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KRUMPLER

This electric-powered biplane looks like it might actually have been a post-WW I full-scale plane or an early homebuilt—but it's not! It's an entirely original design. Build it for a lot of easy sport flying. ■Martin Irvine

TWO WEEKS before the 10th Annual KRC Electric Fun Fly I found myself needing a new airplane. I love WW I biplanes but, of course, "everyone knows" that Electric bipes require too much power to overcome their drag to be truly practical. (They obviously have never seen Keith Shaw's 60-size Stearman.) I decided that, if I kept the fuselage fairly small and the number of struts to a minimum, it should be OK—a nice slow flier. What I banged together in those two weeks is what you see here.

I test flew it as the sun was going down on Friday September 15, 11 hours before I was to leave for the KRC meet. I'd like to say it flew right off the board (as so many designers do), but I have to admit that it required three-fourths of Right rudder and two clicks of Up elevator trim before it flew straight. Big deal!

I thought that the amount of rudder required is because of a lack of right thrust in the motor. Small bipes often require side- and down-thrust, but in my haste I forgot the side-thrust. I tried it on the model, but it still required some right trim. I can't see any warps in it, but anyway I don't mind the small amount of trim.

The down-thrust is built in by way of the wing incidence, (+2½° and +3° in the top and bottom wings, respectively), and the stabilizer incidence (+2°). This causes the airplane to fly at a slight downward angle, effectively giving down-thrust.

I flew a number of flights at the KRC meet, (a terrific weekend that anyone interested in Electrics should attend at least once) and got requests for plans from five people. This made me think that it might have a wider appeal, so this article is the result.

The specification table will tell you most of what you might want to know about the Krumpler, but there are just a couple of additional notes needed.

I first used a DSC 075 motor which is similar to most of the 075/550-size motors in the current generation of "complete kit" Electric trainers and sport planes. The battery pack was a Sanyo seven-cell 900SCR pack, and the prop used was a Taipan 8 x 4. With this combination the motor draws 19 amps, which calculates to a total power input of 130 watts. I think the airplane needs the seven-cell pack if you use the 550-type motor and you want reliable takeoffs on grass. Although they can be done with six cells, it is marginal and not much fun.

Then I remotored it with a Great Planes Goldfire motor, which has much more poop than the usual 550, but of course at the expense of a much higher current (over 30 amps). My current-limiting STW speed controller wouldn't let more than 26 amps get through, so flight times were short but not absurd. Then I tried the Futaba MCR 4A receiver with great success and was able to use the six-cell packs.

But I am getting ahead of myself. Let's build it first.

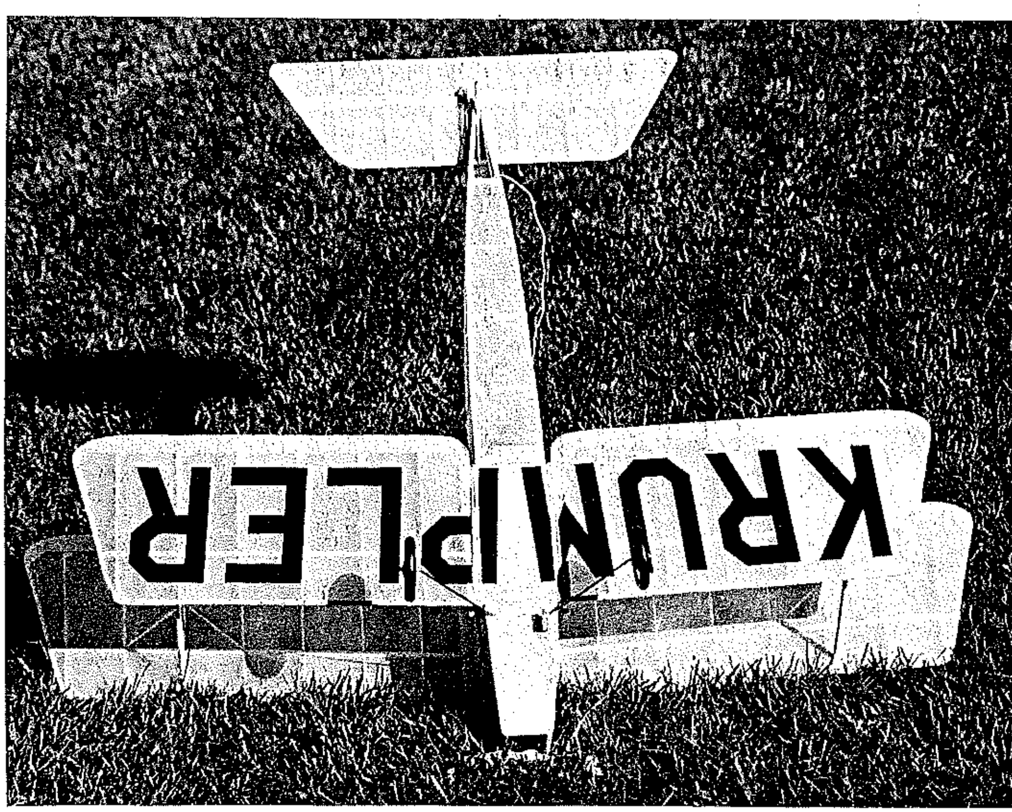
Construction

Wings: I make a plywood master rib and cut all my ribs with a sharp No.11 blade. For the center section ribs, just trim ⅙₆ off their top and bottom surfaces. Decide what size spars you want, and make the spar cutouts to suit. I used ⅛ x $\frac{3}{16}$ basswood spars—a rather uncommon size—so you might use ⅛ x ¼ bass or spruce. *Don't use balsa spars!* They won't be as strong, and the weight saving would be negligible.

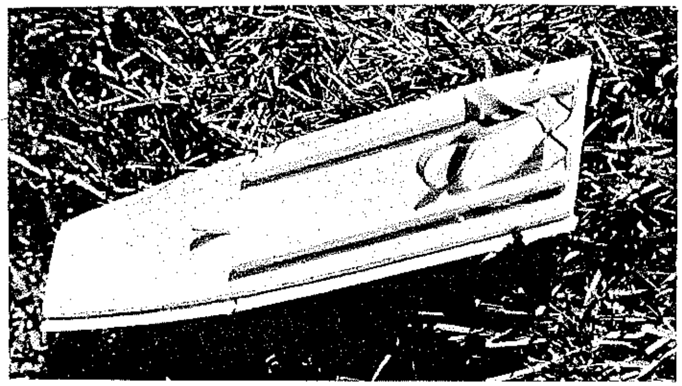
Use medium weight, straight-grained balsa for the rest of the wing. The dihedral brace is ply and goes between the spars, as does the shear webbing. Don't leave this webbing out. It weighs little but adds a lot of strength.

