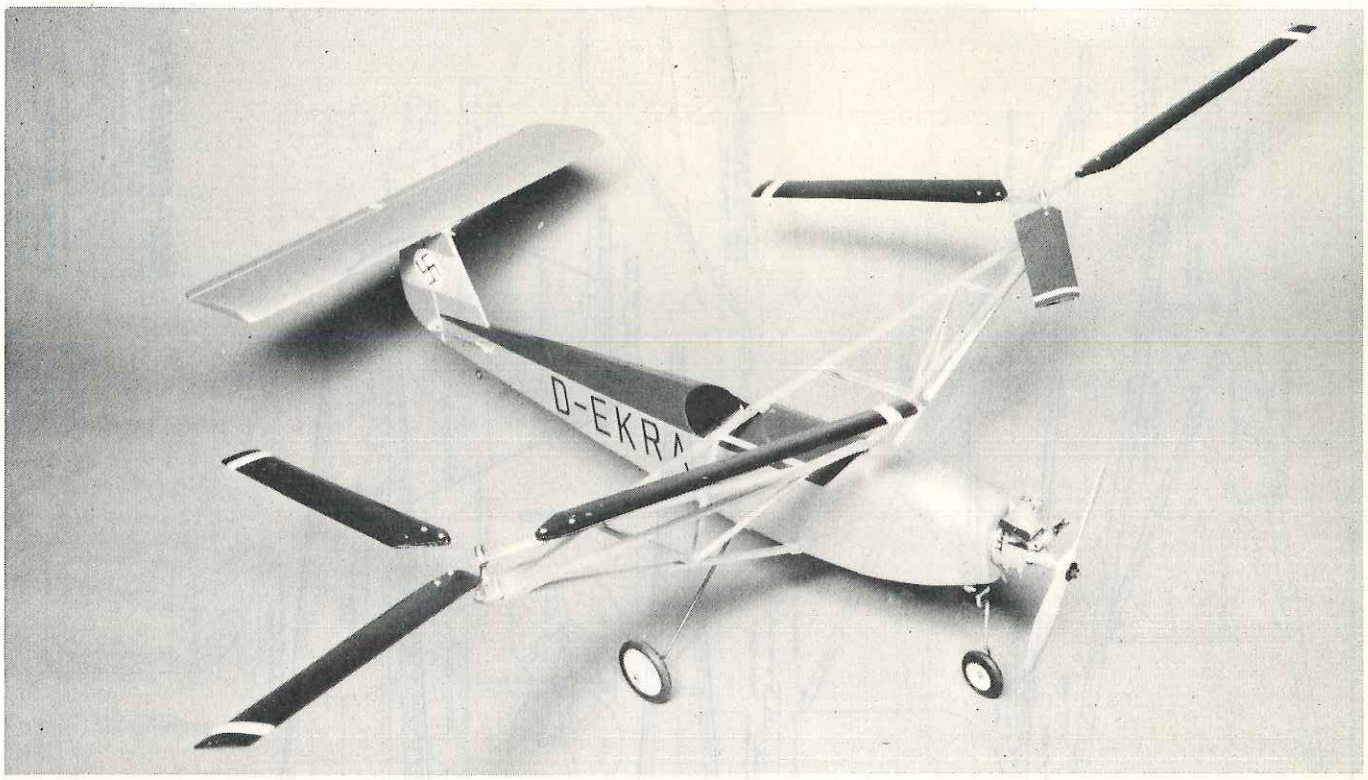

PHOTOS BY BOB HOFFMAN & RUSS HIATT

FOCKE-ACHGELIS 61 RC AUTOGYRO

By SKIP RUFF . . . A real breakthrough in model aircraft design, this R/C autogyro is easier to fly than many so-called "trainers." It's also great for modelers who hate to build wings! Be the first in your block . . .

• This twin-rotor, semi-scale helicopter can be flown by anyone capable of flying a 3-channel trainer. The reason, of course, is that the helicopter is not really a helicopter at all, but an autogyro! However, before I confuse everyone, let me give a short history of the real FOCKE-ACHGELIS 61.

