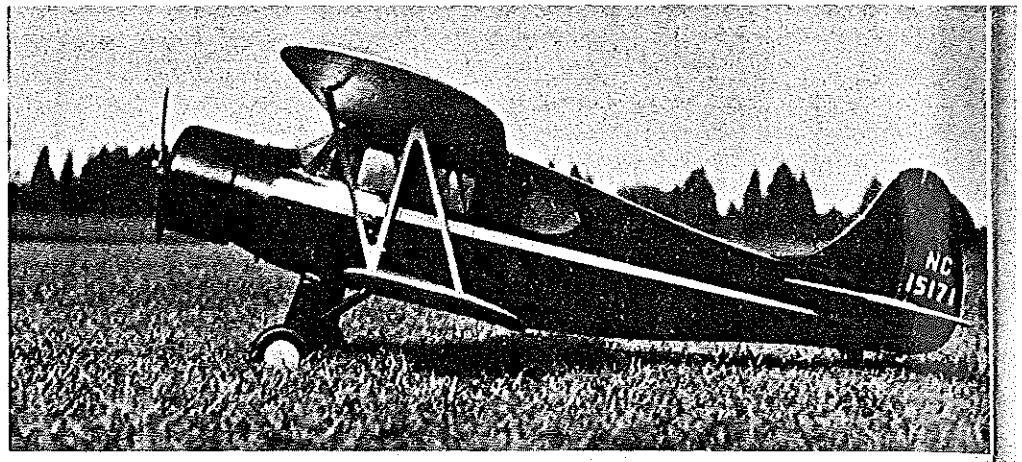
# The WACO 1936 Custom Cabin

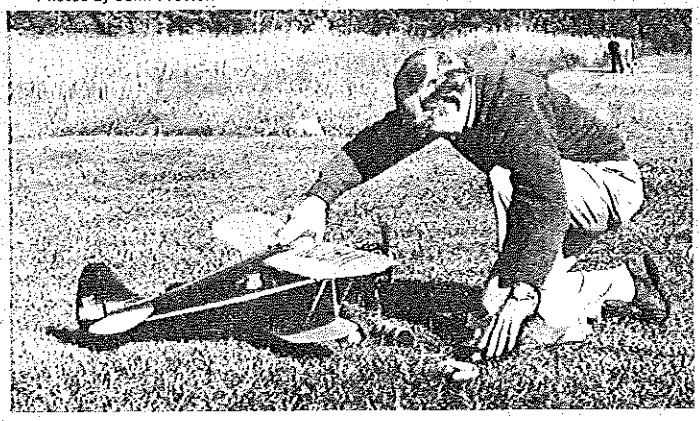

What appears to be a big Waco at old Siwash airport on a lazy afternoon, is Don's Custom. These slightly different views tell you a great deal about strut arrangements and the stringers on top of the cabin. That rigid strut, rather than flying wires, is a natural for bipe modelers.

I'LL never forget that huge, shiny red and silver biplane sitting on the runway. As the cabin door swung open, the 9-year-old kid had to be boosted up onto the lower left wing and into the spacious cabin. Impressions of my first airplane ride at Detroit City Airport that day linger still—the roomy plush interior, the funny-shaped rear window, and the roaring surge of power accelerating us to an exciting takeoff over the Michigan landscape. I learned later that the airplane was a 1936 model Waco custom cabin.

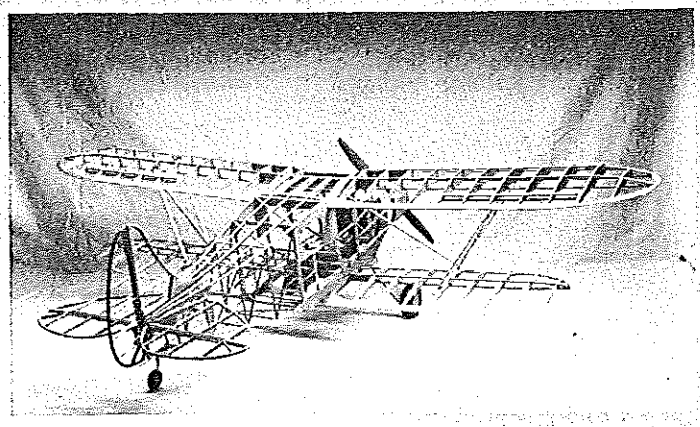
I finally got around to building a model of this Waco classic several years ago. It started out as a compulsion to build the huge 50-inch span rubber-powered model from the old Megow plans. Although I love free-flight scale as much as RC scale, I couldn't resist the thought of a lightweight radio version of that chubby beauty which could perform low fly-bys, touch-and-goes, and maybe bring back a little of the excitement of that first airplane ride. The original free-flight idea may have unintentionally affected my design of the Waco, since the model's all-up weight turned out to be a rather surprising 2 pounds. By usual standards of RC construction, a 52-in. span multi-channel scale biplane with over 550 sq. in. of wing area would weigh more than double that figure. Largely because of this very low wing loading (about 8 ounces per sq. ft.) the Waco turned out to be one of the best flying sport models that I have ever built. Slow, scale-like flight, easy takeoffs and landings, and super touch-and-goes are its stock in trade. It is no fragile hangar queen though. Almost three years of use and 100 plus flights under all sorts of conditions attest to the model's serviceability. The only repairs that have been required so far include the usual handling scrapes and punctures and a

**We guarantee without reservation that you will thoroughly enjoy the excellent sport-flight characteristics of this 15-powered scale job for REM controls—ailerons can be added if you wish, but are entirely unnecessary. ■ Don Srull**

Photos by John Preston



Fingering the throttle lever, the designer listens to the note of the trusty Max 15. See the depth of the grass? The Custom lifts off quickly in a short distance, with elevator held up until flying speed is almost attained, and a single rudder application against torque swing sometimes needed. Based on a Megow rubber model, the ship acts like big one.



