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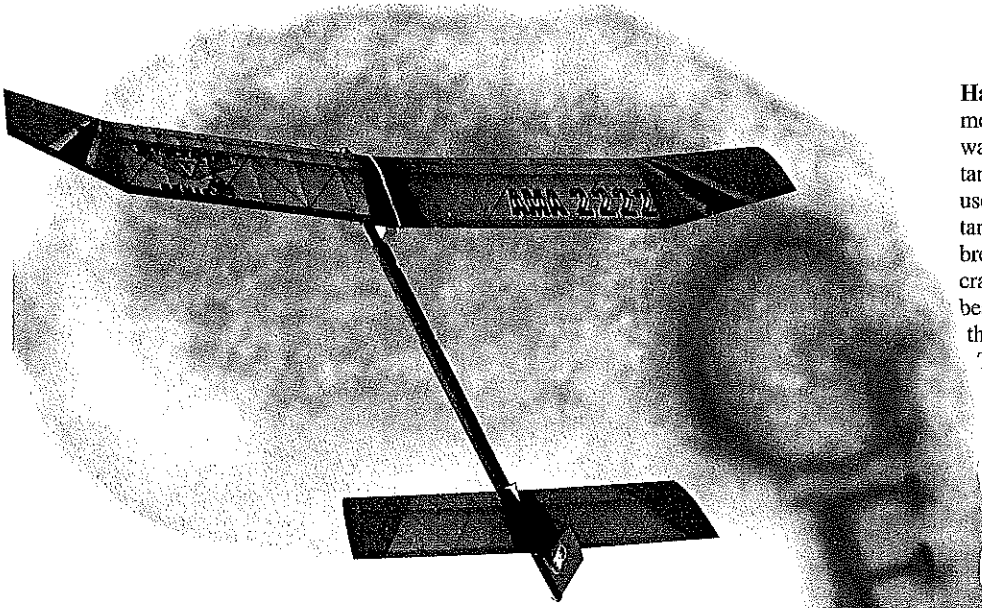
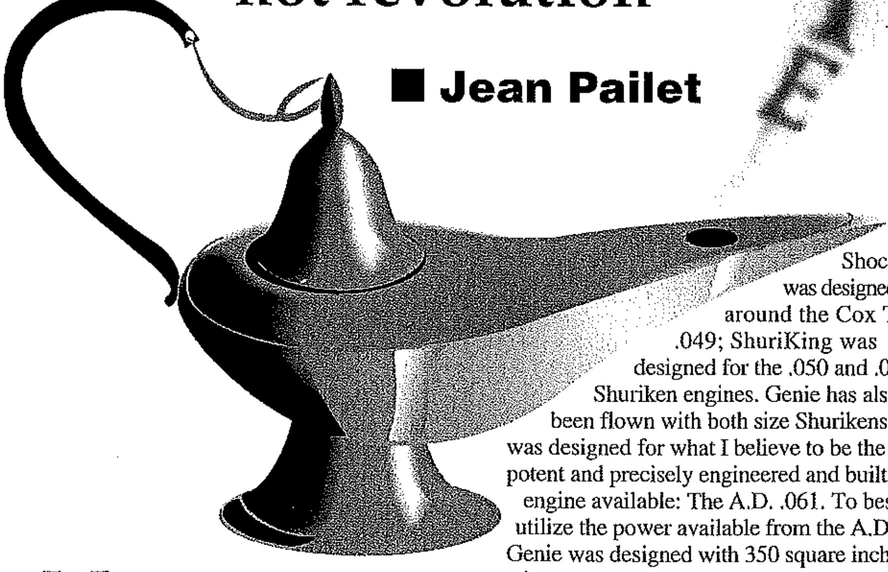


Fixed-geometry model for ½A-F1J has a winning pedigree: "Evolution, not revolution"

■ Jean Pailet



Most competitive Free Flight models are the result of evolution, not revolution; Genie is no exception.