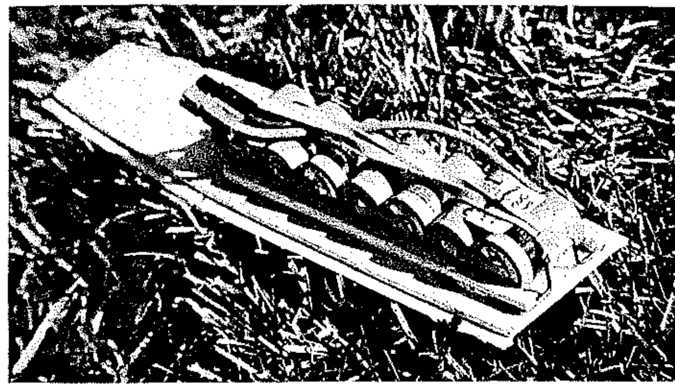
You can build either the top or the lower wing first. It will be constructed one panel at a time. Start by laying down the lower spar and the trailing edge. Place the ribs in position, (angling the root rib a bit for dihedral), and add the top spar "dry" (i.e., no glue). Eyeball everything to assure it is straight, and then use thin CyA to glue things solid. Add the leading edge, being careful to shim it up so that it is lined up with the top and bottom of the ribs. Glue the wing tip pieces on, and add the vertically grained shear webbing between the spars. I braced the trailing edge with gussets.

Now build the other wing panel. When you're finished, cut a slot in the root ribs for the dihedral brace.

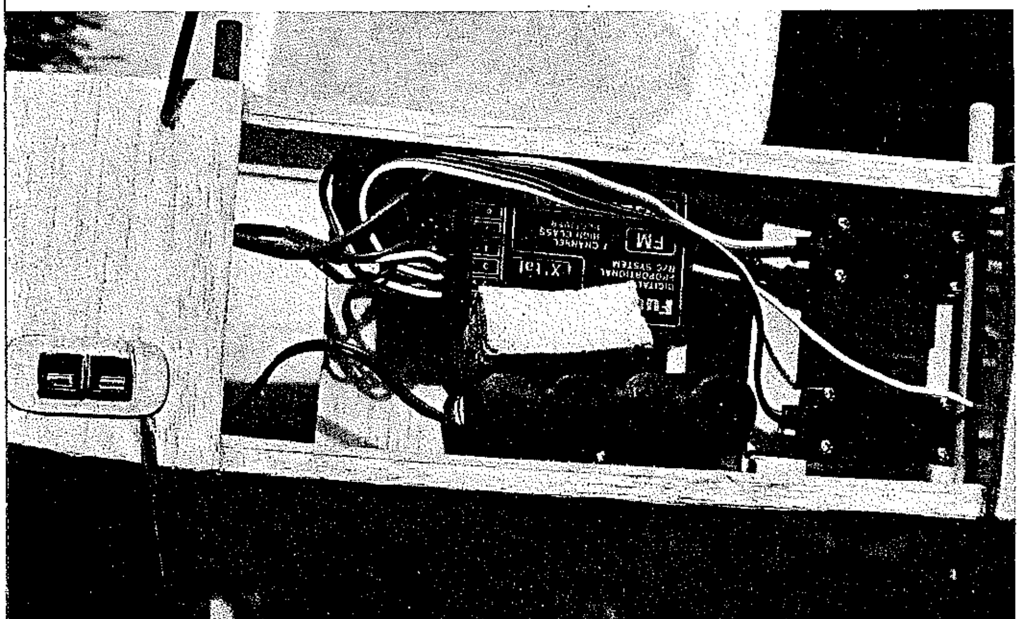


No, I haven't just landed! This underside view shows the slight wing sweep, generous tail moment and translucent covering. Barely visible is the fuse mount ahead of the lower wing center section.





Bottom of the hatch. Balsa rails keep the motor pack (seven 900SCRs) centered. Note the wire yoke at rear with a No. 64 elastic and the 3/16-in. dowel that acts as the forward battery hold-down point. Everything's mounted on the hatch base. Yoke, held with CyA only, has withstood some unexpected arrivals. The four notches in the sides are to clear the cabane struts.



Lower wing cutout: The radio bay has enough room but not a lot more. Two S133s are to the right while the receiver and battery pack sit in the middle. Note that these are mounted on a balsa floor, grain across the fuselage. Minimal foam is needed because of the lack of vibration, but some should be used for protection from rough landings. The fuselage holder on/off switch is ahead of the wing. Construction of the wing is outlined in the article.

Top view of the nose sans hatch. Note the side thrust of the DSC 075 motor. Looks snug but everything fits fairly easily. In the bottom is the STW (Sommeraur) MK3 speed controller with motor/controller connectors on top of it. Loose set of connectors are for the battery pack attached to underside of hatch.

Join the two halves with epoxy so that you have time to make any adjustments assuring that you have the correct dihedral (one inch each side for the top wing, and 1½ in. each side for the bottom wing).

Next the ¼-in. center section trailing edge piece can be shaped and added, as can the leading edge ⅛-in. piece. Glue on the center section sheet. Keep in mind that the spars are flush with the covering, so you don't sheet over them.

The strut fittings are made from ¼-in. sheet notched for the interplane struts and backed with 1/64 ply. They are just butt-glued to the side of the ribs. This is strong enough, as the struts are weaker than the wing structure and will knock out or break before damaging the wing (experience speaks!). Brace the rear fitting with ⅛-in.-sq. flush with the covering surface.

The other wing is built in exactly the same way.

Tail: The stabilizer needs no explanation.

The fin and rudder are built using an old Free Flight technique called laminating. It's easy, strong, and looks great.

First cut a ¼-in. balsa blank (or form) to the inside line of the fin and rudder. Don't bother to wax it or anything.

