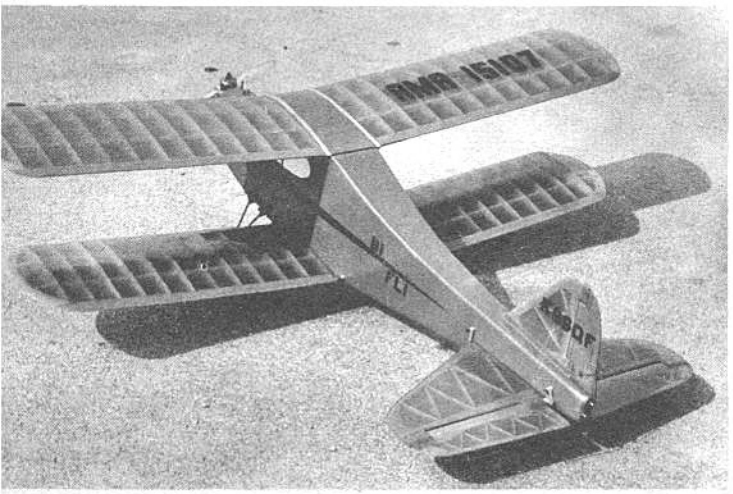
Plenty of turns on the rubber is essential for "intermediate" flying with Vari-comps. Operating speed remains suitably constant.

If you can't beat rudder-only jobs by 50 points with this truly great ship, you are not a hot pilot! Nor do you need four servos for performing sport aerobatics.

Lighter loadings in smaller size result in biplane configuration. The aerodynamically balanced surfaces minimize escapement loads.



Any long-suffering RCer who knows his onions will quickly recognize the functional, practical features. Well over 200 test hops were made.

