Sparrow

It's practice, practice, practice that turns a flier into a smooth, accomplished pilot. But all those hours can run up quite a toll in fuel costs and transportation hassles with a big, high-powered airplane. This small model for four-channels and .19- to .25-size engines gets the practicing done without the expenses.

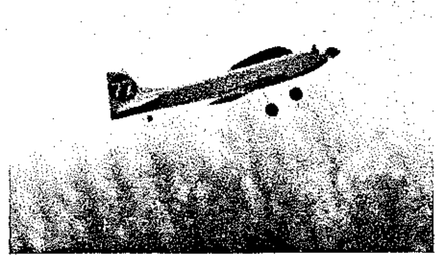
■**Steve Gardner**

HAVE YOU BUILT any small models lately? If not, *and* your answer to the following questions is "yes," read on. A lighter, scaled-down airplane may be just what you need right now.

Do you have to spend the first hour at the flying field on your hands and knees assembling your newest .60-powered wonderbird equipped with a tuned pipe? Have you ever passed over a trip to the flying field because you didn't want to go to the trouble of hauling, assembling, and feeding a large model? I myself have passed up trips to the field for no other reason than that I was down to about a quart of glow fuel. We all know that a quart of fuel won't fly a model long enough to make the trip worth it, right?

Frankly, in my opinion large models can be a pain and a nuisance. Propellers that run $2 apiece and break if you look at them wrong. Having to purchase MonoKote four rolls at a time. Trips to the flying field that are awkward at best and downright uncomfortable at worst. Even disassembled, the cumbersome airplanes take up so much room in a car that someone must either hold the engine in his lap, or hold the tail to keep it from blocking the driver's line of sight in the rearview mirror.

And did you ever notice how much



Top: Although this model is quick, the large horizontal stabilizer prevents it from having the nasty habits of other little models. The bright colors help your eyes stay locked onto this small, high-speed target. Aside from being fun, the main objective of this model is to hone your piloting skills while doing it with a minimum investment in money and aggravation. Take things slowly the first few flights and be sure to keep plenty of air under you when trying out new maneuvers.

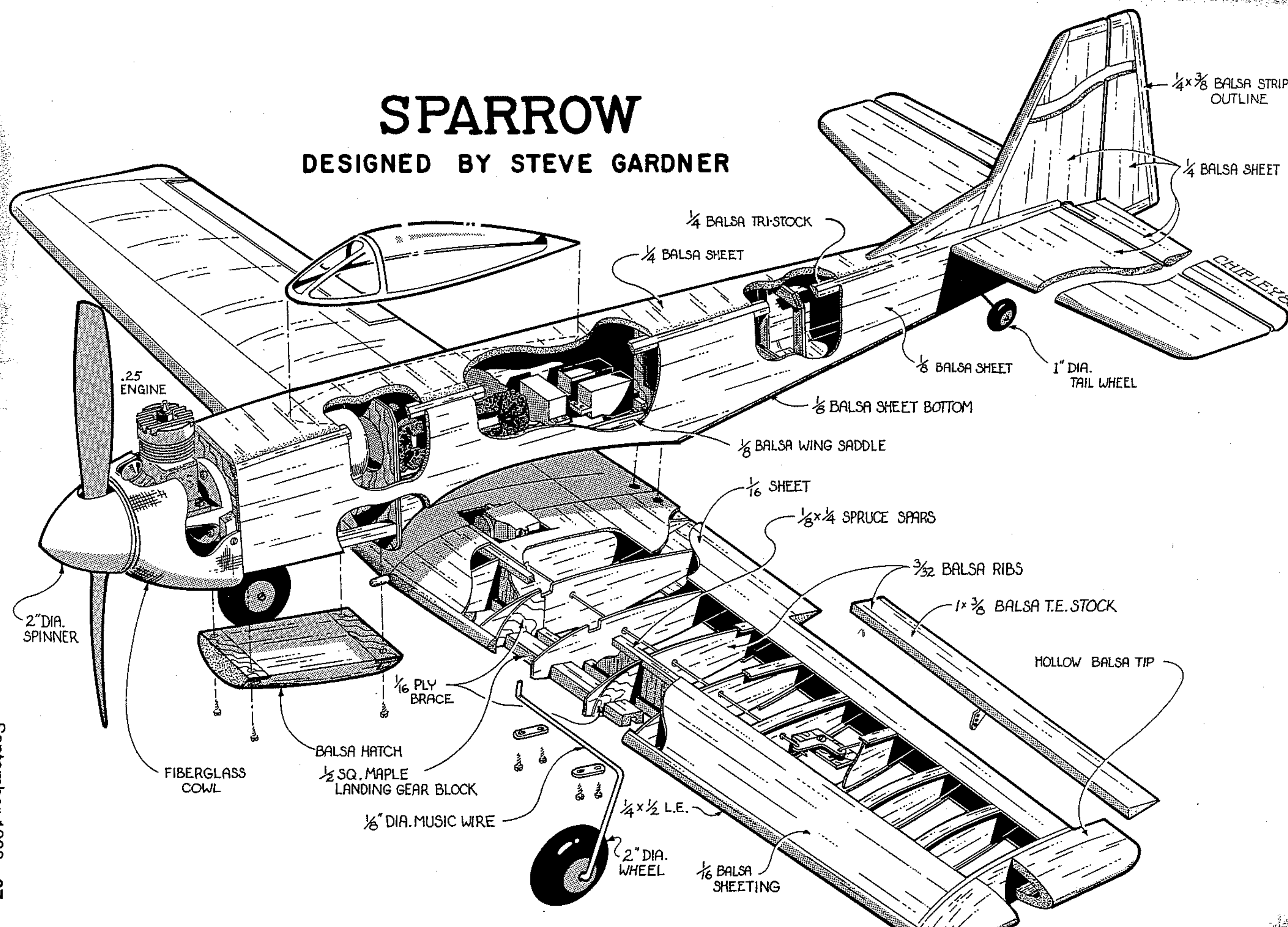
farther big models scatter when they break? "The bigger they are, the harder they fall" certainly holds true at the flying field. Larger models just have a wider radius of catastrophe.