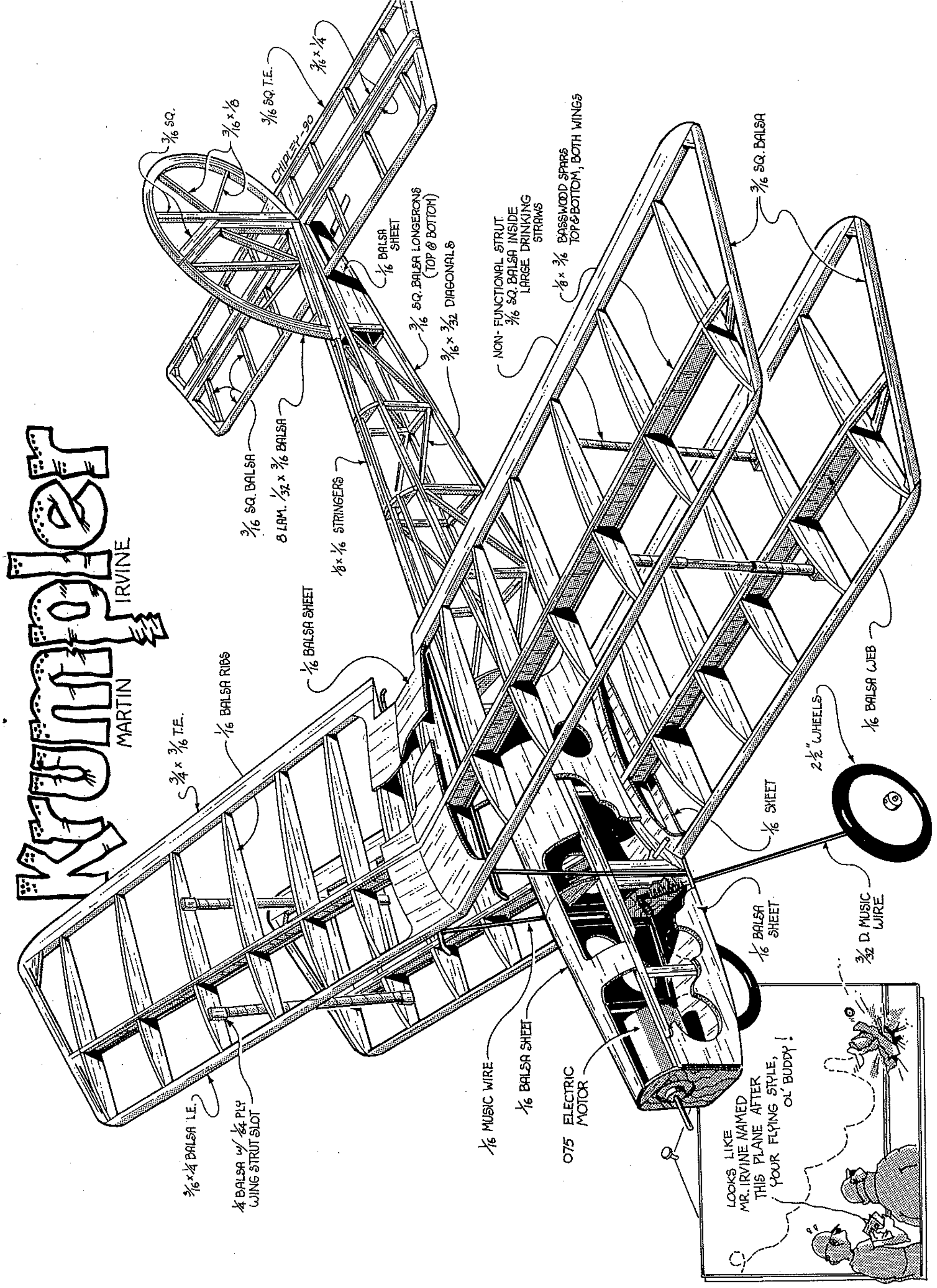
Next cut seven strips of soft 1/32 x ¼ x 24-in. balsa and one additional strip a little wider.

Pin the form down to a surface covered with waxed paper. Stack the strips together and, using pins to hold things in place, wrap them around the form. The slightly wider strip should be on the inside next to the form. If you use a little tension while pulling the strips around, you will find that, even dry, the wood bends quite easily.

Once the strips are pinned in place, push the laminations down flush with the building surface. Now use thin CyA to glue everything solid, being careful not to get glue on the form. The slightly wider piece that was placed against the form acts as a dam to stop the CyA from sticking the laminations to the form.

Once the glue has set, unpin the outline, turn it over, and CyA the other side of the stack. When that has set, gently spring the outline open. You will quickly see any laminations that need more glue.

Now thumbtack a sheet of fine sandpaper


Krumpler
MARTIN IRVINE
3/16 SQ.
3/16 x 1/8
3/16 SQ. T.E.
3/16 x 1/4
CHIDLEY-90
1/16 BALSA SHEET
3/16 SQ. BALSA LONGERONS (TOP & BOTTOM)
3/16 x 3/32 DIAGONALS
NON-FUNCTIONAL STRUT 3/16 SQ. BALSA INSIDE LARGE DRINKING STRAWS
1/8 x 3/16 BASSWOOD SPARS TOP & BOTTOM, BOTH WINGS
3/16 SQ. BALSA
3/16 SQ. BALSA
8 LAM. 1/32 x 3/16 BALSA
1/8 x 1/16 STRINGERS
1/16 BALSA SHEET
1/16 BALSA RIBS
3/4 x 3/16 T.E.
1/16 BALSA WEB
2 1/2" WHEELS
1/16 SHEET
1/16 BALSA SHEET
3/32 D. MUSIC WIRE
1/16 MUSIC WIRE
1/16 BALSA SHEET
075 ELECTRIC MOTOR
3/16 x 1/4 BALSA L.E.
1/4 BALSA w/ 1/64 PLY WING STRUT SLOT
LOOKS LIKE MR. IRVINE NAMED THIS PLANE AFTER YOUR FLYING STYLE, OL' BUDDY!

to a flat surface, and carefully sand the outline smooth. I find it works best if I hold it under my extended fingers and sand in a circular motion. Once it is reasonably smooth, pin it to the plan and add the other pieces.

When trimming the outline, leave the leading edge a little long so that it can act as a key in the rear fuselage upper surface. Now you can cut the rudder free. I think that you will be pleasantly surprised at how strong the structure is.

Fuselage: Construct both basic sides from $\frac{3}{16}$ square and sheet. It is best if the second side is constructed over the first with small pieces of wax paper at the glue joints to prevent the two sides from sticking together. Note that the right side is $\frac{1}{8}$ in. shorter than the left to give built-in side thrust.

The cabane struts will be glued into the slotted balsa pieces on the fuselage. Dry fit the pieces and then groove them to accept the $\frac{1}{16}$ spring steel cabane wires before gluing them in place. Make sure that the slots are on the inside surface of the fuselage.

Groove the upper longerons to accept the cabanes, and then add the $\frac{1}{16}$ sheet doubler on the inside of both sides. Note that this does not run full length to the nose but stops short of the motor bulkhead to provide a slot for its insertion later. Fill in the forward two bays with $\frac{3}{16}$ sheet.

Now add the $\frac{1}{8}$ x $\frac{3}{16}$-in. strips to the tail end and let in the $\frac{1}{16}$ sheet on the outside edge.

Of course, all this time you are being careful to build a right and a left side—aren't you?

To assemble the basic fuselage, put it together upside down with the forward upper longerons flat against the building board. There is a temporary $\frac{3}{16}$-in.-sq. crosspiece at the forward cabane mount and permanent ones at the rear of the battery hatch and at the leading and trailing edges of the wing. Now you have a basic box that should be square from all angles. Check it and redo it if necessary. You can't expect a plane to fly straight if it looks like it should have "Chiquita" painted on the side!

