To launch hold slightly nose high, give preliminary spin to rotor, let pick up speed, then release.

LITTLE JUAN

Gas, rubber, or tow-line, gyros are fun. After six rubber-powered and ten gas jobs, this nifty .049 ship was perfected. Described are unusual characteristics and techniques for flying and adjusting. Anyone for radio?

By W. C. HANNAN

The author has long been interested in creating an ultra-light personal flying machine (He means man-carrying.—Ed.) which could safely fly at low speeds, and still retain good high-speed characteristics. Helicopters were ruled out because of their complexity. Conventional airplanes were considered unsuitable because of their poor low-speed characteristics. Two interesting concepts remained: One was aircraft of the "Flying Flea" type, which are able to operate in the super-stalled realm of flight, but which suffer from certain other drawbacks. The remaining type was the autogyro, which was pioneered and developed by Juan de la Cierva, of Spain, in whose honor "Little Juan" was named.

To me, the autogyro seemed to be the most logical approach to filling my requirements. Therefore, I have concentrated on the development of an ultra-light version. Originally, my intention was to build a radio-controlled model to explore the overall design concept. However, by the time that a model was produced which was stable enough to entrust with expensive RC gear, remote controls no longer seemed necessary. Furthermore, the less crowded conditions in the free flight area of our local model flying field enabled a great many more flights to be made during any given visit to the field. Since a large number of experiments were required to learn the characteristics of autogyros, many test flights were required before a satisfactory configuration was developed.

Models ranging from a 1/20th-size, indoor rubber (*Continued on page* 54)

Last month's cover girl Carrie Caswell and three variations of Little Juan.

Little Juan

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job, to a 1/5th-size .099-powered gas model were built during a period of about three years. A total of six rubber- and ten gas-powered models were constructed and flown to evaluate the various design features, and to learn as much as possible about autogyros, prior to committing myself to a full-size project. Many friends criticized me for proceeding so rapidly on the models and yet so slowly on the full-sized aircraft. My stock answer to them was: "Why hazard my neck on unexpected problems, which can be discovered and solved without risk in a model!" Besides, it's a lot of fun to fly the little ones!

At the present time, my full-scale mock-up has been completed, the actual flying version is underway, and some of the recent refinements have been incorporated in the model drawing. The "Little Juan" model is quite conventional in its construction, and should present no unusual problems, however some clarification of details, especially those peculiar to autogyros, may be in order.

Rotor Spider: Bend the three 1/16" diameter music-wire rotor spider arms, as shown on the drawing. Position the arms as indicated, then bind and solder them together. The hub is made by drilling a 3/32" diameter hole in the center of the thin brass disc. Insert a 3/32" O.D. brass tube into this hole, being careful to achieve correct alignment. Now solder the tube and the spider arm assembly to the brass disc which will complete the unit.

Rotor Blades: Glue 1/16" sq. spruce strips to the leading edges of the 3/32" balsa blades. Sand the blades to shape, as indicated by the blade cross-section drawing. Next, glue the 1/16" sheet balsa rectangles on the underside of each rotor blade. Be sure that the grain of the 1/16" sheet is running across the grain of the rotor blade. Carefully position and glue a rotor blade to each arm of the spider. Finish the rotor blades with two coats of sealer, two coats of dope, and finally a coat of wax. Final adjustments of the rotor can be made during testing.

Rotor Axle: The rotor axle assembly is constructed of 1/16" diameter music wire and brass tubing. It can be adjusted to tilt to the right or left by means of the spring-loaded screw on the pylon. The thrust washers are of the ball-bearing variety usually used on rubber-powered model prop shafts.

Pylon: The pylon consists of a piece of 1/16" plywood sandwiched between two 1/16" sheets of balsa. A 3/32" O.D. brass tube is secured to the top of the pylon with epoxy and a strip of silron cloth. This tube serves as the tilt axis pivot for the rotor axle assembly.

Fuselage: The fuselage is constructed in the normal "body sides and bulkheads" fashion. Note the engine downthrust and sidethrust angles, which should be built in. The engine is retained with blind mounting nuts, which are installed on the rear of the firewall prior to adding the top sheeting. The turtleback and headrest are carved from soft balsa blocks, and are hollowed out for lightness.

Landing Gear: Bend the main landing gear legs from 1/16" diameter music wire, and secure to F-2 with strong thread and epoxy. The tailwheel assembly is secured to F-5 in the same manner. The sheet balsa landing gear fairings are strictly for looks, and therefore are optional.