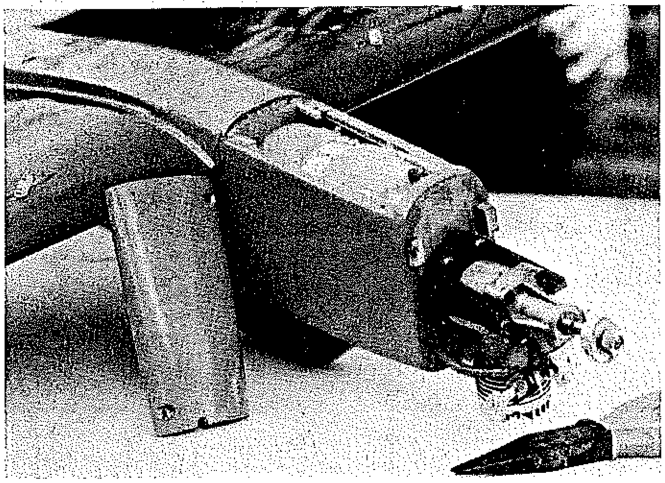
Well then, why *do* we ever build large models? Simply because they are worth it. Their size and weight allow them to fly more gracefully, more gently, more *easily* than small models, and there's no remedy for that. As a rule larger models have lighter wing loadings, and due to scale effects they retain good flight characteristics even at very high wing loadings. You can't argue with "bigger is better" in Scale building.

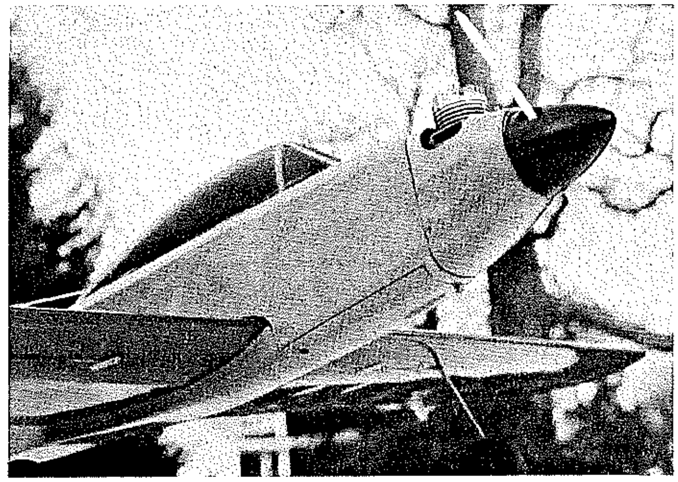
Big engines seem easier to adjust (but not to buy!), and they last longer. Radios fit right where you want them and still leave plenty of room for other things such as retractable landing gear or a smoke system. Big planes simply have an air of being more serious, more respectable than little ones do. (Brawny appearance isn't everything, though. Oddly enough, the most sophisticated models I know of happen to be the lightest—the Indoor microfilm models.) Al-

SPARROW

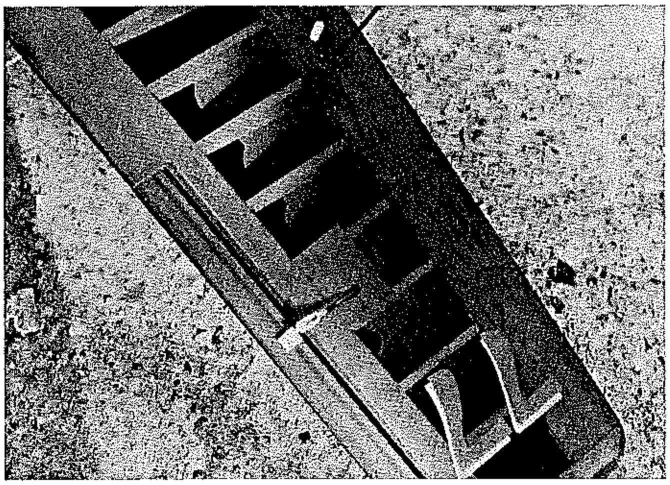
DESIGNED BY STEVE GARDNER

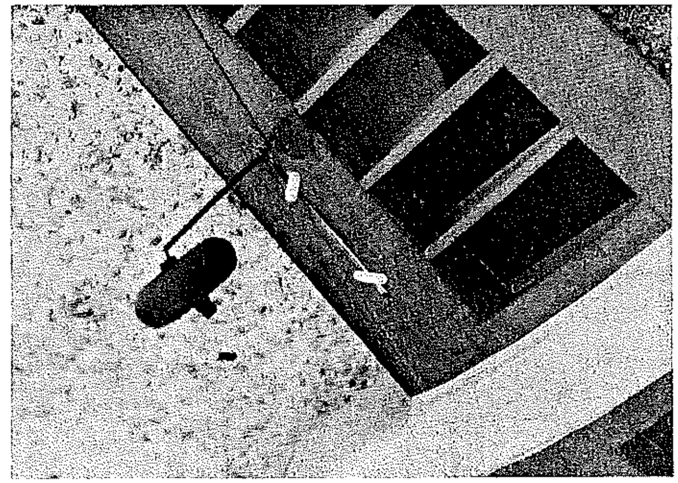






Left: Remove the prop and five sheet metal screws and you have easy access to the engine, fuel tank, and battery pack. Many engine problems are really problems with the fuel system, so it is important to have easy access to the fuel tank. Right: The height of the firewall makes the cowl for the .15-size engine appear short. The height at the front allows larger engines and longer cowlings to be used without looking odd.





