should be 1 1/2", or the total of the dihedral of both wings.

Hold one half of the wing down on your work board with the cut section on the bottom. Gently bend the other half upwards. The bend should take place at the partially cut section on the bottom.

You will find it necessary to crack the wing slightly to get the correct angle. Raise the tip of the wing just enough to insert the dihedral block beneath the tip of the wing (see Figure 4).

Now cement along the cut on the underside of the wing and pin one wing half down onto the board over a piece of wax paper. Pin the dihedral block into place under the other wing tip. Next apply two coats of cement across the crack on top of the wing. See reference to this point in the top-view drawing of the full-size parts. When the glue has set firmly, the wing can be removed

FIG. 5



from the work board. The rudder and stabilizer are cut out next and finished in the same manner as the wing.

When all the parts have been finished, sand them to a fine smooth finish. Then apply two coats of *thin*, clear dope. Because clear dope has the tendency to warp thin wide sections, it is good practice to hold such parts absolutely rigid and square between the fingers of both hands while they dry.

Light, strong elastic bands are used for assembling the glider. The wing and stabilizer are affixed at the points shown on the side view of the fuselage. After assembly, hold the glider at eye level and check to see that all surfaces line up (as in the front view on the plans) and are at right angles to the fuselage when viewed from the top. Should a part be out of line, insert slivers of balsa at the proper places until they are properly lined up. Then cement the slivers firmly in place.

When the glider has been assembled and lined up, balance it in this fashion: Raise the glider between your finger tips, at a point one-third back from the leading edge of the wing. If the model settles with the tail hanging low, add weight to the nose (see Figure 5). Three kinds of weight can be used: [1] A nail (for which a hole must be drilled); [2] B shot (which is placed in a hole made for this purpose, after which a plug of modeling clay or balsa wood is added to hold it in place); or [3] Modeling clay (which is the most commonly used ballast for this purpose). Add only as much weight as is necessary to balance the glider.

Should the model settle with the nose hanging downward, move the wing forward, as shown in Figure 6, until the glider balances with the fuselage level.

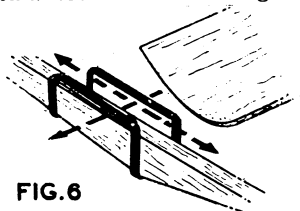


FIG. 6

**FLYING YOUR GLIDER:** With the model exactly balanced, you are ready

to do some flying. Patience is needed, but the techniques you acquire now will carry over and into the entire science of model airplane flying. The first step is test-gliding. Early evening of a calm day is an ideal time to do this. Select a good open area—a field with a growth of soft grass on it is good.

Kneel down and launch the glider forward, holding it so that the nose is pointing slightly downward. Should the glider tend to stall, or nose-up, move the wing a little to the rear (again see Figure 6). A stall is a complete loss of lift, usually resulting from too steep an angle of climb. Keep launching the glider and sliding the wing a little bit at a time until the glider has an absolutely straight glide, with a slight, even sinking action over its entire length.

If the glider, on being launched from your kneeling position, dives forward, a nose-heavy condition is indicated. This is corrected by moving the wing forward until the glide is flat and steady. It may sometimes become necessary to move the wing too far forward to be practical. In such a case, a sliver of balsa should be inserted beneath the trailing edge of the stabilizer.

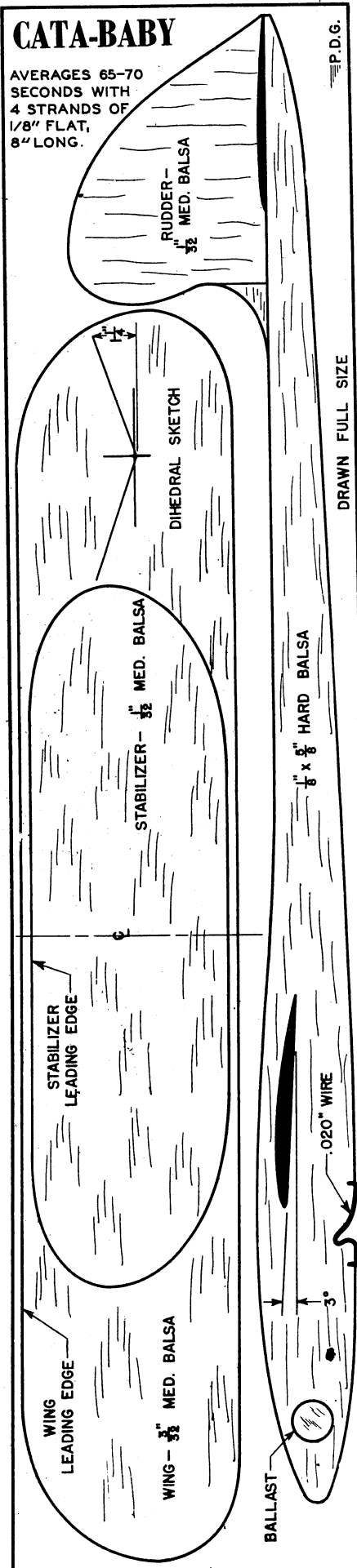
Should the wing have to be set too far to the rear, a balsa sliver must be inserted beneath its trailing edge. As these adjustments are made, and the glider is launched for testing after each adjustment, study the results obtained. By doing so you will soon learn how every move of each part of the plane affects its flight characteristics. This is the foundation of the science which is used to fly all types of models. Watch every detail and remember which adjustment caused what action.

With the correct glide achieved, we must now check the turn. In a glider, it is better to have the turn opposite the power. The power in this case is the hand-launch, or throw. The turn can be established by bending the trailing edge of the rudder in the desired direction.

When the glider is launched, the model should begin to turn a few feet in front of you, and the turn should be a very shallow bank. A steep or vertical banked condition is wrong and will cause a fast downward spiral.

This being accomplished, it's time to get up and really try out your glider. This power-launch should be a firm one—not a wild full-strength pitch. Remember that the throw should be straight ahead—never up or down—and in a banked position. This banked condition should be opposite to the turn which has already been determined. Keep in mind that the launch is *straight ahead*. A well-adjusted glider will perform well in its climb when properly launched and will level off without any loss of altitude and glide tightly in the direction of the turn.

If, however, your glider tends to loop in the climb, move the wing rearward or increase the turn. Increasing the turn is the best way to prevent the loop, but it requires cautious and careful adjustment—otherwise you will suddenly find your glider in a steep spiral dive. Correcting the turn permits the maximum in gliding endurance.





# FM DATA SHEETS

#19 — Model Building Materials

MATERIAL	USED FOR
SHEET BALSA	
PLYWOOD	
BLOCK BALSA	
BAMBOO	
RUBBER TUBING	

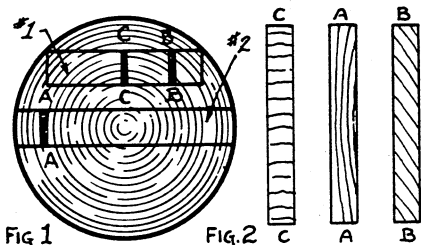
MATERIAL

USED FOR

EXPANDED POLYSTYRENE	
SHEET DURAL	
PIANO WIRE	
FIBRE GLASS	
SHEET ACETATE	
COTTON CLOTH	

● An expert model builder doesn't buy balsa when he needs it, he buys it whenever he sees a good stock. In that way, he gets the grades best suited for his needs. After all, it doesn't make sense to spend days building a model, only to have it break on the first flight because of structural failure.

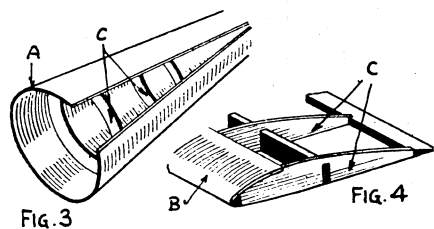
In selecting balsa sheets and strips remember that, as on full-size aircraft, you want high strength with low weight. It is surprising how easily this can be achieved by utilizing special balsa weight and grain-cut characteristics. Did you know that one sheet of



balsa can be three times stronger than another, although both may have been cut from the same log? And that one sheet can be bent into tubing without trouble, while another will crack under comparatively light pressure? Also, that small hard balsa spars will absorb crack-up shock that normally would snap large soft balsa spars?

Balsa, like any other wood, grows by accumulating material around its diameter—each period of growth is like a separate tube. This periodical growth can be seen and is known as annular rings.

Figure 1 illustrates a cross-section of a log, on which plank cuts are shown. Examining planks No. 1 and No. 2, you will note that sheets cut from plank No. 1 along C-C contain material which accumulated in several years, as you can see by the annular rings. Such cuts



are known as quarter-grain in lumber circles, or C-Cut in the model world. You can recognize such cuts by their glazed and scale-like surface.

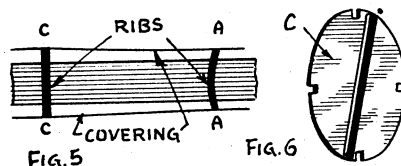
C-Cut sheets are exceptionally stiff and are liable to crack when pressed between thumb and palm. The stiffness is caused by the laminated-like structure of the wood, as sketched in Figure 2-C—and it is this stiffness which can be used to great advantage in model building.

C-Cut balsa is perfect for wing ribs, bulkheads, and any other surface that must not warp but must still be light (see Figures 3 and 4). Ribs made of this type of balsa will hold their shape under the pressure of the paper without buckling—and that pressure is greater than you think. Figure 5 shows a com-

# Buying Balsa?

parison between C-Cut and A-Cut balsa under pressure. Proper strength balsa will help keep the wing lined up, and so prevent warping.

To obtain similar anti-bending



strength from A-Cut balsa, you will need sheet three times as thick. When C-Cut is used on bulkheads, as in Figure 6, it is advisable to cement a small strip across the grain, to keep it in line during assembly. On indoor models, where a rib is nothing else but 1/32" sheet balsa cut to airfoil outline to make it 1/32" square, your balsa must be cut from true C-Cut. We could say more about C-Cut, but you will learn more by getting a sheet and actually using it. Look for it every time you go to a hobby store—you will not find it very readily, so it's best to buy it when you see it.

Sheets cut from plank No. 2 along line A-A have just the opposite of C-Cut characteristics. You can recognize A-Cut, illustrated in Figure 2A, by its velvety feel and by the ease with which it can be bent into tubular shapes (note comparison between C-Cut and A-Cut in Figure 7). It will bend without moisture, except when making tubing. It is not advisable to use true A-Cut for ribs, bulkheads or the like—use it where you need considerable bending, like covering round surfaces as in Figure 3.

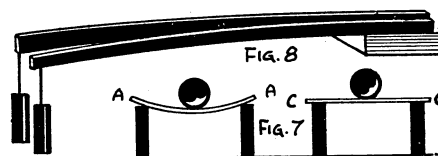
There is still another cut which is most common on your dealer's shelf... cut B-B, illustrated in Figure 2B. This can be recognized by its small speckles, and by the diagonal grain lines at the ends. Always take B-Cut in preference to A-Cut if you cannot obtain C-Cut.

B-Cut comes in handy on shallow bending surfaces, such as the leading edges of a wing, as shown in Figure 4. It is recommended for all ord thick sheet work, like wing tips, where a certain amount of thickness is required for shaping. It will not snap like C-Cut, nor bend or warp like A-Cut.

As for strip balsa, the strength of balsa, like any other wood, depends on its density or weight per cubic foot. Two spars cut to identical size but of different weight will vary in strength according to their weight. That is, a spar cut from twelve pound stock will be twice as strong as the same size cut from six pound balsa. In other words, if two spars weigh the same, regardless of dimension, but have a similar cross-section shape, their strength will be the same. This means that if you follow

plans by using the same sizes but lighter balsa, your model will not be as strong as the original.

So, remember—the strength of balsa strips depends on the weight of the balsa from which they are cut. There is, however, a distinction between hard and soft spars or strips which must be considered. As illustrated in Figure 8, a cross-section spar cut from hard balsa will bend at least twice as much as one of the same size cut from light balsa, when under a similar load. So, if we multiply the load by the bending distance, we find that the harder stock will consume shock energy over a greater distance, while the light balsa spar might snap under a sudden shock. This fact is in evidence on the flying field.



Balsa is strongest under direct compression (Ever wonder how a 1/8" square longeron can take such a load as a fully wound rubber motor?). Therefore, make every effort to have it under full compression at all times. This means generous use of ribs and uprights, to prevent the spars or longerons from getting out of direct compression.

One secret of fine workmanship is to use light and generously sized balsa where shaping is required. This will give you a chance to shape and sand to exact shape and have a smooth-looking surface. Whenever you have to cut ribs or other irregular outlines, use light or medium balsa. On hard stock, the blade will tend to follow the grain line and it will be most difficult to obtain smooth razor cuts.

Don't be tempted to use 1/64" or even 1/32" balsa sheet for covering—you'll be disappointed! In the first place, you will not have much thickness left to sandpaper smooth—and nothing looks as bad as rough balsa. Also, cement will pull the thin sheet down along the bulkheads or ribs. Never use less than 1/20" balsa for covering. It's much better to use thicker but lighter grades, and then sandpaper them smooth. While sanding, the joints will be filled with dust, and so produce a clean-cut appearance.

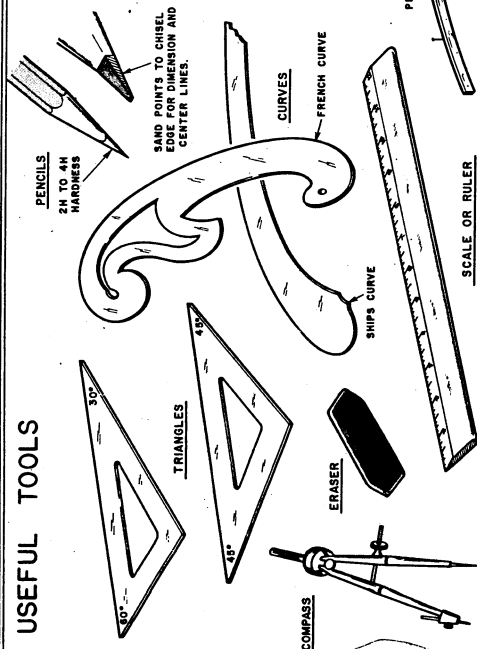
To summarize: Test the advantages of using quarter grain or C-Cut balsa. Use hard balsa strips and spars to obtain "elastic" strength. Stock up whenever you find good balsa. When selecting, be particular about surfaces. A sheet or strip is as weak as its deepest saw cut. Always sand out saw marks. And always remember that good balsa, properly used, is your cheapest insurance for successful model building.

## No. 22 — SCALING UP PLANS

## No. 22 — SCALING UP PLANS

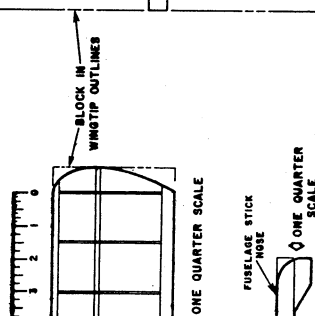
[illegible]

SHEET	SHT.
INCH	IN.
RADIUS	R.
SQUARE	SQ.
PLYWOOD	PLY.
DIAMETER	DIAM.
THRUST LINE	T.L.
CENTER LINE	C.
ALUMINUM	ALUMIN.
REFERENCE LINE	R.L.
LEADING EDGE	L.E.
TRAILING EDGE	T.E.
INSIDE DIAMETER	I.D.
OUTSIDE DIAMETER	O.D.
BUILDER HAS CHOICE	OPTIONAL
CENTER OF GRAVITY	C.G.



**BALSA OR HARDWOOD STRIP**  
**(FOR MAKING LONG, SHALLOW CURVES)**

## STRAIGHT DIMENSIONS

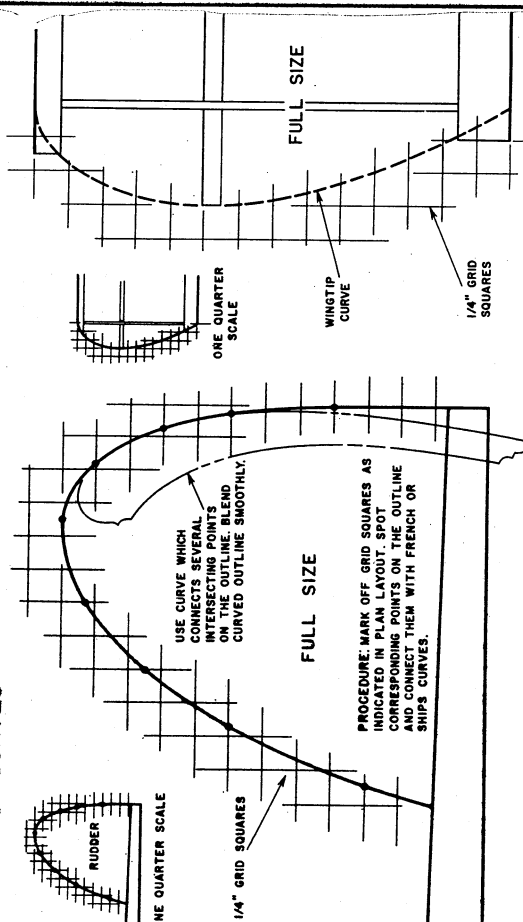
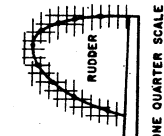


NOTE: WING LEADING EDGE OR TRAILING EDGE CAN BE USED AS REFERENCE LINE FOR MARKING OFF DIMENSIONS.

**FULL SIZE**

**FULL SIZE**

## SCALING CURVES



**FULL SIZE**

11 FULL SIZE

**PROCEDURE: MARK OFF GRID SQUARES AS INDICATED IN PLAN LAYOUT. SPOT CORRESPONDING POINTS ON THE OUTLINE AND CONNECT THEM WITH FRENCH OR SHIPS' CURVES.**

# SCALING AIRFOILS



**1/8" GRID SQUARES**

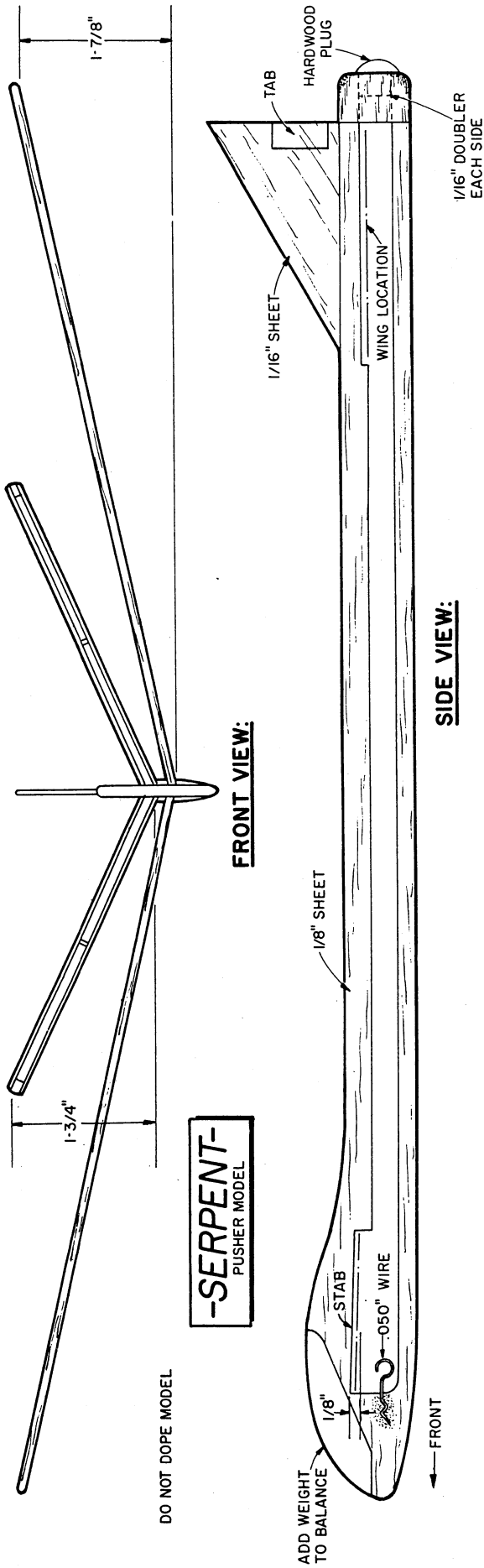
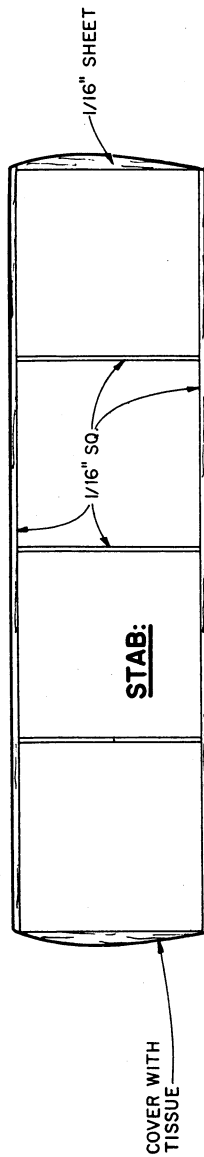
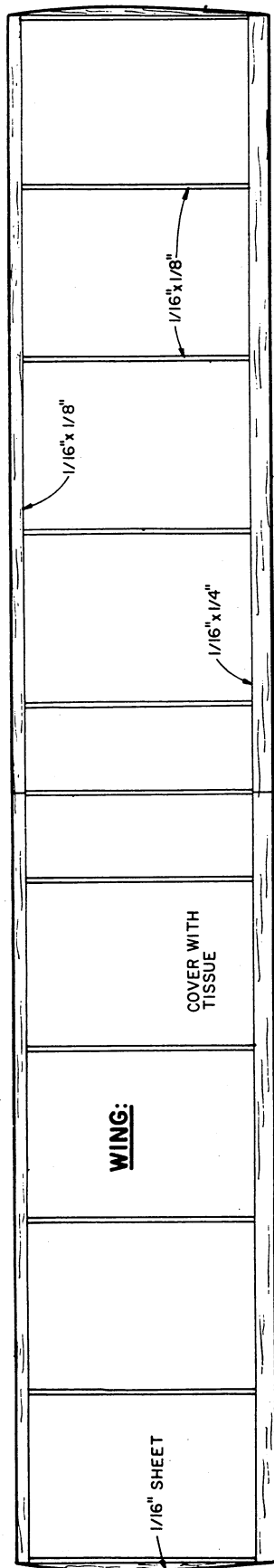
REQUIRED ACCURACY OF CURVE  
MORE EASILY OBTAINED BY USING  
CLOSER GRID SPACING.

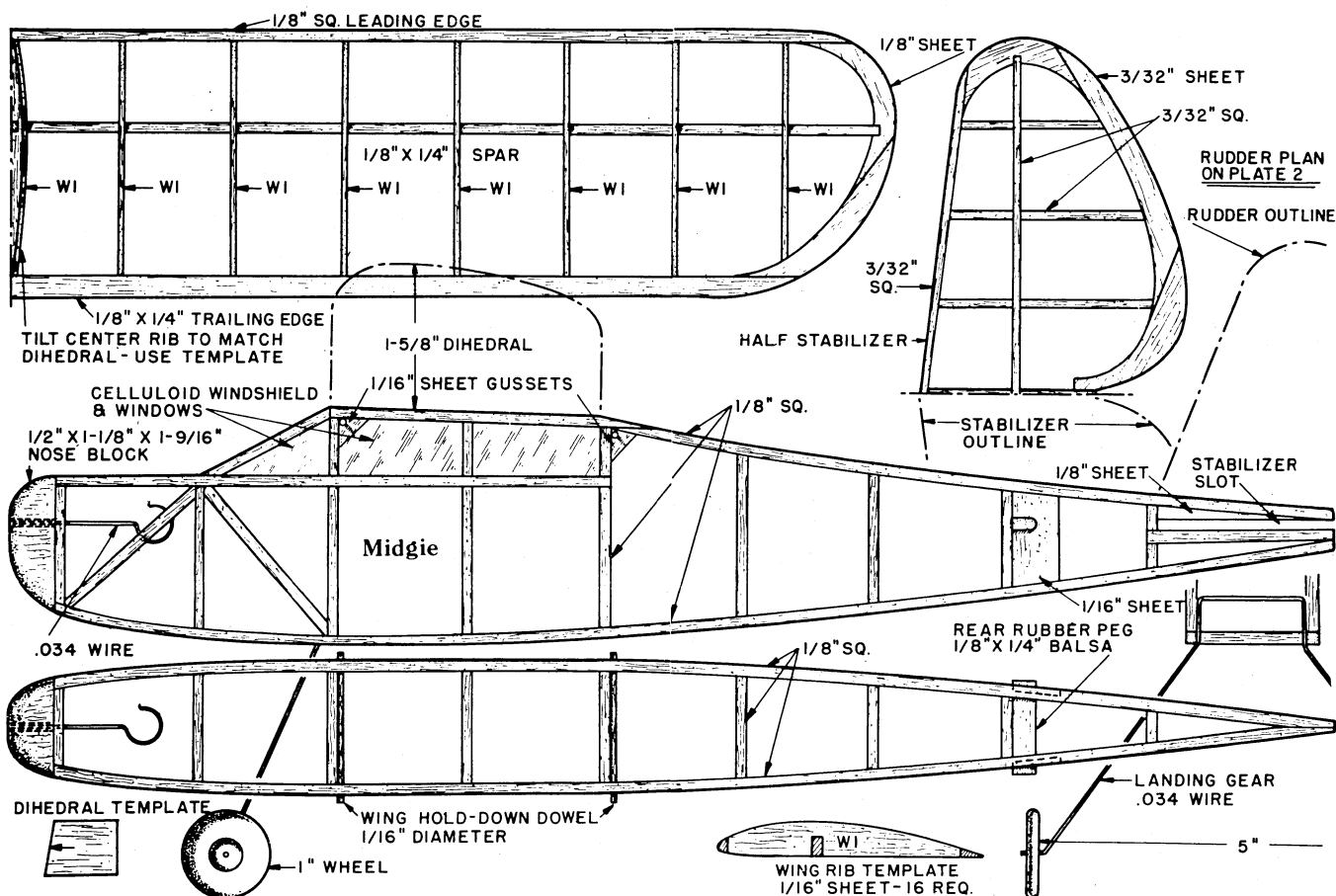
**FULL SIZE:**

**NOTE: FOLLOW SAME PROCEDURE AS OUTLINE FOR BUDGET**

6







# "MIDGIE" Rubber Powered Trainer

## 1/2 Scale Plans-

## Illustrated Assembly Data!

● Begin Midgie's construction with the fuselage, completing all phases of its construction, including the covering, before tackling any other parts. The series of drawings herewith should make the entire construction job relatively simple and help you produce a model you will be proud of.

Let's get started, by gathering together the following materials:

### BILL OF MATERIALS

(Balsa unless otherwise specified)

6-1/8" x 1/8" x 36" (hard).....Longerons, uprights, cross pieces, wing leading edge

1-1/2" x 1/2" x 1 9/16".....Nose block

1-1/16" x 2" x 24" (medium).....Gussets, wing ribs

1-1/16" diameter 8" long dowel.....Wing hold-on

2-1/2" x 1/2" x 36" (hard).....Spar, wing trailing edge

1-1/4" x 2" x 36" (medium).....Wing tips

2-3/32" x 3/32" x 36" (hard).....Tail leading edges, spars, ribs

1-3/32" x 2" x 36" (medium).....Tail tips, trailing edges

1-1/4" x 1 1/4" x 8" (medium).....Propeller

Celluloid, rubber model tissue, elastic bands, 1" diameter hardwood wheels, 24" .034 music wire (landing gear, prop. shaft).

All of these supplies should be readily obtainable at your local hobby store.

In covering the fuselage, note that there are five pieces of tissue used: two for the top, one for the bottom, and one for each of the sides. The top of the fuselage is broken up into two sections: forward of the cabin and rearward of the cabin.

A nice touch is to use the covering tissue to form the trim around the cabin windows and the windshield. To do this, dope the tissue to the celluloid where it covers the fuselage structure. Be sure to apply the dope at the structural members only. When the tissue is dry, use a sharp razor blade to trim away the excess tissue over the windows and windshield.

As the construction of the stabilizer and rudder duplicates that of the basic structure of the wing, detailed illustrations for building these parts have been omitted. Just follow the wing construction instructions for these parts. Note that only half of the stabilizer is shown on the plans—trace a duplicate of this half on waxed paper, reverse, place beside the half shown, and your stabilizer plan is ready. The rudder plan is presented on this page.

After you've finished constructing all of the various members of your Midgie, the next step is to carve the propeller. Elsewhere on this page you'll find a drawing giving all the dimensions for the propeller blank.

Lay out the propeller as indicated, using a soft pencil for drawing the lines on your block of balsa, to prevent digging into the wood. After the lines are all indicated, drill the prop shaft hole. Use a 1/32" drill, to allow clearance for the shaft. On the original propeller, a shaft bearing of 1/16" diameter aluminum tubing, with a 1/32" inside diameter, was used. Most hobby stores can supply you with this material.

If you use the tubing, a 1/16" hole will have to be drilled through the propeller hub. Press the tubing into the propeller, using cement to keep it from rotating in the hole.

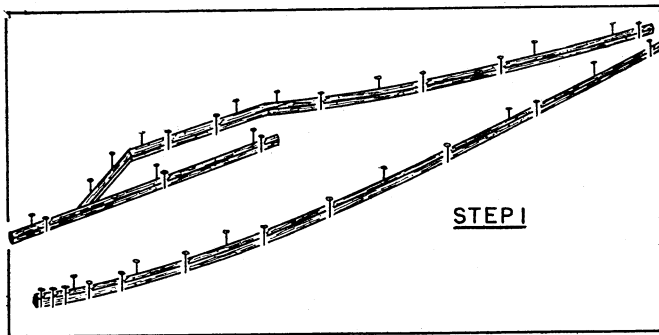
To start fabrication of the propeller, cut out the bottom as indicated on the drawing, using your coping saw for this operation. Allow at least 1/32" clearance outside the line, then sand to the line.

After the bottom has been sanded, cut out the sides as indicated; again using your coping saw. Sand and finish as in the previous operation.

The balance of the work requires extreme accuracy. Start by carving the bottom of the blade, rough carving to the line shown on the propeller blank. Finish with sandpaper. Then carve and sand the upper section of the blade until it resembles an airfoil shape. It should be about 3/32" thick at about 1/3 the distance from the leading edge of the blade. The leading edge should not exceed 1/16" in thickness and the trailing edge should be brought down to a thin edge. Don't make it razor thin—leave just enough for the finishing touches.

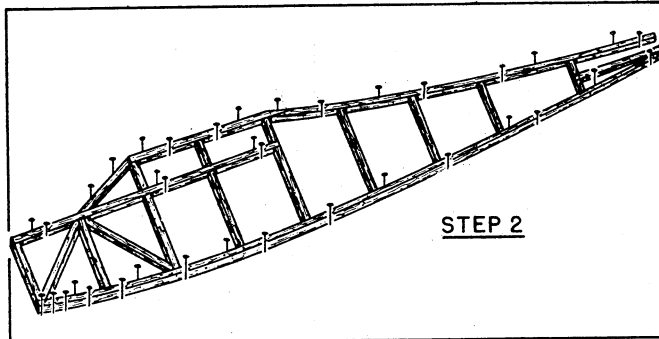
After the shaping, carving and sanding operations have been completed, give the prop at least three coats of plasticized clear dope. Plasticized dope consists of at least 20 drops of good quality castor oil (Bakers AAA is a good type) to a four ounce bottle of clear dope. This special dope preparation will prevent shrinking and warping of the prop blade. Be sure to sand the prop with 4/0 sandpaper between coats of dope.

Now attach the propeller to your plane, as indicated in Step 11. Attach the wing by stretching two rubber bands across its top, attaching the ends of the rubber bands to the wing hold-downs shown in Step 7. The rudder and stabilizer are cemented as shown. One more step and we'll



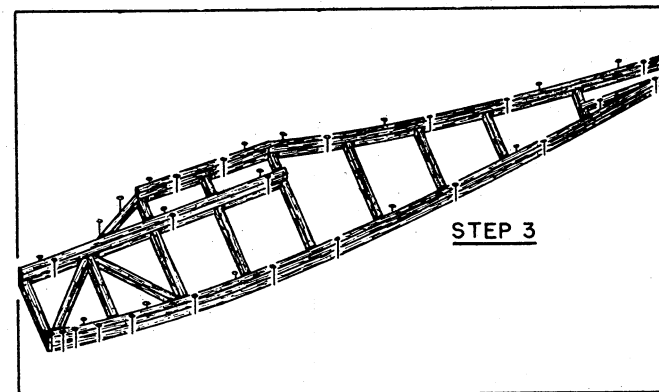
**STEP 1**

1. Lay the full-size plans of Midgie on your worktable and cover with good, lightweight wax paper. Then, use firm, straight  $\frac{1}{8}$ " square balsa for the longerons. The fuselage outline is laid down with pins beside, not through, the wood. Mate all angular joints accurately.



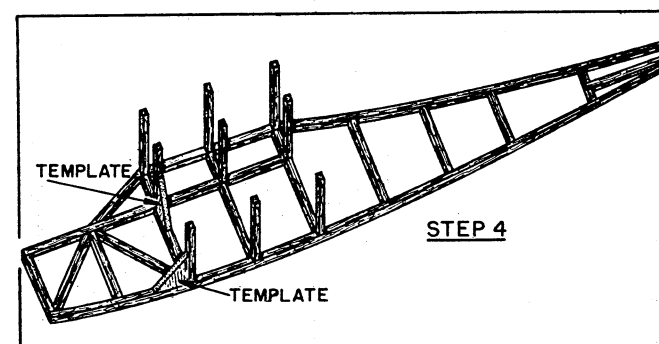
**STEP 2**

2. Cut uprights and diagonals in pairs to proper length, to insure accuracy for the two sides. Coat the end of each piece with cement and allow to dry. Similarly coat the longerons at the point where the uprights are inserted. Now cement lightly and set members in place.



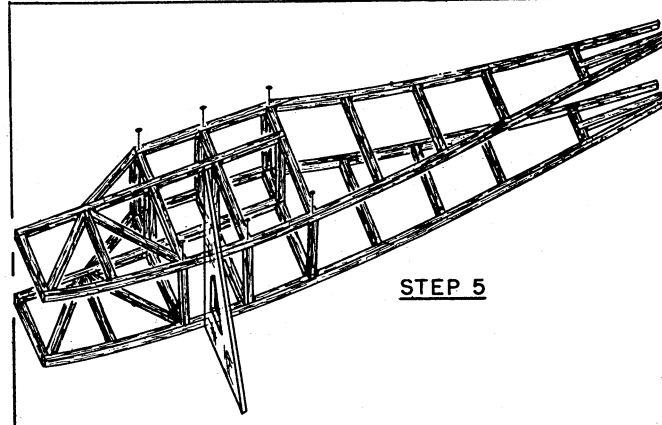
**STEP 3**

3. To insure accuracy, the fuselage frames are made one over the other. Insert the  $\frac{1}{8}$ " square longerons for the second frame between the pins already in place and repeat steps 1 and 2. Use a sharp double-edge razor to separate frames, pressing lightly but not cutting.



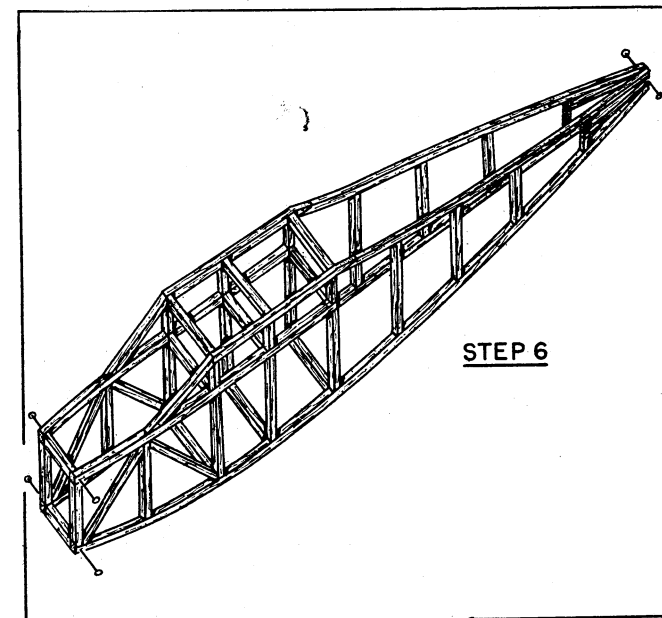
**STEP 4**

4. Remove frames from workboard, using needle-nose pliers to remove pins. Hold framework tightly while removing pins. Then, cut out the cross pieces for the cabin section. Coat with cement and allow to dry. Then cement in position, using right-angle template for squareness.



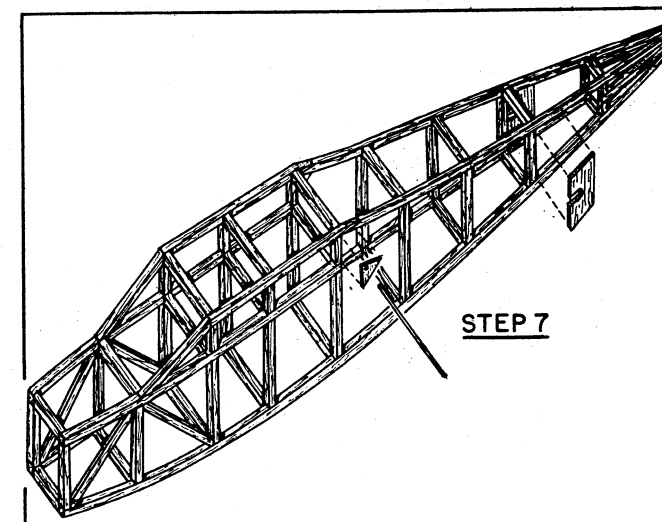
**STEP 5**

5. Taking your time, assemble the sides by pinning as shown. Use a triangle or other right-angle instrument to gauge squareness. Check all four sides: the bottom as shown, the sides and front by setting the fuselage upright, and the top by laying the framework on its side.



**STEP 6**

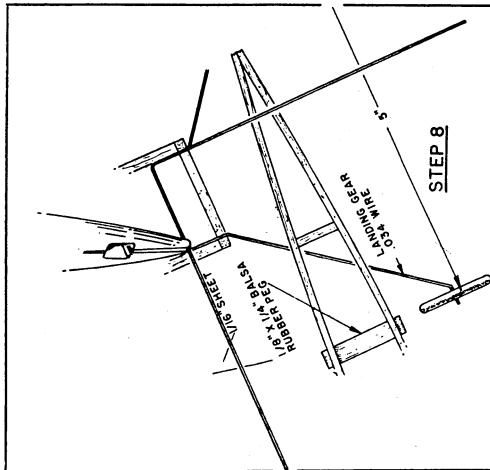
6. Be absolutely sure that the cement has set firmly before inserting the front cross pieces and drawing the ends of the fuselage frames together. Pin as shown, then cement, checking for squareness. When securely set, insert the other cross pieces and complete framework.



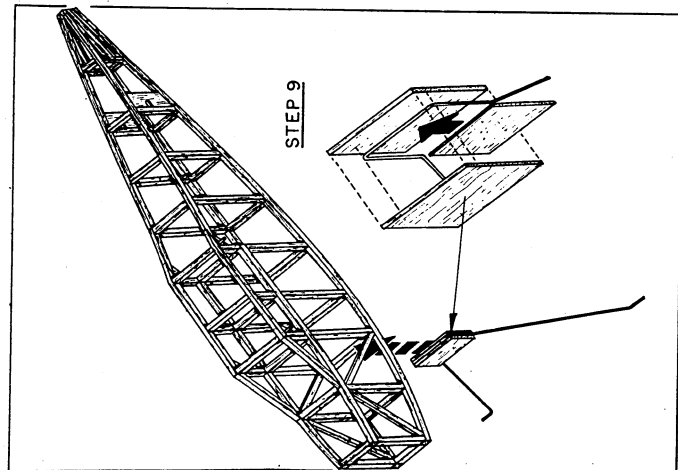
**STEP 7**

7. The wing hold-down dowels and their gussets, the rear rubber peg brace, and the  $\frac{1}{8}$ " sheet insert at the stabilizer slot are now added. Cement the  $\frac{1}{16}$ " sheet gussets in place, then drill a  $\frac{1}{16}$ " diameter hole and insert the dowels. Insert other pieces as shown.

