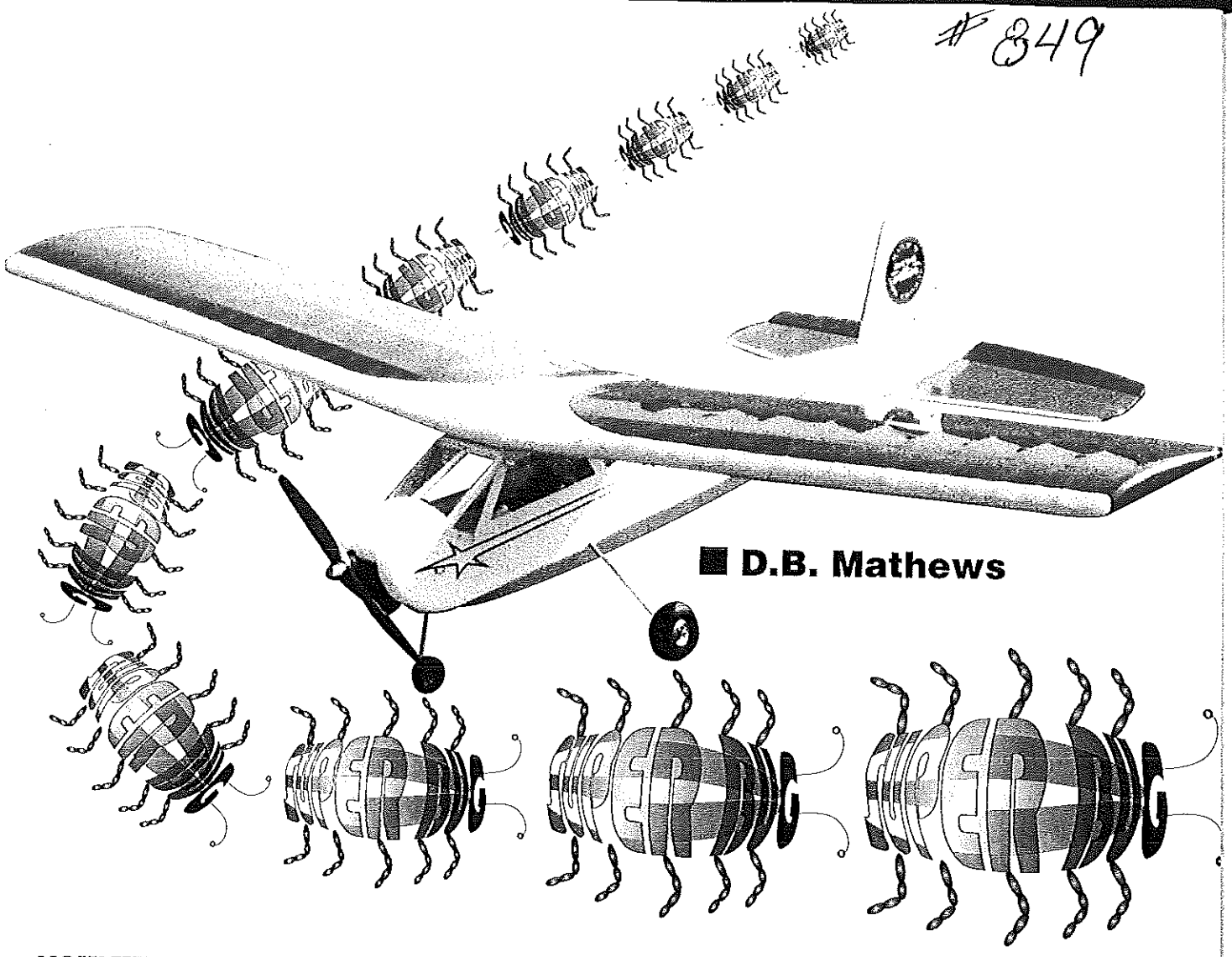
#849



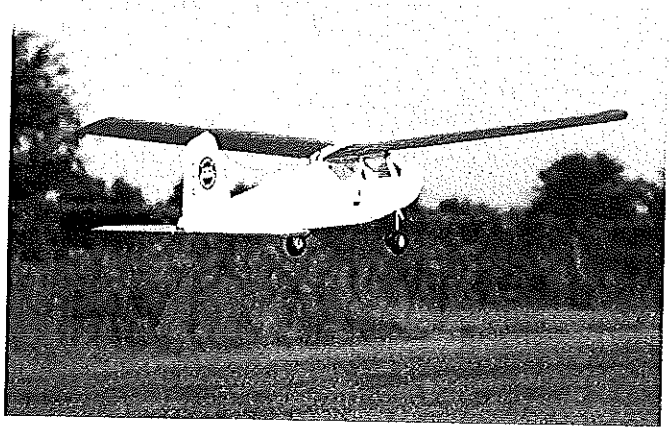
■ D.B. Mathews

NOW HERE IS a model design with a true "blue-blooded" pedigree. Its great grandmother was Walt and Bill Good's pioneering and frequent Nationals RC winning Big Guff, which is now in the Smithsonian.

Grandmother Rudder Bug, a 1948 Good design, was published in *Model Airplane News* in 1949. That year, no less than 11 of the 32 entries in Radio Control at the Olathe (KS) Nationals were Rudder Bugs.

Our project's mother was the Royal Rudder Bug, a scaled-down Bug published in the February 1954 *Flying Models* and kitted by Berkeley Models that same year. This version differed most noticeably in its five-foot wingspan, compared to the original's six feet; replacement of the original undercambered airfoil with the ubiquitous Clark Y; and the use of a smaller radio system.

