

ELECTRIC BRIGADIER

By MITCH POLING . . . Our "Electric Power" columnist introduces a famous early post WW-II design by Bill Effinger, kitted by Berkeley, that is a perfect match for the latest in model aircraft power . . . electric motors.



Sandra Smith Poling, M.D., with husband Mitch's electric powered Berkeley Brigadier.

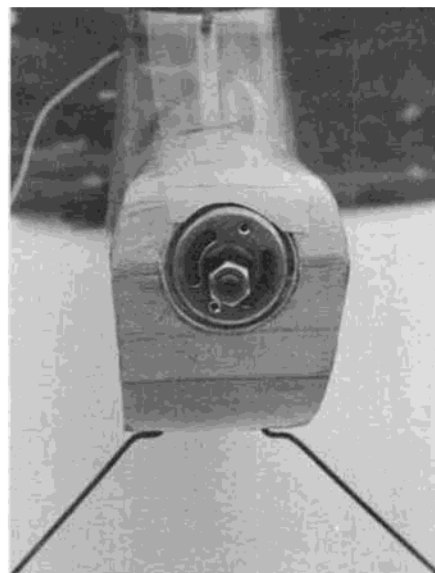
• The sun shines through the covering of the old timer as it cruises by, and then it slowly turns into the field. It gently settles in, almost hovering, like a bird in flight, then touches down in almost dreamlike slow motion. Suddenly there is applause from the field, the fliers and spectators have been captivated by the beauty and the sheer class of the experience! The Berkeley Brigadier does that to you, and does it every time! It can't help it, as the song goes, and it just comes natural, just like anything that is just perfectly right.

The Brigadier has class, and it shows on the ground and in the air, perhaps "charisma" is a better word, for lack of any other. But, its talents don't stop just there. It is competitive, having won first place in every electric old timer contest I have entered. It can fly itself, once a rudder servo failed, and it flew overhead until the motor ran down, then made a perfect landing just at the end of the field! It is a perfect trainer; I taught my 11-year-old nephew to fly R/C on it, and after he had soloed after two flights, he said, "Gee, this is easy!" Right, if you are flying a Brigadier! It loves thermals, it will turn into one and stay there until you insist on it coming back. In fact, at times I feel like I'm interrupting its business, and I'll let it fly free, with just a little rudder trim for gentle circles. So, if you would like to

have a plane that has a free spirit of its own, and appeal, and superb flying abilities, try the Brigadier!

The construction of the Brigadier is a little simpler than the usual old timer, especially the wing, which is very simple indeed, with only a leading edge, solid spar, and trailing edge. Let's start with the wing first, as it is so simple. Cut the ribs from 3/32 sheet. I always keep track of the weight of the balsa; a 3x36 sheet of 3/32 balsa should weigh about 3/4 ounce. After the ribs have been cut, stack them to be sure that the spar notches and the leading edge notches line up, and that the trailing edge is the same length on all of them. Cut the notches in the trailing edge with an Xacto saw. The notches are quite important; they make the wing assembly much easier, and strengthen the rib to trailing edge attachment, which really helps when the covering goes on! The leading edge is just a 1/4 square balsa or spruce length, set on edge, like a baseball diamond. Round the edge that will face forward a little, I use an emery board (for fingernails) for this. A lot of rounding isn't needed, I just take off the sharp edge. The spar is 1/2x1/4 spruce. This size is sometimes hard to find, so you can glue two 1/4x1/4 spruce lengths together to get the same result. Basswood should do as well, but do not use balsa, it could fail under stress.

