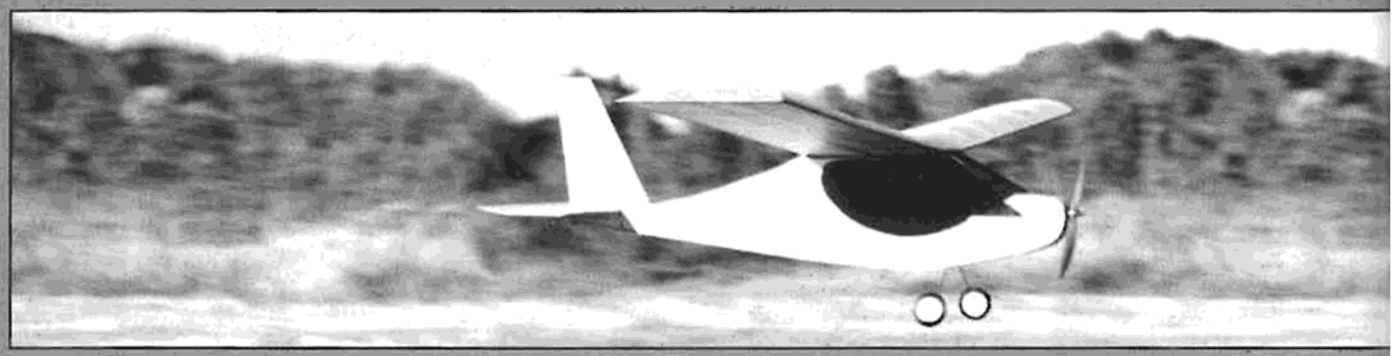
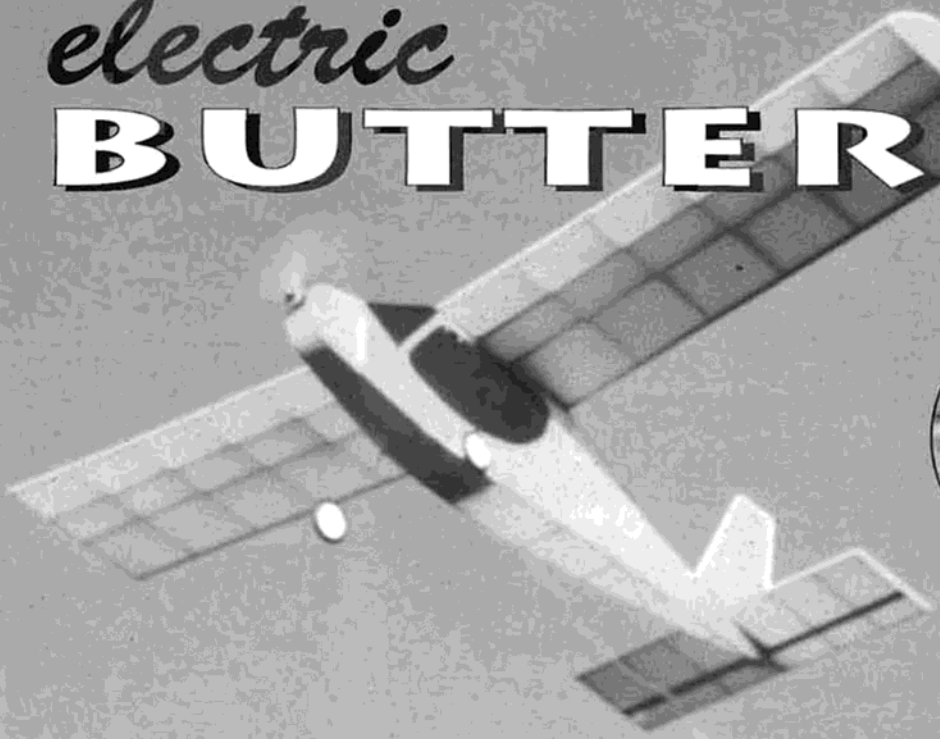


electric BUTTERCUP



By Fred Reese

Speed 400 Powered Sport Flier

The Electric Buttercup is a simple and inexpensive approach to a park flier electric model that gives a wide range of performance from gentle to aerobatic. Flight times range from 5 minutes of aerobatics to 20 minutes plus of just cruising using a Speed 400 motor and the Mini-Olympus gearbox.

The Electric Buttercup has turned out to be a really fun little airplane. I have been flying it regularly for the last few months, several times a week. I fly mostly with Harry Stewart of Nevada City, CA. He also has a little electric model of his own design with similar performance. We often go up together and see how long we can stay up, just cruising around, chasing lift. At the local parks and schoolyards, we fly in the evenings, low and slow, with an occasional loop or roll. The other people at these places hardly notice that there are R/C models flying.

I had gone through one of those bad periods of having lost several good airplanes. Two were dumb thumbs, another was a mid-air, and I'm still not sure of the other. Nevertheless, I was out of airplanes to fly at our weekly gatherings. I had been thinking about this project for a while and about trying a geared Speed 400 electric motor in something. Meanwhile, on the Internet, I had been having a conversation with Larry Parkerson about my Buttercup, an old 2-channel design for .020 sized motors. Larry had scaled up the Buttercup to 60" for a 4-stroke .40 and sent me the file. I had been thinking of building the larger version, when all this other stuff happened.