Left: Our author says he has always preferred bellcranks to actuate the ailerons because they have the least amount of play of any system available. They also allow the aileron servo to be mounted flat in the wing to save space. Right: To hold the thin wire of the landing gear in the groove, the nylon straps are slanted. This puts the screw head closer to the wire and applies more pressure directly on the wire.

though most of them don't say it in so many words, devotees of big models often think of the smaller-scale airplanes as little better than toys.

So big models are imposing at the flying field and have other virtues, but smaller craft offer different compensations. These lighter birds are often very distinctive, and flying them challenges the modeler in ways that the big ones don't. Small models are an antidote to complacency. If you can stand to not be taken all that seriously; if you're game for piloting a ship that will not fly smoothly unless *you* fly it smoothly; if your reaction time is up to the smaller airplane's more unruly manners, then you might just be ready to think small. You might just be ready to sacrifice the prestige and ease of those big, prepossessing models for the excitement of knowing *you've* learned to handle an airplane competently and well.

If you're weary of lugging around all the support gear for a big model, then a little guy is definitely the ticket. All you need is a starting battery, a pint of fuel, and the transmitter and you're ready to go. Because the smaller plane will fit into most cars without having to be disassembled, no tools are needed; and the pint of fuel will keep you in the air for four 10-minute flights.

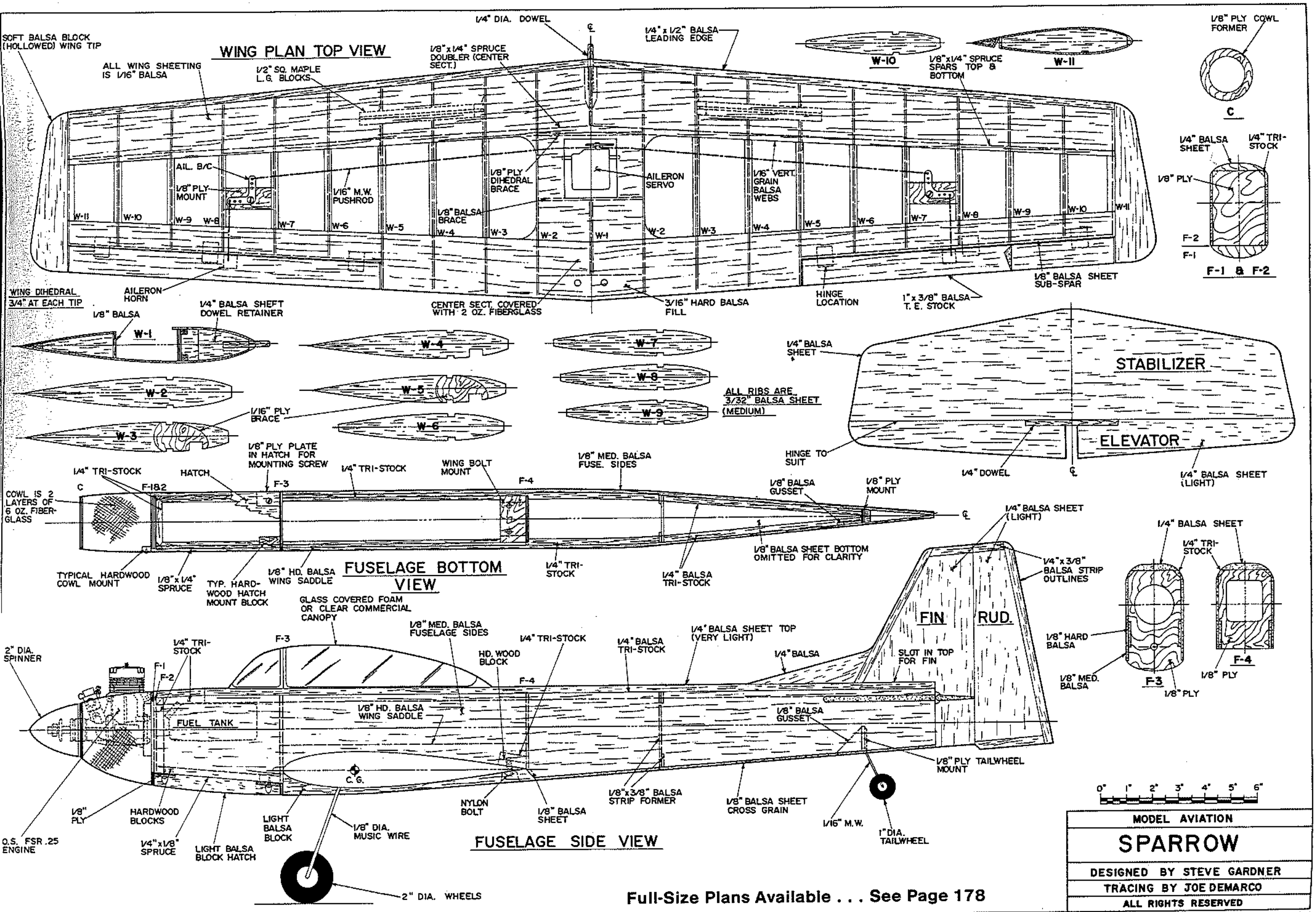
The smaller model will bounce where a larger one would shatter. Above all, as we said before, a lighter bird will keep you on your toes. Small models have a characteristic twitchiness and don't want to fly smoothly. They are nervous, giddy machines, always quick to translate any control input into an abrupt change of flight path. But what this amounts to is much greater control authority for the pilot—extra maneuverability that the motivated flier can use to good advantage. With practice he can learn to orchestrate more intricate maneuvers than can be gotten from a larger airplane.