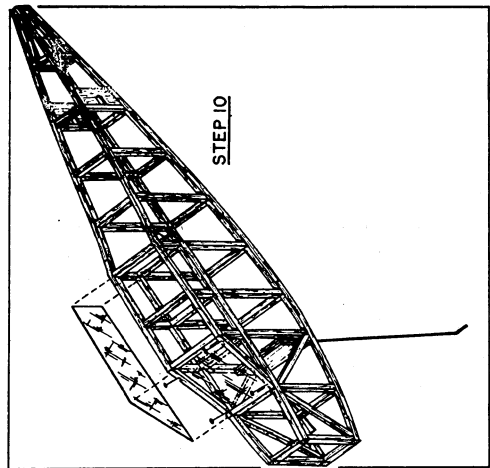




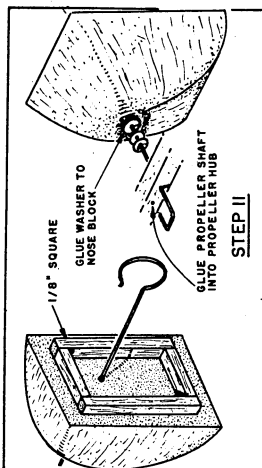
8. Bending the landing gear is quite simple. Use needle-nose pliers and bend the complete gear directly over the plans. As the plans show only half of the gear bend one side first—then reverse and bend the other. Bend the forward stagger of the gear before the axle.



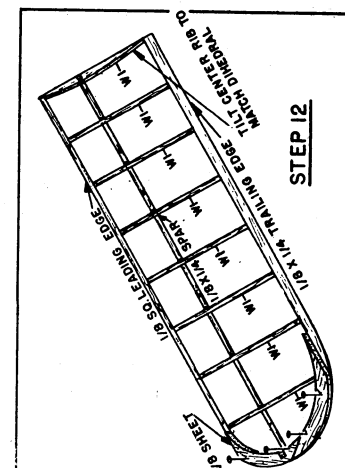
9. The sandwich method is used for holding the landing gear and mounting it in place. Cut 1/32" sheet to fit in the landing gear 'U' section, then add the 1/16" sheet as shown. Insert sandwich between longerons and cement at all points where it contacts fuselage



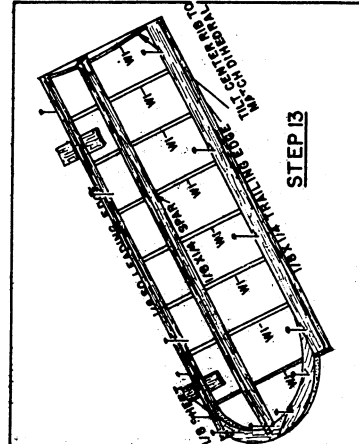
10. Three pieces of .010 or .015 sheet celluloid are used for the wind-shield and cabin windows. As celluloid is of the same base as your cement, don't use too much cement or the celluloid will dissolve. Apply cement lightly to framework and pin sections in place as shown.



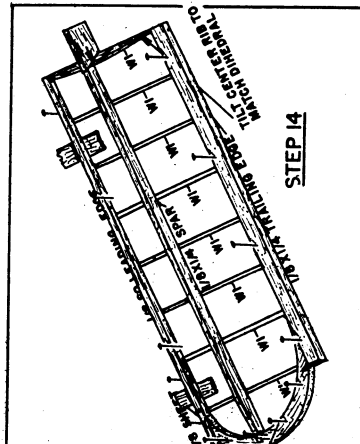
11. Before carving nose block to the correct outline, cement the 1/4" square members to the rear of the block. Arrange so that a snug fit results between the block and fuselage nose. Cement a metal washer to the block and use extra washers to permit a free-running prop.



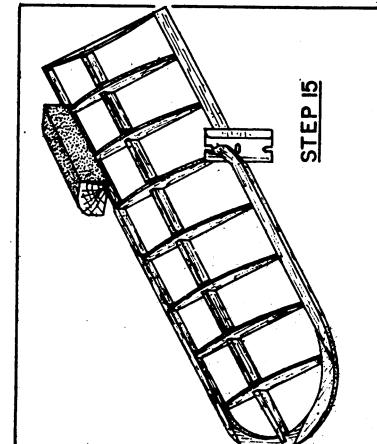
12. After sanding and covering fuselage (see steps 17, 18 and test) build the wing. Trace wing plan on waxed paper and reverse, to get whole wing. Construct as shown. Trace tips on 1/4" sheet cement, and pin in place. Coat pieces lightly with cement before assembling.



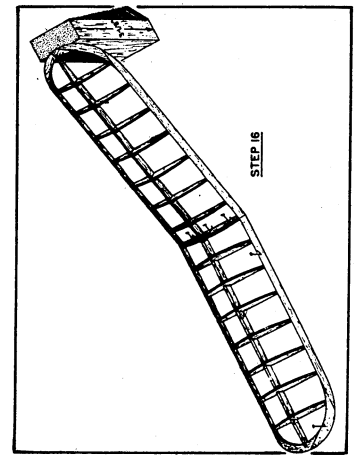
13. Complete the framework of the wing—cementing and pinning the 1/4" square leading edge, the 1/32" x 1/4" spar and the 1/8" x 1/4" trailing edge in place over the plans. Raise the leading edge and tip from the workbench with 1/16" sheet balsa to meet the nose of the rib.



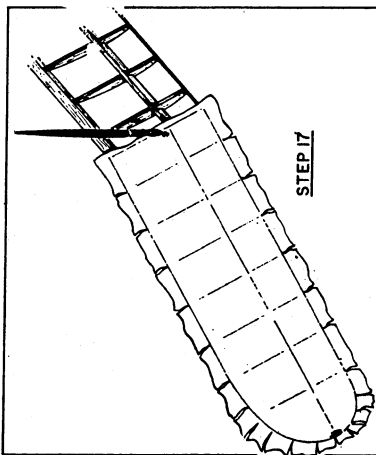
14. Now cut the dihedral template from plan and cement to a piece of firm cardboard. Do the same for wing rib template, then trace 16 ribs on 1/16" medium-grade sheet balsa. Cut from sheet and cement in place. Use dihedral template to get center rib at proper angle.



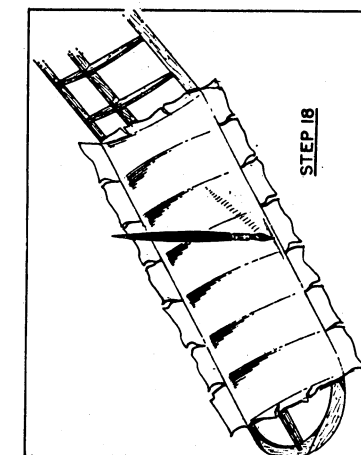
15. Before shaping the wing leading and trailing edges, lay out the leading edge center line and the base of the trailing edge—1/32" thick. Indicate lines by using a pencil between thumb and forefinger, with index finger as support. Finish with razor blade and sanding block.



16. If center ribs on the wing panels were cemented at proper angle, the dihedral should be simple. Put light coat of cement on outside face of each center rib and pin the wing panels together as shown. Pin one panel to workbench and prop with 3/16" long block until dry.



17. To cover bottom of the wing, the stab and rudder, both sides, and the fuselage, cut pieces of tissue the length of work to be covered and tack at two ends. Notch paper at short intervals and dope to outside edge of framework. Remove access paper with razor blade.



18. Two pieces of tissue cover the upper section of the wing—one from the center rib to the tip rib, the other from the tip rib to the wing tip. Fasten on other side of wing section. Spray all covered sections with water, let dry, and apply thin coat clear dope.

be ready to get down to the sport of flying our Midgie . . . we still have to add our rubber motor. Start by removing the covering at the section of the fuselage below the rear rubber hook. This forms a neat access hatch.

Next, lubricate your rubber motor, which should consist of six strands of T-56  $\frac{1}{8}$ " brown rubber. For a lubricant, use a mixture of one part liquid green soap and one part glycerine, rubbing the mixture thoroughly into the rubber. Then, wind the rubber a few times, outside of your airplane, and shake well. This will get rid of any excess lubricant which might splash around the inside of your Midgie and ruin her looks.

The use of this lubricant will extend the life of the motor and add greatly to its elasticity. Rubber has a tendency to heat up while being wound, the heat increasing as more winds are added. Finally the heat becomes so intense that the rubber welds together in many spots and becomes lumpy.

Also, rubber has a tendency to crack at any point of contact between it and the prop shaft or rear rubber hook. Ever notice this condition after a flight and wonder how come?

The rubber lubricant prevents the rubber from welding together, reduces the heat, and prevents friction at the suspension points.

So much for the "how" and "why"—now back to Midgie. To install the motor in your plane, simply attach one end of it to a length of firm, thin wire, take off the nose block, and extend this wire from the front through the inside of the fuselage, out through the bottom of the fuselage at the access hatch.

Then, insert the rear rubber hook through the center of the strands, remove the wire, and the rear connection has been made. Now loop the front end of the motor over the prop shaft hook, insert the nose block back into the fuselage, and your installation is completed.

Before any power flights are attempted, your model must be balanced and then test-glided.

To balance, stand the completed model on a table top. Now place the index finger of each hand under the wing tip at the spar position on the wing. Raise the plane gently from the table and notice the position in which it hangs while suspended.

If the tail hangs low—below the horizontal line between the propeller and stabilizer—the wing must be pushed back until the suspension of the model is absolutely level.

If the nose hangs low, the wing must be pushed forward.

Some builders achieve balance by inserting weight (ballast) at either the nose or the tail, wherever it may be needed. Our Midgie is so designed that it should balance correctly if everything is in the position shown on the plans. Any adjustment will be so slight that ballast will not be needed.

After balancing, the model is test-glided. A calm late evening is about the best time for these tests. Use a nicely sodded field, preferably where the grass is slightly higher than usual. In a kneeling position, throw the model gently forward, having the nose pointing slightly toward the ground when released in the glide.

Try gliding the model a few times before checking its flight characteristics. Then notice what happens when the model is gliding. Does it have a tendency to rise sharply and then seem to fall off to either the right or left? If so, it is stalling. Does it have a tendency to fly speedily into the ground? If it does, it is diving.

To correct the stall, insert a shim (a thin sliver of wood) beneath the trailing edge of the wing, and glide again. If the model continues to stall, increase the thickness of the sliver until the model has a nice straightforward glide, with the model slowly sinking until a gentle landing is made on the ground.

If the model dives, insert the shims beneath the leading edge of the wing and keep increasing thickness until the model slowly sinks and makes a gentle landing on the ground.

When the glide is right, adjust for the turn. Your model should turn to the right in circles of approximately 40 to 50 feet. Be sure to keep the turn to the right. To get this turn, warp the rudder to the right by breathing lightly on it and then gently twisting it with your fingers.

When both glide and turn are right, we are ready for our power flights. A number of test flights are in order, each successive flight with slightly more

power (more turns in the rubber) until maximum power is used.

The first flight should not exceed more than 50 turns on the rubber. With motor wound clockwise, release the model by gently thrusting it forward, directly into the wind. Don't throw it forcibly, just thrust it lightly. When released, the model should go straight ahead, climbing to a height of approximately 15 or 20 feet, and then glide to the ground.

Wind the motor to 75 turns and release in the same fashion. Now the model should turn very gently to the right and continue to climb very slightly, to a height of no more than 30 feet. If, however, the model has a tendency to rise abruptly and then fall off either to the right or left, or slide back on its tail, it is in a power stall. The only correction for this condition is down-thrust.

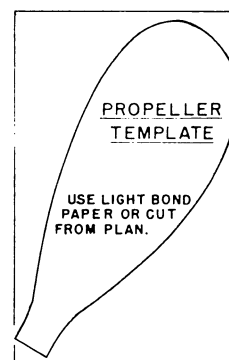
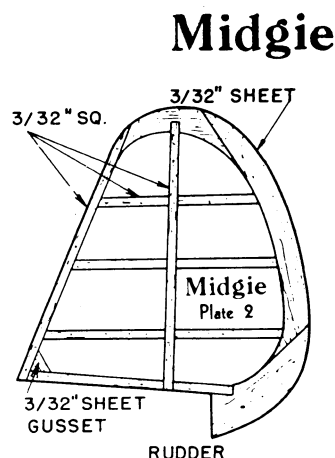
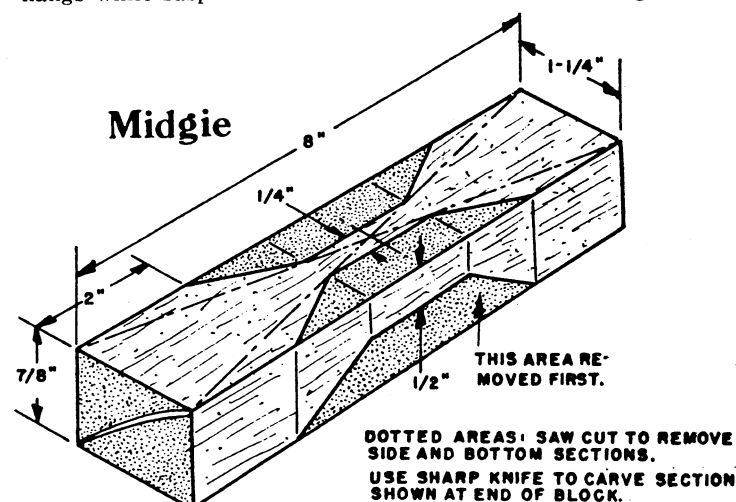
Downthrust is added by inserting a sliver of balsa between the top of the nose block and the fuselage. This will point the nose block and propeller slightly downward.

Now wind the motor again to 75 turns and release. If the model continues to stall, increase the size of the sliver. Continue this operation until all stall has been eliminated from the power climb.

Next, wind the motor to 125 turns and release. If the power stall returns, increase the downthrust. But, more important, notice the turn. If the model continues to turn to the right, everything is still under control. If, however, the model has a bad turn to the left under power, that old Debbil torque is beginning to get in its dirty work.

The only way of correcting torque turn is by use of right offset thrust. Insertion of shims is required again, this time between the side of the nose block and the fuselage. You will notice now that the nose block points down and to the right. Continue inserting shims until the model is climbing nicely to the right under power, and gliding to the right when the prop stops.

With this accomplished, all tests have been completed—the model is ready for all flying conditions short of high winds—and you're all set to become an active participant in the sport of flying model airplanes!



# WARP FREE WINGS

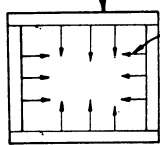
**Warp-free and light, that's the secret of wing structure. Here's the way to do it!**

● To many modelers, warped wings are a problem. Some modelers solve the warped wing problem by turning to stamp collecting, others bear with the problem, and a few design wings that won't warp. This article will show you how to design wings that are more warp-resistant than the spar and rib structure commonly used.

The two main causes of warped wings are: those due to aerodynamic effects, and those due to poor structure. Aerodynamic loads producing twist in the wing will not be considered in this article, since they are small compared to the twist loads produced by faulty construction.

Most modelers will usually agree that a wing doesn't warp until it is

**FRAMEWORK**



**FIGURE 1**

covered, so we will assume that the covering causes the warps. When tissue, silk, silkspan, or nylon are used to cover a model, they are usually put on loosely and then shrunk tight and doped. When the covering is doped it shrinks, and since the edges of the covering are tied down, tension is put into the covering which puts forces on the structure as shown in Figure 1.

When you look in at the end of a wing, the forces are as shown in Figure 2. In Figure 2, the forces on the top of the wing are drawn longer to show that they are larger than the forces on the bottom of the wing. These larger forces on the top of the wing cause the wing to twist and there is your warp. The forces could just as well be

**WARPING FORCES**



**FIGURE 2**

large on the bottom of the wing and small on the top. This would cause the wing trailing edge to warp down.

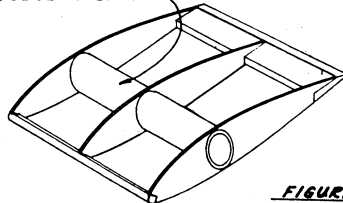
Summarizing, let's say that wing warps are caused by the covering shrinking unevenly. And, since we know the basic cause of wing warps, we can go about designing a structure that will resist them.

First, consider a flat sheet of balsa—it can be twisted very easily. However, if it is rolled up into a tube, it is much more difficult to twist. You can see from this that all you need to resist a warp or twist is to have some cross-sectional area. Going on this idea, a wing like that shown in Figure 3 might be a good type to try. The main trouble with this wing is that it would be rather difficult to build, unless some

kit manufacturer would pre-fab it.

Now that we have concocted a wing design that is warp-resistant but is difficult to build, let's consider a few wings that can be built quite easily.

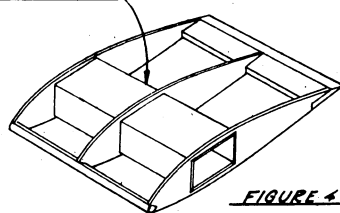
**TUBULAR SPAR**



**FIGURE 3**

One way to make the wing with the tubular spar easier to build would be to change the tube into a box spar, as shown in Figure 4. This wing might be a little heavy, but we can lighten

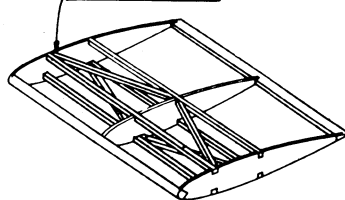
**BOX SPAR**



**FIGURE 4**

the box spar by using longerons and diagonal bracing, as shown in Figure 5. The truss-spar wing can be built very light and strong. One such wing was built for a Wakefield model and, while the complete model weighed thirteen ounces, the wing weighed only one

**TRUSS SPAR**



**FIGURE 5**

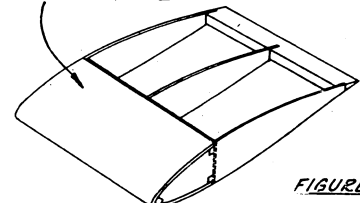
ounce, and had adequate strength to carry the model.

If you don't like the wings that we have shown, we can go to other designs. Again, we will go back to the tubular spar wing in Figure 3 and change the tube a little. This time we will move the spar forward and make it "D" shaped, as shown in Figure 6. This wing is quite conventional since it has a spar on the top and bottom of the wing and a sheet covered leading edge. It is very warp-resistant if a

strong trailing edge is used. However, if the wing is thin and the ribs are not deep enough to carry a strong trailing edge, the rear part of the wing will warp.

It should be noted that the wing in Figure 6 has a built-up spar. The wing is assembled by slipping the ribs onto the  $\frac{1}{8}$  square spar caps. Then the vertical sheeting is inserted between the ribs and cemented in place. The grain in the spar sheeting must run up

**SHEET COVERED LEADING EDGE**



**FIGURE 6**

and down. It has very little strength if it runs spanwise.

Now let's go back and consider in a little more detail the mechanics of how a wing warps. In Figure 7, a spar with its ribs attached is shown. There are no leading or trailing edges so, if the spar is twisted, the trailing edges of the ribs will move, each one moving a little more than the rib before it. You can see that, if a trailing edge is added, the wing will be made stiffer.

However, the trailing edge can be made just so strong and then the size of the trailing edge gets too big and heavy to be practical. Usually the trailing edge has to be made quite large to provide much warp resistance. If the wing still isn't stiff enough when you put the trailing edge on, and it usually isn't, the next thing to do is to add another spar. Of course, you could add a dozen or so spars all over the wing and make it very stiff but it will also be very heavy, and too much weight brings too few trophies.

One way of getting around adding too much weight, by adding too many spars, is to put the ribs to work. You saw in Figure 7 that each rib moved just a little more than the rib just before it. Why can't we have one rib hold the other and prevent it from moving? All you have to do is put the ribs in at an angle, so that the trailing edges can come together.

This is shown in Figure 8 and is basically the same type of construction as the Davis Hoganamic construction.



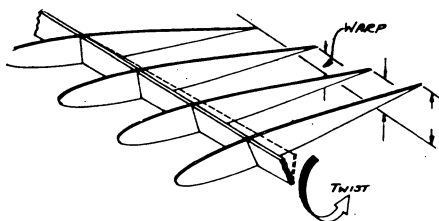


FIGURE 7

It is the most warp-resistant type of wing we've seen and is currently coming into vogue in various parts of the country. This type of construction has been used on real airplanes too. The best known example is the Ercoupe which has a full depth main spar, and aluminum sheet covered leading edge, and diagonal ribs.

Now we have a couple types of wing structure that are very warp-resistant. There are many variations possible that would be quite good, so we will enumerate the requirements of a warp-resistant wing:

First, you must have some thickness in the wing to provide space for a torque tube. The torque tube can take

many forms, such as the tube in Figure 3, the box in Figure 4, the truss in Figure 5 and the distorted tube in Figure 6.

Then, you need a strong trailing edge. Use a wide trailing edge and make it as deep as the airfoil section will allow. Use hard balsa for the trailing edge and cement it in place as firmly as possible.

Remember that the covering causes the warps, so use care. Put it on evenly, and dope both the upper and lower surfaces in one job, and then let it dry.

So far, we have discussed *why* a wing warps, and have shown various structures that are very warp-resistant. Now let's say something about *building* wings:

The wing is the most important structure on an airplane. Since it is the most important structure, it should be given the most attention when it is designed and built. First, pick an airfoil section that is deep enough to hold a strong spar. A thickness of 10% or 12% chord length should be the minimum. Then, use a hard wood for the

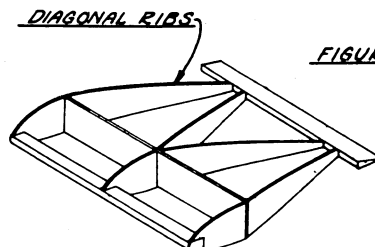
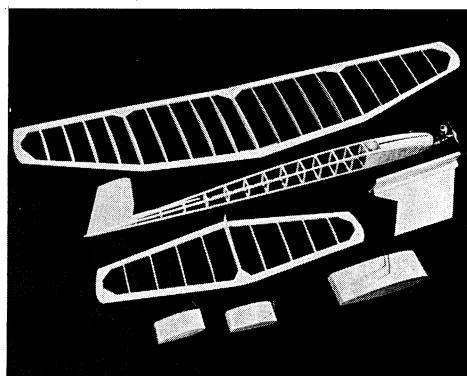
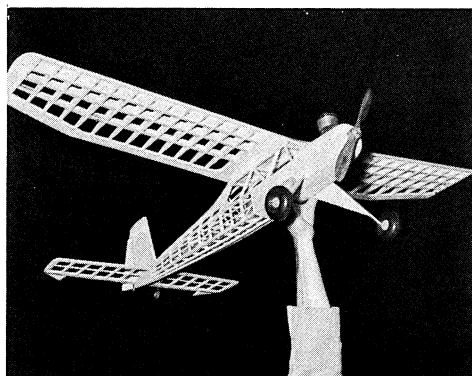
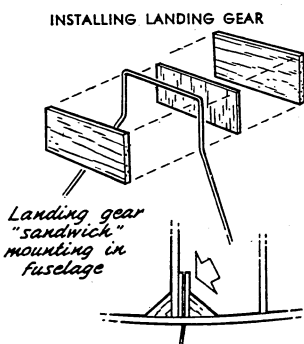
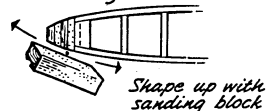
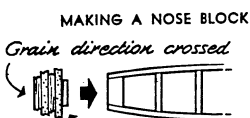
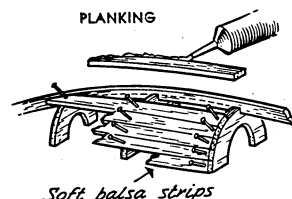


FIGURE 8

spar. Hard balsa or even pine or basswood should be used. Try to pick an airfoil that will allow you to use a strong trailing edge. Don't use soft balsa for ribs.

About this time everyone will be yelling that a heavy structure is being advocated when they want light weight. Sure, it's fine to have a super-light model, but if the wings warp every time a ray of sunshine hits it, the model won't turn in good flights no matter how light it is. To be seen in the winners' circle takes a dependable model, and to be dependable a model must be capable of being flown in all types of weather. Fly *all* the time with *warp-proof* wings!



## Build Better Fuselages

Build good, sturdy, well-designed fuselages  
and you'll get more fun out of model aviation!

● "The trouble with most how-to-do-it articles," said the dealer, "is that you writers review a lot of things that any live modeler can see on a magazine plan or in a kit. Take fuselages, for instance. Who doesn't know a square built-up type when he sees it? Or the carved body of a speed job? Or the slablike fuselage of a profile U-control trainer?"

"So what should we do?" we asked the dealer.

"Well, there's plenty of headaches in construction," replied the shopkeeper. "Why not stress the helpful hints, the tricks of the

trade, things that make for better, more easily constructed models?" That's not a half bad idea, is it fellows?

Model construction is constantly changing. When rubber-powered models were king, probably 90% of the fuselages were "boxes"—square or rectangular cross-sectioned fuselages consisting of four longerons and numerous cross pieces. In fact, they still are!

But, while free-flight gas started the same way, it wasn't long before builders took advantage of the fact that, there being

no need for rubber space down the middle, all manner of structures could be worked up on an easily assembled crutch.

Came U-control, stressing speed at first, and construction got heavier for strength and to permit the streamline shapes you can get from carved blocks. Now stunt, requiring lightness for maneuverability, has brought in the sheet-balsa sided fuselage, often realistically rounded off on top and equipped with a cockpit.

Against this background we might consider the fact that most commercial kits are for U-control

models and that their parts, including entire bodies and wings, are usually prefabricated, leaving only the final smoothing operation to the builder. Most free-flight models, on the other hand, come from magazine plans and inherently have comparatively little prefabrication. Rubber-powered models of the high performance variety are seldom seen in kit form. Most of the things we need to know, therefore, deal with the latter two types of models.

**BOX FUSELAGES:** More fuselages have been built by the "box" method than by any other. Two side frames are assembled directly over the plans, one frame over the other, with straight pins to hold the longerons in place while the cross pieces are added. This simple fuselage can be a man trap, so heed these suggestions!

First, never drive your pins through the longerons. That weakens the wood and may cause a break where a bend exists. Put your pins on either side of the wood.

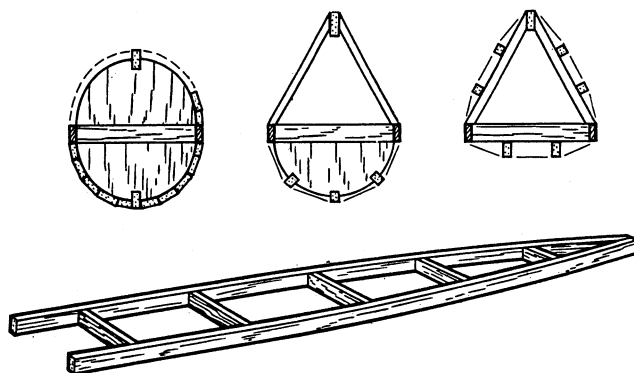
If a very bad bend exists, soak the wood in very hot water for about ten minutes—more if the wood is  $3/16$ " square or larger.

Since the forward ends of the longerons often split when you put the sides together later, it is a clever stunt to leave about 1" of excess longeron wood sticking out at the front. Cut off these extra ends when the body is finished.

On all but the smallest ships, acquire the good building habit of double-gluing joints. The intended joints are coated thinly with cement, then permitted to dry. When dry, put on more cement and put the cross piece in position. Other things may give way but such a joint will never fail.

When you coat the ends of the cross pieces with cement, don't push the cross piece down between the longerons in such a manner that the squeeze causes the cement to shoot out from the joint. Instead, push one end of the cement-coated cross piece against the longeron, then lift up and push the other end against the other longeron. This gets cement where it is needed. Then, put a little more cement on either end of the cross piece and slide it into position.

Joining the two side frames is often difficult. A good tip is to obtain modeler's pins from your dealer. These are small, thin pins that make minimum sized holes when you push them through the



VARIATIONS IN CRUTCH CONSTRUCTION

longerons, as you must do in extreme cases.

The secret of joining side frames is to put in first those top and bottom pieces which fall at the widest point of the fuselage (looking down), provided the longerons are parallel at some point, as, say, from the front of the wing to the back of the wing.

Equal length cross pieces may be prepared by tacking down a short length of strip to the board, then sliding the ends of your cross pieces against this stop, matching each with its neighbor for precise length. In other words, each cross piece may be laid side by side and trimmed to length.

Where fuselages have a continuous curve to the longerons on the top view, put in the cross pieces at the widest station only. Then, attach the rear tips of the longerons together and, finally, draw the side frames almost together at the nose by means of a rubber band wrapped around the fuselage at the front.

It is essential, in making any good model, to check the alignment or squareness of the fuselage. This should be done by sighting on the model from above as well as from the front. By looking down you can see if one side is further back than the other (indicated by "leaning" of the cross pieces) or spot cross pieces that are in crooked. By looking at the fuselage from the front you can see if it leans one way or the other, and then force it into proper shape.

This checking is best done when the first few top and bottom cross pieces have been put in place and the cement is still moist. Place a triangle or some right-angled object against the side of the fuselage while it rests on the bench to check alignment.

Incidentally, in cutting cross pieces, use single-edged razor blades; when the wood is  $1/4$ " square or over, first use a saw, leaving a little excess wood, then trim it evenly with the razor blade. Cutting heavy wood with a razor blade alone usually results in slanted ends and poor joints.

**SCALE-TYPE FUSELAGES:** Hardest of all fuselages to make is the scale type—ironically found most often on flying scale models appealing to youngsters—of the streamline variety, consisting of a number of thin formers and numerous small stringers. Formers may be  $1/16$ " thick and stringers  $1/16$ " square. The easiest way to build such structures is to use two keels of sheet wood, not on the bottom (which allows bulkheads to stagger up and down for the length of the fuselage) but on the sides.

For accurate construction of bulkhead and stringer fuselages, put in two of the widest bulkheads first, assembling them between two stringers, one on either opposite side of the fuselage. It is important to reinforce these key bulkheads across the grain with a thin strip of wood, even if only temporarily. Then pull the stringers together at the rear and put in the remaining bulkheads.

Add one top and one bottom stringer at a time, always balancing the pull which results from bending one stringer with that of a stringer directly opposite. When you have at least four stringers in place, assemble the cabin, if any, as this keystone of rigidity will hold things true.

When finished, always sand away the formers between the stringers. This "scallop" keeps the covering from snagging and wrinkling at stringer joints.

#### JOINING FUSELAGE SIDE

**FRAMES:** The biggest headache in joining fuselage side frames—and this includes sheet-sided stunt models—is an uneven bend. This is caused most often by poorly matched wood or, sometimes, by having one side forward of the other (top view), then trying to make the rear tips of the fuselage meet exactly. If possible, select your wood to match in size, hardness and grain. If you can, lay the strips or sheets over some edge, spring-board fashion, and place a weight on the free tips. If two or more pieces are placed side by side, you can tell from the degree of bending which piece is hard and which is soft. Of course, one heavy side and one light side in a kit leaves you no choice. If this happens, purchase strips or sheet to match one side or the other and replace the undesirable material.

If you must overcome a bad bend, try holding the rear tips of the sides, one in each hand, looking toward the nose, then sliding the sides back and forth slightly until the bend looks right.

Then pin and hold the frames in that position. Sometimes the harder longerons may be sanded away slightly on the inside faces until they bend more freely.

In the case of stunt models, which often have sheet wood bottoms as well, a bad bend may be overcome by joining the rear tip. Then, before adding formers or cross pieces from the wing back, attach the side frames to the edges of the bottom, using plenty of pins to hold the work (push up the pins through the bottom into the sides). The pre-cut bottom will act as a jig.

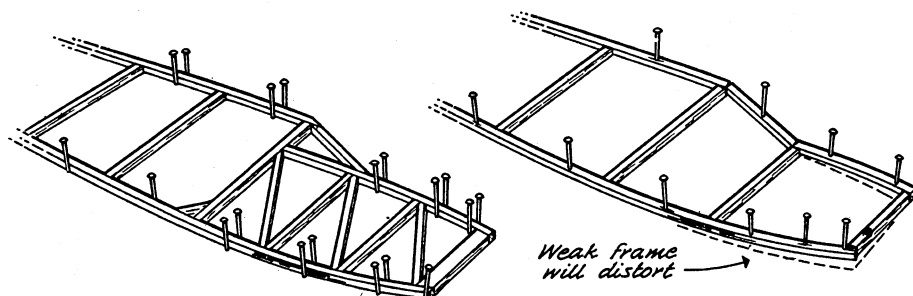
When the box fuselage has been joined at the tail, but before the remaining cross pieces have been added, place it on its side and measure from the bench top up to the rear tip of the body. Now turn the body on its other side and repeat the measurement. If the measurements are identical, your job is accurate; if they are different, remake the joints where the longerons join at the rear and check until the measurements are the same.

**SHEET BALSA SIDES & BULKHEADS:** With sheet balsa coming into wider use, a great many ships, ranging from little rubber sport models to big stunters, have sheet sides and bulkheads. If you are designing your own, always make the sides parallel to each other at the wing location; sometimes this is easily worked out from the nose to the trailing edge position.

Bends on sheet side fuselages put a heavy strain on the bulkheads, especially when their grain is vertical. It is always good practice to reinforce vertically grained corners with a thin cross piece of strip to prevent buckling. If possible, run the grain of the bulkhead from side to side. Properly used, sheet provides the strongest construction for its weight. We have had a radio job with  $1/4$ " soft sheet sides fall 50' from a tall tree onto its nose without suffering any damage!

On small models using  $1/32$ " sheet sides, or on  $1/16$ " sheet

EXAMPLES OF GOOD (left) AND POOR FUSELAGE DESIGN AND CONSTRUCTION



where wide former spacing leaves large unsupported areas, it isn't practical to cover the wood with paper due to the resulting waviness. But, whenever possible, cover larger models—sheet areas especially—with a tough material. The combination of 3/32" or 1/8" sheet and paper is sturdy—the construction becomes almost unbreakable with nylon or silk covering.

Be wary of using coarse sandpaper on sheet balsa—deep, unsightly scoring results. If the wood is not to be covered, use Testors Sanding Sealer or any similar compound to fill the pores and give a smooth surface when lightly sanded.

In selecting sheet for the fuselage keep in mind the needed strength and weight, as well as the use to which each part is to be put. For example, the rounded top of the fuselage need not be covered if it is made of sheet balsa which is more than 1/16" thick. Just be sure to pick a cut of wood that flexes easily across the grain, similar to what you would use to wrap around very sharp cross grain bends. Quarter grain stock is very stiff and will break abruptly when you try to bend it. Use no heavier wood than really required for side frames. It is suggested that an examination be made of well-known stunt job kits. 1/8" thick balsa is a good all-round material, and 3/16" is quite strong.

**SHAPING NOSE BLOCKS:** Another tough construction problem is the shaping of various nose blocks. We have given up shaping these blocks before putting them on the plane—we now cut away most of the excess material, then cement the block assembly to the nose. When dry, a strong arm and a sandpaper block with very coarse paper speedily takes down the projecting material. When the wood comes close to outline, switch to medium paper, then finish by rubbing with fine paper held in your hand. Always cover the outside surfaces of blocks with the same mate-

rial as the rest of the fuselage, if only to give evenly matched surfaces when color doped.

**HOLLOW-BLOCK FUSELAGES:** Where great strength and super finishes are required, as on speed jobs, hollow block fuselage construction is fairly standard. For the average builder, metal bottoms are out of the question, although "Hell-Razor" bottoms and "Speed Shells" recently came on the market. Lower shells always are made of hardwood or metal, due to the pounding of belly landings on concrete, and so on.

Speed kits, or other kits for sport jobs that employ shell construction, usually leave some work to the builder. Material must be routed out to make way for pushrods, tanks, and so on, to varying degrees. It also may be desirable to gouge out more material to lighten the plane or to even off the inside surfaces. Sooner or later, you will want to hollow out wooden blocks for some reason—cowlings for instance—so add a scoop-shaped chisel to your tool collection.

For a solid fuselage, select two blocks of wood of the proper hardness and spot-cement them lightly together. The side and top profiles are marked on and the excess wood cut away. A band saw is ideal for this, but a jig or a coping saw will do fine in a pinch. Leave excess wood for sanding down to outline. The blocks are next sliced apart and hollowed. During this operation always rest the wood on soft cloths. Or have you too hollowed a block neatly only to discover to your dismay that the outer surface was dented beyond salvation from hitting the hard workbench?

While U-control shells are fairly thick, smaller or lighter ships may have their fuselages hollowed from a single very soft block, with the wall quite thin. Small streamlined flying-scale models for rubber or baby engine power are best made this way if you have patience.

**PLANKING:** A frequency encountered compromise between block shells and built-up frames is the use of planking. Planking means simply that strips of wood are put down side by side, like wood on the floor, then sandpapered to a smooth surface.

Planking appears frequently on cowls, on rounded fuselages, or fuselage tops. Very soft or mush wood should be selected. As the planks run toward a narrower portion of the fuselage, each plank will have to be tapered, some of them to a point. How this develops depends on the individual. A good builder will bevel the edges of the planks as well, so that they fit smoothly together, side by side, even around the sharpest bends, or most abrupt former.

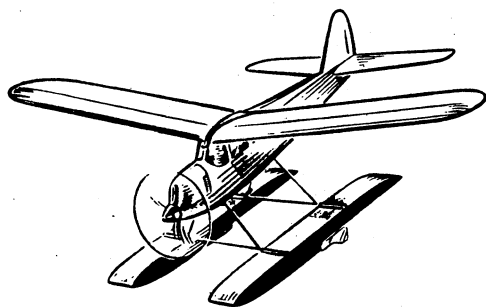
When an entire fuselage is to be planked, start the work at at least two separate points, on opposite sides of the body—four points is better still. Then, having cemented on these two or four planks, begin to add a plank at a time beside each of the beginning planks. As you go round the fuselage, need for tapering will be revealed.

For cementing between planks, file a notch across the nozzle of the cement tube so that the tube can slide along the plank with the greatest speed without slipping. This makes for even cementing. Always avoid putting all the planks on one side of the fuselage first, as the foundation structure may be pulled out of line.

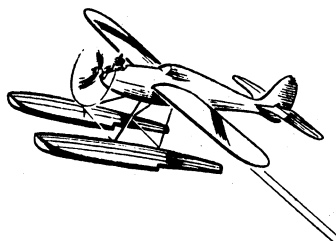
The finished planking job should be rubbed to a smooth contour with coarse paper, as many corners and cement edges will be present. Finish with fine paper. Mix talc and dope and rub it into the cracks, then sand smooth. Use a sanding sealer and cover the surface with paper or nylon or silk. Both nylon or silk may be pulled over double curvatures without wrinkles, whereas paper may wrinkle, and tear more readily.

And there you have a few hints on fuselage construction.