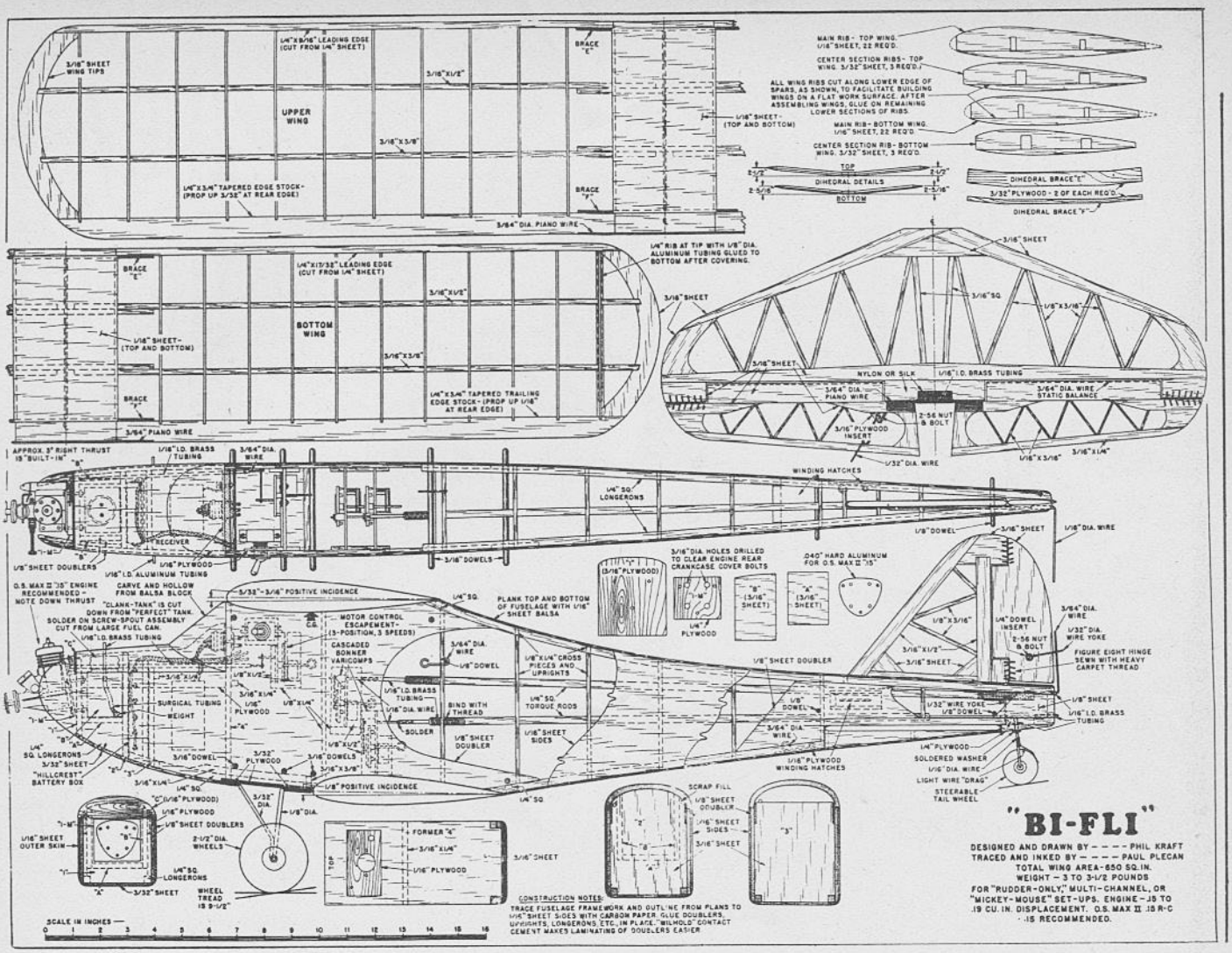
BI-FLI

by PHIL KRAFT

► Full-scale biplanes are no longer produced except for special purpose types such as Grumman's new crop duster. Their relatively low efficiency due to the higher induced drag of two wings has relegated this oldest aircraft type to rapid extinction. However, for our purposes, the lower lift-drag ratio is not a disadvantage and, from the theoretical standpoint, the biplane seems to be the most logical approach to RC stunt. There is little question that the biplane is the most maneuverable type of aircraft. Virtually all of the full scale airplanes used in stunt competition were biplanes.

The reason for the biplane's inherently superior maneuverability lies primarily in its shorter moments and concentration of mass and area which reduce the effects of inertia. Thus, the biplane can respond more quickly and smoothly to control movements. Besides maneuverability, the bi-

For excellent ground handling, plus inverted flight, outsides, or eights, Bi-Fli is small package. Fractional cost of multi trucks.

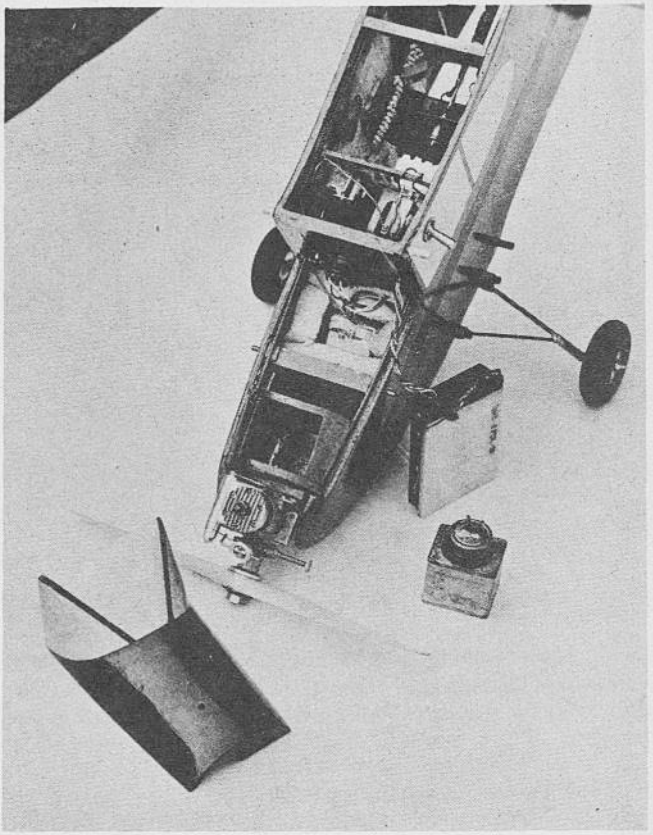


FULL SIZE PLANS AVAILABLE. SEE PAGE 62.

plane offers greatly increased stall resistance. This is because the rear wing is generally set at a slightly lower angle of attack than the front. In a stall, the rear wing retains its lift longer than the front and since it lies aft of the center of gravity the nose of the airplane will drop to regain flying speed without the abrupt loss of lift and sharp dive associated with monoplanes. Ground handling, take-off, and landing characteristics are also excellent. From the model standpoint, the reduced overall dimensions of the biplane provide a stronger, lighter aircraft which is easier to transport.

