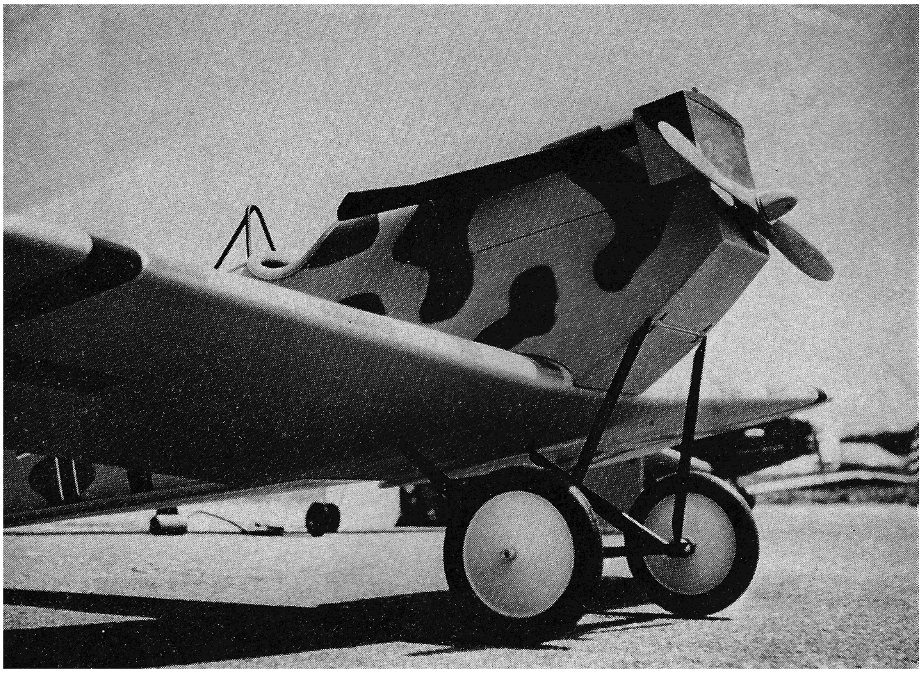


Prominent radiator and exhausts augment the angular lines of this old-timer.

A WWI AIRCRAFT RETURNS

Remarkably advanced for its time — this 1918 fighter has the configuration and proportions for a fine R/C scale model.

JOSEPH M. TSCHIRGI

The Junkers D-1

Our own Ed Sweeney flips the prop while Jerry Hibbard hangs onto the tail.

With the top hatch removed, a neat arrangement of engine, tank, etc. becomes evident.

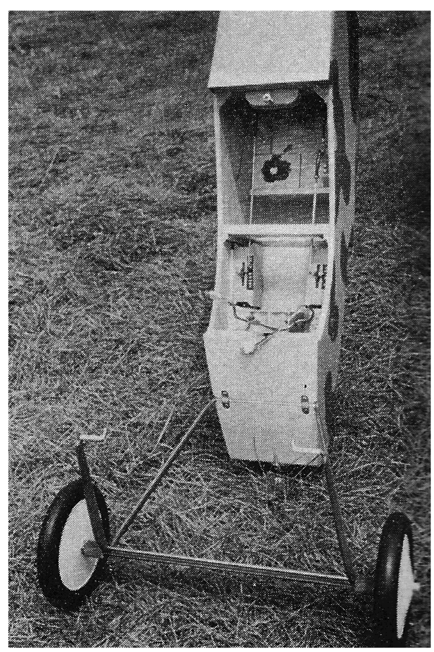
MOST scale modelers spend as much time leafing through old volumes of aviation publications searching for the "perfect" model as they do building. The perfect R/C scale subject must: 1) be a good aerodynamic configuration in its proportions, 2) have simple, yet interesting lines (a minimum of struts and other difficult-to-reproduce features), 3) have a rugged landing gear that still looks like the real thing, and 4) be so obscure that all your flying buddies ask, "What is it?" The last item is most important!