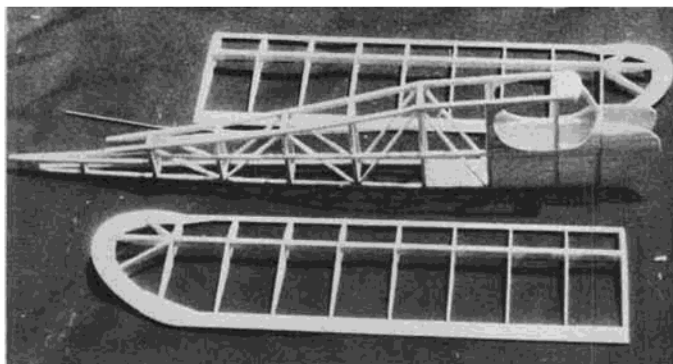
I use the thick cyanoacrylate throughout construction, except where otherwise noted. Note on the plans that the spars are tapered upward at the tips, use the plans to get the right angle. Cut the tip pieces from 1/8 balsa (about one ounce for a 3x36 piece), then assemble the wing. Once the glue has set, remove



Electric 05 motor blends nicely into Brigadier cowl. Patch on top is result of installing new motor tube.



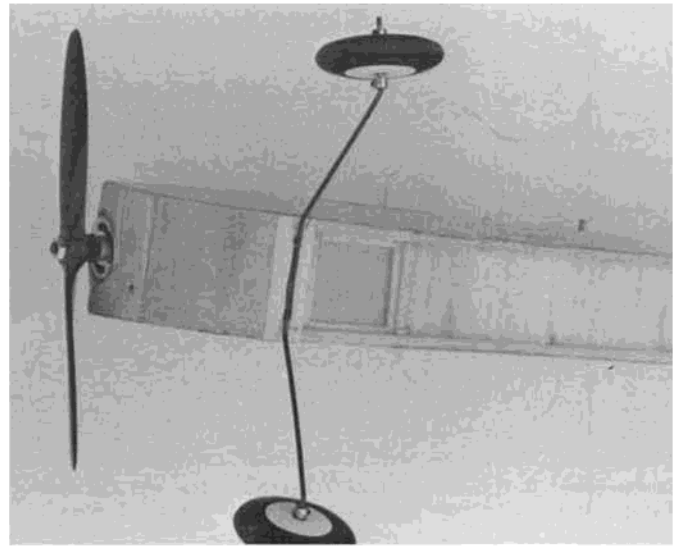
Brigadier gets "refueled" through Leisure Electronics digital charger, from large battery in field box.



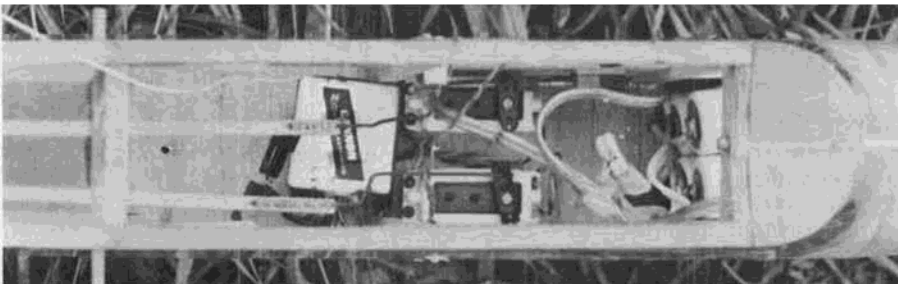
Basic structure of the Brigadier is exceptionally simple. Original was Berkeley free flight gas model kit.



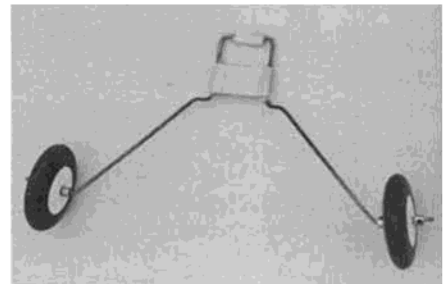
Mitch gives his Brigadier the old heave-ho for another silent powered flight.



Underside showing how landing gear is plugged into slot in fuselage, allowing easy straightening if needed.



Two-channel system is used, with down elevator to operate push-on, push-off switch to electric motor.