In fact, if you can learn to fly a Sparrow smoothly, you'll be able to handle anything larger with a precision that you never knew you had. Little airplanes train your reflexes better than the fastest video games! The low inertia of these models makes possible certain maneuvers that are forbidden to larger ones. The Sparrow will do snapping maneuvers like no other airplane I have ever flown. You can start and stop snaps literally instantaneously once you have the required timing. Eight-sided loops are easy, too, and the corners are sharp!

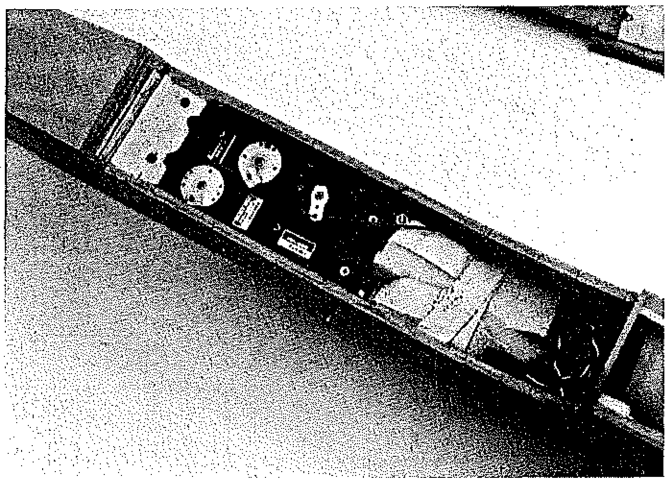
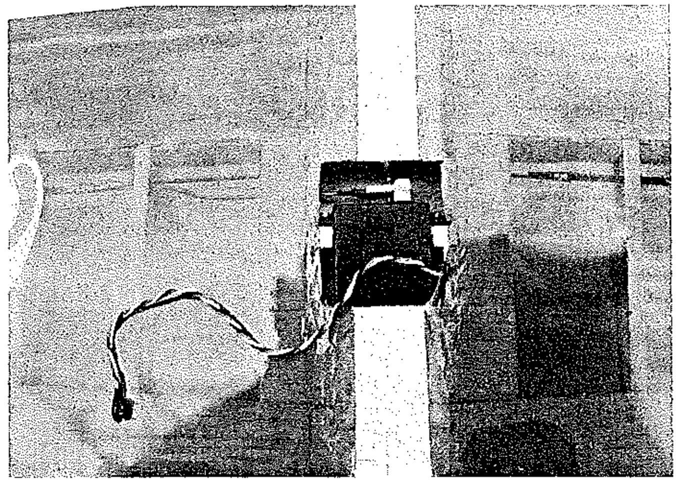
Finally, smaller models are easier to build, up to a certain strength. Like the early Grumman fighters, the Sparrow is designed to be nearly indestructible in flight. Although it's not in the slightest overbuilt, the airplane allows you to enter abrupt maneuvers at much higher speeds then you might with a larger model. Its light weight and low inertia permit a rapid-fire succession of maneuvers; and despite its low drag, when it comes time to slow down the Sparrow will lose speed rapidly. It is rather like having built-in glide path control.

Larger aircraft still rule the flying field, but smaller birds complement them nicely. You could certainly do worse than to build a Sparrow for *your* stable of models, and then learn to put it where you want it. The skills and control authority that you'll develop in maneuvering this airplane are guaranteed to carry over into *all* your flying.

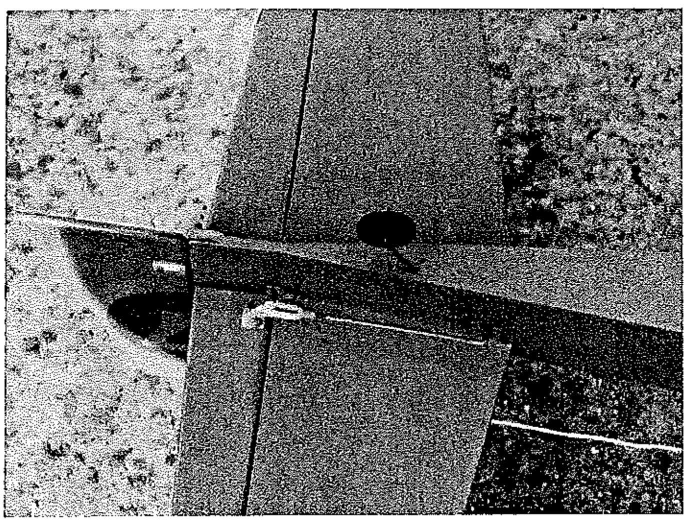
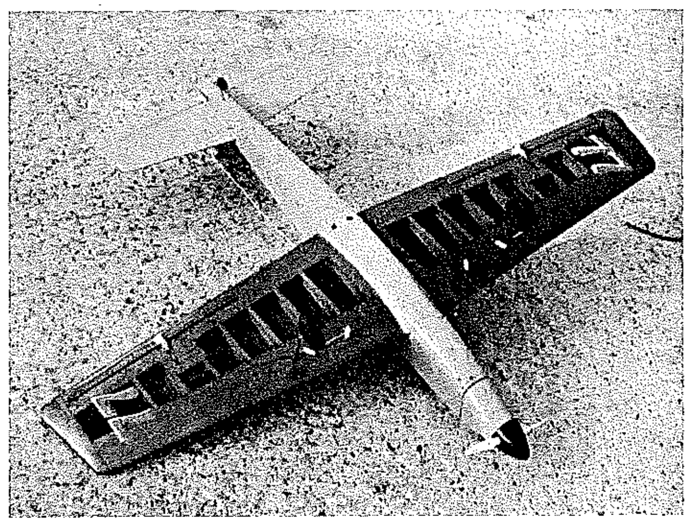
Construction. My standard practice is to build the tail surfaces first, sort of as a warm-up. Tail surfaces are easy to build and not too demanding, so they're a fairly painless way to get into the modeling mood. Not that your tail surfaces shouldn't be as carefully constructed as the rest of your



