R/C MODELER MAGAZINE

# sailplane and soaring manual

by al doig

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SAILPLANE AND SOARING MANUAL


REVISED 1984

PUBLISHED IN THE UNITED STATES OF AMERICA
BY R/C MODELER CORPORATION

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# FOREWORD

In starting out in a new hobby, or a new facet of an old hobby, one of the tackiest problems is getting good information. "Learning by doing" is very effective. It is also expensive, and time consuming. For the person who is isolated from actual observation of how things are done, the problem is compounded. An immense help is a step-by-step guide to getting started. It is possible to get this guidance through reading books and magazines on the subject. The problem is, that the information is scattered, and never quite available when you want it. Also, it never seems to quite fit your situation. In addition, just because it's written down, doesn't always mean it is correct — or practical. What you really need is step-by-step information in one place which, if followed, will lead to achievement of a specific goal. This book can be your step-by-step guide into the wonderful world of soaring.

This book describes the many facets of model soaring. Its specific goal — to help the reader achieve successful and consistent flights of a model sailplane. The book describes ways models are flown, the different kinds of sailplanes, and how they are launched. It will help the reader select a beginning aircraft, and tell exactly how to build it. The book will outline proper trimming procedures, and will describe flying techniques designed to teach you to fly, before completely destroying the aircraft. It is written on the assumption that you are all by yourself, but will also tell you how to use help, if it is available. Although the book is written with the beginner in mind, I would hope that the intermediate, or even experienced pilot will find some new ideas nestled between the covers.

I warned you before that you can't believe everything you read. I guess I'd better convince you that I'm trustworthy, loyal, brave, true, and reverent. Well, to start, I've been in R/C for 28 years, and sailplanes for 10 years or so. When I don't know something for sure, I call on someone who does. The late Lee Renaud designed the sailplane described in the book. Lee designed the Aquila, Olympic, Grand Esprit, Sagitta, and a jillion other sailplanes. Ken Banks, who really knows his way around aerodynamics gave guidance in that area. The illustrations were drawn by an excellent sailplane pilot, Ken Raymond. Photography is by Al Doig and Michael Doig. The finished copy was read by several top sailplaners.

Though this book deals with basics in all areas of sailplanes, construction details are quite specific. I tried to stick to a specific goal rather than discuss all possible ways of doing things. Some more general construction ideas, use of tools and jigs, different radio configurations, etc., are covered quite well in another RCM publication, *Flight Training Course,* by Don Dewey. Although it deals primarily with powered flight, it would be a good supplement to this book.

Al Doig

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# CHAPTER I

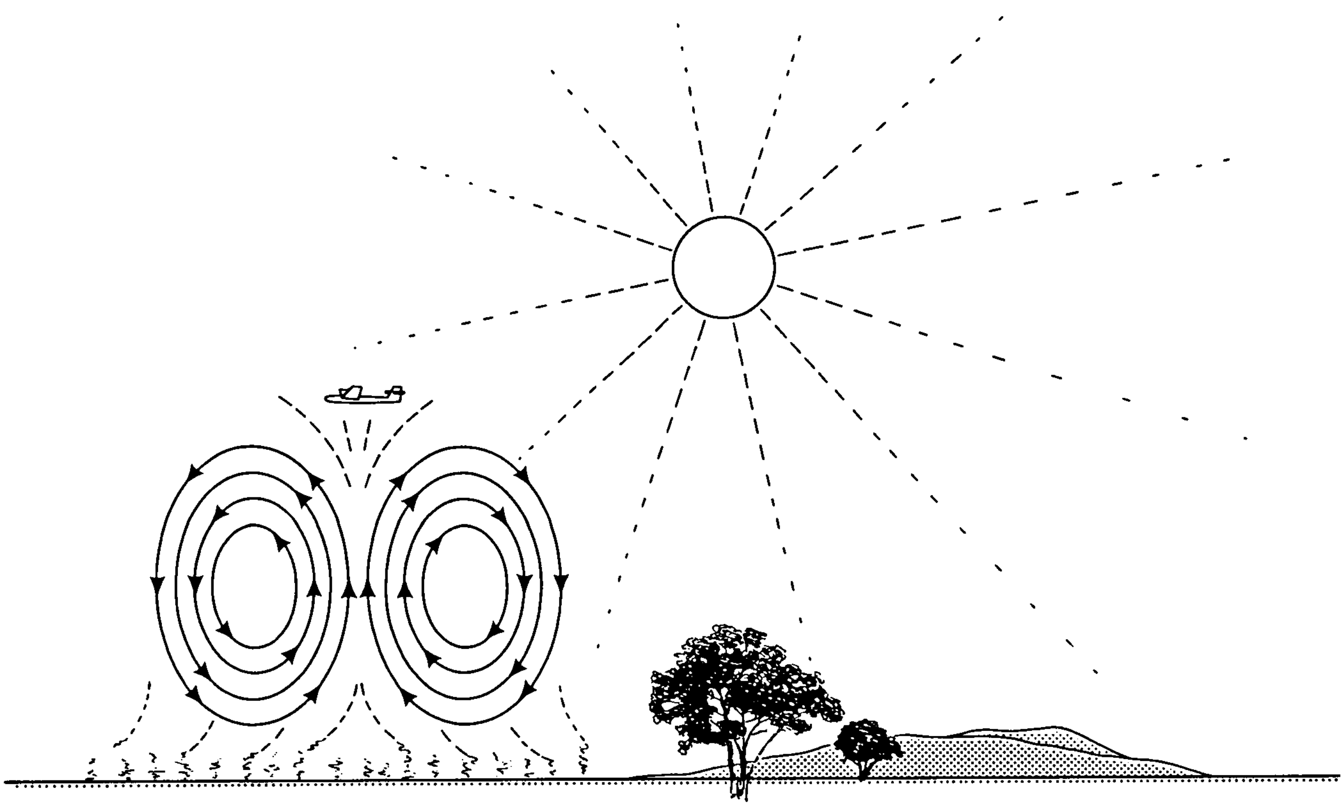
## AN INTRODUCTION TO RADIO CONTROLLED MODEL SOARING

Anyone who has not had the opportunity to watch the soaring flight of the Red Tail Hawk, or similar birds of prey, has missed a relaxing experience. It is so peaceful to see them wheeling round against a fluffy cumulus cloud, or against the blue of the sky. Usually there are several, or as many as a dozen, going round and round in a rising current of warm air. They slowly rise higher and higher, nearly going out of sight at times. Once in awhile, one hawk will be going around counter to the rest, and you wonder why. Sometimes the group will begin to sink, as the lift weakens. One by one, the birds peel off and glide swiftly, straight as an arrow, searching for another air current to sustain them. If you are lucky, you will see the lead hawk rise and fall, as though he floated over a wave. Around he goes again, with the rest in tow. Up he goes, in another current of warm air.

Or, have you seen gulls soaring along an ocean cliff; or eagles riding some invisible wave along mountain ridges? Birds have learned to take advantage of every energy available in the air. Man has spent centuries trying to fathom their secrets. The Albatross has been known to soar over the ocean for long distances without flapping its wings, by using wind shear in ways man does not fully understand. Walt Mooney, who is a crack glider pilot, once followed a gull far out to sea, studying the movements of the gull, and trying to duplicate them. Suddenly, the gull started flapping his wings, and flew away. Walt couldn't flap his wings. He began to realize he was too far from land to make it back — splash!

Have you every watched a gaggle of model sailplanes wheeling in the sky, or soaring silently along a wind swept cliff? It's the same relaxed feeling as watching the hawks. And, when you are in control of one of the models, there is a tingling excitement in the relaxation. It's kind of like sailboating. You are in command, using the forces of nature to the best advantage possible. It takes a good ship and lots of skill to stay aloft for very long, with no motive power other than the power of nature itself.

So, where do we get this power to soar in the sky without a motor? One source is thermal activity. This is what the hawks use when they circle over flatlands. Useful thermals are generated by the sun warming the ground, or some heat-absorbing object. Air near the ground is, thereby, warmed, and rises. Cool air then flows in to replace the risen air; is, in turn, warmed, and also rises. As the air rises, it may be cooled when it reaches a few hundred feet, or it may rise thousands of feet. The cooled air then flows away from the rising column of warm air, and falls back to earth. It may again be warmed and rise in the column, forming a funnel of rising air surrounded by areas of falling air.



FORMATION OF A THERMAL

As a sailplane glides through the air, it is always sinking, with respect to the air surrounding it. However, if the surrounding air is rising faster than the sailplane is sinking, the ship will go up, relative to the ground. Therefore, if we were to fly our sailplane into the area of rising air in Figure 1, and tightly circle so as to stay in that area, it would go up, if the air is rising faster than the sinking rate of our sailplane. If we now fly out of the area of rising air and into the area of falling air, our sailplane will sink to earth very rapidly. It will go down at its normal sinking rate **plus** the downward velocity of the surrounding air. The rising current of air is called "lift" and the falling areas of air is called "sink" — but, I'll bet you already suspected that. We will have a lot more to say about thermals in later chapters.

What are these model sailplanes that can soar like birds? Well, mostly they have a balsa wood framework, for lightness. Time was when this framework was covered with silk, and doped. Now, the silk has been replaced by a plastic film, ironed onto the framework. Using either an iron, or hot air blower, the plastic film is heat shrunk, forming a smooth, tight skin over the frame.

Not all sailplanes are built from balsa. Most are, but some are built using a foam core inside the wing, which is then covered with sheet balsa, very thin plywood, or thin plastic, for smoothness. Some fuselages are formed from fiberglass, or molded from plastic.

In size, these models range form a wingspan of six feet to as much as twelve feet. The majority have wingspans from eight to ten feet and weigh two to five pounds. The models are usually built by the flier. Some fliers, pressed for time, or having a dislike for construction, buy their ships from other sailplaners. Most gliders are built from kits of parts, available through local hobby shops, or mail order houses. Many sailplaners, however, like to build from "scratch." That is, they obtain plans, buy the balsa wood and other supplies piece-meal, cut out their own parts, and build their models. Many others find satisfaction in actually designing their own sailplanes, drawing their own plans, then building. One eventually finds his own niche in the hobby.

Control of these sailplanes is by means of rather low cost, surprisingly sophisticated radio sets. Both the transmitting and receiving units are battery operated. The transmitter is held in the hand, and has a "joy stick" to control the model sailplane. Pulling the stick back raises the plane's nose; pushing the stick forward points the nose downward. Moving the stick left causes a left turn, and right causes a right turn. Inside the plane is a radio receiver to receive, and interpret the commands. An electric motor driven device called a "servo" is connected to the receiver and furnishes the "muscle" to move the control surfaces of the plane, such as the rudder, elevator, etc. Control is "proportional," that is, the control surface will follow the exact movement of the stick; move it a little, and the control surface will move a little. The airborne radio system weighs about 8 ounces, or less. The transmitter unit weighs less than 2 pounds. The effective range of the system is farther than one can see the sailplane. Before radio contact is lost, visual contact is so poor as to make control ineffective.

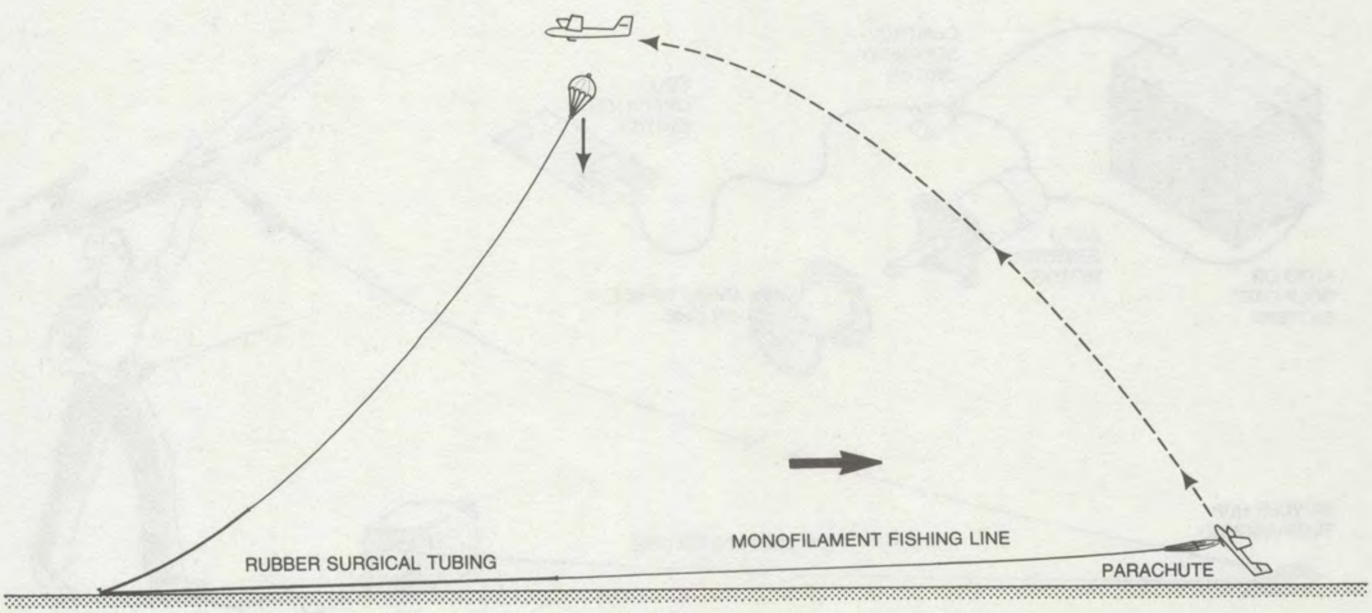
So, once having one of these model sailplanes, how do you get it up in the air? Most thermals are entered at a hundred or more feet in the air. They tend to be funnel shaped, and get bigger the higher you go. Down near the ground they are usually either undefined, or very small. Thermals can actually be entered from a hand launch, but it takes a lot of skill and practice to do this. And, besides, you must be able to recognize one when it comes through — they are almost never painted green, so you can see them. Anyway — the problem is to get the sailplane up three or four hundred feet, in the most painless manner.

The two most common flatland launching methods are the hi-start, and the electric winch. The hi-start is like a great big slingshot. As shown, it consists of one hundred feet of surgical rubber tubing, staked to the ground at one end. To the other end is fastened about four hundred or so feet of small monofilament fishing line. A parachute comes next. This is mostly so you can find the end of the line. Lastly, there is a small ring on top of the parachute, which hooks to a tow hook on the bottom of the sailplane.

To launch from the hi-start, one grasps the parachute and marches back about two hundred feet, stretching the surgical tubing.

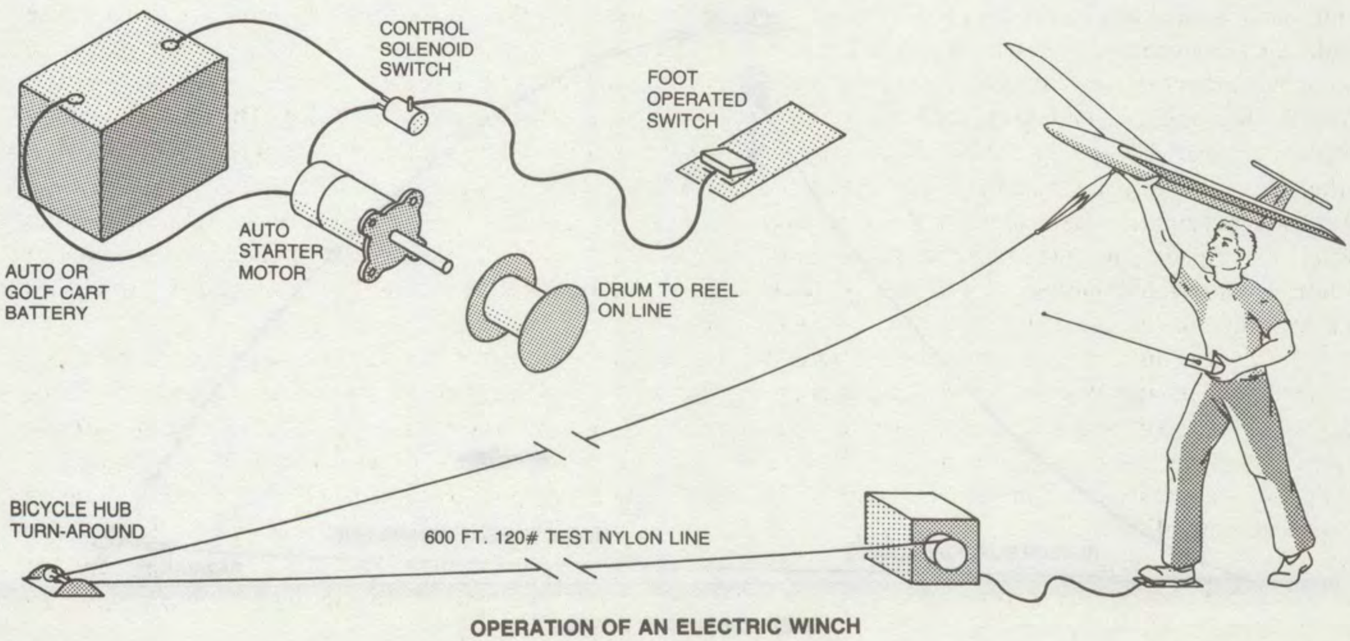
The radio in the sailplane and the controlling transmitter are turned on. The parachute ring is hooked to a towing hook on the bottom of the sailplane. The sailplane is then launched vigorously upward, at about a forty-five degree angle. The ship will go up very steeply. Minor corrections in the trajectory are made by the pilot. If the sailplane is capable of lifting the surgical tubing and line (most are), it will, if properly launched, rise to the full height of nearly five hundred feet. If the nose of the plane is dipped slightly, the parachute ring will slide off the tow hook, and the parachute and line will float back to earth. The sailplane, free of its launch line can now be sent in search of a thermal.

*Launching with a hi-start.*




**OPERATION OF A HI-START**

***Launching with an electric winch.***




**OPERATION OF AN ELECTRIC WINCH**

The electric winch performs the same function as the hi-start, but is controllable by the flier, and is more powerful. Control is by means of a foot switch. If the switch is held down, the winch runs at full speed, winding the line up on the reel. If the switch is tapped on and off, the reel will take in line at a slower rate, with a jerky sort of rotation. Care must be taken with winch operation, especially in windy weather. As I said, the winch is very powerful and, if run too fast, it may break the sailplane wing, which is very undesirable. Anyway — the sailplane is launched in the same way as with the hi-start. Running a winch, however, is like rubbing your head whilst patting your stomach — it requires a bit of coordination.

Many beginning fliers prefer to let another person run the winch while they guide the airplane. The sailplane on tow will now rise to an altitude, dependent on the length of line and the skill of the operator. At the top, the winch is stopped, and the parachute ring will slide off the tow hook. The sailplane is now soaring.

Hi-starts are preferred by most sport fliers since they are much easier for a lone flier to handle. Also, a winch weighs around seventy-five pounds, so it is not easily set up for casual flying sessions. In addition, the hi-start cost is about twenty percent that of the winch.

As can be seen from the lengths of the launch lines, it takes a fair piece of real estate to get a sailplane in the air. School grounds make an excellent launching site, and are widely used by sailplane pilots. Permission to use school property on weekends is usually easily obtained especially if the fliers belong to the Academy of Model Aeronautics (AMA), with its liability insurance provisions. Lacking a school ground, a large vacant field can be used. A sod farm, with its acres of grass is ideal. At least you need a field that is relatively free of brush. It is a mess to pick the line out of the bushes on every launch. One disadvantage of the hi-start is that it falls from the sky wherever the wind blows it. The electric winch can be run down after the sailplane is released, and the parachute pulled down close to the turn-around hub. This makes it possible to launch from a long, narrow strip of ground, which is clear of bushes. With either launch method, a clear landing place is required --- the bigger the better is the size requirement. Learning to land is the most difficult part of flying. For awhile, the challenge is to set the ship down in the same county. As skill develops, landing accuracy improves until, finally, you will be able to land inside a twenty-five foot diameter circle, with regularity.

Some fliers, who live in wooded areas where there is very little large clear areas, solve the take-off problem by using powered gliders. A small glow engine can either be bolted to the front of the glider, or mounted to a pod on top of the wing. Another solution is to use an electric motor system. Electric motor systems are available, complete with a fast charge unit, operating from the car cigarette lighter. Only fifteen minutes are required to recharge batteries between flights. The electric system, however, is about twelve ounces heavier than the glow engine system. Being considerably heavier, it will not soar as well after the motor stops. Electric systems, however, have the big advantage of being silent. Therefore, they can be flown closer to residential areas without fear of complaint.

Okay, we now have our sailplane in the air. The problem is to keep it there. If you don't find a thermal, the ship will be back on the ground in from one-and-a-half to two minutes.

In a later chapter we will have more to say about where to look for thermals. In general, though, each flying site has most likely areas where thermals can be found. It's like fishing in your favorite bass lake. Although you know generally where the fish will be biting in the morning — or in the afternoon, there are always surprises. It's fun to sniff out a thermal when others are having no luck. A search pattern is flown starting with the most likely areas. The sailplane is watched very closely. It will tell you when conditions are right. A slight rise and fall — or the rise of one wing indicates possible thermal activity. Now you turn and narrow the search until the center of the thermal current is found. Then circle — perhaps tightly, perhaps broadly — staying in the area of greatest lift. Then up, up you go; sometimes nearly out of sight. Normally a thermal will last only five to seven minutes. So, to stay aloft for ten or fifteen minutes, you must find more than one thermal. It takes experience to know when to leave a dying thermal and go search out another one. But that is the challenge of thermal flying. Your skill is tested on each flight. Sometimes when you are about to give up and land, you fly through an ever so slight rise. And it's round and round again for another four or five minutes — sometimes no higher than fifty feet. That's the real thrill — pitting your skill against the existing conditions, and getting the most out of them.

Later on in their flying career, many pilots will want to pit their skill against the skill of other pilots. Contests are a lot of fun. Even if you are not so skilled, just being there and watching others to see how they do it is rewarding. The friendships that are built and the good natured kidding that goes on is well worth the trip. There are many different types of contests. Most contests in the United States are of the precision duration variety. The object is to launch the sailplane, stay up exactly a prescribed number of minutes then landing precisely in the center of a circle. Duration times are normally six, seven, or ten minutes. A shorter version is popular as a contest opener — two minute precision. In this version, scoring is extremely harsh on those missing the two minute time by more than a second or two. Another contest task is to fly exactly fifteen minutes total in three flights — no one flight lasting longer than seven minutes. There are any number of other types of tasks, some giving the flier several options to choose from,

***1984 Fall Soaring Festival — Visalia, California.***

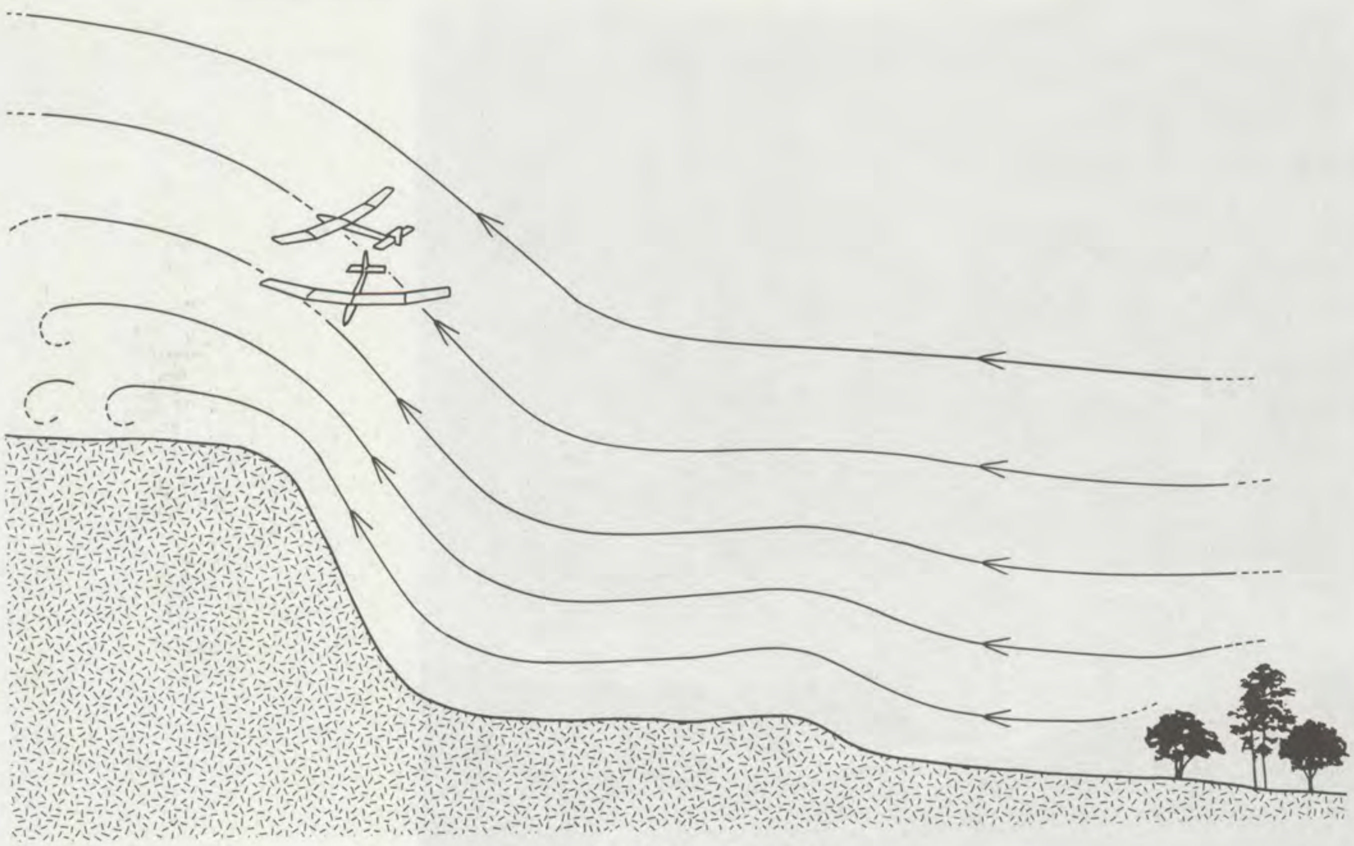
adding another dimension to the judgment.

A quite different type of task is used in international competition. F3B tasks, as they are called, consist of six minute precision duration with scored landing but, in addition, they run speed, and distance. Speed is just that — 150 meters out and 150 meters back for the fastest time. Distance is run on the speed course but is scored on the number of laps completed in four minutes with a maximum of twelve counted. Since the same aircraft must be used for all three tasks, the design must be a compromise between somewhat conflicting requirements. Of course, the tasks were selected for just that reason — to promote technical design. F3B has not been particularly popular in the United States, but has picked up some interest since the United States Soaring Team was beaten decisively in Belgium in 1978.

There is a very fine achievement program that is very popular in the United States, and several foreign countries. This program is administered by the League of Silent Flight. The program has achievement Levels from I to V. The program is self-administered with appropriate witnesses. Level I requires either a five minute thermal duration flight, or a fifteen minute slope duration flight. In addition, it requires that five spot landings be made within a circle three meters in diameter. Required achievement increases in difficulty up to Level V where a two hour thermal duration flight and an eight hour slope duration flight are on the program. In addition, the Level V candidate must complete a ten kilometer (6.21 miles) goal and return flight and win first place in three contests. Information is available on this program from the League of Silent Flight, P.O. Box 647, Mundelein, Illinois 60060. It is a very good way to measure progress, as skill increases.

On the other side of the coin in this model soaring hobby, is slope flying. There are fewer slope fliers than thermal fliers; not because it is less interesting, but because not every community has a good slope. There are, however, more slope sites than is realized. You just need to recognize a slope when you see it.

Slope lift is generated when wind is deflected upward by some object. The object may be a hill, a cliff, a building, a line of trees, or some discontinuity in the path of the wind. Not all these objects are suitable model soaring conditions, however, although I've seen clever fliers use all these things to sustain flight. Most any hill will work provided the prevailing wind blows onto the face of the hill as shown in the following figure.



**DEVELOPMENT OF SLOPE LIFT**

The problem with a great many potential slope soaring sites is the presence of trees, houses, etc., on the slope and/or the top of the hill. Regardless of how good the lift is, you still need a place to land and take-off. Also, if the lift dies, or you have problems of some sort and you are forced to land half way up the slope, you don't want it populated by trees, houses, etc. Also, discontinuities in the face of the hill such as trees, etc., can cause turbulent currents that make flying difficult.

One of the classic slope soaring sites in the world is the cliff at Torrey Pines, near San Diego, California. Here a vertical cliff at the water's edge rises over three hundred feet. The prevailing wind is on-shore. The combination of the flat ocean and the homogenious wall of the cliff gives remarkable lift, that is almost entirely free of turbulence.

The average sport flier at the slope will use one of the standard sailplanes built from a kit. It is the same design used in thermal flying. These are sometimes modified with smaller wings and can be heavier than their thermal counterparts. It is best to start with a well-designed, proven thermal ship that is stable and not full of surprises. At the slope you will also find specialty ships, designed for aerobatics as well as others designed for racing. Because of the constant lift (not found in thermal flying) it is practical to fly a series of aerobatic maneuvers. With thermal-type flying, only about one maneuver can be performed with one launch. This makes aerobatics cumbersome and somewhat impractical. With the constant lift of a slope, however, a full aerobatic pattern can be flown in one flight.

Many fliers like the excitement of pylon racing. In this sport the planes are flown back and forth along the face of the slope, turning when signaled by a flagman. They are either raced in groups, or fly singly and are individually timed.

Launching on a slope is generally rather simple. Unlike the thermal launch, the slope launch is slightly down and straight out from the hill.

The sailplane is then flown out to the area of best lift, normally fifty to a hundred feet out from the crest. The pilot is then free to turn and fly back and forth, parallel to the slope face. Turns are made away from the slope. Downwind turns toward the slope can be trouble for the beginning pilot. Some sites provide lift far out from the slope and permit far-ranging exploration. It is possible to find thermal activity out in the valley beyond the slope. The flier then can combine the best of both worlds by starting on the slope and then going thermal seeking. Or the reverse is often done. Sometimes behind a thermal flying site is a slope which can be reached from the thermal flying field. This was the case at the soaring site of the 1977 Nationals Competition at Riverside, California. About a half-mile downwind from the launch area was a large hill. In the afternoons, when the wind was blowing the thermals away, the fliers launched and raced downwind to the slope, where they could easily fly the maximum time, and then return for a landing.

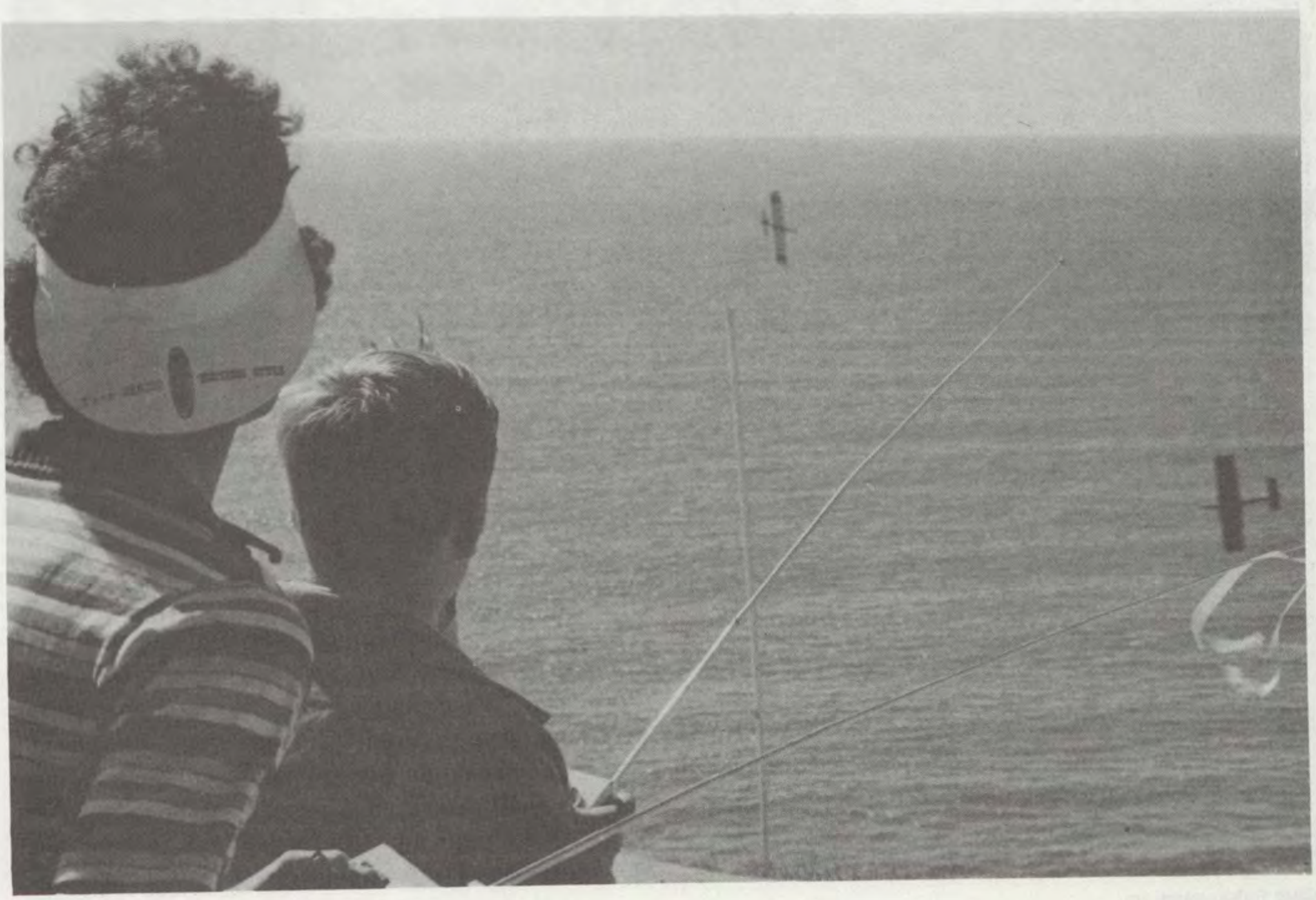
***Inland slope site.***

***Glider slope soaring — Torrey Pines, Calif.***

There seems to be much less competitive slope flying than thermal flying. One reason, of course, is the absence of a good slope in every area to practice on. The perfect precision aerobatic skills seem to be satisfied by power pattern flying and there is very little serious activity in this area. Many clubs, however, hold aerobatic competition, mostly using whatever ships the fliers have. The maneuvers tend to be simple ones that can be done with just rudder and elevator. These tend to be fun-flys rather than serious competition. There is some competitive activity in pylon racing among slope fliers. An International Pylon Race is held each year near San Francisco. The Torrey Pines Gulls also hold yearly pylon racing at the Torrey Pines site near San Diego. The English are quite keen on racing and have many fine slopes suitable for competition.

You see, there is something for everyone in model soaring. Whether you are isolated from other fliers or live in a big city, you can participate. If possible, join a club. Generally club members meet at least once each week at some selected flying site, for informal flying. If you fly regularly with other glider guiders, you will have more fun, and your flying will improve much more rapidly than if you are by yourself. Clubs usually have monthly meetings with technical talks and social activities. They also have at least once-a-year parties and banquets. This social activity with a bunch of really fine people can make the whole thing worthwhile. You can usually find out about clubs in your area at your local hobby shop, or by writing to the Academy of Model Aeronautics, 1810 Samuel Morse Drive, Reston, Virginia 22090.

So, Reader meet Model Soaring, Model Soaring meet our Reader. There — as promised in the title to this chapter — you have been introduced to Model Soaring. I've talked about a lot of things in this chapter. It's been an over-view though; meant only to tell you about everything at once. Many important points were glossed over and many were over-simplified. The following chapters will get down to the nitty-gritty and tell it like it is. So, here we go into the wild, wonderful world of Model Soaring.



***Glider slope pylon racing.***

*Launching a glider at Torrey Pines.*

*Club flying session.*

# CHAPTER II

## ABOUT THE TYPES OF SAILPLANES

Now that we've found out about the different types of soaring, let's take a look at the different types of sailplanes. We will look at the many different types of models that are available and see how they are the same - - - and how they differ.

First, let's look at the most generally popular type of sailplane. The designer or manufacturer usually says it is for thermal or slope flying. Representative designs are the Wanderers, Gentle Ladys, Sagittas, and on up to the larger Windsongs, Bird of Time, and Panteras. As we look through the advertisements, and plans, we find that though the shapes are roughly the same, sizes vary quite a bit. Dimensions of models tend to be in multiples of 3'. Larger dimensional requirements are grudgingly 4', and, even more grudgingly, 2'. The reason for this is not some exotic law of aerodynamics, but the commonly available lengths of balsa wood. More than one design has been rejected for production because of an uneconomical selection of wood sizes. I even heard of one kit manufacturer who shortened the nose moment of a model because the fuselage sides wouldn't fit in the box --- and he had ten thousand boxes. The smaller models, consequently, have 6' wingspans. If wingspans are reduced much below about 6', very light radio equipment and light construction are required. This is because the wing loading — the number of ounces each square foot of wing area must support — is high, and performance suffers. On the other end, the limit is about 12'. Beyond this size it gets difficult to transport, and handle in general. Accurate landings with very large sailplanes becomes more difficult due to their high inertia. Between these limits we find 99% of all the available designs. In competitive flying, three class sizes are used. 100'' wingspan, and over, is called Open Class. Gliders with wingspans between 2 meters (78¾'') and 100'' are in the Standard Class. Sailplanes with two meter (78¾''), and under, wingspans are, surprisingly, called Two Meter Class. Most designs and kits fit one of these classes.

Typical of the smaller 6' ships that are sold in kit form are the Wanderer, Drifter, 2X4, and Olympic 650. These can be found listed in the various advertisements. These and others like them make good beginning aircraft. They typically have five to six hundred square inches of wing area, and one piece wings. They are low cost and easily built and repaired. They are light enough so that if they land in a bush they sustain only minor tears. The wing is flat bottomed and they fly slowly. Properly built, they are gentle and not full of surprises.

The next size up is the Two Meter Class sailplane. Typical kits available are the Metrick, Gentle Lady, El Primero, Sagitta 600, and the Pixy. Most Two Meter size aircraft were designed for Two Meter competition. Presumably, they have some characteristics that the designer thought important to win in thermal contests. Most of them do not fly much different than the six footers. They generally do have a lower wing loading, and the designer has selected a wing airfoil section that he believes will result in a more efficient aircraft. Two Meter planes that are kitted tend to have flat bottom airfoils. This is because the flat bottom airfoil has generally higher lift, flies slower, and results in a more gentle airplane. Although the airplane may have been designed with contest capability in mind, most of the customers who buy the kits are sport fliers --- there are many more sport fliers than contest types. The contest flier may add a wing with a slightly semi-symmetrical airfoil, to improve penetration in windy contest conditions.

Stepping up one more notch, we find a whole herd of sailplanes available in the 99'' to 100'' wingspan size. This is a very popular size of aircraft. Performance shows a noticeable improvement, even over the Two Meter ships. Price and complexity also shows an increase. Also, the bigger they are, the harder they fall. Some of the Standard Class sailplanes have the slow, gentle characteristics for the less experienced flier. These are recognized by their somewhat boxy appearance — with thick, flat bottomed airfoils. The Olympic II and Windrifter are typical. On the other end of the scale are ships like the Sagitta that are designed to be flown fast. Sagittas do not respond well when being flown nose high and slow. A plane like the Sagitta is also a fairly complex piece of machinery and will require about sixty hours of construction time, for an experienced builder. On the other hand, planes like the Windrifter or Olympic II can be assembled by a person of modest skills in about thirty-five or forty hours.

Open Class sailplanes normally have at least 10' wingspans. They are fairly expensive to build, and some require considerable skill to construct. They are also, overall, more difficult to fly than their little brothers. Even more than the Standard Class sailplanes, the Open Class ships vary in flying characteristics. The Paragon is a very slow, gentle ship. The Mirage looks very similar to the Paragon but has a slightly symmetrical wing and is capable of fair penetration, but has a light enough wing loading to be in the floater class. The Pantera, the Bird of Time, Sagitta — each of these has its own flying characteristics but, generally, are meant to fly fast, with good penetration abilities.

At the top of the expense range are the sleek and slippery Adante, Camano, and Windsong. The Windsong and Camanos are unusual in that they have all the bells and whistles — spoilers, flaps, ailerons (flaperons), rudder and elevator. There are only a few kits available with these features. One of the largest of the Open Class sailplanes is the Sailaire, at 12½', with nearly 11½ square feet of wing area. Despite its size, the Sailaire flies very slowly and is remarkable in light air.

Another class of sailplane is developing out of the F3B International Rules competition. As stated before, International competition prefers flying tasks that include not only thermal flights, but one pure speed run, and another which is a flight for distance. The thermal flight is rather short — six minutes — which places a bit of weight on speed. The United States Soaring Team went to York, England in 1983, quite confident of doing well. They were as good as anyone in the world at thermal soaring. They were resigned to giving up a bit in the speed events, but felt their thermaling abilities would pull them through. While luck certainly plays a part in contests, the U.S. team manager said they were just out-planed. The Europeans were flying a different breed of plane. These machines were the epitomy of precision. Molded from fiberglass, the molding was precise to within a hundredth of a millimeter. The West German Team won handily with a combination of flying skill and aerodynamic superiority.

This experience launched many United States designers into a cleanliness campaign. Emerging were several new designs with pencil-thin fuselages and semi-symmetrical wing airfoils. These new designs, such as the Sagitta by Lee Renaud, are definitely not for the beginning flier. They are very fast, and not too easy to fly. Their purpose is to be able to fly fast and yet thermal well. These are thermal machines, compromised for speed. The European machines are speed machines, compromised for thermaling. Though speed events are not too popular in the United States, it is probable that all will benefit by new developments in construction and finishing.

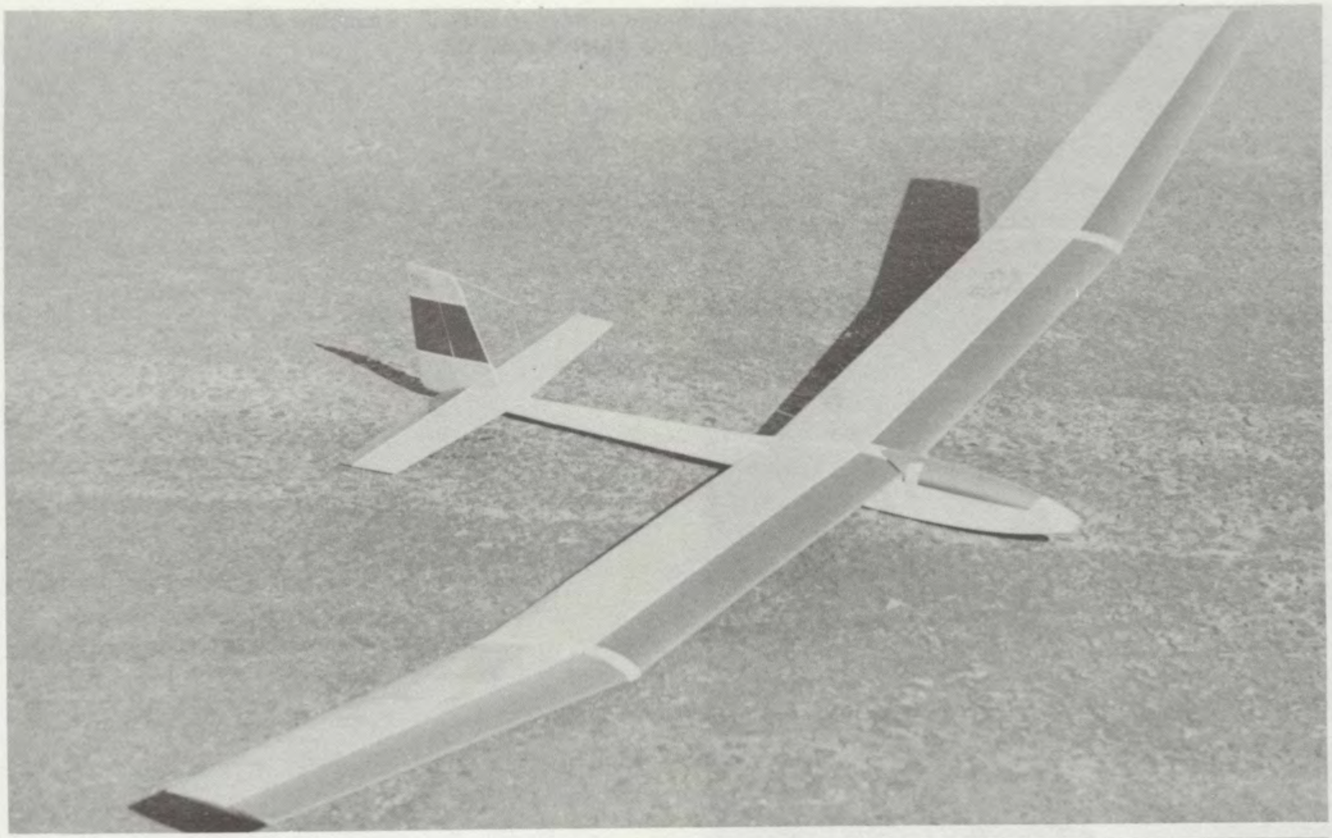
While there are a great many designs and kits available for thermal sailplanes, the number specifically designed for slope soaring is rather small. As an example, in the *RCM Illustrated Plans Guide,* out of fifty-six sailplane plans, only about ten were deliberately designed for slope flying. This ratio seems to hold for fliers also. The Torrey Pines Gulls club has about one hundred twenty members. There are about thirty serious thermal fliers, and about six serious slope fliers in the club. This, despite the fact that one of the best slope sites is in their backyard. However, the club has upward of fifty sport slope fliers. These fliers have fun flying thermal airplanes, modified thermal airplanes, or plastic ready-to-flys. Serious slope flying is nearly all on the West Coast, Denver, and Salt Lake. Most of the suitable slope sites are located in these areas.

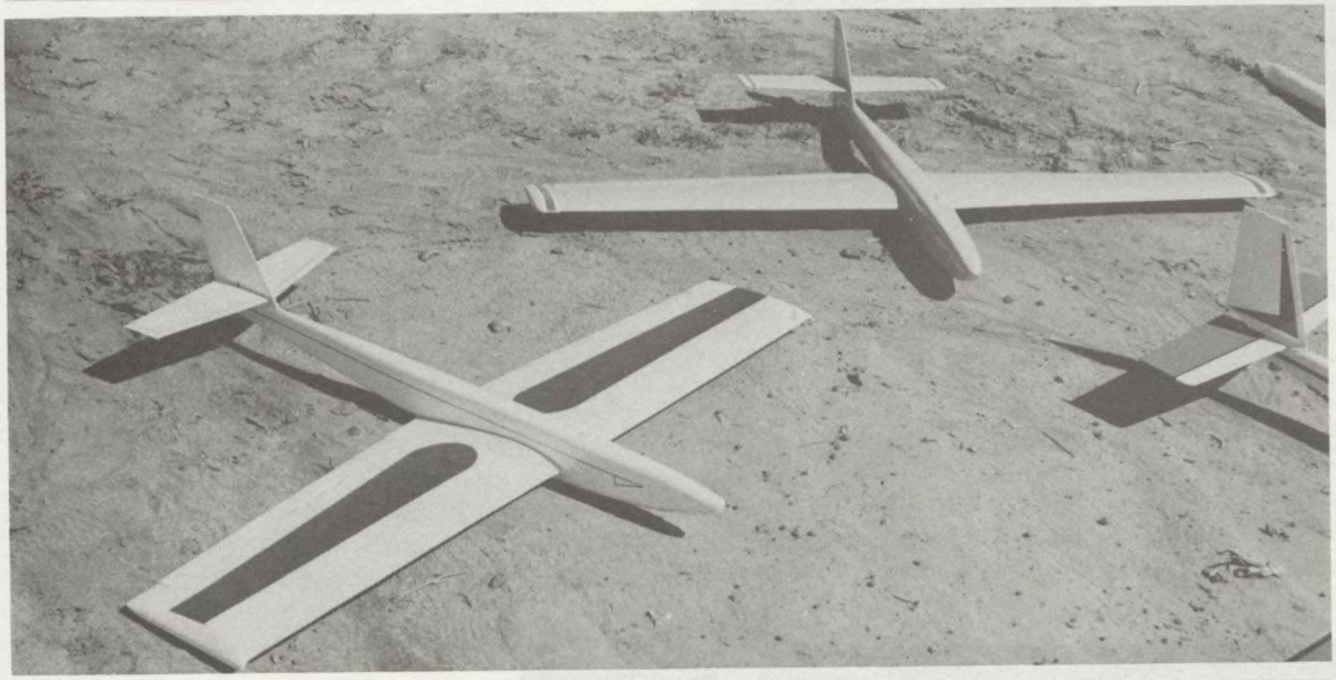
Although most slope fliers enjoy doing simple aerobatics, almost no one is involved with aerobatics of the type seen in powered pattern ships. Most slope fliers use just rudder and elevator control for aerobatics. As a matter of fact, old timers in radio control can remember a rudder-only class in aerobatic competition. Maneuvers such as loops, rolls, Immelman turns, Cuban eights, spins, and stall turns could be performed reasonably well. Some maneuvers were a little hard to recognize, as all maneuvers had to be entered from a spiral dive in order to get enough speed to carry through.

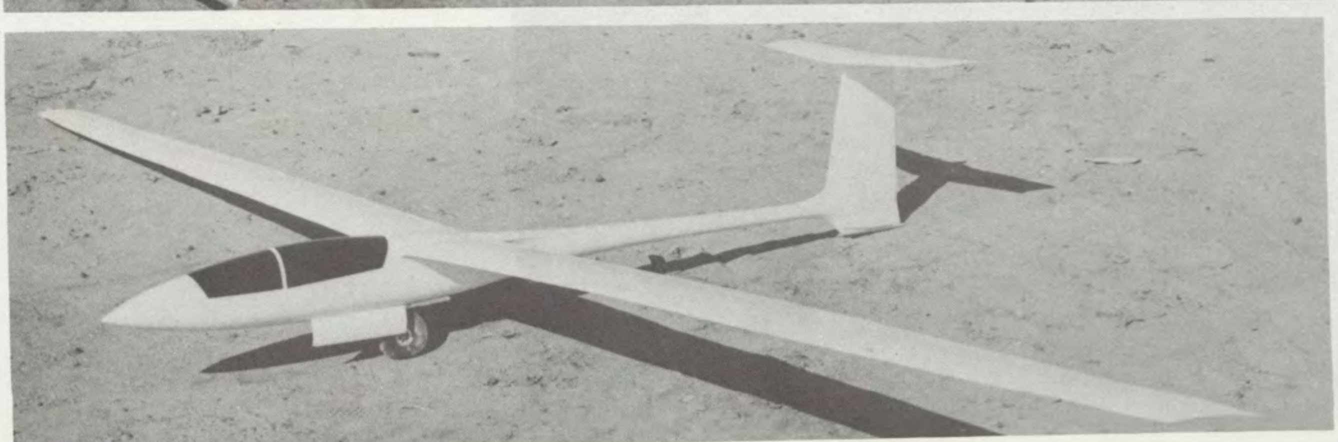
Any of the simple airplanes will perform enough maneuvers to keep the average sport flier happy. Some fliers may want to advance to aileron control as their skill increases. There are several aileron sailplanes available designed for slope aerobatics and racing. A number of good slope ships are available such as Savage, Son of Savage, and the Ridge Rider, Ridge Recruit and Ridge Rover, from Solent as well as the Xingu family from Victor Stubs. Plans are available from RCM Magazine for the Puranas sloper (RCM Plan #775).

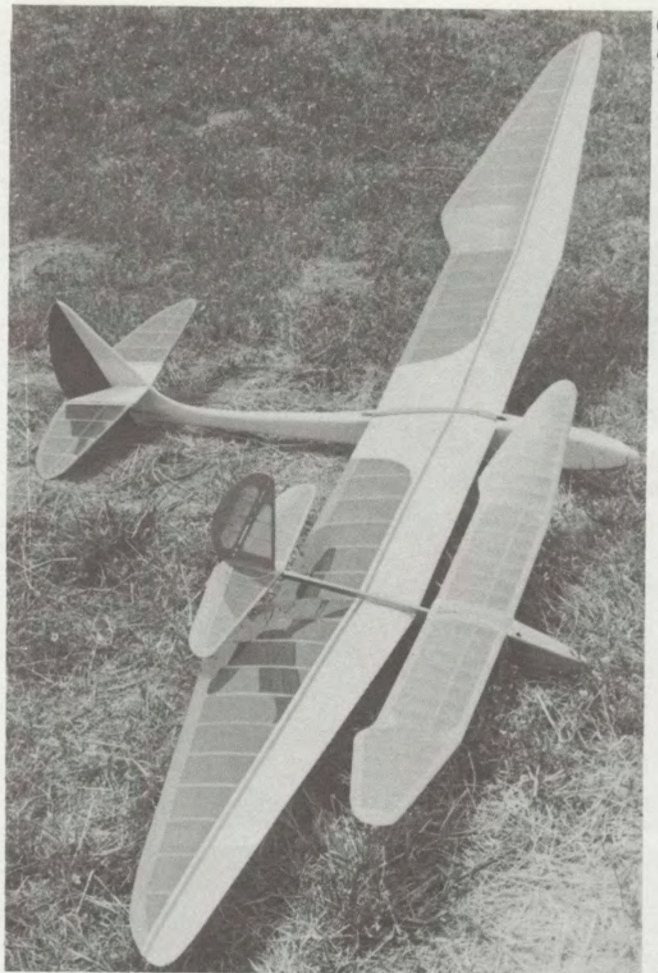
Each year new designs appear. Some are brought to the market as a result of contest success; some to fill the need for something a little different. There are fliers who always appear at the field with "the plane of the month." Some just plain like to build, which is fine. Some are looking for that magic that will put them head and shoulders above the crowd. If you want to become proficient at flying a sailplane, find a design you are comfortable with, and stick with it. Until you really know that ship, you will not be consistent. Eventually you may grow out of that particular design, but this does not happen in a month or two.

***OPPOSITE PAGE, TOP: 10' Paragon MIDDLE: "Swallow" club design by Torrey Pines Gulls for one-class pylon racing. BOTTOM: "Hyper Locus" designed for slope speed.***



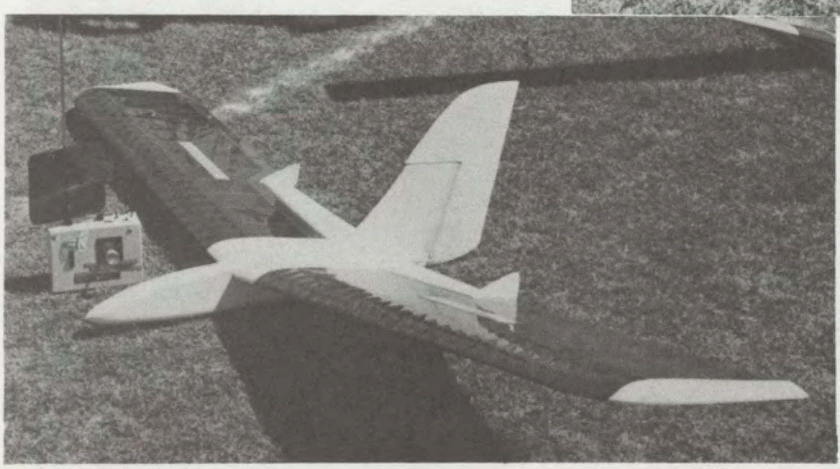






*Gliders come in all sizes. A 10 foot Bird Of Time and a 3 foot Thermic 50.*

*Two Meter Icarus.*



*Windlord Flying Wing.*

# CHAPTER III

## SELECTION OF THE FIRST SOARING SYSTEMS

**A. Selection of a Beginning Glider**

The first thing to resist is any temptation to build a big, beautiful, scale sailplane. The chances are excellent that it wouldn't last long enough to provide much training. While these ships look great in the air, it is difficult to keep them there. The long, narrow wings are very efficient on a full sized sailplane. When reduced to model size, they become increasingly inefficient. The very narrow wingtips are especially a problem. They are particularly susceptible to a condition known as tip stall. This causes an instability that makes flying, especially at slower speeds, very difficult. It is also difficult to make the long thin wing strong enough to withstand the rigors of training flights. If the size of the model is reduced, the wing area may become too small for proper flight. As wing area goes down, it becomes increasingly difficult to reduce the weight of the model proportionately. As the weight per unit of wing area (wing loading) goes up, the model will fly faster and faster to generate enough lift to keep airborne. This leads to a model that is very hard for the novice flier to handle.

Perhaps it would be helpful to list a few characteristics that would be desirable in a ship for a relatively new flier.

(1) It should be a gentle, slow flying airplane. It should be stable enough to fly by itself.

(2) It should be easy to build using simple tools and available materials. Construction of the wing center section should be foolproof so that it will be strong even if the builder is inexperienced. If the wing is capable of being taken apart, the joint should be simple to construct.

(3) In order to reduce cost and damage it should be small, strong and light. The maximum wingspan should be 2 meters (78") with a minimum of wing area of 600 square inches. It should weigh about 2 pounds, having a maximum wing loading of 8 ounces per square foot of wing area.

(4) It should break down to a reasonable size for transport. A one-piece wing is unacceptable. With the trend toward smaller cars, getting a 72" or 78" wing inside can be a trying task. It is also nice to be able to take the plane on holiday and try new flying sites outside your area. If it could be carried on an airplane as baggage, so much the better.

(5) It should be capable of performance above that of a simple trainer. It should have contest capability in the Two Meter class. It must be a proven design.

When a design for presentation in this book was being examined we looked at many existing kits. Three or four would have been quite suitable but each seemed to lack some quality which was required. Finally, we started looking hard at a design I had been flying in Two Meter competition for about two years. Several prototypes had been built by members of the Torrey Pines Gulls Soaring Club because of its fine flying characteristics. It proved to be a perfect machine for several fliers who had difficulty keeping other gliders flying. Pepper Kay of the TPG Club took his model to Hawaii several times during vacations there.

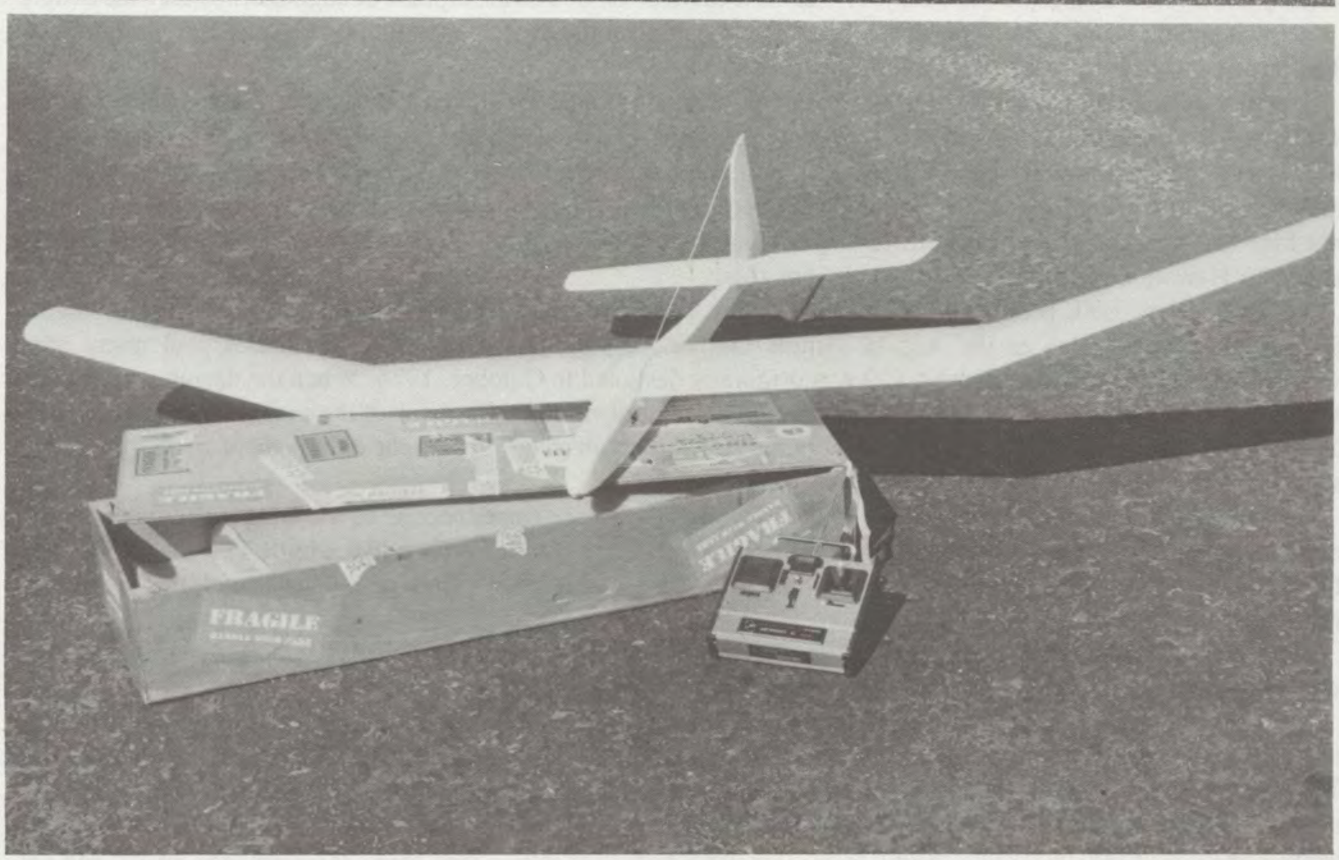
The Olympic 650, presented in Chapter IV, was designed by Lee Renaud, President of Airtronics. Lee is famous for such designs as the Aquila, Aquila Grande, Olympic II, Grand Esprit, Sagitta, and many other well-known sailplanes. The Olympic 650 was originally designed in October, 1976. When the design was selected for presentation in this book, in mid-1980, the design was slightly modified; a result of the considerable testing by the TPG group. The modifications were a lengthening of the aft fuselage and slight enlargement of the horizontal stabilizer to improve the pitch stability.

The Oly 650 is a super simple ship to build. The flat, one-piece center section of the wing makes construction easy, even for those with no previous model building experience; and it's strong like a bull! Yet, the whole thing breaks down to fit in a box with inside dimensions of 5½" x 11½" x 38½". Built of 1/4" plywood, this box will go everywhere.

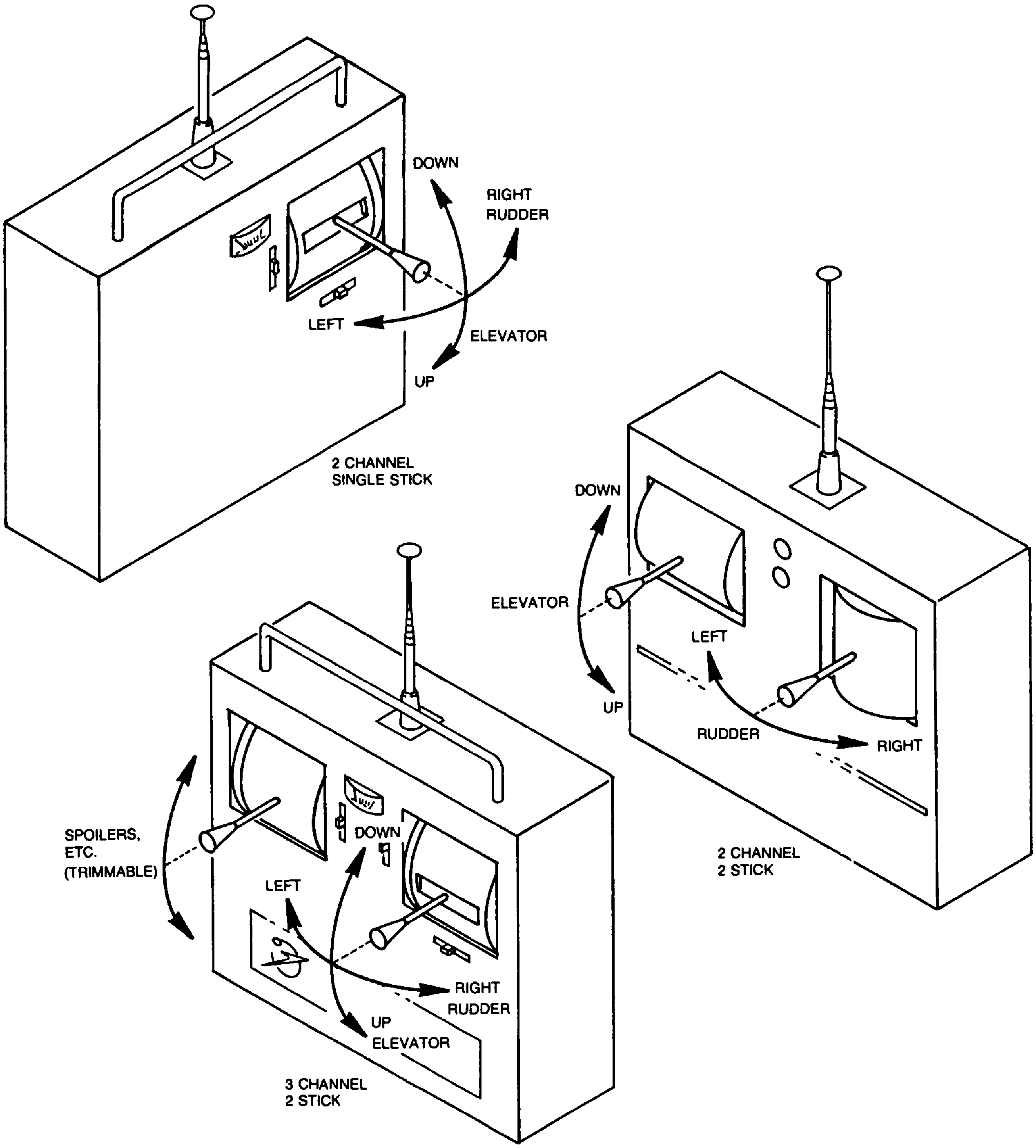
Only standard materials were used in the construction, as well as readily available hardware. Any well-equipped hobby shop should be able to supply all material.

In the flying department, the Oly 650 won't win too many speed contests but in thermal flying and slope flying it is just super. It will stay up in the lightest lift. It will out-launch most gliders of its class. It has won many awards in Two Meter contests. But, the place it really shines is just plain fun flying on a lazy Sunday afternoon, wheeling under the fluffy cumulus clouds. Or, back and forth on a slope, ranging far out into marginal lift. It also has the advantage of being able to come into restricted landing areas, which are typical of many slope areas. It is very responsive, and will turn on a dime.

I hope you will decide to build and fly the Oly 650; it's a neat glider. The next few chapters tell exactly how to build it and fly it. Almost anyone can do it, so give it a go.


*The Olympic 650 with travel box.*




TRANSMITTER STICK CONFIGURATION

**B. Selection of a Radio**

There are many factors which, in varying degrees, affect the decision about which make and model to buy:

(1) Do you insist on a locally made product as opposed to an import?
(2) Does the manufacturer seem to have adequate repair stations?
(3) Do you prefer buying from a discount house or a local hobby shop?
(4) How many functions, or channels, will you need?
(5) How about dry battery power versus rechargeable nicad batteries?
(6) What "mode" should you buy, i.e., single stick versus two stick?
(7) Which of the 18 (49 in 1991) available frequencies should you order?

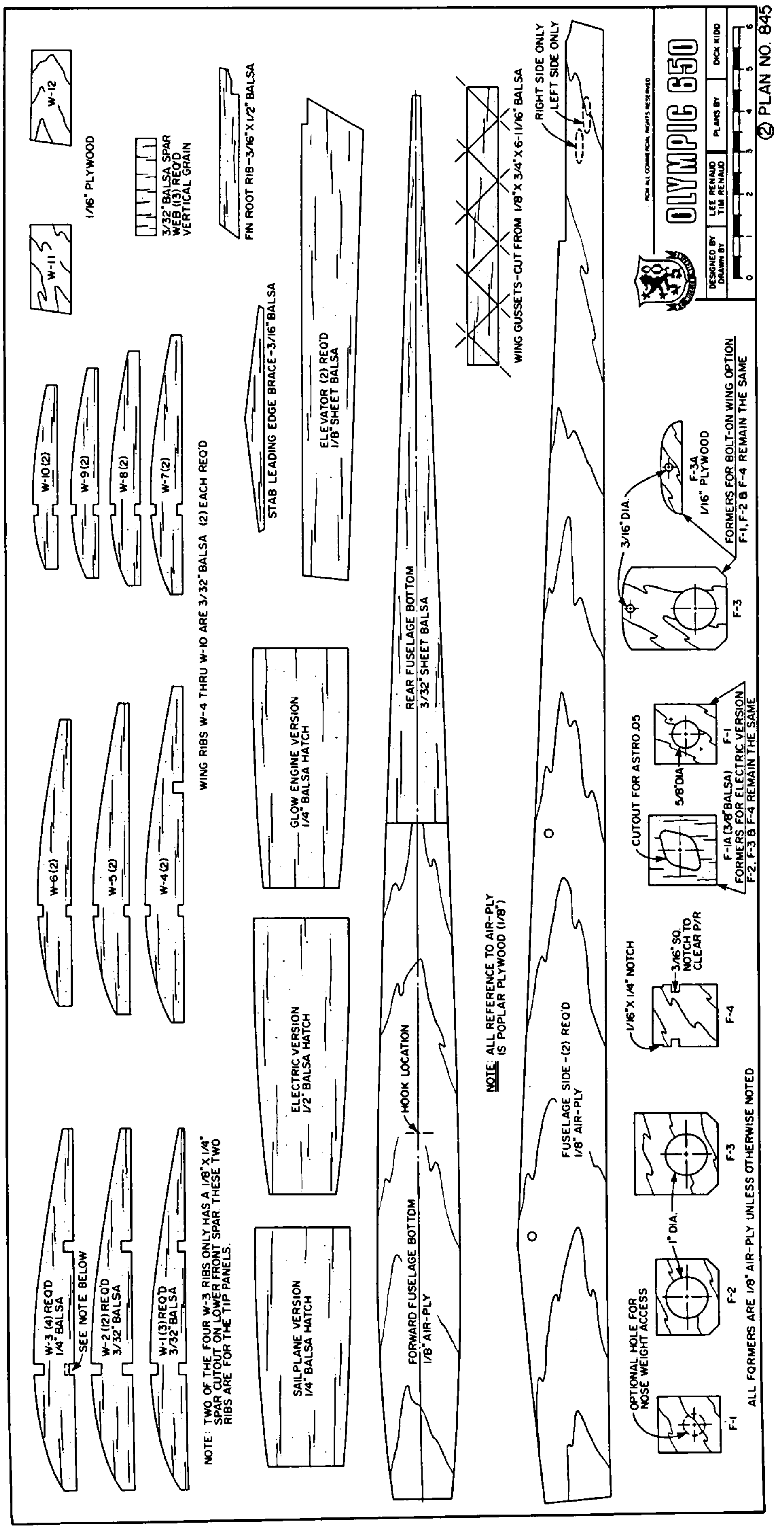
Most of these factors are related to how much money you have to spend. If you are a young person whose total income is from a paper route, perhaps all you can scrape together is just enough to buy a two channel radio powered by dry batteries. You can do just as well, and have just as much fun, as the guy with the chrome plated Zilch 8 system. Fortunately, with today's technology, for glider control, low cost radios will operate just as well as their high cost big brothers. In fact, no matter how fat one's wallet, many of the features of the high priced radios have no function in flying gliders.

With respect to the decision of where to buy your radio, this is a matter of price versus personal service. The big discount houses have their own name brand radios. These are built by a big-name radio manufacturer and are quite reliable. They have such features as servo reversing switches and servo throw adjustment. These features were unknown in any radio, however, a few years ago. The big advantage of the discount house radio is its price. It is about 20% to 30% less than the big-name brand, which the discount house also carries. Local hobby stores cannot usually compete with these prices. What the local hobby dealer **does** offer, though, is personal service. A professionally run hobby shop can offer invaluable aid in equipment selection, construction tips and a good selection of balsa wood and hardware items. He can't stay in business, though, just selling balsa wood. It might be worth your while to discuss your equipment needs with your friendly hobby dealer, early on.

The question of dry batteries versus rechargeable nicads is one of pure economics. If at all possible, get a system with all nicads. Although a dry battery system is cheaper initially, about four sets of new alkaline cells equals the system nicads and charger. Don't forget, you must lay out about 12 bucks for the required alkaline cells before the dry system will play. Anyway — it's your choice; and you do what you must do.

In the transmitter mode department, mode II is most popular overall for gliders. This means that the rudder and elevator are controlled from a single stick on the right side of the transmitter. The importance of conformity here is because if help is available from an experienced flier, he will be more comfortable flying a familiar stick configuration.

The number of channels, or function capability of the equipment is, again, a question of economics. I have owned only one glider that could use 6 channel equipment. It had elevator, aileron, rudder, flaps, spoilers, and releasable tow hook. You must really be agile to twiddle that many controls. The beginning flier will require only two channel equipment for many moons. This will control the rudder and elevator. The next step up is generally the addition of spoilers requiring three channels. If aileron controlled sailplanes is the next step, three channel equipment is still good, as it is usual to couple rudder and ailerons. If you add releasable tow hook, you need one more channel. The problem in stepping up to four channel equipment is that the control is wrong. In three channel equipment, spoiler action is controlled by a trimmable lever on the left hand side of the transmitter face. The four channel has a stick on the left hand side with the up and down action trimmable, and the side to side action spring loaded, for center return. What you would really like is a switch. So, with all this mish-mash, the most probable step up from the three channel radio is to a six channel one. Anyway — my recommendation for a beginning radio would be a three channel set with rechargeable nicad batteries. Lacking the wherewithall to purchase one of these, a **single stick,** two channel, run by dry cell batteries, will serve you very well for a long time. This is the set used in Chapter V, to be installed in the glider described in Chapter IV.