Genie was designed in the fall of 1995 and evolved from the ShuriKing (1994 NFFS Model of the Year; first place in FlJ and ½A and second in A at the 1992 Westover Nats); and the ShocKing (first in ½A at the 1988 and 1989 Eastern States Championships; third at the 1988 Lawrenceville Nats). Genie placed first in F1J at the 1996 Muncie Nats, first in ½A at the 1995 Florida King Orange, and first in F1J at the 1996 SkyScrapers International Challenge.

ShocKing was designed around the Cox TD .049; ShuriKing was designed for the .050 and .061 Shuriken engines. Genie has also been flown with both size Shurikens but was designed for what I believe to be the most potent and precisely engineered and built F1J engine available: The A.D. .061. To best utilize the power available from the A.D., Genie was designed with 350 square inches of wing area. To accommodate other power plants, the plans also show 335- and 320-square-inch versions.

My basic design philosophy has always been two-pronged: 1) Bigger is better, and 2) KISS (Keep It Simple, Stupid). I prefer to emphasize glide performance over power performance, and a larger model is almost always more docile and easier to trim. And the less complex the model, the less that can go wrong, especially in terms of automated flight systems. Therefore, these models use no autosurfaces.

Hardware: Until about a year ago, these models didn't use pressure fuel systems; that was the primary reason for the Cox red plastic tankmounts. However, even if you choose to use pressure (as I do now), the Cox tankmounts offer the advantage of a breakaway type engine mount. Under most crash circumstances the tankmount's engine bearers will shear off, saving the front end of the fuselage from more serious damage. They also enable engine switching with great ease; just remove four screws and change the entire engine/mount/tank assembly.

However, because of doubts about the continued availability of the Cox tankmounts, and for the more conventionally inclined, the plans show a Dave Brown #0405 engine mount, which I am also using on some of my models.

(Both mounts are really designed for the TD engines, and require some reworking to adapt them to the ADs and Shurikens. The Cox tankmount also requires balsa fairings to blend its square rear face into the round fuselage tube cross-section.)

I use Texas Timers Max I (for F1J) and Max III (for ½A). Both are dual-function (engine cutoff and DT) timers and I couple them with the Texas remote fuel pinch-off mechanism. I prefer to install a larger-than-stock disc on my timers to provide more precise engine-run settings; however, that is strictly a personal choice. The timers are excellent just as they come, and most fliers use them that way.

Commercially available propellers for ½A and F1J are a different story; in my opinion, "There ain't none!" except those sold by various "cottage industry" entrepreneurs.

In 1988 I began an ongoing program to measure the static thrust produced by any ½A/FlJ-size props I could get my hands on. The tests have been run using TD .049s, Shuriken .050s and .061s, and A.D. .061s. (Results through early 1991 were published under the title "It's What's Up Front That Counts" in the 1991 NFFS *Symposium*.

Additional tests have strengthened my belief that the "ideal" ½A/F1J prop will have a diameter of 5¾-6 inches with a two-inch pitch—the exact diameter being a function of the particular engine and airplane. Large airplanes like the Genie require larger-diameter propellers even if they don't scream at those supposedly magic 27-30,000 rpm.

The "best" (highest thrust) props I've ever tested or used are the single-blade folders made by Mario Rocca of Italy. They are sold in the US by Bill Lynch, importer of the A.D. engines. Their drawback is the up-to-½-ounce weight penalty caused by the required counterbalance for the single blade. Seeking an "almost-as-good" alternative in a lighter two-bladed prop led me to develop the rigid and folding-bladed opellers that I am now using.

The folders utilize hubs machined by ıgeny Verbitsky and sold as an assembly ith his blades by Mike Achterberg. The rigid ɾo-blader and the blades for my folder to fit e Verbitsky hub are now available from ike Hazel. The Pailet/Hazel props come in a ısic 6-inch diameter, which can be reduced nd rebalanced!) to best suit any ½A/F1J ɔplication.