Full-Size Plans Available . . . See Page 178

Left: If you use an older, large radio like this one, the installation will be tight but not impossible. Using smaller servos and a 225 mAh battery pack makes things easier and saves weight. Right: Mounting the aileron servo flat in the wing gives more room between it and the other servos.

Left: A dog-leg in the wire of the elevator pushrod of a model this small is not the mistake it would be on a big .60-powered job, but be careful to make the cross leg as short as possible and be sure the longer sections are parallel. Right: Control surfaces may seem too small at first glance, but they are more than adequate for any conceivable maneuver. Do keep the hinge gaps as small as possible for maximum efficiency.

model; it's just that they aren't very hard to build correctly.

The most critical step in constructing an airplane's tail is the proper choice of wood. Every gram that you build into the tail will add about five grams to the weight of the finished model. Overbuilding will force you to compensate with extra nose weight. Worse still, you may try to fly without adding any extra weight at all. Add the extra nose weight, and performance suffers. Sidestep the problem, and your model won't fly at all. Obviously, building your tail too heavy puts you in a quandary best avoided.

The ideal wood for the Sparrow tail surfaces—balsa in the 6- to 8-lb.-per-cu.-ft. class—eliminates the need to add any nose weight at all. However, in the form in which we need it this balsa is usually hard to find. What's wanted is a stiff, firm grade of balsa, not that punky material that feels like Styrofoam. This type of balsa is also the wood of choice for building Hand-Launched Glider wings, and Free Flighters hoard it like the treasure it is. Even mentioning the possibility of getting some of the stuff from a Free Flighter would probably be foolhardy.

Don't try to substitute 3/16-in. balsa for the ¼-in. thickness specified in the plans. This extra thickness is needed to lend adequate stiffness to the horizontal stabilizer. My rationale is based on having seen just about as many stab failures as wing failures. Not only do stabilizers get a pounding in flight, they're also subject to getting hung on door jambs and trunk lids because of their prominence. Stabs built of ¼-in. balsa can withstand this abuse and won't come apart until you break them off against the ground.

As shown in the plans, I've made up the edges of the fin and rudder using strips with the grain running parallel to the edge. My purpose is simply to make the edges easier to round, as well as to help hold the tail straight. Since pieces of ¼-in. balsa this small tend not to warp too badly, the strips are optional; but they save you from having to round the end grain of the surfaces. I can't do that well enough to suit my standards, so I use the strips.

The elevators are joined by either a strip of hardwood or a dowel. A square of fiberglass cloth may be folded over the dowel and the leading edge of the elevator to reinforce the joint. This will also strengthen the area where the elevator horn is mounted. Trim all the cloth away from the slot for the fuselage, and resist the urge to make the slot in the elevator smaller. Although the clearance may seem excessive now, it can quickly become inadequate if the tail gets wet and the fuselage swells just a tad. In that situation the elevator will jam—and when that happens the flight is over, maybe for good!

Sand the leading edges of the rudder and elevator to a housetop-shaped point, then set the hinges into the wood until the hinge pin centerlines are even with the point of the housetop. This will allow you to leave a very small gap in the hinge line. MonoKote hinges may be used if preferred, but because of their particular geometry it might be necessary to enlarge the hole in the fuselage in order to clear the greater motion of the elevator joiner.

Fuselage. Underestimating the structural importance of the fuselage seems to be a fairly common error among modelers. Apparently, such builders assume that the function of the fuselage is merely to hold the wing and tail in proper juxtaposition. This is an oversimplification. Any part of the model which is exposed to the airflow has an impact on performance, and in reality

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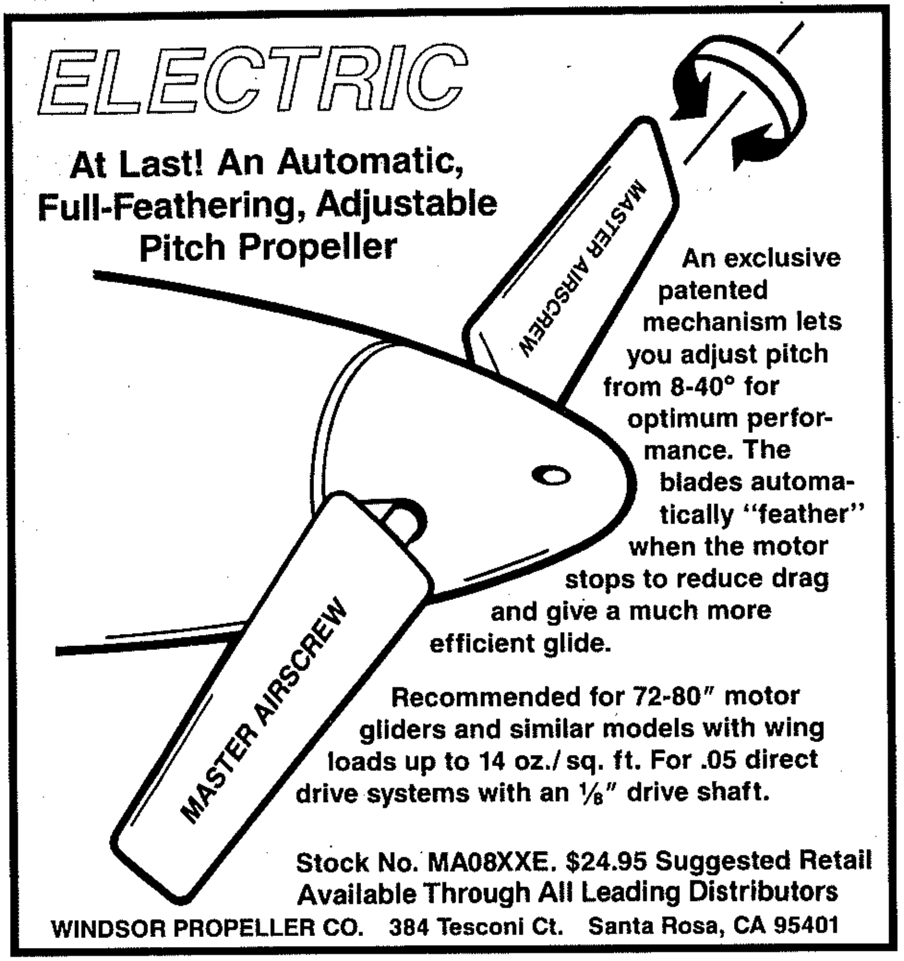