Tape keeps gear from spreading, provides snug fit in fuselage slot.

the wing from the plans and glue a 1/8 plate over the root of the wing, and trim it to the outline of the root rib. This will reinforce the root rib against the pull of the covering. Now drill a hole through the first two ribs just under the spar, using 1/8 I.D. aluminum tubing. Sharpen the tubing by running an exacto knife around the inside edge, then put a few nicks in the edge for "bite." Hold a balsa block behind each rib as you drill by hand (not with an electric drill) to take up the stress. Cut a length of the aluminum tubing as long as the first two rib bays, and glue it to the underside of the

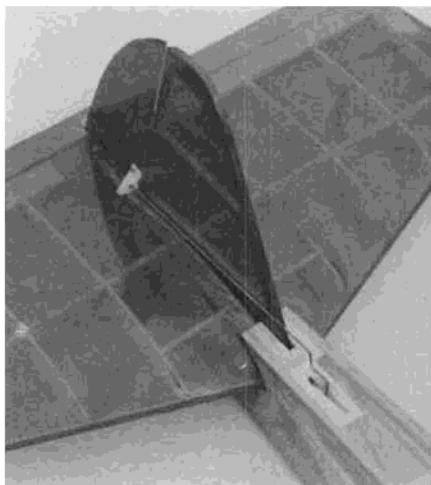
spar. Put three turns of nylon tape around the tubing at each end of each rib bay, secure the tape with glue through all the wrappings. I use the Carl Goldberg nylon tape, 3/4 inch wide, item 264, and it works very well. Build right wing panel in the same manner, shifting tip to other end.

Cover the wing, the bottom first, then the top. I used transparent red Solarfilm for its dramatic effect. The top and bottom were done with one piece each, including the wingtips, which are easy to do if you pull on the covering while you apply it. Cut and bend the wing dihedral wire from 1/8 music wire. Assemble the wings by sliding the wire into the wing tubes and pushing the wing panels together. Do not glue them, there is no need to, and the take apart feature is very handy. Run a band of tape around the center joint to hold the panels together. I use 3/4 inch vinyl tape for

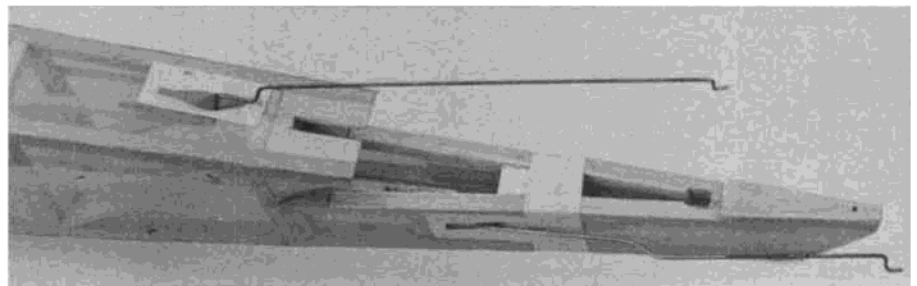
this. The tape can pull quite hard on the covering if you want to take the wings apart later, so I use three bands of tape, one for each wing root, and the one around the center. The tape bands on the wing root are permanent, and save the covering from wear and tear. I do not slant the wing root ribs on my planes, so there is a small gap at the top of the wings where they are pushed together, but the tape hides this perfectly, and it has no effect on flying.

Check the wings for warps, I use about 1/4 inch of washout in each tip, that is, with the wing root flat on the table, the tip rib trailing edge should be about 1/4 inch above the table, and the entire leading edge should be flat on the table. This is not especially critical . . . what is important is that both panels should have the same washout, and that there is

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Fin and stab fit into slots in fuselage, for consistent alignment.



Aft end of fuselage showing alignment and mounting slots, and control pushrods. Single screw into fin-post retains tail surfaces, permits demounting for easy transport.

no wash-in, the opposite type of twist (root rib trailing edge higher than the tip rib trailing edge). I put in the washout by twisting the panel in the direction that I want it to go, then I iron out the wrinkles in the covering. Then check that you have the twist that you want. The covering will hold the wing washout pretty well, but it should be checked occasionally, especially if the sun heats up the covering, which can cause it to loosen or tighten.