I did some research on the Speed 400 and the Mini-Olympus 2.33:1 gearbox, reading the recommended areas and size for a model, thus powered. The data and other models available all seemed too small and with too high a wing loading for what I wanted to achieve. I wanted a model that would fly slowly in a confined

Designed by:
Fred Reese
TYPE AIRCRAFT
Speed 400 Electric Sport
WINGSPAN
50 Inches
WING CHORD
8.25 Inches
TOTAL WING AREA
406 Sq. In.
WING LOCATION
Top Of Fuselage
AIRFOIL
Flat Bottom
WING PLANFORM
Constant Chord
DIHEDRAL, EACH TIP
2.5 Inches
OVERALL FUSELAGE LENGTH
32 Inches
RADIO COMPARTMENT SIZE
(L) 8.25" x (W) 2.5" x (H) 6"

STABILIZER SPAN
15 Inches
STABILIZER CHORD (avg.)
5 Inches
STABILIZER AREA
75 Sq. In.
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top Of Fuselage
VERTICAL FIN HEIGHT
7.75 Inches
VERTICAL FIN WIDTH (avg.)
3.5 Inches
REC. MOTOR SIZE
Speed 400 Electric
GEAR RATIO
2.33:1
PROPELLER
8 x 6 APC Slow Flyer
BATTERY SIZE
6 or 7 Cell, 600 mA-1200 mA

LANDING GEAR
Conventional
REC. NO. OF CHANNELS
3
CONTROL FUNCTIONS
Rud., Elev., Throt.
C.G. (from L.E.)
2-3/16 Inches
ELEVATOR THROWS
1/2" Up and Down
RUDDER THROWS
1/2"-3/4" Right and Left
SIDETHRUST
0°
DOWNTHRUST
3°

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa & Ply
Wing	Balsa
Empennage	Balsa
Wt. Ready To Fly	18 Oz. (1 Lb. 2 Oz.)
Wing Loading	6.4 Oz./Sq. Ft.

area, but be able to stand some wind and be more of an all-around model than the super light slow fliers. I had built other Speed 400 models weighing 16 to 18 oz. and felt that was a good weight to shoot for. A 50" wingspan with 400 sq. in. of wing area seemed about right to me. This combination would give a wing loading of about 6 oz. per square foot of wing area.

When push comes to shove, I took the easy way out and re-scaled the Buttercup to 50". The wing area worked out to 406 sq. in. After that, I just changed the 1/4" sq. balsa frame to 1/8" sq. and all the weight went away.

I use either a Hitec 555 or an FMA Direct Tetra receiver and a Viper Model Products Micro Demon speed control. I had also purchased, a while back, some of the Ace RC 8112 micro servos. I also had some 600 and 1000 mA 7-cell battery packs from my Simple 400. Some of the new equipment is even lighter, but the Electric Buttercup flies great with the products listed. I also used the large Deans Ultra Plug connectors and large silicone wire. You could probably save a half-ounce by just going to 18 Ga. wire and smaller plugs. I like the Deans Ultra Plugs for the larger motors and battery packs. One of these days, I will re-wire this system using the small three pin Deans connectors.

I covered the Electric Buttercup with Litespan and Balsaloc, which is quite a bit lighter than the films. The Litespan does not have any adhesive, so the wood must first be coated with the recommended Balsaloc. The Litespan is then ironed on and shrunk like any of the films. You do have to coat the overlaps with Balsaloc. The Litespan gives the look of doped silkspan or tissue, but is much stronger and more puncture resistant. Litespan and Balsaloc are available from Hobby Lobby and New Creations R/C, as are most of the other components.

I built the little Electric Buttercup in about a week and was anxious to fly it. Too anxious. On the first attempt, with witnesses, a new speed control quit working, so no flight. Disappointed, I took the Buttercup home and put in the Viper Micro Demon speed control from out of another model. Here comes the dumb part. I then flew the Buttercup in front of our house. It will fly there easily now, but for a first flight, it was a bad idea. It flew, badly, out of trim, climbing like a homesick angel, and I was dodging trees and light poles. I managed to get it back down and only damaged the landing gear. "That was terrible," I thought, and reluctantly went to work repairing the damage. I checked the fuselage and it wasn't straight. The rudder was glued on, centered on the fuselage, with a whole lot of left turn built in. Whoops. I cut off the rudder and re-aimed it at the propeller. A couple of days later, I tried it again at the field. Well, it was better, at least it flew straighter, but it was still climbing and acting awful. On the next flight, I moved the battery pack forward on the Velcro and tried it again. Magic! The Electric Buttercup flew great now. I repeat this stuff, because maybe it will be helpful to some. The rest of you already know that an out of trim, tail heavy model is no fun to fly.

