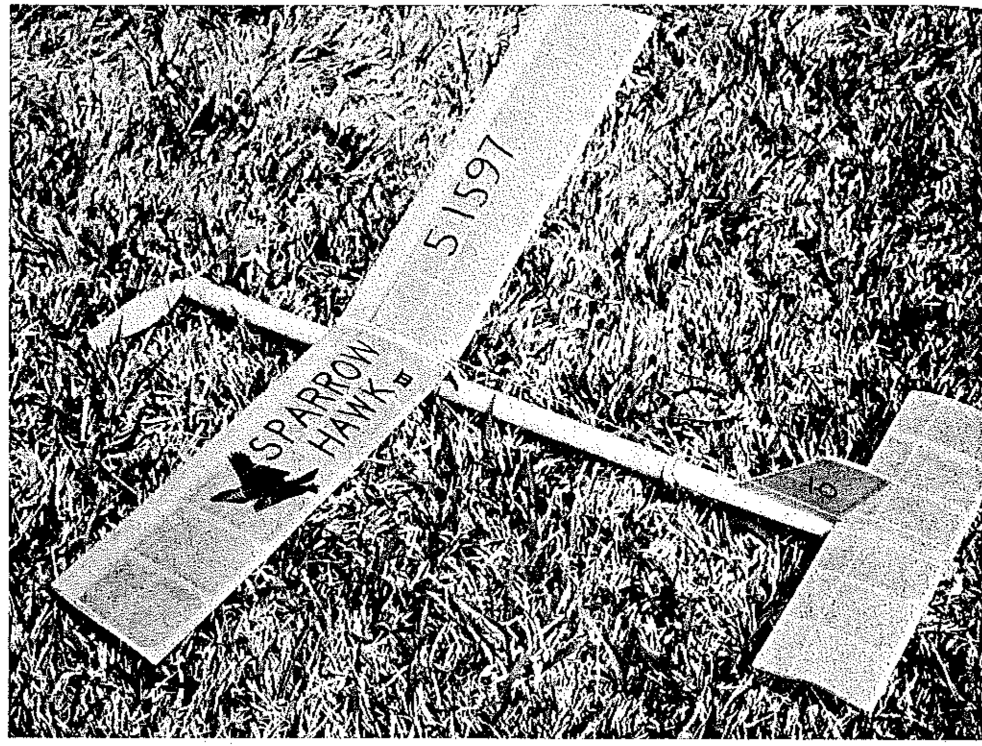
Sparrow Hawk



Above: A lot of research went into making this simple-looking airplane the consistent contest winner it has become. Fortunately the hard work has already been done for you. All that remains is to construct it as per the plans and instructions in this article. Below: Our author and his young friend, Sean Bridges, wind her up again for another trip into the Texas skies.

The P-30 class has become one of the most popular categories in all of outdoor Free Flight modeling. You can join the ranks with a design that's a proven winner.

■John O'Dwyer

WHY, YOU ASK, another P-30? The answer should be dear to every competitor's heart. *This* P-30 lives up to all my hopes for it. It was designed to really *win*—and win it does. The Sparrow Hawk definitely outperforms the breed. It has placed in every contest it's competed in, and yet the airplane maintains a relative simplicity that belies its capabilities.

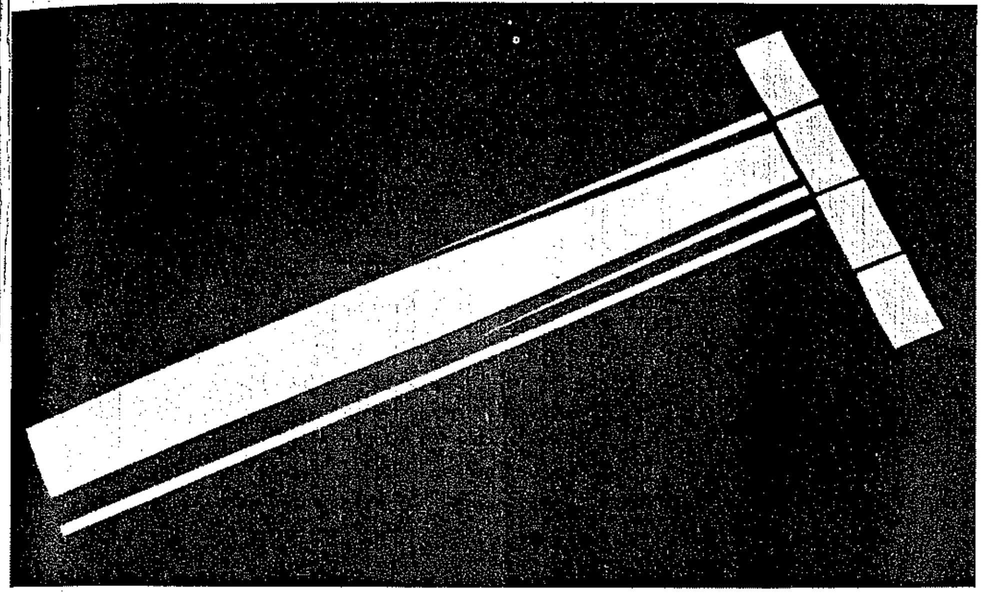
As a retired aeronautical engineer and a relative newcomer to Free Flight modeling, I was looking for a challenging event to start off with. After reading the rules, I roughed out my first P-30, built it, and flew it—or tried to. Heavy and ugly, the model barely got airborne. Clearly, there had to be a better way. I decided to use some of my experience and education to design a better-performing P-30.