the fuselage has a much greater effect than the average modeler credits it with.

As with the fin and rudder, that effect is primarily on flight direction. But the fuselage has more exposed area than do the fin and rudder, and no matter what input you give it, an airplane with a swaybacked fuselage will never fly straight enough to suit you. If a model has a crooked fuselage, it will fly straight at only one speed, trim it how you will.

Because the very tall, narrow fuselage in the Sparrow actually functions like a flight surface, allowing the plane to perform knife-edge flight as gracefully as larger models, it's particularly important to build it straight. The mild bend in the fuselage sides facilitates this, but be very careful in choosing the wood for the two sides. If they don't have an equal degree of springiness, the fuselage is almost fated to come out crooked.

Start by making up one left and one right side. The wing saddle doublers and the spruce tank hatch strips are the only pieces installed before the sides are joined. If you intend to install an engine larger than a .19, or if the engine that you have in mind is very hot, then before assembling the fuselage sides you might fiberglass their inside forward area, say from the wing doubler on up, with 6-oz. glass cloth and Hot Stuff. This isn't necessary if you stay with the engine-size limits dictated by the design, but I have never yet seen a model that someone didn't eventually subject to an oversized engine.

The firewall is made up of two layers of ⅛-in. ply. Glue these together for installation later. Drill the hole for the wing dowel into the No. 3 former. Even if you have a favorite method of locating this hole, follow the location specified in the plans exactly. Slight incidence misalignments which may scarcely be noticed on a larger model will be very detrimental on a model as small as this one.

Make the cutouts in the No. 4 former through which the pushrods extend into the rear of the model. Adapt the parameters for the cutouts shown on the plans to suit your radio if necessary, but don't weaken the area where the wing bolt block attaches. After you have decided on the cutout patterns and made sure the formers are configured for your radio, glue the No. 3 and 4 formers to one of the fuselage sides. Use a triangle to get the formers square to the side. The other side is glued on with the top of the fuselage laid flat on the workbench.

Draw the two sides together to form the tail. Be very careful here, as most of the twists that get built into a fuselage can be traced to this operation. Glue in the firewall using epoxy. (While the fast-setting glues have been much improved in the last few years and serve well for most purposes, I have had better luck with epoxy in very high-vibration applications.)

The top block is made of very light ¼-in. balsa sheet. The punky stuff that we took pains to avoid in building the tail is fine here, as long as it's extremely light. Don't hollow it out unless you were unable to ob-

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tain wood that's sufficiently light, because it should have enough mass to give stiffness to the fuselage. Glue the top block onto the fuselage, and add the triangle stock (which, as you can see from the plans, goes almost everywhere).

Make the tail wheel strut from 1/16 music wire. Sew it to the little ply former, and install it in the rear of the fuselage. If the lack of a steerable tail wheel bothers you, there's no reason not to add one using your favorite method, but it doesn't seem necessary on this model.

Add the strip balsa uprights and crosspieces to the rear of the fuselage as well as to the wing bolt block with its triangle reinforcements. Sheet the bottom of this assembly with the grain running crosswise.

Make the hatch of balsa block with small plywood squares inserted into the inner face. Attach it by wood screws to the small hardwood blocks added to the inside of the nose. This helps control vibration in the front of the model by allowing the hatch to take some of the structural load of the nose. The prototype used only two points of attachment at diagonal corners of the hatch, but using four plywood squares works much better. If easy access to the fuel tank isn't important to you (or if you're planning to install an engine larger than the recommended .19 size), you can skip the foregoing and just glue the hatch in place. Personally, I like the maintainability of a separate tank hatch.

Slot the top block for the fin. Doing this after the fuselage is assembled ensures accurate alignment. The completed fuselage is then shaped by rounding the top block and the hatch. I chose not to round off the sharp corners behind the wing on the prototype, but you can do so if you wish by adding more triangle stock.

The canopy on the Sparrow must be very narrow to fit properly. If you can find a ready-made one that fills the bill, by all means use it. Being unable to find a canopy narrow enough, I used Styrofoam to custom make one for the prototype. After shaping the foam to suit, give it one coat of 2-oz. glass cloth and epoxy resin. Paint and prime the canopy to match the model. Since the canopy was a factor in determining the size of the fin and rudder, it would be unwise not to include it on your model. The airplane's knife-edge capabilities might be diminished, and the model would behave as if it needed more dihedral.