You may have heard this a thousand times, but an important factor in flight success is buiding the frame light, strong, accurate, and neatly. Time invested here pays off. You can add workable ailerons.

bent landing gear strut.

The model is not intended to be a super-scale scale ship, but rather a sport flier. Where compromises were made they were made to simplify construction or to improve serviceability. Overall the Waco turned out to be one of those rare and lucky models in which everything just seems to work out right, and the finished product flies better than expected. Even though it's semi-scale, it also seems to capture that charismatic Waco look in flight—and it's certainly a lot more esthetic than the usual boxy Sunday flier.

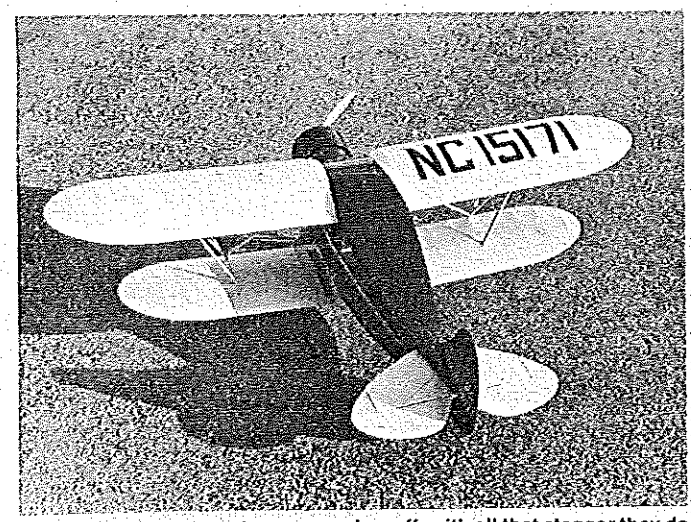
**Full-Size Waco:** In 1931, the closed cabin design was a dramatic and risky departure from the earlier open-cockpit biplanes that Waco had been producing since 1921. With these designs Waco had become one of the most successful American aircraft manufacturers, and had established a long and highly regarded line of aircraft that were marketed world-wide. In the Spring of 1931, Waco introduced the first cabin models. Despite the limited private aircraft market at that time, the new cabin design was enthusiastically accepted. Each year thereafter cabin models were offered, and in 1935 a "custom" series was added to the line. Although the custom models resembled the standard line, they in fact were substantially different designs. In addition to the plush, custom cabin interiors, they had many other special features, such as landing flaps. A choice of various Jacobs, Wright, and Continental engines from 200 to 300 hp was available. The structure was of high quality, though conventional materials: steel tubing fuselage framework with plywood bulkheads and wooden stringers. The wings were of all wood structure with aluminum ailerons in the upper wing only. The fabric covering had a hand-rubbed custom finish in a choice of several colors. Price of the Custom Cabin, F.O.B. Troy, Ohio, ran from $7,300 to $9,600 depending on choice of engine and other options.

The 1936 Custom Cabin had a wingspan of 35 feet and was advertised as having a top speed of 150 to 160 mph, and cruised at 130 to 140 mph. Landing speed was a slow 40 to 50 mph (which means that a 1½" = 1' scale model should land at 5 to 6 mph!). Gross takeoff weight was in the 3100 to 3200 pound range.

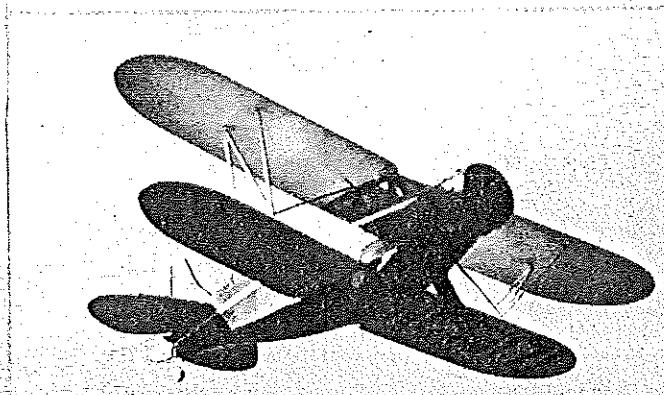
**The Model:** It is built to a scale of 1½" = 1' and is patterned after the Jacobs-powered 1936 Custom Cabin series. These aircraft were designated YQC-6, ZQC-6, or AQC-6, depending on the particular Jacobs engine installed.

