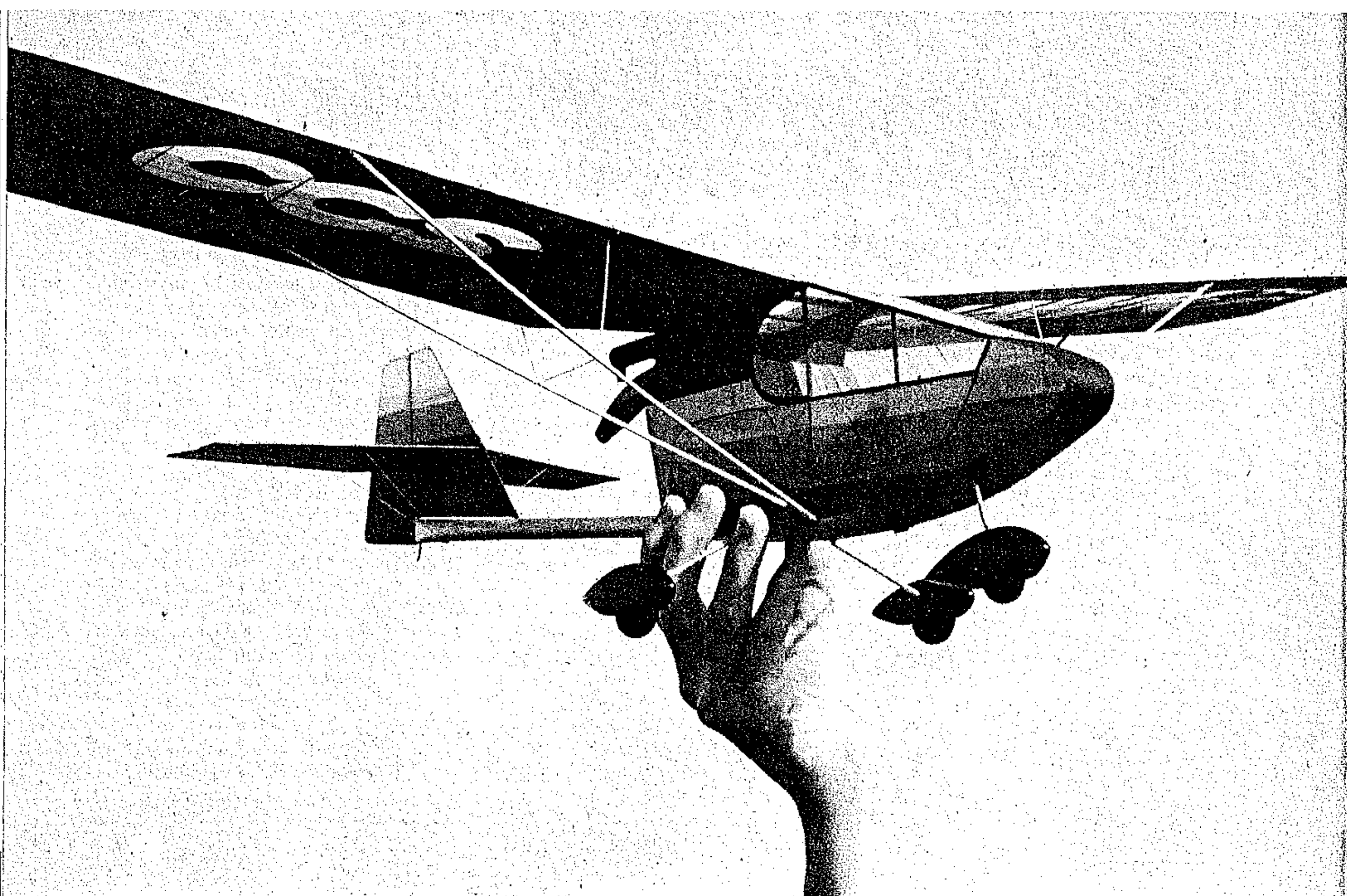


# CGS HAWK

**It is a $CO_2$-powered version of the 1982 winner of Best New Design and Grand Champion at Oshkosh. It should be as competitive in Free Flight Scale as the full-size version was at the big EAA Fly-In.**

**■Larry Kruse**

THE TRIP from model building, to hang gliders, to powered flight, is becoming a rather familiar one nowadays, particularly with the advent of the ultralight aircraft industry.