A week later, I showed the Electric Buttercup to Eut Tileson. Eut took one look, spun on his heels, and walked back to his car. He came back a minute later and said, "Try these," as he handed me three new APC slow flier props. I did, finally settling on the 8 x 6. Wow! What a difference that prop made. I did not know

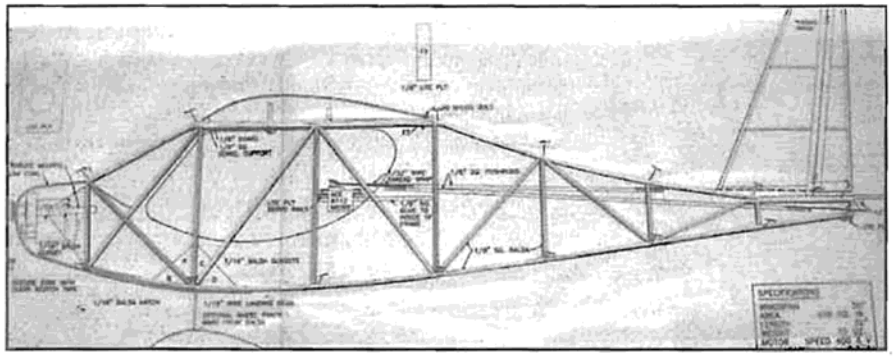
Material List

Wood

- 8 — 1/8" sq. x 36" hard balsa — fuselage
- 4 — 1/8" x 1/4" x 36" balsa — wing trailing edge, fuselage, empennage
- 2-1/2 — 1/16" x 3" x 36" balsa — wing ribs, cowl, sheeting
- 2 — 3/16" x 36" sq. balsa — wing leading edge
- 1 — 3/32" x 5/8" x 3.5" balsa — subfin
- 1 — 1/8" x 1" x 3" balsa — stab center section
- 2 — 1/8" x 1/2" x 36" balsa — wing spars
- 2 — 1/8" x 3/4" x 36" — wing spars
- 1 — 1/8" lite ply 6" x 7" — F1, F2, F3, and servo rails
- 1 — 1/4" sq. spruce x 5" — motor mounts
- 1 — 1/32" plywood 1/2" sq. — control horns
- 1 — 1/8" dowel 2" — wing mount

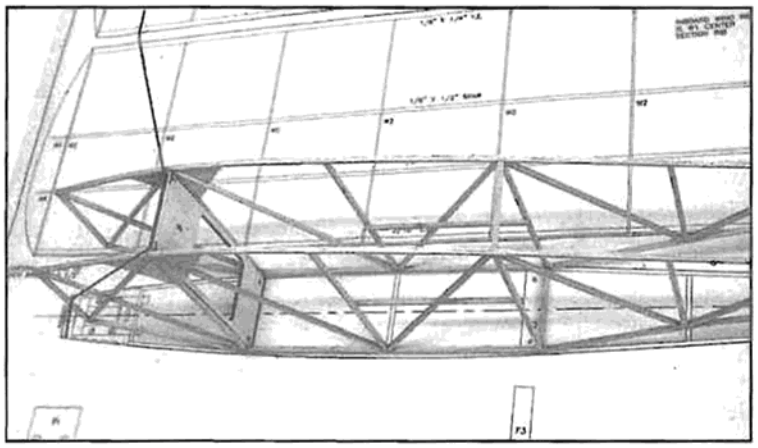
Hardware

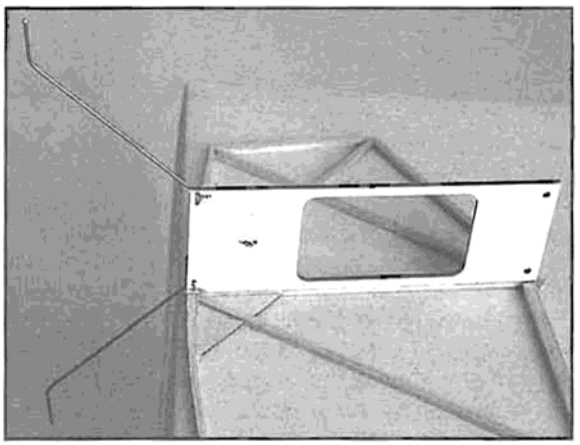
- 1 — 1/32" wire x 18" — pushrods
- 1 — 1/16" wire x 12" — landing gear
- 1 pr. — wheels 1.625 to 2" — wheels
- 4 — #2 x 3/8" SM screws — motor mount
- 2 — 4-40 x 1/2" nylon bolts — wing mount
- 3 — Litespan 36" x 20" sheets — covering
- 1 — Balsaloc 3.7 oz. — adhesive for Litespan
- 1 — Flat black spray paint — windows
- Thread — hinges and landing gear



LEFT: The fuselage sides are built from 1/8" sq. balsa over the plan using waxed paper or plastic wrap to protect the plan. The 1/16" balsa landing gear gussets and 1/8" sq. balsa servo rail supports are added to each side.

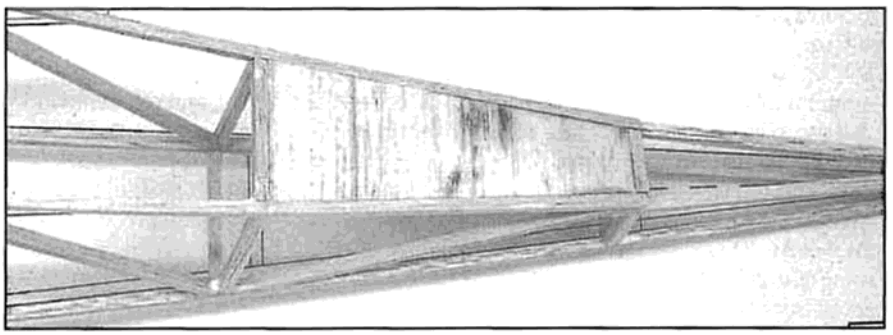
BELOW: Cut out F2 from lite ply and bind the 1/16" landing gear in place with thread or copper wire. Glue F2 to one of the fuselage sides using a square to align.