The F-A 61 was one of the first truly practical helicopters, and was the brainchild of Doktor Heinrich Karl Johann Focke. The machine made its first flight, lasting 28 seconds, on June 26, 1936. The first craft was built using the fuselage and engine of a FOCKE-WULF 44 basic trainer, with the tailplane mounted on top of the fin and the propeller cut down to the diameter of the engine cylinders to serve purely as a cooling fan. It gave no assistance in forward flight, although it probably fooled many authorities into believing that the machine, like the model, was actually an autogyro. The twin rotors, mounted on steel-tube outriggers on both sides of the fuselage, were fully articulated 3-blade assemblies with a blade angle that could be increased or decreased so as to provide lateral movement of the craft by creating a lift differential between rotors.

In May of 1937, the F-A 61 made its first autorotational landing. In 1938, the controlability was demonstrated by Germany's celebrated aviatrix, Hanna Reitsch, who flew the machine inside the Deutschlandhalle Sports Stadium in Berlin. These feats were all accomplished by the first prototype which was given the registration D-EBVU. Meanwhile, a second prototype, D-EKRA, from which my model has been copied, was completed and from 1937 onward established many records including the following:

1. Distance: 143 miles on June 20, 1938.
2. Altitude: 11,243 ft. on Jan. 29, 1939.

You may be interested to know that this particular configuration is still in use today in several Russian helicopters, one of which I believe is gigantic, with two 114 ft. diameter rotors.

Specifications of the F-A 61 are as follows:

Rotor diameter (each) – 22 ft., 11-5/8 inches
Fuselage length – 23 ft., 11 inches
Height – 8 ft., 8 inches
Maximum weight – 2100 lbs.
Power – 160 H.P. Siemens-Halske 14-A radial engine
Cruise speed – 62 M.P.H.
Ceiling – 8600 ft.
Range – 143 miles

The model, of course, is actually an entirely different sort of craft. I have been experimenting with R/C autogyros for several years, and have never really had success until now. All the previous models were of single rotor configuration and all exhibited the same sensitivity to one thing, torque from the engine. To overcome this, I had to install small ailerons, and though the machines did fly, they were very erratic and not too stable.

The idea of the twin rotor design came from an old Roy Clough article in a late 1940's AIR TRAILS. I thought that possibly, a stable craft could result from this configuration. Not being an engineer, I had to rely on my experience with free-flight gyros for blade angles, sizes, and rotor angles. For other dimensions, it was all hit and miss . . . fortunately for me, more hit than miss.

The first model I built using this configuration was nothing more than a highly modified FALCON 56. To my amazement, and everyone else's the model flew after only a couple of changes in center of gravity location and blade angles. A short time later, I came across a picture of the F-A 61 in an old Air Progress magazine, and thought it would make an ideal subject because of its configuration. Since no accurate 3-views were available, and to keep the model simple, I built it from photographs, using as basic a construction technique as possible.

The model itself has a simple box fuselage with spruce rotor booms, and a T-tail. The rotors themselves are also simple. They consist of 3/16 sheet balsa

4751

blades bolted to hubs made from 3/32 aluminum. No complicated hinges or flapping mechanisms, just light simple rigid rotors. The rotor bearings should also prove to be no problem. They are Cox .049 crankcases. Thus, the possibility of expensive and time-consuming machining is eliminated.

By now, you've decided to build it, so finish reading the whole article first before beginning construction. Once you read the section on flying. I'm sure you will be convinced that you will have to build one just to see if I'm putting everyone on!

CONSTRUCTION

Because the plans are pretty self-explanatory, and the model is simple, I'm not going to give a "glue stick A to former B" type of instruction. I will, however, explain things that are out of the ordinary or troublesome. Be sure to study the plans well before beginning construction.

RUDDER

Begin by laying down one side of the rudder sheeting on the plans. It extends clear to the bottom of the fuselage for strength. The 1/8 square framework is glued in place after having the appropriate pieces drilled for the elevator nyrod. I used the Pylon brand Golden Rod with .030 cable size. The elevator platform is a piece of hard 1/8 balsa, with triangular stock used as a fillet for strength where it is glued to the top of the rudder. The small tailwheel wire can be sandwiched in the bottom of the rudder.

FUSELAGE

Before we begin construction here, let me remind you of the importance of weight, especially on this model. This model is somewhat sensitive to weight and power relationships. Adhere to the material sizes shown on the plans. Excess strength is both unneeded and unwanted.