Photos by the author and Don Robinson Graphic Design by Carla Kunz



The Bug in the air and at rest. It "handles well on the ground," and "flies so slowly it looks suspended."

In 1952, largely through the efforts of AMA, e Citizen Band (27 mHz and 465 mHz) were ıade available exam-free (but not license-free) ır modeling use. This relaxation of quirements opened the door for many for hom the Ham requirement had been an surmountable obstacle. Several manufacturers ɛgan to market assembled and kit units and the C segment of our hobby suddenly exited the ɛperimenters' workshops and began to become practical reality for modelers.

his new version was developed from the ɨiginal *Flying Models* and Berkeley plans ɜed to build a Royal Bug in 1954, powered ith a greenhead K&B .19 and "controlled" ith a CitizenShip radio. I carried those plans ound for 42 years, thinking that some day d build another Royal Rudder Bug.

With the surging interest in models of ose early years and the growth of the intage Radio Control Society (2 Hemlock t., Saugerties NY 12477) I finally have been tten by the Bug again. I dug out those old ans, enlarged the Royal to six feet, tried to iminate some of the notorious structural eak spots, added elevator and throttle ɔntrols, a steerable nose wheel, changed the ademark side doors to top access, and ɜworked the aerodynamics.

For those who feel we've desecrated the ɔirit of the model and era, authentic drawings ɔr the rudder-only Royal Rudder Bug are ɣailable from Bill Northrop's Plans Service !019 Doral Court, Henderson NV 89014). ill also has construction drawings for several ɦer Vintage RC designs.

With today's light, yet highly reliable ɛoportional radio equipment, the addition of ırottle and elevator, and the use of modern dhesives and covering materials, this Bug is ɔtally different than the one I built 42 years ɜo. With three controls, rechargeable ıtteries, and vastly improved reliability, this ɜw version actually weighs less than the ɨiginal rudder-only version.

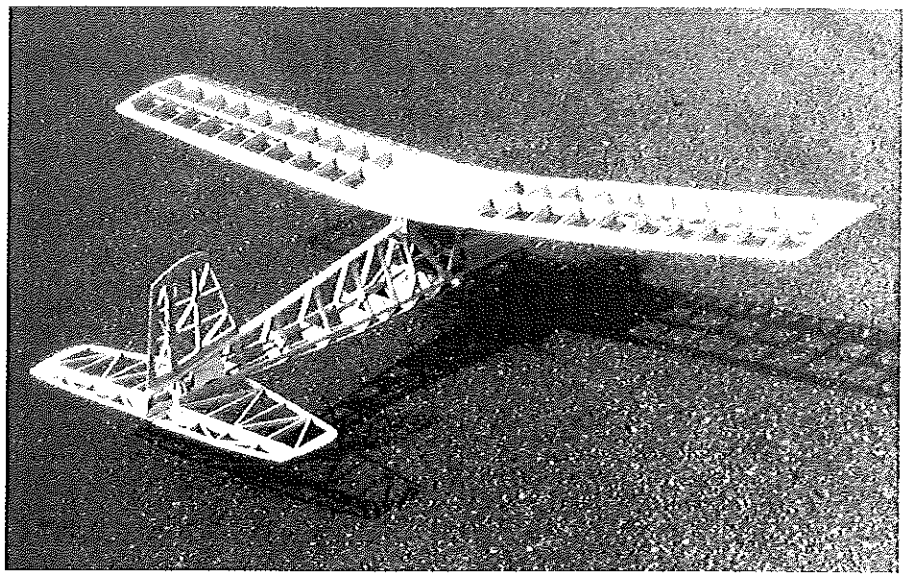
At the 1996 Celebration of Eagles in luncie I was astonished to see Bob Noll fly ı original Rudder Bug with original ɥuipment, and fly it well. The man even did ɔops and rolls with rudder only!

My version does handle well on the ground, ies so slowly it looks suspended, is remarkably able and gentle, and can do the neatest touch-ıd-gos imaginable. All this without the need ɔr the advanced flying skills exhibited by Bob oll, or for spending endless hours adjusting credibly "fussy" radio equipment!

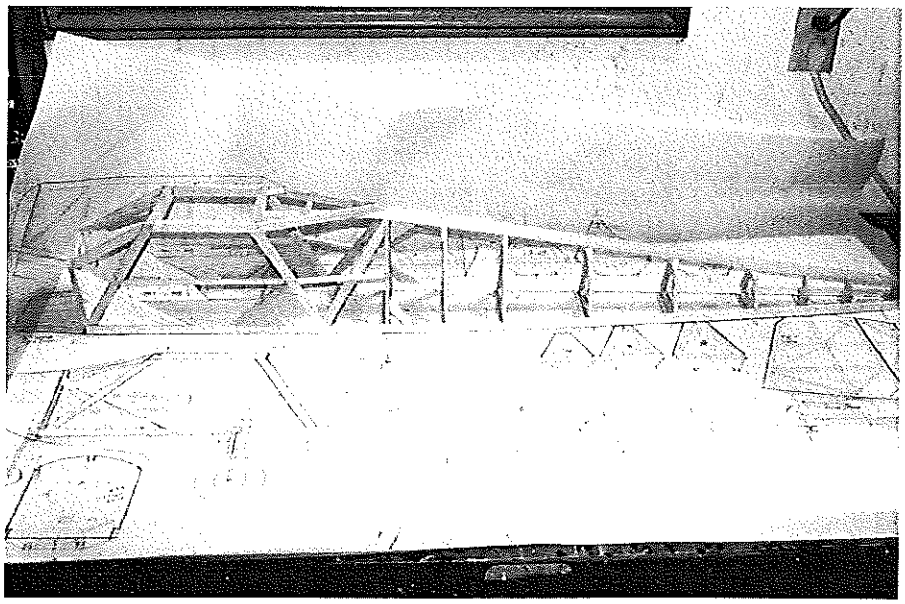
CONSTRUCTION

Several construction approaches are narkers" for Walt Good designs: building the ıselage on a crutch; the "tepee" top formers; ıd the method of introducing washout in the ing tips. These now-nearly-forgotten chniques place a certain appeal to building a ug. Its novel appearance and strong historical gnificance certainly are also attractive.