At this point, let's review the AMA rules for P-30:

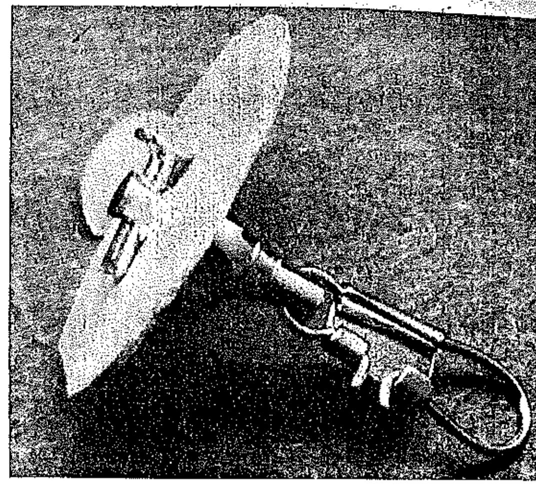
- 40-gram minimum weight. (This is probably the most important consideration.)
- 30-in. maximum dimension (no long, skinny, and efficient high aspect ratio wings).
- 10 grams of rubber only. (How do you use this most effectively?)
- A freewheel plastic prop between 9.05 and 9.84 in. in diameter. (Are all plastic props alike?)

Other challenges became apparent as development progressed; these will be covered later.

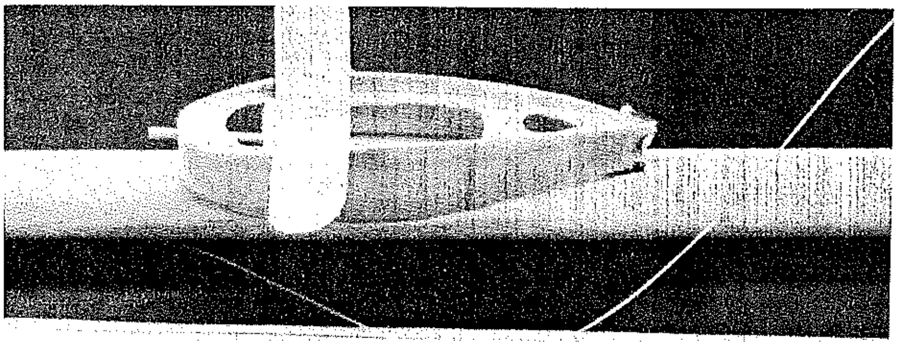
One thing 40 years of experience in designing full-scale aircraft will make totally obvious is that excess weight is invariably the primary reason for poor performance. Hence if you want a competitive model, keeping the weight down should be your number one consideration. To achieve this, you need a scale. Any scale, such as a postal scale or a weight watchers' scale, will do. Best of all, though, is a good three-beam laboratory scale calibrated in grams.



The balsa sheet trimmed to shape before it's formed around a broom handle to make the body tube. The four pieces on the right are glued together to make the wing mounting pylon.



The aft end bulkhead and mini swivel. Once the wing pops off its pylon for dethermalizing it remains connected to the fuselage by a piece of monofilament line tied to this swivel.



The pylon is glued to the body tube with CyA. Placed as shown here it acts as a partial external bulkhead strengthening the body's center. Cut out the middle of the pylon to save weight.

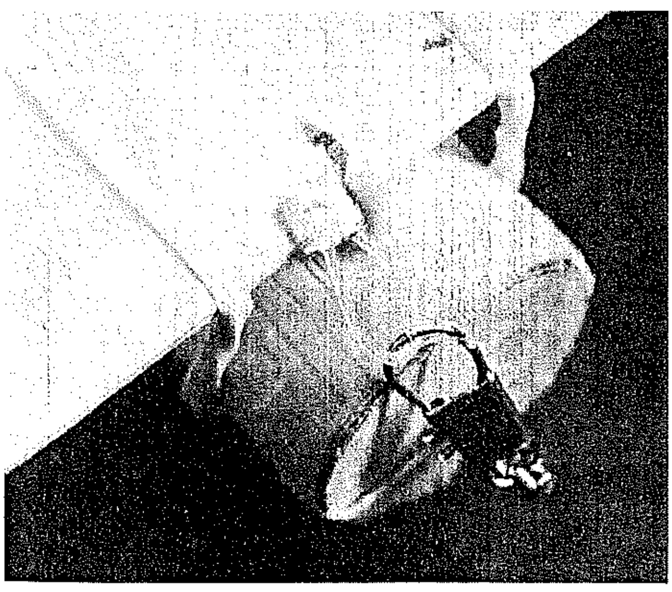
The rear edge of the pylon is notched to center the snuffer tube. Dark band around the tube is 24-hr. epoxy. Use sparingly; it's heavy.

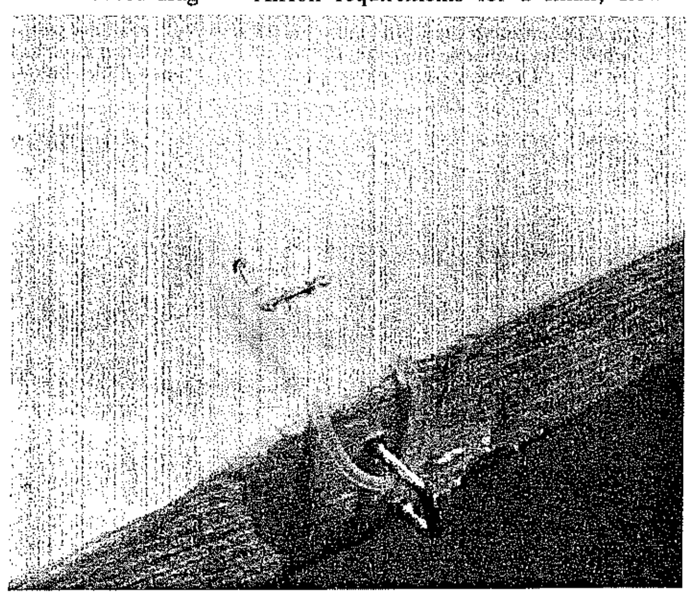
Thus equipped, you can weigh several pieces of balsawood and pick the lightest—or discover that two apparently identical plastic props actually differ in weight by more than two grams. Also, a scale allows you to check that you're flying with the maximum legal weight of rubber and aren't shortchanging yourself.

