LADY'S FANCY

If you're looking for a new design in a stunt and pattern aircraft, you can stop right here. This sleek bipe could very well be the answer.

BY CHARLES B. POWELL, JR.

During the summer of 1978 I overheard a few pattern pilots commenting that there does not seem to be a biplane that really flies the contest pattern to the same standards as the better pattern ships. Well, I got my head in gear (or out, as the case may be) and designed a biplane which, in my opinion, fits the bill as a first class pattern ship. I call it "Lady's Fancy," a name I took from an old Bluegrass Fiddle Waltz. I feel the biplane performs the pattern maneuvers with the smoothness of a waltz. How's that for working out why I chose the name? Well, let's get to the airplane design itself.

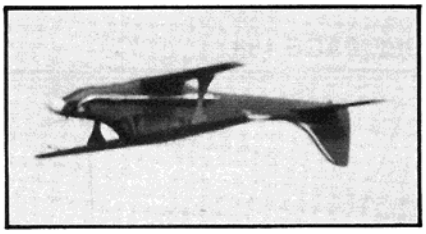
My first consideration was that if I was going to use two wings and achieve the pattern ship forces and moments, I would have to pay very close attention to drag. I decided to go with ample wing area (820 square inches) since I would suffer some wing lift and drag interference penalties because of the two wings. Also, smooth lines were required and blending of the fuselage and wings became a desired objective. Although somewhat fat looking at first, I settled on a full depth fuselage between the two wings. I am pleased how this turned out. A friend suggested large windows to reduce the fat look.

The wings are a high aspect ratio design to produce good lift to drag. The ailerons are a conventional 40% chord half-span design. I decided on large ailerons to reduce drag due to aileron inputs and because I installed ailerons on the top wing only. The 40% chord aileron turned out to be more than required. The plans call for a 30% chord one-half span design. This should be very adequate.

The horizontal tail is an all-movable design I have been using on other pattern ships. I like smooth control action that results from the flying stabilizer and I think it adds interest to the model. The horizontal tail is balanced about the hinge line to eliminate flutter and hinged about the mean geometric chord to avoid hinge moments. The combination of hinge point and balance about the hinge eliminates forces feeding back to the elevator servo. The horizontal tail halves are connected by a 5/16" diameter aluminum tube. This arrangement has worked completely satisfactorily for me for years so I do not hesitate to recommend it.

The engine I am using is an O.S. Max.60 with tuned pipe. I do not run a pump or fuel pressure. I use a double clunk tank design I have been using for years with complete satisfaction. The double clunk tank arrangement is an idea I started using before the good carburetors came on the market. However, I have found that it provides added stability to the fuel draw system, even with the new carburetors. Here's how I use the tank. I close off the line going to the top of the tank (overflow line) once the tank is full. Vent air is drawn into the tank through the short clunk line. This causes the tank to operate at a slightly negative pressure which is equal to the draw pressure required to raise the fuel to the tank centerline. If the carburetor barrel and centerline of the tank are at the same level, and the clunk vent line comes out at the middle of the tank, a constant fuel pressure in the feed line is provided whether inverted, on the side or upright, full or empty tank. I know you may be saying, "What?" and I don't blame you. However, if you are having idle and lean-out problems at the end of your flights, give this tank arrangement a try and I believe you will be happy with the results. I think you will also find that the engine runs better during vertical maneuvers. I take pride in taxiing back to the pits after each flight and having to stop the engine by hand. I must say here that I was reluctant to write about my tank arrangement because it sounds too good to be true. Well, I did it, so there! Send cards and letters, and I will send you the theory and test results.