While the plans show a three-channel radio installation for rudder, elevator, and throttle control, a fourth channel for aileron control could easily be added. The basic requirement is to keep the weight down; between 2 and 2½ pounds is ideal. The prototype was flown with both an O.S. Max .10 and an O.S. Max .15. Both engines were satisfactory although the .10 takeoff performance from small fields or grass runways was somewhat marginal. I would therefore recomend a .15 engine as ideal. At 2 pounds weight, the .15 will provide quick, safe takeoffs from even heavy grass strips.

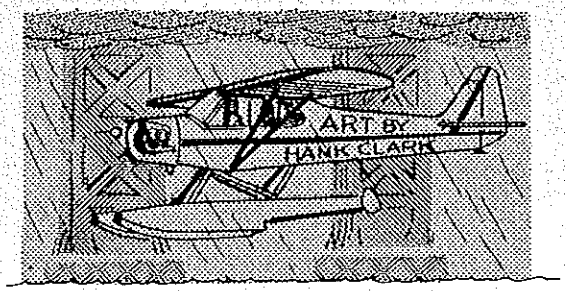
In order to keep the weight within limits it will be necessary to use one of the newer miniature, lightweight radios. Not only would a heavier radio add unnecessary weight of itself, but the heavier servos would require substantial structural beefing up in the cabin area to take the increased loads generated in the inevitable hard landings and bumps during those Sunday flying sessions. Also, please resist the temptation to beef up the structure with additional plywood or much heavier materials, or to




Wacos—like Hawks—always scared us off; with all that stagger they do seem so short-coupled. Rest assured, flight is absolutely rock solid. Paint schemes abound—this one was dark blue with silver surfaces.



This fly-by was as close as it looks—ship is smoothly responsive and you can put it exactly where you want it. It flies about the same as a typical sport model, yet has unparalleled realism. Do build it light.




1/8" DOWEL WING HOLD DOWNS

WIRE STRUT MOUNT SAME AS BOTTOM (IN DETAILS)

F-11 FORMER IS GLUED TO WING T.E.

1/16" X 1/4" DUMMY AILERON GAP (NO AILERONS USED)

F-14 FORMER (2) GLUED TO WING RIBS

1/8" SHEET CABIN SIDE PANELS

R-1

1/8" X 5/16" HARD BALSA STRUTS

F9

F8

F5

1/8" DOWELS FOR ACETATE WINDSHIELD

ENGINE SERVO

3/8" DIA. VENT HOLES (6)

1/32" PLYWOOD COWL WRAP

F-2

ROCKER BOX COWL BUMPS (OPTIONAL)

FUEL

NEEDLE EXTENSION FOR SCREW DRIVER

F-1

O. S. MAX .15 ON METAL MOUNT

F-3

EXHAUST EXTENSION THROUGH BOTTOM OF COWLING

1/4" SHEET BALSA RINGS (3) LAMINATED AND CARVED TO SHAPE

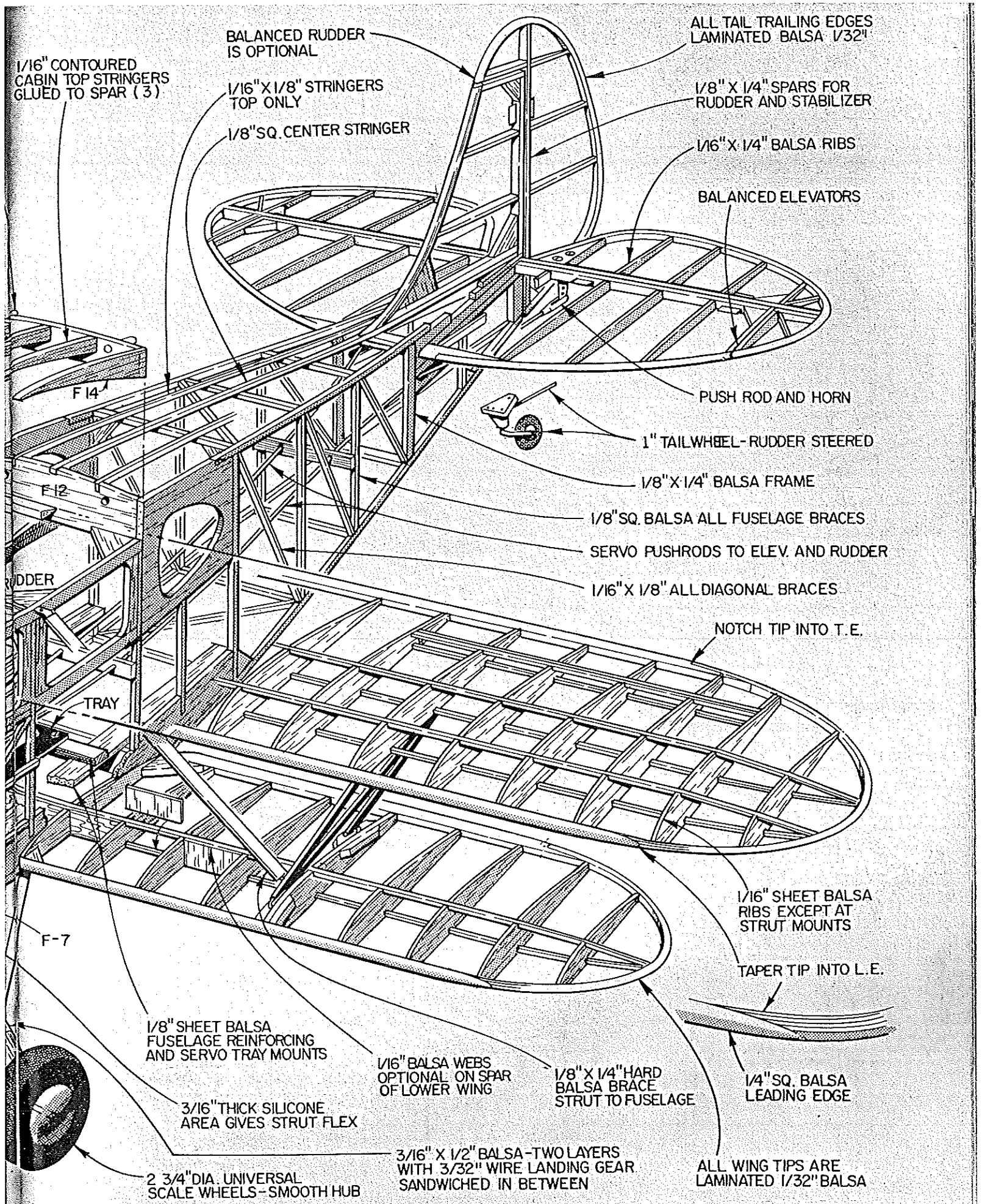
1/16" WIRE STRUT BRACE AND SHOCK ABSORBER