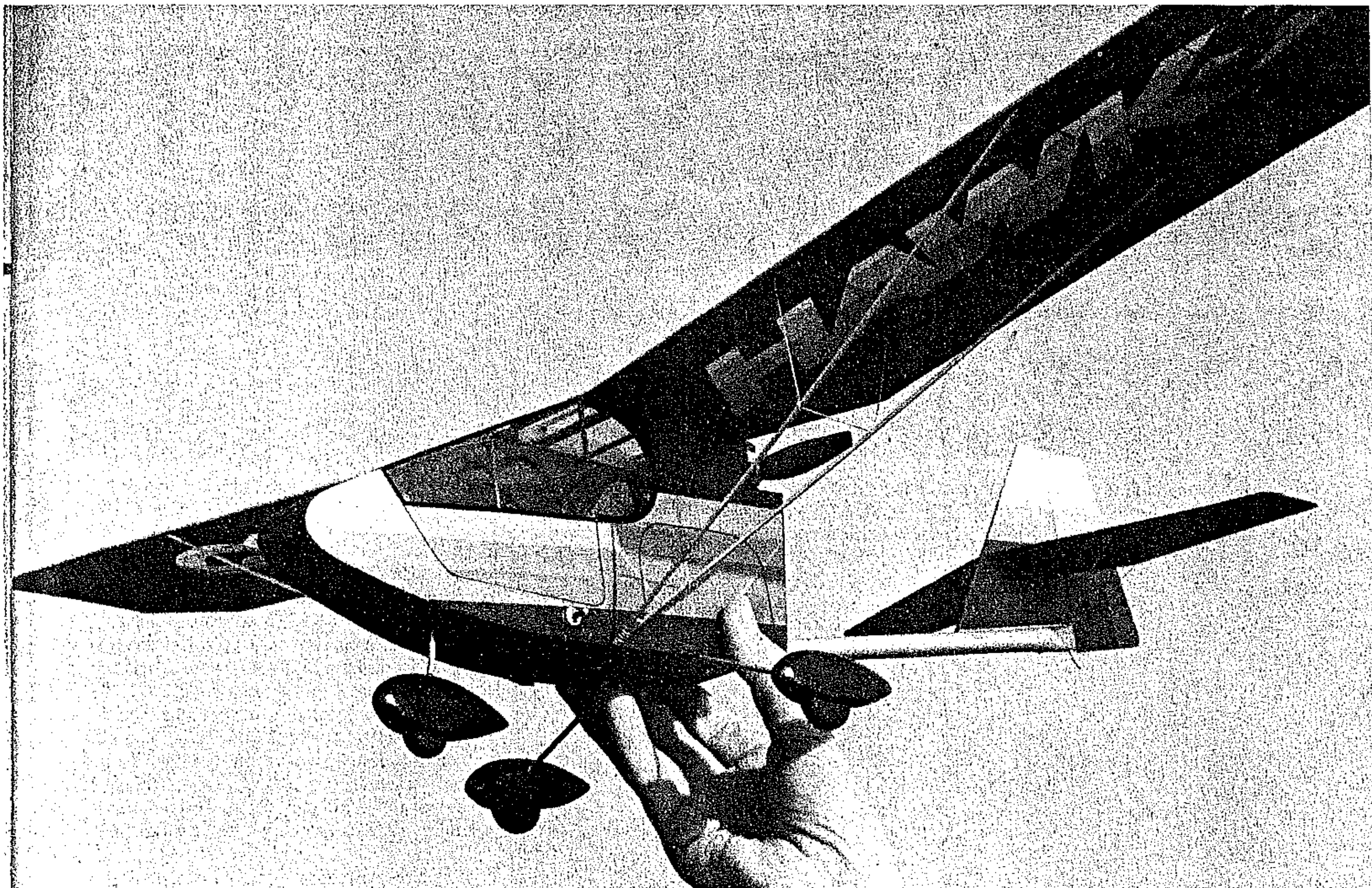
In recent years, commercial aircraft have become so complex that individual designers are only rarely given credit for their work, a circumstance in direct contrast to the early days of aviation when it was the individual that counted. The age of the ultralight has spawned what Walter J. Boyne calls "the second Golden Age of Aviation. As inflation and complexity hiked up the price of all aircraft, including the smallest Piper Cub types, would-be pilots and engineers began to seek their own solution in homebuilt aircraft, hang gliders, ultralights, and in some instances, the restoration of old classics. As a result, one finds reappearing the phenomenon of individual genius imprinted upon design."