If all you have is a simple postal scale calibrated in ounces, one ounce equals 28.34 grams, 1½ oz. is a little more than 40 grams, and ¼ oz. is slightly less than 10 grams.

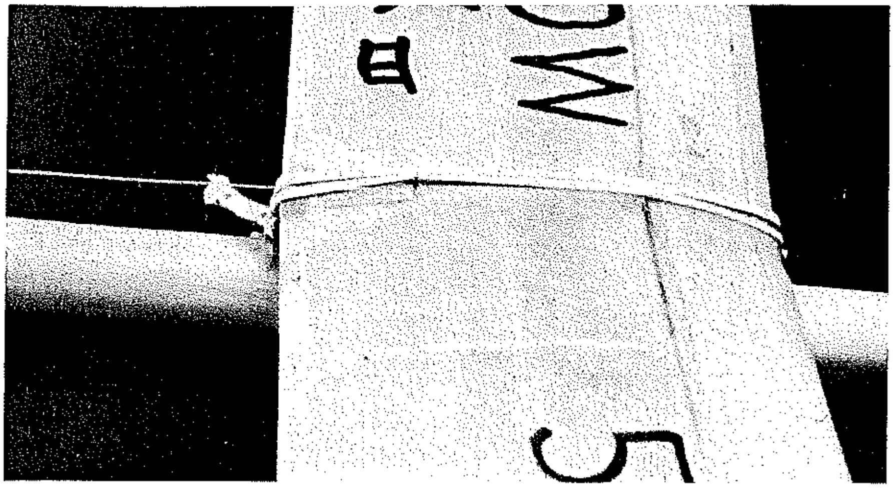
Since the wingspan is limited to 30 in., a low aspect ratio and low wing loading seem best. An aspect ratio between 6:1 and 7:1 is indicated as the lower limit for several reasons, including a rapid rise in induced drag and structural stability. The wingspan being the compromise that it is, we can at least compensate by using the best possible airfoil.

Airfoil requirements for a small, slow



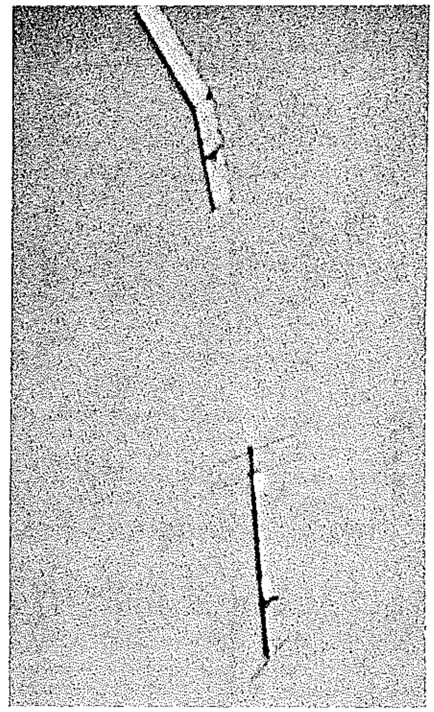


Left: When fastening the monofilament line to the swivel, use a piece of aluminum tubing crimped over the line's end instead of trying to tie a knot which will inevitably slip out. Right: The other end of the monofilament line is permanently attached to the model's left wing tip.

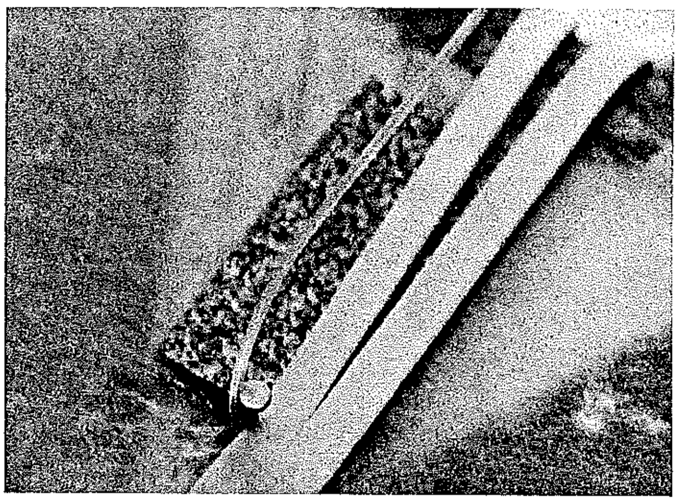


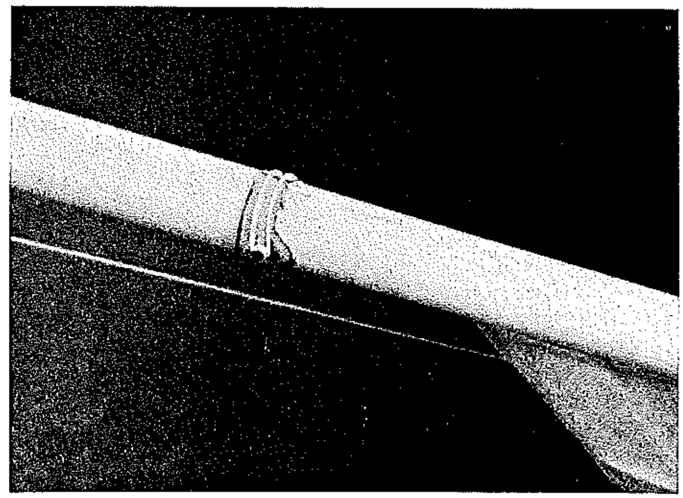
The DT line runs along the upper surface of the wing, under the hold-down rubberband, back along the left side of the fin, over the stab, and to the swivel on the end of the body tube.

plane like this one differ greatly from what full-size aircraft need, and only airfoils specifically designed for a low-speed regime were considered. Much has been written on this subject. Among the more authoritative works is that published by Dieter Althaus based on studies at the low-speed tunnel in Stuttgart, Germany. Using a P-30 model, a flight speed of 8 to 10 ft. per sec. was measured by test gliding from the bleachers of the local gym. The best airfoil for this size and speed appeared to be the Sokolov, a Russian Glider section that exhibited the very good lift/drag ratio of 60:1 with a turbulator. Lift/drag ratio is the best index of gliding efficiency, and the Sokolov measured nearly 80% higher than the easy-to-use, flat-bottomed Clark Y airfoil shape.

