PHOTOS BY AUTHOR

SYNCHROGYRO

By GEORGES CHAULET . . . A genuine autogyro rather than an airplane with a full wing and a rotating ceiling fan on top that merely adds to the drag, this one's easy to build and fly, and easy on the wallet.

• *(Introduction: This article, because of its uniqueness, has been published almost entirely in its original form. Mr. Chaulet's English is quite clear, and we have only added interpretations where we thought it might be necessary. wcn)*

This new kind of flying machine has been presented briefly in **Model Builder** (Oct. '78). The first three Synchrogyros were more or less experimentals. This one is much more evolved, with clean lines, and easy to build. It's cheap, too. Just a simple .35 engine, not Schneurle, and a 2-channel radio.

As monorotor gyros have a tendency to instability, I use two rotors turning in opposite directions, and synchronized through gears. These gears are stock Meccano items, with a 45° angle between the axis. Less angle would be better . . . for instance, 30° should fit OK . . . but such gears were not currently available. Another possibility is to use parallel gears about 3/16 inch thick, with filed teeth to become conic.

The 5/32-inch steel shafts are fitted inside a dural block, with flat ball bearings. The shafts could be mounted on standard ball bearings, but this is not quite necessary, because the efforts *(loads)* on the whole system are extremely reduced. The gears don't have to stand power from a motor, like in helicopters. Here, they just have to keep both rotors at the same rpm, the drive coming from the relative airflow. (Remember that on an autogyro, the rotor is separated from the engine. It is freely windmilling.)

You will notice that the right rotor is turning clockwise, while the left one is anti *(counterclockwise)*. The purpose is that in case a blade strikes the ground, the tip has a tendency to go back, thus reducing the shock.

The rotors are set at a 90° angle. When one rotor is parallel to the fuselage, the other is exactly perpendicular. This trimming is made with a small L-shaped fitting, screwed upon the arms. This 'L' holds a long screw fitted inside a wheel collar which is settled *(mounted)* to the shaft. Once the rotors are put at a 90° angle, the 'L' is screwed firmly to the arms (see fig. 1).

The gears, too, must be strongly fixed to the shafts with screws and Loctite, apart *(in addition to)* using filed surfaces on the shaft (see fig. 2).

ROTORS

Compared with the ones used on a helicopter, the blades will appear very broad. Innumerable tests made during the seven last years showed that narrow blades give but a poor lift. The airfoil is of lenticular shape, that is, a sector of a circle, with sharp edges. The model can fly with the flat-bottom type (marked A on the plan), but a slightly curved foil *(airfoil B)* gives more lift. This airfoil is the same as the one used on the Antoinette aeroplane. A good old one!

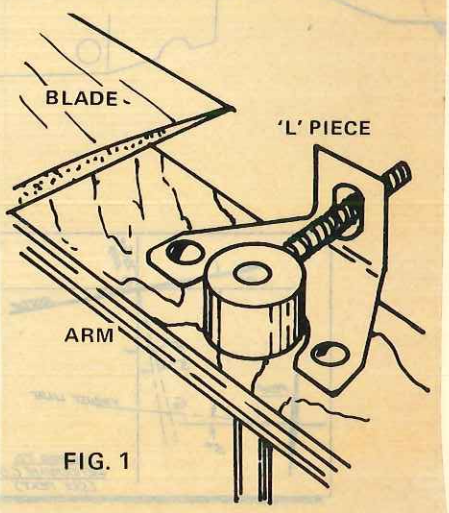

FIG. 1

For the blades, select a very good medium grade balsa sheet 7/32 inch thick. Take care that every blade has the same weight, to avoid vibration. This problem is well-known by helicopterists.

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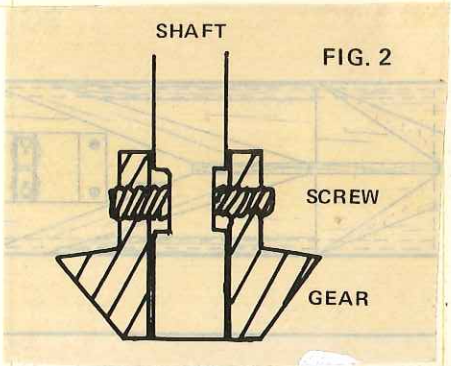


FIG. 2

Shape is given with a razor plane, then sanded. Small rectangular plywood pieces (3/64-inch thick) are glued to the blades to give more strength on the spots where the blades are secured with *wing nuts* (see fig. 3).

Covering can be made with dope coats and cellulose paint, or with thermo sheets *(heat-shrink plastic)*. That is according to the way you prefer.


FIG. 3

The rotor central arms are made of plywood 3/16 inch thick. The tips are slightly cut in such a way that the blades are set at a small negative angle: 2°. So, the rotor is somewhat helicoidal, which helps to build up the revolutions. Under the arms, shrouds are cut from 3/64-inch dural sheet, then shaped and screwed to the plywood. In the middle of the arm, the collar holds the long screw which is fitted inside the 'L' plate, of which we have already spoken.