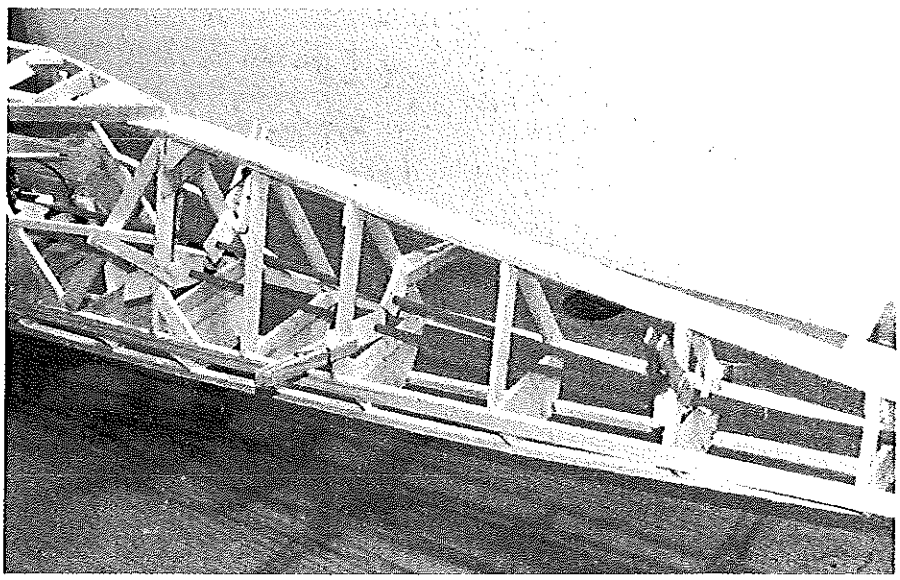
Wood selection should be in the medium ınge; sizes are all standard hobby shop stock; ırdware is all off-the-shelf. The principle dhesive is cyanoacrylate (CyA), with epoxy



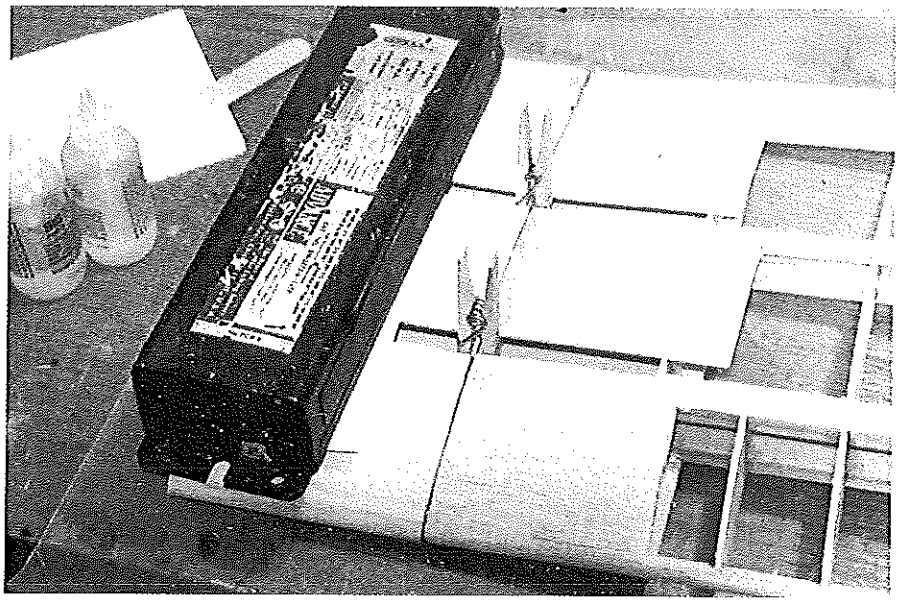
Classic construction is light, strong. "Not nearly as difficult as it looks."



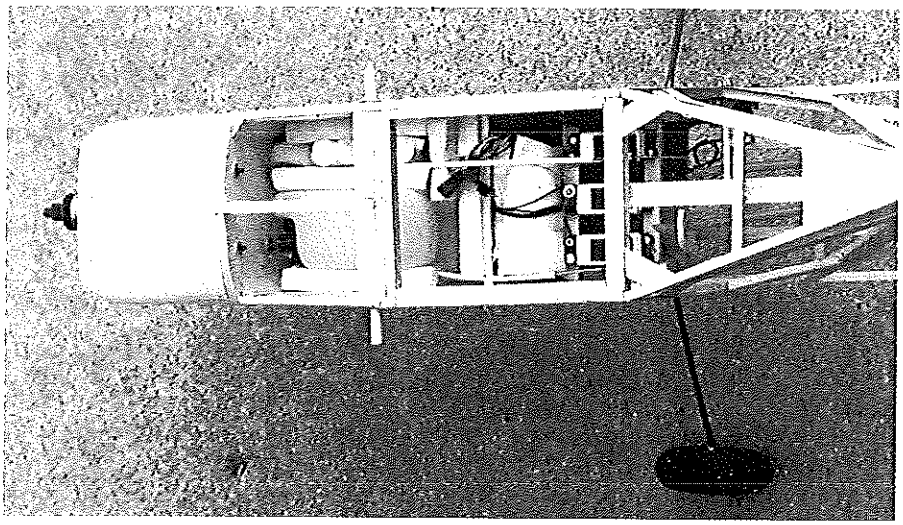
The fuselage top is assembled with the crutch pinned to the building board.