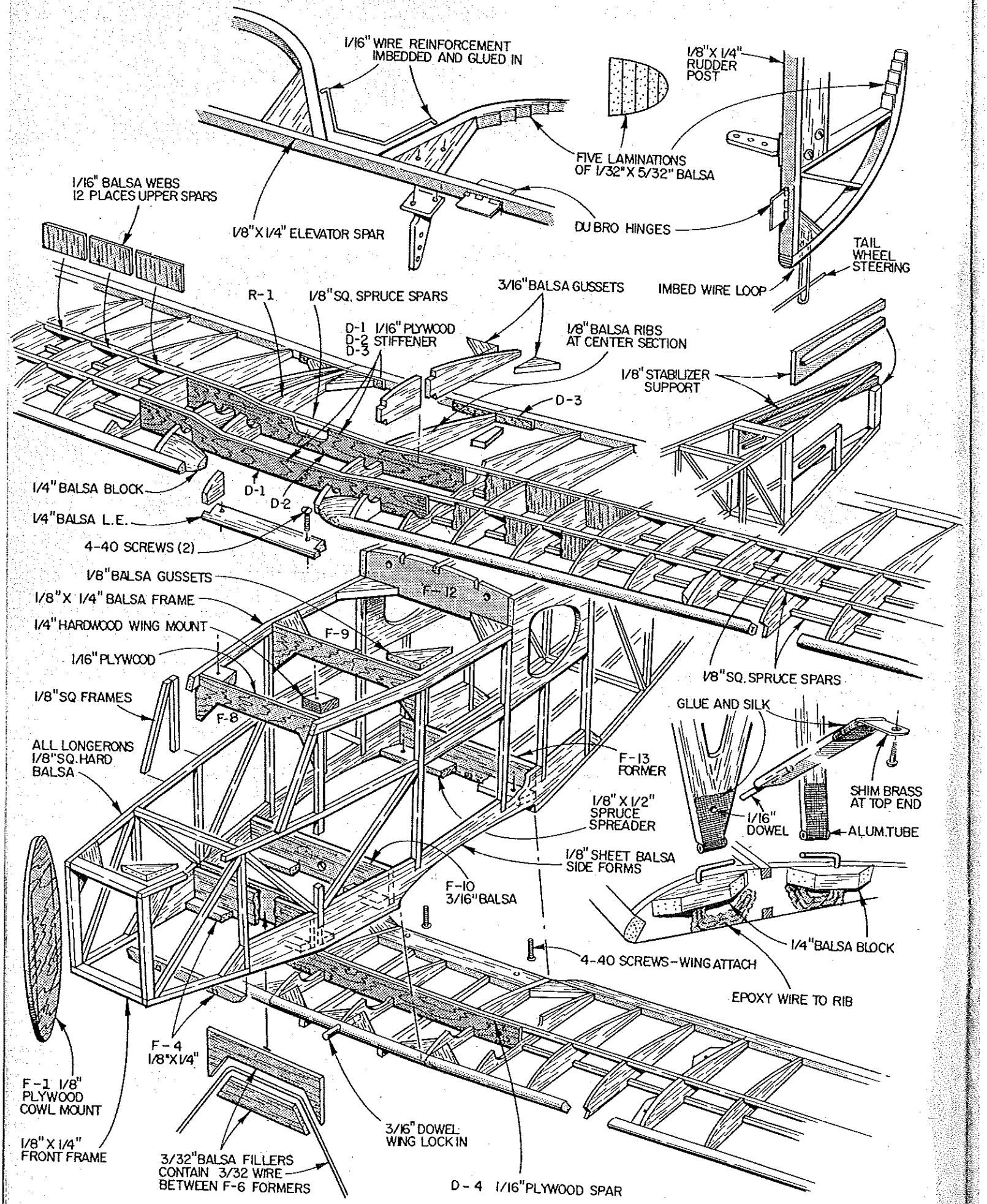
3/16" SQ. COWL STRINGERS (8)