The only other really specialized ɿuipment on my Genies is the transmitter for e Walston Retrieval System—probably the ıost invaluable piece of equipment a serious ree Flighter can own. Tales of its success in ıcating otherwise-lost models are legend, and can't imagine any great concern over the ansmitter's minuscule four-gram weight.

:ONSTRUCTION

I use cyanoacrylates (CyAs) for virtually ll construction, and particularly where carbon ber is involved.

Ving: The airfoil is 8% thick and its shape ɿas developed to be aerodynamically ffective while accommodating a simplified eodetic construction. The result is a traight/flat surface from leading edge to main par on the lower surface and from main spar ɔ trailing edge on both the top and bottom surfaces. This allows the desired small amount of undercamber and somewhat Jedelskylike shape, which in turn assures that the covering material can be properly adhered to the top and bottom of every rib and crossbrace. That is the only way to achieve the required torsional rigidity for such a lightweight structure.

All carbon-fiber bracing utilizes rods, as opposed to the more common strips. If you check the cross-sectional area of .030 rod versus .007 x ⅛ strip, you may be surprised to find that the area of the rod is smaller, and hence, lighter in weight. Yet the rod is obviously much more rigid, and therefore stronger—even before being bonded to any other structural material.

The rod is also flexible enough to be "curved" so that it can extend in one piece from polyhedral joint to polyhedral joint. This enhances the strength at the critical center dihedral joint and requires only short lengths of .050 diameter rod for additional localized strength. These short pieces must be of varying length and must have their ends tapered to avoid stress concentrations.

The airfoil is undercambered throughout the main inboard wing panels and transitions from the polyhedral joint outward to a flat undersurface at the wingtips. During construction this necessitates a 1/16 shim under the entire inboard length of the main spar. Build the four wing panels directly over the plans without the ⅛ center and polyhedral ribs.

Note that 1/16 washout should be built into each outboard wing panel during construction. Note also that no washin is built into either inboard wing panel; that is a trimming adjustment that may or may not be incorporated during flight testing.

To accommodate imbedding the rod in the wing leading edge I cut an appropriate groove with a thin-bladed modeler's table saw. Cutting the groove 1/32 above the bottom surface of the LE strip also incorporates the proper amount of Phillips entry into the airfoil contour when the LE strip is shaped and sanded to conform to the rib contours. (However, none of the carbon-fiber rods are installed until the wing is more fully constructed and assembled.)

During initial construction all spars should be at least ½ inch longer than required, to permit the proper diagonal lap joints when the wing panels are joined. These lap joints add needed strength without the weight penalty of extra bracing, particularly at the polyhedral joint where the strength requirements are not nearly as high as at the central dihedral joint.

The 1/16 x ⅛ geodetic cross-braces must be glued together wherever they cross (this

Photos provided by the author Graphic Design by Carla Kunz

Above: Genie ready to go. Author has long preferred large, less-complex models that emphasize glide performance.

Left: Jean and Genie. Three sizes (320, 335, and 350 square inches) are shown on the plan. Weight for the 350 is 240 grams.

ıplies to both the wing and the horizontal stabilizer construction). On e stab they will either be very close or will actually contact each other their intersections; on the wing, there will be a gap between them at must be bridged with scrap balsa. This is critical to attain the quired structural strength. Notch the cross-braces at their forward ıds to fit slightly into the main spar structure.

When the outer wing panels are being built the ⅛ soft sheet balsa ingtips should be rough-shaped and installed at a 45° angle to yield ɔs that are somewhat Hoerner-style; they can be finish-shaped and ınded later to blend into the outer panel contours. The top main spar ıd the turbulator spar abut and are glued to the tips to support them.