Now here is the story on my own design retractable landing gear system. About six years ago I participated in a discussion about using engine crankcase pressure for powering the retract system. The result of this discussion was that a small retract system using only crankcase pressure was not practical because of the size of the piston required to raise the gear and the problem of gear droop during maneuvers and when the engine was at low power settings. Well, to me this was the same as waving a red flag in the face of a bull. I decided to charge the problem. After about a year of design and testing, I came up with, as you can see by the plans and pictures, a mechanism that is certainly small enough for any 60 size pattern ship. I ran tests on several engines using a one-way check valve and found I could obtain 6 pounds of pressure from the crankcase at full engine power. With the retract mechanism design, 6 pounds pressure was more than enough to raise the gear. The retract mechanism provides up-lock for the gear which eliminates gear droop during maneuvers. At low power settings, the gear remains locked for an extended period of time. After a gear



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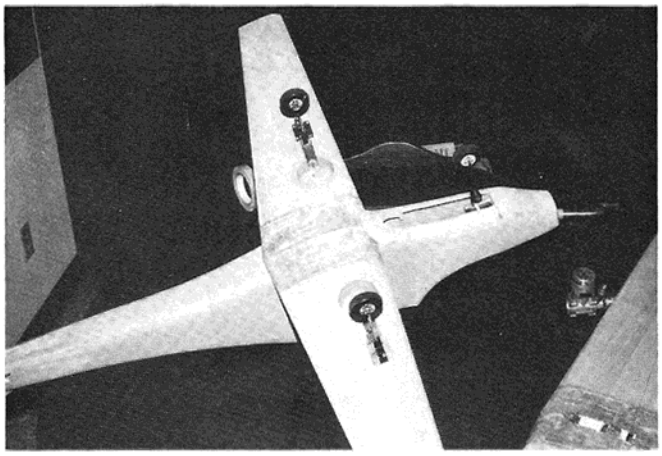
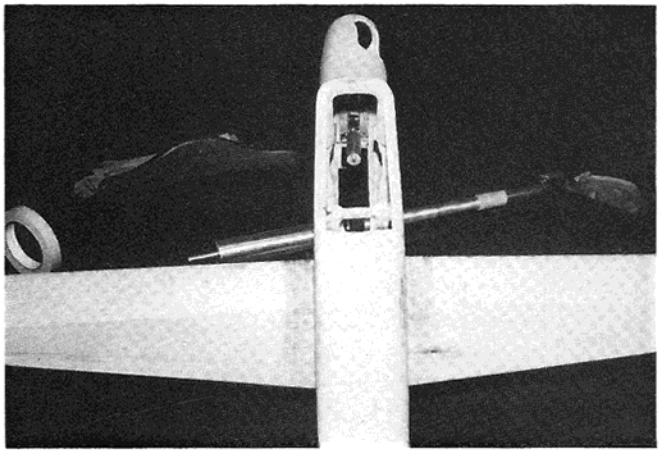
Designed By: Charles B. Powell, Jr.

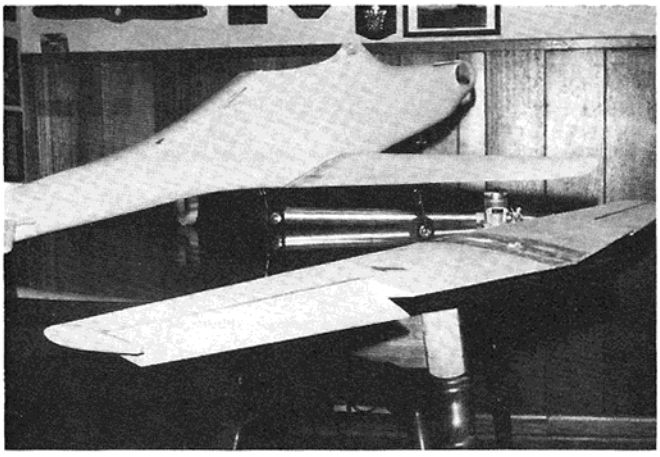
TYPE AIRCRAFT
Stunt Pattern Biplane
WINGSPAN
Top 66.7". Bottom 53.3"
WING CHORD
Top Root 10". Tip 5"
Bottom Root 8". Tip 4"
TOTAL WING AREA
820 Sq. In.
WING LOCATION
Biplane
AIRFOIL
Symmetrical
WING PLANFORM
Double Taper
DIHEDRAL EACH TIP
Top 1 . Bottom 0
O.A. FUSELAGE LENGTH
55.5 Inches
RADIO COMPARTMENT AREA
(L) 10" x (W)3" x (H)7"
STABILIZER SPAN
27 Inches
STABILIZER CHORD (incl. elev.)
7" (Avg.)
STABILIZER AREA
212 Sq. In.
STAB. AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Mid-Fuselage
VERTICAL FIN HEIGHT
10.5 Inches
VERTICAL FIN WIDTH (incl. rudder)
7.5" (Avg.)
REC. ENGINE SIZE
.60 Cu. In.
FUEL TANK SIZE
16 Ounce
LANDING GEAR
Tricycle - Retracts
REC. NO. OF CHANNELS
5 w retracts
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.