Now for the rudder, fin, and stabilizer. The rudder is just a simple sheet of 1/8 balsa (check the weight). The fin is built up from 1/4 square balsa and 1/4 inch sheet. The 1/4 square balsa should weigh about 1/4 ounce for a 36 inch long piece, the 1/4 inch sheet should weigh about 2 ounces for a 3x36 sheet. A small diet or postal scale is handy for this, or just compare sheets by holding them at one end and flap them a little, like a diving board. The heavy sheets will feel heavy!

The vertical fin post is 1/4 inch spruce (or basswood). Cut out the pieces and assemble. Bevel the rudder leading edge and the trailing edge of the fin down as far as the height of the rudder. Lightly sand all edges with the emery board, a lot of rounding is not needed, just take the edge off. Cover the fin and rudder together with one piece per side, with about a 1/16 inch gap between, so that the covering is the hinge as well. This makes a very free hinge, seals the hinge gap, and it is easy to repair with scrap covering or tape (I have never needed to, the Brigadier has four years of service). Wrap thread around the bottom 1/2 inch of the fin post, and drill a 1/16 inch hole vertically up in the center about 1/2 inch. This hole will be for a wood screw which holds the fin down.

Now for the stabilizer. Cut the ribs from 3/32 sheet, and check that when the spar notches line up that the trailing edges are all the same length. Notch the trailing edge stock for the ribs. Cut out the tip pieces, and assemble the stabilizer. The 1/4 inch spar will have to be cracked a little in the center so it can slope from the root rib to the tip ribs on both sides. Sand the leading edge lightly with an emery board. Put in the 1/8 square braces from the root rib to the second rib, these help keep the ribs from bending from the pull of the covering. Cut the elevator strip, and bevel its leading edge. Cover the bottom and top of the stabilizer and elevator with one piece each, leaving about a 1/16 inch gap between the stabilizer and the elevator. The covering forms the

hinge, as in the rudder and fin. Trim the covering off the gap between the two root ribs. Now check the fit of the fin with the stabilizer. The notch in the front of the fin should evenly engage the front spar of the stabilizer when the fin rests squarely on the stabilizer. Check this and cut or fill the fin until it does. Drill a 1/16 inch hole in the center of the stabilizer trailing edge. This hole is for a wood screw that will hold the stabilizer to the fuselage.

Last, the fuselage. Most of the fuselage is built from 1/4 square balsa, use the weight guidelines, about 1/4 ounce for a 36 inch long piece. The top longeron of the cabin is spruce or basswood, since that is where you usually pick up the plane when the wing is off, and balsa will crunch! Build the sides over the plan, and check the small detail drawing. There is a side stringer that will go on later, which makes the plans a little harder to read, so the detail drawing should help. Lay the two sides over one another when they are done to see that they are identical. I then added small 1/64 plywood gussets at all the glue joints for extra strength. These are easily cut from 1/64 inch plywood with scissors. I built my Brigadier before the days of thick cyanoacrylate, so it may not be necessary now.

Cut the firewall, F-1, from 1/8 plywood. I prefer Sig Lite Ply, it is quite light and strong. Now bend the landing gear, and build up the landing gear box on the front of F-1. Before you put the front of the landing gear box on, check that the landing gear slips into it easily. Now assemble the fuselage with 1/4 square cross pieces from the nose to the rear of the cabin. Check that the sides are square to each other, a triangle is best for this. Once this is done, lay in the cabin floor, using 3/32 balsa crosswise in the fuselage, on the top of the lower

fuselage longerons. Leave 1/8 inch space on the top of the longerons for the fuselage side insets. Inset the 3/32 side panels, just flush with the outside of the longerons. Now pull the tail ends together, and tape or clamp them. Lay the fuselage flat on the table and measure the distance from the table to the fuselage end. Turn the fuselage over and lay it flat again, and measure the distance again. If the two measurements are the same, the fuselage is straight and true, so glue the ends together as is. If the measurements are not the same, adjust the ends and repeat until the measurements agree.

