Doug Joyce and his 1/2A Li' Lightning at the 1975 Nationals in Lake Charles.

Li' Lightning

By DOUG JOYCE

This is an "it went thattaway" design that is a top competition machine. It has been built in many sizes, and is well tested and refined.

Li' Lightning was designed primarily as a simple-to-build plane to introduce modelers to a fully-developed canard arrangement. This is not an experimental, one-of-a-kind canard, but a fully-developed plane capable of competition, with innovations in aerodynamics, fuel system, and V.I.T. The design is simple and lightweight, the original being constructed in about one week and weighing in at 7 ounces, ready to fly.

Why is the Li' Lightning different from other canards? First, it is aerodynamically refined, particularly the matching of the two wings with respect to airfoil and aspect ratio. The front wing has greater camber and a higher aspect ratio than the main wing, and incorporates an efficient turbulator to give good performance in the subcritical Reynolds number range in which it operates. The front wing will usually limit the glide, since it is smaller and more heavily loaded. The rear wing, being four times as large as the front wing, has the greater influence on the climb, and was designed accordingly. To minimize drag during the climb, the airfoil is thinner and has no undercamber.

Secondly, Li' Lightning was designed for competition, not as an experiment like most of my previously published designs. This plane was not intended to be different, but rather, to win meets.

The third and most important feature of Li' Lightning is its performance edge. It climbs like a plane with 290 square inches, and glides like one with 380 square inches. The unique zig-zag turbulator on the front wing was developed from the triangular turbulator design reported in Frank Pearce's article in Zaic's book (1959-60). The performance improvement provided by this turbulator is remarkable, as it not only improves the glide performance, but also greatly aids consistency of the glide trim. Once set, it is not necessary to retrim the glide, except to open or close the turn, depending on the field and the wind conditions. In addition to the practicality of this turbulator, it is also easily installed with the aid of a simple template.

The superiority of the pen-bladder tank is unquestionable with regard to the way the engine runs. However, its use does present some unpleasant drawbacks; such as the squirt in the eye and the cramped fingers when filling the tank and getting the engine started. Also, the mess the flood-off makes of the plane as it dumps, not to mention the flooded engine for the next start, are other problems of this design.

The design of the Li' Lightning canard provides a simple solution to one of these problems. The solution is to dump the fuel overboard, rather than into the engine. This operation is just as positive as a flood-off, and the fuel is thrown clear of the plane. Also, the cut-off is much cleaner than that obtained with a pinch-off.

A conventional flood-off timer is used in this design. A second line from the tank is routed through the timer, but instead of the line going to the Venturi as per usual, it is routed downward. When the timer is actuated, the pen bladder is emptied very quickly and the engine stops. This innovation was a necessity for Li' Lightning since it was being ruined by the dousing of raw fuel on the wing and wing mounts during each flight.

WINGS

The construction of the wings has a new twist. Namely, the main full-depth spar is built up first. In this manner, each joint may be fitted exactly with the overlapping tapered splices, thereby making the usual dihedral joint doublers unnecessary. Most of the usual stress concentrations are also eliminated, and the amount of dihedral is accurate, which is most important for a canard.

The panels of the wings are built one at a time, using Titebond in the usual manner. A simple way of making the ribs is to strip the 1/16 inch C-grained sheet to the depth of the wing spar (i.e., 1/2 inch). The rib can then be accurately cut to length and fitted, and then cut to shape.

A simple trick to try when constructing the wing is to reglue each joint with Hot Stuff. This will harden the balsa around the joint, thereby increasing its strength and also waterproofing the Titebond.

RUDDER

Build the rudders of light balsa. Assemble the outlines using Hot Stuff. Add the diagonal rib unshaped, but carefully cut to length, starting at the top. When shaping the rudders, remember that they are flat on one side and must be shaped both right and left-handed. Before shaping, Hot Stuff all joints on the plan side. Shape the airfoil with a large sanding block, giving the rudder a slight taper toward the tip. Cover and dope the airfoil, and glue it to the wing upon completion. Set the rudder with the leading edge outward at 1°, with the flat side to the outside. The sub-rudders should be straight.

FRONT WING

For the front wing, select very light C-grain wood (less than 2-1/2 ounces for a 3/8 x 3 x 36 inch piece). Trim the wood to the proper width, squaring both edges. Glue on the hard balsa leading edge. Carve the airfoil, using a template for the leading 7/8 inch. Now remove the two cut-out sections and add the ribs. Cut the wing at the dihedral break, and sand the joint to a 9° angle.

Apply three coats of Titebond to the joint. Make certain that the dihedral is as shown on the plan, as it affects the directional stability of the plane. The turbulator is then added after the covering and doping are completed.

For the turbulator, construct a template from a 15 inch piece of 1/8 x 1/4 hard balsa. Mark the balsa strip in 1/4 inch increments with a ball point pen. Pin the template to the upper surface of the front wing so that it is 5/32 of an inch back from the leading edge. Place a diagonal pattern of pins on the wing. Remove the template and repeat the procedure on the other wing panel. Zig-zag heavy button thread, starting at the tip. Apply four coats of dope to the thread immediately. Remove the pins just before the final coat dries.

FUSELAGE

Construction of the fuselage begins with the center ply. The filler pieces of 3/32 sheet for the power fin slot will be added after the 1/8 inch sheet sides are epoxied to the center ply.

The wing platforms can be made using either two laminates of 1/32 plywood or 1/16 plywood joined at the center. The laminate is better, and can easily be made with a pine form. However, either choice should be acceptable.