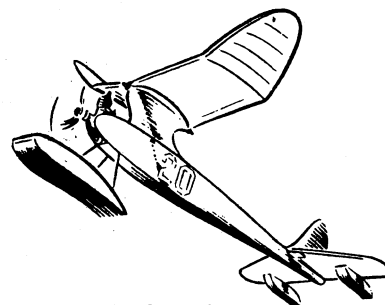
## Float Types



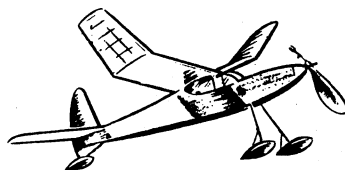
Twin float gear is very realistic



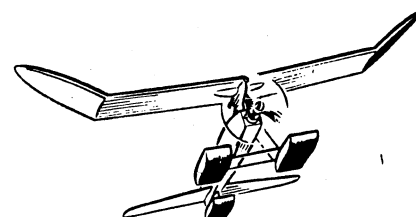
Twin floats on control-line  
Fireball



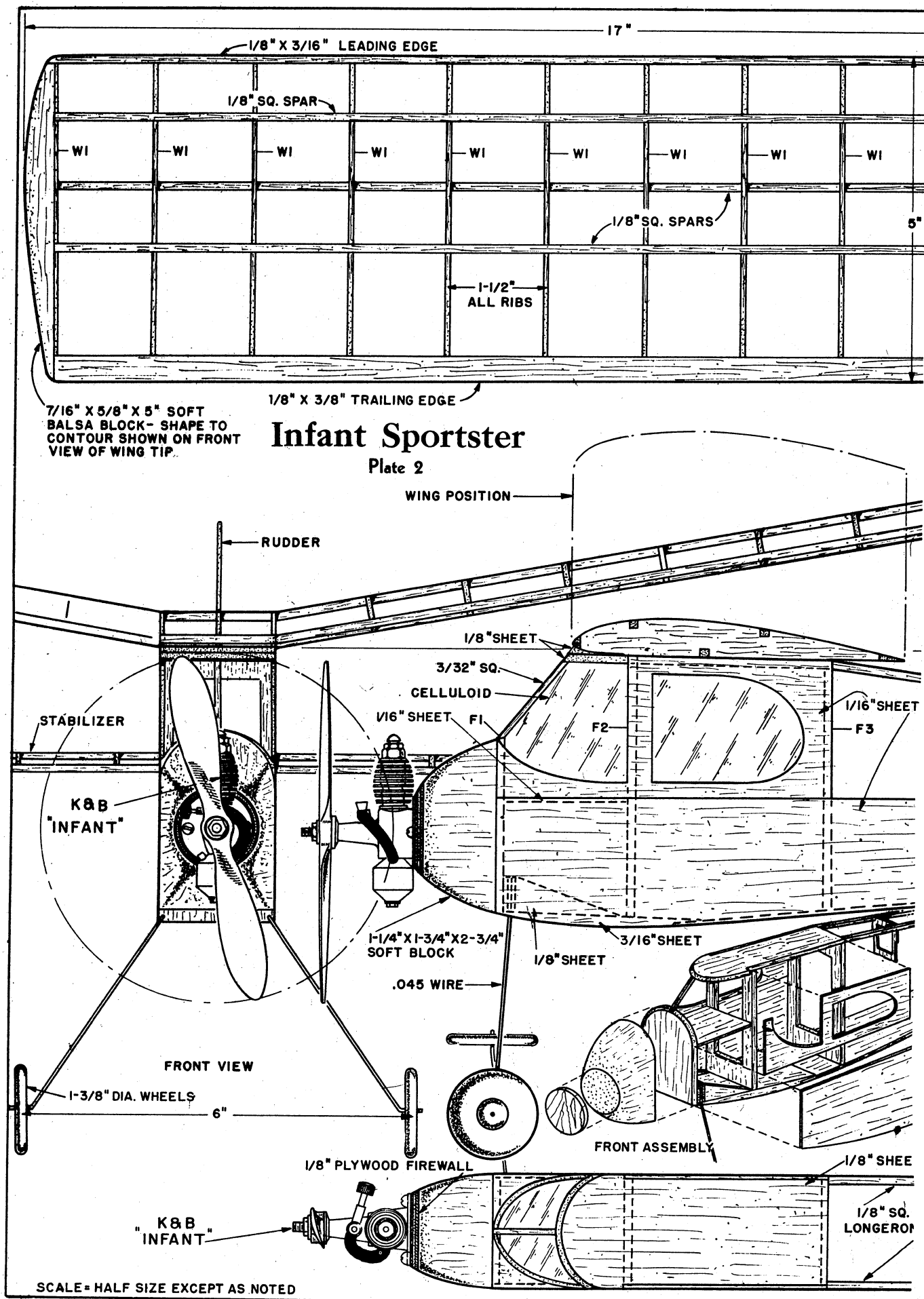
Contest model has sled  
type float for quick take off



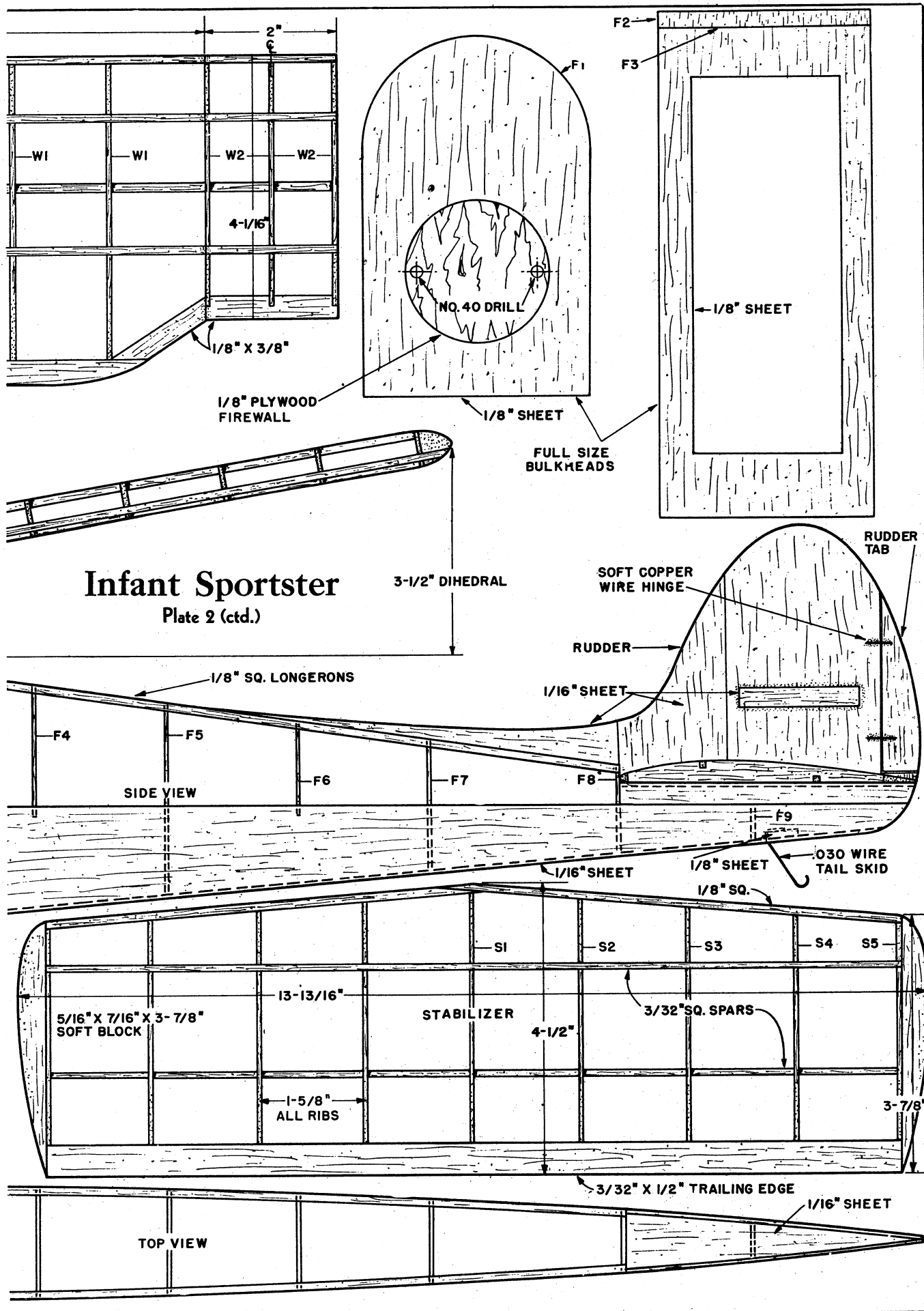
Rubber model floats are  
small and usually of rec-  
tangular configuration



Three float gear type

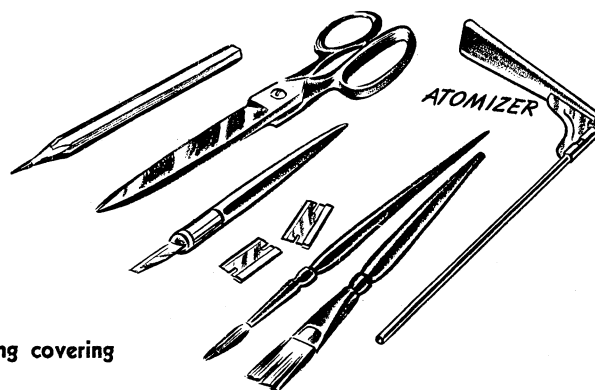
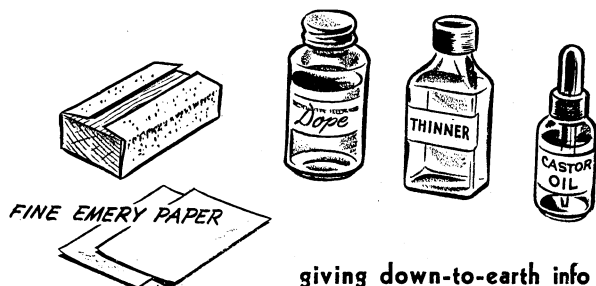






# Here's How To Cover That Plane!

TOOLS AND MATERIALS USED IN COVERING.  
Sharp cutting edges and good quality brushes are needed to do a good job of covering.



giving down-to-earth info on applying covering

● **What Material To Use:** If you're building your model from a kit, the necessary covering material undoubtedly has been supplied. If, on the other hand, you're building from magazine plans, you have a choice of covering materials, depending on the size and purpose of your model. Most common are rubber-model tissue, light and heavy Silkspar or Sky-Sail tissue, silk, and rayon.

*Rubber-model tissue*, as its name implies, is best for all types of rubber-powered ships, except for the larger contest types. On the latter, a heavier, tougher material may be employed on the fuselage to minimize tears. Tissue also is used frequently on small gas models and, on occasion, with numerous coats of dope, for large powered models.

*Silkspar-type materials* are used on all but the smallest gas models—particularly on U-control stunt and sport designs, where the wings take a beating. This covering may be applied either wet or dry. If affixed wet, Silkspar or Sky-Sail tissue dries taut, and is doped later. If applied dry, the covering is water-sprayed and then, after stretching tight, doped.

*Silk and rayon* are extremely tough materials and supply the durability needed on stunt models, the larger free-flights, radio jobs, sport ships, and so on. Applied either wet or dry, these materials give excellent, lasting finishes, but require several coats of dope to seal the pores. Both silk and rayon have the highly desirable characteristic of being capable of covering double curvatures found on faired pylons, wing tips and some fuselages.

**How To Apply Covering:** It is advisable to first coat the necessary members of the area to be covered with heavy dope, waiting for it to dry before going ahead. This helps fill the pores of the wood, making the material adhere better to the structure. Uncoated wood absorbs dope and sometimes makes your covering job difficult, especially in the case of undercambered wings.

For actual application of the covering, use heavy, clear dope to stick down light tissue, and a mix-

ture of half cement and half dope to stick down silk or rayon. If heavy Silkspar or other gas-model tissue proves difficult to fasten down, thicken the dope to a ratio of about one-third cement to two-thirds dope. However, don't use this thickened dope for over-all brushing of the completed job.

As a general working principle, covering material usually is applied at one end of the frame to be covered, then stretched taut and attached at the opposite end of the frame. Finally, the remaining two edges are secured.

For example, the side covering of a box fuselage should be applied (when dry-covered) to the foremost cross piece, then to the rudder post, and finally to the top and bottom longerons. After the tissue is in place, spray it with water. When it has dried, and the material is taut, brush on the final coats of dope. If the framework has been predoped, the dope will seep through the paper, adhering to all cross braces beneath. Other methods are apt to produce wrinkles.

In attaching the material, dope is first brushed on the wood, then the material is rubbed smoothly into place with the forefinger. Another coat or two of dope may be brushed on over the same area previously doped during the rubbing process, until the material shows no inclination to lift off the frame.

In the case of wet silk and rayon, the material should be stretched quickly in place and wrinkles pulled out. Then the attaching dope is brushed on in the proper places, and finally rubbed through to the wood with the forefinger. Whenever possible use wet covering, as it is easier to work with. The dope will bluish temporarily wherever it was applied, but once the covering has tightened and dried, this blushing will disappear with the secondary coating.

**How To Cover A Wing:** First, analyze the job in hand. Assuming you already have your material, and decide to cover dry, determine how many separate sections will have to be applied to avoid wrinkles. This, of course, depends en-

tirely on the type of wing and whether or not it uses dihedral, polyhedral or just tip-hedral.

*Straight Vee Dihedral:* This type of wing should be covered with four separate panels of material for best results—one each for the top and bottom of the wing on either side of the centerline. Some builders use three sections, with one long piece running from tip to tip or tip to center on the bottom of the wing, providing it is a flat-bottomed airfoil.

Attach one section of covering to the center rib. When it will stand a pull, stretch it fairly taut out to the tip rib, and again fasten down. Roll the tissue or other dry covering away from the trailing edge, then coat the edge with dope, and press the material back down. Work the material fairly taut, to the leading edge after having prepared that member with a coat of attaching dope. It makes no real difference whether the top or bottom of the wing is covered first.

Now attach covering to the same side of the opposite wing panel and trim away excess material. Then repeat the process on the top or bottom of the wing, as the case may be. Until the covering is sprayed with water, it is normal for the tissue to have a slightly loose appearance. Try to cover as evenly as possible, however, to avoid undue straining and warping tendencies.

*Dihedral with Flat Center Section:* Found most often on scale-type ships, this sort of wing can have its main panels covered with separate pieces of material, but the center section should be covered first with a small piece of covering. After trimming the center section, overlap the pieces that will cover the outer panels, at least an  $\frac{1}{8}$ " or more.

*Polyhedral:* The method used in covering this type wing depends on how many breaks there are. Most often, there is a break on the center line, and another on each panel, about two-thirds of the way out on the wing. In all, this makes four distinct wing panels which, to cover top and bottom, require eight pieces of material. If the bottom of the wing is flat, and is to be covered in one long

strip, then five pieces of material should be prepared, one each for the tops of the panels and one for the entire bottom of the wing.

*Tip-hedral:* This type of wing requires six rather than eight pieces because its center portion lacks the center break common on polyhedral wings.

**How To Cover A Fuselage:** Everything depends on the type of the fuselage and the material to be used. If the body is *flat-sided*, use one piece of material. Tissue may be attached at one end, then stretched slightly and fastened to the other; finally being doped down to the top and bottom longerons. Dry-covering with silk, rayon or Silkspar can be done in the same way. Wet-covering materials are simply laid over the frame, worked taut and wrinkle free at the outer edges with the finger tips, and quickly doped down while still wet.

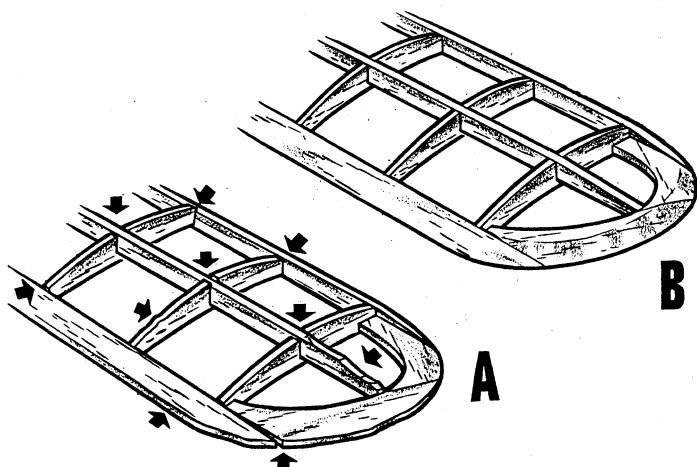
If the fuselage is *streamlined*, or has a *rounded fairing or nose section*, the job is a little more difficult. Silk and rayon, being capable of a simultaneous two-way stretch, can be put on in one piece when wet. If tissue is used, it is necessary to cut sections to do the flat portions first, then use narrow strips or gores which will cover the area between two or more stringers. How wide these strips should be, or how many of them should be used, depends on the design of the airplane. Sand away fairing formers between stringers, so covering won't touch.

For example, the *turtleback* or *top fairing* on an SE-5 scale model can be covered with one piece of tissue from the cockpit back to the tail. This piece is cut to a taper, with one end narrower than the other. If the material is trial-fitted, it can be worked so that the covering attaches easily only to the top longeron on each side.

However, if your plane fairing has a *double curvature*, it is necessary to use narrower strips of material to avoid wrinkles. If the curves are severe, these strips may only cover the area between two stringers at a time; if the curves are gentle perhaps three or more stringers can fall under one piece without wrinkles. After a

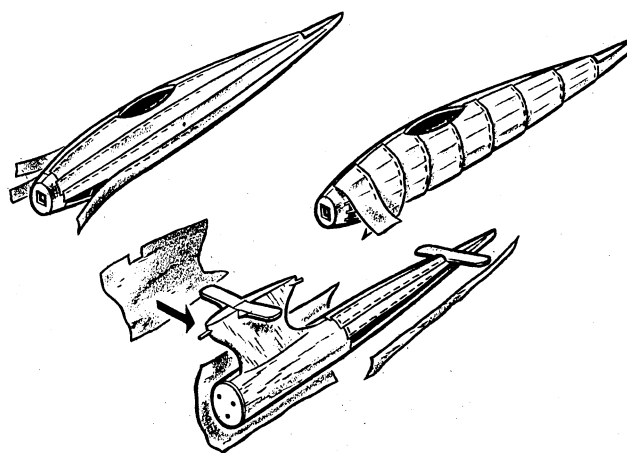
## PREPARING STRUCTURE FOR COVERING

No covering job will conceal the obvious defects of "A". Neatly cut parts, careful assembly, bevelled trailing edges and tips, and painstaking sanding on external surfaces assure good covering for wing "B".



## FUSELAGE COVERING

Cover rounded fuselages with fitted sections in lengthwise strips or former-to-former pieces. Silk can negotiate entire half in one piece. Cover solid or wood-covered parts with thin tissue.



narrow strip has been applied, trim away the excess material and lay down the adjacent material. At the end, you will have to trim the last strip while it is attached to its neighbors. Break a two-edge razor blade with your pliers and use this sliver to run down the desired seam, always pressing the point against a wood-supported surface. When trimming a section that is already covered underneath, hold a sharp razor blade against the excess tissue or silk, then pull this excess covering upwards, sheering it off. This prevents cutting the completed covering underneath.

With a *slab-sided fuselage*, the top and bottom panels follow after the sides, in any order. When trimming the top and bottom of the fuselage, always be careful that the razor does not remove paper from the sides of the longerons—if colored tissue is used white spots of wood will show through. After final trimming, rub the trimmed corners with heavy dope to fasten down all frayed edges.

**How To Cover Tail Surfaces:** The method here depends on whether the stabilizer is of the lifting type—in which case it is handled like a wing—or whether it is flat or symmetrical. Usually, a stabilizer can be done with two pieces of material—one for the top and one for the bottom. Vertical tails are almost always flat or of symmetrical cross section, and can be handled with two pieces of material, one for each side.

It is advisable to brace the bottom cross piece, or the rib of a fin which is attached to the top of the fuselage, otherwise the pull of the doped material will bow in this member. In any case, where two surfaces are involved, apply the covering to one side, then trim, finally adding the other side.

**Direction Of Grain:** As a rule, best results are obtained by affixing your covering material with the grain running lengthwise on a surface, as from nose to tail on a fuselage, or tip to tip on a wing. Chordwise grain on a wing, for instance, gives an appearance of extreme tightness. Actually, however, it bows between the ribs, distort-

ing the desired wing or rib section, and making it thinner between the ribs than it is at the ribs. This in effect gives the undesirable effect of a fast and slow airfoil section on one wing.

On light structure, chordwise grain also tends to pull the tips up, for a warped kind of dihedral. It also tends to tear badly if a weed should snag the bottom surface of the wing.

You can determine the grain direction by making small tears in your material—it will tear easiest along or with the grain.

**Water Spraying:** It is best to use an atomizer, or any fine sprayer, in wetting down a wing. If you don't have one, wet a cotton swab and rub it as gently as possible over the surface.

Do not force or hurry the drying of the wet covering. Well-made wings will not warp. But, in lighter models, where the structure is small and light in proportion to the thickness of the material,

it is advisable to pin or weigh down the wings and tails to the bench to prevent warps. The wet covering will not adhere to either bench or weights. Just be sure that weights are resting on the tip rib and the center rib and not on unsupported paper.

In wetting a polyhedraled wing, try water-doping one panel at a time, holding it flat on the bench while drying.

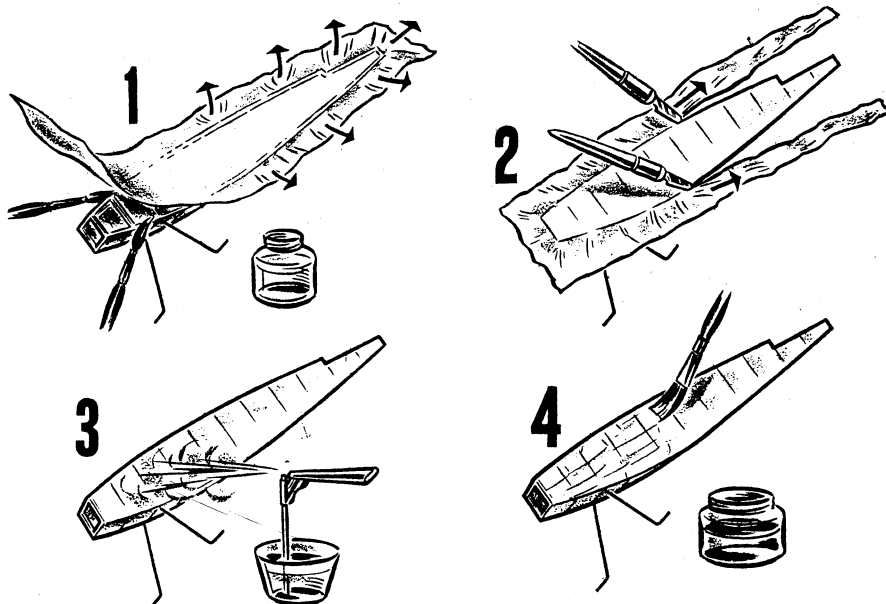
Do not water-spray in a chilly room when rubber model tissue is being used or it will dry with a kind of crinkled, loose appearance.

**Final Doping:** More bad warps result from careless doping than from all other causes put together. One good precaution is to cut your dope with thinner to a half and half consistency.

With *tissue*, use a minimum of two coats on a small model, and from three coats up, depending on the size, on larger ships. A large rubber model or

## STEPS IN COVERING A FLAT SURFACE

1. Using cement-thickened dope, brush outer edges of area and pat tissue down smooth, pulling outward evenly all around. 2. Trim excess neatly, holding it taut as you trim. 3. Spray water evenly to saturate paper. 4. Apply one or more coats of thin dope with large, flat brush.



small gas model needs at least three such final coats.

The wise builder makes his last coat with a *plasticized dope*. This prevents further pulling of the paper, resists warps, and gives the paper a more durable, flexible translucent quality. Plasticized dope is made by mixing about three drops of castor oil in a two-ounce jar of dope. Use no more than five drops of oil, or the covering will get a faint gummy appearance. Plasticized dope also lends a sheen to colored covering tissues.

When silk or rayon are used, numerous coats of full-strength dope should be applied. As a rule, six or more coats are needed to fill the pores. Close examina-

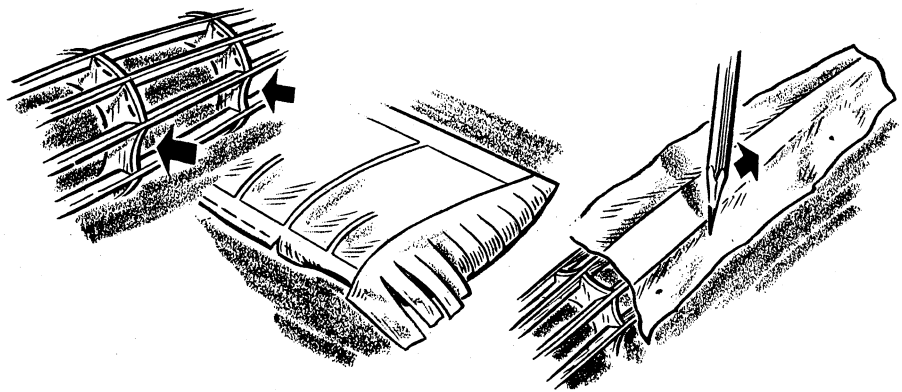


#### FOR ADDED STRENGTH

To add toughness, double-cover center sections and other parts subject to damage, with grain of second sheet crosswise to that of the first.

tion of the surface will show you whether or not the pores are filled.

One easy test is to try blowing through the wing from bottom to top while holding the palm close to the top surface. If you can feel warmth on your



#### SPECIAL COVERING TIPS

Upper Left: "Scalloping" formers between stringers prevents unsightly bulges and wrinkles in covering. Lower Left: Lap covering around leading edges. Cover compound curves and solid tips by pleating. Right: Mark long tapering gores by drawing side of lead along stringer edges.

palm, the wing needs further doping: Rayon does not appear to pull more tightly under doping than it was already under the wet covering or water-doping, but silk will continue to pull terrifically. Therefore, with silk a plasticizer is desirable. A strong structure should be used for silk covering if you intend to dope it well without a plasticizer. We have seen silk warp ribs badly, and crush sections of the fuselage.

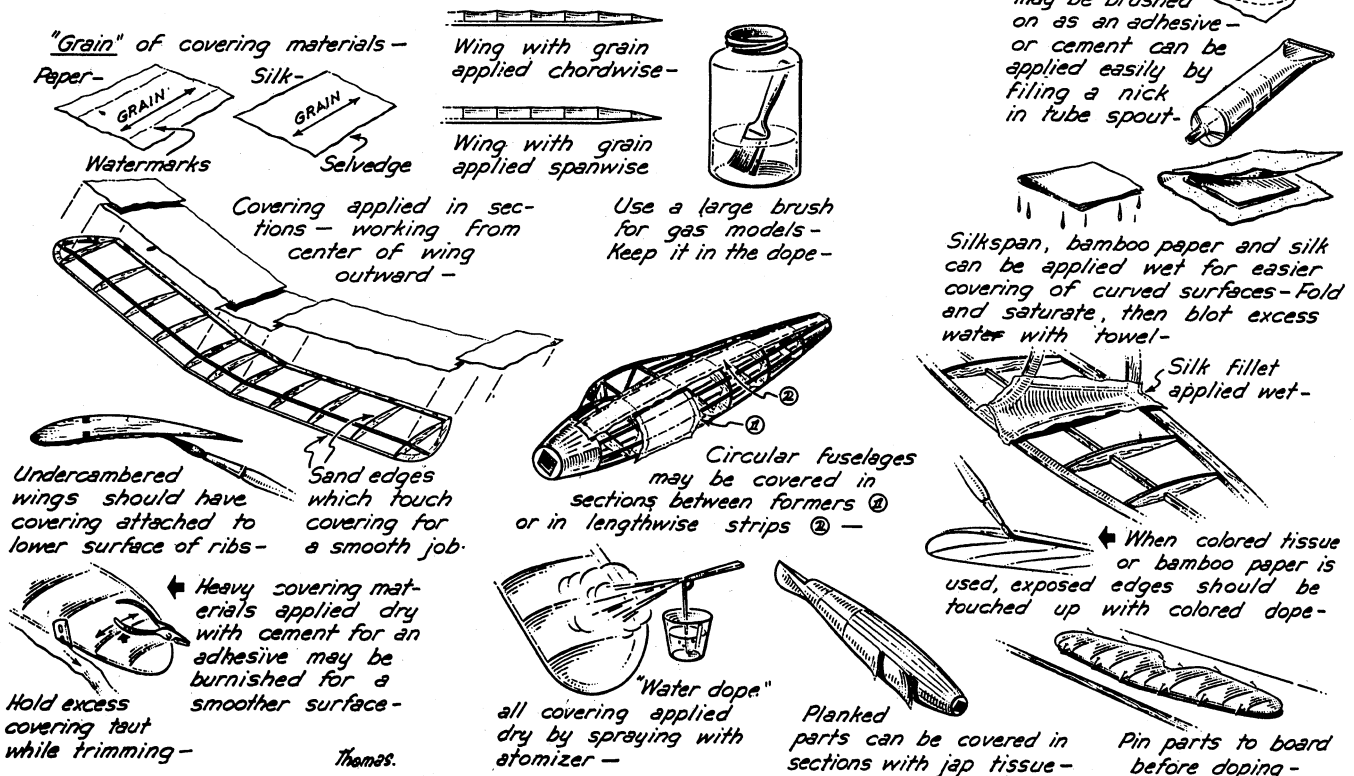
*Silkspan-type covering materials* sometimes require several careful coatings of dope to avoid "leaking" wings. Open pores permit a loss of lift, because the positive-pressure air beneath the wing seeps through the wing to the low-

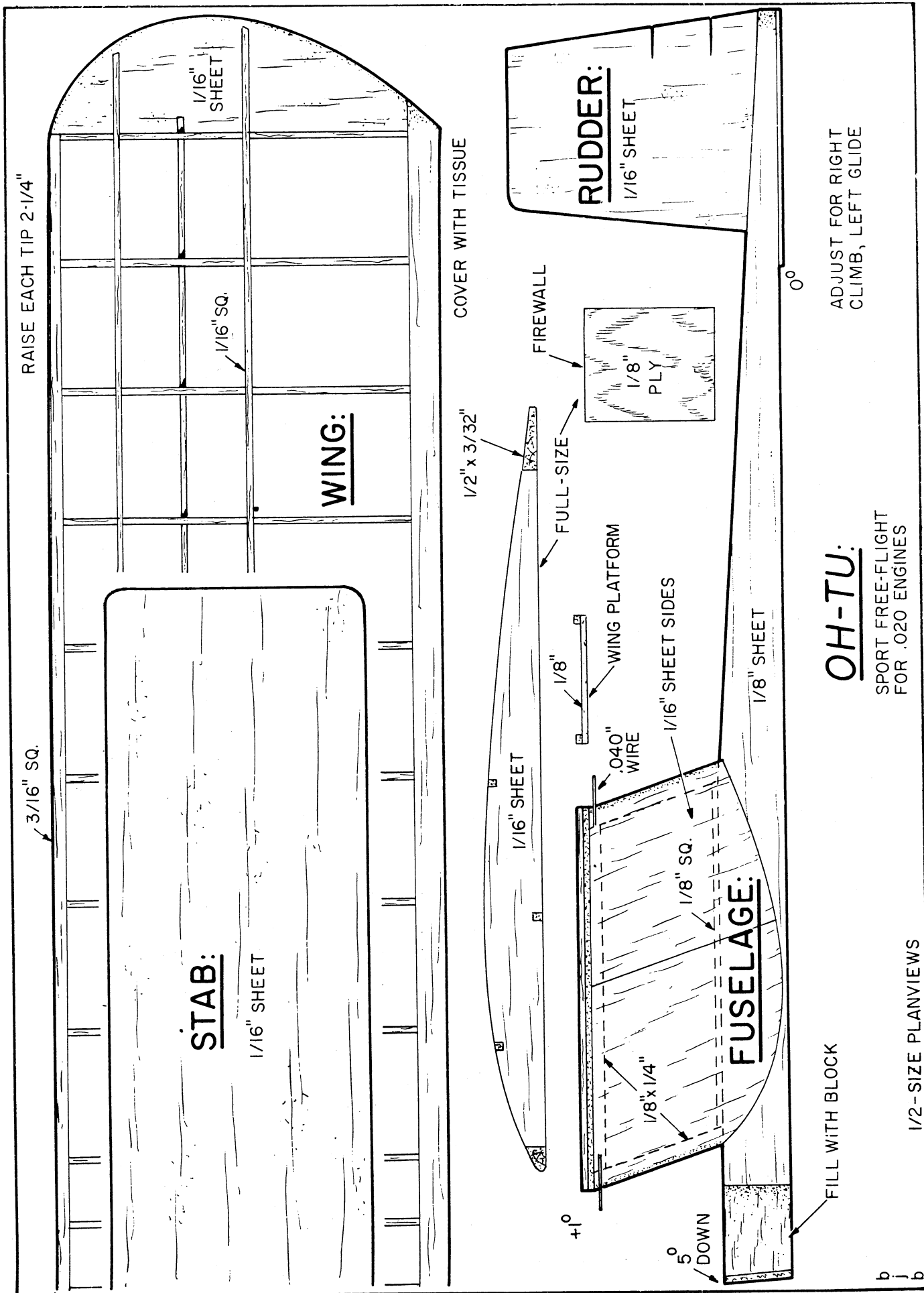
pressure air area just above the surface.

Quite frequently you will find models that refuse to glide and seem greatly out of trim (nose-heavy). When no other reason seems evident, look carefully at the surface. Sometimes Silkspan or Sky-Sail tissue-covered wings that have remained closeted for months will require a fresh coat of dope before another flying session.

When for no apparent reason your model suddenly begins to need positive incidence in the wing, or negative incidence in the tail, the wing is either not doped sufficiently or dampness is causing loss of lift through loosening of the covering material.

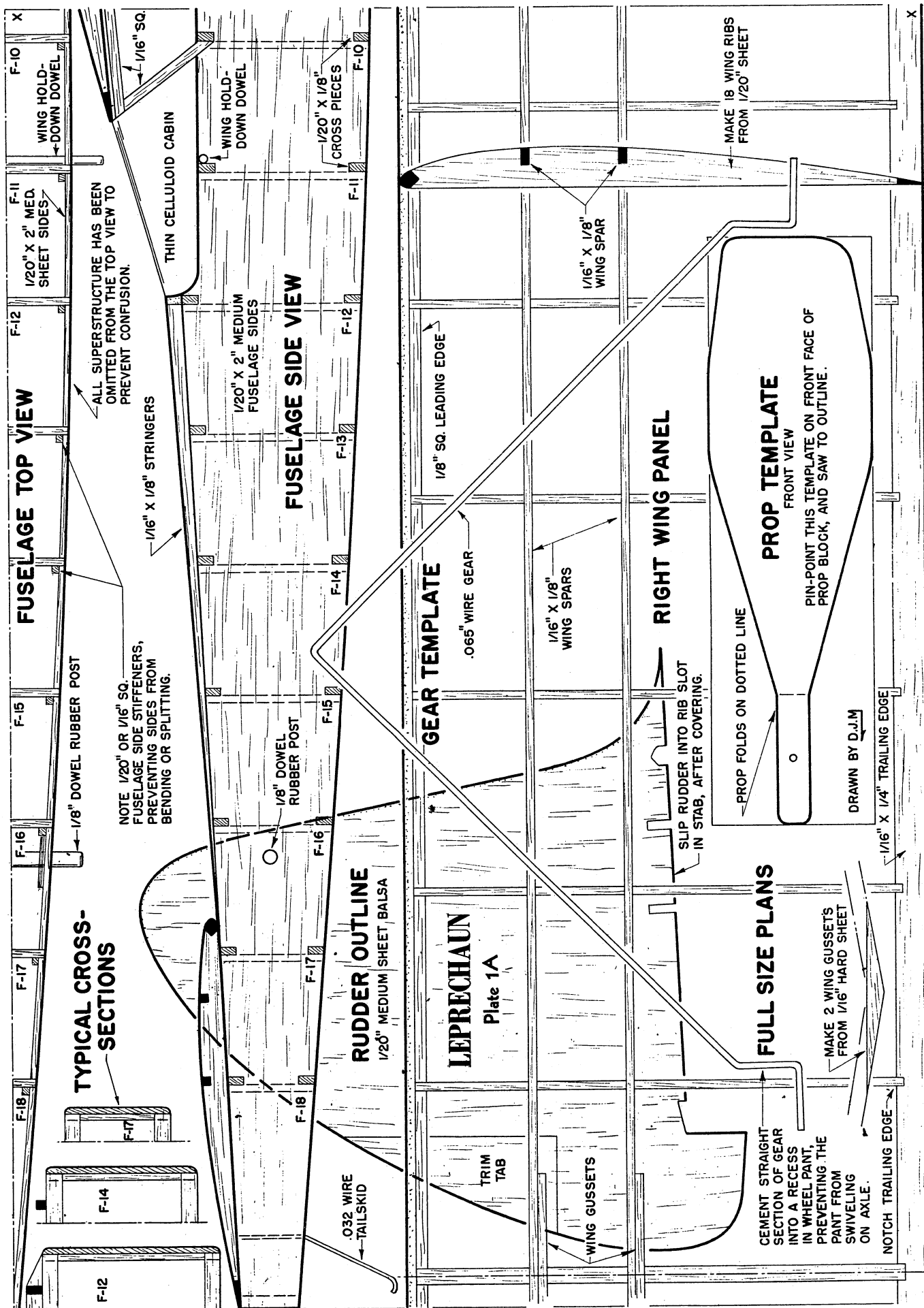
## Tips On Covering

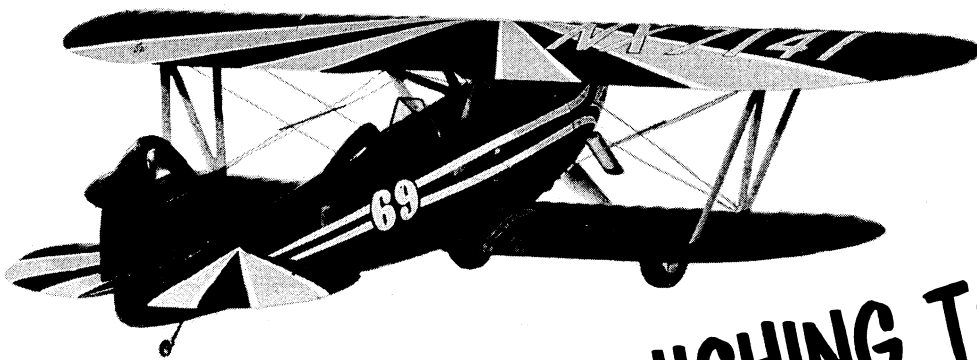












# THE FINISHING TOUCH

The winner of the \$1,000 Testor Perpetual Trophy for the Best Finish on a model plane gives you step-by-step instructions for obtaining a smooth and glossy contest-winning finish on your model airplane

● How many models have you seen with that really high lustre of a fine finish? It really shows off good workmanship and in many cases wins contests. All the speed experts agree that the surface of your plane should be smooth and glossy. In stunt competition, the outcome of a contest can ride on that extra 8 or 16 points for appearance—and I have seen beautifully finished scale models win over finely detailed jobs. When the competition is tough and the chips are down at a contest, next to performance, it's the finish that counts.

As you undoubtedly have discovered for yourself, a really brilliant finish is not obtained by an extra coat of filler, as we so often have read. Don't let me scare you though; there is nothing very difficult about getting a smooth, glossy finish—if you understand what you are doing, and don't mind investing a little time. No matter what class of gas model you build, it has to be finished—so why not do it right? Remember, a good finish is the mark of a fine craftsman.

With the introduction of glow plug engines and glow fuel, the choice of materials is a major problem. Of course, if you are using an ignition set-up, you can

work with the old standby: aircraft dopes.

Many models are now finished with regular nitrate dope, then covered with fuel proofer. This is not very satisfactory if you desire a really brilliant finish, but it is O.K. for sport flying. For a completely fuelproof finish, one that can be polished better than any real plane or automobile, nothing will beat the fuelproof color dopes now on the market. The ones we've tested are Aero Gloss, Testor's Sta, and Midwest Fuelproof Dope. We used Aero Gloss on the little biplane in the picture, but have found the others mentioned do the job equally well.

On any surface where fuel is likely to soak up from underneath, from a broken gas tank or crash, we use fuelproof finish from the very start. You can never repair the job once the undercoating is made gummy by fuel.

On the other hand, these fuelproof finishes are expensive; so use them only where necessary. It is perfectly safe to use Speed-O-LaQ or regular airplane dopes for the undercoating and filler on the wings and tail surfaces of your ships, where there is no danger of damage by fuel.

Before we start painting, let's

look at the construction. It goes without saying that the workmanship on your model should be the best of which you are capable. A good finish really shows off good workmanship, but it equally shows up poor construction. So make sure yours is the finest.

In connection with the finish sanding and shaping, let us emphasize two things. First: "A sanding block is worth its weight in gold." We use the two sizes of Xacto sanding blocks in all our work: the large one with coarse (80D) paper for shaping, and the small one with the real fine (32DA) paper for smoothing rough wood. They are made just right for all kinds of shaping.

The second thing to remember is that "Attention to detail adds polish to the finished product." Make all the cemented joints, fillets, covering joints, and blocks with an eye toward perfection of detail, and keep visualizing what each part will look like with paint on it.

Now we are ready to paint that fine scale, semi-scale stunt, or streamlined speed job. First: lay out a plan of attack. That is, figure out in what sequence the parts will be painted. On a speed job or a monoplane, the whole plane can be finished at once. A biplane requires a much different treatment.

Our little biplane is of all built-up construction, covered with silk. After building the whole plane, we covered the tail surfaces and fuselage except for the bottom, which we left open. We completely finished the body before putting on the wings. Then we first put on the bottom wings, joining the spars through the bottom of the body. Next, we finished the mahogany struts and put on the top wing. We wound up by covering the rest of the wings with silk and painting them. Remember, on a biplane, to finish and polish the

bottom of the center section of the top wing before putting it on.

Now, let's get to work on that job of yours.