Install F-1 with five-minute epoxy, making sure that the notches in the sides line up with the cabin pieces, and that the notch in the top is centered. Cut the side stringers to length, and taper the ends. Glue on the side stringers, then add the four F-4 pieces. Cut out the cabin window balsa pieces, and glue them flush with the F-4 pieces and the outside edge of the side stringers. Install the F-3 pieces and the F-2 piece, and glue in the 1/4 square balsa piece for the notch at the top of F-1. Install the front windshield balsa cowl pieces. Glue in the front wing dowel and the rear wing dowel. Install the front cowl pieces F-7, F-8, and F-9 next. These are glued to F-1 and the side stringer. The top pieces will keep them from cracking. Grooving the undersides will also make bending easier. Plank the bottom of the cowl up to F-9 with 3/32 balsa crosswise.

Now the nose is all closed in, so you are wondering how to mount the motor! Have patience! Cover the fuselage, the sides first, then the top and bottom. I used transparent yellow Solarfilm for the dramatic effect. Cut the cabin windows and windshield from thin celluloid, and glue them in place with RC 56 glue or cyanoacrylate. The RC 56 glue does a very neat and clean job, since it is water soluble and can be cleaned off.

Now to mount the motor. You have a couple of choices. I used a motor tube, which I made by rolling file card stock (from a drafting materials store) around an Astro 05. The turns were secured with five minute epoxy. Be sure to wrap Saran Wrap around the motor first, or it will become a permanent part of the tube! The tube was 4 inches long. Bevel one end of the tube, mark one side 3/16 shorter than the other, run masking tape around to serve as a guide, and cut with scissors or an Xacto saw. This bevel is necessary for the motor down thrust and side thrust. Now use the other end of the tube as a guide and draw the cut out on the nose for it. Cut out the hole with a #11 Exacto blade, and push in the tube for a trial fit. Put the motor in the tube with a propeller, and rotate the tube until the motor shows about 3° down thrust and 2° right thrust. This is an eyeball measurement, an exact value is not necessary. Mark the tube and the nose with about four marks that match up as a guide for gluing. Run a bead of five minute epoxy just inside the beveled end and on the beveled end edge, and

will go through the hole in the front of the cowl. Drill holes for screws for the motor mount, and fasten on the mount with 3° down and 2° right, using shims (spruce works well). A 3/16 shim in the upper right (as you face the plane) hole, and a 1/8 shim in the lower right hole should be close. Now check the cowl fits, glue in a couple of spruce blocks for cowl mounting screws to go into, and hold the cowl on with screws, or with tape if you prefer.

Which motor to use? I prefer the regular Astro 05 motor or the Astro 05 XL motor, both with six sub-C cell battery packs. The Astro 075, the Leisure 05 motor, and the regular Astro 05 with eight cells are all quite satisfactory as well. The best prop for the Astro 05 XL, the Leisure 05, and the regular 05 with eight cells is the Cox 7x3-1/2 gray prop. This prop is hard to get, so the Top Flight 7x4 nylon or wood prop, or the Rev Up 7x4 prop will do quite satisfactorily. My top favorite combination is the regular Astro 05 motor with six sub-C cells, it turns a 9x4 Cox prop, and it is perfect in the air. In general, the sub-C cell systems give the longest run time, you can easily get six minutes of flight, and usually you'll do better than that. The battery pack fits in the front of the cabin, long side vertical.