Theory and practice do not always coincide, but the apparent advantages of the biplane layout prompted the design of the Bi-Fli. A great deal of thought went into the design in an attempt to produce a maneuverable yet stable, smooth-flying model suitable for any type of control from rudder-only to multi-channel equipment. For flight smoothness, a moderate wing aspect ratio (6-1) and fairly long tail moment with plenty of stabilizer area has been used. Logically, the two wings should be the same size, but for appearance sake the lower wing was designed 10% smaller. While free-flight experience has taught that an unduly scientific approach to airfoil selection is rather senseless, the NACA 23015 section was selected because its characteristics seemed ideal as to center of pressure travel, etc. More important, the section looked "right." Negative stagger was seriously considered, but the more conventional positive stagger was decided upon to simplify landing gear installation.

The first Bi-Fli weighed only 37 ounces and was powered with the K&B .09. The ship was a beautiful flier, living up to all expectations, but it was a bit slow due to the very light wing loading. (*Continued on page 57*)



Nose hatch removed to show receiver (in place), battery box, tank. Motor-control escapement, cabin front; Vari-comps in mid-cabin.

The .09 ran particularly smoothly and consistently at the higher speeds of around 14,000 to 17,000 rpm, although it will be noted that, at the latter speed, the Fox is turning well above its peaking speed and, to achieve maximum power, it would be preferable to avoid props which allow static rpm to exceed about 14,000. Incidentally, it may be mentioned that this peaking speed is, so far as we know, the highest ever recorded with a 3-port engine.

Summary of Data

Type: Reverse-flow scavenged three-port two-cycle.
Weight: 3.1 oz. including integral fuel tank.
Displacement: .0974 cu. in. or 1.596 c.c.
Bore: 0.527 in. Stroke: 0.450 in.
Stroke/Bore Ratio: 0.854:1.
Specific Output (as tested): 1.14 bhp/cu.in.
Power/Weight Ratio (as tested): 0.50 bhp/lb.
Price: $4.95.
Manufacturer: Fox Manufacturing Company Inc., 5305 Towson Avenue, Fort Smith, Arkansas.

Bi-Fli

(*Continued from page* 17)

A second was then built with generally heavier construction and powered with the O.S. Max II .15 R.C. This is the one pictured and weighs 3½ pounds. Its flight characteristics leave nothing to be desired and its stunt capabilities are limited only by the ability of the pilot and the radio equipment used.

As shown on the plans, control is via cascaded Bonner Vari-comps. The receiver used is the same unit as presented in the March '59 issue of MAN. With this set-up, outside loops, inverted flight, vertical figure-eights, etc. are easily performed (with practice). Outside loops are done with the engine at about half throttle. The Vari-comps and associated torque-rod linkage will not hold elevator position at high speeds and attempts at outside loops with full power result in rather exciting inverted power dives. The ship flies very well inverted with half throttle and elevator held in down position. The limited control provided by having to hit four blips for down requires that down elevator be held continually during inverted flight. If this is tried with full power, the ship will climb out of the inverted flight but on medium power it will fly slowly inverted as long as desired. Inverted flight is entered at the top of a slow half loop. It is in such maneuvers that the excellent stall characteristics of the biplane are of real importance.

Since this design was to provide the basis for a larger all out multi-channel ship, I decided to satisfy my curiosity concerning the possibilities of full symmetrical airfoils. New wings were built with a 14% depth at 35% chord full symmetrical section. The ship flew faster and seemed less responsive because of the loss of lift. There seemed to be no advantages to the symmetrical wings as inverted characteristics remained about the same. Actually, the difference in performance between the two sets of wings was not great further confirming my belief that so long as certain basic principles are adhered to, airfoils are not critical. It is certainly a waste of time to spend hours accurately plotting sections from co-ordinates.

Thus, the background to the final design of the Bi-Fli. A 1,000 square inch version is now under construction with ailerons added to the lower wing.