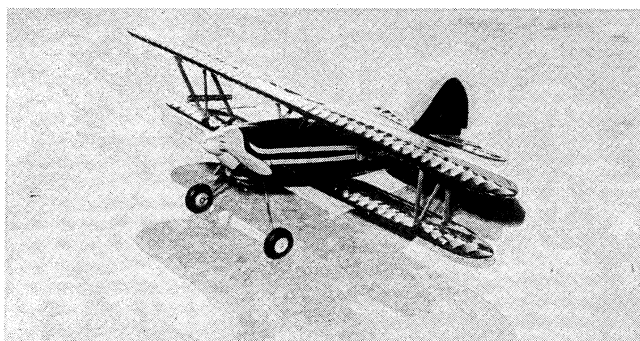
**COVERING:** If the body is balsa-planked, or a balsa block (like a speed job), cover it before painting. Use silk with the weave on the bias to cover two-way curves, and silkspan on the flat surfaces. This not only adds greatly to the strength of the wood but it is the only way we have found to make the finish stay flat.

If bare wood is finished, you can get the paint polished to a brilliant shine. But, a couple of weeks later, as the paint hardens, it will draw down into the grain of the wood and into the cemented joints.

We saw the paint on a beautiful scale Navion crack when taken out into the cold. It was sanded down, covered, and refinished and it held up well. This plane was built by Fred Dunn, designer of the Testor scale model line. He won second place in the Beauty Scale Event at the 1949 Mirror Meet. He also won the National Scale Exhibition held in Cleveland, using this same scale Navion.

**SANDING:** After covering, brush on two or three coats of clear dope and allow to harden. Then knock off the fuzz with No. 320 Wet-or-dry auto refinishing sandpaper (available at any auto paint store). Cut the sandpaper into 2" squares and use it dry. Wet sanding is a mess at best and you can't see what you are sanding. With the right choice of materials, the paper won't fill up—all you have to do is wipe it to clean it.

**APPLYING FILLER:** Now comes the question of a filler that is easy to work with and will stay put. We have used commercially available fillers and undercoatings and found some of them to be good but not better than home-



made filler. Take clear dope—fuelproof or whatever kind you have chosen—and shake in some talcum powder. I use Johnson's Baby Powder. Mix this up in small amounts because you always want the same consistency. Mix about four parts dope to one part powder. If you have too much powder, the surface will be chalky and soft.

Brush on about three coats of this filler, thinned to a good brushing consistency. You don't need to worry about spreading it on as thin as possible—just get it on. When this is thoroughly dry, take your little squares of fine sandpaper and go to work. If you have mixed the primer right, the paper will not fill up and good smelling talcum powder will sand right off, leaving the surface feeling real silky.

These first three coats will not sand down enough to get rid of the grain in the silk. Try three more coats and sand until it is smooth when you hold the model up to the light, and the grain of the silk is invisible.

The principle in undercoating is to fill the pores in the silk or silkspan—not to build up a plastic crust on the model. Filler that is piled on is just added weight. When you put on a coat of filler, you fill the holes—but you build up the high spots too. So you have to sand them down to the same level as the filled low spots.

**SEALING THE UNDERCOAT:** Now we are ready to put on the color. Put one coat of clear over the whole surface. This seals in the talcum powder and keeps the color from looking

chalky. Make sure that all the cement fillets are coated with clear fuelproof dope or Aero Gloss Cement. This is important because it prevents the fuelproof color from working loose from the fillet and making a great big fillet. Just coat all the corners and fillets with fuelproof cement, wipe off the excess with your fingers, then wipe your fingers on your pants (if you want to start a war around your house).

**APPLYING COLOR DOPE:** Now mix your color dope just a little thinner than usual for brushing, and brush on about six coats. Don't be alarmed when you see the grain of the silk show right through the color dope. This will rub right down if you have prepared the surface correctly.

**RUBBING:** Next comes the rubbing process, the most important step in obtaining a fine finish. If it is performed properly, a good rub job will give your model that high lustre you are seeking. Use fine or medium-fine rubbing compound, available at any auto paint shop.

Old flannel pajamas make good rubbing cloths. Take about a 10" square and wrap it around your first two fingers. Now just pat the rubbing compound until the flannel is discolored—too much rubbing compound won't cut the paint at all. Now, just rub the painted surface as you would with sandpaper. If light spots begin to appear about the time the paint is getting smooth and glossy, clean the surface thoroughly and brush on about four more coats of color.

When rubbing a silk-covered wing or

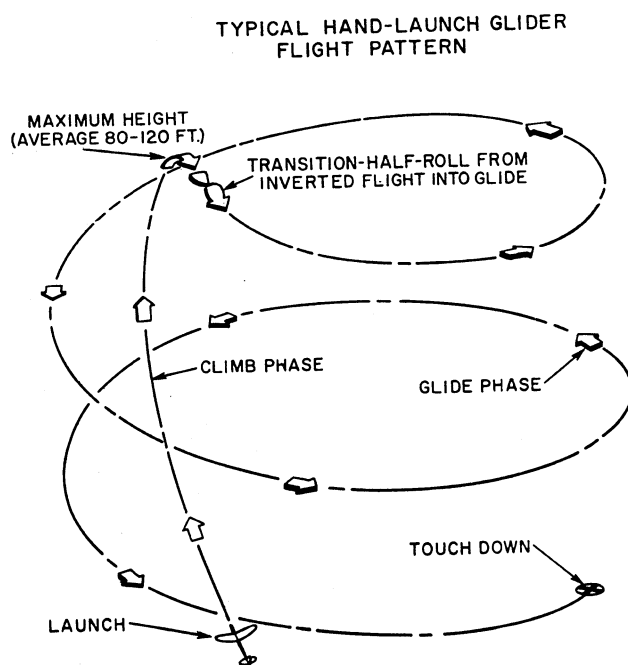
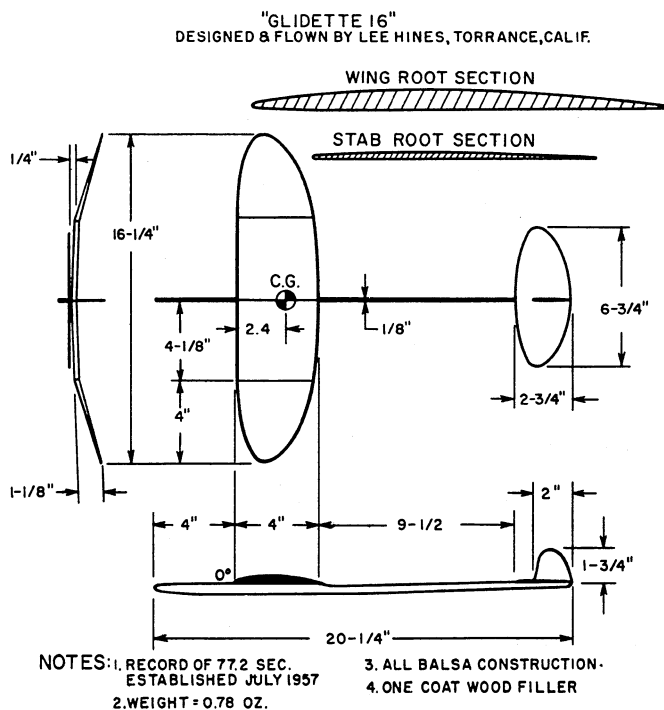
built-up surface, steer clear of the edges. By the time you get the center of each section done, the edges will be plenty smooth.

Finish the rubbing process with Simoniz Kleener. This is a fine compound and should be used very sparingly and quickly. It does not take long—just go over the surface lightly to obtain that high lustre.

Now a word about your choice of colors: If you want a really outstanding job, use a darker color. But, beware!—a dark color, like a mirror, shows up the slightest imperfections. On a dark plane, I finish and rub the plane completely before painting on the lighter trim. I find the lighter colored trim then only takes a little rubbing to polish it.

**WAXING:** Complete the job with a couple layers of good wax. While at the 1950 Nationals in Dallas, Lou Andrews gave me some Butcher's Wax. It gave my model the best wax finish I have seen yet, and I didn't notice that the glow fuel bothered it much. He says that it is a high grade furniture wax and can be purchased in furniture stores or furniture repair shops.

Whenever you are in doubt about a new type of finish material, or a mixture of finishes, don't depend entirely on what anyone tells you. Just try out whatever you have in mind on an old model. Paint a small section, exactly duplicating what you will do on your good model. Once you get the finish on a new model checked or cracked, it is a difficult job to repair it. So proceed with caution and avoid disappointment!



# Jet POWER

A simple approach to rocket-age model projects, properly used Jetex motors can provide fun

● The Jetex motor, now seen popularly on model fields around the nation, is a simple and safe answer to the current trend of building rockets and missiles. Operating on a solid fuel pellet, the motors function exactly like full-scale rockets and are capable of extreme amounts of thrust in consideration to their size and weight.

The motors are available in a variety of sizes providing many possibilities for design and flight. Most popular today are the small and sporty Jetex 50 units which can be used for craft spanning slightly more than the average handlaunch glider. When greater power is desired, the modeller can choose one of the other three units, the last of which is the super-sized Scorpion motor.

Perhaps the most striking advantage of these motors is the complete ab-

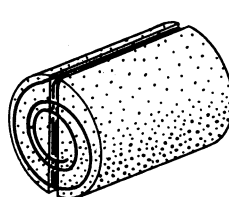
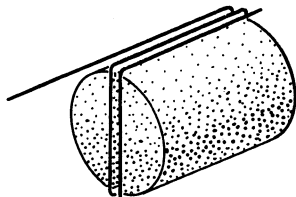
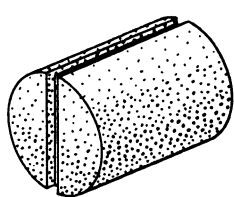
sence of torque since there is no propeller. The units operate on Newton's Third Law which specifies that "To every force there is an equal and opposite action." On burning fuel, the pressure at the nozzle expels the gases and the motor moves due to the "opposite" force on the container.

Each motor is a self-contained unit and is attached to the model by a simple mounting clip. A single motor can, consequently, be used on several models of similar size and weight. Although there are no moving parts to wear out, regular cleaning of the motor is a necessity along with occasional replacement of the sealing washers. The purpose of this article is to discuss the use and operation of these motors with the intention of conveying methods for better and more efficient operation.

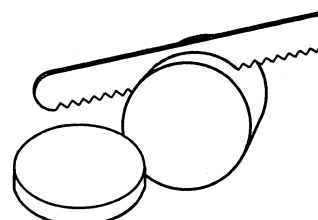
Because of the simplicity of these motors, they are often handled without due care or consideration for their design. A simple thing like loading is often the cause of unnecessary problems. The charges should fit easily into the motor case. If this is not so, you should clean the interior of the case to assure the removal of all fuel residue and sand the sides of the charge down if binding still persists.

"Keep your power dry," has always been a good axiom and it applies to Jetex fuels too. Damp charges lose power so make sure to store them in a dry container and not on the ground when out flying. Even damp atmosphere causes small beads of condensation to form on the fuel, if they are left exposed for any great period of time.

Proper sealing cannot be over-emphasized. The sealing washers must

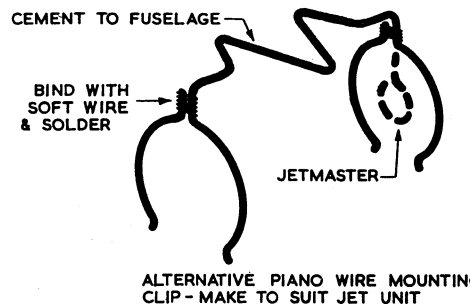
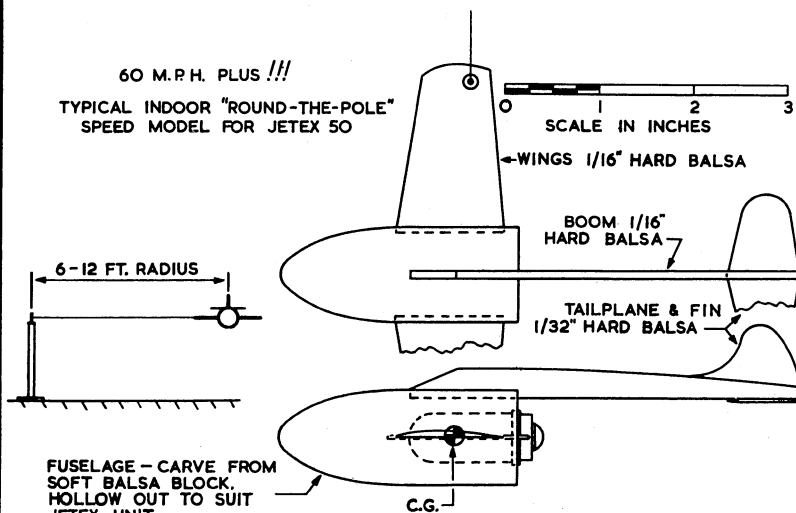


TO INCREASE THRUST CUT GROOVE IN SOLID FUEL PELLET AS SHOWN. WIND ABOUT 9" OF IGNITER WICK TWICE ROUND THE PELLET IN THE GROOVE. COIL LONG END IN SPIRAL AGAINST REAR FACE OF PELLET. LOAD INTO JETEX MOTOR CASE IN NORMAL MANNER.



FOR SHORT TEST FLIGHTS CUT FUEL INTO QUARTERS

60 M.P.H. PLUS !!!  
TYPICAL INDOOR "ROUND-THE-POLE"  
SPEED MODEL FOR JETEX 50



IGNITER STICK FOR USE WITH AUGMENTER TUBE  
1/8" SQ. Balsa WITH END SOAKED IN A STRONG SOLUTION OF SALTPETRE AND WATER



seat securely to get the maximum power from the motors. "Blow by," the loss of gases past the motor cap, can be detected by the formation of brown stains or smears on the side of the motor case. When you see these form, replace the gaskets and clean up the seating edge of the case.

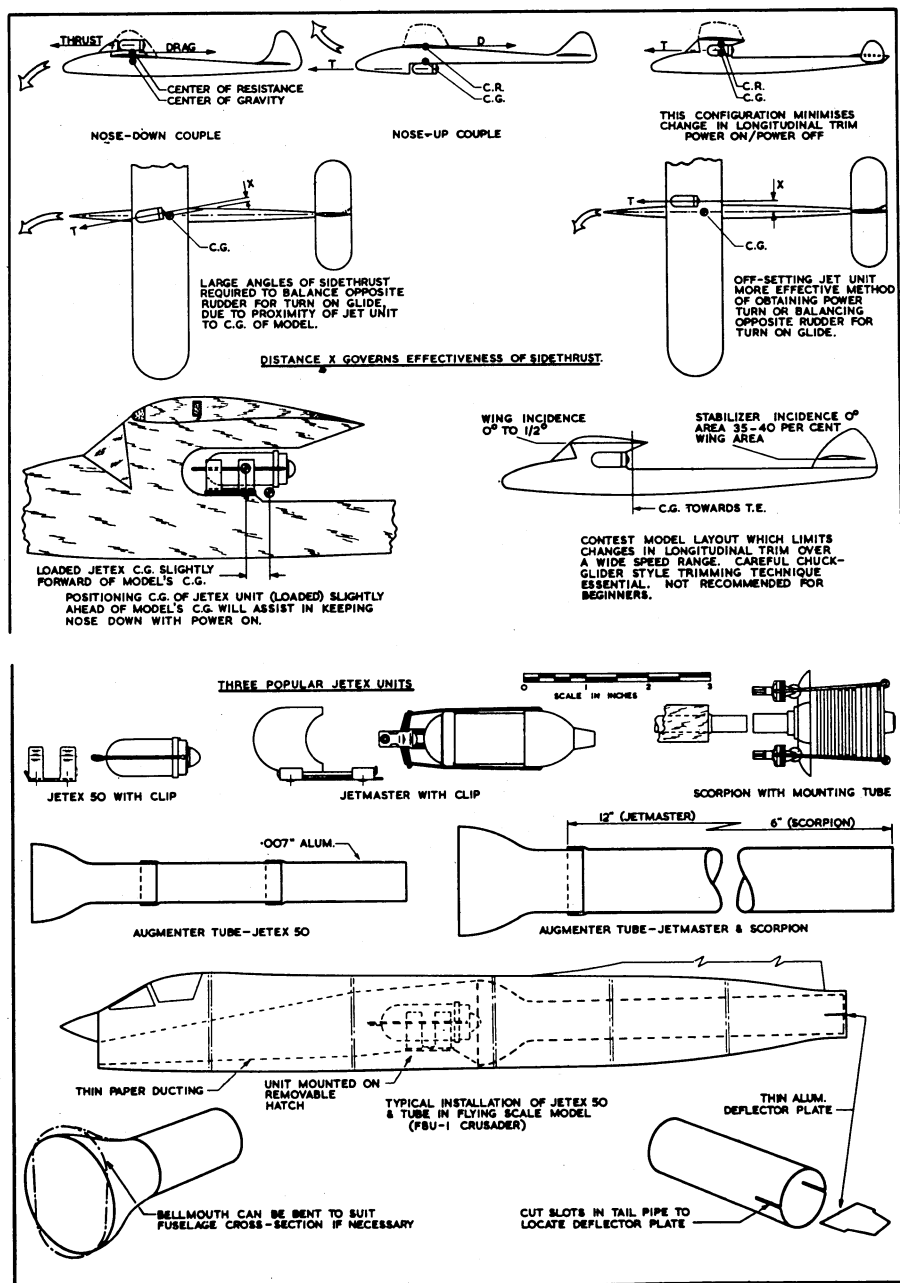
Perhaps the most alarming thing about Jetex is the highly corrosive nature of the hot gases which are generated during burning of the fuel. Only thorough cleaning after use can prevent the container from being permanently damaged, since the corrosive action continues all the time that the aluminum cases are contaminated by the burnt charge. After each day's flying, strip the motor down and give all of the metal parts a kerosene bath, then scrape the corrosion away from the motor with a piece of hardwood. Follow this with a bath in soapy water and a final rinse in clear water. Dry all of the parts thoroughly and then oil all of the ferrous parts with a thin film of oil before reassembly. A Jetex motor, simple as it is, requires the same care and maintenance as other engines.

When re-loading, follow the manufacturer's instructions carefully, making sure that the fuze is tight up against the fuel to prevent a misfire. If your unit fails to eject the wire core of the fuze on igniting, you may have to pull it out of the case using care not to grab the nozzle of the hot engine. This minor blockage will cause loss of power and often tends to cause a turbulent jet flow from the nozzle. The new V-Max fuels can be loaded without using wire screens to hold the fuze in contact with the fuel. Make sure that you use sufficient fuze inside the case to cause ignition but try to keep this near the minimum that it takes to do the job. A straight piece of fuze pushed through the nozzle, and broken off about  $\frac{1}{4}$ " from the jet orifice, will light the new fuels and cause the fuze core to blow out on lighting.

Cleaning of the jet orifice is periodically necessary since the burnt fuels tend to cause a caking around the edges. This is noticed when the fuze is loaded and the fine limits of fuze-to-hole are disturbed. Use a wire cleaner that is the same size as the hole—never force larger cleaners as the increased hole size will reduce power.

Although the Jetex craft is a basically simple thing, trimming procedure for flight is almost exactly the opposite of that used on other power models, particularly those powered by rubber. In the latter case, the power dwindles down as the model climbs skyward. Jetex models tend to increase their speed as they go up and generally follow a path of constant acceleration all through the power pattern. This is due largely to the fact that efficiency of the model increases as the model's speed builds up—the thrust output stays about constant throughout the entire run.

Because of this power build-up, models often tend to loop, spin, or



reverse turn toward the last few seconds of power flight. In general, it is wise to make the model on the larger, or heavier, side to take care of this characteristic.

The sketches accompanying this article indicate some of the set-ups which can prove ideal. Power flight should be arranged to obtain a straight, or near straight, climb. Setting the center of gravity (point of balance) of the Jetex unit (loaded) slightly forward of the model's balance point will assist in keeping the nose down under power.

In other words, a model should be trimmed for a slightly "nose heavy" condition until the charge burns away. To maintain a straight climb, it is best to offset the Jetex motor to the side, twisting it with relation to the model's centerline, and compensating this by offsetting the rudder until this side-thrust is neutralized. Due to the

motor's proximity to the center of gravity, very little side, or down, thrust can be achieved by swivelling the motor unless angles of about  $10^\circ$  are applied. Positioning the motor to one side of the model often proves more effective.

Tables are included to give approximate sizes for models using Jetex motors. If you have doubts as to size, a safe way is to build the models on the bigger side which produces a model that is virtually underpowered.

For contest flying, where it is necessary to get the utmost out of a model, a smaller and more powerful ship is necessary. Light weight is an important factor too. The smaller and lighter a model is, the faster will be the rate of climb—and the more critical it will be to adjust. Naturally, it is necessary to take chances to get the highest possible altitude.

The limit on minimum size then be-

JETEX UNIT	LOADED WEIGHT IN OZS.	CHARGE WEIGHT IN OZS.	STATIC THRUST IN OZS.	THRUST DURATION IN SECS.	MODEL SPECIFICATIONS				
					WING AREA IN SQ. IN.	APPRX. SPAN IN IN.	WING SPAN IN IN.	WING WEIGHT IN OZS.	WING WEIGHT IN OZS.
35	250	094	375 TO 500	7 TO 8	30 TO 40	10 TO 12	10 TO 12	625 TO 750	
50B	328	109	500 TO 625	12 TO 15	40 TO 55	12 TO 16	12 TO 16	750 TO 1250	
50R (ROCKET)	380	109	3500 TO 5000	4 TO 5	70 TO 130	20 TO 30	20 TO 30	2250 MAX.	
JETMASTER	938	250	1375 TO 2250	13 TO 15	130 TO 150	30 TO 30	30 TO 30	4500	
SCORPION	2000	375	5500 TO 7000	8 TO 10	175 TO 320	35 TO 48	35 TO 48	15000	

• WITH AUGMENTER TUBE

comes the amount of wing area required to produce a slow and soaring glide coupled with a design that is capable of maintaining stability under excess power.

Regarding longitudinal stability, a good contest layout is similar to an all-balsa handlaunch glider where the ship is trimmed with a minimum amount of longitudinal dihedral—the wing and tail being set as close as possible to zero-zero with relation to each other. This setting minimizes the possible changes in longitudinal stability between high-powered and slow-gliding flight. Obviously, this means

trimming with the center of gravity well aft, near the trailing edge of the wing, and reduces the “static margin” or inherent stability of the ship. Careful and patient flight adjustment is, therefore, essential for ultimate success.

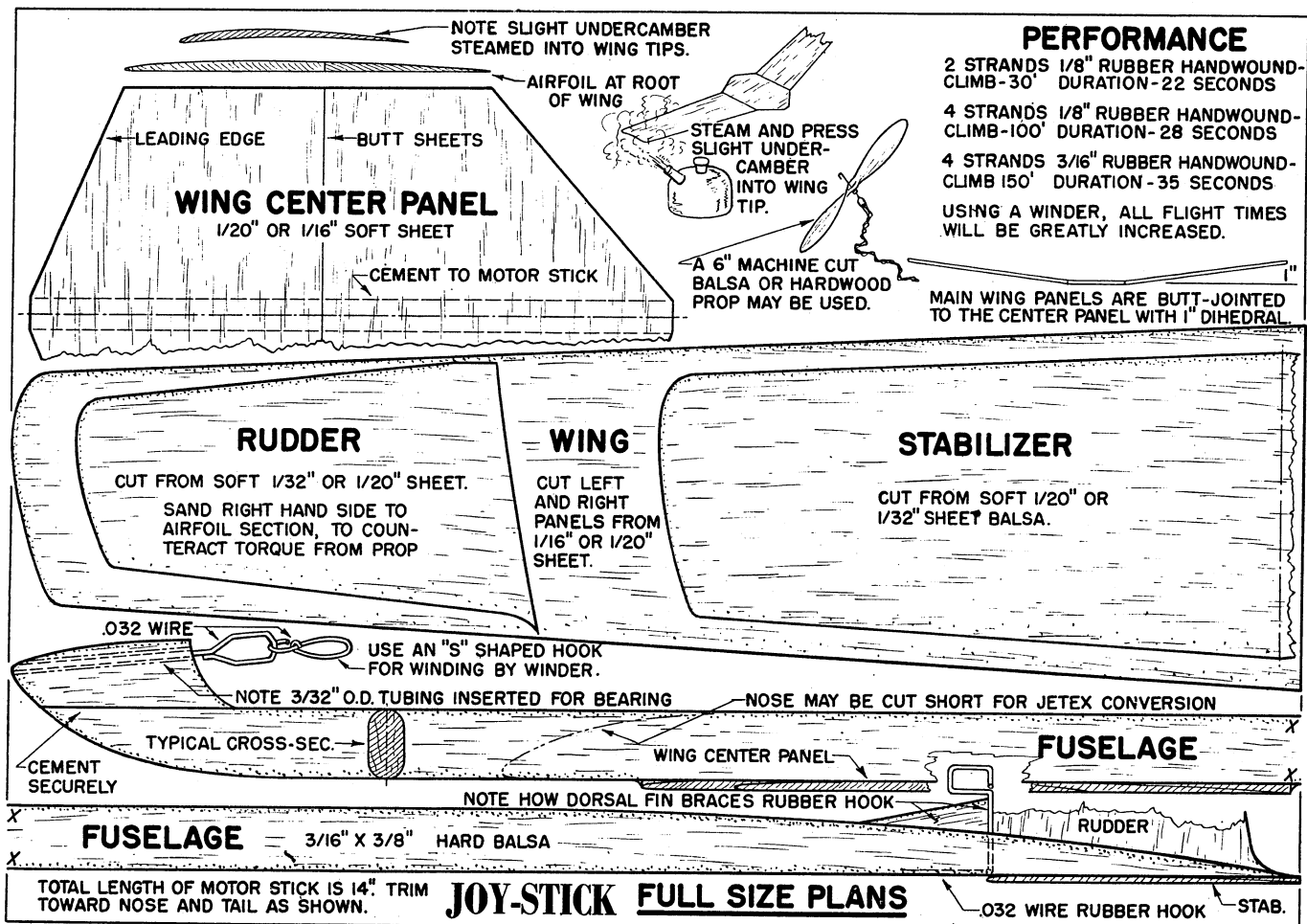
Flying wing designs are particularly suited to Jetex power. Models of this type, usually sensitive to torque, can be trimmed with relative ease if they are built large enough to handle the power. Note that the overall drag is considerably reduced which means that the models should be built at least twice the size, in wing area, as conventional wing and tail ships. Longitudinal stability on wings is achieved through the use of up-turned elevons or flaps making them sensitive to longitudinal trim because of the high/low speed pattern.

A small highspeed ship, therefore, will require a thrust line mounted fairly high above the wing and the exact amount can only be found by trial and error tests. This again emphasizes the need to build ships very

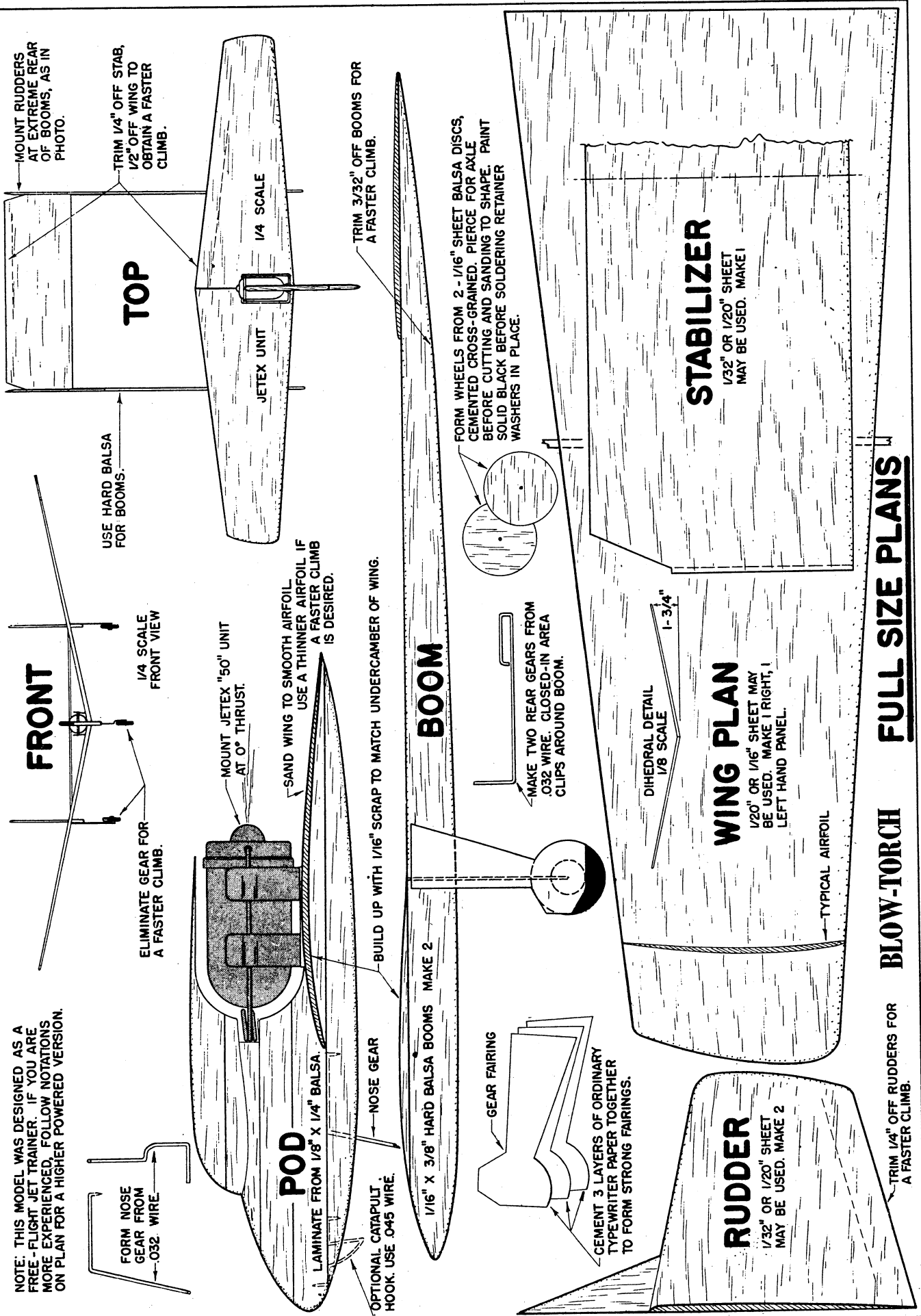
large until the stability problems are solved.

Jetex is reaching the point of general acceptance in all phases of design. Current model designs are centering on VTO rockets and missiles with more than limited success. As an example of some of the things which can be, and have been, done we'd like to point to successful helicopters, autogyros and delta wing craft. PAA Load models have shown modellers that rise-off-ground flights can be accomplished with great sporting success.

Though most models are built with the motor hanging out in the breeze to facilitate cooling (providing greater efficiency), this type of power is suited to internal mounting in jet scale models. Structural simplicity and lightweight installation provides many successful models. Use of augments tubes provides high thrust and aids internal mounting. Not to be forgotten is the fun that can be had tethering these models for single line speed flying. All in all, here are many possibilities for safely powered rocket models which can add pleasure to our model building.

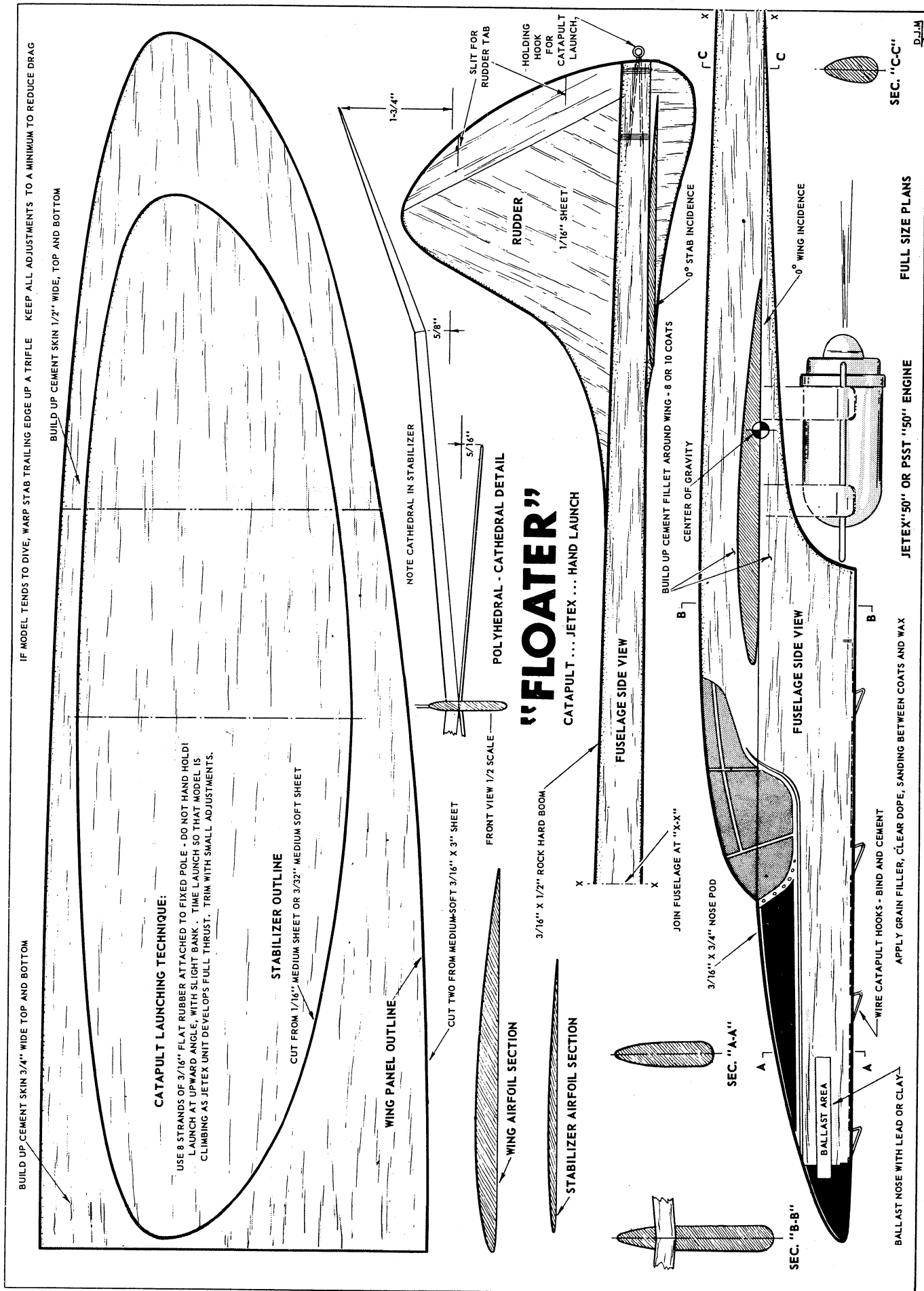


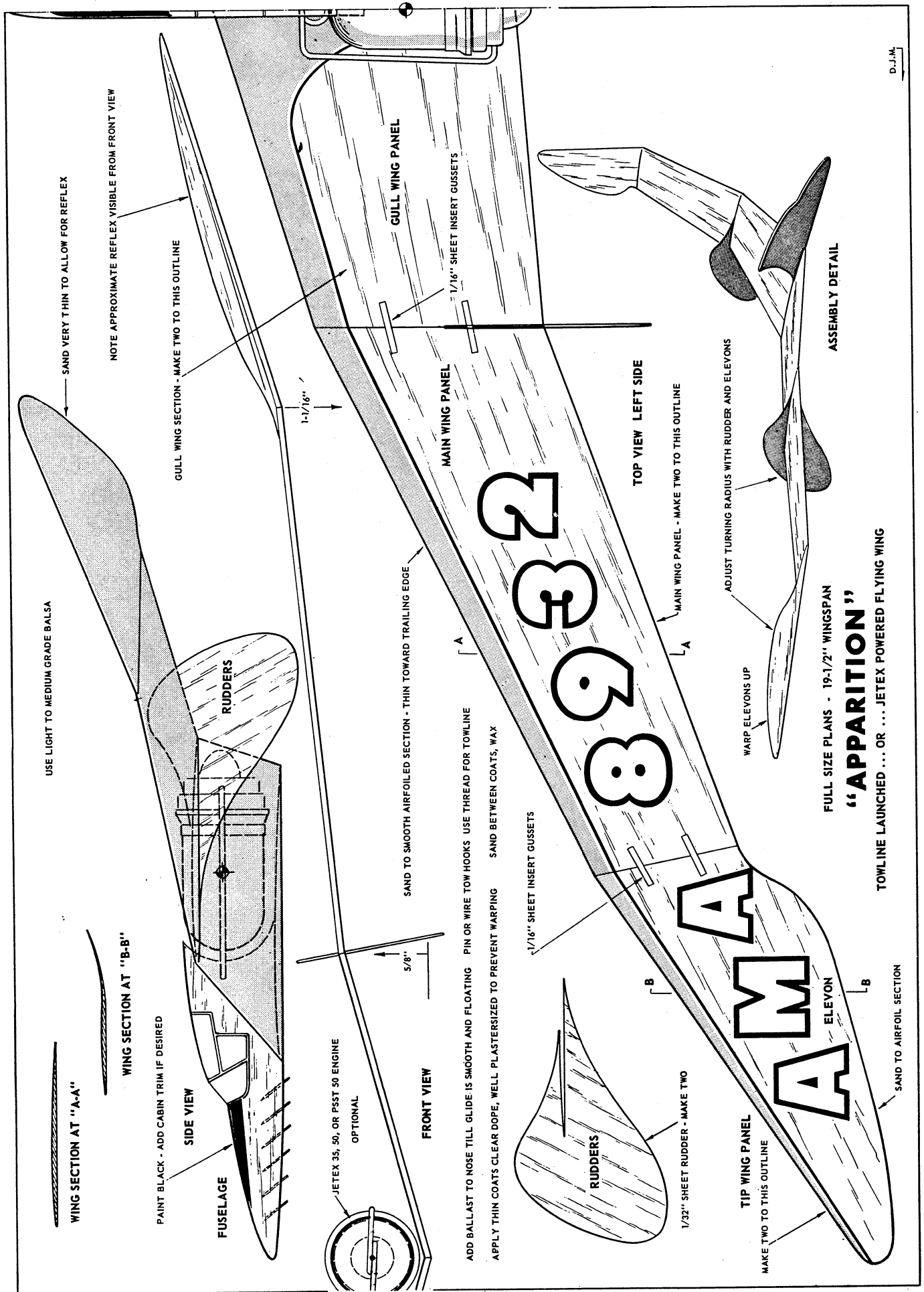
NOTE: THIS MODEL WAS DESIGNED AS A FREE-FLIGHT JET TRAINER. IF YOU ARE MORE EXPERIENCED, FOLLOW NOTATIONS ON PLAN FOR A HIGHER POWERED VERSION.