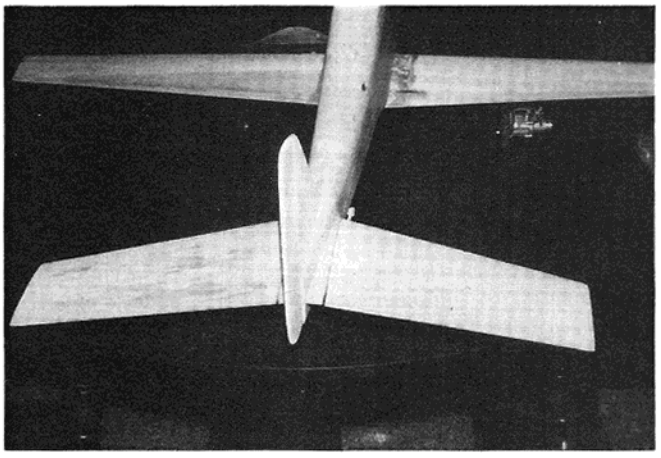
BASIC MATERIALS USED IN CONSTRUCTION

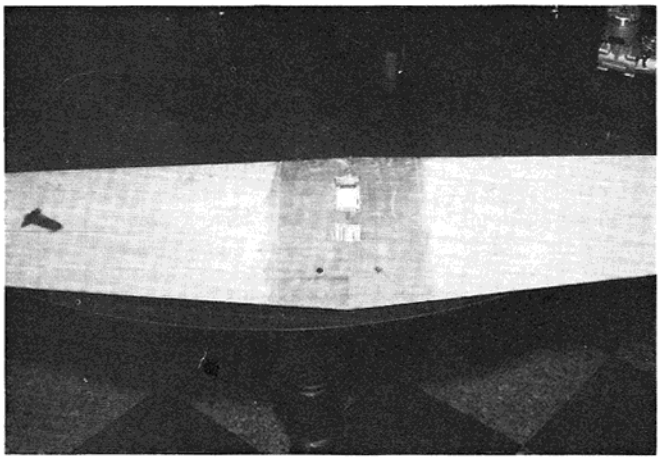
Fuselage	Balsa and Ply
Wing	Balsa, Ply and Foam
Empennage	Balsa and Foam
Wt. Ready To Fly	**#1 172 Oz.**
	#2 140 Oz.
Wing Loading	**#1 30.2 Oz./Sq. Ft.**
	#2 24.6 Oz./Sq. Ft.