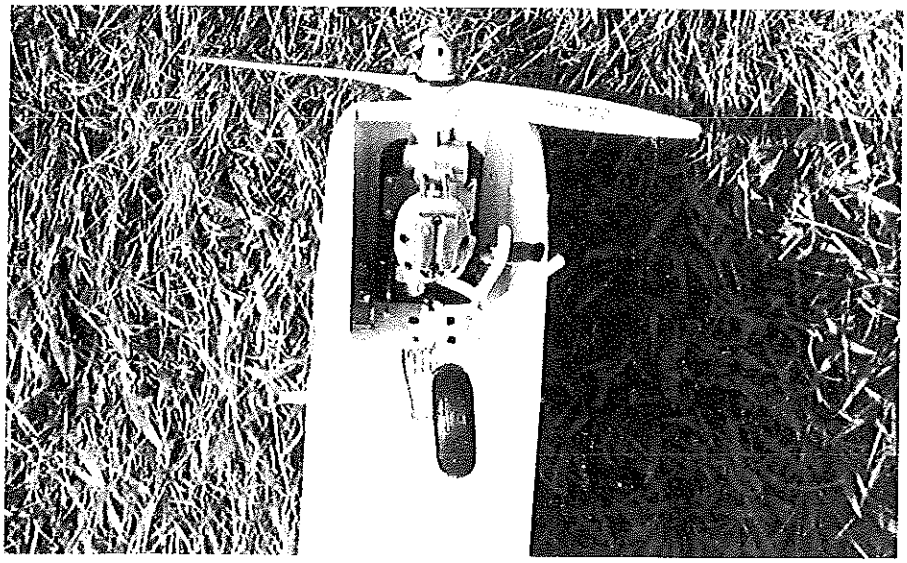
Predrilled Lite Ply scraps are used to align pushrods, then glued and trimmed.



Left wing panel being joined to the center section. Note shear webs.



Prefit radio components before covering—limited access through wing saddle.



Inverted engine no problem if care is exercised. Steerable nose gear a modern touch.

used on the firewall and wing joints. Some good triangles are essential; otherwise, special tools are not required.

The structures are sufficiently stiff to allow use of any finishing method, from silk-and-dope to iron-on. I'd be inclined to avoid some of the prepainted heat-shrink fabric materials, however, because of their weight.

Fuselage: This technique is called "crutch construction" for a pretty self-evident reason. The crutch is assembled directly over the top view, then the preassembled cabin sides and top formers are added. Small sections of scrap 1/64 plywood adhered to the inside of the cabin sides are helpful as "locators" when placing the sides onto the crutch. All assemblies must be at right angles to the crutch and to the building surface.

Don't forget the hole for the rudder post in the capstrip! The post runs all the way down onto the top of the stabilizer!

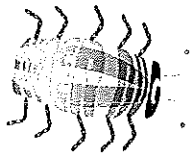
The firewall should be drilled for fuel lines, throttle pushrod, nose gear rod, and engine mounts before assembly to the fuselage. The firewall is tilted forward to build in downthrust and a scrap jig is handy for checking its position against the sides.

Our photo prototype does not have the cabin sides constructed per the drawings, simply because I had toyed with the idea of using the removable doors of the original. After thinking about it, the complexities of accessing the components outweighed any desire for authenticity. I subsequently sheeted in the bottom portion.

The "tepees" are assembled over the drawings and are simple to fabricate if a good razor saw is utilized. As with any scratch-built project, assemble the largest components first; this way, if a piece is cut short, it can still be used for the next former.

Once the sides and tepees are in place, the forward wing saddle framing and windshield braces should be added; again, be sure they are square. To be frank, the rear tapered portion of the cabin and its joint with the rear capstrip is nearly impossible to draw and hard to describe.