The Junkers D-1 comes as close to filling all these requirements as any WW I aircraft. Built during the summer of 1918, the D-1 culminated three years of single-seat fighter development by the Junkers plant in Dessau. All the prototypes (J1-J9) in this period were remarkably advanced air craft: all-metal, cantilever monoplane configuration. Originally (J1-J2), they were covered with sheet steel and earned the title "Tin Donkey." They were quite heavy and apparently difficult to fly. The latter "J" series, and the D-1 were covered with corrugated aluminum, extremely rugged, and powered with Mercedes or BMW engines, and had competitive performance.

Structurally, they were not similar to modern skin-stressed design, since, for example, the wing was a complex steel tubing framework which, in modern automotive terminology, resembled a space frame. Here the corrugated skin only covered the wing ribs and carried no spanwise load. But, it was an exceptionally clean machine for the period. It is an ideal modeling subject, since it combines simple, but appealing lines, with interesting scale features — such as the car-type radiator which allows a fully enclosed engine.

About 50 of the type were built. A few got into action before the end of WW I, hence some latitude is available where finish is concerned. Photographs indicate that both the "sand and spinach" camouflage used on our model, and plain aluminum finished types, existed. Windshield, markings, cowling and gun installation details also varied between individual aircraft. (I recommend that you get a Profile No. 187.) This publication will furnish the AMA required proof-of-scale documentation. Incidentally, both a short and long fuselage version of the D-1 existed. Our model is the "long," since short nose- and tail-moment arms are not happy combinations.

In designing a WW I model, I have one approach to determining scale — Williams Brothers' wheels which come in discrete sizes, so you must match the scale to the



This view, showing installation and landing gear details, reflects painstaking planning.

Junkers D-1

Continued from page 20

available wheel. In our case, the $4\frac{3}{8}''$ wheel is about 1.72 inch-to-the-foot scale. This works out to a little over 500 sq. in. of wing, while the 5″ wheel is about 2″ scale for 650 sq. in.

After much hemming and hawing, I decided on the smaller scale; mostly because I wanted to use an ancient and reliable Enya 45. The one lesson I've learned about scale R/C is the virtue of power. Never, never underpower a scale model. If you want to impress the judges by flying slowly, use the throttle, but an underpowered machine on a windy day is an incipient accident. Incidentally, similar remarks apply to wing loading. A light Avro 504, with yards of wing, looks beautiful floating along on a calm day. But, in a wind, it's agony.

While scale-size airfoil, dihedral and tail are used on the model, it is not a "museum piece." Rather, the aim is for a practical flying machine that will still gather lots of scale points in a "Rhinebeck" type meet. Hence, I did not try to reproduce the corrugations. Appearance is helped by the dull camouflage which hides the lack of corrugations.

Have no fears about the huge rudder and no-fin tail. Low-wing configurations with small dihedral simply are not very sensitive to rudder deflections. Roll-due-to-yaw produced by dihedral is countered by an opposite roll torque produced by the rudder because it is situated well above the center of gravity. Hence, lots of rudder throw may be used to produce some control on the ground. Hold full rudder and blast the tail around with throttle — it really impresses the judges if they know anything of old airplanes. I was worried about the small, horizontal scale tail before the first flight. But the pitch action proved quite gentle as indicated by the fact that I managed to land right-side up (with the engine still ticking over) on our rather rough grass strip after the D-1's first flight. Anyone who's seen me fly will know that it was not all piloting skill. This particular characteristic is probably due to the wing thickness and camber taper, which in effect, produces a heavily washed-out surface even though the bottom is flat. This also is scale. Because of their generous size, aileron action is very positive.

While the all-up weight of 5 lbs. 4 ozs. is not light for 500 sq. in., the high-lift wing produces a landing speed considerably lower than the average multi-pattern machine. All in all, it's an easy flying model and anyone with even a minimum of multi-proportional experience should have no difficulty. However, I would not recommend use of Reed equipment on any scale model unless you are a real Reed hot-shot. A good digital proportional system will make an acceptable pilot out of the most ham-handed Reed switch thumber.