Construct the fuselage from two matched pieces of 1/8 sheet for the sides. Add the longerones and uprights and also the 1/8 doublers at the nose. Join the two fuselage sides at the nose and tail with the firewall and rudder respectively. Use epoxy on the firewall. Install the rest of the formers and nose gear and main gear attachment points now. The main gear attachment is familiar if you've ever built a Falcon 56. It also makes the rather wide gear removable (for you V.W. owners).

Before covering the top and bottom of the fuselage, you should install the fuel tank and locate the blind nuts for your engine mount.

While on the subject of engines let me say that the O.S. 30 has proven to be the perfect power choice for the model. The Sullivan 6 ounce tank gives long flights to the three and one-half pound craft. If you plan on using a muffler, however, a .35 may be needed. I don't think anything smaller than a .29 should be used. Mine flew with a .25 but was hopelessly underpowered.

The bottom of the fuselage is covered with 1/8 balsa. The top, from the cockpit rearward, is 1/8 square stringers over formers. Forward of the cockpit is 3/32 planking, and a small block at the nose. The bottom, from the firewall to the radio area, is 1/2 inch sheet balsa. Make the radio hatches out of 1/16 plywood and secure them with small woodscrews into the hardwood strips underneath. Leave 3/8 inch of space between the two hatches for the aluminum bracket that connects the bottom of the rotor booms.

ELEVATOR

Elevator construction is normal except for the cut-out portion that allows clearance for the rubber bands and dowel. Remember to make the center section ribs 1/16 narrower on the top and bottom because of the planking. Other than that, just try to keep it light.

ROTOR BOOMS

The rotor booms are made out of 3/8 by 1/4 spruce with 1/4 square and by 1/8 by 1/4 balsa crosspieces. Simply build them right over the plans as you would a wing, remembering to make a right and left side. The Cox crankcase mounts should be shimmed up approximately 10 degrees before being epoxied between the 3/8 by 1/4 spruce strips, remembering again to make a left and right side. Don't try to be exact, because we will make the fine adjustments later.

Now cut the rotor boom mounting brackets out of 1/16 aluminum and drill the appropriate holes in them. They are mounted with wood screws, to the stubs on top of the fuselage and to the space between the radio hatches on the bottom. Assemble the landing gear on the fuselage and attach the elevator with rubber bands. Set the model on a flat surface and bend the gear legs until the model sits level. This can be determined by measuring to see if both ends of the elevator are the same height.

Next, place the rotor boom ends in their proper position on top of the fuselage and block them up until the tips are one and one-half inches higher than the attachment points on the fuselage. This will give 5 degrees of dihedral to each side. Now, with the booms blocked in their proper positions, cut the lower boom legs to the correct length and epoxy them to the boom tip and bolt them to the bottom bracket. Finally, cut and epoxy the balsawood crossbraces in position. This should give a set of booms that are true and very rigid.

ROTORS

The rotor blades are next, and should be made of medium 3/16 balsa. Cut 6 blanks and epoxy the hardwood leading edge, insert, and ply reinforcement to them, remembering to make 3 left hand and 3 right hand blades. Sand the blades to an approximate Clark Y (flat-bottom) airfoil. For a light finish, give the blades 2 or 3 coats of clear dope, followed by just enough color to cover the wood. I colored mine black. Do not use any of the plastic coverings on the blades as this adds considerable rotating weight and can cause the rotors to set up unwanted gyroscopic forces.

The rotor hubs are cut out of mild 3/32 sheet aluminum. Bolt the blades to the hubs, and before bending the hubs for pitch and coneing angles, bolt the complete rotor assemblies to the crankcases on the ends of the booms. The left side rotor turns clockwise when viewed from the top and the right rotor turns counterclockwise.

We are now going to adjust the rotor angles by wedging shims under different sides of the Cox crankcases until the rotors have the same backward and inward tilt. Again, with the model sitting on a flat surface, begin with the left rotor by measuring the height from the surface to the rotor tip as it is pointing straight forward. Now rotate the same blade 180 degrees and again measure its height off the flat surface. Do the same with the right rotor. The difference in height should be about 6 inches. This gives a rotor tilt equal to about 10 degrees. It doesn't have to be exact because the angles aren't critical here. What we *do* want is for the two rotors to be equal in their angles to each other. That is important. Shim the crankcases with washers or thin cardboard until the rotors match.

The same procedure is used to check the inward slope of the rotors, except the difference in height is measured with the blades pointing directly at the fuselage and 180 degrees or directly away. A 5 degree angle will give 3 inches difference in height. Time spent here will help to insure that your rotors will produce equal lift when flying, and thus a stable aircraft.