1/8" SQ. BALSA SIDE STRINGERS 2 ONLY

C-1 1/8" PLYWOOD RING SECURES COWL TO F-1 FORMER WITH 3 SCREWS

1/16" SHEET COWLING


BALANCED RUDDER IS OPTIONAL
ALL TAIL TRAILING EDGES LAMINATED BALSA 1/32"
1/16" CONTOURED CABIN TOP STRINGERS GLUED TO SPAR (3)
1/16"X1/8" STRINGERS TOP ONLY
1/8"SQ. CENTER STRINGER
1/8" X 1/4" SPARS FOR RUDDER AND STABILIZER
1/16" X 1/4" BALSA RIBS
BALANCED ELEVATORS
F 14
PUSH ROD AND HORN
1" TAILWHEEL-RUDDER STEERED
F 12
1/8"X 1/4" BALSA FRAME
1/8"SQ. BALSA ALL FUSELAGE BRACES
SERVO PUSHRODS TO ELEV. AND RUDDER
1/16" X 1/8" ALL DIAGONAL BRACES
NOTCH TIP INTO T.E.
TRAY
1/16" SHEET BALSA RIBS EXCEPT AT STRUT MOUNTS
F-7
TAPER TIP INTO L.E.
1/8" SHEET BALSA FUSELAGE REINFORCING AND SERVO TRAY MOUNTS
1/16" BALSA WEBS OPTIONAL ON SPAR OF LOWER WING
1/8" X 1/4" HARD BALSA BRACE STRUT TO FUSELAGE
1/4" SQ. BALSA LEADING EDGE
3/16" THICK SILICONE AREA GIVES STRUT FLEX
3/16" X 1/2" BALSA-TWO LAYERS WITH 3/32" WIRE LANDING GEAR SANDWICHED IN BETWEEN
ALL WING TIPS ARE LAMINATED 1/32" BALSA
2 3/4" DIA. UNIVERSAL SCALE WHEELS-SMOOTH HUB


1/16" WIRE REINFORCEMENT IMBEDDED AND GLUED IN
1/8"X 1/4" RUDDER POST
FIVE LAMINATIONS OF 1/32"X 5/32" BALSA
1/16" BALSA WEBS 12 PLACES UPPER SPARS
1/8"X 1/4" ELEVATOR SPAR
DU BRO HINGES
TAIL WHEEL STEERING
IMBED WIRE LOOP
3/16" BALSA GUSSETS
R-1
1/8" SQ. SPRUCE SPARS
D-1 1/16" PLYWOOD
D-2 STIFFENER
D-3
1/8" BALSA RIBS AT CENTER SECTION
1/8" STABILIZER SUPPORT
1/4" BALSA BLOCK
D-1
D-2
1/4" BALSA L.E.
4-40 SCREWS (2)
1/8" BALSA GUSSETS
1/8"X 1/4" BALSA FRAME
1/4" HARDWOOD WING MOUNT
1/16" PLYWOOD
F-12
F-9
F-8
1/8" SQ FRAMES
ALL LONGERONS 1/8" SQ. HARD BALSA
F-13 FORMER
GLUE AND SILK
SHIM BRASS AT TOP END
1/16" DOWEL
ALUM. TUBE
1/8" X 1/2" SPRUCE SPREADER
1/8" SHEET BALSA SIDE FORMS
F-10 3/16" BALSA
1/4" BALSA BLOCK
4-40 SCREWS - WING ATTACH
EPOXY WIRE TO RIB
F-4 1/8"X1/4"
F-1 1/8" PLYWOOD COWL MOUNT
1/8" X 1/4" FRONT FRAME
3/16" DOWEL WING LOCK IN
3/32" BALSA FILLERS CONTAIN 3/32 WIRE BETWEEN F-6 FORMERS
D-4 1/16" PLYWOOD SPAR

use a much larger, heavier engine. The airframe is plenty strong enough, and the model's good flying characteristics are dependent on the low wing loading. So if you're ready, let's build!

**The Airframe:** The basic airframe is of rather simple built-up construction. The fuselage longerons are of ⅛" sq. spruce, while all of the uprights and cross members are of balsa. I find that thinned Titebond or the equivalent aliphatic glue works well in these cases. The cyanoacrylate "super glues" do not seem to bond well to spruce or other hard wood end grain. After the two fuselage sides are built and joined together, install the 4-ounce clunk tank and the connecting filler and vent tubes. Since the tank will not be accessible after the fuselage is closed-up, make sure that the tank is properly supported and that it has no leaks.

After the wire landing gear is constructed and epoxied into the fuselage, it is faired with 3/16 sheet balsa struts. The struts have a flexible joint of silicone or foam rubber near the fuselage juncture. This layer of material should be shaped to blend into the struts and the balsa landing gear fillet which is attached to the fuselage. After covering and priming the fuselage a strip of 3/8" vinyl tape is wrapped around this joint, and after final painting, the joint is hardly visible.