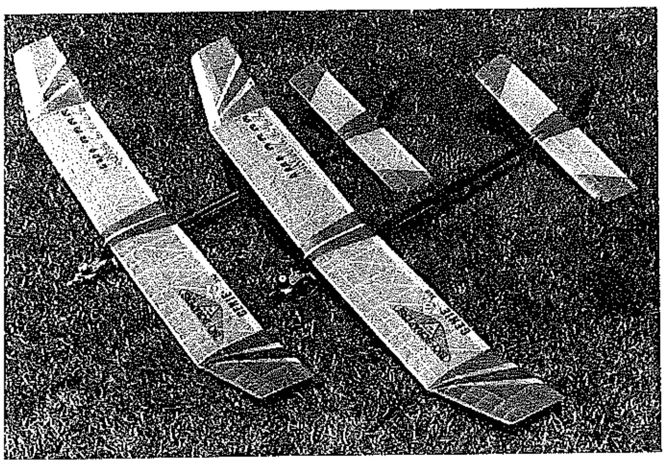
Once the four wing panels have been framed as described thus far ıey can be joined at the designated dihedral and polyhedral angles, ɜing the previously mentioned diagonal lap joints and the insertion of ıe ⅛ dihedral and polyhedral ribs.

Now that you have the wing assembled into one piece it is time to ɫd the .030 carbon-fiber rods to the top and bottom of the main spar ɔd into the notched LE. Because the rods are bent or curved through ıe dihedral joint angle, and because of their natural tendency to :raighten back out, it is important that the wing panels be supported at ıe required angle until the rods are glued in place full-length.

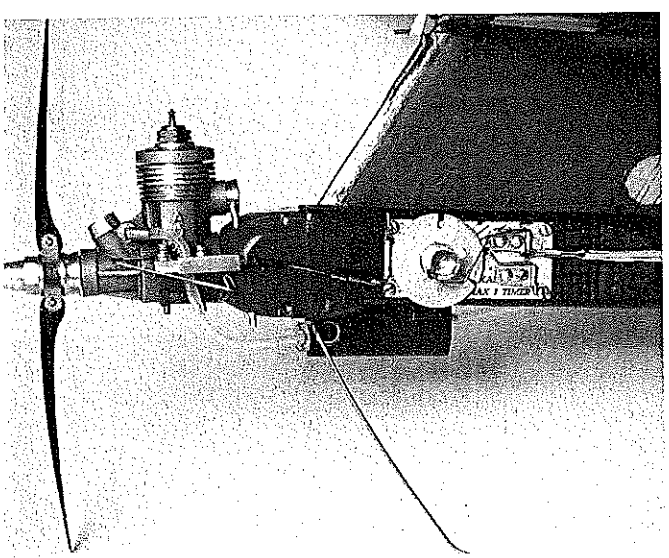
The main spar rods must be installed so that they are flush with the uter (upper and lower, respectively) surfaces of the wooden spars so ıat the 1⁄32 shear webbing can be properly inserted. Except for the ɜading edge, there are no CF rods used in the outer wing panels.

The 1⁄32 shear webs are now installed between the ribs and between ıe rods, along the entire length of the inboard wing panels. Similar shear webs are also required between the ribs of the outer wing panels. Once the shear webs are in place the final .050 CF rod dihedral braces can be added at the wing center section. Because of their increased diameter and stiffness, these short rods cannot and should not be bent to conform to the dihedral angle; they must be notched into the center area ribs and glued directly to the front face of the shear webbing.

The .030 CF rod bracing at the trailing edge and at the turbulator spar can also be added now; note that they can and should be bent to conform to the dihedral angle.



ſwo Genie 350s. Model on the left has an A.D. .061 power plant; ı Shuriken .050 powers the version shown at right.



A.D. .061 front end. Note enlarged disc on dual-function timer, tube for pressure tank, Cox tank mount, folding prop.

Tail Feathers: The stab utilizes an airfoil section virtually identical to the wing, except that it is only 6% thick. The vertical tail (fin) is simply shaped to a symmetrical cross-section (rounded LE and tapered TE) from 3⁄16 soft and light balsa sheet.

Fuselage: My models use carbon-fiber fuselage tubes, available from Ron McBurnett or Ken Oliver. These tubes provide a much more durable fuselage than can be produced with a wooden structure. However, since the fuselage really only serves the purpose of being an engine mount and a means of locating the wing and tail surfaces in their proper aerodynamic positions, you can, if you prefer, build a balsa box-cross-section fuselage.