**Full size plans available from**
**RCM Plans Service**
**P.O. Box 487**
**Sierra Madre, Calif. 91024**

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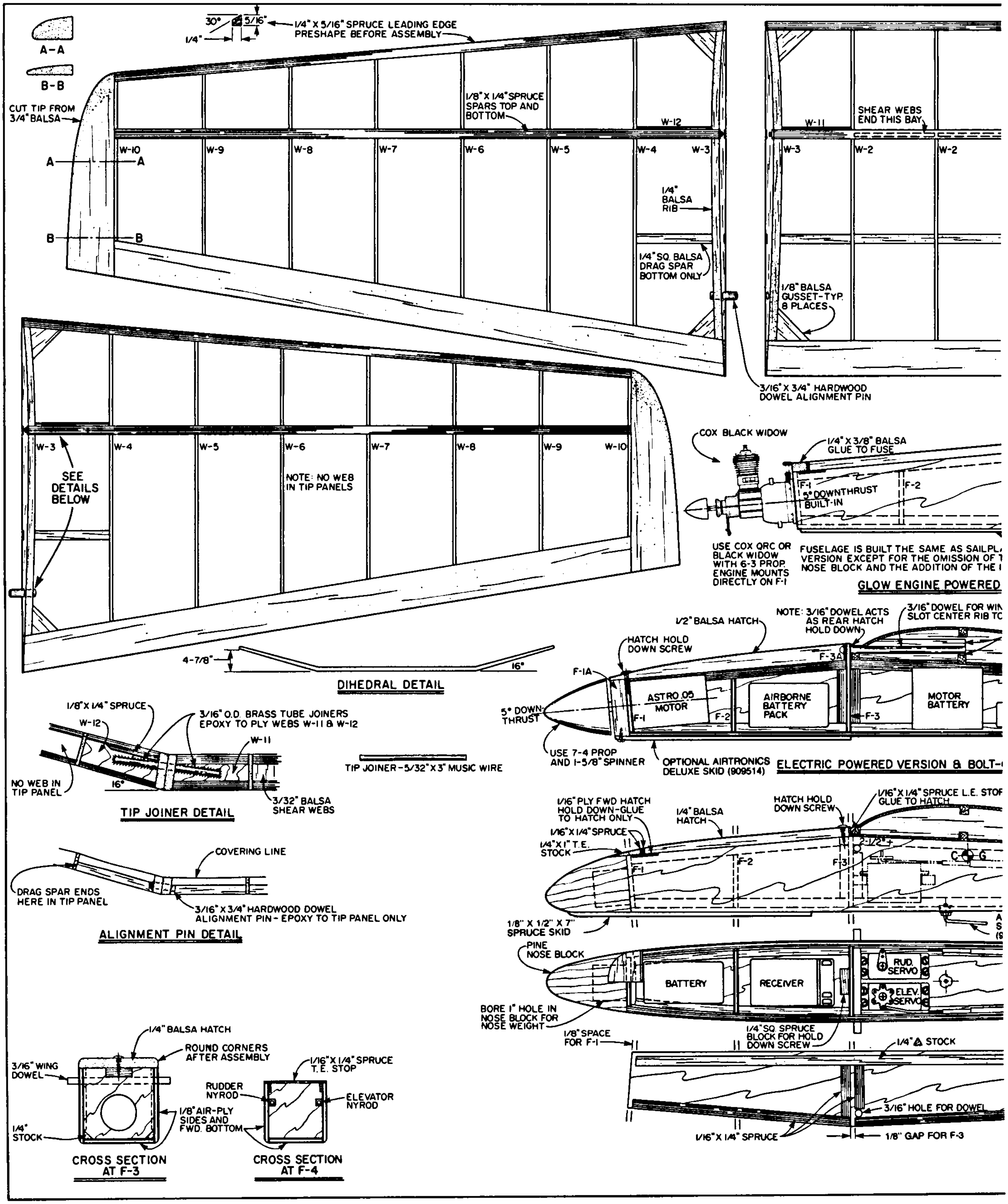
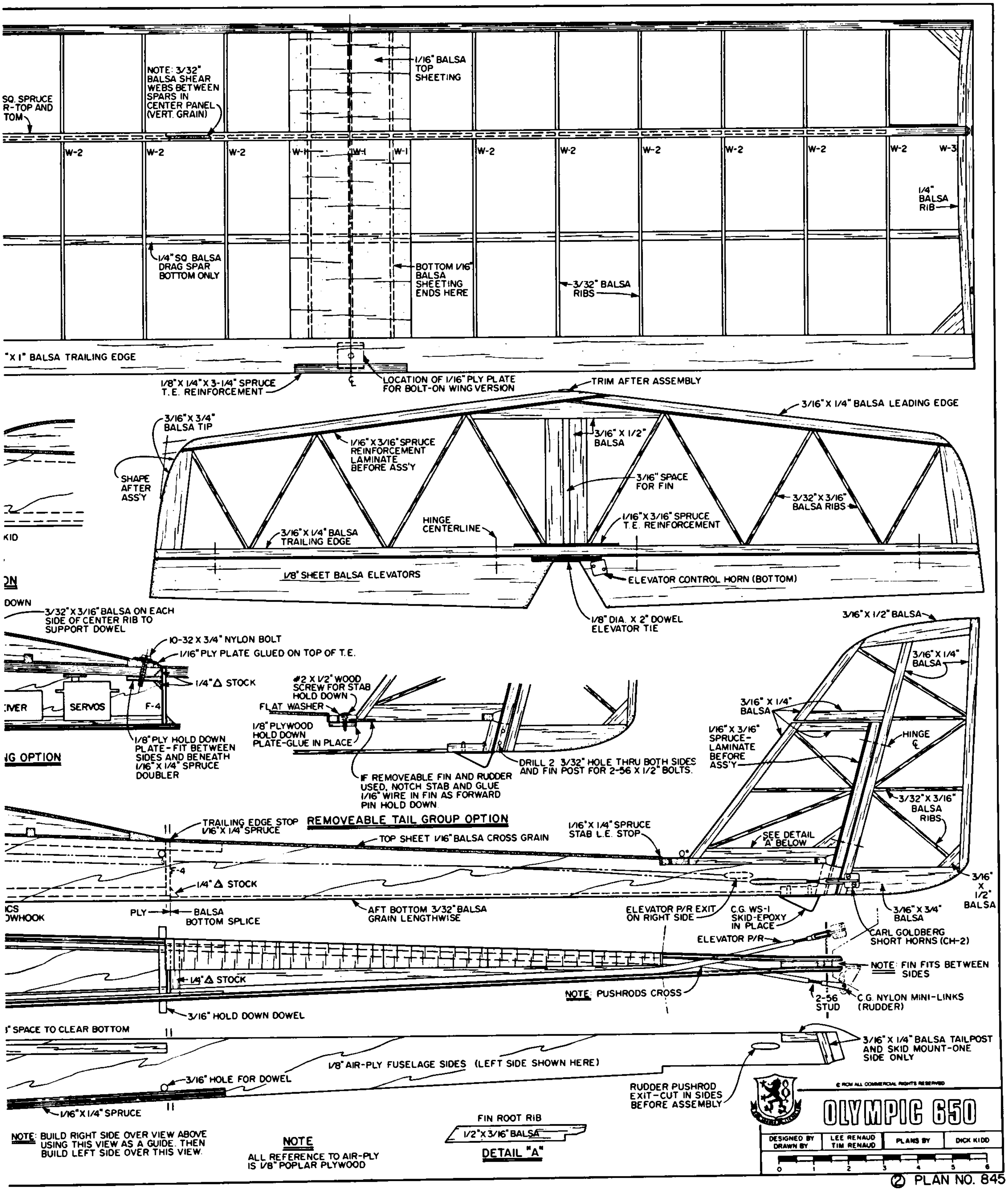
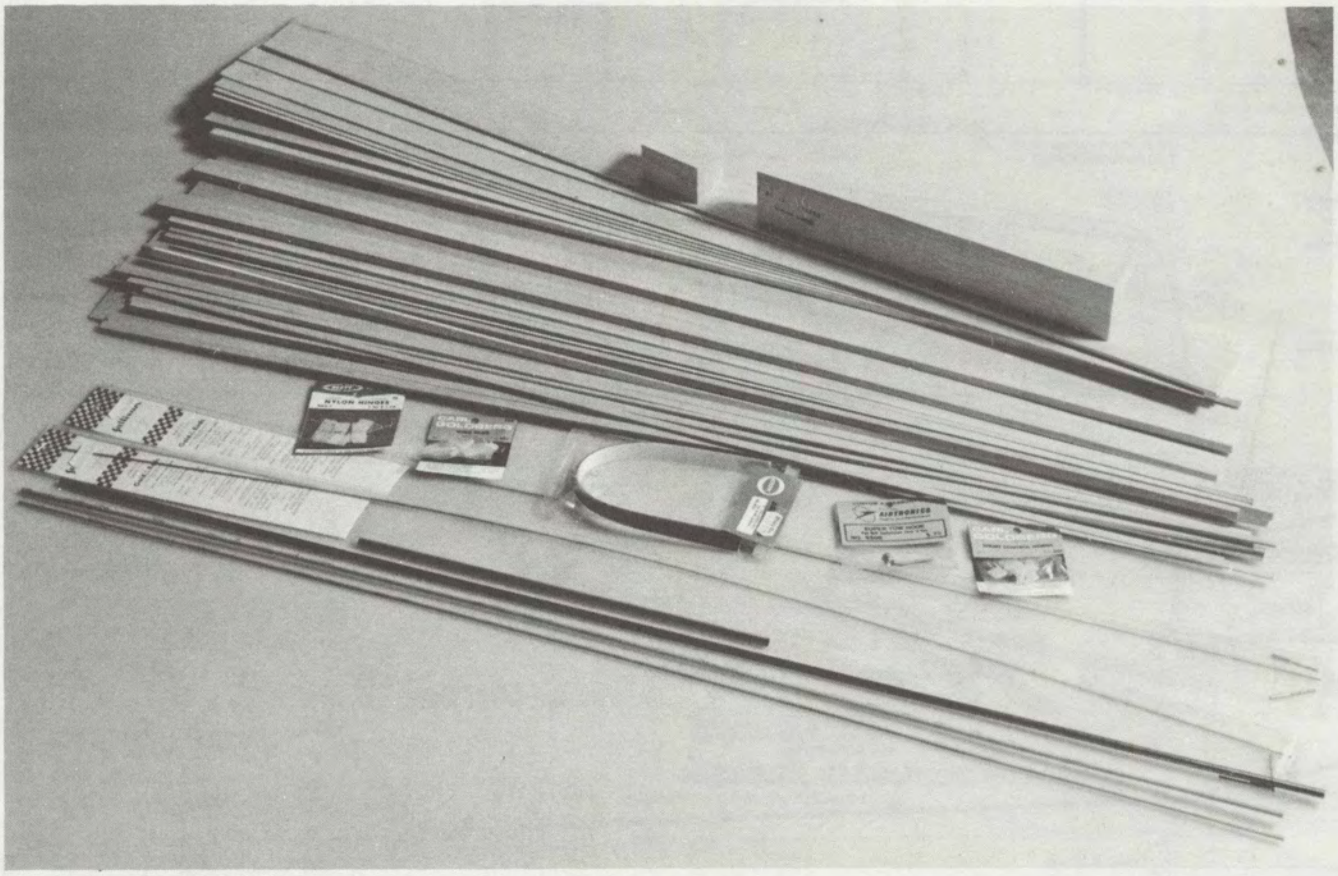



NOTE: 3/32" BALSA SHEAR WEBS BETWEEN SPARS IN CENTER PANEL (VERT. GRAIN)
SQ. SPRUCE R-TOP AND TOM
1/16" BALSA TOP SHEETING
W-2
W-1
W-3
1/4" BALSA RIB
1/4" SQ BALSA DRAG SPAR BOTTOM ONLY
BOTTOM 1/16" BALSA SHEETING ENDS HERE
3/32" BALSA RIBS
"X 1" BALSA TRAILING EDGE
1/8" X 1/4" X 3-1/4" SPRUCE T.E. REINFORCEMENT
LOCATION OF 1/16" PLY PLATE FOR BOLT-ON WING VERSION
TRIM AFTER ASSEMBLY
3/16" X 1/4" BALSA LEADING EDGE
3/16" X 3/4" BALSA TIP
SHAPE AFTER ASS'Y
1/16" X 3/16" SPRUCE REINFORCEMENT LAMINATE BEFORE ASS'Y
3/16" X 1/2" BALSA
3/16" SPACE FOR FIN
3/32" X 3/16" BALSA RIBS
HINGE CENTERLINE
1/16" X 3/16" SPRUCE T.E. REINFORCEMENT
3/16" X 1/4" BALSA TRAILING EDGE
1/8" SHEET BALSA ELEVATORS
ELEVATOR CONTROL HORN (BOTTOM)
1/8" DIA. X 2" DOWEL ELEVATOR TIE
KID
DOWN
3/32" X 3/16" BALSA ON EACH SIDE OF CENTER RIB TO SUPPORT DOWEL
10-32 X 3/4" NYLON BOLT
1/16" PLY PLATE GLUED ON TOP OF T.E.
1/4" △ STOCK
IVER
SERVOS
F-4
1/8" PLY HOLD DOWN PLATE-FIT BETWEEN SIDES AND BENEATH 1/16" X 1/4" SPRUCE DOUBLER
IG OPTION
#2 X 1/2" WOOD SCREW FOR STAB HOLD DOWN
FLAT WASHER
1/8" PLYWOOD HOLD DOWN PLATE-GLUE IN PLACE
IF REMOVEABLE FIN AND RUDDER USED, NOTCH STAB AND GLUE 1/16" WIRE IN FIN AS FORWARD PIN HOLD DOWN
DRILL 2 3/32" HOLE THRU BOTH SIDES AND FIN POST FOR 2-56 X 1/2" BOLTS.
3/16" X 1/2" BALSA
3/16" X 1/4" BALSA
HINGE ℄
1/16" X 3/16" SPRUCE-LAMINATE BEFORE ASS'Y
3/32" X 3/16" BALSA RIBS
TRAILING EDGE STOP 1/16" X 1/4" SPRUCE
REMOVEABLE TAIL GROUP OPTION
TOP SHEET 1/16" BALSA CROSS GRAIN
1/16" X 1/4" SPRUCE STAB L.E. STOP
SEE DETAIL "A" BELOW
3/16" X 1/2" BALSA
ICS
OWHOOK
PLY
BALSA BOTTOM SPLICE
AFT BOTTOM 3/32" BALSA GRAIN LENGTHWISE
ELEVATOR P/R EXIT ON RIGHT SIDE
C.G. WS-1 SKID-EPOXY IN PLACE
3/16" X 3/4" BALSA
CARL GOLDBERG SHORT HORNS (CH-2)
ELEVATOR P/R
NOTE: FIN FITS BETWEEN SIDES
NOTE: PUSHRODS CROSS
2-56 STUD
C.G. NYLON MINI-LINKS (RUDDER)
3/16" HOLD DOWN DOWEL
" SPACE TO CLEAR BOTTOM
3/16" X 1/4" BALSA TAILPOST AND SKID MOUNT-ONE SIDE ONLY
1/8" AIR-PLY FUSELAGE SIDES (LEFT SIDE SHOWN HERE)
3/16" HOLE FOR DOWEL
RUDDER PUSHROD EXIT-CUT IN SIDES BEFORE ASSEMBLY
1/16" X 1/4" SPRUCE
NOTE: BUILD RIGHT SIDE OVER VIEW ABOVE USING THIS VIEW AS A GUIDE. THEN BUILD LEFT SIDE OVER THIS VIEW.
NOTE
ALL REFERENCE TO AIR-PLY IS 1/8" POPLAR PLYWOOD
FIN ROOT RIB
1/2" X 3/16" BALSA
DETAIL "A"
OLYMPIC 650
DESIGNED BY DRAWN BY
LEE RENAUD TIM RENAUD
PLANS BY
DICK KIDD
0 1 2 3 4 5 6
② PLAN NO. 845



***Materials Required.***

# CHAPTER IV

## BUILDING THE OLYMPIC 650

After finding out a little bit about gliders and their habits, it's time to put a real one together — if you are still interested. This chapter, along with RCM Plan #845, will guide you through the construction of a first glider. This plan is available through R/C Modeler Magazine Full Size Plan Service for a modest price. Although the Oly 650 was designed as a trainer — stable and gentle — it is perfectly capable of winning thermal contests, and prototypes of the ship have done just that. It is easy to build and is very strong and durable. It is designed to take the hard knocks required of a first plane.

For the very first-time flier, it is advisable to build the Oly 650 as a glider and learn the basics of control on a slope, or on a hi-start. Later on, it can be modified to take an electric power system, or a glow engine to provide convenient launching options, as described in Chapter VIII. Before you start, read through the entire chapter, so as to have a clear view of what you are going to do.

**Section 1 — Tools Required**

Although the tools required to build models are rather simple, there are some that are indispensable. The first thing you will need is a good **flat** building board. It must be soft enough to stick pins into and must be knot-free. An ideal building surface is a cheap hollow core door. Defective doors or odd sizes are often on sale at lumber yards. Do not get one with masonite skins. You will want one skinned with 1/8" Philippine mahogany, or the like — soft enough for pins. Or, another good board is a piece of redwood 1" x 12", about 6' long. Redwood is generally soft and straight and less expensive than clear pine. The following hand tools will also be needed.

X-Acto knife with #11 blades.
Waxpaper.
Tack hammer.
"T" pins (Sig #16), 24 or so.
Sandpaper — 80 and 120 grit, #400 wet or dry.
Drills — 1/16", 5/32", 1/8", 3/16", 9/64" (a drill set from 1/16" to 1/4" is handy).
Electric or hand drill.
Square, or 90 degree triangle.
Metal meter, or yardstick (Lufkin #1261 or equivalent). A straight wooden yardstick can be used.
Hand coping saw (or jig saw if you have one).
Clothespins, 12 (preferably wooden).
3" C clamp, 2 (or Kraft 200-106 Modelers Clamp).
Thumb tacks.
Hacksaw.
8" flat smooth file.
1" hole saw and/or wood bit (optional, see photo for use).

Contact cement or glue the 80 and 120 grit sandpaper to each side of a 3/4" x 2¾" x 9" board to make a sanding block.

**Adhesives:**

Aliphatic resin glue (Titebond or Wilhold).
5-minute epoxy (Hobbypoxy No. 4 or equivalent).
Rubber cement (Sanford's #494 or equivalent, 4 oz.).

**Note:** I like to put the aliphatic glue in a small bottle with a screw lid and apply it with a brush.

**Section 2 — Materials Required**

Assemble the following materials. Everything should be available from your friendly hobby shop with exception of the pine nose block. This can be had from the scrap bin of your lumber yard, or the nearest construction site.

## BILL OF MATERIALS:

| Quantity | Size | Material | Use |
|---|---|---|---|
| 1 | 12" x 36" x 1/8" | Air Ply or Lite Ply* | Fuselage sides and floor |
| 2 | 1/16" x 1/4" x 36" | Spruce | Fuselage reinforcement |
| 1 | 1/16" x 3/16" x 36" | Spruce | Stab and fin reinforcement |
| 3 | 1/4" x 1/4" x 36" | Spruce | Wing spars |
| 2 | 1/4" x 5/16" x 36" | Spruce | Wing leading edge |
| 1 | 1/8" x 5/8" x 36" | Spruce | Skid (optional) |
| 2 | 1/8" x 1/4" x 36" | Spruce | Outer wing spar |
| 1 | 3/16" Dowel x 36" | | Wing hold-down |
| 1 | 1/8" Dowel x 36" | | Elevator joiner |
| 1 | 2" x 2" x 2½" | Pine | Nose block |
| 1 | 1/16" x 6" x 12" | Birch plywood | W11, W12, Canopy hold-down |
| 1 | 5/32" dia. | Piano wire | Wing joiner |
| 1 | 3/16" O.D. | Brass tubing | Wing joiner |
| 1 | 1/16" x 3" x 36" | Medium balsa | Fuselage and wing sheeting |
| 4 | 3/32" x 3" x 36" | Medium balsa | Wing ribs, fuselage floor |
| 1 | 1/4" x 3" x 36" | Soft balsa | W3 ribs and fuselage canopy |
| 1 | 1/8" x 2" x 36" | Soft balsa | Elevator |
| 2 | 1/4" x 1/4" x 36" | Medium balsa | Drag spar |
| 3 | 3/16" x 1/4" x 36" | Medium balsa | Stab/rudder structure |
| 2 | 3/32" x 3/16" x 36" | Medium balsa | Stab/rudder ribs |
| 1 | 3/16" x 3/4" x 36" | Soft balsa | Stab/rudder tips, etc. |
| 1 | 1/4" triangular x 36" | Medium balsa | Fuselage reinforcement |
| 2 | 1/4" x 1" T.E. Stock | Medium balsa | Wing trailing edge |
| 1 | 3/4" x 1" x 12" | Soft balsa | Wing tips |
| 1 | 1/8" x 3/4" x 36" | Medium balsa | Wing gussets |

| | | |
|---|---|---|
| 1 pack | Wing skids | Goldberg WS1 |
| 1 | Skid | Airtronics 9514 |
| 1 | Towhook | Airtronics 9508 |
| 1 pack | Hinges | Klett RK 2-7 |
| 1 pack | Small rudder horns | Goldberg CH 2 |
| 2 | Control Rods | Sullivan 515 (see note) |
| 2 | Super MonoKote | Top Flite (color optional) |
| 1 box | Rubberbands | #64 |
| 2 packs | Snap Links | Goldberg #207 |

* Do not use birch plywood, it is too heavy — use Italian poplar.

**Note:** These are metal cable pushrods. They have the advantage of not changing length with temperature changes. They are, however, somewhat difficult to work with. The end connectors are meant to be soldered, although epoxy **can** be used. It is also hard to cut them cleanly without using something like the #409 cutting wheel in a Dremel tool. Good wire cutters will also work, or a Tuff Grind Wheel in a drill motor. If you do not have the proper tools, I recommend using Sullivan #504 Gold'N-Rods. These can be installed easily, using the recommended tools. Adjustments in control trim may have to be made during extreme temperature changes.

**Removable Tail Option**

If the removable tail option is taken, the following additional material is required:

2 — 2-56 x 1/2" machine screws, with nuts.

1 — #2 x 1/2" wood screw.

3 — #2 Washers.

1 — 1/16" diameter x 36" piano wire

**Additional Tool**

1 — 3/32" drill bit.

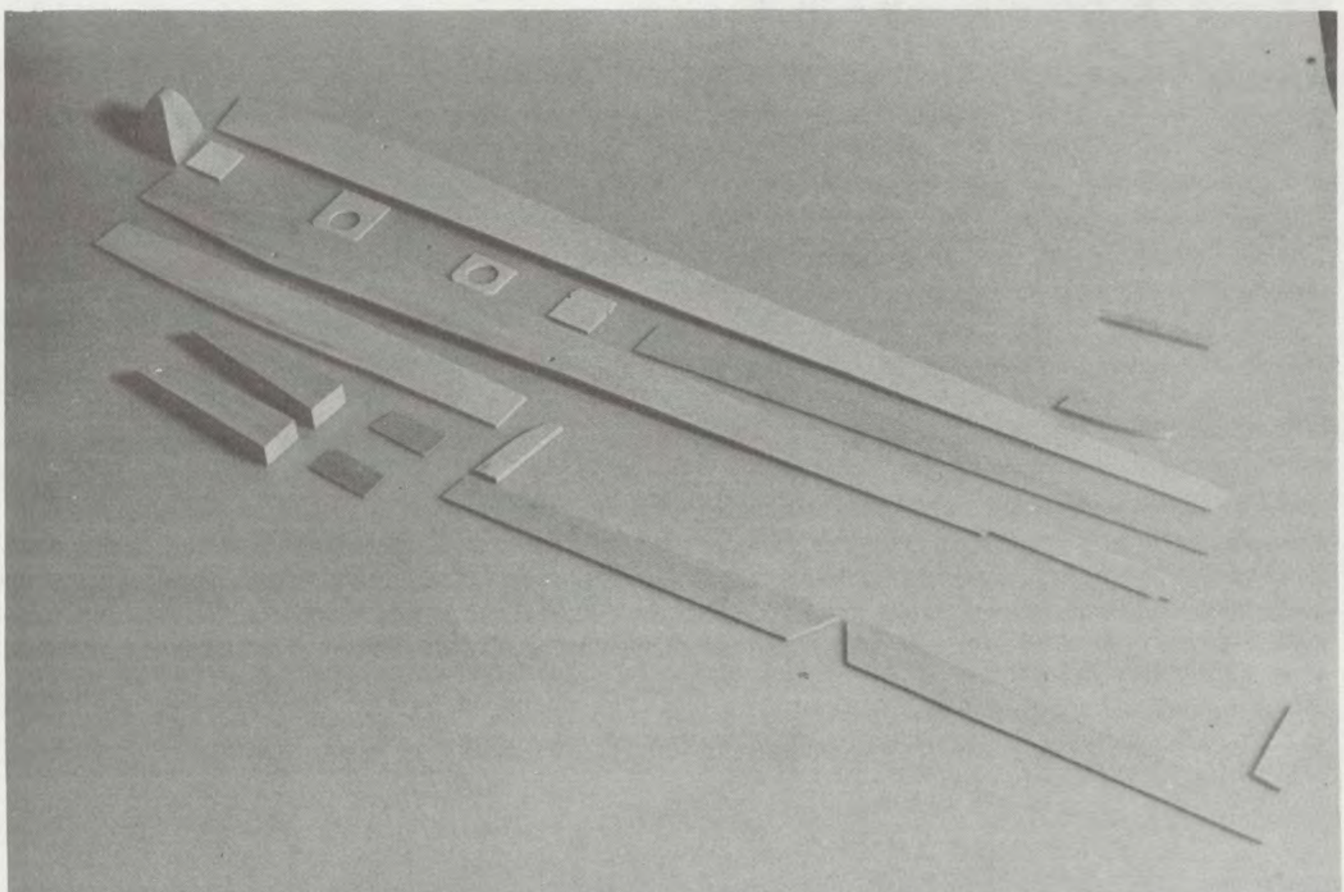
## Section 3 — Material Preparation

We will begin construction by cutting out all the parts that must be cut to pattern. That way, we will have a complete kit to start. RCM Plan #845 contains a pattern sheet which we will use to cut the parts to exact size. In the construction, when the word "glue" is used we mean Titebond, or Wilhold. When using glue or epoxy, spread a thin layer on **each** mating surface.

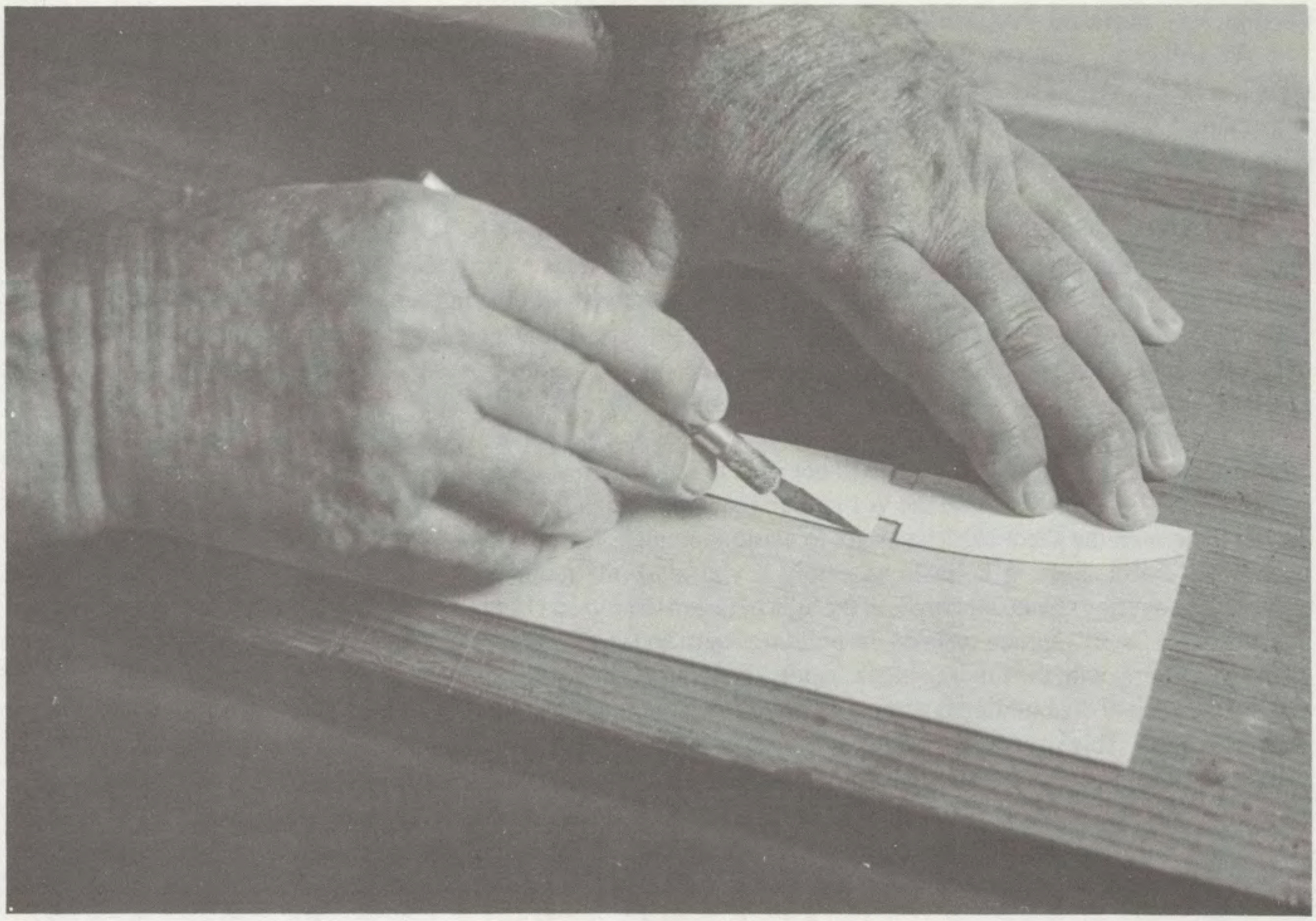
### Parts Preparation

(a) Since we will cut around the outline of the rib patterns with an X-Acto knife it is easier if the patterns are thicker than paper. You will need a light cardboard that can still be easily cut with scissors. The cardboard that laundries put in dress shirts is ideal. Cut the rib patterns from the sheet, leaving some trim all around. Now, glue them to the cardboard, using rubber cement. Wipe off the excess cement and let it dry a few minutes until not sticky. **Very carefully** cut to outline with scissors. It is important to do as good a job as possible, so the rib contours will be correct and they will fit properly. Cut out the spar notches using the X-Acto knife.

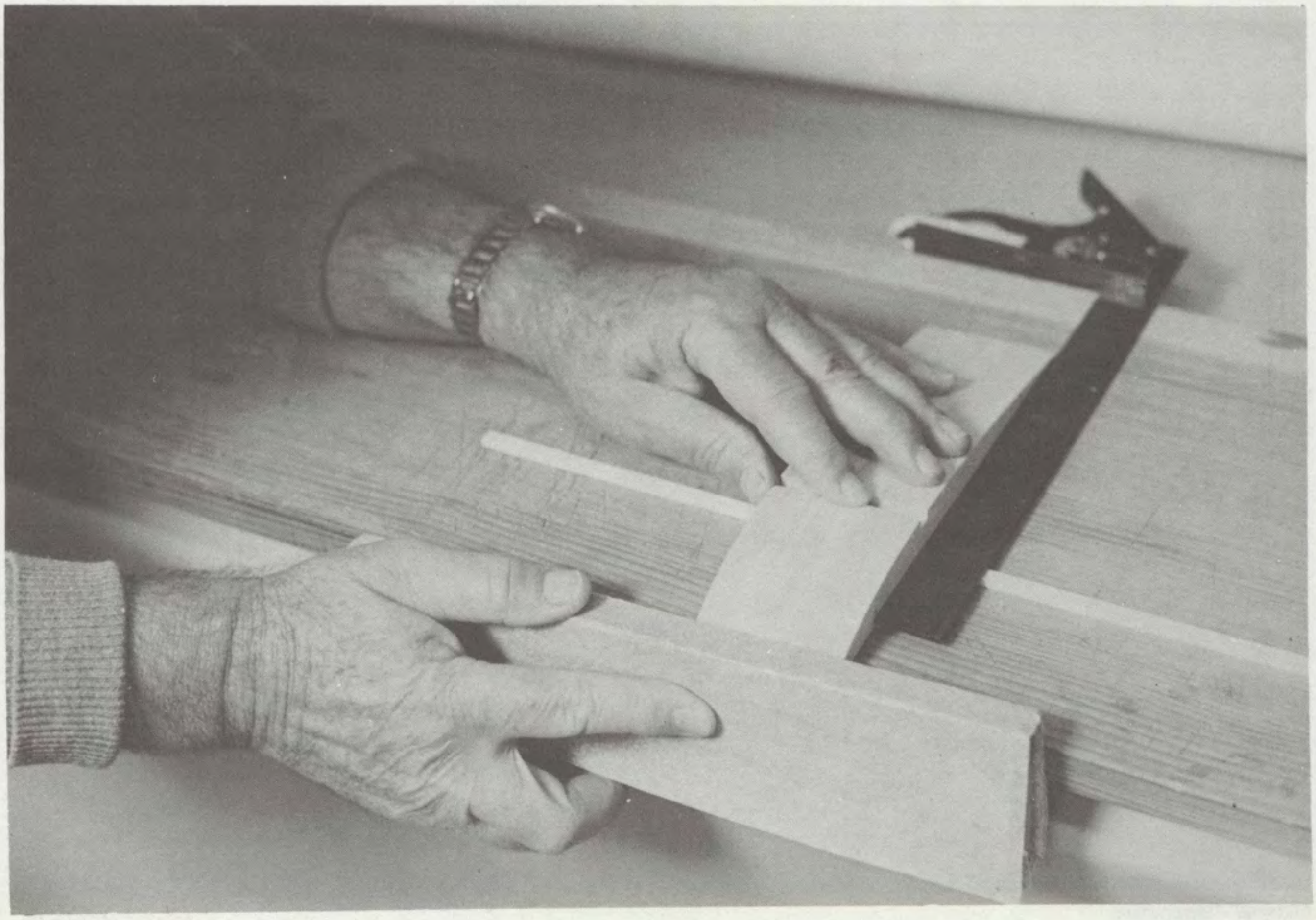
(b) From one of the 3/32" x 3" x 36" pieces of balsa, cut twelve W2 ribs. If you keep the blade against the pattern and cut a smooth contour, you will not need to sand the ribs. (See photo.) From the sheet of 1/4" x 3" x 36" soft balsa, cut four W3 ribs. Use the W1 pattern to cut three ribs from the 3/32" sheet balsa. You should plan your cutting pattern on the sheet balsa so as not to waste too much. Cut two each W4, W5, W6, W7, W8, W9 and W10 from 3/32" balsa sheet. It helps in assembly if you mark the number on each rib, but if you are going to use transparent covering, make this mark in the area between the top and bottom spar, where it can't be seen. Lay one of the 1/8" x 1/4" x 36" spruce spars on the building board and stack all the W1, W2, and W3 ribs together, and **square** on the spar. Now, with the sanding block, gently dress the leading and trailing edges so all ribs are the same length. If you use the edge of the building board, or the edge of a workbench to guide the sanding block, the ends will be square with the bottom. This is a good technique to use when squaring or sanding an angle on all small parts or strips. Put the patterns in a safe place in case you want to build another wing later.



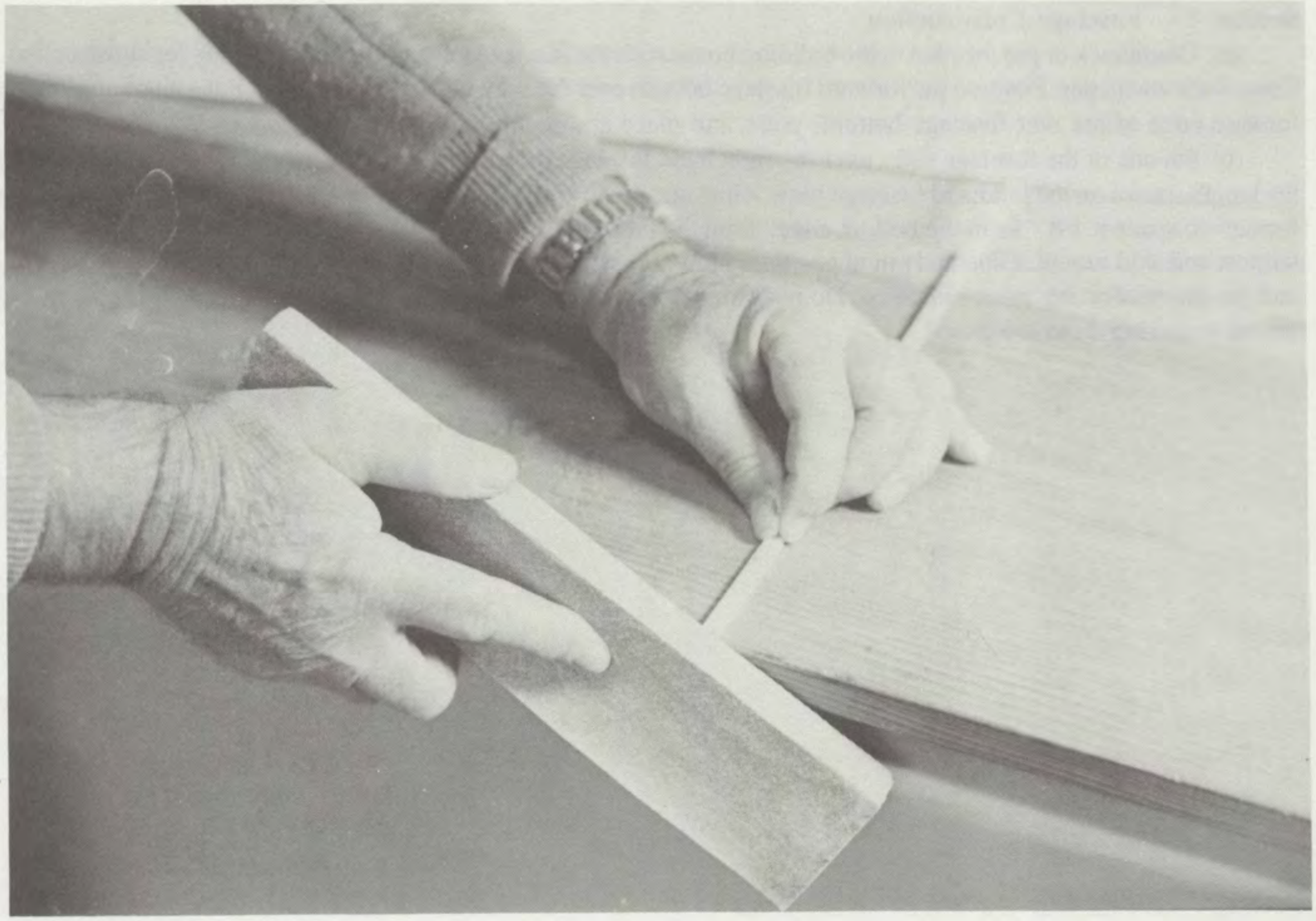
*Material Preparation.*



*Wing ribs cut out.*



*Technique for squaring wing ribs.*



***Technique for squaring all parts.***

(c) Cut two pieces of 2-1/2'' x 36'' from the sheet of 1/8'' Air Ply. If you cut one from each side of the sheet, both will have one straight edge. Stack these with the straight edges together and fasten them together with three small brads, or a few dabs of rubber cement. Cement the fuselage side pattern to one sheet, with the straight side of the pattern along the straight side of the wood. Saw both pieces of wood to the pattern outline using the coping saw, or a jig saw, if you have one. Use the sanding block to sand the fuselage tops and bottoms straight, while still fastened together. Before taking them apart, mark the position of the reinforcing strips. Take the sides apart and lightly sand off any burrs.

(d) Rubber cement the patterns for fuselage formers F1, F2, F3, and F4 to 1/8'' Air Ply sheet. Cut all formers to the pattern outline and sand to size. If a 1'' hole saw is available, this is an ideal tool for cutting the 1'' holes in F2 and F3. If not, bore a 3/16'' hole in these formers, saw the 1'' hole, and sand smooth. It is not important that these holes be perfect, they are just used for cable access. Remove the patterns before the rubber cement completely dries.

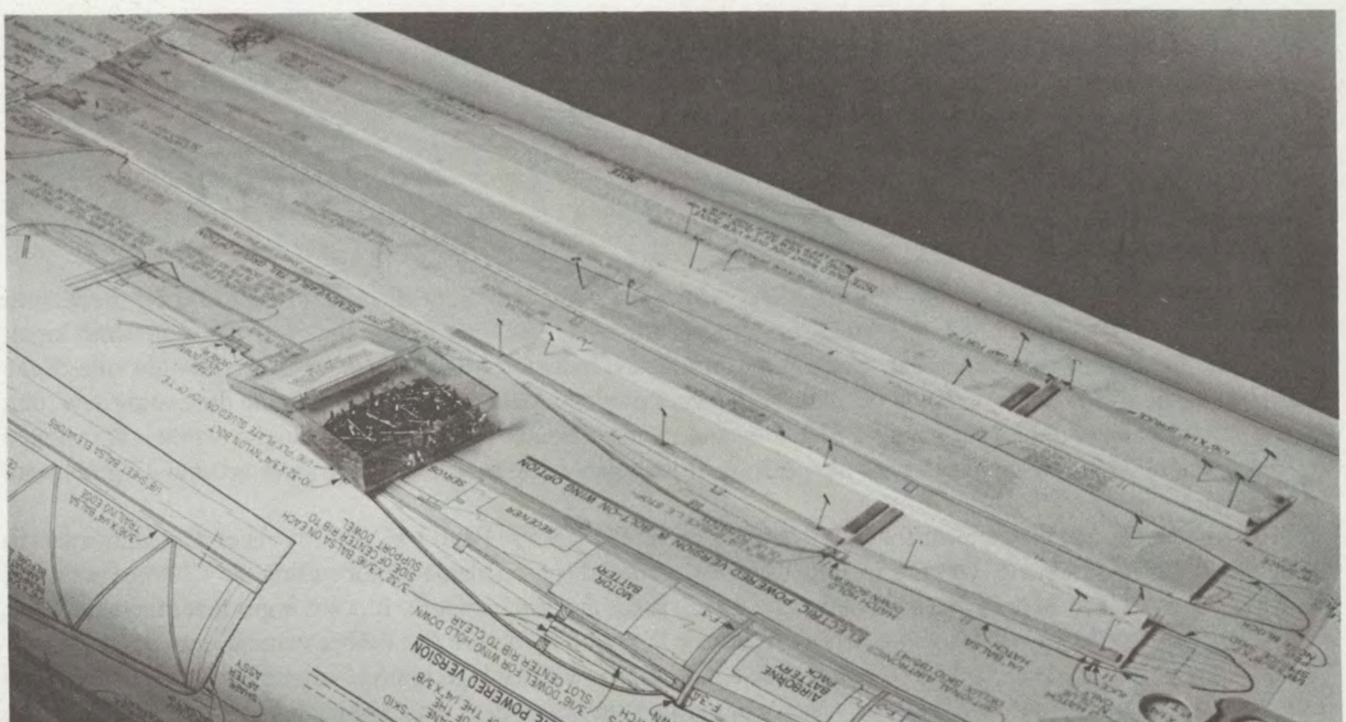
(e) In a similar manner, cut the forward fuselage bottom, rear fuselage bottom wing gussets, elevators, stab leading edge brace, fin root rib, spar webs (note: the grain runs vertically), and two each W11 and W12 from the material listed on the drawing.

(f) It will save a lot of hard carving later if the 1/4'' x 5/16'' x 36'' spruce leading edge material is trimmed to the shape shown in the upper left hand corner of the drawing before assembly. The angle can be trimmed using a razor plane, a block plane, or your trusty X-Acto knife. Just be careful of the grain. Irregular grain can cause a cut too deep into the material. If the cut starts going too deep, reverse the direction of the cut. It's really not as hard as it sounds, I'm just trying to draw your attention to the pitfalls as we go. When the bulk of the material is removed, sand straight with the sanding block. It's easier to do this carving now, rather than when the leading edge is glued onto the wing.

**Section 4 — Fuselage Construction**

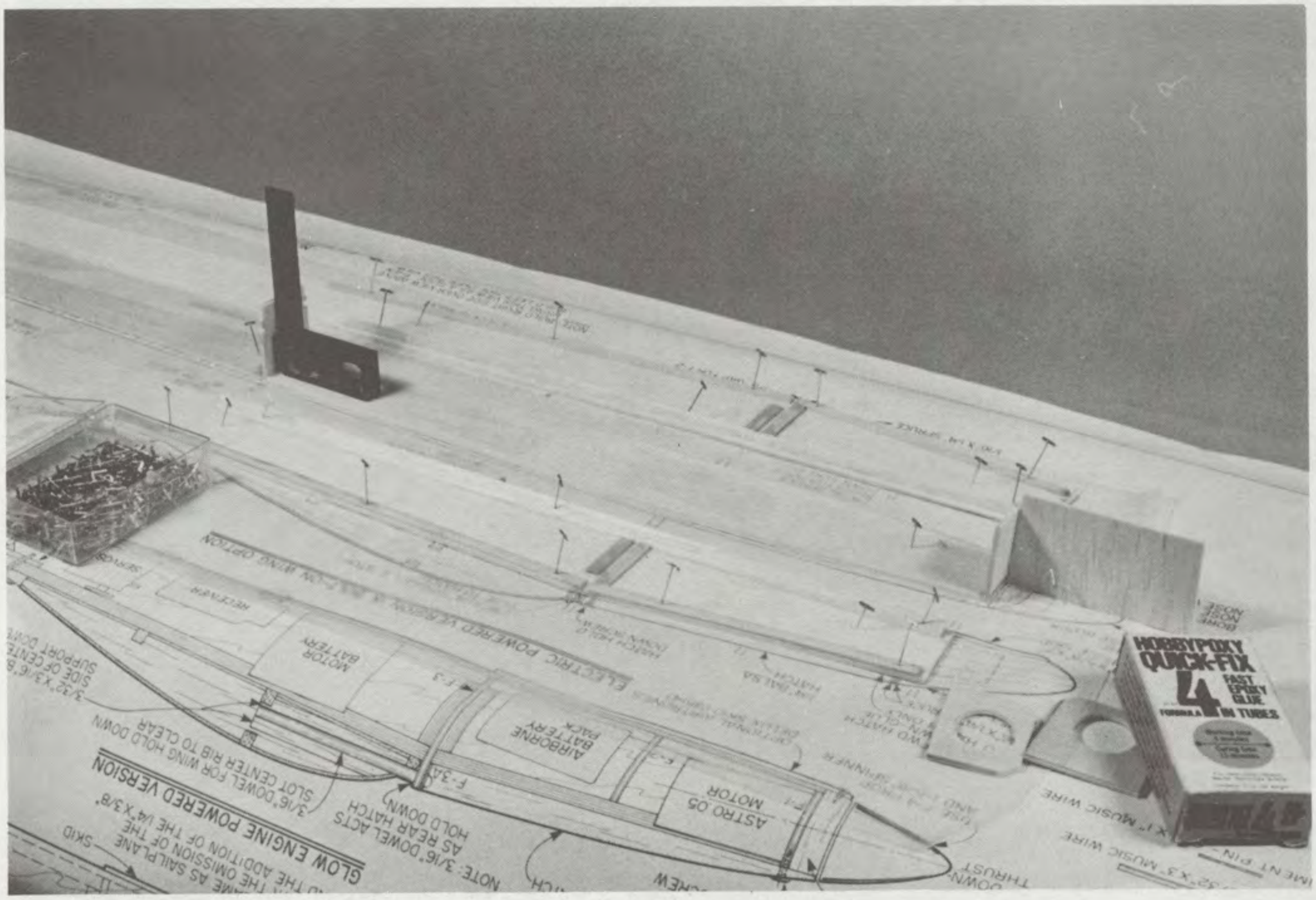
(a) Thumbtack or pin the plan to the building board with the fuselage top and side views handy for construction. Cover with waxpaper. Position the forward fuselage bottom over the drawing and pin in place. Put a bit of glue on the forward edge of the rear fuselage bottom, press into place and secure with pins. Wipe off excess glue.

(b) Pin one of the fuselage sides over the right hand fuselage drawing. Trim a piece of 1/4'' triangular balsa to the length shown on the left hand fuselage view. Glue and pin in place. Use a piece of 1/8'' ply or one of the fuselage formers to space it 1/8'' from the bottom edge. Trim the pieces of 1/16'' x 1/4'' spruce and the 3/16'' x 1/4'' balsa tailpost and skid mount. Glue and pin in position. Now, pin the left hand fuselage side over its drawing. Trim, glue and pin the reinforcing pieces in place. Do not put another tailpost and skid mount on this side. Allow glue to dry before removing from the board.




***Reinforcements glued to fuselage sides.***

(c) Try formers F1, F2, F3, and F4 in their places to make sure they do not overhang the fuselage bottom. They should be flush on both sides. Take a piece of cardboard a couple of inches square, and trim one side to the 5 degree angle of the forward fuselage side. This will be used to set F1 at the proper angle.



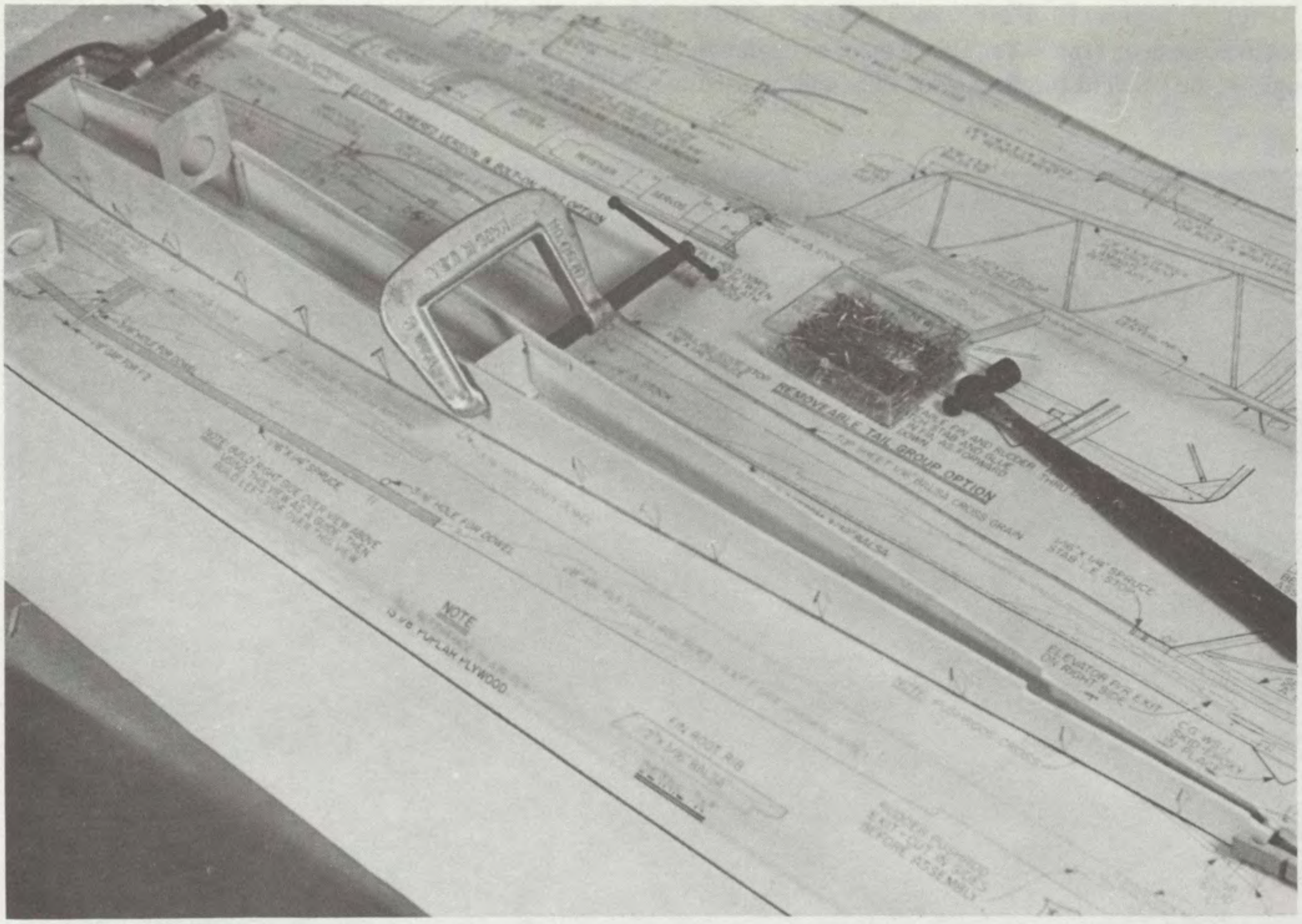

***Formers F1 and F4 epoxied in place.***

Cut a piece of 1/4'' triangular balsa stock to the width of F4. Mix a small amount of epoxy and epoxy F4, and the triangular brace in place. Check to see that it is square with the fuselage bottom. In the same manner, install F1. Use the cardboard template to set and hold the proper angle until the epoxy cures. Be sure F1 is tipped forward the 5 degrees, not backward.

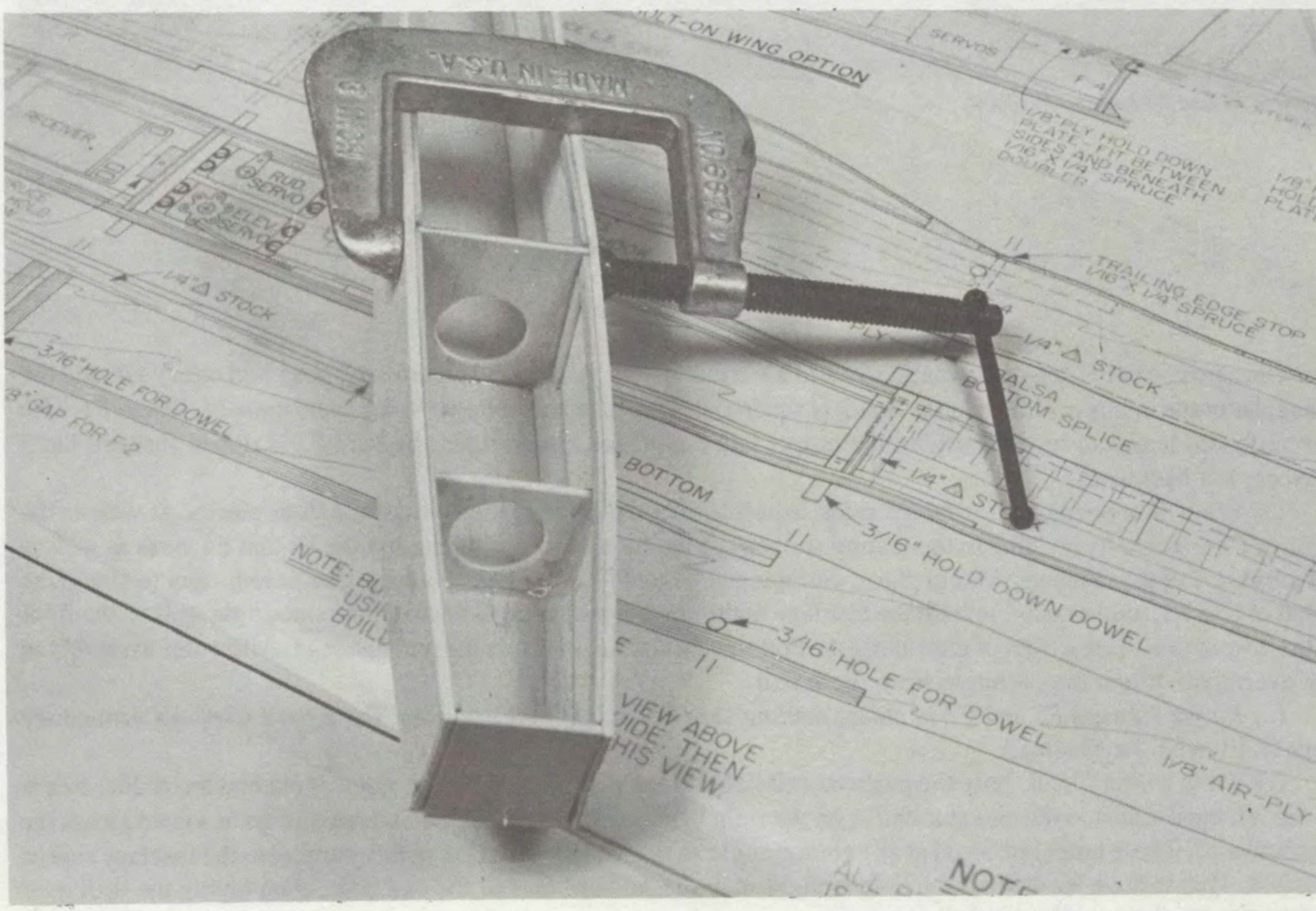
(d) We will now erect the fuselage sides. Apply a ribbon of glue to the sides of the floor pieces, as well as the sides of F1 and F4. Apply glue to the mating surfaces of the fuselage sides, including the F1 and F4 areas as well as the tailpost. Put the fuselage sides in place, clamping at F1 and F4 with 3'' C clamps. Use a clothespin to clamp the tailpost. Use F3, temporarily, to hold the fuselage to the correct width. Hold the fuselage sides tight against the floor with a row of pins. Lay a fillet of glue along the bottom and side seam inside the rear fuselage. Allow this assembly to dry overnight. When dry, remove from the board.

(e) Epoxy formers F2 and F3 in place, making sure F2 is tight to the bottom. Put a bead of epoxy around the joint of F1 with the fuselage.

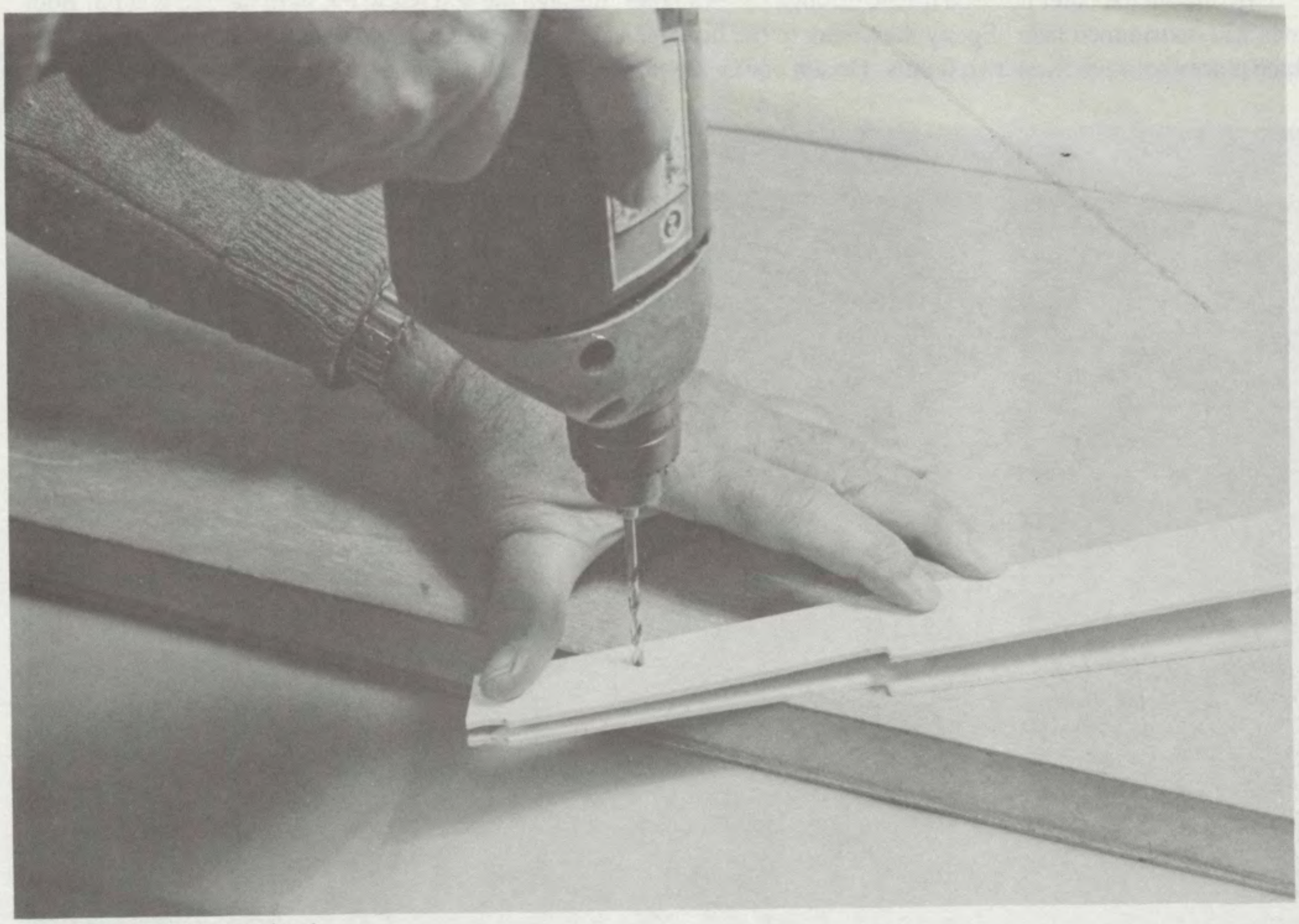
(f) Using a 9/64'' drill, bore the pushrod exit holes in the rear of the fuselage sides. Note that the rudder exit is on the left hand side and the elevator exit is on the right hand side (left and right hand are always as viewed from the rear forward). These holes are bored at an extreme angle so the pushrod exit is as nearly parallel to the fuselage side as possible. This is done by drilling the hole straight in at the forward part of the exit hole, then laying the drill over against the fuselage while the drill is running.



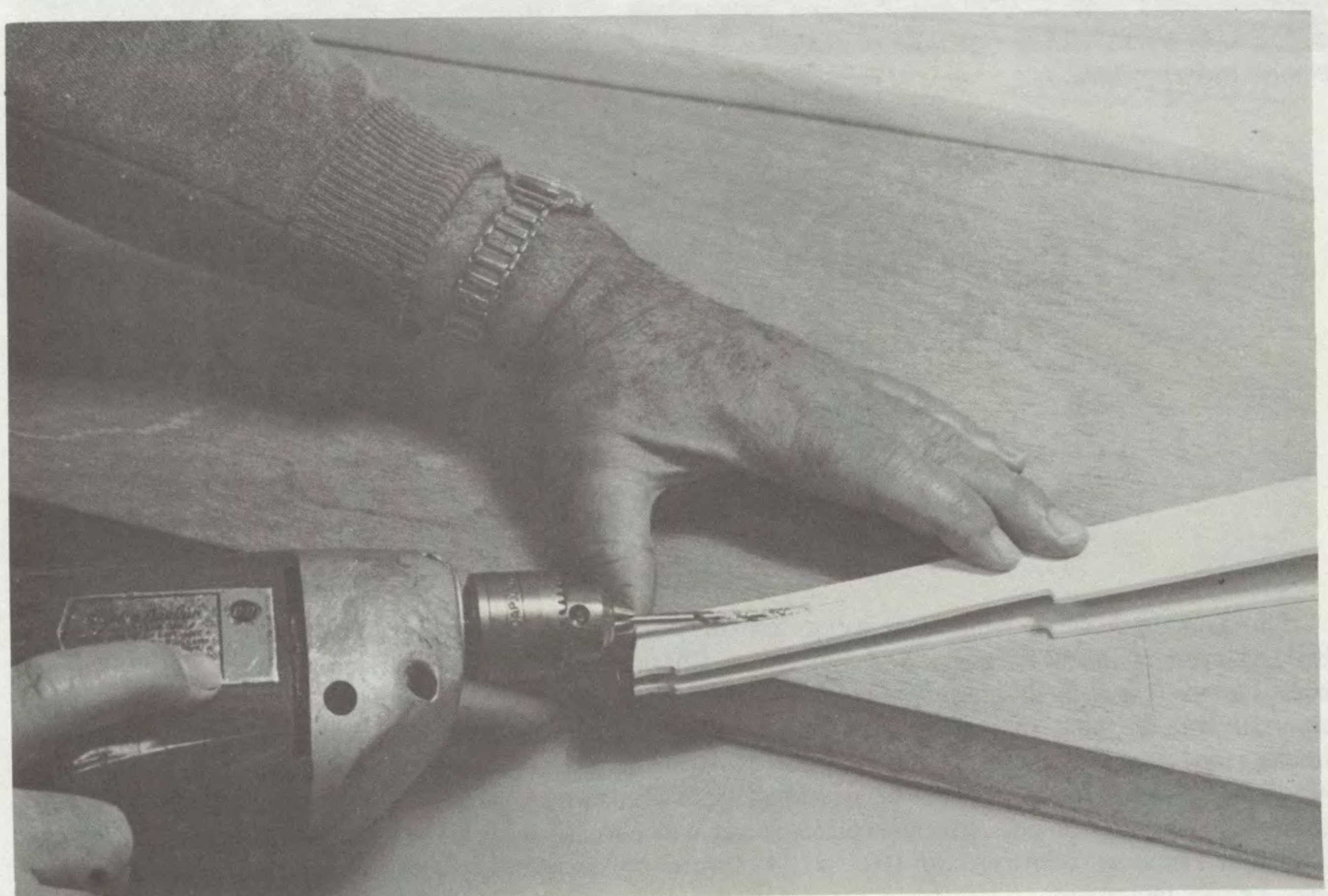

*Fuselage sides erected.*




*Formers F2 and F3 added.*

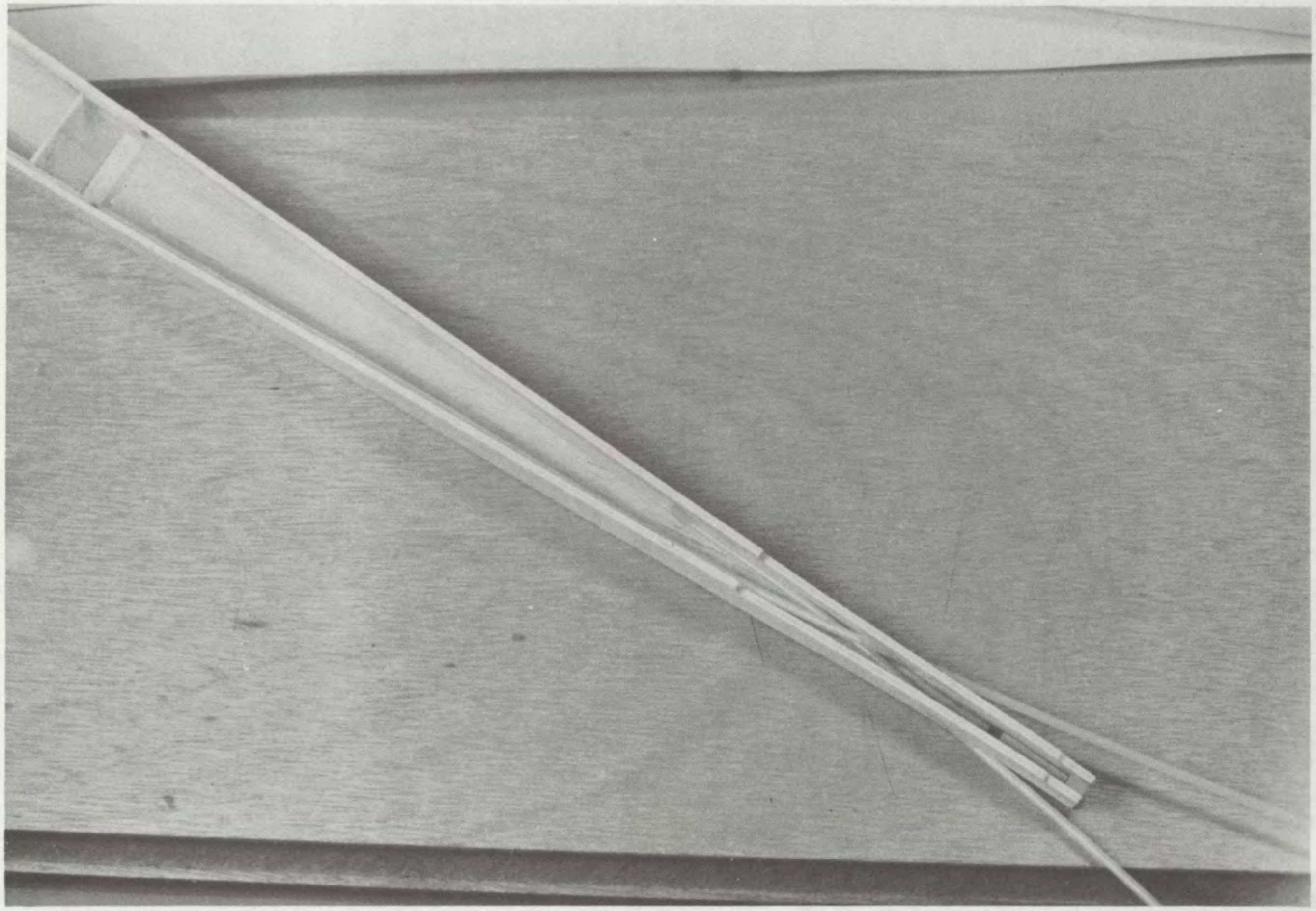


*Technique for drilling pushrod.*



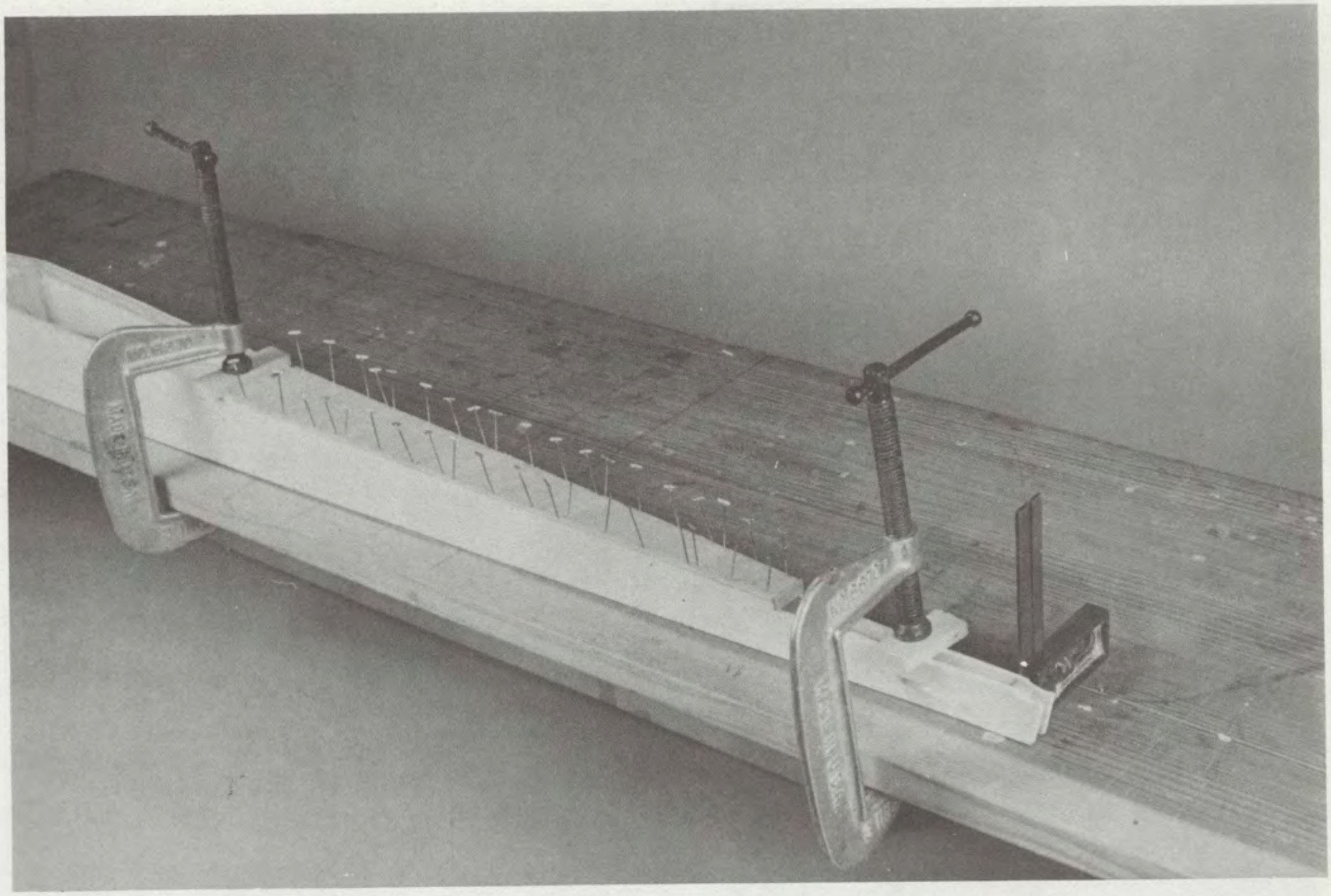
*Technique for drilling pushrod exit hole, Step 2.*

(g) Install the outer pushrod tubing through the exit holes, through the notches in F4, until the end is at F3. Both ends will be trimmed later. Epoxy the tubing to the fuselage sides inside and out, at the exit holes, former F4, and three places between these two points. Do not epoxy the tubing forward of F4 until the servos have been located.



***Pushrod tubing installed.***

(h) Trim the pushrod tubing where it exits from the fuselage to get it out of the way. Clamp the fuselage to the building board forward of F4, and in the stabilizer area. Check that the rear of the fuselage is vertical. We do all this to make sure the rear of the fuselage does not twist when we put on the rear top sheeting. If it twists, the fin will be crooked. Trim the wing trailing edge stop from 1/16'' x 1/4'' spruce, and glue in place. Trim the five pieces of fuselage top rear sheeting from 1/16'' x 3'' balsa. Note that the grain runs across the fuselage. These pieces should be trimmed to size so the fuselage will be the correct width when they are installed. Coat the fuselage top, and mating areas of the sheeting with glue, and put in place. Secure with pins, adjusting the width of the fuselage so the sheeting is flush with the sides. Trim a piece of 1/16'' x 1/4'' spruce strip, and glue in place to form the stabilizer leading edge stop. Let dry thoroughly.