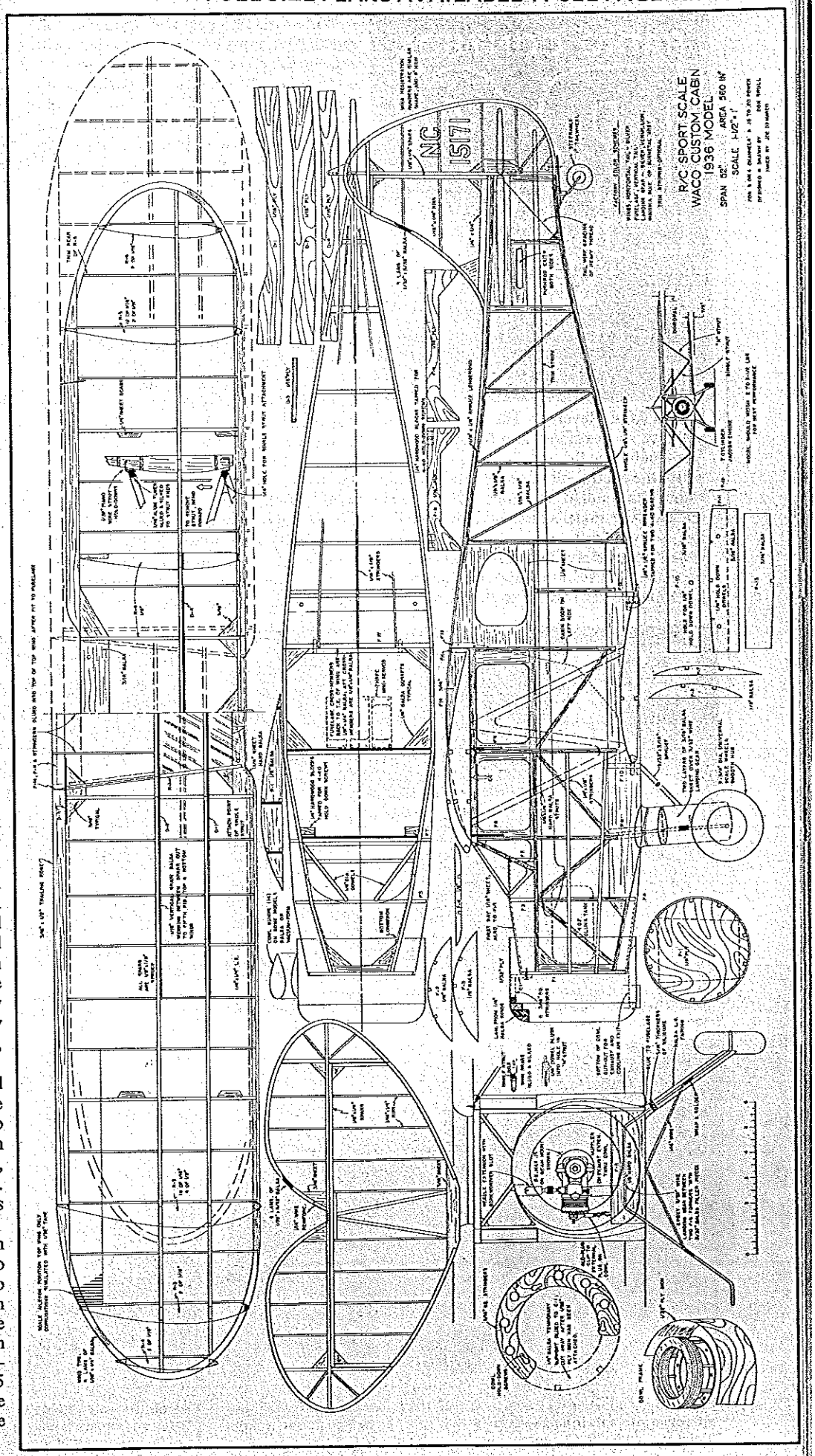
The fuselage top stringers should not be added until the wings are completed and fitted to the fuselage. At that time, former f-11 and stringers can also be added to the top wing center section and blended into the fuselage.

The wings use ⅛ sq. spruce top and bottom spars. These are relatively light weight and extremely strong, particularly after the 1/16 balsa shear webs are cemented between the spars. Wing tips and tail outlines are laminated from strips of balsa which have been moistened, wrapped around plywood forms, and glued with Titebond glue. If you are worried about the strength of these members, you can add an inside lamination of 1/32" plywood with very little additional weight. This layer of ply stiffens up the laminated pieces significantly, and decreases their warp susceptibility.

After both wings have been finished and final sanded, they should be fit to the fuselage. Take extreme care in lining up both wings accurately with respect to each other and with respect to the fuselage. Sand, carve, shim, etc. until they align perfectly. Then drill holes for the hold-down screws and dowels.