Construction is reasonably simple and very strong. The wings are designed so that they may be built flat on the work

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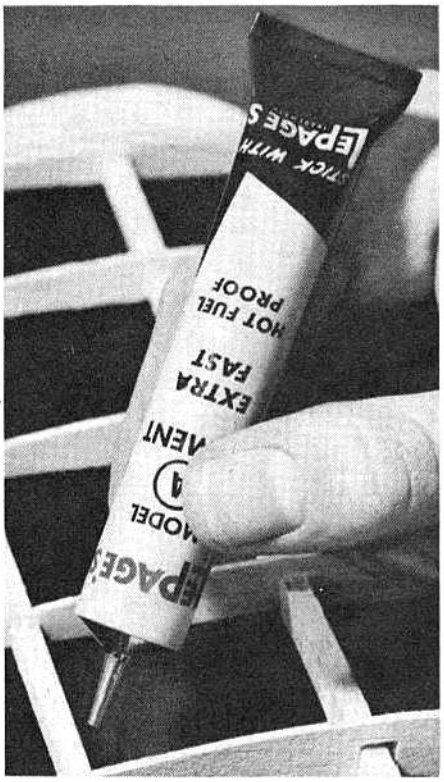

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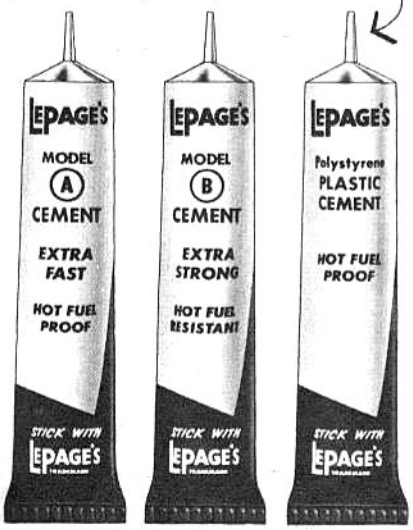

board. After the wings have been completely assembled including dihedral (subtract the thickness of the bottom half of the rib section from the specified dihedral), the bottom half of the ribs are cemented in place and the center section planked. Cover with silk and dope with nitrate dope.

Begin fuselage construction by splicing 1/16" sheet as necessary to provide a section large enough to cover the plan side view of the fuselage. Then trace the complete fuselage side plan to the sheet side with back-to-back carbon paper so that the right side of the fuselage will be traced on the back of the plans as the left is traced on to the balsa. Then turn over the plans and trace the right side to the other 1/16" balsa side. Repeat this process for the ⅛" sheet doublers. Cut the ⅛" doublers to outline shape and cement to the untrimmed 1/16" sheet sides. Contact cement will greatly speed and simplify the lamination. Cement the longerons, uprights, escapement guides, etc. to the sides to form complete units. Then trim the sides and assemble in the usual manner. The fuselage, fin and stabilizer are covered with Jap tissue and doped with nitrate dope. After color doping, apply fuel proofer to the entire airplane.

The O.S. Max II .15 RC was selected for the Bi-Fli as it is powerful, smooth running, and has the excellent fuel suction so necessary for violent maneuvers. Its throttle characteristics are excellent. A wire drag is used on the steerable tail wheel to keep the plane from rolling on low speed. If you don't like flying, you can have a ball just taxying around the field.

The tank shown will run the O.S. about 4-5 minutes. I've just changed the battery arrangement to accommodate a Hillcrest square four pencell battery box mounted right behind the firewall in a horizontal position. The box slides into balsa tracks on its mounting ears. The "B" battery is wired in right beside the pencell box. This runs the O.S. about 10-15 minutes.

If the cascaded Vari-comp set-up is used, be sure to use 4½ volts on all escapements. This was found to be an absolute necessity for reliable operation. The escapements should be checked to see that there is a slight clearance between the escapement pole and moving arm to prevent sticking due to the arm becoming magnetized by touching the pole piece. The 4½ volts also will insure positive action of the quick-blip motor control. Use ¼" flat rubber well lubricated with castor oil to drive the escapements.

The Bi-Fli has well over 200 flights with this system without any kind of trouble.

Final trim settings will depend on the type of equipment used. The angular differences and downthrust shown will be about right for rudder only flying and are a good starting point for more elaborate systems. The original is trimmed with about 1/16" positive angular difference in the top wing and 1/32" positive in the lower wing. Draw a pencil reference line lightly on the fuselage parallel to the stabilizer to check win settings as they should be accurate.

Test flying is a snap as the Bi-Fli is very stable and quite forgiving. However, it responds very quickly to control so go easy. Don't be satisfied with good flight performance. Keep careful trimming until everything is as nearly perfect as possible. After flying, I think you will agree that the Bi-Fli has a lot to offer in flight performance that monoplanes cannot equal. It may be that, in the future, correctly designed biplanes will prove unbeatable for RC stunt.

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