But, scale is no more difficult to fly than any other model, except for a psychological factor. The first flight of any scale model is a traumatic experience. It's just that spending all that effort and then going wing-tip-over-wing-tip while landing is not very profitable. No scale model can be as durable as a good trainer, and the average flyer can do much better landings with digital-proportional.

Since it's my firm conviction that no beginner should tackle any "scratch built" model, much less a scale model, I'll not give a bit-by-bit description of construction but will touch on particular points.

Fuselage: This is a simple box. Install horizontal stabilizer with tail block, rudder post, and both control pushrods before covering the bottom. This way, all control horns can be inside and out of sight. Note that, by using Rand hinges, the elevator may be removable. I used cable in nylon tube for elevator and rudder actuation. This works well, but these must be supported every three or four inches to avoid compression buckling. For good tight control, even "Nyrods" should also be supported at about that interval. The rudder is not glued to the tail post until the model is completely finished.

The cowling is built in place. Attach cowl formers to base frame, place it on model and tape the water-soaked $\frac{3}{32}$-sheet cover over it, and let dry. Then glue it to the formers and base frame. This easily forms the $\frac{3}{32}$-sheet to the complex cowl curve, and assures that the base frame does not warp with respect to the fuselage. This same technique is used to cover the turtle-back. Incidentally, never glue wet sheet wood in place, since it will shrink and either pull your joints apart, or sag badly on curved portions. I recommend alphatic resin glues, such as Titebond for sheet covering. They are strong; slow drying aids in sheeting large areas with one piece, and, unlike white glues, they set up hard enough to sand.

A good trick on open cockpits is to cover the inside with a piece of Celastic. This strengthens the cutout. Similarly covering the inside of the cowling between the formers with heavy cloth and epoxy will also make it as strong as a fiberglass cowl without the necessity of finishing the plastic.

Internal rubber bands are my favorite method of holding a cowl. Rubber bands run from former #2 through a hole in the cowl to a hook on the bottom of the dummy motor. Another hole, large enough to admit a plug-on connector, is centered over the glow plug. In this manner the dummy motor may be lifted, turned 90 degrees and rested on the cowl top to allow access for the glow-plug connector. After the engine is started, the dummy BMW engine is returned.

A working manifold and exhaust system is well worth the effort. The sight of blue smoke coming out that saxaphone more than repays for the few hours work required. Be certain to use silver solder and neoprene tubing. Also use a cool fuel, like Supersonic 100, and run the engine a wee bit rich, or you will melt even the silver solder. Priming the engine through the door-screen radiator can be simply accomplished with a hypodermic needle.

Wing: I'd like to be able to say this construction was my own invention. Personally, I think it's lighter, stronger and just as quick as a foam wing. But, you've all seen the Ken Willard "school" of design, so you'd know I was lying. What you may not know is one Charles Hampson Grant beat Ken to the idea by about 30 years, and I don't know who invented it before C.H.G. Anyway, it is sparless, built in three pieces (two outer panels and a center section) and then butt-joined with epoxy and cloth over the joint.

Start with bottom cover, glue in leading edge, tip piece, and all ribs. Before proceeding with the top cover, shape the leading edge and tip to conform with the profile, and install nylon tubing for the aileron cable. Cut a one-piece top cover to approximate shape, soak in hot water, and then strap it to the wing while it's still pinned to the work board. Lots of bands around the tip will form the cover over the slight compound curve. When dry, remove, squirt glue on all the mating surfaces and it will literally fall in place.

The $\frac{3}{16}''$ aileron spar is not installed until after the Rand #1025 hinges are glued to the top cover. If the hinges are roughened with coarse emery paper, alphatic resin glue will hold them without dowls or pins. Pinked aircraft cloth tape makes a good wing joint cover that is easier to work with than glass cloth.