These components are cut on two angles in



Type: RC Sport

Wingspan: 75 inches

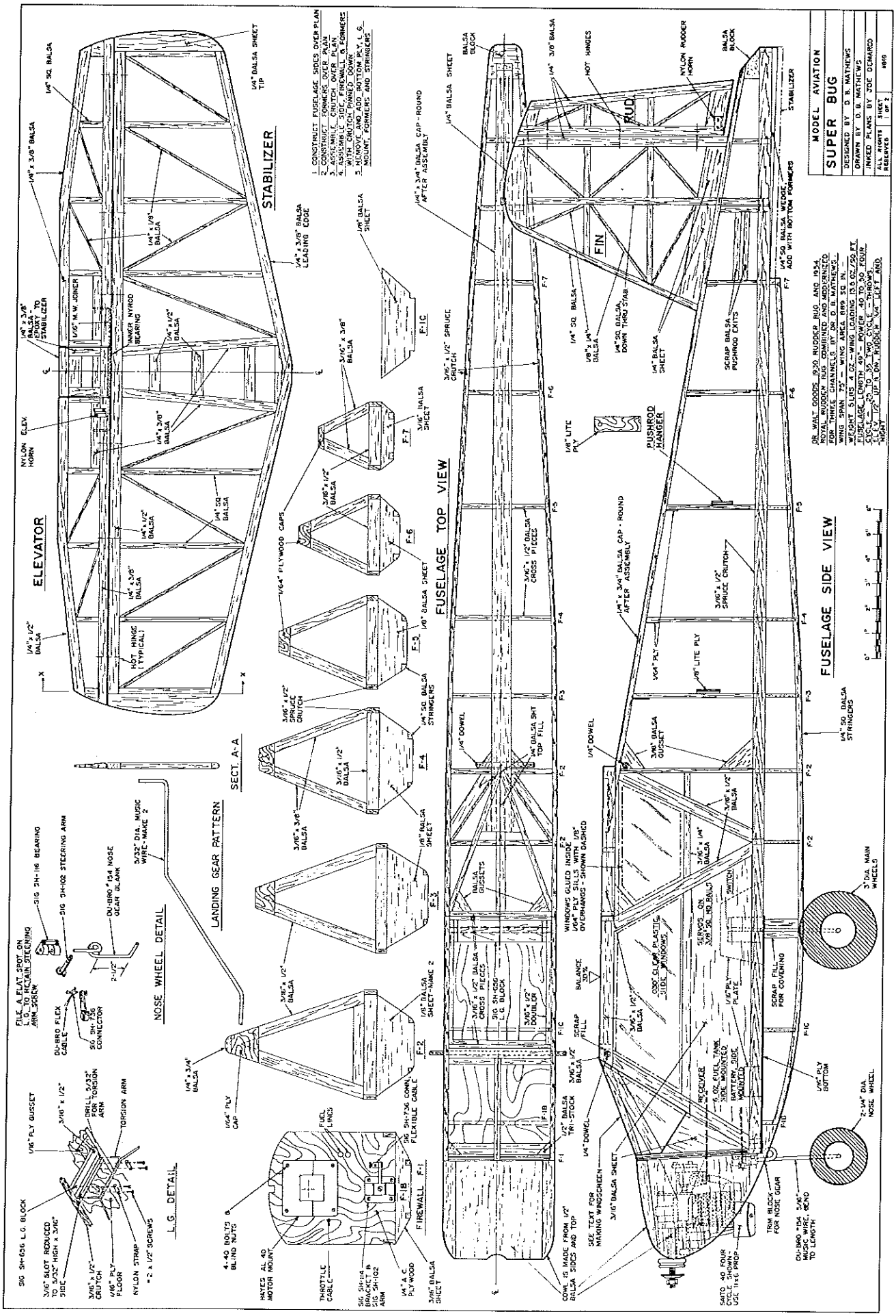
Engine: 40-50 four-stroke or .25-.35 two-stroke