Once it is straight, pull the forward fuselage together, and install the motor bulkhead. Next, draw the rear fuselage together at the tail and join, checking for straightness. Add the remaining $\frac{3}{16}$ cross pieces.

Next bend the landing gear and sew it to the landing gear bulkhead with wire. Spread epoxy glue over the sewn joint, and then glue the assembly into position in the fuselage. While doing this you might want to temporarily attach the lower wing to check that all is level.

The rear fuselage has a piece of $\frac{1}{8}$-in. sheet set in between the upper rear longerons to act as a base for the fin. If you left the leading edge of the fin a little long, you can cut a slot in the forward edge of the piece to accept it. Don't add the tail skid yet. It is easier to do so after you have covered the fuselage.

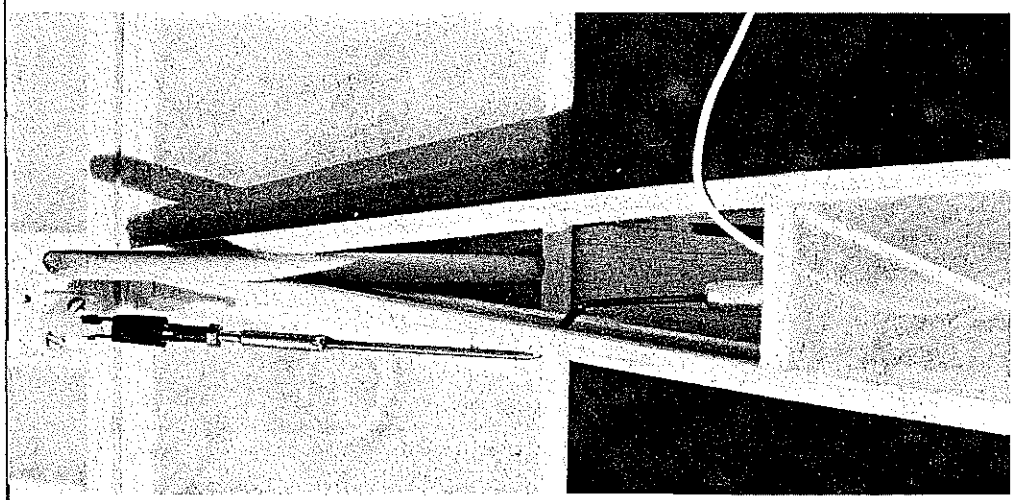
Now you can add the rear turtledeck formers. Cut a slot for the center $\frac{1}{16}$ x $\frac{1}{8}$-in. stringer at the top center of each former. Adjust things until the stringer is straight and level and then glue it in place.

Next, using a straightedge and a very sharp blade, cut the slots for the other two stringers, one on each side equidistant from the center stringer and the upper longeron. All three stringers end up being flush with the last crosspiece, just ahead of the fin.

Add the diagonal bracing, top and bottom first. Then add the side bracing. The lower cowl sheeting should not be added yet.

Now we get to the hatch. Hold a piece of $\frac{1}{8}$-in. sheet on top while you trace along the inside of the upper longerons. Cut the $\frac{1}{8}$-in. sheet out, leaving the line. Next carefully break out the temporary crosspiece that was glued across at the forward center section struts. (The landing gear bulkhead helps hold the sides apart now.) Carefully sand the hatch base until it is a snug (but not tight) fit.

Glue the formers in place, and add the sheeting in two halves, front and back. Now add the side pieces (it is easier to add them after adding the sheeting than before). Trim the cockpit outline, and notch the sides for the cabane struts. Add the lower cowling $\frac{1}{16}$ sheet, the wing dowels, and the bits and pieces for the nose. Round these off to make the nose look a little like a radiator. Now it's done.



Lower rear fuselage. Simple tail skid is from dowel and is quite strong. Note the small brass locknut backing the Quick Link. It's from a railroad supplier. Looks neat. Don't overtighten or you'll weaken the brass coupler. If you fly off pavement, consider using a wire tail skid and run the antenna to the fin top.