The rotors can now have their pitch and coneing angles bent in. This is done by bending the aluminum hubs with pliers. A simple jig may be made out of an 18 inch 2 by 4, with a Cox crankcase on one end, and a plywood plate with a 3 degree angle on the other end, fitting in a slot cut in the board. Adjust the blades of the rotors until they all have a minus 3 degree pitch angle (trailing edge higher than leading edge).

Now put the rotors back on the crankcases to bend in the coneing angle. This can be done by sight. Each rotor has a 5 degree coneing angle. Therefore, when they are bent properly, the blades should be level to each other when the tips are closest to one another . . . while pointing directly at the fuselage. Bend the hubs by hand until all blades are parallel to each other and the same height, when 90 degrees to the

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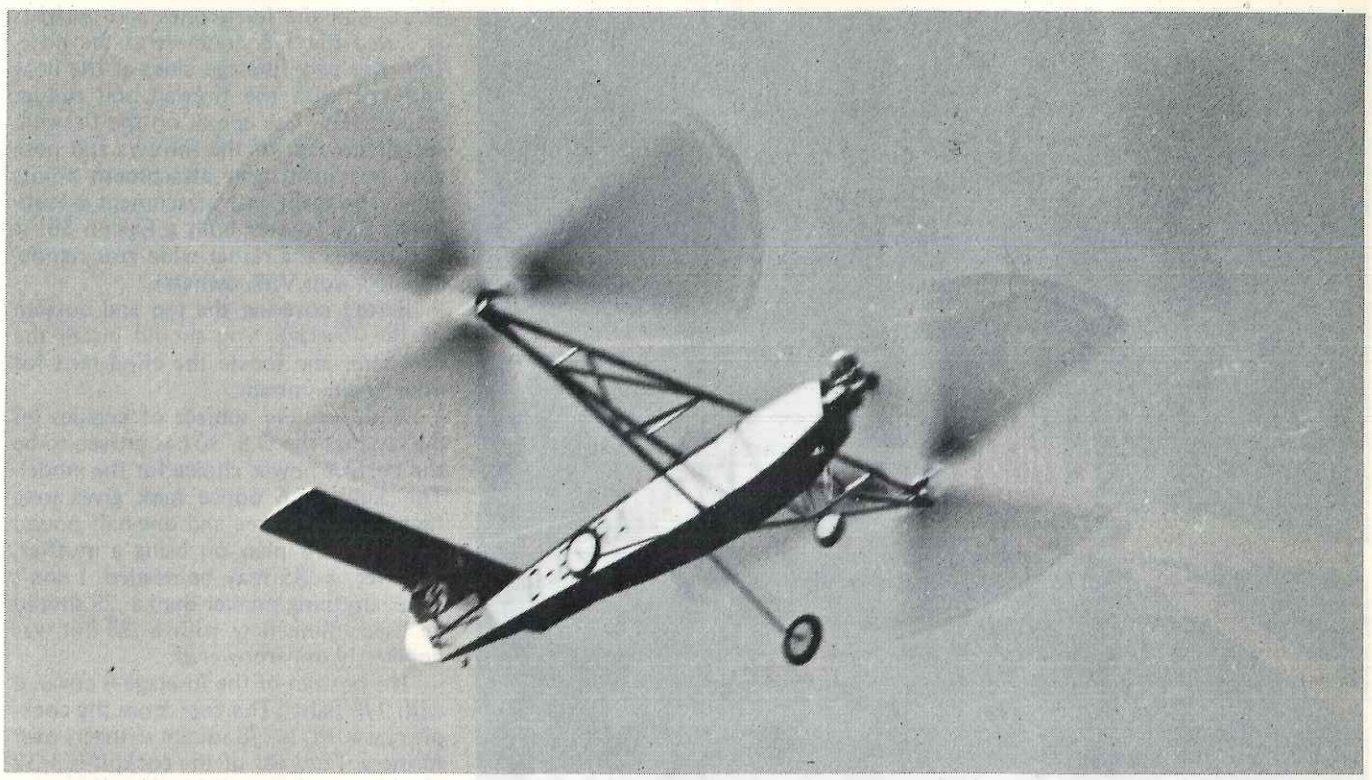

The FA 61 makes a slow pass overhead for the photographer. With full back stick, the ship will mush along at about 10 mph. Ship will even fly when out of trim, but looks strange.

fuselage. Taking your time and doing it correctly will guarantee success. The rotors can now be balanced by epoxying slivers of solder to the tips of the light blades.