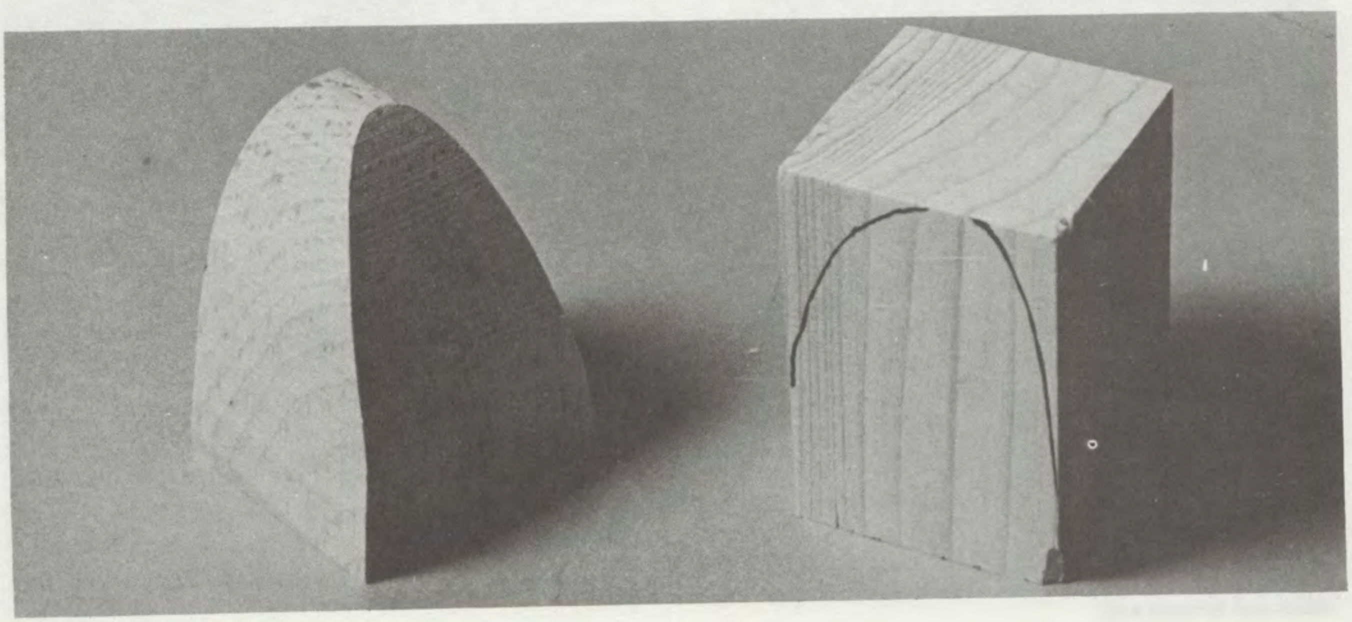
*Fuselage is clamped down while rear top sheeting is installed.*

(i) Trace the side view of the nose block on the 2'' x 2'' x 2½'' pine nose block material. Saw to shape, leaving a bit of material all round for final sanding. Do the same for the top view contour.

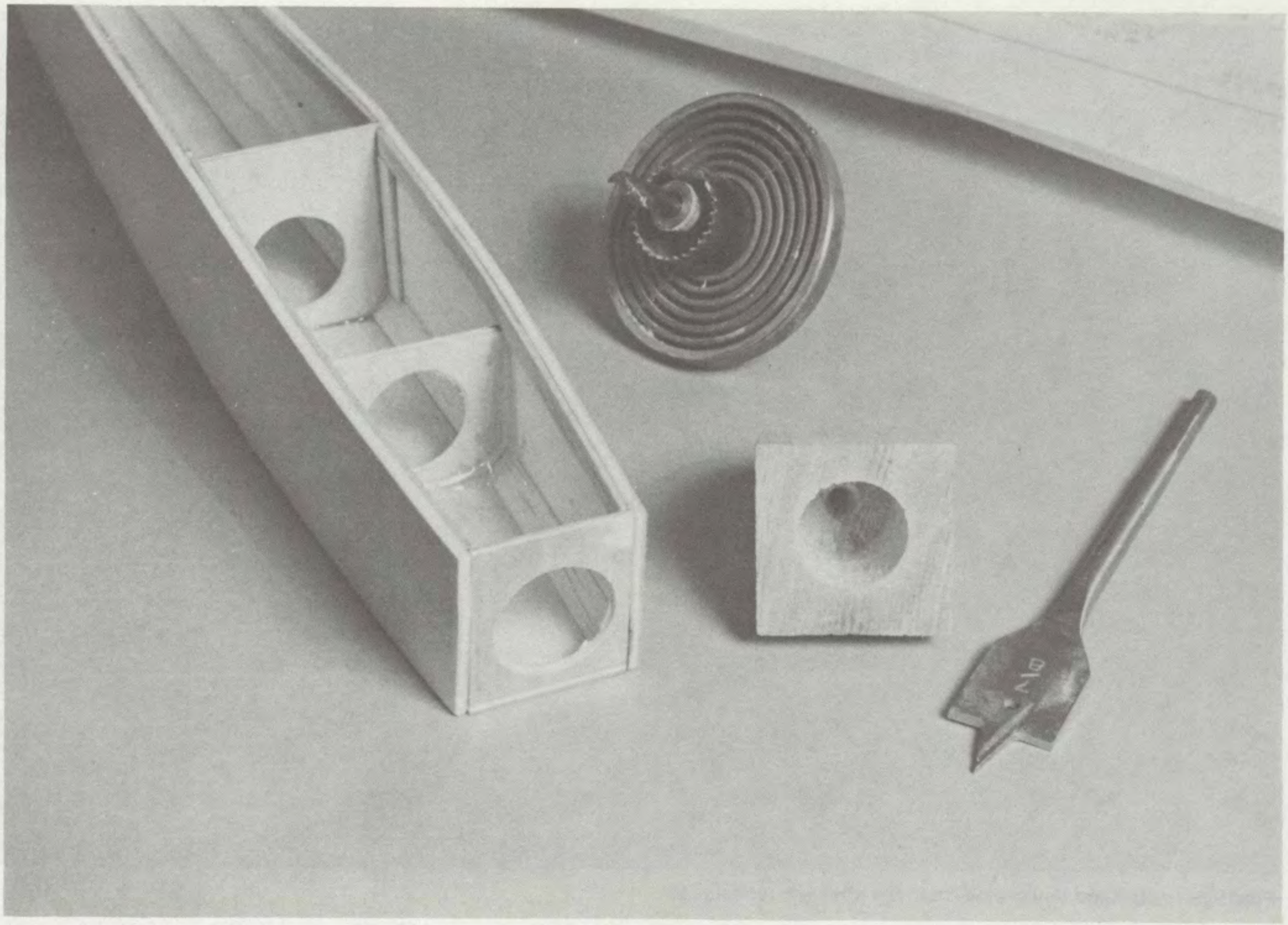
If you have a 7/8'' or 1'' wood bit, bore a hole in the nose block for nose weight. Cut a matching hole in former F1. If the tools are not available, the nose weight can be placed in the forward compartment with the battery.

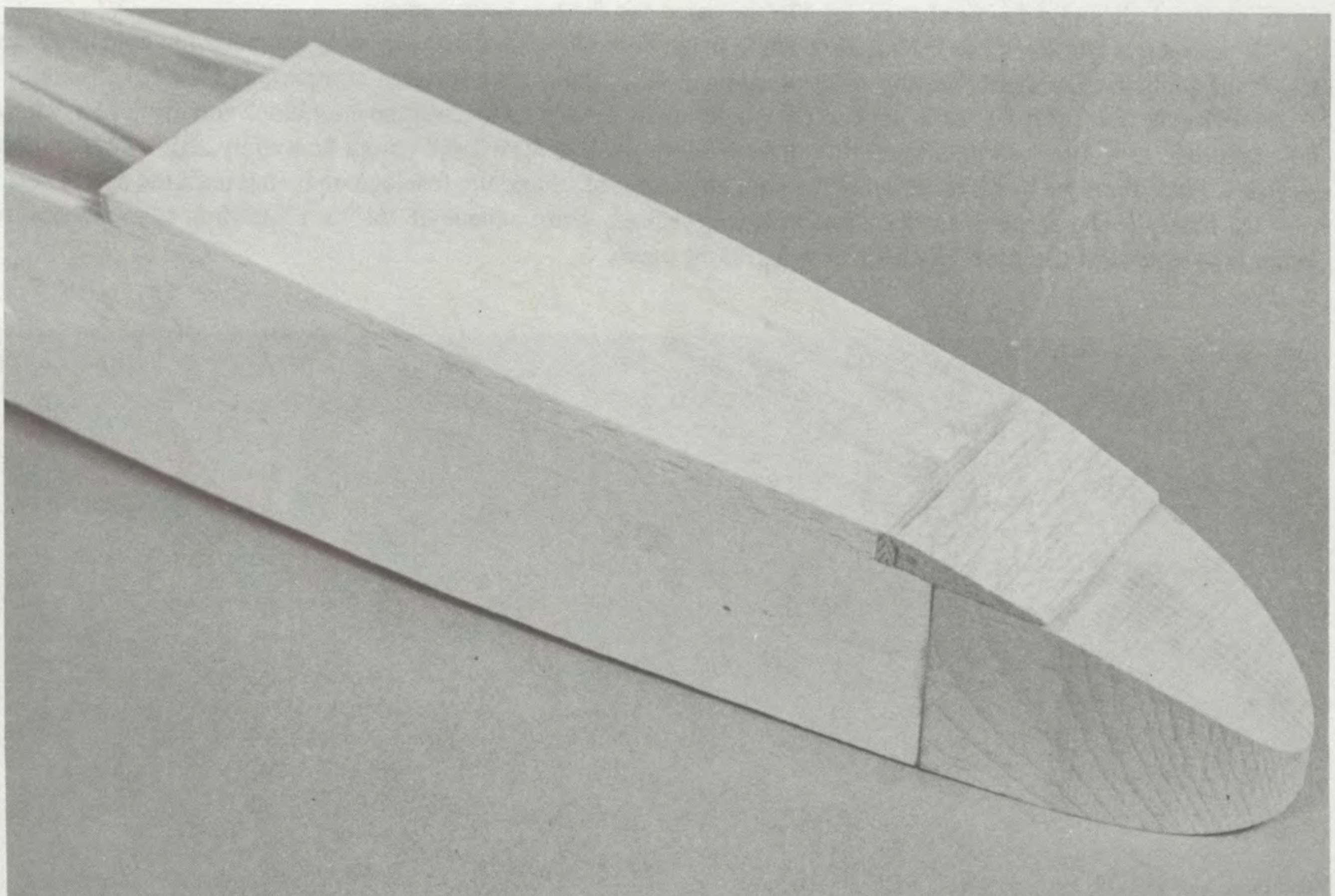
(j) Use the point of the X-Acto knife to poke holes in the mating surfaces of the nose block and former F1. These holes provide a ''tooth'' so the adhesive will hold more tightly. Mix some epoxy and apply a thin coat to both surfaces. Place the nose block on F1, making sure it is centered. Stand the fuselage on its tail until the epoxy sets.

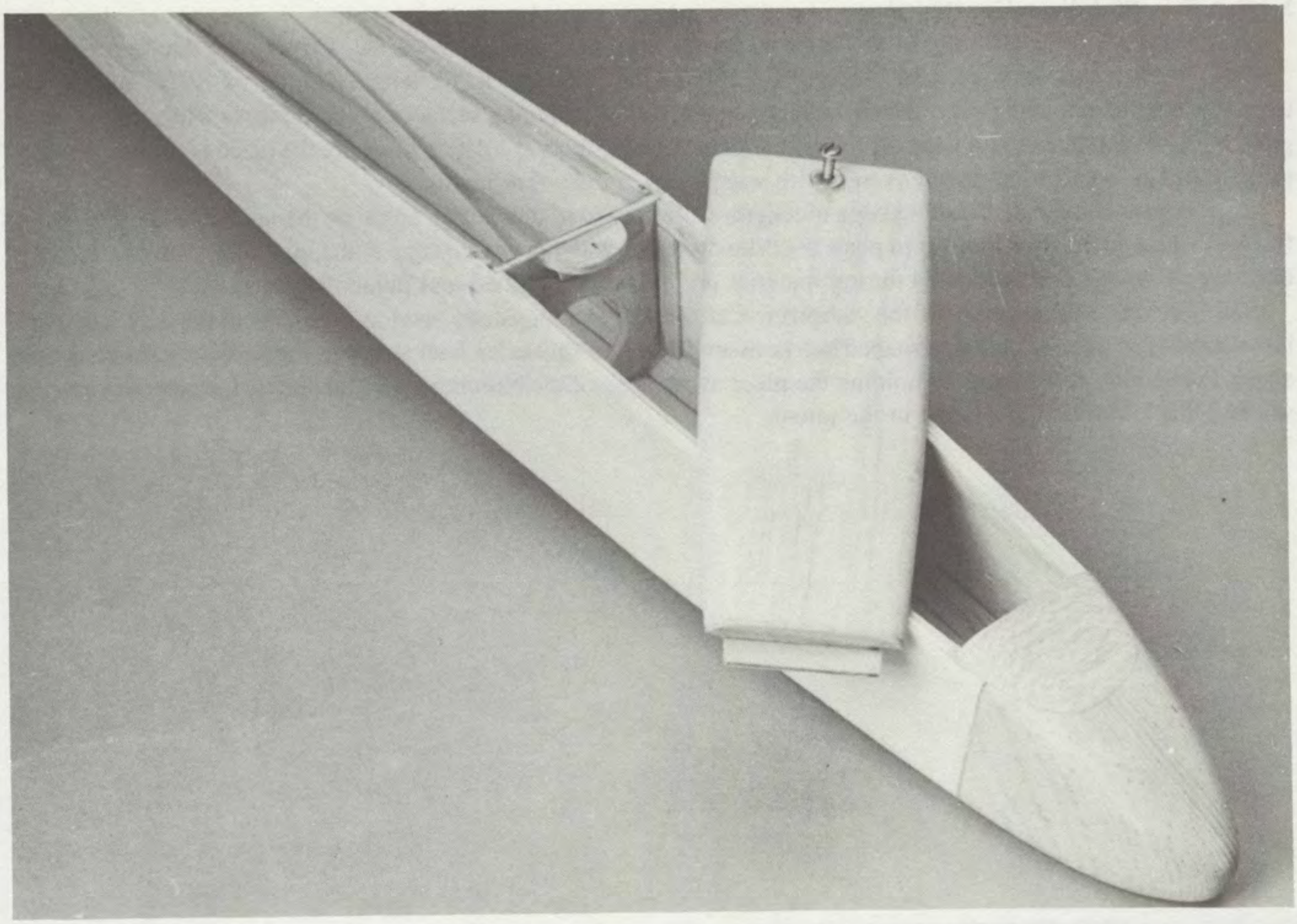
(k) Sand the top of the nose block flat with the fuselage. Trim a piece of 1/4'' x 1'' trailing edge material to length and glue it to the nose block as shown. Pin in place.



*Noseblock cut to shape.*


Tools for boring nose block.


Hatch and forward stop.



***Hatch construction.***

(l) Trim the sailplane version shape hatch from the 1/4'' x 3'' balsa. Trim the ends and sand to exact length but leave about 1/16'' material on both sides so it can be sanded to exactly fit the fuselage. Trim the 1/16'' x 1/4'' pieces of spruce and glue them to the ends. Trim the 1/16'' x 1¼'' x 3/4'' ply hatch hold-down and glue it in place. Allow glue to dry. Cut the canopy hold-down block from a scrap of 1/8'' Air Ply or 1/4'' sq. spruce and epoxy in place as shown on the drawing. Put the hatch in place, centered on the fuselage. Drill a 1/16'' hole through the hatch and hold-down block for the screw. This attachment can be made more durable by epoxying a small metal washer over the hole on top of the hatch; or by epoxying a short piece of the brass tubing into the hole; or, etc., etc.

(m) Locate and drill the 3/16'' holes for the 3/16'' wing hold-down dowels. Do not install the dowels, though, until after covering has been completed on the fuselage.

(n) Carve the nose block and hatch to a rounded shape that pleases you and sand smooth and flush with the fuselage. Sand the rest of the fuselage smooth, slightly rounding the edges. Be careful when sanding the rear top sheeting not to sand the edges thin — just make a slight radius on the edge. Finish with a light sanding using #400 wet or dry sandpaper.

(o) Cut a 7'' skid from the 1/8'' x 5/8'' spruce. Round the front edge. This can either be epoxied in place now, or you can wait until the covering has been completed. It makes covering the fuselage a little easier if the skid is not in the way.

This completes the basic construction of the fuselage.

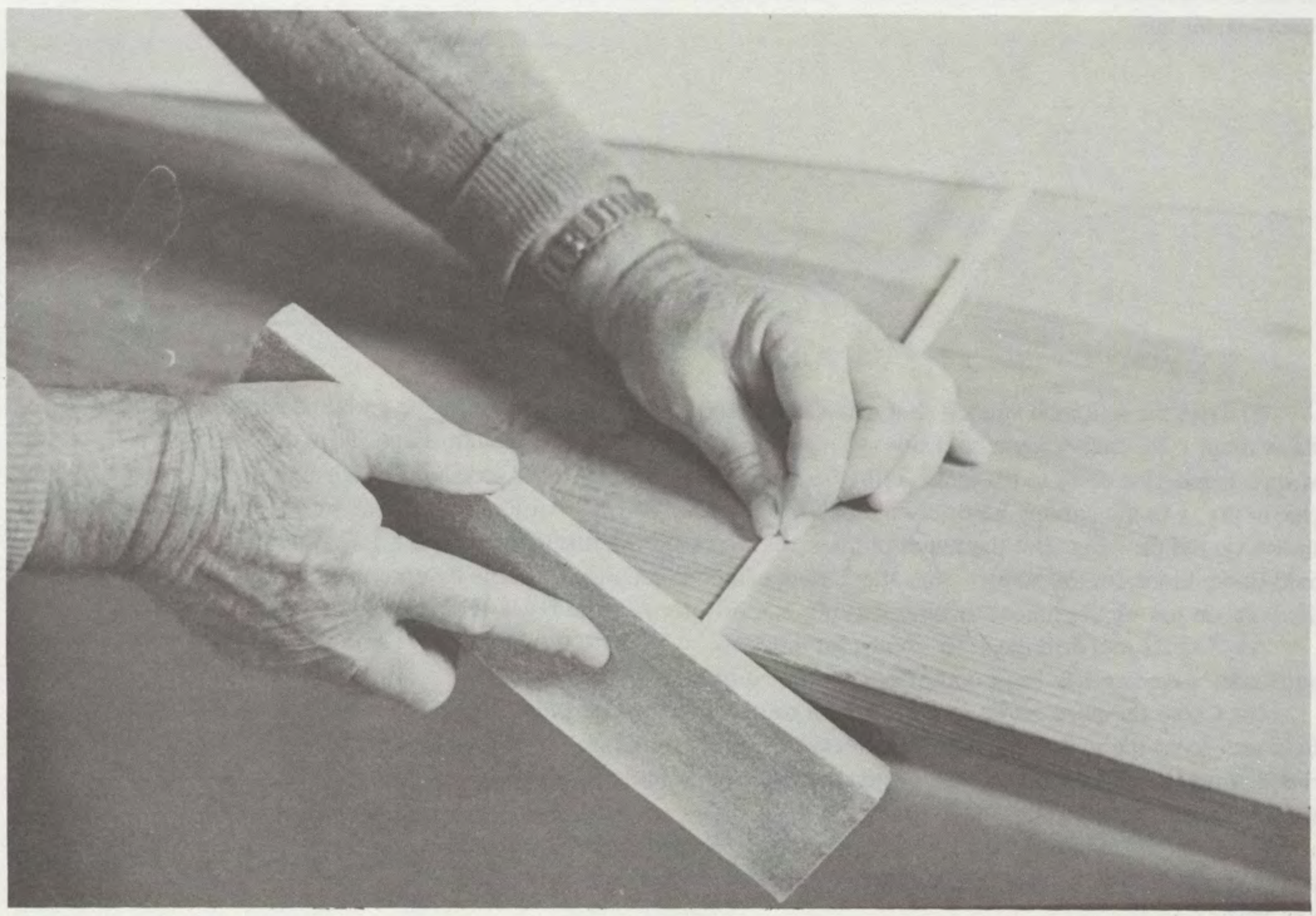
**Section 5 — Stabilizer Construction**

(a) Thumbtack the drawing to the building board with the stabilizer available. Cover with waxpaper.

(b) We will now laminate a 36'' length of 3/16'' x 1/4'' balsa and a 36'' length of 1/16'' x 3/16'' spruce, for use as the stabilizer leading edge and the rudder tailpost. Coat the mating surfaces of these pieces with a thin coat of glue. Press them together and wipe off the excess glue. Use the metal yardstick to assure the piece is straight and pin to the building board in an area covered with waxpaper. Let dry thoroughly.

(c) Trim the laminated leading edge to length. Carefully sand the mating angle on the leading edge for a good fit. Apply glue to the joint and pin in place over the drawing, with the spruce edge to the rear. The stabilizer leading edge brace, which was fabricated during material prep, should be glued and pinned in place.

(d) Complete the framing of the stabilizer. Cut the tips and the center section pieces from the 3/16'' x 3/4'' balsa stock. The tips can either be shaped before assembly or left square for later shaping. Pieces can be squared, and angles made quite accurately, by holding the piece at the edge of the building board and using the edge to keep the sanding block vertical, as shown in the photo.



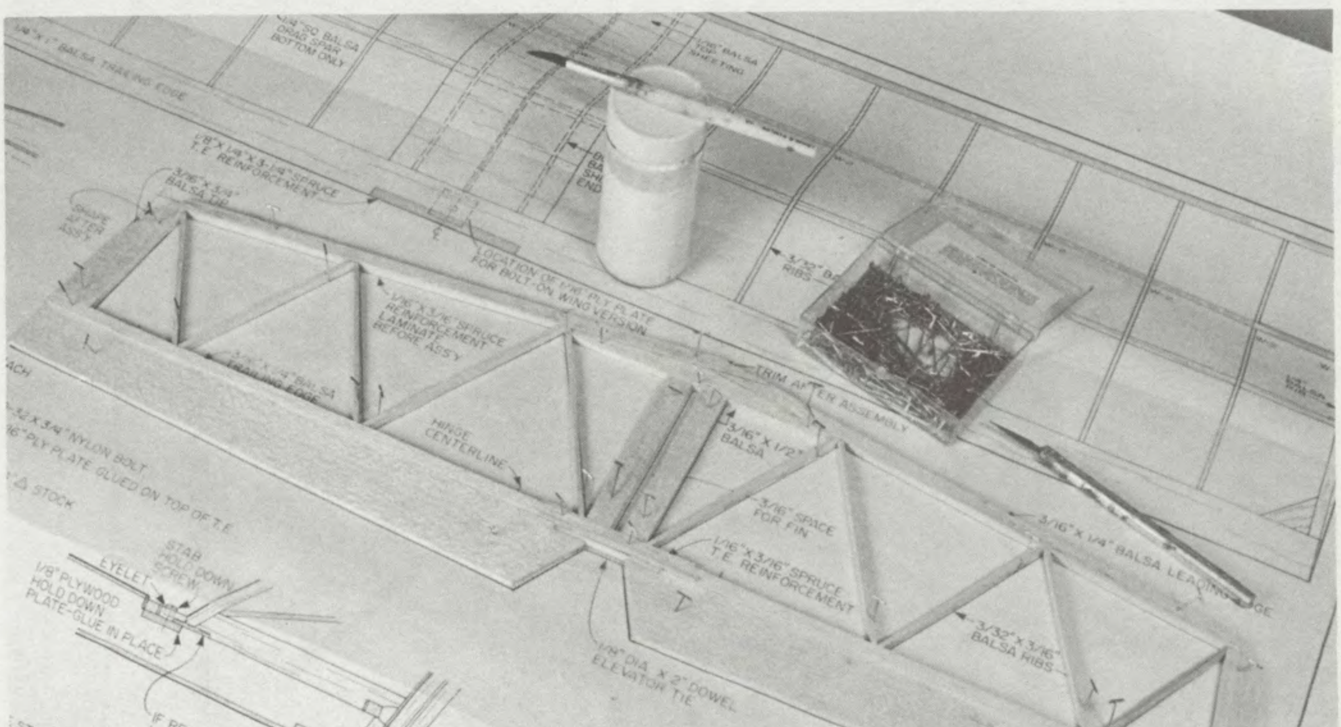
***Technique for squaring all parts.***

(e) The elevators were trimmed to shape in the material prep step. Cut a piece of 1/8'' dowel to a length of 2''. Cut a piece of waxpaper about 1'' x 4'' to keep the epoxy from sticking to the trailing edge. Use the X-Acto knife to poke holes in the mating surfaces for good adhesion of the epoxy. Epoxy the dowel to the elevators. Put the small piece of waxpaper between the dowel and trailing edge, and pin the elevator in place against the stabilizer trailing edge.

(f) Allow the assembly to dry overnight. When dry, remove from the building board. Put a fillet of glue at each joint. Allow to dry.

(g) Sand the top and bottom surface smooth. Sand the leading and trailing edges and the tips to a smooth radius. Finish with a light sanding with #400 wet or dry sandpaper.

This completes the stabilizer construction.




*Stabilizer construction.*

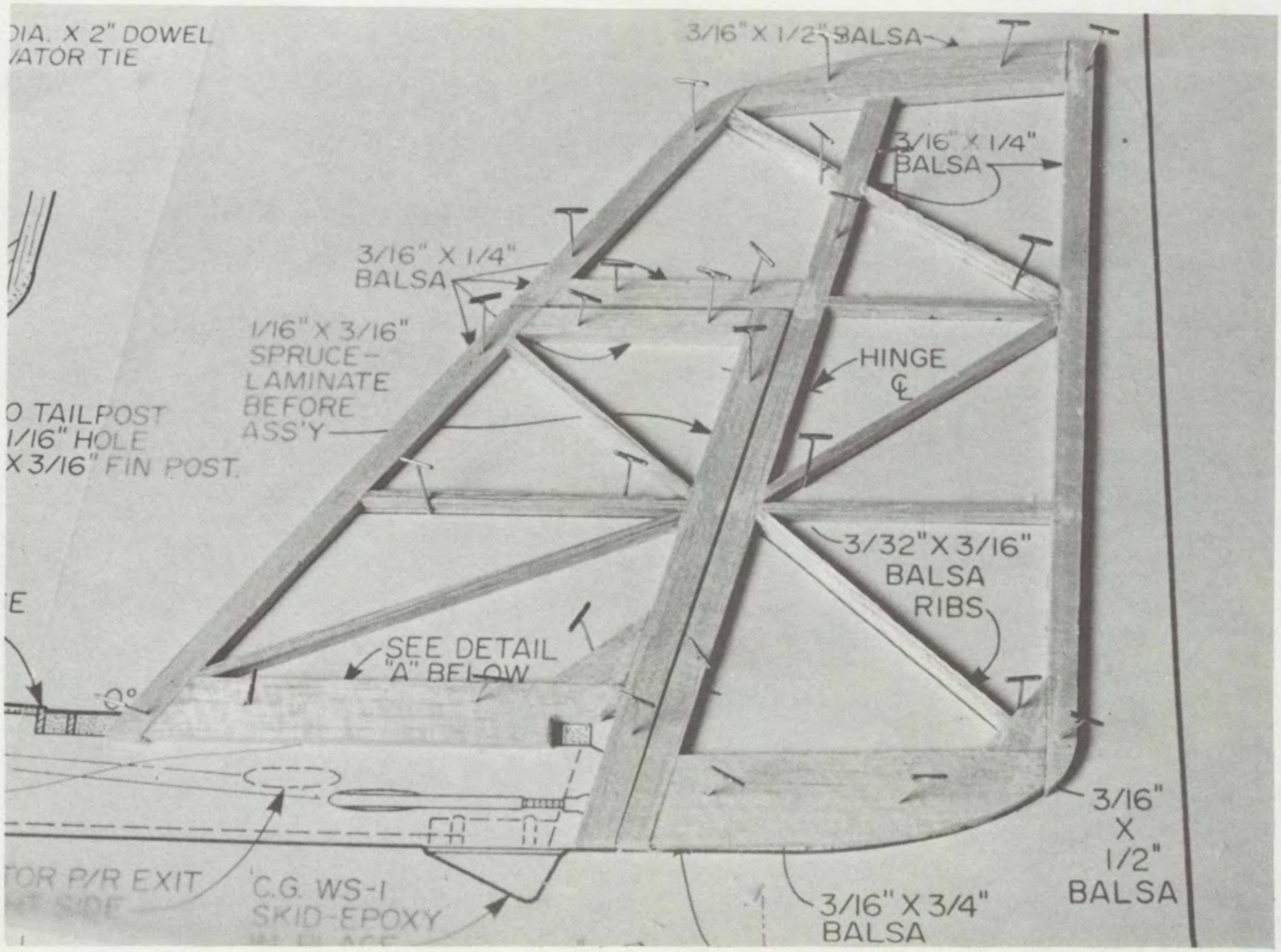
## Section 6 — Rudder/Fin Construction

(a) The fin and rudder are constructed in the same manner as the stabilizer. Note that the fin tailpost is made from the piece of laminated material left from the stabilizer leading edge. The fin root rib shown in Detail "A," was cut to shape during material preparation. Be sure the laminated tailpost is pinned to the drawing with the spruce edge facing forward, as shown. Do not glue the rudder to the fin tailpost.

(b) When the assembly is dry, remove from the building board and put a fillet of glue at each joint. Allow to dry.

(c) Sand each side flat. Sand a smooth radius around the outside of both fin and rudder as well as the hinge line of both pieces. Lightly sand the assembly with #400 wet or dry sandpaper.

This completes the rudder and fin construction.



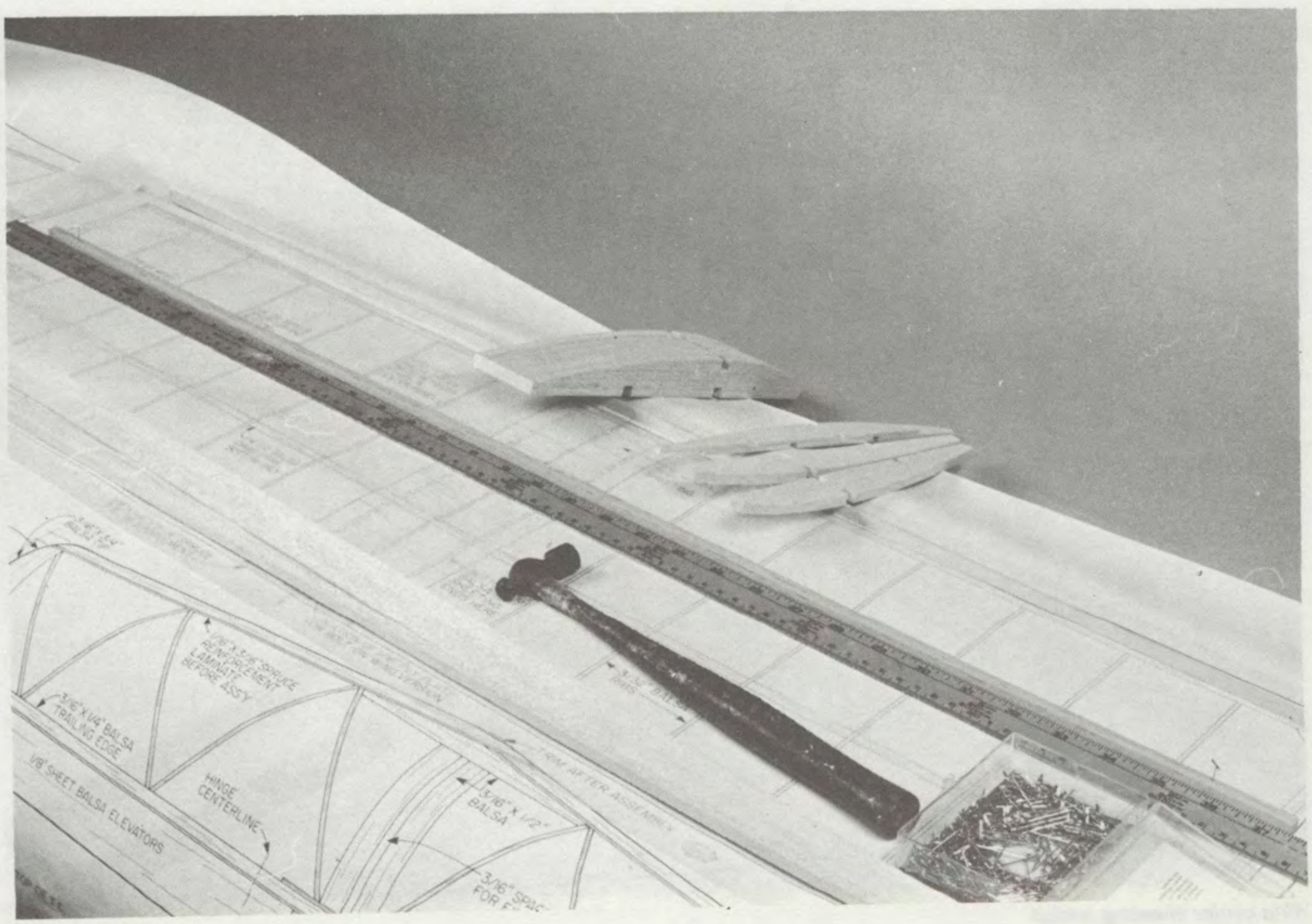

*Fin/Rudder construction.*

## Section 7 — Wing Construction

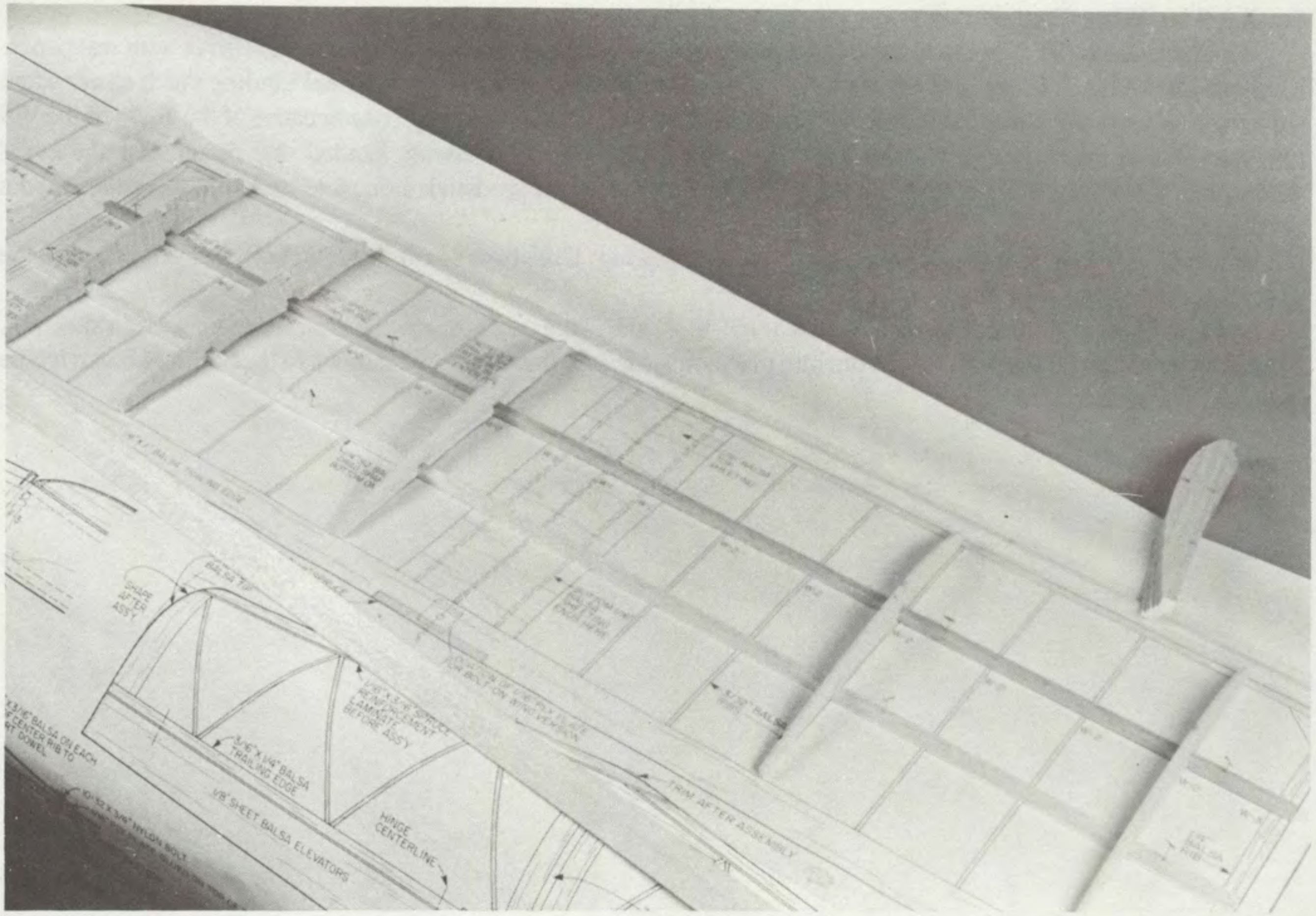
(a) Thumbtack the drawing to the building board so the wing center section is available. Cover with waxpaper. Sand one side of the 1/4'' sq. and 1/8'' x 1/4'' spruce spar material. This will make final sanding much easier when the wing is assembled. Note that the top spar is somewhat shorter than the bottom one because of the angle of the W3 rib. With this in mind, pin the bottom 1/4'' sq. spruce spar over the drawing, sanded side down. Use the metal yardstick to make sure it is perfectly straight. Pin the ends, hold the yardstick alongside, then pin the middle and a couple of other spots.

Place the 1/4'' sq. x 36'' balsa drag spar over the drawing. Use six or so ribs set onto both spars to establish the exact position of the drag spar, and pin in place.

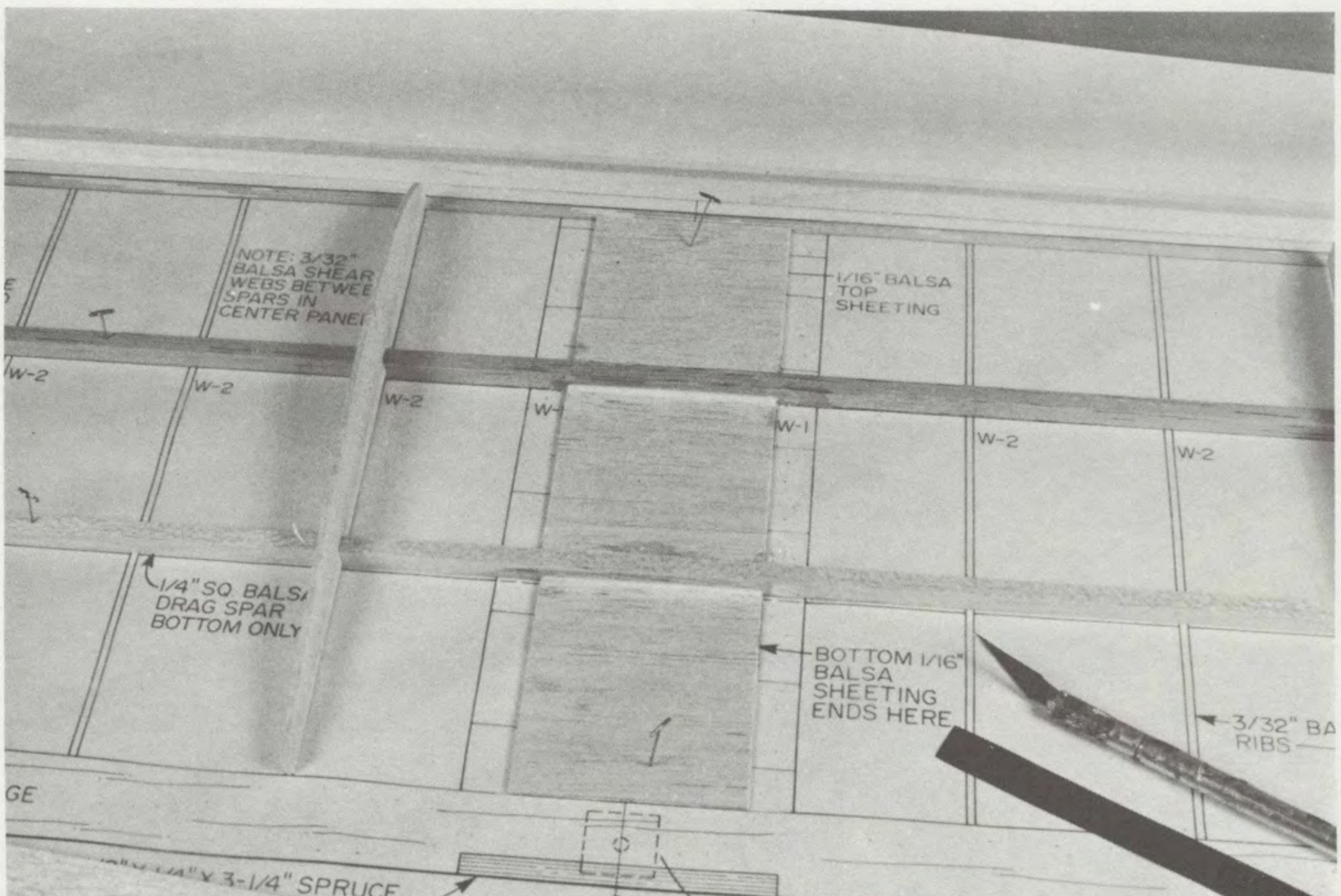
(b) Cut three 2½'' pieces from a sheet of 1/16'' x 3'' x 36'' balsa. These are the bottom center section sheeting. Trim to fit between the spars. Glue and pin into place, making sure they are pressed down to the building board where they join the spars.




*Wing spar aligned.*




*Positioning the wing spars.*




*Wing center sheeting added.*

(c) Glue the two W3 1/4'' balsa ribs to the two spars. Use the W11 marked ''pattern'' to set the proper angle shown on the Tip Joiner Detail on the drawing. Pin tightly to the board.

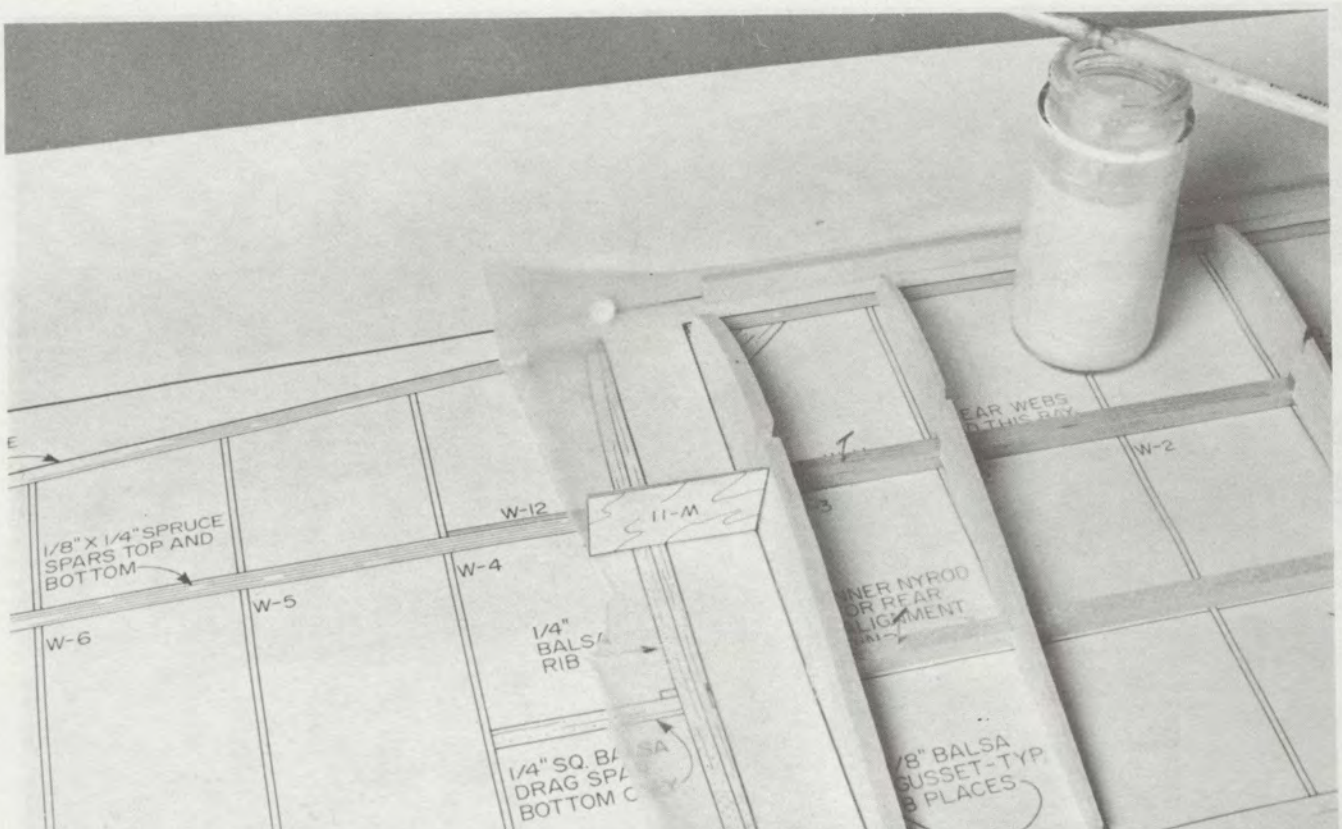
Now, install the rest of the ribs, gluing them to the spars and the bottom sheeting in the case of the W1 ribs. Be sure you have the right ribs at W1. Check each rib with a square to make sure it is vertical. Pin all ribs in place.

(d) Lay the yardstick along the leading and trailing edges of the ribs to make sure they are all aligned. Carefully sand any that protrude, until the yardstick touches all the ribs (or very nearly so). Put a dab of glue on the leading edge of each rib, and one at the mating spot on the 5/16'' side of the shaped leading edge. Pin in place, tightly against the ribs. Similarly, install the 1/4'' x 1'' trailing edge stock and glue it to the trailing edge of the ribs. Note that the trailing edge must be installed right side up, or the ribs won't be flush against it.

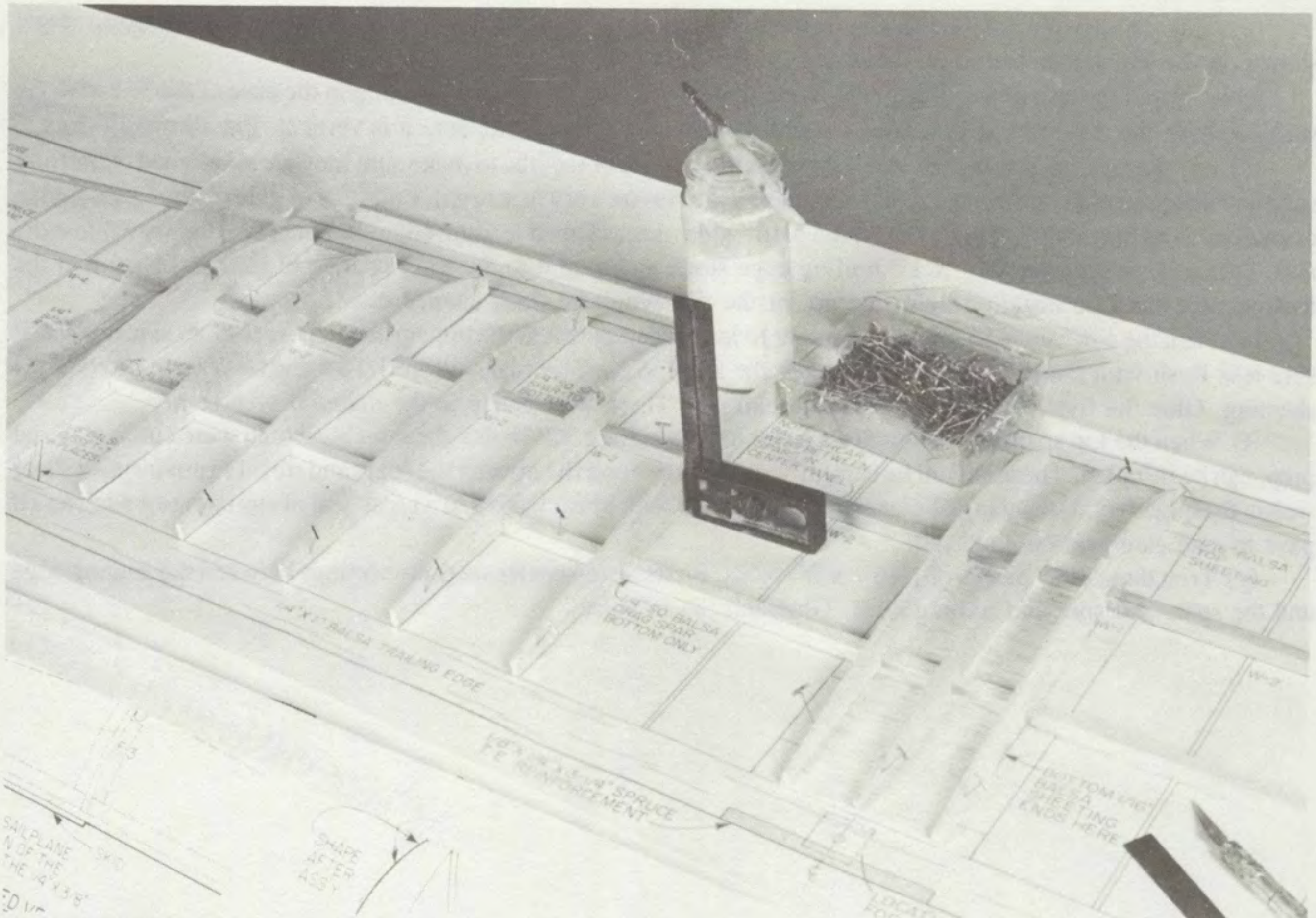
(e) Trim the 1/4'' sq. x 36'' spruce top spar to length and glue it in the upper rib notches, smooth side up. Make sure it is flush with the tops of all ribs, except the three W1s. The spar will be 1/16'' above W1s to provide for sheeting. Glue the four wing gussets in place and pin. These were made in the material prep step.

(f) When the top spar is dry enough so as not to move, the 3/32'' balsa shear webs, which were cut in material prep, can be installed. These should be carefully sanded to a good fit between the spars and ribs. Do not install a shear web in the outer bay. Use plenty of glue when putting in place. Shear webs add a great deal of strength to a wing and it pays to take care to do a good job.

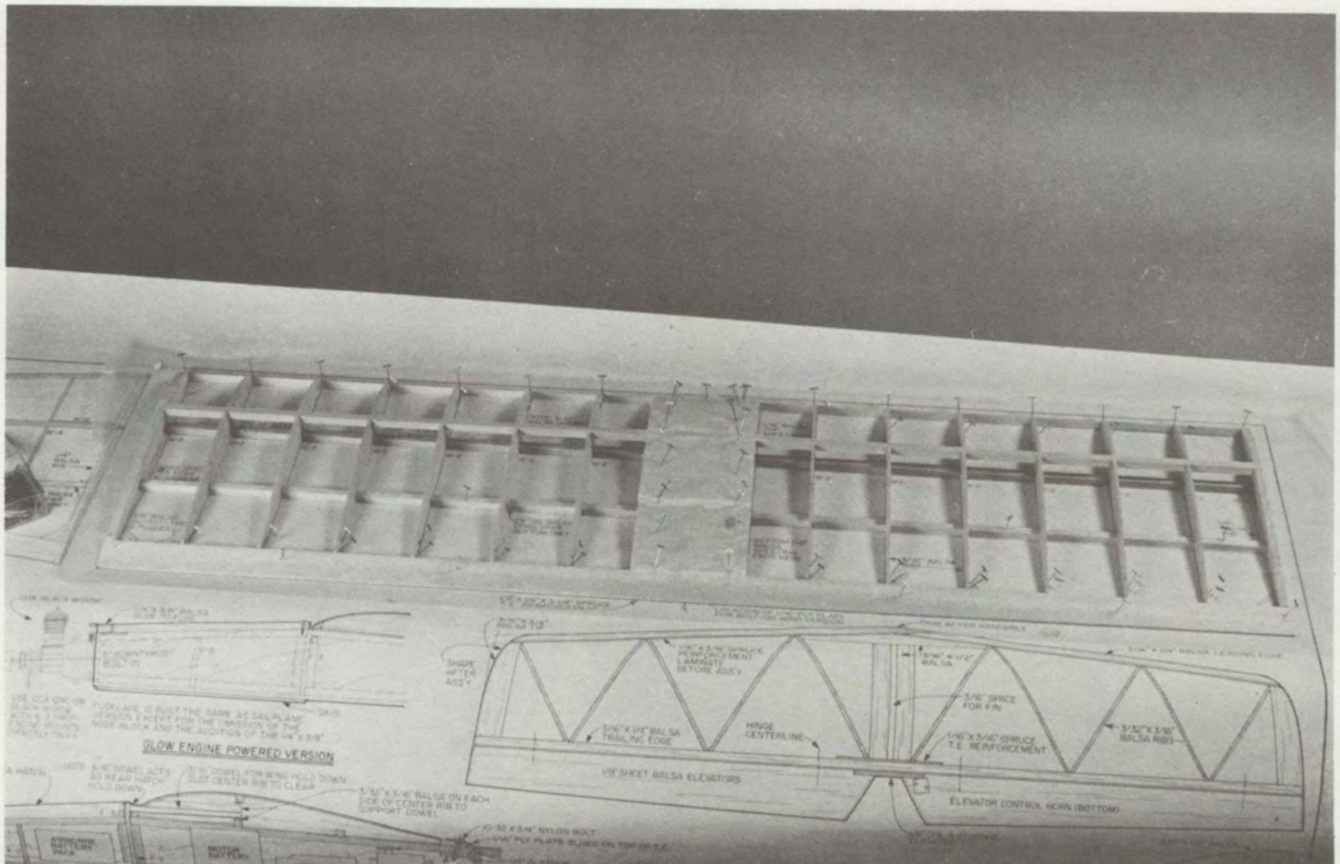
(g) Trim three 3½'' pieces of 1/16'' x 3'' balsa. Fit these top center section sheetings between the leading edge and the spar, and spar and trailing edge. Glue and pin in place.




***W11 used to set angle on W3 rib.***




*Wing rib installation*




*Completed framing of wing center section.*

(h) When dry, remove from the building board. Put a generous fillet of glue at each joint, standing the assembly up so the glue will not run until somewhat set.

(i) Thumbtack the drawing to the building board so one of the outer wing panels is handy. If your building board is large enough, you can build both outer panels at the same time. Cover with waxpaper. Trim the lower spar from 1/8'' x 1/4'' x 36'' spruce. Trim carefully. The rest is used for the upper spar, and there is just enough left to make the filler between the upper spar and W3. Pin the spar to the drawing, checking for straightness with the yardstick. Glue the 1/4'' W3 rib in place. Use the W11 angle pattern to set the 8 degree angle, and pin securely to the board. Now, glue ribs W4 through W10 in place, checking each to make sure it is vertical. Pin in place.

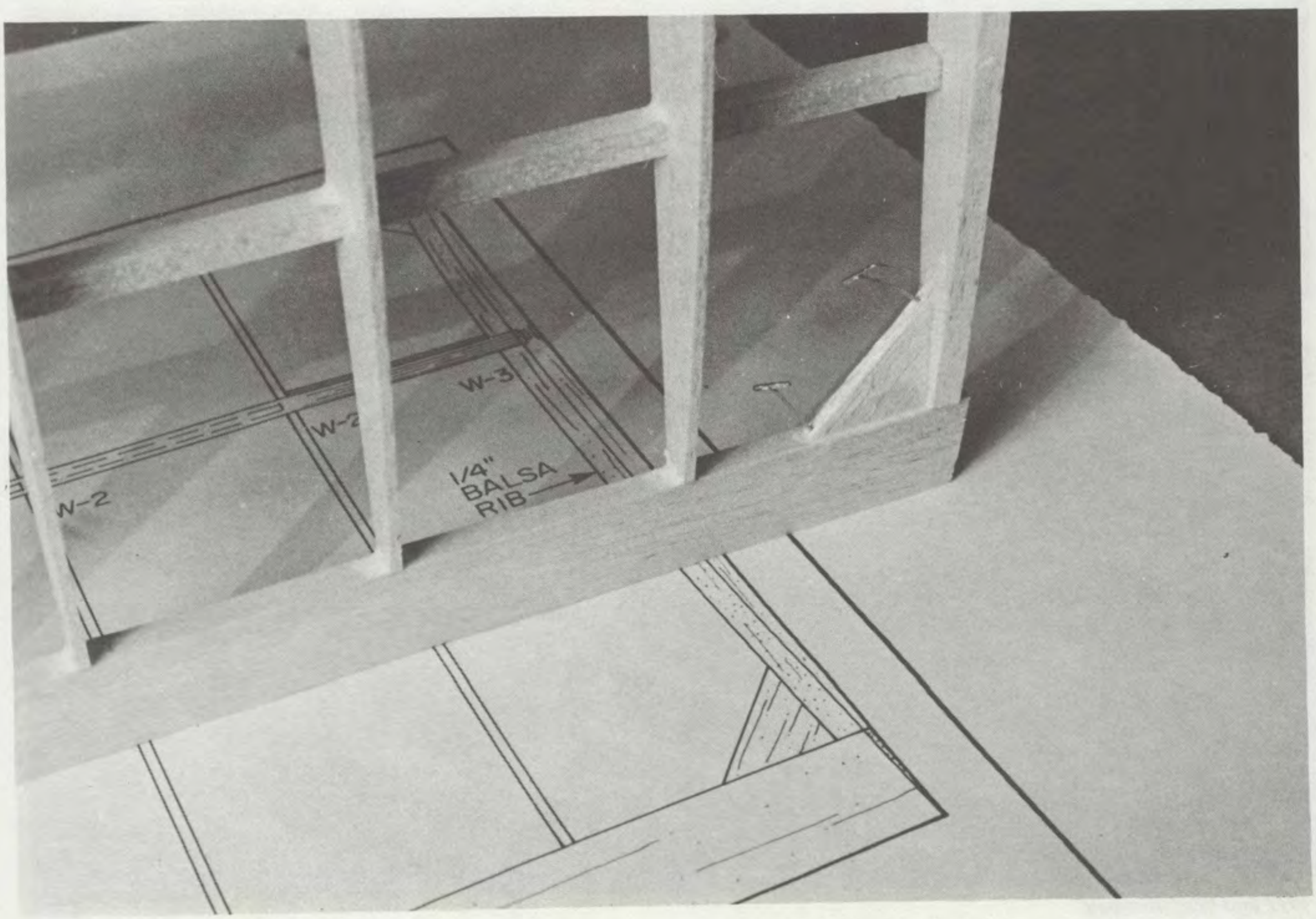
(j) Trim the top spar and the W3 filler from the remaining 1/8'' x 1/4'' spruce. Glue the filler to the spar and the spar to the ribs. Clamp the filler with a clothespin. Make sure the spar is flush with the tops of the ribs.

(k) Check the alignment of the leading and trailing edges of the ribs with the yardstick as you did with the wing center section. Trim the leading and trailing edge material to length, leaving a bit of overhang to be trimmed later. Glue these pieces to the ribs and pin in place.

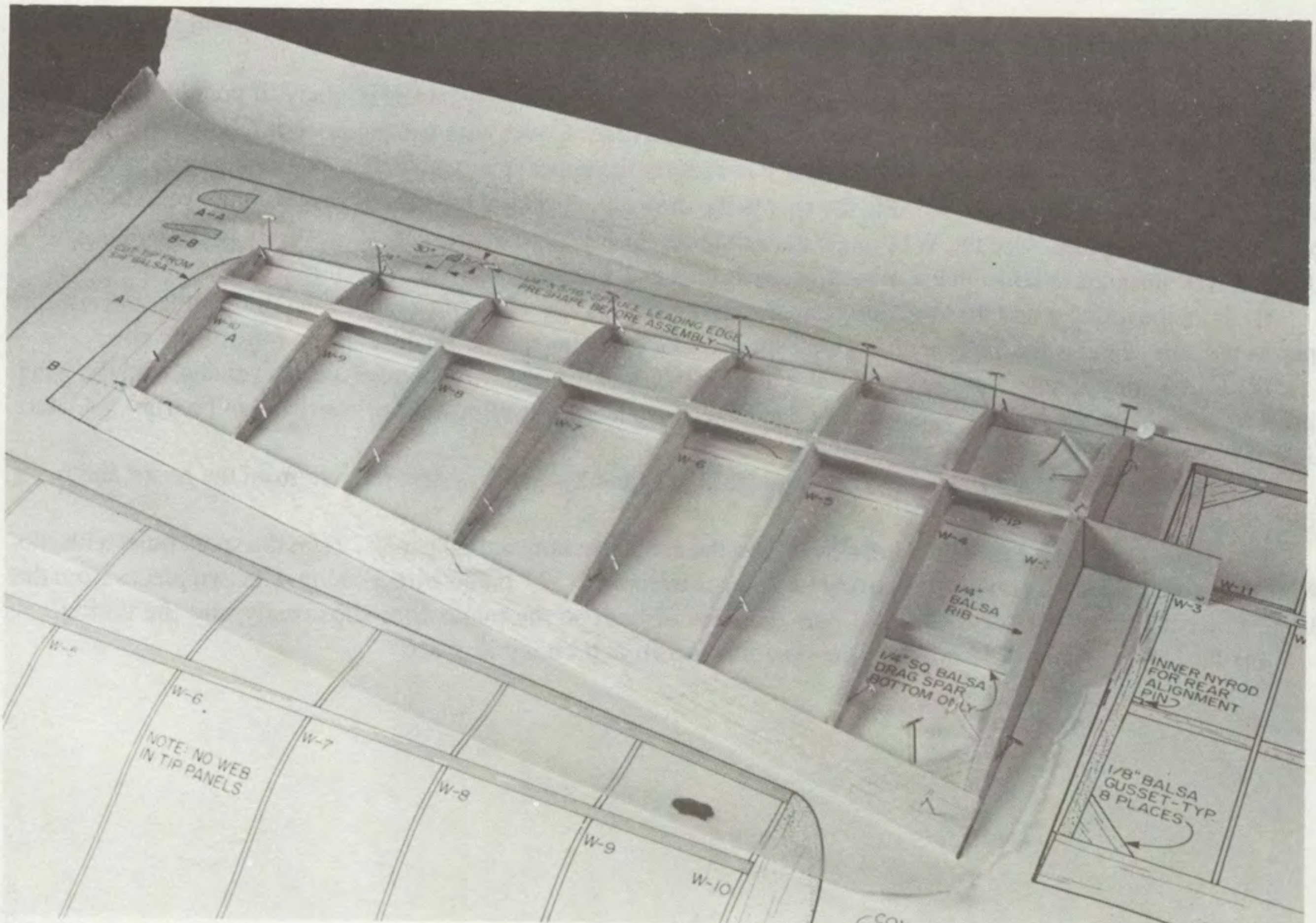
(l) Trim the gussets to fit; glue and pin in place. When the assembly is dry, remove from the board and put a fillet of glue at each joint.

(m) Trim the spars, etc., flush with ribs W3 on the center section and tip panels. Trim the spars flush with ribs W10. Use your hacksaw, or whatever, to cut two pieces from the 5/32'' piano wire 3'' long. Cut two pieces from the 3/16'' brass tubing, 1⅝'' long. File and burr the ends of both so the piano wire slips easily into the tubing.

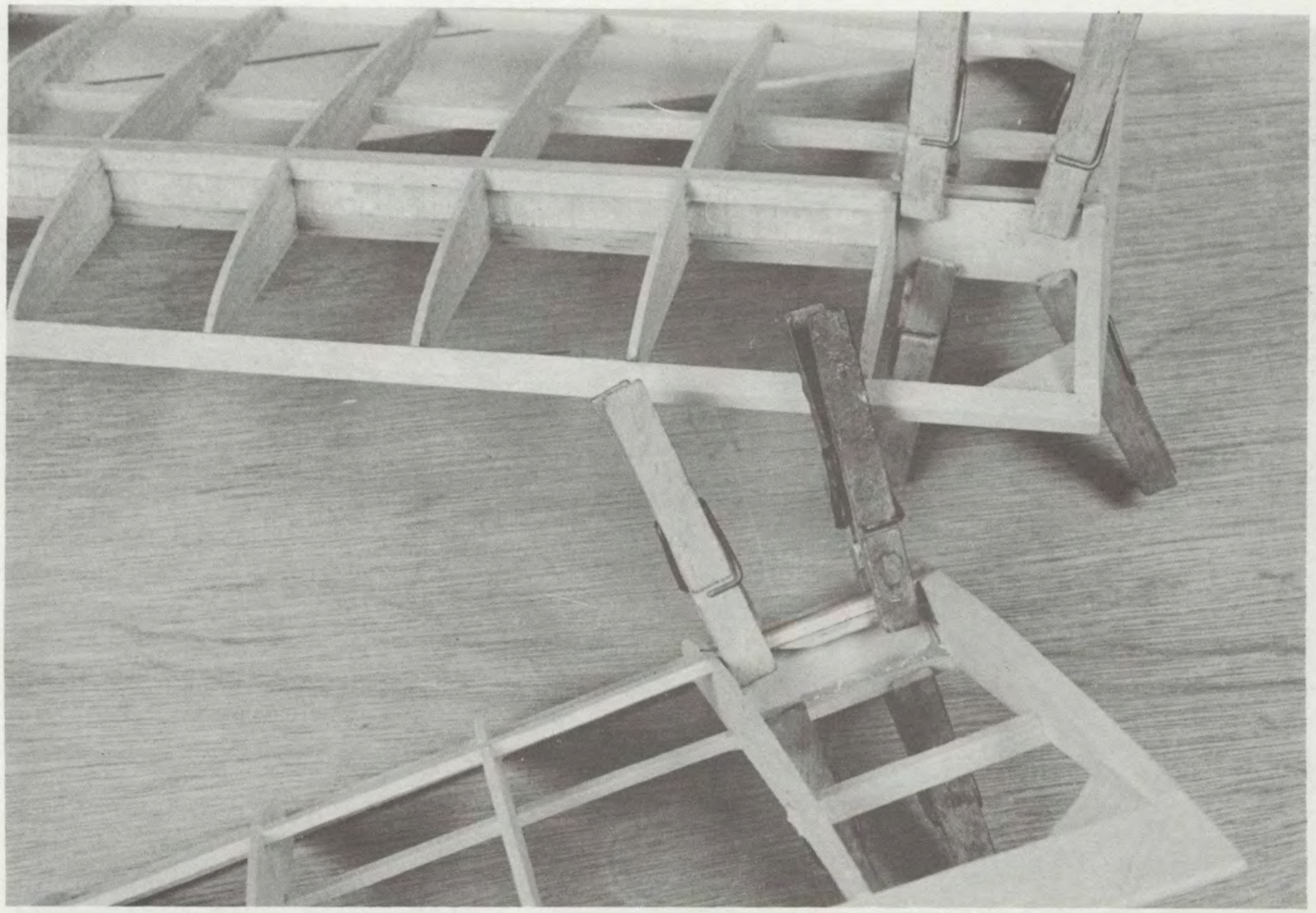
(n) Fit the W11 and W12 webs to the position shown and epoxy in place.




***Joints receive extra fillet of glue.***



*Outer wing panel framed.*


*W11 and W12 installed.*

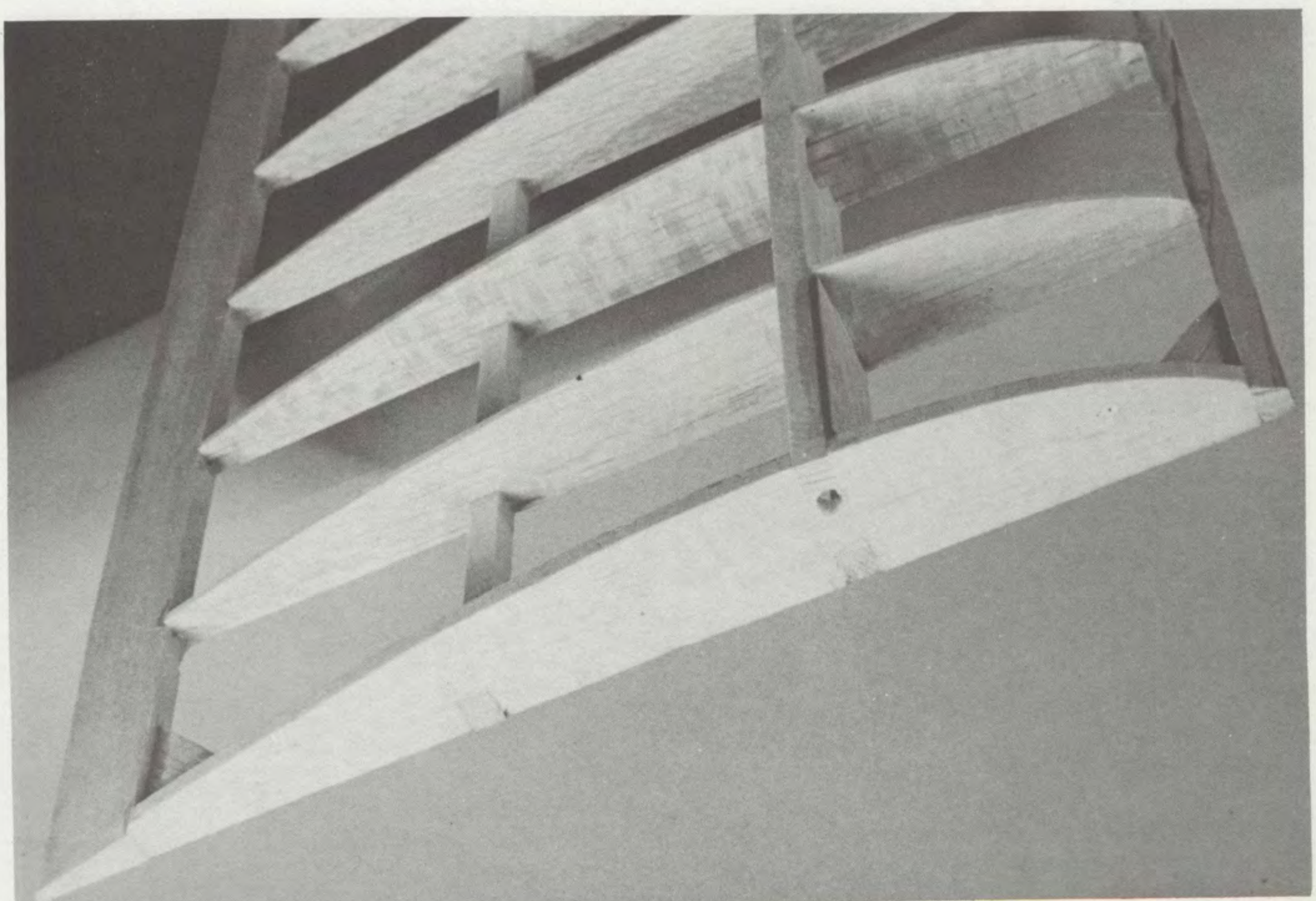
Clean the 3/16'' brass tubing with sandpaper. Holes for the tubing are located in W3, touching the top spar and W11 and W12.

Mark this location on W3 of both the center section, and tip panels. Drill a 3/16'' hole in each. Slip the tubing into the holes and check that it lies flat against the W11 and W12 webs. If it doesn't, open up the hole with a round file or X-Acto knife. It is more important that the tubing be snug against the web than snug in the hole.

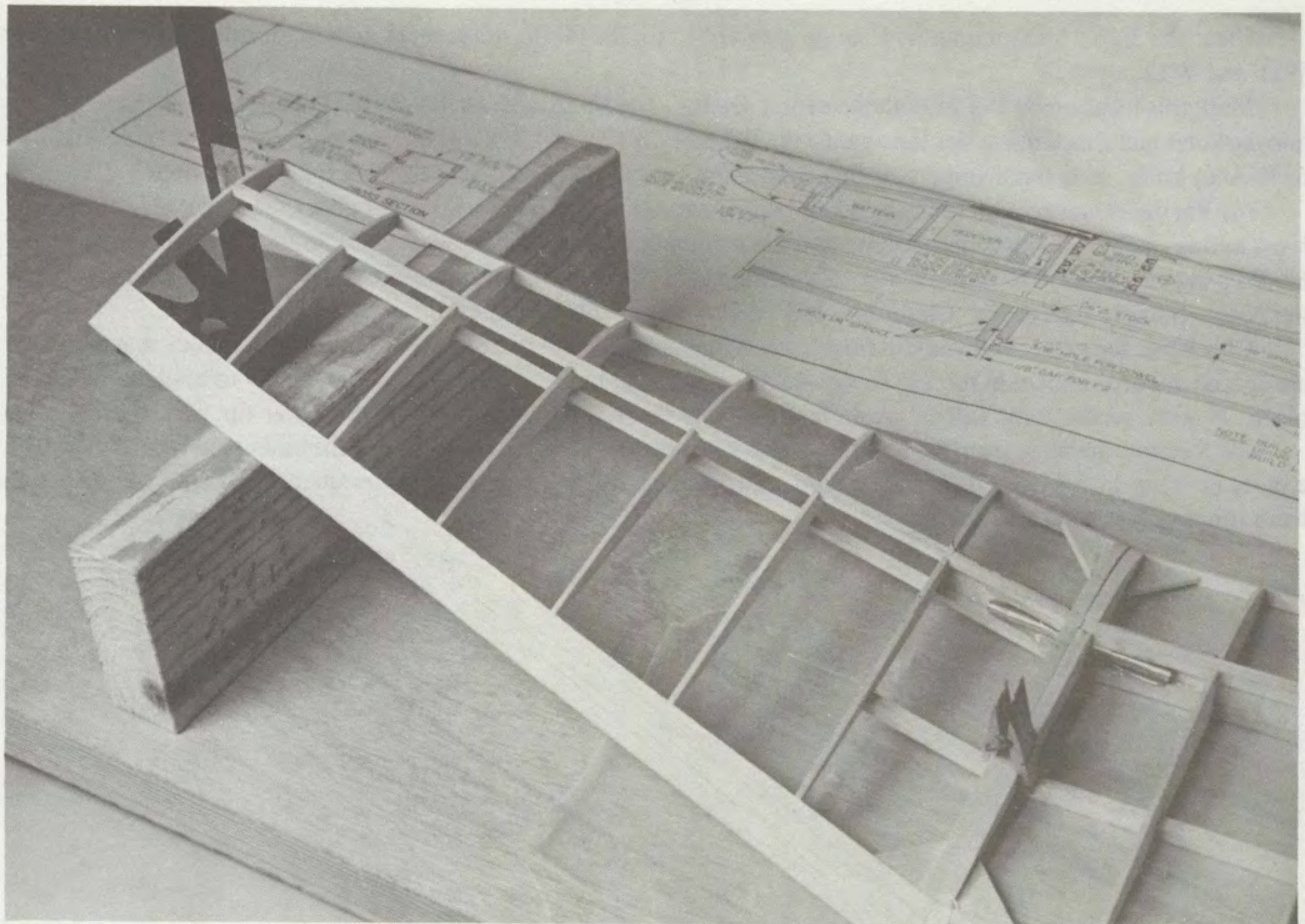
(o) Pin the center section to the building board, with a small piece of waxpaper under the joiner area. Slide the brass tubing in place in the center section and the matching tip panel, flush with W3. Put the tip panel in place and block up the end, until W10 is raised 4⅞'' above the board. Remove the panel, insert a 5/16'' wire joiner, and replace the panel, pinning it in place. Clamp the W3 ribs together with a clothespin.

Check that the brass tubing is still flush with W3, and hasn't slid in a bit. Mix a bit of epoxy; check that the tubes are spaced about as shown in the Tip Joiner Detail, and epoxy in place. Use just enough epoxy to hold the tubing in place. A more secure joint will be made later. Repeat the whole procedure with the other tip.

(p) Remove the wing from the building board when the epoxy is hard and remove the outer panels carefully. Cut a piece of scrap 1/16'' balsa and make a dam across the cavity, to confine the larger quantity of epoxy and keep it from running into the brass tubing.