Radio and power installation: I found that

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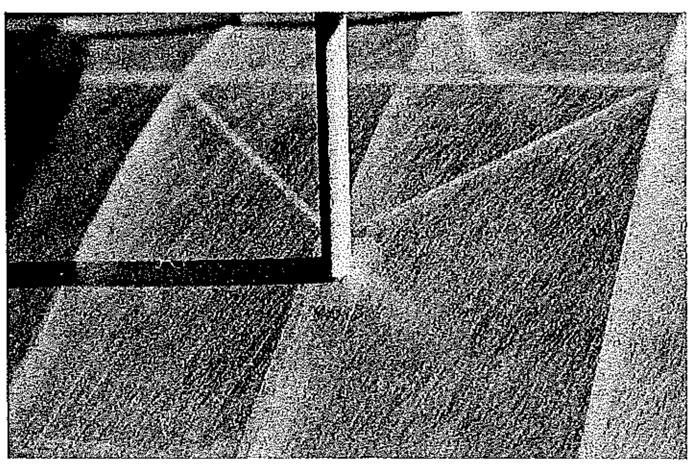
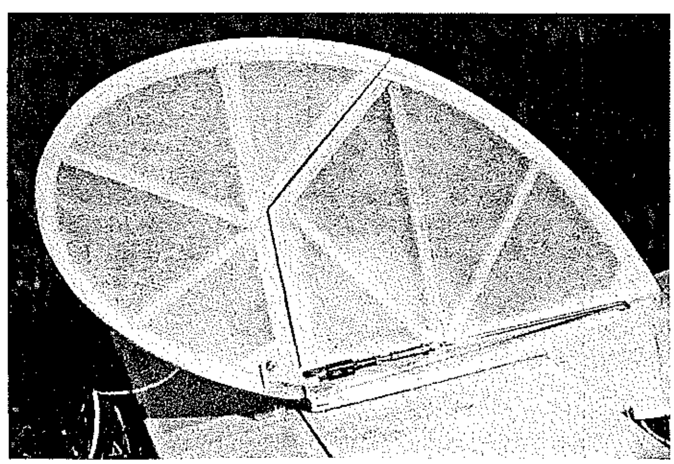
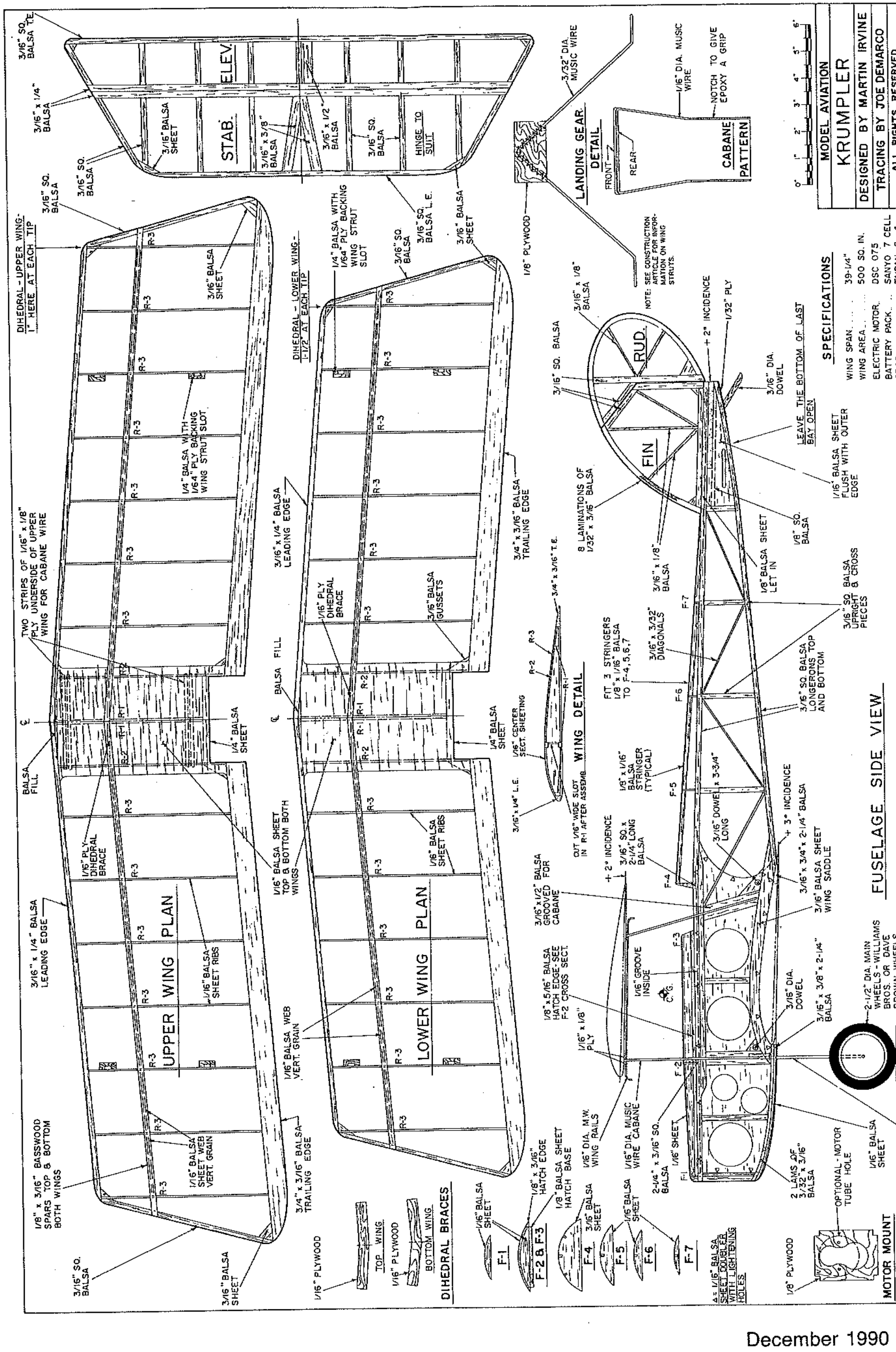




Lower end of interplane struts. Diagonal bracing from spar to rib looks flimsy, and it is. Strut is a plastic straw with roughly-shaped balsa strip inside. Wing holds it in place. For appearance only. Laminated outline technique of fin and rudder is illustrated on right. Straight pieces brace the outline against warping. Rudder pushrod is longer than ideal because of the tight rear fuselage. Note that all links use a tubing keeper.


MODEL AVIATION
KRUMPLER
DESIGNED BY MARTIN IRVINE
TRACING BY JOE DEMARCO
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SPECIFICATIONS
WING SPAN 39-1/4"
WING AREA 500 SQ. IN.
ELECTRIC MOTOR DSC 075
BATTERY PACK SANYO 7 CELL
PROP TAIPAN 8 x 4
UPPER WING PLAN
LOWER WING PLAN
FUSELAGE SIDE VIEW
WING DETAIL
LANDING GEAR DETAIL
CABANE PATTERN
DIHEDRAL BRACES
MOTOR MOUNT
STAB.
ELEV.
RUD.
FIN
DIHEDRAL - UPPER WING - 1" HERE AT EACH TIP
DIHEDRAL - LOWER WING - 1-1/2" AT EACH TIP
3/16" SQ. BALSA T.E.
3/16" x 1/4" BALSA
3/16" BALSA SHEET
3/16" x 3/8" BALSA
3/16" x 1/2" BALSA
HINGE TO SUIT
3/16" SQ. BALSA L.E.
3/32" DIA. MUSIC WIRE
1/16" DIA. MUSIC WIRE
NOTCH TO GIVE EPOXY A GRIP
1/8" PLYWOOD
NOTE: SEE CONSTRUCTION ARTICLE FOR INFORMATION ON WING STRUTS.
1/4" BALSA WITH 1/64" PLY BACKING WING STRUT SLOT
3/16" x 1/4" BALSA LEADING EDGE
3/4" x 3/16" BALSA TRAILING EDGE
TWO STRIPS OF 1/16" x 1/8" PLY UNDERSIDE OF UPPER WING FOR CABANE WIRE
1/16" PLY DIHEDRAL BRACE
3/16" BALSA GUSSETS
BALSA FILL
1/4" BALSA SHEET
1/16" BALSA SHEET TOP & BOTTOM BOTH WINGS
1/16" BALSA SHEET RIBS
1/16" BALSA WEB VERT. GRAIN
1/8" x 3/16" BASSWOOD SPARS TOP & BOTTOM BOTH WINGS
3/16" SQ. BALSA
1/16" CENTER SECT. SHEETING
CUT 1/16" WIDE SLOT IN R-1 AFTER ASSEMB.
3/16" x 1/4" L.E.
3/4" x 3/16" T.E.
+ 2° INCIDENCE
+ 3° INCIDENCE
1/32" PLY
3/16" DIA. DOWEL
LEAVE THE BOTTOM OF LAST BAY OPEN
1/16" BALSA SHEET FLUSH WITH OUTER EDGE
8 LAMINATIONS OF 1/32" x 3/16" BALSA
1/8" SQ. BALSA
1/8" BALSA SHEET LET IN
3/16" x 1/8" BALSA
3/16" SQ. BALSA UPRIGHT & CROSS PIECES
FIT 3 STRINGERS 1/8" x 1/16" BALSA TO F-4, 5, 6, 7
3/16" x 3/32" DIAGONALS
3/16" SQ. BALSA LONGERONS TOP AND BOTTOM
1/8" x 1/16" BALSA STRINGER (TYPICAL)
3/16" DOWEL x 3-3/4" LONG
3/16" x 3/4" x 2-1/4" BALSA
3/16" BALSA SHEET WING SADDLE
3/16" SQ. x 2-1/4" LONG BALSA
3/16" x 1/2" BALSA GROOVED FOR CABANE
1/16" GROOVE INSIDE
C.G.
1/8" x 5/16" BALSA HATCH EDGE-SEE F-2 CROSS SECT.
1/16" x 1/8" PLY
3/16" x 3/8" x 2-1/4" BALSA
2-1/2" DIA. MAIN WHEELS - WILLIAMS BROS. OR DAVE BROWN WHEELS
1/16" DIA. MUSIC WIRE CABANE
1/16" DIA. M.W. WING RAILS
2-1/4" x 3/16" SQ. BALSA
1/16" SHEET
2 LAMS OF 3/32" x 3/16" BALSA
OPTIONAL - MOTOR TUBE HOLE
1/16" BALSA SHEET
3/32" DIA. MUSIC WIRE
1/8" BALSA SHEET HATCH BASE
1/8" x 3/16" HATCH EDGE
1/16" BALSA SHEET
TOP WING
BOTTOM WING
1/16" PLYWOOD
Δ = 1/16" BALSA SHEET DOUBLER WITH LIGHTENING HOLES
F-1
F-2 & F-3
F-4
F-5
F-6
F-7
R-1
R-2
R-3