ABOVE: The second fuselage side is in place over the plan with the gear up. The top and bottom 1/8" sq. crosspieces are glued in place between the sides at the wing trailing edge.

RIGHT: Fuselage sides are pulled together at the tail and glued in place. Add the 1/8" sq. cross braces and the 1/16" balsa.



that APC made electric props, but Eut told me that most of the APC electric props went to Europe. They are very lightweight and have the typical APC efficiency and performance you would expect. APC now makes a selection of electric props for different applications. Check their Web site at:

www.apcprop.com

CONSTRUCTION

Building the Electric Buttercup is like building a large rubber powered model; two fuselage sides and everything else made from sticks. As fragile as it appears, the only damage sustained to my model was from the first flights. I broke out the landing gear, making a terrible landing on pavement, and cracked a fuselage stringer somewhere between the second and third flight while handling it.

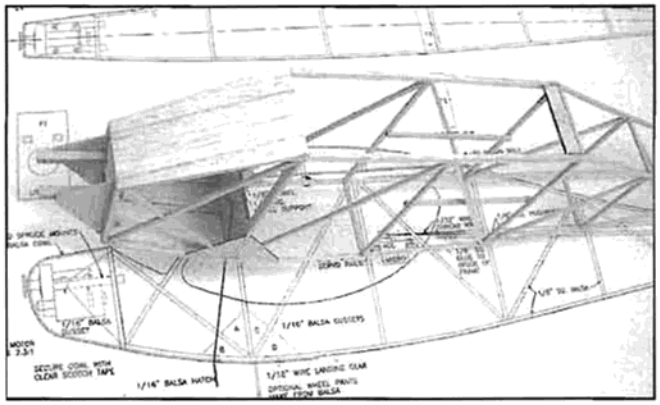
Lay a piece of waxed paper or Saran Wrap over the plan. Pin the bottom 1/8" sq. fuselage stringer to the plan with straight pins or T-pins from the hobby shop. Do not stick the pins through the wood. One by one, cut, glue, and pin in place the uprights, diagonals, and top pieces until you have one fuselage side. Remove the pins and lay another piece of waxed paper or Saran Wrap over the completed side. Build the second side right over the first side. Glue in the 1/16" balsa landing gear gussets and 1/8" sq. servo rail supports to each side. Glue in the 1/16" balsa switch mount on the left side.

Cut out F1, F2, and F3 from 1/8" lite ply. Bend the 1/16" wire landing gear and bind it in place on F2 using heavy thread or copper wire. Glue over the knots.

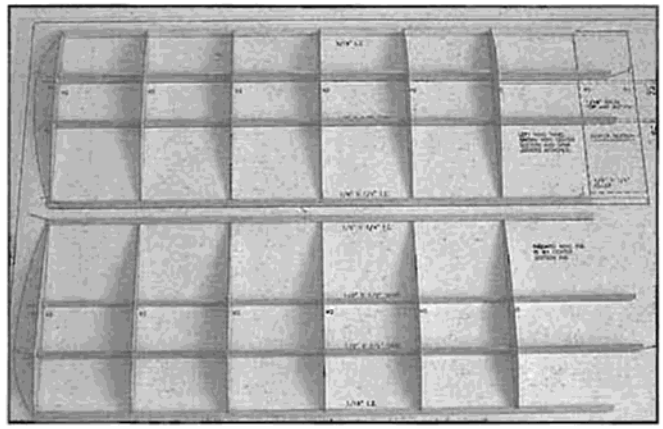
With a fuselage side lying on the edge of the bench, glue F2 in place, using a square to keep it square to the side. Glue on the other side, over the top view of the plan, with the landing gear sticking up. While there, glue in the top and bottom 1/8" sq. cross pieces behind the wing. Pull the sides together at the tail, aligned with the plan, and glue. Add the remaining rear crosspieces between the two sides. Secure F1 in place with a rubber band. Adjust the rubber band tension until the fuselage is straight, then Zap F1 to the frame. Before proceeding, check the fuselage for straightness. If necessary, crack any glue joint, make the shift, and re-glue. Glue in the 1/16" balsa sheet between the top stringers at the rear for the fin support.

Using the plan as a guide, glue the 1/16" balsa gussets to the 1/4" sq. spruce motor mounts. Glue the motor mounts in place on F1. Glue on the top, forward 1/16" balsa sheet. Also, glue on the 1/16" balsa cabin bottom and 1/8" sq. gussets between the bottom of F2 and the bottom stringers. Glue in F3, the wing hold-down plate, and the two lite ply servo mounts using your servos as spacers.