*Wing joiner hole drilled in W3.*



*Wing joiner installed.*

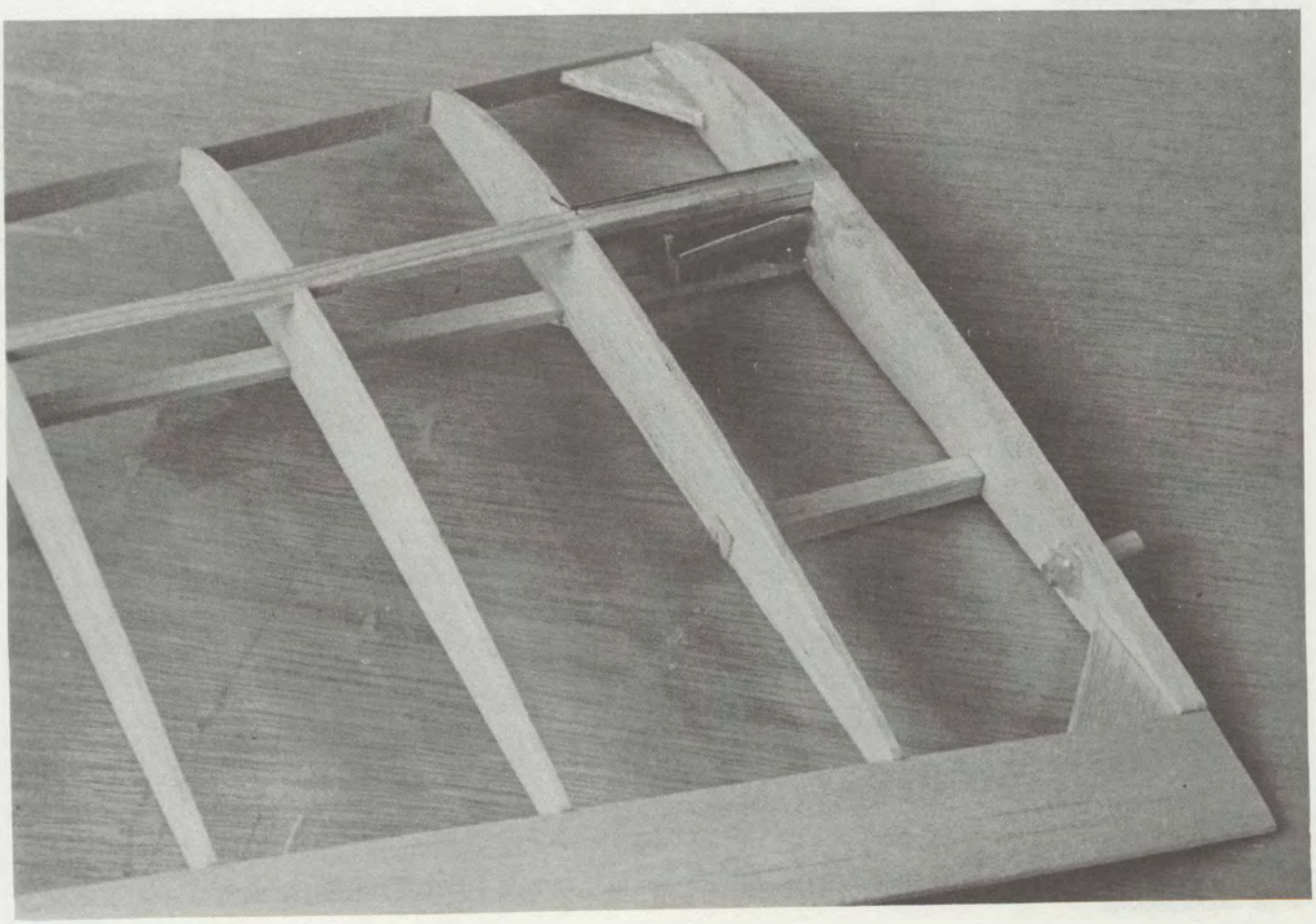
*Wing joiner epoxied in place.*

(q) Insert one 5/16'' wing joiner wire into the tubing and slip the tip panel in place. Carefully align the trailing edges and clamp the W3 ribs together with a clothespin. Mark the position of the 3/16'' dowel alignment pin on one W3. Making sure it is straight and square, push a pin through both ribs at this point. Now, drill a 3/16'' hole in both ribs at the pin mark. Cut two 3/4'' pieces of 3/16'' dowel, rounding the ends slightly. With the tip panel in position, push the dowel through both ribs. Make sure the trailing edges are still aligned. If not, open up the holes in the tip panel until they are. Epoxy the alignment dowel into the outer panel **only,** holding the ribs in position with a clothespin.

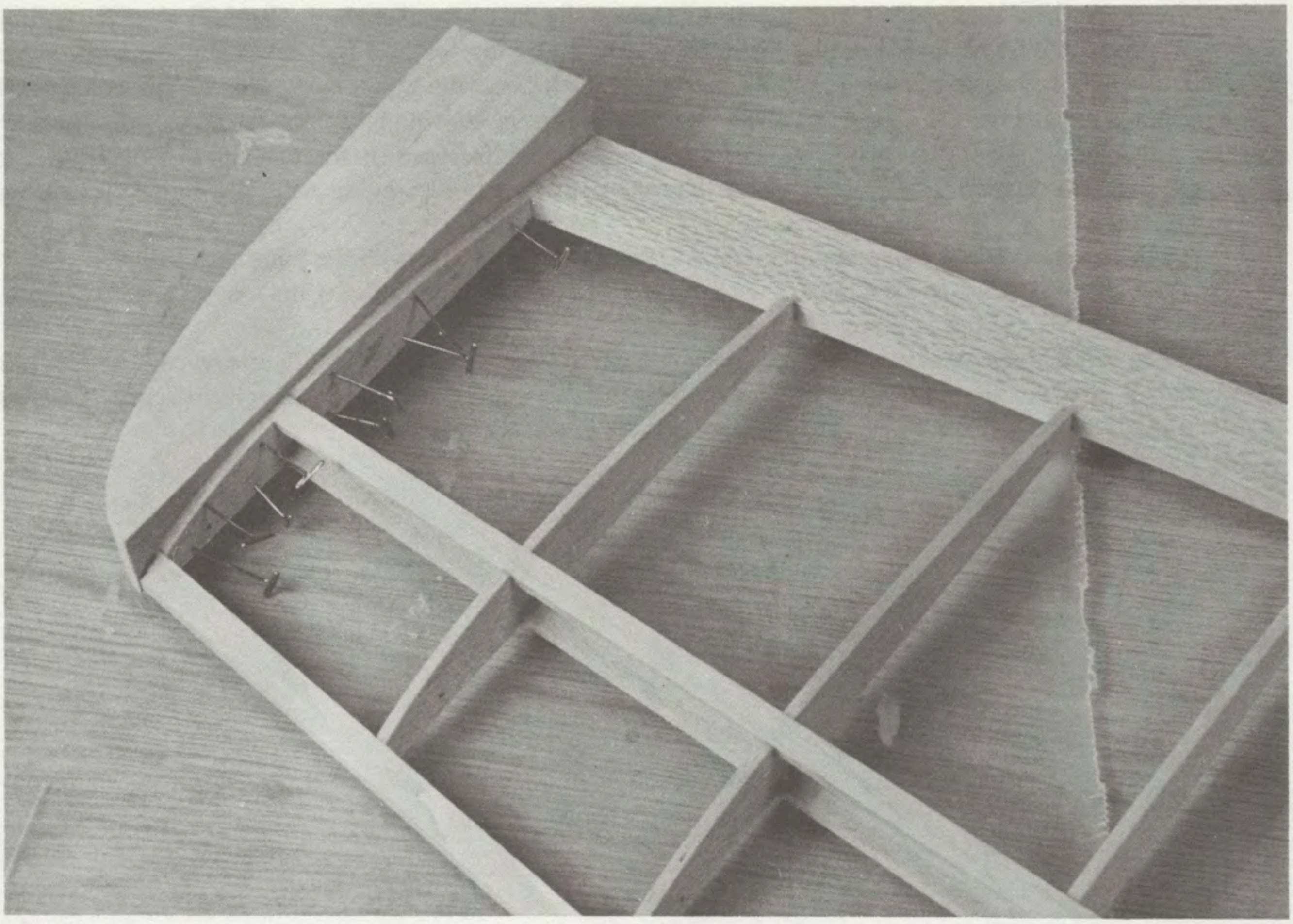
When the epoxy is set, remove the tip panel and repeat the procedure with the other panel.

(r) Trace the top outline of the wing tips onto the 3/4'' x 1'' x 12'' balsa block. Cut both tips roughly to size. Glue the tips to W10 and pin in place.

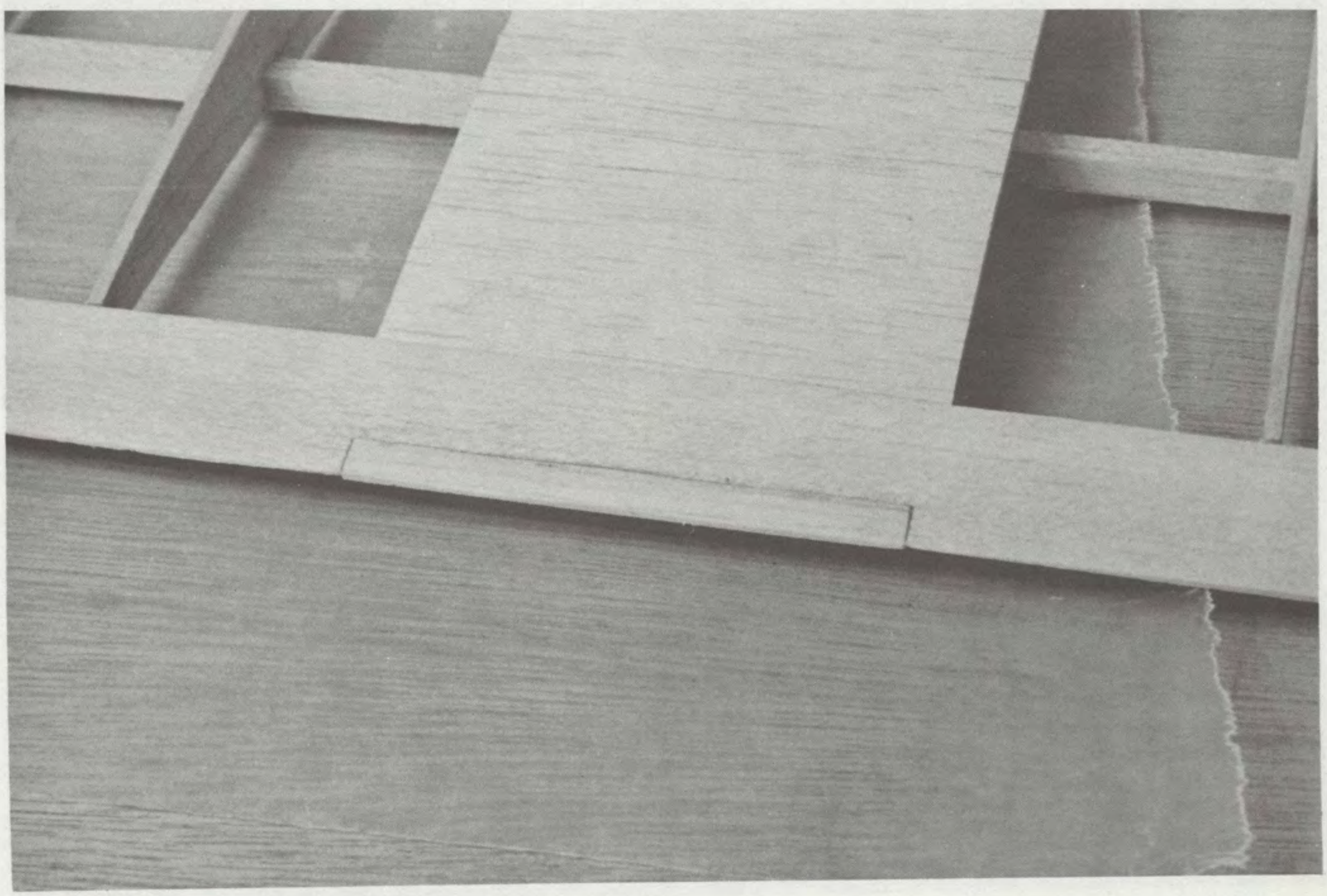
(s) A spruce reinforcement is inlaid into the trailing edge of the wing center section to prevent damage from rubberbands. Cut a 3¼'' piece of 1/8'' x 1/4'' spruce. Notch the trailing edge to receive this piece. Taper and sand it to match the trailing edge. Epoxy in place, wiping off any excess



***Rear wing joiner epoxied in place.***



*Wing tips glued in place.*

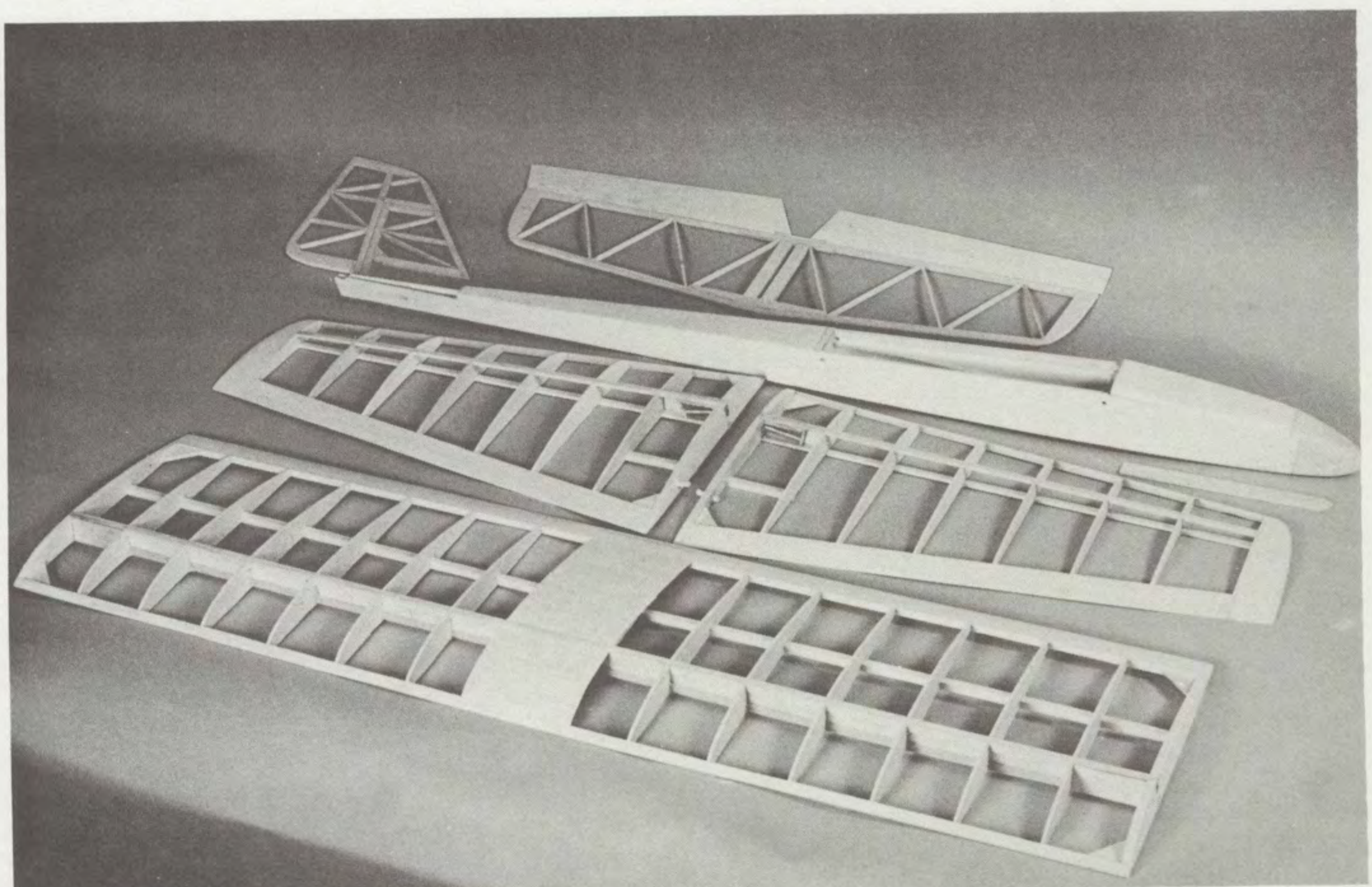


*Inlaid reinforcement.*

(t) Using the X-Acto knife, carefully carve the leading edges to the contour shown on the drawing. Watch the grain when carving. Slightly uneven grain can cause the knife to dig in and take out a bigger chip than desired. It is safer to sand the contour but spruce is fairly hard and it's easy to damage the structure during vigorous sanding. In any event, finish up with the sanding block, so the leading edge contour is smooth and not wavy when viewed from the end. It pays to take time to get a good leading edge as this is an important factor in the aerodynamics of the wing. Now, blend the rib contour in with the leading edge. Do not sand back very far on the rib or the airfoil shape will be changed. Carve the wingtips to the shape shown on the drawing and sand smooth. Carefully sand the trailing edge so the ribs blend smoothly and, again, sand the top of the ribs only as absolutely necessary. Finish with a light sanding with #400 wet or dry sandpaper.

(u) Assemble the wing, using the wire joiners. Balance the wing at its center to check that one wing is not heavier than the other. If so, tape a small weight to the tip rib of the light wing. Trim the weight until the wing balances, and epoxy in place.

We have now completed the structure of the Oly 650. Next, we will install the hardware and radio before covering the framework.



*Completed Oly 650 framework.*

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# CHAPTER V

## INSTALLATION OF HARDWARE AND RADIO IN THE OLYMPIC 650 SAILPLANE

The framework of the Oly 650 has now been completed and we are ready to fit it with the hardware and radio. Outfitting is done before covering, because it is easier to do at this stage and the covering doesn't get banged up.

During this description, specific manufacturers' equipment is called out. This equipment has been used and found quite satisfactory by the author. This does not mean, however, that other brands will not work just as well.

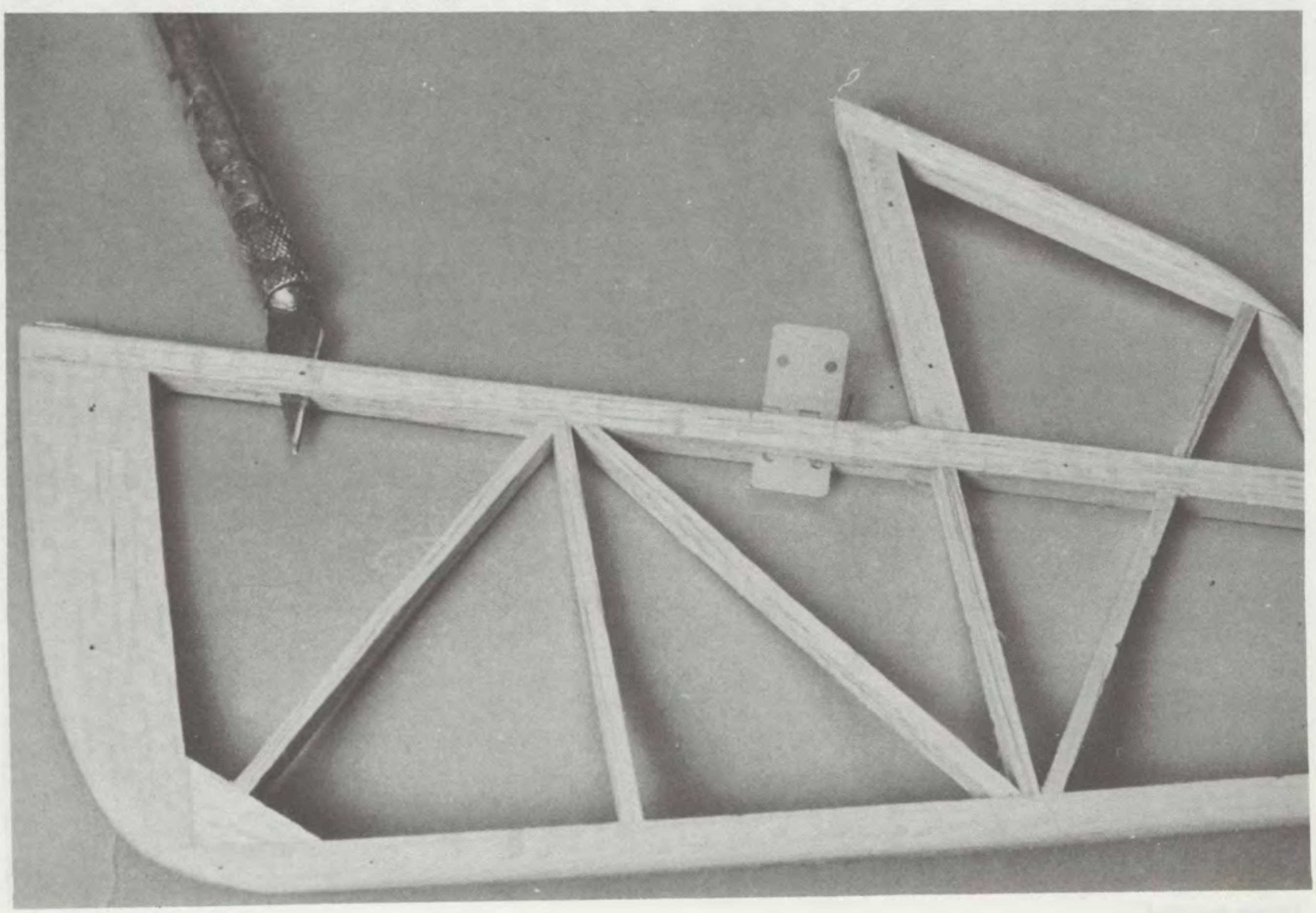
**Section 1 — Hinge Installation**

Any small hinge can be used. Klett RK2-7 nylon hinges work well and are easily installed. A strip of MonoKote or a strip of Scotch Tape can be used for hinge material. This makes a very simple installation, but is less permanent than hinges.

(a) To install Klett hinges, mark the hinge center-to-center locations on the stab and rudder/fin. Knowing the location is important because we will cut the hinge slots before covering. We must be able to find them again after the surfaces are covered, in order to install the hinges.

(b) Carefully cut a slot, the width of the hinge, at the location marked. Use an X-Acto knife.

Be sure the blade is straight so it does not pop out the side somewhere. Force a hinge into each slot to assure that the slot is clean. Now, put hinges in the slots on the trailing edge of the stab. In final installation, the L-shaped hinge pin end is tucked into the slot with the hinge to prevent its loss. Carefully insert the tabs, one at a time, into the elevator slots. Do the same for the rudder hinges. Seat the hinges on both sides, so there is just a bit of a crack between the surfaces.



*Slotting rudder for hinge.*

**Section 2 — Tail Installation**

I strongly recommend the removable tail option. With the tail removed, the Oly 650 will fit in a box that can be carried on an airplane. More important, if a tail member is damaged, repairs are facilitated if removal is easy.

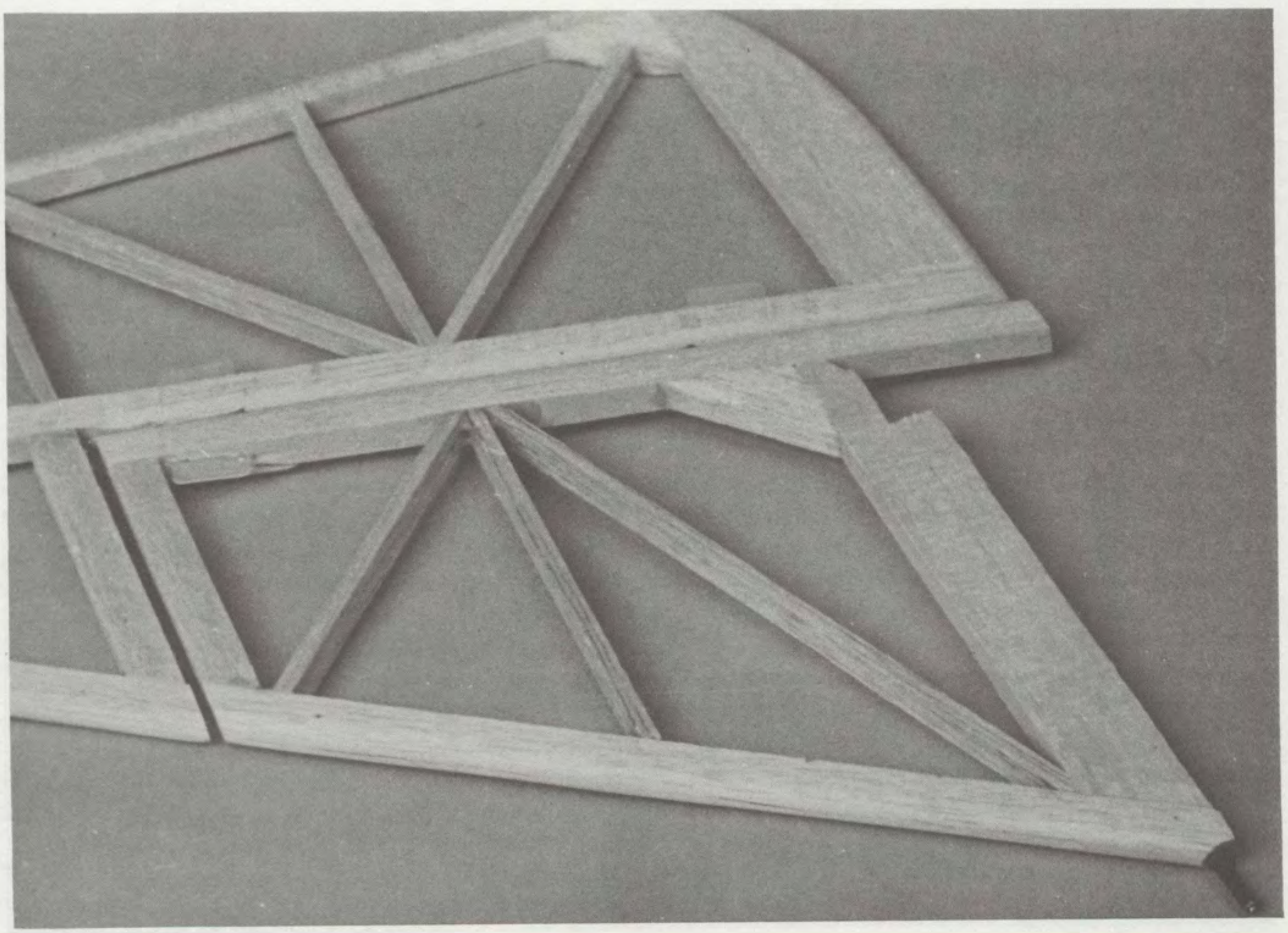
If the tail is to be glued in place, go through the fitting process. Then pin the stab and fin, while the pushrod linkage is fitted. Gluing in place should be done after covering, as it is considerably easier to cover the loose pieces.

(a) Test the stab and fin assembly. When the stab is in place and the fin tailpost snug in the fuselage slot, the elevator connecting dowel should not rub against the tailpost. The front of the stab should just touch the leading edge stop on the fuselage. If there is a gap, glue on another 1/16'' x 1/4'' spruce piece. If the stab does not go far enough forward, sand a bit off the leading edge. The fin root rib may have to be trimmed a bit, or the fin leading edge may have to be sanded a bit, in order for the fin to fit into the slot in the stab.

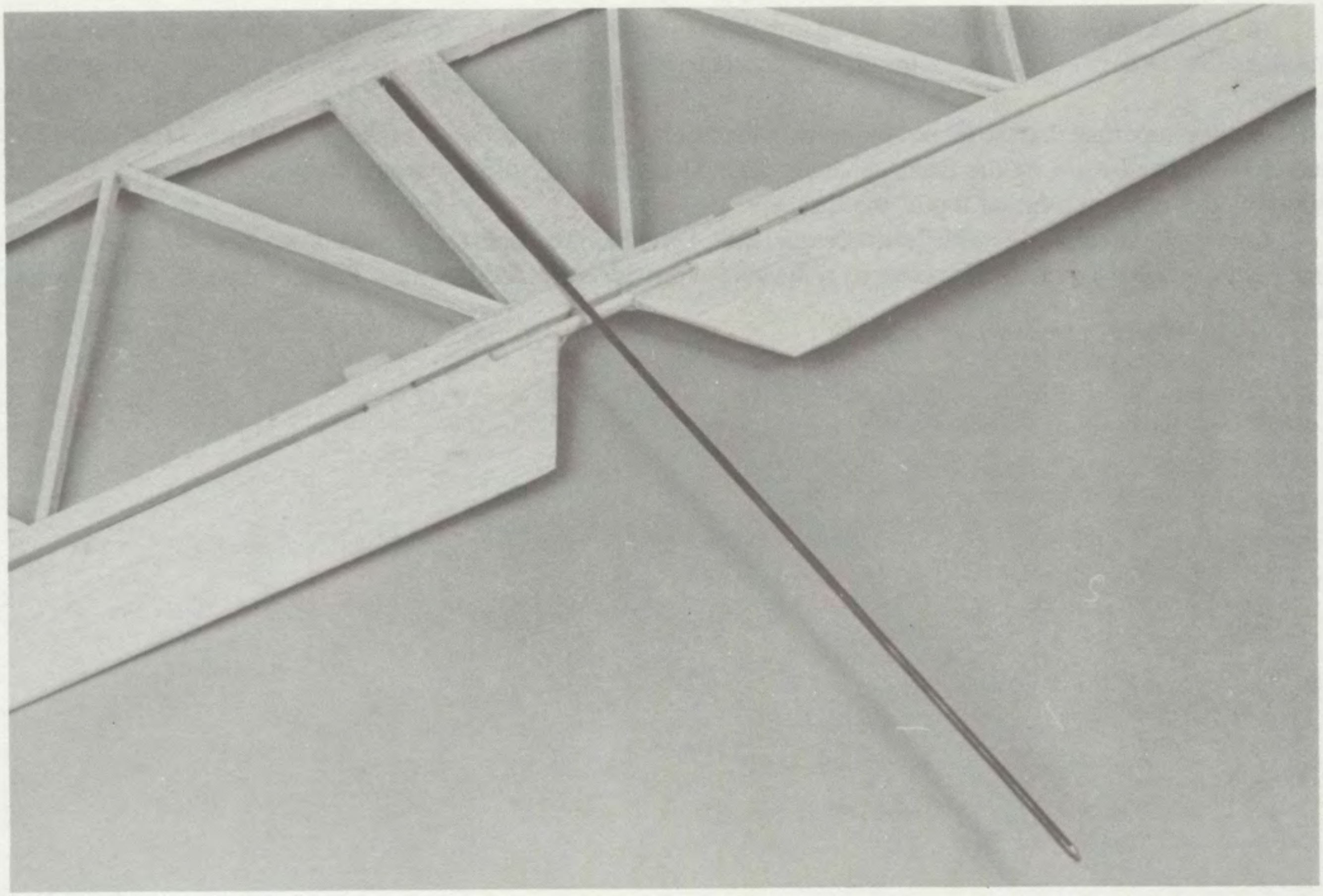
(b) Cut a piece of 1/16'' piano wire 1'' long. Drill a 1/16'' hole into the lower leading edge of the fin, about 3/32'' from the bottom. Use a file to roughen up one end of the 1/16'' wire and epoxy it into the hole in the fin.

Use a sharpened piece of 1/16'' piano wire to drill a matching hole in the stabilizer.

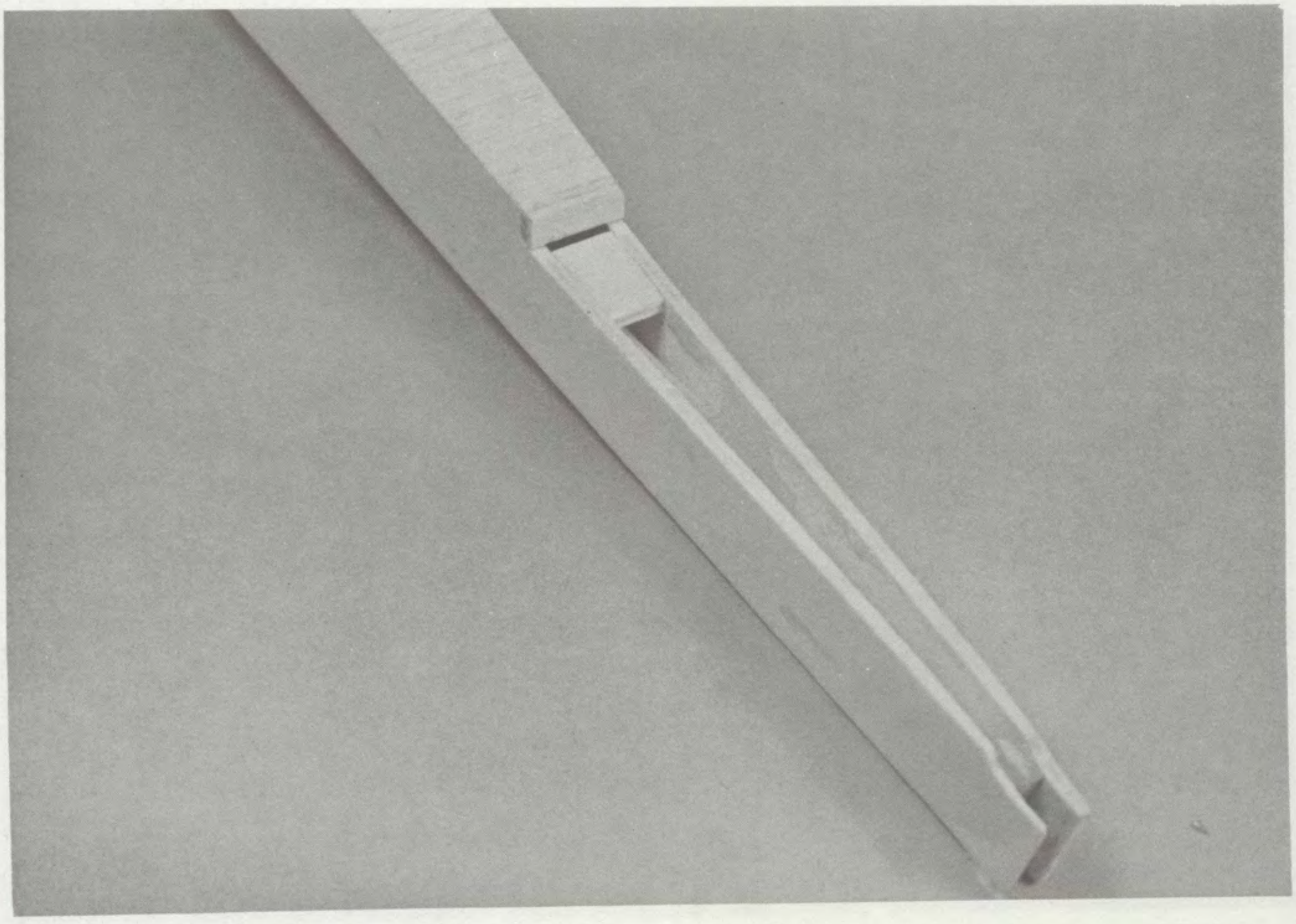
(c) Cut the 1/8'' ply plate to size and epoxy in place.



***Fin pin installed.***



*Drilling fin pin hole in stab.*

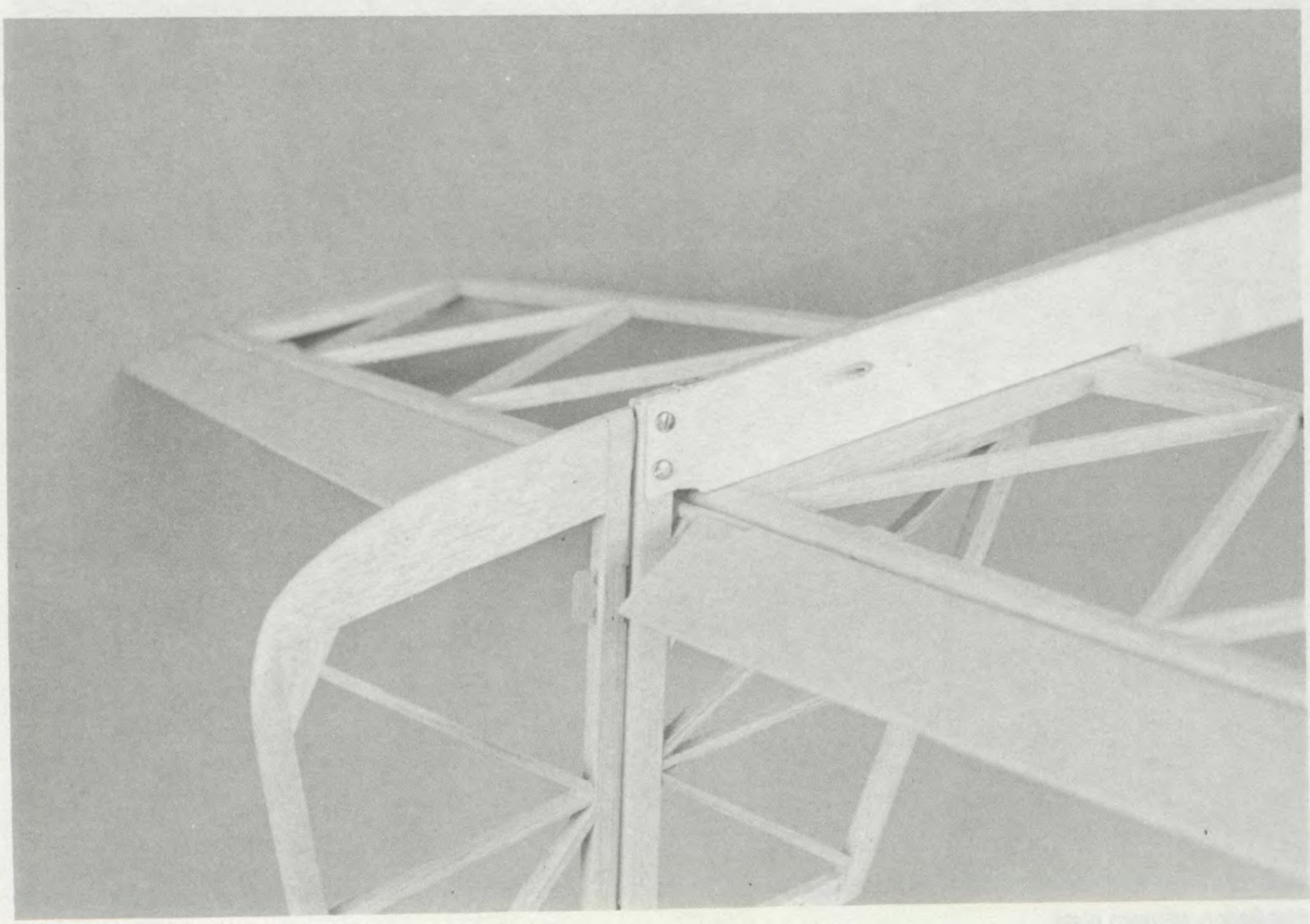


*Stabilizer hold-down plate.*

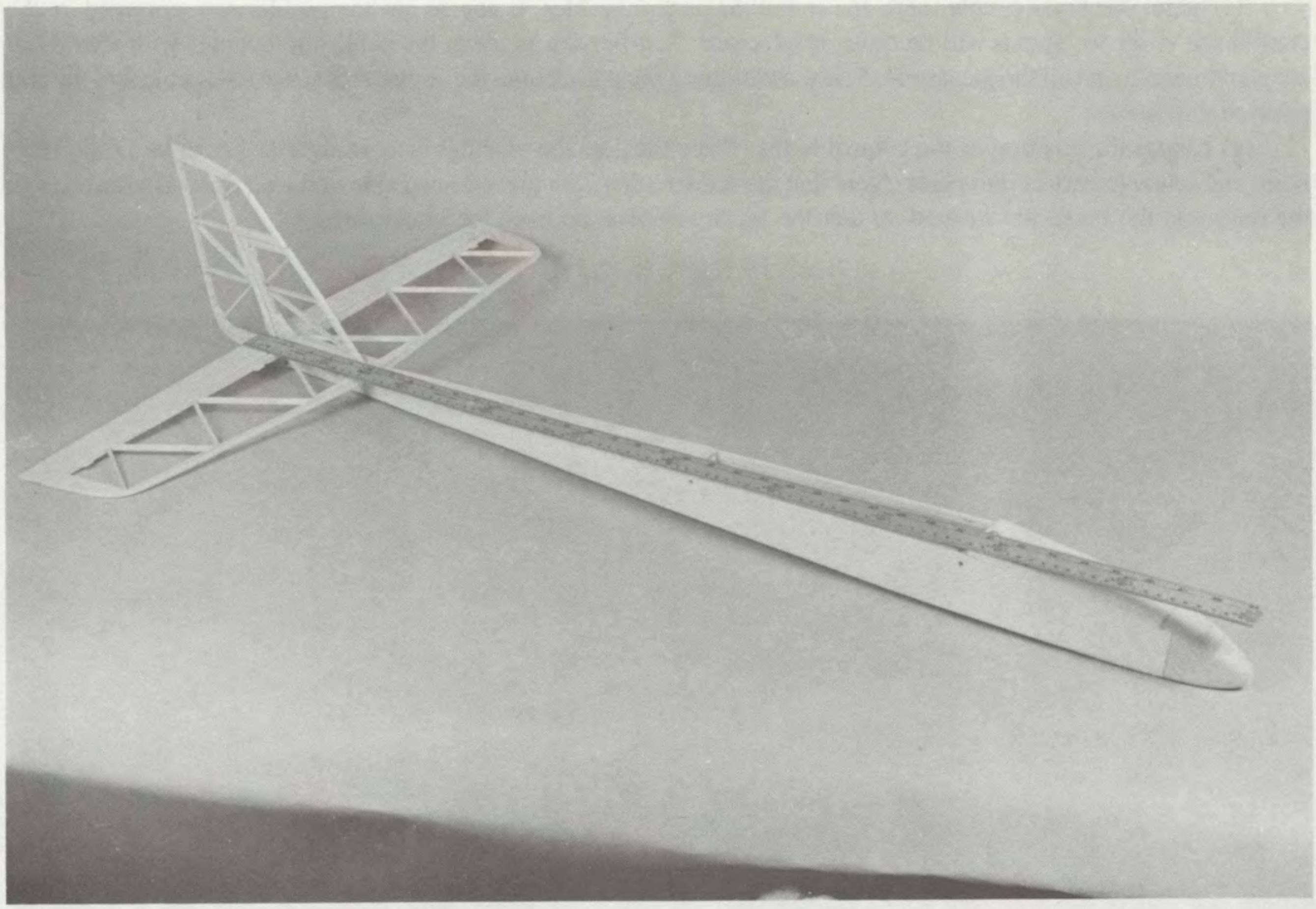
(d) Put the tail assembly in place. Make sure the stab is snug against the fuselage and the tailpost is seated in the fuselage slot. Drill two 3/32'' holes through the fuselage and tailpost as shown on the drawing. Fasten with two 2-56 screws.

(e) It is important that the fin be aligned with the fuselage center line. Measure across the hatch (or bulkhead F3) and make a small mark on the fuselage center line. Measure 3/32'' off-center and make another mark. Lay the straight edge along the fin on top of the fuselage.

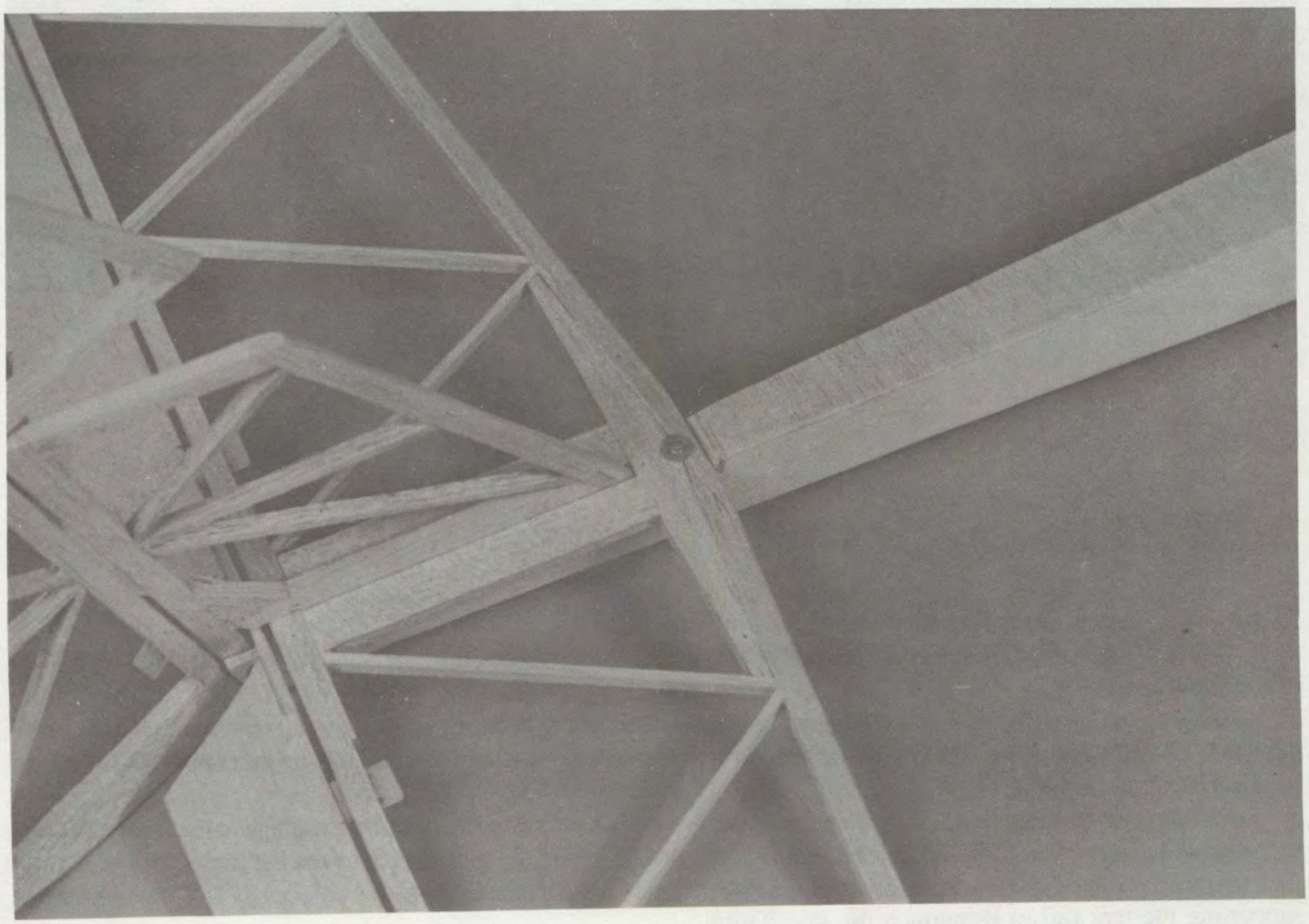
Line up the straight edge with the off-center mark. Drill the 1/16'' hole for the hold-down screw through the stab and ply plate. Epoxy a small #2 washer over the hole to provide a seat for the screw. Fasten with a #2 x 1/2'' wood screw.



*Fin attachment.*



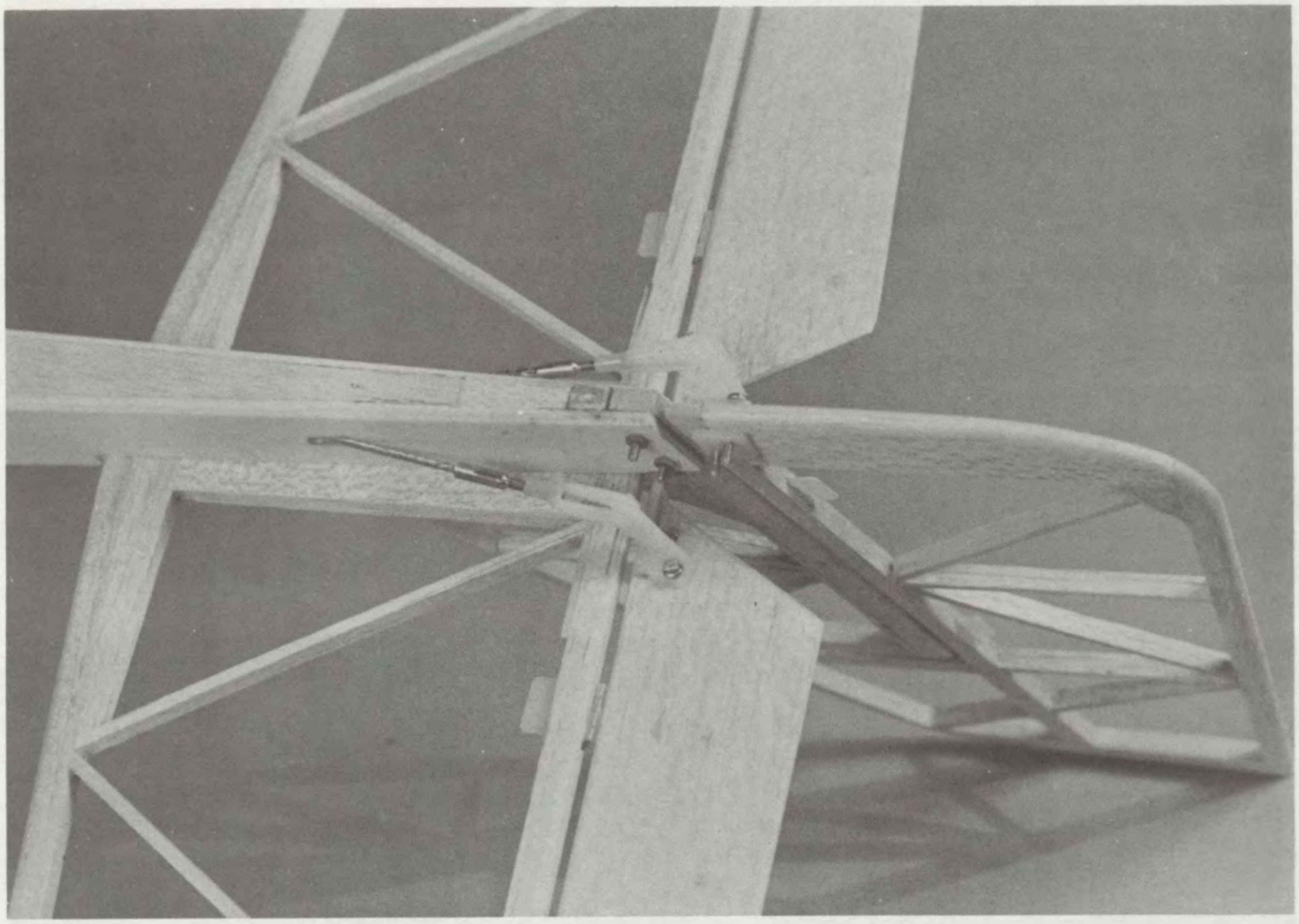
*Fin alignment.*



*Stabilizer hold-down screw.*

(f) Solder one brass coupler onto one end of the pushrod cables. If you do not have soldering equipment, or the confidence to do so, epoxy will be quite satisfactory. Just be sure to clean the cable and coupler with alcohol or lacquer thinner to get all the grease off. Screw a Goldberg Snap Link onto the coupler and insert the cable into the rear pushrod exit holes.

(g) Locate the position of the control horns. Place them so the pushrod is as straight as possible. Drill 1/16'' holes and screw the horns into place. Note that the rudder horn is on the left hand side of the aircraft (as viewed from the rear) and the horns are located so that the pushrod holes are over the hinge line.



*Control horn installation.*

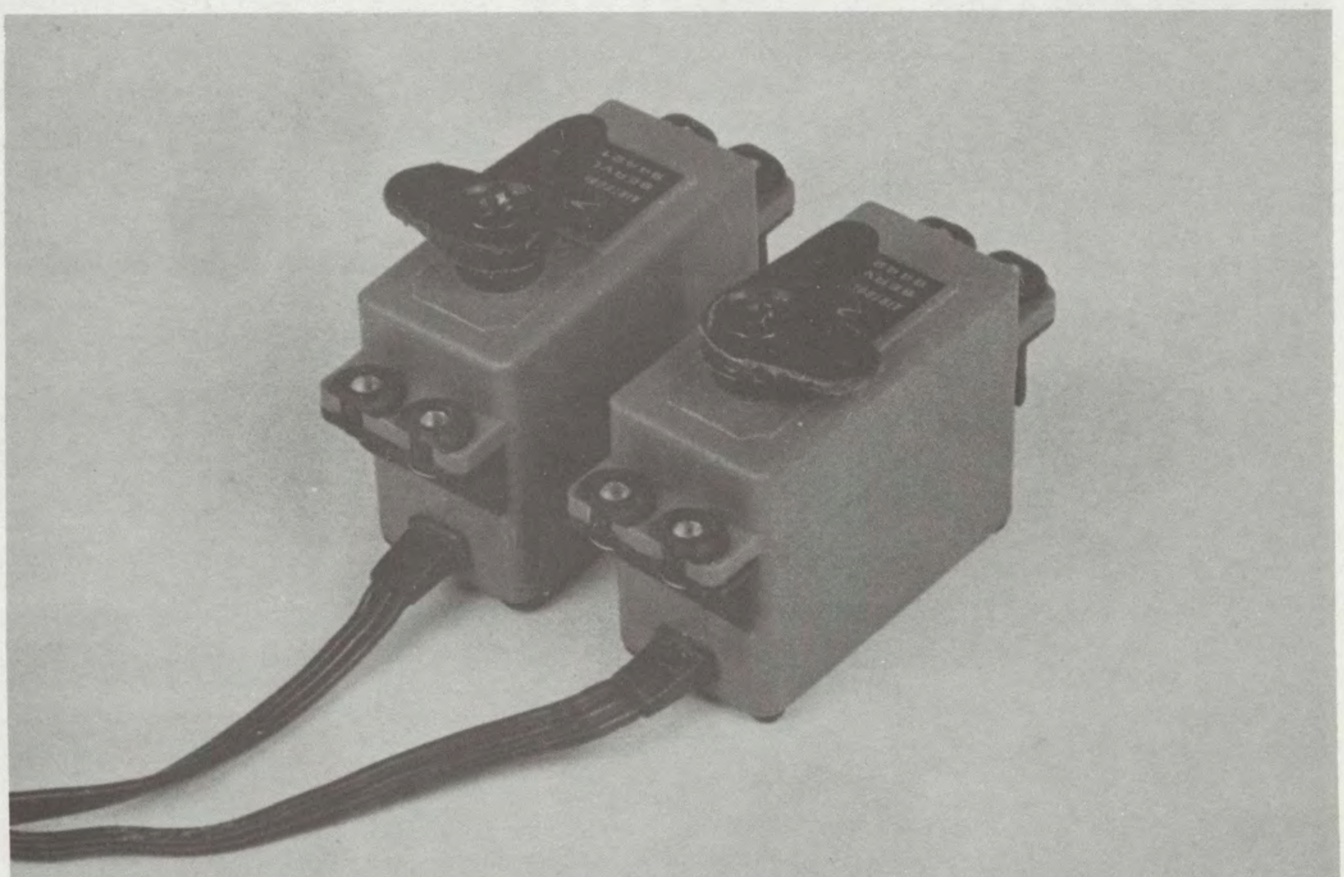
**Section 3 — Servo Mounting Airtronics XL Series Radio**

Although these instructions relate specifically to the Airtronics radio, they are applicable to most any type, with minor variations.

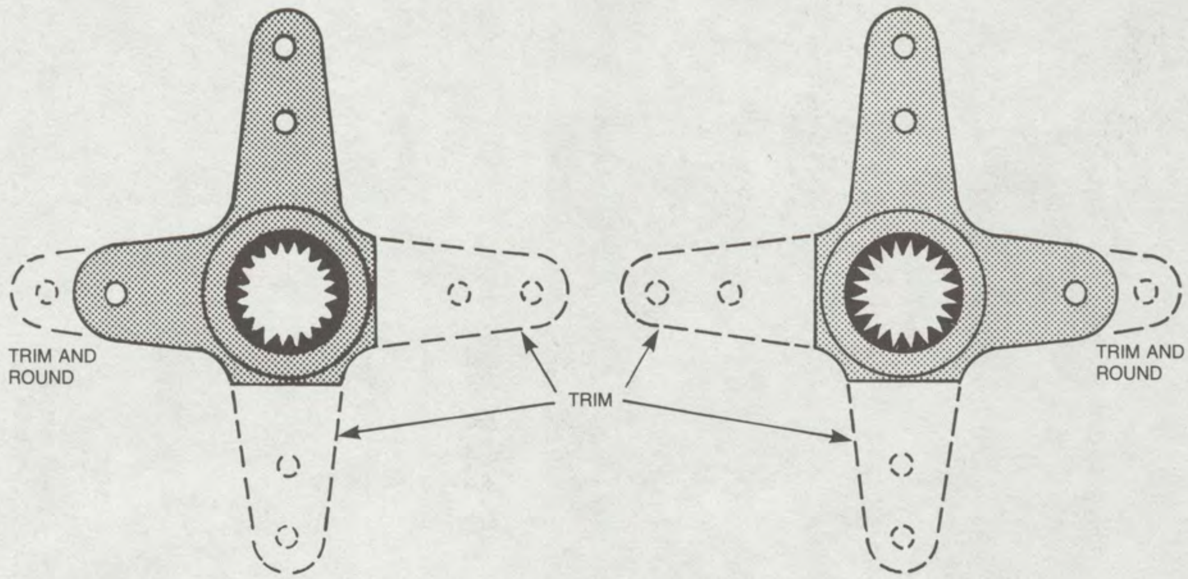
(a) Since the servo arms are a bit long for convenient mounting in the Oly 650, we will trim the four post servo arms to fit. Saw two adjacent arms off at the hub. Trim one right and one left arm, leaving the inner hole only. Be sure to make a right and left.

(b) Trim two pieces of 1/4'' square spruce for servo rails, to exactly fit across the fuselage at the front and back of the servo location. The forward rail fits against bulkhead F3, and the separation between the two is 1-9/16''. Both are mounted with the top 1'' above the fuselage floor. Epoxy both in place, with short pieces of 1/4'' square spruce supporting the rear rail to strengthen the installation.

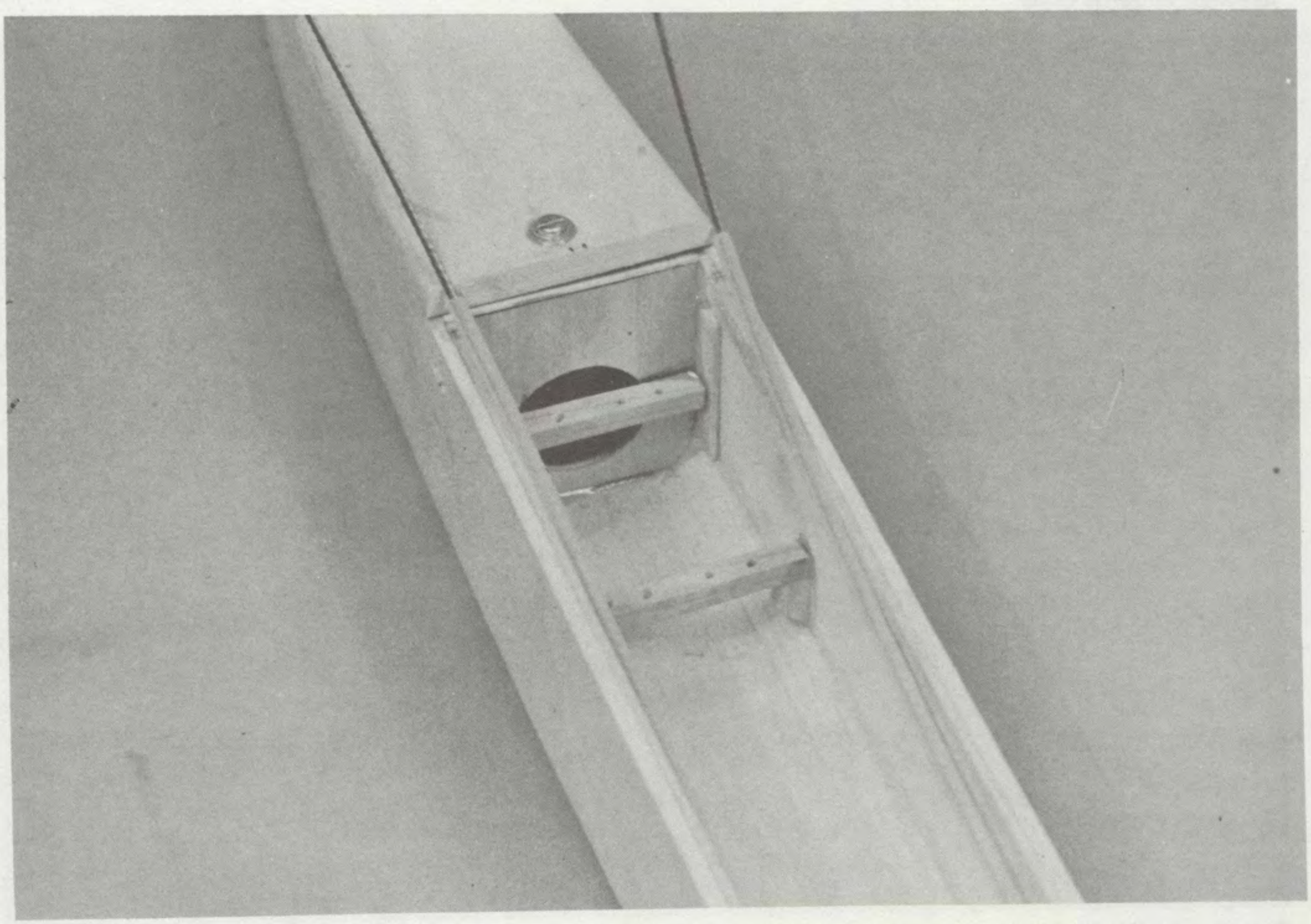

*Airtronics XL Series radio.*



*Servo arm modifications.*




**SERVO ARM TRIMMING PATTERN**

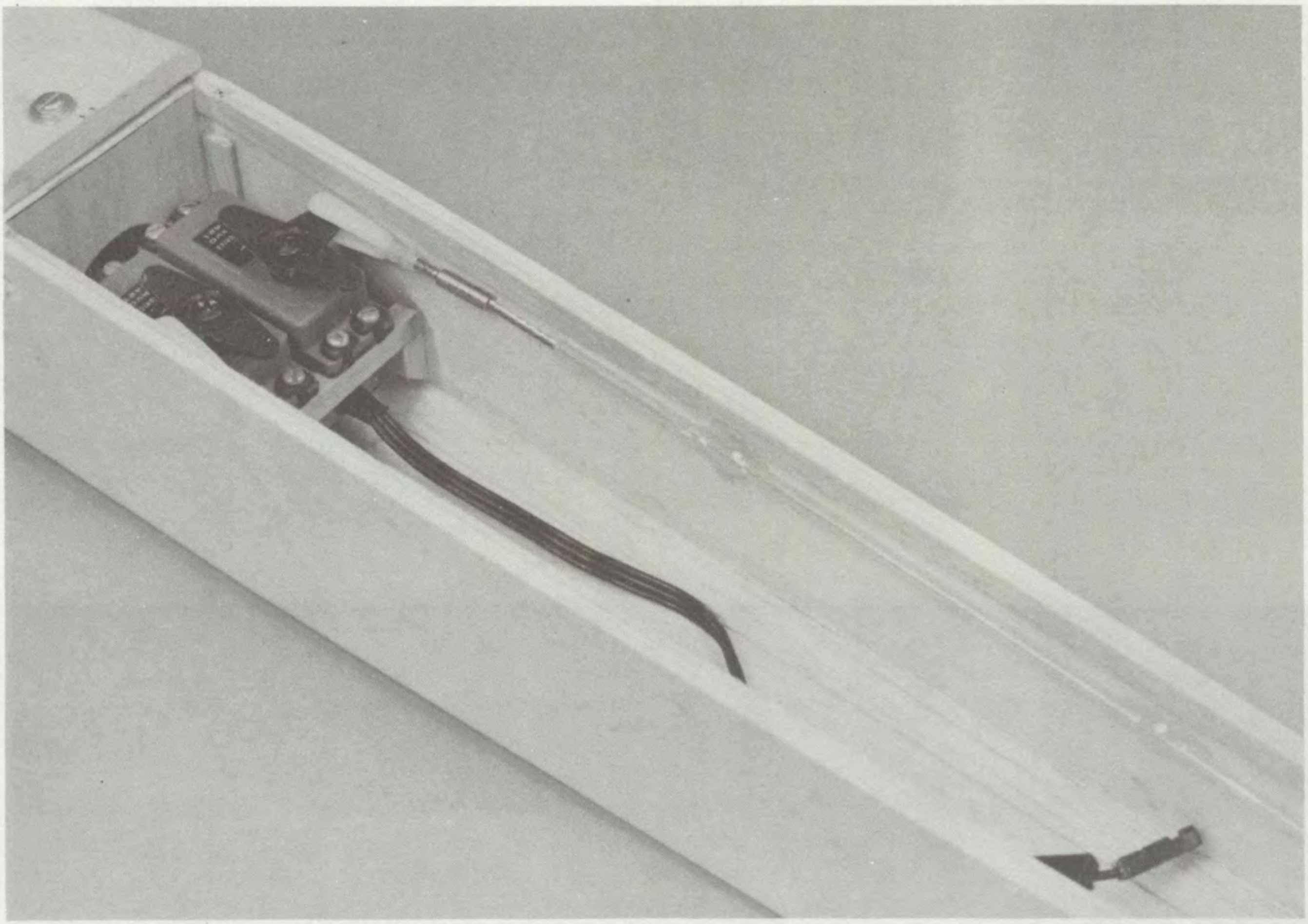


*Servo rail installation.*

(c) Place the servos on the rails and mark the location of the eight mounting screw holes. Carefully drill the holes with a 1/16'' drill. Screw the servos in place.

The Airtronics radio has servo reversing capability at the transmitter, so it doesn't matter which servo goes where. With radios not having this capability, care must be taken that servo rotation is proper for a given transmitter command.

(d) Install a Goldberg Snap Link on each pushrod coupler, and snap it on the servo arm.



*Servo mounting and Snap Link installation.*

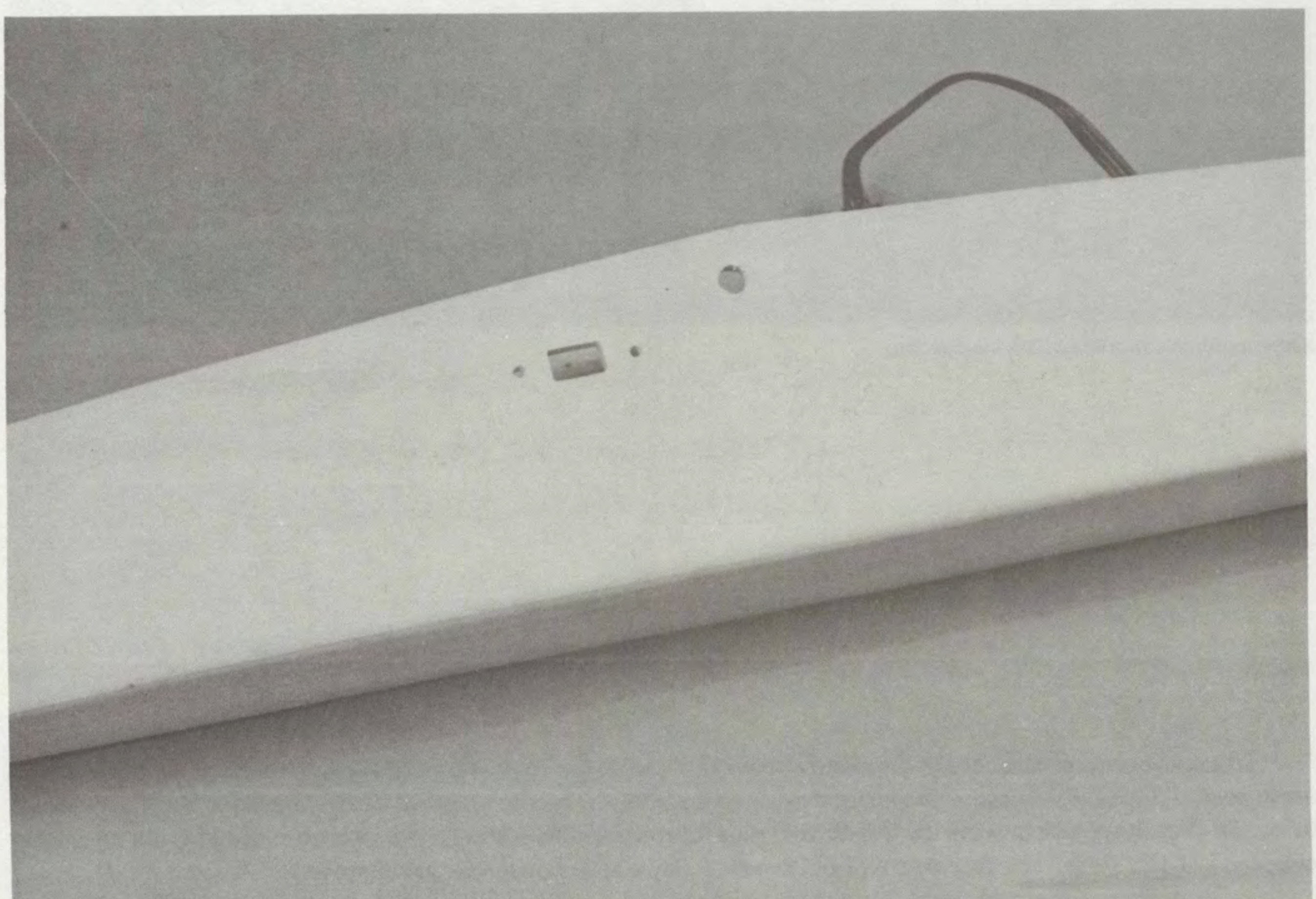
Trim the outer plastic sleeve of the pushrod back to 2'' from the control arm. Make sure both rudder and elevator are in neutral. Carefully measure the pushrod cable so it will be the proper length to fit the connector. Cut the pushrod to length. (See the note following the Bill of Materials for recomended cutting tools for wire cable.) Do not install the connector at this time. The fuselage will be easier to cover if the pushrods are removed.

(e) With the pushrod and connector properly aligned to the servo arm, epoxy the pushrod sleeve to the fuselage side about 1'' from the front end, and again halfway back to bulkhead F4.

## Section 4 — Switch Mounting

The switch is mounted in the receiver compartment. It can either be on the right or left hand side of the airplane. If it will be natural for you to launch the airplane with the right hand, the switch should go on the left side. That way, you can easily make a last minute check to see if the receiver is turned on.

(a) Remove the escutcheon plate from the switch and hold it on the fuselage side as high and as far back as it will go without the switch interfering with the 1/16'' x 1/4'' strips on the inside. The switch may be mounted either horizontal or vertical, whichever pleases. Mark the rectangle and the mounting holes. Drill a 3/16'' hole in the rectangle and 1/16'' mounting holes. Enlarge the 3/16'' hole to the rectangle size with an X-Acto knife, or small file.



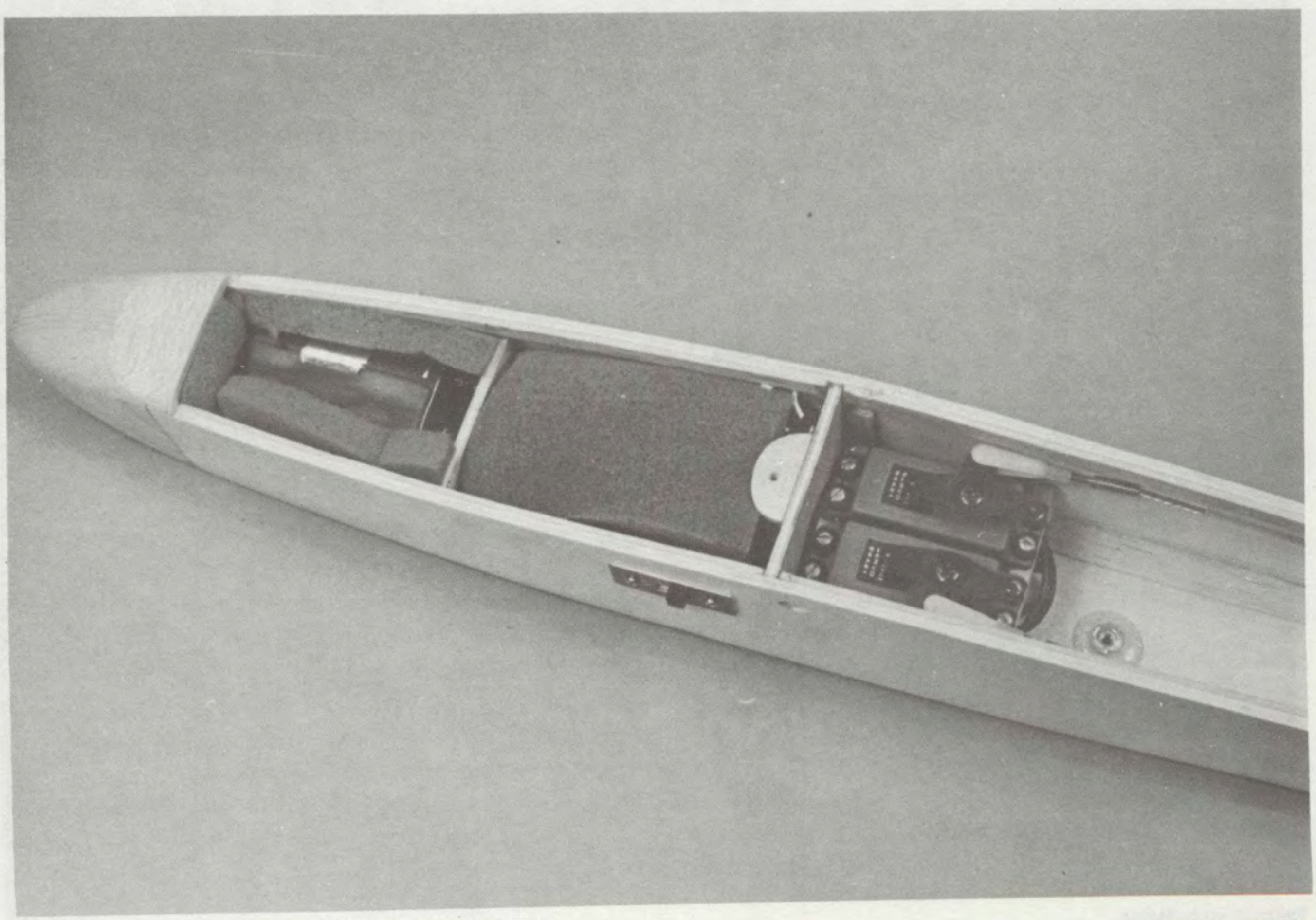
*Switch mounting holes.*

**Section 5 — Receiver Mounting**

(a) Drill a 1/16'' hole near the top of the receiver compartment to exit the antenna. Both the receiver and battery pack should be wrapped in foam rubber as a protection against damage from hard landings. 3/8'' thick foam rubber is ideal as it makes a neat installation.