As we look around the world of the ultralight, Boyne's analysis rings particularly true in the case of Chuck Slusarczyk, the founder and president of CGS Aviation, the largest, and by reputation, the most advanced manufacturer of power plants for ultralights.

As a boy, Chuck began by building, and later designing, model airplanes. By age 13 he began to win model airplane contests, and over the years he has accumulated over 400 trophies and ribbons in AMA-sanctioned events. He still retains an avid interest in model aviation today, remembering what first sparked his interest in the magic of flight.

After high school Chuck went into a five-year apprenticeship with NASA, working on such projects as the B-70, the X-15, and the Lunar Orbiter. Following his stint with NASA, Chuck joined the Scheutzow Helicopter Corporation; while employed there, he began designing and building hang gliders on his own. As a natural evolutionary step, in the early 1970s Chuck's attention turned toward powering his hang gliders. A five-year research and development program culminated in his marketing the first commercial reduction-drive unit called the CGS Power Hawk. The accomplishments and success Chuck had with the first Power Hawk changed the industry's outlook on reduction drives and large-diameter propellers for ultralights.

All of Chuck's background, experience, and design ability came together in 1982 when his new design, the CGS Hawk,



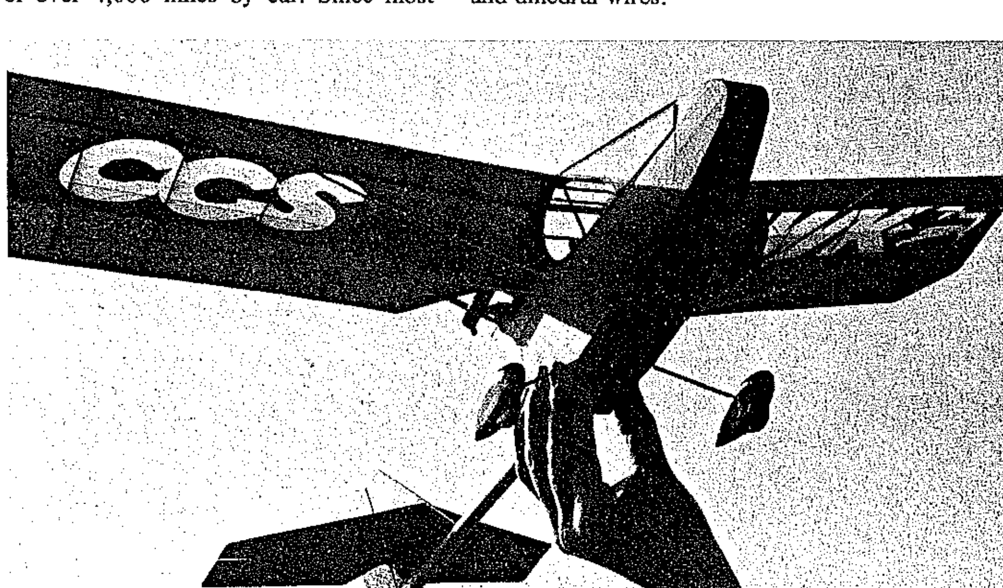
complete with reduction-drive unit in a pusher configuration, was named the Best New Design and Grand Champion at Oshkosh. At this point I became aware of the design and (through correspondence) knowledgeable of the man behind the Hawk.

The first time I saw a photo of the plane, I was struck by its perfect proportions for modeling—the generous tail volume, the ample dihedral, and the proportionately roomy cabin—the true "airplane" appearance from an industry that has a reputation for spidery-looking creations. It was only in the course of corresponding with Chuck and his generosity in providing me with factory drawings, photos, and three-views, that I became aware of his modeling heritage—although even a cursory look at the Hawk gives it away.