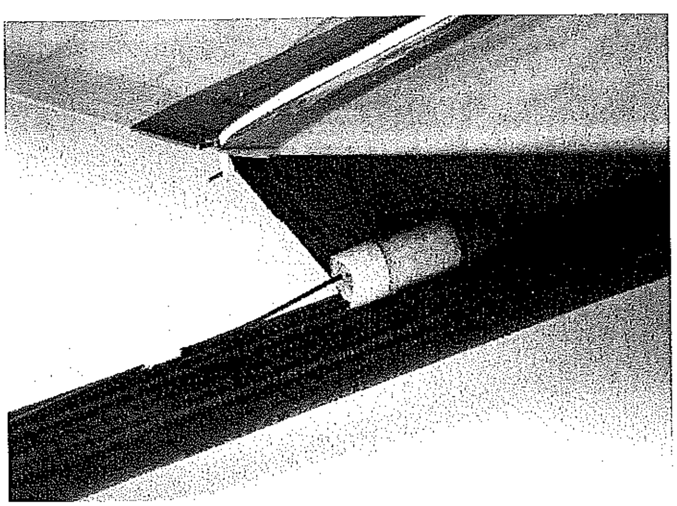
The McBurnett and Oliver tubes come with their own timer-mount pads and also provide ring mounts for locating and mounting the front of the horizontal stab. McBurnett also offers a T-mount for the stab, which I prefer because it can be run through the fuselage tube, providing an excellent tail skid mount. I am a firm believer in using front and rear wire skids to absorb some of the high loads imposed on the fuselage from DT landings on runways and other hard surfaces.

The stab mount should be positioned so that the stabilizer is parallel to the right inboard wing panel. This will provide an initial right glide turn, which can be adjusted during flight testing. The aft plywood stabilizer mounting pad should be elevated with a balsa shim to set the stab at 0° incidence relative to the fuselage centerline.

The bottom of the vertical tail should be contoured to mate with the tube shape; the fin is then simply glued directly to the fuselage. Care must be taken to assure that it is aligned with the centerline to avoid imparting any unwanted turn tendency. It should also be vertical—aligned parallel with the pylon.

The pylon structure is simple and straightforward, with tapered spruce leading and trailing edges. Note that the LE and TE extend into the fuselage tube, with the TE piece butting against (and glued to) the inner bottom surface of the tube. The LE extends into front-end balsa plug and against the ⅛ plywood firewall. The length of the front end and the position of the pylon LE where it intersects the fuselage will vary by ½ inch, depending upon which engine mount you choose. If you use a radial mount, they will extend forward an additional ¼ inch.

The engine must be mounted with 3° downthrust. The plywood firewall, with anchor (or blind- or T-) nuts installed for your particular engine mount, is glued to a ½-inch thick hard-balsa plug (the outside diameter of the firewall and balsa plug should fit within the tube). The



Walston transmitter installation. Popular unit has helped retrieve many lost models. "Invaluable," says the author.

grain of the balsa plug must be parallel to the length of the fuselage (the firewall is glued against the end-grain of the plug). No sidethrust should be built into the model. It can be added later, if required, by inserting flat washers between the engine mount and firewall during flight tests.

The front skid is mounted via a hole through the firewall, or some engine mounts may have a built-in provision for mounting a skid.

I use a short length of CF tube glued to the fuselage adjacent to the front skid as a pressure fuel-tank housing. Alternatively, you can make provision to house the tank within the fuse-tube. Lengths of 1/16 OD aluminum tubing glued to the fuselage provide guides and a stop for the dethermalizer line, which should permit the stab to elevate to a 45° angle when activated. A length of guide tube must be used to prevent the stab rubber bands from impinging upon the DT line.

Covering/Finish: I am sold on Polyspan! I install it much like tissue: as tightly and perfectly as possible right from the start.