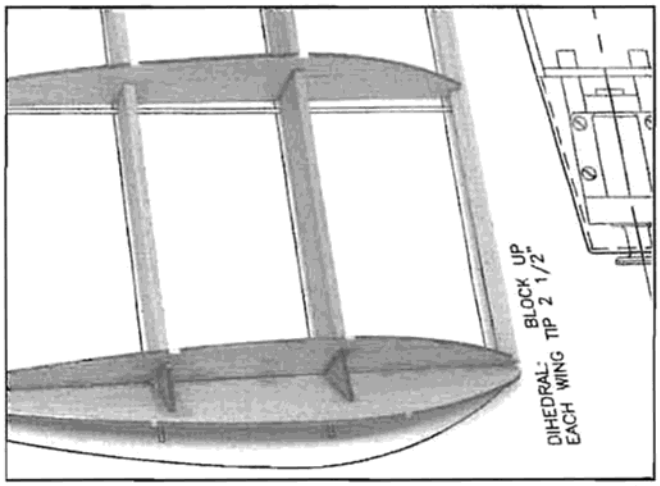
Build the wings next. Cut out the



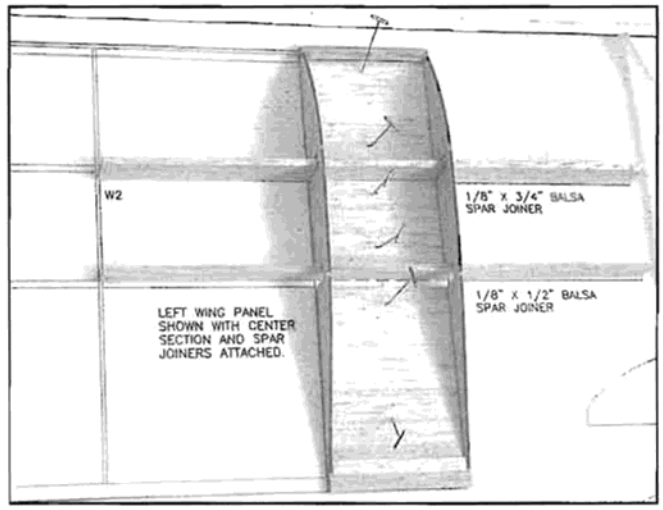
A rubber band is used around the fuselage sides at the front, then F1 is glued in place. The motor mounts are 1/4" sq. spruce with 1/16" balsa gussets glued to F1.



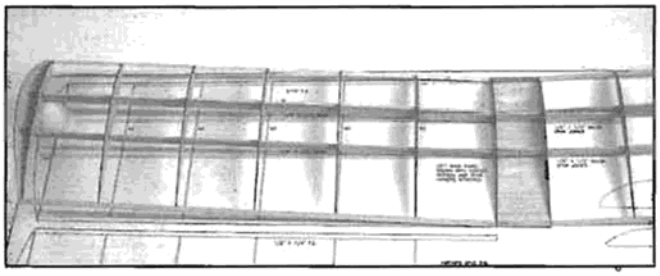
The wing ribs and leading and trailing edges all glued in place. Note that the inboard rib is the wing center section.



The 1/16" balsa wingtips are glued in place using the W4 wedges to set the angle.

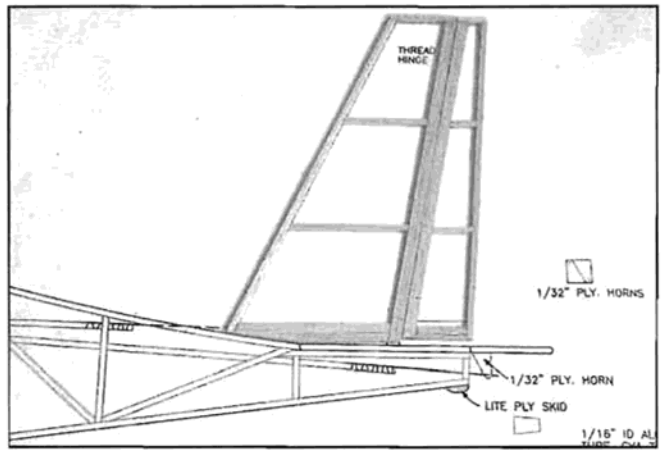


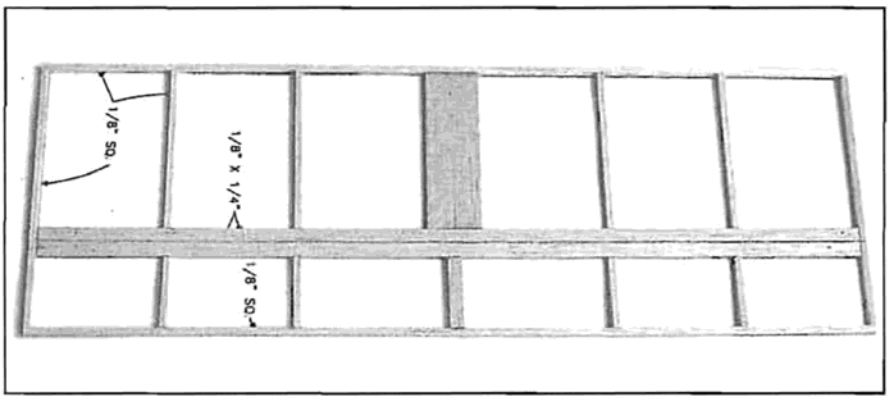
The wing center section assembly.