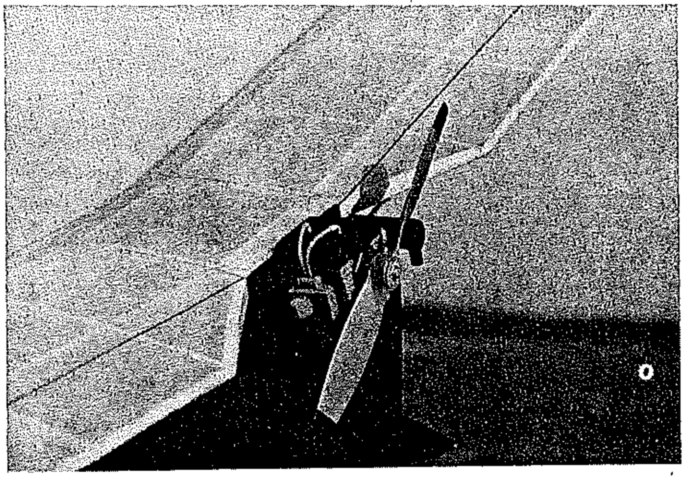
Although my long-range plan was to construct a four-channel RC version of the plane, my immediate needs dictated that I build a Free Flight Scale version for the 1983 National Contest. I'm pleased to say that the model built quickly, flew right off the board, and received top scale points against some excellent competition at the event. Its second-place finish was due to bad flying judgment on my part, rather than any inherent problem with the plane. Chuck Slusarczyk has designed a winner for us, whether in the full-size, man-carrying mode or in model form.

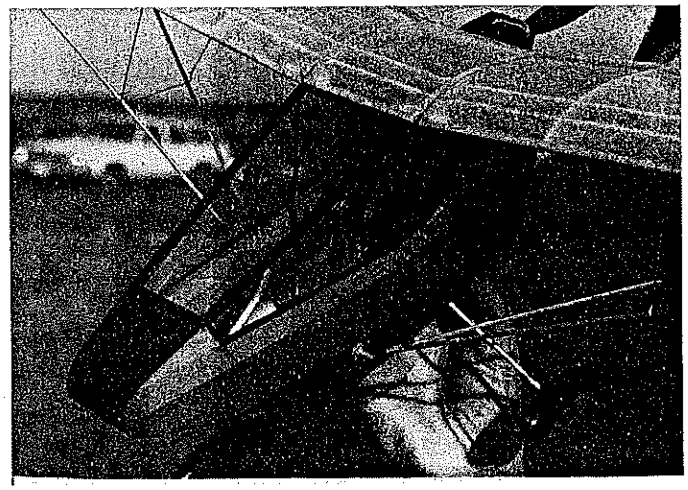
**Construction** of the CGS Hawk will not be difficult for those who have built stick-and-tissue models before, but there are some areas that need explanation.

To begin with, I built the prototype with removable wings and wing struts in order to ease packing it with the several models I took to the Nationals that year, a round trip of over 4,000 miles by car. Since most modelers won't have to face such a problem, I've drawn the wings as one unit for ease of construction. Certainly, time and weight will be saved by simply Hot-Stuffing the wings to the cabin top rather than having to fiddle with aligning wing tubes and dihedral wires.