Prior to covering, all structure that will contact the Polyspan (the top and bottom of every rib and cross-brace, every spar, the wingtips, and the leading and trailing edges) should receive two coats of nitrate dope thinned 50% and a final coat of unthinned nitrate dope. The Polyspan is then applied using unthinned nitrate dope. This assures good adherence, which is of particular importance on the spar and rib bottoms (for proper undercamber) and on the tops of the 1/8 ribs at the polyhedral joints, where the material will tend to pull away as it tightens.

Use a small hot covering iron to "bend" the Polyspan around any tight curves and to tighten any sags after initial covering.

After covering I apply two coats of clear nitrate thinned 50%. This pretty well tightens the Polyspan and any problem spots can usually be quickly cured with the hot covering iron. Trimming is now done with tissue of any desired color applied directly over the Polyspan with thinned nitrate. After trimming an additional two coats of thinned nitrate dope is applied to all surfaces. Decals, logos, and what-have-you can now be applied. Final fuelproofing is accomplished with a coat of clear epoxy thinned at 50% to 70% *after the last coat of nitrate has dried for at least a week!*

The pylon and fin are covered with your choice of colored tissue, using thinned nitrate dope, and are given four coats of thinned nitrate. After the above prescribed week-or-more drying time, the fuselage, pylon, and fin should receive a fuelproofing coat of unthinned clear epoxy. As with the nitrate dope, the finish coats of clear epoxy should be allowed to dry for at least a week before traipsing out to the flying field.

Flight Testing and Trimming: Verify that the center of gravity (CG) is approximately correct and adjust as required using lead or clay for ballast. After a few hand-glides to assure a moderate turn with no severe stall or dive tendencies (adjusting as required with stab tilt and ballast), proceed to the first powered flights.

Genie is intended to fly a right/right pattern—right turn under power and in glide. Engine runs on the first few flights should not exceed three seconds at about 3/4 power. (Unless it is dangerous in some manner, don't worry about glide trim at this time.)

Adjust the power pattern using stabilizer (decalage) and rudder trim—side-thrust adjustments are only effective immediately after launch and diminish as the model accelerates and rudder affects take over. Experimenting with washout and/or washin at the outboard end of the inboard wing panels is the usual way to correct or induce rolling tendencies.