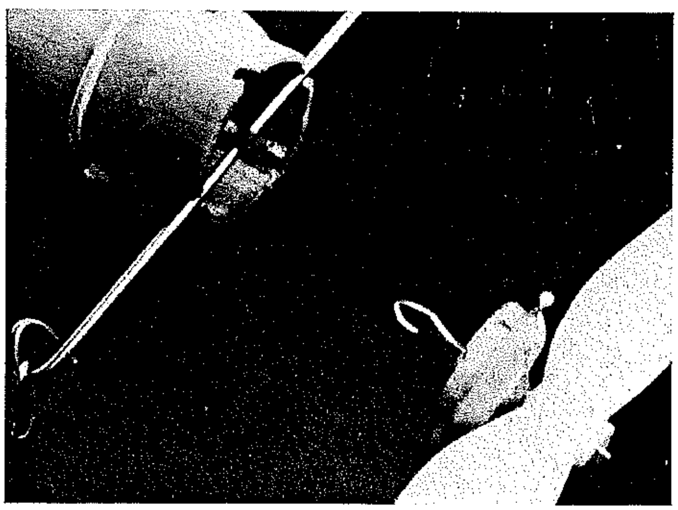


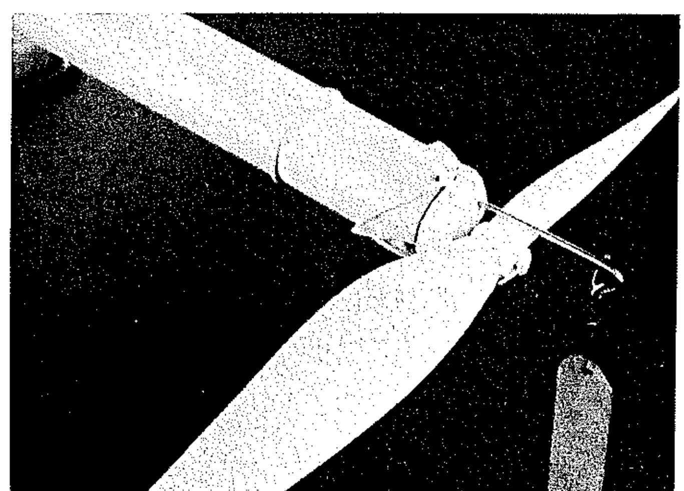
Our author lost the first five Sparrow Hawks when the usual pop-up stab DTing failed to bring them back down. Popping the wing off this way almost always gets the model out of the thermal and brings it safely back down.





Left: A common straight pin holds the DT line in place at the wing center while the rubberband is secured. Once the band is in place, lift the line over the pinhead; the rubberband will hold it in place against the sandpaper. Right: A band of 1/64 ply is wrapped around the fuselage to strengthen it in the area of the rear motor peg. A small rubberband keeps the hollow peg in place after the tension of the rubber motor is gone.