Landing gear: To insure a perfect fit, solder the gear joints while it is attached to the model. Use tinplate soldered to the two $\frac{1}{16}''$ wire spreader to form an axle fairing. A $\frac{3}{4}''$ length of heavy-wall surgical tubing ($\frac{1}{4}''$ I. D., $\frac{1}{2}''$ O. D.) makes the best shock-cord, but rubber bands or small "O" rings can also be employed. Use twice as many as you think necessary. Landing gear fairings are epoxied to the struts and then wrapped with nylon tape or ribbon and coated with epoxy. This adds considerably to buckling stiffness of the strut and, while you can break the fairing when the strut's bent, it will never pop off.

Equipment installation: Nose-heavy scale models are rare, so mount everything as far forward as possible. On the original, all R/C equipment (Bonner 4RS) was forward of former #3. The throttle servo mounts on an aluminum tray with foam tape and then is screwed to former #2, closing off the battery compartment. Rudder and elevator servos mount on the fuselage sides with foam tape, and the RX rests in the middle.

The throttle servo drives vertically through a cable and Teflon tubing with a 90 degree bend. Rudder and elevator servos work through throw-reducing arms mounted on the cockpit floor. Total control-surface motion, measured at the trailing edges is:

Rudder $\pm 1\frac{7}{16}$; Elevator $\pm \frac{7}{16}$; Aileron $- \frac{11}{16}$-$\frac{9}{16}$. I like to fly a model with very snappy aileron action. In general, it does not make smooth control more difficult since motion in roll is always better damped than either pitch or yaw. But if a trainer-type response is preferred, the aileron travel should be reduced somewhat.

Finish: One of my major failings in model building is incurable optimism — I always believe that I have a better way to finish a model. In this case, the bright idea was a dope and talc mix on bare wood with an acrylic color sprayed on. Yes, it was easy, and light. Yes, cracks appeared after three days cure time. No, I'll never do that again.

The finish was saved by another bright idea — satin polyurethane varnish was sprayed on over the top. This is available through Montgomery Ward in inexpensive spray cans. It is tough, flexible, and completely fuel-proof. Anyway, my favorite sheet-balsa finish remains butyrate over silkspan, as a compromise between toughness, weight, and difficulty.

Do not finish any WW I model with a "patent leather" shine. First of all, no one spent that amount of time on the real thing. Secondly, shiny finishes were avoided intentionally since they would glint in sunlight, and no pilot wanted an enemy to have the advantage of first detection. Note that the bright colors, used by many German WW I units, were not any great disadvantage, if they did not shine, since all aircraft at a great distance looks like a black dot against the sky.

There are several good ways to get a

"dull" finish. All involve final overcoating. Under no circumstances, make all your finish coats a dull color, since most non-reflective finishes are made by use of an additive which greatly reduces the strength of the original shiny material. The "satin" polyurethane varnish previously mentioned is a good over-spray that gives low reflection — not completely dull — finish. But, remember that dope cannot be applied over varnish, so touching up is more work.

All automotive paint stores carry a "dulling" compound under different trade names which, while made for acrylic, is admissable in Aerogloss or butyrates. Thus, a final coat of dull dope or acrylic is possible. I'd recommend you use a dull, clear overspray, since it can be squirted over everything without masking problems, and is generally a little tougher than pigmented paints.

Flying: I think that scale models should look like the real thing from ten feet away. My other pet peeve, besides shiny finishes, is WW I aircraft models with thick, symmetric airfoils. Therefore, any WW I model of mine either has a thin, cambered airfoil, typical of most; or the thick high-lift airfoil, typical of Fokker and Junkers aircraft. This looks right, produces quick takeoffs and good glides, but they do stall more abruptly than the thick symmetric airfoils typical of "pattern" multi. Most pattern models can be gently landed from a full stall at 20 feet, sinking like an autogyro. This is **not** recommended with any thin or high-lift wing. The Junkers stall is gentle, but it will finally drop its nose, so keep the speed up on final approaches.