Functions: Throttle, rudder, elevator

Flying Weight: 5 pounds, 4 ounces

Construction: Built-up

Covering/Finish: Iron-on film


MODEL AVIATION
SUPER BUG
DESIGNED BY D. B. MATHEWS
DRAWN BY D. B. MATHEWS
INKED PLANS BY JOE DEMARCO
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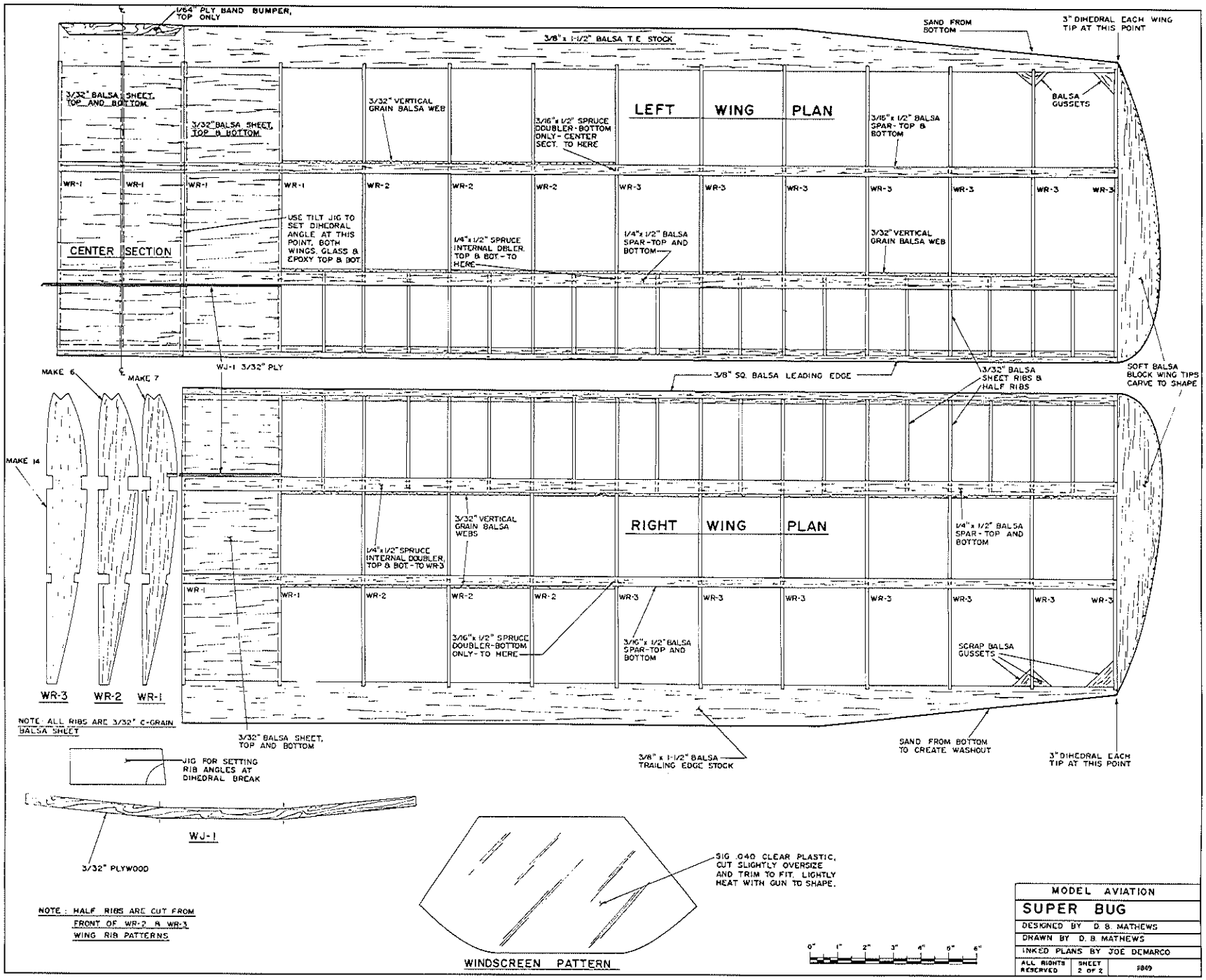
SHEET 1 OF 2
4699
DR. WALT GOODS 1930 RUDDER BUG AND 1934 ROYAL RUDDER BUG COMBINED AND MODERNIZED FOR THREE CHANNELS BY DR. D. B. MATHEWS
WING SPAN 75" – WING AREA 869 SQ. IN. –
WEIGHT 5 LBS 4 OZ – WING LOADING 13.9 OZ/SQ. FT.
FUSELAGE LENGTH 49" – POWER .40 TO .60 FOUR CYCLE – .20 TO .35 TWO CYCLE – THROWS
RIGHT – 1/2" R. ON RUDDER, 1/4" LEFT AND
ELEVATOR
STABILIZER
FIN
RUD.
FUSELAGE TOP VIEW
FUSELAGE SIDE VIEW
SECT. A-A
LANDING GEAR PATTERN
NOSE WHEEL DETAIL
L.G. DETAIL
FIREWALL F-1
1. CONSTRUCT FUSELAGE SIDES OVER PLAN
2. CONSTRUCT FORMERS OVER PLAN
3. ASSEMBLE CRUTCH OVER PLAN
4. ASSEMBLE FUSELAGE SIDES WITH FORMERS, FIREWALL & CRUTCH
5. REMOVE AND ADD BOTTOM PLY, L.G. MOUNT, FORMERS AND STRINGERS
1/4" SQ. BALSA
1/4" x 3/8" BALSA
1/4" DALSA SHEET TIP
1/4" x 3/8" BALSA LEADING EDGE
1/16" M.W. JOINER
INNER NYROD BEARING
1/4" x 1/2" BALSA
1/4" x 1/8" BALSA
1/4" x 3/8" BALSA - EPOXY TO STABILIZER
1/4" SQ. BALSA
1/4" x 1/2" BALSA
1/4" 3/8" BALSA
1/4" x 1/2" BALSA
HOT HINGE (TYPICAL)
NYLON ELEV. HORN
1/8" BALSA SHEET
3/16" x 3/8" BALSA
3/16" x 1/2" BALSA
1/64" PLYWOOD CAPS
3/16" x 1/2" SPRUCE CRUTCH
3/16" x 1/2" BALSA CROSS PIECES
1/4" SQ. BALSA STRINGERS
1/8" BALSA SHEET
3/16" x 3/8" BALSA
1/4" x 3/4" BALSA CAP - ROUND AFTER ASSEMBLY
1/4" BALSA SHEET
BALSA BLOCK
1/4" 3/8" BALSA
HOT HINGES
NYLON RUDDER HORN
1/4" SQ. BALSA
1/8" x 1/4" BALSA
1/4" SQ. BALSA DOWN THRU STAB
1/4" BALSA SHEET
SCRAP BALSA PUSHROD EXITS
1/4" SQ. BALSA WEDGE ADD WITH BOTTOM FORMERS
1/8" LITE PLY
PUSHROD HANGER
3/16" x 1/2" SPRUCE CRUTCH
1/64" PLY
1/8" LITE PLY
1/4" DOWEL
3/8" BALSA GUSSET
1/4" DOWEL
1/4" BALSA SHT TOP FILL
3/16" x 1/2" BALSA
BALSA GUSSETS
3/16" x 1/4" BALSA
SERVOS ON 3/8" SQ. HD. RAILS
SWITCH
.030" CLEAR PLASTIC SIDE WINDOWS
1/16" PLY PLATE
SCRAP FILL FOR COVERING
1/16" PLY BOTTOM
3" DIA. MAIN WHEELS
2-1/4" DIA. NOSE WHEEL
TRIM BLOCK FOR NOSE GEAR
WINDOWS GLUED INSIDE 1/64" PLY SIDES WITH 1/8" OVERHANGS - SHOWN DASHED
BALANCE 30%
SCRAP FILL
3/16" x 1/2" BALSA
3/16" x 1/2" BALSA CROSS PIECES
SIG SH-656 L.G. BLOCK
3/16" SLOT REDUCED TO 1/32" HIGH x 3/16" SIDE
3/16" x 1/2" CRUTCH
1/16" PLY FLOOR
NYLON STRAP - 2 x 1/2" SCREWS
1/16" PLY GUSSET
3/16" x 1/2"
DRILL 5/32" FOR TORSION ARM
TORSION ARM
FILE A FLAT SPOT ON L.G. TO RETAIN STEERING ARM SPRING
SIG SH-116 BEARING
SIG SH-102 STEERING ARM
DU-BRO FLEX CABLE
SIG SH-636 CONNECTOR
DU-BRO #154 NOSE GEAR BLANK
2-1/2"
5/32" DIA. MUSIC WIRE - MAKE 2
1/4" 3/4" BALSA
1/64" PLY CAP
1/8" BALSA SHEET - MAKE 2
4-40 BOLTS W/ BLIND NUTS
HAYES AL 40 MOTOR MOUNT
THROTTLE CABLE
SIG SH-104 BRACKET IN SIG SH-102 ARM
1/4" A.C. PLY WOOD
3/16" BALSA SHEET
FUEL LINES
SIG SH-736 CONN. FLEXIBLE CABLE
1/2" BALSA TRI-STOCK
1/4" DOWEL
3/16" x 1/2" BALSA
COWL IS MADE FROM 1/2" BALSA SIDES AND TOP
SEE TEXT FOR MAKING WINDSCREEN
3/16" BALSA SHEET
RECEIVER
6 OZ. FUEL TANK SIDE MOUNTED
BATTERY MOUNTED UNDER
SAITO 40 FOUR CYCLE SHOWN USE 11x6 PROP
OU-BRO #154 3/16" MUSIC WIRE, BEND TO LENGTH