**Section 6 — Tow Hook Installation**

(a) Drill a 5/32'' hole in the fuselage bottom, at the location shown on the drawing. Put epoxy around the hole and tap the tow hook blind nut in place on the inside of the fuselage bottom. Cover the edges with epoxy, making sure not to get any in the screw hole. Screw the tow hook in a couple of times in case any epoxy is in the threads. Leave the tow hook out until the fuselage is covered.



***Receiver mounting and tow hook blind nut installation.***

## Section 7 — Tailskid Installation

(a) Drill two 1/8'' holes at the fuselage location shown on the drawing. Do not install the tailskid until the fuselage is covered.

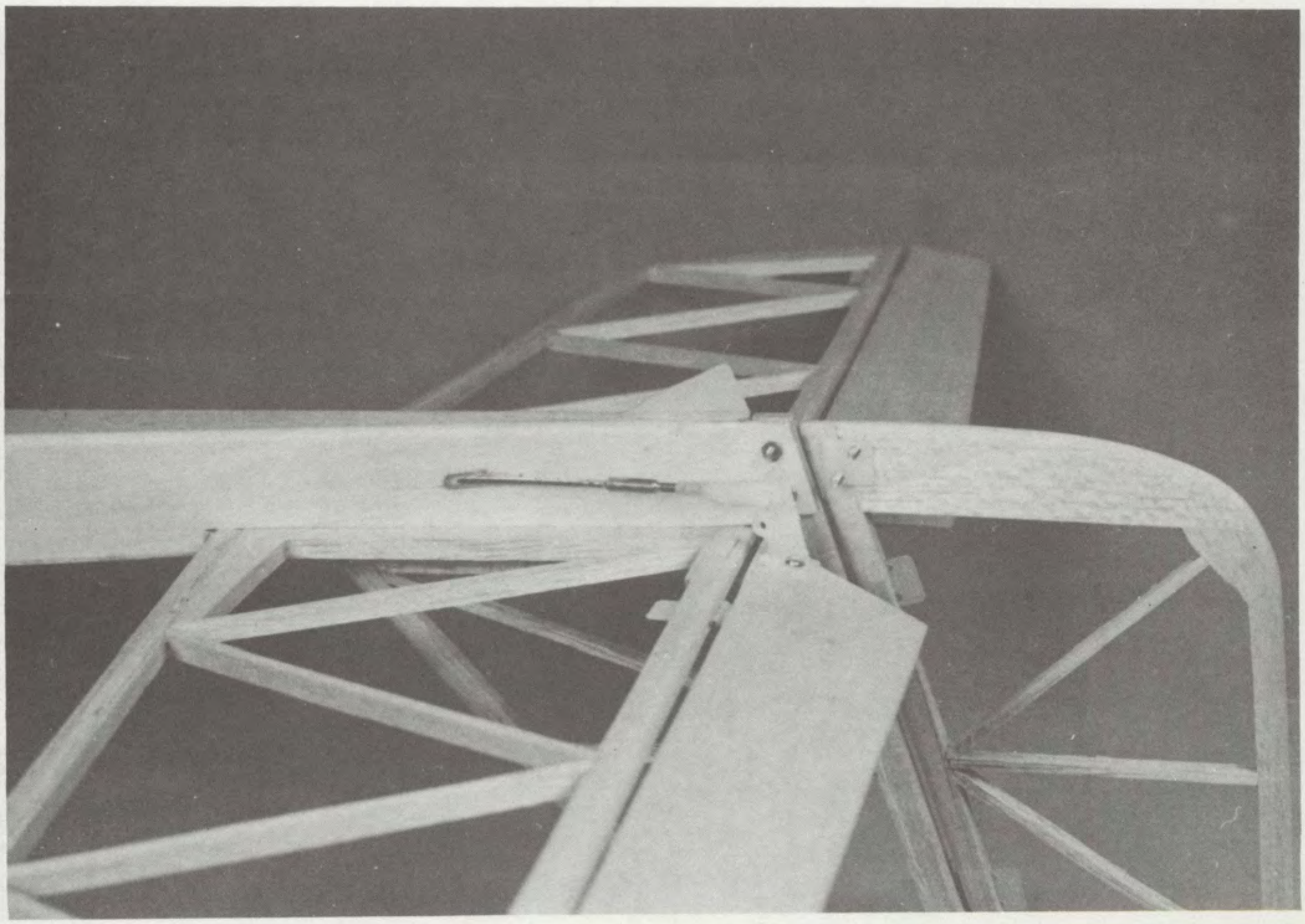
## Section 8 — Control Surface Check

Plug the servos and switch into the receiver and the battery pack into the switch harness. Turn on the radio and check to see that the rudder and elevator travel in the proper direction. Stand in back of the fuselage. Move the rudder lever on the transmitter to the left. The rear of the rudder should move to the left. Similarly right stick movement should give right rudder. Move the elevator lever up (toward the top of the transmitter), the rear of the elevator should move down. Move the elevator stick down and the rear of the elevator should move up.

If movement was incorrect, servo direction must be changed with the reversing switch in the transmitter (if it has them — check the instructions), or the pushrod clevis moved to the other side of the servo wheel (or servo arm).

## Section 9 — Disassembly

Now, completely disassemble the Oly 650, including removal of the hinges, preparatory to covering.



*Tailskid installation.*

# CHAPTER VI

## COVERING THE OLY 650

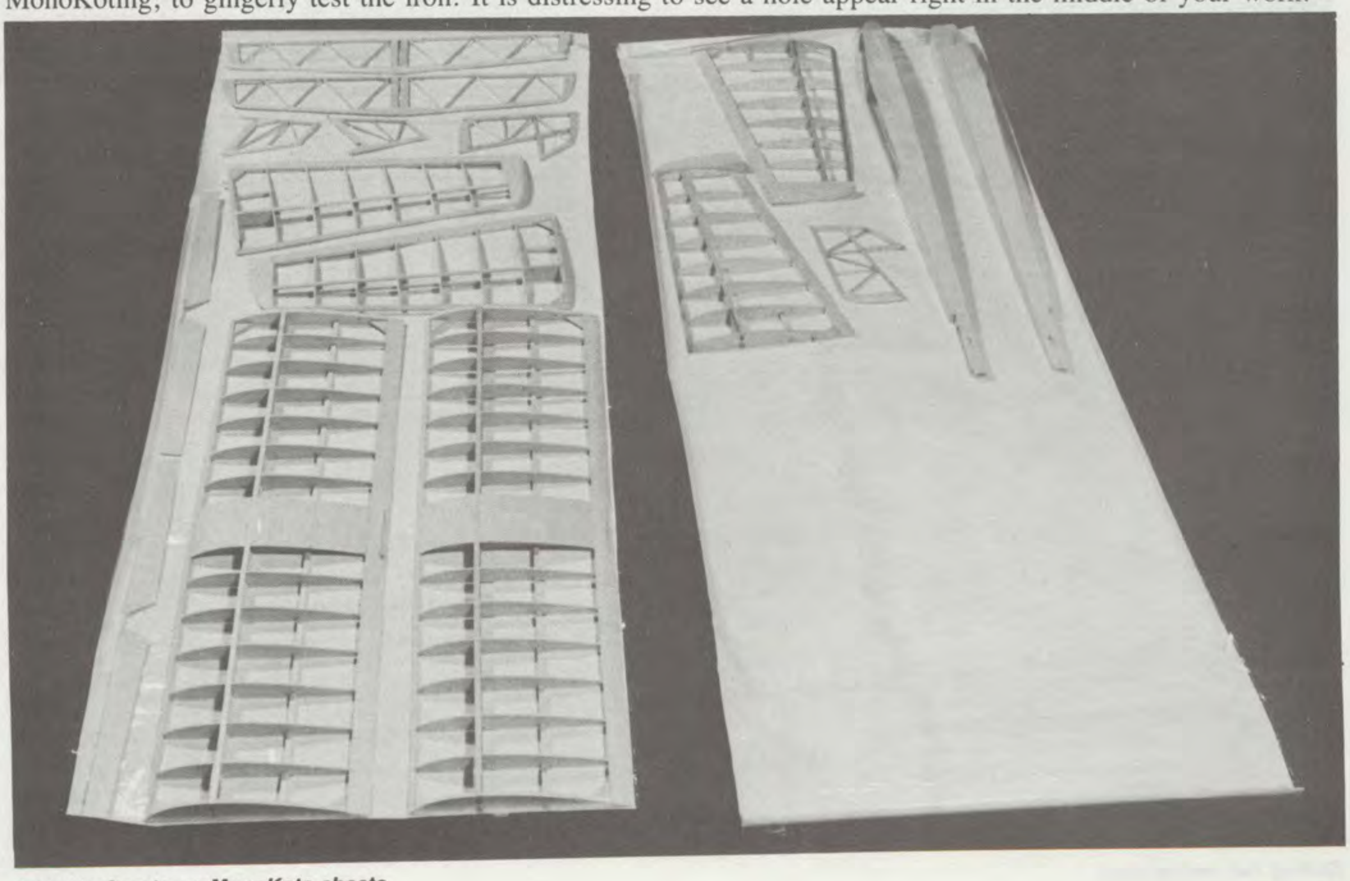
The advent of self-adhesive, heat shrink, plastic films has brought professional looking finishes within the grasp of the average modeler. They are quick and easy to apply, and the beauty is they require no further finishing.

Although there are several heat-shrink coverings available, including some fabric based types, one stands head and shoulders above the rest for sailplanes. Top Flite Super MonoKote is nearly universally accepted as the superior glider covering material. Unfortunately, it is also expensive. MonoKote is strong and resilient. Lower priced coverings have a lower melting point; are thinner and have a lower tensile strength. Fabric based coverings, while extremely tough, seem to lack resiliency; the ability to give and spring back. Fabric materials are nearly puncture and tear proof. In fact, upon impact, the covering remains intact and the relatively light glider internal structure shatters; you wind up with a bag of balsa splinters. If this sounds like the author is a vassal of Top Flite — not so. All the MonoKote you see in the photos was bought at my friendly hobby shop. There are other applications where the other coverings are superior but, for gliders, I like Super MonoKote, full stop.

Before starting, carefully read the instruction sheet that comes with the MonoKote. A regular iron will do a very good job in the application of MonoKote. Downstream, when you really get into glider construction full bore, you may want to invest in a sealing iron and hot air blower. For now, however, it is an unwarranted expense. The ideal iron is a travel iron. These are light and easy to handle. Lacking one a large steam iron will work just fine.

**Section 1 — Setting The Iron Temperature Control**

We must first find the correct temperature to set the control on the iron. It must be set high enough to do a good job, but below the melting point of the material. On my travel iron this setting is between "Wool" and "Cotton." Set your iron control in this area and let the temperature stabilize. Trim about a 1/2" test piece from the end of one of the MonoKote rolls. Remove the backing material and iron it onto a piece of scrap sheet balsa. At proper heat it should iron smoothly onto the wood, and peel off with little difficulty. If it does not really iron down flat and stick well, the iron is too cool. If it curls up, or actually melts, it is too hot. If the material does melt, clean it off the iron right away by rubbing the iron on a soft cloth. When things look right, mark the temperature setting with a piece of tape, or carefully note its position so it can be repeated in the future. It is advisable, when starting a session of MonoKoting, to gingerly test the iron. It is distressing to see a hole appear right in the middle of your work.



*Layout of parts on MonoKote sheets.*

**Section 2 — Covering**

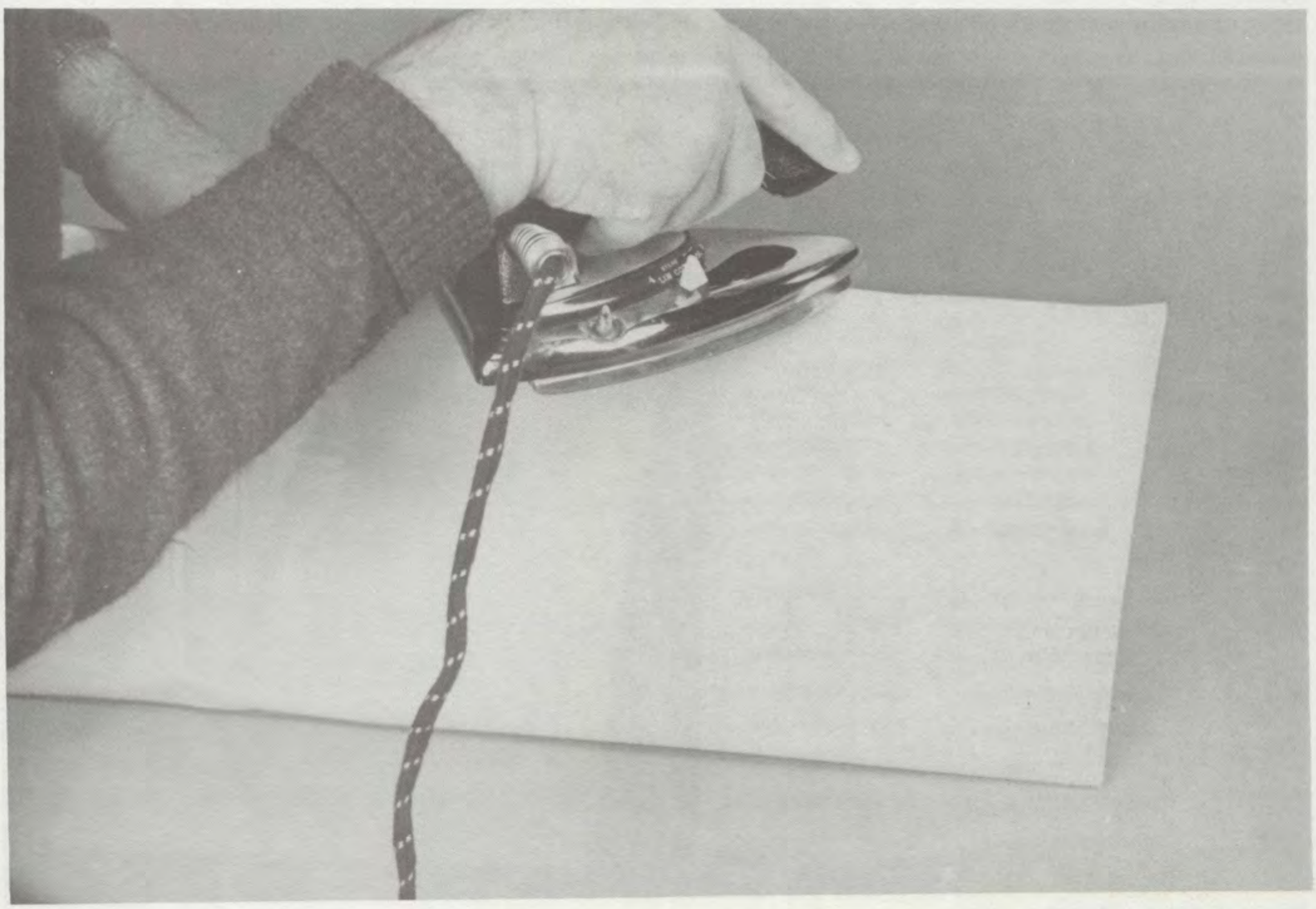
(a) The preceding photo shows the parts (the two sets of parts represent the covering of both sides) laid out on the two sheets of MonoKote. You will note there is material to spare. If this is your first covering job it might be well to spread out a bit and leave a bigger margin around the parts than the photo shows. By the way, MonoKote has a transparent backing. This is left on until you are ready to stick it down. Do all marking on this side. Start with the wing center section. Note the way it is oriented on the MonoKote sheet as shown in the photo. Incidentally, MonoKote does not have anything like grain. You can cut the piece out in any direction and it will shrink the same. Lay the wing on the backing side of the MonoKote leaving about 1/2'' all round. Mark the cutting line with a felt pen. Do the same for the top of the wing, noting that the top takes a wider piece due to its curvature. Cut to size using the straightedge and X-Acto knife, or use scissors.

(b) Remove the backing from the bottom piece. Turn the wing center section on edge, leading edge up. Position the covering with the 1/2'' margins and using the hot iron, tack the far end of the MonoKote to the leading edge.

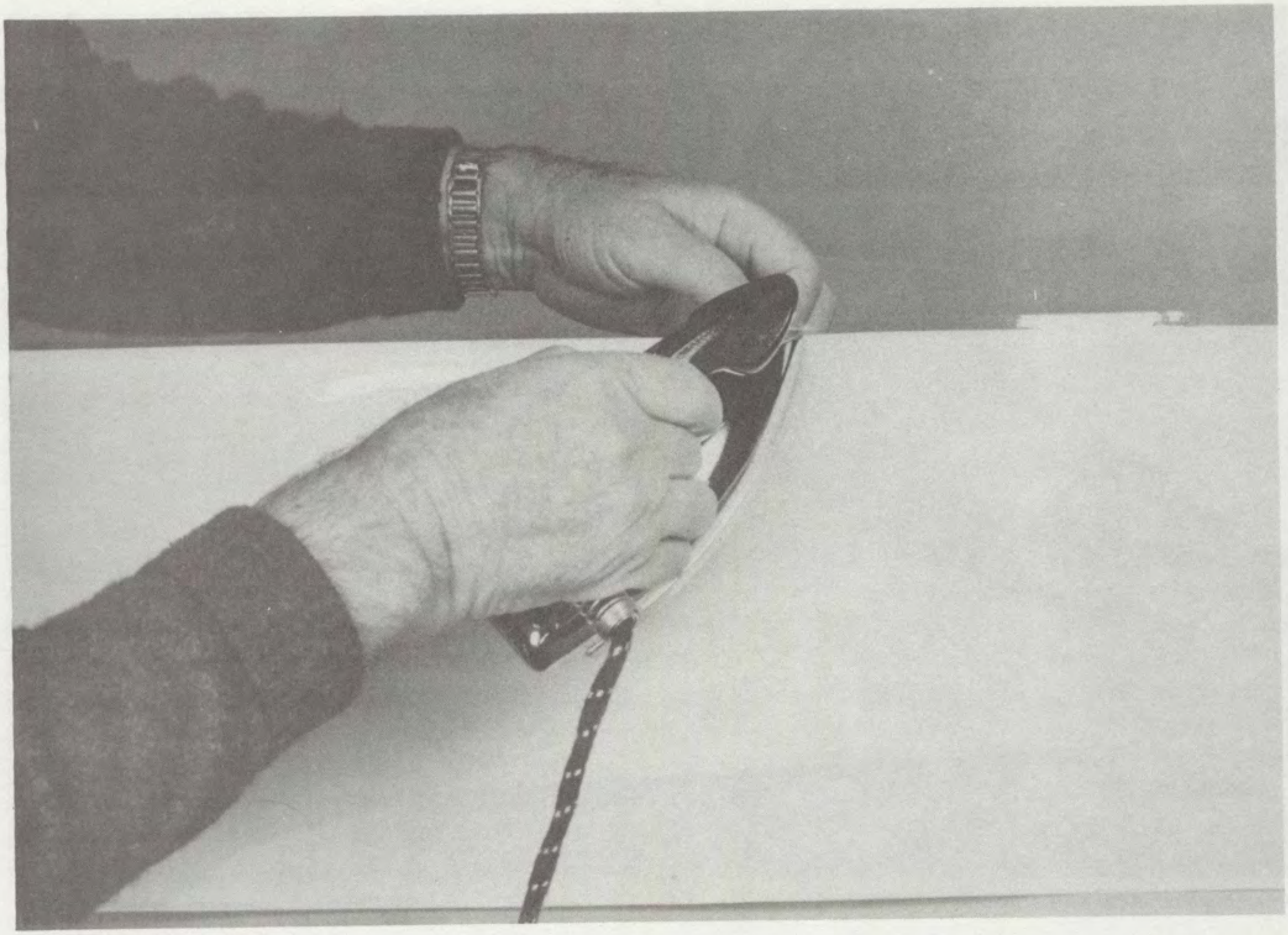
Now, pull the MonoKote tight along the leading edge and run the iron along, sealing it to the entire length of the leading edge. Lay the wing flat, bottom side up. Pull the sheet tight across the center and tack it to the center of the trailing edge. Working outward on one side, while pulling the sheet taut as you go, seal it to the trailing edge.

Repeat the last step for the other side. The MonoKote sheet does not have to be very tight; do not be overly concerned for wrinkles. These will disappear when shrunk. The less wrinkles, however, the easier the job of shrinking. Now, seal the covering to the end ribs. Slowly run the iron all around to make sure all edges are stuck down.

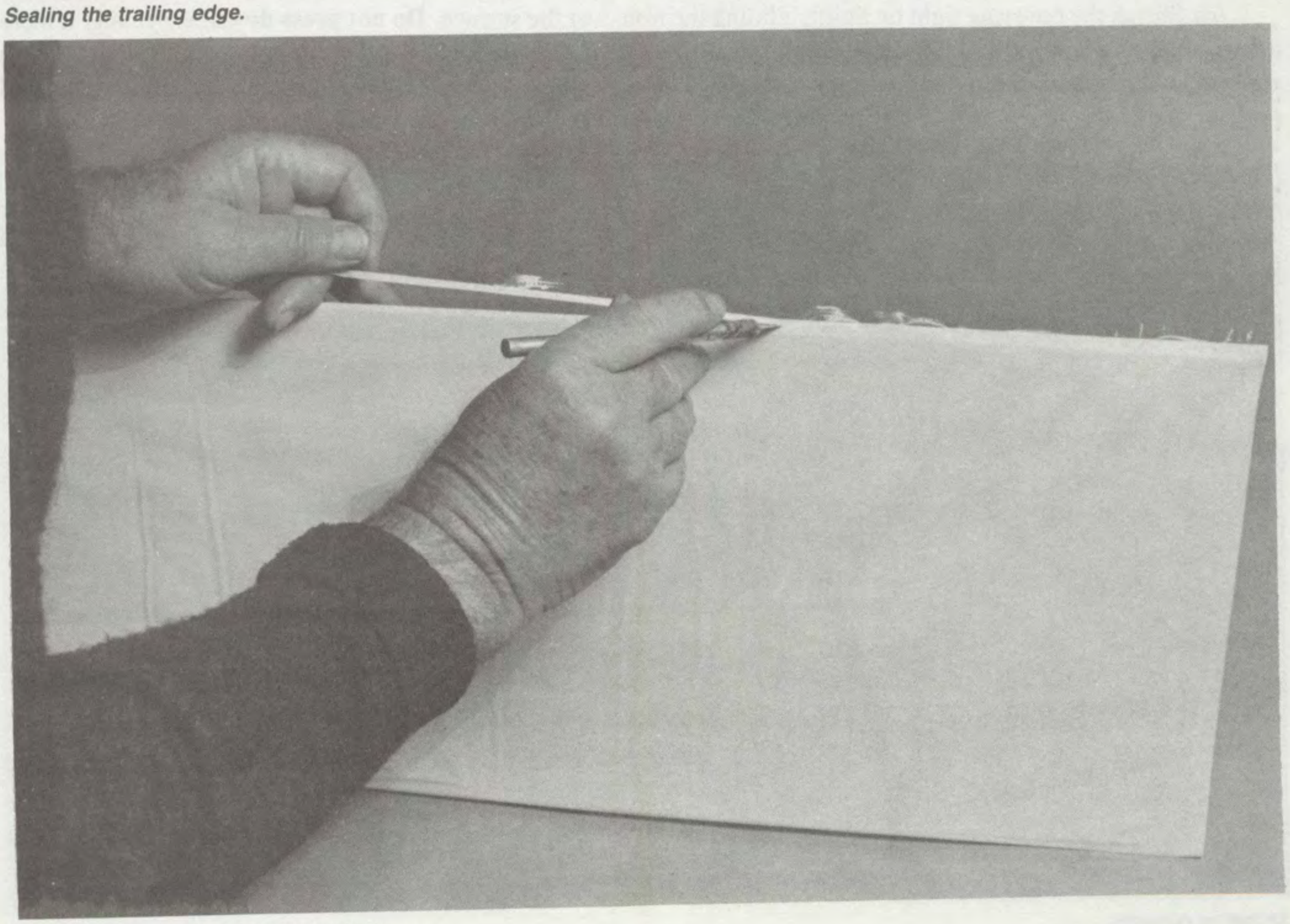
(c) Trim off the excess MonoKote all around. Use either the X-Acto knife, or scissors. If you have a sharp pair of scissors, a very neat job can be done without using scissor action. Just start the cut and hold the scissors in a fixed position. Push them forward, holding the bottom blade against the framework. This makes a very quick, nice straight cut. Seal the edges all around with the iron.



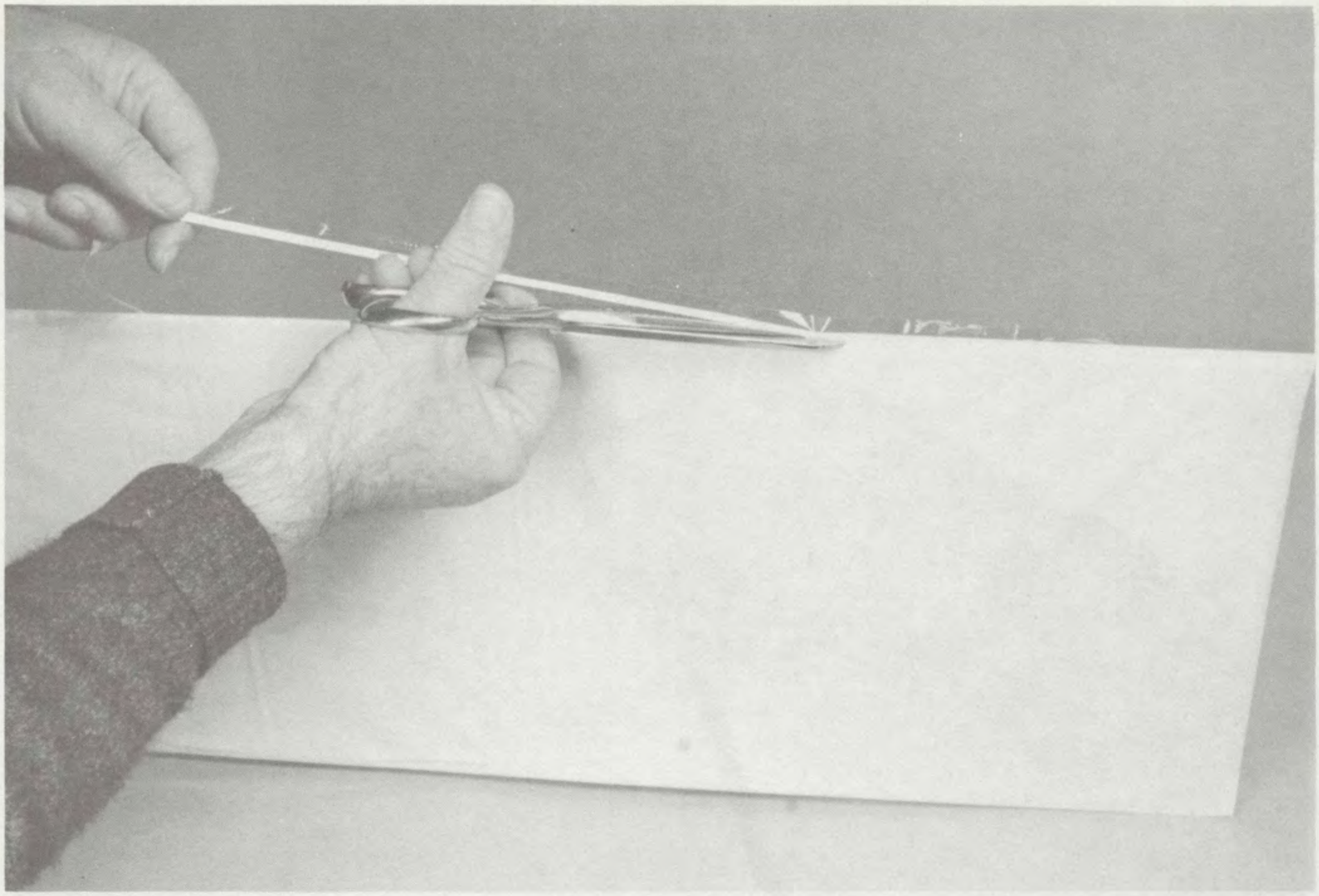
*Sealing the leading edge.*



*Sealing the trailing edge.*

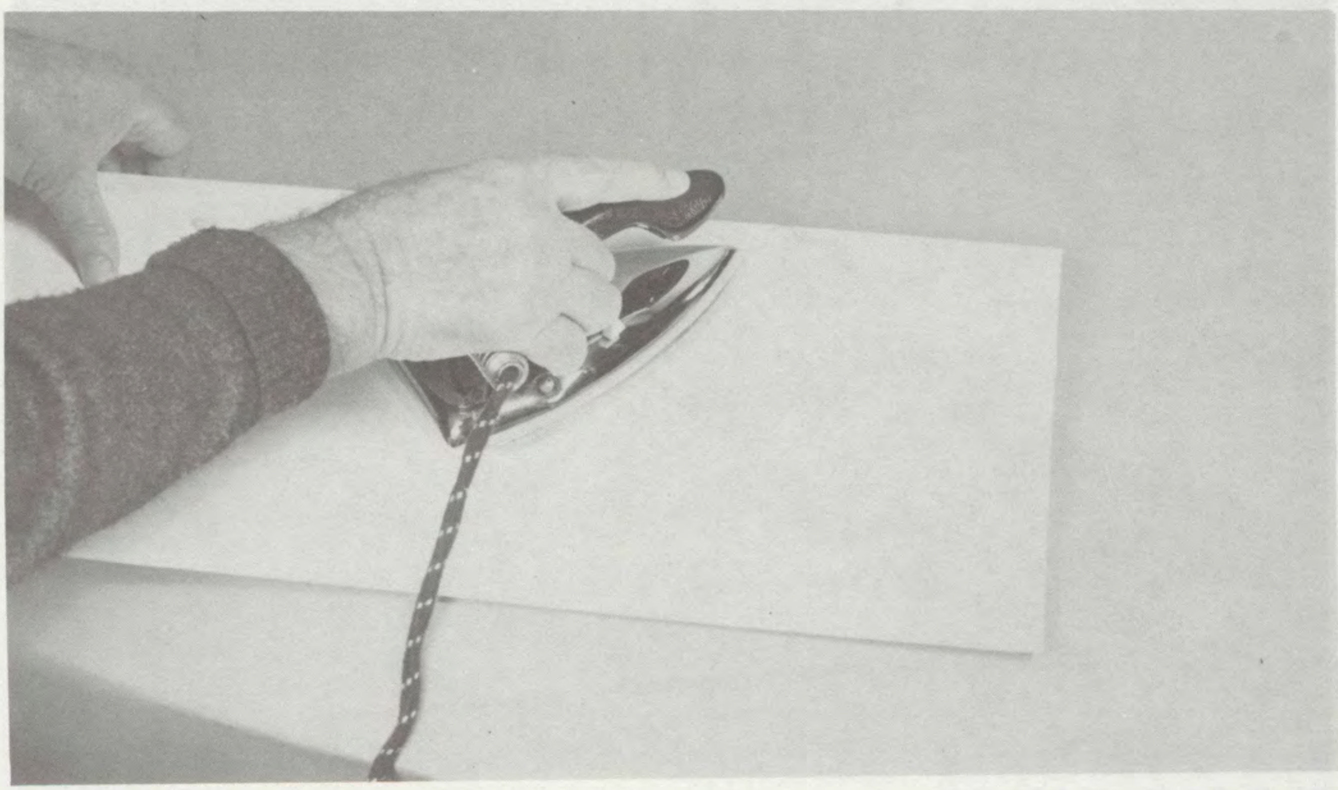


*Trimming MonoKote with X-Acto knife.*



***Trimming MonoKote with scissors.***

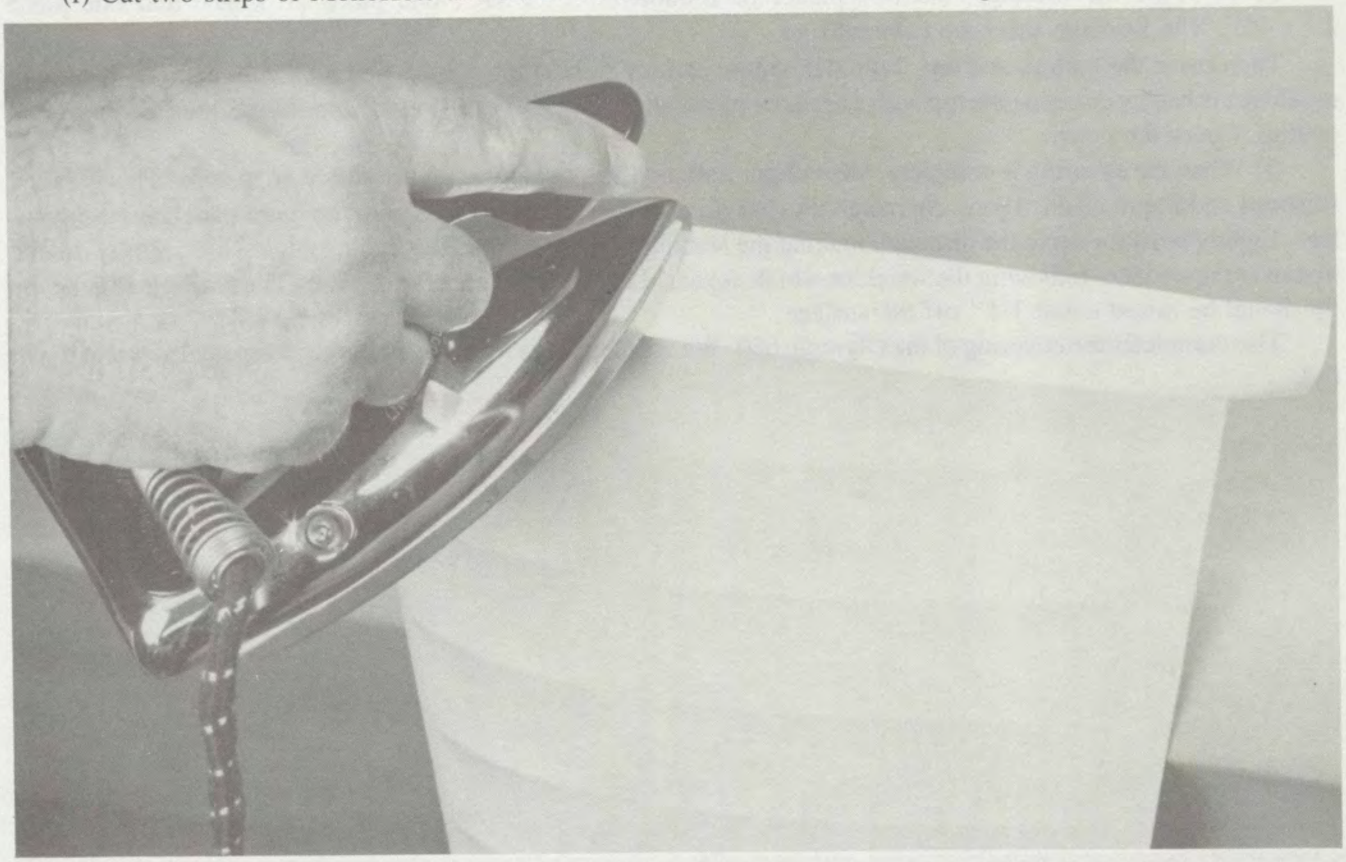
(d) Shrink the covering tight by lightly gliding the iron over the surface. **Do not press down**, especially if there are wrinkles over a wood surface. Here, lightly touch the tops of the wrinkles with the iron and work them out. If you mash them down, they are sometimes hard to remove. In any case, don't get paranoid over the whole thing. You will probably have to mash down a few wrinkles here and there; you will be the only one to notice them.



***Shrinking covering.***

(e) Similarly, cover the top of the wing. Trim the MonoKote a little long all around the edges and wrap it over the leading and trailing edges, overlapping the bottom covering by 1/4'' or so. If you snip the overhang on the end ribs in a few places, you can stick it to the end of the rib without wrinkles.

(f) Cut two strips of MonoKote and cover the end ribs. Trim and seal the edges.



***Covering end ribs.***

(g) In the same manner, cover the outer wing panels. Note Step 6 in the MonoKote instructions when doing the wing tips.

***Covering tips.***

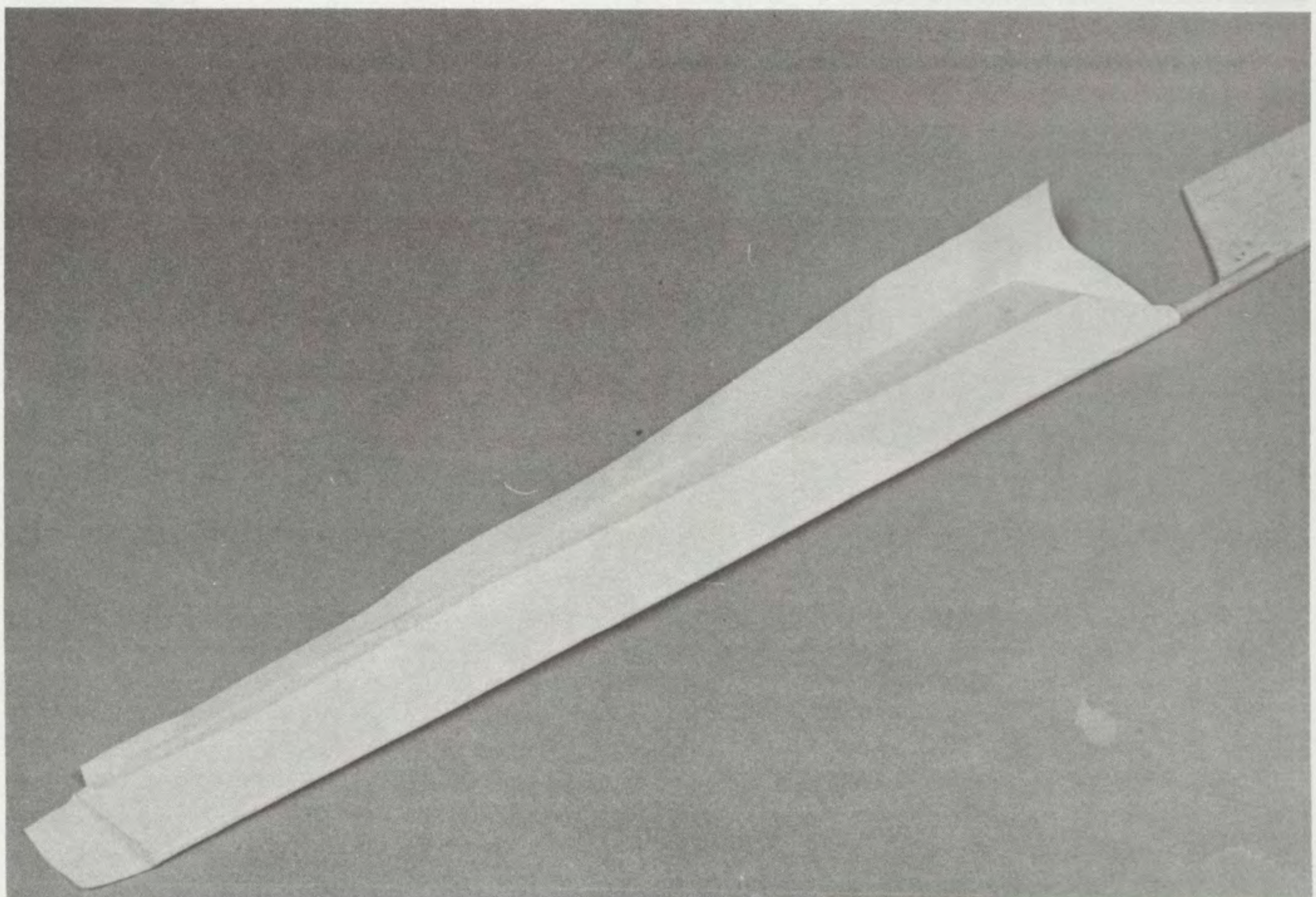
(h) When covering the tail pieces, use the technique detailed in the MonoKote instructions to stretch the material around the tips of the stab and rudder. Each elevator half can be covered with one piece of MonoKote by wrapping it around and joining it on the bottom.

(i) To cover the fuselage, cut two pieces of MonoKote 3'' x 39'', one piece 2'' x 39'' and one piece 2'' x 14''. The fuselage sides are covered first.

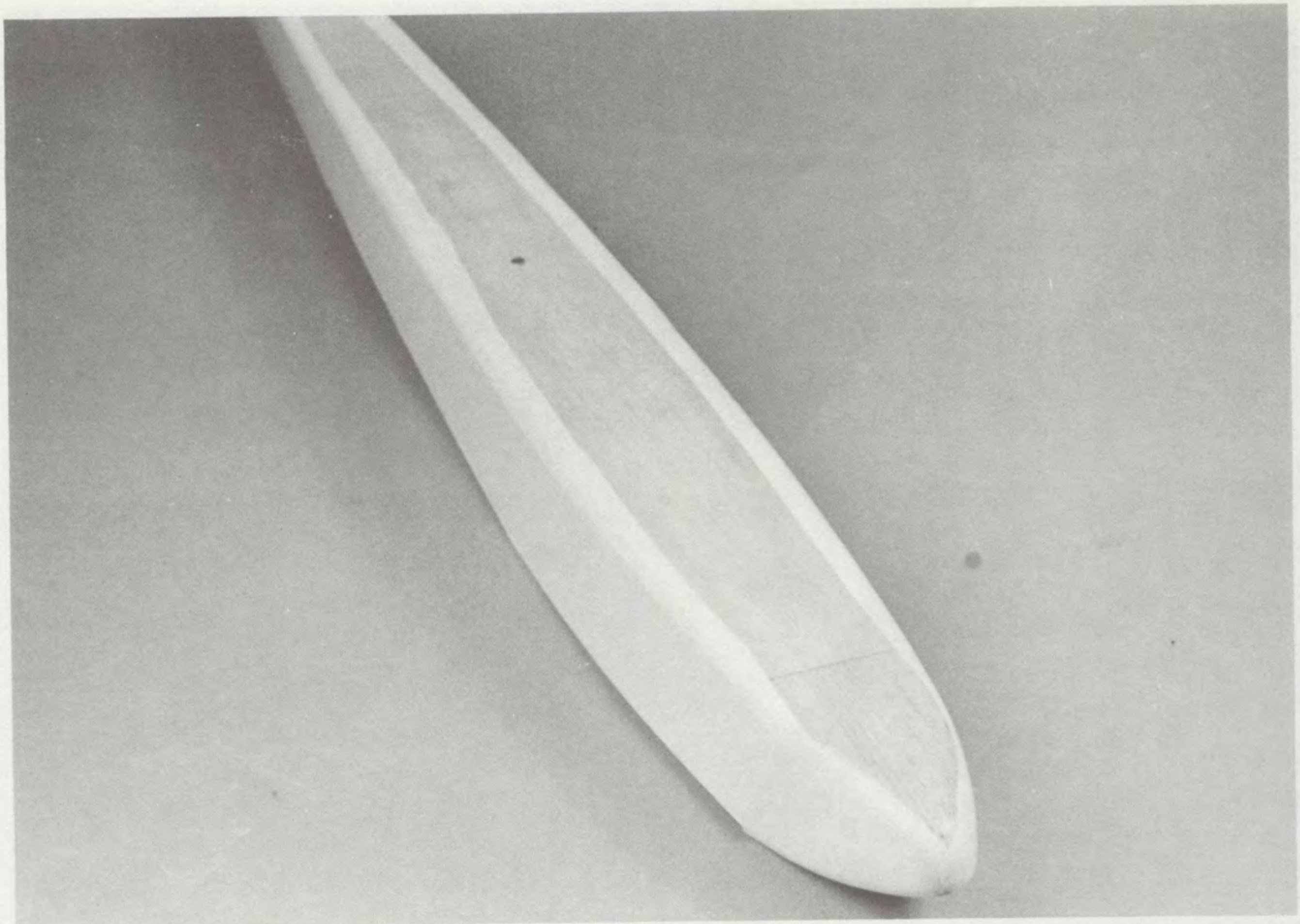
Then cover the bottom and top. Trim the bottom and top right at the corner, and seal with the iron. A smooth noseblock is had by covering the top with a separate piece, stretching it carefully as far as possible; then trimming and sealing. Cover the hatch.

(j) When the covering is complete, we will put a slight downward twist in the outer wing panels. This is called **washout** and improves the flying characteristics, as described in Chapter IX. Clamp the outer panel between your legs. Lightly twist the tip in the direction making the leading edge lower than the trailing edge. Now, lightly run the iron over the surface, removing the wrinkles which appear. Lay the panel on a flat surface. The **trailing edge** of the tip should be raised about 1/4'' off the surface.

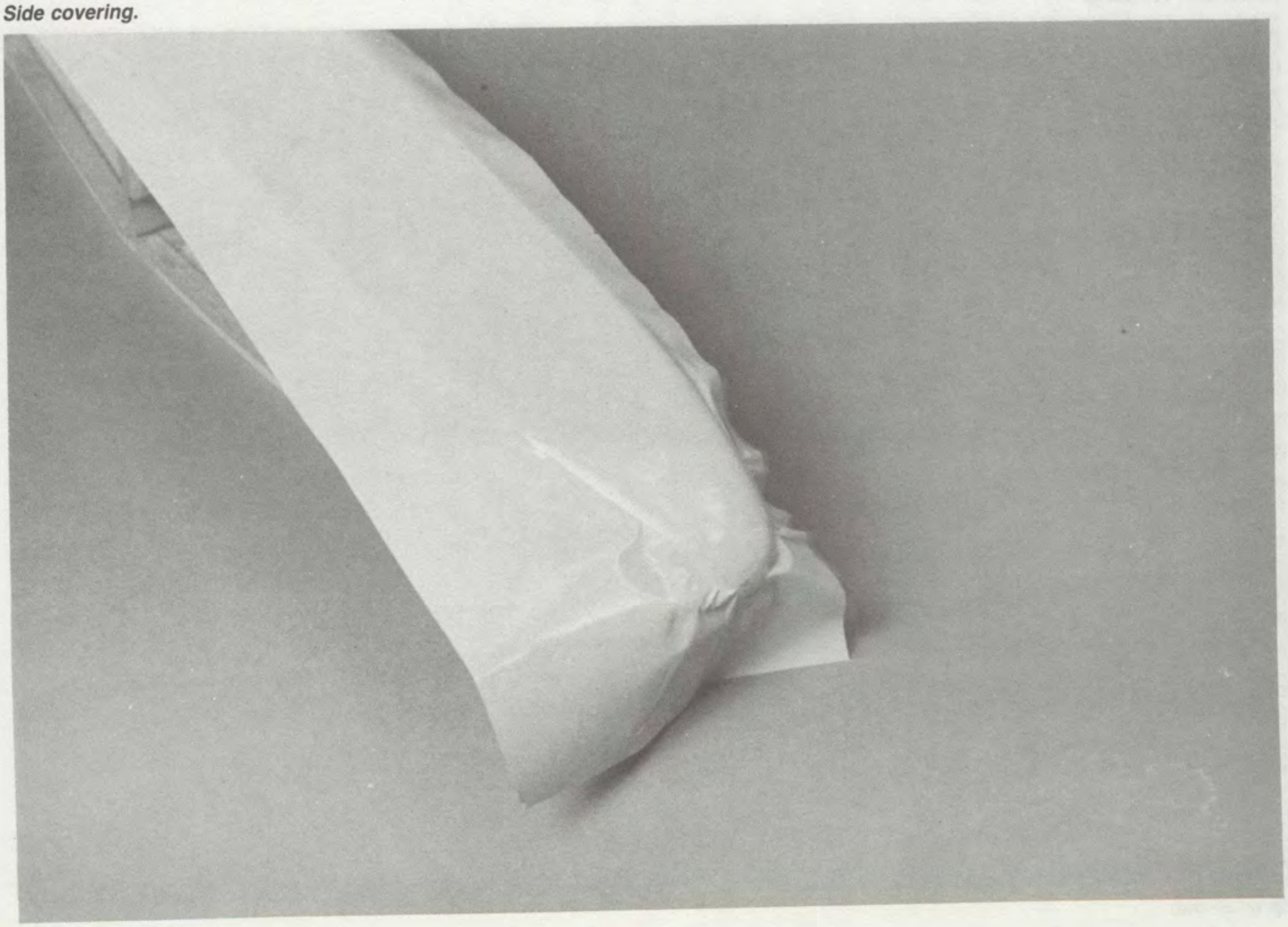
This completes the covering of the Olympic 650. We are now ready to re-install the hardware and go see if it will fly!



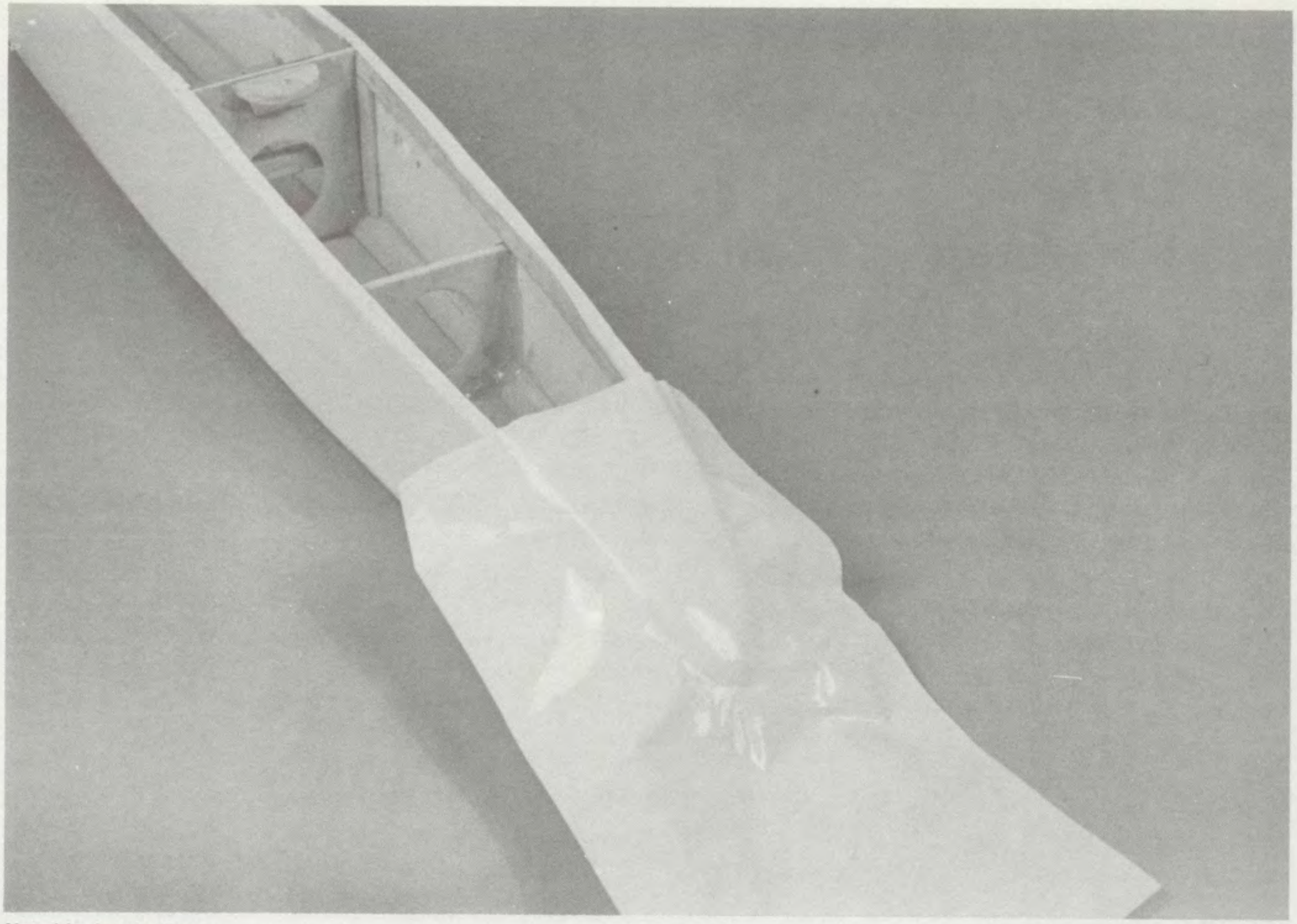
***Elevator covering.***

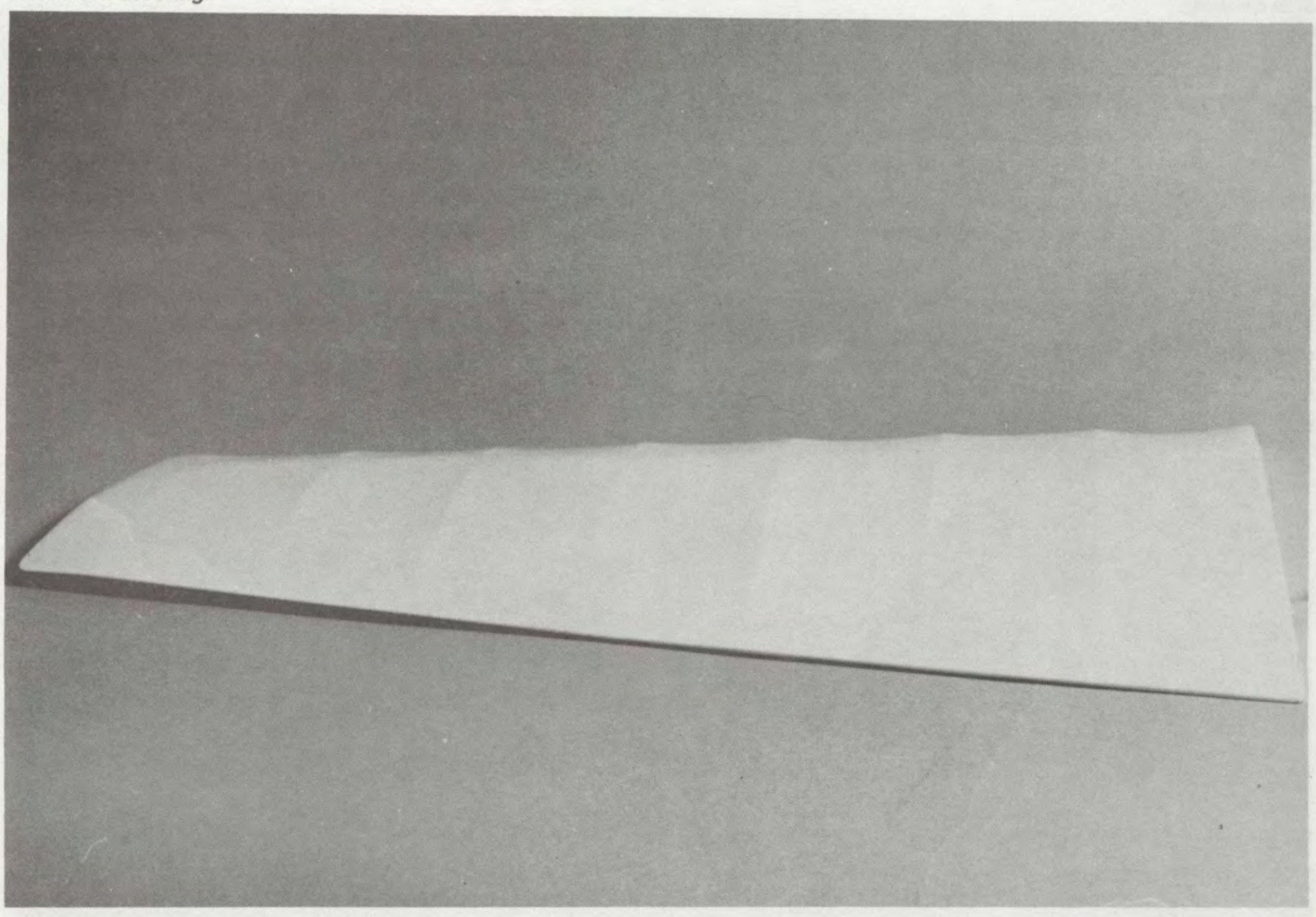


*Side covering.*



*Bottom covering.*


***Noseblock covering.***


***Tip wash-out.***

# CHAPTER VII

## FINAL ASSEMBLY AND BALANCING

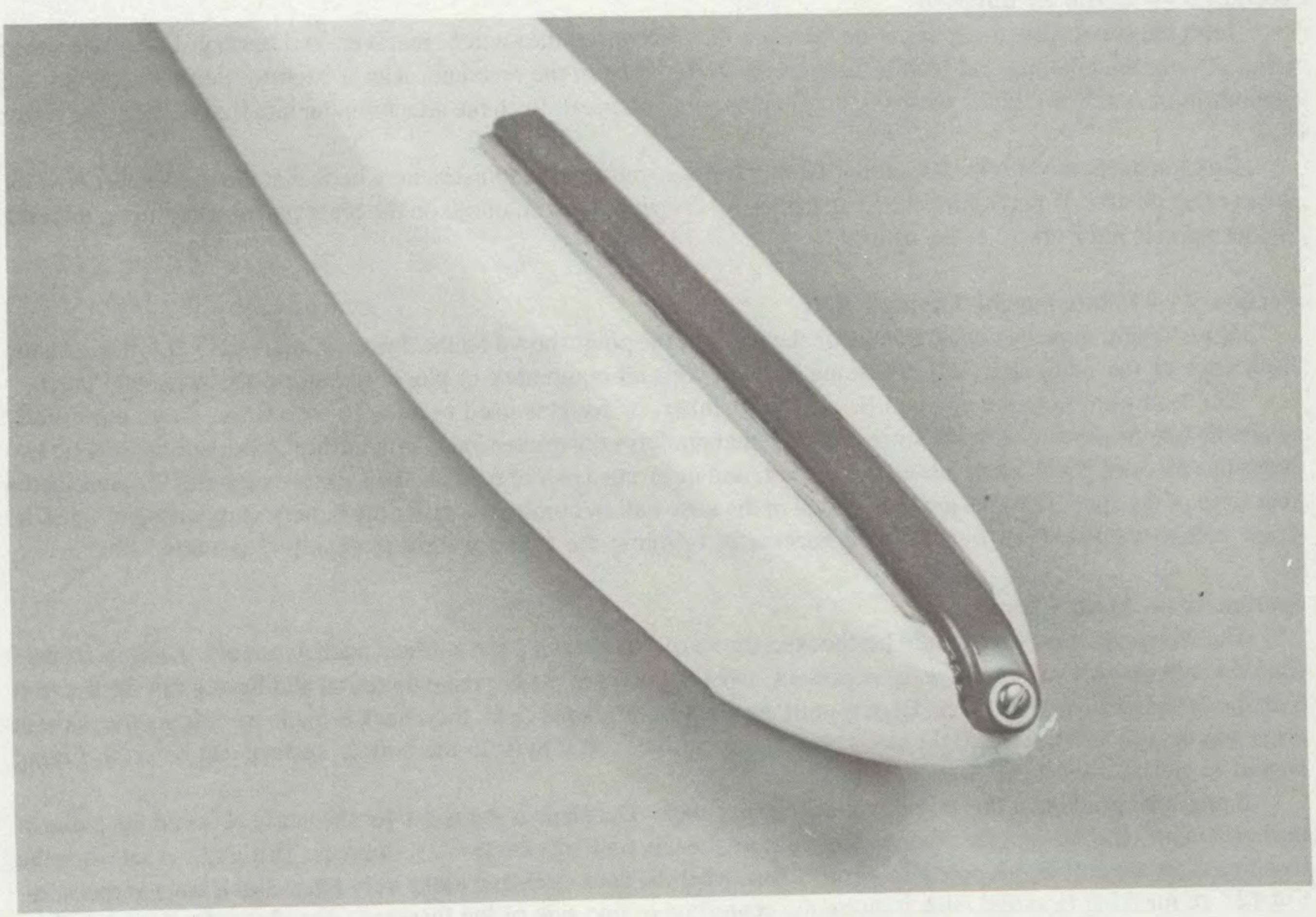
The nice thing about installing all the hardware before covering is that now, when you are anxious to complete the plane, re-installation goes quickly. So, let's get to it!

**Section 1 — Skid Installation**

If you waited until covering was complete to install the skid, now is the time. Hold the skid in place and cut around it with the X-Acto knife. Peel off the MonoKote and epoxy the skid to the bare fuselage. Paint the skid with some kind of wood sealer so it will shed dirt. This can be anything from clear airplane dope to shellac, varnish, etc., etc. — whatever you happen to have. A plastic, or rubber skid will provide additional protection to the bottom of the fuselage as well as to the towhook. If you wish to install an Airtronics skid, fit it up on the nose as far as practical and trim to length. Round the front with the sanding block. Remove the backing and stick it in place. Drill a 1/16'' hole in the very front, into the noseblock. Screw in place.

**Section 2 — Tailskid Installation**

Locate the tailskid holes in the rear bottom of the fuselage. Temporarily install the skid. Cut around the skid with the X-Acto knife. Remove the skid and peel away the MonoKote. Epoxy the skid to the bare fuselage.



*Airtronics skid installation.*

### Section 3 — Tow hook Installation

Leave the tow hook out until after glide tests are complete. When ready for a hi-start launch, screw the tow hook into the bottom of the fuselage, pointing to the rear. Tighten the retaining nut securely against the fuselage. Check the tightness of the tow hook before each launch. If it is loose and rotates during launch, you may find the plane in an unrecoverable attitude, and --- kapow!

### Section 4 — Hinge Installation

Locate the hinge slots in the fin, rudder, and elevator. Slit the MonoKote at these locations using the X-Acto knife. Lightly coat the hinge tabs with glue, and push into the slots. Wipe the hinges free of excess glue. Fully seat the hinges, leaving only a small crack between the surfaces.

### Section 5 — Tail Installation

Locate the rudder and elevator horn holes. Open them with a sharp instrument and screw the horns in place. If the tail is to be glued on, trim the MonoKote away from the mating surfaces. Glue the stab in place, seat and glue the fin into the stab and fuselage. Use the straightedge to align the fin with the fuselage centerline, as described in Chapter V, Section 2e. If the tail is removable, screw it in place using the 2-56 machine screws and the #2 wood screw.

### Section 6 — Pushrod Installation

Push the pushrods through the tubing and solder, or epoxy, the couplers to the inside ends. Re-install the servos with their plugs in the receiver compartment. Attach the Snap Links to the servo arms and the rudder and elevator horns.

### Section 7 — Wing Hold-Down Dowel Installation

Cut the MonoKote from the dowel holes in the fuselage. Trim the dowels to the lengths shown on the drawing. Push them into place, so they protrude evenly. Apply a little glue and rotate the dowels a quarter turn to get the glue between the dowel and the bulkhead.

### Section 8 — Radio Installation

Trim the MonoKote away from the switch holes. Re-install the switch, receiver, and battery. Install the strain relief clip on the antenna and feed it through the 1/16" hole in the fuselage. Run it back to the rudder, using the antenna hook, as shown in the Airtronics radio instruction manual. Push the attaching pin into the rudder at the hinge line.

Turn on the receiver and transmitter. Center the transmitter trim adjustment. Check that the rudder and elevator are in exact neutral. If not, adjust the Snap Links by screwing them in, or out on the brass pushrod couplers, until the rudder and elevator are in exact neutral.

### Section 9 — Balancing the Olympic 650

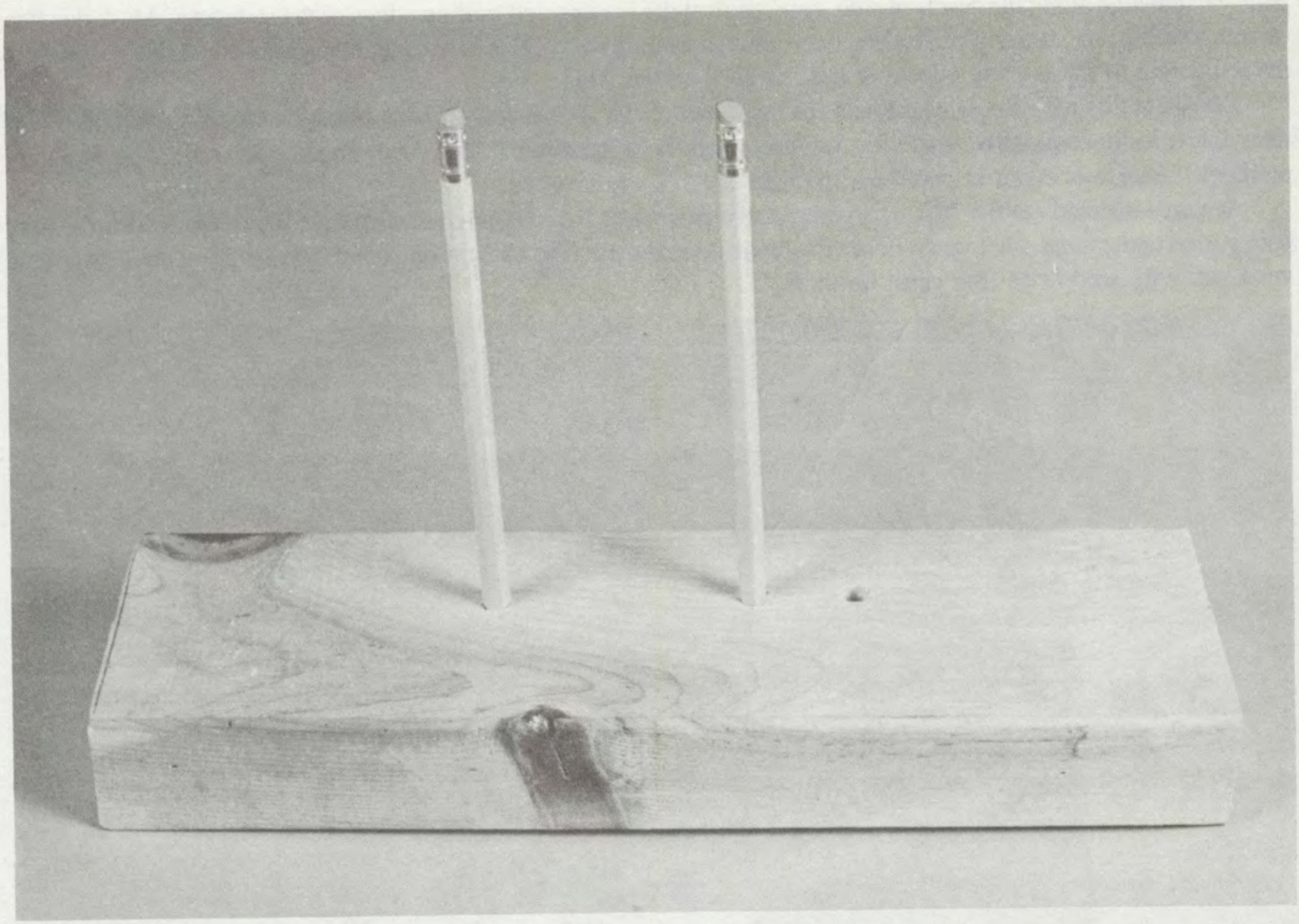
Nose weight must be added to balance the plane at the point shown on the drawing, marked C.G. This is on the back edge of the main spar. All balancing is done with all equipment in place, including the wing and hatch.

The lead used in balancing can be a fishing sinker, or weights used to balance auto tires. These are usually available free from your local tire store. I use a rather crudely constructed balancing fixture. It is made by drilling two holes in a piece of 2 x 4 wood, about 2¾" apart, and inserting a pair of pencils. This fixture supports the plane at the rear edge of the spar. Weights are than added in the nose ballast compartment, or the battery compartment, until the plane balances level. Four ounces were necessary, bringing the flying weight to exactly 2 pounds.

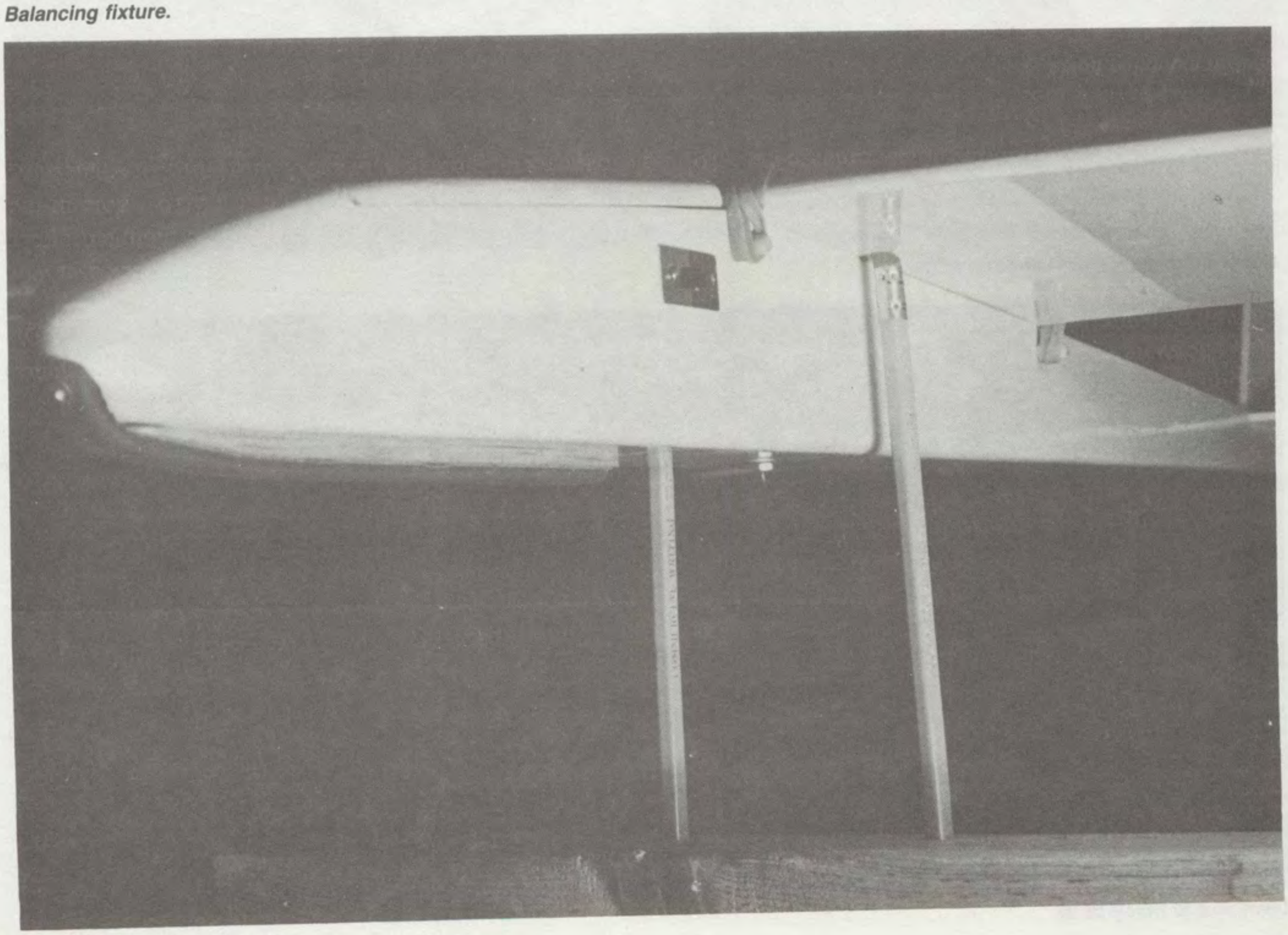
### Section 10 — Final Checks

The wing center section should be checked for warp. Place it on a flat surface, such as a table. All four corners should touch the surface. If any warp is present, twist the wing in the opposite direction and lightly run the hot iron over the upper and lower surfaces. Repeat until the wing is flat. In the field, this check is made by holding the plane at arms length, eye level high. Sight along the bottom surface. Any twist in the bottom surface can be seen. Flying should be delayed until the warp is removed.