GENIE

Type: FF 1/2A-F1J

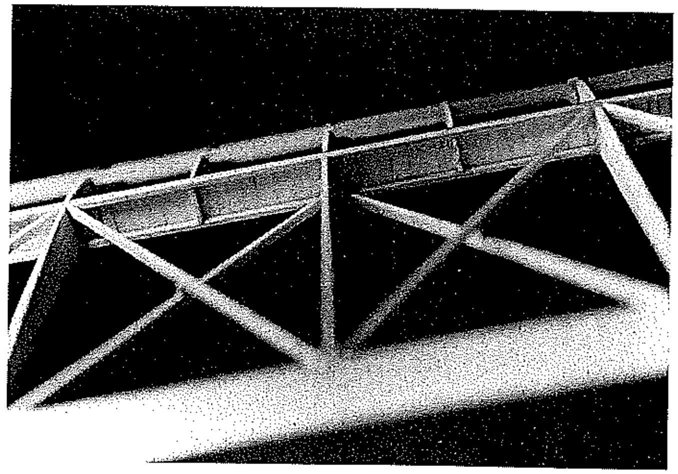
Wingspan: 54.25 inches

Wing area: 350 square inches

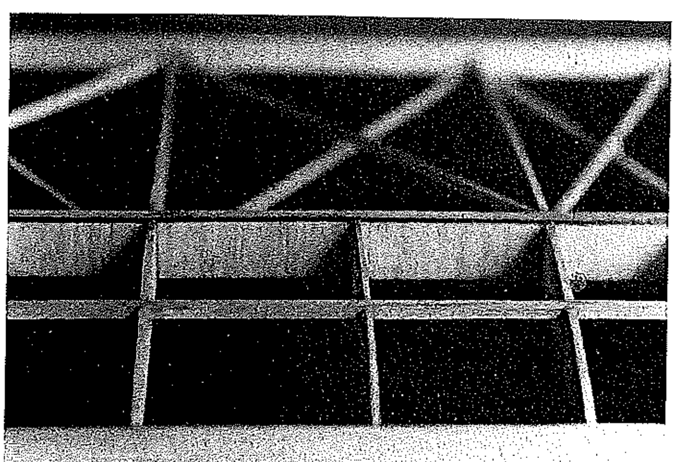
Engine Size/Type: A.D. .06 (for F1J)

Flying Weight: 240 grams

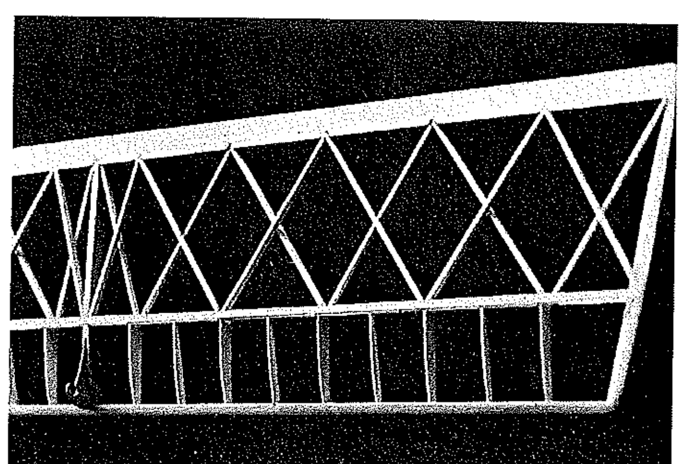
Covering/Finish: Polyspan w/nitrate dope and clear epoxy top coat



Wing main spar is C-shaped. Note placement of shear webs between full ribs and half-ribs.