FINISHING

Except for the booms and rotors, the model is finished entirely with Super Monokote. The booms were sealed with clear Aero-Gloss and then sprayed silver. The fuselage, on top, was covered with blue Monokote from forward of the cockpit to the tail. Except for the red band on the tail, the rest of the fuselage and elevator are covered with aluminum Monokote. The white disc and Swastika on the rudder are trim Monokote, as are the black letters on the fuselage. The red band and white disc are 2-1/2 inches wide. The letters are 2 inches tall and 1-1/8 inches wide.

Assemble the complete aircraft and install the radio, positioning it so that the craft balances about a 1/2 inch forward of the rotor center-line. The rudder should have about 1 inch of the total movement and the elevator about 3/4 inch total. My model required about 3 degrees of down and 3 degrees of right thrust. This can be added by washers, or by filing the mount. You may have to add or subtract from yours, so make it adjustable. I lube the .049 crankcases with a drop of STP every flying session.

FLYING

The model is now ready to fly, and you should have no problems if you've followed directions. I recommend using a 9x6 propeller. The higher pitched propellers seem to give the desired thrust easier than the low-pitch propellers. Start the engine and adjust the needle valve to give a slightly rich top end. A super-low idle is not required because the model will descend at anything less than half power. Make all takeoffs and landings directly into the wind to insure that both rotors reach flying speed at the same time. Taxi downwind, turn around, and head the ship directly into the wind. Slowly advance the throttle and taxi until the rotors begin to turn quite rapidly . . . it won't take long. Now, open the throttle all the way and feed in some up. The model should rise off the ground and climb away smoothly. If one rotor seems to lift more than the other, and the model crabs slightly, reduce the amount of negative pitch in the weak rotor blades until the model flies on an even keel. Mine has flown so far out of trim that it appeared to be flying in a 10 M.P.H. crosswind all the time. Yet it was still manageable.

You will be surprised at the stability of this strange craft. It banks as if it has ailerons, yet returns to level flight as soon as the rudder is neutralized. It will fly rock-steady hands off. It can be landed simply by reducing power and steering to the desired location, descending near vertically. It will fly along at a near 45 degree angle of attack at 10 M.P.H. It doesn't have the power to stunt, but it can make a 360 degree turn in almost its own length, while descending, and with practice you will be able to land it on the proverbial dime.

Now a word of caution. You will want to make all landings under power. If the engine quits, the model will autorotate down, however, forward speed is nil and it descends fairly rapidly. No damage will result unless, of course, the model lands on somebody or something. In this respect, it is very much like a helicopter and should be handled with respect when flown over and around crowds.

I hope that you have as much fun with your autogyro as I have had with mine. My dad and I have quite a time chasing each other through the sky with our two machines. They never cease to amaze new onlookers as to their flying ability.

I would appreciate hearing from others who have experimented with autogyros and would like pictures of this machine and other designs built by modelers. I will try to answer all questions. Write to me at 535 B St., Taft, Calif. 93268, or in care of MODEL BUILDER.