1/64" PLY BAND BUMPER, TOP ONLY
3/8" x 1-1/2" BALSA T.E. STOCK
SAND FROM BOTTOM
3" DIHEDRAL EACH WING TIP AT THIS POINT
3/32" BALSA SHEET, TOP AND BOTTOM
3/32" BALSA SHEET, TOP & BOTTOM
3/32" VERTICAL GRAIN BALSA WEB
3/16" x 1/2" SPRUCE DOUBLER-BOTTOM ONLY-CENTER SECT. TO HERE
LEFT WING PLAN
3/16" x 1/2" BALSA SPAR-TOP & BOTTOM
BALSA GUSSETS
WR-1 WR-1 WR-1 WR-1 WR-2 WR-2 WR-2 WR-3 WR-3 WR-3 WR-3 WR-3 WR-3 WR-3
USE TILT JIG TO SET DIHEDRAL ANGLE AT THIS POINT, BOTH WINGS. GLASS & EPOXY TOP & BOT.
CENTER SECTION
1/4" x 1/2" SPRUCE INTERNAL DBLR. TOP & BOT.-TO HERE
1/4" x 1/2" BALSA SPAR-TOP AND BOTTOM
3/32" VERTICAL GRAIN BALSA WEB
WJ-1 3/32" PLY
3/8" SQ. BALSA LEADING EDGE
3/32" BALSA SHEET RIBS & HALF RIBS
SOFT BALSA BLOCK WING TIPS CARVE TO SHAPE
MAKE 6
MAKE 7
MAKE 14
1/4" x 1/2" SPRUCE INTERNAL DOUBLER, TOP & BOT.-TO WR-3
3/32" VERTICAL GRAIN BALSA WEBS
RIGHT WING PLAN
1/4" x 1/2" BALSA SPAR-TOP AND BOTTOM
WR-1 WR-1 WR-2 WR-2 WR-2 WR-3 WR-3 WR-3 WR-3 WR-3 WR-3 WR-3
3/16" x 1/2" SPRUCE DOUBLER-BOTTOM ONLY-TO HERE
3/16" x 1/2" BALSA SPAR-TOP AND BOTTOM
SCRAP BALSA GUSSETS
WR-3 WR-2 WR-1
NOTE: ALL RIBS ARE 3/32" C-GRAIN BALSA SHEET
3/32" BALSA SHEET, TOP AND BOTTOM
3/8" x 1-1/2" BALSA TRAILING EDGE STOCK
SAND FROM BOTTOM TO CREATE WASHOUT
3" DIHEDRAL EACH TIP AT THIS POINT
JIG FOR SETTING RIB ANGLES AT DIHEDRAL BREAK
WJ-1
3/32" PLYWOOD
NOTE: HALF RIBS ARE CUT FROM FRONT OF WR-2 & WR-3 WING RIB PATTERNS
SIG .040 CLEAR PLASTIC, CUT SLIGHTLY OVERSIZE AND TRIM TO FIT. LIGHTLY HEAT WITH GUN TO SHAPE.
WINDSCREEN PATTERN
0" 1" 2" 3" 4" 5" 6"
MODEL AVIATION
SUPER BUG
DESIGNED BY D. B. MATHEWS
DRAWN BY D. B. MATHEWS
INKED PLANS BY JOE DEMARCO
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SHEET 2 OF 2
1849

rder to flare into the tepee and cap. I suggest anding slowly with a block and checking requently for fit. It is essential that the wing addle be flat and level, with solid joints! If all lse fails, do not compromise these joints; cut a ew piece. Add the gussets, reinforcing strip, nd drill the dowel holes, but do not adhere it.

With the upper fuselage assembly still inned to the building board, trial-fit the servos nd pushrods. The scrap plywood supports oupled with the exits and front braces should be rranged to avoid any potential flexing of the ods. I use 30-inch 2-56 threaded pushrods unning inside Nyrods with threaded clevises on ie surface ends and solder links on the servo rms.

Remove the upper fuselage from the board, dd the lower formers, plywood bottom, tabilizer incidence strips, and landing gear orque boxes. Note the forward block at the ottom of the firewall is actually in two pieces to reate a box for the nose gear coil.

Since the main gear will have to be in place efore covering the model, scrap balsa filler is sed around the wire to aid in covering. The ame is true around the pushrod exits at the rear.

Round the bottom stingers, the tepee cap, the ear block, the nose blocks, etc. with 220-grit andpaper on a block.