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• **Bill Slayton (129),** 1005 Phillips Drive, Dumas, TX 79029.

• **E. L. Litchfield (130),** 4707 Woodside Manor, Tampa, Fl 33624; tel. 1-813/878-5382.

• **Peter Calvagna (131),** 1092 Becker School Rd., Freeport, IL 61032.

• **Thomas Albright (132),** 7303 Stony Hill Rd., Wake Forest, NC 27587

Krumpler/Irvine

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my Krumpler was threatening to end up nose heavy so I put my motor battery at the aft end of the hatch. Two 3/16-sq. strips were glued on the bottom of the hatch with a spacing equal to the width of the power pack so that the pack rested between them.

Next a wire yoke was glued to the rear of the hatch and an angled dowel added to the forward end. The battery is placed between the wood strips and is held in place by a #64 rubberband stretched between the yoke and the dowel. This is the first time I have used this technique, but it works so well that I shall use it again. It makes battery access easy. The hatch itself was held on by a #32 rubberband looped over the hatch and the forward wing dowels. It's crude but effective.

If you are going to use a MCR 4A receiver, add cooling scoops to the sides of the nose and even to the top hatch. This will help keep the receiver's MOSFETs *(metal-oxide-semiconductor field-effect transistors—Ed.)* cool, and they are more efficient if they are kept that way.

Servos were mounted as far back as possible. I put a cross sheet of 1/16 below the battery pack and placed my receiver (initially a midsized FM107N) and its battery pack (SR300 mAh), between it and the lower wing.

My speed controller (a Sommerauer Mk 3, 25-amp, 6- to 14-cell unit) was under the motor. While it is of current-limiting design, I installed a fuse under the cowling anyway.

I first saw this particular arrangement in an issue of the newsletter of the Electric Model Flyers of Southern Ontario, (EMF SO): Two Sermos connector housings are glued together with a piece of 1/16 ply between them; then two small pieces of 3/32 ply are glued inside the housings in order to put the contact under pressure. This assembly is glued to a 1/32-in. mounting plate, which is in turn mounted in the aircraft.

The nice part about this is that not only do you have a fused system for safety, but you can use it as your arming switch, removing and replacing the fuse for Off and On. You might want to attach the fuse to the airframe with a short length of cord so that you don't lose it.

I have used this system on a number of models even though the speed controller limits the amperage so that even with a fully stalled motor the fuse doesn't blow (although it certainly will without the controller).

Later I changed the radio for a Futaba Electric radio with the MCR 4A receiver. This dropped the weight by about four ounces (not to be sneezed at!). With a Graupner 8 x 4 prop and seven 900SCR Ni-Cd cells, the motor (Goldfire) now draws over 30 amps(!) according to my DSC ammeter. (My original current-limiting STW controller wouldn't pass more than 26 amps.) That amounts to an input of over 200 watts—or about 100 watts per pound of model weight!

Rocket-propelled biplanes are not my cup of tea, so I substituted a six-cell 1200SC pack, which dropped the peak current from a freshly charged pack to 27 amps (162 watts). This is still a potent combination that has more poop than the original setup. Interestingly, it requires more side thrust than before. This may be due to the fact that removal of the two-ounce speed controller from the nose of the aircraft moved the CG aft a bit and made the controls a little more sensitive.

I added air scoops made from plastic spoons to the nose to increase the airflow over the MCR 4A's MOSFETs, as this controller isn't supposed to handle current of this magnitude. However, I have run a set of seven 900SCRs down with just the cooling you see in the photos while using the Graupner 8 x 4 prop (30-plus amps initially), and it shut down after 105 sec. I let it cool a while and got just 15 sec. more. Therefore I would guess that it would have worked in the air, but adding the scoops is much better for the MOSFETs. As it is now, when I land I can feel that the MOSFETs are cool to the touch as I remove the battery pack.

I have heard of people having difficulty with these radios, such as shutting down the motor too soon or not being able to handle more than 15 amps. Another local flier has had similar results to mine with both his MCR 4A units, so I think that the troubles other people have had must be with defective units or some other installation problem.

My only complaint with this radio is that the 50-Hz controller isn't very good for ferrite motors (in time the magnets will lose their power), and it sounds slightly rough at lower throttle settings. In the right application, I think it is a great little rig. Certainly I have more respect for it now that I know what it can do. It's a keeper!

A note on wiring and connectors may be in order here. Use good stuff. Cheap power systems need the best, and expensive systems deserve it. I have standardized my connectors to those sold by Sermos (which are the same as Anderson Power Poles). They are available from Hobby Horn, Sermos, Jomar, SR, and a number of other Electric suppliers. They are the best available.

Similarly, I use the specialty wire from these same suppliers. If you're not sure of something, phone them, and they will help you out right over the phone. The object of using this wire is to minimize the losses which are in any electrical system. There's no point in wasting power if you don't need to, and the cost of the best, especially when compared to the cost of an airplane, is very small.

Covering: Any iron-on film on the market will work well with this aircraft because of the strength of the wing, thanks to the hardwood spars.

I covered the entire airframe with the lightest Coverite Micafilm, (3/4 oz./yd.), using Balsarite as adhesive. I find the clear easier to put on than the colored, and it gives the airplane a clear-doped tissue look. It also shows off the construction rather well, so it provides incentive to do good work! I was careful to adhere the covering to each rib and spar for the extra strength it imparts.

You can trim with any film you wish over the Micafilm.