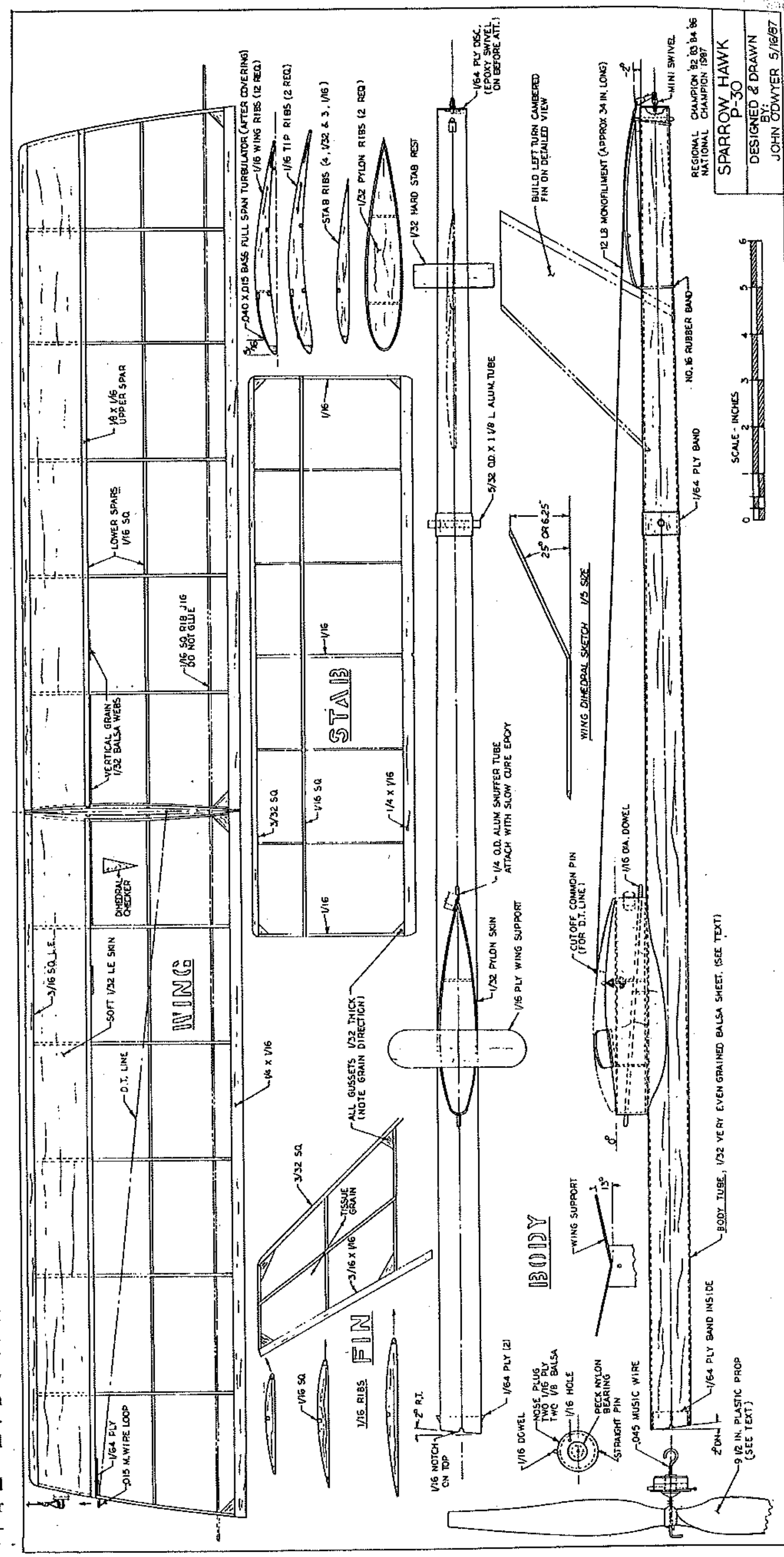




Left: The two side notches hold the safety pin in place on the wound motor until the prop can be installed. The safety pin is then placed in the nose block to prevent the prop from turning while the nose plug holding bands (other one is for backup) are hooked on and the DT fuse is lit.

Full-Size Plans Available . . . See Page 186

Four keys (black areas) are made from two pieces of dowel which have been split into halves. With the keys in place, accurate wing location on the pylon is assured every time.



Fuselage. If this is your first rolled tube fuselage, building one can be kind of fun. To begin with, selecting the correct wood is extremely important. What's required is a very even, straight-grained 3 x 36 x 1/32 sheet of medium-lightweight balsa. Sig has good balsa, but I have also found the Midwest balsa carried by a local hobby shop to be very even-grained and light. The 1/32 sheet is thin enough that it can be held up to the light to check the uniformity of the grain. Reject sheets with dark streaks; these indicate a harder-grained wood which may crack when rolled.

A 3-in.-wide sheet of 1/32 thickness will make a tube roughly 1 in. in diameter. That's bigger than a wound P-30 motor, so we can save weight by using a smaller diameter. Trim 5/16 in. from the edge of the sheet along its full length, then cut off the end to a length of 28½ in. Again to save weight, taper the rear half to a 5/8-in. diameter. Referring to the photo of the prepared sheet, cut two 3/8 x 14-in. triangles from the part of the flat sheet that will become the tail end.

Apply only two coats of undiluted dope to the inside surface of the fuselage, allowing about two hours for drying between coats. This will seal the inside against rubber lubricant, add strength, and cause the tube to curl like magic when wet.

Locate a broom handle, or something comparable, 7/8 in. in diameter. This will serve as the mandrel on which the body tube is formed. After the dope is thoroughly dry, curl the tube by soaking the balsa in hot water in the bathtub for about 10 minutes. A couple of wet washcloths will hold the balsa underwater while it soaks.

Place the sheet on the broom handle, and wrap it with an Ace bandage, gauze, or strips of some stretchable cloth that will al-

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low the wet tube to dry. The handle or dowel should be large enough so that the straight edges of the tube do not quite touch. (Of course, the tapered edges are even farther apart; but never fear, we will deal with that topic later.) Carefully set the whole thing aside, and allow it to dry for about 24 hours.

Cut a 7½-in. piece off the end of the sheet, then cut it cross grain into four equal pieces as shown in the photo. These are glued together on their edges, using cyanoacrylate (CyA) to make a 1⅞ x 12-in. strip that will be formed into the wing mount pylon. (Among the CyAs, I've had the best luck with Goldberg's Super Jet medium-viscosity fast-setting glue.)

Make the wing mount pylon using two of the symmetrical airfoils shown on the plans. One way to make an accurate copy is to obtain a good, dark Xerox copy from the full-size drawing. Lay the Xerox copy face down on the appropriate balsa sheet, using a dry flatiron or MonoKote iron to press down on the backside and neatly transfer the image to the balsa. Do this twice, and you have the two ribs. Glue the two ribs together with the small, spar-like rectangles as shown. Roughly center this subassembly on the 12-in.-long 1/32 sheet, with equal amounts above and below, and glue it on at the nose. Working gradually, attach each side around to the trailing edge using CyA, then cut off the excess at the rear. Rough shape the upper and lower surfaces, but leave plenty of material for sanding.

By this time the basic fuselage tube should be dry. Remove the bandage and slide it from the mandrel. The straight section of the tube can be easily squeezed together, then carefully secured with CyA. Once this straight portion is glued, the aft taper can be closed. Always keeping weight savings in mind, take care not to use too much CyA.

The 1/64 ply bands shown in the drawing are added both inside and outside the nose, the latter being for the rear rubber post. The two bands are made from ½-in.-wide strips of 1/64-in.-thick plywood about 3 in. long. Make sure the outside grain is running in the direction of the ½-in. strips. Soak the bands in hot water, then wrap them around the mandrel that was used for the main body tube. Hold the plywood bands in place with rubberbands until dry, then adhere with CyA.

Shape the pylon for mounting on the body tube by sanding it with 180-grit paper wrapped around either the mandrel or the fuselage body itself. Attach the aluminum snuffer tube at the angle shown using slow-drying metal bond epoxy. Since this epoxy is very heavy, be sure to use only enough to form a narrow band around the tube.