**FULL SIZE PLANS**

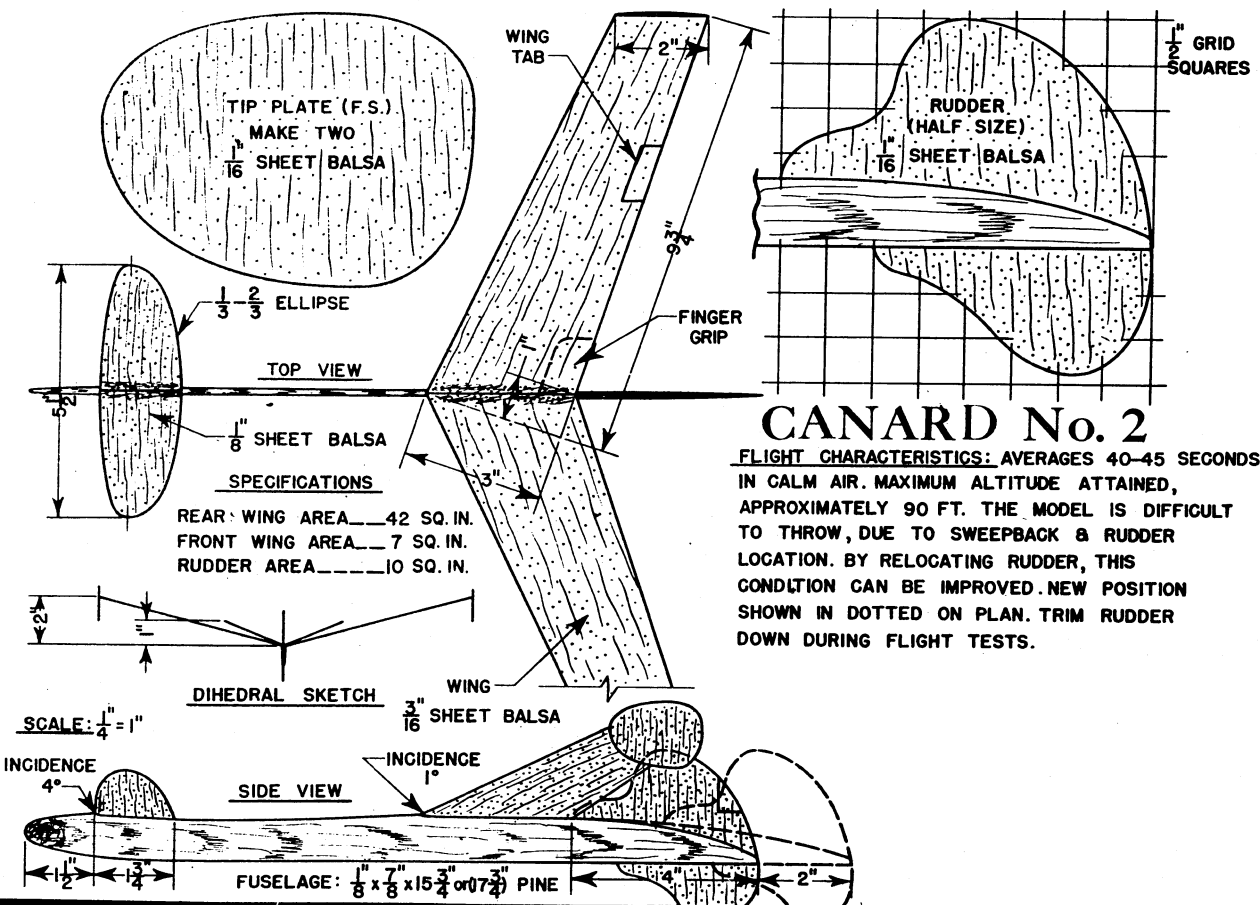
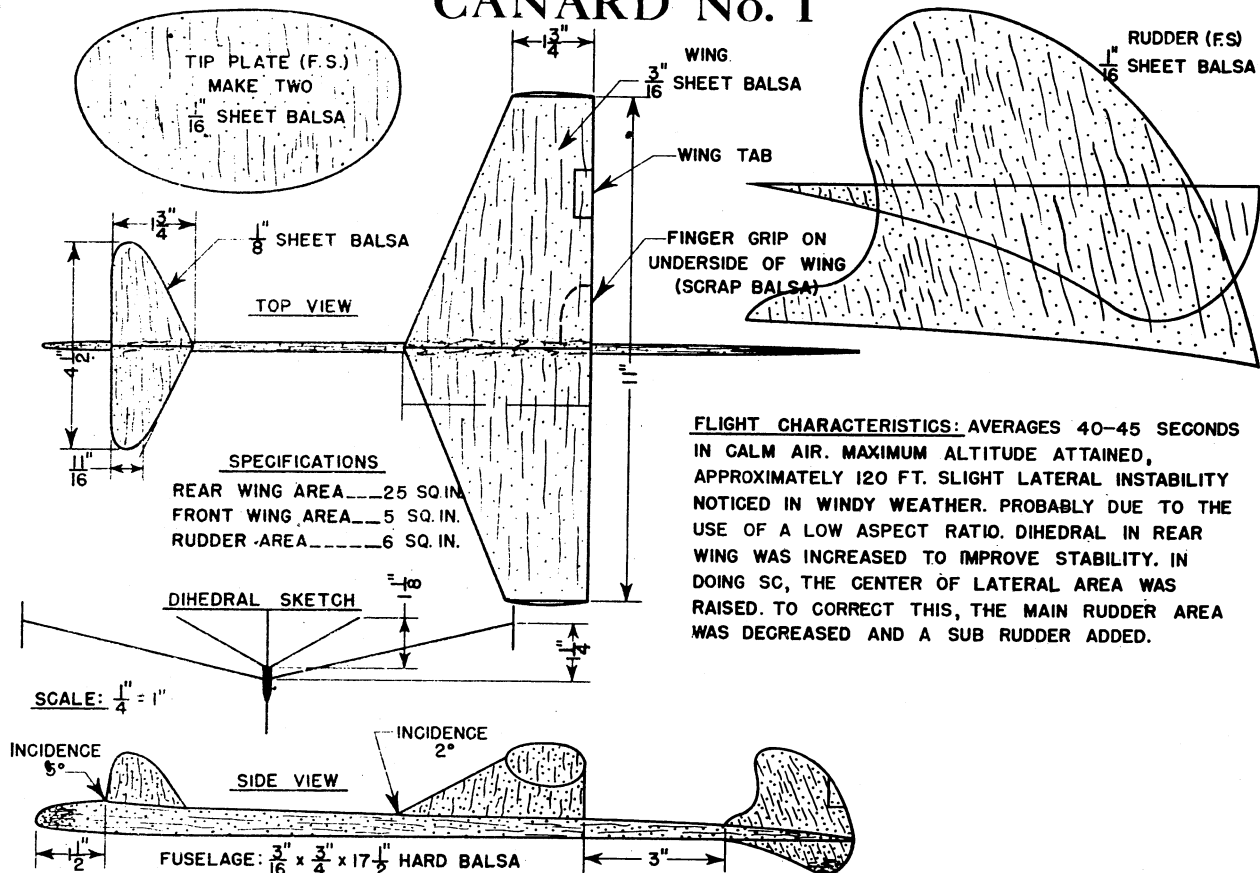
**BLOW-TORCH**



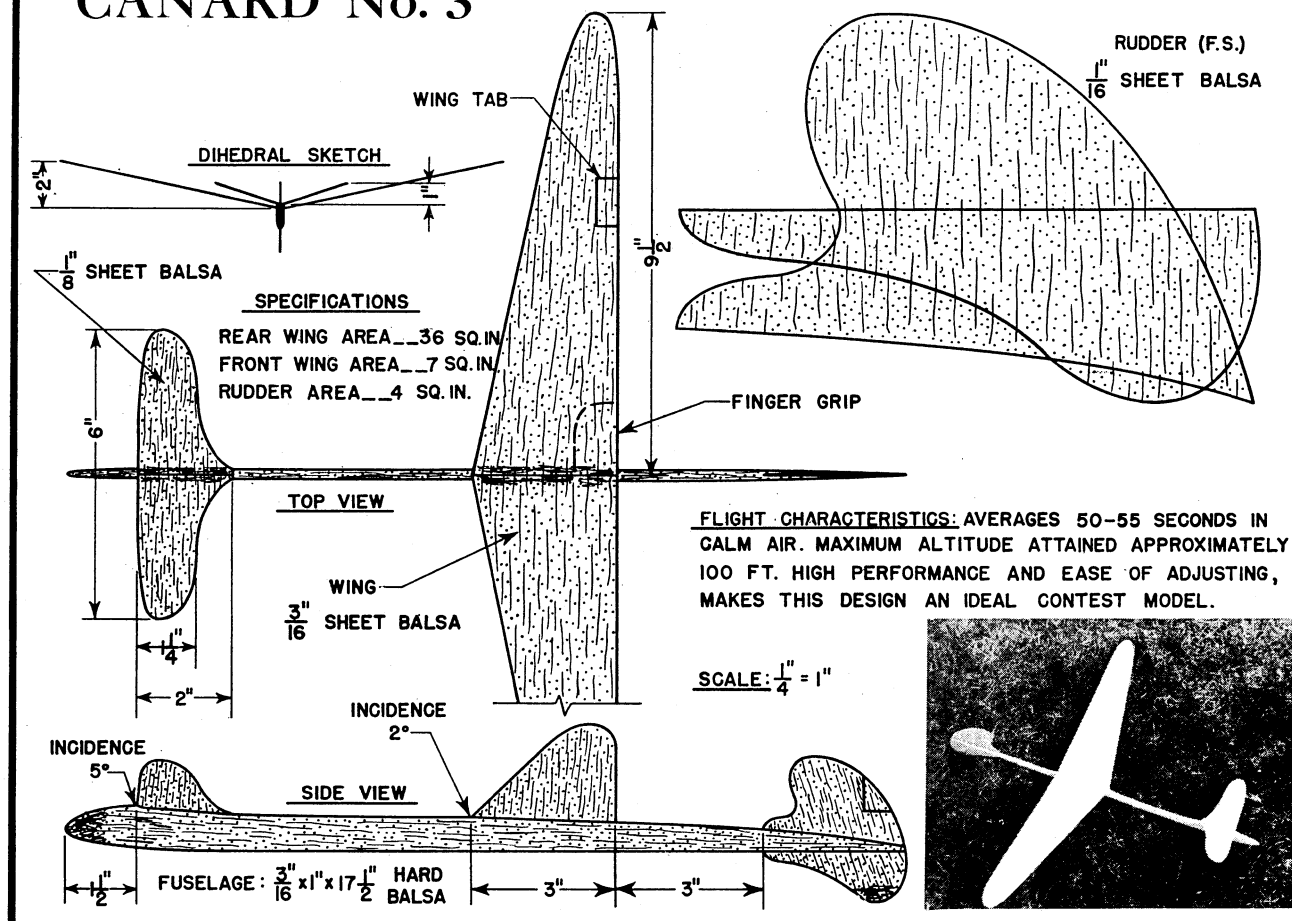




# CANARD No. 1



## CANARD No. 3



# EXPERIMENTAL CANARDS

## There's a lot to be learned from these Tail-First Glider Designs!

● "Why build a canard when a tractor is just as good, if not better?" This often-quoted statement is *not* true in most cases. The canard configuration has its drawbacks as well as advantages—that cannot be denied. But in overcoming these drawbacks—which in most problems of design would be relatively simple—we obtain a model which will provide us with better performance than the conventional tractor.

Comparing both from the standpoint of stability, the canard presents a more difficult problem in obtaining spiral and directional stability. Spiral instability is invariably due to the fact that the center of lateral area is too high. Here are three means of obtaining maximum spiral stability:

1. Try to keep both wing surfaces as close to the thrust line as possible.
2. Due to the fact that both

wing surfaces have dihedral, employ less dihedral in the main supporting surface than you would in the conventional tractor.

3. Incorporate a low rudder in conjunction with a sub-rudder. In a majority of cases, this method alone will solve your stability problem.

Directional instability is caused primarily by having too little or too much rudder area. In the case of the canard, it will invariably be too little, because the distance from the rudder to the center of gravity is comparatively short when compared with the tractor. The force exerted by the rudder through the shorter distance will not be sufficient unless there is a proportional increase in the area of the rudder. This increase may be as much as thirty per cent more for a particular planform when compared with that of a tractor of the same approximate dimensions.

Thus, the difficulties in designing a successful canard are not, in reality, drawbacks. We have been exposed to the same problems in designing a tractor. However, because we are familiar with this type, visualizing the correct solution seems comparatively easy.

The canard has a definite edge over the tractor when considering longitudinal stability, because of the arrangement of wing surfaces. By using an average of three to five degrees more incidence in the front wing surface of a canard, it will stall before the rear wing surface. Since it is the smaller of the two lifting surfaces, the stall will be less violent. Thus, the recovery being rapid, the loss of altitude will be kept down to a minimum. In the event two different airfoil sections are to be employed in the design, be certain that the most stable airfoil is located in the rear wing surface.

After reading the previous paragraph, someone might say, "Should all that incidence be used in designing a canard U-Control speed model?" The answer is definitely, "No." The reason is that, in designing a U-Control model, we must concentrate primarily on obtaining the lowest drag, rather than the highest lift possible. Since our control lines help to enhance longitudinal stability, it may only be necessary to employ different airfoil sections in the manner previously outlined. Should you desire to proceed with extreme caution, use a little incidence. However, do not use more than one degree, as you may find it detrimental both for speed or stunt flying.

For those who are not as yet aware of it, the primary reason for putting the engine or rubber motor of a tractor at the nose of the airplane is to properly locate the center of gravity. The word "tractor" conveys the thought

that the model is being pulled through the air. However, in the case of the canard, in order to properly locate the center of gravity, the pusher arrangement is most appropriate.

The decreased wing efficiency caused by the rotation of the propeller in a tractor design may be as much as twenty-five per cent of the total. By comparison, in a canard endurance design, a greater altitude can be obtained even if lower power is used, because of the pusher arrangement. Higher altitude means greater endurance.

For the speed merchant, a canard makes it possible to use a smaller lifting surface, both in the front and rear wings, which enables the designer to obtain higher speeds because of the overall decrease in drag. And, the stunt fan will welcome the excess available power for performing the most intricate maneuvers.

For the glider enthusiast, there is not as great a difference, because the plane is powerless throughout the complete flight. However, considering the fact that airfoils with high-lift coefficients can be employed throughout, there is still a sufficient increase in performance to justify building a canard for powerless flight.

The gliders presented herewith are of all different arrangements. If you would like to design a canard, first build one of the glider designs that seems to conform with what you have in mind. The four gliders represent less than a day of actual modeling, yet many flights can be made with them and much about the characteristics of canards learned, with little trouble.

Our first canard design is small and has a low aspect ratio. Tip plates are employed to keep wing efficiency to a maximum. The altitude obtained was surprisingly high, which goes to prove that canard hand-launch designs are

not as impractical as they may seem. The fact that the rudder is placed an appreciable distance behind the wing provides the model with as much leverage as you would find in a conventional model. This particular design would be best suited for a speed gas or rubber model.

Canard design No. 2 is a radical departure from No. 1. Our idea in formulating this design was to try and close-couple the model but still attain an appreciable altitude before recovery. Though the front wing surface may seem small, it is more than sufficient in conjunction with the sweptback wing. The altitude obtained was as much as you could expect from a conventional model, even though the glider is a little unwieldy—due to the location of the rudder just aft of the wing. Locating the rudder so close to the center of gravity necessitates using a very large area. Just how large, was one of the things we desired to find out. This design would probably be suited to all types of gas or rudder models, with the possible exception of a stunt ship.

Our idea behind Canard design No. 3 was to improve glider No. 1. The aspect ratio of the rear wing was increased a great deal. Since the tip plates were originally employed because of the low aspect ratio, they were discarded on this design.

Of all the models shown, No. 3 was the best performer. The lateral stability was excellent under all conditions. Though the altitude attained was not as much as that of the first design, the glide was superior. This design would probably be suited to all types of models.

Canard design No. 4 is an attempt at close-coupling the third design. Though its performance does not measure up to its predecessor, it is quite evident that

it would probably be more ideally suited for a stunt model.

As a result of our experimentation, we feel that an ideal layout for a canard design should be something like this:

A. The front wing surface should be twenty to twenty-five per cent of rear wing surface.

B. The rudder area should be between twelve and eighteen per cent of the rear wing surface. There is a great deal of flexibility here, since a great deal hinges on the amount of dihedral used in the wing surfaces and on the location of the rudder in relation to the center of gravity. When in doubt, use the larger figure and decrease during flight tests.

C. Dihedral in the front wing surface should be approximately 2" to 1', while dihedral in the rear wing surface should be approximately 1" to 1'.

D. The distance between wing centers should be approximately fifty to sixty per cent of the rear wing span—for an aspect ratio of six to one. An increase in aspect ratio will mean a proportional decrease in the percentage, while a decrease in aspect ratio will mean a proportional increase in the percentage.

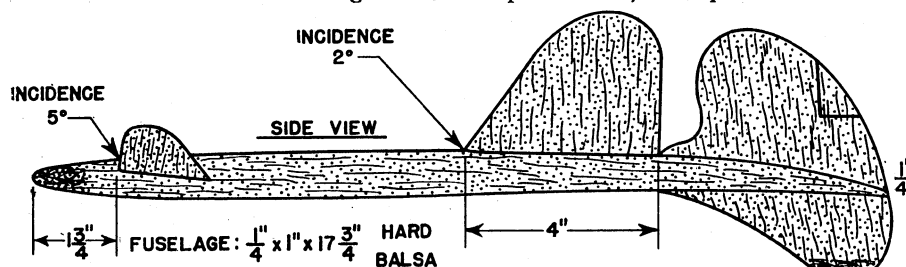
The data presented here will start you on the right track as far as canards are concerned—once you've experimented with the four gliders given you should be able to evolve even better designs.

#### BILL OF MATERIALS

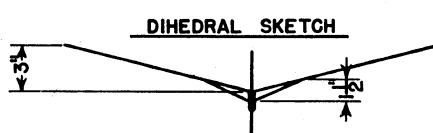
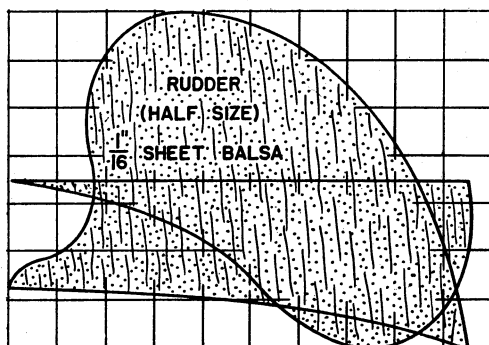
(Balsa unless otherwise specified)

1-1/4" x 3" x 36" (medium)	.....	Rear wing
3-3/16" x 3" x 36" (medium)	.....	Rear wings
1-1/8" x 2" x 36" (medium)	.....	Front wing
1-1/16" x 2" x 36" (medium)	.....	Rudders
1-1/4" x 1" x 18" (hard)	.....	Fuselage
1-3/16" x 1" x 18" (hard)	.....	Fuselage
1-3/16" x 3/4" x 18" (hard)	.....	Fuselage
1-1/8" x 7/8" x 18" (soft pine)	.....	Fuselage

Two ounces of cement; six ounces of clear dope; clay.



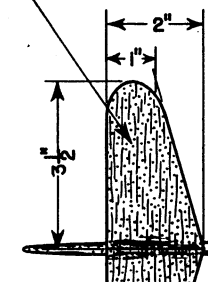
**FLIGHT CHARACTERISTICS: AVERAGES 45-50 SECONDS IN CALM AIR. ALTITUDE ATTAINED APPROXIMATELY 80 FT. UNWILDEY, DUE TO LARGE SIZE AND RUDDER POSITION. SUGGEST RELOCATING RUDDER FURTHER BACK.**



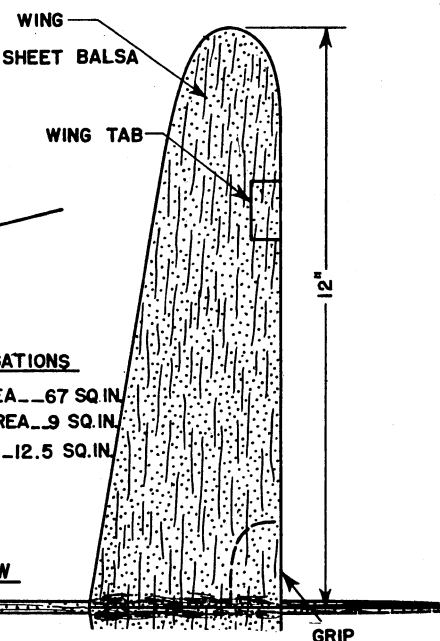
1/8" SHEET BALSA

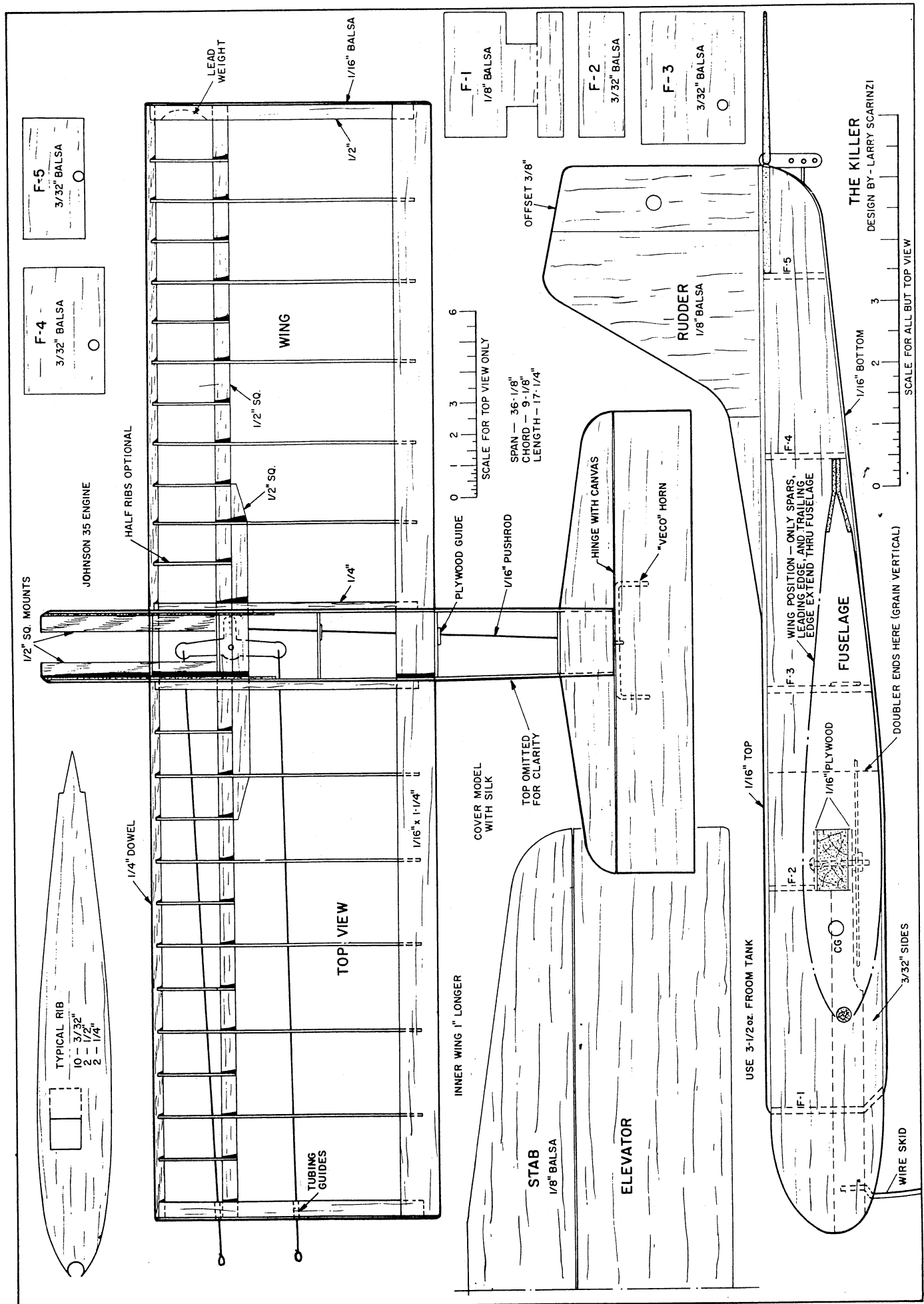
#### SPECIFICATIONS

REAR WING AREA—67 SQ. IN.  
FRONT WING AREA—9 SQ. IN.  
RUDDER AREA—12.5 SQ. IN.



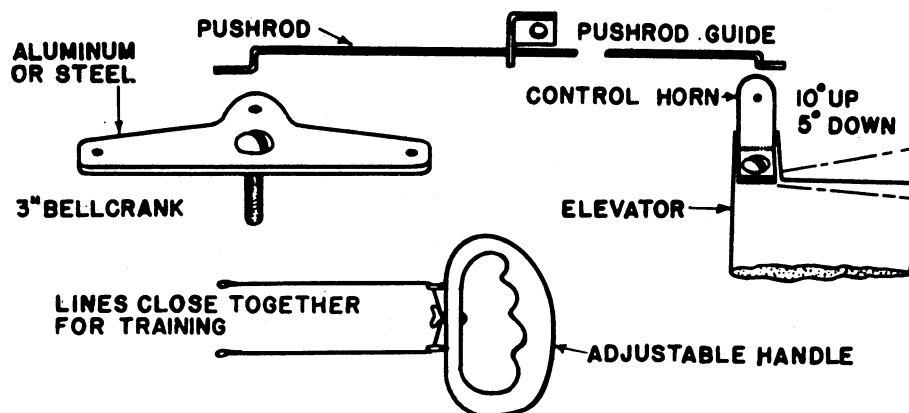
## CANARD No. 4



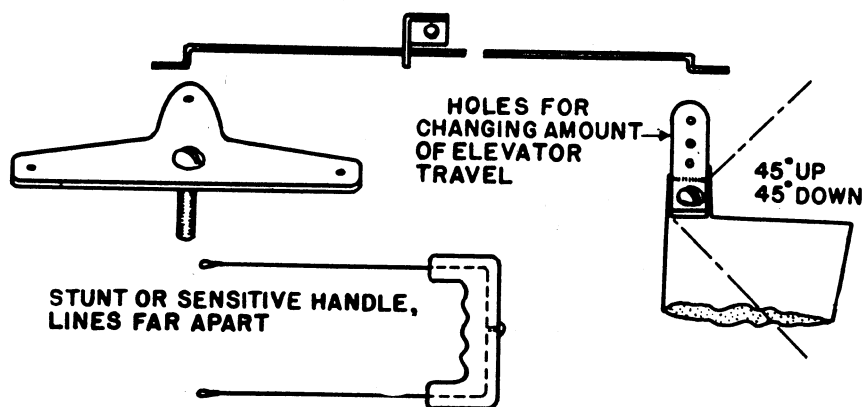


# The CONTROL-LINE SYSTEM

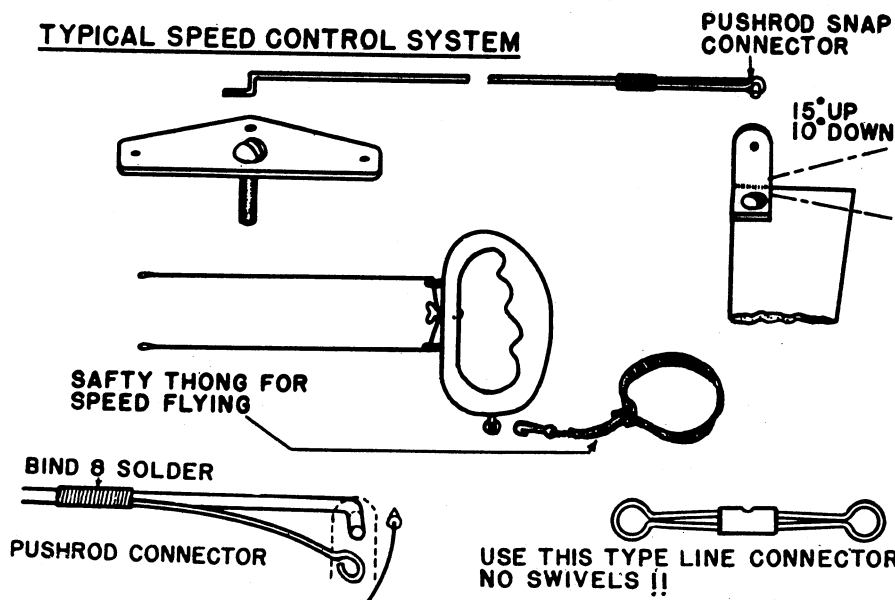
Smooth-flying control-line models are not the result of chance. They take planning.



**TRAINER TYPE CONTROL SYSTEM**



**STUNT CONTROL SET-UP**



● Control-line flying is always new to the beginner and novice, a fact which many of us experienced flyers take for granted. For this reason, we've decided to recap the subject even though many articles have been written in the past. It should also be mentioned that the experienced modeller might gain a little by reviewing the subject. It seems we all tend to get rusty on fundamentals.

First, the control system should be set up to suit the user and the user's purpose. Trainers should not use the same control system that fast Combat models require and a Stunt model using a Speed model setup will hardly stunt.

To determine which methods should be used for a particular system requires a knowledge of the factors involved. These are then varied to produce the type of control desired.

The four basic dimensions, or factors, which determine the amount and quality of control which can be obtained from the motion of the control handle are:

1—The distance between the lines at the control handle. 2—The distance between the leadout holes on the bellcrank. 3—The distance between the bellcrank pivot and the pushrod hole in the bellcrank. 4—The distance between the horizontal centerline of the elevator (hinge line) and the pushrod hole in the elevator horn.

It is obvious that through the variation of these four dimensions an infinite variety of combinations can be obtained—all supplying a different type of control response.

Our basic aim is to obtain practical applications to particular control systems. Let's start with the handle and work on from there step by step.

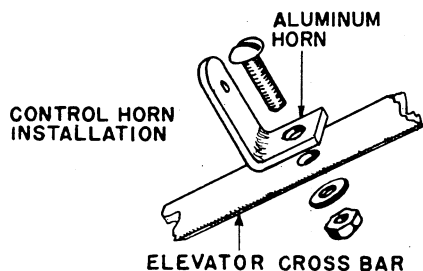
The distance between the lines at the handle governs the amount of motion which can be transmitted to the bellcrank. When the lines are attached to the handle close together, the response is less than when they are far apart. Wide spacing is used for stunting where abrupt and tight-turning control is desired with little wrist motion. Speed flyers require only enough control to keep their ships level and prefer the lines closer together. As a general rule, handles which have lines spaced from 4-1/2" to 5" are very sensitive.

When the lines are spaced 2" to 2-1/2" apart it is possible to get a broad "insensitive" control for it takes quite a bit of hand motion to move the bellcrank. Since beginners tend to "over-control" while learning to fly, this insensitive handle should be used until the flyer gains confidence and experience. These close-spaced handles are also used on Speed models, Team Racers, Flying Scale models, and any other type where stable flight is desired rather than quick maneuvers.



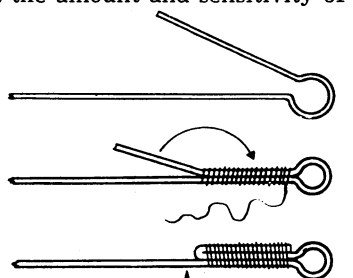
Line spacing also governs the response of the control. As with the handle, close spacing of the lines makes for a sensitive control while lines are spaced far apart provide insensitive and smooth control. A distance of 3" is about right provided that the construction of the plane will allow free rotation and clearance. Models such as Speed ships make this impossible, so it is best to use the widest line spacing possible.

The position of the pushrod, with



relation to the bellcrank pivot, determines how much of the control motion at the bellcrank will be transmitted to the horn. If the pushrod hole is close to the pivot, the amount of motion transmitted to the horn will be less than if the pushrod were mounted further away. A good practice is to drill three or four holes so that this motion can be adjusted by moving the pushrod. Note that if the bellcrank transmits more motion than can be accepted by the elevator horn, the full control range will be shortened since full "up" or "down" control will be reached before maximum control is applied at the handle. The reverse can also occur which would mean a very limited amount of control. Excessive control motion at the bellcrank will also impose an excess load on the elevator hinges.

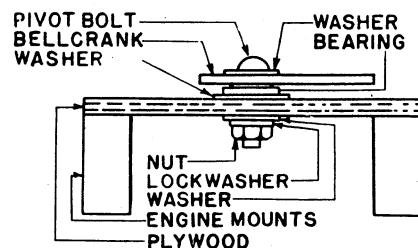
The control horn is the final link since it is the part which moves the elevator. Again, as with the bellcrank and handle, the spacing between the control wire (in this case the pushrod) and the pivot point controls the sensitivity of the control. When the pushrod is mounted close to the elevator hinge line, the response is greater than when it is mounted further away. If the horn has two or three holes drilled in it for the pushrod, it is possible to adjust the amount and sensitivity of the



control. By juggling the pushrod mounting at the bellcrank and the

horn, it is possible to obtain a broad range of control response.

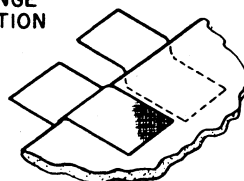
Note that all four control factors must be balanced to obtain a practical system. As an example we'd like to give you an illustration of a very poor control system—one which shows up in practice from time to time because of a lack of planning. The handle, with wires spaced 5" apart; is connected to



a bellcrank which has the lines spaced 1-1/2" apart and the pushrod 3/4" from the bellcrank pivot point; is coupled to an elevator horn which mounts the pushrod only 1/8" from the hinge center line. This control would prove almost impossible to use as the slightest motion of the handle would immediately provide a violent up or down action.

The design of the plane also determines the control system and, of course,

#### FABRIC HINGE INSTALLATION



the purpose to which the plane will be put. The tail moment arm, the stabilizer area and the elevator area all work together and must be considered when designing the control. There are also many other fine points of design which we cannot attempt to cover in this short article.

Rather than suggest any cut and dried rules for making up a control system we'd rather suggest that you make a mock-up control. Through some experimentation on the workbench you will soon see the relationship between the controls and we're sure this will spark the answer to your problems.

Make up a proposed horn, bellcrank, stabilizer and elevator from stiff cardboard and reinforce the pieces with balsa wood. Drill the necessary holes and mount the parts. Masking tape can be used to secure the horn to the elevator. You might find that by varying the horn size alone you can reach your solution. Use a couple of pieces of thread hooked up to your flying handle for lines and use any stiff piece of wire for a pushrod. Test this control out and vary the line and pushrod positions until the control works the way you want it to. You'll find that these mock-up pieces make fine templates for making the finished metal parts.

This way of testing the control sys-

tem, and we suggest that you do it with your models before installing controls too, pays off in getting the right control without guessing. It also means better performance and probably a longer life for the model, plus the security that is gained from your knowledge that the control is right for your ship.

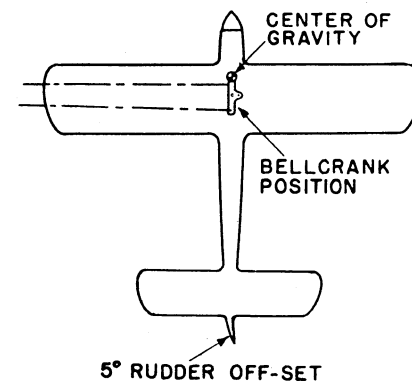
This knowledge of the basic control set-up is also a means of correcting a fault which exists in a poorly flying model. Suppose that you find your model gives poor "up" response and tries to plow up the field when you give "down." A practical answer to this would be to move the "up" line closer to the bellcrank pivot point making "up" more sensitive. The opposite could also be done if there's enough metal to move the "down" line further away from the pivot point.

The tendency of a model to yaw, especially on the completion of a maneuver, can be reduced by keeping the lines closer together at the wingtip guide. It is wise to keep the lines close together at the tip whenever possible.

All of your planning and design will be wasted if you do not follow good installation practice. Every part of the control system must move freely and yet be tight enough to prevent loose play. The pushrod should be stiff enough to handle the force of air pressure and 1/16" piano wire is considered a best minimum size. A pushrod guide, usually mounted midway between the bellcrank and the horn, is also good practice.

The control hinges should be free after the model is doped. Many builders install and check their system before painting only to find that the control binds once the model is finished. It is wise to disconnect the pushrod at the horn when checking for elevator freedom. Do not depend on a strong pull on the lines to overcome the binding for when the lines go slacker, on the upwind side you might find yourself with locked controls!

We'd like to emphasize one point. A control system is more often an individual thing. What works best for one modeller may not be the best for another. Some like their ships hot and tricky while others want smoother precision. Design your control system to give you the control you want—there's no need to follow the flock.



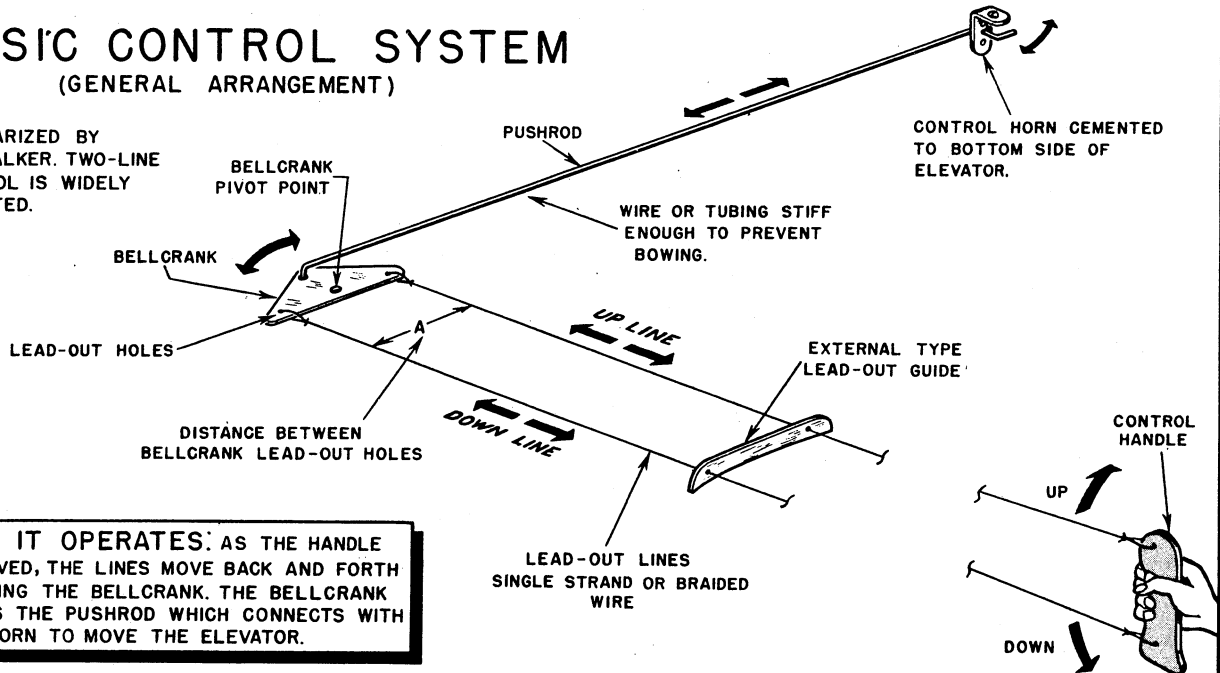
# FM DATA SHEETS

## #20 — Two-line Control System Design

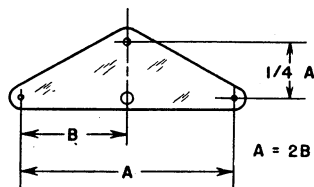
### BASIC CONTROL SYSTEM

(GENERAL ARRANGEMENT)

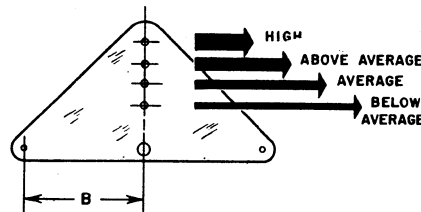
POPULARIZED BY  
JIM WALKER. TWO-LINE  
CONTROL IS WIDELY  
ACCEPTED.



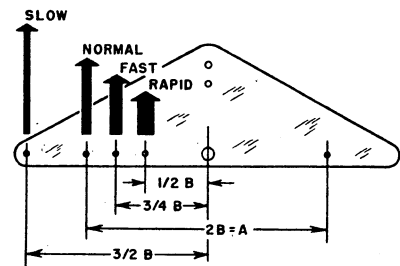
### BELLCRANK AND CONTROL HORN DESIGN



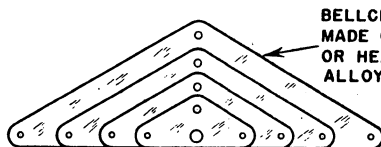
TYPICAL BELLCRANK DESIGN



CONTROLLING DEGREE OF RESPONSE



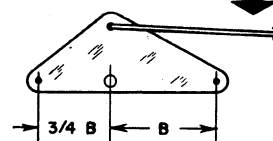
CONTROLLING RATE OF ACCELERATION



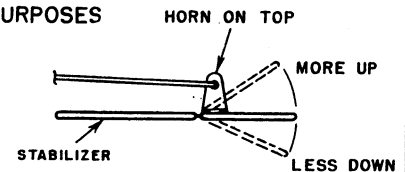
THESE BELLCRANKS HAVE THE SAME CONTROL RATIO DISREGARDING HANDLE EFFECT.

BELLCRANKS GENERALLY  
MADE OF THIN GAUGE STEEL  
OR HEAVY GAUGE ALUMINUM  
ALLOY.

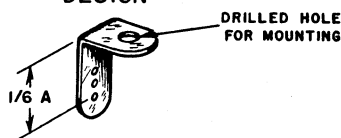
FOR SPECIAL PURPOSES



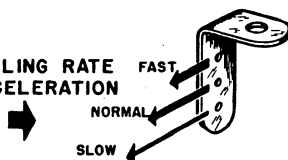
ASYMMETRICAL BELLCRANKS CAN BE USED  
TO VARY UP AND DOWN RELATIONSHIP



### TYPICAL CONTROL HORN DESIGN

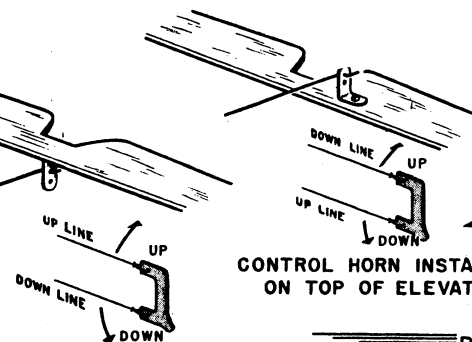


CONTROLLING RATE OF ACCELERATION



CONTROL HORN  
INSTALLATION ON  
ELEVATOR BOTTOM.