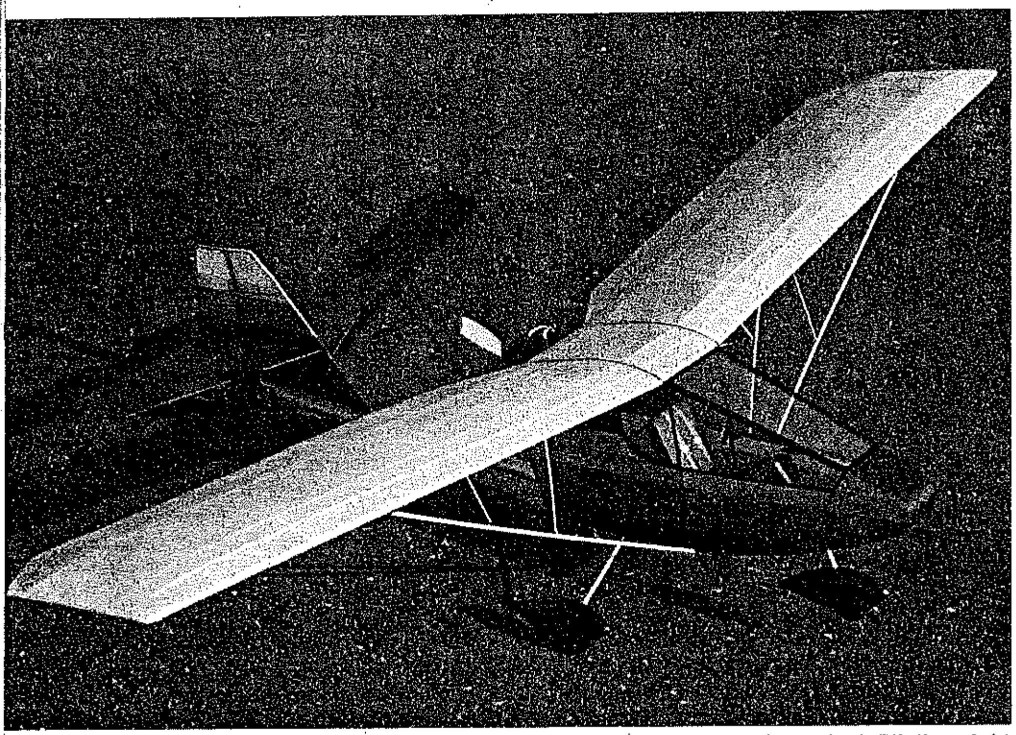



**Opposite page: In this view the Hawk looks less like an ultralight and more like a typical home-built ship. Strut-braced wings and pusher configuration give it uniqueness. Top picture: The CO-2 filler tube, strut, and wheel pant details can be seen. Above: Light shines through the wing and illuminates the multi-colored lettering. Very pretty craft in the air.**



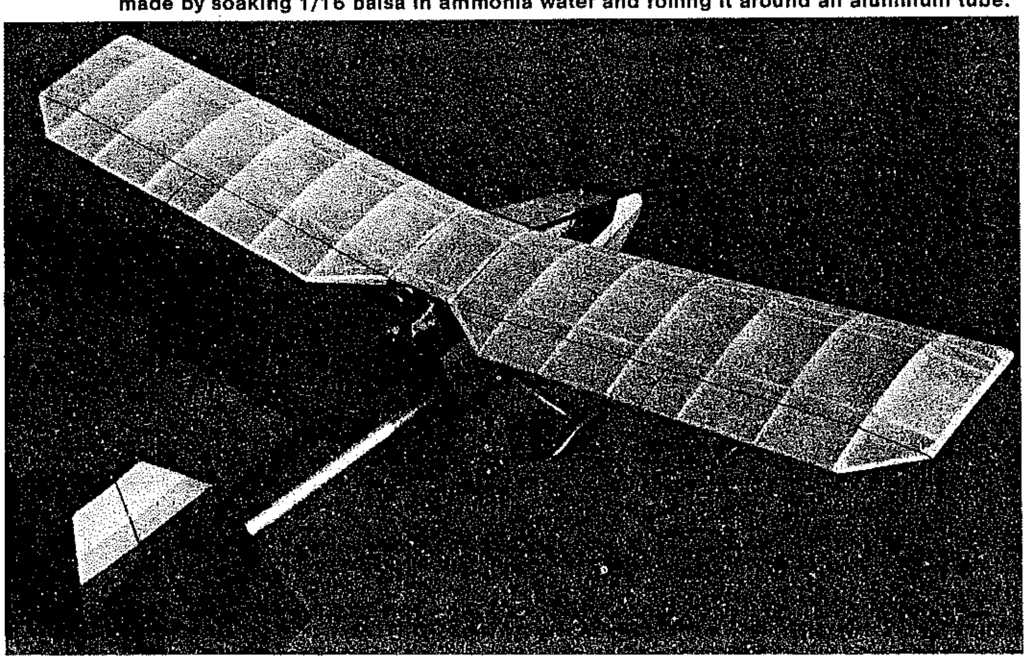


Left: Dummy engine details. Plug wires and mag cover the inverted Telco CO-2 motor; as a pusher, it turns clockwise. Right: Cabin details: seat, seat belt, throttle, and flap controls on left; stick is in the middle. The tip of the CO-2 tank shows just under the front of the seat.