Wing. This is where the builder encounters his biggest challenge. Generally, the wing is the hardest part of the model to build right. More than with any other part of the model, you want the wing to be warp-free—and yet it's the most *difficult* part to build without warps.

If you want an honest-flying Sparrow, its wing must be straight. Ensure that it's straight and warp-free before you cover it; once the webbing is in place the wing will not twist to any great extent. With a wing area this small, the old trick of straightening a wing with MonoKote will work very poorly. Don't rely on it.

Make the spar from carefully selected, straight-grained spruce. Using only very straight-grained wood protects the model from coming apart in the air no matter how much of a beating it's given. Test your sample by seeing if you can follow each grain layer at least 10 in.; if not, find a piece with a straighter grain.

The spar is joined in an unusual manner. Two strips of spruce, scraps left over from making the spars, are used to double the joint between the spars at the center of the wing. These are installed between the top and bottom caps just like splints.

A 3/16-in. ply plate is shaped to conform to the wing spar sweep and is epoxied into place after the wing is joined. The wing dowel should be glued into place before the wing is sheeted to ensure a strong bond with the center ribs and with the 1/4-in. balsa pieces on each side. The wing is no stronger than this joint, so be very certain of its accuracy and double-check that the wing is straight before you web the spar.

The webbing should be installed very carefully. It is under a great deal more strain than many modelers realize. You don't want to have gaps that would need to be filled with glue, and the webbing should run along a straight vertical for best effect. Nothing else gives as much strength for so small a weight increase as does proper webbing.

On the prototype, I built up the ailerons

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from the pieces of the trailing edge sheeting that had been cut out to make the aileron wells. If I could do it over again, I would simply make them from solid balsa as I have indicated on the plans. The weight savings turned out to be almost nonexistent, and the construction was much more time-consuming than making solid ailerons would have been.

I recommend using bellcranks, because if you're careful about how you rig them they offer the least amount of play of any system that this wing can accommodate. I'd think twice about substituting something else. This airplane needs ailerons that center every time you let go of the stick, and even a little stiffness is not acceptable.

Once the sheeting is in place, cover it at the center joint with 6-oz. glass cloth and epoxy resin or Hot Stuff. The cutout for the servo in the wing sheeting is easier to make before the center section is covered with glass.

The wing is faired into the fuselage with very light balsa block glued on top of the glass. The wing block bolts should be set into the fairing until they bear on the wing itself. I used 10-32 nylon bolts for the prototype because of their ability to break away before the wing block does. However, since the nylon bolts are difficult to find in some areas, you can substitute regular ¼-20 bolts if necessary.

Assembly. Bolt the wing in place and true it to the horizontal stabilizer by eye. This is much easier than it sounds. Holding the model up with the nose pointed towards you, change the angle of the model until the stab makes a line just above the top surface of the wing. Adjust the stab until it is parallel to the wing, and measure from the top center of the firewall to the tips of the stab to get the proper alignment as indicated in the plan view.

The fin is simply fitted into the slot in the top block, and its alignment will be no better than that of the slot. Use a triangle to get the fin square to the stab. On such a small model any misalignments will have a magnified effect, so be as exacting as you can during assembly.

The cowling is built up in the same way as the canopy, but it's a bit more difficult to make it fit perfectly. With the engine in its mount and the mount on the model, tack glue foam blocks around the engine up to the back of the spinner. Mark the foam at the front to locate the spinner circle. Gently remove the foam and take the engine and the mount off the model; then, to preserve the location of the spinner circle, tack the foam back onto the model exactly where you broke it off. Glue the front cowl former onto the foam.

Carve and sand the foam to the shape you prefer. If you try for a fancier shape than the prototype, keep the lines simple or it will look odd. Remove the cowl form from the model, and cut off about $\frac{1}{32}$ from the outside edge of the foam at the back of the cowl to allow for the thickness of the fiberglass.

About three layers of 2-oz. glass cloth and epoxy gives the right combination of lightness and strength. This cowling will never crack from vibration.

Unlike the procedure in making the canopy, the foam must be melted out of the cowling to make room for the engine. I used dope thinner for this. However, the thinner can cause you severe discomfort and is a fire hazard to boot. Use it only outdoors and with extreme care. An alternative method is to dig the foam out with a knife.

The cowling is mounted with small hardwood blocks which are glued to the firewall about 1/32 from the edge. Use as many blocks as desired, as long as you keep them out of the way of the controls and the lines to the engine. Very small countersunk wood screws were used to hold the cowling in place. The front former of the cowling can be cut out to clear the throttle arm. Don't cut away too much or it will rattle when you run the engine.

Covering and finishing. MonoKote was used for the prototype—orange on the fuselage and tail and transparent red on the wings. The color scheme is up to you, but be sure to make it easy to see. A small, fast model flying away from you will quickly shrink to a dot in the ether, so you want it to stand out as vividly as possible.

Covering the model after assembly, rather than before, is only a little more trouble and eliminates the worry that MonoKote between the various pieces could interfere with the glue joints. The cowling can be painted to match the MonoKote, or you can prime the fiberglass with Ambroid cement and MonoKote the cowling. In fact, though it's obsolete for general model building purposes, Ambroid will do wonders in making MonoKote stick to epoxy on firewalls and wing center sections.

Radio and engine. Radio installation in the Sparrow is tight. I managed to fit in an old Tower Hobby System 4 radio with the monster servos and full-size battery pack, but a smaller radio will give you better performance and an easier time with the installation. Use the battery position to balance the model if you can.