NOTE: A CONTROL HORN  
IS FUNDAMENTALLY ONE  
HALF OF A BELLCRANK.



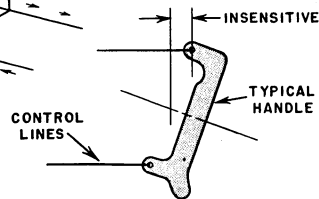
CONTROL HORN INSTALLATION  
ON TOP OF ELEVATOR

P. D. G.

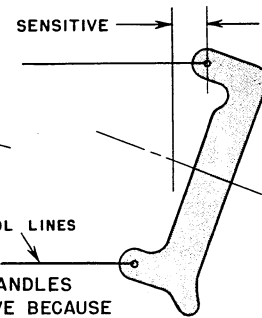
## CONTROL HANDLE DESIGN

A SMALL CONTROL HANDLE IS LESS SENSITIVE BECAUSE THE LINE MOVEMENT IS SMALL.

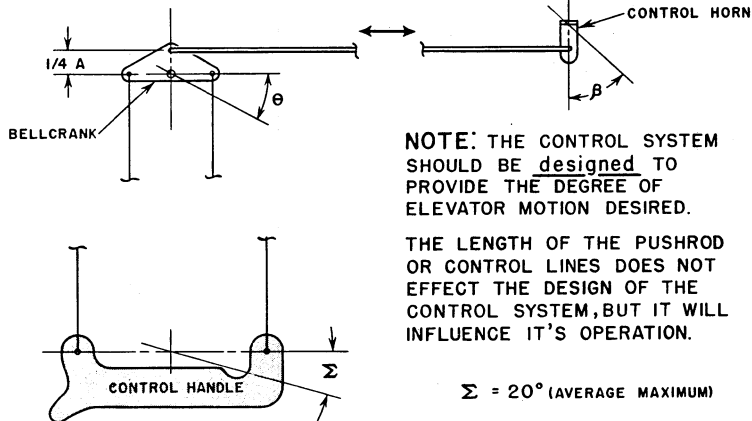
CONTROL LINES



LARGE CONTROL HANDLES ARE MORE SENSITIVE BECAUSE THERE IS MORE LINE MOVEMENT.



## BASIC SYSTEM IN OPERATION



## EXAMPLES OF DESIGN

BELL-CRANK	CONTROL HANDLE	CONTROL HORN	$\Sigma$	$\theta$	$\beta$
3"	5 1/2"	3/4"	20°	37°	33°
3"	5"	5/8"	20°	34°	36°
3"	4-1/2"	1/2"	20°	30°	41°
2"	5"	1/2"	20°	50°	45°
2"	4-1/2"	1/2"	20°	46°	40°
2"	4"	3/8"	20°	40°	46°
1-1/2"	5"	1/2"	20°	70°	50°
1-1/2"	4-1/2"	3/8"	20°	64°	54°
1-1/2"	4"	5/16"	20°	57°	61°

## FLAP CONTROL

FLAP ROD ON OUTSIDE  
[FASTER RATE OF  
ACCELERATION]

FLAP CONTROL HORN ON TOP-  
ELEVATOR CONTROL HORN ON BOTTOM.

NOTE: FLAP CONTROL DESIGN IS SIMILAR TO THAT SHOWN FOR ELEVATORS.

ELEVATOR ROD ON INSIDE  
[SLOWER RATE OF  
ACCELERATION]

LEAD-OUT LINES

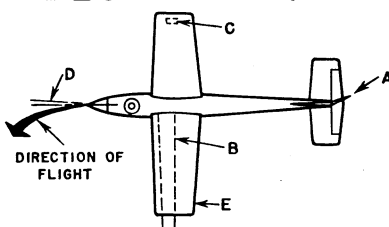
WING FLAPS

ELEVATOR

FLAP HORN LONGER  
[SMALLER DEGREE  
OF RESPONSE]

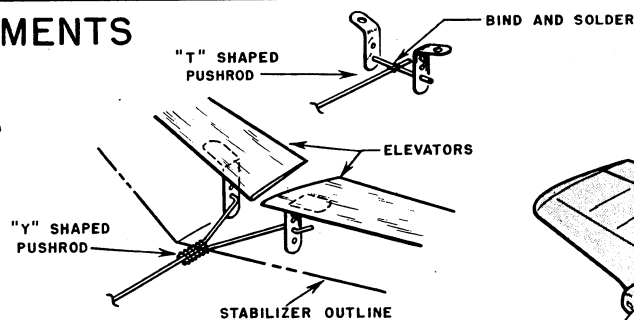
ELEVATOR HORN SHORTER  
[GREATER DEGREE  
OF RESPONSE]

## DESIGN REQUIREMENTS

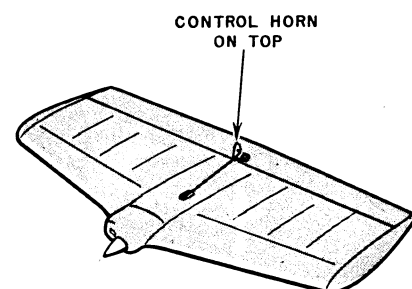


TO MAINTAIN LINE TENSION:

- (A) OFFSET RUDDER  
OR:
- (B) STAGGER LINES SLIGHTLY REARWARD  
OR:
- (C) ADD BALLAST TO OPPOSITE WINGTIP  
OR:
- (D) OFFSET ENGINE  
OR:
- (E) MAKE INBOARD WING LONGER

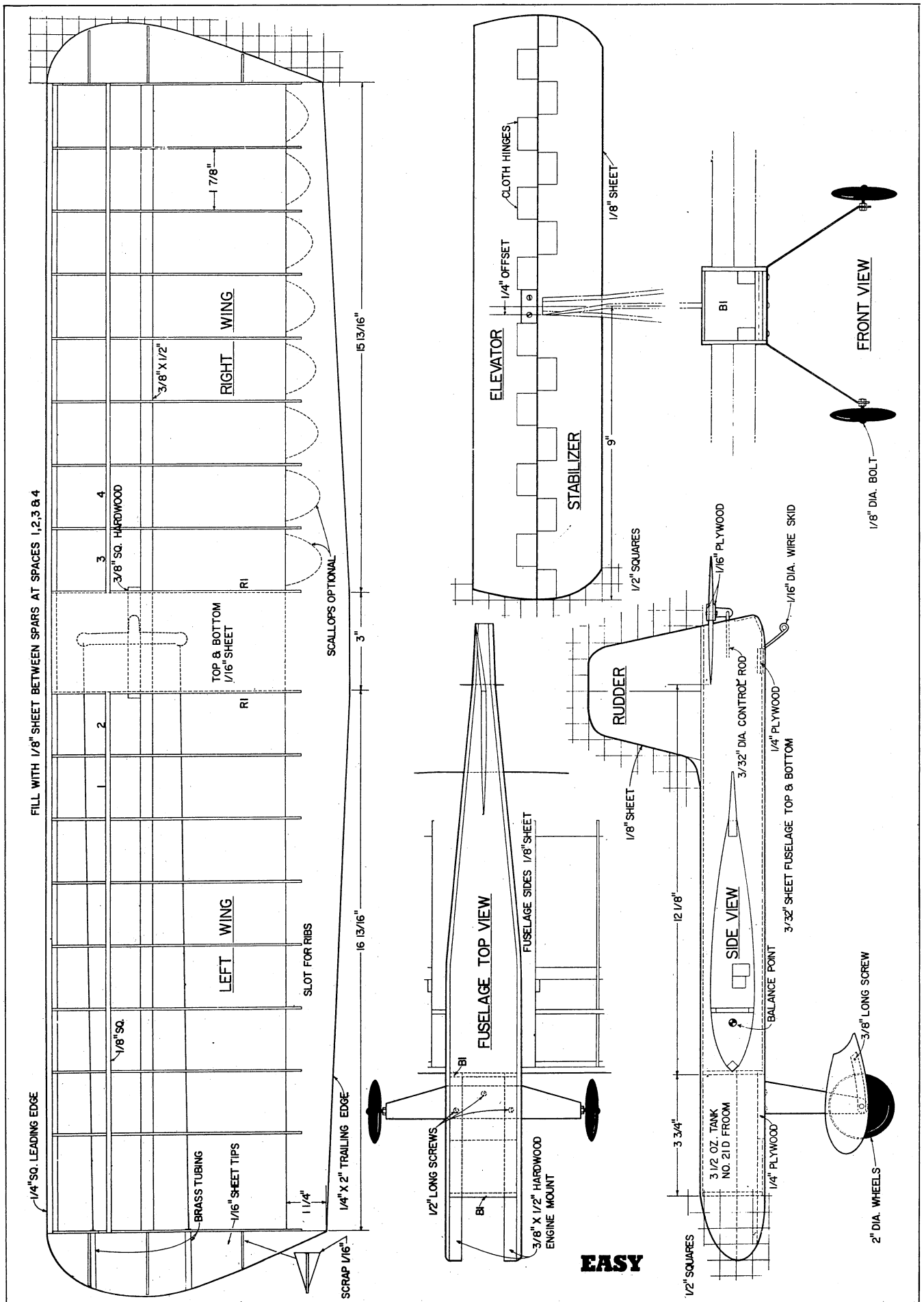


FOR "V" TAILS USE  
"Y" SHAPED OR "T"  
SHAPED PUSHROD AND  
TWO CONTROL HORNS.



FLYING WINGS ARE DESIGNED AND HOOKED UP IN THE SAME MANNER AS FLAP AND ELEVATOR CONTROL SYSTEMS.

P.D.G.









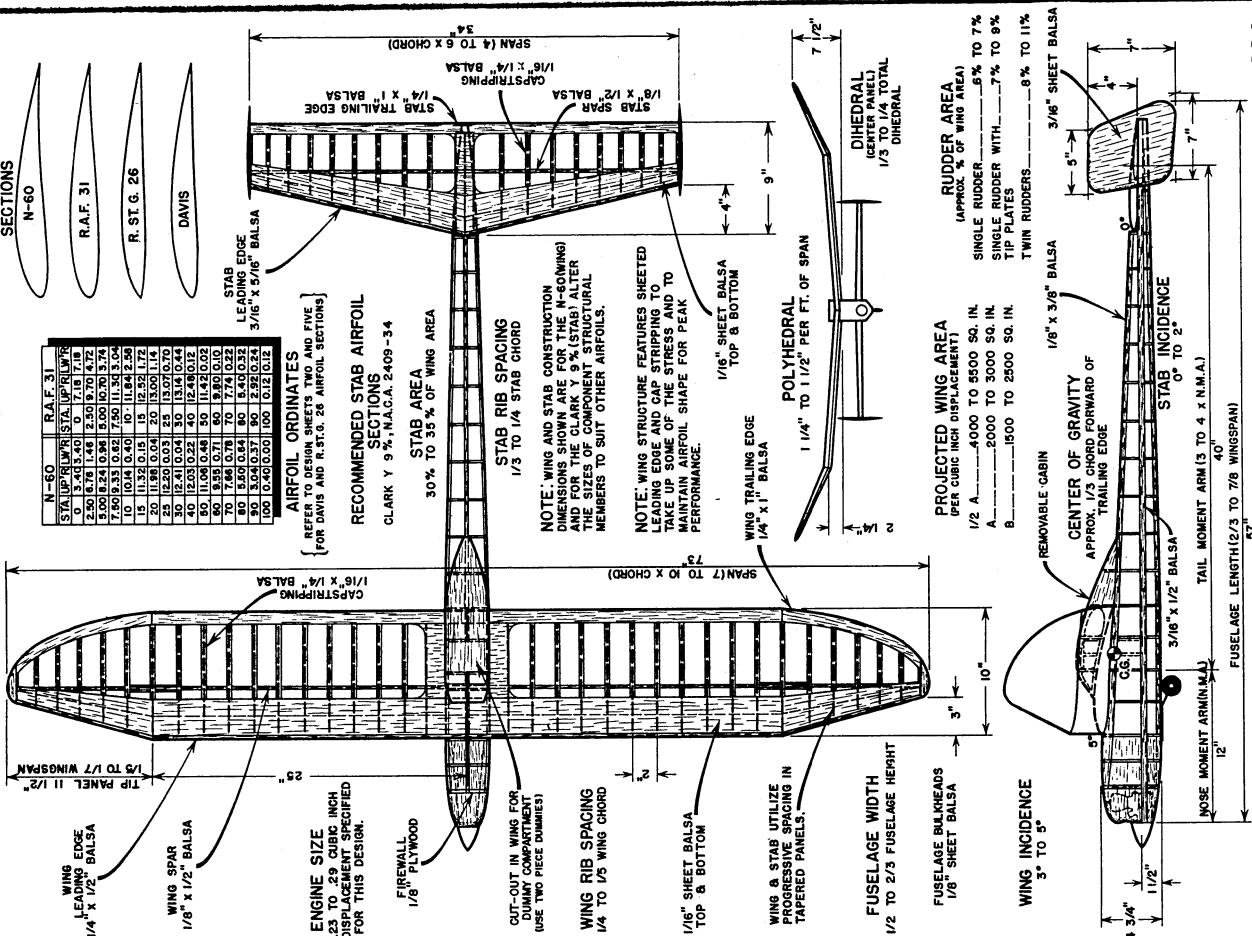




# DESIGN LAYOUT FOR PAA-LOAD CONTEST FREE-FLIGHT GAS (TYPE TWO)

## RECOMMENDED WING AIRFOIL SECTIONS

**(TYPE TWO)**



## No. 4—Design Fundamentals For Control-Liners

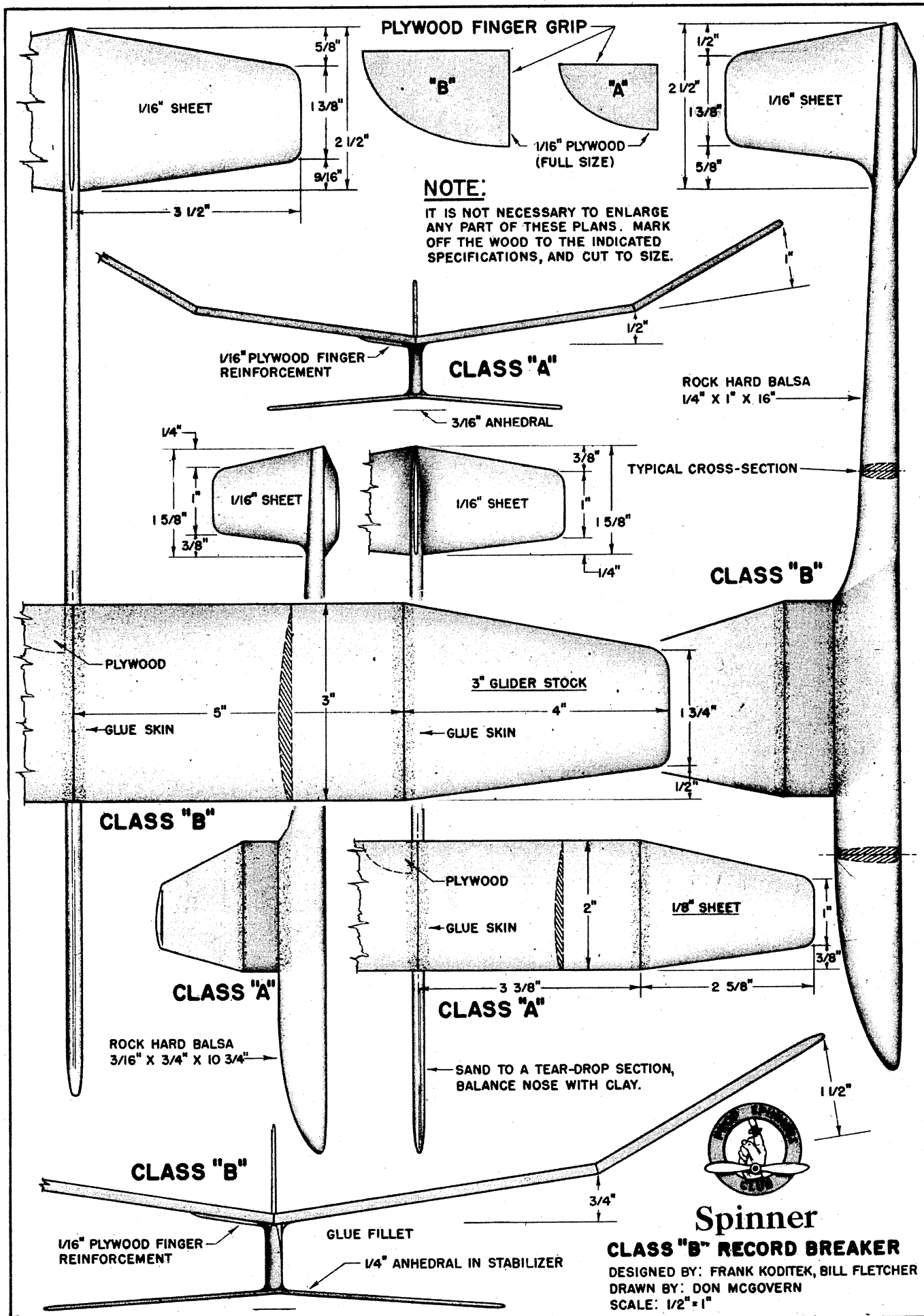
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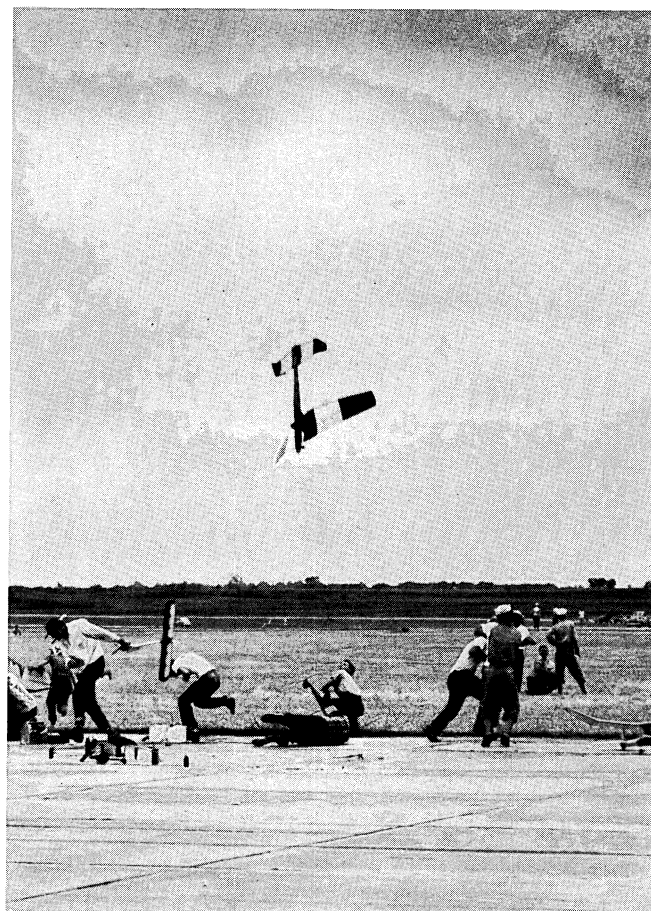
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# Straighten Up and Fly Right

● Ever build a model airplane ... wind up with a swell looking job ... take it out to a nearby field ... make whatever adjustments you believe necessary to achieve good flight — and then have the doggone thing either crack up or prove to be a lemon of the largest variety ... a non-flying free-flight ship?

Or are you luckier than most of us ... getting every ship into the air in short order ... and turning in a consistent record of fairly long flights—but still not the type of flights you were led to believe the models were capable of?

Then read on, brother ... read on! Assuming that you have a sound design to begin with ... that you build your model strictly according to instructions, whether it's a kit job or a magazine design ... then the major difference between getting top-notch flying time or mediocre results will depend on how you adjust your model for flight. And you don't have to be an aeronautical engineer to get good results—all you need is a bit of patience!

So stop grumbling about what rotten models you've been stuck with lately ... stop walking around all hunched over, looking as though you didn't have a friend in the world—straighten up and fly right!

As we said before, the secret of

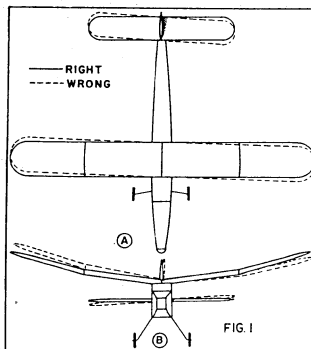
good adjusting is patience. Oh, to be sure, you might make a model fly after a few tries, but peak performance calls for many test flights, each of which is an improvement upon the last, until the ship does exactly what you want it to do. If you don't know what the ship will do on every flight, it *isn't* adjusted.

Perhaps you have heard some experienced builder describe his method of flying a ship as “right-right”, or “right-left”, or “left-left”, or “left-right”. This mysterious jargon simply refers to the direction of the power portion of the flight, then the direction of the gliding portion. For example, “right-right” means that the model circles to the right both under power and in the glide.

“Right-right” is the most popular method of adjusting, since it generally gives the most satisfactory results. For rubber-powered models it is used almost exclusively. Therefore, this article is based on this proven method of adjusting.

Let's assume your latest dream ship has just been finished, and it is a sunny afternoon, with only a hint of a breeze (If it's windy, put the ship away—accurate test glides will be virtually impossible). Even before the model leaves your hand for the first time you should make a simple check of

To fly it right you've got to adjust it right!  
Read this brief, non-technical article, follow the basic rules, and get consistently good performance!



to bank, skid, or even to do occasional unidentifiable maneuvers.

The propeller must “track” properly (see Figure 2A). If the prop is viewed from the side when turning, the blades will seem to wobble (as shown by the broken lines in 2A) when out of track.

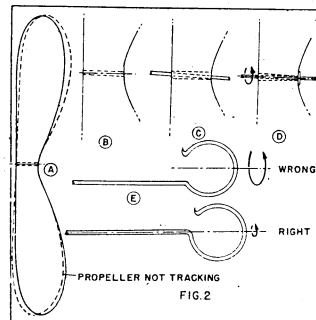
A good turning propeller is assured by:

1—Drilling the shaft hole through the block before attempting to carve the propeller, taking care that the hole is drilled absolutely true, not crooked as in Figure 2B;

2—By using the proper sized

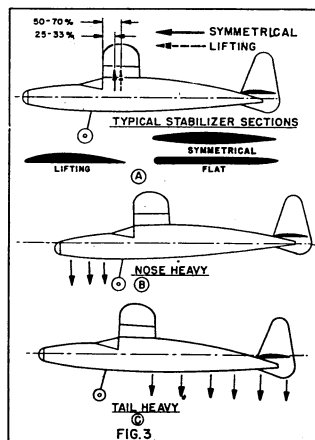
alignment and balance, to eliminate future headaches.

**CHECKING ALIGNMENT:** The airplane *must* be in perfect alignment. When viewed from above, the wing and tail should appear true—both to the airplane as a whole and to each other (see solid lines—Figure 1A). And, when seen from the front, the wing, stabilizer and rudder must be accurately aligned (see solid lines—Figure 1B). A poorly aligned model (such as is indicated with broken lines in 1A and 1B) will cause trouble in flight—tending



hole for the shaft and not one that is oversized as in Figure 2C;

3—By using some type of bearing surface for the shaft where it passes through the propeller hub and the nose block—not permitting an end of the shaft to wobble, elongating the hole in the wood, as in Figure 2D. Note the proper bend in the propeller shaft hook in the bottom drawing of Figure 2E. The wrong bend, with the hook off center (Top, Figure 2E) causes vibration and loss of performance.



**BALANCING THE SHIP:** Balance may be checked roughly by supporting the ship beneath the wing on the finger tips. This balance point (see Figure 3) varies according to the type of model. Ships with lifting-type stabilizer designs—using an airfoil or rib section in the stabilizer—balance further back on their wings than do designs with flat or symmetrical stabilizer cross-sections (see Figure 3A).

Gas-powered pylon jobs, for example, almost always have lifting-type tails, while cabin models frequently have symmetrical sectioned stabilizers. Virtually all high-powered rubber models have lifting type tails, while smaller rubber models frequently have flat-sectioned stabs.

Ships with lifting-type stabilizers generally balance at about 50% to 70% of the wing chord (the width of the wing), while flat or symmetrical tailed planes balance further forward, generally at about 25% to 33% of the chord. Unless the plan specifies a different balance point, it is unwise to attempt flying until the model balances roughly as suggested.

If the airplane is badly out of balance, two things can be done besides adding weights: Either shift heavy objects within the model (such as batteries in a gas model) or slide the wing, if it is movable, to obtain balance. Many models, such as cabin jobs and pylons, have one fixed position for the wings. In this case, if the position of heavy objects in the ship cannot be altered, weight or ballast will have to be added to the nose or tail until an approximate trim is obtained.

If, when balancing on the finger tips, the tail drops down (Figure

3C), the weight will have to be added forward, or the wing moved further to the rear. If the nose drops (Figure 3B) the wing would have to be moved forward or weight added toward the tail. Models built from kits and magazine plans should be in rough balance right from the beginning. It is the first model of an original design that often may give trouble.

**TEST-GLIDING PROCEDURE:** Having checked alignment and balance, the first step in adjusting is to hand-glide the model. Glide tests should be made over grass or some soft surface that minimizes possible damage to your model. Crouch down and, holding the fuselage well back of the wing, "push" but don't throw the ship into the wind (if any) with the nose aimed at a spot on the ground about 30 feet away (see Figure 4A).

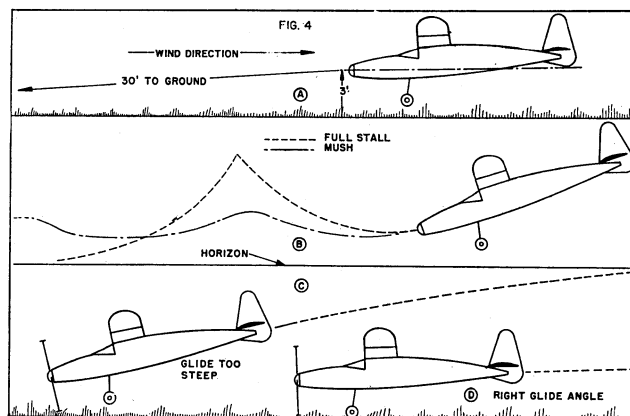
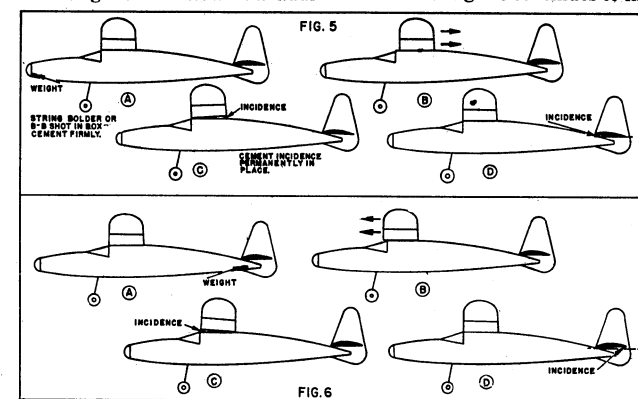
If the model is in proper trim—which rarely happens on the first try—it will glide straight ahead with the nose slightly down, making a two-point landing, or one in which the wheels make first contact with the ground (see Figure 4D).

Watch for any tendencies to stall or dive. A dive is obvious enough (see Figure 4C)—a stall can be more subtle. In a stall, the nose keeps rising above the desired straight-ahead flight path, as in Figure 4B. If the stall is slight, the nose will rise moderately, then drop down as the ship continues gliding forward. The landing may be okay, but the important thing is whether or not a stall occurs.

If the stall is violent, the nose will rise sharply, then abruptly drop and dive into or toward the ground. The ship may even slide back on its tail. Don't be discouraged by the fact that the model hit the ground nose first—if it stalled first in a nose-high attitude, it is the stall that must be corrected, not the dive that resulted from that stall.

It is very important to avoid throwing the model so fast on release that a stall is forced for, in that case, the fault is yours and not the model's. If a stall does occur, try the next test-glide using slightly less shove on release.

**CORRECTING THE STALL:** Figure 5 shows ways of correcting stalling conditions in hand-glide tests. Figure 5A shows an addi-



tion of weight (such as solder) to the nose, the accepted procedure when wings and tail are cemented in position. Figure 5B illustrates how the wing which is not cemented in position may be moved backwards, thus cutting down lift at the nose.

Figure 5C shows how the angle of incidence (angle of the wing relative to the line of thrust of the model—in this case the rubber motor) can be cut down, reducing the lift by placing a small block or sliver of wood or cardboard under the trailing edge where the wing rests on the fuselage. Sometimes positive incidence is added to the stabilizer—raising its leading edge by the use of "shims" (see Figure 5D).

Any of the methods described may be used singly or in combination, but it is inadvisable, however, to add too much positive incidence or angle to the stabilizer, because it lessens the inherent stability of the airplane. For the same reason, too much negative angle should not be placed under the wings. Actual amounts vary widely, as do opinions, but it should not be necessary to use more than 1/16" incidence on small models (those 20" to 30" in span), or 1/8" on large ships (4' to 6' spans).

**CORRECTING THE DIVE:** The cure for this ailment is simpler: Move the wing forward, increase the positive angle of the wing, or increase the negative angle of the stabilizer, raising its trailing edge (see Figure 6). Least desirable in this case is the use of weight.

Once the ship glides as shown in Figure 4D, the nuisance work has been done. It is now safe to hand-glide the ship from a standing position. If the glide continues to im-

prove, swell! But if further slight corrections for stall or dive become necessary, make them as you did before.

Finally you will have a model that glides smoothly in a straight flight path. You will know it is correct because any attempt to make it glide faster will cause it to dive, and any effort to make it glide slower will cause it to stall or make a "mushing" descent. Incidentally, any swooping descent, no matter how pretty, in which the model touches down for a perfect three-pointed, is too slow a glide.

**TRIMMING THE RUDDER:** Let's look forward to what we want the model to do. If it is a good flying model, it will be a problem to make it perform within the confines of a small flying field. If it is a high-performance job that you hope will soar and perhaps "hook" a thermal (a rising current of air), it must be made to circle for best results. Or perhaps you just don't want to run a quarter mile after a straight flying model. So, before trying a power flight, you'll have to work on the glide to achieve a turn.

For accurate control that won't cause crack-ups, a reliable means of applying rudder must be available. If a rudder trim tab is used, be it sheet wood or metal, it must be positive enough to hold its position and to take very slight corrections.

Having found a good glide angle, your next step is to turn the rudder, or rudder tab, very slightly. The actual amount of movement should be the smallest that it is possible to see. Even 1/16" is too much, for it is apt to result in a spin. It may be necessary to add a little more incidence to account for lift lost by the turn.

Hand-glide the model as before, until you have the right amount of rudder offset to make the ship turn slightly in the glide, as in Figure 7. For every 30' forward, the ship should turn about 10' to 12' to the right. When adjusting has been completed, the model should glide in circles of approximately 70' diameter.

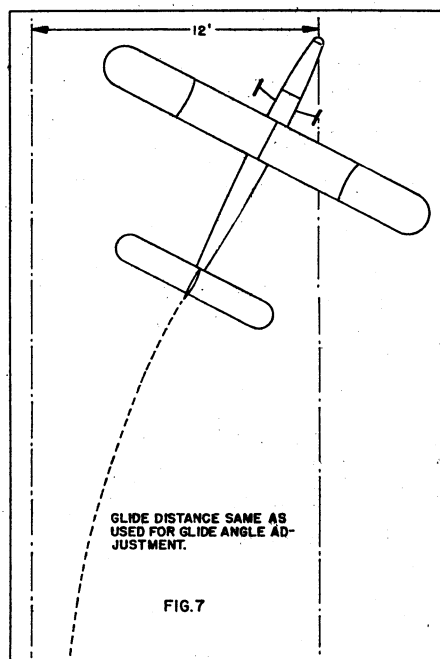
**CORRECTING SKIDDING:** Many builders run into trouble at this point with "yawing," or skidding (Figure 8). Though this can be the fault of design, most commercial designs are proven performers, so accidental warps in wing and tail most likely are the

trouble makers (see Figure 9 for detecting and removing warps).

If the model skids, it is necessary to make the wing tip on the inside of the turn ride lower; elimination of warps most probably will result in this kind of a turn. Sometimes weight can be added to a wing tip to produce a nice turn.

Figure 9A shows typical warps. For an accurate check, place the warped flying surface flat on the bench and note whether both leading and trailing edges are perfectly parallel to the surface (see Figure 9C). Some builders prefer to hold the wing edgewise and sight on the trailing edge, looking toward the front of the wing.

Figure 9B shows how steam can be



used to soften the covering. The surface is then held in the hand or fastened on the bench with the desired twist until the covering again pulls taut. In Figure 9D, the warped surface is pinned down flat and then the covering is given a light application of thinner (don't put on too much thinner as it has a tendency to remove the dope). After drying, the warp generally is eliminated, although this method has the disadvantage of loosening only one surface at a time.

Builders of very high-powered rubber contest models often resort to an intentional warp to obtain precisely the kind of turn they require. With models adjusted to the "right-right" system here described, the right wing tip—the one riding on the inside of the circle—is given a very slight wash-in—warping down the trailing edge.

The proper amount of warp is about the minimum that the eye can detect. This warp tends to lift the right wing, to prevent it from dropping too much on a turn. Instead of a steep ineffective turn, this warp causes more of a flat turn. It is a safeguard, too, because too much right thrust and too much right rudder under high power will produce a violent spiral dive (see Figure 10). A

good example of wash-in would be  $\frac{1}{4}$ " maximum on a 6' gas model.

**POWER FLIGHTS:** The ship is now ready for its first power flight. On any but some low-wing models—which don't concern us here—the first power flight probably will show a tendency to stall. Don't let this discourage you—it happens to everybody.

You know that your gliding angle and turn is in fair shape, so the obvious conclusion is that the power flight must be adjusted independently of the glide. This is done by gradual alterations to the thrust (see Figure 11).

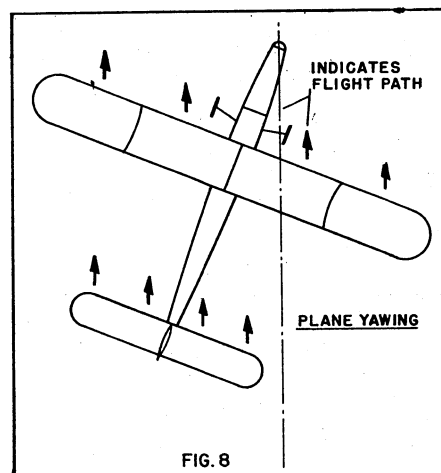
Your ship will tend to do two things when first flown under power: it will tend to stall and it probably will turn left when the prop is ticking over, due to the force of torque (again see Figure 10). Torque is the tendency of the model to roll opposite to the direction of the rotation of the prop; thus, the left wing drops and the model turns toward the left (looking forward on the model).

The corrections are simple: Add down thrust (see Figure 11A) to prevent the stall, and right thrust (Figure 11B) to stop the left turn, making the model turn slightly toward the right.

Down thrust is accomplished by placing shims (thin pieces of wood or cardboard) behind the top of the nose block, in effect making the propeller pull down hill. Right thrust is built in by putting shims behind the left side of the nose block (see Figure 11C).

While the principle is simple the procedure must be painstaking. Hurrying always leads to a crack-up. Start with 50 turns, winding the prop by hand. On your first mild power flight, a slight stall may be indicated. If so, place a thin piece of wood (like  $\frac{1}{32}$ " sheet) or paper (a single thickness of match cover paper) behind the top of the nose block.

If the first short-flight looks good, increase the number of turns by 25, making 75 turns on its second flight. But if that first flight looked bad, stick to 50 turns on the second flight and then, if the down thrust did its job, try 75 turns on the next flight. The basic idea is to keep stepping up the turns slowly. Every time a stalling tendency reappears, add downthrust; every time the ship turns left or goes straight ahead, add right thrust. If too many turns are used without sufficient right thrust, a spiral dive to the left will result, due to torque (see Figure 10C). Bit by bit ap-



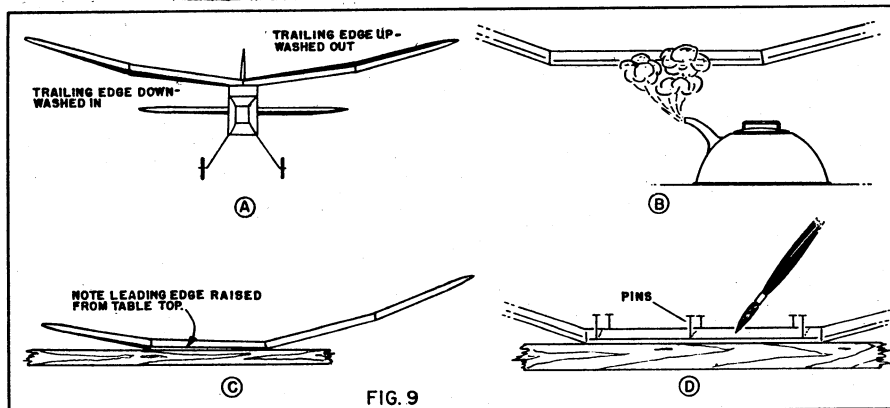
proach high power, compelling the ship to circle right by use of right thrust—remember that your right rudder will take care of the glide.

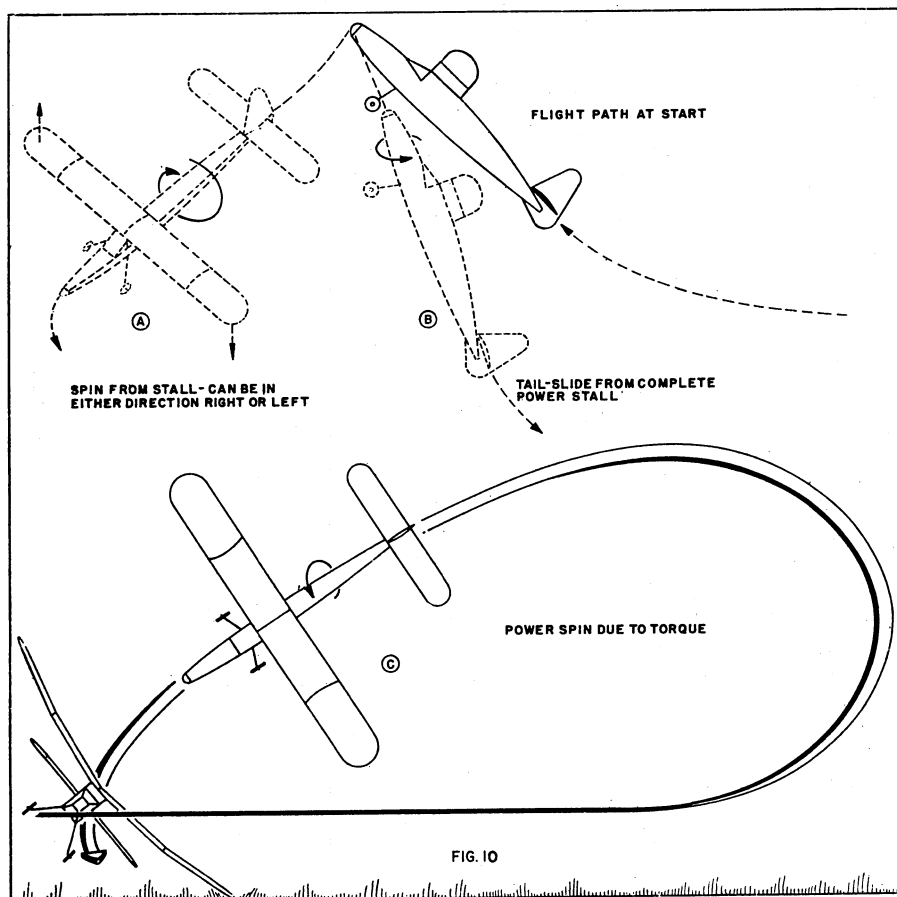
Figure 10A illustrates a power stall. In a really bad power stall the ship climbs steeply after launching until it hangs nose high in the sky (see Figure 10B). Then it may drop back, sliding on its tail, rolling over as it does so, to begin a dive to earth. If it is high enough, it may affect a recovery or perhaps go on stalling and recovering throughout a very poor flight.

A milder version of a power stall is shown in Figure 10A. In this case, the nose rises, but not so steeply, then drops as the stall occurs. Sometimes the model will resume flying. Other times it may drop a wing tip, rolling into a diving turn, which may build up in severity until the ground is reached.