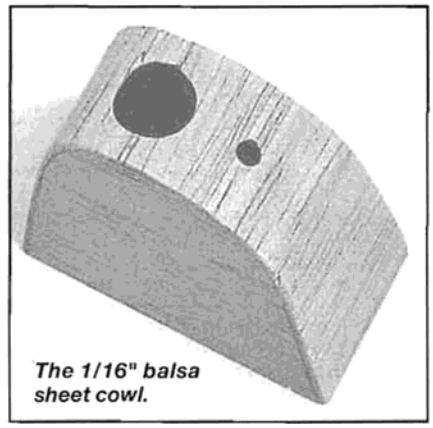
ABOVE: The bottoms of the spars are beveled where they will be in the center section. Trim the spars, leading and trailing edge ends to proper length. When fit, glue the wing panels into the center section, blocking up the tips 2-1/2".

RIGHT: Make the fin and rudder over the plan.





The stabilizer and elevator are built-up like the fin and rudder.



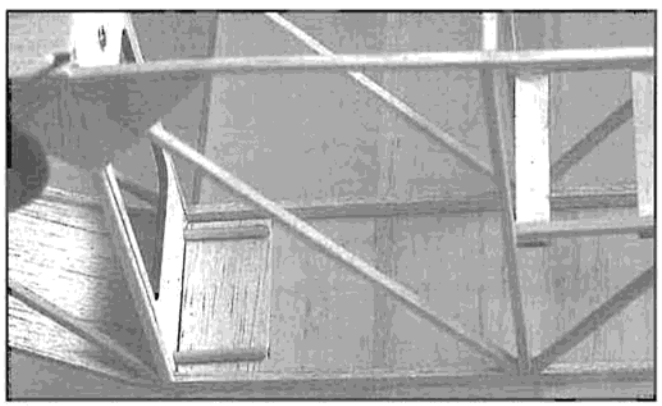
The 1/16" balsa sheet cowl.

1/16" balsa ribs and make the four 1/8" balsa spars. Pin the 1/8" balsa spars to the plan over waxed paper. Glue the ribs to the spars. Note that the inboard wing rib is the center section rib. Glue on the 3/16" sq. leading edges and the 1/8" x 1/4" trailing edges. Using the W4 angle guides, glue on the 1/16" balsa wingtips.

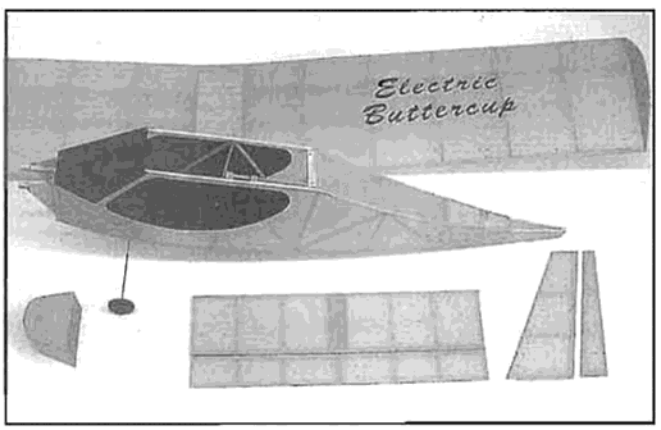
Build the wing center section by first pinning down the two 1/8" overlap spars to the plan, over waxed paper. Glue the 1/16" bottom sheet in place between, ahead of, and behind, the spars. Glue the two W1 ribs in place. Glue on the 3/16" leading edge and the 1/8" x 1/4" trailing edge. Glue in a 1/8" x 1/4" balsa filler strip that has been sanded to a wedge shape, just ahead of the trailing edge. Do not glue on the top sheet until the wing panels are joined.

Bevel the bottoms of the inboard ends of the wing spars so the wing leading and trailing edges align with the center section when the wingtips are blocked up for the dihedral. Trim the ends of the leading and trailing edges of the wing panels to fit the center section. Glue the wing panels to the center section and the two overlap spars with the tips blocked up 2-1/2". Glue on the top 1/16" balsa sheet to the center section. Sand the leading edge round and taper the trailing edge. Sand the wing in preparation for covering.

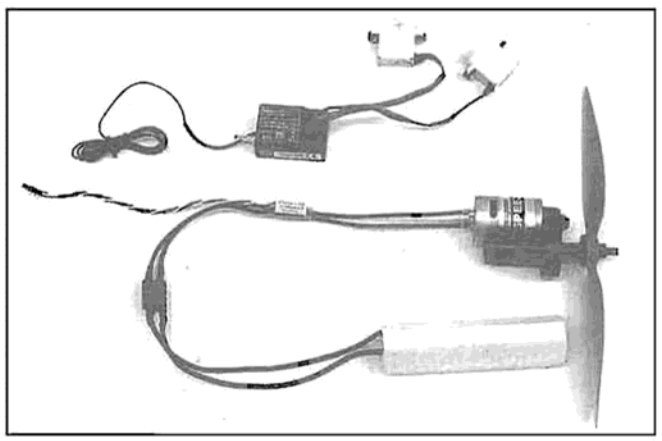
Build the tail surfaces over the plan and waxed paper using 1/8" sq. and 1/8" x 1/4" hard balsa. Round off the edges with