It might be prudent at this point to check the decalage. Decalage is the name for the angle between the plane of the horizontal stabilizer and the plane of the wing. In the Oly 650, this angle is 2½ degrees. This angle is set when the fuselage sides are cut, and is pretty foolproof. But, what the heck, it doesn't take very long, and is easy to measure. Cut 12" of masking tape and stick it along the centerline of one side of the fuselage, directly under the wing. Lay



*Balancing fixture.*

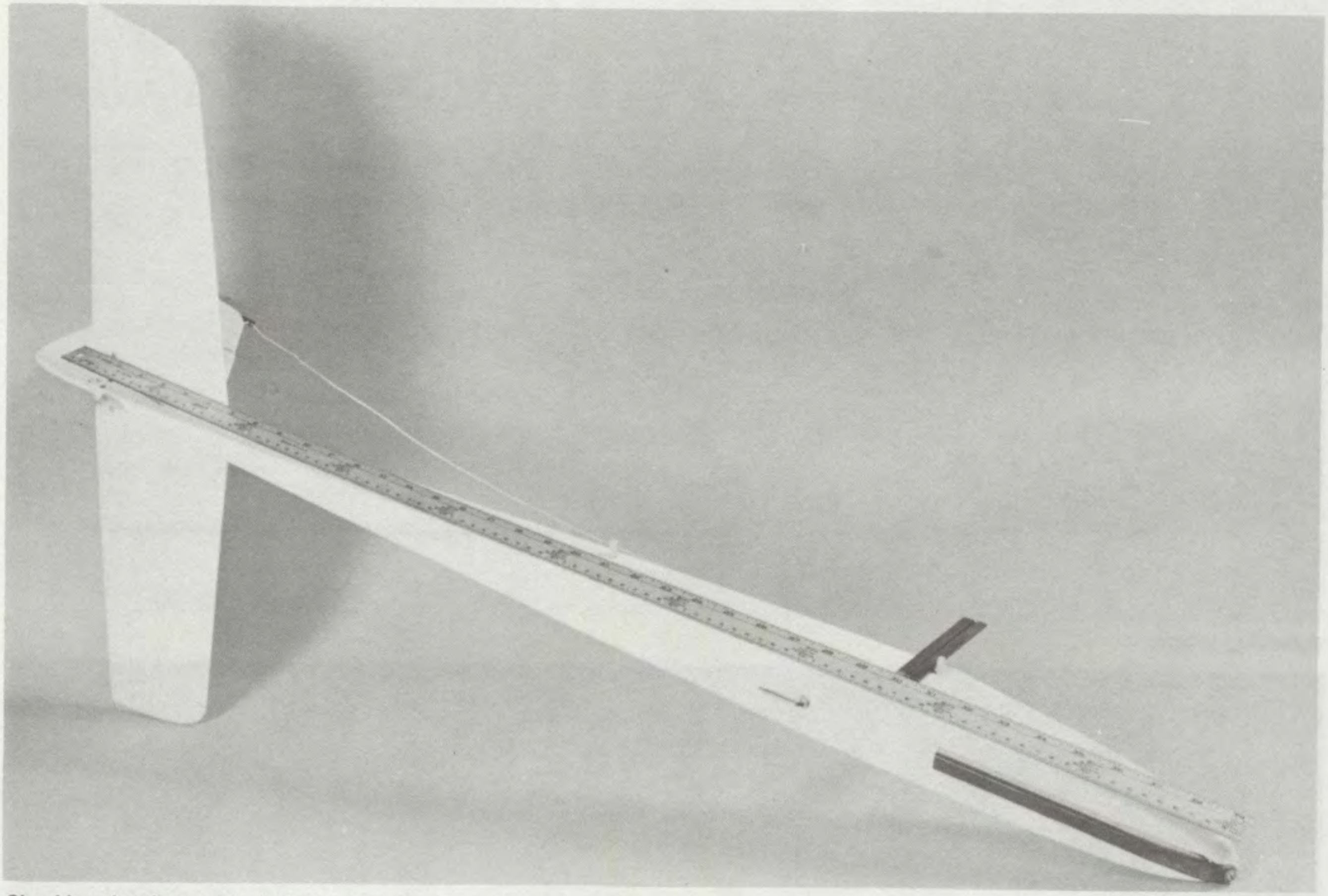


*Balancing the Olympic 650.*

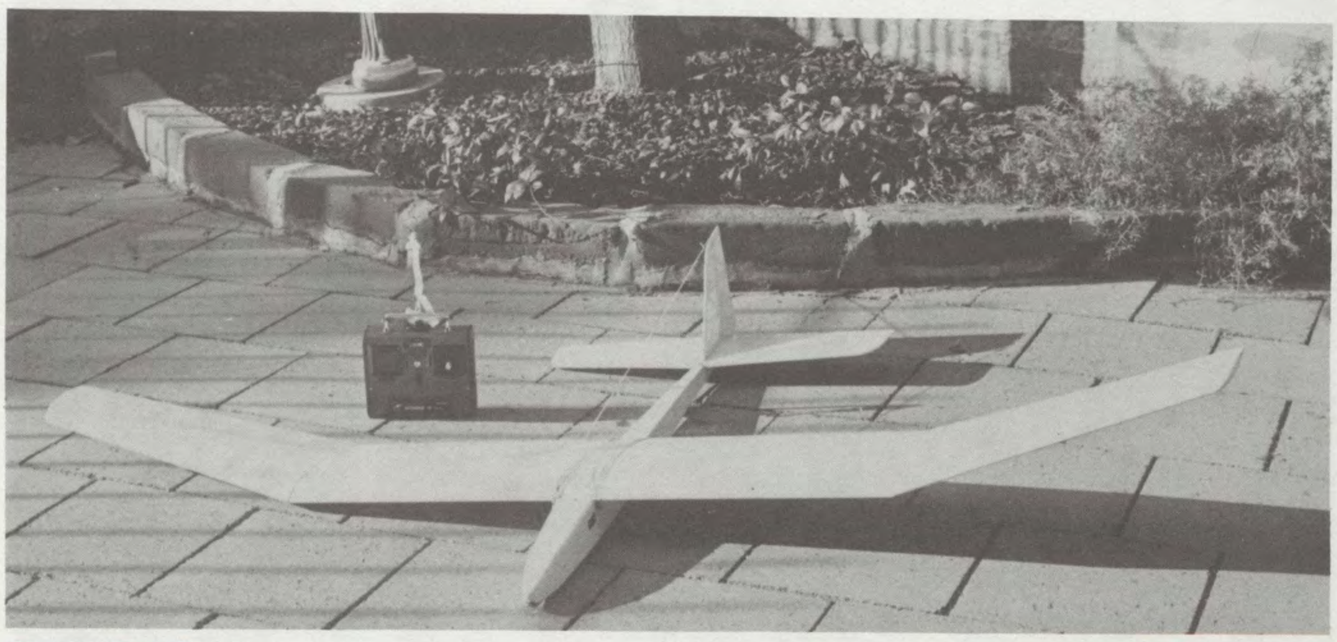
your straightedge along the fuselage side, snug against the leading and trailing edges of the stabilizer. Mark this line on the masking tape at the wing leading edge and the trailing edge. This is the stab horizontal plane. Now, measure from this line to the leading edge and trailing edge of the wing.

Compare this with the measurements of the drawing. Measurements should correspond within about 1/16''. If they don't, a shim should be made for the fuselage to hold the wing at the proper angle. This procedure is highly unlikely if care was taken in trimming the fuselage sides to size.

We are now ready to fly. I suggest you read the chapter on basic aerodynamics before the flying sessions; it may help you to understand what you will see the plane do in the air. The chapter on launching equipment will advise on what you will need to get the beast up there.



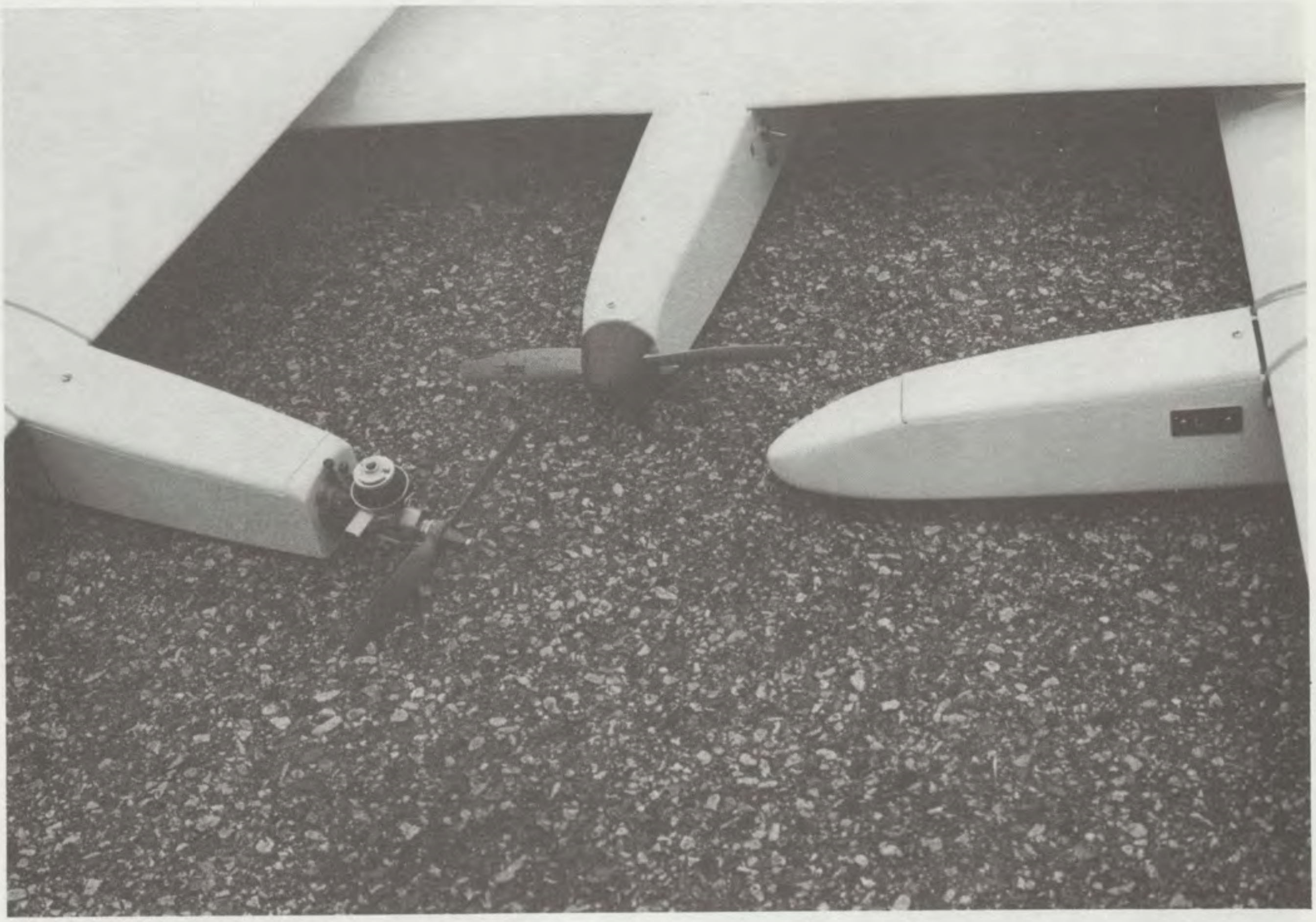
***Checking decalage with straight edge.***



***Olympic 650 ready to fly.***

# CHAPTER VIII

## ALTERNATE CONSTRUCTION — ELECTRIC AND GLOW ENGINE POWERED MODELS



*Glider, glow, and electric versions.*

For those wishing to use launching methods other than a hi-start, or winch, two alternatives are shown on the plans. Conventional glider launching equipment requires a fairly clear area 600 to 700 feet long. Many fliers live in areas where this size facility is not readily available, and so prefer glow engine, or electric power to get the plane airborne. This chapter will detail the construction and installation differences for these alternatives. Although the plans show installation on the Cox QRC glow engine and the Astro Flight electric system, an equivalent system will work just as well.

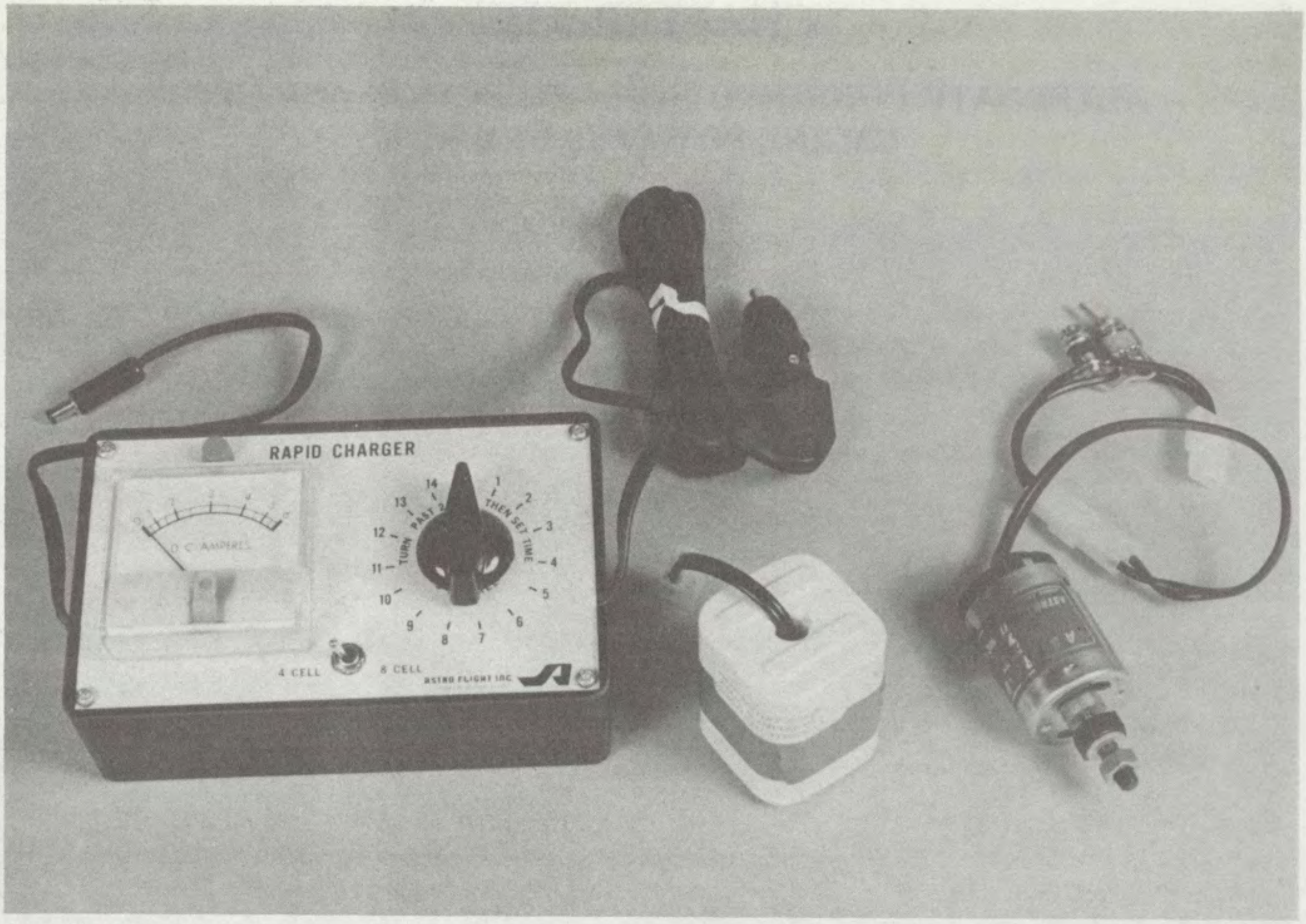
**Section 1 — Electric Power System**

A. Construct the fuselage as described in Chapter IV, Section 4, with the following exceptions:

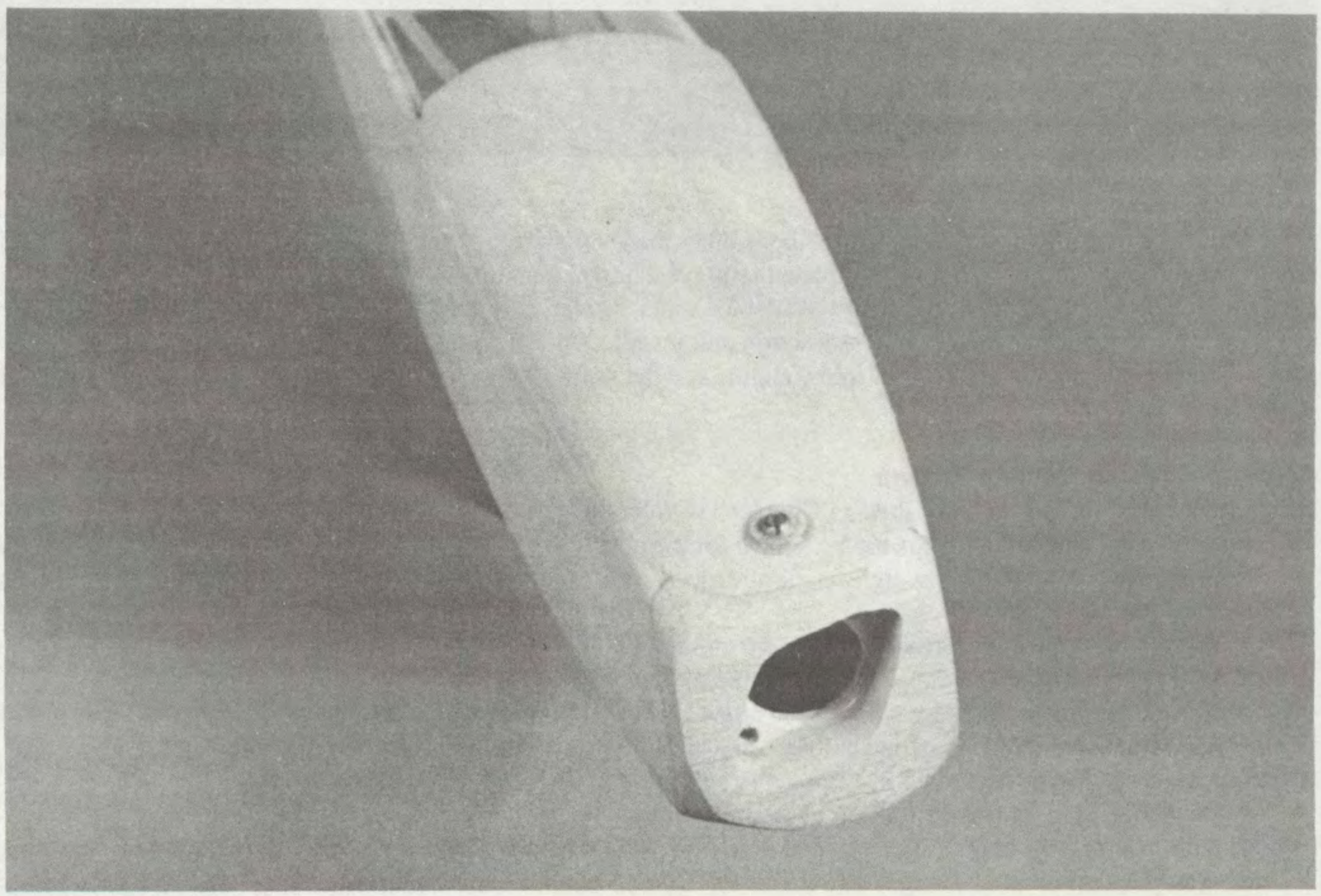
1. In Step 4c, substitute the former F1 shown for the electric version and the former F3, shown for the bolt-on wing version. (The bolt-on wing is preferred, to permit easy removal during battery charging. This aids in cooling the battery during charge.)
2. In Step 4j, substitute former F1A for the noseblock.
3. In Step 4l substitute the electric version of the hatch.
4. Do not do step 4m (drilling wing dowel holes). Instead, cut the outer plastic pushrod tubes 1/4'' forward of former F4. Construct the plywood hold-down plate and epoxy it to former F4, bracing it with triangular stock.

B. Construct the wing as described in Chapter IV, Section 7, with the following exceptions:

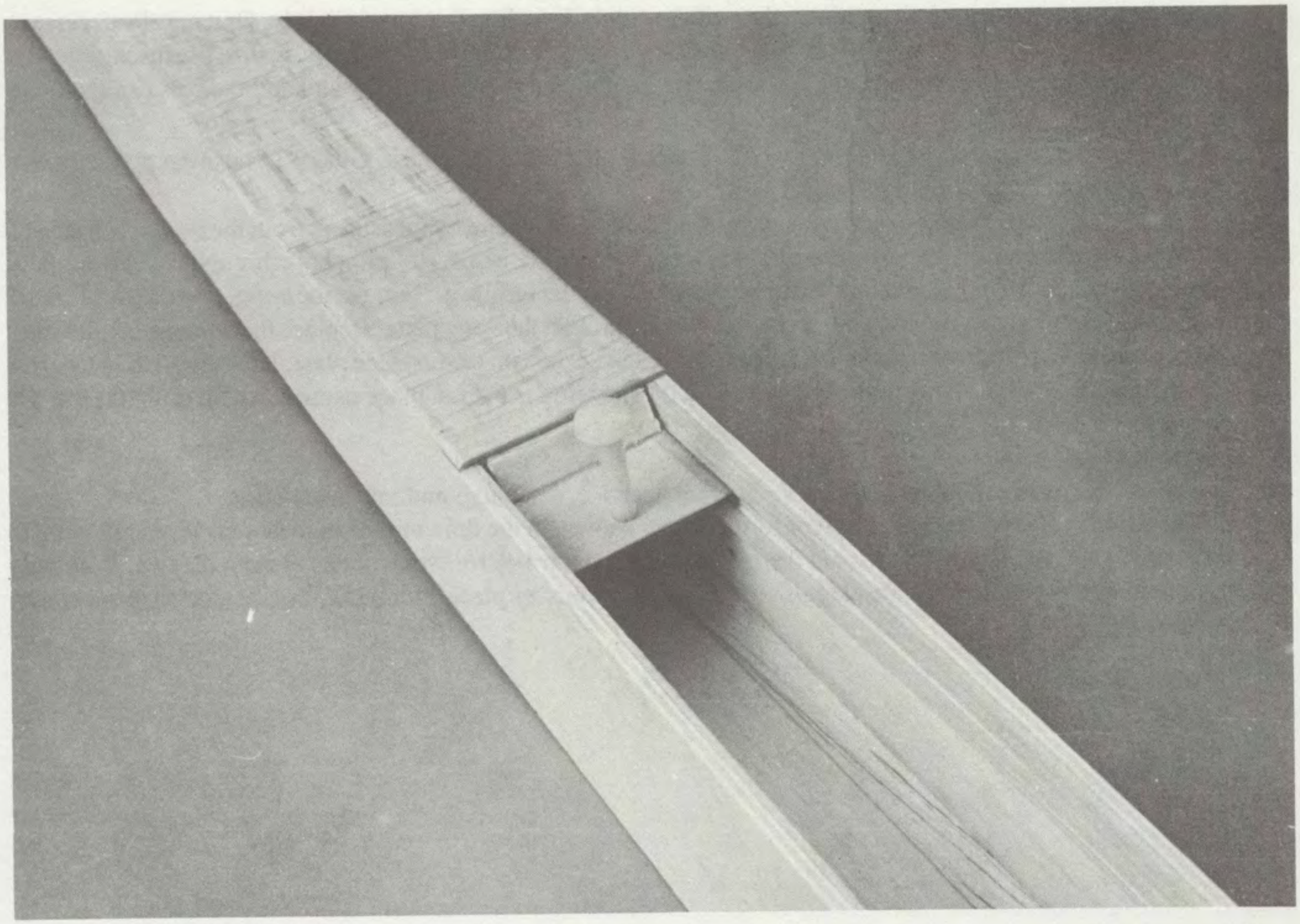
1. Do not do step 7s (inlaid trailing edge reinforcement).
2. After completing step 7t, cut a piece of 3/16'' dowel to the length shown, for the wing hold-down. Place the wing in position on the fuselage. The center rib must be slotted to receive the dowel at a height such that the dowel mates with the 3/16'' hole in Former F3.



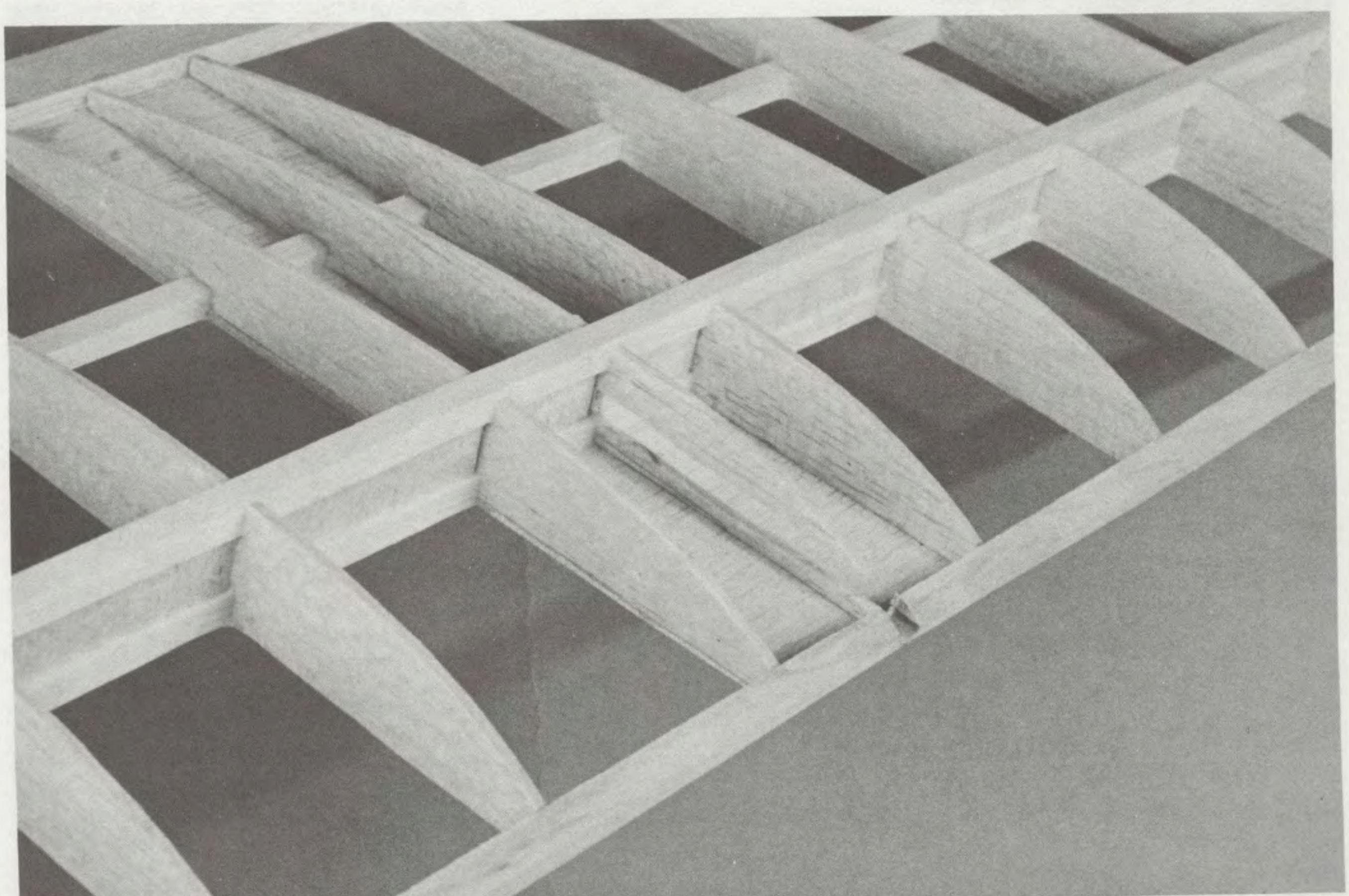

*Astro Flight 05 electric system.*



*Installation of nose former F1A and electric version hatch.*



*Screw hold-down plate installation.*



*Rib slot for hold-down dowel.*

It may be necessary to notch the leading edge with a round file to drop the dowel slightly. Or it may be necessary to slightly elongate the hole in F3. The important thing is that the wing be held tightly against the fuselage by the dowel. When the slot is properly cut in the center rib, glue the dowel in place, and add the balsa supports on each side.

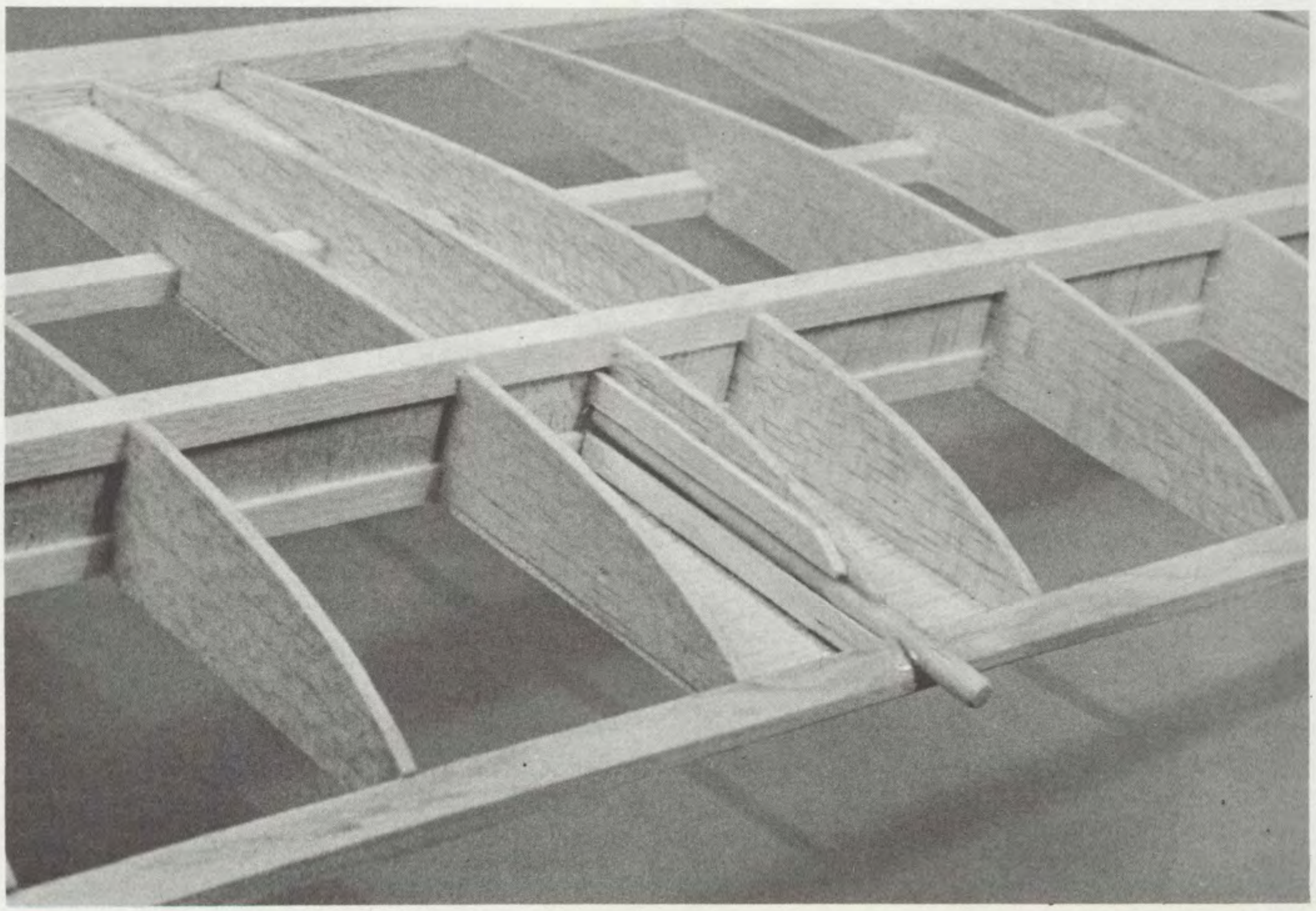
3. Cut a 1/2'' x 1'' piece of 1/16'' plywood. Taper it all around the edges. Glue it in position on the center trailing edge, to support the hold-down bolt.

4. Put the wing center section on the fuselage. Check that it is square by measuring from the tip of each side of the wing, back to the tail. Make sure these distances are equal. Drill a 1/16'' pilot hole through the center of the plywood plate on the wing, and into the hold-down plate in the fuselage. Remove the wing, and drill an 11/64'' hole in the fuselage hold-down plate, and a 3/16'' hole through the wing plate. Replace the wing on the fuselage and run a 10-32 tap through both holes, cutting threads in the hole in the fuselage plate. Lacking a 10-32 tap, use a 10-32 machine screw. This will work just as well. The wing is held in place using a Sig Sh 530 10-32 x 1'' Nylon Wing Bolt.

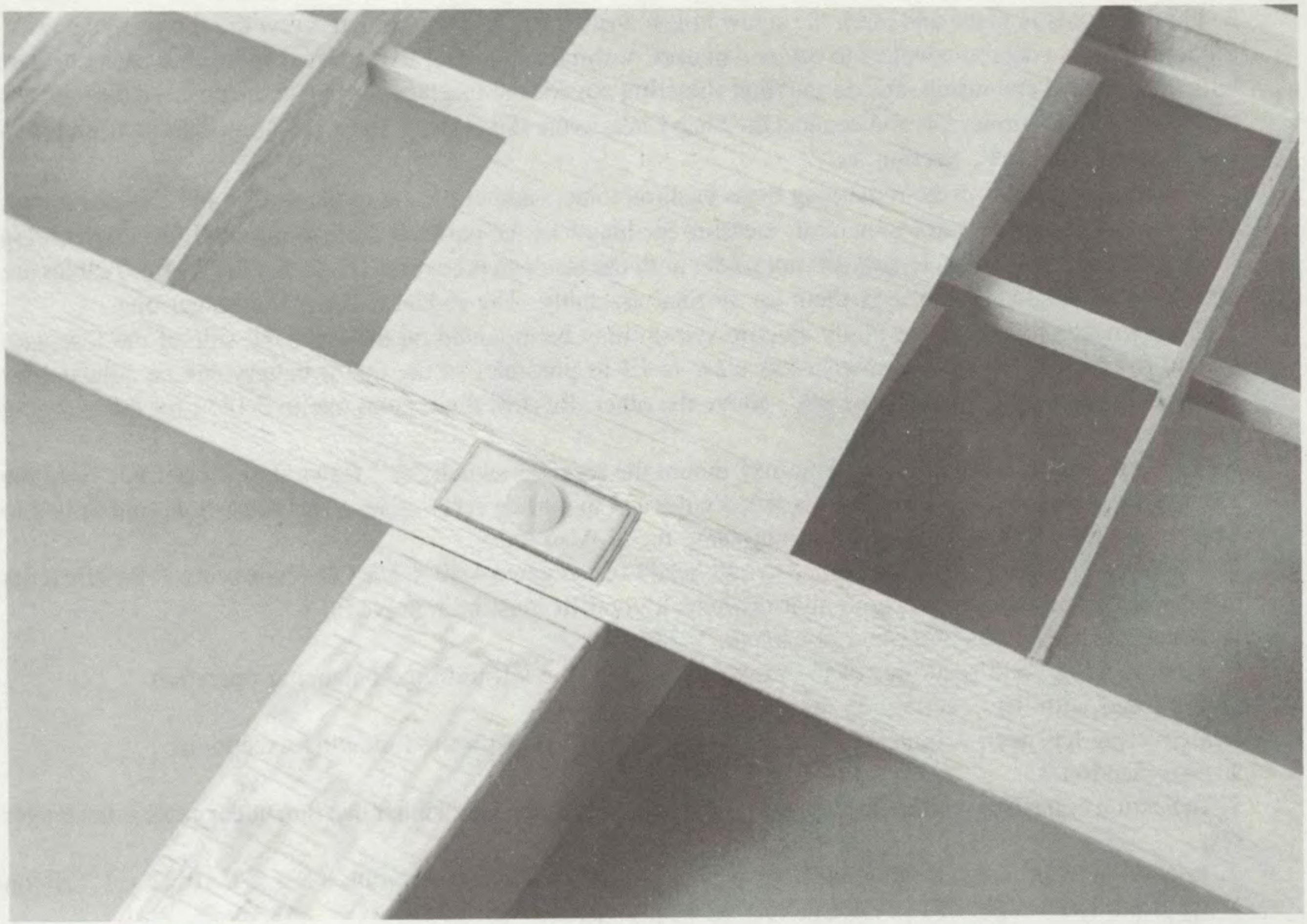
C. Equipment Installation.

1. Follow the instructions in Chapter V, Section 1 and 2, for hinge and tail installation.

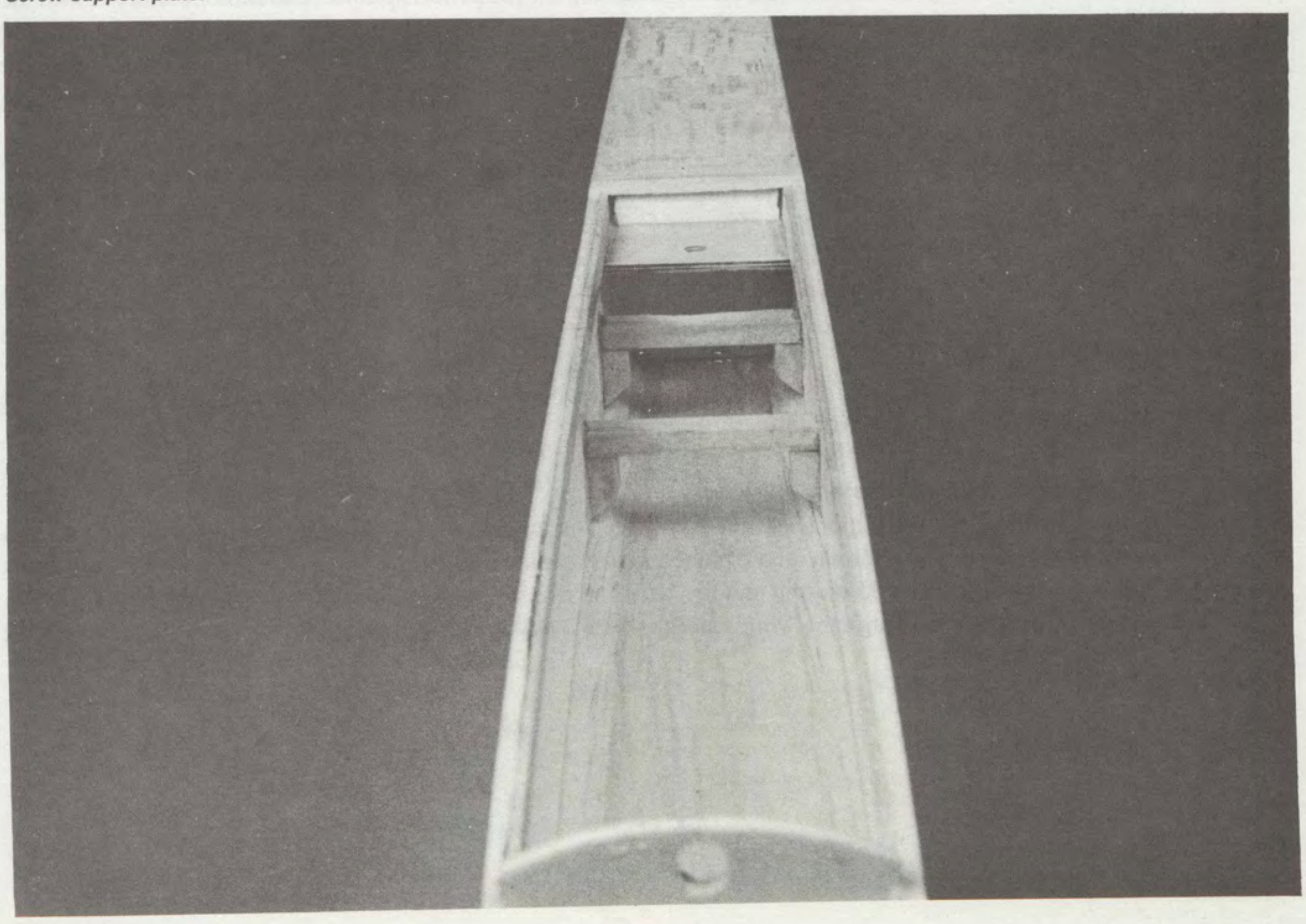
2. The servos are mounted just ahead of former F4 as shown on the drawing. Mount the rear servo rail with its back edge 1⅛'' forward of F4. Mount the front servo rail with 1-9/16'' separation between the two. Both rails are mounted 3/4'' above the fuselage floor. Epoxy the rails in place, with 1/4'' sq. spruce support blocks underneath.



***Hold-down dowel in place.***



*Screw support plate.*



*Servo rail installation.*

3. Put the servos in place and mark the screw holes. Drill 1/16" pilot holes and screw the servos to the rails. Solder the brass pushrod couplers to one end of each pushrod cable. Due to restricted space, it is easier to start with this finished end inside, and do the final soldering outside the fuselage. So, poke the pushrod through the tubing forward of former F4, and connect the Snap Links to the servo arms. The servo arms must be trimmed as decribed in Chapter V, Section 3a.

4. Screw a Snap Link on the remaining brass pushrod joiners and clip them to the rudder and elevator horns. With the rudder and elevator in neutral, measure the length of the pushrod cable to properly fit into the brass joiner. Cut the cable to this length. Do not solder until the fuselage is covered. Note that the pushrod cables are not the same length. Do not mix them up on final assembly. The rudder cable is the longer one.

5 .The switches for the Astro Flight electric system may be mounted on the left hand side of the fuselage, behind former F3. Mount the switches as close to F3 as possible, so the motor battery can be adjusted for balance. Drill two 1/4" holes, one 3/4" above the other. Re-drill the bottom one to 5/16", for the charging plug.

6. To keep the switches clustered, you may mount the receiver switch 3/8" forward of former F3. Hold the escutcheon plate in place, and mark the rectangular and mounting screw holes. The screw holes are drilled to 5/64", and the rectangular hole is cut out using the X-Acto knife.

7. The Astro Flight 05 motor is mounted to bulkhead F1, using two 4-40 x 3/8" machine screws. Be sure it fits flat against F1. Any epoxy or glue that prevents a good fit must be removed.

8. Install the tailskid as described in Chapter V, Section 7.

9. Final location, and securing, of the motor battery will be left until the balancing operation.

D. Now, proceed with the covering, as described in Chapter VI.

E. When covering has been completed, proceed with Chapter VII, with the following exceptions:

1. Skip Section 3.

2. In Section 6, push the cables through the tubes, from the inside. Remember that the rudder cable is the longer one.

3. In Section 7, in place of wing hold-down dowels, the wing is secured with a Sig 530 10-32 x 1" Nylon Wing Bolt. The weight of the electric version is 43 ounces.

4. In Section 9 (balancing), install all equipment, including the propeller, spinner, and motor battery. Place the motor battery 3/4" behind former F3. Screw the wing in place and, using the balance fixture described, note the balance point. If it does not balance at the C.G. point shown on the plans, remove the wing and slide the motor battery forward, or backward, until the C.G. is where shown. Trim lengths of 1/4" sq. spruce, and epoxy these to both sides of the fuselage, front and back of the battery, to prevent movement.

F. This completes the electric power version of the Olympic 650. Since considerable heat is developed during the charging, and discharging of the battery, it is advised that you remove the wing, and charge with the battery outside the fuselage. This will improve the life of the battery.

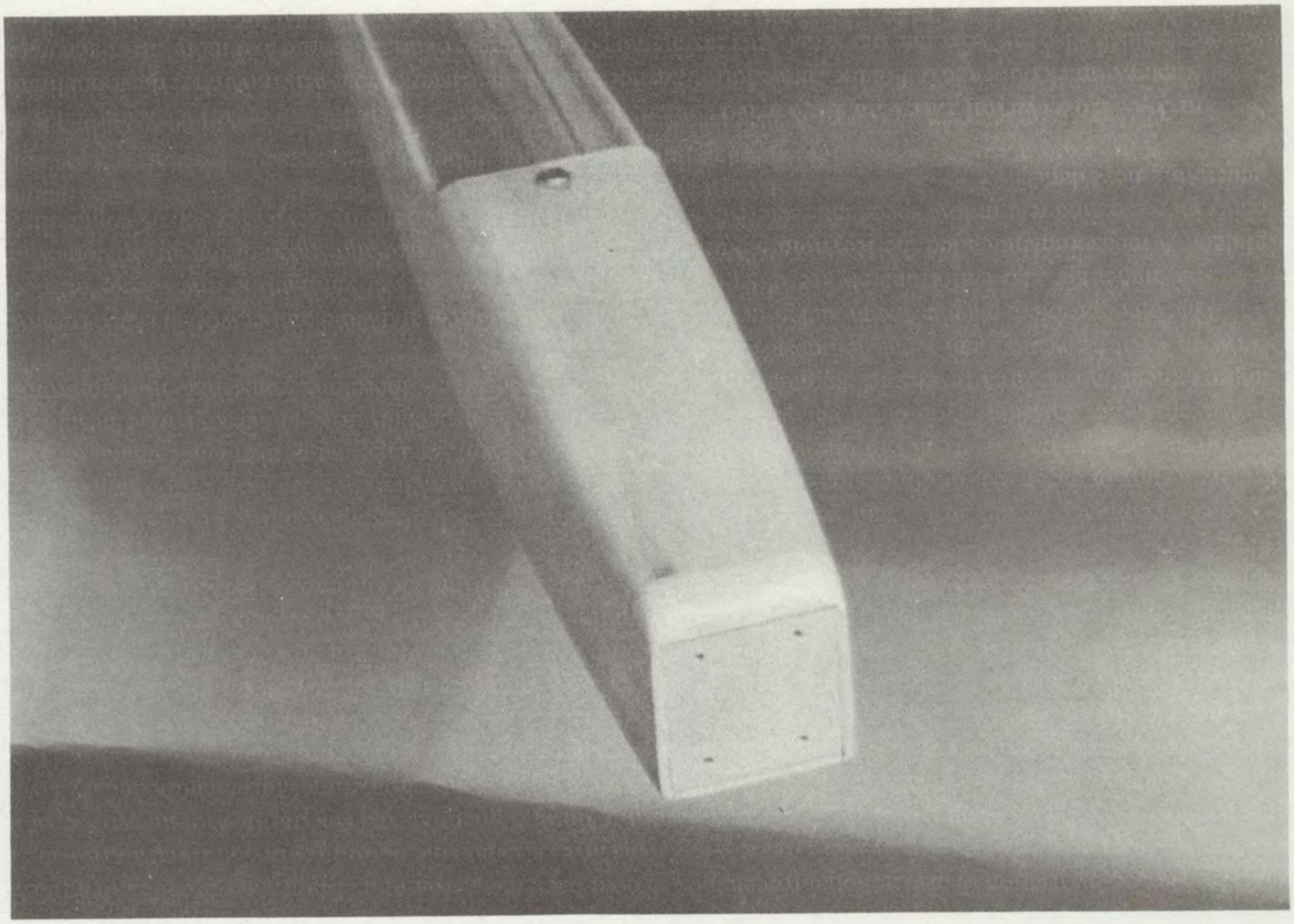
**Section 2 — Glow Engine Powered Version.**

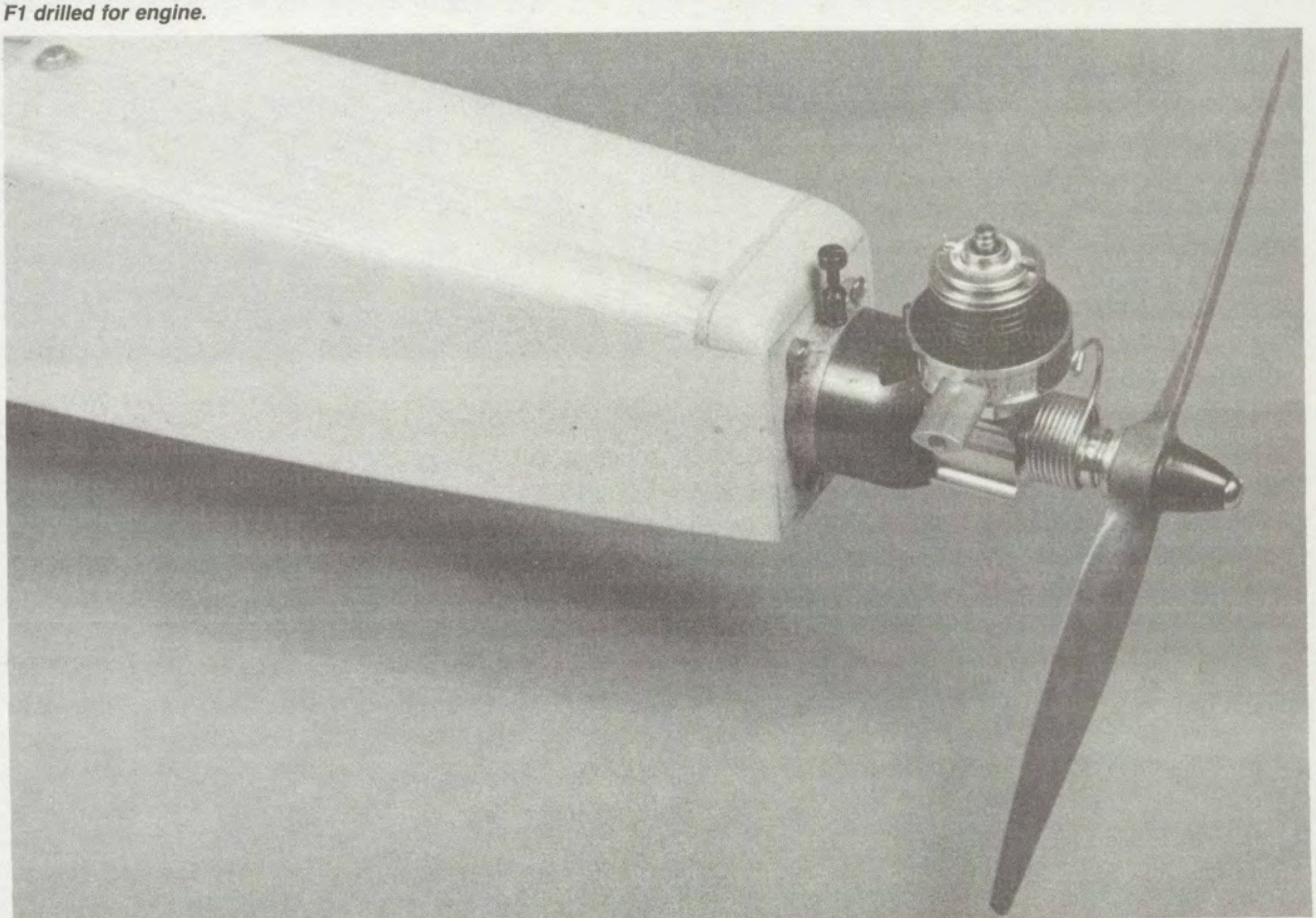
The entire construction of the glow engine version is exactly the same as the glider version, except the noseblock is not installed.

The engine is mounted, using 2-56 x 3/8" machine screws. The finished weight of the prototype, dry, was 32 ounces. Balancing took 2 ounces of lead, directly behind F1.

**Section 3 — 2 Meter Wingspan Version**

Although not shown on the plan, modification to 2 meter wingspan is very simple. If the outer wing panel spars are cut to 20¾" instead of 17¼" as shown on the plan; and the leading and trailing edges are made longer, to fit this increased spar dimension, the Oly 650 will be an Oly 715. The ribs will need to be spaced out equally, and will be farther apart than the original. Although the wing loading of the 2 meter version is slightly lower, performances will be nearly identical.


*F1 drilled for engine.*


*Engine in place.*

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# CHAPTER IX

## BASIC AERODYNAMICS

In this chapter, I'm going to talk about some basic principles of aerodynamics. It will not be an in-depth discussion —just enough so that when we come to the point of trimming a glider for flight, or analyzing its flight characteristics, you will be able to understand what is going on — at least in broad terms.

**Section 1 — The Forces in Flight**

A powered airplane moves through the air by means of its motor. It derives its energy from the fuel the motor burns. The powered plane has another source of energy — its height above ground. It took considerable fuel energy to attain the height, and at least a portion of this energy is now available as **potential energy**. That is, if the motor were to stop, the airplane could travel many times its height, by using up this potential energy. If we restart the engine, and fly level again, we are not changing the potential energy, as the height is not changing. The energy in the fuel is now expended to overcome the forces trying to pull it down, and hold it back. The forces trying to hold the airplane back are called **drag**, and are created by the air rubbing against the surface of the airplane, as well as a number of complex factors having to do with the air having to change its direction and velocity, due to the passage of the airplane.

As we know, gravity is trying to pull the airplane back to earth so something must be preventing this. This something is called lift. Lift operates upward to conteract the downward force of gravity. When our airplane is flying level, going neither up nor down, the force of lift exactly equals the force of gravity. Since we do not get something for nothing, the deflection of the air molecules to create lift also generates considerable drag force.

Not having the engine like that of the powered airplane, our glider uses the potential energy it has, by virture of its height, to fly around the sky. Most times, but not all, we try to use this energy up as slowly as possible so we will stay in the air as long as possible. Sometimes, in order to fly faster, we use our available energy faster, in order to get to an area of external energy — a rising current of air — a thermal. But, regardless of whether the glider is rising in a thermal with respect to the ground, it is always **falling** with respect to the surrounding air. It must continually use energy to fly.

**Section 2 — How A Wing Lifts**

While driving in a car as a kid, I'm sure you have all held your hand out the window, and felt the force of the wind. If you rotated your wrist, so the front of your palm was slightly elevated, you felt an upward force on your arm. This rotation is called **positive angle of attack** which refers to the angle your palm makes with respect to the flow of air. A downward twist would be **negative angle of attack** and would cause your arm to be pushed down. Rotate you palm straight up and down, and your arm was almost broken by the rearward force. This is called **drag.**

A simple flat board with no curvatures can be made to lift, and serve as a wing, but lift will be only marginal, and the drag will be great. So we have learned, through experience, that airfoils add to the performance of wings. If we were to cut through a typical glider wing, the end (or cross-section) would look like Figure 1.

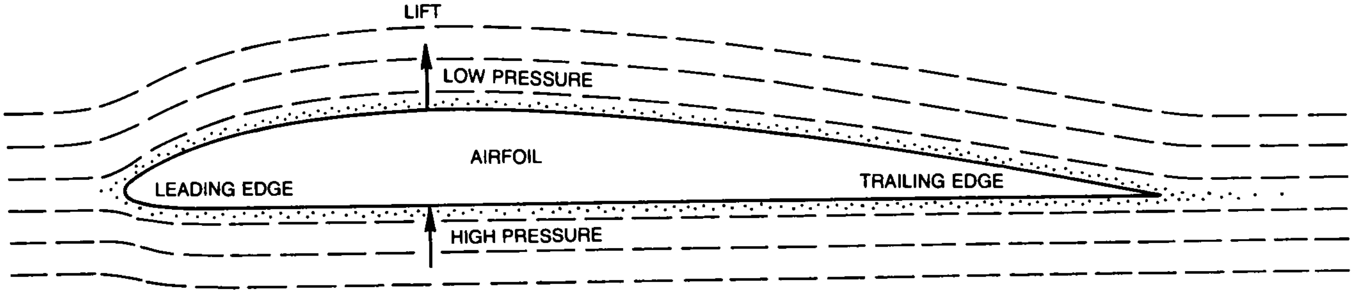



**FIGURE 1**
**AIRFLOW OVER AIRFOIL CAUSES LIFT**

This is called an **airfoil**. The leading edge is rounded; the trailing edge is sharp; the upper surface is curved, with the high point from 1/3 to 2/5 of the way back from the leading edge; the bottom surface is flat, or very slightly curved. An airfoil of this type generates about 1/3 of its lift from the lower surface and 2/3 of its lift from the upper surface.

How does it do this? As the airfoil-shaped wing moves forward through the air, the air separates at the leading edge and meets again at the trailing edge. If you will look at the airfoil in the illustration you will notice that the air must travel a greater distance over the top surface of the airfoil than the bottom surface. If it is to arrive at the trailing edge at the same time, it means that the air must travel faster over the top of the airfoil than the bottom. Due to a principle of physics called the Bernoulli Principle, the faster moving air on the top surface causes a lower pressure against the top surface than the slower moving air at the lower surface. As a result of this pressure differential, the wing tends to move from the higher pressure area on the bottom side, toward the lower pressure area on the top side. This upward movement is called **lift**.

As the air molecules move over the airfoil, both on the top surface and the bottom surface, they rub the surface, and are slowed by friction. This frictional force tends to hold back the airfoil in its flight, and is called **drag**. This frictional force occurs in a layer very close to the wing. This layer is called the **boundary layer**. If the air flowing in the boundary layer is flowing smoothly, it is called **laminar flow**. Sometimes the smooth flow of air will separate from the surface, and the boundary layer will fill with turbulent air currents. Sometimes turbulent boundary layers are caused by surface roughness. In any case, a turbulent boundary layer causes more drag than a laminar flow layer. However, for reasons beyond the scope of this discussion, turbulent flow may be desired on model wings, and airfoil geometry, and/or surface roughness, is sometimes deliberately introduced to generate a turbulent condition. A number of other types of drag are generated having to do with how a particular airfoil or wing form disturbes the air through which it is traveling. The way the air leaves the trailing edge of the wing, and rejoins air from the opposite surface, creates a **wake drag**. Air flowing off the wingtips generate swirling air currents called vortexes causing **tip drag**.

The geometry of the airfoil and wing shape has a very complex relationship with the air in which it flies. Changing any of the shapes or dimensions of a wing, or even the speed at which it flies can have a profound effect on the lifting, or drag characteristics of the wing. The designer can, at will, change the performance characteristics. However, the expression ''you can't get something for nothing,'' is especially true in aerodynamic design. An improvement in one area results in degradation in another. The designer, therefore, must reach a compromise between what he wants, and what he doesn't want.

One other problem plagues the model glider designer. Much theoretical and wind tunnel work has been done on wings at higher speeds. Unfortunately, results obtained at higher speeds are not valid at the low speeds of model gliders. A measurement called the **Reynold's Number**, having to do with size and speed of the airfoil comes into play. Increased interest in low speed characteristics of airfoils for energy producing devices, such as windmills, is generating new data.

### Section 3 — How Airfoil Lift Can Be Varied

When we stuck our hand out of the car window, we noticed that the faster the car was traveling, the more lift that was generated. Also, as we rotate our wrist, increasing the positive angle of attack, more and more lift is generated. At some point, however, lift seems to be suddenly lost, and our hand is pushed backward with pure drag. Referring to the airfoil shown in the drawing, if it is at a negative angle of attack, with respect to the air flow, negative lift is generated and the airfoil is pushed down. As we rotate the airfoil clockwise, less and less negative lift results. At some point, usually a slightly negative angle, there will be zero lift generated, and the airfoil is pushed neither up nor down. As the airfoil is further rotated, positive lift is generated, and it is pushed upward. Lift continues to increase with further rotation, until it reaches a maximum point. If the airfoil is rotated further, the air flowing over the upper surface acheives complete separation from the surface and swirls and eddies in complete turbulence. At this point, lift is lost from the top surface, and the wing has only that small lift generated by the bottom surface. Drag goes up, and the lift to drag ratio falls dramatically. This point is called the **stall** angle. When a glider wing reaches the stall angle, the nose generally drops, and the ship may fall ten or fifteen feet before it recovers. Some wings stall very gently, others stall violently, to the point where the glider can flip over on its back. Just remember, a wing can stall at any speed, as long as the stall **angle** is exceeded. People make the mistake of believing that planes stall when the speed is too low. The reason for this error is that to the casual observer, it **appears** that slow speed is the fault when a ship stalls. As the plane is slowed up, lift goes down. To compensate for the loss in lift due to speed, the angle of attack of the wing is increased, to generate enough lift to support the airplane. This process is continued, until the wing exceeds the angle where stall occurs, and it does indeed stall.

One type of stall, often seen in model gliders, is called **tip stall**. In a tip stall, the outer end of the wing panel reaches a stalled condition before the inner panel. The stall usually progresses down the wing, from the tip to the root. This type of stall is very undesirable. It often occurs during launch. The glider veers wildly to one side, and it requires quick, and drastic corrective measures to prevent a crash. Sometimes it occurs during a low-speed turn, and the glider will nearly flip on its back. Proper wing design will prevent this condition by causing the wing to begin a stall at the root, progressing outward to the tip. One method of preventing tipstall is to use **washout** in the end of the wing panel. This means that the wing tip is permanently twisted so that the leading edge is lower than the trailing edge. As the angle of attack of the tip is now always lower than that of the inner wing, the tip will stall last.

**Section 4 — Center of Pressure**

We talked before about lift being generated by a pressure differential between the top and bottom surfaces of the wing. This pressure differential changes from place to place on the airfoil, and depends on the shape of the airfoil, which affects the velocity of the air at any given spot. The amount of lift generated is generally higher at the front part of the airfoil than at the rear. It is convenient to not think about all these small areas of lift, but pretend they are replaced by one big lifting force, at one spot on the airfoil. This spot is called the **Center of Pressure**. Pulling up at this spot would make the wing behave exactly as it really does with upward pressures all over the wing.

One bothersome point is that, with different angles of attack, this center of pressure changes location because of a changing pressure pattern over the wing surface. As the angle of attack increases, the center of pressure moves forward which tends to further increase the angle of attack, and the wing will rotate. If you take just a wing panel and try to glide it, the panel does not glide, but will turn over and over, all the way to the ground. So, to be useful to us, we must make the wing stable and keep it from rotating.

**Section 5 — Wing Stabilization**

Flying wing designers have obviously solved the wing instability problem. In a flying wing, the airfoil is so designed that as the angle of attack increases; the center of pressure moves rearward, opposing the increase. This is normally done with an up-curve in the trailing edge. This is called a reflex airfoil. In this solution to instability, one characteristic of the airfoil fights another to keep things in balance. Despite claims to the contrary, flying wings are less efficient than conventional designs and are usually not competitive in model glider competition.

The more conventional way to stabilize the wing is to add another small wing, called a stabilizer, at a distance behind the wing. The stabilizer has another important function — that of changing the angle of attack of the wing. To increase the angle of wing attack, the stabilizer incidence is decreased. This forces the stabilizer down, which increases the angle of the wing. To decrease the angle of the wing, we increase that of the stab, causing it to become a lifting surface which raises the tail and decreases the angle of the wing.

**Section 6 — Rudder Action**

The rudder of a sailplane performs the same action as it does on a boat. In order to turn the plane, sideward lift is generated by the rudder, usually located over the stabilizer, aft of the wing. This points the nose of the airplane in the desired direction; which is called **yawing**. Unfortunately, this action will not satisfactorily turn an airplane. We need to tilt the plane in the direction of the turn. This prevents the plane from just skidding. This tilting is called **banking**. A plane with just rudder and elevator control has no pilot-controlled way to cause the plane to bank in a turn. We must, therefore, build in some automatic banking method. This is done by means of **dihedral**. Dihedral means that each side of the wing is bent up so that each tip is higher than the root. If we were to hold up a glider having dihedral, looking directly at the nose, and turn it a bit, we find that we see the bottom of the wing nearest us, and the top of the far wing. This means that when we yaw, or turn a glider, the forward wing has a greater angle of attack than the rearward wing. The wing with the greater angle of attack has more lift and, therefore, rises and the glider rolls into a bank, which is what is desired.

Another method of banking is by the use of ailerons. These are a section of the trailing edge, hinged at the front edge as shown in Figure 2.

The ailerons are normally deflected in opposition; that is, when the right hand aileron is raised, the left hand aileron is lowered. Air pressure on the lowered aileron causes that wing to rise. Air pressure on the raised aileron causes that wing to drop, causing a rolling action which banks the airplane. This does not turn the airplane. The rudder must be also deflected in the direction of the lowered wing to cause a yawing, or turning motion in the direction of the lowered wing. Many times, in gliders which use ailerons, the rudder is coupled to the ailerons so that one control action moves both in a coordinated fashion. This automatically produces a smooth, coordinated turn, requiring only one control lever.

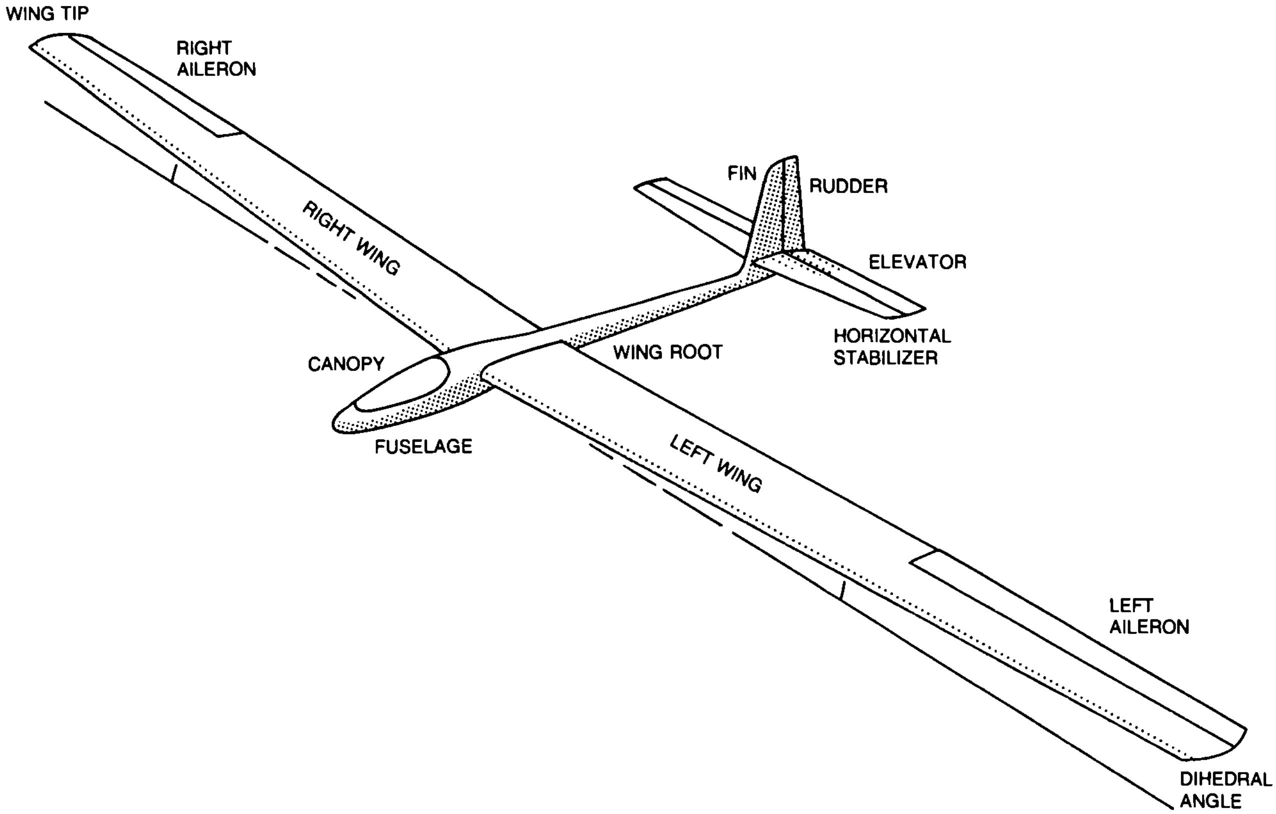



**FIGURE 2**
**PARTS OF A SAILPLANE**

## Section 7 — Maximum Glide Angle versus Minimum Sink Rate of Sailplanes

We talked before about how the lift of an airfoil varied when we changed the angle of attack. As the angle is increased relative to the flow of air, the amount of lift generated increases. The drag, created by the wing, also increases. At that point of negative attack (zero incidence), where the wing is generating no lift at all, the glider will dive straight into the ground. As we increase the angle of attack, the ship will glide farther and farther. The glide angle of the glider is represented by the ratio of Lift/Drag, or L/D. If the lift is increasing faster than the drag, the glide angle of the ship becomes flatter and flatter, and it will glide farther and farther. This is exactly what happens: as the nose of the glider is raised, the angle of attack increases and the ratio of L/D increases. At one particular angle, however, the drag begins to increase faster than the lift, and the ratio of L/D and, therefore, the glide angle reaches a maximum. This is an important concept to remember. Another point is: from the zero lift setting at which the plane dove into the ground, to the setting of flattest glide angle, the glider was flying slower and slower.

As we continue to increase the angle of attack, the ship continues to slow down. However, as the L/D ratio is now decreasing instead of increasing, the glide angle begins to worsen. As the angle of attack continues to increase, a point is reached where the airfoil airflow becomes suddenly turbulent and drag increases rapidly, with lift dropping dramatically. This is the stall point we talked about earlier. The nose of the glider will normally fall, and it will lose altitude rapidly.

At an attack angle between the maximum L/D point and stall, is another angle of attack of interest; it is the point of minimum sink. At this angle, the ship will not travel as far or go as fast, as at the maximum L/D point, but it will stay in the air longer. This is the point of minimum energy dissipation, and is a useful setting for climbing in thermals or staying up in light slope lift.

### Section 8 — Flaps

On some gliders a long strip of the trailing edge of the wing is hinged, permitting it to be raised a few degrees and lowered as much as 90 degrees.

The basic purpose of flaps is to permit an in-flight modification of the airfoil. If the flaps are raised slightly above the zero position, the speed of the glider will increase and it will penetrate into wind better. As flaps are lowered, the airfoil bottom becomes **undercambered**, or concave, and lift will increase, which is useful when in thermals or in take-off. When lowered all the way, flaps become an air brake as they create a tremendous amount of drag. This is useful to slow the ship to a safe airspeed when diving out of a thermal, or to slow the speed for landing.

### Section 9 — Spoilers

On some gliders you will notice a fence that pops up out of the top (and sometimes the bottom also) of the wing as shown in Figure 3.

These are called spoilers. As they are deployed, they do two things: they **spoil** the lift in that area of the wing but, even more important, they add a great deal of drag to the glider. This combination destroys the L/D ratio and changes the glide ratio from 10-12:1 to about 3:1. Spoilers are used to control the descent rate when landing, so that the ship can be more easily landed on a particular spot.

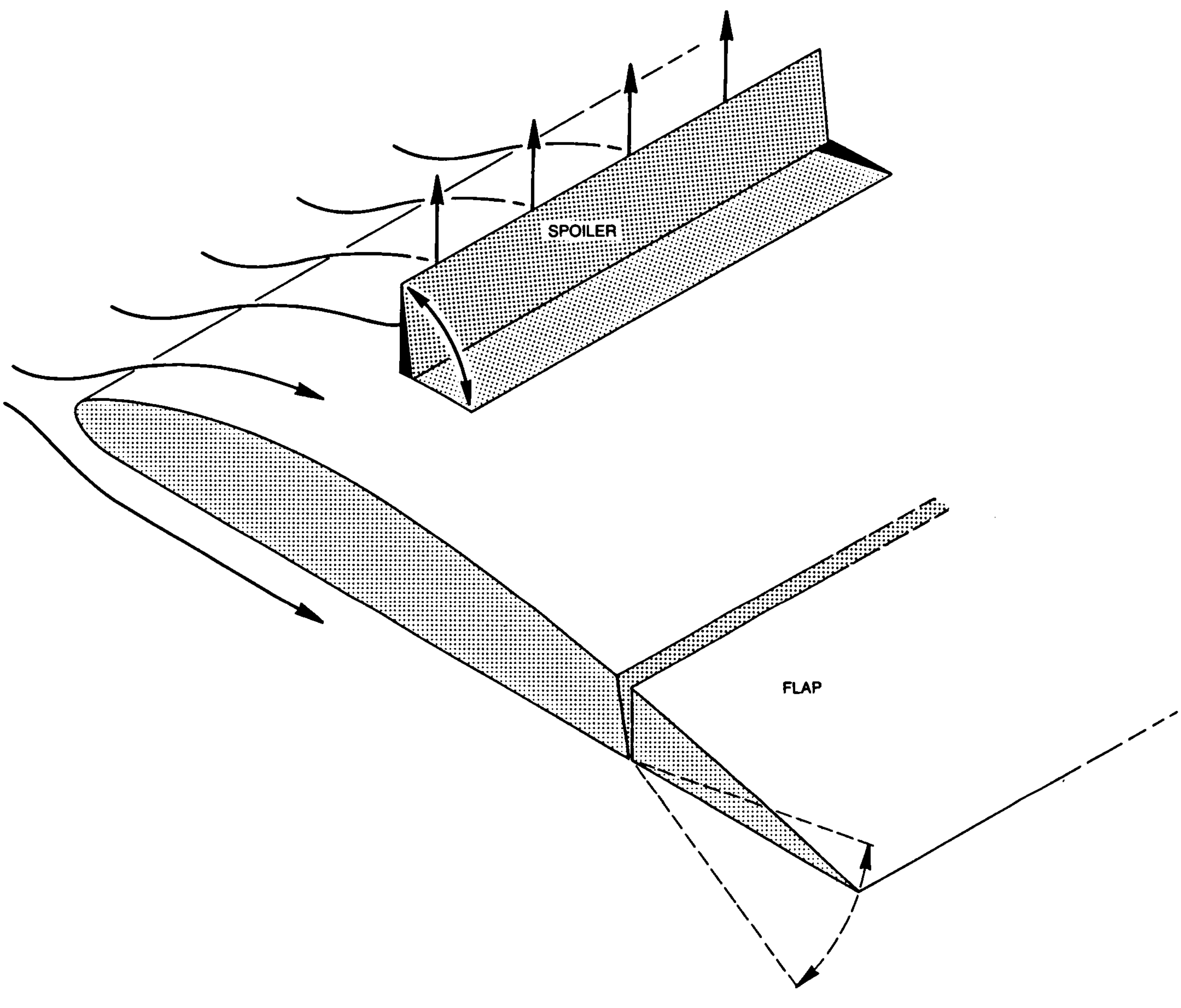



**FIGURE 3**
**FLAPS AND SPOILER CONFIGURATION**

**Section 10 — Trimming An R/C Sailplane**

This section is included in this chapter so you can think about it while the terms and concepts are fresh in your mind. You won't want to put them into practice until you have become a little experienced at flying — at least experienced enough to detect changes in flying characteristics. There are really only three things you can adjust: lateral balance, decalage (the angle between the wing and the stabilizer) and Center of Gravity.

First of all, lateral balance is easy. This just means you must make sure that one wing is not heavier than the other. You will, of course, check this every time you build a new airplane. You should also re-check it each time you make any repair to either wing. Before covering the wings, suspend the assembled ship by the nose and tail. There should not be a tendency to drop one wing. If there is, tape a weight to the light tip. Add or remove weight until balance is achieved. Now, epoxy the weight in position on the tip spar (in front of the spar to help statically balance it). If the wing is already covered, drill a hole in the wing tip or remove the covering from the lower panel to add weight. Do not skip this procedure or you may have a glider that needs a mysterious bit of rudder trim in order to fly straight.

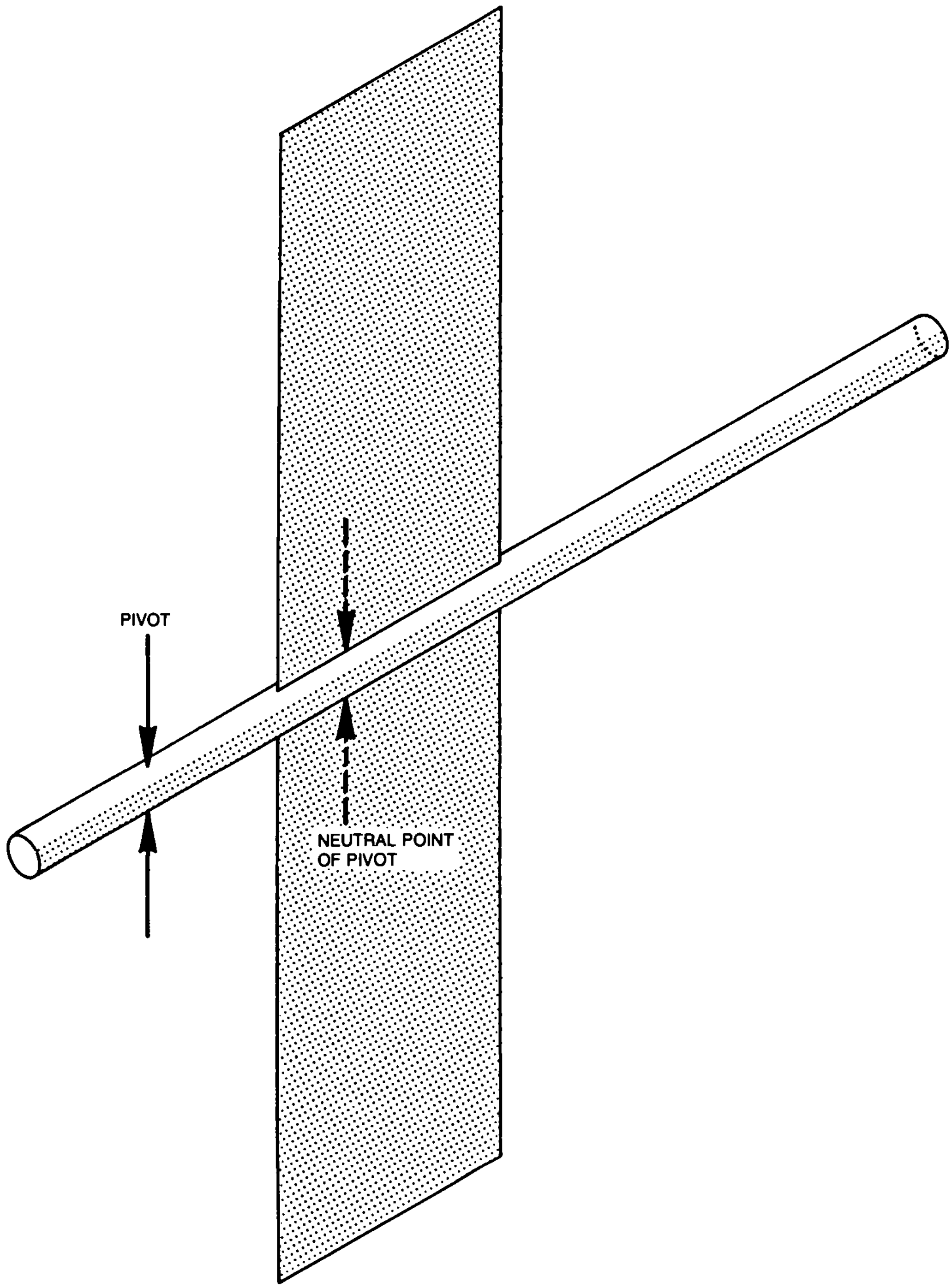



FIGURE 4
WEATHERVANE ILLUSTRATES NEUTRAL POINT

Before adjusting the Center of Gravity, check the decalage. This is the incidence angle of the wing with respect to the stabilizer. The correct angle can be obtained from the side view of the plans. Most designs try to establish this angle with some foolproof construction method. I have found, however, that it is possible to circumnavigate all these methods, and do it wrong. If you find the angle is not correct, you may have to shim either the stabilizer or wing or modify the fuselage or stabilizer platform support by sanding. If the stabilizer design is of the flying stab type (i.e., the whole stabilizer rotates instead of having an elevator section at the rear), there is no adjustment necessary. Adjustment is with the transmitter trim lever. You should, however, in this case, mark the center position on the fin so you can easily make initial adjustment.