Sand both the fuselage body tube and the pylon to smooth the surface and reduce weight. The ribs in the pylon may be cut out somewhat to reduce weight even further.

Locate and glue the pylon 6⅞ to 7 in. from the nose of the body. It is important that the seam in the tube be positioned on the bottom centerline before the pylon is attached.

Cut out a disc of 1/64 plywood, making it the diameter of the aft end of the body tube. Drill a 1/16 hole in the center, and insert through it the end of the small fishing swivel. A short piece of pin will prevent its removal. Secure the swivel with clear five-minute epoxy. Glue the disc as shown on the aft end of the fuselage body tube, reinforcing it with a couple of small strips of silk or nylon.

A single wrap of ½-in.-wide silk and five-minute epoxy will strengthen the front end as well.

After the epoxy has set up on the front, cut the three 1/16 notches into the forward edge. The purpose of the upper one is to position the nose plug, while the two side notches keep the winding safety pin from turning during the transition from winding the motor to installing the prop.

The fin is made directly on the separate plan view facing to the right, since it is cambered for a left turn and is flat on the left side. Before you begin, make Xerox copies of all the fin and tail ribs to use as patterns for transferring to wood.

I use a flat piece of ceiling panel material as a work surface for making wings and tails. I first spray a light coat of Scotch spray adhesive on this board, stick the section of the appropriate plan to the board, then spray the plan section with a *light* coat of the same adhesive. *(Caution! Be sure you keep the spray light.)* Cover the plan section with a sheet of wax paper. The latter works much better than anything I have tried, and cement, super glue, and epoxy will not stick to it or damage the plan. Afterwards the wax paper peels off the plan, leaving it slightly sticky for a day or so.

Once you've made the fin, sand it lightly and paint the outer edges with one coat of Aero Gloss Balsa Sanding Sealer. Cut the Japanese tissue following the grain in the longest dimension of the fin. Coat the structure with thick dope, and lay on the tissue while stretching out any wrinkles. If there are problem areas, dampen them with a little thinner.

The trailing edge of the fin is intended to be long enough to extend through the body tube and add strength to the attachment. Line up the fin on a vertical with the wing pylon. The flat side of the fin should be parallel to the body centerline.

The stabilizer rest is glued to the body tube with the left side about one degree high to aid the left turn glide.

Water shrink the fin tissue, then brush on one coat of very thin nitrate dope. Finish by painting on two coats of thin sanding sealer to waterproof the outside of the body tube and pylon, sanding lightly between coats.

Wing. While fairly standard construction techniques are followed, a few suggestions are in order. Iron on the Xerox copy of the main wing rib to a piece of 1/32 plywood or white painted aluminum, then carefully cut and file to shape. Use this as a template to cut out all the ribs. Stack the balsa ribs, using two pieces of scrap 1/16-sq. balsa in the spar grooves. Sand the stack so that all ribs are of uniform contour and length.

Pin down the trailing edge on the wax-paper-covered plan, using some scrap pieces of wood to block up the forward edge 1/32 in. The 1/16-sq. rib jig strip is located about 3/8 in. forward on the trailing edge. This preparation assures an accurate undercamber, which is extremely important to a low-speed airfoil.

The triangular dihedral checker is used to assure that the center ribs are set at the proper angle prior to gluing each in place. One completed half is removed from the plans, propped up to the correct dihedral angle, and glued together with quite a bit of Super Jet CyA. This is a rather steep 'V' dihedral, but a 'V' saves about 1½ grams of weight over a polyhedral configuration. Cover with Japanese tissue with the grain running spanwise. The turbulator is made from model railroading HO gauge scale 2 x 4's.

The wing is finished so that it is free of warps, washin, and washout. This makes it much easier to check prior to a flying session. A generous amount of dihedral and the correct pylon height will lessen the need for intentional wing warps.

Stabilizer. Construction is straightforward. Use lightweight wood and, if you can get away with it, only one coat of dope. (In Ft. Worth, TX, one coat does the job. If you live near water, you may have to use two coats. Just keep it as light as possible.) Note the little notch in the trailing edge at the center. This mates with the short peg of 1/16 dowel which is added at this point to the rear end of the body to help keep the stab in line. The bottom of the peg also keeps the stab hold-down rubber on the body and prevents it from interfering with the dethermalizer (DT) swivel.

Propeller assembly. Only a few of the plastic props available are suitable for P-30 models. Of these, the most common are the Japanese rounded-tip type, which come in green, blue, or silver-gray. While there doesn't seem to be any verifiable difference among them, some people claim the silver ones are better. The propellers are 9⅜-in. diameter, 7½-in. pitch, and weigh 6.8 to 7.1 grams.

Another prop style is now imported from Europe. This type has a square tip, has the same 9⅜-in. diameter as the rounded-tip type, but has a 9-in. nominal pitch and weighs seven grams. As far as we know, these props are available only in yellow. FAI Model Supply carries a facsimile of this prop, which, however, is more than one gram heavier than the original and is frequently out of balance. By AMA rules, it is *illegal* to shave or sand a P-30 prop to lighten or balance it.

For a comparative evaluation of the performance of each type of propeller, three different nose block assemblies were constructed—one with a round-tip prop, one

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with a square-tip prop, and a dummy nose of the same weight. These were glide tested many times from the bleachers at the local Indoor site. The square-tip prop consistently showed approximately 15% longer endurance than the other types, probably due to its higher pitch and lower blade area. The higher pitch has also appeared to help the climb by reducing the initial, difficult-to-manage acceleration and increasing the length of the prop run by a small degree. I haven't discovered a method of accurately determining which prop gave the P-30 a higher climb.

The prop and nose block are assembled in the standard way, but the freewheel notch in the prop will work better and last longer if the short outer end of the shaft is bent first to about 95° in as small a bend radius as possible. Assemble and bend the hooked part last.