As the number of turns is increased, the ship will get high enough to display its gliding capabilities. Inasmuch as the initial glide adjustment to the rudder was only approximate, the ship having been glided out of your hand, you now will be able to further observe the glide and make improvements. Is it too fast and steep, tending toward a dive? Or is it too slow, tending to approach a stall, perhaps even stalling mildly, or "mushing."

Since we have the rudder set to make the ship glide in right-hand circles, it is simple to remove any stalls or dives from your gliding flight and make the model circle in smooth, easy turns like a hawk. If the model is turning while gliding, it follows that any dive or fast descent will be in the form of a spiral.





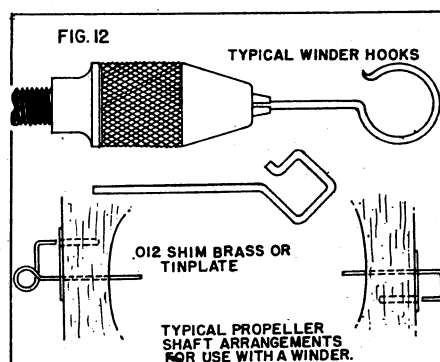
ship unless you use a winder (see Figure 12). A model that flies unspectacularly at low altitude across a small area will climb high and fast, fly a greater distance, and stay in the air several times as long when a winder is employed. A simple winder can be devised by bending a wire hook (Figures 12A and B) and locking it very firmly in the jaws of the chuck of a sturdy hand drill.

Have a friend hold the model, then attach the loop of the prop shaft to the hook on the drill. Now stretch the rubber to approximately three times its natural length and begin to wind. It is safe to assume that the maximum turns possible with the winder will be a minimum of four times the turns possible when handwinding an unstretched motor. Where 150 turns might be tops hand-wound, 700 are possible with a winder.

The rubber should be stretched out as desired before beginning to wind. Then, maintaining that stretch, 50% of the desired turns should be put into the motor. Continuing to wind, walk in slowly toward the model, timing the operation so that the nose block reaches the front of the ship—if winding from the front—as the full number of turns is attained.

Fresh rubber can be stretched better by "prewinding." This means simply that the rubber is stretched out and then partly wound, allowing the prop to run down without launching the airplane. This should be done once at 50% turn capacity, then a second time at 75% of turn capacity. When not in use the rubber should be kept in a dark container. Unused rubber should be covered with talcum. Wash the rubber in warm water before preparing it for use.

Before installation in a model, the prepared new motor should be coated

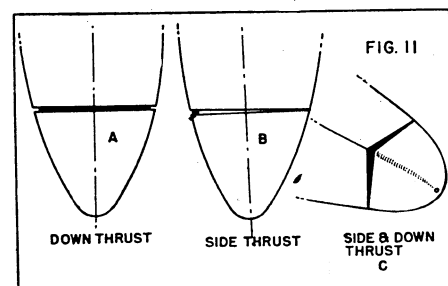


with rubber "lube." Homemade "lube" can be made from green-soap and glycerine in equal parts, obtainable in the drug store. Rub the "lube" onto the strands, then partially wind the motor outside the ship and let it run down to shake off any excess. If possible, use a ball-bearing washer. Place a drop of oil between friction washers, if used, but don't let the oil coat the wood at the prop shaft or at the nose bearing. Firm bearing surfaces should be cemented to the front of the nose block and to the back of the propeller hub.

A flight can be no better than its launching. On a windless day, this is not difficult. If an R.O.G. (rise-off-

Only two causes exist for a diving turn in the glide: the ship has been trimmed slightly nose heavy, or a little too much rudder turn has been applied.

If the downward spiral is extremely steep and vicious, making an extremely tight, diving turn, then the rudder is the cause. If the spiral is in the form of a fairly wide circle with the airplane banked a little too much for a good gliding turn, then the model should be trimmed more tail heavy, or "slowed up" in the glide, as it is called.



This can be done by any of the methods described earlier. Usual practice is to place incidence under the leading edge of the wing, or under the trailing edge of the tail. If the wing is movable, slide it forward a trifle. Be sure to make only minor changes, taking successive flights if necessary to check, rather than make a big change that will produce an extremely different and perhaps worse condition.

Now suppose that the ship tends to stall mildly or "mush" in the glide. If it is a definitely recognizable stall, with the nose rising and then falling—the

ship flying like a roller coaster—then the model must be trimmed more nose heavy. If it "mushed"—raised the nose slightly with the ship obviously squashing along in flight, meanwhile sinking too rapidly to earth—a trifle more right rudder is needed.

In using more rudder to improve the glide we are making use of the fact that the steeper the model banks, the less lift it can exert effectively. In other words, the tighter the turn, the steeper the ship will descend. So, up to a point, adding right rudder will assist the glide and remove the "mush," but beyond that point it will cause the ship to spiral or spin in toward the ground. So we must add right rudder only in the tiniest amounts.

Your model now is beginning to circle to the right under power and, at last, is gliding perfectly to the right. Your rubber motor so far has had only a moderate amount of turns. Now, as you add more and more turns on each flight, only minor adjustments to the thrust line remain to be made.

Be sure, in adding shims behind the nose block, that the block is resting properly against the nose at the desired angle. Taper the shims with a razor blade if necessary. When your adjustments are complete, cement the shims in place, being careful that excess cement does not build up the thickness of the shims beyond what is needed for safe flying. Better yet, carefully carve a sliver of wood to the thickness of the shims and cement it in place.

**WINDING THE RUBBER:** Long flights cannot be made with a rubber-powered



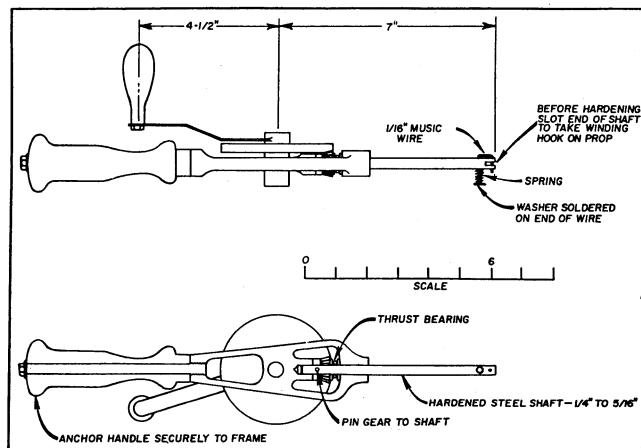
ground) take-off is made, a good rubber model will jump off and climb well without an assist of any kind. Just hold the prop blade with your left hand and the fuselage, back of the wing, with your right hand. When ready to launch, move both hands simultaneously. If the prop is released a split second before the model it will rev up, insuring a good take-off.

In a wind, the model will literally jump into the air. When hand-launching with a fully wound motor, release

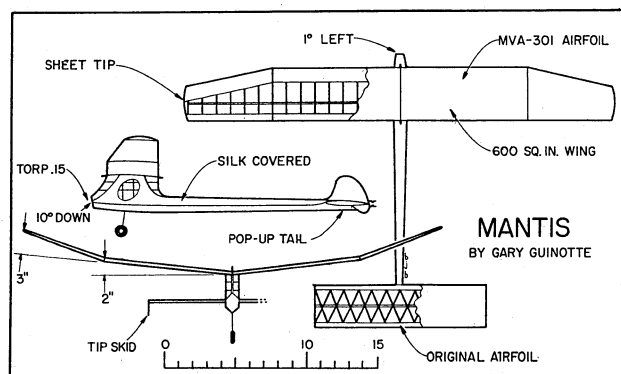
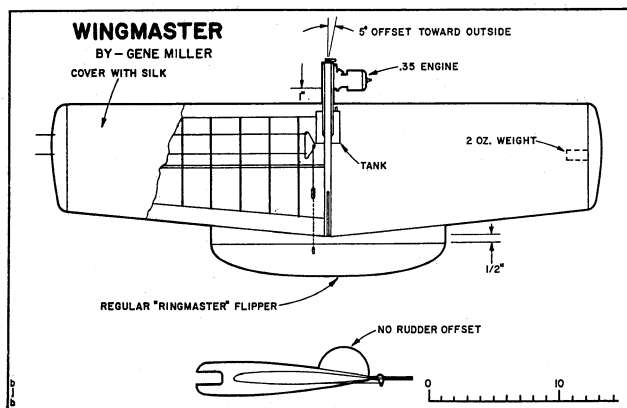
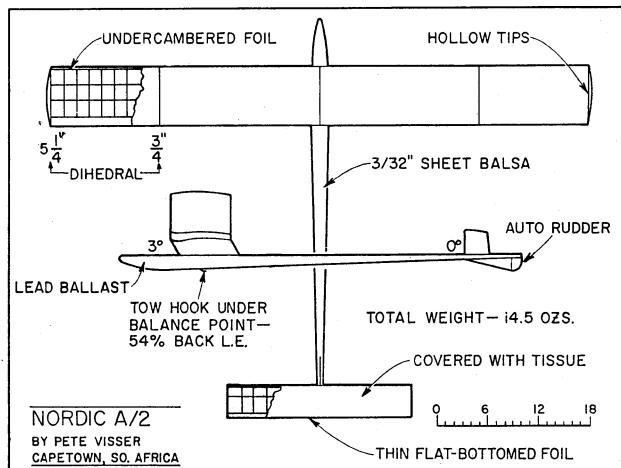
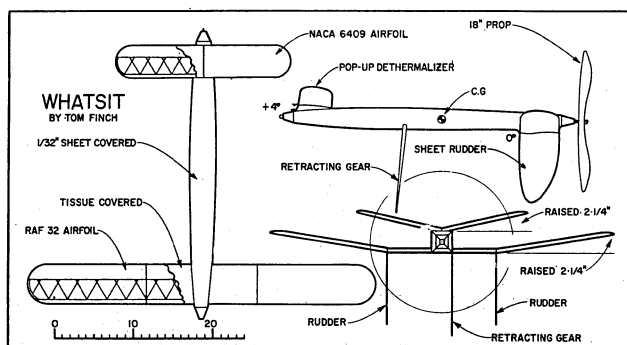
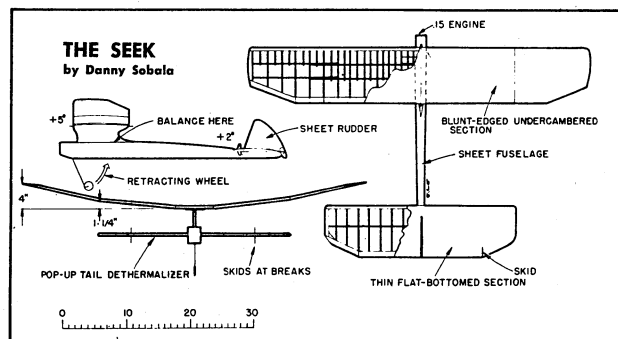
the prop first, then move the launching hand forward smoothly, almost letting the ship fly itself out of your hand. Excessive throwing or pushing of a model causes more harm than good. In a wind, point the ship slightly off to the left, quartering into the wind. Its right adjustments will take it into the wind, then around in a fast, rolling climb in the circle, with the ship climbing overhead. It is undesirable to point the right circling model to the right of the wind because a strong gust, getting under

the uptilted wing on the outside of the circle, may roll the ship into the ground.

With this simple system of adjusting, and the patience to go at things slowly, you can squeeze the last second of duration out of your rubber job. Moreover, the same basic principles can be applied to your free-flight gassies and CO<sub>2</sub> jobs. Next time you build a model, refer back to this article before attempting to fly it . . . take the time to adjust your ship correctly . . . and enjoy getting top flight performance!



Rubber motors should be wound at a steady rate. A properly constructed winder can do the job and insure the safety of both the model and the builder during this important operation.





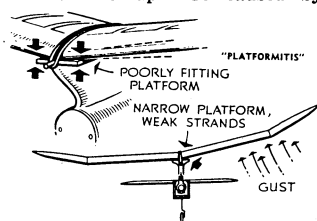


# R for Free-Flight Maladies

A consistent West Coast contest winner  
prescribes some cures for ailing gassies

● This article is not written for hangar hot-rocks, free-flighters turned yo-yoers, or slide-rule dodo birds—it's intended for the average free-flight model builder who is sincerely interested in improved and consistent performance in his models. We all know that crack-ups are unfortunate and sometimes inevitable, but nine out of ten of them could have been prevented. How? Here are some of the major causes of crack-ups, and a bit of advice, based on our own practical experiences, on how to attain more consistent performance.

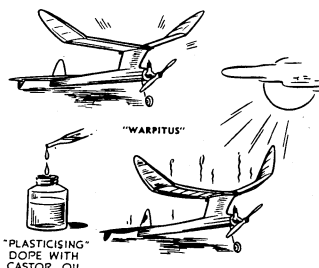
**PLATFORMITIS:** Five out of seven crack-ups are caused by



wings and tails rocketing around on insufficient or ill-fitting platforms. This is especially true in winds of above average velocity.

Platforms should be large enough to prevent all rocking tendencies. Rubber bands should pull down on the wing or tail, holding it firmly in place. There is a tendency, especially with pop-up dethermalizers, to use the rubber bands for purposes other than securing the wing or tail. This is really dangerous and has been responsible for many sad accidents.

**WARPITIS:** Undetected warps are certainly responsible for their

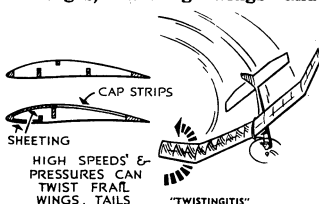


share of crack-ups. Extreme heat (usually prevalent at large model airplane contests, for some reason or other!) and rapid changes of temperature cause the covering to tighten or loosen up, or cause the structure to shrink.

Neutralizing (or plasticizing) the dope on the covering helps a lot to discourage this. A few drops of castor oil or oil of wintergreen in the last two coats of dope will do the job. A good stiff structure, obtained by using ample cement and sheet planking in con-

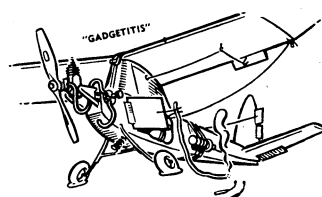
junction with capstrips on the upper camber of the ribs, discourages warping.

**TWISTINGITIS:** Twisting fuselages, twisting wings and



stabs and over-twisted trim tabs take their toll in splattered gassies. Thoughtful use of sheet planking will do a lot to prevent the twisting of structures.

**GADGETITIS:** Gadgets don't exactly cause crack-ups, but they



are responsible for a lot of lost airplanes. And, after all, which is worse? Timers, fuel shut-offs, trick tanks, dethermalizers and more timers—all are constantly in need of adjustment. A great deal of improvement has been seen in such equipment in recent months, but as yet perfection has not been reached. So use such devices only when necessary.

**TECHNICITIS:** How important are items like gyroscopic effect, torque, counter torque, C. L. A. position and the Reynolds number to you? Well, as far as the average model flyer is concerned, he has a lot more important things to worry about. Let's face it, these items are a product of a now obsolete phase of model aerodynamics called "the theory or science of model aerodynamics." As long as we build our models of balsa, cement and paper, and anoint them with warpo airplane

dope, it ain't no science, brother, it's a hobby and an art—a sporting art!

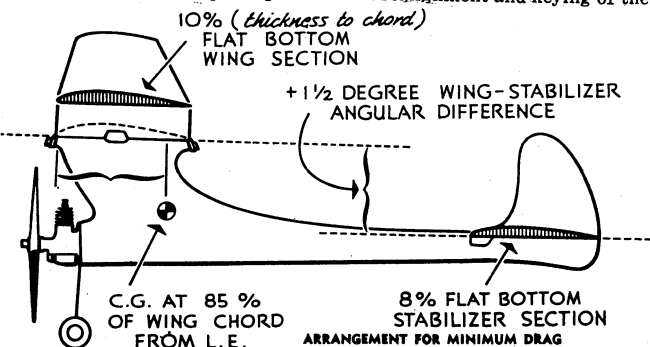
If there is one thing that has kept the free-flight phase of our hobby popular it is the fact that the average modeler has just as good a priority on the thermals as the so-called "experts." Of course, the so-called "experts," the celebrities, and the hot-rocks' names do appear conspicuously often on the winning lists. This is due partly to our familiarity with their names and partly to the trait they have developed called "consistency"—something that any model builder can readily obtain.

**TO GET GOOD PERFORMANCE:** Consistent performance with a model airplane, like anything else, is the practice of good common sense and persistence under pressure. Flying in a model airplane contest, large or small, can be trying and any contestant is always under a little pressure.

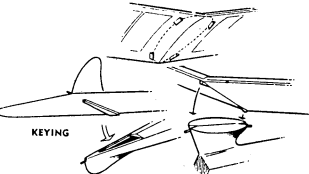
Consistent flying starts at home on the drawing board and on the workbench. When designing your models, always plan as much out as possible on paper—the items such as areas, the proportion of moment arms, construction details, etc. Always design your next ship based on what you have learned from your previous model. Little improvements kept in the back of the mind are what make good ships better. A radical departure from previous designs means headaches galore.

Consistent building brings consistent flying, too. Adopt a logical, accurate, rugged, easy-to-build type of construction and stick to it. Improve it with succeeding models. Accurate, straight construction without any warping tendencies is the ideal to shoot for. Built-in warps aren't recommended and don't encourage the planned, consistent type of performance we strive for. Warps tend to emphasize any faults the model might have and the less warps the more likely the model is to survive the tryout stage.

Prealignment and keying of the



surfaces is a good practice and assures accurate, quick assembly.



Keying also prevents vibration and the moving around of wings and stabilizers.

It is a darn good idea to measure the angle of incidence between the wing and tail and keep this figure in mind when adjusting your model. It is always okay to increase the angle (to correct diving tendencies, etc.) but be very careful about decreasing this angle less than 1° positive or the angle specified or shown on your plans. Too small an angle of incidence means trouble—usually in the glide. A prolonged recovery is a warning symptom.

This is no mysterious force, odd Reynolds number or anything else, just the fact that we don't have enough angle between the wing and tail. Moving of the center of gravity forward will take care of the stalling in the glide.

Hot engines mean hotter climb, if you can utilize the power and convert it to climb instead of gyrations, dideoes and a general tendency of going everywhere but up. Hot power means the ship will fly faster, providing you don't have a bunch of built-in headwind.

My pet peeve is the thick wing section still advocated in these days of the control-line-developed short-stroke engine. Thick sections simply won't let a good engine go to work for you.

The function of undercamber in a wing is also questionable. Of course, it slows a glide down—but is this desirable? It also slows the climb and a short-stroke engine down! Undercamber usually contributes the effect of making a section more critical, and making an exact angle of trim necessary. Why go to all that bother?

There is a notable trend toward increasing the size of the rear horizontal surface—the stabilizer. This is a progressive step toward utilizing all lifting surfaces as much as possible. The idea is to let the stabilizer carry part of the load. Why not? It's got to be there anyway—you may as well let it handle part of the burden.

But, utilizing the rear lifting surface must be done right. The larger the stab, the further back the center of gravity should be. If it is too far forward with a large stab, too much incidence is

necessary. Therefore the stab will be dragging along at a non-lifting angle and doing more harm than good. We have found that a 46% stab with  $1\frac{1}{2}^\circ$  incidence (between the wing and stab) and with the c.g. 85% back from the leading edge of the wing is a safe, minimum drag, lift-utilizing combination (10% thickness of wing chord with no undercamber wing section and 8% thickness with no undercamber section in stab).

The conversion of power into glide sometimes presents problems. Prolonged recovery or a long dive before pulling out into the glide can be taken care of

by careful, precise adjusting of trim tab and incidence and using just the right prop to prevent hanging. Use a prop with enough forward thrust that it simply "flies" the ship into the glide. Use a type of prop that comes in a variety of sizes and pitches, or alter the diameter or blade area and pitch yourself, and experiment.

Compromise between peak power performance and peak airplane performance. There is always a 16,000 r.p.m. prop lying around which will let an engine scream even beyond its rated maximum horsepower—but chances are that this prop won't even budge your

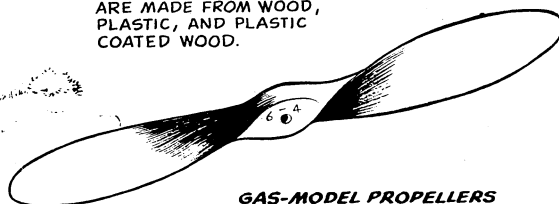
airplane. Then there is the other extreme, the 3,402 r.p.m., 16" prop that will fly the heck out of your ship providing you have an engine which will put out its maximum h.p. at that r.p.m. The correct answer is somewhere between the two and can be found only by experimentation.

In conclusion, I think it should be said that the average design seen at contests is darn good, but can be improved. Chances are that the builder is worried a lot more about the right fuel to use and when the thermals will bounce, than he is about gyroscopic effect, torque, shmorque, the Dutch roll, and the tootsie roll.

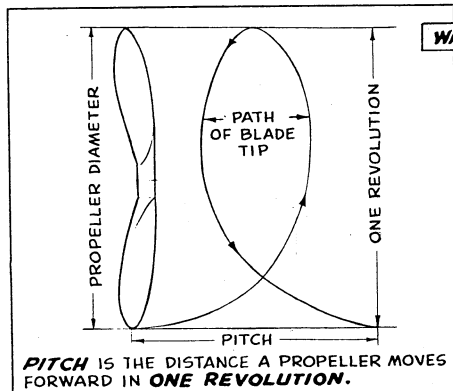


## Facts to know about GAS-MODEL PROPELLERS

**GAS-MODEL PROPELLERS**  
ARE MADE FROM WOOD,  
PLASTIC, AND PLASTIC  
COATED WOOD.

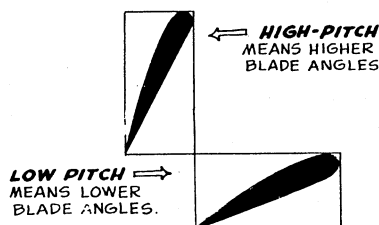


**GAS-MODEL PROPELLERS**  
ARE FINISHED WITH:  
WAX TO FUEL-PROOF THEM  
AND FUEL-PROOF LACQUERS.



### WHAT IS MEANT BY A 6-4 PROP?

A 6-4 PROP IS ONE WITH A  
DIAMETER OF 6" AND A  
PITCH OF 4"



● Using just any-old prop will never do, if you're interested in getting top performance from your model engine. It's easy to understand that a small engine cannot turn a very large diameter propeller.

Propellers which have a very high pitch require more power to turn over at high rpm, that is if propellers of the same diameter are being compared.

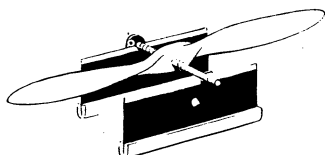
Generally speaking, low pitch propellers are suited to free-flight model airplanes while higher pitched propellers are favored for speed models. This is, of course, not a hard and fast rule. Proper propeller size can only be found through experimenting with various sizes until the prop which produces the best performance is found. As unscientific as this sounds, it happens to be the way that professionals do it.

Propeller balance is a very important point. Unbalanced propellers cause vibration and this leads to lost power.

To properly balance a propeller it is necessary to force a snug-fitting round rod into the propeller hole. A loose-fitting, small-diameter rod will not do the job properly. When the rod is placed on two knife edges, razor blades will do, the heavy side of the propeller will turn to the bottom.

The propeller is balanced by adding fuel-proof dope to the light side. Wait for the dope to dry before rechecking the balance. Small differences can be eliminated by sanding the heavy side until the prop is in balance. Check the balance from both sides of the propeller to eliminate errors which might be caused by the balancing rod or the knife edges. Balancing should be done at home and not on the flying field.

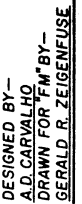
## PROP BALANCE:



**PROPELLERS MUST BE BALANCED FOR BEST RESULTS.** TO CHECK BALANCE, INSERT A BOLT, THE SAME SIZE AS PROP SHAFT, AND BALANCE ACROSS THE EDGES OF TWO RAZOR BLADES. PAINT LIGHT SIDE WITH FUEL-PROOFER TO BALANCE

# DANGER!

**PATCHED PROPELLERS ARE NEVER SAFE! DISCARD PROPS WHEN THEY BECOME SPLIT OR BROKEN!**

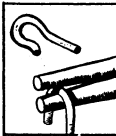


# How to bend METAL



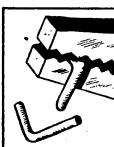
GIL EVANS

## 2 USE THE RIGHT TOOLS:



USE BOX NOSE PLIERS TO BEND RIGHT ANGLES

NEEDLE-NOSE PLIERS HELP WITH SMALL PARTS.

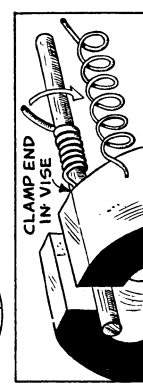


## PIANO WIRE:

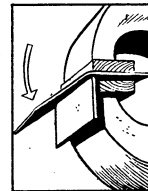
1 USE A VISE TO BEND WIRE. DO NOT MAKE SHARP CORNERS OR WIRE WILL SNAP.



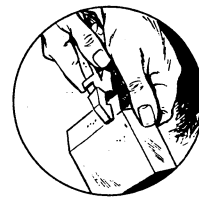
BENDING WIRE OVER A RADIUS PREVENTS BREAKING. VERY SHARP BENDS ON THICK WIRE ARE MADE BY HEATING WIRE OVER FLAME. WITH TEMPER REMOVED, IT BENDS EASILY.



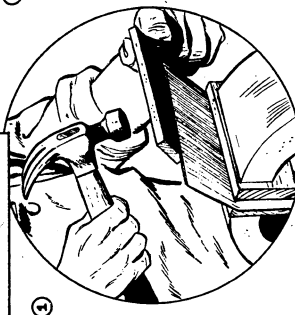
SPRINGS CAN BE MADE BY WRAPPING WIRE AROUND A ROD OR DOWEL. DIAMETER WILL INCREASE AND LOOPS SPREAD OUT WHEN WINDING PRESSURE IS RELEASED.



3 SQUARE-NOSED PLIERS ARE USED FOR SHARP BENDS ON SMALL PARTS. MARK BEND CAREFULLY AND BEND SLOWLY, SECTION BY SECTION.



NOTE: ROUNDED SHAPES SHOULD BE BENT AROUND A CURVED BLOCK, DOWELS, OR SUITABLE SHAPES!



BEND SHEET METAL IN A VISE, USING A HAMMER. PLACE A SMALL WOODEN BLOCK OVER THE METAL TO AVOID DENTING IT. CLAMP METAL IN VISE BETWEEN PIECES OF WOOD TO FURTHER PROTECT IT.

## SHEET METAL:

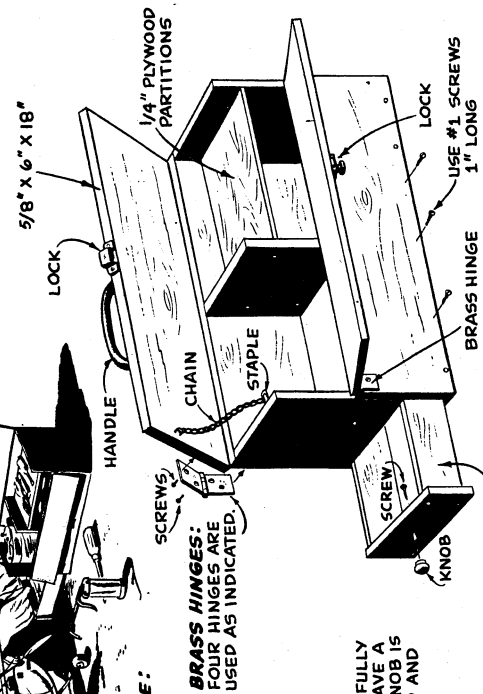
A SMALL RADIUS IS USED WHEN BENDING SHEET METAL. USE SCRAP METAL THE SAME THICKNESS AS SHEET, WITH ROUNDED EDGES, FOR "BEND ALLOWANCE".

# How to build a FIELD BOX



GIL EVANS

FIELD BOX:  
6" WIDE X 18" LONG X 10" HIGH  
MADE FROM 5/8" FINISHED LUMBER.  
SPACE COMPARTMENTS TO SUIT  
YOUR NEEDS.



COLOR SCHEME:  
PAINT SOLID GREEN.

BRASS HINGES:  
FOUR HINGES ARE USED AS INDICATED.

DRAWER:  
MEASURE CAREFULLY IN ORDER TO HAVE A SMOOTH FIT. KNOB IS MADE OF WOOD AND SCREWED ON.

GIL EVANS

# How to Metal-emboss a NAME PLATE for the Field Box!

## WHAT YOU NEED:

ALUMINUM



PIECE OF CARDBOARD

ALL-PURPOSE UTILITY TOOL

## WHAT TO DO:



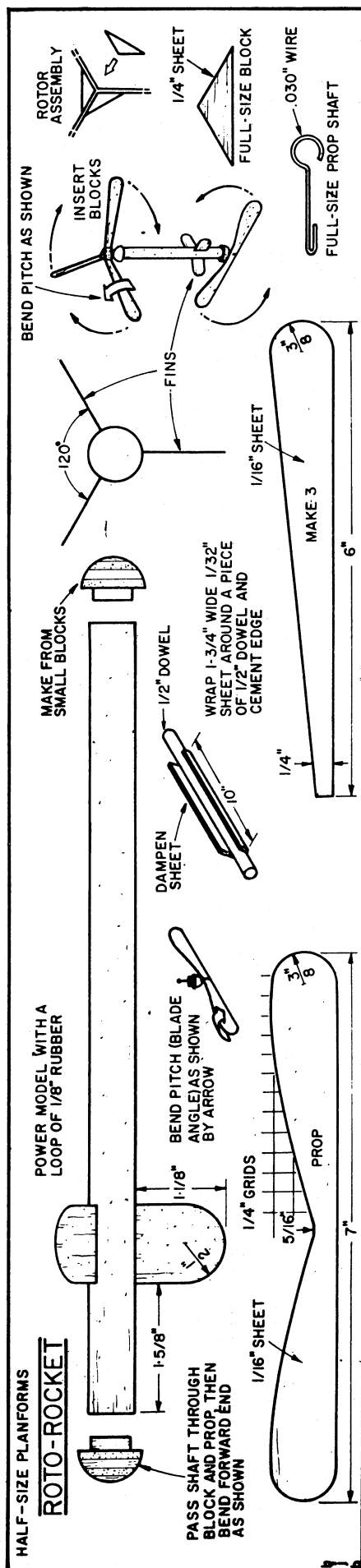
TURN ALUMINUM OVER, RETRACE NAME ON REVERSE SIDE.

WITH ALUMINUM OVER CARDBOARD, WRITE NAME WITH TOOL.



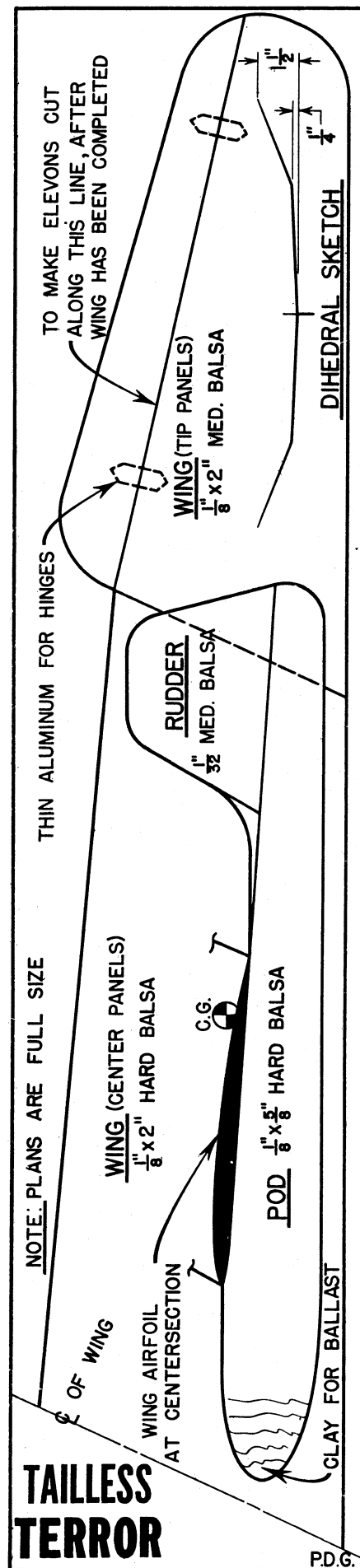
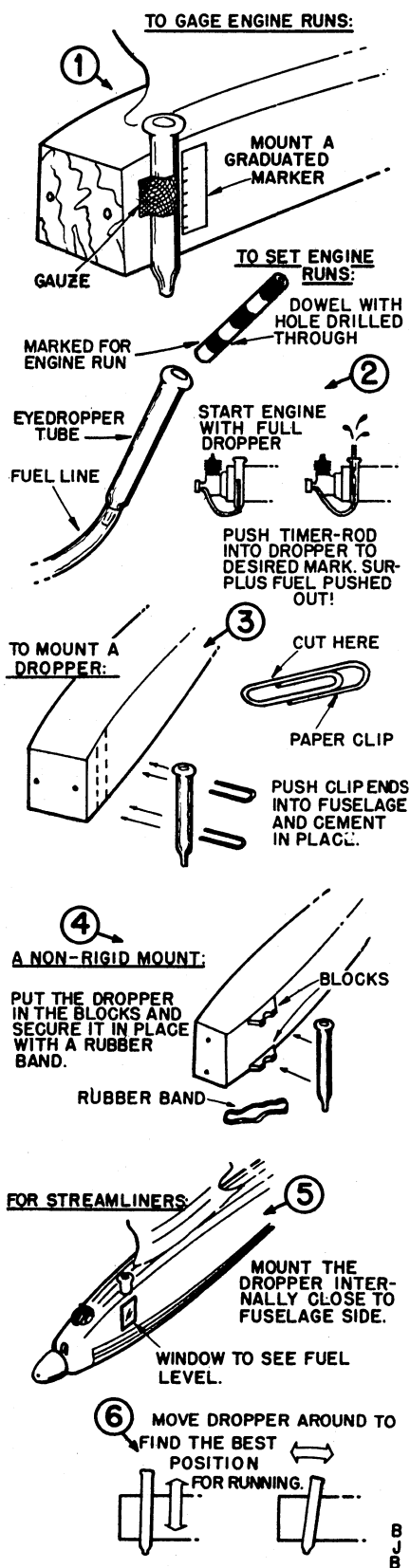
TURN OVER AGAIN, USE FLAT END OF TOOL TO SMOOTH DOWN AROUND NAME. TACK ON BOX

Our thanks to Hazel Pearson Handicrafts (Temple City, Calif.) for their cooperation.

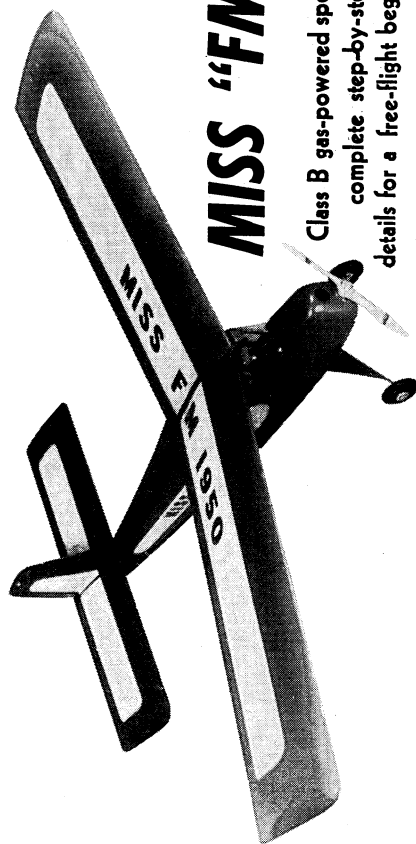


## EYEDROPPER TANKS

How to install them  
and how to use them







# MISS "FM"

Class B gas-powered sportster—  
complete step-by-step  
details for a free-flight beginner—

● Meet Miss FM, sturdy, highly realistic and good-looking cabin sportster. Built primarily for rugged, every-day sport flying, it can be readily converted for the PAA-lead event, and also hold its own in any of the club or local endurance events.

Sturdiness is the byword. To add to its durability, we covered our model with nylon which—with the exception of possible explosions, etc.—makes the ship practically indestructible. We were sold on nylon after watching one of Bill Winters' radio jobs fall from the top of a 35 ft. tree. Waiting for the customary rending crash and hearing nothing more than loud whump we looked up to see Bill brush the ship off and prepare it for another flight. So help us, it didn't even have a scratch! Not two minutes ago we found another decided advantage: Our fields have just been worked over with the manure spreader, our model landed in the midst of the mess, and brother it was covered. Yet soap and water removed every stain!

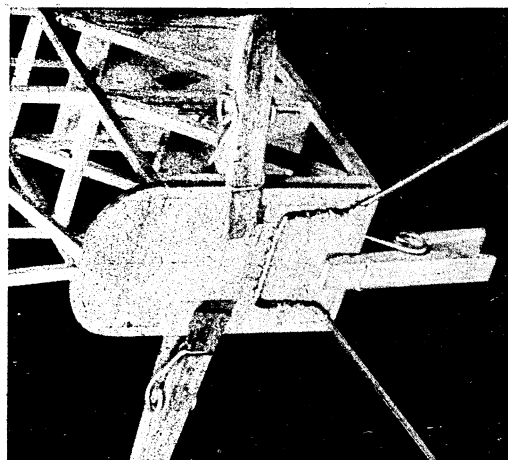
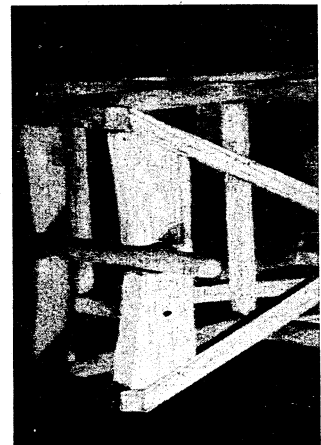
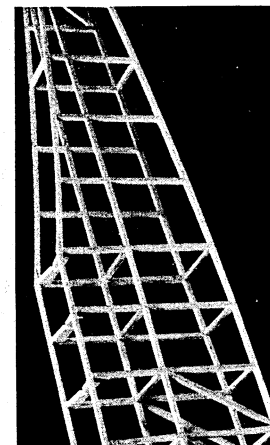
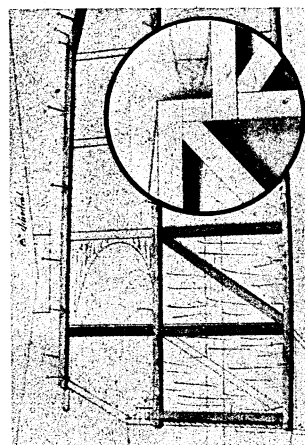
Construction has been amply covered by the plans and photos—simplicity is the keynote—and a little care and patience should produce a really nice job. If you find nylon a little steep for your pocketbook (in the long run it's cheaper—no costly repairs, long wear, 100 times more flying, and permanent good appearance), silk or regular gas model tissue can be used for the covering.

Three dress snaps hold cowl

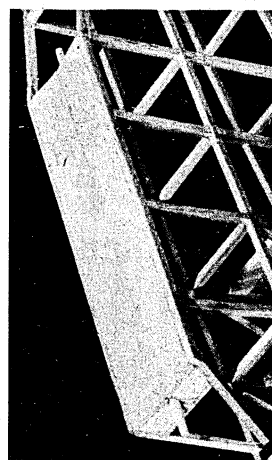
**1.** Scale up fuselage drawing to indicated dimensions (see article on Page 18 for details on how to enlarge drawings). Lay down 3/16" square cement 3/16" square uprights in place, followed by diagonals. Cut all uprights and diagonals at angles indicated on plans, joining as shown to get maximum strength.

**2.** When assembly has dried, make second fuselage side directly over the first. When dry, separate sides with a razor blade. Next, cut cross pieces given in top-view drawing. Insert and cement widest members first, followed by the cement bars (F2). Then cement fuselage sides together and let assembly dry thoroughly.

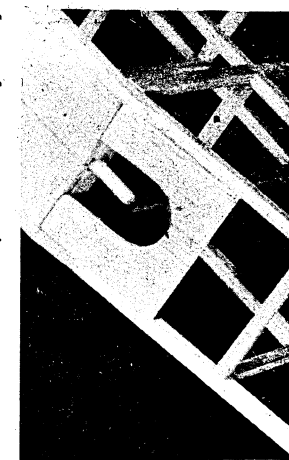
**3.** The photo at left shows how the first F2 cabin section is cut to fit angular setting of the cabin front members. Note the position of the 3/16" hardwood dowel used for wing hold-down rubber. When inserting cross members, start with the piece three stations to rear of cabin structure—then insert and cement others into place. Lay structure aside to dry.