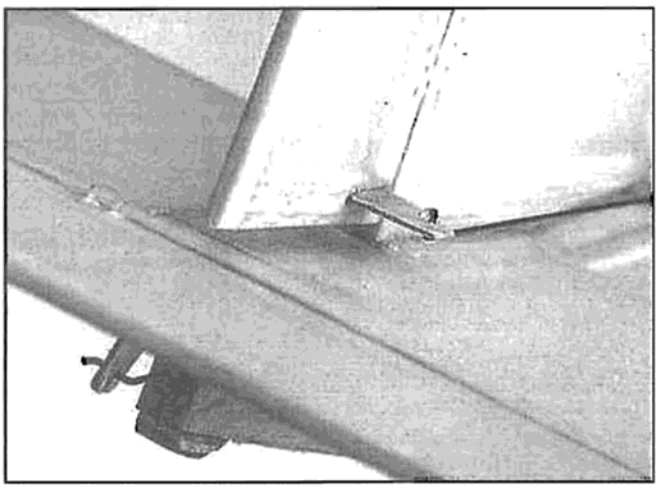
The two wing mounting dowels are glued to the bottom of the wing after removing covering. Drill through the wing and F3 for the two nylon wing mount bolts at the trailing edge. Tap for 4-40 nylon bolts.



Cover the model with a lightweight covering such as Litespan. The fuselage was masked for the windows with contact paper and sprayed with flat black Krylon paint.



The radio and geared Speed 400 electric motor system. Ace RC 8112 micro servos, Hitec 555 micro receiver, Castle Creations Pixie 14 speed control, Graupner Speed 400 motor, Mini Olympus 2.33:1 gear box, APC 8 x 6 slow flier propeller, and 6-cell 1200 mA NIMH battery pack. About 11 oz. total weight.



The pushrods are 1/8" sq. balsa with 1/32" wire ends connected to the 1/32" plywood control horns with "Z" bends. Thread hinges link the control surfaces.

sandpaper and prepare for covering.

Build the cowl from lite 1/16" balsa. First cut the two sides and tack glue them to a base and center. The base and center are made using the plan as a guide. Bend lite 1/16" balsa sheet over the sides and glue. Break out the base and center and cut the prop and cooling holes in the front of the cowl. Brush the entire cowl with Balsaloc and cover with Litespan. The cowl is secured to the fuselage with Scotch tape down the sides.

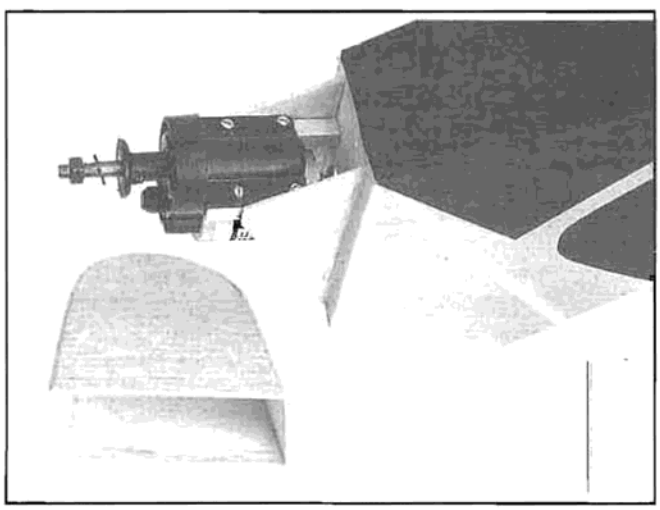
Give all of the wood edges a coat of Balsaloc to adhere the Litespan covering. Balsaloc is like thick white glue and is water soluble until it dries. Cover the wing first, as it is easier to install the wing dowels if the fuselage is not covered. Follow the directions that come with the Litespan and get the covering taught and as free of wrinkles as possible before shrinking. It shrinks, but not a lot.

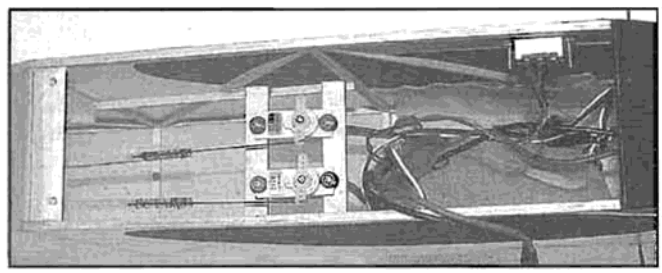
Seat the wing with the two 1/8" dowels inserted into F2. Trim away the covering on the wing over the dowels. The dowels should glue to the wing, but fit a spacer if needed. Glue the dowels to the wing and add a piece of 1/8" sq. between the dowels as a brace. Mark the positions of the two rear 4-40 nylon bolts on the trailing edge of the wing. Drill one of the holes and tap with a 4-40 tap. Install the first bolt, then drill and tap the second hole. Remove the screws and apply a drop of thin Zap into the holes. When dry, run the tap back through to clean out the threads.