Assembly. Our first five Sparrow Hawks were lost in thermals, even though a conventional pop-up-tail dethermalizer was activated. Two disappeared straight up. This taught us that the very light wing loading of a P-30 requires something more reliable than a standard DT. The method I have used on the last five ships is a variation of a system which was first used by Ken Wernicke locally, but which may have been invented by George Xenakis.

It works like this. The DT fuse (I like Peck's 3/10-in.-diameter lightweight fuse) burns through the #32 rubberband wing hold-down. The wing pops off, but is retained by the 12-lb.-test monofilament fishing line that is attached to the wing tip and to the swivel at the tail end of the fuselage. The freewheel prop and spinning wing restrain the model during the fall.

Using this system, the Sparrow Hawk has never failed to break out of the strongest thermal, yet the model has landed on concrete runways without the prop or nose breaking. A slight drawback of this method is that it can be difficult to extricate the model from a tree with the fishing line wrapped around branches. The solution is to simply cut the line and carry an extra supply with you.

Don't try to tie the fishing line; a short piece of 1/16-diameter aluminum tubing squeezed with pliers is both easier to adjust and more reliable. A short piece of the head end of a straight pin protrudes from the top of the wing centerline. To assemble the wing to the body, the fishing line is pulled tight from the tail, over the stab, around this pin, and out to the wing tip. Monofilament line has sufficient stretch to stay taut if it's the proper length. The wing hold-down rubberband then goes over the line to hold it in place during flight.

With the wing in place, check that it is square with the body centerline. Glue the four keys, made from split halves of a 1/8-in. dowel, onto the wing. These will serve as guides to ensure accurate positioning when reattaching the wing.

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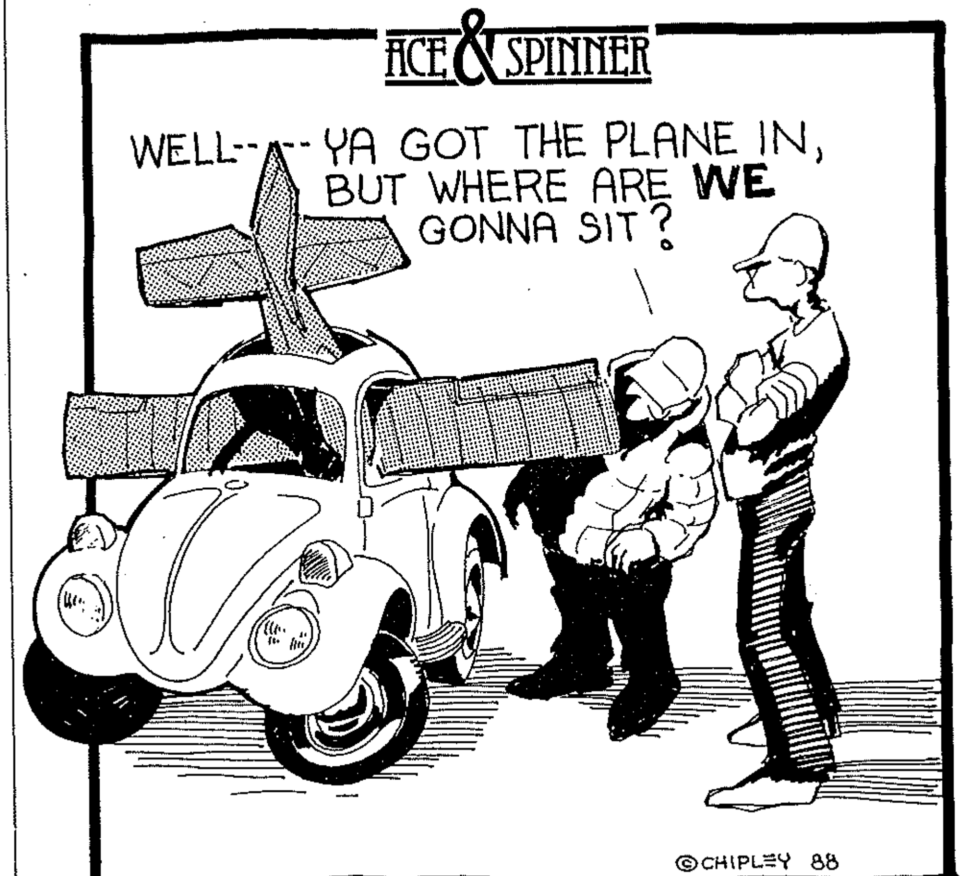

lizer braces
2—1/16 x 3/4 x 36-in., soft—wing TEs
1—3/4 x 1 1/4 x 4 1/2-in. soft block—nose & tail blocks

Other Wood
1—3/32 x 1/4 x 19-in. hardwood strip—flap & elevator joiners
1/8 plywood, approx. 1 1/4 x 7 1/2 in., firewall, landing gear bulkhead, bellcrank mount
1—1/4 x 1/4 x 13-in. hardwood—motor mounts

Other Materials
Plans
Building board
Straight pins
Wax paper
1—Cox Tee Dee .049 or .051 engine
1—propeller, 6 x 4, Cox plastic or Top Flite, Zinger wood
1—1-in. plastic spinner, Ace RC, Inc.
1—3/4-oz. wedge fuel tank, Perfect #20
1/16 x 4-in. brass tubing—tank vent extension, lead-out guides
2 1/2 in. small plastic flexible fuel line
1/16 x 28-in. music wire—pushrods, landing gear
.032 x 4-in. music wire—tailskid
1—2-in. bellcrank with mounting hardware, Perfect or comparable
36-in. length braided lead-out line, Perfect or comparable
1 pair—flying wire clips, Perfect, Du-Bro, or comparable
1 pair—1 3/8-in.-dia. plastic wheels, Sig or comparable
1 pair—1/16-in. wheel collars, Perfect, Du-Bro, or comparable
4—2-56 x 3/4-in. engine mounting bolts with locknuts
2—small control horns, Perfect or comparable—flaps, elevator
4—wire pushrod keepers for 1/16-in.-dia. music wire
48—3/8 x 3/4-in. or similar size fabric control surface hinges
Aliphatic resin glue, Franklin Tite Bond or comparable
Five-minute epoxy glue, Duro or comparable
Garnet paper, 100- and 200-grit, Norton or comparable
Wet-or-dry paper, 400-grit, 3M or comparable
1 sheet—lightweight silkspan
Fuel-proof dope—Sig clear; sanding sealer, Diana Cream and Stearman Red or comparable
1-in. numerals for AMA license number
1 set—.012-in.x 35-ft. braided steel flying wire, Sullivan or comparable
1—1/2A control handle, Sullivan or comparable
Cox Super Power Glow Fuel