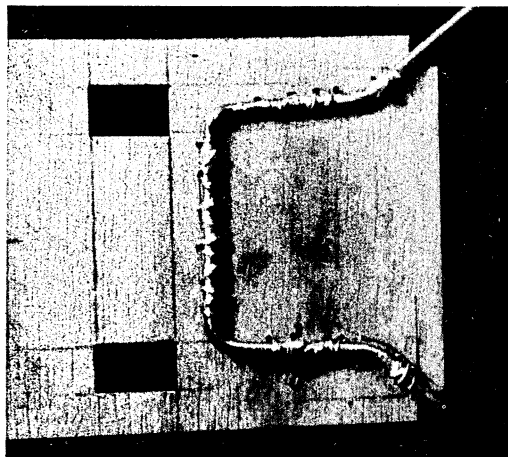
**6.** Cement the firewall (F1), complete with the front member of the landing gear, into its proper position at the front of the fuselage. Spring-type clothespins will come in mighty handy for holding this bulkhead firmly in position, as shown in the photograph above, while cement is drying. Rear landing gear brace is installed later.



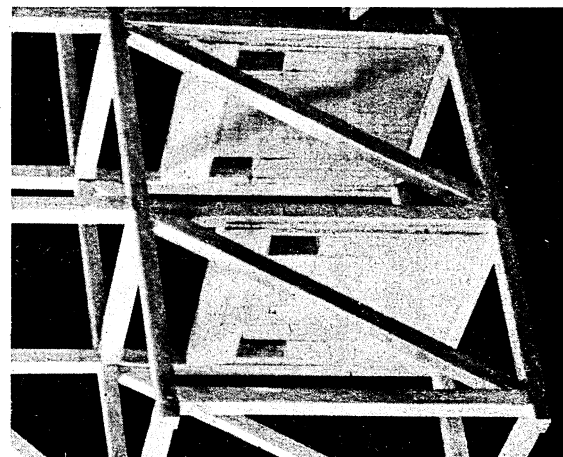
**7.** To complete the top of the cabin, insert and cement the 1/8" x 2 3/16" x 3" sheet balsa between the cabin longerons and on top of F2 members and hardwood dowel. The above photo shows the cabin top in position. As you will note in front plan view, this sheet is cracked in middle to compensate for dihedral angle of wing.



**8.** Now cut 1/16" sheet balsa to the dimensions shown in the top view, making cut-out as shown in above photo, to permit access to wing rubber hold-down dowel at rear of the cabin. Leave this cut-out open when applying covering to fuselage. Mounting the wing rubber on dowels permits wing to pop off virtually undamaged in crashes.

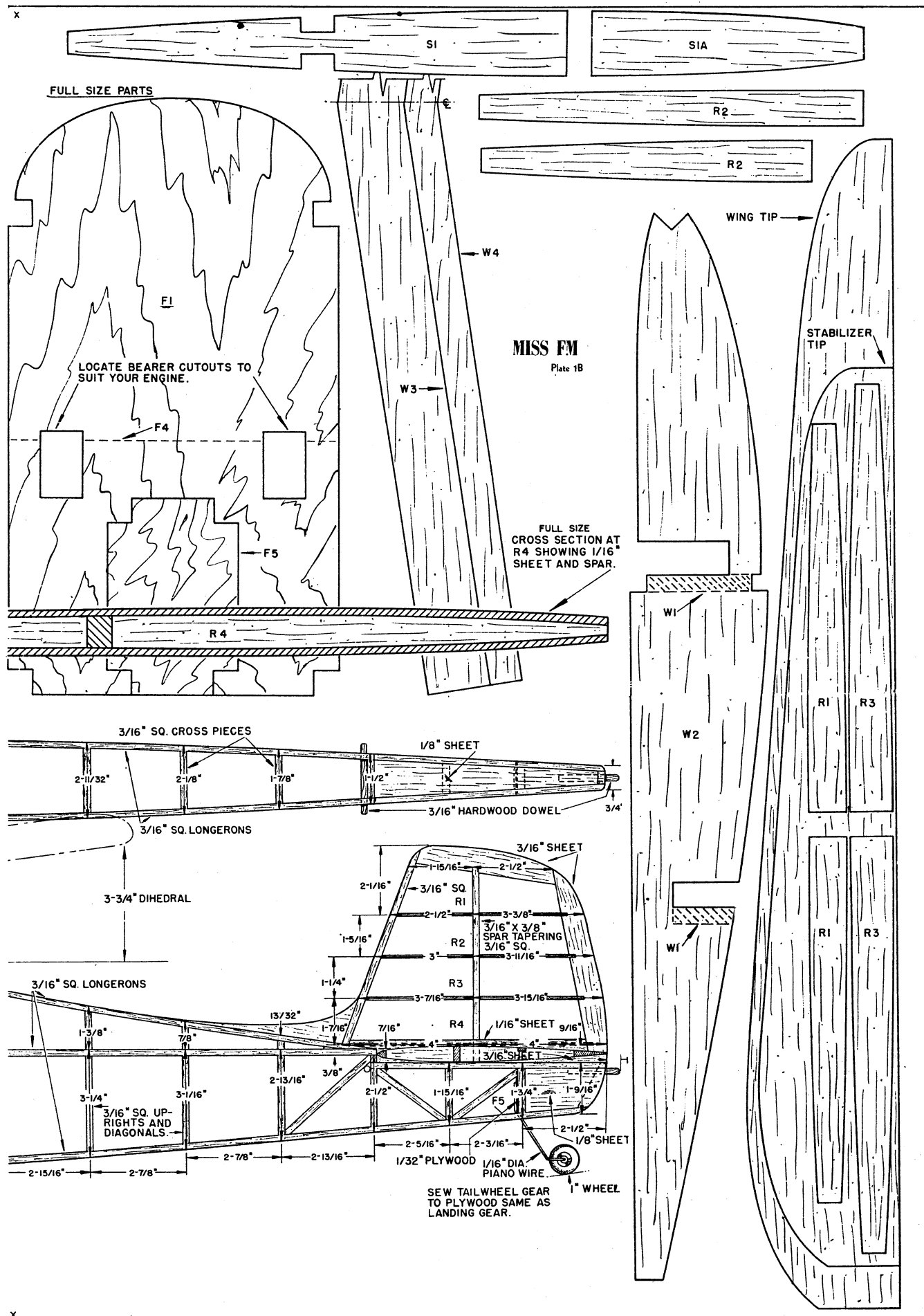


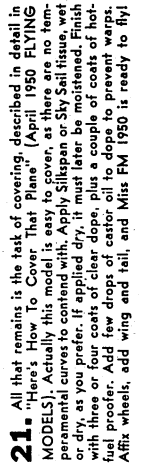
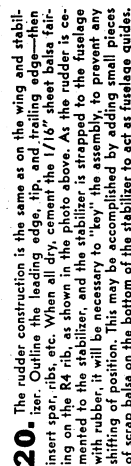
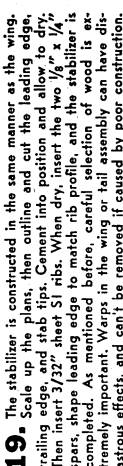
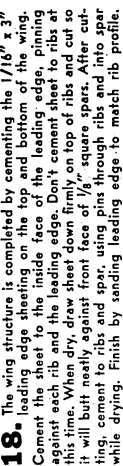
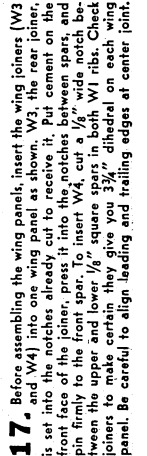
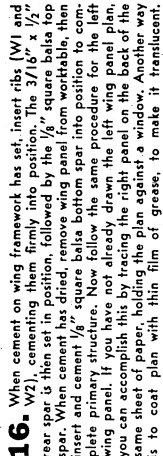
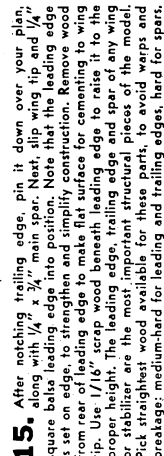
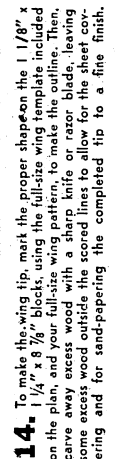
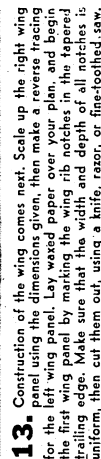
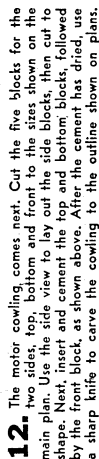
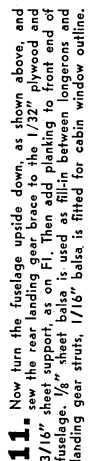
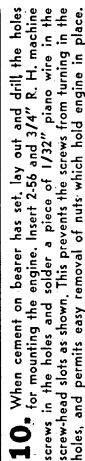
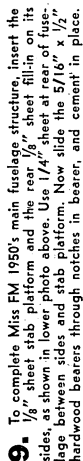
**4.** Cut firewall (F1) from 1/4" plywood, using full-size pattern on drawing. Mark off engine bearer holes on firewall. Then drill 3/16" hole in center of each indicated cut-out and use coping saw to cut holes to pencil lines. Bend front member of landing gear to shape and use it as a guide when drilling 1/16" holes needed to sew the gear to the firewall. Remove insulation and use soft copper bell wire to sew gear in place, as shown in the photograph. The rear landing gear brace and tail gear similarly are sewed to their formers.



**5.** Now insert and cement the 3/16" x 2 1/16" x 2 1/16" bearer supports between the uprights of the two stations directly to the rear of F1 (see plans). Cut 5/16" x 1/2" notches at the top of these supports to receive the engine bearers. Cement supports securely in position, flush with fuselage uprights and lower cross pieces. Finish job by cementing a piece of 3/16" x 1/2" x 2 1/16" balsa to the top edge of each support, as shown in the above photograph. Use extreme care in securely cementing all joints in forward section of fuselage.







in place: one on the top, two on the bottom. The larger size snaps are easier to handle and hold more firmly. A piece of  $\frac{1}{8}$ " diameter copper tubing extending to the outside of the cowl will take care of the filling of the tank, and a small prime in the exhaust port will eliminate the need of choking your engine when starting. Be sure your engine is adequately cooled by making the air entries the size shown on the plans.

**FLYING:** Realistic cabin models of this type are exceedingly simple to fly—a large enough flying area, reasonably calm weather, and ordinary patience are the only basic requirements.

If built according to plan, only minor glide adjustments will be necessary. Hand glides are the first order of business. Kneel in a grassy area and thrust the model gently forward into the wind (always glide and fly the model directly into the wind, never downwind. A simple rule to remember is to have the wind in your face never at your back).

Only three things can happen on your first glide: A stall (the model nosing up into the wind and then falling directly forward into the ground); a dive (in which the model seems to fall directly to the ground after release); or the proper glide—straight forward at a slight angle toward the ground, with the model touching the ground approx-

imately 35 feet in front of you with a gentle resting motion and rolling forward slightly.

If the model tends to stall, a small sliver of  $\frac{1}{32}$ " sheet wood placed beneath the leading edge of the stabilizer should correct this condition. If it doesn't, one or more slivers beneath the leading edge should ultimately straighten out the glide.

If your model tends to dive, place the slivers beneath the trailing edge of the stabilizer (incidence is the correct terminology for this correction). Be sure that the incidence correction is in small amounts.

After the glide is correct, tackle the problem of turn. Our model had a turn circle to the left of approximately 250 feet in the glide and approximately 100 feet under power. If you desire right turn in flight, the opposite of the turn circumferences will occur, torque will keep the turn to the right large, and the rudder will tighten the turn in the glide. Slight adjustments of the rudder in either direction will take care of the turn.

Remember that, as soon as turn is incorporated, the model will speed up in the glide, so slight readjustments of glide incidence will have to be made as the turn circumference becomes tighter.

After glide and turn are correct, pow-

er flights can be attempted. Engine runs of short duration (5 to 7 seconds maximum) should be the rule until all power flight characteristics are noted. If the power turn to the left is too tight, open the rudder adjustment until the model can take full power without a low wing on the inside of the circle. If the flying area is spacious enough, engine runs of 30 to 40 seconds will produce flights of 3 to 5 minutes' duration, which is plenty long enough in any man's country!

#### BILL OF MATERIALS

(Balsa unless otherwise noted)

12— $\frac{3}{16}$ " x  $\frac{3}{16}$ " x 36" (hard)....Fuselage longerons  
3— $\frac{1}{4}$ " x  $\frac{1}{4}$ " x 36" (medium)....Wing, stab leading edges  
3— $\frac{3}{16}$ " x  $\frac{1}{2}$ " x 36" (medium)....Wing, stab spars  
2— $\frac{3}{16}$ " x  $\frac{3}{32}$ " x 36" (medium)....Wing spar  
2— $\frac{1}{4}$ " x  $\frac{1}{2}$ " x 36" (medium, tapered)....Wing trailing edges  
1— $\frac{3}{16}$ " x  $\frac{1}{2}$ " x 36" (medium)....Stabilizer  
3— $\frac{3}{32}$ " x  $\frac{3}{32}$ " x 36" (medium)....Wing, stab ribs  
4— $\frac{1}{16}$ " x  $\frac{3}{32}$ " x 36" (soft)....Wing covering, leading edges  
1— $\frac{1}{8}$ " x  $\frac{3}{32}$ " x 36" (medium)....Wing, stab platforms; fuselage fill; landing gear struts  
1— $\frac{3}{16}$ " x  $\frac{1}{2}$ " x 36" (medium)....Rudder outline; fuselage fill; and F2  
1— $\frac{1}{4}$ " x  $\frac{1}{2}$ " x 24" (soft)....Cowling blocks  
1— $\frac{3}{4}$ " x  $\frac{1}{2}$ " x 8" (soft)....Cowling block  
1— $\frac{5}{16}$ " x  $\frac{1}{2}$ " x 17" (hardwood)....Engine bearers  
 $\frac{1}{8}$ " plywood;  $\frac{1}{32}$ " plywood; 1 length  $\frac{3}{32}$ " piano wire; 1 length  $\frac{1}{16}$ " piano wire; Pair  $2\frac{1}{2}$ " Veco wheels; 1" tail wheel;  $1\frac{1}{2}$  yds. nylon or other covering material;  $\frac{3}{16}$ " hardwood dowel; Celluloid for windshield; O & R 23 or similar .23 glow-plug engine.

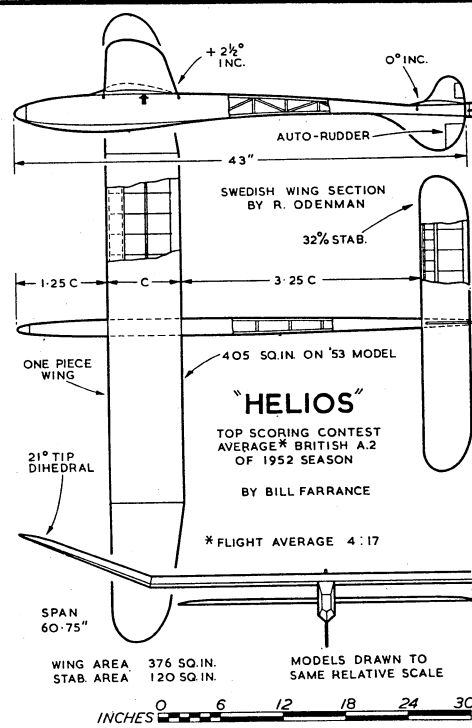
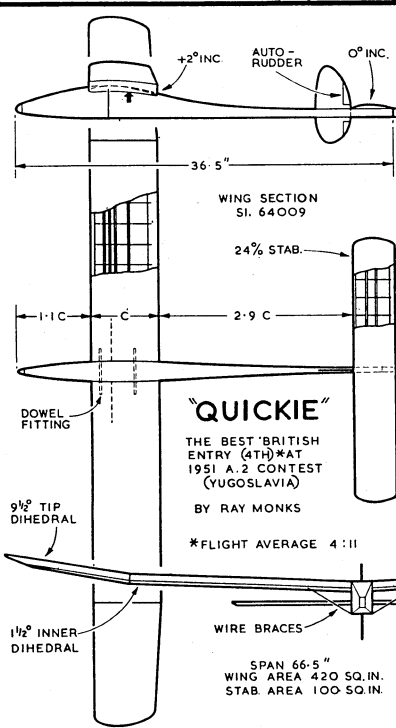
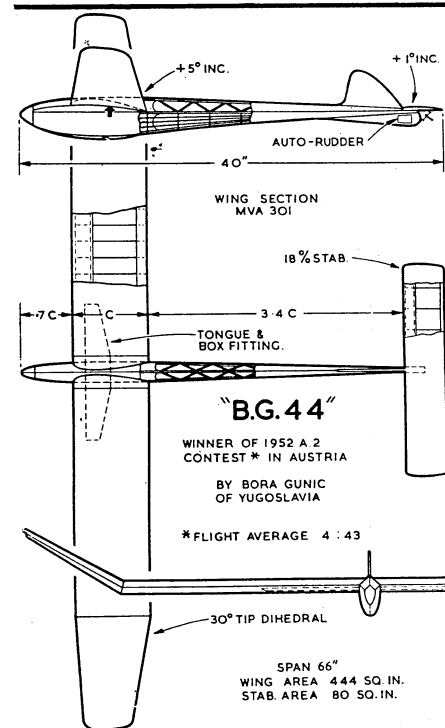
### SUCCESSFUL A/2 GLIDER DESIGNS

The B.G. 44 features an ultra-short nose design ( $\frac{3}{16}$  oz. nose ballast) with tongue and box wing fitting; crutch fuselage with pear-shaped formers added underneath and triangular structure (formers and strip) above; sheeted wing and stabilizer leading edges; forward set fin—integral with the fuselage; very small stabilizer area; and weight of 14.5 ounces.

The Quickie is a simple slab-sider (sheet fuselage) with dowelled wing fitting, and features fixed sheet fins; wire wing braces are for taking towing

stresses. After balancing, trim is obtained by packing stab. If needed, weight is added under the C.G. to bring up to necessary specifications.

The Helios features a box fuselage, built from strip, with small triangular formers added under the nose. One-piece wing (sheeted L.E.) rests on top of fuselage. Main fin area is underneath, integral with fuselage. Total area is 496 square inches—30 square inches less than permissible maximum. The stabilizer area is larger than average. Weight comes to a total 14.75 oz.



INCHES 0 6 12 18 24 30

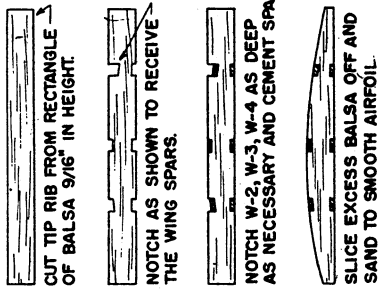




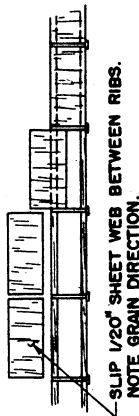


# One-Horse Shay

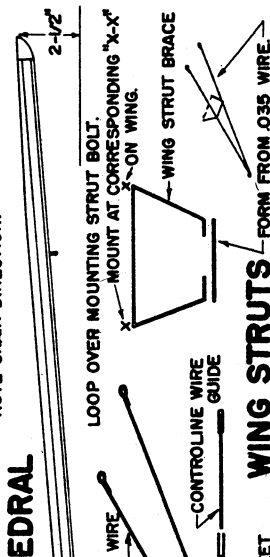
## TIP RIB DETAIL



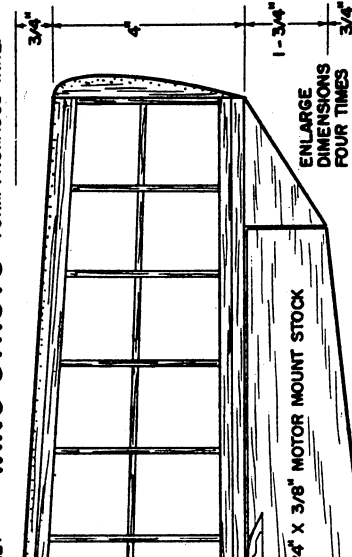
## BOX SPAR



## DIHEDRAL



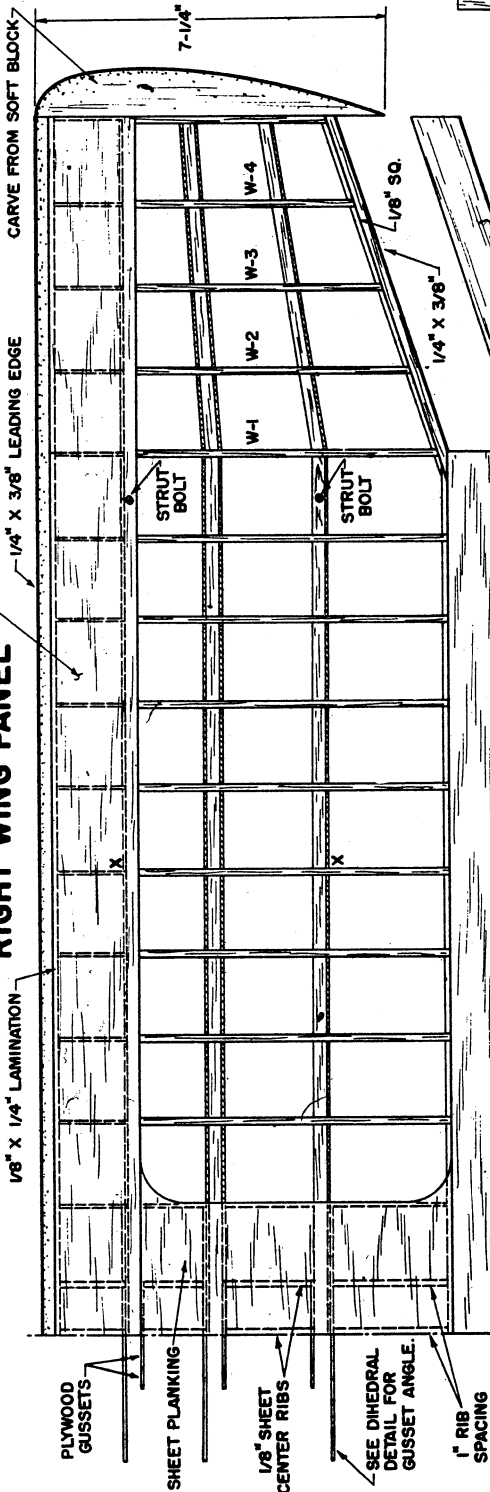
## WING STRUTS



TUBING SECTIONS MARKED "S" ARE ATTACHED TO THE STABILIZER, SECTIONS MARKED "E" ARE ATTACHED TO ELEVATOR. A LENGTH OF WIRE RUN THROUGH THE TUBING FORMS PIVOT POINT OF HINGE.

1/16" X 2" SOFT SHEET PLANKING

## RIGHT WING PANEL



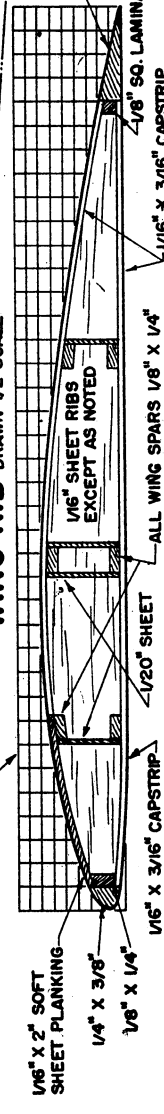
CHORD - 9-1/2" RIB SPACING 1-3/4" SEE RIB DETAIL FOR MATERIAL SIZES. MULTIPLY ALL NECESSARY DIMENSIONS FOUR TIMES.

## 1/4 SCALE PLANS

ENLARGE DIMENSIONS FOUR TIMES WITH A RULER, DIVIDERS, COMPASS OR A MARKED PIECE OF PAPER, FACING THE MEASUREMENT OFF.

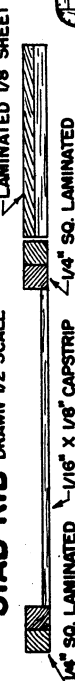
## WING RIB

ENLARGE TO 1/8" X 1/4" GRID.



## STAB RIB

ENLARGE TO 1/8" X 1/4" GRID.



## STABILIZER

ENLARGE TO 1/8" X 1/4" GRID.



## HINGE DETAIL

10 1-1/2" LENGTHS 3/32" O.D. TUBING  
2 1" LENGTHS OF 3/32" O.D. TUBING  
FILL IN WITH 3/32" SCRAP

THIS HINGE IS EASY TO MAKE, VERY NEAT.



# GUIDED MITE

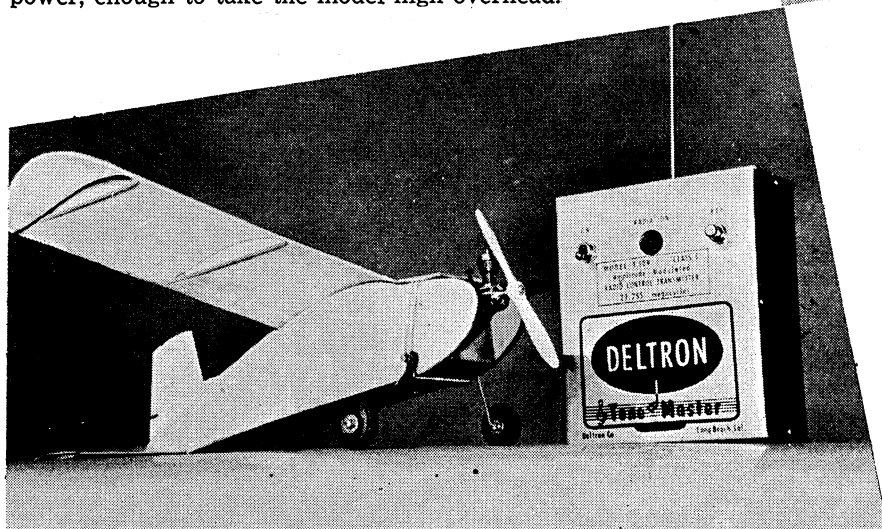
**Here's a ship to challenge the multi-monsters—and, it's powered by the smallest production model engine**

● The "Guided Mite," a vest-pocket-size R/C model, was conceived and flown within a two week period. It has proven itself a good performer and should please those beginners in radio control who wish their efforts and expenditures to remain on a lower plane than is currently fashionable.

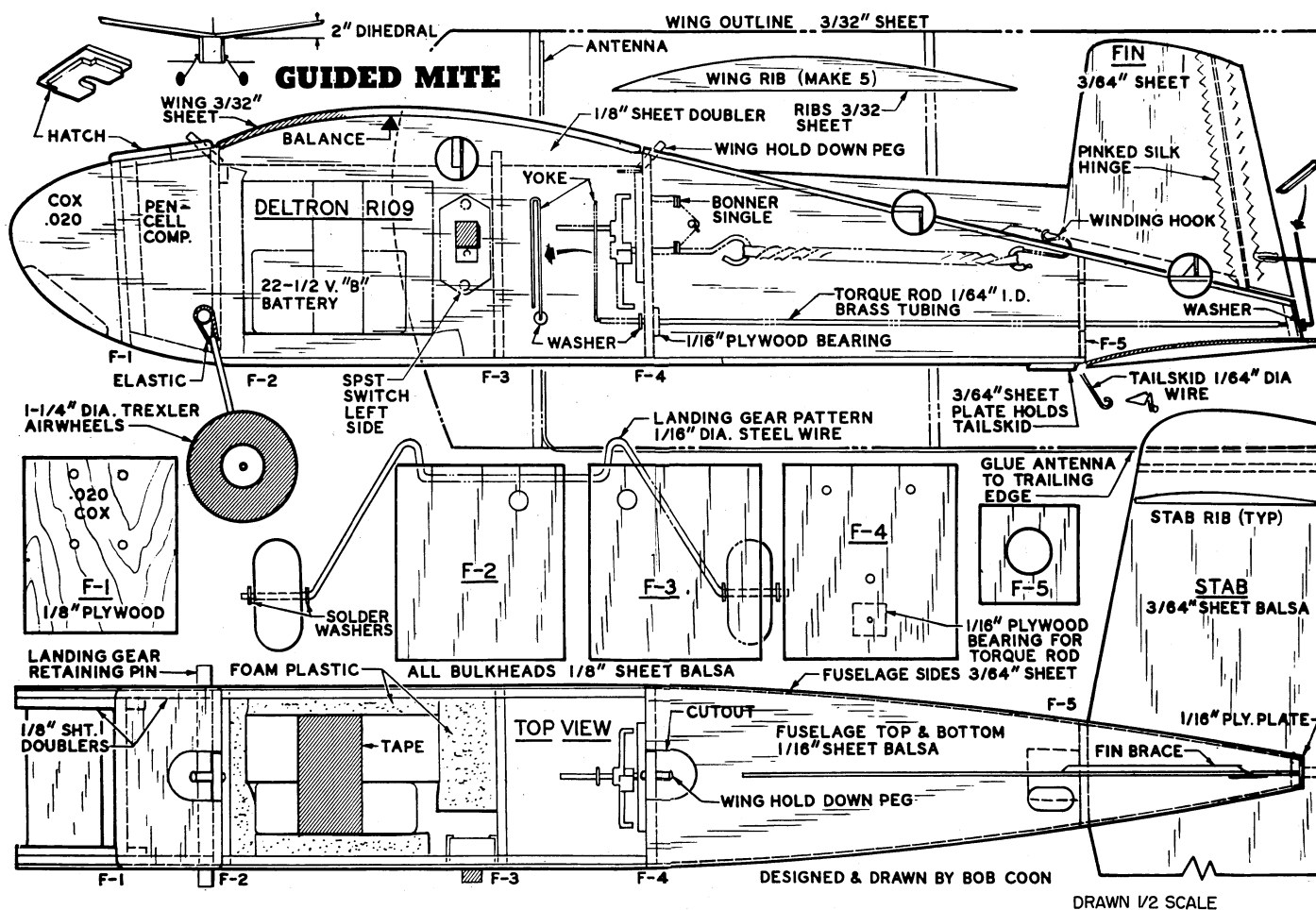
The Deltron R109, the latest in transistorized tone receivers, was used because of its extremely small size and weight. A single sub-miniature 22½ volt battery is the only current source needed to operate the receiver. Total receiver and battery weight is just 2½ ounces. The all-up weight of the model is only 8 ounces which works out to a wing loading of 12 ounces per square foot.

The simple single escapement may seem like a backward step to some, but it remains the simplest, most reliable actuator for the lowest weight penalty. For those who prefer a compound type escapement, the fuselage has ample room and will accommodate it.

The Cox .020 is a surprise package and provides plenty of power, enough to take the model high overhead.



Above: When transmitters start looking bigger than R/C models, that's something to think about. More important, this ship doesn't use special home-built equipment to make it go—it uses stock Deltron units. The tiny Cox .020 "Pee-Wee" is ample power for this ship, as you'll find if you build one. That part's easy, too. The following pages contain full-size plans for this radio-control model.



**STAB AND FIN:** Cut the stabilizer and vertical fin from a sheet of  $\frac{3}{64}$ " balsa (or sand a sheet of  $\frac{1}{16}$ "). For a rudder hinge, pink a piece of silk and dope it to the rudder and fin as shown on the plan. After drying, make sure the rudder moves loosely.

Cement the fin in position on top of the fuselage using a small strip of balsa at the base for added reinforcement.

Cement three ribs to the underside of the stab so that a curve is evident on the top, then, cement the stab to bottom of the fuselage.

**WING:** The "skyhook" wing is made from  $\frac{3}{32}$ " sheet balsa dampened on the top with water. This makes the wood fibres on top swell, thereby creating an airfoil shape. While still damp, cement all the ribs except the center one in place on the bottom side. Block up for the required dihedral and cement the wing halves together. When dry, cement the remaining center rib in place on the underside and clear dope the top and bottom.

**FUSELAGE:** Cut two fuselage sides from  $\frac{3}{64}$ " sheet balsa. Cut out bulkheads F-2, F-3, F-4 and F-5 from  $\frac{1}{8}$ " sheet balsa and attach them to the sides with fuel-proof cement. Cut the firewall F-1 from  $\frac{1}{8}$ " plywood and attach it to fuselage. Make the doublers

at the wing mount and firewall from  $\frac{1}{8}$ " sheet balsa. Make sure the firewall lies flush against doublers.

Before adding top and bottom of fuselage, install the escapement, torque rod and yoke as shown on the plan. Make sure the rudder linkage operates freely with absolutely no bind anywhere. Add the top and bottom panels. Sand them flush to the edges of the fuselage. Make a hatch for the battery compartment (see plan).

**RADIO:** Cement the antenna to the trailing edge of the wing as shown. Be sure there is at least 24" of antenna available.

Install a SPST (single pole single throw) switch on the left side of the fuselage and complete all wiring as shown on the detailed Deltron instruction sheet.

The radio compartment is lined with plastic sponge material for impact protection of the receiver and the receiver is held in place by friction.

**FLYING:** First make a range check as per Deltron instructions. Wind the escapement rubber and be sure the wing is fastened securely.

Start the engine.

Hold the transmitter in your hand with all switches on (transmitter and receiver). Holding the plane in your other hand, check the rudder response

by pressing the transmitter button and if everything works properly, set the rudder for "right coming up."

Launch out of the hand straight into the wind—no dive or climb. The model should climb out straight ahead with no control required. Wait until you have a surplus of altitude before feeling her out. You'll find she's a swell little model. Great for tossing in the back of the family car out of the way. Good flying!

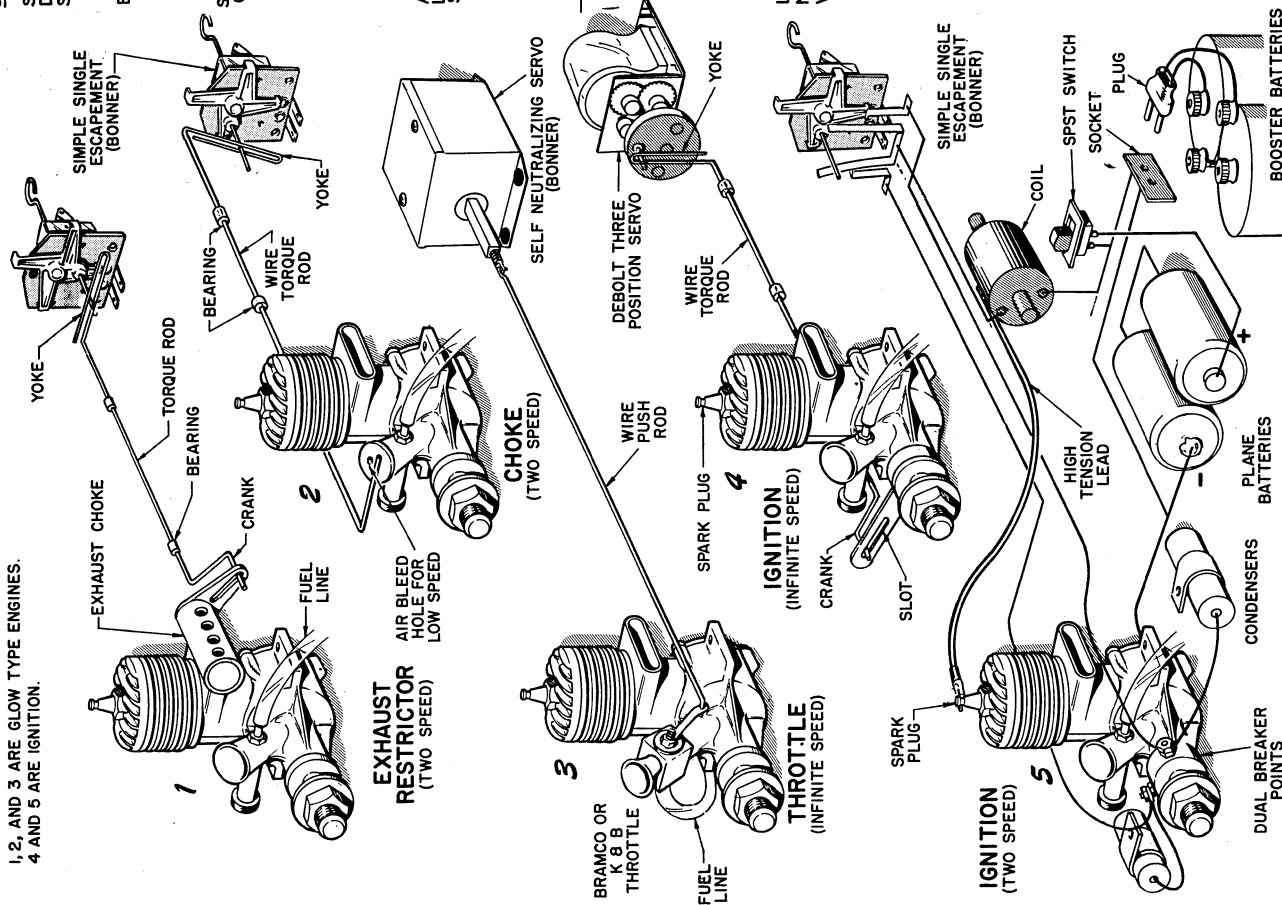
## GUIDED MITE

**BILL OF MATERIALS**  
(Balsa unless otherwise specified)

2- $\frac{3}{64}$ " x 3" x 36"	Fuselage sides, stab and fin.
1- $\frac{1}{16}$ " x 3" x 36"	Fuselage top and bottom.
1- $\frac{3}{32}$ " x 5" x 32"	Wing, ribs
1- $\frac{1}{8}$ " x 2" x 36"	Fuselage doublers bulkheads
1- $\frac{1}{8}$ " x 2" x 2"	Firewall
1- $\frac{1}{4}$ " Trexler airwheels; $\frac{1}{16}$ " diameter steel wire; $\frac{1}{4}$ " diameter steel wire; $\frac{1}{4}$ " i.d. brass tubing; $\frac{3}{16}$ " dowel; plastic sponge; Bonner simple single escapement; $\frac{1}{8}$ " T-56 rubber; .020 cu. in. Cox engine; Deltron R109 transmitter and receiver; fuel proof cement; clear Butyrate dope; SPST switch.	

## ENGINE SPEED CONTROLS

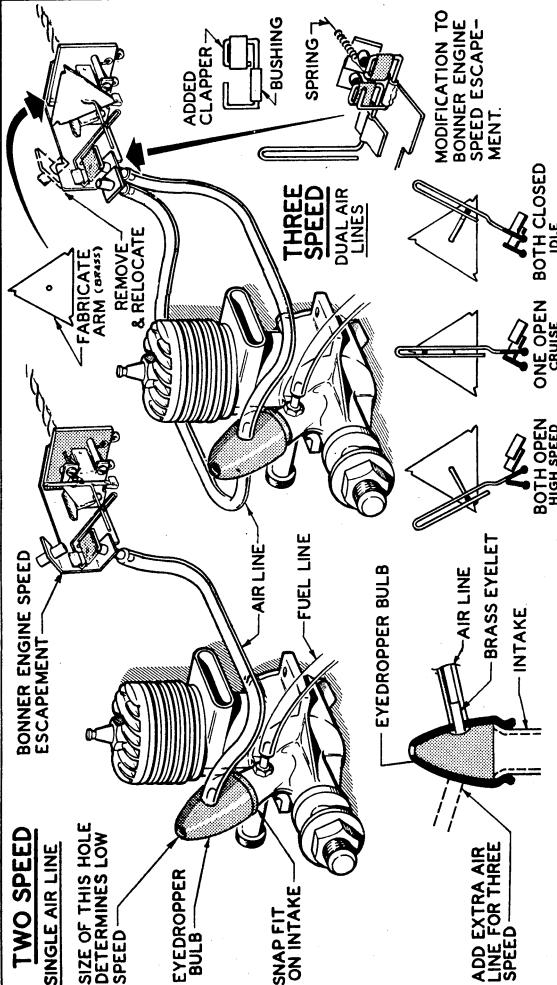
1, 2, AND 3 ARE GLOW TYPE ENGINES.  
4 AND 5 ARE IGNITION.



## TWO SPEED

SINGLE AIR LINE

SIZE OF THIS HOLE DETERMINES LOW SPEED



## ENGINE SPEED CONTROLS

## TWO SPEED

PRESSURIZED