The struts can now be tailor-made from hard ⅛ by ¼ balsa which has been sanded to a streamline section. First build the two "N" struts slightly oversize, then trim them to about ⅛ inch clearance at each end. Glue and silk small pieces of 1/16 aluminum tubing to each strut end. Bend the "U"-shaped strut holddown clips from .045 piano wire as shown on the plans. With the wings bolted in place, clamp the clips to the

*Continued on page 95*



## For Openers/Winter

*continued from page 4*

Over Don Srull's drawing table is a big homemade projector. Finally, we opted for two of the best looking drawings, scaled a side view to a size which, if multiplied by 5, would give us the model profile. Another drawing was scaled for multiplication by 8—this for planform. Srull, Bowers, and the old wizard, Ned Kragness, had a bull session with us during which we projected the color slides from the Antique Aircraft Museum, and Ned explained the why of every tube, nut and bolt.

All the while we've been whipping out sheets of drawings and cross sections—started over three times. What we now are trying to do is to freeze at a reasonable level of scale—this is a Sport Scale model—and when the crate has been flown, crank in numerous minute corrections for a final drawing. Everyone has advice on how we ought to do it—scale exhaust, etc.—you know. Ned wants us to build up the Warren Truss ribs with all those little ply gussets. His eyes roll. When we said it would be covered and painted and we would be the only one to know what was inside, he was absolutely horrified. Come on fellows, we only wanted a nice crate to fly, no competition, just so long as it does not exhibit visual errors.

Now we know what these scale guys go through for documentation. It begins insidiously, then builds and builds like an anvil-head thunderstorm. Research becomes a game in itself, fascinating and enjoyable. You tend to forget the model. Research is unveiled as a hobby in itself, and within that, one could enjoy a lifetime hobby of uncontrolled documentation of a single design, and even a single airplane. What license numbers were on the ship we are building? Which variation are we really copying?

We find stringers no one knew about—that nobody shows on any drawing. Longerons are shown curved on every drawing but the engineer types tell us that's a no-no—that a steel tube is never bowed because it's compression strength would be shot. The darn wheels are 7½ inches. Do we have to make them? This is supposed to be a fun project! So we'll put on Williams' biggest—6½ inches—and maybe replace them later. The biggest Williams cylinders are ¼ scale Gnome rotary. How do we make a 7-cylinder Warner out of them? Now it is a Fox 78 with an extension shaft, mounted 8 o'clock to put its head between dummy cylinders—but the head doesn't show anyway!

We have an epoxy allergy. Murder. Now what? So some guys tell us that if you fool long enough with the stuff an allergy is part of the game. The fumes! Being an editor, we have a big advantage—three weeks research would take six months to a year otherwise. Now we are hung up on the wing tips—nothing accurate on the front view, everything in disagreement. Sooner or later we'll backtrack and make detailed drawings of the tail wheel assembly, etc.—we hope. Time becomes meaningless. Whereas building was always a frantic rush to get into the air, now you feel that enjoyment in building is the big deal, and you really don't care when you'll get done. Enjoy every step. The drawings look like a road map of rural Saudi Arabia—vast open spaces.

Will we live long enough to see this thing fly? Who cares? How do we get it to the field? You got a station wagon? Who cares? The shop is 9 x 12 and three six-foot airplanes hang in it, plus the bench, plus drawing table, plus a couch, and usually the cat. The Aristocrat cannot be assembled indoors! Now we dig the guys who built the Tower of Babel, the Pyramids, the Eiffel Tower. Maybe we should have stuck with those rubber-scale guys! Join us next Saturday afternoon for episode 15.

## Radio Technique/Myers

*continued from page 17*

We are dealing with a subject called EMI (Electro-Magnetic Interference). According to the experts, getting rid of EMI is more of an art than a science. Whatever works is the right thing to do.

On the other hand, my flying buddy, Nick Ziroli, has been building and flying all types of models for years, ranging from ½A to 200-pound RPVs. Nick says that he has never found the need for chokes in any set that was working correctly before it was installed. So, if you are having trouble, it is most likely to be caused by wear and tear, which will yield to the solutions proposed above.

Owners of Kraft radios can purchase a special harness No. 200-193 direct from the factory, containing chokes of the proper size. They use 22 H high-current chokes. You must specify the system the harness is to be used on, because Kraft has used several types of connectors over the years, and several patterns of connections. They might even make leads up for other brands, if you ask nicely, but I don't know that for sure. The worst that can happen is that they say "no!"

The February 1979 issue of *QST* magazine has a feature story on a device called the Incon. If you need a choke or filter, the Incon looks like a good possible solution. You'll have to make your own, if you want it, because it isn't in production yet.

The above bits of information were given to me by BOB ABERLE, W2QPP. Keep the letters coming, folks. I'd particularly like to hear from some folks who have solved problems.

*George Myers, 70 Froehlich Farm Rd., Hicksville, NY 11801.*

## Waco/Srull

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appropriate ribs (clothes pins work well for this), and slip the "N" struts into place. Move the clips around until a nice fit is obtained and spot glue the clips with a small dab of epoxy. When the epoxy sets, remove the struts and secure the clips with plenty of epoxy and the ⅛ balsa rib scabs.