The above parts and materials should be available at your local hobby shop. There's word on some streets that supplies for Control Line models aren't available anymore, but we've found that not to be true. We were able to secure everything we needed to build Lil' Bit and other models from Johnny Clemens' Hobby Counter in Dallas, and we know of other shops that stock and order Control Line supplies. So don't accept, "Gee—we can't get that anymore," because it's just not true. Control Line is alive

Sparrow Hawk/O'Dwyer

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The Sparrow Hawk flies best on four strands of 3/16-in. rubber. Ten grams of FAI or Champion rubber will be 78 to 80 in. long. Wash off the powder that coats the rubber in soapy water. Use the following method for tying rubber that will never slip. Tie a single overhand knot as close to each end as possible. Laying the two ends adjacent to each other, tie another overhand knot of the two strands. Use liberal amounts

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Sparrow Hawk/O'Dwyer

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of saliva to lubricate the knot, as it is pulled very tight with the small knots acting as limit stops. Cut off the excess.

Coat the rubber with a good grade of rubber lube, and install it in the body tube with a push stick of adequate length. The rear rubber support tube is retained with a small rubberband as shown in the photo.

Put two small rubberbands on the front end of the body tube behind the little triangles. One of the bands serves as a backup, as they are difficult to replace when the motor is wound. Cut a short piece of DT fuse, and slide it into the snuffer tube. If you use a pair of tweezers to hold back the wing mount rubberband, be sure it is positioned against the fuse, once the latter is in place, and not against the snuffer tube. Check the center-of-gravity with the prop installed. It should balance on the rear spar of the bottom surface of the wing. If it is more than ¼ in. off in either direction, a little lead tape is needed at the light end. Of course, an out-of-balance situation can be avoided entirely by waiting until this time to glue the pylon onto the body.

Check the Sparrow Hawk over for warps in the wing and tail, and steam out as necessary.

If you plan to use the model in competition, put your AMA number on the right panel and your name and address somewhere on the plane. I'm usually eager to go fly, so I write on the AMA number with black marking pen and use mail address stickers for my name. Since none of my lost P-30s have even been returned, maybe I should also mention a reward on the address label.

Flying. Wait for a calm day to test fly. Before each flying session, lubricate the prop and shaft with a thin oil such as sewing machine oil. This type comes in a neat pencil dispenser that fits nicely in a toolbox.

Test glide and shim or trim the rear stab support until you obtain the slowest possible glide without stalling.

Using a winder, put in about 200 turns on the motor. The use of the various holes and notches with the flagged safety pin (see photos) is obvious. Light the DT fuse with another piece of fuse. Never use a match or cigarette lighter to light the fuse on the airplane, as the nitrate dope on the tissue is almost explosive.

Launch the model, positioning it slightly nose up and a little to the left of the wind.

If the thrust line angles are adequate, the model should gently climb in a right spiral for about 10 seconds, and then glide in a large left circle. If you use a short DT fuse, be forewarned. The Sparrow Hawk could startle you by disassembling itself in the air and coming straight down!

If the plane does not climb on 200 turns but flies much faster than the glide speed, the downthrust should be reduced. If the flight speed is slow and there's no climb, try to find some peppier rubber. If the speed is up and the right turn is tight with very little climb, reduce the right thrust and try again at 200 turns. Always use a DT fuse for even the simplest test flight.

If things look good, gradually increase the number of turns to 650 or 700. At about 500 turns, you will encounter the so-called knee-in-the-torque curve where there is a sharply rapid rise in potential power output. It's in this zone that many Scale and sport fliers tend to give up, but to win a contest you have to keep trimming. If the model zooms to near-vertical at 50 ft. and then drops off to the right, the center-of-gravity should be moved aft and the elevator angle reduced to correct the glide. Don't change the thrust line if the plane flew well at 200 turns.

While entire books have been written on adjusting Free Flight models, there's still no substitute for a lot of practice and a little experimenting on your own. A great deal can be learned from a small model like the P-30, without the anxiety and worry associated with flying a bigger, more expensive one. After all, crashing a P-30 wouldn't be such a big deal, so why hold back?

For optimal glide, remember that the freewheel prop way out on the front is a destabilizing influence and functions as a gyro. Therefore, the slower the glide, the less effect the prop will have on it.

I'll see you at the next contest. If you bring a Sparrow Hawk, we'll both have winners. Good luck!

Reno/Berliner

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The next year, 1973, saw quite a few records overturned. Lyle Shelton, in a Wright R-3350-powered Bearcat, turned in a time trials record of 427 mph and a finals record of 428 mph. In Formula One, Falck set a qualifier record at 235 mph, but Cote won the finals at 231 mph. Among a small field of Sport Biplanes, the new all-metal Sundancer was flown by Sid White to a record-setting 194 mph in time trials and 195 mph in the finals. The AT-6 time trials winner was Jim Mott at 211 mph, while Bill Turnbull took the finals at 207 mph.

In 1974, Lyle Shelton came through with another time trials record, 432 mph in Unlimited, but bowed to Ken Burnstine at 382 mph in the finals when all the hot ones dropped out. In Formula One, Ray Cote also scored record speeds, with 240 mph in