The exact position of the Center of Gravity is **somewhat** a matter of preference. The C.G. position is commonly measured in percentage of wing chord. Its effect, however, is related to its position ahead or behind a thing called the **Neutral Point**. As we remember, gravity is the force that holds us on the ground and pulls our gliders out of the air. Even though gravity is pulling on every piece in our glider, we can, to simplify things, replace all these forces pulling all over the glider, by just one big, force pulling at the centroid of all these little forces. Like the equator, C.G. really doesn't exist. C.G. is the exact spot where, if the whole world grabbed onto our glider, it would behave exactly like it does with all those little forces acting all over it.

C.G. is rather like the pivot point of a weathervane. As we add nose weight to our glider, it would be like moving the pivot point of the weathervane forward. As we remove nose weight from our glider, it would be like moving the pivot point back. As shown in Figure 4, if the pivot point is ahead of the vane, the weathervane will point into the wind. As we move the pivot point back, a point is reached where the weathervane doesn't know which way to point, and the system goes unstable. This point of instability is called the **Neutral Point.**

**On aircraft, the distance between the C.G. and the Neutral Point is called the Static Margin**, and is measured in wing chords. In our glider, as we move the C.G. rearward, we reach a point of weathervane instability and our system starts going bananas. The result is the familiar "nose light" glide which is not the result of a stall, but the system instability. This switchback motion is called Phugoid motion, and generally increases in violence as drag goes down. In a clean model, Phugoid may set the maximum glide angle that can be obtained. This somewhat over-simplified explanation was presented to a DCRC Symposium of R/C models in 1958 by Norman K. Walker and seems quite lucid.

Now that we have defined a few things, let's let Ken Banks of the Torrey Pines Gulls Club tell us about the effects of C.G. movement.

*For slope aerobatic flying I prefer a C.G. only slightly forward of the Neutral Point. If you dive such an airplane, it will stay in the dive until you give up-elevator to pull out. Left to itself, it would require perhaps 700-1000 feet to pull out. Such a C.G. makes it easier to fly precise maneuvers as you are not obliged to make additional control inputs to compensate for the aircraft's attempts to pull itself into level flight. For sport flying and thermal flying, a slightly more forward C.G. is desirable as you do not want to have to correct for the effect of every gust. However, an excessively forward C.G. has undesirable effects. First, the aircraft recovers very quickly from any pertubation and may overshoot, and either stall, or make repeated short dips and climbs. Secondly, if the C.G. is far forward, considerable down-force will have to be exerted by the stab. The stab must, in other words, act as a wing flying at a negative angle of attack, lifting downward. The generation of negative lift subtracts from the wing lift to reduce the total lift generated by the airplane, and also may result in additional profile drag from the stab, both of which cause a reduction in performance of the airplane. The drag discussed here is called* ***trim drag****. Too far aft a C.G. may also be ineffective, as the stab is forced to lift. This does not sound bad at first, but the stab makes a poor wing because of low Reynold's Number, and/or aspect ratio. As the stab angle is increased, the penalty in drag for this lift eventually becomes worse than the benefit from the lift.*

*You can get an idea where your C.G. is, in relation to the Neutral Point, by making a dive test. Trim the aircraft in level flight. Now, push over into about a forty-five degree dive. Stabilize the aircraft in the dive (usually this means backing off the down-elevator from the amount used in the initial pitch-over). The idea is to establish a steady straight dive, for ten feet or so. Then freeze the stick position and observe the aircraft trajectory. If the dive steepens of its own accord (tucks), the C.G. is behind the Neutral Point. If it continues on a straight line, the C.G. is just on the Neutral Point. If the aircraft pulls out by itself, the C.G. is forward of the Neutral Point, and the faster the pull-out, the more forward. Be careful, especially with aircraft wings, with undercambered airfoils. They often have an uneven center of pressure movement with angle of attack. For a given C.G., they may be stable at high angles of attack and unstable at low angles. In other words, at low dive speeds they will pull themselves out, but if you hold the dive to high speeds (low angles of attack), they may tuck.*

Ken also warns us to start this whole thing high enough so as not to run into the ground, and take it easy on pull-out so as not to rip the wings off. So, to review what Ken said: If we start with the decalage and C.G. position shown on the plans, and start adding nose weight, the sailplane will become more and more stable. The elevator will become less and less sensitive. As we continue to add weight, flying becomes tutti-fruitti. The ship becomes inclined to stall around the sky, and the glide worsens. Of course, as we added nose weight, we had to add compensating up-trim. This is why our nose heavy ship will recover from a dive very quickly. The extra up-elevator serves to pull the aircraft out more rapidly after it is put into a dive. If we go the other way and start to remove weight, we find the elevator becoming more and more sensitive. You will eventually start to notice that the plane is harder to control, and will tend to stay in a dive until deliberately pulled out. As we continue to remove weight, the ship will again go tutti-fruitti, and you will have to fight to keep it straight and level. Again, as we removed nose weight we had to add down-trim to the elevator to hold level flight.

In moving the C.G. fore and aft from the nominal position we find, in most gliders, a fairly broad region of perhaps one half to three-quarters of an inch where the ship is stable and seems to fly well. It is within this region that personal preference comes into play. If you are a new flier and want a ship that will sort itself out of trouble without too much help, lean toward the forward end of the range. If you want an efficient machine, it may help to adjust the C.G. as far aft as you can stand comfortably. Ken Banks gives us some advice when moving the C.G. rearward.

*You will find another effect as the C.G. is changed. The closer the C.G. is to the Neutral Point (the further aft), the less elevator movement is required for a given response. This leads to a common error when trimming an aircraft. As the C.G. is moved back, the airplane seems to become too "unstable" in pitch, as it is hard to fly smoothly. The problem may* ***really*** *be that there is too much elevator travel, and you will find the airplane easier to fly if you simply move the pushrod out on the elevator horn.*

Now that we understand a little better how C.G. affects the way our glider flies, it's time to talk about the effect of elevator trim on flight performance. There are two trim positions in sailplanes that is of high interest to the pilot. The first produces the flattest glide angle. The second produces the minimum sinking rate. The first is called a maximum L/D glide, and is attained when the angle of attack of the wing is such that the ratio of lift to drag is at maximum. The minimum-sink glide is attained when the airplane is flying very slowly — near to stall. It is the minimum-sink glide that will give the lowest possible descent rate under given conditions. Although you might think that you always want to have your sailplane adjusted to come down the slowest, this is not the case. When you are flying in rising air, such as a thermal, you want your sailplane adjusted to sink the slowest. It will, therefore, go up the fastest. If, however, your plane is in sinking air, you don't want to sit there and sink the slowest — you want to get the heck out of there in the most efficient manner — at maximum L/D.

Writing in the "South Bay Soaring Society News" of November 1979, Ian Turner describes these two conditions very clearly.

*Having found a comfortable C.G. position, how can we use the trim controls to the best advantage? Let's just run through the observable effects as we go from very under elevated to the stall point. To begin with, when pushing the trim (or stick) hard forward, the model flies fast and comes down very fast! The wing is made to operate at a very low angle of attack and its drag is lowest. Unfortunately, so is the lift, with the resulting lift over drag ratio being poor.*

*As the trim is moved back, the plane slows down and its angle of descent reduces. At some point the glide reaches its flattest. The model is still flying quite fast and is not near a stalled condition. This point is the so-called best lift to drag ratio. Interestingly, it is not the point of minimum sink because, although the glide angle is the flattest, the model is flying quite fast down the glide slope. However, it is the point of maximum distance coverage and is, therefore, the trim to use when trying for distance or moving between thermals. As the trim is moved back further, the flying speed reduces more and the glide angle increases (becomes steeper). Just before the stall, the wing is at its highest angle of attack, and it can be shown that the plane is in a condition of minimum energy dissipation and, hence, minimum sink . . . One of the confusing things about this condition is that the glide angle may appear (it is) much worse than the optimum and this can give the illusion of high sink. If you have fallen into this pitfall, I suggest you try timed flights from two launches (on a day without too much thermal activity), one trimmed at best glide angle and one just off the stall. The difference in time may be as high as 25% better for the near stalled condition!*

*At this point, I'm sure some of you are saying to yourselves, "What, no mention of Reynolds Numbers?" Well, as usual, Reynolds Number effects can completely upset the above statements, so I will make some remarks. Since the flying speed can be greatly different between minimum sink and best glide ratio, it is possible for a very clean model (such as the Aquila Grande) to be operating sufficiently fast at best glide angle that the performance of the airfoil is improved significantly compared to that at minimum sink because of operating at a higher Reynolds Number. In this case the sink rate may be little different between the two cases.*

So, there you have Mr. Turner's thoughts. So what do we do about all this interesting information? It would be convenient to have the transmitter elevator trim-tab trim to minimum sink in full up-trim position and to maximum glide in another known position, say, in neutral (assuming your pushrods don't change length with temperature). Making measurements to determine these two positions is not easy.

Blaine Rawdon, writing in the August, 1979 issue of "Model Aviation," the Official Publication of the Academy of Model Aeronautics, describes a measurement program conducted by the Research and Development Committee of the San Fernando Valley Silent Flyers Club. The data collected enabled this group to determine minimum-sink and maximum-glide speeds of several sailplanes and was done about as well as could be by a club group. It still required six people and two inclinometers of modest accuracy. The tests were run at dawn. Now I can, by using several six-packs as bait, assemble six people. I have sufficient motor skills to assemble the inclinometers. The thing that puts me right off is this dawn business.

Don Edberg of San Diego, has used a measurement technique which, while yielding only minimum-sink trim, can be done by one, or at most two, people. Don uses a short hi-start of perhaps two hundred foot length. He tethers the parachute back to a spot somewhat in front of the launch position, using a hundred feet or so of light string or monofilament line. This tether will provide a constant-altitude release point. The plane is then launched and flown in wide circles without touching elevator, using the rudder trim control only. Flights are made at several elevator trim positions from near stall to fast flight. Each flight is timed. Several flights are made at each setting and the averaged time is used. If the sailplane has a flying stabilizer, each setting should be marked on a piece of masking tape stuck to the fin. If the sailplane has an elevator, the angular deflection should be measured. You will find that one trim setting gives longer average flight times than any other. The transmitter full up-trim position can now be set to this trim position. I forgot to tell you that these measurements must also be made in dead air, very early in the morning (again at dawn). A rough measure of maximum L/D might also be made by finding the trim setting that gives the most distance on an out and back course, or around a constant radius course around the pilot.

Now, if you are lazy like me and believe that only roosters should get up at dawn (us chickens like to stay in bed), you will end up estimating the whole thing. Knowing that the minimum-sink angle of attack is just below stall, set the full up-trim on your transmitter to this setting. This can be done by flying across the field in front of you and pulling back the elevator trim until the sailplane begins to mush; now push the trim lever forward a bit until the plane is flying slowly but in a stable manner. Land and mark this stabilizer or elevator position. Adjust the stabilizer to this position with full transmitter up-trim. Now, when in a thermal, it is easy to find the trim where **most** sailplanes will thermal best.

Finding the angle of attack for best glide angle is tougher. You just have to fly the plane back and forth in front of you and vary the trim until your best guess is that the glide is most flat. On some sailplanes you can "see" the right setting. In his description of flying the "Bird of Time," sailplane designer Dave Thornburg says:

*To find that magic setting, you need flat morning air, preferably calm. I can't tell you just where the setting is, but I guarantee you'll know it when you find it: the plane will speed up a little and "go on step" and the L/D will appear to double.*

I can vouch for this statement — I've seen it happen.

When you find what you think is the best setting, mark your trim lever on the transmitter. It is convenient if this position is at neutral, then you can find it without looking. This position will be the one to use when you are cruising around the sky looking for thermals — or trying to get back home from too far out. Of course, these settings are only good if your pushrods don't change length with temperature. This means balsa or metal pushrods — but that's a whole other subject.

### Section 11 — Adding Weight To A Sailplane To Improve Its Performance

This just doesn't sound right, does it? One specification of sailplanes (and also other types of planes) is called wing loading. For models (in the United States), it is commonly given in ounces per square foot. It is found by dividing the gross weight of the glider in ounces, by the wing area in square feet. For R/C sailplanes it runs from about 5½ for very light floater types to as much as 24 for a slope speed job.

Why add weight? To make it go faster. When wing loading is increased, and the angle of attack of the wing is held constant, the plane must increase its speed to generate enough additional lift to support the added weight. Within a wide range of wing loadings, only the speed varies. The glide angle remains the same. The sailplane will glide just as far — it just gets there faster. The speed will increase by the square root of the increase in wing loading. If you were to double the wing loading, the speed would increase to the square root of 2 or 1.41, to 1.41% of the unloaded speed.

Aside from making speed runs, the time added weight is desired, during windy weather, both for slope and thermal flying. In order to cover ground, it is necessary to be able to penetrate the wind. Hence, the requirement for greater speed. It is not just for contest flying that this requirement exists. Many sport fliers lose much of the ability to enjoy windy weather flying because they do not know how much performance can be improved with increased wing loadings. It also helps to stabilize the plane during windy landings. The weight should be added either on the Center of Gravity, or distributed either side, so that the balance is not changed. It must be securely fastened to some rigid structure, so as not to move during flight or landing. It doesn't enhance the sailplane flight characteristics to have a half-pound weight slide two inches to the rear upon launch. This same half-pound of lead makes an excellent bulkhead remover, when it flies around during landings.

So, these are a few aerodynamic tidbits for you to chew on. You probably didn't understand all the points, it's a big mouthful to chew early in the game. After you get a bit of flying under your belt, you may want to come back and re-read this chapter. With a bit of flight time, some of the points will be more clear.

So, on to the fun of getting your Oly 650 in the air.

# CHAPTER X

## LAUNCHING EQUIPMENT

There are many ways to coax a sailplane into the air. One way is with a hand tow. A small ring is tied to about 400' of monofilament fishing line. The ring is hooked to the tow hook and a runner to the other. With no wind, the runner needs good legs to get the sailplane up to altitude. With a bit of wind, it isn't so bad. The launch takes a bit of coordination; you can't throw the sailplane or it will become unhooked. This method is much more popular in Europe than in the United States. Another method is to tow the sailplane up using a powered model. This requires a reasonably large and powerful powered model, preferably a high wing design. Line connection should be made to the top of the wing at about the spar line. The line is connected to the nose of the glider. It is preferable if both ends of the line can be disconnected by radio. In this way, either pilot can terminate the tow. At any rate, the sailplane end needs controlled disconnect. Take-off is critical, and the sailplane must take-off first and stay slightly above the powered tow plane. An electric, or a fuel powered model airplane engine can, of course, be attached to the sailplane for launch power. These are described in another section of this book.

**Section 1 — The Hi-Start**

By far the most popular launching method in the United States, aside from tossing the plane off a slope, is the hi-start launch. This is essentially a giant slingshot which propels the sailplane into the air by means of a long length of elastic tubing. The hi-start consists of about 100' of elastic surgical tubing with 3/16'' inside diameter and 1/16'' wall thickness; 400' of 30 pound test monofilament fishing line; a parachute; a stake; and some fishing swivels. The parachute provides drag to release the line from the sailplane.

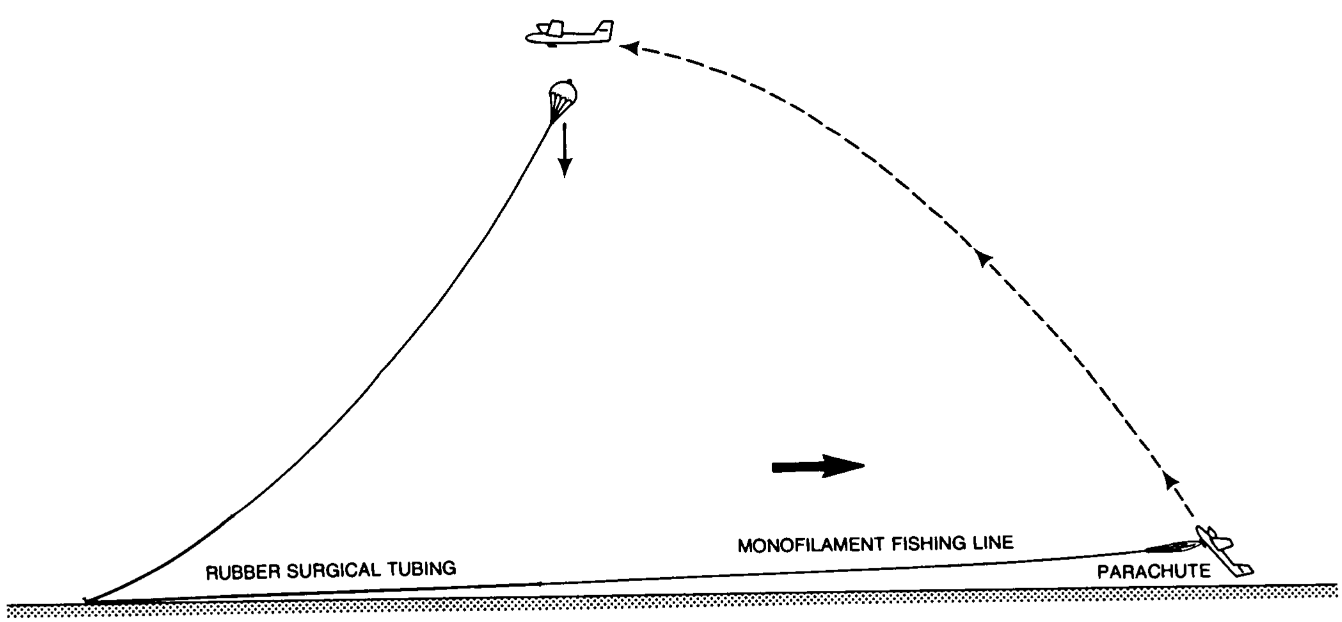



**FIGURE 1**
**HI-START CONFIGURATION**

All of the components for assembly of the hi-start are available in even the smaller cities, if the flier wants to assemble his own. The problem revolves around the cost of the surgical tubing. I suspect that most surgical supply houses where Joe Flier would have to go to get the tubing are used to selling to hospitals at inflated prices, and you can't get there from here. A call to two surgical supply houses got quotes of $50.00 and $60.00 for 100' of tubing. A quick check of discount prices told me I could get the whole complete hi-start for around $40.00, and just the tubing for $20.00. Anyway — you can make the parachute and the fishing type components are readily available; the stake is a 10'' spike or tent stake or screwdriver.

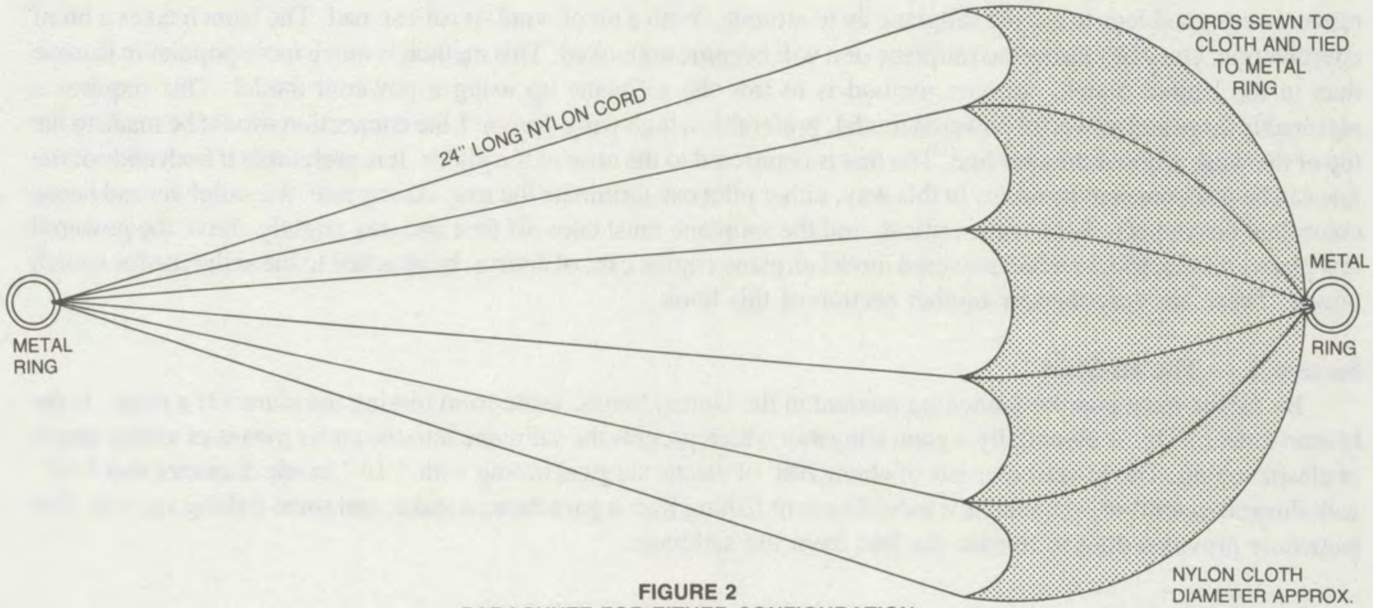
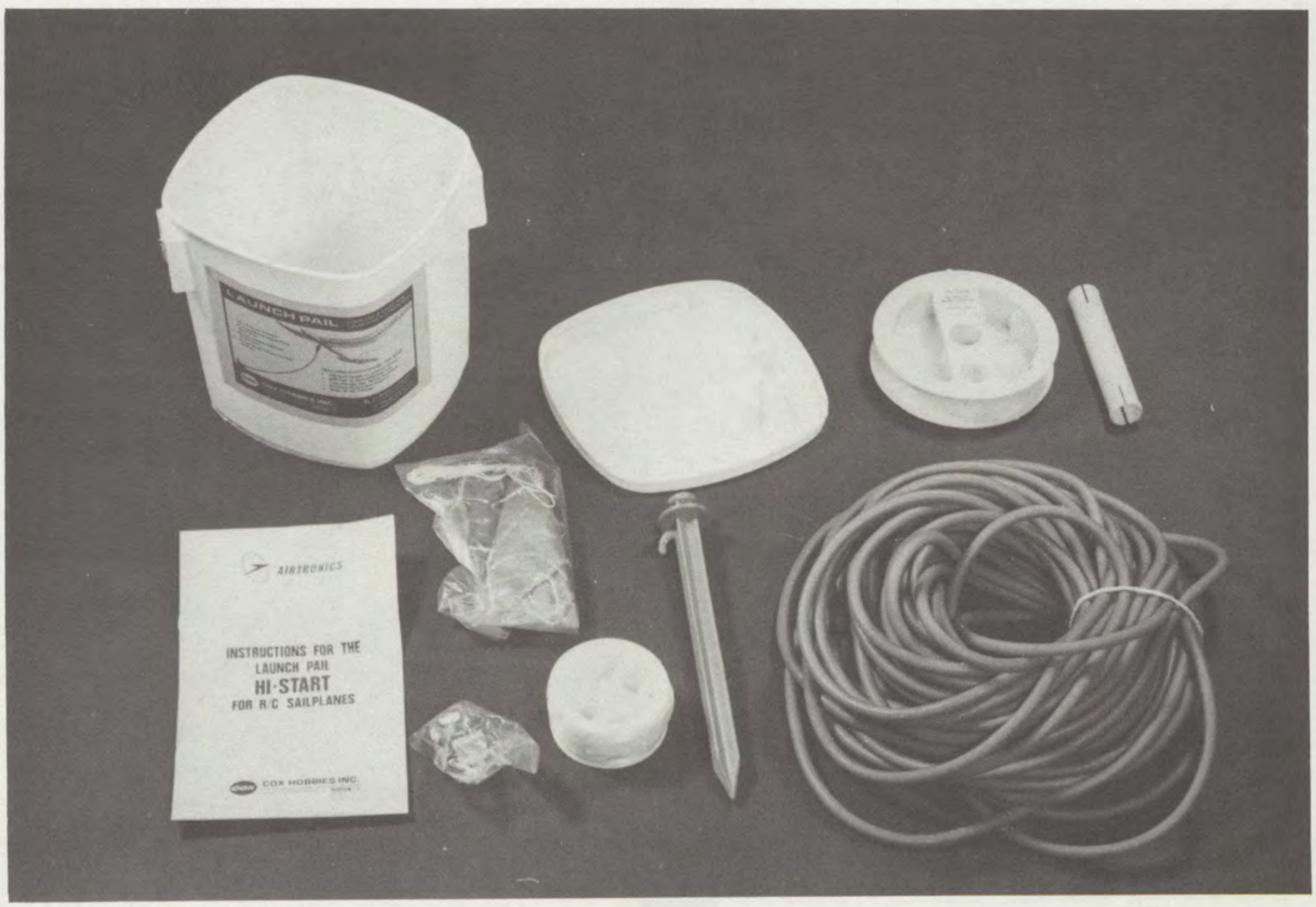



**FIGURE 2**
**PARACHUTE FOR EITHER CONFIGURATION**

You need a reel for the line and a reel for the surgical tubing so unless Uncle Harvey owns a surgical supply house, I guess my recommendation for the day is — buy a hi-start.




***Airtronics' commercial hi-start.***

I suggest you buy a heavy duty hi-start. It will be zippy for your beginning gliders but if you keep it out of the sunlight when not in use and dry it off before putting it away (dusting with talcum powder), it should last for three to five years.

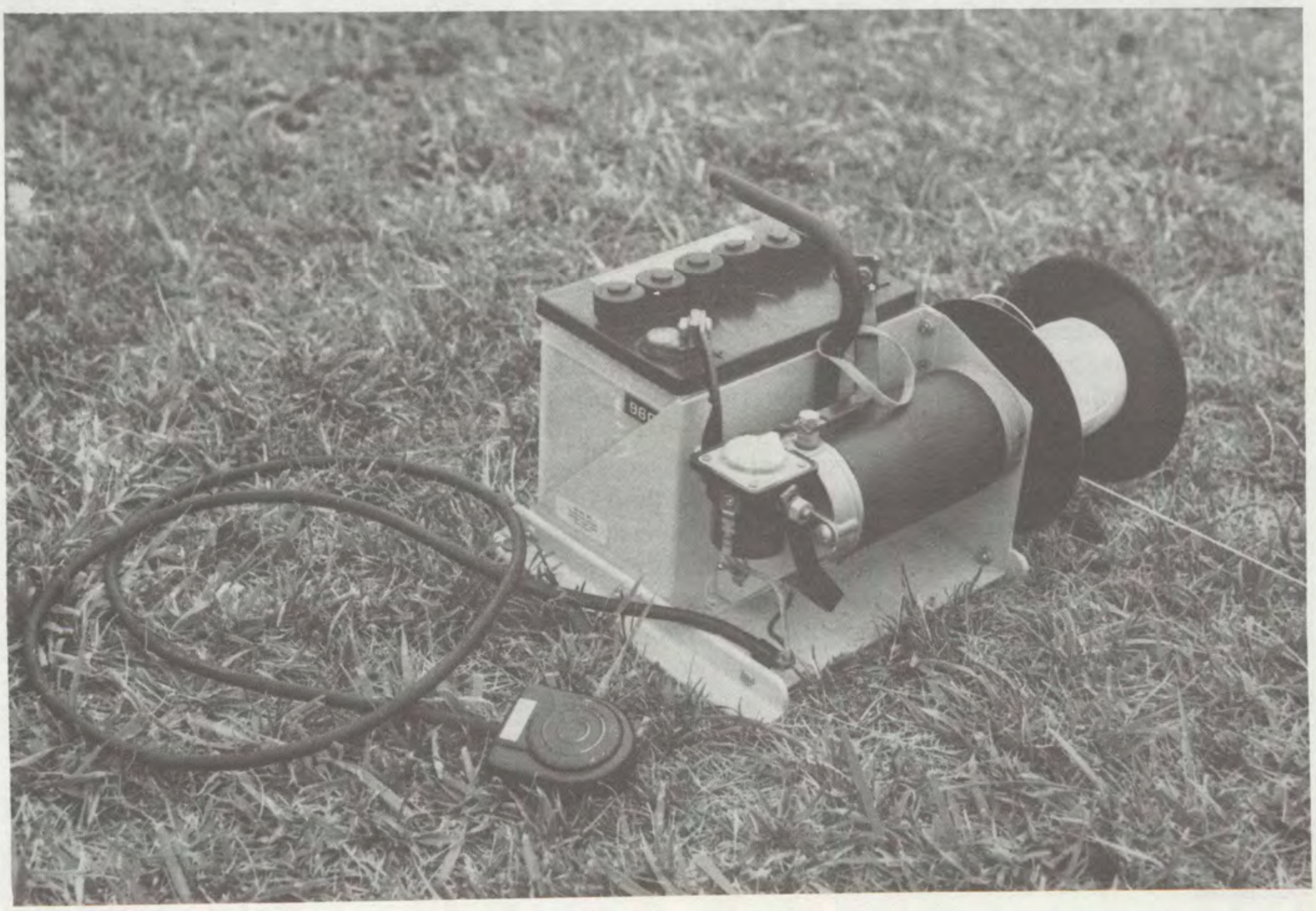
**Section 2 — Electric Winches**

Electric winches have two advantages over the hi-start; they are much more powerful and, once set up, are more convenient to use.

One big problem with the hi-start is that if you fly on a field with any kind of brush, weeds, or other obstructions, the line will invariably be blown to one side or the other and get tangled in the bushes. It must then be sorted out after every launch. If more than one hi-start is set up, one will blow across the other and a delay ensues while they are uncrossed. After each launch, the electric winch is run down, either by the flier or a helper, so the parachute is pulled near the turn-around. The line may then be pulled straight back to the launch area.

Disadvantages of the electric winch are: initial cost, maintenance cost and the weight and bulk of the unit. By the time you buy the battery and line, a commercially built winch will cost about $250.00, at the time of writing.

Batteries must be recharged with each use and replaced every three or four years. And the darned thing weighs about 75 pounds. Getting it in and out of the car is a grunt and if you have far to haul it once you're at the field, you need a dolly. But — they are indispensable for getting large sailplanes in the air and, after you get used to using one, are easier to use than a hi-start. If a group, such as a club, buys or builds one, the cost isn't so bad.



***Fab Tec commercial winch.***


*Mark's Models electric winch.*

**Section 3 — Building An Electric Winch**

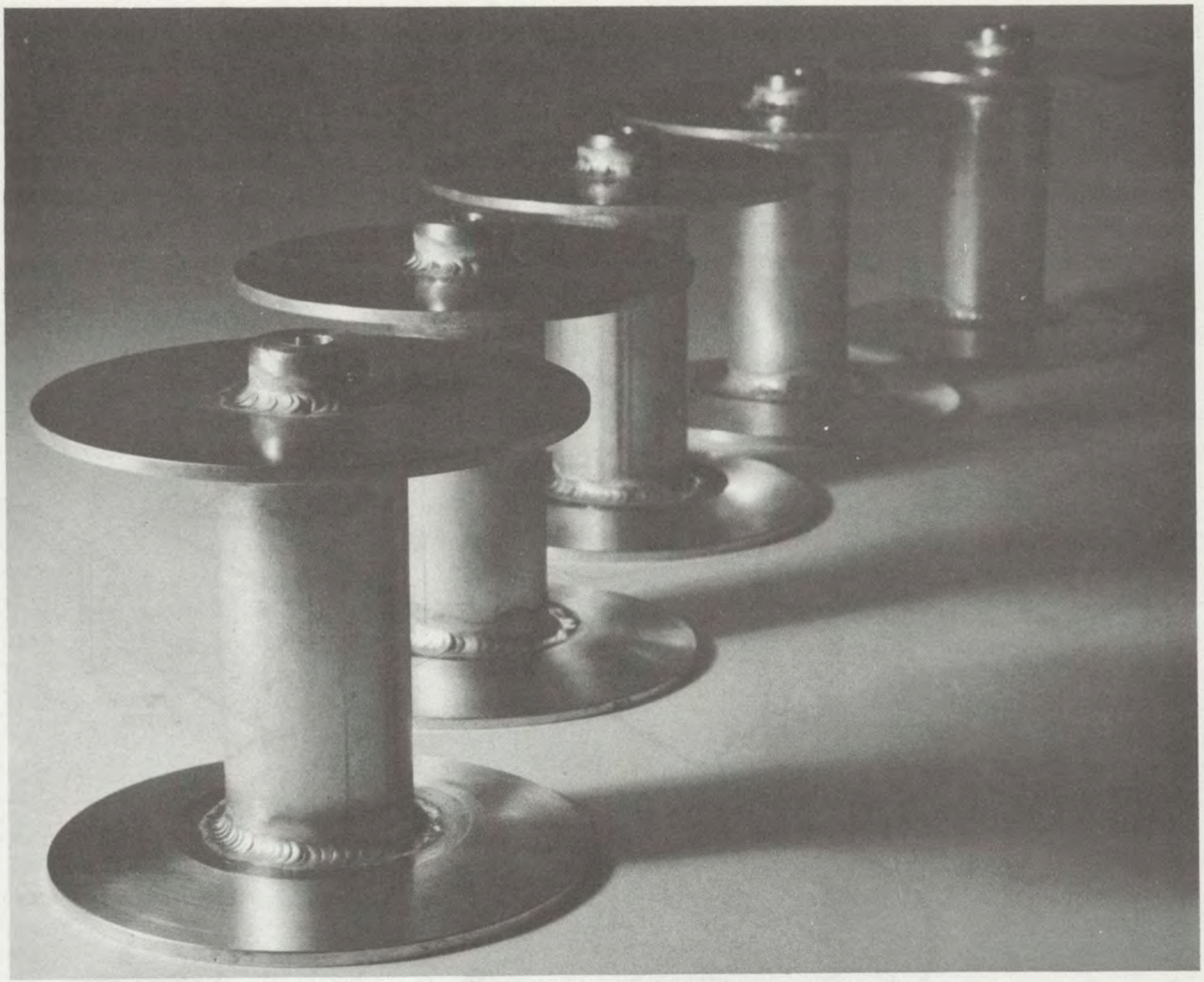
The first thing to decide is whether you are going to build a 6 volt or 12 volt winch. The 12 volt winch is popular among advanced fliers because it is really peppy. During downwind launch conditions, the 12 volter will still do a job of hauling the sailplane up.

It has a further advantage of using a standard 12 volt car battery which is more obtainable than the 6 volt battery. I believe, however, that most winches in the U.S. are of the 6 volt type. Perhaps this is because this is the way they started out and people got used to them. From an operational standpoint, I would recommend starting with a 6 volt one. They are a bit more gentle and more than satisfactory in most launch conditions. A 12 volt winch can be too much for a beginning, or somewhat inexperienced, pilot to handle.

The winch described here was designed to be built by the average guy who is handy with tools, but requires only those tools you are likely to have. It is housed in a plywood box which is heavier than the open welded frame used by commercial winches but does not require welding equipment and is also a neat place to store the turn-around, foot switch, etc.

An alternative construction method may be found in the June 1976 issue of R/C Modeler Magazine.

From a procurement standpoint, the most critical item is the drum. Unless you are very well-equipped and a very good mechanic, I suggest you buy this item. It requires a very sturdy hub as the crushing force of the wrapping line is incredible. For a 6 volt winch, a 4'' hub is used and for 12 volts, a 2'' hub. Hub size must be specified when purchased.



***Winch drums available from Mark's Models, 1578 Osage, San Marcos, Calif. 92069.***

The motor is a Ford starter motor and normally runs from 12 volts. Some of the speed lost when running it on 6 volts is made up by the larger 4'' hub diameter, but it does run slower than if 12 volts were used. In any event, the same motor is used on either version. This motor was selected because it has a long shaft on which to mount the drum. The starter was used in Fords for a long time and is a common item in auto wrecking yards. Just ask for a long shaft starter, motor vintage 1964. The shaft is 5¾'' long. They can be had for about $10.00. Normally, at wrecking yards, what you see is what you get, so it's wise to have a knowledgeable person select a starter with good bearings and brushes, one that turns freely with no end or side play to the shaft (not the one the salesman is going to give you — the one in the starter). If possible, get out your jumper cables and try it before you buy. Or, for a bit more money, you can get a rebuilt motor from an auto parts house.

Placement of the various components is not critical. Locations are shown in Figures 3 and 4.

The motor is mounted about 6'' from the top, and 6'' from the front, on the left hand side of the box. The motor has a flange that prevents it from setting flat when mounted. The side must, therefore, be routed out or carved with a wood chisel, so the motor will mount solidly.

The brake shown is optional, but handy for stopping the drum. It is nothing more than a piece of 2 x 4 wood, to be pressed against the drum, or swung out of the way.

A 6 volt golf cart battery was used in the author's winch. These are designed for the deep discharge duty seen in winch operation. They also have holes in the terminals for bolt-on cables. These make battery removal easier, which facilitates one-man winch handling.

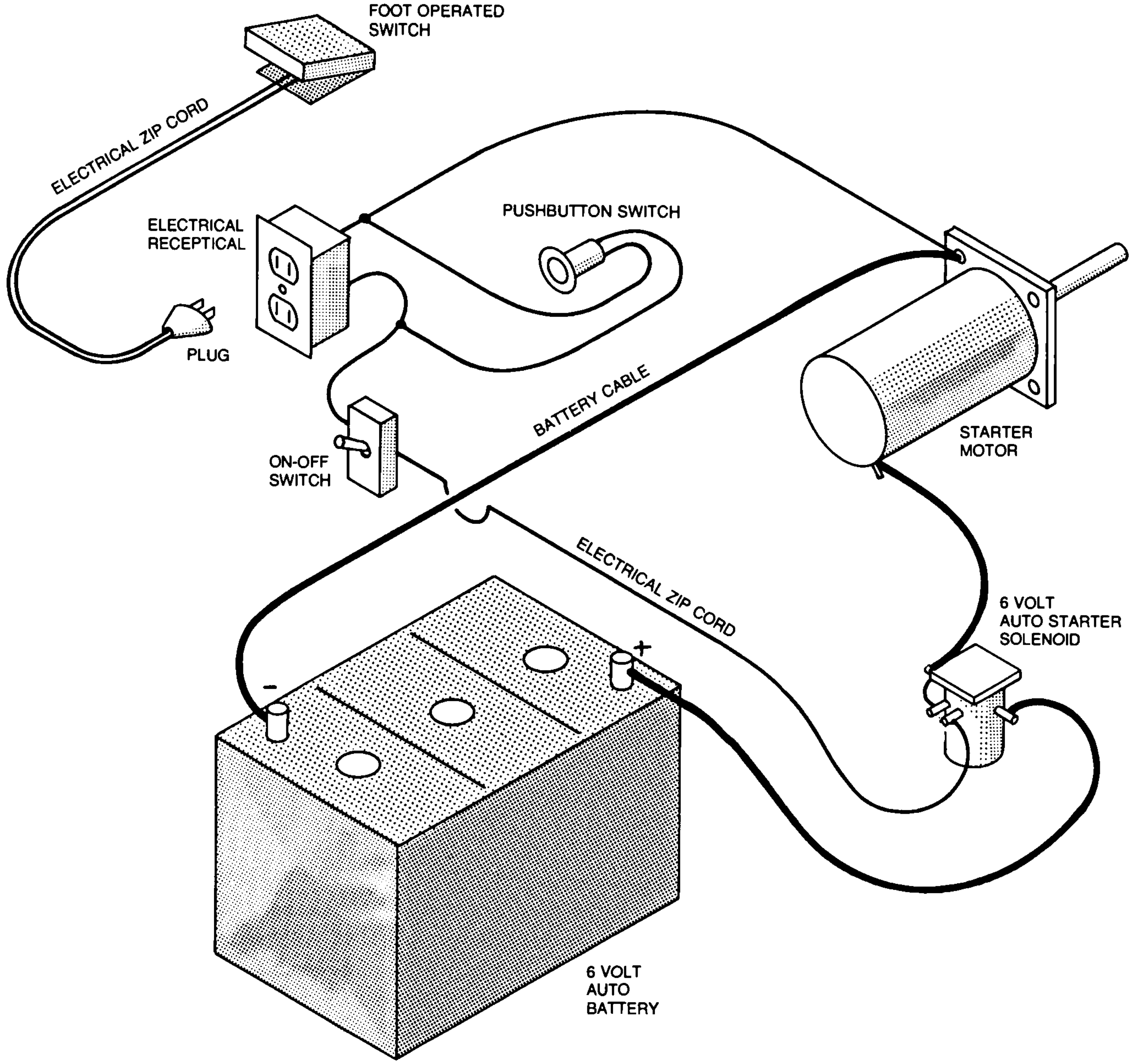



**FIGURE 3**
**SCHEMATIC — ELECTRIC WINCH**

**BOX (1/2" PLYWOOD)**
BOTTOM — 13" x 16" (1)
SIDES — 13" x 17" (2)
ENDS — 13" x 13" (2)
TOP — 17" x 14" (1)

1. STARTER MOTOR 1964 FORD.
2. BATTERY 6 VOLT AUTO.
3. 6 VOLT SOLENOID 4 TERMINAL.
4. 12" BATTERY CABLE (3).
5. ELECTRICAL "ZIP" CORD 6'.
6. DOORBELL SWITCH.
7. ON/OFF SWITCH 115V WALL MOUNT.
8. 115V ELECTRICAL OUTLET.
9. 115V ELECTRICAL PLUG.
10. FOOT SWITCH — RADIO SHACK.
11. 6" x 12" x 1/2" PLYWOOD.
12. DRUM — 4" HUB — MARK'S MODELS.
13. BOLT & NUT 1/4" x 1¼" ALLEN HEAD.
14. CUP HOOK.
15. HANDLES (2).
16. 1/4" IRON ROD — 2'.
17. U-BOLTS (2).
18. 3/16" x 1½" BOLTS & NUTS (8).
19. 2" x 4" PINE 5" LONG.
20. 3/4" x 1/8" IRON STRAP — 2'.
21. WOOD SCREWS (6).
22. 1/2" BOLT 6" LONG.
23. 1/2" NUTS (3).
24. FRONT BICYCLE HUB WITH NUTS.
25. 1" U-BOLT 3" LONG (2).
26. 5¼" x 8" x 1/2" PLYWOOD.
27. 1½" x 8" x 1/2" PLYWOOD.
28. 6" SPIKE.
29. HINGES (2).
30. 1800' OF 120 LB. TEST NYLON CORD.

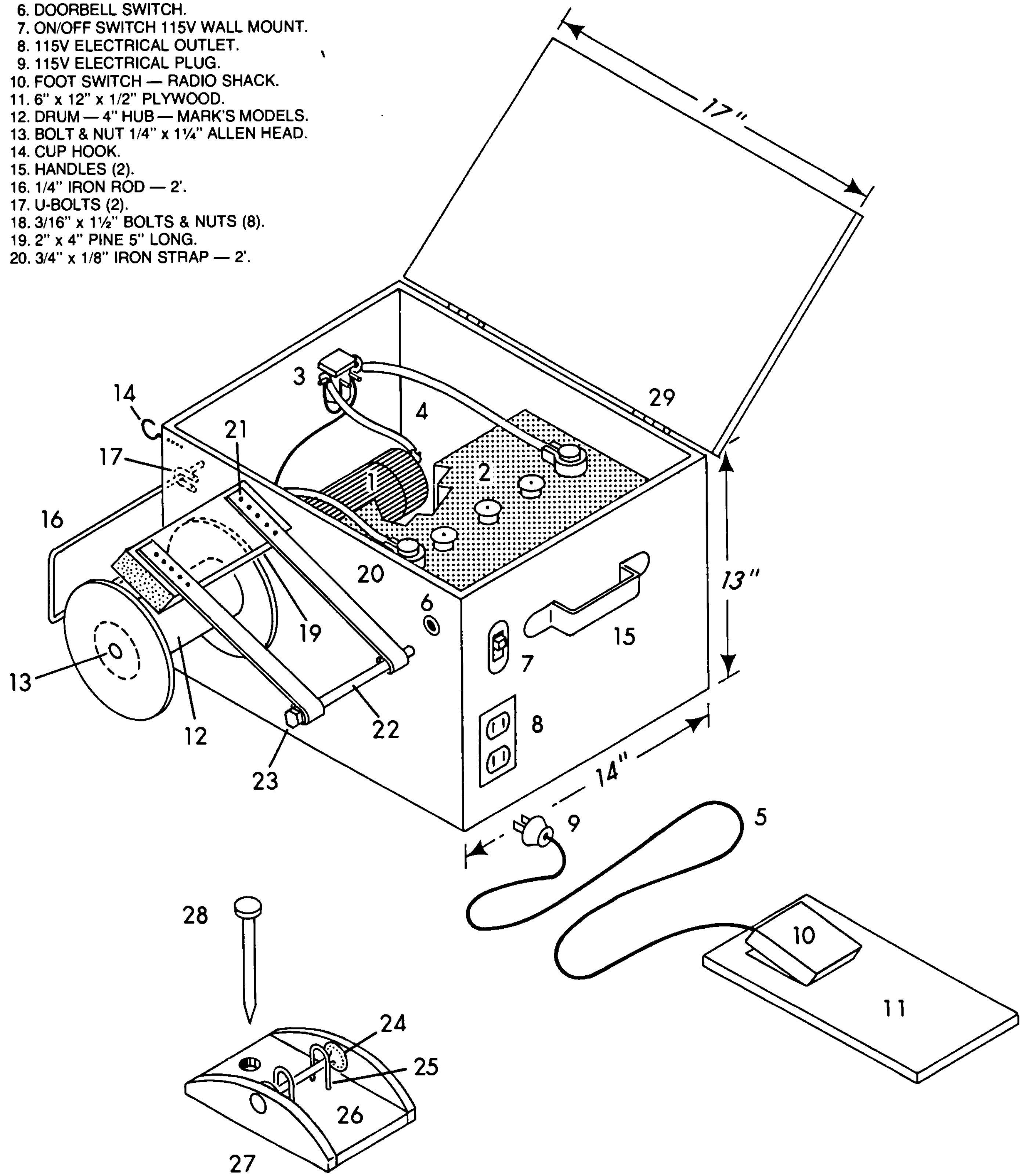



**FIGURE 4**
**ELECTRIC WINCH CONSTRUCTION**

# CHAPTER XI

## TESTING, TRIMMING, AND FLYING YOUR SAILPLANE

Now that you have your Oly 650 completed, and the equipment installed, it's time to see if it will fly. Although the procedures to be described were written with the Oly 650 in mind, they apply to most any sailplane, and can be used to trim future sailplanes. The procedures presume that you have never flown a radio controlled airplane, and that you are all by yourself. Any experience you may have had will shorten some of the familiarization of hand gliding. If you happen to have a copy of the RCM Flight Training Course book, it will be helpful to review Chapter 20, "How the Controls Should Work." It may also help your orientation to sit in a chair at home, with the plane on the floor in front of you, facing away. Turn on the radio and transmitter and make an imaginary flight. Watch the control surfaces to make sure you are moving them in the right direction to turn the way you wish.

**Section 1 — Glide Tests**

We will begin our trimming by making test glides. Hopefully you have a grass field handy; an athletic field or very large lawn area, such as a park, is ideal. A football field is good because it doesn't have trees. Trees have a habit of jumping in front of gliding sailplanes. Select a time of day with little or no wind. Also, select a time when there are no dogs or children in sight. It is terribly distressing to have a large Irish Wolfhound retrieve your sailplane; or have two kids fall on it while fighting for the honor of picking it up.

Assemble the Oly 650 using six #64 rubberbands. Again, check the radio; stick left — rear end of the rudder goes left; stick right — rudder goes right; stick back — rear end of elevator goes up; stick forward — elevator goes down. With the trim levers on the transmitter centered, both rudder and elevator should be in neutral. If not, adjust as described in Chapter VII.

One thing to remember when gliding or launching a sailplane — don't be wishy-washy; do things firmly. The first thing we will do is get confidence that nothing violent will happen, and the thing will glide. Always do all launching **into** the wind. Eventually, you may be in a situation where launching in slight downwind conditions is inescapable, but until you are thoroughly experienced don't do it! Another habit to acquire is to wiggle the controls before **every** launch. This will prevent the disaster of launching with the radio turned off!

What you are going to do now is face into any slight wind, holding the Oly 650 in your throwing hand at shoulder height. Hold your transmitter in your other hand; you are not going to use it, but it will give you something to do with your spare hand. Turn on the radio and transmitter, which is a good trick with both hands full. Now, run full tilt; let the plane lift slightly out of your hand — watch how it sails.

Does it tend to climb, or dive, or turn? Now, catch the plane — don't let it get more than a couple of inches from your hand.

The plane should float buoyantly, straight ahead. If it consistently tries to climb, dive, or turn — stop. Check for any wing warps, by sighting down the bottom of the wing.

Check that the wing is properly seated, and not on backward (don't laugh, this happens), etc. When you get your breath back, try it again. This time, let the plane fly a little longer before catching it.

Correct any slight turning tendencies with slight displacements of the trim levers on the transmitter. Make sure each time you release the Oly 650 that the wings are level.

When you finally have a semblance of confidence in the 650's ability to sustain itself in the air; or are on the narrow edge of a cardiovascular seizure, take another run, and let it fly all the way to the ground. Don't try to control it. Let it free flight. Incidentally, if you are doing all this on a football field, don't run into the goalpost while watching the antics of the sailplane. Do this several times, making any small needed trim corrections with the transmitter trim lever. The plane should fly straight ahead, and land gently. If it seems to glide too steeply, landing heavily, pull the elevator trim lever back a bit. If it seems to try to fly nose-high, or mush along, push the elevator trim lever up a bit.

**Section 2 — Hand Gliding**

Now you are ready to graduate to the big league — hand gliding. The idea here is to do what you have been doing without all the running. If you are a bowler, you are halfway there. The idea is to launch the plane at the same speed as when you were running — without running. In test gliding, the sailplane should be thrust straight out — firmly. **Do not throw it upward.**

*Glider is allowed to lift out of hand to test trim.*

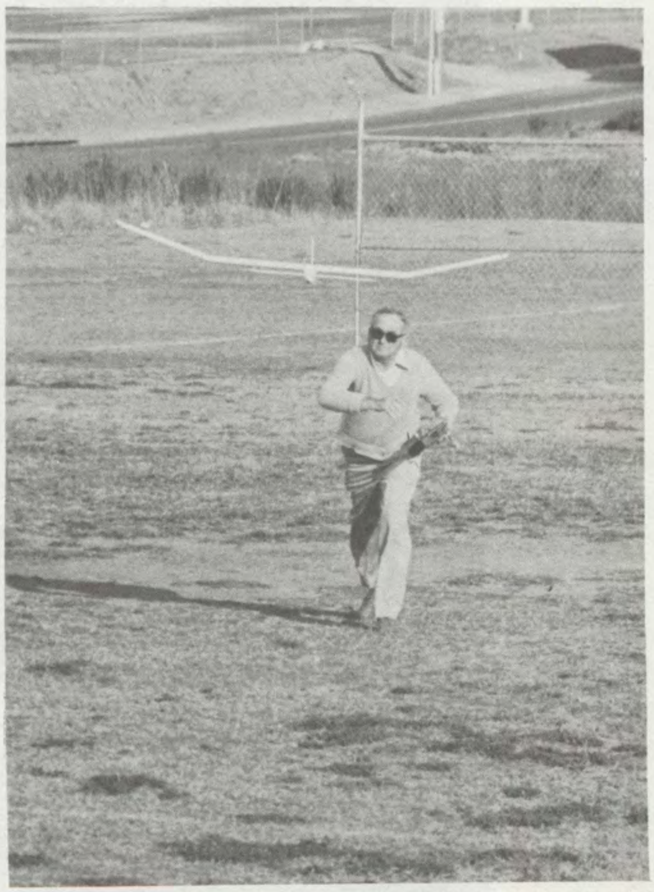
*Glider is then caught.*

*Check for wing warps by sighting down the wing.*

*Test glides are made firmly.*

*The glider is thrown straight out, not up.*

*The plane should glide straight.*



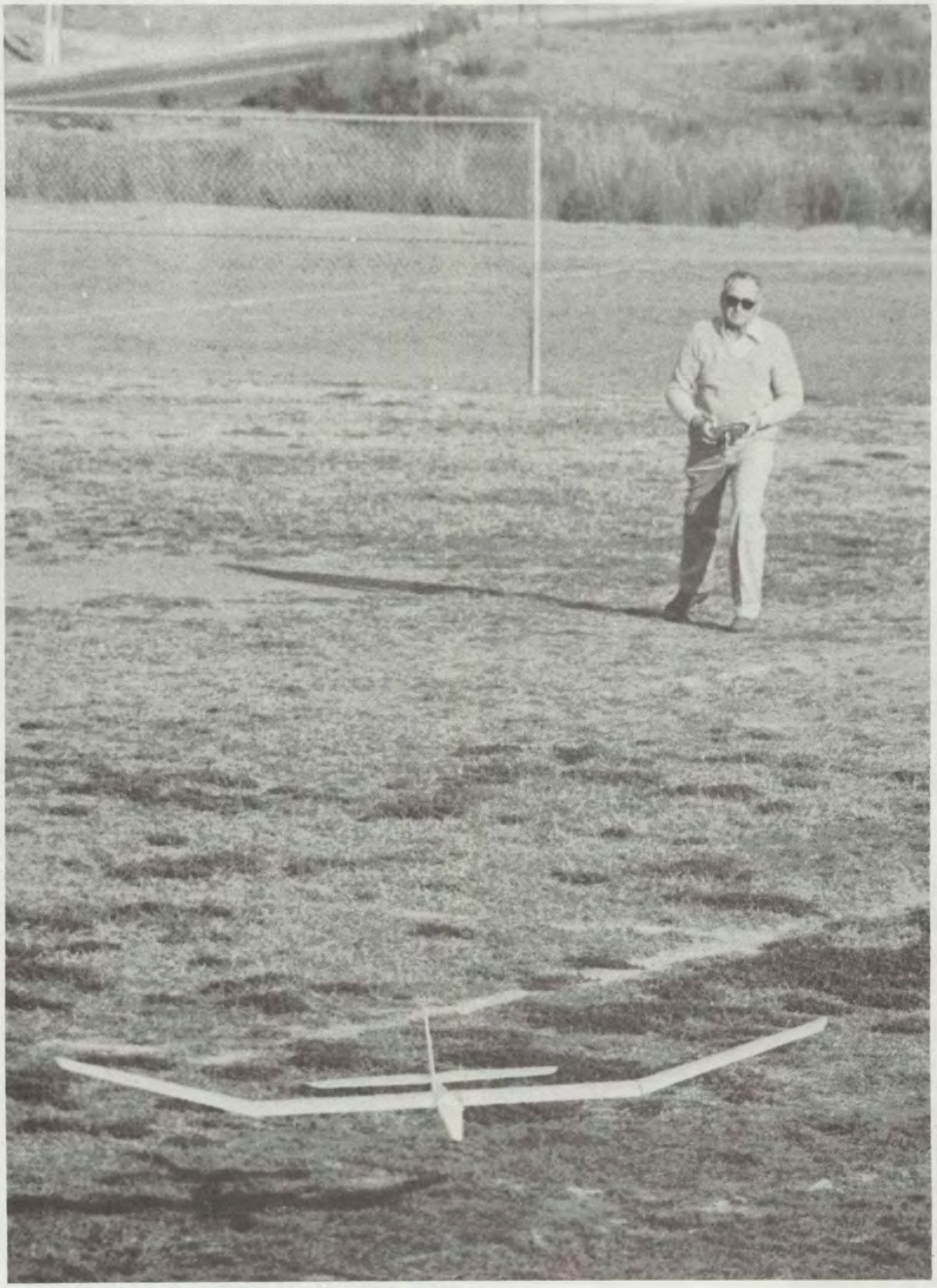
*There should be no tendency to an undulating, or wave-like glide.*

The Oly should glide straight out, flying at a constant angle of descent (no roller coaster action).

The Oly should make a good landing, fifty or sixty feet out. If it comes down rather steeply, and lands rather hard, you are either: not **quite** launching firmly enough, or it needs a tad more up-trim (transmitter trim lever back a bit).

If it tends to roller coaster a bit, or noses up into a stall, and comes down hard, you are either throwing too hard, or it needs a tad more down-trim (transmitter trim lever forward, or up, a bit). If the glide tends to curve in one direction every time, move the transmitter trim lever in the opposite direction, slightly. Keep this up until you can get a good straight glide every time. It is best to do all this when there is no wind. Gusts of wind will change the flight enough that you can't tell whether it needs trim adjustment, or whether it was the wind.

When you are getting a good straight glide every time, look at the position of the rudder and elevator. They should both be very close to neutral position. If the rudder is displaced more than a couple of degrees from the neutral position, go home and look for any warping or twisting in the wing, rudder, or fin, and correct the condition. If the elevator is **slightly** displaced from neutral, don't worry about it.



***Landing should be straight out 50 or 60 feet away.***

## Section 3 — Applying Control

Now, we are ready to apply a **little** control over the glide. Make sure the radio and transmitter are turned on and, again, make a test glide. Quickly get your hand to the stick. When the glider is a foot or so off the ground, apply just a bit of up-elevator, by pulling back on the stick slightly. You will see the nose come up, and the glide will stretch out a bit, and the landing will be more gentle.

After a few glides, while experimenting with elevator control, try the rudder. Push the stick slightly, either left or right. The glider will make a very gentle turn. One caution — be patient. Sailplanes do not, in general, react instantaneously. Sometimes new fliers, not seeing immediate response, apply more and more control. Suddenly, they are in an over-control condition. The sailplane over-reacts, and — thud. When the ship is a foot or so off the ground, apply a bit of opposite rudder, then back to neutral, to get the wings level. Keep practicing these test glides under control until you get a bit of confidence in basic control, and understand how the glider responds to this control.

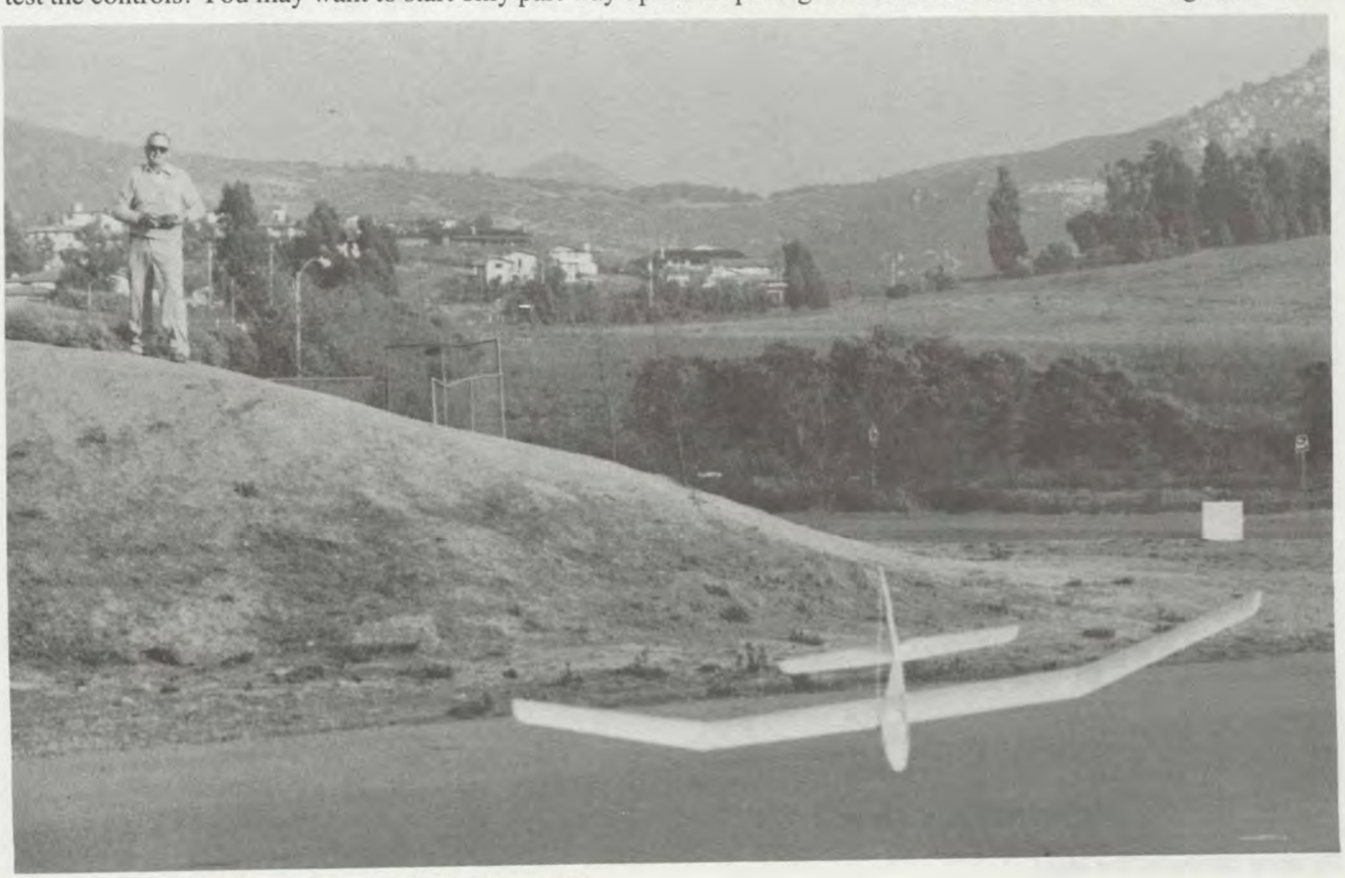
If you have had previous R/C experience, you can eliminate the free flight part of the testing. Most experienced pilots, however, go through the controlled test glide routine on a new sailplane. It is the quickest way to set the initial trim. It also gives the experienced pilot a preview of the ship's response. He can get a feel whether more, or less rudder throw (deflection) is needed.

If you have no previous experience, remember these procedures are written assuming you do not have any experienced sailplane pilots in your area. If there are, get some help, both in trimming your ship, and learning to fly. But, be sure the ''experienced pilot'' is really experienced. Even a thousand hours at the controls of a full-sized plane does almost no good as training to fly an R/C model.

## Section 4 — On A Little Slope

The next step depends on a number of factors — all related to where you live. A reasonable next step is more hand gliding, but with more of a chance to feel out the control system. One of the best ways to learn to fly a glider is on a slope. On a good slope, lift is relatively constant, permitting the student to concentrate on guiding the plane, rather than staying in the air. Good slope sites are hard to come by in many parts of the country. If you can find a small hill, overlooking a big grassy area, this would make a good training area. The hill need only be 6 or 8 feet high to give you a little more air time. You will need a clear area in front of the hill to land in. Parks are a good place to try, if you can find an area clear of trees.

If you find such a place to fly, again select a time when there is no wind, kids, or dogs. Assemble your glider and test the controls. You may want to start only part way up the slope to get the feel of control. Glide straight out a few



*Later on, a little hill will give a chance for test of controls.*

times, flaring slightly for landing, with a touch of up-elevator. Use the same launching technique as before; thrust the glider straight out from the shoulder, firmly, but no so hard as to cause it to go up into a stall. When you launch from the top of the hill, you will have enough altitude to try a gentle turn. Fly straight out until clear of the slope, then turn very gently, then back the other way. When two feet from the ground, level the wings (push the high wing down with the stick), and apply a little back stick to flare for landing. Just don't do anything suddenly — easy does it. If your landing space is restricted, or the hill is high enough that obstructions might come into play, continue the gentle circle round and round, leveling the wings for landing. If you have enough height, try a square pattern. Fly straight out, make a 90 degree turn left, and straighten out. Now, fly parallel with the face of the hill for awhile. Now make a 90 degree right turn, flying straight out from the hill again. When close to the ground make sure your wings are level and flare for landing.

Keep up this practice until you are confident that the glider will do what you want, not what it wants to do. Put a white handkerchief or paper plate, or such, out in the landing area as a target. Try, time after time, landing near the target until it comes easily. If a larger slope is available, progress to that one. If the prevailing wind is directly into the face of the hill, try flying when there is a 10 or 15 mph wind blowing. Try the rectangular pattern. You may find there is enough lift to stay up longer. If you find your glider going up slightly after launch, push the stick slightly forward to get the nose down and then release the stick. Fly straight out from the slope until well clear, then make a left turn, and fly parallel to the slope as in the rectangular pattern. Fly a ways, then make a right turn away from the slope, but continue a full 180 degrees. Now fly back along the face of the slope in the other direction.

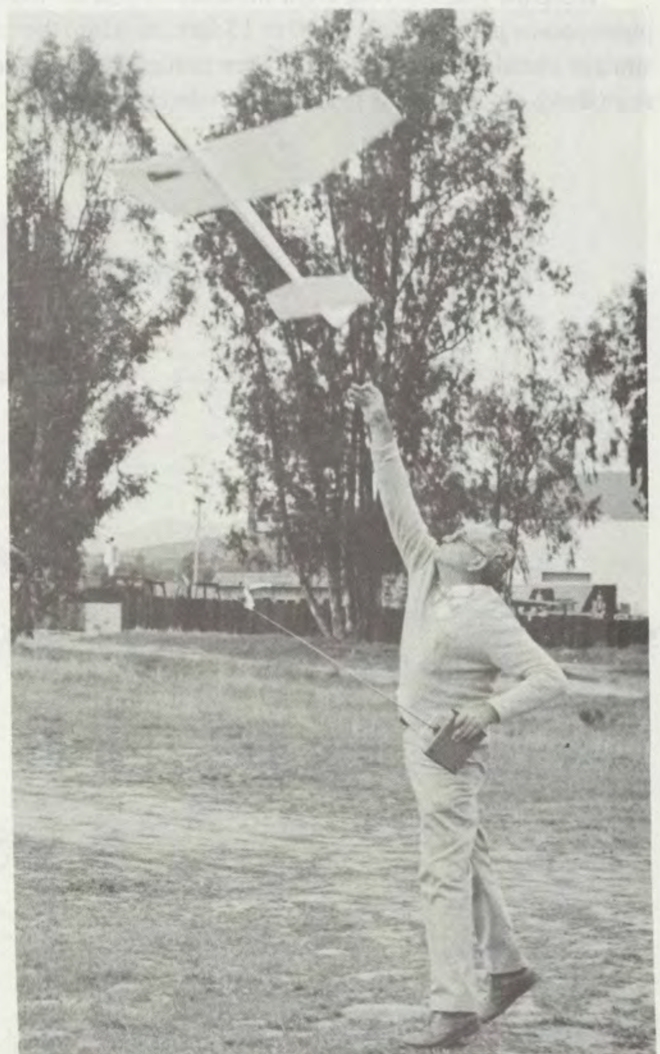
Make another 180 degree left turn and fly back parallel to the slope face. Since the wind will tend to blow the glider back toward the slope face, you will have to apply a bit of rudder to keep the nose of the glider pointing slightly away from the slope. Always land with the glider pointing into the wind. Be alert that the ship does not "balloon," that is rise up into a stall, when coming around into the wind. Get corrective down-stick in as soon as you see the nose start to rise. Also, on landing, watch for any tendency to turn. Keep the noise pointed into the wind — be alert. In windy conditions, keep it straight; keep the nose down; the wind can get under a wing and you can get into a turn that you don't have enough rudder authority to correct, and the ship will cartwheel. If your slope is a right and proper slope site, you will soon learn how much or how little wind is flyable. If it is a good site, you will soon find yourself flying higher than where you launched. You can then explore the slope by flying back and forth, and out away from the slope, to see what the lift pattern is — where it is good and bad. One caution: behind the slope is usually bad news. The wind will come up the slope and curl over the crest causing all sorts of turbulence. You can get banged into the ground trying to land behind some slopes, so be careful until you are thoroughly familiar with the wind pattern.

***Fly along the face of the slope.***

## Section 5 — Launching With A Hi-Start

If you are in an area where there is no reasonable hill to practice from, you will have to proceed straight away to the hi-start. If you had some hill practice, and have a bit of confidence in how your ship responds to command, you are also a candidate for hi-start launch. You will need a hi-start like the one described in Chapter X, and a large field. The field should be at least 700 feet long (in the direction of the prevailing wind) by 200-300 feet wide, hopefully with few obstructions around the edge. The stake is placed at the extreme upwind end of the field and the hi-start laid down the middle. Choose a time for the initial flight when there is no wind. Leave your airplane lay and stretch the hi-start out about 200 feet. Stake the parachute ring to the ground using a large screwdriver and go get your transmitter and airplane. Here's where it pays to have three hands. Turn on the radio and carefully check the operation. Pull out the transmitter antenna and set the transmitter on the ground. Now, grab the parachute firmly, and pull out the screwdriver. If you weren't holding tight, the parachute goes zinging down the field, and you must repeat the process. If you **were** holding tight, pick up the airplane with your throwing hand and hook the parachute ring to the tow hook. Make sure you have a good hold on the plane, without crushing the fuselage. At this point, you have nothing to fear except fear itself. Pick up the transmitter with your free hand in such a position that you can get the other hand to the stick quickly after launch. One thing you must do is act firmly, and positively. If you do two things right you can't miss; first, you must throw the plane smoothly and firmly up at about a 45 degree angle.

*Launch at 45° angle.*



*After launch, glider goes up steeply.*

The airplane must have enough speed to generate enough lift to go up. If you just let go, the darned thing may fall out of the air. The second thing is to make sure the wing is level when you launch. If you throw it with one wing low, it will turn toward the low wing and you will have to make an immediate correction. If you remember those two things you will hardly have to touch the stick at all. Your glider will go up very steeply.

You don't have to touch the elevator control. It may wander slightly off course. If it does, bring it back with very gentle corrective rudder. Don't do anything suddenly. Above all — think! Even though no control is necessary, think about what you will do if the ship turns left — apply a bit of right stick, right! Keep you mind open. It's easy for your mind to go completely blank.

When the sailplane reaches the top of its arc, just keep it headed straight out. The whole thing is automatic and, with a well-trimmed ship, you really don't have to do much. The parachute will fall off by itself most times. If it doesn't come off when you think it should, you can hurry the process by a pulse of down elevator. This will dip the nose, releasing tension on the line, and the parachute will come loose. About the only time the parachute won't come off by itself is when the glider flies through some lift on launch and it rises putting tension on the tow line. In this case, a touch of down elevator will do the trick.

Okay, now you are about 400' in the air — if all went according to the directions. The object of the first flight is to get down safely — on the field. First, just let the sailplane free-flight. Watch it carefully. If it starts a series of roller coaster-like motions, stop them by turning the plane. Any time you want to settle down a ship that is stalling around, put it in a turn. If you try to do it by correcting with elevator, you may make it worse, until you have more experience. When you get it settled down, find the transmitter elevator trim lever and slowly feed in a little down trim (lever up). Since you made considerable trim glide tests, it is not likely that the ship will be far out of trim, even on the maiden flight. If elevator trim is required, keep turning the airplane to keep it generally close to the field. Don't let it fly out of sight while adjusting the elevator trim. Now, using only rudder control, fly it round and round in a circle with yourself as the center. Try to keep it within the bounds of the flying field.

Keep the ship off your right shoulder so you are looking to the right at it, turning as it circles the field. When the plane passes point A at about 10 or 15 feet, turn into the center of the field, straighten out and land, keeping it pointed straight ahead. Don't try to turn, even though you land down the field a ways — unless you are heading for a tree or something. Just pretend it is a hand launch.