On the ground it rests only on the main wheels (same as the full-scale version). Pilot's weight in the full-size machine drops it to the nose wheel (prop thrust does the same on the model).

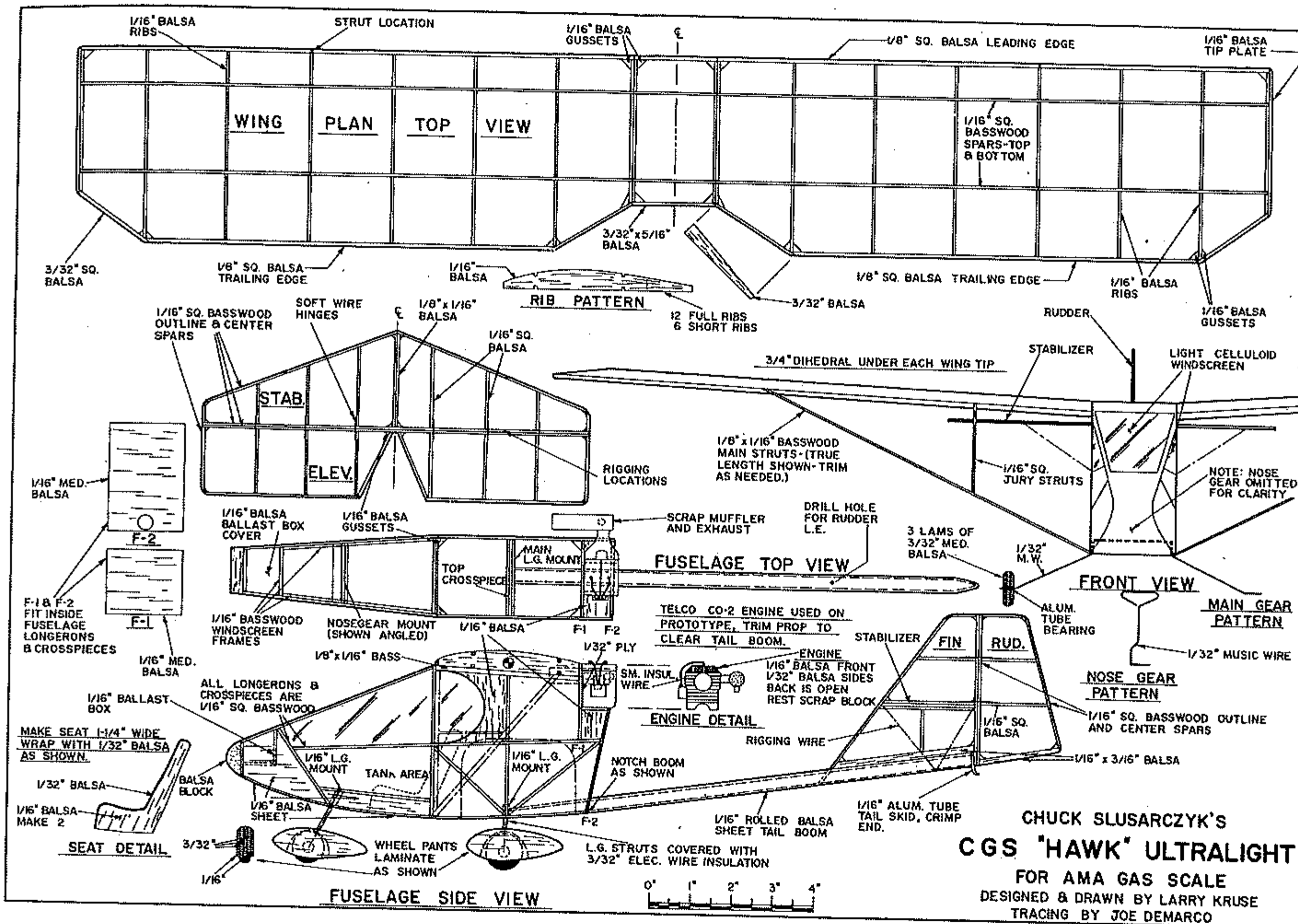
This view shows the opaque white upper surface of the wings. The tail boom is a tube made by soaking 1/16 balsa in ammonia water and rolling it around an aluminum tube.