It is very important to check that the rotor is perpendicular to its shaft. Don't forget that each blade must pass over the head of the neighboring rotor!

A drop of oil on the gears, and the rotors must turn easily.

Now about the rotor positioning. You will see that the holding *(mounting)* system is perpendicular to the top of the cabin. This top is set at 10° incidence, so the rotors have the same 10° of incidence. Don't hurry to settle *(mount)* the rotors on the fuselage. You'll first have to do some trim with the center of gravity. We'll see this later on.

FUSELAGE

I have probably drawn one thousand sketches before coming to this shape (I must own [*admit*] that I design autogyros EVERY day, between two typewriting sessions. My job is writing books for children.). The fuselage incorporates only flat surfaces, to make the building easier. It is all made with 1/8-inch balsa sheet, with inside 5/32 sq. stringer. There is just one former which holds the undercarriage.

A classic balsa block is in the nose, and another one forms the top of the cabin. Three hardwood bars are inserted in this block, to hold the plastic windscreen. It covers only the front part of the cabin. The sides are left opened, to permit access to the tank and the electronic items.

TAILPLANE

It is cut from light 3/32 balsa. Nothing particular to say. There is just rudder control, no elevator.

CARRIAGE

The 3/32 steel legs may seem somewhat weak. In fact, the Synchrogyro lands very gently (if there is no piloting mistake, of course), and the carriage has no hard efforts *(loads)* to stand. So, it may be kept very light. The wheel coverings are optional. If you plan to take off from grass, they are not adequate. But taking off from a concrete runway has been done.

MOTOR

A current .35 or .40 is quite good, driving a low pitch 11-inch prop.

It is mounted 2° right and 5° down on a plastic holder, with elastic rubber blocks. If there's a tendency to stall, the motor may have a downthrust to -10°. This holder is not shown on the plan, because each modeler has his own way to put a motor in the nose of a model. Just behind the balsa block is the battery, then a 10 cubic inch *(6 oz.)* tank is positioned at the center of gravity. Then the receiver and the two servos.

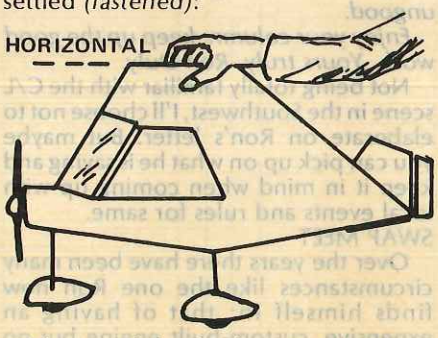
The model is covered with modelspan paper, then three coats of dope, and three coats of cellulose yellow paint. But you may Monokote or Solarise. . .

C.G. LOCATION

This is a problem which brought me innumerable headaches, during years! At last I went to a solution which may be used for every kind of autogyro. The center of gravity of the model is spotted at a point which is the intersection of two lines. One is the axis of the engine, i.e. the thrust line. The other is the OG line as shown on the sketch. This line is set at an angle which is half of the incidence. For instance, if we have 10° incidence, as on the Synchrogyro, the over angle is 5°.

Correct positioning of the CG is done by moving the battery fore or aft.

But before settling *(mounting)* the rotors holder on the top of the cabin, do this test: when everything in the fuselage is in place, hold the fuselage by the point where the holder *(mount)* is to be settled *(fastened)*:



The top of the fuselage must be horizontal. This gives you a first idea of the repartition *(distribution)* of the weight. You will see immediately if the tail is too light or heavy, and how to correct by moving the battery. If it appears that this will not be sufficient to obtain a horizontal attitude of the fuselage, then you may modify the position of the rotors. If the motor is too heavy, for instance, bring the holder a half an inch or so forward. With a low tailplane *(tail heavy condition)*, bring the holder aft.

Once the model is correctly centered *(balanced)*, it will fly with good stability, without the help of an elevator. This reminds me of the word of Henry Ford: "What you don't put into a car won't disturb it." Or something like that. Or said: the simplest, the best.

TESTS

These are to be made, of course, in calm air, or with a very gentle breeze. If there is no wind at all, just run a few yards until the rotors build up revs. If you have some wind, the rotors will start running without moving at all, and you can throw the model like an airplane. The Synchrogyro flies straight and up at a 10°/15° slope, according to the power of the engine. The stick does not require large movements for directional control, the rudder being quite effective (even with this short fuselage). Facing a moderate wind, with the engine at half power, the model will hover like a helicopter.

When you want to land, you put the motor at idle, and the chopper comes slowly down. You don't meet the problems which happen with a plane, such as looking for a good position according to the runway or fighting with the elevator to have the plane at a good attitude for landing. A gyro is much easier to pilot than a plane. And when you run out of gas, all you have to do is to switch off the transmitter, light a cigarette and go quietly to pick up your chopper which has slowly landed. •

Yes, it do fly, and quite easily.