Wing: This is actually a simple wing to build. The original used interior spars in slotted ribs, vhich is fine for a kit but a bearcat to scratch-uild without warps. The four-spar method I hose is not only much simpler, it is stronger. On the other hand, the half-ribs add nothing but osmetics and a touch of nostalgia, and they ould be omitted if the builder should choose to lo so.

The wing panels are built by placing the ottom spars and sheeting over the plans, adding ie ribs, the leading edge, the half-ribs, and then ie top spars, shear webs, and center-section heeting. The inboard ribs are tilted using the jig, nd the spars are trimmed flush with the ribs.

Tip blocks should be added at this time and ontoured using an X-Acto carving blade and anding blocks. Cut and adhere all gussets and ound the leading edge strip.

Center-section construction follows this equence except that the outboard ribs and spar nds are cut at right angles to the building board.

Outboard wing panels are built to a full ectangle, cutting the trailing edge slant after

completing assembly. The bottoms of the ribs and the rear spars are sanded to flare into the trailing edge. This creates built-in washout, which adds tremendously to the Bug's inherent stability.

When both panels and the center section have been completed, they are joined by blocking up a tip to the dihedral measurement and block-sanding the face rib parallel with a table edge. Repeat for the other panel. Join an outboard panel (blocked up) to the pinned and weighted-down center section using epoxy; when the epoxy has cured, repeat with the other panel.

Cut slots along the spar/rib face for the plywood dihedral braces and epoxy in place. The joint is completed by sanding out the rough spots and wrapping it with glass tape and finishing epoxy resin. The plywood rubber band "bumpers" are installed after glassing the center section.

The tail feathers are of simple construction and don't require much comment. The spars at the hinge lines should be relatively hard and absolutely unwarped. The wire elevator connector runs inside a section of inner Nyrod and is installed with the same techniques used in setting up strip aileron horns.

Hinges on the 1954 version were small sections of music wire running inside brass grommets. The grommets were thread-wrapped and cemented to the top and bottom of the fin. On this model, I used "hot hinges!" One of the numerous newer products that are incomparably superior to those available 42 years ago.

Dr. Good's original Royal Rudder Bug (as well as the earlier versions) used thin semisymmetrical airfoils for the stab and rudder. The stab was set at about 3° negative; no downthrust or wing incidence was used.

(These rudder-only models could sometimes be looped by climbing to considerable altitude, then using rudder to spiral down—creating sufficient speed to cause the negative stab setting to drive the model up and over into a loop when the rudder was

neutralized. All intentional landings were power-off).

I chose to eliminate the semisymmetrical sections for construction simplicity, and because engine downthrust will serve the same function. I originally set the stab at 0° incidence, but even with 7° of downthrust the Bug needed full down trim to control climb in any throttle setting above 30%. Changing to 3° positive in the stab cured the unwanted climb problem.

I also increased the area of the rudder slightly to tighten the turn radius, particularly in super-slow flight. The dihedral angle is unchanged, which provides very positive leveling of the model once rudder is neutralized.

Covering and Finish: If the builder has the time, money, and most importantly, the skill, this project would be truly beautiful when covered in silk and clear dope. Unfortunately, my wife is violently allergic to dope fumes; therefore the photo model is finished in transparent MonoKote trimmed with Rust-Oleum® paint, trim tape, and Sig Four-Star 40 wing and fuselage graphics.

I placed a 600 mAh battery pack, the receiver, and the tank on their sides with sections of foam in between, forming a multilayered vertical sandwich just back of the firewall. A strip of balsa should be run across the top of this to prevent vibration from lifting the parts.

Pushrod, servo, and horn installation is at the builder's preference. As suggested earlier, these components should have been prefit before covering—the access through the wing saddle is limited.

The windows are installed as the last step in construction. They are sections of clear plastic scored over the plans, popped apart, and trimmed to fit inside the scrap 1/64 plywood frames. They are adhered to the inner edges with RC-56 adhesive. This technique has worked well for me on several projects; it looks neat, is utilitarian, and is simple to do.

Flying: What a joy it was to finally—after all these years—have a Bug take off gracefully, fly beautifully, and land at my feet, over and over again, with total predictability. That's what the whole project was about!

I could go to great lengths relating the

virtues of the Bug in this new version, but they can be summarized rather succinctly: This model flies like an in-between-size Sig Kadet Senior/Seniorita—and that is a pretty good recommendation! A sound aerodynamic design is a sound design, regardless of its age.

A brief observation on inverted four-stroke engines: While one of the highly respected magazine "engine" columnists used to get ballistic on this subject, many of us run strokers inverted with no particular problem.

If there is a secret to successfully operating them it is *never, but* never *choke them*, be absolutely certain the fuel tank location will not allow siphoning of fuel into the carburetor, and set the low-end and idle a bit lean—never rich. Almost all potential problems are associated with swamping the glow plug with fuel.

An onboard glow driver is helpful, but not essential. Don't back away from some project with an inverted four-stroke engine: it's a manageable installation.

This Bug is so simple to fly that it ranks right in there with the best of the modern sport/trainers. The design would be a worthwhile building project without all the nostalgia baggage, but with it this has been super-delightful.

I suppose a purist would construct a Royal Rudder Bug exactly as originally designed, use original radio equipment of that period, Ambroid cement, silkspan, clear nitrate dope, vintage wheels, over-and-under fabric hinges, etc. Then he'd haul the model to the flying site in a 1952 Ford Victoria, while wearing clothing of the period. To each his own! Whatever brings them fun.

If you have wondered how well one of these old RC designs would fly with modern radio equipment, here is a wonderful chance to find out.

One warning however: You will have a difficult time figuring out how to wind the rubber strip for the escapement. ✈

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