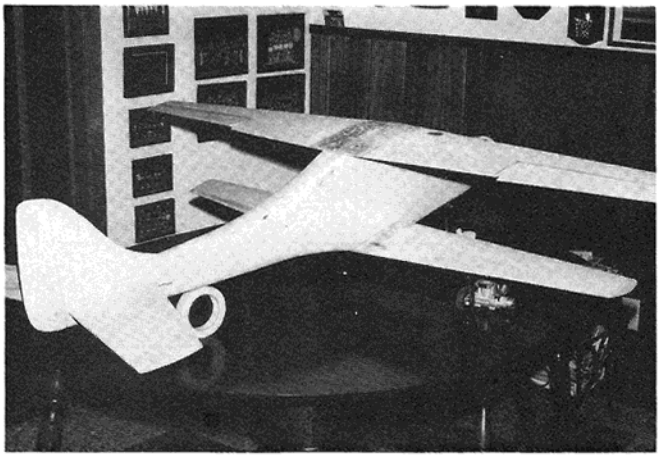


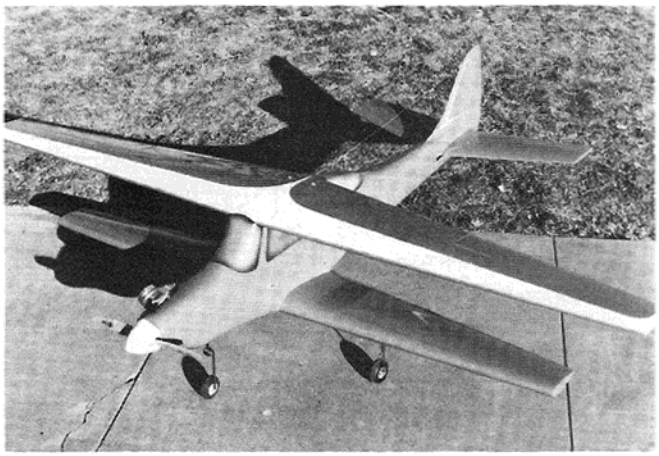






TOP ROW, LEFT: Bottom view of the "Lady" showing the retracts installed. RIGHT: Looking down through top wing opening, shows the nose wheel retract and ample room for R/C gear. 2ND ROW, LEFT: This view shows the large effective ailerons on the top wing. RIGHT: Note the swept back full flying stab — also very effective. AT LEFT: Bottom view of top wing showing cut-out for aileron servo and linkage. BOTTOM ROW, LEFT: Completed model just prior to the final stage of painting. RIGHT: "Lady's Fancy" painted and complete, ready to go out and prove itself in competition.





maintenance service consisting of injecting a drop or two of heavy oil into each cylinder, I can fly at idle for two or three passes up and down the field before one of the gears begins to droop. The gear is extended by a combination of relieving pressure, gravity and spring force which pulls the gear into the down and locked position. Since finishing the design, I have not landed with gears up, but I have had the nose gear on "Lady's Fancy" fail to extend one time due to improper nose gear door operation. The nose gear door has its own actuator which is sequenced by the position of the nose gear.

The nose gear door actuator is pressurized when the gear is selected to the up position. The door closes when unlocked by the action of the nose gear pulling a nylon trip-string. The door is spring-loaded to the open position. I have not shown details of the gear retract mechanisms because I plan to explore a manufacturing venture for the system. The actuation valve for the gear system consists of a standard mini-servo operating on the fifth channel and a simple line-pinch set-up. I used a slide valve design on two previous ships which operated from throttle trim; however, I had leak problems and servo position problems when the battery pack was not near full charge. The new line-pinch set-up on "Lady's Fancy" works very well and is practically foolproof. When the gear is selected to the down position, the pressure line from the engine is pinched closed and the system pressure relief line is opened. When the gear is selected to the retracted position, the system pressures relief line is pinched closed and the pressure line is opened to pressurize the gear system. This set-up is so simple and reliable I was disgusted with myself for fooling around with the slide valve on my other pattern ships for so long.

I decided to go with a tricycle landing gear set-up for good ground handling characteristics and to be a bit different from most biplane designs. Although not completely novel, a tricycle gear system is rare on biplane designs because of weight, drag, and complexity considerations. I decided the improved ground handling was worth it and since the gears are retractable I would not suffer a drag penalty.