Also, as will be noted on the plan, the model uses a lot of 1/16 sq. basswood strips for basic outline and stringer construction. Do not be tempted to substitute balsa; it simply does not have the required strength in most areas. Likewise, where balsa is specified instead of basswood, use the balsa. You'll incur unacceptable weight penalties if you use basswood all the way in construction. The best source I have found for basswood is your local model railroad emporium, although some model aircraft hobby dealers are beginning to stock it.

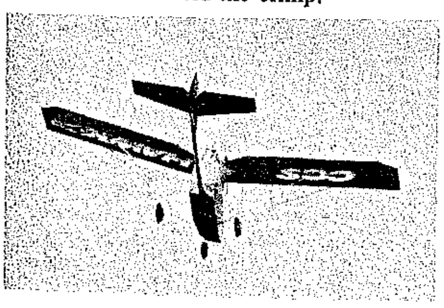
**Fuselage.** Build one side on top of the other, separating the two with a layer of Saran Wrap. Construct the fuselage "box" by adding the tail boom formers and cross members. Then install the main landing gear and nose gear before planking the fuselage buttom. Cut and fit the top of the nose ballast box, then lay it aside until after test flights are successfully accomplished—so that ballast can easily be added or subtracted.

The tail boom is a rolled balsa tube, prepared by soaking the 1/16-in. C-grain blank (shown on the plans) for 30 minutes in a sink full of hot water laced with a cup of ammonia. While the balsa is soaking, cut a piece of tissue at least 2 in. wider and 1 in. longer than the balsa blank, and lay it flat on a tabletop or smooth work surface. Fish out the balsa blank, and towel-dry it, removing as much excess moisture as possible. Place it squarely in the center of the tissue. You should have a minimal tissue overlap of 1 in. on each side and 1½ in. on each end. Using a 3/16-in.-I.D. aluminum tube as a former, begin rolling the tissue around the aluminum tube, continuing as you reach the balsa—until both the tissue and the balsa are wrapped tightly around the tube. Hold the shape at the ends and the middle with masking tape in three or four places, and bake the assembly in a pre-heated 200° oven for 20 min. to remove all moisture and set the shape of the balsa. After 20 min., carefully remove the tissue, and close up the seam in the balsa, starting at one end, by gently squeezing it together. Apply a small bead of Hot Stuff as you move from one end




to the other. That's all there is to it.

Insert the tail boom, seam side down, into the holes in the main fuselage formers. The incidence angle should be set by the formers, but check it again by laying the fuselage structure over the plan. Make any necessary adjustments prior to Hot-Stuffing the boom in place. Re-wet the aft end of the boom, and squeeze it gently together to form a crimped-tubing effect as on the full-size plane. A drop or two of Hot Stuff will be sufficient to hold the crimp.



The prototype model was powered with a standard Telco CO-2 unit with the tank placed as far forward as possible (under the pilot's seat in this case). Drill mounting holes in the 1/32-in. firewall/motor-mount-block assembly, and test-fit everything into position. When threading the tank and tubing through the fuselage, be careful to avoid kinking the tubing. Construct the seat, and then trim it as needed to slip over the tank. When you've achieved a satisfactoy fit, a couple drops of Hot Stuff will keep the tank tacked to the cabin floor in the correct position, and then you can install the filler nozzle and its pressure box (if you choose that method). (An easier way to handle the filler nozzle—and one that I would use in the future—is to simply cut a small circular hole in the bottom of the floor and poke the filler nozzle through it. The landing gear ought to provide sufficient protection for the nozzle during landings, and if it's too obtrusive, poke it a little bit back up into the hole until it's needed.)

The rest of the cockpit interior may now be installed, and it's time to construct the dummy cylinders and muffler. The fuselage is then ready for covering. Wheels and wheel pants are both laminated from standard balsa stock as shown. If you plan to make ROG takeoffs and landings from concrete or asphalt on a regular basis, I would suggest adding one layer of 1/32 ply to each wheel as the center core; with this, the wheels will withstand a great deal more abuse.

**Flying surfaces.** The wings, stabilizer, and rudder are all built in the traditional manner and should require little explanation beyond the notations shown on the plan. Do be conscious of which areas call for basswood and which require balsa. While the adjustable double spar in the rudder and stab are not mandatory, I would certainly encourage you to use this feature. Fiddling with shimming and warping is an inexact way of making flight adjustments.