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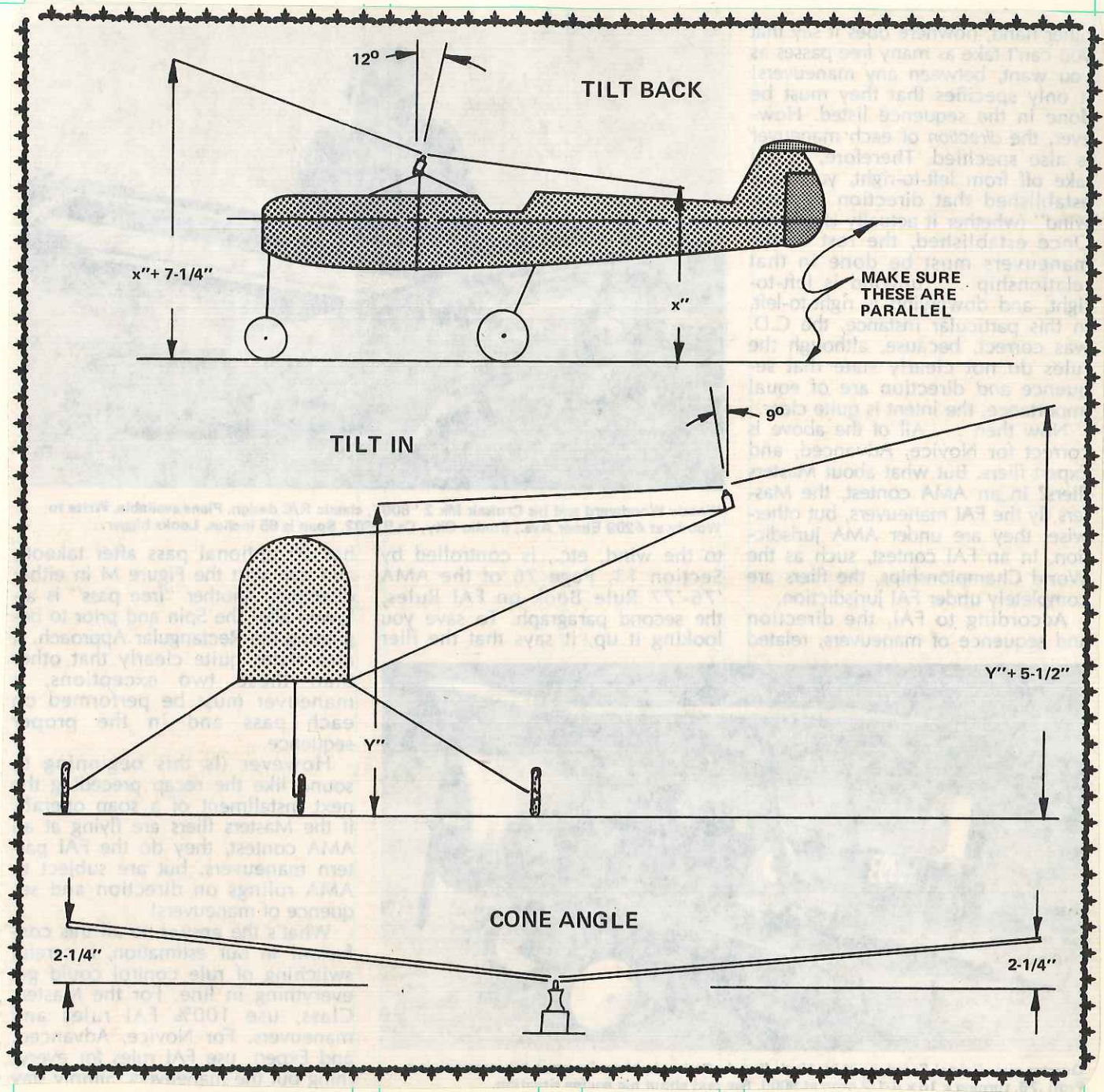

F.A.-61 MODIFICATIONS AND RECOMMENDATIONS by Skip Ruff

The following is a list of changes and recommendations for the FA-61 autogyro. The latest model I built used the specifications listed here, and the model "flew off the board", so I highly recommend their use. No structural changes are needed.

First, use the building sequence and especially the method of rotor adjustment, except as noted below.

Adjust the cone angle to give 2-1/4 inches of dihedral of each rotor blade tip. The pitch remains at –3 degrees. Now mount the rotors on the booms and shim the Cox cases to give a difference in height at the tips of the blades of 7-1/4 inches in the fore-aft position and 5-1/4 inches in the left-right position. Use the same method of adjustment as outlined in the article, making sure that the centerline of the fuselage is parallel to the surface you're measuring from. Block up the wheels if necessary. The center of gravity is 1/4 inch behind that shown on the plans with the fuel tank empty. I use an O.S. .35 turning a Top-Flite 9 x 6 wood prop. The engine has 5 degrees down and 4 degrees right thrust.

If your model has a tipping tendency when on the ground, bend the main gear forward until there is very little weight on the nose wheel. Do all your test flying in dead-calm air, if possible, and make all takeoffs and landings straight into the wind. Once the rotors are set properly, don't be afraid to fiddle with the C.G., thrustline, or elevator incidence, as you would a conventional model when making final trim adjustments. Most importantly, keep it light. Mine weighs 3 lbs., 6 ozs., ready to fly. If you have any further questions write to me at 128 Lexington Ave., Taft, CA 93268.