The form must be the exact size of the platform, i.e., 3 x 1-1/2. This enables the laminates, which are also this same size, to be centered as the clamps are tightened.

After drying overnight, cut the laminates into three sections and glue them to the fuselage. Be sure to reglue the platforms with Hot Stuff.

ADJUSTING PROCEDURES

The climb pattern and launch of the Li' Lightning should be very steep, with just a slight turn to give a good transition. The glide circle can be to the operator's liking, from very tight to loose, since the plane's performance is not sensitive to the glide speed. The climb angle can be adjusted with incidence, and the climb pattern with the power fin. Adjust the glide trim with ballast, and the turn with front wing tilt. No warp in either wing is necessary.

The climbing pattern of Li' Lightning, however, is sensitive to incidence. Therefore, use IBM cards for rough adjustment and paper for the final trim. Glue the shims on the seat of the rear wing. After final adjustments are made, replace the paper shims with plywood.

The climb turn can be adjusted using the power fin. The principal of the power fin is that fin area aft of the center of gravity and in the lower part of the slipstream from the propeller will produce a turn proportional to the area of the fin. Li' Lightning will turn in a direction opposite to that of the slipstream.

Increasing the fin area produces a left turn, while decreasing the area results in a right turn. A height change of 2 inches will alter the turn from one extreme to another, while 1/16 will result in only a slightly perceptible turn.

To change the glide circle, tilt the front wing into the direction of the turn. This adjustment is very sensitive, and should be done with paper shims glued to the wing platform.

The final adjustment necessary is usually a small amount of ballast to achieve the desired glide speed. This adjustment will vary, depending on the tightness of the glide turn used.

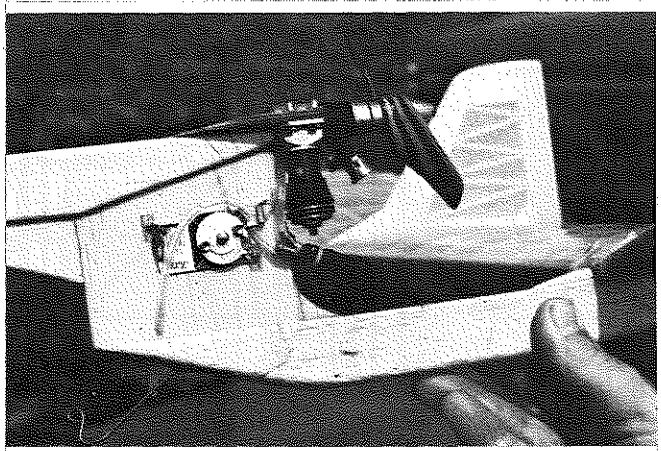
FLYING PROCEDURES

Li' Lightning must be aligned and balanced very carefully, making sure the wing keys are tight. First, hand glide the plane, with the auto wing disengaged to obtain a straight, flat glide. With no tilt in the wings, correct any turn with a trim tab cut into one of the rudders. Next, tilt the front wing to the right about a 1/4 inch at the tip. The plane is now ready for its first flight.

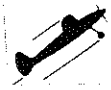
The first power run should be very short (about 2 seconds), since this canard is not very forgiving until adjusted. Use about 5 to 7 cc in the pen bladder tank, and allow about a 1-second delay for the engine to quit after the dump is triggered.

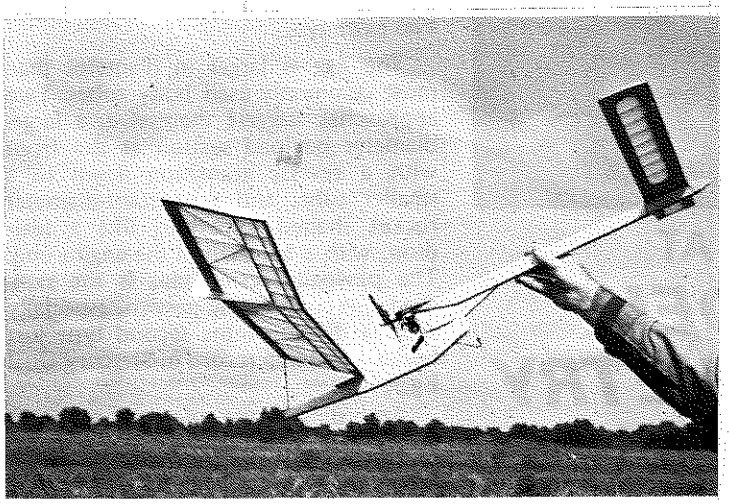
Increase the engine run length only when the climb is straight. When no perceptible turn is obtained and no looping tendencies exist, the engine run can be increased by 1 or 2 seconds. Short fuses should be used during these flights, and any deficiencies in the glide must be corrected. When the full-length engine run is finally obtained, reduce the power fin size in 1/16 increments until the transition is obtained, which is usually at about 1/8.

Normally, the best flight pattern for the Li' Lightning is right-right, but every combination has been used. This depends on the plane itself. If your plane will not behave in the right-right pattern, try another. In these instances, let the plane be your guide, and follow its natural tendencies. ●



To cut down on messiness, fuel is dumped for cut-off, rather than flooding. Hand carved prop is best, but it lasts forever.





That's right, it's the main wing that pops up for the DT. The twin .010 Tee Dee version took first in Cargo.

MODEL BUILDER

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