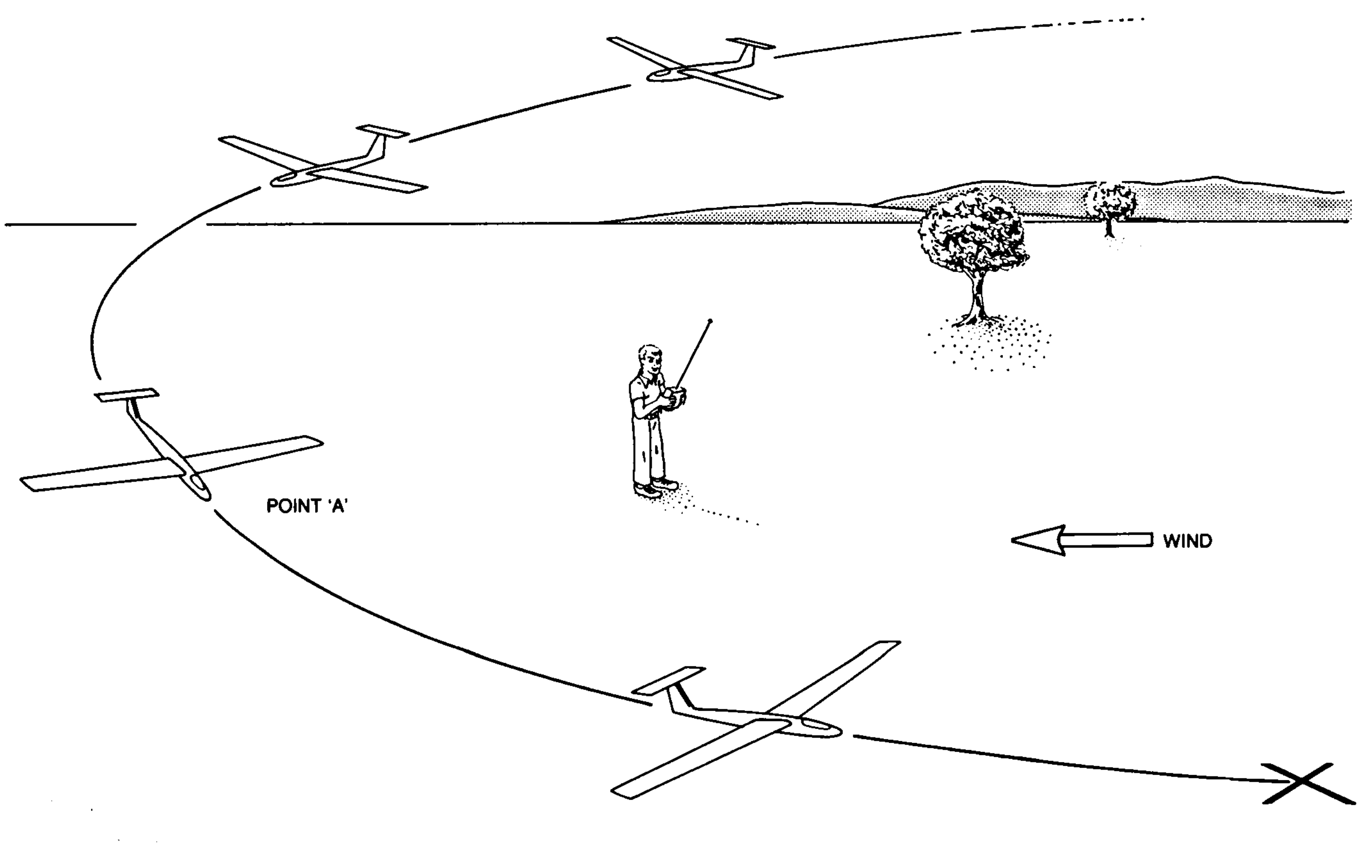



**FIGURE 1**
**BEGINNING LANDING PATTERN**

When you hook your first "boomer," take care not to get so enraptured with it all that you let the sailplane get out of sight. A plane that is just a speck in the sky is nearly impossible for a novice flier to control. You can't tell whether it is coming or going. A really powerful thermal will take a sailplane out of sight in just a few minutes. When you get to an altitude where you are beginning to feel uncomfortable, come down, you can go look for another one at a lower altitude. To get down from a thermal can sometimes be a problem — just don't panic. It takes time, and sometimes it doesn't seem that you are coming down, when you really are. When you are ready to come down, fly out of that area. When the plane appears to be coming down, stay in that location, and watch it carefully. A good way to come down is to hold full up-elevator, and full rudder. The plane will spiral down, almost in a spin, but will do it gently. Just hold this position until you are at the proper height. The least desirable way is to dive the plane. It is very difficult to tell how fast the plane is going. You can tear the wings, or the stab off in a second, if flutter develops. Any airfoil will develop flutter if it goes fast enough, so just be careful. Use the more gentle ways. If you are good at inverted flight, turn the plane over. Airfoils are very inefficient upside-down.

Another type of lift develops when the wind blows — wave lift. This type of lift is generated by some irregularity or thermal activity on the ground.

Wave lift takes the form of lifting air, forming a stationary ridge which is sometimes quite wide, over a path 90 degrees to the wind direction, but is usually narrow in the direction of the wind. The lift also tends to move back and forth, but is relatively stable in the direction of the wind. The lift also tends to build up and die out, seldom lasting as long as 10 minutes.

Wave lift is recognized by its stationary nature. In wind, thermals will move downwind at a speed slower than the wind — but they do move. If you are flying upwind and encounter an area of lift, you naturally start to circle to locate the thermal. If you sink on the downwind side but encounter strong lift upwind, it is probably wave action. You just park, heading into the wind, and you will go up. Waves have a definite height. Some are quite high, others not so high. It seems to help to range back and forth a hundred feet or so. Be alert, when the lift seems to be waning, fly quickly several hundred feet either right or left. If you don't relocate the lift in one direction, try the other. Just don't die, sitting in one spot. Eventually, however, you will lose lift in every location and it is prudent to get the heck out of there and look for something more promising.

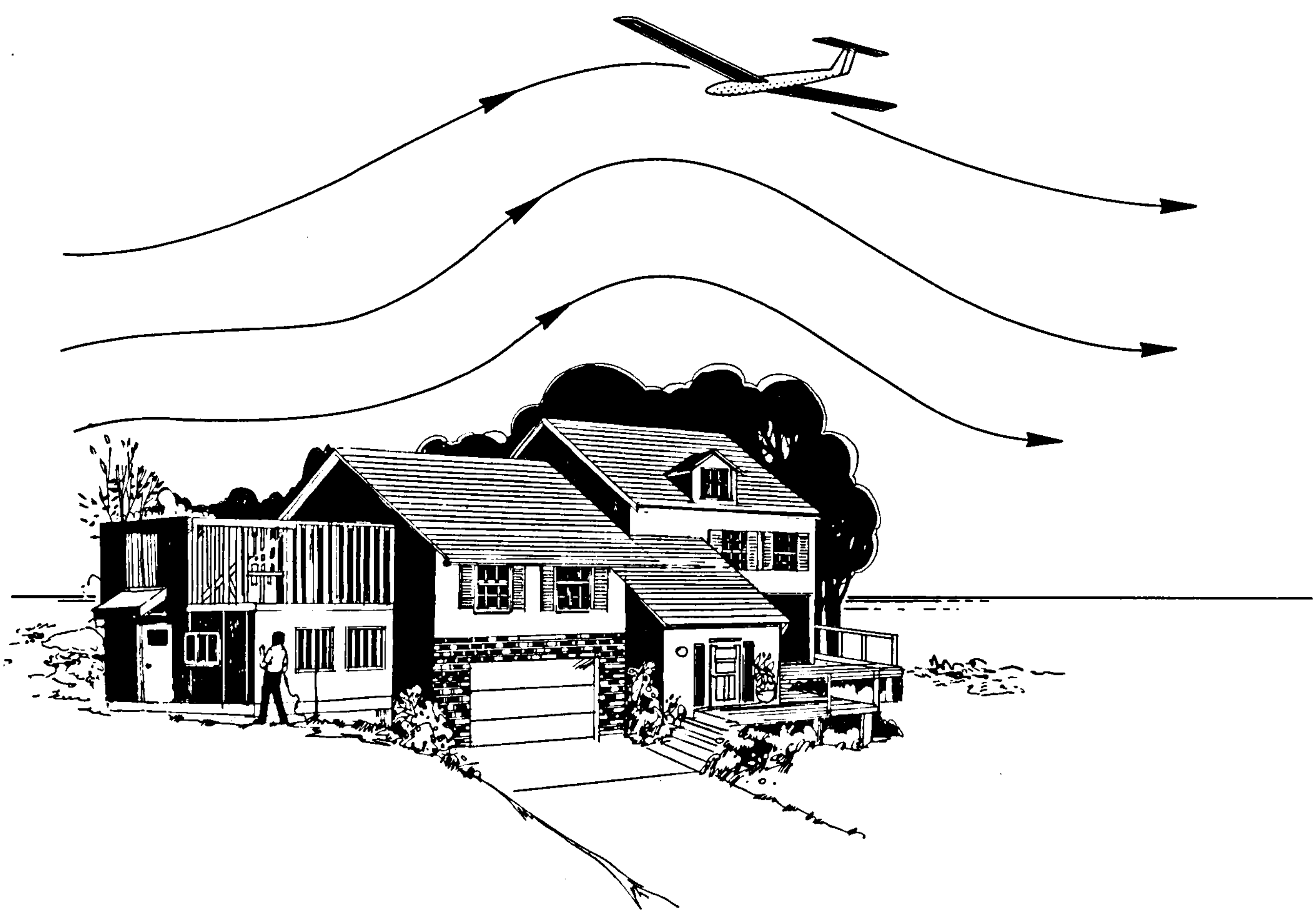


**FIGURE 2**
**GENERATION OF WAVE LIFT**

Each time you fly, check the position of the trim levers on the transmitter to make sure they haven't been knocked out of positions. Continue the simple training pattern until you feel comfortable, and can handle the various situations that arise. Try flying in light wind, always launching and landing directly into the wind. Gradually work in varying flight patterns before entering the landing pattern. Put out a target, and practice trying to land near it. Keep working toward the landing pattern as shown in Chapter XII, Figure 1. Read the section in Chapter XII on landing. In this landing pattern, the entry altitude is set up by circling so that entry of the downwind leg is always made at the same altitude (determined by judgment). The ability to make precision landings is important because sooner or later you will find yourself flying at a strange field with obstructions, which have a habit of jumping in front of sailplanes. Also, you may eventually wish to try your hand at a contest or two, where precision landings are a part of the ball game.

The thing that causes new fliers the biggest problem in landing is the fact that the plane is coming toward you, and control is reversed. Eventually you will react automatically with the correct control, but in the beginning it is confusing. There are several ways to get around this problem. Some fliers look over their shoulders at the landing airplane. This will work, but it is not really a good long term solution. It is hard on the neck, and merely begs the question. Another way is to mentally talk to yourself. Just tell yourself that if a wing drops, gently move the stick in the direction of the low wing. A method that worked for me way back when, was to keep the ship in a series of very gentle S turns — back and forth. That way I always knew which way I had turned last. Whatever method you use — concentrate — but don't go to sleep. In a very short time you will begin to react automatically, without thinking about it. It will take practice, practice, and more practice. Every time you land, pick a spot and try to land near it. That is the only way you will become proficient at precision landings.

A word of caution when landing in the wind: When flying with the wind, the plane appears to be going much faster than it really is. Remember, the important thing is how fast the ship is going with respect to the surrounding air. If the plane is going 20 mph, with respect to the ground, and the wind is blowing 10 mph, the plane only has an airspeed of 10 mph. The lift generated by the wing depends on airspeed and angle of attack. If the plane flying downwind does not have enough airspeed to generate enough lift to support itself, it will sink rapidly. In an attempt to keep it airborne, the new flier tends to pull back on the stick, to increase the angle of attack, thereby, generating more lift. Soon the wing reaches the stall angle, and the plane falls out of the air. It is especially critical if the plane has a tendency to tip stall; that is the tip area reaches stall conditions and, therefore, loses lift, before the inner panel of the wing. As a final turn is started, the yaw, combined with the dihedral, can cause a very quick tip stall and it is possible to find one's self upside-down. Anyway — the way to avoid all this embarassment is to fly fast downwind — keep that airspeed higher than it looks necessary. You do this by keeping the nose down, even holding a bit of down elevator. Or even better, make it a habit to put a little down trim in the transmiter, which will help the whole landing process. This will help to avoid ballooning when you come around into the wind. It is easier to overcome the down trim with a little back-stick than it is to overcome ballooning tendencies with down-stick.

**Section 6 — Thermal Flying**

As you continue to expand your flying skills, you will feel more and more comfortable in the air and you can stretch the hi-start out to 250 feet. You will begin to notice more things about the sailplane's flight. Sometimes you will notice that it will rise and fall in its flight; or one wing will rise when you are in level flight. This means you are **probably** flying through a thermal. The trick at this point is to locate the center of the thermal, and judge its size. Normal thermal size is perhaps 50 to 100 feet in diameter, though some can be as small as 20 feet and others are huge. Thermals tend to start out small at ground level, and build up like a funnel. Sometimes when you get high up, the whole sky is going up and you can cruise around anywhere, in lift. Sometimes the thermal will disappear at 200 or 300 feet. Anyway — when you detect a bump or turning of the sailplane, remember the location and turn back for a look. Some people say to turn toward the wing that goes up, that's where the thermal is; but, in truth, it doesn't really matter which way you turn. Fly back through the area. When you get another indication from your sailplane, start to circle. Turn in the direction where you **think** the thermal might be, based on your two encounters. Turn in a circle of perhaps 20 feet or so in diameter. If the sailplane rises on one side of the circle and falls on the other side, you are on the edge of the thermal. Straighten your turn so as to move the center of your circle toward the rising side. When you are centered in a thermal you will rise all the way round. Pull your transmitter elevator trim lever a bit down (up-trim), and concentrate on making a smooth circle. The secret of thermal flying is to fly smooth! Every time you stall the airplane, you lose 20 feet, and it doesn't take long to lose the thermal. Some thermal indications are not for real. If you rise when you come around into the wind and fall going downwind and can't seem to find a spot where you go up all the way round, you are in a "stick thermal." That is, the extra lift from the wind or inadvertent up-stick movement can look like a thermal. Go try somewhere else. Finding, and working a thermal takes much practice and skill, but is sure rewarding. It's a real thrill to find your first thermal and go up, and up.

## Section 7 — Thermal Sensors

There is an electronic gadget which will tell you whether you are going up or down; it's called a Thermal Sensor.

Thermal Sensors consist of an airborne unit which weigh two or three ounces, and a radio receiver which hooks on your belt. They tell whether you are flying at a constant altitude, or rising, or falling. They also tell you how fast you are going up or down. However, all they do is whistle at you. It's like having a girl whistle at you — it's up to you to determine why.

The Thermal Sensor works on changes in air pressure. Aside from the 9 volt transistor battery and switch, the whole thing is contained in a transparent plastic tube 1¼'' in diameter and 5'' long and weighs about 2 ounces. As the tube is raised and lowered — even only a foot or two — air density changes enough to cause air to exit and enter the tube. Entrance and exit of the air is through a very small orifice into a cleverly designed cavity. A pair of thermistors, in a balanced bridge circuit, measure the rate of air flow and whether it is going into or out of the tube. A tone is generated, controlled by the thermistor bridge. If the Thermal Sensor is held still, we get a steady reference tone. If we move the Sensor up at a constant speed, we get another tone, higher in pitch. The faster we raise the Sensor, the higher the pitch. If we stop and hold the Sensor still, the tone will return to the original reference pitch, even though the Thermal Sensor is at a higher altitude. If we now lower it, the tone will be lower than the reference tone. The faster we descend, the lower the tone. This tone is used to modulate a low-power transmitter. We can now put the whole shebang in a sailplane and listen to the rock and roll with a receiver hooked to the belt, with an earplug stuck in your ear. Okay, that's how it works, now what do you hear? When you launch you hear a whoeeeeee. When you get as high as you are going, the tone returns to the same one you heard when you were holding the ship in your hand; so it's time to get off tow. When you fly through a thermal, you hear a wheeeyoooo, the tone rising as you enter the thermal and falling as you leave it. So, turn around and look for the wheeee, trying to get the tone as high as possible — which means you are going up fast.

Thermal Sensors are extremely useful in three situations. During launch they tell you when you have reached the top. It's not all that easy to tell when you've topped out. When the plane is directly overhead, a Sensor is invaluable. You really can't tell visually whether you are going up or not. The last situation is when you are way out, scratching for thermals. It can be very difficult to tell if the plane is in lift; at least it takes long enough to find out for sure that you can be in deep trouble. At other times, when you have good visual contact, it is easier to see lift as to translate what you are hearing. In any case, if you are not flying smoothly, you will get information from your Sensor that will do more harm than good. Anyway — are they worth the hundred and some odd bucks they cost? They are at least interesting. It all depends on your pocketbook and interest in this sort of device. At this writing I know of only one U.S. manufacturer — Ace R/C, Inc., Box 511B, 116 West 19th St., Higginsville, Missouri 64037.


Ace Thermic Sniffler.

## Section 8 — Slope Flying

If you have a site in your area suitable for slope soaring, you are fortunate. A great part of the United States is either too flat or too wooded or too something, to offer a slope site. Learning to fly radio controlled sailplanes is much easier when flying from a good slope than launching from flatlands. The principal reason is that you get more air time during a flying session because you eliminate the constant launching. Also, launching is easier and does not require any equipment. The whole process is much neater. As opposed to getting out a hi-start, laying it out, taking it in, etc., you can just walk up, and heave your ship off the cliff and you're in business. This sometimes means you can get in a bit of flying on the way home from work.

### Finding a Slope

What you need is a hill or bluff with the prevailing wind blowing almost directly into the face of the sloping surface. Trees or houses on the slope are undesirable, as they can cause turbulence, and besides you may have to land there if the wind quits. You also need a clear area at the top where you can land safely. Before you fly at any slope site, decide where you are going to land. The hill need not be really steep; you just need a surface to create a wave of lift out front. Lots of things will work; a sand quarry cut into the side of a hill; the face of an earthen dam; or a bluff along a river or lake (provided there is a beach area to land on).

If you find a candidate slope you still need to go through the hand glide routines described previously to get a feel for the trim of the airplane and control. When you are reasonably adept at turning the plane and controlling pitch, you can give it a go from the slope.

Although never is a long time, I feel quite secure in telling you that lift is **never** behind the top of the hill; it is always out front. Select a day when the wind is blowing about 15-20 mph and is relatively steady, not gusty. Assemble your glider and check out the radio. Face the wind and hold the glider at shoulder height. Now launch firmly and slightly downward just as though you were aiming for a spot at ground level and out 15 feet or so. **Do not throw the ship upward**.

Now apply enough down elevator to keep the glider level, and fly straight out from the face of the hill.

As the lift increases, the glider will rise above your head; do not let the nose come up, but keep the fuselage relatively level. When the ship is well out away from the slope face, make a gentle turn and fly parallel to the slope face. After getting used to flying in this direction, make another turn **away** from the slope, all the way round 180 degrees and fly parallel to the slope in the other direction. Pass by yourself and when it seems appropriate, make another 180 degree turn **away** from the slope and fly back and forth repeating the pattern.

When you've had enough excitement for one flight, it will be time to land. I hope you previously planned your landing, because now is not the time to plan it. Gain enough altitude so you are about 10 feet above the landing area and fly downwind, turning back toward the landing area when you are about 50 feet or so downwind. Now head for the landing area, concentrating on keeping the nose down and into the wind. If you see you are too high, don't try to land, but continue right out over the edge, and back into flying space again.

Gain some altitude and try it again, this time a little lower. If you encounter turbulence you can't handle, get it down the best way you can. Tall grass, or a bush will ease the landing. Of course, it goes without saying, that if there is an experienced pilot available, take lessons from him (or her). Let the instructor launch, and land, and guide you through the flight. This saves much repair time.

After a half dozen flights and perhaps a bit of repair, you will be somewhat more at ease. Barring any unusual happenings, you will probably be able to get up and down by yourself. Don't become discouraged, it will come — you will get better and better. Lift patterns on slopes differ, and change with changing winds. After many flying sessions, you will learn where the best lift can be found. It's fun to go exploring a slope with your sailplane, but you must always be prepared to land at the bottom, or halfway up the slope.

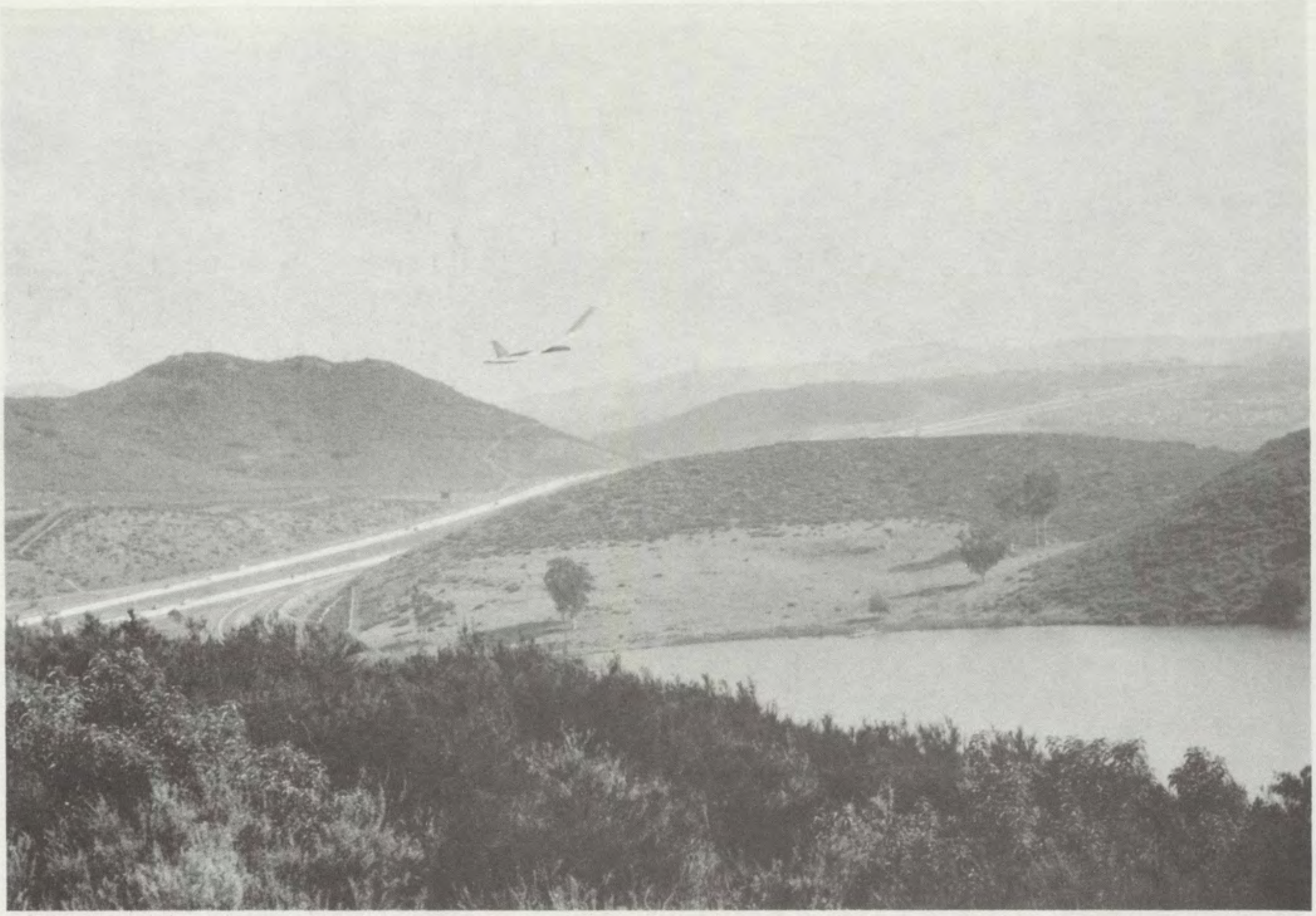
Sometimes you get caught below the landing area without enough lift to get back home. An alternate safe landing area somewhere below is a necessity and should be explored before you need it.

If the slope is not too steep, a downwind landing can be made right on the face of the slope. If the slope is grassy, without obstructions, this type of landing can be made without too much danger. Since you will be landing with the wind, the landing is made quite fast. The plane is flown directly at the slope and, as the ground is approached, up-elevator is fed in gently until you are flying at about the angle of the slope — then ease the plane onto the ground. It isn't as bad as it might appear, but you will need a bit of room as the plane travels fast and will slide in the grass a ways.

*Ocean slope site — the cliffs at Torrey Pines, Calif.*

*Inland slope site.*

*Launch slightly downward from slope.*



*Fly parallel to slope.*

*If you are too high, don't land.*

***Be prepared to land in odd places.***

**Section 9 — Glow Engine Version Flights**

This version of the Oly 650 should be put through all the glide tests of the non-powered version. If you've never flown R/C before, you should go through all the steps up to the hi-start launch. In this case it would be well to bolt a weight on the nose in place of the engine. This will keep from getting dirt in the engine during the learning process. Rebalance the ship using the balancing fixture. When you have gained enough confidence to try a powered flight, reinstall the engine. Again, check the balance.

It is well to practice starting the engine at home, if you have limited experience with glow engines, and tolerant neighbors. Read the instructions that came with the motor very carefully. When you have started the motor a few times, turn on the receiver and the transmitter, start the engine and peak it out. Try both elevator and rudder control. They should move smoothly with no jitter or hesitation. If the control is not perfect, the engine vibration is affecting the receiver operation. Check the installation to be sure the receiver and battery are fully encased in the foam rubber and not touching the fuselage anywhere. Check the servo mounting screws. They should be tightened just to the point where they begin to compress the rubber grommet, no more. If the problem persists, try a different foam, either softer, or firmer. If all efforts fail, have the radio checked for vibration problems by a service agent. In any event, do not attempt to fly until the problem is cured. This is not a common problem, but it does happen.

If there are experienced fliers in the area, for heaven's sake get help in learning to fly. If there is no one to help you, you can learn by yourself, it just takes more work. The Oly 650 is a very gentle sailplane, and quite easy to learn to fly.

For the first flight, select a day when there is no wind. Select a flying site well-removed from houses, trees, kids, etc., etc. Turn on the receiver and transmitter.

Start the engine and adjust the needle valve so it is running slightly rich; that is, with the needle valve slightly backed off counter-clockwise from the peak setting.

Be sure the engine is running the right direction; they **can** run backwards. With the plane in your throwing hand, wiggle the control to make sure the radio is on (do this before **every** flight). Pick up the transmitter in your free hand. Launch the Oly firmly, straight ahead.

***Starting glow engine Oly 650.***

The plane should climb out in a gentle left turn with no control corrections required. It should continue to climb in a gentle spiral until it runs out of fuel. If it appears to be getting a bit too high, use the rudder to turn a bit tighter. This will stop the climb. If the ship begins to roller coaster or go into a series of stalls, put it in a turn. If you are not experienced, use of the elevator will only aggravate the situation. Try not to use the elevator at all, fly rudder-only. When the engine quits, fly around and around yourself, with the plane off your right shoulder, landing as described in the glider section, and shown in Figure 1. Keep flying this pattern until you acquire enough confidence to experiment a bit. Just keep thinking; don't do anything sudden; don't panic!

***Peaking glow engine before launch.***


***Launching glow engine Oly 650.***

### Section 10 — Electric Power Version Flights

Since the electric power units weigh 16 ounces, the wing loading of the electric powered Oly 650 will be considerably higher than the glider version. The gliding speed of the electric will be 20% faster. Due to this increased weight, the possibility of damage in a bad landing is higher, for the electric. For these reasons, hand gliding the electric version should be limited to straight-ahead controlled test gliding.

Follow the charging instructions for the electric system. The wing should be removed and the motor battery slipped out of the fuselage while charging. The battery gets warm during charge and it is better if additional cooling is provided. At the end of the charge cycle, put the plane back together and turn on the radio and transmitter. Wiggle the stick to make sure the radio is on, and launch firmly, straight ahead, with the wing level.

The electric Oly will climb slowly in a gentle right turn. Do not try to force a steep climb by using elevator. It should climb to 400 to 500 feet. At 3 to 4 minutes, the motor will begin to lose power and the plane will start to lose altitude. Fly it round and round yourself in the same way as the glider section instructed, finally landing down the middle of the field. The motor will still be turning, and the ship will land rather fast, so give yourself lots of room.

*Launching electric powered Oly 650.*

# CHAPTER XII

## LAUNCHING WITH AN ELECTRIC WINCH

**Section 1 — Winch Power**

While it is probable that you started soaring using a hi-start for launching, it is also probable that somewhere along the line you will be called upon to launch your sailplane using an electric winch. While winches come in varying degrees of speed and power, they are generally categorized as "6 volt," or "12 volt." This refers to the number of cells in the battery used to power the winch. In general, the 12 volt winch is much zippier than the 6 volt but, of course, this is not always true. The power developed depends on the condition of the battery and motor, size of the drum, and even the quality of the electrical connections in the system.

**Section 2 — Winch Safety**

First, the safety aspects of the electric winch. Winches are perfectly safe devices, but so is a rattlesnake, if you know how to handle it and are ever alert. A winch is a mindless thing that keeps on grinding along as long as your foot is on the pedal; and sometimes when your foot is **not** on the pedal. There are two ways the winch can runaway, that is, run when your foot is not on the pedal. First, the solenoid which sends current to the motor can fail with the contacts closed, or welded together. Secondly, the footswitch can fail. There may be a mechanical failure in the switch itself, or the electric cord may short. It can happen that if the winch line breaks, it can whip to the rear and grab the footswitch cord and wind it into the drum. This breaks the cord and may cause a short circuit, which causes a runaway winch. Does this sound impossible? It isn't, I've had it happen to me.

To deal with a runaway winch, the battery cables must be easily disconnected. Either the clamp must be loose enough to slide off the post, or a quick disconnect provided. A large knife switch which mounts on the battery is available from Recreational Vehicle supply houses, or an arc welder quick disconnect can be had from welding supply stores.

Aside from these rather rare mechanical failures, which are beyond your control, there is the human failure. Whenever you step on the footswitch, make sure the system is clear, and no one has their hands on the line, or near the winch. Also, when walking near the winch, be extremely careful not to step on the footswitch!

The last type accident is, of course, wing breaks due to improper winch technique. Especially in windy weather, the winch should be pulsed to keep the launch speed down. A very careful watch should be kept on the wings to detect any bowing, indicating wing stress. After experience has set in, you will have a feel for the whole thing and proper launch speed will come automatically.

**Section 3 — Learning To Launch**

So, now that we all know what the warning track feels like, let's try a launch. If you are launching on a winch, there is probably an experienced winch operator nearby. If so, have him launch you for a few times until you get accustomed to the techniques. If you have used a hi-start, do just as you did before. Stand well back of the launcher so you will have a good view of the start. Wiggle your controls to make sure the radio is on. Give the launcher the ok and — up, up and away. If the tow hook is properly located and the glider trim is proper, the ship will go up quite steeply. Watch for any tendency to veer off course and correct immediately. If the rudder correction does not take, you are probably going up too steeply and have a wingtip stalled. Push the nose down and have the launcher stop the winch. Concentrate on straightening the ship out for landing. Use the trim lever to put a little down trim in the elevator and try again.

If the ship should pop off tow during launch, it means you are going up at too steep an angle. Immediately apply down elevator to get the nose down and prepare to land. Check the position of the tow hook. If may be too far aft. Correct position depends on personal preference and glider characteristics. It normally works well about 1/4" ahead of the Center of Gravity.

When you feel comfortable with the launch, it's time to try it yourself. The most important thing is to keep alert. The safest launch, until you gain a lot of experience, is straight out, or just slightly up (about 20 degrees). It doesn't matter which foot you use on the pedal — whatever feels natural. Get a good hold on the glider; again, check the controls to make sure your radio is on. Start the winch and let the tension build in the line until it feels about the same as the hi-start. Now, **don't just let go of the airplane;** throw it firmly and smoothly. But don't throw yourself off balance. If the wind is blowing, start pulsing the footswitch immediately. If not, start after the ship is up 20 feet or so.

*Typical launching technique.*

Proper pulsing of the winch will come after a few tries. It's like patting your head and rubbing your stomach. Just keep tapping the footswitch at a regular rate and keep the ship climbing at a brisk rate. Do not slack off the pedal unless you are in trouble. You do not want the line to go slack; keep it moving. When you reach what seems to be the top, slow the pulsing until the parachute comes off the hook, then give the footswitch one last quick pulse. This will prevent the elasticity of the line from throwing some loops at the drum and causing a snarl.

If the parachute does not slip right off the hook, dip the nose; that should do it. In the unlikely event that the parachute ring should become fouled in the hook and not release, circle directly over the turnaround and descend quickly and smoothly. If you do not stay over the line but try to make a long straight landing, you will come to the end of your tether and you may have a bent airplane. While it is unlikely that this will ever happen to you, it's nice to know recovery procedures.

**Section 4 — Using A Retrieval System**

One other thing I should mention is launching on winches using a retrieval system. Most retrieval systems have a spinning reel which pays out a line which is attached to the winch line near the parachute. This retrieval line will billow out in back of your ship. When the parachute is free from the glider, it is pulled back to the winch by the retriever. Aside from seeing the retriever line behind your ship, you won't notice any difference. Just be sure that when you launch, the retriever line is free from snagging anything, such as the winch, then launch normally.

So, there is all the help I can give on winch launching, the rest is up to you. Just keep thinking — don't let your mind go blank. And remember, a winch is like a horse; once it finds out you are afraid, it has the upper hand.

***Local club contest.***

***Regional contests draw many contestants.***

# CHAPTER XIII

## COMPETITION

### Section 1 — Thermal Contests

I've had people say, "I have no interest in contests, I like to fly for fun." Then they turn around and say, "I'll bet I can stay up longer than you on this flight." The first statement implies that contest flying is not fun — but it is! Almost everything is a contest of some sort. People play golf for relaxation and fun and, yet, in every game they are competing - - - either against other players, or themselves, or the course. One real benefit of competitive flying is that it is the fastest way to become a really good flier. A second reason for flying in contests is the wonderful people you will meet. Glider Guiders are the best, and you will begin to look forward to the next contest with anticipation of a good time. The interchange of technical information with your peers is also an invaluable plus to contest flying.

A good way to start competing is with yourself. Join the League of Silent Flight. The LSF program is purely an achievement program. There are no meetings, or dues. You administer it yourself, and send in your achievements at each of five stages. To get started, send 25¢ in stamps or coin to LSF, P.O. Box 39068, Chicago, Illinois 60639 (or send a dollar, this is the only income this program has). Tell them you want to get started in the LSF program. You will receive a form that explains the tasks, and gives you a place to record your completions. To qualify for Level I, the flier must complete a five minute thermal duration flight, landing no more than 200 meters (656 ft.) from the launch point. He must also complete a fifteen minute slope flight, also landing within 200 meters of the launch point. However, for those without a slope site, a second five minute thermal duration flight may be substituted. In addition to the flying requirements, five spot landings must be made within three meters (9.8 ft.) of a designated spot. These tasks must be witnessed and signed off by either a Level I pilot, not related to the flier, or someone over 21 years of age, not related to the flier. The tasks increase in difficulty up through Level V. Level V tasks are sufficiently difficult that only a handful of fliers in the world have attained this level.

Contests come in all sizes. At the local level, most clubs hold monthly events with three or four entrants; up to thirty or forty for the larger clubs.

Associations of clubs hold regular contests. Groups such as the tri State Soaring Society in the Pennsylvania, Ohio, West Virginia, area, and the Southern California Soaring Council are typical. The Southern California group is a council of ten soaring clubs in Southern California, and one club sponsors a thermal contest in each of ten months. These contests draw from fifty to eighty contestants each month.

On the National level, the AMA sponsors a National Contest "NATS" each year and eighty to one hundred fliers compete. The grand-daddy of all times was the SOAR NATS, held in Lockport, Illinois, and sponsored by the Greater Detroit Soaring and Hiking Society. This one grew so big it finally had to be discontinued. The last one, in 1976, had 186 entries. Master Contest Director, Dan Pruss, had that meet organized better than any before or since. With that many entries it took an iron hand and a chair and a whip to finish before dark.

To become familiar with contest procedures, it will be helpful to understand the duties of the key people running the contest. Not all these people are in place at every contest. Sometimes the contestant performs the function. It depends on the size and formality of the contest. Nearly all the tasks must be performed by **someone,** however.

#### Contest Director (CD)

The Contest Director **runs** the contest. He decides which events will be held, sees to pre-contest publicity, assigns people to the tasks, makes sure all needed equipment is at the field and in place. He conducts a pilot's briefing before the contest to spell out the rules, especially deviations from accepted practice, or local ground rules. He is **the** authority who settles all disputes. But, most important of all, he makes sure the contest is moving along smoothly and on schedule.

#### Winch Boss

Someone is needed to keep the fliers moving to the launch area and get them into the air. In a man-on-man contest, the winch boss stands in front of the line of winches and directs the sequence of launches so there is no interference between sailplanes on tow, waiting until the launching ship is clear before giving the go-ahead to the next. When one group has launched, he makes sure the next group is in place and ready, when winches and frequency pins are available to **all** fliers. If the Winch Boss is busy at the winch area, an assistant is needed to call up the next flight and get the fliers and their sailplanes into the staging area. In small contests the function of Winch Boss is usually performed by the Contest Director.

#### Winchmaster

Someone must take care of the winches. At large contests, a person is assigned to each winch. At a small contest, one person can handle more than one winch. In any event, no matter how small the contest, someone must have equipment responsibility. After launch, each winch must be run down, and the parachute pulled down close to the turnaround. Otherwise, lines get crossed and fouled, and the contest grinds to a halt. Run-down can be done by the flier's helper, or helper/timer, but he must know this is his responsibility and do it. The winchmaster also makes sure that line breaks are promptly repaired, and that the broken line does not foul another launch station.

**Landing Judge**

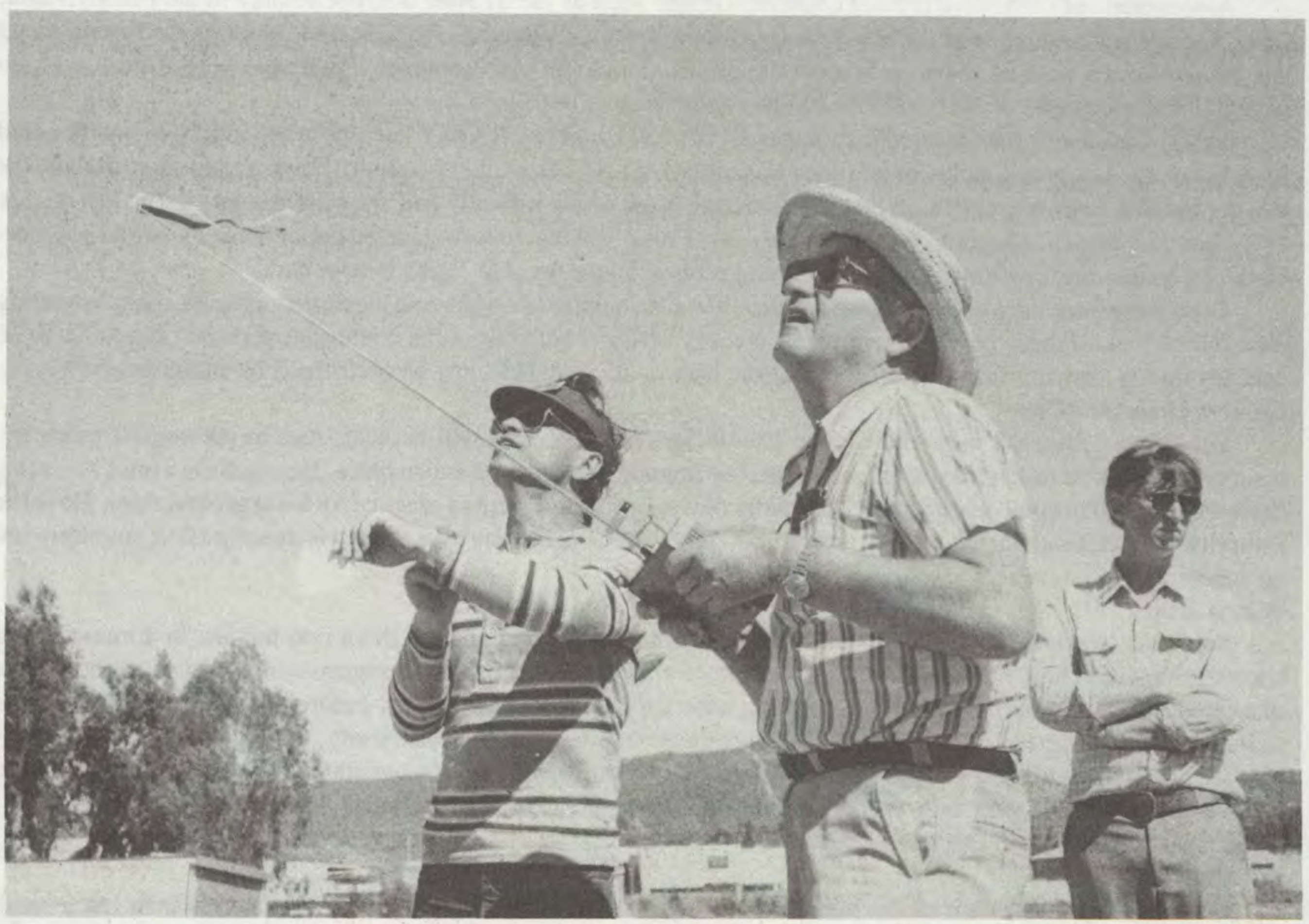
It is the responsibility of the Landing Judge to determine the landing score of each flier, and enter it on the flier's score card. It is also preferable that he look at the timer's stopwatch, and enter the time. Even if no landing score was made, the Judge must enter the zero score. It is also the responsibility of the Judge to keep the landing area clear. If one plane has landed and another is on close final, the Judge should mark the nose position of the plane on the ground and remove it from the landing area. He can then read the score after the last plane has landed. Many times the flier is prohibited from entering the landing area and must remain behind a ''foul'' line. In this case the Landing Judge, after reading the score, picks up the sailplane and carries it to the flier. It is important that the Landing Judges be competent people.

**Timer**

The function of the Timer is to start the stopwatch when the tow line leaves the sailplane on launch, and stop it when the sailplane touches the ground, or some ground-based object. This means if the sailplane hits a tree, the time is stopped, even though the plane might continue to fly. The Timer **may** also record the time and landing score on the score card, though it is preferable that a Landing Judge be assigned this function. This procedure will have been established by the Contest Director. The Timer may also act as the flier's helper in informal contests. If the Timers are assigned to the fliers by the CD, the one assigned may not be known by the flier. In this case, the flier may wish to have a helper with whom he feels more comfortable.

**Flier's Helper**

The Flier's Helper will assist the flier in getting ready to launch. He may actually do the launching and run the winch, unless specifically prohibited from doing so by the contest rules. After launching, the helper will guide the flier away from the winch and to the landing area — permitting him to keep his eye on his airplane. The Helper must also call time to the flier. If there is an assigned Timer, the Helper should provide a second stopwatch, having the Timer start both watches simultaneously. He should check to see that both watches are synchronized. If the Helper



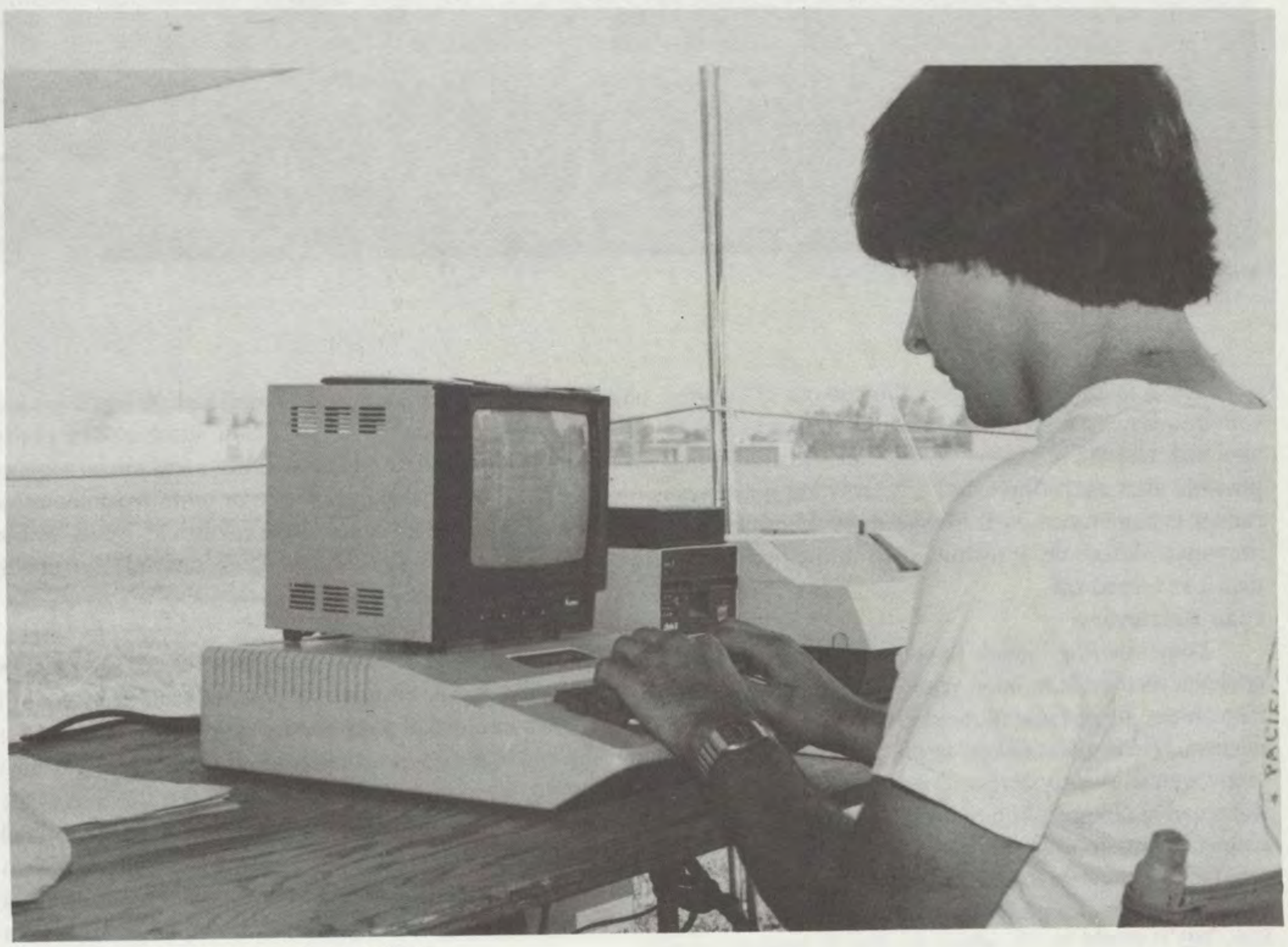
***Timer/Helper must be alert.***

does not have a watch, he can read the time from the Timer's watch. The Helper should remain alert and note the progress of other contestant's planes which are in the air, and advise the flier just who is in lift, and who isn't. If the Helper is more experienced at thermal flying than the flier, he may assist him in finding thermals and staying in them, He may not, however, touch the transmitter.

Before the flight, the flier must tell the Helper (or the Timer, if they are one and the same) exactly how he wants the time called. On a 2 minute precision flight, it is normal to call each 10 or 15 seconds for the first minute; then each 5 seconds until 1 minute, 30 seconds; then each second to 2 minutes. The last count may be either up or down. That is: 30, 31, 32, etc. Or: 30, 29, 28, etc. It takes experience to count down, and it behooves the flier to find out whether the Helper is comfortable with this count. It is also very difficult to do, using a digital stopwatch. Reading one number, and saying another, takes discipline. I find it less distracting if the Helper stops counting, with 5 seconds to go. At this point, you are committed to do whatever you are doing, and it doesn't help to know the time unless you have no chance for landing points. It is better to concentrate on a proper landing. Time-counts for longer flights are normally spaced out. In a 10 minute flight, it doesn't help to know you have only been up for 2 minutes. In fact, it's downright disappointing. It does help to know when you are half way through. From then on, time calls at frequent intervals, say 15 seconds, are important, especially if you are nearly out of sight. The correct time to start your descent is crucial. Too soon can put you on the ground early, and too late will run over the time, and you may incur a penalty.

**Scorekeepers**

As the fliers are called up to fly, the Scorekeeper will hand the score card to the flier, or to the Winch Boss, as instructed. When the card is returned by the Timer, it is checked for the flier's and timer's initials (if required). The score is then calculated, and entered on a tabulation sheet. It should also be posted on a larger scoreboard as soon as practical. It is preferable if the scoring can be done in a trailer, or van, to protect Scorekeepers from interruption. Some large meets are scored by computer.



*Computers are used to score large contests.*

**Transmitter Impound and Frequency Control**

Basic frequency control at any field is usually by means of clothespins, painted with the various frequency colors. That is, orange and white, red and white, etc. — one for each authorized frequency. When ready, fliers take the pin corresponding to the frequency flag on their transmitter, and clip it to the transmitter antenna. It is the gravest of sins to turn your transmitter on without the correct pin.

To greatly reduce the possibility of interference, transmitters are usually kept in a compound area for the duration of the contest.

*Transmitters are kept in impound area.*

The transmitters are never allowed out of the area, unless the correct frequency pin is attached. When fliers are called to fly, they go to the impound area and ask for their transmitter, usually by contestant number. The pin is attached, and the unit given to the flier. It is important for the contestant to return the transmitter and pin as soon as possible after each flight, to keep crowded frequencies moving. If a real jam exists on one or more frequencies, a runner is sometimes used to take the transmitter from the flier, at the landing area, and expedite its return to the impound. Before the transmitter is returned to its place, it is the responsibility of the frequency controller to check that it is turned off.

**Line Retrievers**

Somehow the launch lines must be brought back to the winch area in a timely fashion. A most satisfactory retrieval method is to have youngsters do it. Sometimes a Boy Scout troop, or other such youth organization, will take on the job to raise money. Often, as part of the entry fee, each contestant pays twenty-five cents per flight for retrieval. He is given tickets to give to the Line Retriever. At the end of the day the tickets are turned in for cash. In a large contest, twenty-five or thirty dollars is available for retrieving. Even in a small club contest, the children of the fliers can make spending money. Also, any flier who doesn't want to pay for retrieval can shag his own lines and collect tickets too. A less satisfactory retrieval method is to have the contestants shag their own lines. It is less satisfactory because this nearly always slows up the contest. This forces the honor system and it has been found that not all fliers are completely honorable in this matter. It is much better if the person up to fly does not retrieve his own line, but is ready to fly when the line is brought to him.

**Types of Thermal Contest Events**

There are two basic types of contest events. One is Precision Duration. The idea here is to launch and stay up exactly a given number of minutes, and land with the nose of the sailplane exactly on a target. Duration times are popularly two, five, six, seven, or ten minutes. The time selected by the Contest Director is usually based on flying conditions and the number of fliers in the contest. The second general contest type is commonly called ''add 'em up.'' In this type of contest, each flier has three flights to stay up a total time of fifteen minutes, with no one flight lasting longer than seven minutes. Flying longer than seven minutes penalizes the flier a specified number of points a minute, that cannot be made up. The interest in this type contest is that nearly all fliers are in the race until the last flight — except those whose time remaining is greater than seven minutes.

The Two Minute Precision event is seen at eighty percent of the contests. It is very popular with Contest Directors, if not the contestants, because it is a good contest opener. It doesn't make much sense to start a contest in the cool of the morning with a Ten Minute Duration flight when nobody can make more than two minutes. In this event, a premium is placed on precision, both in landing and duration time. Missing two minutes by one second reduces the score by one percent. Missing by four seconds gives a ten percent reduction. Ten second miss penalizes forty percent, and a thirty second miss gives zero. Landing points are usually half the score, so are extremely important. This event is AMA Task III and the bell-curve scoring is listed in the score table in the R/C Sailplane section of the Official Model Aircraft Regulations.

**Landings**

All times are measured from the time the ship leaves the tow line. Landings are most often made using a twenty-five foot radius circle as a target. Points are awarded using a twenty-five foot tape measure, marked at each foot. Measurement is to the nose of the sailplane. If the plane turns over on landing, all landing points are lost. If any part of the plane is shed during landing, except rubberbands, all landing points are lost. If the plane is damaged in landing, so it cannot be immediately flown, all landing points are lost. These rules are an attempt to prevent ''spear landings.'' Some fliers, in order to get maximum landing points, approach the center of the circle slightly high. When over the center of the circle, they dive the last foot or two and spear the circle center with the nose of the sailplane. This is very hard on airplanes, especially if the circle is painted on asphalt. There have been suggestions that landings be judged as to their ''scale-like'' qualities, as well as awarding points for accuracy. This procedure has

*Landing through gates.*

proved very difficult as it requires subjective judging, and at least requires a trained judge at each landing circle. Some Contest Directors have used landing centerlines and measured points from the line to remove the incentive to "spear." To date, no universally satisfactory method has been found.

Another problem facing the Contest Director are the landing patterns of the sailplanes. There are times when the contestant is really not set up for a proper landing pattern. Perhaps he was far out in front of the winches and is falling out of the air. The temptation is to by-pass a sensible landing pattern, take the shortest return path, zing right through the launch area, fliers, Timers, etc., and go for the landing circle. This is not only dangerous, but throws the launch area into, at least, temporary confusion. To prevent this, a pair of poles (knock-down type) are sometimes placed about 25 feet apart, and about 25 feet in front of the landing circle. To receive any landing points at all, the landing sailplane must pass through these gates. This removes all incentive for anyone to approach the landing from any direction except the normal, straight-in direction.

Time-count is extremely important in setting up your landing pattern. Landing accuracy depends on setting up a timed pattern and practicing, practicing, practicing, and practicing. It doesn't matter what pattern you establish. What **is** important is that you use the same pattern **every time** you land. There are exceptions, of course. Sometimes you are just not in position; such as coming in from far out, without enough altitude, or time to set up a pattern. A pattern used by many fliers is shown in Figure 1.

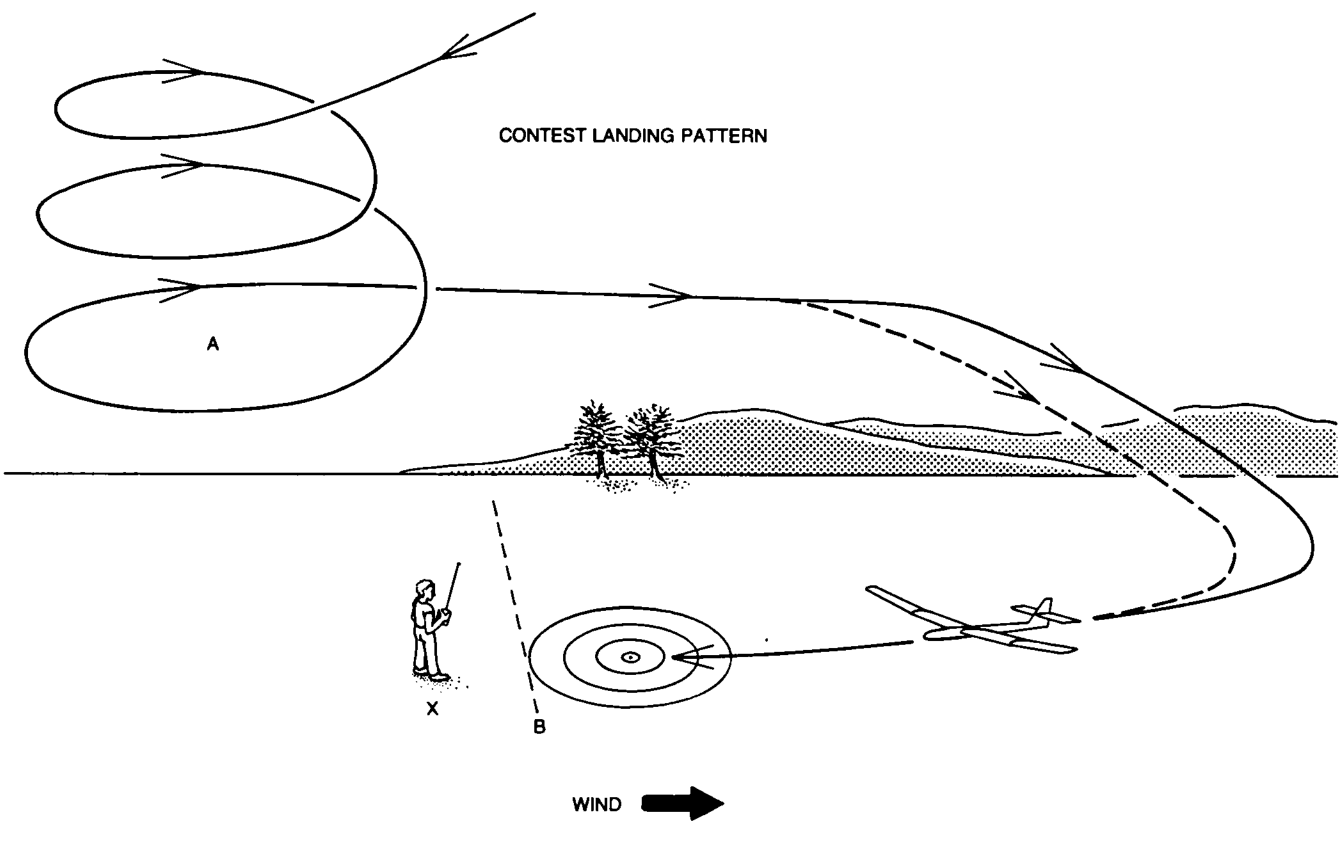



**FIGURE 1**
**LANDING PATTERN**

With the flier standing at X, arrival is made at point A, about 1 minute before target time, at an altitude of about 100 feet or so. The altitude depends on conditions, and the sink rate of the sailplane. A flat turn is set up, and held, until 30 seconds to go. Then roll out of the turn and head downwind, crossing line B at 20 seconds to go. Line B is normally a foul line, set up 30 or so feet from the target, beyond which the flier is not permitted to stand. If there is no wind, a fairly long approach is used. With wind, the downwind leg is shortened; otherwise; you won't make it back to the target. Using a set pattern, and practice, you will be able to set the ship down, not always in the exact center, but within 5 seconds or so of target time. Even if you see that you are going to be off a little in time, go for the center of the target. If you try to take action to stretch, or shorten, the time, chances are that you will miss the spot, and lose more points than can be gained with the few seconds of time.

## Contest Luck

There is no doubt that luck plays a part in contest success. One does notice, though, that the top fliers are "lucky" time after time. This is because it is under the really marginal conditions that flying skill becomes apparent. However, when the air is "down," the best flier in the world will fall out of the sky. The good flier can recognize the symptoms of bad air and, if possible delays his flight until conditions are more favorable. This has led to a practice known as "sandbagging." Sandbagging means that the flier uses every legal (and sometimes questionable) means to avoid flying during bad conditions. Unscrupulous fliers have been known to try everything from hiding the frequency pin to deliberately breaking the launch line on tow. It doesn't take long, though before their reputation becomes well-known, and all eyes are on them every flight. The really top fliers are mostly straight arrow, and would rather take a loss in standings than a loss in their reputation.

There have been many attempts by means of contest format, or rules, or scoring, to equalize the air for all flights. If the lift was exactly the same all day, then every contest would be a true test of soaring skill and not depend on the time of the day you flew. One quite widely used means of lift equalization is called "Man-on-Man." In Man-on-Man, fliers are launched in groups nearly simultaneously. The number of fliers per group will depend on the number of winches available — at least four is desirable. Launches are made at about fifteen second intervals, as directed by the Winch Boss. The flier staying up the longest wins the round and gets a thousand points (or whatever), plus his landing points. All other fliers are awarded points based on how they did against the round winner. That is — flier's time divided by winner's time, times one thousand. The winner is the person who is closest to target time. In a seven minute precision event, one flier may stay up 6:56 and another, 7:05. As 6:56 is closer to 7:00, that flier is the winner. From a scoring standpoint, the flier who went five seconds over seven minutes must be treated as though he was short of seven minutes by five seconds. Otherwise, by the above formula, he would be awarded more points than the winner.

Man-on-Man would **seem** to solve all the problems. The truth is, it creates a new bunch of problems. It is cumbersome to run. First, a lot of winches are needed. They all must be good winches, and not malfunction. If anything goes wrong with a launch, such as a broken line, all fliers are brought down (usually), and the round is started over. It is hard to get four to six fliers all at the winch at the same time, ready to fly. So, the whole thing tends to move rather slowly. It is harder to score. Fliers in each round must be carefully identified as to which round they were in. And scoring is more confusing, and can't be done until all score cards for a round are in. Worst of all, you may be flying with the world champ in your flight. The next flight has a herd of turkeys. So, your good flight scores worse than a bad flight in the next round.

Fliers in the Pacific Northwest part of the United States have tried yet another method of providing the pilot who hits bad air with a way to score well. It is called "Variland Scoring." The scoring graph is shown in Figure 2.

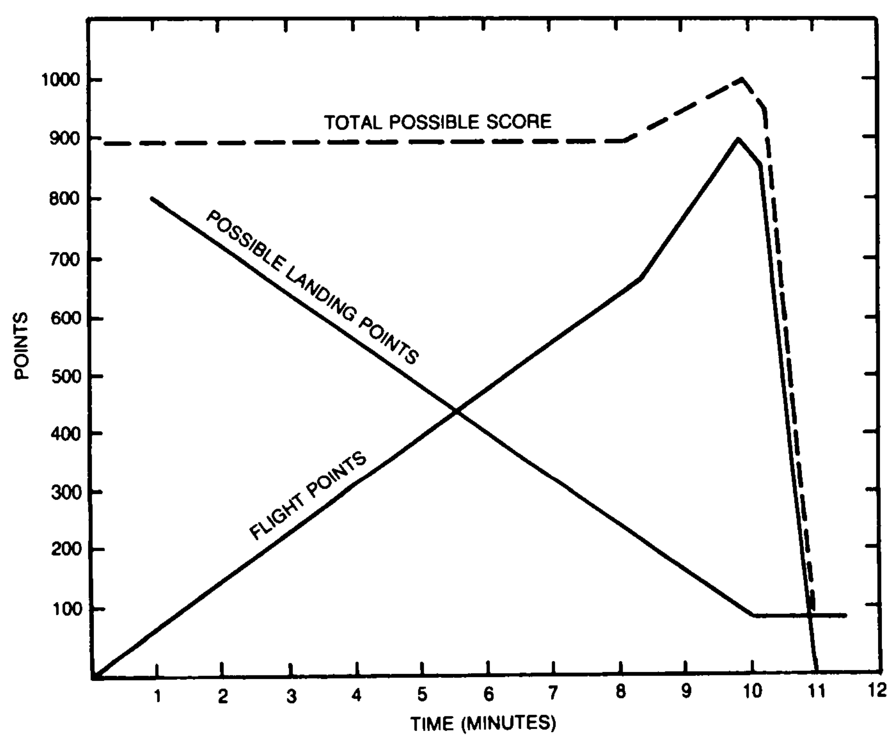



**FIGURE 2**
**VARILAND SCORING**

In this method, possible landing points start at 800 for a 1 minute flight and fall to 100 for a 10 minute flight. Flight points start at 0 and go up to 650 for an 8 minute flight. At this point, they go up at a greater rate, giving an extra bonus for flights over 8 minutes. The net result is a total possible score of 900 points for all times above 1 minute, up to 8 minutes. Above 8 minutes, the possible score increases linearly to 1000 at 10 minutes, so that long flight times are rewarded. After 10 minutes, scoring falls rapidly. This system says that if you hit bad air, and come down early, you still have a chance to place, if you ace your landings.

The complaint, of course, with this system is that it takes the luck out of the air, and puts it in the landing. A flier **could** make all two minute flights and, if he aced his landings, make 90% of a perfect score — beating someone making all ten minute flights. Maybe the guy who can make all perfect landings deserves to win. And anyway, 90% of perfect, and forty cents, will get you a cup of coffee in a great many contests I've attended.

Yet another equalizer is called "Triathlon." Here the score is the total of three separate scores — for duration, for precision, and for landing. Duration points are awarded at so many per second of flight. The longer you stay up, the more points you get. Precision points are awarded for landing at one of the exact minute intervals. Or, to make it harder, on either even or odd minutes. Points are on an AMA Task III bell-curve, and are the same as two minute precision points. The points fall off very rapidly either side of the minute, and go to zero at the half minute. This creates an interesting decision point for a flier who is having difficulty staying up. Should he try to make the next precision point minute, or be safe and land on the precision minute coming up? Contests that involve decisions, risks, and rewards are always fun.

So, these are some of the things that have been tried to take some of the luck-of-the-draw out of sailplane contests. There are those who say, "Let me fly when **I** think best, that's part of the skill." That is the free-flight way of doing it. One big constraint is that we have a limited number of radio frequencies. Everyone can't wait until the eleventh hour to fly so I guess we will have to continue to queue up, or devise yet another neat way so we don't have to.

**Participating in your First Contest**

You will find the date and place of all AMA sponsored contests in the contest calendar section of the AMA publication, "Model Aviation." Most contests require membership in the Academy of Model Aeronautics (AMA), to enter. This is because of the insurance coverage afforded members for accident liability. Other contest information comes word of mouth, or from club newsletters.

At most contests, you can register at the field on the day of the contest. Some larger contests, however, require advance registration. This is because of the R/C frequency problem. With advance registration, the number of fliers on one frequency can be limited, to prevent slowing down the contest. Advance registration involves filling out the form attached to the contest notice, and sending it in with your entry fee. This is normally required a month or so before the contest. Acceptance notification is then sent to the entrant in time for him to plan to attend. It is probable that at your first contest, you will register at the field. With your AMA membership, you will receive a publication, "Official Model Aircraft Regulations." These rules are used to guide most contests, read them carefully.

Preparation for the contest starts the night before. Put your name on your transmitter; there will be others that look exactly like yours. Be sure your name, address, and phone number is in, or on, your sailplane. Make a list of everything you will want to take. Completely check your sailplane; charge your batteries in the normal manner. Get all your gear together: flight box, chair, umbrella (if you take one), plane, transmitter, hat, sunglasses, jacket, FCC license, and AMA card. These last two items must be shown at AMA sponsored contests. Before leaving, you will want to make a lunch (contests are almost never near a MacDonalds). Take water, or something cold to drink, as you will be in the sun all day (hopefully). Check the operation of your radio and, for goodness sake, turn it off! Check this three times. Arriving with a dead radio is just as bad as arriving without your transmitter. After the car is loaded, check your packing list once more. Check for things like wingtips and stabilizers. Mentally go over putting your plane together, and flying, to see if you have everything in the car you will need. Now, you are ready to leave.

Plan to arrive at the flying site a half hour before the scheduled start of the contest. This will give you ample time, as contests never seem to start when scheduled. Locate the site on a map before you leave so you won't be wandering around in the backwoods all morning. Most contests are scheduled in the morning, before the wind comes up. Nine o'clock is a normal starting time although smaller contests may start later.

When you arrive, find the registration table and sign up. You will probably fill out a score card with your name, AMA number, FCC number, transmitter frequency (or colors), and, perhaps, the type sailplane and class (i.e., Open, Standard, Modified Standard or Two Meter). The score card is normally left at the desk. You pay the entry fee and, perhaps, receive retrieval tickets. You may receive two stickers with your contestant number printed on them. One goes on your transmitter, and the other you stick somewhere where you can see it. You may need to know your contestant number to get your score card and transmitter. You may also be required to turn in your transmitter to a compound area. In any event your transmitter should be turned into impound, if there is one, as soon as practical. Under no circumstances should you turn on your transmitter at the field unless you have the proper frequency clip attached. This would make you extremely unpopular right off the bat.

Unpack the car and stake out a place to camp. Assemble your sailplane right away so you will be ready to fly when it is your turn. Some Contest Directors allow test gliding before the contest, some do not. Check first, and if you would feel better about the whole thing, give it a few chucks — **but only after getting the frequency pin**! When you are all set, scout the site. Go out and look at the landing area close up. Note any hazards on the approach path such as trees, etc., and plan your landing pattern. Look around the field for possible areas that might generate lift, such as asphalt parking areas or plowed ground. Look for possible wave generators such as buildings, rolling ground, etc. Then talk to some local flier about typical field conditions. I've never found a glider guy yet who isn't willing to tell you all he knows about what to expect at his field. Now go back, sit down and relax.

It is usual to start with a pilot's meeting. Here the rules of the contest are explained by the Contest Director. You should make **sure** you understand. The CD should explain whether there is a landing qualification area --- that is, whether you must land within certain boundaries to get any points at all — usually the field boundaries. It is important to know what the penalty is for popping off the tow line — usually you get whatever points you are able to get from that altitude. A broken line or malfunction of launch equipment, though, entitles the flier to a re-launch. You will find out about the launching order — whether you will be called, or whether it is open winch. You should know how the rounds are scored --- that is, what is the ratio of flying points to landing points. This helps if you are faced with the decision whether to try to stay up a little longer, or to get into position for a maximum landing. The CD should also say whether times should be written on the individual score sheets in minutes and seconds (usual), or just seconds; also, whether the timer and flier must sign the score sheet. Again, who writes down the times, the timer or landing judge?

Decide who is to be your timer, or helper. Ask him ahead of time and talk over the time-hack strategy. Select a ''silent Sam'' if you can. There is nothing more distracting than listening to all the details of your timer's last flight. An experienced timer never talks except to give pertinent, and requested, information. When you are called, try to keep from throwing up — keep calm. You may need to know your contestant number when you go to the scoring

***Launch with wings level.***

table for your score card. Proceed to transmitter impound and ask for your transmitter by contestant number, or whatever. Make sure the proper colored clothespin is attached. Give your score card to your timer, get your sailplane and proceed to the winch, if so instructed. Give the ticket to the retriever, and turn on your radio. Check all controls. Make sure the rudder and elevator are in neutral. If not, set them with the trim control. Now, hook up and you are ready to go. Get your mind working. Think about what you are doing. Okay, check that your timer is ready. Start the winch, let plenty of tension build up. Make sure your wing is level. Now, rear back and heave.

Don't forget to pulse the winch, you don't want to pull your wings off, but keep the ship moving **up**. When ready to release, pulse slower and slower, letting the winch come to a stop. Let the sailplane fly off the hook. Now, off on the search pattern you have decided on. Don't change your mind unless there is strong evidence you were wrong. Try to fly smoothly. If you find a thermal, circle smoothly. If you don't, head back in time to set up your landing like you practiced. If you are short of target time, forget the time and concentrate on the landing. Crank in down trim, come in low, and **concentrate** on the target. If you miss the spot, take it in stride. Don't yell "oh do-do," throw your transmitter, or stomp on your airplane. These are definitely bad show. Now, you can stop shaking and pick up your plane, unless the landing judge is to bring it to you. **Turn off your radio** — both receiver and transmitter. Return your transmitter, with the frequency clip, to the impound area as soon as possible. Your timer will turn in the score card to the scorekeeper but, before he does, **check it** to make sure it is correct — sign it if that is required. Now you can turn to the crowd and take your bows — you did it — up and down in one piece. Go back to your chair, sit down, have a cup of coffee and think over the flight. Decide what you are going to do different on the next round. You are now a contest veteran.

**Section 2 — Slope Contests**

In the U.S., slope contests are few and far between. A big reason is that slopes, suitable for big contests, are few and far between. Another reason is the weather. Thermal contests can be held in a fairly wide-range of weather conditions, perhaps not comfortably, but they can go on. Slope flying demands at least a minimum wind velocity, and it must be from the right direction. It is very distressing to have fliers travel long distances for a slope contest, and have two days of dead calm.

Most slope contests are devoted to pylon racing. Very few fliers have developed aerobatic slope gliders. I have never heard of any serious aerobatic contests. Many club contests have aerobatic events however, usually flown with regular thermal, or slope aircraft. A most prestigious slope meet is the International Trophy Race, held in April of each year in Northern California. This event has drawn fliers from as far away as England. Most all entries have been specially designed slope racers.

The Torrey Pines Gulls club is quite active in slope flying, holding monthly slope contests, weather permitting, at the famous Torrey Pines Cliff. The Gulls have developed a club slope racer in order to hold one-class pylon races. This equalizes the aircraft, so the pilot skill determines the winner.

Many other clubs regularly hold slope contests: San Fernando, California; Seattle, Washington; Denver, Colorado; Salt Lake City, Utah; Los Angeles area; and I'm sure, many more. Inquire at your local hobby shop, or ask other glider guiders for locations of slope sites, if you are interested.

**Section 3 — Fun Contests**

Many contests are just held for the fun of it. These are mostly club affairs, and are held to get the whole group involved in a day of flying. They may hold bomb drops or other events that do not involve a high degree of pilot skill. One club held a contest where the flier launched, got the glider flying level, then handed the transmitter to a blindfolded flier. He then flew his ship by giving instructions to the blindfolded pilot. His time was measured from the time he handed off the transmitter, until he couldn't stand it any more and took the transmitter back. Only one team had enough nerve to continue all the way to a landing.

Some fun-flys are just a gathering at some famous soaring site. Annual get-togethers take place at Harris Hill, New York, and the Cumberland Slope Soaring Site in the Blue Ridge Mountains of Virginia. Fliers gather for two days of good fellowship and fun soaring under conditions not possible at their home fields.

# GLOSSARY OF TERMS

**Aileron:** A portion of the trailing edge of each wing which is movable, usually both up and down. The right hand and left hand ailerons are cross connected; that is, when one rotates up, the other rotates down. When deflected, air reaction on the aileron that was raised causes that wing to drop. Reaction on the aileron that was lowered causes that wing to rise. The aircraft, therefore, rolls in the direction of the lowered wing. Also see Flaperon.

**Attack Angle:** The angle the wing makes with respect to the passing air. It is measured from the chord line, drawn from the forwardmost tip of the leading edge to the rearwardmost point of the trailing edge. Also see Incidence Angle.

**Bank:** To tip the aircraft to one side or the other on an axis through the length of the fuselage. This is known as the roll axis.

**Center of Gravity:** The static balance point of the entire aircraft. Or, more precisely, the centroid of the forces of gravitation acting upon all the particles.

**Channel:** The ability of the radio to control one independent action. For instance, a three channel radio can control, for example, rudder, elevator, and spoilers.

**Drag:** A force exerted against the direction of flight by the resistance of air.

**Elevator:** The movable portion of the horizontal stabilizer. When moved, it causes a change in pitch of the aircraft.

**Flaperon:** A term used to describe a combination control wherein both aileron and flap action are obtained from a single control surface.

**Flaps:** Panels hinged to the lower surface, or trailing edge, of the wing which, when lowered, can increase lift and reduce speed.

**Glider:** A term used synonymously with sailplane to describe a powerless aircraft. More properly, a glider is an older training aircraft, without much ability to soar in thermals as does a sailplane.

**Incidence Angle:** The angle formed between the chord line of the wing and the datum line of the fuselage.

**Inertia:** The tendency of all objects not to move, if at rest or, if moving, to keep moving in the same direction.

**Lift:** The upward force exerted by the wing. Or, the upward force of air due to thermal, or wave action.

**Moment:** The product of a force magnitude and the distance from its action line. As used in modeling, it refers to the distance through which a force is acting, and should more properly be called the moment **arm**. That is, the tail moment is the distance from the center of pressure of a tail surface, and the Center of Gravity.

**Pitch:** The control movement effected by the elevator, causing the aircraft to move in a nose up, or nose down condition.

**Reynolds Number:** A correction factor related to air density and viscosity; but more importantly to chord length, and velocity of the wing. The greater the chord, and the higher the velocity, the higher the Rn.

**Rudder:** The movable portion of the vertical fin which affects the yaw mode of the aircraft.

**Roll:** See Bank.

**Sailplane:** See Glider.

**Sink:** Downward movement of air.

**Spoiler:** Panels hinged to the upper surface of a sailplane wing which spoil the lift of a portion of the wing, and increase the drag, causing it to descend.

**Stall:** A condition usually characterized by the dropping of the nose and rapid descent of an aircraft due to loss of lift caused by the angle of attack of the wing reaching a critical angle.

**Thermal:** An upward current of air caused by warming of the ground.

**Tip Stall:** Loss of lift at the wing tip caused by the tip area reaching the critical stall angle before the root.

**Turbulence:** Swirling air currents.

**Undercamber:** Normally refers to an airfoil shape with a concave lower surface, fore and aft.

**Wing Loading:** The weight each unit of wing area must support. For models, it is the total weight, in ounces, divided by the wing area, in square feet. For sailplanes, it usually runs between 6 and 10 ounces per sq. ft.

**Yaw:** A rotation about a vertical axis through the center of the aircraft normally caused by rudder action. This vertical axis is called the yaw axis.