Fin and Rudder: The fin and rudder are made from 1/16" sheet balsa. Soft wire hinges are used to permit easy adjustment of the rudder.

Stabilizer: The stabilizer is constructed in conventional fashion. The leading edge is covered with 1/32" sheet balsa, while the remainder may be covered with Silkspan. The tips of the stabilizer are made from ⅛" sheet balsa, and are inclined at an angle of 45 degrees. The left-hand member has a rudder which functions in keeping the nose of the model up, during a right turn.

Finishing: Our model has only a minimal finish, inasmuch as it was intended to be a flying test-bed, rather than a show piece. There is no reason, however, why a really "first class" paint job should not be applied, as long as the total weight of the finished model (with engine) does not exceed ten ounces.

Exhaust Restrictor: Our model is equipped with an exhaust restrictor device, to permit easy adjustment of the engine's power output. In use, the restrictor may be rotated to vary the power, then locked in place by tightening the screw.

Preliminary Flight Adjustments: Although the alignment and balance of the rotor assembly are not super-critical, they should be within reasonable limits. Adjust each rotor blade to a slight negative angle of incidence (trailing edges of blades should be approximately 1/16" above the leading edges). Blades may be adjusted by twisting each blade mounting wire. Adjust the rotor tilt to about 4 degrees left (as viewed from the rear of the autogyro).

Adjust the exhaust restrictor ring so that all except approximately ⅛" of the exhaust ports are covered. Mount a 6" diameter x 3" pitch plastic prop on the engine, for the initial flights. (As a matter of interest, the equivalent scale diameter prop would be 7½".)

Flying: Select a calm day. Fill the gas tank about 1/3 full, start the engine, and adjust the needle valve to obtain smooth running. Hold the model in a slightly nose-high attitude, and give the rotor a preliminary spin. Walk toward the breeze if any exists. The rotor should pick up speed rapidly, and the autogyro should exhibit definite lift. Note: If excessive vibration appears, recheck the rotor alignment and balance. If all seems well, release the model gently (do not throw) and observe the flight.

TROUBLE SHOOTING:

The problems encountered in adjusting a model autogyro for successful flight can usually be classified within two main categories: I) Those problems common to all conventional aircraft flying at similar airspeeds; II) Those problems peculiar to the autogyro.

TYPE I PROBLEMS

Problem A: Reduced rate of climb during a downwind turn, which may cause the aircraft to settle to the ground.
Solutions: 1) Reduce rate of turn, 2) Increase rate of climb of aircraft by increasing power slightly, 3) Fly only on a calm day.

Problem B: Spiral instability, as exemplified by a continually increasing velocity, and rapid loss of altitude.
Solutions: 1) With the forces as set up in "LITTLE JUAN," fly the aircraft in a wide diameter left circle; 2) Increase coning angle (this angle corresponds roughly to dihedral angle), by bending each rotor blade slightly upward; 3) Install pendulum rudder or elevator control; 4) Invent something of your own!

Problem C: Looping and various other aerobatics.
Solutions: 1) Reduce power (easily done, by rotating the exhaust restrictor ring); 2) Bend rotor mast forward slightly.

TYPE II PROBLEMS

Problem D: Autogyro sinks to ground after launch.
Solutions: (If model flies at high speed): 1) Reduce angle of incidence of each rotor blade; 2) Reduce rotor bearing friction; 3) Be sure that rotor blades are smooth; 4) Reduce engine downthrust; 5) Bend rotor mast back, to increase rotor disc angle of incidence.

If model flies at low speed): 1) Increase angle of incidence of each rotor blade; 2) Increase engine power slightly; 3) Increase engine downthrust; 4) Decrease rotor disc angle of incidence. (See Problem "A" also.)

Problem E: Autogyro flies well, under power, but spirals down with power off.
Solutions: 1) Adjust rotor tilt, to correct for turn, and use rudder to compensate during power-on flight; 2) Move C.G. forward.

The ideal flight pattern is for the model to climb to a moderate altitude in a series of left-hand circles until the fuel is exhausted. "Little Juan" does not glide in the conventional sense, but should settle to earth in a stable autorotating manner, at about the same rate of descent as a dethermalized gas model.

Oh yes, the question has been raised as to whether "Little Juan" is, in fact, a scale model. Well, we'll let you know, right after the real one is completed!

Full-size plans including an instruction sheet, are available from:
W. C. Hannan, Graphics; 6245 Craner, North Hollywood, Calif. 91606. Price: $1 postpaid.