**Covering.** The prototype model duplicates the color scheme of the Hawk owned by Terry Fuller of Conneaut, OH. In descending order, from the top of the fuselage, the colors are black, white, yellow, orange, red, and (again) black. The tail boom is silver. The top of the wing is white tissue, and the bottom is black with the banded colors spelling out CGS Hawk. There are simpler color schemes, but none with more visual appeal.

If you wish to use Fuller's color scheme, cover the fuselage, rudder, and wing with white tissue, using a 50/50 mixture of white glue and water for the adhesive. Cover the stabilizer with black tissue, available from Peck-Polymers. Shrink the tissue with rubbing alcohol, and then brush on three coats of thinned (60/40) nitrate dope. Let the dope dry at least overnight, and then add the trim colors by laying them flat, in their respective positions, one color at a time. Liberally brush thinner over the colored tissue strips, letting it soak into and soften the doped surface underneath. Occasional light finger pressure may be necessary to get the tissue to adhere to the covering

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torque. Record the torque and the rpm reading taken just before you caught the model. Make a small change in trim and repeat the rpm/torque measurements.

The best trim will be that setting which gives both the lowest rpm and the lowest level-flight torque. A model which is slightly under-elevated (needs more incidence in the wing) will have slightly higher rpm at approximately the same level flight torque as a properly-trimmed model. As the incidence is increased, the rpm and torque will drop lower. For an over-elevated model, rpm is lower than at good trim, and the torque will be higher. The level-flight torque increases on the over-elevated model because higher torque is needed to overcome the higher drag of the extra wing incidence. Actually, the model will start sinking faster than for good trim as soon as level flight ceases. On a full flight, it will take longer for the properly-trimmed model to reach level flight than for either the under- or over-elevated model.

**Wrap-up.** Here's how it all holds together: The peak altitude of a flight depends on the launch torque, and the altitude vs. time curve levels off at level-flight torque. Unless air temperature or an air inversion (we'll talk about those next time) intervenes, the model will descend slowly as torque decreases. If the motor runs out of turns before touchdown (reaches critical torque), the model will come down much faster. Jim Clem coined the appropriate phrase—the model becomes a "lead sled" when it has to push the prop!

**More to come.** There are several other test procedures which allow you to get into trim for the big meet, but I'm out of room. Next time!

*Bud Tenny, Box 545, Richardson, TX 75080.*

## CGS Hawk/Kruse

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beneath it or to smooth out any wrinkles. Three more coats of thinned nitrate dope on top of the tissue trim should be sufficient to seal all surfaces.

All detailing, including the seat, celluloid windscreens, wheel pants, struts, rigging, and dummy engine, can now be added to complete the model and make it come "alive."

**Flying.** Balance the plane as shown on the plan by adding lead shot and/or clay to the ballast box. I don't like to test glide CO-2-powered models, because that doesn't give much of a feel for how the ship is going to perform under power. Wait for a calm evening, find the softest grass surface you can, set the motor for a low power setting, and give it a gas charge from the last of a filler cartridge. Flick the prop to get the motor started (remember that it's a pusher!), aim the model at a spot about 50 ft. in front of you, and give it a gentle toss. If it settles to the ground without stalling or diving, increase the gas charge (no liquid, yet, please!), and try it again. It should show a slight tendency to climb and to gently turn to the right. If it turns too tightly, bend the rudder just a shade to the left, and try it again. If the power pattern seems safe, increase the motor speed a bit, and watch it climb to the right and come back overhead. A full gas charge, with the model being hand launched, should get you flights ranging from 45 sec. on up—depending on how buoyant the air is—and the quality of the CO-2 charge.

The Hawk has been one of the most enjoyable Free Flight Scale ships I've built in a number of years. It is unique enough to elicit both admiration and questions from spectators—and competitive enough to win any Scale contest in the nation. If you decide to build it and have questions or comments, please write to me: Larry Kruse, Box 1137, Liberal, KS 67901. I'll be happy to supply documentation information at cost.

## CL Aerobatics/Fancher

*Continued from page 64*

able. In practical terms, a CG aft of the C/L (center of lift), although technically stable, rapidly becomes too sensitive for