I strongly recommend pushrods made of wood. Nyrod pushrods change length at different temperatures, and in a small model this can make for unacceptable trim changes. Don't use servo tape to install flight control servos.

The first time around I installed an Enya .15 plain bearing engine in the prototype. This provided enough power for liftoff in about 40 ft. and for flight in the 50 mph range, but when pulled to the vertical the model quickly slowed down. If I piloted it smoothly the airplane would do a vertical figure eight, but a bigger engine was clearly called for to improve vertical performance.

Replacing the .15 with a Fox .25 plain bearing engine made the difference I had hoped for. Upon command the model would

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Sparrow/Gardner

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now dart straight up and almost out of sight. If you happen to have a hot .15 or .20, it will do fine. Please resist the urge to put a .40 in this model. You'd have to rebalance the airplane to the point that it would scarcely be flyable unless the engine were three-quarters full throttle, and the over-burdened model would also be very hard to land.

Flying. Careful trimming will help you get the most out of the Sparrow. Start with about 3⁄16 in. of aileron throw, 3⁄8 in. of elevator throw, and 1 in. of rudder throw. Balance the model at a point about 3⁄8 in. in front of the center-of-gravity on the plans. Fly it this way for several flights before you change anything. Quick, isn't it? But you'll get used to it after a few flights. Once you feel comfortable with the model, you can wring it out a bit.

When you begin to get your timing right, move the balance point back to the one indicated on the plans. This will make the model a little quicker yet, and will also release its snapping and spinning potential.

Snapping maneuvers are the Sparrow's strongest suit. The airplane will perform two full inside or outside vertical snaps and still be heading straight up afterwards. You can do partial snaps with precision. Granted that intricate tricks like gliding from three quarters of an outside snap into knife-edge flight are hard to learn, but this airplane is happy doing them. Once you have sharpened your timing, you'll find that the possibilities are almost limitless. If you're quick enough at stirring it into the sticks, chances are the Sparrow will do almost any maneuver.

On days when hauling and flying a larger model doesn't seem worth the trouble, a model like the Sparrow can really help you keep your edge. Fly it for all the singular things that it alone can do. If the model isn't taken all that seriously (at least not right off the bat), the improvement in your flying skills definitely will be!

Radio Technique/Myers

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Hams are required to listen before they transmit, which tends to limit RF interference, but there are no guarantees. Any quiet spot in the band can be used by a Ham operator.

Charging ahead, I used the Pacific Plan to distribute all of the Ham-band RC00-09 channels as shown in Table 4, because they are on a 20-kHz raster, and because I expect that most of the current users can obtain Gold Sticker performance. The Hams should get together on this group and insist on moving everything to Gold Sticker as soon as possible . . . certainly by 1991.

AMA only permits the even-numbered channels in sanctioned events, but the Hams are at liberty to use all 10 of them right now at your park, and that makes Gold Sticker performance necessary for safe operation.

TABLE 4
50 MHz Ham Band
Aircraft/Surface/Communications Uses
(ARRL band plan recognizes assignment to RC only)

Station:	A	B	C	D	E
20-kHz raster	00 07	03 05	01 08	04 06	02 09

The 53 MHz (six-meter) distribution of Table 5 was per the Pacific Plan, but may not be necessary due to the 100 kHz raster.

TABLE 5
6-Meter Ham Band
Aircraft/Surface/Communications Uses
(100-kHz raster)

Sta.: A	B	C	D	E
53.3 53.6	53.1	53.4 53.7	53.2	53.5 53.8

Replacing transmitter batteries: How many times have you noticed that your transmitter output meter reads lower than usual, and/or that the operating time is shorter than it used to be? The most common problem is that one cell in the battery pack has developed a short circuit.

If the transmitter is still under warranty, you probably send it back to the manufacturer and wait. But it may be that it is out of warranty and/or you don't want to wait. Decision time: Do you find and replace the bad cell, or do you replace the whole pack?

In order to make that decision you must remove the pack from the transmitter. **Step one is to disconnect the pack!** Of all the mistakes you can make when working on an electronic circuit, the least forgivable is to damage components because you were too lazy to disconnect the power supply. A momentary short circuit in the wrong place can destroy your transmitter's electronics. So unplug the battery pack, if you can, and **cut both wires if you can't!**

It is a simple matter to put Deans connectors (19K54, $1.55 from Ace R/C, Inc., Box 511E, Higginsville, MO 64037) on the cut ends of the wire when you want to reassemble the transmitter. Match the wire colors when you install the Deans connectors (making sure that the male plug side is on the transmitter), and pull the pins out of the isolated contact to provide means for a quick visual check that you are not connecting the battery pack with the polarity reversed.

On the matter of polarity: Practically everyone uses Red for + and Black for −. Larry Sribnick told me that *in the particular case of PCM transmitters from Futaba and JR only,* the Red wire on the charger is − and the Black wire is +. A voltmeter is a necessary tool when working with batteries—and *don't assume anything!*

Now that you have the pack in your hand, put a number on each cell using a pen or paper stickers. Then attach a 20-ohm/10-watt resistor to the pack and monitor the voltage in each cell as the pack is discharging. Write down the voltages for each cell at five-minute intervals. Keep discharging the pack until each cell reads 0 VDC. Leave the resistor connected (it won't hurt anything).

Looking at the list of voltages will tell you which cells are shorted (they start at 0 VDC) and whether the pack is balanced (all cells get to 0 VDC at about the same moment) or unbalanced (they don't). If the pack is unbalanced, remove the resistor, charge the pack overnight, and repeat the test. If the pack is still unbalanced, my suggestion is that you junk it, because another cell is probably going to fail. Ace R/C sells all kinds of Ni-Cds and probably can supply what you need.

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