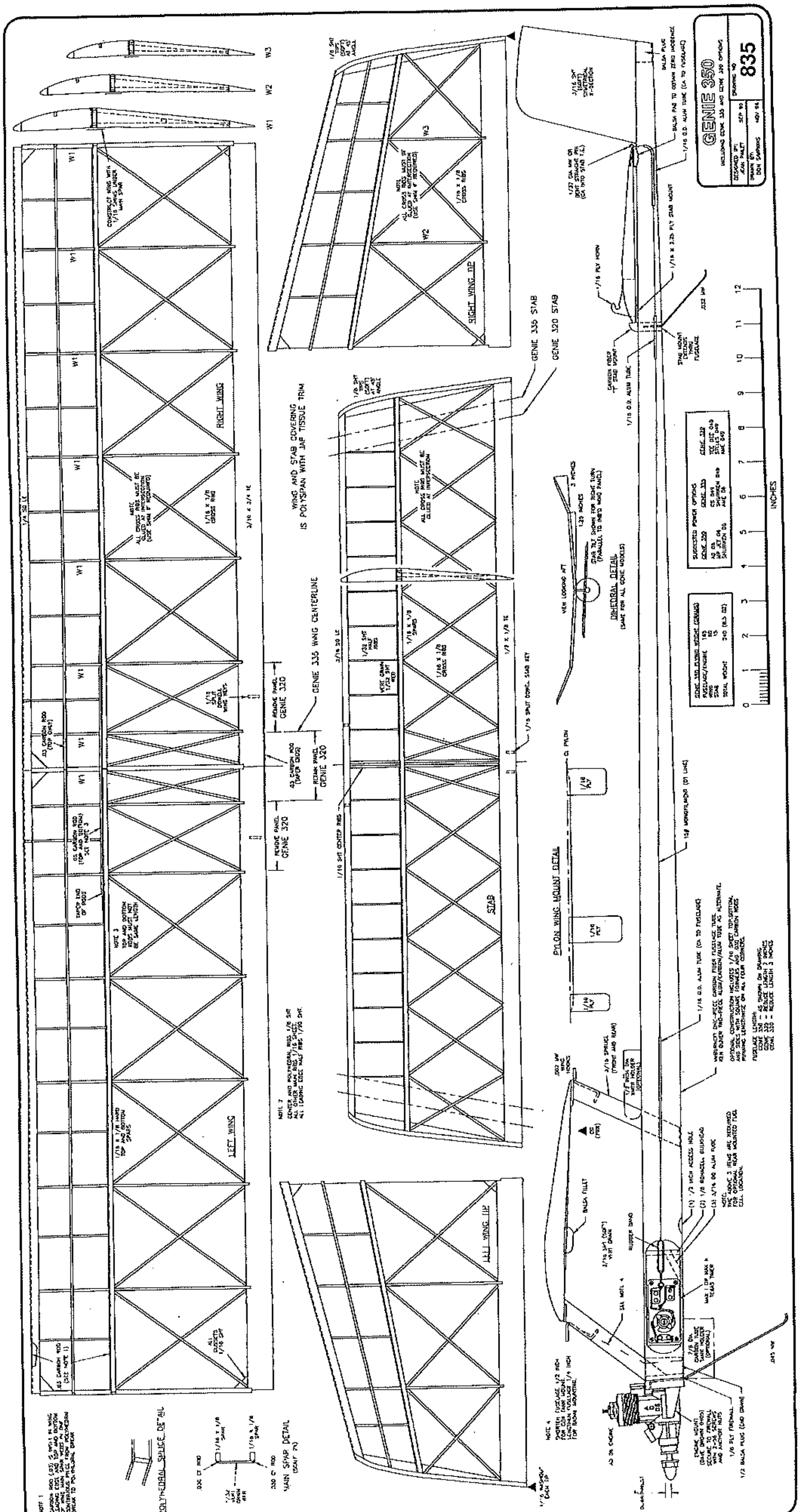


Top front view of wing construction. Hard balsa forward spar, vertical-grain shear web. Carbon-fiber rod on main spar.



Stabilizer structure. Diagonals are glued to each other where they cross. Shear web in front of spar is 1/32.

Full-Size Plans Available—see page 184



I prefer washout to washin, because the drag created by any significant amount of washin can create a turning effect that overpowers the intended rolling effect. Drag and turning effects from washout tend to work in concert with the intended rolling effect.

As the flights progress, gradually tune the engine to full power and increase the run duration to the maximum (generally seven seconds here in the East and Midwest). The final power pattern should be a very steep climb (almost vertical) with about ¾ turn from launch to engine cutoff and subsequent transition into the glide pattern.

During the power-pattern adjusting a "quick DT" is used, anywhere from one to ten seconds after engine cutoff. As you become more secure in the safety and perfection of the power pattern, you can begin to extend the glide duration and more closely observe the glide pattern. A fairly small circle with a slow, flat, almost-stalled glide attitude is the goal.

Adjustments here should primarily center on stab-tilt changes for turn and ballasting for CG changes to attain that ideal almost-stalled glide. Any tendency to spiral with an outboard-wing-high/inboard-wing-low attitude in the turn may require washin and/or washout adjustments. They must be done with caution, for they will more-than-likely affect the power pattern, too! Now begins the fine-tuning, tweaking, and compromising of adjustments to obtain the optimum balance between the powered- and gliding-flight cycles.

Now that the Genie is out of the bottle, it is up to you to master it so that it fulfills your wishes as it has mine.

Genie's success, and that of its predecessors, is not mine alone to claim; I had lots of help along the way. Many other avid Free Flighters counseled and cajoled, helped and hollered, advised and admonished me in my attempts to create airworthy aircraft. Thanks, and a share of the credit, to them.

Jean G. Pailet
30 Emerson Road
Brookville NY 11545

SOURCES:

AD Engines, Rocca Props, Misc.:
Bill Lynch
11137 Creekhaven Court