The wings are conventional symmetrical airfoil designs with foam cores and balsa skins. The plans call for a plywood skin on the top wing to improve strength and stiffness over that of a balsa skin. This change was brought about by a flutter problem I experienced on the first flight of "Lady's Fancy" which resulted in failure in bending of the top wing. This failure resulted in a crash. Fortunately the crash did not destroy the airplane and I was able to use the original parts to reconstruct the ship. The crash did have a good side effect. I had to learn more about flutter and solve the flutter problem before I made another flight. I began to talk to flutter engineers at the aircraft company where I am employed as an aeronautical engineer. I learned a good deal about the flutter phenomenon. I also read the three articles published in RCM on flutter. These two sources were very informative and invaluable. The solution to my flutter problem was to balance the ailerons about the hinge line. To be sure I had adequate wing bending strength, I also added two spars in the top wing. I stiffened up the aileron torque rods and added struts between the wings. I may have overdone the rebuilding of the wing but I now feel good about the improvements. I have not had any problems since flight number one. I believe the design, as layed out in the plans, is completely adequate to avoid any problems.

The top wing is a 15% thick chord design with zero twist. The bottom wing is 24% thick with zero twist. The thick bottom wing was required to house the retractable main gears. The thick section also eliminated the need for spars in the lower wing (it's plenty strong). The two wings are aligned vertically at the trailing edges at the fuselage centerline.

The ailerons are actuated by a centerline mounted servo connected to the aileron by an aluminum torque rod. This design was chosen to provide good torque rod stiffness and clean airplane lines. The ailerons are supported at the inboard and tip chord points only. The ailerons and aileron cut-outs are stiffened by plywood end-plates. Tight fit ailerons will result in effective ailerons. The aileron tip hinge pin is an aluminum Chicago screw stud glued to the wing-tip plywood stiffener.

Both wings are fiberglass reinforced at the centerlines with 6" wide glass cloth. The wings are mounted to the fuselage in the conventional manner by 5/16" dowels in the leading edges and two 1/4" nylon bolts in each wing.

The fuselage is constructed with 3/16" sidewalls the entire length. The top and bottom surfaces of the fuselage are constructed with triangle stock and balsa blocks cut to fit tight. Lots of sanding is required to achieve smooth blended lines. The fuselage is blended with the wing saddle openings to achieve smooth air flow transition about the wing-fuselage joints. The engine compartment is built-up after the engine is positioned. The engine is mounted straight with the fuselage (no side thrust or down thrust). The spinner is 3¾" in diameter.

The horizontal tail is an all movable, symmetrical airfoil design with foam core and 1/16" balsa skin.

The rudder extends below the plane of the horizontal tail to give good high angle of attack effectiveness. The rudder is mounted in a conventional hinged manner with nylon hinges.

The cockpit windows are painted to simulate depth. First the windows were masked and a coat of black paint applied. Then a fine mist of aluminum was applied, followed by a fine mist of white. Another very thin application of black around the window outline added the finishing depth touch. The windows were sealed with two coats of clear.

The finish is K & B epoxy paint throughout.

Finally, how does it fly? Well, it flies better than I expected and I usually expect a lot. The ailerons are effective down to stall. The directional stability is good. The pitch stability is good, and power is good. Roll due to rudder input is as tame as any pattern ship I have flown, and much better than most.

Four point rolls, knife edge flight, and slow rolls are super easy to perform with no, I say **no**, loss of altitude. With the large side area fuselage, "Lady's Fancy" can fly knife edge on half throttle and about 10° rudder. I just recently was able to fly two consecutive 360° turns in 90° bank knife edge flight. I have never seen that before. The airplane rolls without wobble and exhibits inverted characteristics equally as impressive as upright. I let weight get away from me when I was building and rebuilding the airplane. It weighs 10¾ lbs., but this has not detracted noticeably from power maneuvers because of the 820 square inch wing area. I can pull up to a vertical climb and complete two 360° rolls before the airplane quits climbing.

I plan to build another "Lady's Fancy" this spring/summer, and I believe I can get the weight down to about 9 pounds. I have not had a chance to completely evaluate landing characteristics because the old Texas wind has been nearly 90° crosswind to the runway every time I have taken the plane out. At this point, it appears the landing speed is about the same as current pattern ships.

If you decide to build "Lady's Fancy," the controls will be completely adequate for first flight with the following initial deflections: aileron ± 15 degrees; elevator ± 15 degrees; rudder ± 15 degrees.

Good luck and good flying. □

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