The cowl shown on the plans is simple, light and strong. First build the balsa drum-like frame. Sand the outside surface smooth and to a perfect circle. Next, cut a heavy

paper pattern for the cowl skin. When it fits properly, cut the skin from a piece of 1/32 plywood. Finally, clamp and epoxy the skin in place; it may help to moisten the outside of the skin with water to help it conform to cowl curvature. After sanding and fitting the cowl to the fuselage, cut holes in the cowl for your engine's needle valve, exhaust extension, and a cooling air exit on the bottom. You can also cut a hole in the cowl for the glow plug connector, or instead, install a jack in the cowl which is permanently wired to the engine glow plug.

**Covering And Finishing:** My model was covered in silk on the fuselage and medium weight Silkspan on the wings and tail surfaces. Plastic shrink film could be used on the wings and horizontal tail surfaces without a weight penalty, and at the same time increase their resistance to punctures. Before final painting, add the windshield and window framing cut from heavy paper. I finished my airplane with 3 to 4 coats of butyrate low-shrink dope, followed by two coats of butyrate sanding sealer. After a light sanding I then sprayed on two coats of color butyrate. Trim stripes and registration numbers were masked off and sprayed on after which the door outlines and various panels were outlined with a drawing pen and ink. The inked areas were sprayed with a coat of clear butyrate to seal them against fuel and oil.

**Flying:** Make sure the model balances within ½ inch of the position indicated on the plans, and that no warps have crept into the flying surfaces. If your model weighs less than 2½ pounds there is hardly anything else to say; the first test flights should be a piece of cake. A small amount of right rudder may be needed at the beginning of the takeoff roll. Hold it down on the runway with a bit of down elevator if necessary to build up a reasonable amount of speed before you lift her off on those first few flights. A very small amount of up elevator will get the Waco airborne in a smooth, straight, and shallow climb-out. Later, you will be able to pull it off after a very short ground roll and still have solid control. With a 9–4 prop and mild fuel, my model performs very well off of grass and hard-surfaced runways with no quirks of any kind on the ground or in the air. At 2/3 throttle its flight characteristics are very smooth and scale-like. To repeat once again, I believe that the light wing loading is the principal reason for this docile performance. After several trim flights you should be doing spot landings and touch-and-goes with the best of them.

Welcome to the Waco club, and happy landing!

## RC Scale/Wischers

*continued from page 25*

increase in climb angle used to borrow altitude from speed to clear the obstacle, returning to normal climb as soon as possible. At the instant of touch-down, for a three-point landing with a tail wheel plane, there is also an exceeding of the attack angle for flat glide. During aerobatics we often use high angles of attack for intentional maneuvers but these are done with an awareness of results. What we are trying to avoid is the condition in which up elevator is held inadvertently, an unnoticed easing back of the stick while concentrating on the takeoff or landing approach.

Our best weapon against the problem of control reversal is to de-sensitize elevator control by reducing travel, to approximately 15 degrees each side of center. An expensive solution would be a dual-rate elevator control at the transmitter so that travel could be limited for takeoff and landing. The elevator stick springs could be tightened in the transmitter so that a conscious effort is needed to obtain greater travel, a solution we dislike because of our affinity for aerobatics. Finally, holding the angle of bank during turns near the ground to less than 20 degrees will help to avert trouble. Let's disappoint those who come to watch our thousand-hour scale models crash. A flier who confesses no fear of accidents cannot fly our planes. Our qualification to fly them is a built-in apprehension.

**Single Strut Landing Gears:** A scale model's best friend is a landing gear that will absorb shock without damage to structure. To devise such a gear it is best to follow full-scale practice, using coil compression springs to absorb both direct and rebound shock.

Preferred material for the strut body is thin-wall chrome molybdenum 4130 steel tube of the type used in welded aircraft fuselage construction. Scrap lengths needed are usually obtainable from your friendly neighborhood airport fixed base operator. The desireable size is .50" outside diameter with a wall thickness of .035". Its retail price should be about $1.50 per foot. Other materials such as brass and lower grades of steel can be used but their strength does not approach that of 4130 aircraft tubing.

The lower leg, that moves vertically within the strut body, is formed from .156" music wire, built up with brass tube to the proper scale diameter. A brass turning, made from rod, covers the wire bend and also serves as a mount for the lower scissors yoke. Scissors are filed from solid aluminum bar, preferably 2024 alloy for ease of machining and hardness. All four scissors parts are identical.

Springs are wound of music wire. Winding forces are greater than can be managed by hand. Our springs are wound on a mandrel chucked in a lathe, using the back gears to obtain the slowest possible winding speed. To wind springs by hand, the mandrel would need to be driven by a 6" or 8" long crank lever with the mandrel supported by substantial bearings clamped in a vise. The mandrel should be slightly smaller than the desired inside diameter of the spring because there will be some opening of coils after winding. A wire-size hole drilled through the mandrel secures the wire for starting the coiling.

When winding manually, one person turns the crank while the second uses a vise-grip plier to apply maximum tension on the wire. Coils are laid with spacing that will result in the proper free length of spring when the desired number of turns has been reached. Spacing between adjacent coils is important in winding a spring with length to fit the strut body. Music wire is the hobby shop variety. Be not discouraged if first attempts are not correct. Most of ours are made by the trial and error method. The only real trick is to get two sufficiently similar in length and number of turns for both landing gear legs. Springs that are