Which radio? Any two or three-channel radio will do, I prefer to keep it light for the best climb, so I use a Cannon receiver, two Bantam Midget servos, and an Astro Flight 250 mah receiver pack. I use a push-push switch available from Astro Flight, activated by full down elevator, for on and off. The servos are mounted by servo tape to the cabin sides, as is the switch. The push-rods are 1/4 square balsa, with 1/16 music wire ends. The pushrod exits in the tail are cut out in the covering, then tape around the cutouts to keep the covering from tearing. The control horns are the Carl Goldberg mini horns. The elevator horn is on the right side (as you face the aircraft) below the elevator, the rudder horn is on the left side as you face the nose of the aircraft. A threaded clevis at the rudder and elevator end simplifies neutral adjustment tremendously, I recommend it (I didn't!).

Now for final assembly. Fit the landing gear in, if it is loose, wrap some masking tape around the wire until it is a snug fit in the landing gear box. The landing gear is removable, for a special reason. The landing gear is a little underweight for the plane, on purpose. It will bend in a hard landing, and take up all the abuse that otherwise would be transmitted to the frame. Since it is removable, you can pull it out, bend it back into shape, and pop it back in. This feature has been a real life saver, the front end has never been mashed in a hard landing, though the landing gear has been many times, in the four year life of my Brigadier.

Slip the stabilizer into place in the back, and fasten the trailing edge down with a 1/2 inch screw. Check that the leading edge is held down firmly by the F-10 pieces, if not, build them up or cut

them down as needed. Slip the fin into place, and bolt it in with a 5/8 inch screw from the bottom of the fuselage into the vertical fin post. Check that F-5 holds the front of the fin firmly in place, if it does not, build it up or cut it down as needed. Connect the pushrods, check for neutral and that right is right, and up is up (as you look from the tail to the nose of the plane). The all up weight of the plane should be between 38 to 44 ounces, mine weighs 41 ounces.

To the flying field! I recommend the Astro Flight Rapid Charger or the Leisure Model 105 (for six cells), and at least a 6 Ah. field battery if you do not charge from your car. I recommend a hand launch, though the Brigadier does excellent ROG off pavement. A little up trim may be needed. The climb is slow and gentle, as is the flight in general. Use moderate control, as the Brigadier responds quickly and strongly to commands, though it goes back to normal flight just as easily when you leave it alone. Compare the flight with the motor on and the motor off. Give up, then down, for each motor command, to clear the switch (the up allows the switch to clear). If the climb is nose high, but the glide is normal, the plane needs more down thrust. Shim the motor mount, or if a tube was used, pull out the tube using needle nose pliers and an Xacto knife, and insert a new one at the new angle. If the climb is normal, but the glide is either nose high or nose down, shim the stabilizer under the trailing edge. Shim up if the glide is nose down, shave off some of the material at the back if the glide is nose up. The Brigadier is actually quite tolerant of a range of trim, so the chances are that you can do most of the trim by adjusting the transmitter trim or the horn clevises.

Once the Brigadier is adjusted, normal flight times are four minutes or better with the regular eight cell Astro 05, and six minutes or better with the six cell systems. Check the battery after every two flights. If it is hot, let it cool down before proceeding. The usual flight altitudes are from 400 to 600 feet. If there are any thermals, though, the bets are off! Then you fly as long as you find more thermals, and as high as your courage allows! Enjoy, and see how much the Brigadier knows about flying, it knows more than most pilots! At this point, I would like to make a special acknowledgement, my thanks to Bill Effinger, the designer of the Brigadier and the man who runs W.E. Technical Services, for his permission to use the design in this article, and for a very special airplane.

Fly high!

on the tube where it comes out of the nose. Slip the tube in, and let the fuselage stand vertically (nose straight up) so the epoxy will spread out on the firewall, and let it set. Trim the excess tube sticking out the nose with an Xacto saw. That's it, all done!

The other choice is to use the excellent radial mount sold by Astro Flight. If you use an .09 or .10 glow engine, install an .09/.10 radial mount.) For this, again, use the front of the radial mount tube as a guide, draw the cut out on the nose for it, and cut the hole with a #11 blade. Now cut the entire cowl free of F-1. Mount the motor in the radial mount, and place it on F-1, then push the cowl back on. Mark where the mount sits so the motor