Assembly: Glue the wing hold-down dowels in, and rubberband the bottom wing in position. Next slide the formed center section struts into place. Lift them in and out of the 1⁄16-dia. holes in the fuselage until the top wing sits at the indicated angle of incidence (a Robart incidence meter works well for this). Remove them and make sure that they are free of surface oil or grease and notched to provide a good grip for the glue. Smear them with slow-setting epoxy, drip some into the holes, and reassemble. Again, check the angle of incidence while checking that the upper and lower wing tips are the same distance apart. When you are satisfied, let it set overnight.

Now the top cross pieces are bent, bound to the center section struts and soldered. Plywood strips, used to provide bearing surfaces and positive location keying of the wing, are then glued to the top wing, cutting away some of the film to ensure adequate adhesion. I used quite a crude locating system because of the tight schedule for building the model, but the plan shows a better one. You can add some balsa strips to simulate more scalelike struts, but make sure that they won't foul your battery hatch.

With the wing attachment finished, carefully glue the stab and fin in place making sure that they are straight. I used Sig CA hinges on the original.

Williams Bros. 2½-in. wheels were used for the undercarriage. About this time the tail skid can be added.

The nonfunctional interplane struts were made from slightly rounded 3⁄16 balsa inside large plastic drinking straws. They are designed to be held in place by the wing tension and are meant to come out or break before the wing is damaged by them in case of a hard landing or hitting something.

Now you can balance the airplane. The best procedure is to try and move things around inside if necessary to achieve the correct balance rather than adding balance weights.

The following is a summary of the original's weights (1 oz. = 28.35 grams):

- Top wing, complete (uncovered)—46 gm
  Balsarite adhesive—3 gm
  Covered—54 gm
  Covered and lettered—59 gm
- Bottom wing is 3 grams less.
- Fuselage, complete (dowels, cabane wires, landing gear; no pushrods, wheels or cabane cross wires—uncovered)—78 gm
  Balsarite adhesive—2 gm
  Covered—83 gm
- Stabilizer and elevator (uncovered)—8 gm
  Covered—11 gm
- Fin and rudder (uncovered)—4 gm
  Covered—5 gm
- Total airframe—12 oz.
- Radio weight—7.5 oz.
  (later, with the MCR 4A RX)—3.5 oz.
- Motor weight with connectors, prop, and adapter—9 oz.
- Battery weight with connectors (7 x 900SCR)—10.5 oz.
  With 6 x 1200SCR—11.5 oz.
- Total flying weight with STW and regular radio (7 x 900s)—39 oz.
- Total flying weight with MCR 4A radio (6 x 1200s)—36 oz.

Flying: As was stated in the introduction, the original Krumpler required Right and a little Up trim. Level flight is maintained at ¼ to ⅓ throttle, but quick takeoffs and aerobatics require full (or nearly full) throttle.

With the landing gear fairly far forward, you have to be ready to correct any swing on takeoff. This isn't hard to do. So far I have only ground looped the Krumpler once, and that was on its test flight before I knew how much right trim would be necessary. It takes off in less than 50 ft. with no wind and even less with a breeze.

I keep it flat for a while after it breaks ground to gain a little speed before I start pulling much elevator. Keep your first flight or two gentle until you have a feel for the airplane. Later you can throw it around more.

The rudder throw is quite sufficient with the elevator to do figure eights in a very small area. Loops are fairly straightforward but require either nearly-full power or a little dive first, and are better into the wind. If

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your loops are deteriorating and the plane is falling off the top, the battery is running down, and it's time to plan your landing.

Spins require the CG to be further back than what I used initially. With the removal of the two-ounce speed controller from the nose, I can get it to spin with a little power just at the top of the stall. It needs that blast of air across the tail to get it going.

Stall turns are easy. Just go into them with power and push the stick over.

Snap rolls from level flight are just as easy. Feed in a little Up elevator, and just as you see the nose start to rise, pull the stick right over and full back. It zips right around and actually pauses at level flight before going into a spiral dive. That pause is your cue to let go of the stick!

You can make your way down the length of the field, snapping every 10 or 20 yards, do a stall turn at the other end, and repeat it coming the other way.

The glide is moderate (remember biplanes are draggy) and better without the struts than with them. Nevertheless, I find a biplane without struts mildly offensive, so mine usually have them!

Make your first few approaches with battery power left so that you have the option of going around or rumbling in. I generally fly until I detect a slight drop in power and then cut the throttle and come in with just that last little bit in reserve.

The SCR cells have a sharp discharge "knee" that is almost like running out of fuel; whereas the SCs give you about a 30-second warning.

This airplane is best in calm weather or in a steady breeze. The 1989 KRC Fun Fly was quite windy, but it varied from constant (which was fine for the Krumpler) to gusty, which is flyable but not much fun.

The best time I have had so far has been evening flying when the wind has dropped and I can shoot one touch-and-go after another, all the while admiring how the setting sun shines through the covering.

I put skis on for winter flying when I put the Goldfire in. Flying qualities deteriorated slightly because of the extra drag and weight of the skis, but it was nothing major.

Conclusion: What might I change in a second Krumpler? I might shorten the nose a bit or build straight wings to ease the tendency towards nose-heaviness. I might turn it into something else.

In the air the Krumpler has a bit of Tiger Moth in it—and a little Bucker Jungmann as well. A creative modeler might take that and, with a few minor changes, create a nice, small Scale Electric.

One last point. If you do build a Krumpler, please send me your comments and a photo: Martin Irvine, 34 Beaver Crescent, Kingston, Ontario, Canada K7M 7C1.

I will answer all correspondence but would appreciate your sending a stamp.

RC Helicopters/Jolly

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The Concept 30 SX is a complete high-performance package for expert fliers.

On To The Kit My Concept 30 SX arrived nicely packaged in a gold box vividly displaying the SX's sleek lines. When the lid is slid off and the parts exposed, it is evident that the Concept 30 SX is pure Kyosho. This kit features excellent quality with obvious thought put into every part.

My SX was shipped with a standard Concept instruction manual and two separate addendum sheets that pertain specifically to the SX. Kyosho understands the multinational necessity for clear pictures, and as a result their manuals feature excellent illustrations and just enough text to take you over the rough spots. The standard Concept manual is over 30 pages and is a super piece of work. Anyone can build a Concept merely by looking at the pictures and matching parts and fasteners.

The Concept 30 SX is not difficult to assemble. Following the instructions to the letter took me under seven hours from start to finish. You'll have no problems, but I'll expand here just briefly on a few steps I feel may be lacking in the text.

Step 11: Set the clutch lining in place, and then glue it with thin CyA. If you add glue first, you'll never get the lining where it belongs before it sticks to itself, to you, the table—you get the picture.

In step 13, the main frame assembly, there is a call out for 2 x 3 x 10mm-long self-tapping screws. The illustration shows that they could be even shorter to hold the cooling shroud in place. In fact, if the screws are too long, you will bind up the clutch bell.