Cover the rest of the model. The windows are painted on with a light spray coat of flat black lacquer or Krylon. Use low stick contact paper, they call it movable, to cut a mask for the fuselage around the window outlines. Use other paper and tape to mask the rest of the fuselage when you spray. Apply any other trim at this time, before assembly.

Hinge the rudder and elevator with figure eight thread hinges. Pull the thread hinges tight and lock the thread with a drop of thin Zap. Trim away the covering on the bottom of the stabilizer for the fuselage side glue joints. Glue the stabilizer and elevator to the fuselage. Cut a strip away on the top of the stabilizer and fuselage for the fin. Glue the fin and rudder in place, taking care to align it with the center of the fuselage and nose. Cover and glue in place the balsa sub-fin. If you will be flying from pavement, glue a piece of 1/32" wire to the bottom of the sub-fin to keep it from wearing.

Make the pushrods from hard 1/8" sq. balsa and 1/32" wire. Cut the 1/8" sq. balsa to length using the plan as a guide. Bind the wire ends in place with thread and thin Zap. Make a "Z" bend at the servo ends and cut slots for the exits at the rear. The elevator pushrod exits through the rear of the fuselage. Cut the two 1/32"





***ABOVE:** Ace RC micro 8112 servos on lite ply servo mounts. Wire pushrod ends are wrapped with thread and thin CA. Switch is inserted in the wire between the speed control and the battery plug. Receiver and speed control are just suspended in the wiring.*

***LEFT:** The geared Speed 400 motor is mounted with four #2 SM screws. The balsa cowl is secured with Scotch tape to the fuselage sides.*

plywood control horns and drill the pushrod holes. With the servos centered and the control horns held in place, make ninety-degree bends in the pushrod wires. Complete the "Z" bends in the rear. Cut away the covering on the rudder and elevator where the control horns will be glued. With the control horns on the wires, glue the control horns in place, keeping the surface straight. Put a second coat of medium Zap around these joints.

Hook up the motor, speed control, switch, and battery pack. Leave the propeller off during all of the installation and testing for safety sake. With the switch off, plug the speed control into the receiver. Test and adjust the throttle response according to the speed control directions. The speed control expects maximum control throws from the transmitter, both high and low. Install the motor, receiver, and speed control in the model. You can use a little small bubble pack or thin foam around the receiver, mainly to keep it from poking out the side of the fuselage; otherwise, the receiver and speed control can be suspended by the wires in the fuselage.

I have several different battery packs that I use in the Electric Buttercup. For normal flight time hot-dogging, I use a 7-cell 600 mA pack that weighs 5 oz. For maximum flight time, I use a 7-cell 1000AE pack that weighs about 7.5 oz., or a 6-cell 1200 mA NiMH that weighs 6 oz. There is also a 7-cell 1200 mA NiMH pack available from Hobby Lobby that weighs 7 oz. that might be best of all, but I don't have one yet. The longest flight so far, of 25 minutes, has been with the 1200 mA pack. I charge everything with my Astro Flight peak charger.

Cut away a strip of covering on the bottom of the wing center section and glue on a strip of the loop side of the Velcro. Do not use the adhesive backed Velcro. Get the sew-on type from the fabric store. Glue the fuzzy side of the Velcro to the battery pack. Position the battery pack on the wing so the model balances about 1/4" ahead of the spar. This is a little nose heavy, but that is the way it flies best. Still with no propeller, check out the system, noting the throttle response and control response with the motor running. Do not run the motor for long times on the bench, with or without the propeller. Resist that temptation to see how long it will run. There is a possibility of burning up either the motor or the speed control.

If you are used to flying ailerons on the right stick and rudder on the left stick, I suggest you hook up the rudder to the aileron output and mix ailerons to the rudder stick so either stick will move the rudder. That way, you can take off and land using your left hand and fly the rest of the time with your right hand. The airplane won't ever know the difference.

When all of the systems are checked out, you might as well fly it. In spite of the performance envelope, it still needs fairly calm winds to fly. Evenings or mornings are best. For the first flights, choose a field that is smooth and free of obstacles. Once you fly it in a large place, you will know how small a space it can be flown in.

I hand-launched my Electric Buttercup for the first few flights until I found out how easy it will take off from the ground. It does need a smooth surface for the first few feet of the take-off, but then it is off the ground in less than ten feet. When flying from grass, there is usually a bare spot that will work; otherwise, bring a small piece of carpet for a take-off strip.

Full power performance is spirited. Most people are surprised at the power the first time they see it fly. The Electric Buttercup will loop, roll, and stall turn from level flight at full power. Be sure to back off the power on the downhill, as it will overpower the tiny servos. If this happens, just throttle back and it will slow up enough for the servos to catch up and pull out. It has only happened to me once, but it really got my attention. Most of my flights are spent flying low, over the runway, slow, but with occasional loops and stuff. I like flying in close so I can see the model up close. The Electric Buttercup is responsive with the rudder and elevator throws indicated. The generous dihedral causes the model to roll quickly. With less dihedral, it would be smoother, but then it probably wouldn't roll. Some exponential will help. I hope you have fun with your Electric Buttercup or you use these parameters to create your own little electric airplane.

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