In step 19, the tail rotor assembly, make sure to use the plastic-compatible screw cement supplied with the kit, and do a good job of tightening the pitch ring nut to the slide bushing. This assembly could be better designed to allow a more positive grip during assembly. That would help to ensure that the nut will not separate from the bushing during use.

In step 21, don't glue the new control rod supports in place. Instead, decide where they go and apply a ¾-in. strip of vinyl electrical or trim tape to the boom. Rub the edges of the tape down well, and slide the supports into position with a twisting motion. You'll find that they fit snugly and are removable. You can also put some tape on the boom under the horizontal stabilizer to help snug it up.

In step 31, installation of the canopy, you should use an additional two screws at the front lower sides of the canopy to keep the decals from lifting on the canopy front edge.

I'd like to add that these suggestions are just that, and they are in no way intended to detract from the Concept manual. It is an excellent building aid, and with it and a kit as complete as the Concept, you would literally have to *try* to fail to keep from achieving success.

What radio? For my Concept SX I used an Airtronics Vanguard six-channel FM system and SGX gyro.

The transmitter features dual rates on elevator and aileron. It has one idle up setting, pitch trim, revolution mix, throttle hold and servo reversing switches. By today's standards the Vanguard rates as a very basic heli system.

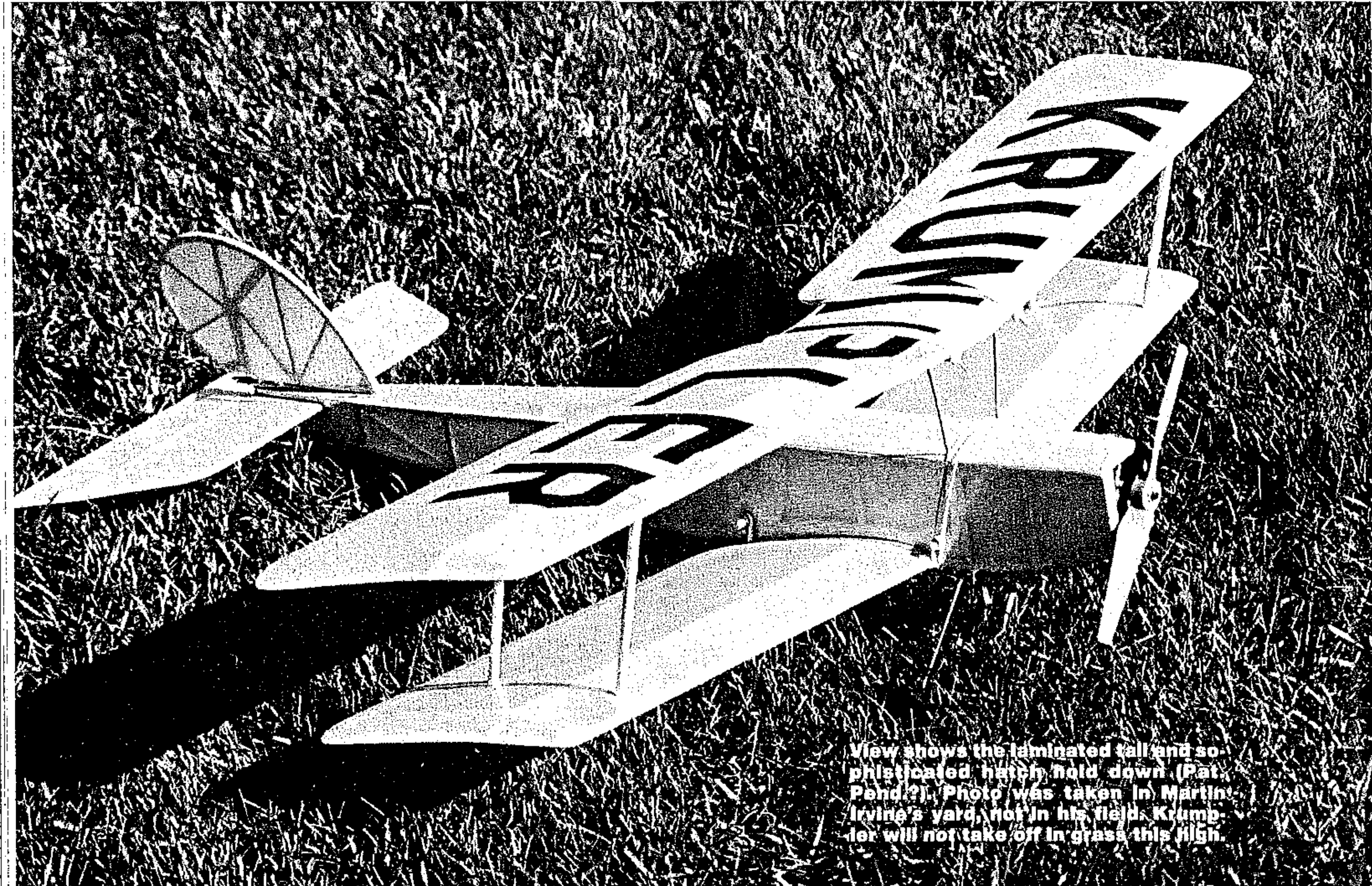
Unlike a PCM 10 or 1024, most heli pilots will be able to use everything on a Vanguard-type system. It's perfect for the beginner and will perform as a contest system for Novice and Scale, and maybe as far as Intermediate, since it can perform all the upright maneuvers.

The SGX system comes with a gyro, a mixer and dedicated tail rotor servo. It features a single adjustable gain and a reversing switch. While not FAI caliber, it's perfect for the novice who will want to set the gain up to a high authority and then adjust the gyro to suit his taste as he progresses. The SGX will also find favor with fixed-wing tail-dragger pilots. I think that it's just the ticket for a short-coupled Scale ship that gets feisty on takeoff. Check it out. It couldn't be easier to install.

The Vanguard performed admirably without a glitch. I think, however, that while it is suitable for training on the SX, it will not be capable of everything an expert will want his SX to do.

With this in mind, I switched over to my Airtronics Spectra 7 PCM. This radio is still pre-microprocessor but it has enough bells and whistles to allow a competent pilot to explore his SX's inverted capabilities.

The motivator. For power I used the standard O.S. 32 FSR H coupled to Vortex's Eikohgiken C 30 muffler. What can you say about an O.S.? They start, they idle, they produce a lot of power—all the good things you want from your heli motor. The C 30 seems to help out in the power department and has the added advantage of allowing you to adjust the low idle mixture on your motor which you do once, of course!



View shows the laminated tail and sophisticated hatch hold down (Pat. Pend.?). Photo was taken in Martin Irvine's yard, not in his field. Krumpler will not take off in grass this high.

Fairly long tail is evident here. Notice how the fuselage, turtledecking, wing and tail show through the clear Micafilm. Struts add a lot to the appearance.